RCA TUBE
HANDBOOK
HB-3

SEMICONDUCTOR DEVICE SECTION

This Section contains data on semiconductor devices such as transistors and diodes.

For Further Technical Information, write to Commercial Engineering, Semiconductor Division, Radio Corporation of America, Somerville, N. J.

Semiconductor Devices

World Radio History

World Radio History

Sheets in the RCA Semiconductor Products Handbook are arranged in the Table of Contents in order of appearance in each section. The Index of Types, which follows the Table of Contents, lists type numbers in numerical-alphabetical-numerical sequence.

The Table of Contents and Index of Types may be used to determine:

(1) location of individual sheets
(2) completeness of Handbook
(3) arrangement of Handbook sheets

Reference is to front of sheet unless otherwise indicated. Date appearing on sheet is identified by month and year (e.g., 8-62).

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For types in Semiconductor Device Section, see Index of Types

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Index of Types

1N440-B to 2N175

This Index of Types is arranged in numerical-alphabetical-numerical sequence of types.

S = SEMICONDUCTOR DEVICE

* Type is approaching obsolescence. Not recommended for new-equipment design.

• Discontinued type. Data retained in Handbook for reference purposes only.

Reference is to front of sheet only. Date appearing on sheet is identified by month and year only (e.g., 2-61).

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	S	OUTLINE & NOTES CE-9728R1 & RATING CHART 92CS-10060
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1N442-B..	S	DATA, 8-59
1N443-B..	S	DATA, 8-59
1N444-B..	S	DATA, 8-59
1N445-B..	S	DATA, 8-59
1N536....	S	DATA, 8-59
	S	OUTLINE & NOTES CE-9728R1 & RATING CHART 92CS-10082
1N537....	S	DATA, 8-59
1N538....	S	DATA, 8-59
1N539....	S	DATA, 8-59
1N540....	S	DATA, 8-59
1N547....	S	DATA, 8-59
1N1095...	S	DATA, 8-59
1N1763...	S	TENT. DATA 1, 4-59
	S	TENT. DATA 2, 4-59
	S	CURVES 92CS-9723 & 92CS-9720
	S	CURVE 92CS-9982
1N1764...	S	TENT. DATA 1, 4-59
	S	TENT. DATA 2, 4-59
	S	CURVES 92CS-9722 & 92CS-9721
	S	CURVE 92CS-9988
1N2326...	S	DATA 1, 6-60
	S	DATA 2, 6-60
1N2858...	S	DATA 1, 6-60
	S	DATA 2, 6-60
1N2859...	S	DATA 1, 6-60
	S	DATA 2, 6-60
1N2860...	S	DATA, 6-60
1N2861...	S	DATA, 6-60
1N2862...	S	DATA, 6-60
1N2863...	S	DATA, 6-60
1N2864...	S	DATA, 6-60
1N3128...	S	DATA 1, 2-61
	S	DATA 2, 2-61
1N3129...	S	DATA, 2-61
1N3130...	S	DATA, 2-61
1N3138...	S	DATA, 2-61
2N104....	S	TENT. DATA 1, 6-56
	S	TENT. DATA 2, 6-56
	S	TENT. DATA 3, 6-56
	S	CURVE 92CM-8530R1
	S	CURVE 92CM-8512R1
	S	CURVE 92CM-8534R1
	S	CURVE 92CM-8517R2
	S	CURVE 92CM-8544R2
2N105....	S	TENT. DATA 1, 6-56
	S	TENT. DATA 2, 6-56
	S	CURVE 92CM-8572R1
	S	CURVE 92CM-8581R1
	S	CURVE 92CM-8576R1
	S	CURVE 92CM-8573R1
2N109....	S	DATA, 8-59
	S	OUTLINE CE-8550R4
	S	CURVES 92CS-8602R2 & 92CS-8598R2
2N139....	S	TENT. DATA, 6-56
	S	CIRCUIT CE-8851R1
2N140....	S	TENT. DATA, 6-56
	S	CIRCUIT CE-8850R1
2N173....	S	DATA 1, 2-61
	S	DATA 2, 2-61
	S	DATA 3, 2-61
	S	DATA 4, 2-61
2N174....	S	DATA 1, 2-61
	S	DATA 2, 2-61
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For key to symbols, see sheet Index of Types 1

Type	Section	Sheet & Date
2N175....	S	CURVE 92CM-8914R1
2N176....	S	TENT. DATA 1, 11-58
	S	TENT. DATA 2, 11-58
2N215....	S	DATA, 8-56
2N217....	S	DATA, 8-59
2N218....	S	DATA, 10-56
2N219....	S	DATA, 10-56
2N220....	S	DATA, 10-56
2N247....	S	TENT. DATA 1, 12-56
	S	TENT. DATA 2, 12-56
	S	CURVES 92CM-9106R1
2N269....	S	TENT. DATA 1, 4-57
	S	TENT. DATA 2, 4-57
	S	CURVE 92CS-9150
	S	CURVE 92CS-9152
2N270....	S	DATA 1, 6-59
	S	DATA 2, 6-59
	S	CURVE 92CM-9182
	S	CURVE 92CS-9181
2N274....	S	DATA 1, 3-60
	S	DATA 2, 3-60
	S	DATA 3, 3-60
	S	DATA 4, 3-60
2N277....	S	DATA 1, 2-61
	S	DATA 2, 2-61
	S	DATA 3, 2-61
	S	DATA 4, 2-61
2N278....	S	DATA 1, 2-61
	S	DATA 2, 2-61
2N301....	S	DATA 1, 11-58
	S	DATA 2, 11-58
	S	DATA 3, 11-58 & CURVE 92CS-9250R1
	S	SUGGESTED MOUNTING ARRANGEMENT CE-9253R2
	S	CURVES 92CS-9248R1 & 92CS-9249R2
2N301-A..	S	DATA, 11-58
2N331*...	S	TENT. DATA 1, 6-59
	S	TENT. DATA 2, 6-59
	S	CURVE 92CS-9596
	S	CURVES 92CS-9622 & 92CS-9621
2N351....	S	TENT. DATA 1, 11-58
	S	TENT. DATA 2, 11-58
2N370....	S	TENT. DATA, 4-58
	S	OUTLINE & NOTE CE-9122R3
	S	CURVE 92CM-9107
2N371....	S	TENT. DATA, 4-58
2N372....	S	TENT. DATA, 4-58
2N373....	S	TENT. DATA 1, 9-58
	S	TENT. DATA 2, 9-58
2N373....	S	CURVE 92CM-9107
	S	CURVE 92CM-9602
2N374....	S	TENT. DATA 1, 9-58
	S	TENT. DATA 2, 9-58
	S	CURVE 92CM-9607
2N376....	S	TENT. DATA 1, 11-58
	S	TENT. DATA 2, 11-58
2N384....	S	DATA 1, 3-60
	S	DATA 2, 3-60
	S	DATA 3, 3-60
	S	DATA 4, 3-60
2N398....	S	TENT. DATA, 8-57
	S	OUTLINE & NOTE CE-9371R1
2N404....	S	TENT. DATA 1, 4-58
	S	TENT. DATA 2, 4-58
	S	RATING CHART 92CS-9449
2N405....	S	DATA, 4-58
2N406....	S	TENT. DATA 1, 4-58
	S	TENT. DATA 2, 4-58
2N407....	S	DATA, 4-58
2N408....	S	TENT. DATA, 4-58
	S	OUTLINE & NOTE CE-9148R2
2N409....	S	DATA, 4-58
2N410....	S	TENT. DATA 1, 4-58
	S	TENT. DATA 2, 4-58
	S	OUTLINE & NOTE CE-9148R2
2N411....	S	DATA, 4-58
2N412....	S	TENT. DATA 1, 4-58
	S	TENT. DATA 2, 4-58
	S	CURVE 92CM-8849R1
2N441....	S	DATA 1, 2-61
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	S	DATA 4, 2-61
2N442....	S	DATA 1, 2-61
	S	DATA 2, 2-61
2N443....	S	DATA 1, 2-61
	S	DATA 2, 2-61
2N456....	S	TENT. DATA 1, 8-59
	S	TENT. DATA 2, 8-59
2N457....	S	TENT. DATA 1, 8-59
	S	TENT. DATA 2, 8-59
	S	OUTLINE CE-9993
	S	CURVE 92CM-9826R1
	S	CURVE 92CM-9828
	S	CURVES 92CS-9837 & 92CS-9834
2N544....	S	TENT. DATA, 4-58
	S	OUTLINE & NOTE CE-9122R3

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2N544....	S	CURVES 92CS-9514 & 92CS-9515
2N561....	S	TENT. DATA 1, 6-59
	S	TENT. DATA 2, 6-59
	S	TENT. DATA 3, 6-59
	S	SUGGESTED MOUNTING ARRANGEMENT CE-10053
	S	RATING CHART III 92CM-9835
	S	CURVE 92CM-9826R1
	S	CURVE 92CM-9828
	S	CURVES 92CS-9834 & 92CS-9830R1
2N578....	S	TENT. DATA 1, 9-58
	S	TENT. DATA 2, 9-58
2N579....	S	TENT. DATA 1, 9-58
	S	TENT. DATA 2, 9-58
2N580....	S	TENT. DATA 1, 9-58
	S	TENT. DATA 2, 9-58
2N581...	S	TENT. DATA, 9-58
	S	OUTLINE & NOTE CE-9371R3
2N582....	S	TENT. DATA, 9-58
	S	OUTLINE & NOTE CE-9371R3
2N583....	S	DATA, 9-58
2N584....	S	DATA, 9-58
2N585....	S	TENT. DATA 1, 9-58
	S	TENT. DATA 2, 9-58
2N586....	S	DATA, 2-59
	S	OUTLINE & NOTE CE-9176R3
2N591....	S	TENT. DATA 1, 11-58
	S	TENT. DATA 2, 11-58
2N640....	S	TENT. DATA 1, 6-59
	S	TENT. DATA 2, 6-59
	S	CURVE 92CM-9107
	S	CURVE 92CM-9758
2N641....	S	TENT. DATA 1, 6-59
	S	TENT. DATA 2, 6-59
	S	CURVE 92CM-9107
	S	CURVE 92CM-9788
2N642....	S	TENT. DATA 1, 6-59
	S	TENT. DATA 2, 6-59
	S	CURVE 92CM-9107
	S	CURVE 92CS-9784
2N643....	S	TENT. DATA 1, 6-59
	S	TENT. DATA 2, 6-59
	S	OUTLINE & NOTE CE-9371R4
2N644....	S	TENT. DATA 1, 6-59
	S	TENT. DATA 2, 6-59
2N644....	S	OUTLINE & NOTE CE-9371R4
2N645....	S	TENT. DATA 1, 6-59
	S	TENT. DATA 2, 6-59
	S	OUTLINE & NOTE CE-9371R4
2N647....	S	TENT. DATA, 6-59
	S	CIRCUIT CE-9843
	S	CURVE 92CM-9844
	S	CURVE 92CS-9845
2N649....	S	TENT. DATA, 6-59
	S	CIRCUIT CE-10059
	S	CURVE 92CM-9844
	S	CURVE 92CS-9845
2N706....	S	DATA 1, 2-61
	S	DATA 2, 2-61
2N706-A..	S	DATA, 2-61
2N1010...	S	TENT. DATA, 8-59
	S	OUTLINE & NOTE CE-9148R4
2N1014...	S	DATA, 6-59
2N1023...	S	DATA 1, 3-60
	S	DATA 2, 3-60
	S	DATA 3, 3-60
	S	DATA 4, 3-60
2N1066...	S	DATA, 3-60
2N1067...	S	TENT. DATA 1, 8-59
	S	TENT. DATA 2, 8-59
	S	SUGGESTED MOUNTING ARRANGEMENT & MOUNTING CLAMP CE-10011R1-10012
	S	RATING CHART II 92CS-10000 & CURVE 92CS-10002
	S	CURVES 92CS-10003 & 92CS-10004
2N1068...	S	TENT. DATA 1, 8-59
	S	TENT. DATA 2, 8-59
	S	RATING CHART II 92CS-10027 & CURVE 92CS-10007
	S	CURVES 92CS-10008 & 92CS-10004
2N1069...	S	TENT. DATA 1, 8-59
	S	TENT. DATA 2, 8-59
	S	SUGGESTED MOUNTING ARRANGEMENT CE-10038
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	S	RATING CHART II 92CS-10028 & CURVE 92CS-10026
	S	CURVES 92CS-10031 & 92CS-10034
2N1090...	S	DATA 1, 8-59
	S	DATA 2, 8-59
	S	OUTLINE & NOTE CE-9371R4
	S	CURVE 92CM-9992
2N1091...	S	DATA 1, 8-59
	S	DATA 2, 8-59
	S	OUTLINE & NOTE CE-9371R4
	S	CURVE 92CM-9994
2N1092...	S	TENT. DATA 1, 8-59
	S	TENT. DATA 2, 8-59
	S	RATING CHART I 92CM-10041R1
	S	CURVE 92CM-10043R1
	S	CURVES 92CS-10046 & 92CS-10010
2N1099...	S	DATA 1, 2-61
	S	DATA 2, 2-61
	S	DATA 3, 2-61
	S	DATA 4, 2-61
2N1100...	S	DATA 1, 2-61
	S	DATA 2, 2-61
	S	DATA 3, 2-61
	S	DATA 4, 2-61
2N1169...	S	DATA 1, 9-60
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	S	DATA 3, 9-60
	S	DATA 4, 9-60
	S	DATA 5, 9-60
2N1170...	S	DATA, 9-60
2N1177...	S	DATA 1, 3-60
	S	DATA 2, 3-60
	S	DATA 3, 3-60
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2N1179...	S	DATA 1, 3-60
	S	DATA 2, 3-60
2N1180...	S	DATA 1, 3-60
	S	DATA 2, 3-60
2N1183...	S	DATA 1, 3-60
	S	DATA 2, 3-60
	S	DATA 3, 3-60
	S	DATA 4, 3-60
	S	DATA 5, 3-60
2N1183-A.	S	DATA 1, 3-60
	S	DATA 2, 3-60
2N1183-A.	S	DATA 3, 3-60
	S	DATA 4, 3-60
	S	DATA 5, 3-60
2N1183-B.	S	DATA 1, 3-60
	S	DATA 2, 3-60
	S	DATA 3, 3-60
	S	DATA 4, 3-60
	S	DATA 5, 3-60
2N1184...	S	DATA 1, 3-60
	S	DATA 2, 3-60
2N1184-A.	S	DATA 1, 3-60
	S	DATA 2, 3-60
2N1184-B.	S	DATA 1, 3-60
	S	DATA 2, 3-60
2N1213...	S	DATA 1, 6-60
	S	DATA 2, 6-60
	S	DATA 3, 6-60
	S	DATA 4, 6-60
2N1214...	S	DATA 1, 6-60
	S	DATA 2, 6-60
2N1215...	S	DATA 1, 6-60
	S	DATA 2, 6-60
2N1216...	S	DATA 1, 6-60
	S	DATA 2, 6-60
	S	DATA 3, 6-60
2N1224...	S	DATA, 3-60
2N1225...	S	DATA, 3-60
2N1226...	S	DATA, 3-60
2N1300...	S	DATA 1, 3-60
	S	DATA 2, 3-60
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2N1301...	S	DATA, 3-60
2N1358...	S	DATA, 2-61
2N1384...	S	DATA 1, 9-60
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	S	DATA 4, 9-60
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2N1396...	S	DATA 1, 3-60
	S	DATA 2, 3-60
2N1397...	S	DATA 1, 3-60
	S	DATA 2, 3-60
2N1412...	S	DATA, 2-61
2N1425...	S	DATA 1, 3-60
	S	DATA 2, 3-60
2N1426...	S	DATA 1, 3-60
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2N1481...	S	DATA 1, 3-60
	S	DATA 2, 3-60
2N1482...	S	DATA, 3-60
2N1483...	S	DATA 1, 3-60
	S	DATA 2, 3-60
	S	DATA 3, 3-60
	S	DATA 4, 3-60
	S	DATA 5, 3-60
2N1484...	S	DATA, 3-60
2N1485...	S	DATA 1, 3-60
	S	DATA 2, 3-60
2N1486...	S	DATA, 3-60
2N1487...	S	DATA 1, 3-60
	S	DATA 2, 3-60
	S	DATA 3, 3-60
	S	DATA 4, 3-60
	S	DATA 5, 3-60
2N1488...	S	DATA, 3-60
2N1489...	S	DATA 1, 3-60
	S	DATA 2, 3-60
2N1490...	S	DATA, 3-60
2N1491...	S	DATA 1, 6-60
	S	DATA 2, 6-60
	S	DATA 3, 6-60
	S	DATA 4, 6-60
	S	DATA 5, 6-60
2N1492...	S	DATA, 6-60
2N1493...	S	DATA, 6-60
2N1511...	S	DATA 1, 9-60
	S	DATA 2, 9-60
	S	DATA 3, 9-60
	S	DATA 4, 9-60
2N1512...	S	DATA, 9-60
2N1513...	S	DATA 1, 9-60
	S	DATA 2, 9-60
2N1514...	S	DATA, 9-60
2N1524...	S	DATA 1, 9-60
	S	DATA 2, 9-60
	S	DATA 3, 9-60
2N1525...	S	DATA, 9-60
2N1526...	S	DATA 1, 9-60
	S	DATA 2, 9-60
2N1527...	S	DATA, 9-60
2N1631...	S	DATA 1, 9-60
	S	DATA 2, 9-60
	S	DATA 3, 9-60
2N1632...	S	DATA, 9-60
2N1633...	S	DATA 1, 9-60
	S	DATA 2, 9-60
	S	DATA 3, 9-60
2N1634...	S	DATA, 9-60
2N1635...	S	DATA 1, 9-60
	S	DATA 2, 9-60
	S	DATA 3, 9-60
2N1636...	S	DATA, 9-60
2N1637...	S	DATA 1, 9-60
	S	DATA 2, 9-60
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2N1638...	S	DATA 1, 9-60
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2N1639...	S	DATA, 9-60
2N1683...	S	DATA, 9-60
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2N497....	S	DATA 1, 4-61
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2N578....	S	DATA 1, 4-61
	S	DATA 2, 4-61
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2N579....	S	DATA, 4-61
2N580....	S	DATA, 4-61
2N656....	S	DATA, 4-61
2N794....	S	DATA, 4-61
2N795....	S	DATA, 4-61
2N796....	S	DATA, 4-61
2N1300...	S	DATA 1, 4-61
	S	DATA 2, 4-61
	S	DATA 3, 4-61
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	S	DATA 2, 4-61
	S	DATA 3, 4-61
	S	DATA 4, 4-61
	S	DATA 5, 4-61
2N1319...	S	DATA 1, 4-61

Type	Section	Sheet & Date
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	S	DATA 3, 4-61
	S	DATA 4, 4-61
	S	DATA 5, 4-61
2N1384...	S	DATA 1, 4-61
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2N1450...	S	DATA 1, 4-61
	S	DATA 2, 4-61
2N1683...	S	DATA 1, 4-61
	S	DATA 2, 4-61
	S	DATA 3, 4-61
	S	DATA 4, 4-61
2N1700...	S	DATA 1, 4-61
	S	DATA 2, 4-61
2N1701...	S	DATA 1, 4-61
	S	DATA 2, 4-61
	S	DATA 3, 4-61
2N1702...	S	DATA 1, 4-61
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	S	DATA 3, 4-61
2N1703...	S	DATA 1, 4-61
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Type	Section	Sheet & Date
2N105....	S	TENT. DATA 1, 6-56
	S	TENT. DATA 2, 6-56
	S	CURVE 92CM-8572R1
	S	CURVE 92CM-8581R1
	S	CURVE 92CM-8576R1
	S	CURVE 92CM-8573R1
2N247....	S	TENT. DATA 1, 12-56
	S	TENT. DATA 2, 12-56
	S	CURVES 92CM-9106R1
2N331....	S	TENT. DATA 1, 6-59
	S	TENT. DATA 2, 6-59
	S	CURVE 92CS-9596
	S	CURVES 92CS-9622 & 92CS-9621
2N456....	S	TENT. DATA 1, 8-59
	S	TENT. DATA 2, 8-59
2N457....	S	TENT. DATA 1, 8-59
	S	TENT. DATA 2, 8-59
	S	OUTLINE CE-9993
	S	CURVE 92CM-9826R1

Type	Section	Sheet & Date
2N457....	S	CURVE 92CM-9828
	S	CURVES 92CS-9837 & 92CS-9834
2N544....	S	TENT. DATA, 4-58
	S	OUTLINE & NOTE CE-9122R3
	S	CURVES 92CS-9514 & 92CS-9515
2N561....	S	TENT. DATA 1, 6-59
	S	TENT. DATA 2, 6-59
	S	TENT. DATA 3, 6-59
	S	SUGGESTED MOUNTING ARRANGEMENT CE-10053
	S	RATING CHART III 92CM-9835
	S	CURVE 92CM-9826R1
	S	CURVE 92CM-9828
	S	CURVES 92CS-9834 & 92CS-9830R1
2N640....	S	TENT. DATA 1, 6-59

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2N640....	S	TENT. DATA 2, 6-59
	S	CURVE 92CM-9107
	S	CURVE 92CM-9758
2N641....	S	TENT. DATA 1, 6-59
	S	TENT. DATA 2, 6-59
	S	CURVE 92CM-9107
2N641....	S	CURVE 92CM-9788
2N642....	S	TENT. DATA 1, 6-59
	S	TENT. DATA 2, 6-59
	S	CURVE 92CM-9107
	S	CURVE 92CS-9784
2N1014...	S	DATA, 6-59

DISCONTINUED TYPES

The following types have been discontinued. To indicate this fact for your future reference please place a large dot (●) after each of the types in the "Type" column of the Index-of-Types sheets.

2N105
2N247
2N331
2N456
2N457
2N544
2N561
2N640
2N641
2N642
2N1014

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For key to symbols, see sheet Index of Types 1

Type	Section	Sheet & Date
1N248C, 1N248RC.	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
1N248RC..	S	*See 1N249C, 1N249RC sheets*
1N249C, 1N249RC.	S	DATA, 6-61
1N249RC..	S	*See 1N249C, 1N1249RC sheet*
1N250C, 1N250RC.	S	DATA, 6-61
1N250RC..	S	*See 1N250C, 1N250RC sheet*
1N1195A, 1N1195RA	S	DATA, 6-61
1N1195RA.	S	*See 1N1195A, 1N1195RA sheet*
1N1196A, 1N1196RA	S	DATA, 6-61
1N1196RA.	S	*See 1N1196A, 1N1196RA sheet*
1N1197A, 1N1197RA	S	DATA, 6-61
1N1197RA.	S	*See 1N1197A, 1N1197RA sheet*
1N1198A, 1N1198RA	S	DATA, 6-61
1N1198RA.	S	*See 1N1198A, 1N1198RA sheet*
1N1199A, 1N1199RA	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
1N1199RA.	S	*See 1N1199A, 1N1199RA sheets*
1N1200A, 1N1200RA	S	DATA, 6-61
1N1200RA.	S	*See 1N1200A, 1N1200RA sheet*
1N1202A, 1N1202RA	S	DATA, 6-61
1N1202RA.	S	*See 1N1202A, 1N1202RA sheet*
1N1203A, 1N1203RA	S	DATA, 6-61
1N1203RA.	S	*See 1N1203A, 1N1203RA sheet*
1N1204A, 1N1204RA	S	DATA, 6-61
1N1204RA.	S	*See 1N1204A, 1N1204RA sheet*

Type	Section	Sheet & Date
1N1205A, 1N1205RA	S	DATA, 6-61
1N1205RA.	S	*See 1N1205A, 1N1205RA sheet*
1N1206A, 1N1206RA	S	DATA, 6-61
1N1206RA.	S	*See 1N1206A, 1N1206RA sheet*
1N3193...	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
1N3194...	S	DATA 1, 6-61
	S	DATA 2, 6-61
1N3195...	S	DATA, 6-61
1N3196...	S	DATA, 6-61
2N269....	S	DATA 1, 6-61
	S	DATA 2, 6-61
2N384....	S	DATA 1, 6-61
	S	DATA 2, 6-61
2N404....	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
	S	DATA 4, 6-61
	S	DATA 5, 6-61
	S	DATA 6, 6-61
2N404A...	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
2N414....	S	DATA 1, 4-61
	S	DATA 2, 4-61
2N497....	S	DATA 1, 4-61
	S	DATA 2, 4-61
2N578....	S	DATA 1, 4-61
	S	DATA 2, 4-61
	S	DATA 3, 4-61
2N579....	S	DATA, 4-61
2N580....	S	DATA, 4-61
2N581....	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
2N582....	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
2N583....	S	DATA 1, 6-61
	S	DATA 2, 6-61
2N584....	S	DATA 1, 6-61
	S	DATA 2, 6-61
2N656....	S	DATA, 4-61
2N705....	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
	S	DATA 4, 6-61

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ADDITIONS AND REVISIONS

For key to symbols, see sheet Index of Types 1

Type	Section	Sheet & Date
2N705....	S	DATA 5, 6-61
	S	DATA 6, 6-61
2N710....	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
	S	DATA 4, 6-61
2N711....	S	DATA 1, 6-61
	S	DATA 2, 6-61
2N794....	S	DATA, 4-61
2N795....	S	DATA, 4-61
2N796....	S	DATA, 4-61
2N1300 ..	S	DATA 1, 4-61
	S	DATA 2, 4-61
	S	DATA 3, 4-61
	S	DATA 4, 4-61
2N1301...	S	DATA 1, 4-61
	S	DATA 2, 4-61
	S	DATA 3, 4-61
	S	DATA 4, 4-61
	S	DATA 5, 4-61
2N1319...	S	DATA 1, 4-61
	S	DATA 2, 4-61
	S	DATA 3, 4-61
	S	DATA 4, 4-61
	S	DATA 5, 4-61
2N1384...	S	DATA 1, 4-61
	S	DATA 4, 4-61
2N1450...	S	DATA 1, 4-61
	S	DATA 2, 4-61
2N1479...	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
	S	DATA 4, 6-61
2N1481...	S	DATA 1, 6-61
	S	DATA 2, 6-61
2N1482...	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
	S	DATA 4, 6-61
	S	DATA 5, 6-61
2N1485...	S	DATA 1, 6-61
	S	DATA 2, 6-61
2N1487...	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 4, 6-61
	S	DATA 5, 6-61
2N1489...	S	DATA 1, 6-61
	S	DATA 2, 6-61
2N1491...	S	DATA 1, 6-61
	S	DATA 4, 6-61
	S	DATA 5, 6-61
2N1511...	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
	S	DATA 4, 6-61
2N1513...	S	DATA 1, 6-61
	S	DATA 2, 6-61
2N1683...	S	DATA 1, 4-61
	S	DATA 2, 4-61
	S	DATA 3, 4-61
	S	DATA 4, 4-61
2N1700...	S	DATA 1, 4-61
	S	DATA 2, 4-61
2N1701...	S	DATA 1, 4-61
	S	DATA 2, 4-61
	S	DATA 3, 4-61
2N1702...	S	DATA 1, 4-61
	S	DATA 2, 4-61
	S	DATA 3, 4-61
2N1703...	S	DATA 1, 4-61
	S	DATA 2, 4-61
2N1768...	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
	S	DATA 4, 6-61
	S	DATA 5, 6-61
2N1769...	S	DATA, 6-61
2N1905...	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
2N1906...	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
	S	DATA 4, 6-61
	S	DATA 5, 6-61
2N2015...	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
	S	DATA 4, 6-61
	S	DATA 5, 6-61
2N2016...	S	DATA, 6-61

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DELETIONS

For key to symbols, see sheet Index of Types 1

Type	Section	Sheet & Date	Type	Section	Sheet & Date
2N105....	S	TENT. DATA 1, 6-56	2N544....	S	CURVES 92CS-9514 & 92CS-9515
	S	TENT. DATA 2, 6-56	2N561....	S	TENT. DATA 1, 6-59
	S	CURVE 92CM-8572R1		S	TENT. DATA 2, 6-59
	S	CURVE 92CM-8581R1		S	TENT. DATA 3, 6-59
	S	CURVE 92CM-8576R1		S	SUGGESTED MOUNTING ARRANGEMENT CE-10053
	S	CURVE 92CM-8573R1		S	RATING CHART III 92CM-9835
2N247....	S	TENT. DATA 1, 12-56		S	CURVE 92CM-9826R1
	S	TENT. DATA 2, 12-56		S	CURVE 92CM-9828
	S	CURVES 92CM-9106R1		S	CURVES 92CS-9834 & 92CS-9830R1
2N331....	S	TENT. DATA 1, 6-59	2N640....	S	TENT. DATA 1, 6-59
	S	TENT. DATA 2, 6-59		S	TENT. DATA 2, 6-59
	S	CURVE 92CS-9596		S	CURVE 92CM-9107
	S	CURVES 92CS-9622 & 92CS-9621		S	CURVE 92CM-9758
2N456....	S	TENT. DATA 1, 8-59	2N641....	S	TENT. DATA 1, 6-59
	S	TENT. DATA 2, 8-59		S	TENT. DATA 2, 6-59
2N457....	S	TENT. DATA 1, 8-59		S	CURVE 92CM-9107
	S	TENT. DATA 2, 8-59	2N641....	S	CURVE 92CM-9788
	S	OUTLINE CE-9993	2N642....	S	TENT. DATA 1, 6-59
	S	CURVE 92CM-9826R1		S	TENT. DATA 2, 6-59
	S	CURVE 92CM-9828		S	CURVE 92CM-9107
	S	CURVES 92CS-9837 & 92CS-9834		S	CURVE 92CS-9784
2N544....	S	TENT. DATA, 4-58	2N1014...	S	DATA, 6-59
	S	OUTLINE & NOTE CE-9122R3			

DISCONTINUED TYPES

The following types have been discontinued. To indicate this fact for your future reference please place a large dot (●) after each of the types in the "Type" column of the Index-of-Types sheets.

2N105	2N457	2N641
2N247	2N544	2N642
2N331	2N561	2N1014
2N456	2N640	3746

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ADDITIONS AND REVISIONS

For key to symbols, see sheet Index of Types 1

Type	Section	Sheet & Date
1N248C, 1N248RC.	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
1N248RC..	S	*See 1N249C, 1N249RC sheets*
1N249C, 1N249RC.	S	DATA, 6-61
1N249RC..	S	*See 1N249C, 1N1249RC sheet*
1N250C, 1N250RC.	S	DATA, 6-61
1N250RC..	S	*See 1N250C, 1N250RC sheet*
1N1195A, 1N1195RA	S	DATA, 6-61
1N1195RA.	S	*See 1N1195A, 1N1195RA sheet*
1N1196A, 1N1196RA	S	DATA, 6-61
1N1196RA.	S	*See 1N1196A, 1N1196RA sheet*
1N1197A, 1N1197RA	S	DATA, 6-61
1N1197RA.	S	*See 1N1197A, 1N1197RA sheet*
1N1198A, 1N1198RA	S	DATA, 6-61
1N1198RA.	S	*See 1N1198A, 1N1198RA sheet*
1N1199A, 1N1199RA	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
1N1199RA.	S	*See 1N1199A, 1N1199RA sheets*
1N1200A, 1N1200RA	S	DATA, 6-61
1N1200RA.	S	*See 1N1200A, 1N1200RA sheet*
1N1202A, 1N1202RA	S	DATA, 6-61
1N1202RA.	S	*See 1N1202A, 1N1202RA sheet*
1N1203A, 1N1203RA	S	DATA, 6-61
1N1203RA.	S	*See 1N1203A, 1N1203RA sheet*
1N1204A, 1N1204RA	S	DATA, 6-61
1N1204RA.	S	*See 1N1204A, 1N1204RA sheet*
1N1205A, 1N1205RA	S	DATA, 6-61
1N1205RA.	S	*See 1N1205A, 1N1205RA sheet*
1N1206A, 1N1206RA	S	DATA, 6-61
1N1206RA.	S	*See 1N1206A, 1N1206RA sheet*
1N1612, 1N1612R.	S	DATA 1, 8-61
	S	DATA 2, 8-61
1N1612R..	S	*See 1N1612, 1N1612R sheet*
1N1613, 1N1613R.	S	DATA, 8-61
1N1613R..	S	*See 1N1613, 1N1613R sheet*
1N1614, 1N1614R.	S	DATA, 8-61
1N1614R..	S	*See 1N1614, 1N1614R sheet*
1N1615, 1N1615R.	S	DATA, 8-61
1N1615R..	S	*See 1N1615, 1N1615R sheet*
1N1616, 1N1616R.	S	DATA, 8-61
1N1616R..	S	*See 1N1616, 1N1616R sheet*
1N3193...	S	DATA 1, 8-61
	S	DATA 2, 8-61
	S	DATA 3, 8-61
1N3194...	S	DATA 1, 8-61
	S	DATA 2, 8-61
	S	DATA 3, 8-61
	S	DATA 4, 8-61
1N3195...	S	DATA 1, 8-61
	S	DATA 2, 8-61
	S	DATA 3, 8-61
1N3253...	S	DATA, 8-61
1N3254...	S	DATA, 8-61 (On 1N3253 sheet)
1N3255...	S	DATA, 8-61 (On 1N3253 sheet)
1N3256...	S	DATA, 8-61 (On 1N3253 sheet)
2DG001...	S	DATA 1, 8-61
	S	DATA 2, 8-61
	S	DATA 3, 8-61
2N173....	S	DATA 1, 8-61
	S	DATA 2, 8-61
	S	DATA 3, 8-61

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For key to symbols, see sheet Index of Types 1

Type	Section	Sheet & Date
2N174....	S	DATA 1, 8-61
	S	DATA 2, 8-61
	S	DATA 3, 8-61
2N269....	S	DATA 1, 6-61
	S	DATA 2, 6-61
2N277....	S	DATA 1, 8-61
	S	DATA 2, 8-61
	S	DATA 3, 8-61
2N278....	S	DATA 1, 8-61
	S	DATA 2, 8-61
2N384....	S	DATA 1, 6-61
	S	DATA 2, 6-61
2N404....	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
	S	DATA 4, 6-61
	S	DATA 5, 6-61
	S	DATA 6, 6-61
		See also 3907/2N404
2N404A...	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
2N414....	S	DATA 1, 4-61
	S	DATA 2, 4-61
2N441....	S	DATA 1, 8-61
	S	DATA 2, 8-61
	S	DATA 3, 8-61
2N442....	S	DATA 1, 8-61
	S	DATA 2, 8-61
2N443....	S	DATA 1, 8-61
	S	DATA 2, 8-61
2N497....	S	DATA 1, 4-61
	S	DATA 2, 4-61
2N578....	S	DATA 1, 4-61
	S	DATA 2, 4-61
	S	DATA 3, 4-61
2N579....	S	DATA, 4-61
2N580....	S	DATA, 4-61
2N581....	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
2N582....	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
2N583....	S	DATA 1, 6-61
	S	DATA 2, 6-61
2N584....	S	DATA 1, 6-61
	S	DATA 2, 6-61
2N656....	S	DATA, 4-61
2N696....	S	DATA 1, 8-61
	S	DATA 2, 8-61
2N697....	S	DATA, 8-61
2N705....	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
	S	DATA 4, 6-61
	S	DATA 5, 6-61
	S	DATA 6, 6-61
2N708....	S	DATA 1, 8-61
	S	DATA 2, 8-61
	S	DATA 3, 8-61
2N710....	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
	S	DATA 4, 6-61
2N711....	S	DATA 1, 6-61
	S	DATA 2, 6-61
2N794....	S	DATA, 4-61
2N795....	S	DATA, 4-61
2N796....	S	DATA, 4-61
2N828....	S	DATA 1, 8-61
	S	DATA 2, 8-61
	S	DATA 3, 8-61
	S	DATA 4, 8-61
2N1099...	S	DATA 1, 8-61
	S	DATA 2, 8-61
2N1100...	S	DATA 1, 8-61
	S	DATA 2, 8-61
	S	DATA 3, 8-61
2N1300...	S	DATA 1, 4-61
	S	DATA 2, 4-61
	S	DATA 3, 4-61
	S	DATA 4, 4-61
2N1301...	S	DATA 1, 4-61
	S	DATA 2, 4-61
	S	DATA 3, 4-61
	S	DATA 4, 4-61
	S	DATA 5, 4-61
2N1319...	S	DATA 1, 4-61
	S	DATA 2, 4-61
	S	DATA 3, 4-61
	S	DATA 4, 4-61
	S	DATA 5, 4-61
2N1358...	S	DATA, 8-61
2N1384...	S	DATA 1, 4-61
	S	DATA 4, 4-61
2N1412...	S	DATA, 8-61
2N1450...	S	DATA 1, 4-61
	S	DATA 2, 4-61
2N1479...	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
	S	DATA 4, 6-61
2N1481...	S	DATA 1, 6-61

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2N1481...	S	DATA 2, 6-61
2N1482...	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
	S	DATA 4, 6-61
	S	DATA 5, 6-61
2N1485...	S	DATA 1, 6-61
	S	DATA 2, 6-61
2N1487...	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 4, 6-61
	S	DATA 5, 6-61
2N1489...	S	DATA 1, 6-61
	S	DATA 2, 6-61
2N1491...	S	DATA 1, 6-61
	S	DATA 4, 6-61
	S	DATA 5, 6-61
2N1492...	S	DATA, 8-61
2N1493...	S	DATA, 8-61
2N1511...	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
	S	DATA 4, 6-61
2N1513...	S	DATA 1, 6-61
	S	DATA 2, 6-61
2N1613...	S	DATA 1, 8-61
	S	DATA 2, 8-61
	S	DATA 3, 8-61
	S	DATA 4, 8-61
	S	DATA 5, 8-61
	S	DATA 6, 8-61
2N1683...	S	DATA 1, 4-61
	S	DATA 2, 4-61
	S	DATA 3, 4-61
	S	DATA 4, 4-61
2N1700...	S	DATA 1, 4-61
	S	DATA 2, 4-61
2N1701...	S	DATA 1, 4-61
	S	DATA 2, 4-61
	S	DATA 3, 4-61
2N1702...	S	DATA 1, 4-61
	S	DATA 2, 4-61
	S	DATA 3, 4-61
2N1703...	S	DATA 1, 4-61
	S	DATA 2, 4-61
2N1708...	S	DATA 1, 8-61
2N1708...	S	DATA 2, 8-61
	S	DATA 3, 8-61
2N1768...	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
	S	DATA 4, 6-61
	S	DATA 5, 6-61
2N1769...	S	DATA, 6-61
2N1905...	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
2N1906...	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
	S	DATA 4, 6-61
	S	DATA 5, 6-61
2N2015...	S	DATA 1, 6-61
	S	DATA 2, 6-61
	S	DATA 3, 6-61
	S	DATA 4, 6-61
	S	DATA 5, 6-61
2N2016...	S	DATA, 6-61
2N2102...	S	DATA 1, 8-61
	S	DATA 2, 8-61
	S	DATA 3, 8-61
	S	DATA 4, 8-61
	S	DATA 5, 8-61
	S	DATA 6, 8-61
3DG001...	S	DATA 1, 8-61
	S	DATA 2, 8-61
3907/ 2N404...	S	DATA 1, 8-61
	S	DATA 2, 8-61
	S	DATA 3, 8-61
CR101....	S	DATA 1, 8-61
	S	DATA 2, 8-61
	S	DATA 3, 8-61
CR102....	S	DATA, 8-61
CR103....	S	DATA, 8-61
CR104....	S	DATA, 8-61
CR105....	S	DATA, 8-61
CR106....	S	DATA, 8-61
CR107....	S	DATA, 8-61
CR108....	S	DATA, 8-61
CR109....	S	DATA, 8-61
CR110....	S	DATA, 8-61

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DELETIONS

For key to symbols, see sheet Index of Types 1

Type	Section	Sheet & Date	Type	Section	Sheet & Date
2N105....	S	TENT. DATA 1, 6-56	2N544....	S	CURVES 92CS-9514 & 92CS-9515
	S	TENT. DATA 2, 6-56	2N561....	S	TENT. DATA 1, 6-59
	S	CURVE 92CM-8572R1		S	TENT. DATA 2, 6-59
	S	CURVE 92CM-8581R1		S	TENT. DATA 3, 6-59
	S	CURVE 92CM-8576R1		S	SUGGESTED MOUNTING ARRANGEMENT CE-10053
	S	CURVE 92CM-8573R1		S	RATING CHART III 92CM-9835
2N247....	S	TENT. DATA 1, 12-56		S	CURVE 92CM-9826R1
	S	TENT. DATA 2, 12-56		S	CURVE 92CM-9828
	S	CURVES 92CM-9106R1		S	CURVES 92CS-9834 & 92CS-9830R1
2N331....	S	TENT. DATA 1, 6-59	2N640....	S	TENT. DATA 1, 6-59
	S	TENT. DATA 2, 6-59		S	TENT. DATA 2, 6-59
	S	CURVE 92CS-9596		S	CURVE 92CM-9107
	S	CURVES 92CS-9622 & 92CS-9621		S	CURVE 92CM-9758
2N456....	S	TENT. DATA 1, 8-59	2N641....	S	TENT. DATA 1, 6-59
	S	TENT. DATA 2, 8-59		S	TENT. DATA 2, 6-59
2N457....	S	TENT. DATA 1, 8-59		S	CURVE 92CM-9107
	S	TENT. DATA 2, 8-59	2N641....	S	CURVE 92CM-9788
	S	OUTLINE CE-9993	2N642....	S	TENT. DATA 1, 6-59
	S	CURVE 92CM-9826R1		S	TENT. DATA 2, 6-59
	S	CURVE 92CM-9828		S	CURVE 92CM-9107
	S	CURVES 92CS-9837 & 92CS-9834		S	CURVE 92CS-9784
2N544....	S	TENT. DATA, 4-58	2N1014...	S	DATA, 6-59
	S	OUTLINE & NOTE CE-9122R3			

DISCONTINUED TYPES

The following types have been discontinued. To indicate this fact for your future reference please place a large dot (●) after each of the types in the "Type" column of the Index-of-Types sheets.

2N105	2N457	2N641
2N247	2N544	2N642
2N331	2N561	2N1014
2N456	2N640	3746

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ADDITIONS AND REVISIONS

For key to symbols, see sheet *Index of Types 1*

Type	Section	Sheet & Date
1N1183A, 1N1183RA	S	DATA 1, 2-62
	S	DATA 2, 2-62
	S	DATA 3, 2-62
1N1183RA.		*See 1N1183A, 1N1183RA sheet*
1N1184A, 1N1184RA	S	DATA, 2-62
1N1184RA.		*See 1N1184A, 1N1184RA sheet*
1N1186A, 1N1186RA	S	DATA, 2-62
1N1186RA.		*See 1N1186A, 1N1186RA sheet*
1N1187, 1N1187R.	S	DATA 1, 2-62
	S	DATA 2, 2-62
	S	DATA 3, 2-62
1N1187R..		*See 1N1187, 1N1187R sheet*
1N1188, 1N1188R.	S	DATA, 2-62
1N1188...		*See 1N1188, 1N1188R sheet*
1N1189, 1N1189R.	S	DATA, 2-62
1N1189...		*See 1N1189, 1N1189R sheet*
1N1190, 1N1190R.	S	DATA, 2-62
1N1190...		*See 1N1190, 1N1190R sheet*
2N398A...	S	DATA 1, 2-62
	S	DATA 2, 2-62
2N955....	S	DATA 1, 2-62
	S	DATA 2, 2-62
	S	DATA 3, 2-62
	S	DATA 4, 2-62
	S	DATA 5, 2-62
2N1708...	S	DATA 1, 2-62
	S	DATA 2, 2-62
	S	DATA 3, 2-62
	S	DATA 4, 2-62
	S	DATA 5, 2-62
	S	DATA 6, 2-62
	S	DATA 7, 2-62
2N2205...	S	DATA, 2-62
2N2206...	S	DATA 1, 2-62
	S	DATA 2, 2-62
	S	DATA 3, 2-62
	S	DATA 4, 2-62
	S	DATA 5, 2-62
	S	DATA 6, 2-62
	S	DATA 7, 2-62

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ADDITIONS AND REVISIONS

For key to symbols, see sheet *Index of Types 1*

Type	Section	Sheet & Date
1N3754...	S	DATA 1, 8-62
	S	DATA 2, 8-62
1N3755...	S	DATA, 8-62
1N3756...	S	DATA 1, 8-62
	S	DATA 2, 8-62
1N3847...	S	DATA 1, 8-62
	S	DATA 2, 8-62
1N3848...	S	DATA, 8-62
1N3849...	S	DATA, 8-62
1N3850...	S	DATA, 8-62
1N3851...	S	DATA, 8-62
1N3852...	S	DATA, 8-62
1N3853...	S	DATA, 8-62
1N3854...	S	DATA, 8-62
1N3855...	S	DATA, 8-62
1N3856...	S	DATA, 8-62
1N3857...	S	DATA, 8-62
1N3858...	S	DATA, 8-62
1N3859...	S	DATA, 8-62
1N3860...	S	DATA, 8-62
1N3861...	S	DATA 1, 8-62
	S	DATA 2, 8-62
1N3862...	S	DATA, 8-62
1N3863...	S	DATA, 8-62
2N398...	S	DATA, 8-62
2N398A...	S	DATA 1, 8-62
	S	DATA 2, 8-62
2N398B...	S	DATA 1, 8-62
	S	DATA 2, 8-62
	S	DATA 3, 8-62
2N709....	S	DATA 1, 8-62
	S	DATA 2, 8-62
2N955....	S	DATA 1, 8-62
	S	DATA 2, 8-62
2N955A...	S	DATA 1, 8-62
	S	DATA 2, 8-62
	S	DATA 3, 8-62
	S	DATA 4, 8-62
	S	DATA 5, 8-62
	S	DATA 6, 8-62
2N1853...	S	DATA 1, 8-62
	S	DATA 2, 8-62
	S	DATA 3, 8-62
2N1854...	S	DATA 1, 8-62
	S	DATA 2, 8-62
2N2273...	S	DATA 1, 8-62
	S	DATA 2, 8-62

Type	Section	Sheet & Date
2N2475...	S	DATA 1, 8-62
	S	DATA 2, 8-62
	S	DATA 3, 8-62
	S	DATA 4, 8-62
	S	DATA 5, 8-62
	S	DATA 6, 8-62
	S	DATA 7, 8-62
2N2476...	S	DATA 1, 8-62
	S	DATA 2, 8-62
	S	DATA 3, 8-62
	S	DATA 4, 8-62
2N2477...	S	DATA 1, 8-62
	S	DATA 2, 8-62
2N2482...	S	DATA 1, 8-62
	S	DATA 2, 8-62
	S	DATA 3, 8-62
	S	DATA 4, 8-62
	S	DATA 5, 8-62
CR101....	S	DATA 1, 8-62
	S	DATA 2, 8-62
	S	DATA 3, 8-62
	S	DATA 4, 8-62
CR102....	S	DATA, 8-62
CR103....	S	DATA, 8-62
CR104....	S	DATA 1, 8-62
	S	DATA 2, 8-62
CR105....	S	DATA 1, 8-62
	S	DATA 2, 8-62
CR106....	S	DATA 1, 8-62
	S	DATA 2, 8-62
CR107....	S	DATA 1, 8-62
	S	DATA 2, 8-62
CR108....	S	DATA 1, 8-62
	S	DATA 2, 8-62
CR109....	S	DATA 1, 8-62
	S	DATA 2, 8-62
CR110....	S	DATA 1, 8-62
	S	DATA 2, 8-62
CR201....	S	DATA 1, 8-62
	S	DATA 2, 8-62
	S	DATA 3, 8-62
CR203....	S	DATA, 8-62
CR204....	S	DATA, 8-62
CR206....	S	DATA, 8-62
CR208....	S	DATA, 8-62
CR210....	S	DATA, 8-62
CR212....	S	DATA, 8-62

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AUDIO-FREQUENCY APPLICATIONS

SMALL SIGNAL—Class A

2N104	2N215	2N220	2N1010
2N175			

DRIVER

2N405	2N406	2N591

LARGE SIGNAL—Classes A and B

2N109	2N270	2N408	2N649
2N217	2N407	2N647	

POWER AMPLIFIER

Dissipations—Up to 4.9 Watts

●2N497	●2N699	●2N1092	●2N1613
●2N656			

Dissipations—5 to 49.9 Watts

2N176	2N1183	●2N1480	●2N1700
2N301	2N1183A	●2N1481	●2N1701
2N301A	2N1183B	●2N1482	●2N1768
2N351	2N1184	●2N1483	●2N1769
2N376	2N1184A	●2N1484	●2N2102
●2N1067	2N1184B	●2N1485	●2N2270
●2N1068	●2N1479	●2N1486	

Dissipations—50 Watts and Higher

2N173	●2N1069	●2N1488	●2N1702
2N174	●2N1070	●2N1489	●2N1703
2N277	2N1099	●2N1490	2N1905
2N278	2N1100	●2N1511	2N1906
2N441	2N1358	●2N1512	●2N2015
2N442	2N1412	●2N1513	●2N2016
2N443	●2N1487	●2N1514	

● Silicon type.

RADIO-FREQUENCY APPLICATIONS

VHF AMPLIFIER

2N384	2N1177	2N1396	●2N1491
2N1023	2N1225	2N1397	●2N1492
2N1066			●2N1493

HF AMPLIFIER

2N274	2N1066	2N1395	●2N1492
2N370	2N1224	2N1396	●2N1493
2N384	2N1225	2N1397	2N1631
●2N708	2N1226	●2N1491	2N1632
2N1023			2N1637

MIXER

2N274	2N1023	2N1224	2N1395
2N372	2N1066	2N1225	2N1396
2N384	2N1179	2N1226	2N1397

OSCILLATOR

2N274	2N1023	2N1224	2N1395
2N371	2N1066	2N1225	2N1396
2N384	2N1178	2N1226	2N1397

CONVERTER

2N140	2N412	2N1226	2N1526
2N219	2N1023	2N1395	2N1527
2N274	2N1066	2N1396	2N1635
2N374	2N1224	2N1397	2N1636
2N384	2N1225	2N1426	2N1639
2N411			

IF AMPLIFIER

2N139	2N410	2N1225	2N1425
2N218	2N1023	2N1226	2N1524
2N274	2N1066	2N1395	2N1525
2N373	2N1180	2N1396	2N1633
2N384	2N1224	2N1397	2N1634
2N409			2N1638

● Silicon type.

COMPUTER SWITCHING APPLICATIONS

Stage Delays Greater than 300 Nanoseconds[a]

2N398	2N398A	2N586

Stage Delays of 100 to 300 Nanoseconds[a]

2N269	2N580	2N1091	2N1306
2N388	2N581	2N1169[b]	2N1307
2N388A	2N582	2N1170[b]	2N1308
2N404	2N583	2N1302	2N1309
2N404A	2N584	2N1303	2N1319[b]
2N414	2N585	2N1304	2N1605
2N578	2N1090	2N1305	2N1605A
2N579			3907/2N404

Stage Delays of 30 to 100 Nanoseconds[a]

●2N696	2N796	2N1215[c]	2N1301
●2N697	2N1213[c]	2N1216[c]	2N1384
2N794	2N1214[c]	2N1300	2N1683
2N795			

Stage Delays of 10 to 30 Nanoseconds[a]

2N643	●2N706	2N710	2N1450
2N644	●2N706A	2N711	●2N1708
2N645	●2N708	2N828	●2N2205
2N705			●2N2206

Stage Delays of 5 to 10 Nanoseconds[a]

2N955

[a] Measured in resistor-capacitor-transistor logic circuit except for drift-transistor types 2N643, 2N644, 2N645, and 2N1450 which are measured in transistor-current-steering logic circuit. Nanoseconds = 10^{-9} seconds.

[b] Bidirectional type.

[c] Thyristor type.

● Silicon type.

World Radio History

POWER SWITCHING APPLICATIONS

Dissipations—Up to 4.9 Watts

●2N497	●2N699	●2N1092	●2N1613
●2N656			

Dissipations—5 to 49.9 Watts

●2N1067	2N1184A	●2N1482	●2N1700
●2N1068	2N1184B	●2N1483	●2N1701
2N1183	●2N1479	●2N1484	●2N1768
2N1183A	●2N1480	●2N1485	●2N1769
2N1183B	●2N1481	●2N1486	●2N2102
2N1184			●2N2270

Dissipations—50 Watts and Higher

2N173	●2N1069	●2N1488	●2N1702
2N174	●2N1070	●2N1489	●2N1703
2N277	2N1099	●2N1490	2N1905
2N278	2N1100	●2N1511	2N1906
2N441	2N1358	●2N1512	●2N2015
2N442	2N1412	●2N1513	●2N2016
2N443	●2N1487	●2N1514	

● Silicon type.

MILITARY-SPECIFICATION TYPES

JAN-2N220	Meets MIL-T-19500/1 dated Jan. 14, 1957
USA-2N274	Meets MIL-T-19500/26 (Sig C) dated Oct. 3, 1957
USA-2N384	Meets MIL-T-19500/27 (Sig C) dated Oct. 14, 1957
USA-2N706	Meets MIL-S-19500/120 (Sig C) dated June 2, 1960
USA-2N1183 USA-2N1183A USA-2N1183B USA-2N1184 USA-2N1184A USA-2N1184B	Meet MIL-S-19500/143 (Sig C) dated Oct. 10, 1960
USA-2N1358	Meets MIL-S-19500 (Sig C) dated June 9, 1961
USAF-2N404	Meets MIL-T-19500/20 USAF dated July 23, 1957

World Radio History

AUDIO-FREQUENCY APPLICATIONS

SMALL SIGNAL—Class A

2N104	2N215	2N220	2N1010
2N175			

DRIVER

2N405	2N406	2N591

LARGE SIGNAL—Classes A and B

2N109	2N270	2N408	2N649
2N217	2N407	2N647	

POWER AMPLIFIER

Dissipations—Up to 4.9 Watts

●2N497	●2N656	●2N1092

Dissipations—5 to 49.9 Watts

2N176	2N1183	●2N1479	●2N1485
2N301	2N1183A	●2N1480	●2N1486
2N301A	2N1183B	●2N1481	●2N1700
2N351	2N1184	●2N1482	●2N1701
2N376	2N1184A	●2N1483	●2N1768
●2N1067	2N1184B	●2N1484	●2N1769
●2N1068			

Dissipations—50 Watts and Higher

2N173	●2N1069	●2N1488	●2N1702
2N174	●2N1070	●2N1489	●2N1703
2N277	2N1099	●2N1490	2N1905
2N278	2N1100	●2N1511	2N1906
2N441	2N1358	●2N1512	●2N2015
2N442	2N1412	●2N1513	●2N2016
2N443	●2N1487	●2N1514	

● Silicon type.

RADIO-FREQUENCY APPLICATIONS

VHF AMPLIFIER

2N384	2N1177	2N1396	●2N1491
2N1023	2N1225	2N1397	●2N1492
2N1066			●2N1493

HF AMPLIFIER

2N274	2N1224	2N1396	●2N1493
2N370	2N1225	2N1397	2N1631
2N384	2N1226	●2N1491	2N1632
2N1023	2N1395	●2N1492	2N1637
2N1066			

MIXER

2N274	2N1023	2N1224	2N1395
2N372	2N1066	2N1225	2N1396
2N384	2N1179	2N1226	2N1397

OSCILLATOR

2N274	2N1023	2N1224	2N1395
2N371	2N1066	2N1225	2N1396
2N384	2N1178	2N1226	2N1397

CONVERTER

2N140	2N412	2N1226	2N1526
2N219	2N1023	2N1395	2N1527
2N274	2N1066	2N1396	2N1635
2N374	2N1224	2N1397	2N1636
2N384	2N1225	2N1426	2N1639
2N411			

IF AMPLIFIER

2N139	2N410	2N1225	2N1425
2N218	2N1023	2N1226	2N1524
2N274	2N1066	2N1395	2N1525
2N373	2N1180	2N1396	2N1633
2N384	2N1224	2N1397	2N1634
2N409			2N1638

World Radio History

COMPUTER SWITCHING APPLICATIONS

Stage Delays Greater than 300 Nanoseconds[a]

2N398	2N586

Stage Delays of 100 to 300 Nanoseconds[a]

2N269	2N579	2N583	2N1091
2N404	2N580	2N584	2N1169[b]
2N404A	2N581	2N585	2N1170[b]
2N414	2N582	2N1090	2N1319[b]
2N578			3907/2N404

Stage Delays of 30 to 100 Nanoseconds[a]

2N794	2N934	2N1215[c]	2N1301
2N795	2N1213[c]	2N1216[c]	2N1384
2N796	2N1214[c]	2N1300	2N1683

Stage Delays of 10 to 30 Nanoseconds[a]

2N643	2N705	●2N706A	2N711
2N644	●2N706	2N710	2N1450
2N645			

[a] Measured in resistor-capacitor-transistor logic circuit except for very high speed drift-transistor types 2N643, 2N644, 2N645, and 2N1450 which are measured in transistor current steering logic circuit. Nanoseconds = 10^{-9} seconds.

[b] Bidirectional type.

[c] Thyristor type.

● Silicon type.

POWER SWITCHING APPLICATIONS

Dissipations—Up to 4.9 Watts

●2N497	●2N656	●2N1092

Dissipations—5 to 49.9 Watts

●2N1067	2N1184	●2N1481	●2N1486
●2N1068	2N1184A	●2N1482	●2N1700
2N1183	2N1184B	●2N1483	●2N1701
2N1183A	●2N1479	●2N1484	●2N1768
2N1183B	●2N1480	●2N1485	●2N1769

Dissipations—50 Watts and Higher

2N173	●2N1069	●2N1488	●2N1702
2N174	●2N1070	●2N1489	●2N1703
2N277	2N1099	●2N1490	2N1905
2N278	2N1100	●2N1511	2N1906
2N441	2N1358	●2N1512	●2N2015
2N442	2N1412	●2N1513	●2N2016
2N443	●2N1487	●2N1514	

MILITARY-SPECIFICATION TYPES

JAN-2N220	Meets MIL-T-19500/1 dated Jan. 14, 1957
USA-2N274	Meets MIL-T-19500/26 (Sig C) dated Oct. 3, 1957
USA-2N384	Meets MIL-T-19500/27 (Sig C) dated Oct. 14, 1957
USAF-2N404	Meets MIL-T-19500/20 USAF dated July 23, 1957
USA-2N706	Meets MIL-S-19500/120 (Sig C) dated June 2, 1960

World Radio History

RECTIFIER APPLICATIONS

MAXIMUM DC FORWARD AMPERES[a] at indicated temperature[b] (°C)		MAXIMUM PEAK INVERSE VOLTS	MAXIMUM OPERATING TEMPERATURE[b] (°C)	RCA TYPE
Forward Currents—Up to 0.750 Ampere				
0.500[c]	≤75 T_A	400	100 T_A	1N1763
0.500[c]	≤75 T_A	500	100 T_A	1N1764
0.500 0.400[c]	≤75 T_A	800	100 T_A	1N3196 1N3256
0.750 0.500[c]	≤75 T_A	50	125 T_A	1N2858
0.750 0.500[c]	≤75 T_A	100	125 T_A	1N2859
0.750 0.500[c]	≤75 T_A	200	125 T_A	1N2860
0.750 0.500[c]	≤75 T_A	300	125 T_A	1N2861
0.750 0.500[c]	≤75 T_A	400	125 T_A	1N2862
0.750 0.500[c]	≤75 T_A	500	125 T_A	1N2863
0.750 0.500[c]	≤75 T_A	600	125 T_A	1N2864
0.750 0.500[c]	≤75 T_A	200	100 T_A	1N3193 1N3253
0.750 0.500[c]	≤75 T_A	400	100 T_A	1N3194 1N3254
0.750 0.500[c]	≤75 T_A	600	100 T_A	1N3195 1N3255
0.750	≤50 T_A	100	165 T_A	1N440B
0.750	≤50 T_A	200	165 T_A	1N441B
0.750	≤50 T_A	300	165 T_A	1N442B
0.750	≤50 T_A	400	165 T_A	1N443B
0.750	≤35 T_A	500	150 T_A	1N444B

RECTIFIER APPLICATIONS

MAXIMUM DC FORWARD AMPERES[a] at indicated temperature[b] (°C)		MAXIMUM PEAK INVERSE VOLTS	MAXIMUM OPERATING TEMPERATURE[b] (°C)	RCA TYPE
0.750	≤35 T_A	600	150 T_A	1N445B
0.750	≤50 T_A	50	165 T_A	1N536
0.750	≤50 T_A	100	165 T_A	1N537
0.750	≤50 T_A	200	165 T_A	1N538
0.750	≤50 T_A	300	165 T_A	1N539
0.750	≤50 T_A	400	165 T_A	1N540
0.750	≤50 T_A	600	165 T_A	1N547
0.750	≤50 T_A	500	165 T_A	1N1095
Forward Currents—1 to 40 Amperes				
5	135 T_C	50	175 T_C	1N1612, 1N1612R
5	135 T_C	100	175 T_C	1N1613, 1N1613R
5	135 T_C	200	175 T_C	1N1614, 1N1614R
5	135 T_C	400	175 T_C	1N1615, 1N1615R
5	135 T_C	600	175 T_C	1N1616, 1N1616R
12	150 T_C	50 100[d]	200 T_C	1N1199A, 1N1199RA
12	150 T_C	100 200[d]	200 T_C	1N1200A, 1N1200RA
12	150 T_C	200 350[d]	200 T_C	1N1202A, 1N1202RA
12	150 T_C	300 450[d]	200 T_C	1N1203A, 1N1203RA
12	150 T_C	400 600[d]	200 T_C	1N1204A, 1N1204RA

RECTIFIER APPLICATIONS

MAXIMUM DC FORWARD AMPERES[a] at indicated temperature[b] (°C)		MAXIMUM PEAK INVERSE VOLTS	MAXIMUM OPERATING TEMPERATURE[b] (°C)	RCA TYPE
12	150 T_C	500 700[d]	200 T_C	1N1205A, 1N1205RA
12	150 T_C	600 800[d]	200 T_C	1N1206A, 1N1206RA
20	150 T_C	55	175 T_C	1N248C, 1N248RC
20	150 T_C	110	175 T_C	1N249C, 1N249RC
20	150 T_C	220	175 T_C	1N250C, 1N250RC
20	150 T_C	300	175 T_C	1N1195A, 1N1195RA
20	150 T_C	400	175 T_C	1N1196A, 1N1196RA
20	150 T_C	500	175 T_C	1N1197A, 1N1197RA
20	150 T_C	600	175 T_C	1N1198A, 1N1198RA
35	140 T_C	300	175 T_C	1N1187, 1N1187R
35	140 T_C	400	175 T_C	1N1188, 1N1188R
35	140 T_C	500	175 T_C	1N1189, 1N1189R
35	140 T_C	600	175 T_C	1N1190, 1N1190R

[a] With resistive or inductive load except as noted.
[b] T_A = ambient temperature, T_C = case temperature.
[c] With capacitive load.
[d] Transient voltage rating.

World Radio History

RECTIFIER APPLICATIONS

MAXIMUM DC FORWARD AMPERES[a] at indicated temperature[b] (°C)			MAXIMUM PEAK INVERSE VOLTS	MAXIMUM OPERATING TEMPERATURE[b] (°C)	TYPE
Forward Currents—1 to 40 Amperes					
40	150	T_C	50	200 T_C	1N1183A, 1N1183RA
40	150	T_C	100	200 T_C	1N1184A, 1N1184RA
40	150	T_C	200	200 T_C	1N1186A, 1N1186RA
Peak Inverse Voltages—Up to 10000 Volts					
0.825	60	T_A	1200	125 T_A	CR101
0.825	60	T_A	2000	125 T_A	CR102
0.715	60	T_A	3000	125 T_A	CR103
0.605	60	T_A	4000	125 T_A	CR104
0.605	60	T_A	5000	125 T_A	CR105
0.550	60	T_A	6000	125 T_A	CR106
0.550	60	T_A	7000	125 T_A	CR107
0.550	60	T_A	8000	125 T_A	CR108
0.550	60	T_A	9000	125 T_A	CR109
0.550	60	T_A	10000	125 T_A	CR110

[a] With resistive or inductive load except as noted.
[b] T_A = ambient temperature, T_C = case temperature.

MILITARY-SPECIFICATION TYPES

JAN-1N538 Meets MIL-E-1/1084A dated Jan.28, 1958

JAN-1N540 Meets MIL-E-1/1085A dated Jan.28, 1958

JAN-1N547 Meets MIL-E-1/1083A dated Jan.28, 1958

USA-1N249B, USA-1N250B, USA-1N2135A: Meet MIL-S-19500/134 (Sig C) dated Aug.9, 1960

TEMPERATURE- AND VOLTAGE-COMPENSATION APPLICATIONS

1N2326

COMPUTER APPLICATIONS

GERMANIUM TUNNEL DIODES

1N3128
1N3129
1N3130

GALLIUM-ARSENIDE TUNNEL DIODE

1N3138

GERMANIUM MULTIPLE DIODES

2DG001 (Twin)
3DG001 (Triple)

RECTIFIERS & DIODES

World Radio History

AUDIO-FREQUENCY APPLICATIONS

SMALL SIGNAL—Class A

2N104	2N215	2N220	2N1010
2N175			

DRIVER

2N405	2N406	2N591

LARGE SIGNAL—Classes A and B

2N109	2N270	2N408	2N649
2N217	2N407	2N647	

POWER AMPLIFIER

Dissipations—Up to 4.9 Watts

•2N497	•2N1092	•2N1480	•2N1482
•2N656	•2N1479	•2N1481	

Dissipations—5 to 49.9 Watts

2N176	•2N1068	2N1184-A	•2N1486
2N301	2N1183	2N1184-B	•2N1700
2N301-A	2N1183-A	•2N1483	•2N1701
2N351	2N1183-B	•2N1484	•2N1768
2N376	2N1184	•2N1485	•2N1769
•2N1067			

Dissipations—50 Watts and Higher

2N173	•2N1069	•2N1487	•2N1513
2N174	•2N1070	•2N1488	•2N1514
2N277	2N1099	•2N1489	•2N1702
2N278	2N1100	•2N1490	•2N1703
2N441	2N1358	•2N1511	2N1905
2N442	2N1412	•2N1512	2N1906
2N443			

• Silicon type.

RADIO-FREQUENCY APPLICATIONS

VHF AMPLIFIER

2N384	2N1177	2N1396	•2N1491
2N1023	2N1225	2N1397	•2N1492
2N1066			•2N1493

HF AMPLIFIER

2N274	2N1224	2N1396	•2N1493
2N370	2N1225	2N1397	2N1631
2N384	2N1226	•2N1491	2N1632
2N1023	2N1395	•2N1492	2N1637
2N1066			

MIXER

2N274	2N1023	2N1224	2N1395
2N372	2N1066	2N1225	2N1396
2N384	2N1179	2N1226	2N1397

OSCILLATOR

2N274	2N1023	2N1224	2N1395
2N371	2N1066	2N1225	2N1396
2N384	2N1178	2N1226	2N1397

CONVERTER

2N140	2N412	2N1226	2N1526
2N219	2N1023	2N1395	2N1527
2N274	2N1066	2N1396	2N1635
2N374	2N1224	2N1397	2N1636
2N384	2N1225	2N1426	2N1639
2N411			

IF AMPLIFIER

2N139	2N410	2N1225	2N1425
2N218	2N1023	2N1226	2N1524
2N274	2N1066	2N1395	2N1525
2N373	2N1180	2N1396	2N1633
2N384	2N1224	2N1397	2N1634
2N409			2N1638

COMPUTER SWITCHING APPLICATIONS

Stage Delays Greater than 300 Nanoseconds[a]

2N398	2N586

Stage Delays of 100 to 300 Nanoseconds[a]

2N269	2N580	2N584	2N1169[b]
2N404	2N581	2N585	2N1170[b]
2N414	2N582	2N1090	2N1319[b]
2N578	2N583	2N1091	3907/2N404
2N579			

Stage Delays of 30 to 100 Nanoseconds[a]

2N794	2N934	2N1215[c]	2N1301
2N795	2N1213[c]	2N1216[c]	2N1384
2N796	2N1214[c]	2N1300	2N1683

Stage Delays of 10 to 30 Nanoseconds[a]

2N643	2N705	•2N706-A	2N711
2N644	•2N706	2N710	2N1450
2N645			

Stage Delays Less than 10 Nanoseconds[a]

2N931	2N932

POWER SWITCHING APPLICATIONS

Dissipations—Up to 4.9 Watts

•2N497	•2N1092	•2N1480	•2N1482
•2N656	•2N1479	•2N1481	

Dissipations—5 to 49.9 Watts

•2N1067	2N1183-B	•2N1483	•2N1700
•2N1068	2N1184	•2N1484	•2N1701
2N1183	2N1184-A	•2N1485	•2N1768
2N1183-A	2N1184-B	•2N1486	•2N1769

Dissipations—50 Watts and Higher

2N173	•2N1069	•2N1487	•2N1513
2N174	•2N1070	•2N1488	•2N1514
2N277	2N1099	•2N1489	•2N1702
2N278	2N1100	•2N1490	•2N1703
2N441	2N1358	•2N1511	2N1905
2N442	2N1412	•2N1512	2N1906
2N443			

[a] Measured in resistor-capacitor-transistor logic circuit except for very high speed drift-transistor types 2N643, 2N644, 2N645, and 2N1450 which are measured in transistor current steering logic circuit. Nanoseconds = 10^{-9} seconds.

[b] Bidirectional type.

[c] Thyristor type.

World Radio History

SILICON RECTIFIERS

RECTIFIER APPLICATIONS

MAXIMUM DC FORWARD AMPERES[a] at indicated temperature[b] (°C)		MAXIMUM PEAK INVERSE VOLTS	MAXIMUM OPERATING TEMPERATURE[b] (°C)	TYPE
20	150 T_C	55	175 T_C	1N248-C, 1N248-RC
20	150 T_C	110	175 T_C	1N249-C, 1N249-RC
20	150 T_C	220	175 T_C	1N250-C, 1N250-RC
0.750	≤50 T_A	100	165 T_A	1N440-B
0.750	≤50 T_A	200	165 T_A	1N441-B
0.750	≤50 T_A	300	165 T_A	1N442-B
0.750	≤50 T_A	400	165 T_A	1N443-B
0.750	≤35 T_A	500	150 T_A	1N444-B
0.750	≤35 T_A	600	150 T_A	1N445-B
0.750	≤50 T_A	50	165 T_A	1N536
0.750	≤50 T_A	100	165 T_A	1N537
0.750	≤50 T_A	200	165 T_A	1N538
0.750	≤50 T_A	300	165 T_A	1N539
0.750	≤50 T_A	400	165 T_A	1N540
0.750	≤50 T_A	600	165 T_A	1N547
0.750	≤50 T_A	500	165 T_A	1N1095
20	150 T_C	300	175 T_C	1N1195-A, 1N1195-RA
20	150 T_C	400	175 T_C	1N1196-A, 1N1196-RA
20	150 T_C	500	175 T_C	1N1197-A, 1N1197-RA
20	150 T_C	600	175 T_C	1N1198-A, 1N1198-RA
0.500[c]	≤75 T_A	400	100 T_A	1N1763
0.500[c]	≤75 T_A	500	100 T_A	1N1764
0.750 0.500[c]	≤75 T_A	50	125 T_A	1N2858
0.750 0.500[c]	≤75 T_A	100	125 T_A	1N2859
0.750 0.500[c]	≤75 T_A	200	125 T_A	1N2860
0.750 0.500[c]	≤75 T_A	300	125 T_A	1N2861
0.750 0.500[c]	≤75 T_A	400	125 T_A	1N2862
0.750 0.500[c]	≤75 T_A	500	125 T_A	1N2863
0.750 0.500[c]	≤75 T_A	600	125 T_A	1N2864
0.750 0.500[c]	≤75 T_A	200	100 T_A	1N3193
0.750 0.500[c]	≤75 T_A	400	100 T_A	1N3194
0.750 0.500[c]	≤75 T_A	600	100 T_A	1N3195
0.500 0.400[c]	≤75 T_A	800	100 T_A	1N3196

[a] With resistive or inductive load except as noted.
[b] T_A = ambient temperature, T_C = case temperature.
[c] With capacitive load.

DIODES

TEMPERATURE- AND VOLTAGE-COMPENSATION APPLICATIONS

1N2326

COMPUTER APPLICATIONS

GERMANIUM TUNNEL DIODES

1N3128
1N3129
1N3130

GALLIUM-ARSENIDE TUNNEL DIODE

1N3138

MILITARY-SPECIFICATION TYPES

TRANSISTORS

JAN-2N220	Meets MIL-T-19500/1 dated Jan.14, 1957
USA-2N274	Meets MIL-T-19500/26 (Sig C) dated Oct.3, 1957
USA-2N384	Meets MIL-T-19500/27 (Sig C) dated Oct.14, 1957
USAF-2N404	Meets MIL-T-19500/20 USAF dated July 23, 1957
USA-2N706	Meets MIL-T-19500/120 (Sig C) dated Jan.4, 1961

SILICON RECTIFIERS

JAN-1N538	Meets MIL-E-1/1084A dated Jan.28, 1958
JAN-1N540	Meets MIL-E-1/1085A dated Jan.28, 1958

World Radio History

Information on prices of RCA semiconductor devices described in this Handbook may be obtained from your local RCA Semiconductor Distributor or from your RCA Equipment Sales Representative, who may be reached at the following RCA Equipment Sales Offices:

(East)	744 Broad Street Newark 2, New Jersey HUmboldt 5-3900
	605 Marlton Pike Erlton, New Jersey HAzel 8-4802
	731 James Street Room 402 Syracuse 3, New York GRanite 4-5591
	Greater Baltimore Area ENterprise 9-1850
(Northeast)	64 "A" Street Needham Heights 94, Massachusetts HIllcrest 4-7200
(Southeast)	Suite 1 1520 Edgewater Drive Orlando, Florida GArden 4-4768
(East Central)	714 New Center Building Detroit 2, Michigan TRinity 5-5600
(Central)	Suite 1154 Merchandise Mart Plaza Chicago 54, Illinois WHitehall 4-2900
	2132 East 52nd Street Indianapolis 5, Indiana CLifford 1-1405
	5805 Excelsior Boulevard Minneapolis 16, Minnesota WEst 9-0676
(West)	6801 East Washington Boulevard Los Angeles 22, California RAymond 3-8361
	1838 El Camino Real Burlingame, California OXford 7-1620
(Southwest)	7905 Carpenter Freeway Dallas 7, Texas MElrose 1-9720

World Radio History

(Government)	Route 202 Somerville, New Jersey RAndolph 2-3200
	1725 "K" Street, Northwest Washington 6, D.C. FEderal 7-8500
	224 North Wilkinson Street Dayton 2, Ohio BAldwin 6-2366

EXPORT

(International)	Radio Corporation of America RCA International Division Electronic-Components Marketing Operations 30 Rockefeller Plaza New York 20, New York (U.S.A.)

World Radio History

Transistor-Dissipation Rating Chart

Pulse or Switching Service

From Table I:

$T_{JMAX} = 175^\circ$ C
$\tau_1 = 8$ milliseconds $= 8 \times 10^{-3}$ second
$R_{T_{MAX}} = 75$ $^\circ$C/watt

Then:

$t_o/\tau_1 = 10^{-3}/8 \times 10^{-3} = 1.25 \times 10^{-1}$
$d = t_o \times PRR = (10^{-3})(10^1) = 10^{-2} = 0.01$

Entering the Chart with $t_o/\tau_1 = 1.25 \times 10^{-1}$ and $d = 0.01$, read $Y = 2.5 \times 10^{-1}$. Solving for T_o in the equation:

$$\boxed{T_o = T_{J_{MAX}} - P_{MAX}\, Y\, R_{T_{MAX}}}$$

$$T_o = 175 - (3)(2.5 \times 10^{-1})(75) = 119^\circ \text{ C}$$

Solving for ΔT_{JMAX} in the equation:

$$\boxed{\Delta T_{J_{MAX}} = T_{J_{MAX}} - T_o}$$

$$\Delta T_{JMAX} = 175 - 119 = 56^\circ \text{ C}$$

TABLE I

RCA TRANSISTOR TYPE	MAXIMUM JUNCTION OR STORAGE TEMPERATURE T_{JMAX} (°C)	THERMAL TIME CONSTANT τ_1 (msec)	MAXIMUM THERMAL RESISTANCE R_{TMAX} (°C/WATT) COLLECTOR JUNCTION TO: FREE AMBIENT AIR	CASE	MOUNTING FLANGE
2N109	85	12	400	-	-
2N139	85	10	750	-	-
2N140	85	10	750	-	-
2N217	85	12	400	-	-
2N218	85	10	750	-	-
2N219	85	10	750	-	-
2N269	85	10	500	-	-
2N270	85	12	320	-	-
2N274	100	12	620	310	-
2N384	100	10	620	310	-
2N398	85	12	750	-	-
2N404	85	10	500	-	-
2N578	85	15	500	-	-
2N579	85	15	500	-	-

World Radio History

Transistor-Dissipation Rating Chart

Pulse or Switching Service

RCA TRANSISTOR TYPE	MAXIMUM JUNCTION OR STORAGE TEMPERATURE T_{JMAX} (°C)	THERMAL TIME CONSTANT τ_1 (msec)	MAXIMUM THERMAL RESISTANCE R_{TMAX} (°C/WATT) COLLECTOR JUNCTION TO: FREE AMBIENT AIR	CASE	MOUNTING FLANGE
2N580	85	15	500	–	–
2N581	85	10	500	–	–
2N582	85	10	500	–	–
2N583	85	10	500	–	–
2N584	85	10	500	–	–
2N585	85	12	500	–	–
2N586	85	12	240	–	–
2N643	85	10	500	–	–
2N644	85	10	500	–	–
2N645	85	10	500	–	–
2N1023	100	10	620	310	–
2N1066	100	10	620	310	–
2N1067	175	8	100	30	–
2N1068	175	8	100	15	–
2N1069	175	10	–	–	3
2N1070	175	10	–	–	3
2N1090	85	12	500	–	–
2N1091	85	12	500	–	–
2N1092	175	8	225	75	–
2N1183	100	8	75	10	–
2N1183-A	100	8	75	10	–
2N1183-B	100	8	75	10	–
2N1184	100	8	75	10	–
2N1184-A	100	8	75	10	–
2N1184-B	100	8	75	10	–
2N1224	100	10	620	310	–
2N1225	100	10	620	310	–
2N1226	100	10	620	310	–
2N1300	85	10	400	–	–
2N1301	85	10	400	–	–
2N1395	100	10	620	310	–
2N1396	100	10	620	310	–
2N1397	100	10	620	310	–

For transistor types not listed in Table I above, refer to the data sheets for the specific type for the required values.

World Radio History

CLASSIFICATION CHART FOR TYPES IN SEMICONDUCTOR DEVICE SECTION

JUNCTION TRANSISTORS

Germanium P-N-P Alloy Types

For small-signal af applications

2N77■
2N104
2N105■
2N175▲
2N206■
2N215■
2N220■▲

For af driver-amplifier applications

2N405
2N406■

For large-signal af applications

2N109
2N217■
2N270■
2N407
2N408■

For af power applications

2N301
2N301-A

For 455-kc if applications

2N139
2N218■
2N409
2N410■

For 540- to 1600-kc converter applications

2N140
2N219■
2N411
2N412■

For rf amplifier applications

2N247■
2N274■
2N370■
2N384■
2N544■

For rf oscillator applications

2N371■

For rf mixer applications

2N372■

■,▲: See next page.

World Radio History

CLASSIFICATION CHART FOR TYPES IN SEMICONDUCTOR DEVICE SECTION

JUNCTION TRANSISTORS (Cont'd)
For "on-off" control applications 2N269■ 2N398■ 2N404■
SEMICONDUCTOR DIODES
Germanium Point-Contact Types *For low-power-rectification applications* 1N34-A *For large-signal applications* 1N38-A 1N58-A *For applications requiring high back resistance* 1N54-A

■ Flexible-lead type.
▲ Low-Noise type.

World Radio History

RCA TRANSISTORS NOT RECOMMENDED
For New Equipment Design

Certain transistors should be avoided in the design of new equipment because they are approaching obsolescence or have limited or dwindling demand. Such RCA types are listed below for the benefit of equipment designers.

JUNCTION TRANSISTORS

2N77

World Radio History

World Radio History

TENTATIVE DEFINITIONS
OF SEMICONDUCTOR DEVICE TERMS

Current Transfer Ratio. The quotient of the change of output current with ac output circuit shorted divided by the change in input current producing the change in output current. The current components are understood to be small enough so that linear relations hold between them.

Large-Signal DC Current Transfer Ratio. The quotient of the dc output current with the dc output circuit shorted divided by the dc input current producing the dc output current.

Circuit Stability Factor. The quotient of the change of dc collector current divided by the change in collector saturation current producing the change in dc collector current.

Collector Saturation Current. The temperature-sensitive dc collector current that flows when a dc collector-to-base voltage greater than -0.2 volt is applied with emitter circuit open.

Class A Amplifier. An amplifier in which the bias of the input electrode and the alternating input signal are such that output current flows at all times.

Class B Amplifier. An amplifier in which the bias of the input electrode is such that the output current is approximately zero when no alternating input signal is applied, and such that when an alternating input signal is applied, the output current flows approximately one-half cycle.

Collector Transition Capacitance. The capacitance across the collector-to-base transition region. (A transition region is a region between two homogeneous semiconductor regions, in which the impurity concentration changes).

Unilateralization. Unilateralization is a special case of neutralization in that the feedback parameters are completely balanced out. In the case of transistors, these feedback parameters include a resistive component in addition to a capacitive component. Unilateralization changes a bilateral network into a unilateral network.

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RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

World Radio History

TRANSISTORS

Transistors are a new form of electron device. They can perform many of the functions of an electron tube and, in addition, can do some things better and more efficiently than electron tubes. Unlike electron tubes which depend for their functioning on the flow of electrons through a vacuum, a gas, or a vapor, transistors make use of the flow of electrons in a solid — a semiconductor.

A semiconductor is a material having a conductivity lower than that of metals but higher than that of insulators. There are many varieties of semiconductors, but the one employed for the transistors described in this section is germanium. Germanium in its very purest state behaves like an insulator, but its conductivity can be increased by the addition of exact but almost infinitesimal amounts of certain impurities. Peculiarly, the manner in which a germanium crystal conducts can be changed by the choice of the impurity. Thus, by the addition of the proper amount of certain impurities to pure germanium, its conductivity is increased because a surplus of electrons which can migrate freely through the crystal is provided. A conducting germanium crystal so made is identified as *n*-type because it depends on negative particles of electricity, electrons, for conduction.

On the other hand, the addition of other impurities provides a deficiency of electrons which effectively behave like positive particles of electricity. This deficiency of electrons leaves vacancies or holes in the crystal structure. These holes which are free to migrate can carry current but in a direction opposite to that of the *n*-type crystal. Because these carriers of the conduction current are positive in nature, a germanium crystal of this type is identified as *p*-type.

It should be noted that whereas electron tubes depend ordinarily on electrons for conduction, transistors not only make use of electrons but also of holes for obtaining conduction.

The transistors described in this section make use of both kinds of conduction and employ two different types of structures. These two types of structures are identified as "point-contact" and "junction".

Fig.1 shows the structure of a point-contact transistor. It consists of a crystal of *n*-type germanium having three electrical contacts. Two of these are point contacts and are known as the emitter and collector. A third, the

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World Radio History

base, makes area contact with the germanium crystal. The complete assembly is encased in plastic to provide ruggedness and freedom from atmospheric contaminants.

Fig.1 also shows the point-contact transistor connected in a simple circuit in which the base connection serves as the common return for the input circuit and the output circuit. The input circuit on the left is completed through the battery, the emitter, and the germanium crystal to the base connection. When a positive voltage is applied to the emitter, electrons will be drawn from the crystal into the emitter and thus leave holes in the crystal structure. Under the influence of the negative field of the collector, these holes flow to the collector and thereby increase the collector current appreciably. Or as is sometimes stated, the emitter electrode injects holes into the germanium crystal. Holes near the collector allow electrons to pass into the crystal. Some of these electrons neutralize the holes; others flow to the base connection and thus complete the circuit.

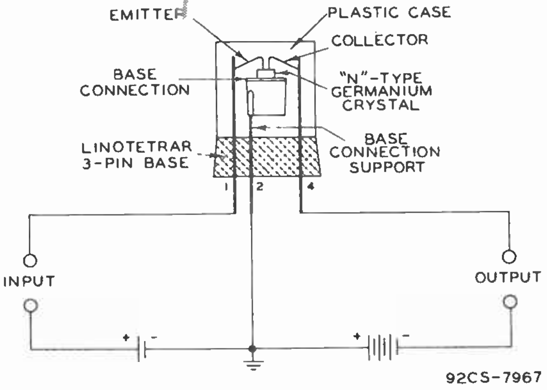

Fig.1 - Diagrammatic Sketch Showing Structural Arrangement of Type 2N32 or Type 2N33 with Associated Simple Circuit.

If the assumption is made that every unit of hole current which leaves the emitter reaches the collector, it follows that a small change in emitter current will result in an equivalent change in collector current, and consequently produce a current amplification factor of one. The current

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TRANSISTORS

amplification factor or "alpha" of a transistor is defined as the ratio of change in collector current to a change in emitter current when collector voltage is maintained constant. In point-contact transistors "alpha" is greater than unity; in junction-type transistors, it is less than but approaches unity.

If the germanium crystal employed in Fig.1 is of the *p*-type, a negative voltage is applied to the emitter and holes will be drawn from the crystal into the emitter and thus leave an excess of electrons in the crystal structure. Under the influence of the positive field of the collector, these electrons flow through the crystal to the collector. In general, the *p*-type germanium crystal has characteristics similar to the *n*-type except that in operation all battery polarities are reversed.

Fig.2 shows the structure of a junction transistor of the *n-p-n* type. It is composed of a wafer of *p*-type germanium between two smaller layers of *n*-type germanium. Low-resistance connections are made to the *n*-layers, one of which serves as the emitter and the other as the collector. A third low-resistance connection to the *p*-layer is the base connection. The complete assembly is encased in plastic to provide ruggedness and freedom from atmospheric contaminants.

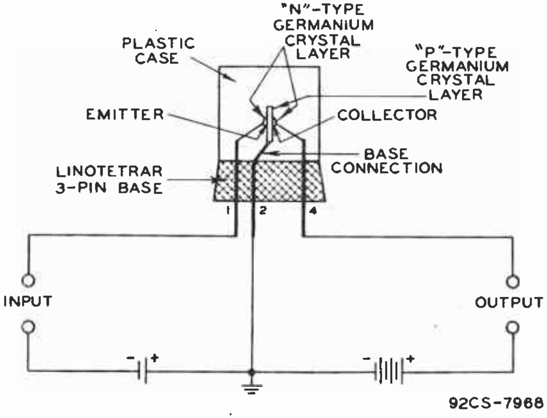

Fig.2 - Diagrammatic Sketch Showing Structural Arrangement of Type 2N35 with Associated Simple Circuit. For Illustration Purposes, the Crystal Assembly is Rotated 90° Within the Plastic Case.

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World Radio History

TRANSISTORS

The principle of operation of the junction transistor is somewhat different from that of the point-contact transistor. In the *n-p-n* junction transistor, electrons from the *n*-layer diffuse through the *p*-layer and are attracted to the collector. The *p*-layer has a surplus of holes. Because the *p*-layer is very thin, most of the electrons entering the base region from the emitter will reach the collector region without recombining (neutralizing) the holes. Practically all of the electrons leaving the emitter reach the collector, thus resulting in a current amplification factor approaching unity.

The action of the *p-n-p* type of junction transistor is similar to that of the *n-p-n* type except that the polarities of the battery voltages are reversed and conduction is caused by holes instead of electrons.

Transistors are essentially low-impedance devices, that is, they deal with current changes rather than voltage changes. They are small in size and the power requirements for their operation are extremely small. In addition, they operate instantaneously on application of voltages to the electrodes.

The point-contact transistor has a current amplification factor greater than unity. This feature contributes to its usefulness in oscillator and triggering applications. In addition, the point-contact transistor can be operated at relatively high frequencies. Because of this feature, it has considerable application in switching circuits and in radio circuits such as intermediate-frequency amplifiers, radio-frequency amplifiers, and radio-frequency oscillators.

The junction transistor has a current amplification factor approaching unity. This characteristic contributes to the stability of the junction transistor even under short-circuit conditions. It has a high operating power gain and can operate with extremely low values of input power — features which are of primary importance in oscillator and amplifier applications in the audio-frequency and low-frequency ranges.

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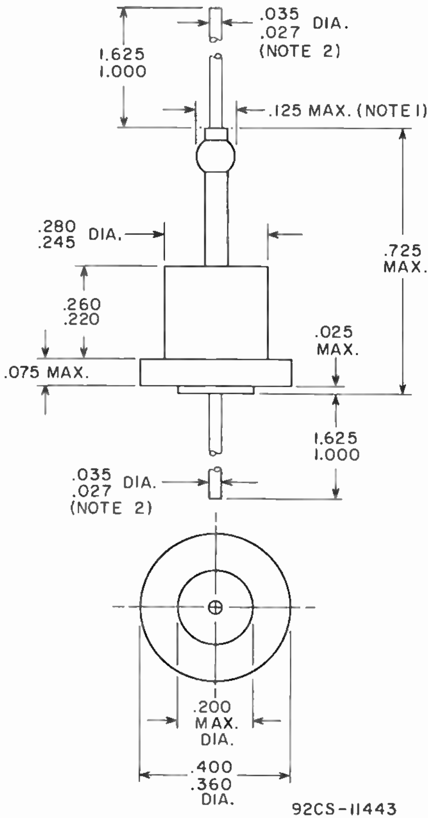
JEDEC No. DO-1
All Dimensions in Inches



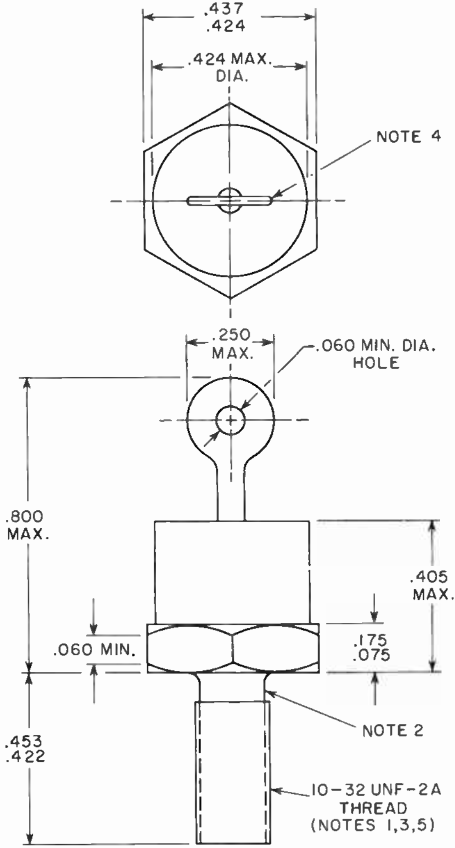
NOTE 1: DIMENSION TO ALLOW FOR PINCH OR SEAL DEFORMATION ANYWHERE ALONG TABULATION (OPTIONAL).

NOTE 2: DIMENSION TO BE CONTROLLED FROM FREE END OF LEAD TO WITHIN 0.188 INCH FROM THE POINT OF ATTACHMENT TO THE BODY. WITHIN THE 0.188 INCH DIMENSION, THE DIAMETER MAY VARY TO ALLOW FOR LEAD FINISHES AND IRREGULARITIES.

World Radio History

Outline DO-4

JEDEC No.DO-4
All Dimensions in Inches



92CS-11446

NOTE 1: UNIT MUST NOT BE DAMAGED BY TORQUE OF 15 INCH-POUNDS APPLIED TO 10-32 UNF-2B NUT ASSEMBLED ON THREAD.

NOTE 2: DIAMETER OF UNTHREADED PORTION D.189 INCH MAXIMUM, D.163 INCH MINIMUM.

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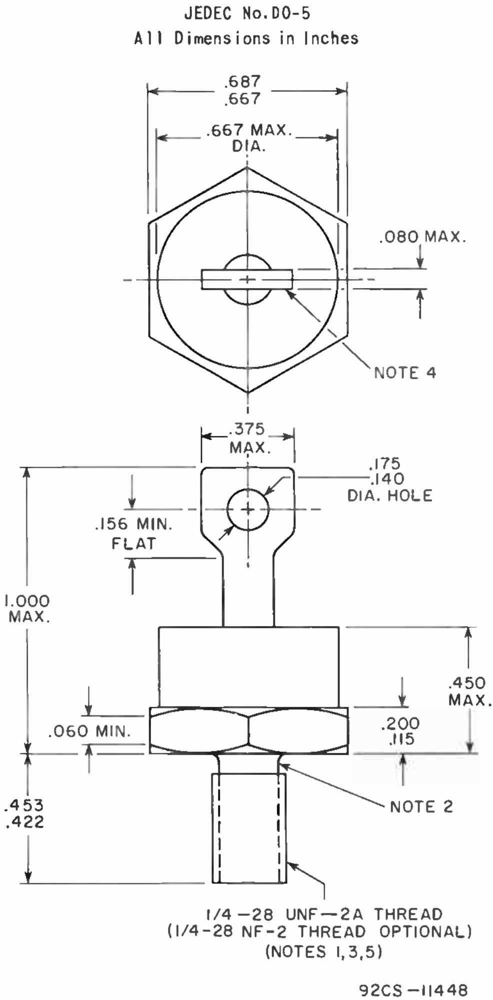
NOTE 3: COMPLETE THREADS TO EXTEND TO WITHIN 2-1/2 THREADS OF HEAD.

NOTE 4: ANGULAR ORIENTATION OF THIS TERMINAL IS UNDEFINED.

NOTE 5: MAXIMUM PITCH DIAMETER OF PLATED THREADS SHALL BE BASIC PITCH DIAMETER (0.1697 INCH) REFERENCE (SCREW THREAD STANDARDS FOR FEDERAL SERVICES, 1957) HANDBOOK H28 1957 P1.

World Radio History



NOTE 1: UNIT MUST NOT BE DAMAGED BY TORQUE OF 30 INCH-POUNDS APPLIED TO 1/4-28 UNF-2B NUT ASSEMBLED ON THREAD.

World Radio History

NOTE 2: DIAMETER OF UNTHREADED PORTION 0.249 INCH MAXIMUM, 0.220 INCH MINIMUM.

NOTE 3: COMPLETE THREADS TO EXTEND TO WITHIN 2-1/2 THREADS OF HEAD.

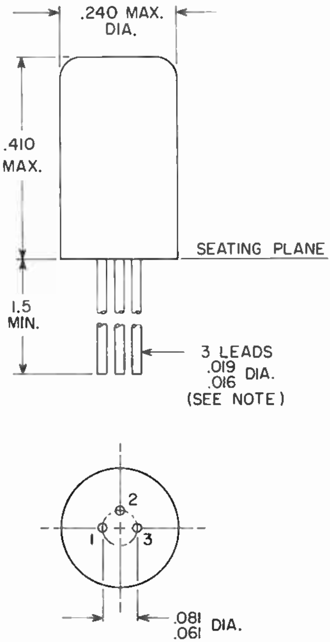
NOTE 4: ANGULAR ORIENTATION OF THIS TERMINAL IS UNDEFINED.

NOTE 5: MAXIMUM PITCH DIAMETER OF PLATED THREADS SHALL BE BASIC PITCH DIAMETER (0.2266 INCH) REFERENCE (SCREW THREAD STANDARDS FOR FEDERAL SERVICES, 1957) HANDBOOK H28 1957 PI.

World Radio History

World Radio History

JEDEC No. TO-1
All Dimensions in Inches



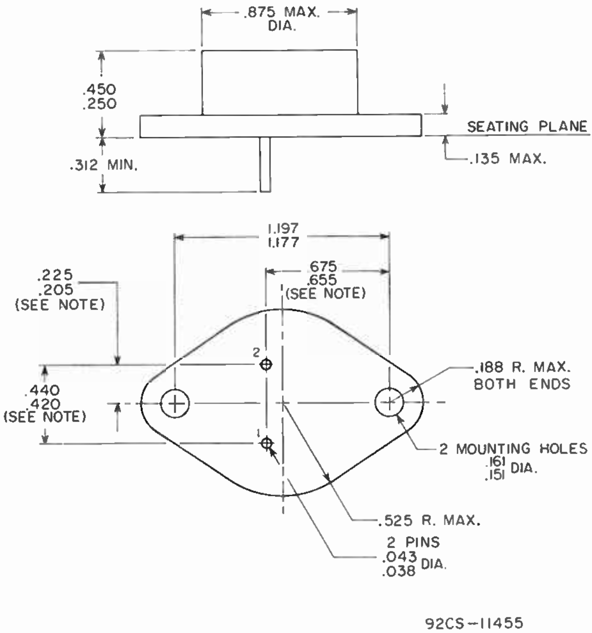
92CS-11449

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN ZONE BETWEEN 0.050 INCH AND 0.250 INCH FROM THE SEATING PLANE. BETWEEN 0.250 INCH AND 1.5 INCHES, A MAXIMUM DIAMETER OF 0.021 INCH IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

Outline TO-3

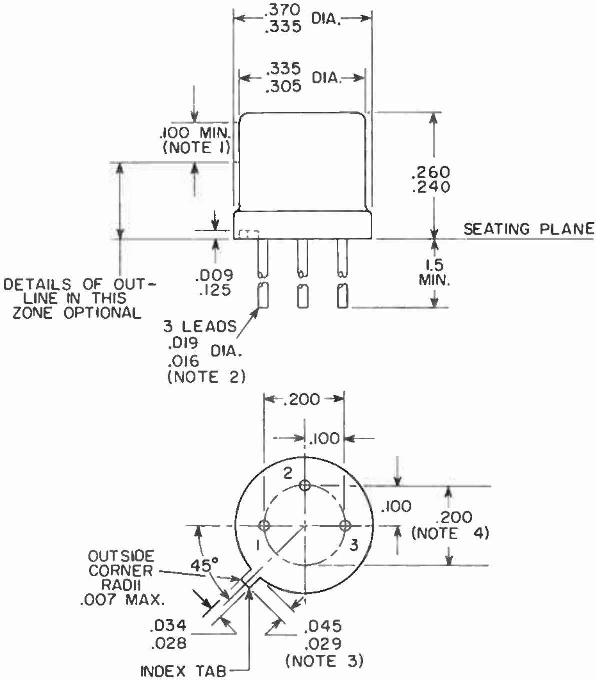
JEDEC No. TO-3
All Dimensions in Inches



NOTE: THESE DIMENSIONS SHOULD BE MEASURED AT POINTS 0.050 INCH TO 0.055 INCH BELOW SEATING PLANE. WHEN GAUGE IS NOT USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

World Radio History

JEDEC No. TO-5
All Dimensions in Inches



92CS-11444

THIS DEVICE IS FOR SOCKETED, SINGLE-SIDED-CIRCUIT BOARD, WIRE-IN AND SIMILAR APPLICATIONS. WHERE USED IN DOUBLE-SIDED OR EYELETED-CIRCUIT BOARD, OR SIMILAR APPLICATIONS WHERE SOLDER BRIDGING MAY OCCUR, A DIELECTRIC WASHER OR OTHER STAND-OFF DEVICE MAY BE NECESSARY.

NOTE 1: THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE VARIATION IN ACTUAL DIAMETER WITHIN THE ZONE SHALL NOT EXCEED 0.010 INCH.

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050 INCH AND 0.250 INCH FROM THE SEATING PLANE. BETWEEN 0.250 INCH AND 1.5 INCHES, A MAXIMUM DIAMETER OF 0.021 INCH IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

NOTE 3: MEASURED FROM MAXIMUM DIAMETER OF THE ACTUAL DEVICE.

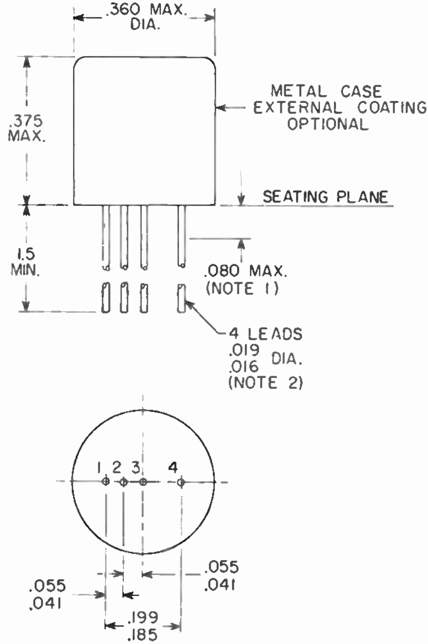
NOTE 4: LEADS HAVING MAXIMUM DIAMETER (0.019 INCH) MEASURED IN GAUGING PLANE 0.054 INCH + 0.001 INCH - 0.000 INCH BELOW THE SEATING PLANE OF THE DEVICE SHALL BE WITHIN 0.007 INCH OF THEIR TRUE LOCATIONS RELATIVE TO A MAXIMUM-WIDTH TAB.

NOTE 5: THE DEVICE MAY BE MEASURED BY DIRECT METHODS OR BY THE GAUGE AND GAUGING PROCEDURE DESCRIBED ON THE SHEET "GAUGE GS-1."

World Radio History

JEDEC No.TO-7

All Dimensions in Inches



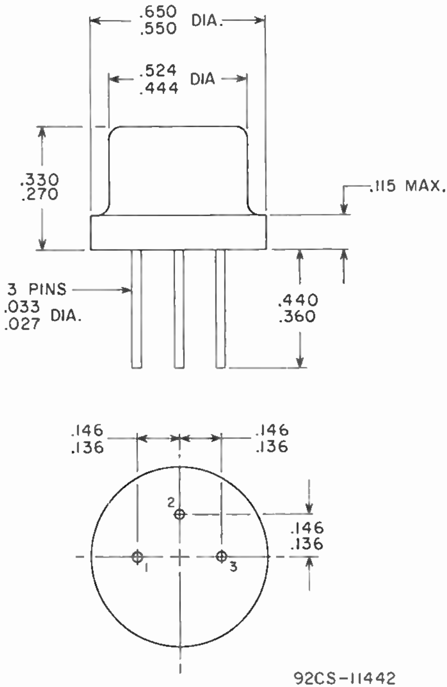
92CS-11447

NOTE 1: EXTERNALLY COATED DEVICES SHALL NOT HAVE COATING ON THE LEADS BEYOND THIS ZONE.

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050 INCH AND 0.250 INCH FROM THE SEATING PLANE. BETWEEN 0.250 INCH AND 1.5 INCHES, A MAXIMUM DIAMETER OF 0.021 INCH IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

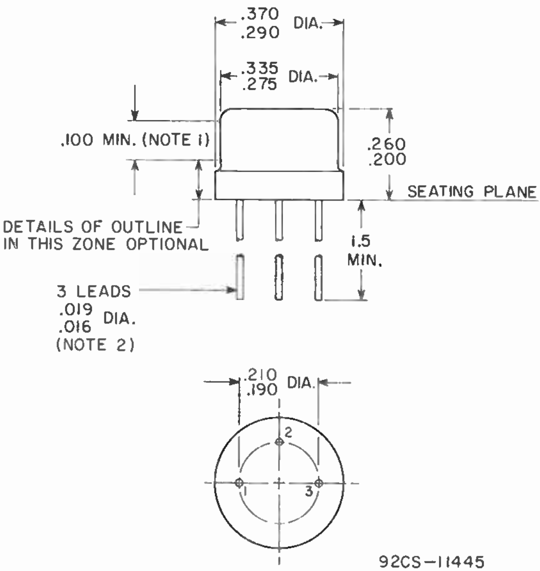
World Radio History

JEDEC No.TO-8
All Dimensions in Inches



World Radio History

JEDEC No.TO-9
All Dimensions in Inches



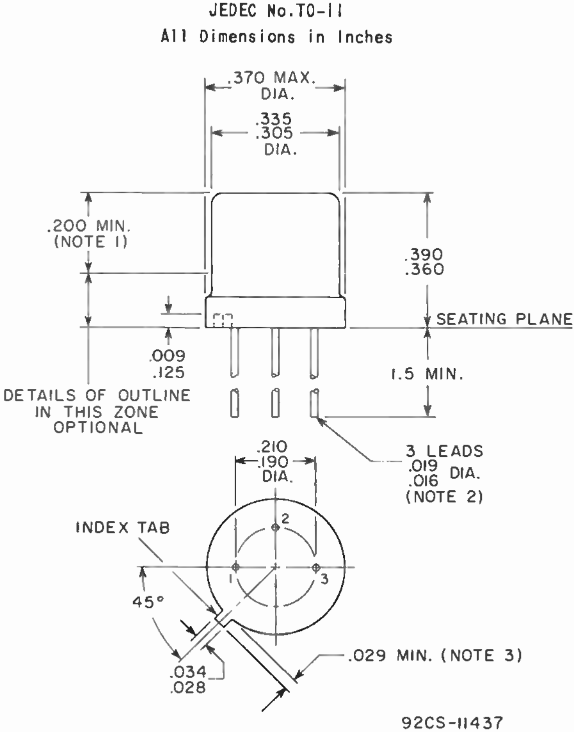
THIS DEVICE IS FOR SOCKETED, SINGLE-SIDED-CIRCUIT BOARD, WIRE-IN AND SIMILAR APPLICATIONS. WHERE USED IN DOUBLE-SIDED OR EYELETED-CIRCUIT BOARD, OR SIMILAR APPLICATIONS WHERE SOLDER BRIDGING MAY OCCUR, A DIELECTRIC WASHER OR OTHER STAND-OFF DEVICE MAY BE NECESSARY.

NOTE 1: THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE VARIATION IN ACTUAL DIAMETER WITHIN THE ZONE SHALL NOT EXCEED 0.010 INCH.

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050 INCH AND 0.250 INCH FROM THE SEATING PLANE. BETWEEN 0.250 INCH AND 1.5 INCHES, A MAXIMUM DIAMETER OF 0.021 INCH IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

Outline TO-11



THIS DEVICE IS FOR SOCKETED, SINGLE-SIDED-CIRCUIT BOARD, WIRE-IN AND SIMILAR APPLICATIONS. WHERE USED IN DOUBLE-SIDED OR EYELETED-CIRCUIT BOARD, OR SIMILAR APPLICATIONS WHERE SOLDER BRIDGING MAY OCCUR, A DIELECTRIC WASHER OR OTHER STAND-OFF DEVICE MAY BE NECESSARY.

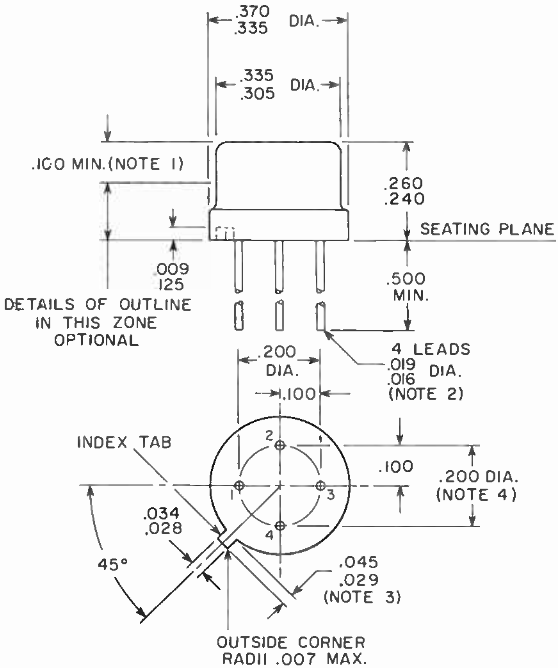
NOTE 1: THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE VARIATION IN ACTUAL DIAMETER WITHIN THE ZONE SHALL NOT EXCEED 0.010 INCH.

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050 INCH AND 0.250 INCH FROM THE SEATING PLANE. BETWEEN 0.250 INCH AND 1.5 INCHES, A MAXIMUM DIAMETER OF 0.021 INCH IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 3: MEASURED FROM MAXIMUM DIAMETER OF THE ACTUAL DEVICE.

World Radio History

JEDEC No. TO-12
All Dimensions in Inches



92CS-11440

THIS DEVICE IS FOR SOCKETED, SINGLE-SIDED-CIRCUIT BOARD, WIRE-IN AND SIMILAR APPLICATIONS. WHERE USED IN DOUBLE-SIDED OR EYELETED-CIRCUIT BOARD, OR SIMILAR APPLICATIONS WHERE SOLDER BRIDGING MAY OCCUR, A DIELECTRIC WASHER OR OTHER STAND-OFF DEVICE MAY BE NECESSARY.

NOTE 1: THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE VARIATION IN ACTUAL DIAMETER WITHIN THE ZONE SHALL NOT EXCEED 0.010 INCH.

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050 INCH AND 0.250 INCH FROM THE SEATING PLANE. BETWEEN 0.250 INCH AND 0.500 INCH, A MAXIMUM DIAMETER OF 0.021 INCH IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 3: MEASURED FROM MAXIMUM DIAMETER OF THE ACTUAL DEVICE.

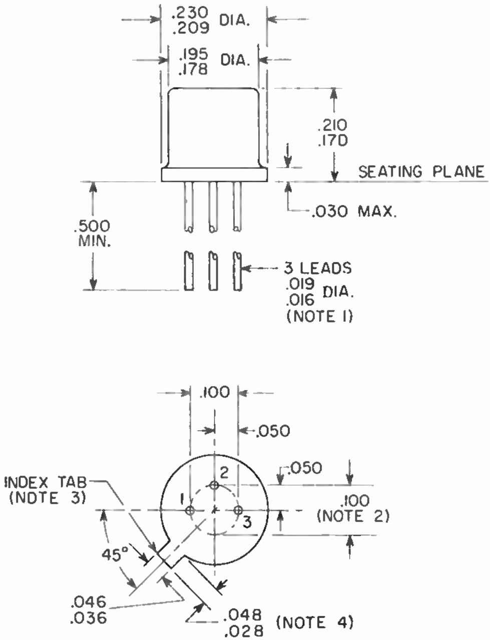
World Radio History

NOTE 4: LEADS HAVING MAXIMUM DIAMETER (0.019 INCH) MEASURED IN GAUGING PLANE 0.054 INCH + 0.001 INCH - 0.000 INCH BELOW THE SEATING PLANE OF THE DEVICE SHALL BE WITHIN 0.007 INCH OF THEIR TRUE LOCATIONS RELATIVE TO A MAXIMUM-WIDTH TAB.

NOTE 5: THE DEVICE MAY BE MEASURED BY DIRECT METHODS OR BY THE GAUGE AND GAUGING PROCEDURE DESCRIBED ON THE SHEET "GAUGE GS-1."

World Radio History

JEDEC No. TO-18
All Dimensions in Inches



92CS-11456

NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050 INCH AND 0.250 INCH FROM THE SEATING PLANE. BETWEEN 0.250 INCH AND THE END OF THE LEAD, A MAXIMUM DIAMETER OF 0.021 INCH IS HELD. OUTSIDE THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

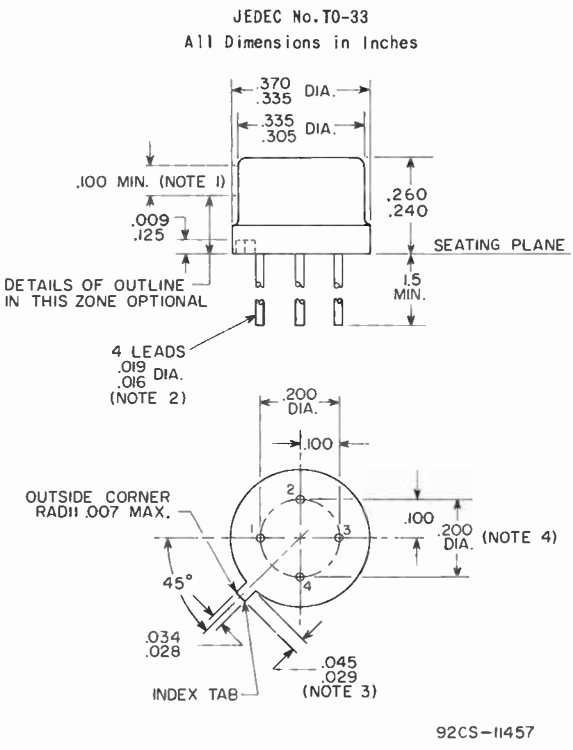
NOTE 2: LEADS HAVING MAXIMUM DIAMETER (0.019 INCH) MEASURED IN GAUGING PLANE 0.054 INCH + 0.001 INCH - 0.000 INCH BELOW THE SEATING PLANE OF THE DEVICE SHALL BE WITHIN 0.007 INCH OF THEIR TRUE LOCATIONS RELATIVE TO A MAXIMUM-WIDTH TAB AND TO THE MAXIMUM 0.230 INCH DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS NOT USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

NOTE 3: INDEX TAB FOR VISUAL ORIENTATION ONLY.

NOTE 4: MEASURED FROM MAXIMUM DIAMETER OF ACTUAL DEVICE.

World Radio History

Outline TO-33



THIS DEVICE IS FOR SOCKETED, SINGLE-SIDED-CIRCUIT BOARD, WIRE-IN AND SIMILAR APPLICATIONS. WHERE USED IN DOUBLE-SIDED OR EYELETED-CIRCUIT BOARD, OR SIMILAR APPLICATIONS WHERE SOLDER BRIDGING MAY OCCUR, A DIELECTRIC WASHER OR OTHER STAND-OFF DEVICE MAY BE NECESSARY.

NOTE 1: THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE VARIATION IN ACTUAL DIAMETER WITHIN THE ZONE SHALL NOT EXCEED 0.010 INCH.

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050 INCH AND 0.250 INCH FROM THE SEATING PLANE. BETWEEN 0.250 INCH AND 1.5 INCHES, A MAXIMUM DIAMETER OF 0.021 INCH IS HELD. OUTSIDE THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 3: MEASURED FROM MAXIMUM DIAMETER OF THE ACTUAL DEVICE.

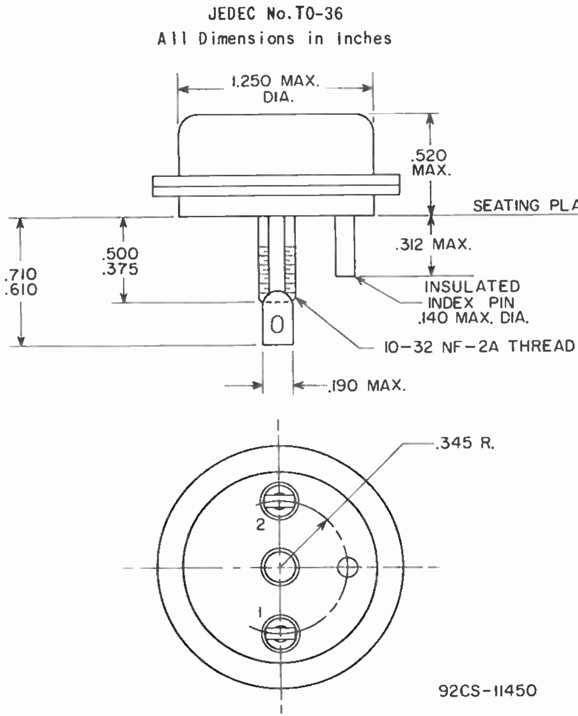
World Radio History

NOTE 4: LEADS HAVING MAXIMUM DIAMETER (0.019 INCH) MEASURED IN GAUGING PLANE 0.054 INCH + 0.001 INCH - 0.000 INCH BELOW THE SEATING PLANE OF THE DEVICE SHALL BE WITHIN 0.007 INCH OF THEIR TRUE LOCATIONS RELATIVE TO A MAXIMUM-WIDTH TAB.

NOTE 5: THE DEVICE MAY BE MEASURED BY DIRECT METHODS OR BY THE GAUGE AND GAUGING PROCEDURE DESCRIBED ON THE SHEET "GAUGE GS-1."

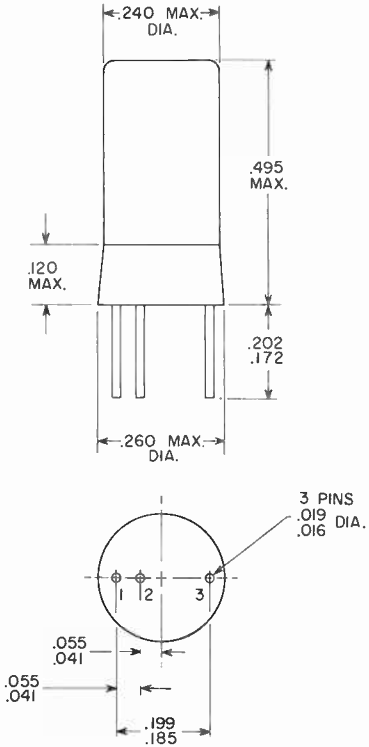
World Radio History

Outline TO-36



World Radio History

JEDEC No. TO-40
All Dimensions in Inches

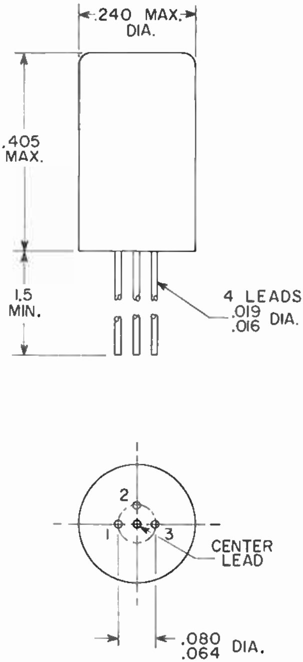


92CS-11451

World Radio History

Outline TO-44

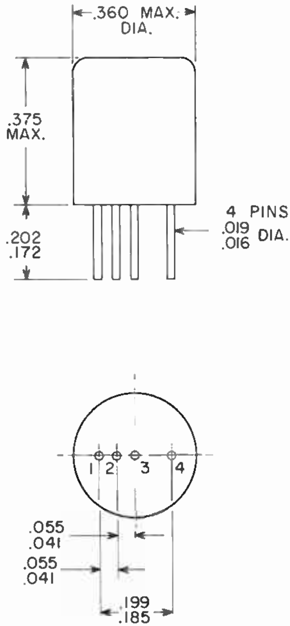
JEDEC No. TO-44
All Dimensions in Inches



92CS-11452

World Radio History

JEDEC No. TO-45
All Dimensions in Inches

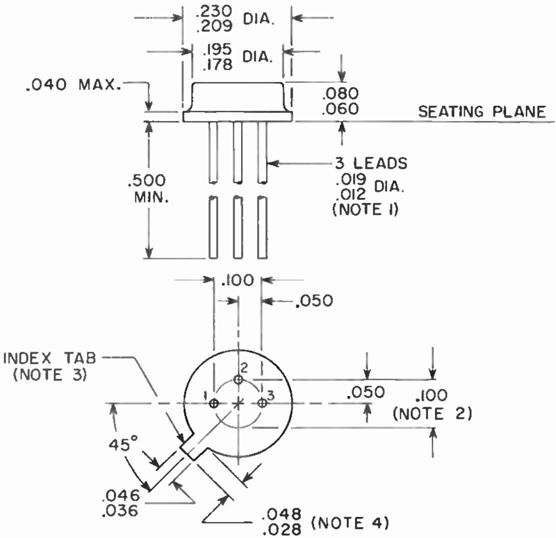


92CS-11453

World Radio History

Outline TO-46

JEDEC No. TO-46
All Dimensions in Inches



92CS-11438

NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050 INCH AND 0.250 INCH FROM THE SEATING PLANE. BETWEEN 0.250 INCH AND THE END OF THE LEAD, A MAXIMUM DIAMETER OF 0.021 INCH IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

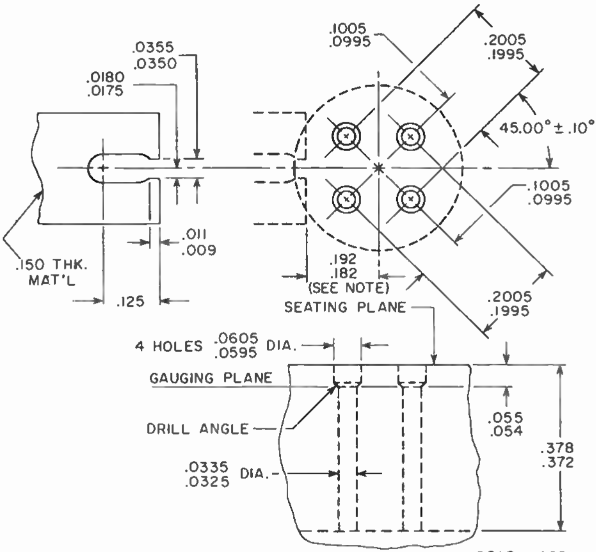
NOTE 2: LEADS HAVING MAXIMUM DIAMETER (0.019 INCH) MEASURED IN GAUGING PLANE 0.054 INCH + 0.001 INCH - 0.000 INCH BELOW THE SEATING PLANE OF THE DEVICE SHALL BE WITHIN 0.007 INCH OF THEIR TRUE LOCATIONS RELATIVE TO A MAXIMUM-WIDTH TAB AND TO THE MAXIMUM 0.230 INCH DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS NOT USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

NOTE 3: INDEX TAB FOR VISUAL ORIENTATION ONLY.

NOTE 4: MEASURED FROM MAXIMUM DIAMETER OF ACTUAL DEVICE.

World Radio History

JEDEC No. GS-1
All Dimensions in Inches



NOTE: THE LOCATION OF THE TAB LOCATOR WITHIN THE LIMITS INDICATED WILL BE DETERMINED BY THE TAB AND FLANGE DIMENSION OF THE DEVICE BEING CHECKED.

THE FOLLOWING GAUGING PROCEDURE SHALL BE USED:

THE DEVICE BEING MEASURED SHALL BE INSERTED UNTIL ITS SEATING PLANE IS 0.125 INCH ± 0.010 INCH FROM THE SEATING SURFACE OF THE GAUGE. A FORCE OF 8.0 ± 0.5 OZ. SHALL THEN BE APPLIED PARALLEL AND SYMMETRICAL TO THE DEVICE'S CYLINDRICAL AXIS. WHEN EXAMINED VISUALLY AFTER THE FORCE APPLICATION (THE FORCE NEED NOT BE REMOVED) THE SEATING PLANE OF THE DEVICE SHALL BE SEATED AGAINST THE GAUGE.

THE USE OF A PIN STRAIGHTENER PRIOR TO INSERTION IN THE GAUGE IS PERMISSIBLE.

A SPACER MAY BE USED TO OBTAIN THE 0.125 INCH DISTANCE FROM THE GAUGE SEAT PRIOR TO FORCE APPLICATION.

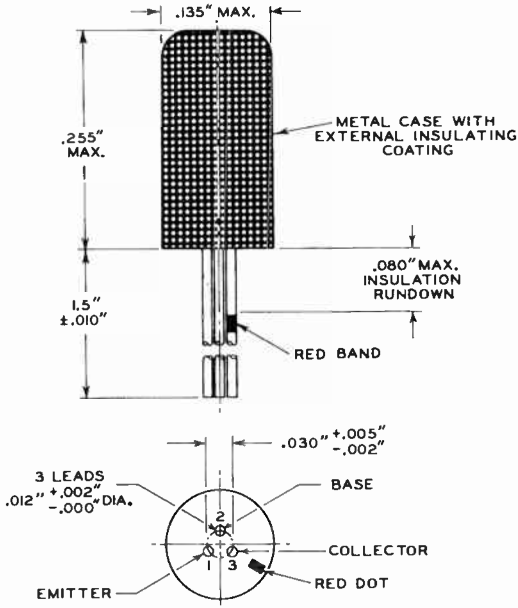
World Radio History

World Radio History

RCA

OUTLINES

SEMICONDUCTOR DEVICES
FLEXIBLE LEAD TYPE

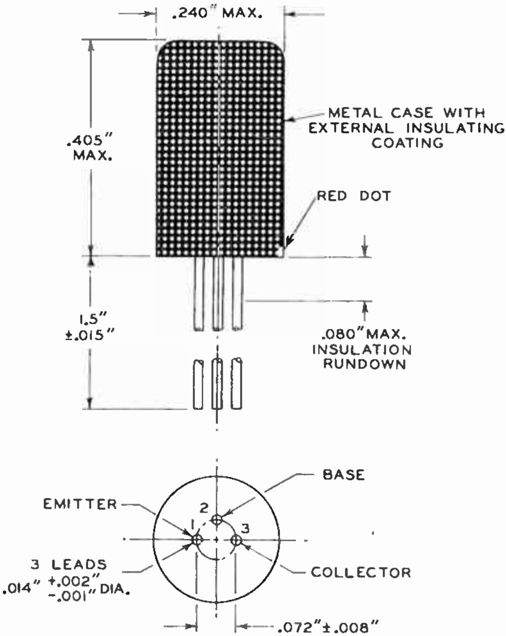


SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

OUTLINES

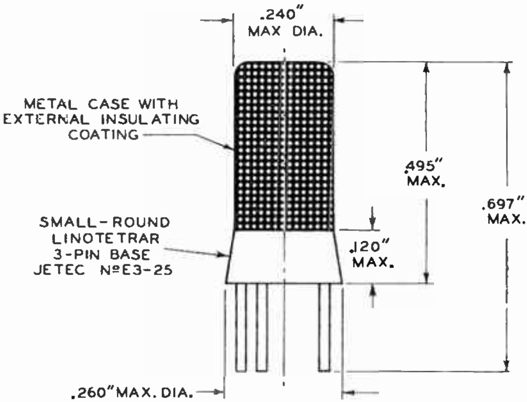
SEMICONDUCTOR DEVICES
FLEXIBLE LEAD TYPE



SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

LINOTETRAR--Linotetrar 3-Pin Base Types

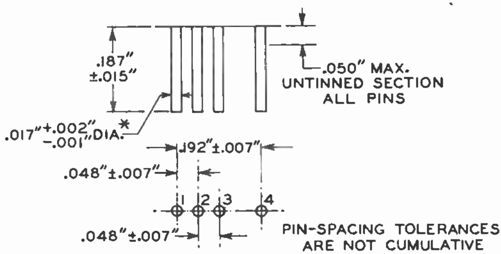


World Radio History

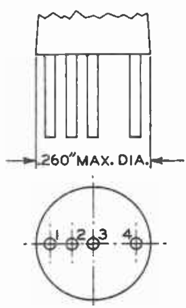
World Radio History

"LINOTETRAR"

PIN DIMENSIONS AND ORIENTATION



SMALL-ROUND LINOTETRAR

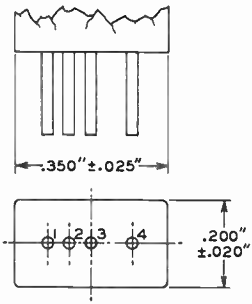


No. of Pins	Pins	JETEC No.	RCA No.
4-Pin	1, 2, 3, 4	E4-24	-
3-Pin	1, 2, 4	E3-25	-

* The specified pin diameter applies only in the zone between 0.050" from the base seat and the end of the pin.

World Radio History

SMALL-RECTANGLE LINOTETRAR



No. of Pins	*Pins*	*JETEC No.*	*RCA No.*
4-Pin	1,2,3,4	E4-31	-
3-Pin	1,2, 4	E3-32	-
2-Pin	1, 4	E2-33	FS6151

For other dimensions, see first page of the "Linotetrar" series

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

World Radio History

IN34-A

SEMICONDUCTOR DIODE

GERMANIUM POINT-CONTACT TYPE

A general-purpose type intended for low-power rectification in applications such as isolating, clipping, and switching circuits, as well as in certain meter circuits

DATA

General:

Maximum Envelope Length (Including studs)	7/8" ←
Maximum Envelope Diameter	1/4"
Maximum Overall Length (Including flexible leads)	4-1/8" ←
Leads, Flexible	2
Length	1-3/8" to 1-5/8"
Diameter	0.029" to 0.032" ←
Envelope, Glass	T-1-1/3
Operating Position	Any

RECTIFIER SERVICE

For power-supply frequency of 25 cps and above

Maximum Ratings, *Absolute Values:*

PEAK INVERSE VOLTAGE	60 max.	volts
FORWARD CURRENT:		
Peak	150 max.	ma
Average*	50 max.	ma
Fault, for duration of 0.1 second max	500 max.	ma
AMBIENT-TEMPERATURE RANGE	-55 to +75	°C

Characteristics, *At Ambient Temperature of 25°C:*

Minimum Forward Current at dc volts = 1	5	ma
Maximum Average Inverse Current:		
At dc volts = -10	30	μamp
At dc volts = -50	500	μamp
Minimum Peak Inverse Voltage for zero dynamic resistance	75	volts
Capacitance Between Stud Tips (Approx.)	1	μμf

* Averaged over one conduction cycle.

← indicates a change.

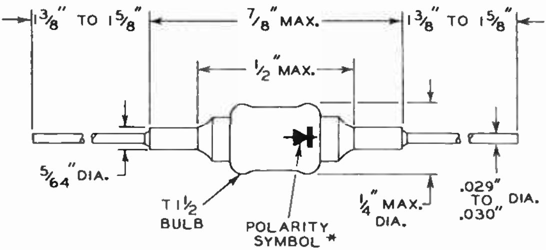
SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

RCA

IN34-A

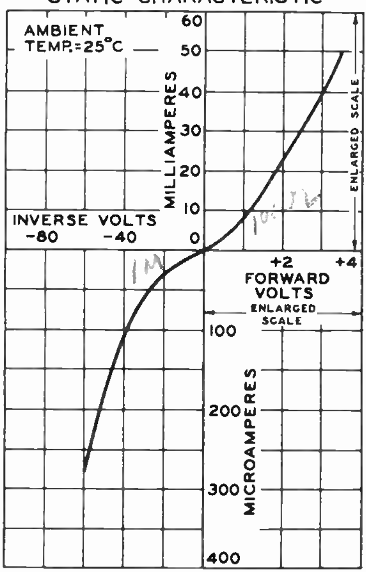
SEMICONDUCTOR DIODE



*ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT AS INDICATED BY DC AMMETER.

92CS-7980R1

STATIC CHARACTERISTIC



92CS-7976T

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

RCA

IN38-A
SEMICONDUCTOR DIODE

GERMANIUM POINT-CONTACT TYPE

A large-signal type having a high peak inverse voltage rating and intended for use in electronic computers and clamping circuits

DATA

General:

Maximum Envelope Length (Including studs)	7/8" ←
Maximum Envelope Diameter	1/4"
Maximum Overall Length (Including flexible leads)	4-1/8" ←
Leads, Flexible	2
Length	1-3/8" to 1-5/8"
Diameter	0.029" to 0.032" ←
Envelope, Glass	T-1-1/2
Operating Position	Any

RECTIFIER SERVICE

For power-supply frequency of 25 cps and above

Maximum Ratings, *Absolute Values:*

PEAK INVERSE VOLTAGE	100 max.	volts
FORWARD CURRENT:		
Peak	150 max.	ma
Average*	50 max.	ma
Fault, for duration of 0.1 second max.	500 max.	ma
AMBIENT-TEMPERATURE RANGE	-50 to +75	°C

Characteristics, *At Ambient Temperature of 25°C:*

Minimum Forward Current at dc volts = 1	4	ma
Maximum Average Inverse Current:		
At dc volts = -3	5	μamp
At dc volts = -100	500	μamp
Minimum Peak Inverse Voltage for zero dynamic resistance	120	volts
Capacitance Between Stud Tips (Approx.)	1	μμf

* Averaged over one conduction cycle.

← Indicates a change.

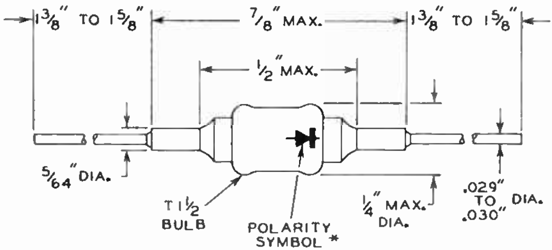
SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

RCA

IN38-A

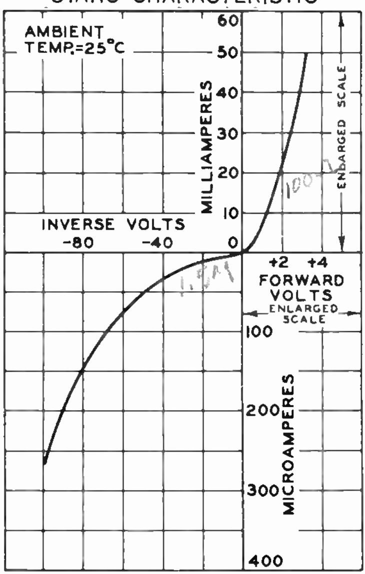
SEMICONDUCTOR DIODE



*ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT AS INDICATED BY DC AMMETER.

92CS-7980R1

STATIC CHARACTERISTIC



92CS-8022T

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

1N54-A

SEMICONDUCTOR DIODE

GERMANIUM POINT-CONTACT TYPE

A high-back-resistance type intended for use in clipping circuits, high-impedance high-voltage probes, dc restorer circuits, and high-impedance detector circuits

DATA

General:

Maximum Envelope Length (Including studs)	7/8" ←
Maximum Envelope Diameter	1/4"
Maximum Overall Length (Including flexible leads)	4-1/8" ←
Leads, Flexible	2
Length	1-3/8" to 1-5/8"
Diameter	0.029" to 0.032" ←
Envelope, Glass	T-1-1/2
Operating Position	Any

RECTIFIER SERVICE

For power-supply frequency of 25 cps and above

Maximum Ratings, ***Absolute Values:***

PEAK INVERSE VOLTAGE	50 max.	volts
FORWARD CURRENT:		
Peak	150 max.	ma
Average*	50 max.	ma
Fault, for duration of 0.1 second max	500 max.	ma
AMBIENT-TEMPERATURE RANGE	-50 to +75	°C

Characteristics, ***At Ambient Temperature of 25°C:***

Minimum Forward Current at dc volts = 1	5	ma
Maximum Average Inverse Current:		
At dc volts = -10	7	μamp
At dc volts = -50	100	μamp
Minimum Peak Inverse Voltage for zero dynamic resistance	75	volts
Capacitance Between Stud Tips (Approx.)	1	μμf

* Averaged over one conduction cycle.

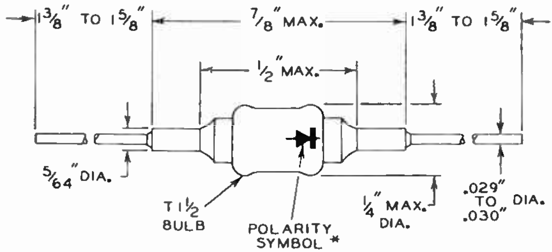
← Indicates a change.

World Radio History

RCA

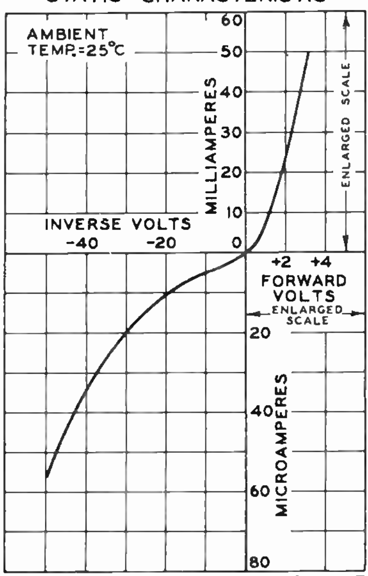
1N54-A

SEMICONDUCTOR DIODE



*ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT AS INDICATED BY DC AMMETER.

92CS-7980R1



92CS-8021T

World Radio History

1N55-A

1N55-A

CRYSTAL DIODE

GERMANIUM POINT-CONTACT TYPE

A large-signal type having a high peak inverse voltage rating and intended for use in electronic computers, clamping circuits, dc restorer circuits, and in high-voltage probes.

DATA

General:

Maximum Envelope Length (including studs)	15/16"
Maximum Envelope Diameter	1/4"
Maximum Overall Length (including flexible leads)	4-3/16"
Leads, Flexible	2
Length	1-3/8" to 1-5/8"
Diameter	0.025"
Envelope, Glass	T-1-1/2
Operating Position	Any

RECTIFIER SERVICE

For frequencies of 25 cps and above

Maximum Ratings, ***Absolute Values:***

PEAK INVERSE VOLTAGE	150 max.	volts
FORWARD CURRENT:		
Peak	150 max.	ma
Average*	50 max.	ma
FAULT CURRENT▲ (For duration of 1 sec. max.)	500 max.	ma
AMBIENT TEMPERATURE RANGE	-50 to +75	°C

Characteristics at Ambient Temperature of 25°C:

Minimum Forward Current at dc volts = 1	4	ma
Maximum Average Inverse Current:		
At dc volts = -150	500	μamp
Minimum Peak Inverse Voltage for zero dynamic resistance	170	volts
Shunt Capacitance (Approx.)- Measured Between Studs	1	μμf

* Averaged over one conduction cycle.

▲ Maximum fault current is the highest value of current that should be permitted to flow through the diode under a fault condition such as load short circuit.

DIMENSIONAL OUTLINE
for Type 1N55-A is the same as that shown for Type 1N34-A

AUG.1, 1953 TENTATIVE DATA

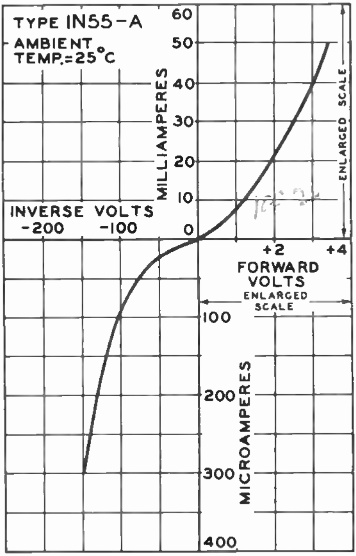
TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

World Radio History

RCA

IN55-A
CRYSTAL DIODE

STATIC CHARACTERISTIC



92CS-7977T

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

World Radio History

RCA

1N56-A

CRYSTAL DIODE

GERMANIUM POINT-CONTACT TYPE

A high-conduction type featuring exceptionally low dynamic impedance and intended for limiter service in FM receivers.

DATA

General:

Maximum Envelope Length (Including studs)	15/16"
Maximum Envelope Diameter	1/4"
Maximum Overall Length (Including flexible leads)	4-3/16"
Leads, Flexible	2
Length	1-3/8" to 1-5/8"
Diameter	0.025"
Envelope, Glass	T-1-1/2
Operating Position	Any

RECTIFIER SERVICE

For frequencies of 25 cps and above

Maximum Ratings, ***Absolute Values:***

PEAK INVERSE VOLTAGE	40 max.	volts
FORWARD CURRENT:		
Peak	200 max.	ma
Average*	60 max.	ma
FAULT CURRENT▲ (For duration of 1 sec. max.)	1000 max.	ma
AMBIENT TEMPERATURE RANGE	-50 to +75	°C

Characteristics at Ambient Temperature of 25°C:

Minimum Forward Current at dc volts = 1	15	ma
Maximum Average Inverse Current:		
At dc volts = -30	300	μamp
Minimum Peak Inverse Voltage for zero dynamic resistance	50	volts
Snunt Capacitance (Approx.) - Measured Between Studs)	1	μμf

* Averaged over one conduction cycle.

▲ Maximum fault current is the highest value of current that should be permitted to flow through the diode under a fault condition such as load short circuit.

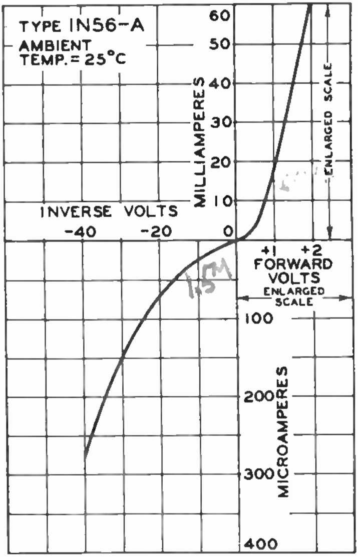
DIMENSIONAL OUTLINE
for Type 1N56-A is the same as that shown for Type 1N34-A

World Radio History

RCA

IN56-A
CRYSTAL DIODE

STATIC CHARACTERISTIC



92CS-7978T

AUG. 1, 1953

CE-7978T

World Radio History

IN58-A

1N58-A

SEMICONDUCTOR DIODE

GERMANIUM POINT-CONTACT TYPE

A large-signal type having a high peak inverse voltage rating and intended for use in electronic computers and clamping circuits

DATA

General:

Maximum Envelope Length (Including studs)	7/8"
Maximum Envelope Diameter	1/4"
Maximum Overall Length (Including flexible leads)	4-1/8"
Leads, Flexible	2
Length	1-3/8" to 1-5/8"
Diameter	0.029" to 0.032"
Envelope, Glass	T-1-1/2
Operating Position	Any

RECTIFIER SERVICE

For power-supply frequency of 25 cps and above

Maximum Ratings, *Absolute Values:*

PEAK INVERSE VOLTAGE	100 max.	volts
FORWARD CURRENT:		
Peak	150 max.	ma
Average*	50 max.	ma
Fault, for duration of 0.1 second max.	500 max.	ma
AMBIENT-TEMPERATURE RANGE	-50 to +75	°C

Characteristics, *At Ambient Temperature of 25°C:*

Minimum Forward Current at dc volts = 1	4	ma
Maximum Average Inverse Current at dc volts = -100	600	μamp
Minimum Peak Inverse Voltage for zero dynamic resistance	120	volts
Capacitance Between Stud Tips (Approx.)	1	μμf

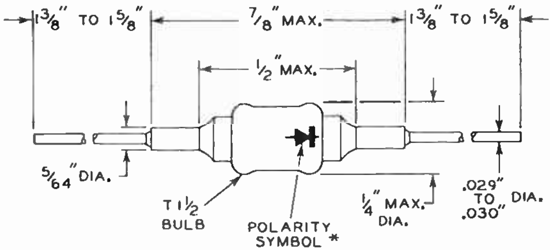
* Averaged over one conduction cycle.

← Indicates a change.

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

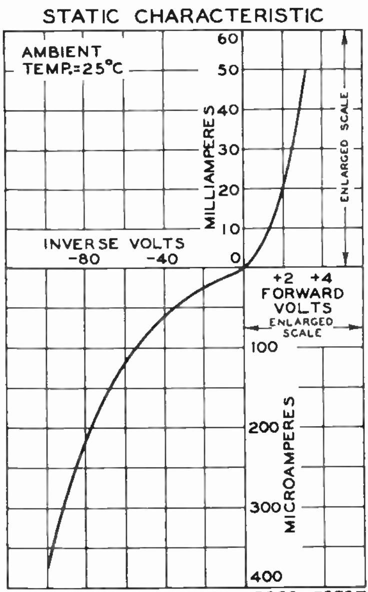
RCA

IN58-A
SEMICONDUCTOR DIODE



*ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT AS INDICATED BY DC AMMETER.

92CS-7980R1



92CS-7979T

World Radio History

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

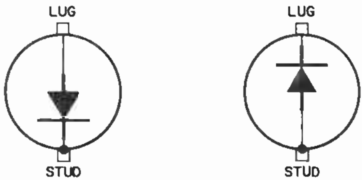
For Industrial and Military Power Supplies

GENERAL DATA

Mechanical:

Operating Position. Any
Dimensions. . . . . See *Dimensional Outline*
Dimensional Outline . . . . JEDEC No.DO-5
Case. . . . . Metal
Seals . . . . .Hermetic
Terminal Diagrams (See *Dimensional Outline*):

Type 1N248C   *Type 1N248RC*



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK INVERSE VOLTAGE.	55 max.	volts
RMS SUPPLY VOLTAGE.	39 max.	volts
DC BLOCKING VOLTAGE	50 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 150° C	20 max.	amp
At other case temperatures. . . See *Average-Forward-Current Rating Chart*		
PEAK RECURRENT CURRENT.	90 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	350 max.	amp
For one or more cycles. .See *Peak-Surge-Current Rating Chart*		
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +175	°C

Characteristics:

At case temperature of 150° C and maximum-rated voltage and average forward current

Maximum Forward Voltage Drop.	0.6	volt
Maximum Reverse Current	3.8	ma

World Radio History

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

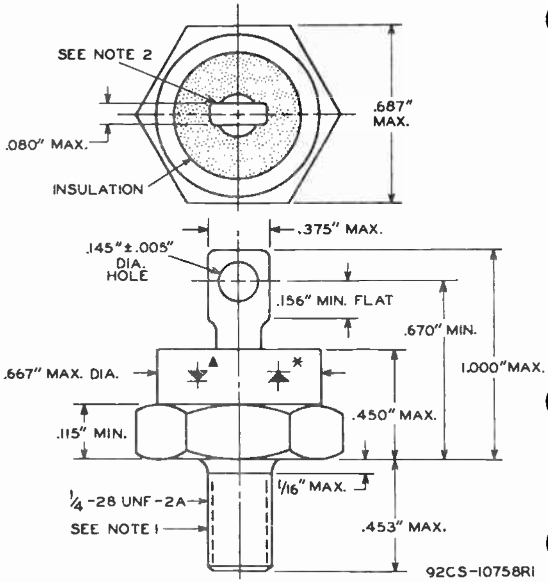
OPERATING CONSIDERATIONS

Because these rectifiers may operate at voltages which are dangerous, care should be taken in the design of equipment to prevent the operator from coming in contact with the rectifier.

The recommended installation torque is 26 to 36 inch-pounds applied to a 1/4-28 UNF-2B hex nut assembled on stud thread.

The applied torque during installation should not exceed 75 inch-pounds.

JEDEC No.DO-5



NOTE 1: MUST WITHSTAND TORQUE OF 30 INCH-POUNDS APPLIED TO 1/4-28 UNF-2B NUT ASSEMBLED ON STUD THREAD.

NOTE 2: ANGULAR ORIENTATION OF THIS TERMINAL UNDEFINED.

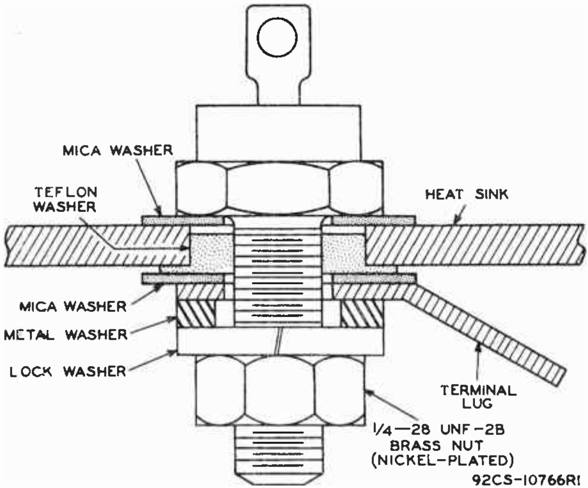
▲ Polarity symbol for types 1N248C, 1N249C, 1N250C, 1N1195A, 1N1196A, 1N1197A, and 1N1198A.

* Polarity symbol for types 1N248RC, 1N249RC, 1N250RC, 1N1195RA, 1N1196RA, 1N1197RA, and 1N1198RA.

World Radio History

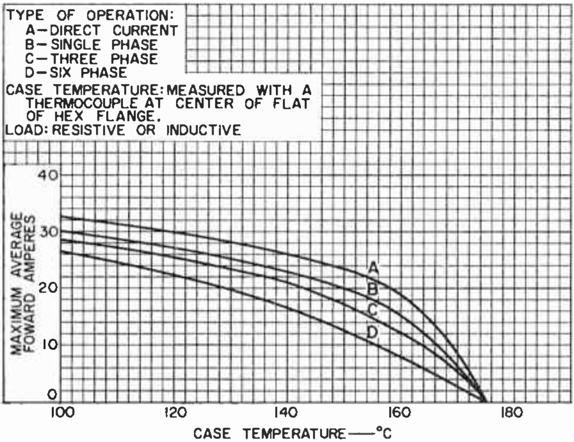
SUGGESTED MOUNTING ARRANGEMENT

Mounting components of the type shown are furnished with each silicon rectifier



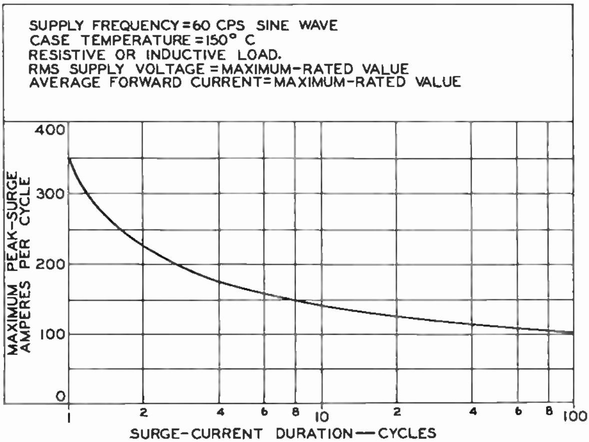
World Radio History

AVERAGE-FORWARD-CURRENT RATING CHART



92CS-10746R1

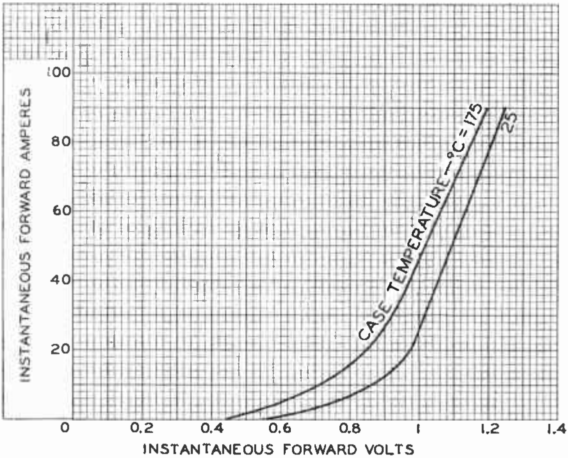
PEAK-SURGE-CURRENT RATING CHART



92CS-10909R1

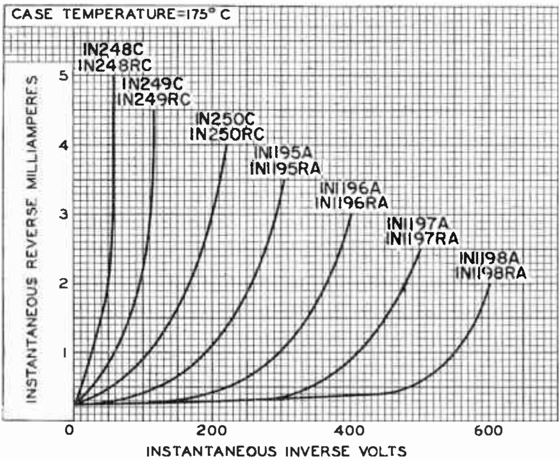
World Radio History

TYPICAL FORWARD CHARACTERISTICS



92CS-10768

TYPICAL REVERSE CHARACTERISTICS



92CS-10767R1

World Radio History

World Radio History

1N249C, 1N249RC

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES
For Industrial and Military Power Supplies

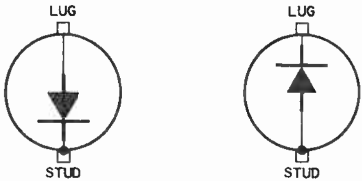
GENERAL DATA

Mechanical:

Operating Position	Any
Dimensions	See *Dimensional Outline*
Dimensional Outline	JEDEC No.DO-5
Case	Metal
Seals	Hermetic

Terminal Diagrams (See *Dimensional Outline*):

Type 1N249C *Type 1N249RC*



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK INVERSE VOLTAGE	110 max.	volts
RMS SUPPLY VOLTAGE	77 max.	volts
DC BLOCKING VOLTAGE	100 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 150° C	20 max.	amp
At other case temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	90 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	350 max.	amp
For one or more cycles	See *Peak-Surge-Current Rating Chart*	
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +175	°C

Characteristics:

At case temperature of 150° C and maximum-rated voltage and average forward current

Maximum Forward Voltage Drop	0.6	volt
Maximum Reverse Current	3.6	ma

World Radio History

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHARTS,
and
CURVES
shown under Types 1N248C and 1N248RC also apply to the 1N249C and 1N249RC

World Radio History

Silicon Rectifiers

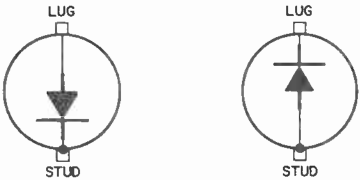
DIFFUSED-JUNCTION TYPES
For Industrial and Military Power Supplies

GENERAL DATA

Mechanical:

Operating Position. . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Dimensional Outline . . . . JEDEC No.DO-5
Case. . . . . Metal
Seals . . . . .Hermetic
Terminal Diagrams (See *Dimensional Outline*):

Type 1N250C *Type 1N250RC*



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK INVERSE VOLTAGE.	220 max.	volts
RMS SUPPLY VOLTAGE.	154 max.	volts
DC BLOCKING VOLTAGE	200 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 150° C	20 max.	amp
At other case temperatures. . .	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT.	90 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	350 max.	amp
For one or more cycles.	See *Peak-Surge-Current Rating Chart*	
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +175	°C

Characteristics:

At case temperature of 150° C and maximum-rated voltage and average forward current

Maximum Forward Voltage Drop.	0.6	volt
Maximum Reverse Current	3.4	ma

World Radio History

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHARTS,
and
CURVES
shown under Types 1N248C and 1N248RC also apply to the 1N250C and 1N250RC

World Radio History

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

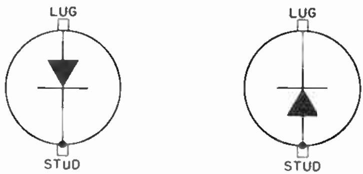
For Industrial and Military Power Supplies

GENERAL DATA

Mechanical:

Operating Position. . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Dimensional Outline . . . . JEDEC No.DO-5
Case. . . . . Metal
Seals . . . . .Hermetic
Terminal Diagrams (See *Dimensional Outline*):

Type 1N1183A *Type 1N1183RA*



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK REVERSE VOLTAGE.	50 max.	volts
RMS SUPPLY VOLTAGE.	35 max.	volts
DC BLOCKING VOLTAGE	50 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 150° C	40 max.	amp
At other case temperatures. . . See *Average-Forward-Current Rating Chart*		
PEAK RECURRENT CURRENT.	195 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	800 max.	amp
For one or more cycles. . . . . .See *Peak-Surge-Current Rating Chart*		
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +200	°C

Characteristics:

Maximum Forward Voltage Drop[b]	0.65	volt
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle for maximum peak-reverse volts = 50, dc forward amperes = 40, case temperature (°C) = 150)	2.5	ma

World Radio History

1N1183A, 1N1183RA

Static (DC value for maximum peak-reverse volts = 50, case temperature (°C) = 25).	0.025	ma
Maximum Thermal Resistance:		
Junction-to-case.	1	°C/watt

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[b] Average value for one complete cycle, for maximum peak-reverse volts = 50, dc forward amperes = 40, case temperature (°C) = 150.

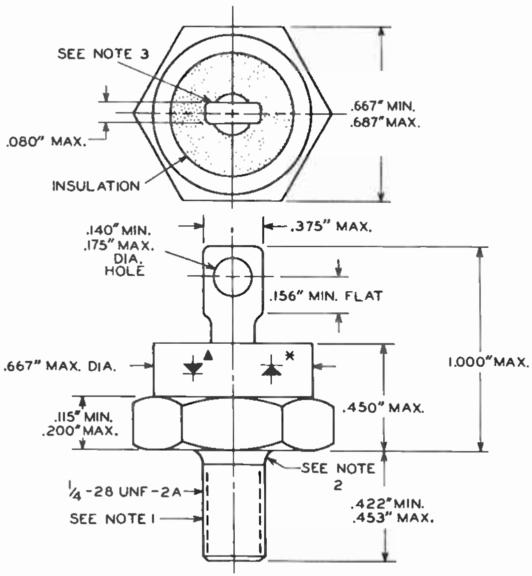
OPERATING CONSIDERATIONS

Because these rectifiers may operate at voltages which are dangerous, care should be taken in the design of equipment to prevent the operator from coming in contact with the rectifier.

The recommended installation torque is 26 to 36 inch-pounds applied to a 1/4-28 UNF-2B hex nut assembled on stud thread.

The applied torque during installation should not exceed 50 inch-pounds.

JEDEC No.DO-5



92CS-10758R3

World Radio History

NOTE 1: MUST WITHSTAND TORQUE OF 30 INCH-POUNDS APPLIED TO 1/4-28 UNF-2B NUT ASSEMBLED ON STUD THREAD.

NOTE 2: DIAMETER OF UNTHREADED PORTION: 0.249" MAXIMUM, 0.220" MINIMUM.

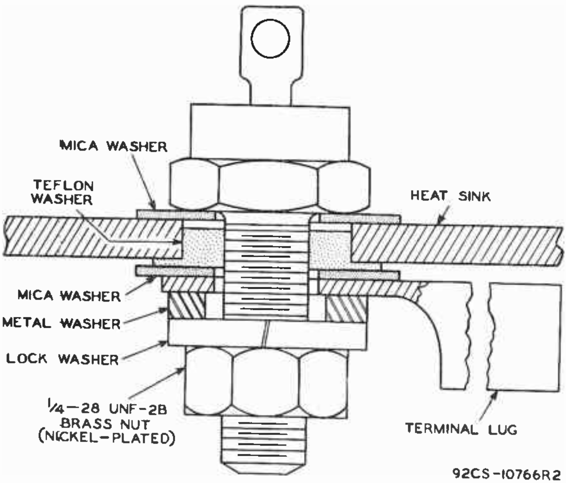
NOTE 3: ANGULAR ORIENTATION OF THIS TERMINAL UNDEFINED.

▲ Polarity symbol for types 1N1183A, 1N1184A, and 1N1186A.

* Polarity symbol for types 1N1183RA, 1N1184RA, and 1N1186RA.

SUGGESTED MOUNTING ARRANGEMENT

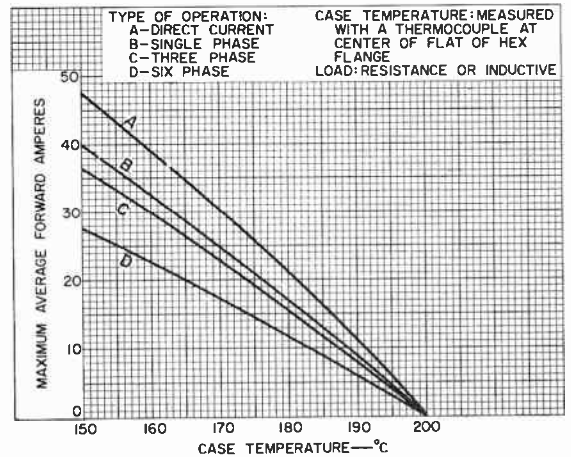
Mounting components of the type shown are furnished with each silicon rectifier. The increase in thermal resistance with these mounting components is approximately 1.5 °C/watt.



92CS-10766R2

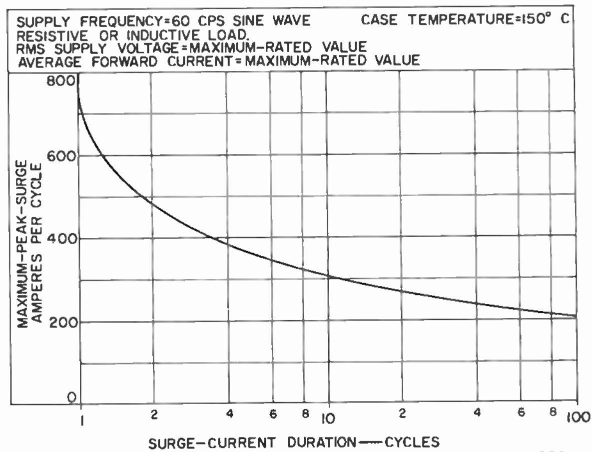
World Radio History

AVERAGE-FORWARD-CURRENT RATING CHART



92CS-11343

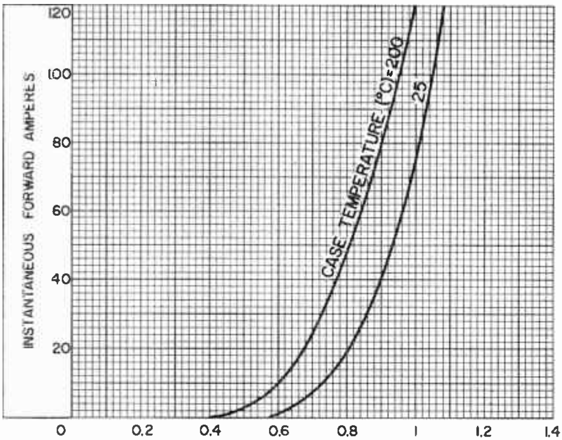
PEAK-SURGE-CURRENT RATING CHART



92CS-11350

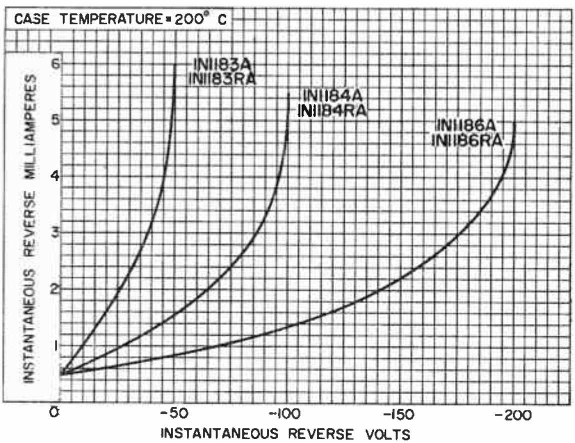
World Radio History

TYPICAL FORWARD CHARACTERISTICS



92CS-11340

TYPICAL REVERSE CHARACTERISTICS



92CS-11335

World Radio History

1N1184A, 1N1184RA

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

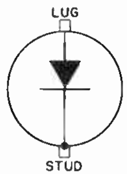
For Industrial and Military Power Supplies

GENERAL DATA

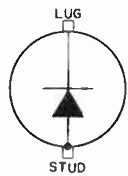
Mechanical:

Operating Position. Any
Dimensions. . . . . See *Dimensional Outline*
Dimensional Outline . . . . JEDEC No.DO-5
Case. . . . . Metal
Seals . . . . .Hermetic
Terminal Diagrams (See *Dimensional Outline*):

Type 1N1184A



Type 1N1184RA



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK REVERSE VOLTAGE.	100 max.	volts
RMS SUPPLY VOLTAGE.	70 max.	volts
DC BLOCKING VOLTAGE	100 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 150° C	40 max.	amp
At other case temperatures. . . See *Average-Forward-Current Rating Chart*		
PEAK RECURRENT CURRENT.	195 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	800 max.	amp
For one or more cycles. . . . . .See *Peak-Surge-Current Rating Chart*		
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +200	°C

Characteristics:

Maximum Forward Voltage Drop[b]	0.65	volt
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle for maximum peak-reverse volts = 100, dc forward amperes = 40, case temperature (°C) = 150)	2.5	ma

World Radio History

Static (DC value for maximum peak-reverse volts = 100, case temperature (°C) = 25).	0.025	ma
Maximum Thermal Resistance:		
Junction-to-case	1	°C/watt

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[b] Average value for one complete cycle, for maximum peak reverse volts = 100, dc forward amperes = 40, case temperature (°C) = 150.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHARTS,
and
CURVES
shown under Types 1N1183A and 1N1183RA also apply to the
1N1184A and 1N1184RA

1N1186A, 1N1186RA

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

For Industrial and Military Power Supplies

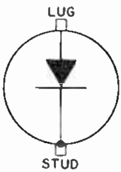
GENERAL DATA

Mechanical:

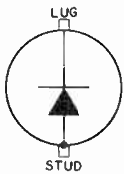
Operating Position	Any
Dimensions	See *Dimensional Outline*
Dimensional Outline	JEDEC No.DO-5
Case	Metal
Seals	Hermetic

Terminal Diagrams (See *Dimensional Outline*):

Type 1N1186A



Type 1N1186RA



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK REVERSE VOLTAGE	200 max.	volts
RMS SUPPLY VOLTAGE	140 max.	volts
DC BLOCKING VOLTAGE	200 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 150° C	40 max.	amp
At other case temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	195 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	800 max.	amp
For one or more cycles	See *Peak-Surge-Current Rating Chart*	
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +200	°C

Characteristics:

Maximum Forward Voltage Drop[b]	0.65	volt
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle for maximum peak-reverse volts = 200, dc forward amperes = 40, case temperature (°C) = 150)	2.5	ma

World Radio History

Static (DC value for maximum peak-reverse volts = 200, case temperature (°C) = 25)	0.025	ma
Maximum Thermal Resistance:		
Junction-to-case.	1	°C/watt

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[b] Average value for one complete cycle, for maximum peak-reverse volts = 200, dc forward amperes = 40, case temperature (°C) = 150.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHARTS,
and
CURVES
shown under Types 1N1183A and 1N1183RA also apply to the
1N1186A and 1N1186RA

World Radio History

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

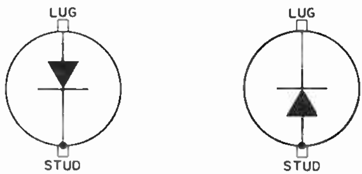
For Industrial and Military Power Supplies

GENERAL DATA

Mechanical:

Operating Position. . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Dimensional Outline . . . . JEDEC No.DO-5
Case. . . . . Metal
Seals . . . . .Hermetic
Terminal Diagrams (See *Dimensional Outline*):

Type 1N1187 *Type 1N1187R*



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK REVERSE VOLTAGE.	300 max.	volts
RMS SUPPLY VOLTAGE.	212 max.	volts
DC BLOCKING VOLTAGE	240 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 140° C	35 max.	amp
At other case temperatures. . . See *Average-Forward-Current Rating Chart*		
PEAK RECURRENT CURRENT.	130 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	500 max.	amp
For one or more cycles. . . . . .See *Peak-Surge-Current Rating Chart*		
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +175	°C

Characteristics:

Maximum Forward Voltage Drop[b]	1.7	volts
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle for maximum peak-reverse volts = 300, dc forward amperes = 35, case temperature (°C) = 140)	10	ma

World Radio History

Static (DC value for maximum peak-reverse volts = 300, case temperature (°C) = 25)	0.025	ma
Maximum Thermal Resistance:		
Junction-to-case.	1	°C/watt

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[b] Peak value for maximum average forward amperes = 35, case temperature (°C) = 140.

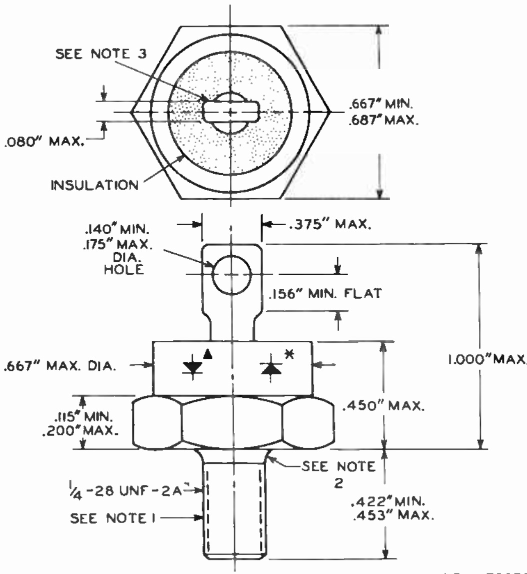
OPERATING CONSIDERATIONS

Because these rectifiers may operate at voltages which are dangerous, care should be taken in the design of equipment to prevent the operator from coming in contact with the rectifier.

The recommended installation torque is 26 to 36 inch-pounds applied to a 1/4-28 UNF-2B hex nut assembled on stud thread.

The applied torque during installation should not exceed 50 inch-pounds.

JEDEC No. DO-5



92CS-10758R3

World Radio History

NOTE 1: MUST WITHSTAND TORQUE OF 30 INCH-POUNDS APPLIED TO 1/4-28 UNF-2B NUT ASSEMBLED ON STUD THREAD.

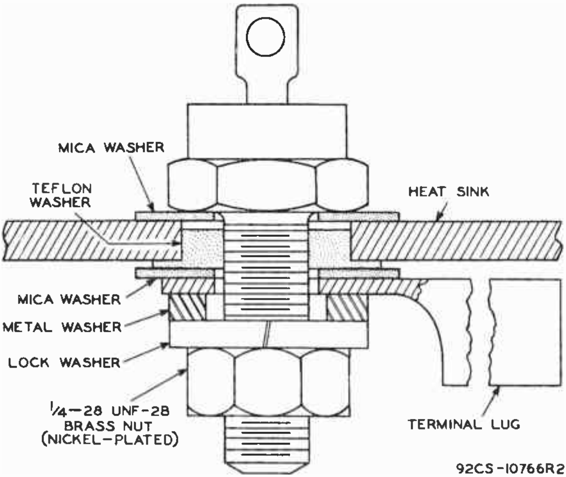
NOTE 2: DIAMETER OF UNTHREADED PORTION: 0.249" MAXIMUM, 0.220" MINIMUM.

NOTE 3: ANGULAR ORIENTATION OF THIS TERMINAL UNDEFINED.

▲ Polarity symbol for types 1N1187, 1N1188, 1N1189, and 1N1190.
* Polarity symbol for types 1N1187R, 1N1188R, 1N1189R, and 1N1190R.

SUGGESTED MOUNTING ARRANGEMENT

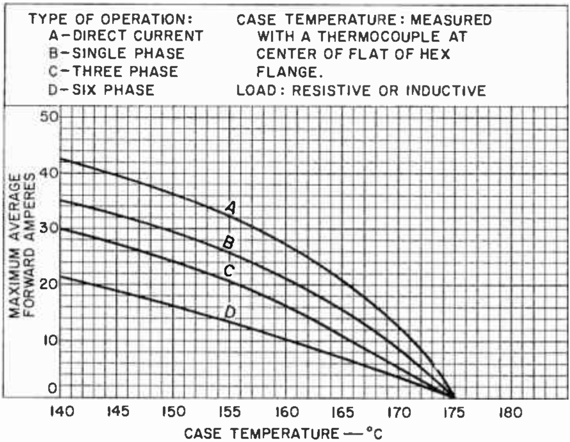
Mounting components of the type shown are furnished with each silicon rectifier. The increase in thermal resistance with these mounting components is approximately 1.5 °C/watt.



92CS-10766R2

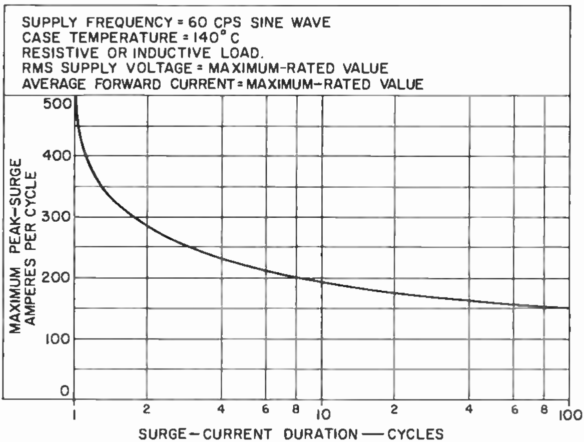
World Radio History

AVERAGE-FORWARD-CURRENT RATING CHART



92CS-11342

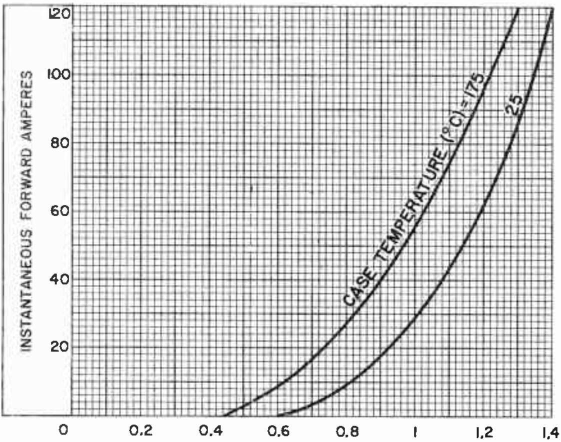
PEAK-SURGE-CURRENT RATING CHART



92CS-11351

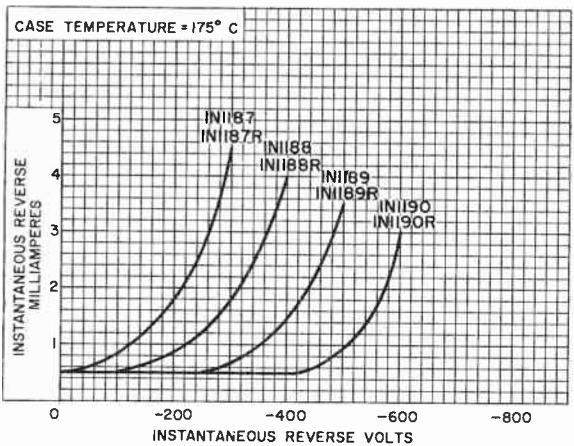
World Radio History

TYPICAL FORWARD CHARACTERISTICS



92CS-11341

TYPICAL REVERSE CHARACTERISTICS



92CS-11336

World Radio History

World Radio History

1N1188, 1N1188R

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

For Industrial and Military Power Supplies

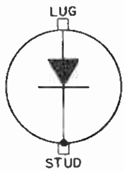
GENERAL DATA

Mechanical:

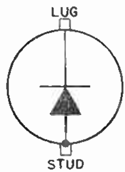
Operating Position	Any
Dimensions	See *Dimensional Outline*
Dimensional Outline	JEDEC No. DO-5
Case	Metal
Seals	Hermetic

Terminal Diagrams (See *Dimensional Outline*):

Type 1N1188



Type 1N1188R



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK REVERSE VOLTAGE	400 max.	volts
RMS SUPPLY VOLTAGE	284 max.	volts
DC BLOCKING VOLTAGE	320 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 140° C	35 max.	amp
At other case temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	130 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	500 max.	amp
For one or more cycles	See *Peak-Surge-Current Rating Chart*	
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +175	°C

Characteristics:

Maximum Forward Voltage Drop[b]	1.7	volts
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle for maximum peak-reverse volts = 400, dc forward amperes = 35, case temperature (°C) = 140	10	ma

World Radio History

Static (DC value for maximum peak-reverse volts = 400, case temperature (°C) = 25).	0.025	ma
Maximum Thermal Resistance:		
Junction-to-case.	1	°C/watt

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings anc may be repeated after sufficient time has elapsed for the device to returr to the presurge thermal-equilibrium conditions.

[b] Peak value for maximum average forward amperes = 35, case temperature (°C) = 140.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHARTS,
and
CURVES
shown under Types 1N1187 and 1N1187R also apply to the 1N1188 and 1N1188R

World Radio History

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES
For Industrial and Military Power Supplies

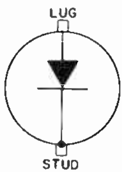
GENERAL DATA

Mechanical:

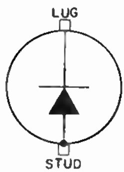
Operating Position	Any
Dimensions	See *Dimensional Outline*
Dimensional Outline	JEDEC No.DO-5
Case	Metal
Seals	Hermetic

Terminal Diagrams (See *Dimensional Outline*):

Type 1N1189



Type 1N1189R



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK REVERSE VOLTAGE	500 max.	volts
RMS SUPPLY VOLTAGE	355 max.	volts
DC BLOCKING VOLTAGE	400 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 140° C	35 max.	amp
At other case temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	130 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	500 max.	amp
For one or more cycles	See *Peak-Surge-Current Rating Chart*	
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +175	°C

Characteristics:

Maximum Forward Voltage Drop[b]	1.7	volts
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle for maximum peak-reverse volts = 500, dc forward amperes = 35, case temperature (°C) = 140)	10	ma

World Radio History

Static (DC value for maximum peak-reverse volts = 500, case temperature (°C) = 25)	0.025	ma
Maximum Thermal Resistance:		
Junction-to-case.	1	°C/watt

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[b] Peak value for maximum average forward amperes = 35, case temperature (°C) = 140.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHARTS,
and
CURVES
shown under Types 1N1187 and 1N1187R also apply to the 1N1189 and 1N1189R

World Radio History

1N1190, 1N1190R

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

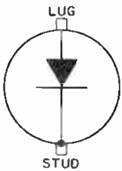
For Industrial and Military Power Supplies

GENERAL DATA

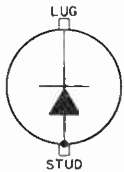
Mechanical:

Operating Position. . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Dimensional Outline . . . . JEDEC No.DO-5
Case. . . . . Metal
Seals . . . . .Hermetic
Terminal Diagrams (See *Dimensional Outline*):

Type 1N1190



Type 1N1190R



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK REVERSE VOLTAGE.	600 max.	volts
RMS SUPPLY VOLTAGE.	424 max.	volts
DC BLOCKING VOLTAGE	480 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 140° C	35 max.	amp
At other case temperatures. . . See *Average-Forward-Current Rating Chart*		
PEAK RECURRENT CURRENT.	130 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	500 max.	amp
For one or more cycles. . . . . .See *Peak-Surge-Current Rating Chart*		
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +175	°C

Characteristics:

Maximum Forward Voltage Drop[b]	1.7	volts
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle for maximum peak-reverse volts = 600, dc forward amperes = 35, case temperature (°C) = 140).	10	ma

World Radio History

Static (DC value for maximum peak-reverse volts = 600, case temperature (°C) = 25)	0.025	ma
Maximum Thermal Resistance:		
Junction-to-case.	1	°C/watt

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[b] Peak value for maximum average forward amperes = 35, case temperature (°C) = 140.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTEO MOUNTING ARRANGEMENT,
RATING CHARTS,
and
CURVES
shown under Types 1N1187 and 1N1187R also apply to the
1N1190 and 1N1190R

World Radio History

1N1195A, 1N1195RA

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

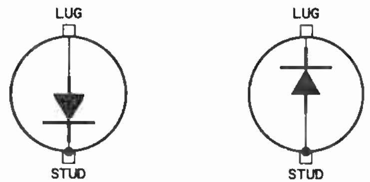
For Industrial and Military Power Supplies

GENERAL DATA

Mechanical:

Operating Position. . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Dimensional Outline . . . . JEDEC No.DO-5
Case. . . . . Metal
Seals . . . . .Hermetic
Terminal Diagrams (See *Dimensional Outline*):

Type 1N1195A *Type 1N1195RA*



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK INVERSE VOLTAGE.	300 max.	volts
RMS SUPPLY VOLTAGE.	212 max.	volts
DC BLOCKING VOLTAGE	300 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 150° C	20 max.	amp
At other case temperatures. . .	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT.	90 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	350 max.	amp
For one or more cycles.	See *Peak-Surge-Current Rating Chart*	
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +175	°C

Characteristics:

At case temperature of 150° C and maximum-rated voltage and average forward current

Maximum Forward Voltage Drop.	0.6	volt
Maximum Reverse Current	3.2	ma

World Radio History

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHARTS,
and
CURVES
shown under Type 1N248C and 1N248RC also apply to the
1N1195A and 1N1195RA

World Radio History

1N1196A, 1N1196RA

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES
For Industrial and Military Power Supplies

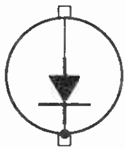
GENERAL DATA

Mechanical:

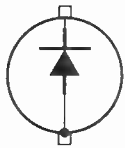
Operating Position	Any
Dimensions	See *Dimensional Outline*
Dimensional Outline	JEDEC No. DO-5
Case	Metal
Seals	Hermetic

Terminal Diagrams (See *Dimensional Outline*):

Type 1N1196A



Type 1N1196RA



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK INVERSE VOLTAGE	400 max.	volts
RMS SUPPLY VOLTAGE	284 max.	volts
DC BLOCKING VOLTAGE	400 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 150° C	20 max.	amp
At other case temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	90 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	350 max.	amp
For one or more cycles	See *Peak-Surge-Current Rating Chart*	
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +175	°C

Characteristics:

At case temperature of 150° C and maximum-rated voltage and average forward current

Maximum Forward Voltage Drop	0.6	volt
Maximum Reverse Current	2.5	ma

World Radio History

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHARTS,
and
CURVES
shown under Types 1N248C and 1N248RC also apply to the 1N1196A and 1N1196RA

World Radio History

1N1197A, 1N1197RA

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

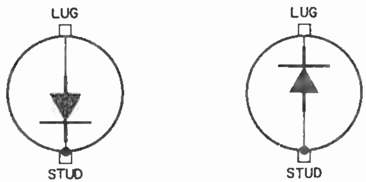
For Industrial and Military Power Supplies

GENERAL DATA

Mechanical:

Operating Position. Any
Dimensions. . . . . See *Dimensional Outline*
Dimensional Outline . . . . JEDEC No.DO-5
Case. . . . . Metal
Seals . . . . .Hermetic
Terminal Diagrams (See *Dimensional Outline*):

Type 1N1197A *Type 1N1197RA*



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK INVERSE VOLTAGE.	500 max.	volts
RMS SUPPLY VOLTAGE.	355 max.	volts
DC BLOCKING VOLTAGE	500 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 150° C	20 max.	amp
At other case temperatures. . . See *Average-Forward-Current Rating Chart*		
PEAK RECURRENT CURRENT.	90 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	350 max.	amp
For one or more cycles. .See *Peak-Surge-Current Rating Chart*		
CASE-TEMPERATURE RANGE:		
Operating and storage	−65 to +175	°C

Characteristics:

At case temperature of 150° C and maximum-rated voltage and average forward current

Maximum Forward Voltage Drop.	0.6	volt
Maximum Reverse Current	2.2	ma

World Radio History

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHARTS,
and
CURVES
shown under Type 1N248C and 1N248RC also apply to the 1N1197A and 1N1197RA

World Radio History

1N1198A, 1N1198RA

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

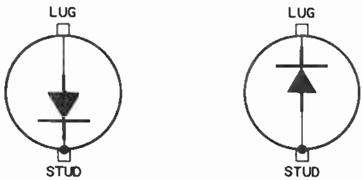
For Industrial and Military Power Supplies

GENERAL DATA

Mechanical:

Operating Position. . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Dimensional Outline . . . . JEDEC No.DO-5
Case. . . . . Metal
Seals . . . . .Hermetic
Terminal Diagrams (See *Dimensional Outline*):

Type 1N1198A *Type 1N1198RA*



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK INVERSE VOLTAGE.	600 max.	volts
RMS SUPPLY VOLTAGE.	424 max.	volts
DC BLOCKING VOLTAGE	600 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 150° C	20 max.	amp
At other case temperatures. . .	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT.	90 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	350 max.	amp
For one or more cycles.	.See *Peak-Surge-Current Rating Chart*	
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +175	°C

Characteristics:

At case temperature of 150° C and maximum-rated voltage and average forward current

Maximum Forward Voltage Drop.	0.6	volt
Maximum Reverse Current	1.5	ma

World Radio History

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHARTS,
and
CURVES
shown under Types 1N248C and 1N248RC also apply to the 1N1198A and 1N1198RA

World Radio History

1N1199A, 1N1199RA

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

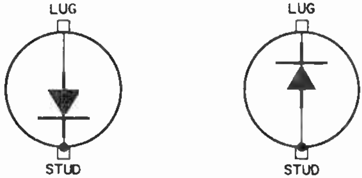
For Industrial and Military Power Supplies

GENERAL DATA

Mechanical:

Operating Position. . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Dimensional Outline . . . . JEDEC No.DO-4
Case. . . . . Metal
Seals . . . . .Hermetic
Terminal Diagrams (See *Dimensional Outline*):

Type 1N1199A *Type 1N1199RA*



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK INVERSE VOLTAGE.	50 max.	volts
TRANSIENT INVERSE VOLTAGE:		
Non-repetitive, for duration of 5-milliseconds maximum.	100 max.	volts
RMS SUPPLY VOLTAGE.	35 max.	volts
DC BLOCKING VOLTAGE	50 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 150° C	12 max.	amp
At other case temperatures. . .	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT.	50 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	240 max.	amp
For one or more cycles.	.See *Peak-Surge-Current Rating Chart*	
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +200	°C

Characteristics:

Maximum Forward Voltage Drop[b]	0.55	volt
Maximum Reverse Current[b].	3	ma

World Radio History

Maximum Thermal Resistance:
Junction-to-case. . . . . 2 °C/watt

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.
[b] At case temperature of 150° C and maximum-rated voltage and average forward current.

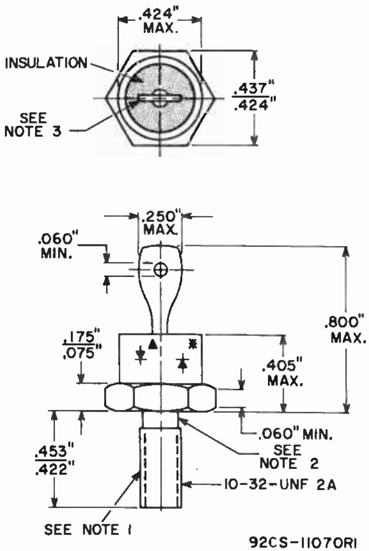
OPERATING CONSIDERATIONS

Because these rectifiers may operate at voltages which are dangerous, care should be taken in the design of equipment to prevent the operator from coming in contact with the rectifier.

The recommended installation torque is 15 to 20 inch-pounds applied to a 10-32 UNF-2B hex nut assembled on stud thread.

The applied torque during installation should not exceed 25 inch-pounds.

JEDEC No. DO-4



World Radio History

NOTE 1: NORMAL INSTALLATION TORQUE IS 15 to 20 INCH-POUNDS APPLIED TO A 10-32 UNF-2B HEX NUT ASSEMBLED ON STUD THREADS. UNDER NO CIRCUMSTANCES SHOULD THIS VALUE EXCEED 25 INCH-POUNDS.

NOTE 2: DIAMETER OF UNTHREADED PORTION: 0.189" MAXIMUM, 0.169" MINIMUM.

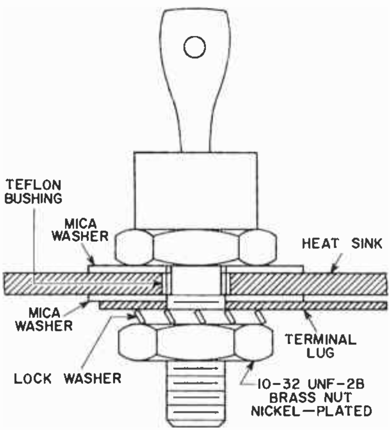
NOTE 3: ANGULAR ORIENTATION OF THIS TERMINAL UNDEFINED.

▲ Polarity symbol for types 1N1199A, 1N1200A, 1N1202A, 1N1203A, 1N1204A, 1N1205A, and 1N1206A.

* Polarity symbol for types 1N1199RA, 1N1200RA, 1N1202RA, 1N1203RA, 1N1204RA, 1N1205RA, and 1N1206RA.

SUGGESTED MOUNTING ARRANGEMENT

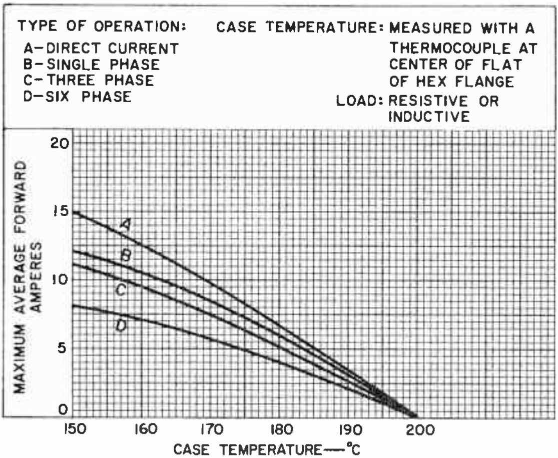
Mounting components of the type shown are furnished with each silicon rectifier



92CS-11072R1

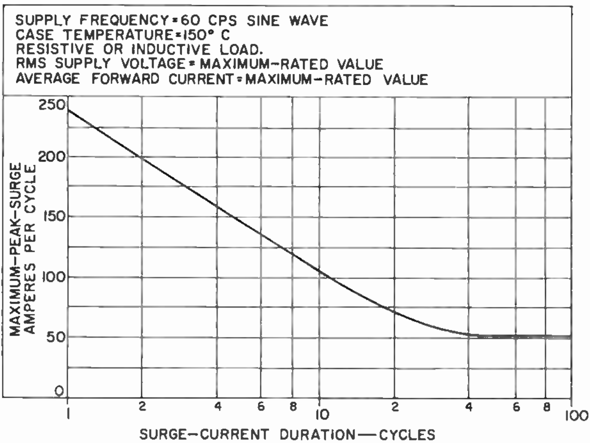
World Radio History

AVERAGE-FORWARD-CURRENT RATING CHART



92CS-11065R1

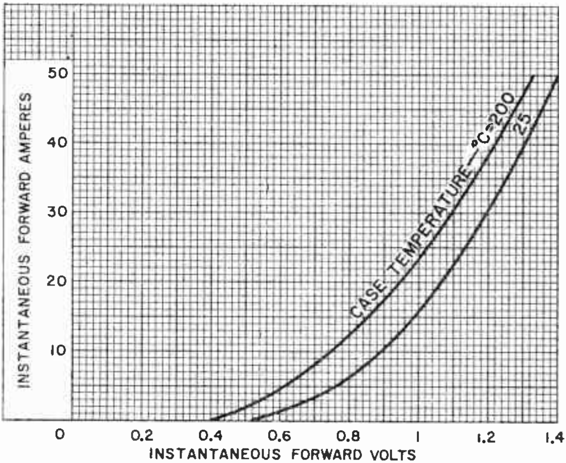
PEAK-SURGE-CURRENT RATING CHART



92CS-11066R1

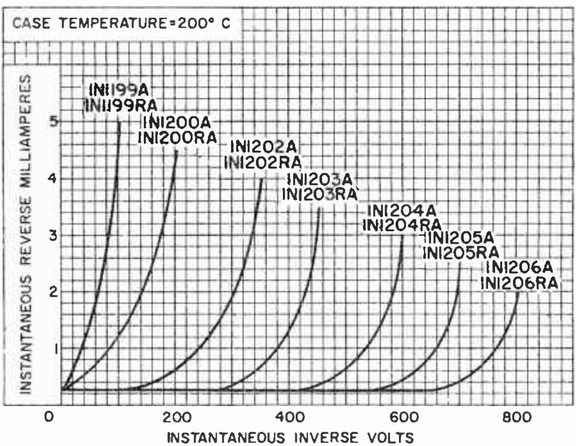
World Radio History

TYPICAL FORWARD CHARACTERISTICS



92CS—11063

TYPICAL REVERSE CHARACTERISTICS



92CS—11064R1

World Radio History

World Radio History

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

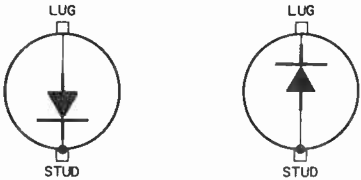
For Industrial and Military Power Supplies

GENERAL DATA

Mechanical:

Operating Position. . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Dimensional Outline . . . . JEDEC No.DO-4
Case. . . . . Metal
Seals . . . . .Hermetic
Terminal Diagrams (See *Dimensional Outline*):

Type 1N1200A *Type 1N1200RA*



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK INVERSE VOLTAGE.	100 max.	volts
TRANSIENT INVERSE VOLTAGE:		
Non-repetitive, for duration of 5-milliseconds maximum.	200 max.	volts
RMS SUPPLY VOLTAGE.	70 max.	volts
DC BLOCKING VOLTAGE	100 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 150° C	12 max.	amp
At other case temperatures. . .	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT.	50 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	240 max.	amp
For one or more cycles.	See *Peak-Surge-Current Rating Chart*	
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +200	°C

World Radio History

1N1200A, 1N1200RA

Characteristics:

Maximum Forward Voltage Drop[b]	0.55	volt
Maximum Reverse Current[b].	2.5	ma
Maximum Thermal Resistance:		
Junction-to-case.	2	°C/watt

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[b] At case temperature of 150° C and maximum-rated voltage and average forward current.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHARTS,
and
CURVES
shown under Types 1N1199A and 1N1199RA also apply to the 1N1200A and 1N1200RA

World Radio History

1N1202A, 1N1202RA

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

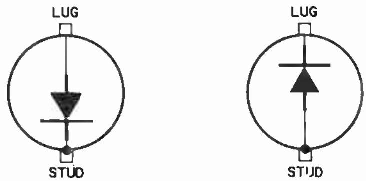
For Industrial and Military Power Supplies

GENERAL DATA

Mechanical:

Operating Position. . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Dimensional Outline . . . . JEDEC No.DO-4
Case. . . . . Metal
Seals . . . . .Hermetic
Terminal Diagrams (See *Dimensional Outline*):

Type 1N1202A *Type 1N1202RA*



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK INVERSE VOLTAGE.	200 max.	volts
TRANSIENT INVERSE VOLTAGE:		
Non-repetitive, for duration of 5-milliseconds maximum.	350 max.	volts
RMS SUPPLY VOLTAGE.	140 max.	volts
DC BLOCKING VOLTAGE	200 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 150° C	12 max.	amp
At other case temperatures. . .	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT.	50 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	240 max.	amp
For one or more cycles.	See *Peak-Surge-Current Rating Chart*	
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +200	°C

Characteristics:

Maximum Forward Voltage Drop[b]	0.55	volt
Maximum Reverse Current[b].	2	ma

Maximum Thermal Resistance:
Junction-to-case. . . . . 2 °C/watt

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[b] At case temperature of 150° C and maximum-rated voltage and average forward current.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHARTS,
and
CURVES
shown under Types 1N1199A and 1N1199RA also apply to the 1N1202A and 1N1202RA

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1N1203A, 1N1203RA

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

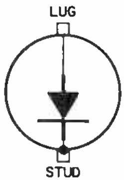
For Industrial and Military Power Supplies

GENERAL DATA

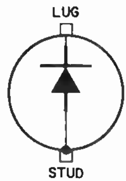
Mechanical:

Operating Position. . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Dimensional Outline . . . . JEDEC No.DO-4
Case. . . . . Metal
Seals . . . . .Hermetic
Terminal Diagrams (See *Dimensional Outline*):

Type 1N1203A



Type 1N1203RA



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK INVERSE VOLTAGE.	300 max.	volts
TRANSIENT INVERSE VOLTAGE:		
Non-repetitive, for duration of 5-milliseconds maximum.	450 max.	volts
RMS SUPPLY VOLTAGE.	212 max.	volts
DC BLOCKING VOLTAGE	300 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 150° C	12 max.	amp
At other case temperatures. . .	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT.	50 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	240 max.	amp
For one or more cycles.	See *Peak-Surge-Current Rating Chart*	
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +200	°C

Characteristics:

Maximum Forward Voltage Drop[b]	0.55	volt
Maximum Reverse Current[b].	1.75	ma

World Radio History

Maximum Thermal Resistance:

Junction-to-case.	2	°C/watt

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[b] At case temperature of 150° C and maximum-rated voltage and average forward current.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHARTS,
and
CURVES
shown under Types 1N1199A and 1N1199RA also apply to the 1N1203A and 1N1203RA

World Radio History

1N1204A, 1N1204RA

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

For Industrial and Military Power Supplies

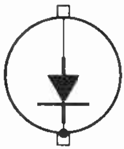
GENERAL DATA

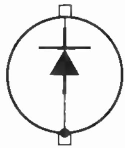
Mechanical:

Operating Position	Any
Dimensions	See *Dimensional Outline*
Dimensional Outline	JEDEC No.DO-4
Case	Metal
Seals	Hermetic

Terminal Diagrams (See *Dimensional Outline*):

Type 1N1204A *Type 1N1204RA*





The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK INVERSE VOLTAGE	400 max.	volts
TRANSIENT INVERSE VOLTAGE:		
Non-repetitive, for duration of 5-milliseconds maximum	600 max.	volts
RMS SUPPLY VOLTAGE	284 max.	volts
DC BLOCKING VOLTAGE	400 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 150° C	12 max.	amp
At other case temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	50 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	240 max.	amp
For one or more cycles	See *Peak-Surge-Current Rating Chart*	
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +200	°C

Characteristics:

Maximum Forward Voltage Drop[b]	0.55	volt
Maximum Reverse Current[b]	1.5	ma

World Radio History

Maximum Thermal Resistance:
Junction-to-case. . . . . 2 °C/watt

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[b] At case temperature of 150° C and maximum-rated voltage and average forward current.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHARTS,
and
CURVES
shown under Types 1N1199A and 1N1199RA also apply to the 1N1204A and 1N1204RA

World Radio History

1N1205A, 1N1205RA

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

For Industrial and Military Power Supplies

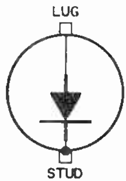
GENERAL DATA

Mechanical:

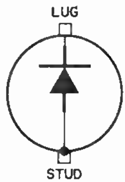
Operating Position	Any
Dimensions	See *Dimensional Outline*
Dimensional Outline	JEDEC No.DO-4
Case	Metal
Seals	Hermetic

Terminal Diagrams (See *Dimensional Outline*):

Type 1N1205A



Type 1N1205RA



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK INVERSE VOLTAGE	500 max.	volts
TRANSIENT INVERSE VOLTAGE:		
Non-repetitive, for duration of 5-milliseconds maximum	700 max.	volts
RMS SUPPLY VOLTAGE	355 max.	volts
DC BLOCKING VOLTAGE	500 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 150° C	12 max.	amp
At other case temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	50 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	240 max.	amp
For one or more cycles	See *Peak-Surge-Current Rating Chart*	
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +200	°C

World Radio History

1N1205A, 1N1205RA

Characteristics:

Maximum Forward Voltage Drop[b]	0.55	volt
Maximum Reverse Current[b]	1.25	ma
Maximum Thermal Resistance:		
Junction-to-case	2	°C/watt

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[b] At case temperature of 150° C and maximum-rated voltage and average forward current.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHARTS,
and
CURVES
shown under Types 1N1199A and 1N1199RA also apply to the
1N1205A and 1N1205RA

World Radio History

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

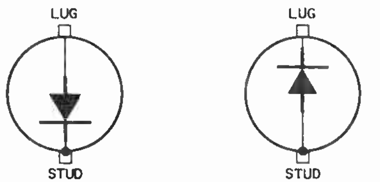
For Industrial and Military Power Supplies

GENERAL DATA

Mechanical:

Operating Position. . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Dimensional Outline . . . . JEDEC No.DO-4
Case. . . . . Metal
Seals . . . . .Hermetic
Terminal Diagrams (See *Dimensional Outline*):

Type 1N1206A *Type 1N1206RA*



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK INVERSE VOLTAGE.	600 max.	volts
TRANSIENT INVERSE VOLTAGE:		
Non-repetitive, for duration of 5-milliseconds maximum.	800 max.	volts
RMS SUPPLY VOLTAGE.	424 max.	volts
DC BLOCKING VOLTAGE	600 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 150° C	12 max.	amp
At other case temperatures . . . See *Average-Forward-Current Rating Chart*		
PEAK RECURRENT CURRENT.	50 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	240 max.	amp
For one or more cycles. . . . . .See *Peak-Surge-Current Rating Chart*		
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +200	°C

Characteristics:

Maximum Forward Voltage Drop[b]	0.55	volt
Maximum Reverse Current[b].	1	ma

World Radio History

Maximum Thermal Resistance:

Junction-to-case.	2	°C/watt

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[b] At case temperature of 150° C and maximum-rated voltage and average forward current.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHARTS,
and
CURVES

shown under Types 1N1199A and 1N1199RA also apply to the 1N1206A and 1N1206RA

World Radio History

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

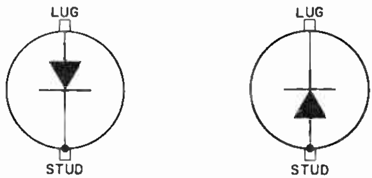
For Industrial and Military Power Supplies

GENERAL DATA

Mechanical:

Operating Position. . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Dimensional Outline . . . . JEDEC No.DO-4
Case. . . . . Metal
Seals . . . . .Hermetic
Terminal Diagrams (See *Dimensional Outline*):

Type 1N1612 *Type 1N1612R*



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK INVERSE VOLTAGE.	50 max.	volts
RMS SUPPLY VOLTAGE.	35 max.	volts
DC BLOCKING VOLTAGE	50 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 135° C	5 max.	amp
At other case temperatures. . . See *Average-Forward-Current Rating Chart*		
PEAK RECURRENT CURRENT.	15 max.	amp
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +175	°C

Characteristics:

Maximum Forward Voltage Drop for dc forward amperes = 10, case temperature (°C) = 25 .	1.5	volts
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle for maximum peak-reverse volts = 50, dc forward amperes = 5, case temperature (°C) = 150).	1	ma
Static (DC value for maximum peak-reverse volts = 50, case temperature (°C) = 25) .	0.01	ma

World Radio History

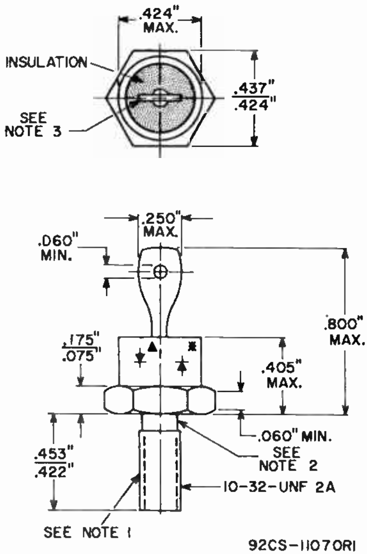
OPERATING CONSIDERATIONS

Because these rectifiers may operate at voltages which are dangerous, care should be taken in the design of equipment to prevent the operator from coming in contact with the rectifier.

The recommended installation torque is 15 to 20 inch-pounds applied to a 10-32 UNF-2B hex nut assembled on stud thread.

The applied torque during installation should not exceed 25 inch-pounds.

JEDEC No. DO-4



NOTE 1: NORMAL INSTALLATION TORQUE IS 15 TO 20 INCH-POUNDS APPLIED TO A 10-32 UNF-2B HEX NUT ASSEMBLED ON STUD THREADS. UNDER NO CIRCUMSTANCES SHOULD THIS VALUE EXCEED 25 INCH-POUNDS.

NOTE 2: DIAMETER OF UNTHREADED PORTION: D.189" MAXIMUM, D.163" MINIMUM.

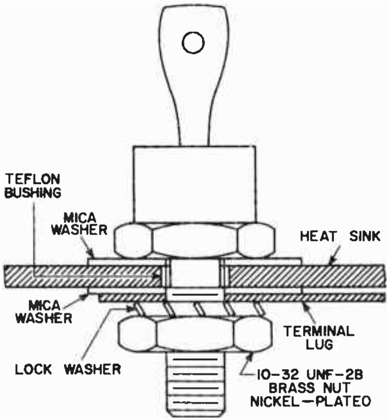
NOTE 3: ANGULAR ORIENTATION OF THIS TERMINAL UNDEFINED.

▲ Polarity symbol for types 1N1612, 1N1613, 1N1614, 1N1615, and 1N1616.

* Polarity symbol for types 1N1612R, 1N1613R, 1N1614R, 1N1615R, and 1N1616R.

World Radio History

SUGGESTED MOUNTING ARRANGEMENT



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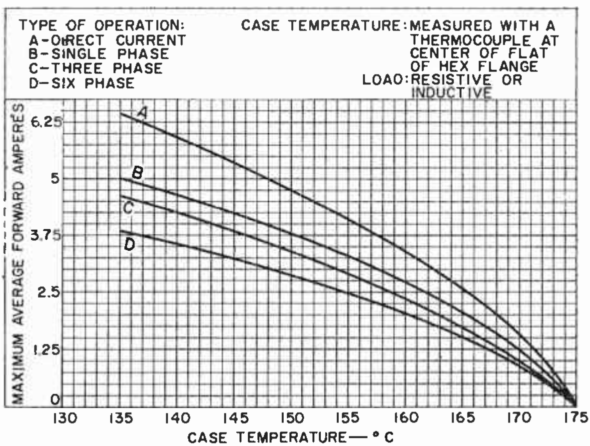
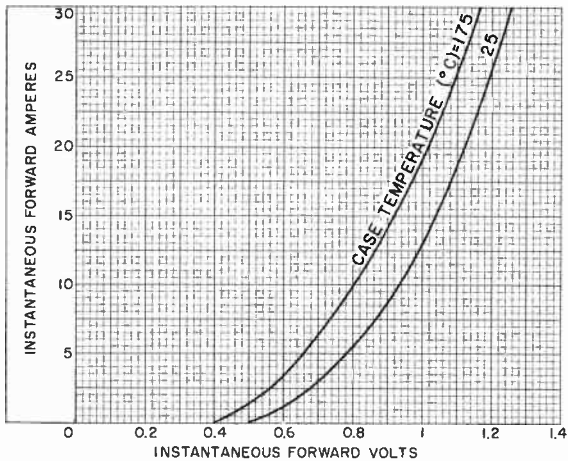
AVERAGE-FORWARD-CURRENT RATING CHART



92CS-11295

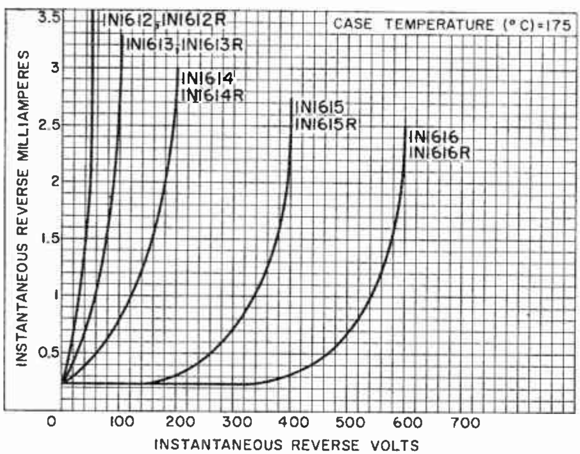
World Radio History

TYPICAL FORWARD CHARACTERISTICS



92CS-11296

TYPICAL REVERSE CHARACTERISTICS



92CS-11297

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

For Industrial and Military Power Supplies

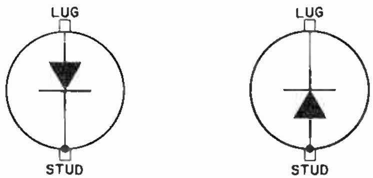
GENERAL DATA

Mechanical:

Operating Position	Any
Dimensions	See *Dimensional Outline*
Dimensional Outline	JEDEC No.DO-4
Case	Metal
Seals	Hermetic

Terminal Diagrams (See *Dimensional Outline*):

Type 1N1613 *Type 1N1613R*



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK INVERSE VOLTAGE	100 max.	volts
RMS SUPPLY VOLTAGE	70 max.	volts
DC BLOCKING VOLTAGE	100 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 135° C	5 max.	amp
At other case temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	15 max.	amp
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +175	°C

Characteristics:

Maximum Forward Voltage Drop for dc forward amperes = 10, case temperature (°C) = 25	1.5	volts
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle for maximum peak-reverse volts = 100, dc forward amperes = 5, case temperature (°C) = 150)	1	ma
Static (DC value for maximum peak-reverse volts = 100, case temperature (°C) = 25)	0.01	ma

World Radio History

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHART,
and
CURVES
shown under Types 1N1612 and 1N1612R also apply to the
1N1613 and 1N1613R

World Radio History

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

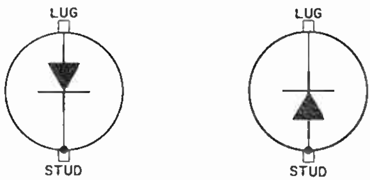
For Industrial and Military Power Supplies

GENERAL DATA

Mechanical:

Operating Position	Any
Dimensions	See *Dimensional Outline*
Dimensional Outline	JEDEC No.DO-4
Case	Metal
Seals	Hermetic

Terminal Diagrams (See *Dimensional Outline*):



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK INVERSE VOLTAGE	200 max.	volts
RMS SUPPLY VOLTAGE	140 max.	volts
DC BLOCKING VOLTAGE	200 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 135° C	5 max.	amp
At other case temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	15 max.	amp
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +175	°C

Characteristics:

Maximum Forward Voltage Drop for dc forward amperes = 10, case temperature (°C) = 25	1.5	volts
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle for maximum peak-reverse volts = 200, dc forward amperes = 5, case temperature (°C) = 150)	1	ma
Static (DC value for maximum peak-reverse volts = 200, case temperature (°C) = 25)	0.01	ma

World Radio History

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHART,
and
CURVES
shown under Types 1N1612 and 1N1612R also apply to the
1N1614 and 1N1614R

World Radio History

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

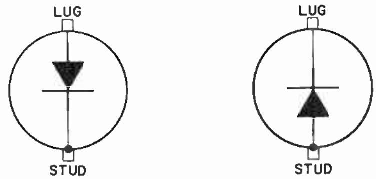
For Industrial and Military Power Supplies

GENERAL DATA

Mechanical:

Operating Position. Any
Dimensions. . . . . See *Dimensional Outline*
Dimensional Outline . . . . JEDEC No.DO-4
Case. . . . . Metal
Seals . . . . .Hermetic
Terminal Diagrams (See *Dimensional Outline*):

Type 1N1615 *Type 1N1615R*



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK INVERSE VOLTAGE.	400 max.	volts
RMS SUPPLY VOLTAGE.	280 max.	volts
DC BLOCKING VOLTAGE	400 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 135° C	5 max.	amp
At other case temperatures. . . See *Average-Forward-Current Rating Chart*		
PEAK RECURRENT CURRENT.	15 max.	amp
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +175	°C

Characteristics:

Maximum Forward Voltage Drop for dc forward amperes = 10, case temperature (°C) = 25.	1.5	volts
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle for maximum peak-reverse volts = 400, dc forward amperes = 5, case temperature (°C) = 150)	1	ma
Static (DC value for maximum peak-reverse volts = 400, case temperature (°C) = 25)	0.01	ma

World Radio History

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHART,
and
CURVES
shown under Types 1N1612 and 1N1612R also apply to the
1N1615 and 1N1615R

World Radio History

Silicon Rectifiers

DIFFUSED-JUNCTION TYPES

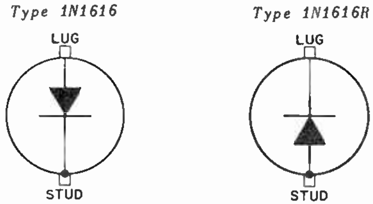
For Industrial and Military Power Supplies

GENERAL DATA

Mechanical:

Operating Position	Any
Dimensions	See *Dimensional Outline*
Dimensional Outline	JEDEC No.DO-4
Case	Metal
Seals	Hermetic

Terminal Diagrams (See *Dimensional Outline*):



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

For power-supply frequency of 60 cps, single-phase operation, and with resistive or inductive load

PEAK INVERSE VOLTAGE	600 max.	volts
RMS SUPPLY VOLTAGE	420 max.	volts
DC BLOCKING VOLTAGE	600 max.	volts
AVERAGE FORWARD CURRENT:		
At case temperature of 135° C	5 max.	amp
At other case temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	15 max.	amp
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +175	°C

Characteristics:

Maximum Forward Voltage Drop for dc forward amperes = 10, case temperature (°C) = 25	1.5	volts
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle for maximum peak-reverse volts = 600, dc forward amperes = 5, case temperature (°C) = 150)	1	ma
Static (DC value for maximum peak-reverse volts = 600, case temperature (°C) = 25)	0.01	ma

World Radio History

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHART,
and
CURVES
shown under Types 1N1612 and 1N1612R also apply to the
1N1616 and 1N1616R

World Radio History

Tunnel Diode

GERMANIUM TYPE

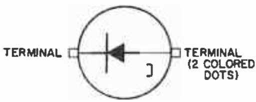
A Low-Current Type for Applications Employing Clock (Pulse-Repetition) Rates up to 100 Mc with Typical Switching Times of 2 Millimicroseconds or Less

GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	0.265"
Maximum Width	0.140"
Maximum Height	0.055"
Case	Metal and Ceramic
Colored Dots for Device Identification (See *Dimensional Outline*)	Red and Gray

Terminal Diagram (See *Dimensional Outline*):



The arrow indicates direction of forward current flow as indicated by dc ammeter.

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

INSTANTANEOUS FORWARD CURRENT	100 max.	ma
INSTANTANEOUS REVERSE CURRENT	200 max.	ma
DISSIPATION:▲		
At ambient temperature of 25° C	40 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating	-65 to +150	°C
Storage	-65 to +175	°C
CASE TEMPERATURE:		
For immersion in molten solder for 10 seconds maximum	275 max.	°C

Electrical Characteristics:

At ambient temperature of 25° C

		Min.	*Typical*	*Max.*	
Static:●					
Peak-Point Current	I_P	4.75	5	5.25	ma
Valley-Point Current	I_V	–	0.45	0.6	ma
Peak-Point-to-Valley-Point Current Ratio	I_P/I_V	8/1	11/1	–	
Peak-Point Voltage	V_P	45	–	65	mv
Valley-Point Voltage	V_V	280	–	330	mv
Positive Voltage at peak-point ma. = 5.25	V_F'	445	–	485	mv

World Radio History

		Min.	*Typical*	*Max.*	
Dynamic:★					
Terminal Valley-Point Capacitance⧫.	C	-	7	15	μμf
Total Series Inductance .	L_S	-	-	0.6	mμh
Total Series Resistance .	R_S	-	-	1.5	ohms
Negative Resistance ($-R_D$) of intrinsic Diode measured at inflection point of negative-resistance characteristic.	$-R_{Dm}$	-	22	-	ohms
Dissipation with diode switched to its high-voltage state ($V = V_F$, and $I = I_{Pmax}$).	P_{OPR}	-	2.5	-	mw
Rise Time♦.	t_r	-	-	5	mμsec
Figure of Merit	I_P/C_{max}	-	0.33	-	ma/μμf

▲ Derate linearly to 0 milliwatts at 150° C.

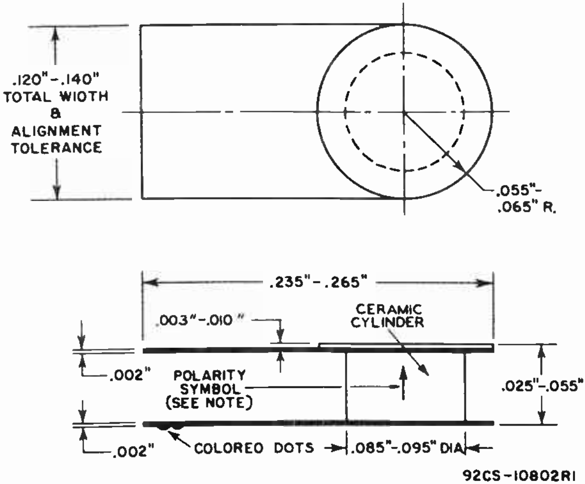
● See accompanying *Static-Forward-Characteristic* diagram.

★ See accompanying *Equivalent Circuit of a Tunnel Diode in the Negative-Resistance Region.*

⧫ At measured I_V for individual diode and includes case capacitance of 0.3 μμf.

♦ The time required for the forward voltage to rise from V_P + 0.1 (V_F - V_P) to V_P + 0.9 (V_F - V_P). For 20 per cent overdrive (dc forward voltage and driving pulse provided by constant-current sources).

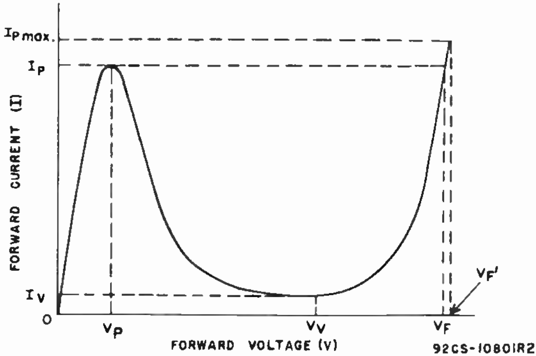
World Radio History



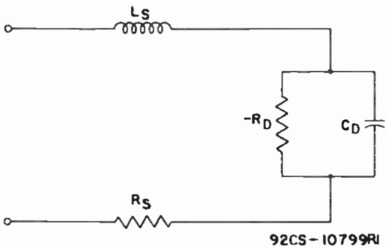
NOTE: ARROW INDICATES DIRECTION OF FORWARD CURRENT FLOW AS INDICATED BY DC AMMETER.

World Radio History

STATIC FORWARD CHARACTERISTIC
OF A TUNNEL DIODE



EQUIVALENT CIRCUIT OF A TUNNEL DIODE
IN THE NEGATIVE-RESISTANCE REGION



L_S = TOTAL SERIES INDUCTANCE
R_S = TOTAL SERIES RESISTANCE
$-R_D$ = NEGATIVE RESISTANCE OF INTRINSIC DIODE
C_D = BARRIER CAPACITANCE OF INTRINSIC DIODE

World Radio History

Tunnel Diode

GERMANIUM TYPE

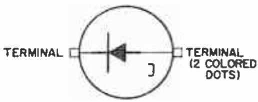
An Intermediate-Speed Type for Applications Employing Clock (Pulse-Repetition) Rates up to 500 Mc with Typical Switching Times of 1/2 Millimicrosecond or Less

GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	0.265"
Maximum Width	0.140"
Maximum Height	0.055"
Case	Metal and Ceramic
Colored Dots for Device Identification (See *Dimensional Outline*)	Red and White

Terminal Diagram (See *Dimensional Outline*):



The arrow indicates direction of forward current flow as indicated by dc ammeter.

SWITCHING SERVICE

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

INSTANTANEOUS FORWARD CURRENT	100 max.	ma
INSTANTANEOUS REVERSE CURRENT	200 max.	ma
DISSIPATION:▲		
At ambient temperature of 25° C	40 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating	-65 to +150	°C
Storage	-65 to +175	°C
CASE TEMPERATURE:		
For immersion in molten solder for 10 seconds maximum	275 max.	°C

Electrical Characteristics:

At ambient temperature of 25° C

		Min.	Typical	Max.	
Static:●					
Peak-Point Current	I_P	19	20	21	ma
Valley-Point Current	I_V	–	1.8	2.4	ma
Peak-Point-to-Valley-Point Current Ratio	I_P/I_V	8/1	11/1	–	
Peak-Point Voltage	V_P	65	–	90	mv
Valley-Point Voltage	V_V	300	–	360	mv
Positive Voltage at peak-point ma. = 21	V_F'	500	–	550	mv

World Radio History

1N3129

		Min.	Typical	Max.	
Dynamic:★					
Terminal Valley-Point Capacitance⧫.	C	–	10	20	$\mu\mu$f
Total Series Inductance .	L_S	–	–	0.6	mμh
Total Series Resistance .	R_S	–	–	1.5	ohms
Negative Resistance ($-R_D$) of Intrinsic Diode measured at inflection point of negative-resistance characteristic	$-R_{D_m}$	–	6	–	ohms
Dissipation with diode switched to its high-voltage state ($V = V_F$, and $I = I_{Pmax}$).	P_{OPR}	–	12	–	mw
Rise Time.	t_r	–	–	2	mμsec
Figure of Merit	I_P/C_{max}	–	1	–	ma/$\mu\mu$f

▲ Derate linearly to 0 milliwatts at 150° C.

● See accompanying *Static-Forward-Characteristic* diagram.

★ See accompanying *Equivalent Circuit of a Tunnel Diode in the Negative-Resistance Region.*

⧫ At measured I_V for individual diode and includes case capacitance of 0.3 $\mu\mu$f.

The time required for the forward voltage to rise from $V_P + 0.1(V_F - V_P)$ to $V_P + 0.9(V_F - V_P)$. For 20 per cent overdrive (dc forward voltage and driving pulse provided by constant-current sources).

DIMENSIONAL OUTLINE,

STATIC FORWARD CHARACTERISTIC
OF A TUNNEL DIODE,

and

EQUIVALENT CIRCUIT OF A TUNNEL DIODE
IN THE NEGATIVE-RESISTANCE REGION

shown under Type 1N3128 also apply to the 1N3129

World Radio History

1N3130

Tunnel Diode

GERMANIUM TYPE

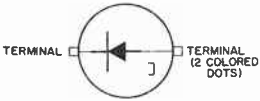
An Ultra-High-Speed Type for Applications Employing Clock (Pulse-Repetition) Rates up to 1000 Mc with Typical Switching Times of 1/5 Millimicrosecond or Less

GENERAL DATA

Mechanical:

Operating Position.	Any
Maximum Overall Length.	0.265"
Maximum Width	0.140"
Maximum Height.	0.055"
Case.	Metal and Ceramic
Colored Dots for Device Identification (See *Dimensional Outline*).	Orange and Green

Terminal Diagram (See *Dimensional Outline*):



The arrow indicates direction of forward current flow as indicated by dc ammeter.

SWITCHING SERVICE

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

INSTANTANEOUS FORWARD CURRENT.	100 max.	ma
INSTANTANEOUS REVERSE CURRENT.	200 max.	ma
DISSIPATION:▲		
At ambient temperature of 25° C.	40 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating.	-65 to +150	°C
Storage.	-65 to +175	°C
CASE TEMPERATURE:		
For immersion in molten solder for 10 seconds maximum	275 max.	°C

Electrical Characteristics:

At ambient temperature of 25° C

		Min.	*Typical*	*Max.*	
Static:●					
Peak-Point Current. . . .	I_P	47.5	50	52.5	ma
Valley-Point Current. . .	I_V	-	4.5	6	ma
Peak-Point-to-Valley-Point Current Ratio. . .	I_P/I_V	8/1	11/1	-	
Peak-Point Voltage. . . .	V_P	90	-	120	mv
Valley-Point Voltage. . .	V_V	350	-	430	mv
Positive Voltage at peak-point ma. = 52.5.	V_F'	540	-	600	mv

World Radio History

		Min.	Typical	Max.	
Dynamic:★					
Terminal Valley-Point Capacitance♦.	C	–	12	25	μμf
Total Series Inductance.	L_S	–	–	0.6	mμh
Total Series Resistance.	R_S	–	–	1.2	ohms
Negative Resistance ($-R_D$) of Intrinsic Diode measured at inflection point of negative-resistance characteristic. . . .	$-R_{Dm}$	–	2.4	–	ohms
Dissipation with diode switched to its high-voltage state ($V = V_F$' and $I = I_{Pmax}$). . . .	P_{OPR}	–	32	–	mw
Rise Time♦.	t_r	–	–	0.5	mμsec
Figure of Merit	I_P/C_{max}	–	2	–	ma/μμf

▲ Derate linearly to 0 milliwatts at 150° C.

● See accompanying *Static-Forward-Characteristic* diagram.

★ See accompanying *Equivalent Circuit of a Tunnel Diode in the Negative-Resistance Region.*

♦ At measured I_V for individual diode and includes case capacitance of 0.3 μμf.

♦ The time required for the forward voltage to rise from V_P + 0.1 (V_F-V_P) to V_P + 0.9 (V_F-V_P). For 20 per cent overdrive (dc forward voltage and driving pulse provided by constant-current sources).

DIMENSIONAL OUTLINE,

STATIC FORWARD CHARACTERISTIC
OF A TUNNEL DIODE,

and

EQUIVALENT CIRCUIT OF A TUNNEL DIODE
IN THE NEGATIVE-RESISTANCE REGION

shown under Type 1N3128 also apply to the 1N3130

World Radio History

Tunnel Diode

GALLIUM-ARSENIDE TYPE

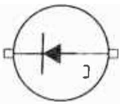
A High-Speed Type for Use as a Switching Device in Digital-Pulse Circuits and Memory Matrices, and in Other Applications Requiring Switching Times of 1/2 Millimicrosecond or Less and Clock (Pulse-Repetition) Rates up to 1000 Mc

GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	0.265"
Maximum Width	0.140"
Maximum Height	0.055"
Case	Metal and Ceramic
Colored Dots for Device Identification (See *Dimensional Outline*)	Yellow and Black

Terminal Diagram (See *Dimensional Outline*):



The arrow indicates direction of forward current flow as indicated by dc ammeter.

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

INSTANTANEOUS FORWARD CURRENT	100 max.	ma
INSTANTANEOUS REVERSE CURRENT	200 max.	ma
DISSIPATION:▲		
At ambient temperature of 25° C	75 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating	-65 to +150	°C
Storage	-65 to +175	°C
CASE TEMPERATURE:		
For immersion in molten solder for 10 seconds maximum	275 max.	°C

Electrical Characteristics:

At ambient temperature of 25° C

		Min.	*Typical*	*Max.*	
Static:●					
Peak-Point Current	I_P	47.5	50	52.5	ma
Valley-Point Current	I_V	-	2.5	3.5	ma
Peak-Point-to-Valley-Point Current Ratio	I_P/I_V	13/1	20/1	-	
Peak-Point Voltage	V_P	120	-	260	mv
Valley-Point Voltage	V_V	510	-	620	mv

World Radio History

		Min.	Typical	Max.	
Positive Voltage at peak-point ma. = 52.5. . . .	$V_{F'}$	1100	-	1400	mv
Dynamic:★					
Terminal Valley-Point Capacitance⧫.	C	-	10	30	μμf
Total Series Inductance .	L_S	-	-	0.6	mμh
Total Series Resistance .	R_S	-	-	2.6	ohms
Negative Resistance ($-R_D$) of Intrinsic Diode measured at inflection point of negative-resistance characteristic	$-R_{Dm}$	-	2.6	-	ohms
Dissipation with diode switched to its high-voltage state ($V = V_{F'}$ and $I = I_{Pmax}$).	P_{OPR}	-	73	-	mw
Rise Time●.	t_r	-	-	2	mμsec
Figure of Merit	$I_P/2C_{max}$	-	0.9	-	ma/μμf

▲ Derate linearly to 0 milliwatts at 150° C.

● See accompanying *Static-Forward-Characteristic* diagram.

★ See accompanying *Equivalent Circuit of a Tunnel Diode in the Negative-Resistance Region.*

⧫ At measured I_V for individual diode and includes case capacitance of 0.3 μμf.

● The time required for the forward voltage to rise from $V_P + 0.1(V_F - V_P)$ to $V_P + 0.9(V_F - V_P)$. For 20 per cent overdrive (dc forward voltage and driving pulse provided by constant-current sources).

DIMENSIONAL OUTLINE,
STATIC FORWARD CHARACTERISTIC
OF A TUNNEL DIODE,
and
EQUIVALENT CIRCUIT OF A TUNNEL DIODE
IN THE NEGATIVE-RESISTANCE REGION
shown under Type 1N3128 also apply to the 1N3138

World Radio History

Silicon Rectifier

DIFFUSED-JUNCTION TYPE

For Industrial and Consumer-Product Applications

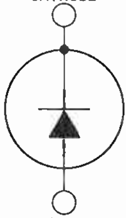
See also Insulated-Version Type 1N3253

GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.405"
Maximum Diameter	0.240"
Case	Metal
Seals	Hermetic
Leads, Flexible	2
Minimum length	1.4"
Diameter	0.027" to 0.035"
Orientation	See *Dimensional Outline*

Terminal Diagram:



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps

	For resistive or inductive load	*For capacitive-input filter*	
PEAK INVERSE VOLTAGE	200 max.	200 max.	volts
RMS SUPPLY VOLTAGE	140 max.	70 max.	volts
FORWARD CURRENT:[a]			
DC	750 max.	500 max.	ma
Peak recurrent	-	6 max.	amp
Surge, for "turn-on" time of 2 milliseconds	-	35 max.	amp
AMBIENT-TEMPERATURE RANGE:			
Operating	-65 to +100		°C
Storage	-65 to +175		°C

World Radio History

LEAD TEMPERATURE:

For 10 seconds maximum.	255 max.	°C

Characteristics:

At ambient temperature of 25° C

Minimum Instantaneous Forward Voltage Drop at dc forward amperes = 0.5.	1.2	volts
Maximum Reverse Current at maximum peak inverse voltage.	10	μa

[a] At ambient temperatures up to 75° C. At ambient temperatures above 75° C see *Rating Chart*.

OPERATING CONSIDERATIONS

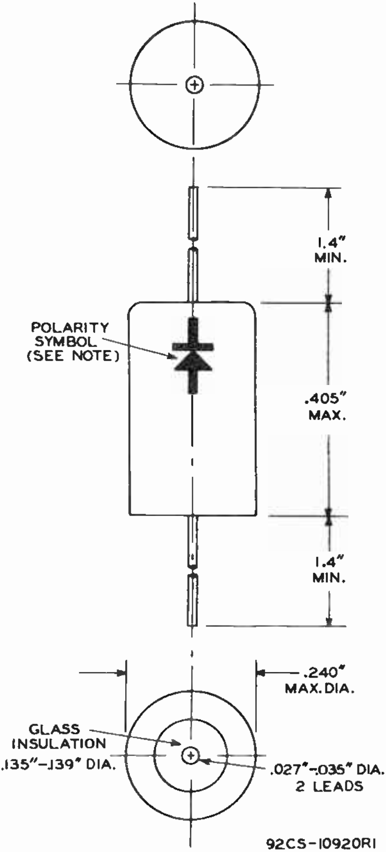
A *surge-limiting impedance* should always be used in series with the rectifier. The impedance value must be sufficient to limit the surge current to the value specified under the maximum ratings. This impedance may be provided by the power-transformer windings, or by an external resistor or choke.

The *flexible leads* of this rectifier are usually soldered to the circuit elements. It is desirable in all soldering operations to provide some slack or an expansion elbow in the leads to prevent excessive tension on the leads. It is important during the soldering operation to avoid excessive heat in order to prevent possible damage to the rectifier. To absorb some of the heat, grip the flexible lead of the rectifier between the case and the soldering point with a pair of pliers.

When dip soldering is employed in the assembly of printed circuitry using this rectifier, the leads should not be dip soldered within 0.5" of the metal case.

Because the case of this rectifier may operate at voltages which are dangerous, care should be taken in the design of equipment to prevent the operator from coming in contact with the rectifier. It is recommended that this rectifier be mounted on the underside of the chassis.

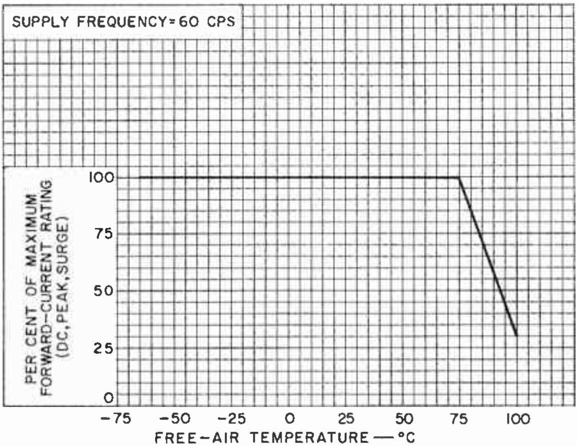
World Radio History



NOTE: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

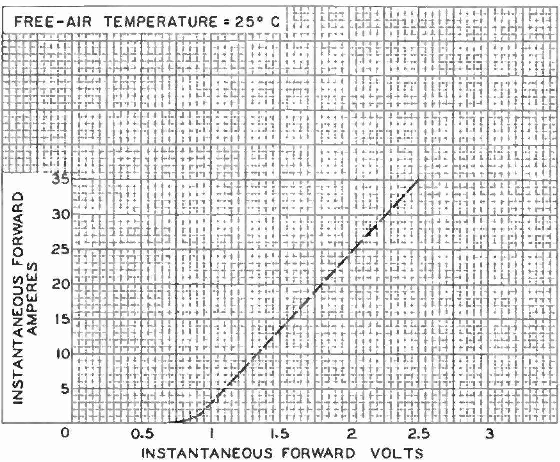
World Radio History

RATING CHART



92CS-9727R2

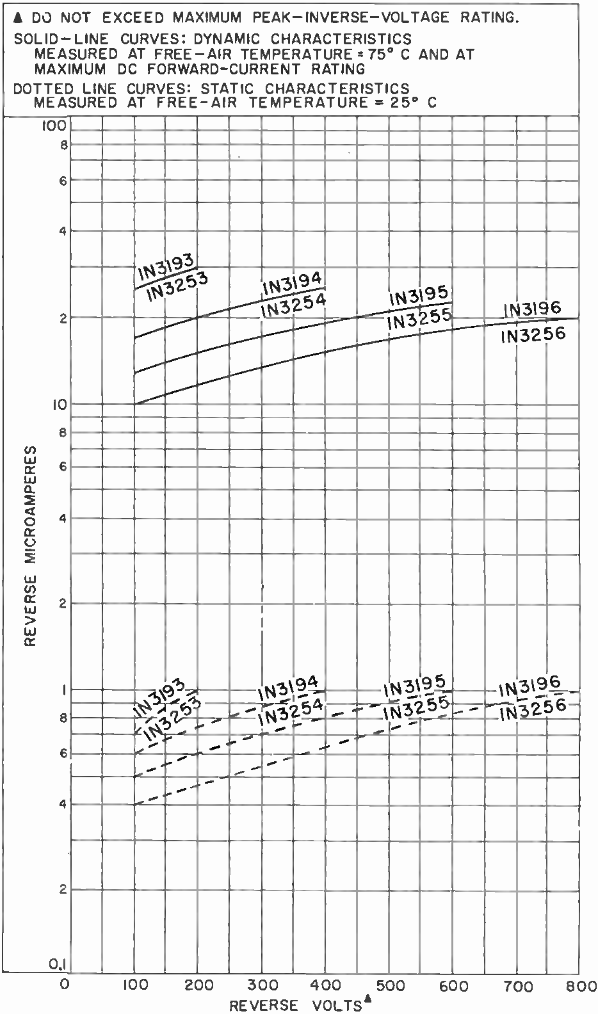
TYPICAL FORWARD CHARACTERISTIC



92CS-9730R2

World Radio History

TYPICAL REVERSE CHARACTERISTICS



92CM-10921R1

World Radio History

World Radio History

Silicon Rectifier

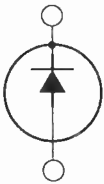
DIFFUSED-JUNCTION TYPE

For Industrial and Consumer-Product Applications

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.405"
Maximum Diameter	0.240"
Case	Metal
Seals	Hermetic
Leads, Flexible	2
Minimum length	1.4"
Diameter	0.027" to 0.035"
Orientation	See *Dimensional Outline*

Terminal Diagram:



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

For power-supply frequency of 60 cps

	For resistive or inductive load	*For capacitive-input filter*	
PEAK INVERSE VOLTAGE	200 max.	200 max.	volts
RMS SUPPLY VOLTAGE	140 max.	70 max.	volts
FORWARD CURRENT:[a]			
DC	750 max.	500 max.	ma
Peak recurrent	-	6 max.	amp
Surge, for "turn-on" time of 2 milliseconds	-	35 max.	amp
AMBIENT-TEMPERATURE RANGE:			
Operating	-65 to +100		°C
Storage	-65 to +175		°C
LEAD TEMPERATURE:			
For 10 seconds maximum	255 max.		°C

World Radio History

Characteristics:

At ambient temperature of 25° C

Minimum Instantaneous Forward Voltage Drop at dc forward amperes = 0.5	1.2	volts
Maximum Reverse Current at maximum peak inverse voltage	10	μa

[a] At ambient temperatures up to 75° C. At ambient temperatures above 75° C see *Rating Chart*.

OPERATING CONSIDERATIONS

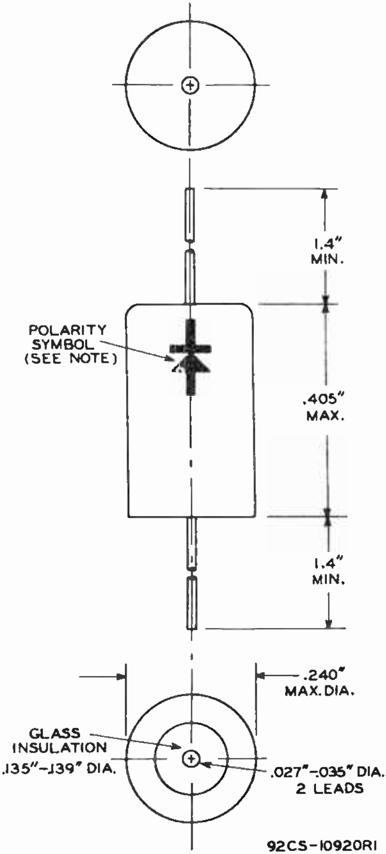
A *surge-limiting impedance* should always be used in series with the rectifier. The impedance value must be sufficient to limit the surge current to the value specified under the maximum ratings. This impedance may be provided by the power-transformer windings, or by an external resistor or choke.

The *flexible leads* of this rectifier are usually soldered to the circuit elements. It is desirable in all soldering operations to provide some slack or an expansion elbow in the leads to prevent excessive tension on the leads. It is important during the soldering operation to avoid excessive heat in order to prevent possible damage to the rectifier. To absorb some of the heat, grip the flexible lead of the rectifier between the case and the soldering point with a pair of pliers.

When dip soldering is employed in the assembly of printed circuitry using this rectifier, the leads should not be dip soldered within 0.5" of the metal case.

Because the case of this rectifier may operate at voltages which are dangerous, care should be taken in the design of equipment to prevent the operator from coming in contact with the rectifier. It is recommended that this rectifier be mounted on the underside of the chassis.

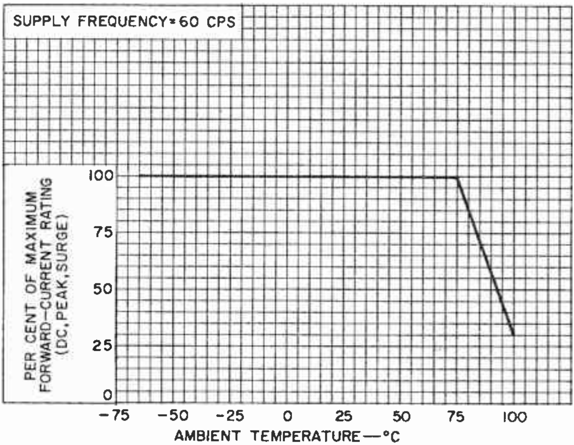
WorldRadioHistory



NOTE: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

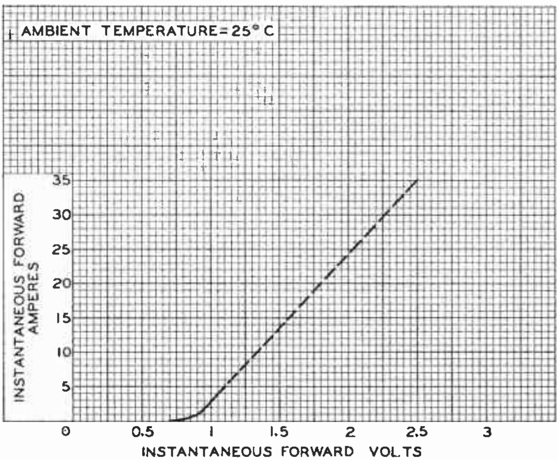
World Radio History

RATING CHART



92CS-9727R1

TYPICAL FORWARD CHARACTERISTIC



92CS-9730

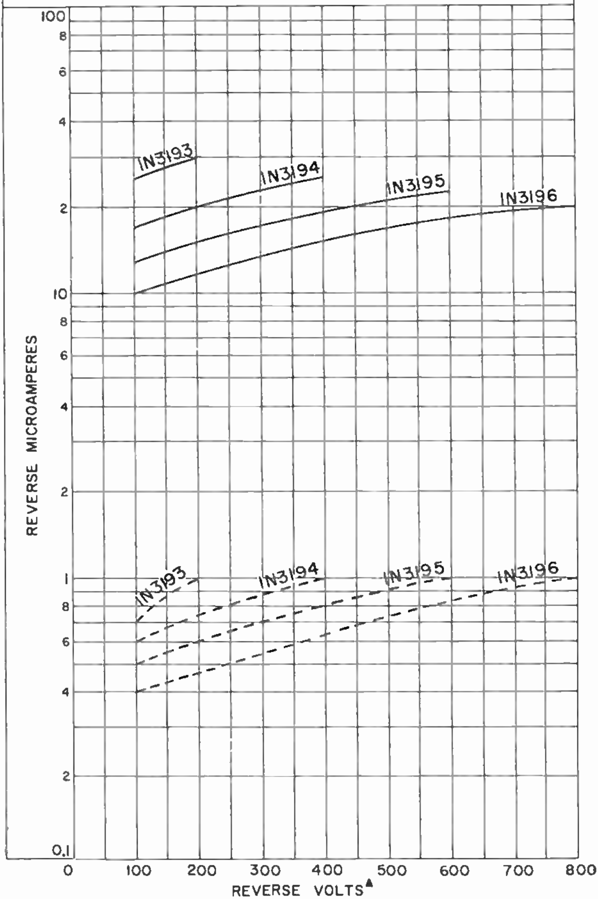
World Radio History

TYPICAL REVERSE CHARACTERISTICS

▲ DO NOT EXCEED MAXIMUM PEAK-INVERSE-VOLTAGE RATING.

SOLID-LINE CURVES: DYNAMIC CHARACTERISTICS MEASURED AT AMBIENT TEMPERATURE = 75° C AND AT MAXIMUM DC-FORWARD-CURRENT RATING

DOTTED LINE CURVES: STATIC CHARACTERISTICS MEASURED AT AMBIENT TEMPERATURE = 25° C



92CM-10921

World Radio History

World Radio History

Silicon Rectifier

DIFFUSED-JUNCTION TYPE

For Industrial and Consumer-Product Applications

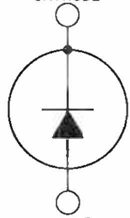
See also Insulated-Version Type 1N3254

GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.405"
Maximum Diameter	0.240"
Case	Metal
Seals	Hermetic
Leads, Flexible	2
Minimum length	1.4"
Diameter	0.027" to 0.035"
Orientation	See *Dimensional Outline*

Terminal Diagram:



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps

	For resistive or inductive load	*For capacitive-input filter*	
PEAK INVERSE VOLTAGE	400 max.	400 max.	volts
RMS SUPPLY VOLTAGE	280 max.	140 max.	volts
FORWARD CURRENT:[a]			
DC	750 max.	500 max.	ma
Peak recurrent	-	6 max.	amp
Surge, for "turn-on" time of 2 milliseconds	-	35 max.	amp
AMBIENT-TEMPERATURE RANGE:			
Operating	-65 to +100		°C
Storage	-65 to +175		°C

World Radio History

LEAD TEMPERATURE:

For 10 seconds maximum.	255 max.	°C

Characteristics:

At ambient temperature of 25° C

Minimum Instantaneous Forward Voltage Drop at dc forward amperes = 0.5.	1.2	volts
Maximum Reverse Current at maximum peak inverse voltage.	10	μa

[a] At ambient temperatures up to 75° C. At ambient temperatures above 75° C see *Rating Chart*.

OPERATING CONSIDERATIONS

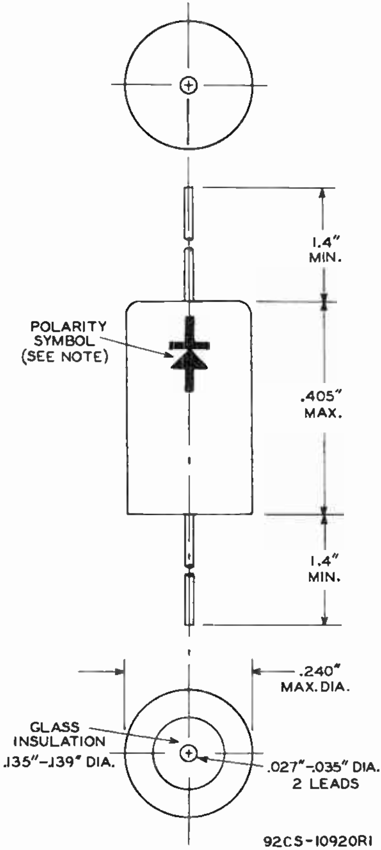
A *surge-limiting impedance* should always be used in series with the rectifier. The impedance value must be sufficient to limit the surge current to the value specified under the maximum ratings. This impedance may be provided by the power-transformer windings, or by an external resistor or choke.

The *flexible leads* of this transistor are usually soldered to the circuit elements. It is desirable in all soldering operations to provide some slack or an expansion elbow in the leads to prevent excessive tension on the leads. It is important during the soldering operation to avoid excessive heat in order to prevent possible damage to the rectifier. To absorb some of the heat, grip the flexible lead of the rectifier between the case and the soldering point with a pair of pliers.

When dip soldering is employed in the assembly of printed circuitry using this rectifier, the leads should not be dip soldered within 0.5" of the metal case.

Because the case of this rectifier may operate at voltages which are dangerous, care should be taken in the design of equipment to prevent the operator from coming in contact with the rectifier. It is recommended that this rectifier be mounted on the underside of the chassis.

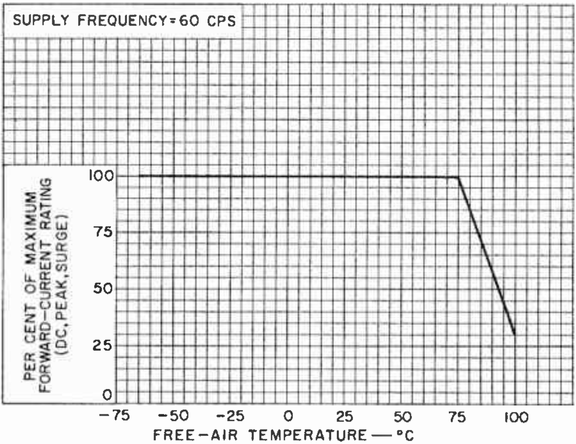
World Radio History



NOTE: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

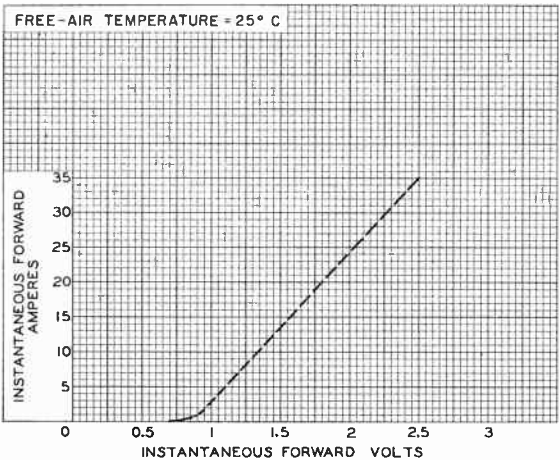
World Radio History

RATING CHART



92CS-9727R2

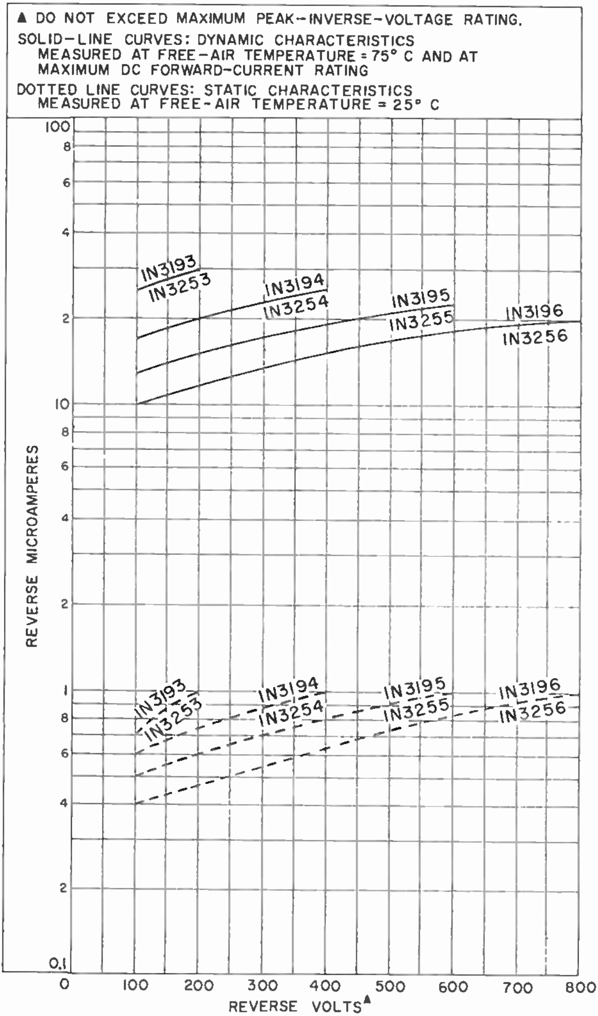
TYPICAL FORWARD CHARACTERISTIC



92CS-9730R2

World Radio History

TYPICAL REVERSE CHARACTERISTICS

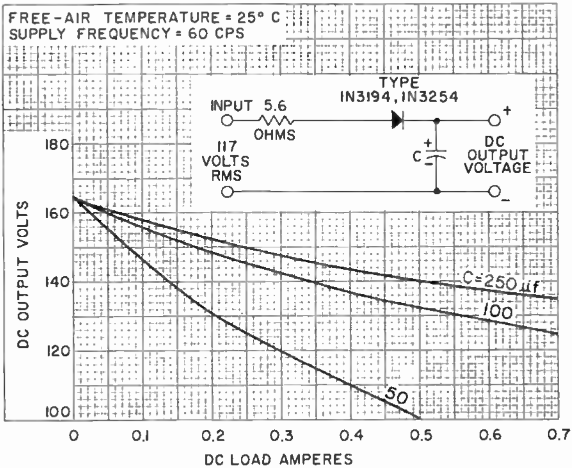


92CM-10921R1

World Radio History

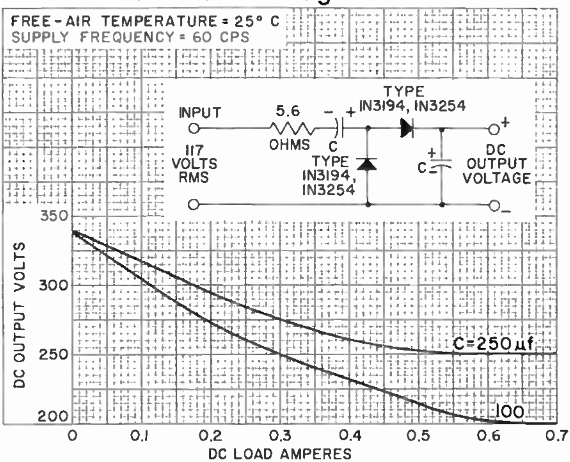
TYPICAL OPERATION CHARACTERISTICS

Half-Wave Rectifier



92CS-10917R1

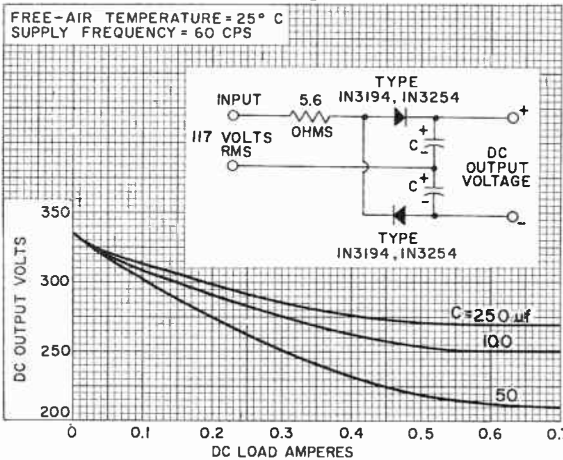
Half-Wave Voltage Doubler



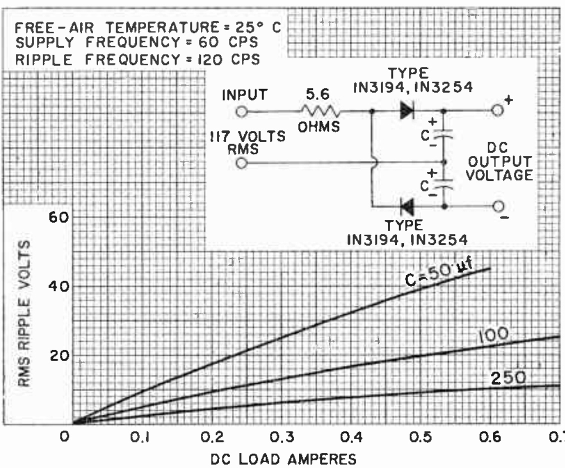
92CS-10916R1

World Radio History

TYPICAL OPERATION CHARACTERISTICS
Full-Wave Voltage Doubler



92CS-10918R1



92CS-10919R1

World Radio History

World Radio History

Silicon Rectifier

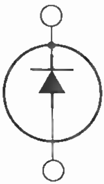
DIFFUSED-JUNCTION TYPE

For Industrial and Consumer-Product Applications

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.405"
Maximum Diameter	0.240"
Case	Metal
Seals	Hermetic
Leads, Flexible	2
Minimum length	1.4"
Diameter	0.027" to 0.035"
Orientation	See *Dimensional Outline*

Terminal Diagram:



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

For power-supply frequency of 60 cps

	For resistive or inductive load	*For capacitive-input filter*	
PEAK INVERSE VOLTAGE	400 max.	400 max.	volts
RMS SUPPLY VOLTAGE	280 max.	140 max.	volts
FORWARD CURRENT:[a]			
DC	750 max.	500 max.	ma
Peak recurrent	–	6 max.	amp
Surge, for "turn-on" time of 2 milliseconds	–	35 max.	amp
AMBIENT-TEMPERATURE RANGE:			
Operating	-65 to +100		°C
Storage	-65 to +175		°C
LEAD TEMPERATURE:			
For 10 seconds maximum	255 max.		°C

[a] At ambient temperatures up to 75° C. At ambient temperatures above 75° C see *Rating Chart*.

World Radio History

1N3194

Characteristics:

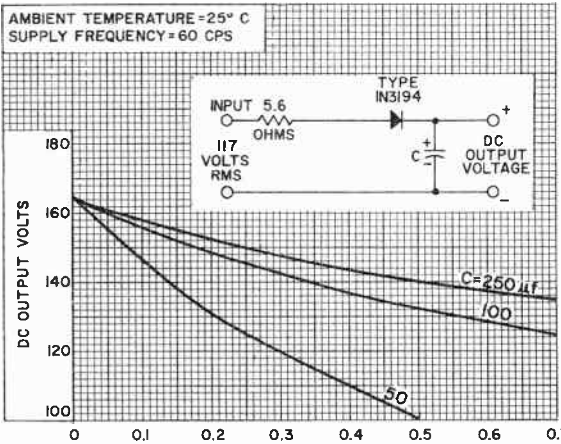
At ambient temperature of 25° C

Maximum Instantaneous Forward Voltage Drop at dc forward amperes = 0.5	1.2	volts
Maximum Reverse Current at maximum peak inverse voltage	10	μa

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE.
RATING CHART,
TYPICAL-FORWARD-CHARACTERISTIC CURVE,
and
TYPICAL-REVERSE-CHARACTERISTICS CURVE
(Given on multitype curve sheet)
shown under Type 1N3193 also apply to the 1N3194

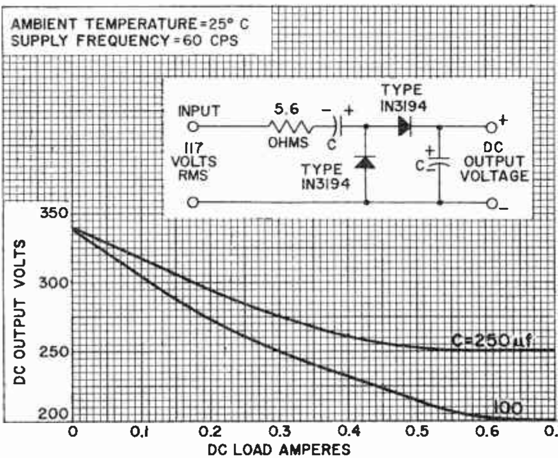
World Radio History

TYPICAL OPERATION CHARACTERISTICS
Half-Wave Rectifier



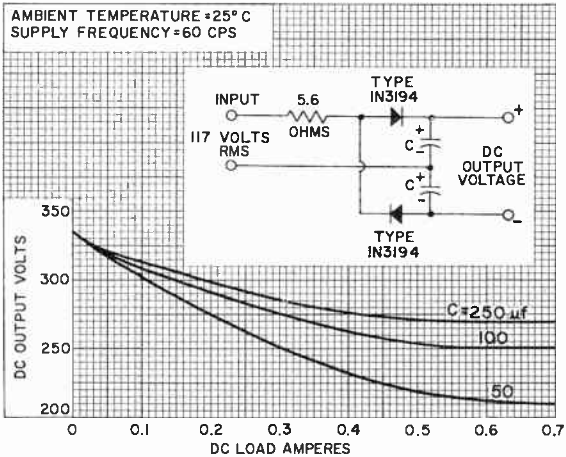
92CS-10917

Half-Wave Voltage Doubler

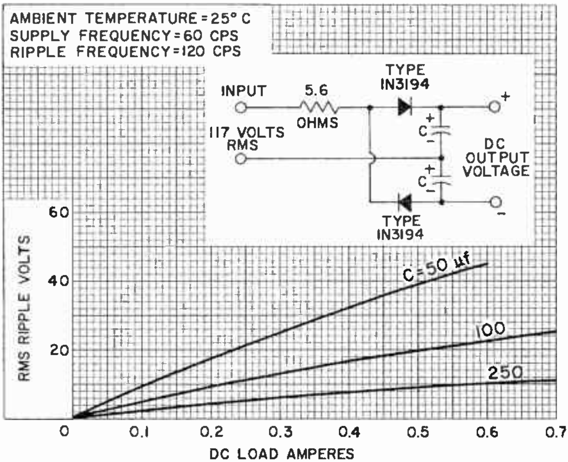


92CS-10916

TYPICAL OPERATION CHARACTERISTICS
Full-Wave Voltage Doubler



92CS-10918



92CS-10919

World Radio History

Silicon Rectifier

DIFFUSED-JUNCTION TYPE

For Industrial and Consumer-Product Applications

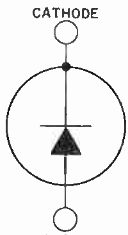
See also Insulated-Version Type 1N3255

GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.405"
Maximum Diameter	0.240"
Case	Metal
Seals	Hermetic
Leads, Flexible	2
Minimum length	1.4"
Diameter	0.027" to 0.035"
Orientation	See *Dimensional Outline*

Terminal Diagram:



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps

	For resistive or inductive load	*For capacitive-input filter*	
PEAK INVERSE VOLTAGE	600 max.	600 max.	volts
RMS SUPPLY VOLTAGE	420 max.	210 max.	volts
FORWARD CURRENT:[a]			
DC	750 max.	500 max.	ma
Peak recurrent	–	6 max.	amp
Surge, for "turn-on" time of 2 milliseconds	–	35 max.	amp
AMBIENT-TEMPERATURE RANGE:			
Operating	-65 to +100		°C
Storage	-65 to +175		°C

LEAD TEMPERATURE:
For 10 seconds maximum. . . . . 255 max. °C

Characteristics:

At ambient temperature of 25° C

Minimum Instantaneous Forward Voltage Drop at dc forward amperes = 0.5.	1.2	volts
Maximum Reverse Current at maximum peak inverse voltage.	10	μa

[a] At ambient temperatures up to 75° C. At ambient temperatures above 75° C see *Rating Chart*.

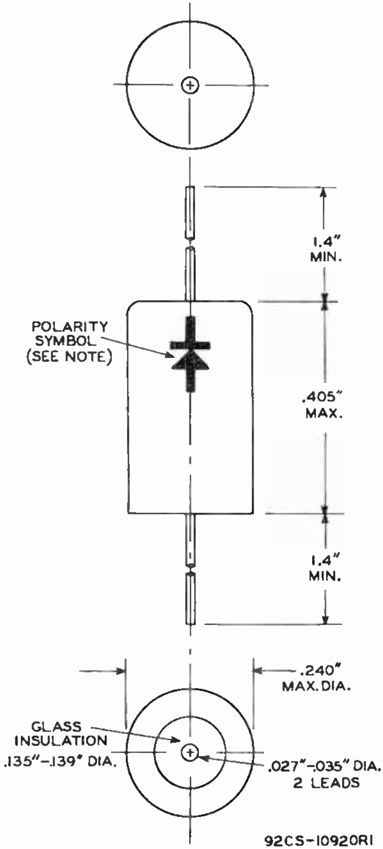
OPERATING CONSIDERATIONS

A *surge-limiting impedance* should always be used in series with the rectifier. The impedance value must be sufficient to limit the surge current to the value specified under the maximum ratings. This impedance may be provided by the power-transformer windings, or by an external resistor or choke.

The *flexible leads* of this transistor are usually soldered to the circuit elements. It is desirable in all soldering operations to provide some slack or an expansion elbow in the leads to prevent excessive tension on the leads. It is important during the soldering operation to avoid excessive heat in order to prevent possible damage to the rectifier. To absorb some of the heat, grip the flexible lead of the rectifier between the case and the soldering point with a pair of pliers.

When dip soldering is employed in the assembly of printed circuitry using this rectifier, the leads should not be dip soldered within 0.5" of the metal case.

Because the case of this rectifier may operate at voltages which are dangerous, care should be taken in the design of equipment to prevent the operator from coming in contact with the rectifier. It is recommended that this rectifier be mounted on the underside of the chassis.

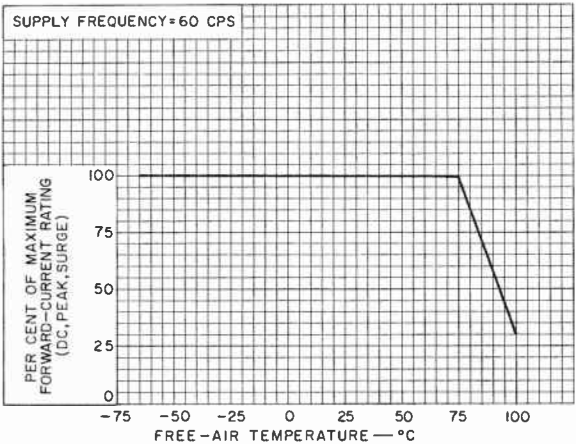


92CS-10920R1

NOTE: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

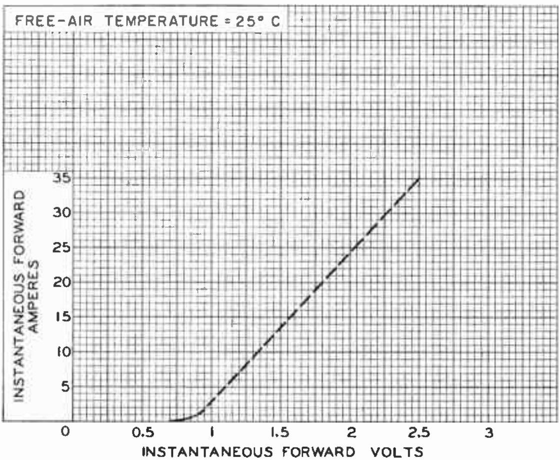
World Radio History

RATING CHART



92CS-9727R2

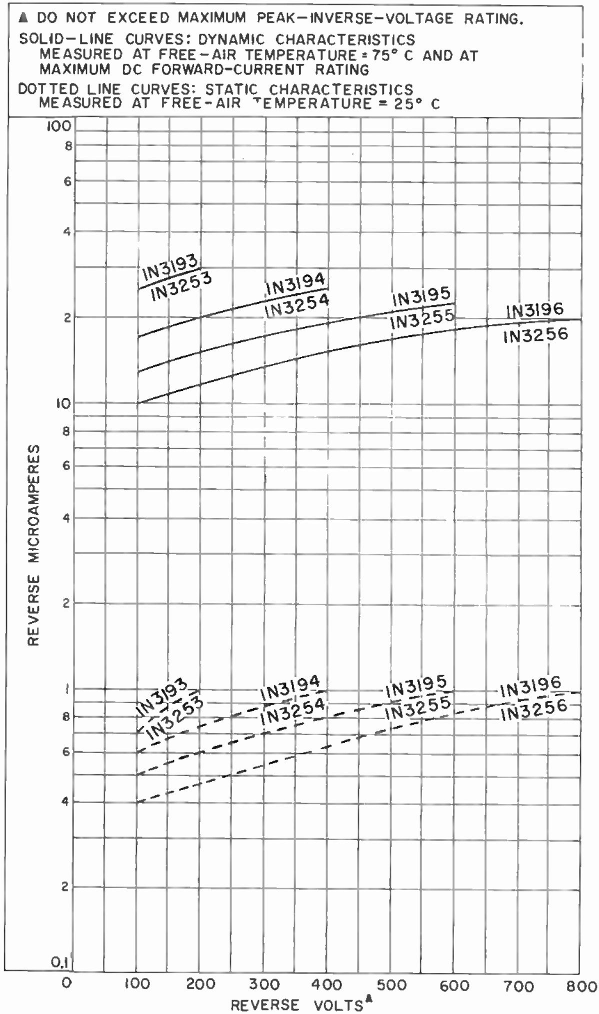
TYPICAL FORWARD CHARACTERISTIC



92CS-9730R2

World Radio History

TYPICAL REVERSE CHARACTERISTICS



92CM-10921R1

World Radio History

Silicon Rectifier

DIFFUSED-JUNCTION TYPE

For Industrial and Consumer-Product Applications

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.405"
Maximum Diameter	0.240"
Case	Metal
Seals	Hermetic
Leads, Flexible	2
Minimum length	1.4"
Diameter	0.027" to 0.035"
Orientation	See *Dimensional Outline*

Terminal Diagram:

The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps

	For resistive or inductive load	*For capacitive-input filter*	
PEAK INVERSE VOLTAGE	600 max.	600 max.	volts
RMS SUPPLY VOLTAGE	420 max.	210 max.	volts
FORWARD CURRENT:[a]			
DC	750 max.	500 max.	ma
Peak recurrent	–	6 max.	amp
Surge, for "turn-on" time of 2 milliseconds	–	35 max.	amp
AMBIENT-TEMPERATURE RANGE:			
Operating	-65 to +100		°C
Storage	-65 to +175		°C
LEAD TEMPERATURE:			
For 10 seconds maximum	255 max.		°C

World Radio History

1N3195

Characteristics:

At ambient temperature of 25° C

Maximum Instantaneous Forward Voltage Drop at dc forward amperes = 0.5. .	1.2	volts
Maximum Reverse Current at maximum peak inverse voltage.	10	μa

[a] At ambient temperatures up to 75° C. At ambient temperatures above 75° C see *Rating Chart*.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
RATING CHART,
TYPICAL-FORWARD-CHARACTERISTIC CURVE,
and
TYPICAL-REVERSE-CHARACTERISTICS CURVE
(Given on multitype curve sheet)
shown under Type 1N3193 also apply to the 1N3195

World Radio History

Silicon Rectifier

DIFFUSED-JUNCTION TYPE

For Industrial and Consumer-Product Applications

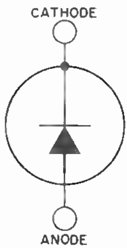
See also Insulated-Version Type 1N3256

GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.405"
Maximum Diameter	0.240"
Case	Metal
Seals	Hermetic
Leads, Flexible	2
Minimum length	1.4"
Diameter	0.027" to 0.035"
Orientation	See *Dimensional Outline*

Terminal Diagram:



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps

	For resistive or inductive load	*For capacitive-input filter*	
PEAK INVERSE VOLTAGE	800 max.	800 max.	volts
RMS SUPPLY VOLTAGE	560 max.	280 max.	volts
FORWARD CURRENT:[a]			
DC	500 max.	400 max.	ma
Peak recurrent	-	5 max.	amp
Surge, for "turn-on" time of 2 milliseconds	-	35 max.	amp
AMBIENT-TEMPERATURE RANGE:			
Operating	-65 to +100		°C
Storage	-65 to +175		°C

World Radio History

LEAD TEMPERATURE:
For 10 seconds
maximum . . . . 255 max. °C

Characteristics:

At ambient temperature of 25^{o} C

Minimum Instantaneous Forward Voltage Drop at dc forward amperes = 0.5.	1.2	volts
Maximum Reverse Current at maximum peak inverse voltage.	10	μa

[a] At ambient temperatures up to 75° C. At ambient temperatures above 75° C see *Rating Chart*.

OPERATING CONSIDERATIONS

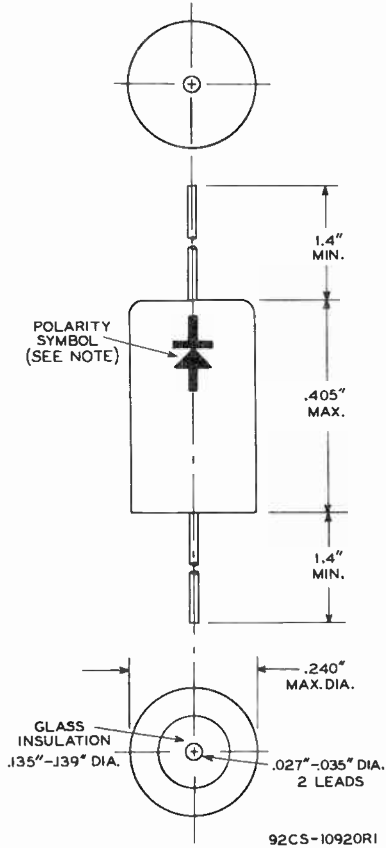
A *surge-limiting impedance* should always be used in series with the rectifier. The impedance value must be sufficient to limit the surge current to the value specified under the maximum ratings. This impedance may be provided by the power transformer windings, or by an external resistor or choke.

The *flexible leads* of this rectifier are usually soldered to the circuit elements. It is desirable in all soldering operations to provide some slack or an expansion elbow in the leads to prevent excessive tension on the leads. It is important during the soldering operation to avoid excessive heat in order to prevent possible damage to the rectifier. To absorb some of the heat, grip the flexible lead of the rectifier between the case and the soldering point with a pair of pliers.

When dip soldering is employed in the assembly of printed circuitry using this rectifier, the leads should not be dip soldered within 0.5" of the metal case.

Because the case of this rectifier may operate at voltages which are dangerous, care should be taken in the design of equipment to prevent the operator from coming in contact with the rectifier. It is recommended that this rectifier be mounted on the underside of the chassis.

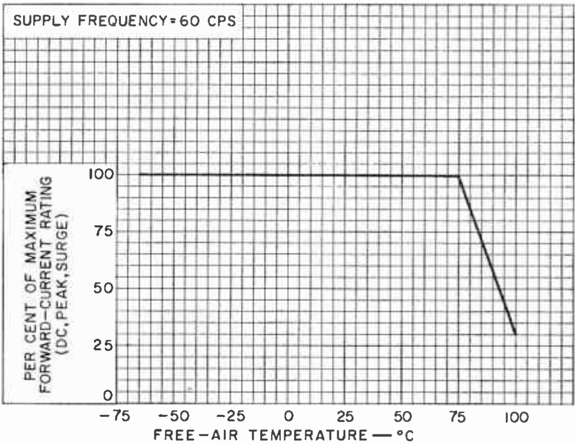
World Radio History



NOTE: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

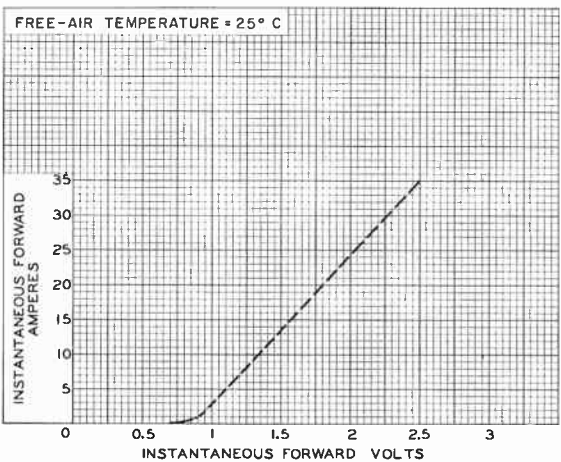
World Radio History

RATING CHART



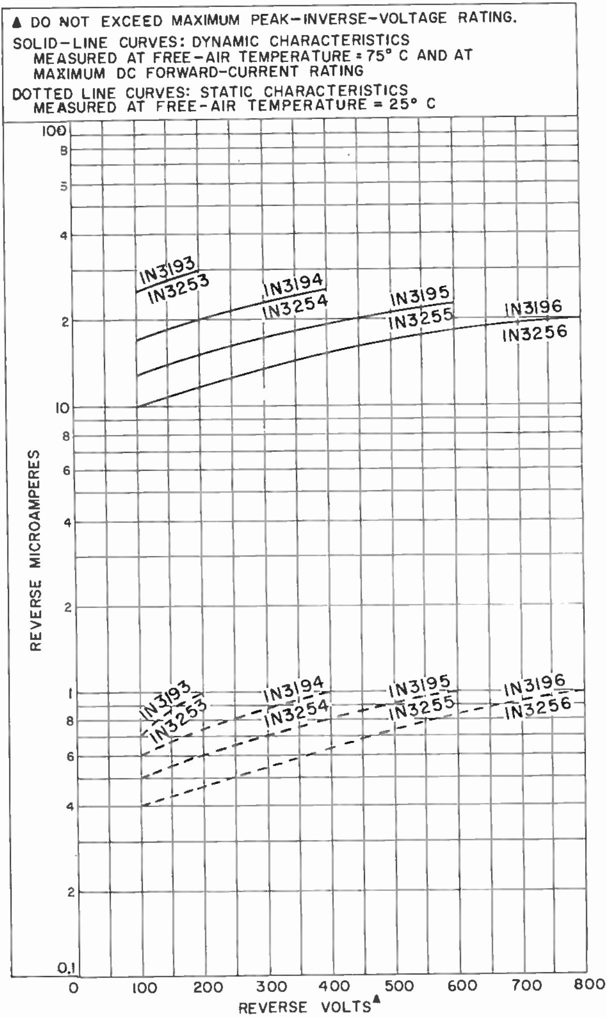
92CS-9727R2

TYPICAL FORWARD CHARACTERISTIC



92CS-9730R2

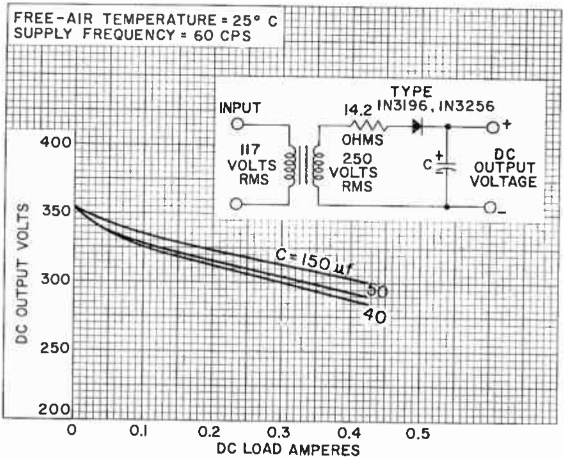
TYPICAL REVERSE CHARACTERISTICS



92CM-10921R1

World Radio History

TYPICAL OPERATION CHARACTERISTICS
Half-Wave Rectifier



92CS-10915R1

World Radio History

Silicon Rectifier

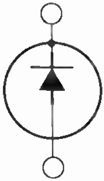
DIFFUSED-JUNCTION TYPE

For Industrial and Consumer-Product Applications

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.405"
Maximum Diameter	0.240"
Case	Metal
Seals	Hermetic
Leads, Flexible	2
Minimum length	1.4"
Diameter	0.027" to 0.035"
Orientation	See *Dimensional Outline*

Terminal Diagram:



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps

	For resistive or inductive load	*For capacitive-input filter*	
PEAK INVERSE VOLTAGE	800 max.	800 max.	volts
RMS SUPPLY VOLTAGE	560 max.	280 max.	volts
FORWARD CURRENT:[a]			
DC	500 max.	400 max.	ma
Peak recurrent	-	5 max.	amp
Surge, for "turn-on" time of 2 milliseconds	-	35 max.	amp
AMBIENT-TEMPERATURE RANGE:			
Operating	-65 to +100		°C
Storage	-65 to +175		°C
LEAD TEMPERATURE:			
For 10 seconds maximum	255 max.		°C

[a] At ambient temperatures up to 75° C. At ambient temperatures above 75° C see *Rating Chart*.

World Radio History

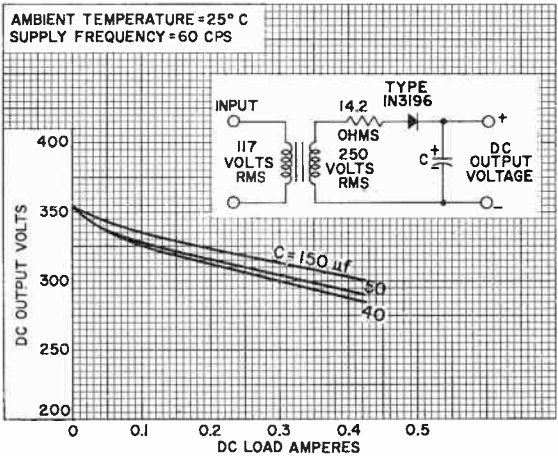
Characteristics:

At ambient temperature of 25° C

Maximum Instantaneous Forward Voltage Drop at dc forward amperes = 0.4	1.2	volts
Maximum Reverse Current at maximum peak inverse voltage.	10	μa

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
RATING CHART,
TYPICAL-FORWARD-CHARACTERISTIC CURVE,
and
TYPICAL-REVERSE-CHARACTERISTICS CURVE
(Given on multitype curve sheet)
shown under Type 1N3193 also apply to the 1N3196

TYPICAL OPERATION CHARACTERISTICS
Half-Wave Rectifier



92CS-10915

World Radio History

1N3253

Silicon Rectifier

DIFFUSED-JUNCTION TYPE

For Industrial and Consumer-Product Applications

See also Uninsulated-Version Type 1N3193

The 1N3253 is the same as the 1N3193 except for the following items:

Mechanical:

Case. . . . . Metal with Insulating Sleeve[a]

1N3254

Silicon Rectifier

DIFFUSED-JUNCTION TYPE

For Industrial and Consumer-Product Applications

See also Uninsulated-Version Type 1N3194

The 1N3254 is the same as the 1N3194 except for the following items:

Mechanical:

Case. . . . . Metal with Insulating Sleeve[a]

1N3255

Silicon Rectifier

DIFFUSED-JUNCTION TYPE

For Industrial and Consumer-Product Applications

See also Uninsulated-Version Type 1N3195

The 1N3255 is the same as the 1N3195 except for the following items:

Mechanical:

Case. . . . . Metal with Insulating Sleeve[a]

[a] The maximum diameter of the metal case with insulating sleeve is 0.240". The specifications of the insulating sleeve are: material, plastic; wall thickness, 0.002"; dielectric strength, 4500 volts/mil at 25° C, 3150 volts/mil at 150° C; moisture absorption, 0.3% (surface resistivity is not affected by moisture); degree of transparency, optically clear.

World Radio History

1N3256

Silicon Rectifier

DIFFUSED-JUNCTION TYPE

For Industrial and Consumer-Product Applications

See also Uninsulated-Version Type 1N3196

The 1N3256 is the same as the 1N3196 except for the following items:

Mechanical:

Case. . . . . Metal with Insulating Sleeve[a]

[a] The maximum diameter of the metal case with insulating sleeve is 0.240". The specifications of the insulating sleeve are: material, plastic; wall thickness, 0.002"; dielectric strength, 4500 volts/mil at 25° C, 3150 volts/mil at 150° C; moisture absorption, 0.3% (surface resistivity is not affected by moisture); degree of transparency, optically clear.

World Radio History

Silicon Rectifier

DIFFUSED-JUNCTION TYPE

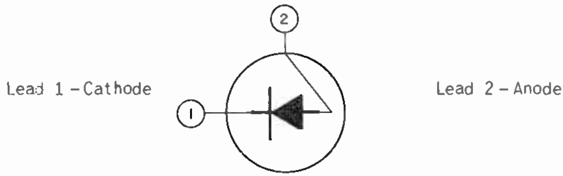
For Industrial and Consumer-Product Applications

GENERAL DATA

Mechanical:

Dimensions. . . . .Similar to *Outline TO-1* in General Section except that lead 3 is omitted

Terminal Diagram: BOTTOM VIEW



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps and for capacitor-input filter

PEAK REVERSE VOLTAGE.	100 max.	volts
RMS SUPPLY VOLTAGE.	35 max.	volts
FORWARD CURRENT:[a]		
DC.	125 max.	ma
Peak recurrent.	1.3 max.	amp
Surge, for "turn-on" time of 2 milliseconds	30 max.	amp
FREE-AIR TEMPERATURE RANGE:		
Operating	-65 to +100	°C
Storage	-65 to +175	°C
LEAD TEMPERATURE:		
For 10 seconds maximum.	255 max.	°C

Characteristics:

At free-air temperature of 25° C unless otherwise specified

Maximum Instantaneous Forward Voltage Drop at dc forward ma. = 125.	1	volt
Maximum Reverse Current:		
Static value at maximum-rated peak reverse voltage, forward ma. = 0, free-air temperature of 25° C.	0.005	ma
Dynamic value at maximum-rated peak reverse voltage, maximum-rated dc forward current, free-air temperature of 65° C	0.3	ma

[a] At free-air temperatures up to 65° C. At free-air temperatures above 65° C, see *Rating Chart*.

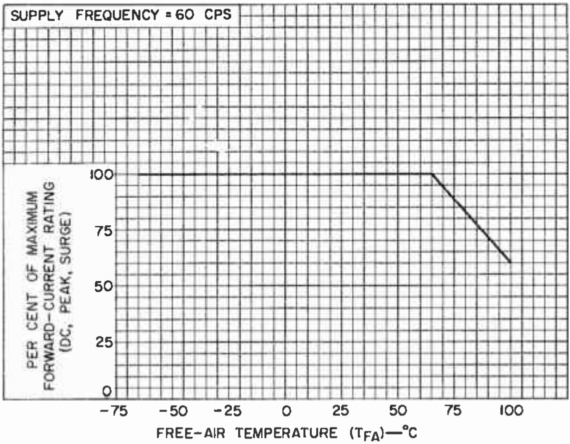
OPERATING CONSIDERATIONS

A *surge-limiting impedance* should always be used in series with the rectifier. The impedance value must be sufficient to limit the surge current to the value specified under the maximum ratings. This impedance may be provided by the power-transformer windings, or by an external resistor or choke.

The *flexible leads* of this transistor are usually soldered to the circuit elements. It is desirable in all soldering operations to provide some slack or an expansion elbow in the leads to prevent excessive tension on the leads. It is important during the soldering operation to avoid excessive heat in order to prevent possible damage to the rectifier. To absorb some of the heat, grip the flexible lead of the rectifier between the case and the soldering point with a pair of pliers.

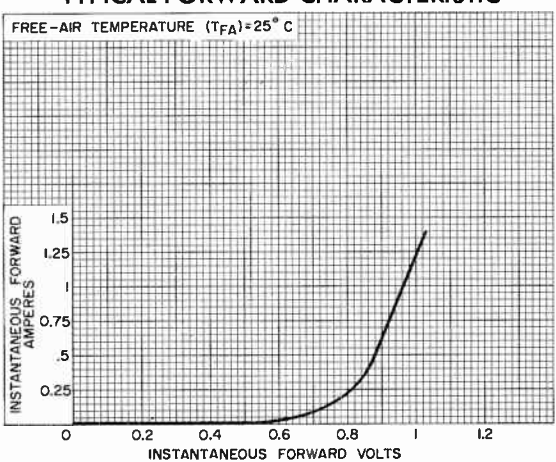
When dip soldering is employed in the assembly of printed circuitry using this rectifier, the leads should not be dip soldered within 0.25" of the metal case.

RATING CHART



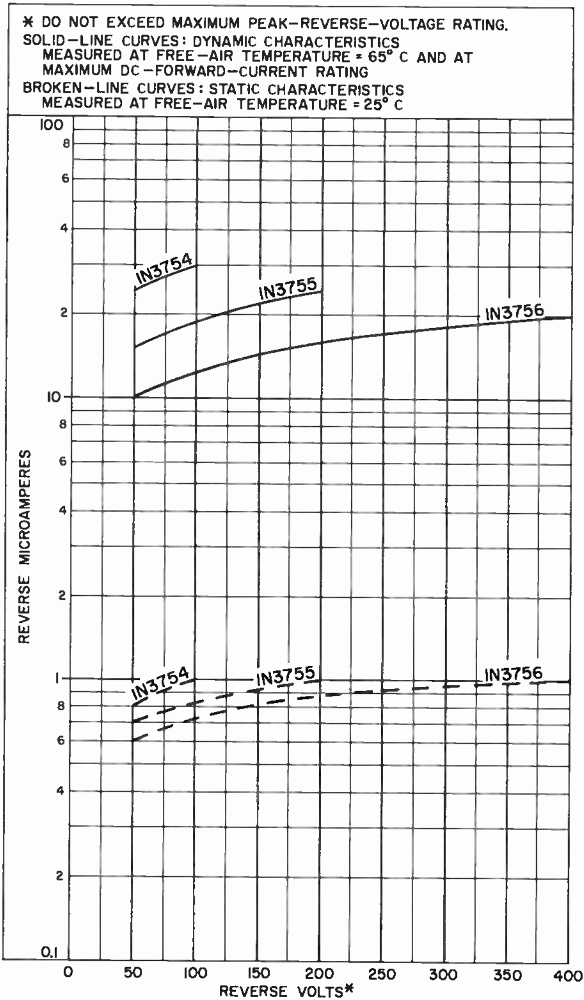
92CS-11670R1

TYPICAL FORWARD CHARACTERISTIC



92CS-11669

TYPICAL REVERSE CHARACTERISTICS



92CM-11671

Silicon Rectifier

DIFFUSED-JUNCTION TYPE

For Industrial and Consumer-Product Applications

The 1N3755 is the same as the 1N3754 except for the following items:

HALF-WAVE RECTIFIER

Maximum Ratings, *Absolute-Maximum Values:*

	For power-supply frequency of 60 cps and for capacitor-input filter	
PEAK REVERSE VOLTAGE	200 max.	volts
RMS SUPPLY VOLTAGE	70 max.	volts

World Radio History

World Radio History

Silicon Rectifier

DIFFUSED-JUNCTION TYPE

For Industrial and Consumer-Product Applications

The 1N3756 is the same as the 1N3754 except for the following items:

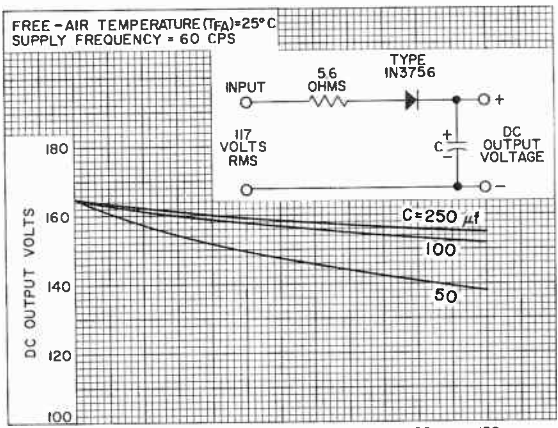
HALF-WAVE RECTIFIER

Maximum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps and for capacitor-input filter

PEAK REVERSE VOLTAGE	400 max.	volts
RMS SUPPLY VOLTAGE.	140 max.	volts

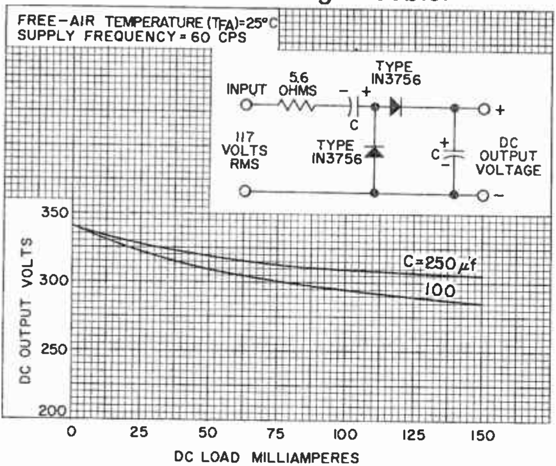
TYPICAL OPERATION CHARACTERISTICS
Half-Wave Rectifier



World Radio History

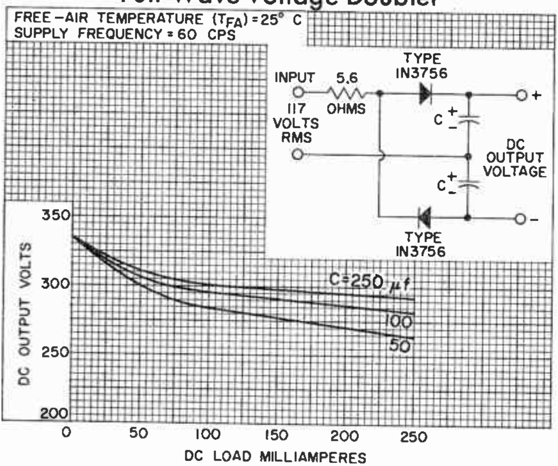
World Radio History

TYPICAL OPERATION CHARACTERISTICS
Half-Wave Voltage Doubler



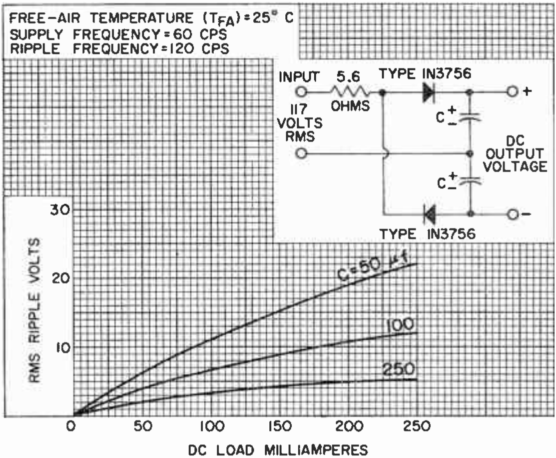
92CS-11673

TYPICAL OPERATION CHARACTERISTICS
Full-Wave Voltage Doubler



92CS-11674

TYPICAL OPERATION CHARACTERISTICS
Full-Wave Voltage Doubler



92CS-11675

World Radio History

World Radio History

Tunnel Diode

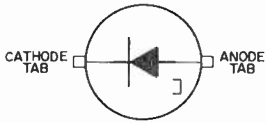
GERMANIUM P-ON-N REGION, EPITAXIAL TYPE

For Switching and Small-Signal Applications Requiring Control (±10%) of Peak-Point Current and Switching Times Greater than 1800 Picoseconds

GENERAL DATA

Mechanical:

Operating Position. . . . . Any
Maximum Overall Length. . . . . 0.270"
Maximum Width . . . . 0.130"
Maximum Height. . . . . 0.055"
Case. . . . . Metal and Ceramic
Terminal Diagram (See *Dimensional Outline*):



The arrow indicates direction of forward current flow as indicated by dc ammeter.

SWITCHING SERVICE

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

DC CURRENT:			
Forward	I_F	10 max.	ma
Reverse	I_R	15 max.	ma
DISSIPATION:	P		
At free-air temperatures:			
From −35° to 25° C.		5 max.	mw
Above 25° C		*Derate linearly to 0 mw at 100° C*	
FREE-AIR TEMPERATURE RANGE:			
Operating	T_{OPR}	−35 to 100	°C
Storage	T_{STG}	−35 to 100	°C
TAB TEMPERATURE:[a]			
For 3 seconds maximum	T_T	175 max.	°C

Electrical Characteristics:

At free-air temperature = 25° C

		Min.	*Typical*	*Max.*	
Static:[b]					
Peak-Point Current.	I_P	4.5	–	5.5	ma
Valley-Point Current. . . .	I_V	–	–	0.75	ma
Peak-Point-to-Valley-Point Current Ratio . . .	I_P/I_V	6/1	–	–	
Positive Voltage at peak-point ma. = 5.5	V_F'	430	–	590	mv

World Radio History

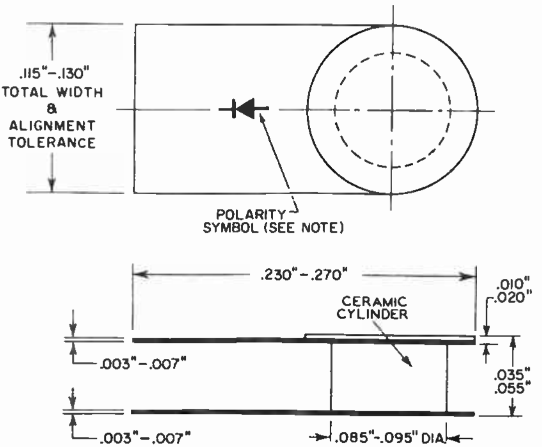
		Min.	Typical	Max.	
Dynamic:[c]					
Terminal Valley-Point					
Capacitance[d]	C	–	–	25	pf
Total Series Resistance . .	R_S	–	–	3	ohms
Switching Time:					
Rise time[e]	t_r	–	1800	–	psec

[a] See *Soldering Considerations*.
[b] See accompanying *Static-Forward-Characteristic* graph.
[c] See accompanying *Equivalent Circuit of a Tunnel Diode in the Negative-Resistance Region*.
[d] Includes case capacitance of 0.8 pf.
[e] Calculated rise time (approximate) for a germanium tunnel diode when switching from V_P to V_F at a constant value of I_P.

$$t_r \simeq \frac{C(V_F - V_P)}{(I_P - I_V)} \simeq \frac{C}{2\ I_P}$$

SOLDERING CONSIDERATIONS

A low-temperature solder, (such as Alpha #111 alloy, rosin-filled, or equivalent) should be used. To minimize soldering time, a pre-tinned circuit board should be used. To protect the junction against overheating, the tunnel diode should be held with long-nose pliers.

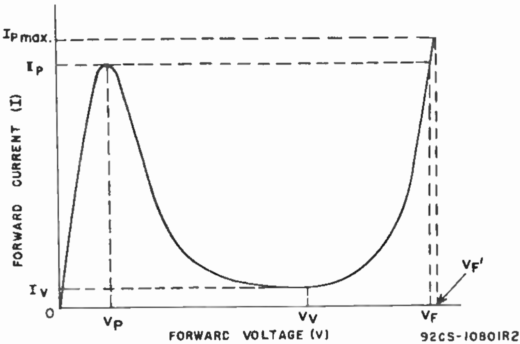


92CS-11806

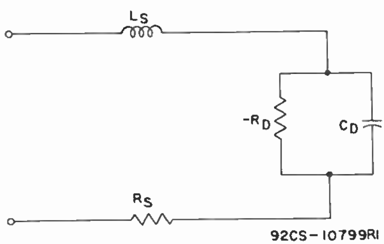
NOTE: ARROW INDICATES DIRECTION OF FORWARD CURRENT FLOW AS INDICATED BY DC AMMETER.

World Radio History

STATIC FORWARD CHARACTERISTIC
OF A TUNNEL DIODE



EQUIVALENT CIRCUIT OF A TUNNEL DIODE
IN THE NEGATIVE-RESISTANCE REGION



World Radio History

World Radio History

1N3848

Tunnel Diode

GERMANIUM P-ON-N REGION, EPITAXIAL TYPE

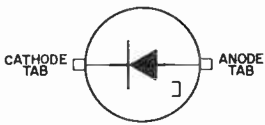
For Switching and Small-Signal Applications Requiring Control (± 10%) of Peak-Point Current and Switching Times Greater than 900 Picoseconds

GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	0.270"
Maximum Width	0.130"
Maximum Height	0.055"
Case	Metal and Ceramic

Terminal Diagram (See *Dimensional Outline*):



The arrow indicates direction of forward current flow as indicated by dc ammeter.

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

DC CURRENT:			
Forward	I_F	18 max.	ma
Reverse	I_R	25 max.	ma
DISSIPATION:	P		
At free-air temperatures:			
From −35° to 25° C		10 max.	mw
Above 25° C		*Derate linearly to o mw at 100° C*	
FREE-AIR TEMPERATURE RANGE:			
Operating	T_{OPR}	−35 to 100	°C
Storage	T_{STG}	−35 to 100	°C
TAB TEMPERATURE:[a]			
For 3 seconds maximum	T_T	175 max.	°C

Electrical Characteristics:

At free-air temperature = 25° C

		Min.	*Typical*	*Max.*	
Static:[b]					
Peak-Point Current	I_P	9	–	11	ma
Valley-Point Current	I_V	–	–	1.5	ma
Peak-Point-to-Valley-Point Current Ratio	I_P/I_V	6/1	–	–	
Positive Voltage at peak-point ma. = 11	V_F'	440	–	600	mv

World Radio History

		Min.	Typical	Max.	
Dynamic:[c]					
Terminal Valley-Point Capacitance[d]	C	–	–	25	pf
Total Series Resistance	R_S	–	–	2.5	ohms
Switching Time:					
Rise time[e]	t_r	–	900	–	psec

[a] See *Soldering Considerations*.
[b] See accompanying *Static-Forward-Characteristic* graph.
[c] See accompanying *Equivalent Circuit of a Tunnel Diode in the Negative-Resistance Region*.
[d] Includes case capacitance of 0.8 pf.
[e] Calculated rise time (approximate) for a germanium tunnel diode when switching from V_P to V_F at a constant value of I_P.

$$t_r \simeq \frac{C(V_F-V_P)}{(I_P-I_V)} \simeq \frac{C}{2\ I_P}$$

SOLDERING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
STATIC FORWARD CHARACTERISTIC OF A TUNNEL DIODE,
and
EQUIVALENT CIRCUIT OF A TUNNEL DIODE IN THE NEGATIVE-RESISTANCE REGION
shown under Type 1N3847 also apply to the 1N3848

World Radio History

1N3849

Tunnel Diode

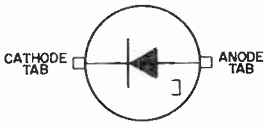
GERMANIUM P-ON-N REGION, EPITAXIAL TYPE

For Switching and Small-Signal Applications Requiring Control (±10%) of Peak-Point Current and Switching Times Greater than 600 Picoseconds

GENERAL DATA

Mechanical:

Operating Position. . . . . Any
Maximum Overall Length. . . . . 0.270"
Maximum Width . . . . 0.130"
Maximum Height. . . . . 0.055"
Case. . . . . Metal and Ceramic
Terminal Diagram (See *Dimensional Outline*):



The arrow indicates direction of forward current flow as indicated by dc ammeter.

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

DC CURRENT:			
Forward	I_F	35 max.	ma
Reverse	I_R	50 max.	ma
DISSIPATION:	P		
At free-air temperatures:			
From −35° to 25° C.		20 max.	mw
Above 25° C		*Derate linearly to 0 mw at 100° C*	
FREE-AIR TEMPERATURE RANGE:			
Operating	T_{OPR}	−35 to 100	°C
Storage	T_{STG}	−35 to 100	°C
TAB TEMPERATURE:[a]			
For 3 seconds maximum	T_T	175 max.	°C

Electrical Characteristics:

At free-air temperature = 25° C

		Min.	*Typical*	*Max.*	
Static:[b]					
Peak-Point Current.	I_P	18	–	22	ma
Valley-Point Current. . . .	I_V	–	–	3	ma
Peak-Point-to-Valley-Point Current Ratio . . .	I_P/I_V	6/1	–	–	
Positive Voltage at peak-point ma. = 22.	$V_{F'}$	460	–	620	mv

World Radio History

		Min.	Typical	Max.	
Dynamic:[c]					
Terminal Valley-Point Capacitance[d]	C	–	–	30	pf
Total Series Resistance . .	R_S	–	–	2	ohms
Switching Time:					
Rise time[e]	t_r	–	600	–	psec

[a] See *Soldering Considerations.*

[b] See accompanying *Static-Forward-Characteristic* graph.

[c] See accompanying *Equivalent Circuit of a Tunnel Diode in the Negative-Resistance Region.*

[d] Includes case capacitance of 0.8 pf.

[e] Calculated rise time (approximate) for a germanium tunnel diode when switching from V_P to V_F at a constant value of I_P.

$$t_r \simeq \frac{C(V_F - V_P)}{(I_P - I_V)} \simeq \frac{C}{2\ I_P}$$

SOLDERING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
STATIC FORWARD CHARACTERISTIC
OF A TUNNEL DIODE,
and
EQUIVALENT CIRCUIT OF A TUNNEL DIODE
IN THE NEGATIVE-RESISTANCE REGION

shown under Type 1N3847 also apply to the 1N3849

World Radio History

Tunnel Diode

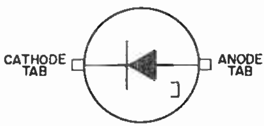
GERMANIUM P-ON-N REGION, EPITAXIAL TYPE

For Switching and Small-Signal Applications Requiring Control (±10%) of Peak-Point Current and Switching Times Greater than 350 Picoseconds

GENERAL DATA

Mechanical:

Operating Position. Any
Maximum Overall Length. . . . . 0.270"
Maximum Width . . . . 0.130"
Maximum Height. . . . . 0.055"
Case. . . . . Metal and Ceramic
Terminal Diagram (See *Dimensional Outline*):



The arrow indicates direction of forward current flow as indicated by dc ammeter.

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

DC CURRENT:			
Forward	I_F	85 max.	ma
Reverse	I_R	125 max.	ma
DISSIPATION:	P		
At free-air temperatures:			
From −35° to 25° C.		50 max.	mw
Above 25° C	*Derate linearly to 0 mw at 100° C*		
FREE-AIR TEMPERATURE RANGE:			
Operating	T_{OPR}	−35 to 100	°C
Storage	T_{STG}	−35 to 100	°C
TAB TEMPERATURE:[a]			
For 3 seconds maximum	T_T	175 max.	°C

Electrical Characteristics:

At free-air temperature = 25° C

		Min.	*Typical*	*Max.*	
Static:[b]					
Peak-Point Current.	I_P	45	–	55	ma
Valley-Point Current. . . .	I_V	–	–	7.5	ma
Peak-Point-to-Valley-Point Current Ratio . . .	I_P/I_V	6/1	–	–	
Positive Voltage at peak-point ma. = 55.	$V_F{'}$	530	–	640	mv

World Radio History

		Min.	Typical	Max.	
Dynamic:[c]					
Terminal Valley-Point Capacitance[d]	C	-	-	40	pf
Total Series Resistance . .	R_S	-	-	1.5	ohms
Switching Time:					
Rise time[e]	t_r	-	350	-	psec

[a] See *Soldering Considerations*.
[b] See accompanying *Static-Forward-Characteristic* graph.
[c] See accompanying *Equivalent Circuit of a Tunnel Diode in the Negative-Resistance Region*.
[d] Includes case capacitance of 0.8 pf.
[e] Calculated rise time (approximate) for a germanium tunnel diode when switching from V_P to V_F at a constant value of I_P.

$$t_r \simeq \frac{C(V_F-V_P)}{(I_P-I_V)} \simeq \frac{C}{2\ I_P}$$

SOLDERING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
STATIC FORWARD CHARACTERISTIC OF A TUNNEL DIODE,
and
EQUIVALENT CIRCUIT OF A TUNNEL DIODE IN THE NEGATIVE-RESISTANCE REGION
shown under Type 1N3847 also apply to the 1N3850

World Radio History

Tunnel Diode

GERMANIUM P-ON-N REGION, EPITAXIAL TYPE

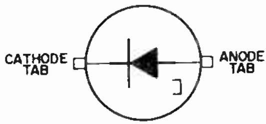
For Switching and Small-Signal Applications Requiring Control (±10%) of Peak-Point Current and Switching Times Greater than 125 Picoseconds

GENERAL DATA

Mechanical:

Operating Position.	Any
Maximum Overall Length.	0.270"
Maximum Width	0.130"
Maximum Height.	0.055"
Case.	Metal and Ceramic

Terminal Diagram (See *Dimensional Outline*):



The arrow indicates direction of forward current flow as indicated by dc ammeter.

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

DC CURRENT:			
Forward	I_F	170 max.	ma
Reverse	I_R	250 max.	ma
DISSIPATION:	P		
At free-air temperatures:			
From -35° to 25° C.		100 max.	mw
Above 25° C		*Derate linearly to 0 mw at 100° C*	
FREE-AIR TEMPERATURE RANGE:			
Operating	T_{OPR}	-35 to 100	°C
Storage	T_{STG}	-35 to 100	°C
TAB TEMPERATURE:[a]			
For 3 seconds maximum	T_T	175 max.	°C

Electrical Characteristics:

At free-air temperature = 25° C

		Min.	*Typical*	*Max.*	
Static:[b]					
Peak-Point Current.	I_P	90	-	110	ma
Valley-Point Current. . . .	I_V	-	-	15	ma
Peak-Point-to-Valley-Point Current Ratio . . .	I_P/I_V	6/1	-	-	
Positive Voltage at peak-point ma. = 110	V_F,	540	-	650	mv

World Radio History

		Min.	Typical	Max.	
Dynamic:[c]					
Terminal Valley-Point Capacitance[d]	C	–	–	40	pf
Total Series Resistance . .	R_S	–	–	1	ohm
Switching Time:					
Rise time[e]	t_r	–	125	–	psec

[a] See *Soldering Considerations*.
[b] See accompanying *Static-Forward-Characteristic* graph.
[c] See accompanying *Equivalent Circuit of a Tunnel Diode in the Negative-Resistance Region*.
[d] Includes case capacitance of 0.8 pf.
[e] Calculated rise time (approximate) for a germanium tunnel diode when switching from V_P to V_F at a constant value of I_P.

$$t_r \simeq \frac{C(V_F-V_P)}{(I_P-I_V)} \simeq \frac{C}{2\ I_P}$$

SOLDERING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
STATIC FORWARD CHARACTERISTIC OF A TUNNEL DIODE,
and
EQUIVALENT CIRCUIT OF A TUNNEL DIODE IN THE NEGATIVE-RESISTANCE REGION
shown under Type 1N3847 also apply to the 1N3851

World Radio History

Tunnel Diode

GERMANIUM P-ON-N REGION, EPITAXIAL TYPE

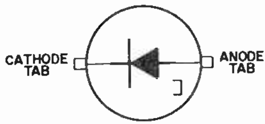
For Switching and Small-Signal Applications Requiring Control (±5%) of Peak-Point Current and Switching Times Greater than 1200 Picoseconds

GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	0.270"
Maximum Width	0.130"
Maximum Height	0.055"
Case	Metal and Ceramic

Terminal Diagram (See *Dimensional Outline*):



The arrow indicates direction of forward current flow as indicated by dc ammeter.

SWITCHING SERVICE

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

DC CURRENT:			
Forward	I_F	10 max.	ma
Reverse	I_R	15 max.	ma
DISSIPATION:	P		
At free-air temperatures:			
From −35° to 25° C		5 max.	mw
Above 25° C	*Derate linearly to 0 mw at 100° C*		
FREE-AIR TEMPERATURE RANGE:			
Operating	T_{OPR}	−35 to 100	°C
Storage	T_{STG}	−35 to 100	°C
TAB TEMPERATURE:[a]			
For 3 seconds maximum	T_T	175 max.	°C

Electrical Characteristics:

At free-air temperature = 25° C

		Min.	*Typical*	*Max.*	
Static:[b]					
Peak-Point Current	I_P	4.75	–	5.25	ma
Valley-Point Current	I_V	–	–	0.6	ma
Peak-Point-to-Valley-Point Current Ratio	I_P/I_V	8/1	–	–	
Peak-Point Voltage	V_P	50	–	90	mv
Valley-Point Voltage	V_V	330	–	–	mv
Positive Voltage at peak-point ma. = 5.25	$V_{F'}$	490	–	560	mv

World Radio History

		Min.	Typical	Max.	
Dynamic:[c]					
Terminal Valley-Point Capacitance[d]	C	–	–	15	pf
Total Series Resistance . . .	R_S	–	–	3	ohms
Switching Time:					
Rise time[e]	t_r	–	1200	–	psec

[a] See *Soldering Considerations*.
[b] See accompanying *Static-Forward-Characteristic* graph.
[c] See accompanying *Equivalent Circuit of a Tunnel Diode in the Negative-Resistance Region*.
[d] Includes case capacitance of 0.8 pf.
[e] Calculated rise time (approximate) for a germanium tunnel diode when switching from V_P to V_F at a constant value of I_P.

$$t_r \simeq \frac{C(V_F-V_P)}{(I_P-I_V)} \simeq \frac{C}{2\ I_P}$$

SOLDERING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
STATIC FORWARD CHARACTERISTIC
OF A TUNNEL DIODE,
and
EQUIVALENT CIRCUIT OF A TUNNEL DIODE
IN THE NEGATIVE-RESISTANCE REGION
shown under Type 1N3847 also apply to the 1N3852

World Radio History

1N3853

Tunnel Diode

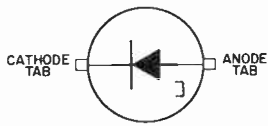
GERMANIUM P-ON-N REGION, EPITAXIAL TYPE

For Switching and Small-Signal Applications Requiring Control (±5%) of Peak-Point Current and Switching Times Greater than 600 Picoseconds

GENERAL DATA

Mechanical:

Operating Position . . . . Any
Maximum Overall Length. . . . . 0.270"
Maximum Width . . . . 0.130"
Maximum Height. . . . . 0.055"
Case. . . . . Metal and Ceramic
Terminal Diagram (See *Dimensional Outline*):



The arrow indicates direction of forward current flow as indicated by dc ammeter.

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

DC CURRENT:			
Forward	I_F	18 max.	ma
Reverse	I_R	25 max.	ma
DISSIPATION:	P		
At free-air temperatures:			
From -35° to 25° C.		10 max.	mw
Above 25° C . . . . *Derate linearly to 0 mw at 100° C*			
FREE-AIR TEMPERATURE RANGE:			
Operating	T_{OPR}	-35 to 100	°C
Storage	T_{STG}	-35 to 100	°C
TAB TEMPERATURE:[a]			
For 3 seconds maximum	T_T	175 max.	°C

Electrical Characteristics:

At free-air temperature = 25° C

Static:[b]		*Min.*	*Typical*	*Max.*	
Peak-Point Current.	I_P	9.5	-	10.5	ma
Valley-Point Current. . . .	I_V	-	-	1.2	ma
Peak-Point-to-Valley-Point Current Ratio . . .	I_P/I_V	8/1	-	-	
Peak-Point Voltage.	V_P	55	-	95	mv
Valley-Point Voltage. . . .	V_V	350	-	-	mv
Positive Voltage at peak-point ma. = 10.5.	V_F	510	-	580	mv

World Radio History

Dynamic:[c]		*Min.*	*Typical*	*Max.*	
Terminal Valley-Point Capacitance[d]	C	–	–	15	pf
Total Series Resistance	R_S	–	–	2.5	ohms
Switching Time:					
Rise time[e]	t_r	–	600	–	psec

[a] See *Soldering Considerations.*

[b] See accompanying *Static-Forward-Characteristic* graph.

[c] See accompanying *Equivalent Circuit of a Tunnel Diode in the Negative-Resistance Region.*

[d] Includes case capacitance of 0.8 pf.

[e] Calculated rise time (approximate) for a germanium tunnel diode when switching from V_P to V_F at a constant value of I_P.

$$t_r \simeq \frac{C(V_F - V_P)}{(I_P - I_V)} \simeq \frac{C}{2\,I_P}$$

SOLDERING CONSIDERATIONS,

DIMENSIONAL OUTLINE,

STATIC FORWARD CHARACTERISTIC OF A TUNNEL DIODE,

and

EQUIVALENT CIRCUIT OF A TUNNEL DIODE IN THE NEGATIVE-RESISTANCE REGION

shown under Type 1N3847 also apply to the 1N3853

World Radio History

1N3854

Tunnel Diode

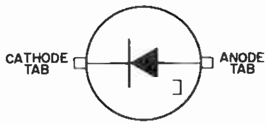
GERMANIUM P-ON-N REGION, EPITAXIAL TYPE

For Switching and Small-Signal Applications Requiring Control (±5%) of Peak-Point Current and Switching Times Greater than 400 Picoseconds

GENERAL DATA

Mechanical:

Operating Position .Any
Maximum Overall Length . . . . 0.270"
Maximum Width. . . . . 0.130"
Maximum Height . . . . 0.055"
Case .Metal and Ceramic
Terminal Diagram (See *Dimensional Outline*):



The arrow indicates direction of forward current flow as indicated by dc ammeter.

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

DC CURRENT:			
Forward.	I_F	35 max.	ma
Reverse.	I_R	50 max.	ma
DISSIPATION:	P		
At free-air temperatures:			
From −35° to 25° C		20 max.	mw
Above 25° C.		*Derate linearly to 0 mw at 100° C*	
FREE-AIR TEMPERATURE RANGE:			
Operating.	T_{OPR}	−35 to 100	°C
Storage.	T_{STG}	−35 to 100	°C
TAB TEMPERATURE:[a]			
For 3 seconds maximum.	T_T	175 max.	°C

Electrical Characteristics:

At free-air temperature = 25° C

Static:[b]		*Min.*	*Typical*	*Max.*	
Peak-Point Current	I_P	19	–	21	ma
Valley-Point Current . . .	I_V	–	–	2.4	ma
Peak-Point-to-Valley-Point Current Ratio. . .	I_P/I_V	8/1	–	–	
Peak-Point Voltage	V_P	65	–	105	mv
Valley-Point Voltage . . .	V_V	365	–	–	mv
Positive Voltage at peak-point ma. = 21	$V_{F'}$	530	–	600	mv

World Radio History

Dynamic:[c]		*Min.*	*Typical*	*Max.*	
Terminal Valley-Point Capacitance[d]	C	-	-	20	pf
Total Series Resistance . . .	R_S	-	-	2	ohms
Switching Time:					
Rise time[e]	t_r	-	400	-	psec

[a] See *Soldering Considerations.*

[b] See accompanying *Static-Forward-Characteristic* graph.

[c] See accompanying *Equivalent Circuit of a Tunnel Diode in the Negative-Resistance Region.*

[d] Includes case capacitance of 0.8 pf.

[e] Calculated rise time (approximate) for a germanium tunnel diode when switching from V_P to V_F at a constant value of I_P.

$$t_r \simeq \frac{C(V_F-V_P)}{(I_P-I_V)} \simeq \frac{C}{2\ I_P}$$

SOLDERING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
STATIC FORWARD CHARACTERISTIC
OF A TUNNEL DIODE,
and
EQUIVALENT CIRCUIT OF A TUNNEL DIODE
IN THE NEGATIVE-RESISTANCE REGION
shown under Type 1N3847 also apply to the 1N3854

World Radio History

Tunnel Diode

GERMANIUM P-ON-N REGION, EPITAXIAL TYPE

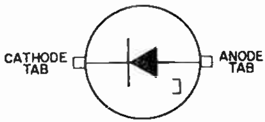
For Switching and Small-Signal Applications Requiring Control (± 5%) of Peak-Point Current and Switching Times Greater than 200 Picoseconds

GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	0.270"
Maximum Width	0.130"
Maximum Height	0.055"
Case	Metal and Ceramic

Terminal Diagram (See *Dimensional Outline*):



The arrow indicates direction of forward current flow as indicated by dc ammeter.

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

DC CURRENT:			
Forward	I_F	85 max.	ma
Reverse	I_R	125 max.	ma
DISSIPATION:	P		
At free-air temperatures:			
From -35° to 25° C		50 max.	mw
Above 25° C		*Derate linearly to 0 mw at 100° C*	
FREE-AIR TEMPERATURE RANGE:			
Operating	T_{OPR}	-35 to 100	°C
Storage	T_{STG}	-35 to 100	°C
TAB TEMPERATURE:[a]			
For 3 seconds maximum	T_T	175 max.	°C

Electrical Characteristics:

At free-air temperature = 25° C

		Min.	Typical	Max.	
Static:[b]					
Peak-Point Current	I_P	47.5	-	52.5	ma
Valley-Point Current	I_V	-	-	6	ma
Peak-Point-to-Valley-Point Current Ratio	I_P/I_V	8/1	-	-	
Peak-Point Voltage	V_P	80	-	130	mv
Valley-Point Voltage	V_V	380	-	-	mv
Positive Voltage at peak-point ma. = 52.5	$V_{F'}$	550	-	620	mv

World Radio History

		Min.	Typical	Max.	
Dynamic:[c]					
Terminal Valley-Point Capacitance[d]	C	–	–	25	pf
Total Series Resistance	R_S	–	–	1.5	ohms
Switching Time:					
Rise time[e].	t_r	–	200	–	psec

[a] See *Soldering Considerations.*

[b] See accompanying *Static-Forward-Characteristic* graph.

[c] See accompanying *Equivalent Circuit of a Tunnel Diode in the Negative-Resistance Region.*

[d] Includes case capacitance of 0.8 pf.

[e] Calculated rise time (approximate) for a germanium tunnel diode when switching from V_P to V_F at a constant value of I_P.

$$t_r \simeq \frac{C(V_F-V_P)}{(I_P-I_V)} \simeq \frac{C}{2\,I_P}$$

SOLDERING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
STATIC FORWARD CHARACTERISTIC
OF A TUNNEL DIODE,
and
EQUIVALENT CIRCUIT OF A TUNNEL DIODE
IN THE NEGATIVE-RESISTANCE REGION
shown under Type 1N3847 also apply to the 1N3855

World Radio History

1N3856

Tunnel Diode

GERMANIUM P-ON-N REGION, EPITAXIAL TYPE

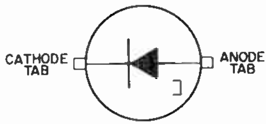
For Switching and Small-Signal Applications
Requiring Control (±5%) of Peak-Point Current
and Switching Times Greater than 75 Picoseconds

GENERAL DATA

Mechanical:

Operating Position.	Any
Maximum Overall Length.	0.270"
Maximum Width	0.130"
Maximum Height.	0.055"
Case.	Metal and Ceramic

Terminal Diagram (See *Dimensional Outline*):



The arrow indicates direction of forward current flow as indicated by dc ammeter.

SWITCHING SERVICE

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

DC CURRENT:			
Forward	I_F	170 max.	ma
Reverse	I_R	250 max.	ma
DISSIPATION:	P		
At free-air temperatures:			
From -35° to 25° C.		100 max.	mw
Above 25° C		*Derate linearly to 0 mw at 100° C*	
FREE-AIR TEMPERATURE RANGE:			
Operating	T_{OPR}	-35 to 100	°C
Storage	T_{STG}	-35 to 100	°C
TAB TEMPERATURE:[a]			
For 3 seconds maximum	T_T	175 max.	°C

Electrical Characteristics:

At free-air temperature = 25° C

		Min.	*Typical*	*Max.*	
Static:[b]					
Peak-Point Current.	I_P	95	-	105	ma
Valley-Point Current. . . .	I_V	-	-	12	ma
Peak-Point-to-Valley-Point Current Ratio . . .	I_P/I_V	8/1	-	-	
Peak-Point Voltage.	V_P	90	-	140	mv
Valley-Point Voltage. . . .	V_V	390	-	-	mv
Positive Voltage at peak-point ma. = 105	$V_{F'}$	560	-	630	mv

World Radio History

		Min.	Typical	Max.	
Dynamic:[c]					
Terminal Valley-Point Capacitance[d]	C	–	–	25	pf
Total Series Resistance . .	R_S	–	–	1	ohm
Switching Time:					
Rise time[e]	t_r	–	75	–	psec

[a] See *Soldering Considerations*.

[b] See accompanying *Static-Forward-Characteristic* graph.

[c] See accompanying *Equivalent Circuit of a Tunnel Diode in the Negative-Resistance Region*.

[d] Includes case capacitance of 0.8 pf.

[e] Calculated rise time (approximate) for a germanium tunnel diode when switching from V_P to V_F at a constant value of I_P.

$$t_r \simeq \frac{C(V_F - V_P)}{(I_P - I_V)} \simeq \frac{C}{2\ I_P}$$

SOLDERING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
STATIC FORWARD CHARACTERISTIC
OF A TUNNEL DIODE,
and
EQUIVALENT CIRCUIT OF A TUNNEL DIODE
IN THE NEGATIVE-RESISTANCE REGION
shown under Type 1N3847 also apply to the 1N3856

World Radio History

Tunnel Diode

GERMANIUM P-ON-N REGION, EPITAXIAL TYPE

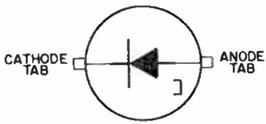
For Switching and Small-Signal Applications
Requiring Control (±5%) of Peak-Point Current
and Switching Times Greater than 600 Picoseconds

GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	0.270"
Maximum Width	0.130"
Maximum Height	0.055"
Case	Metal and Ceramic

Terminal Diagram (See *Dimensional Outline*):



The arrow indicates direction of forward current flow as indicated by dc ammeter.

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

DC CURRENT:			
Forward	I_F	10 max.	ma
Reverse	I_R	15 max.	ma
DISSIPATION:	P		
At free-air temperatures:			
From −35° to 25° C.		5 max.	mw
Above 25° C	*Derate linearly to 0 mw at 100° C*		
FREE-AIR TEMPERATURE RANGE:			
Operating	T_{OPR}	−35 to 100	°C
Storage	T_{STG}	−35 to 100	°C
TAB TEMPERATURE:[a]			
For 3 seconds maximum	T_T	175 max.	°C

Electrical Characteristics:

At free-air temperature = 25° C

		Min.	*Typical*	*Max.*	
Static:[b]					
Peak-Point Current	I_P	4.75	-	5.25	ma
Valley-Point Current	I_V	-	-	0.6	ma
Peak-Point-to-Valley-Point Current Ratio	I_P/I_V	8/1	-	-	
Peak-Point Voltage	V_P	50	-	90	mv
Valley-Point Voltage	V_V	330	-	-	mv
Positive Voltage at peak-point ma. = 5.25	$V_{F'}$	490	-	560	mv

World Radio History

		Min.	Typical	Max.	
Dynamic:[c]					
Terminal Valley-Point Capacitance[d].	C	–	–	8	pf
Total Series Resistance . .	R_S	–	–	3	ohms
Switching Time:					
Rise time[e].	t_r	–	600	–	psec

[a] See *Soldering Considerations.*

[b] See accompanying *Static-Forward-Characteristic* graph.

[c] See accompanying *Equivalent Circuit of a Tunnel Diode in the Negative-Resistance Region.*

[d] Includes case capacitance of 0.8 pf.

[e] Calculated rise time (approximate) for a germanium tunnel diode when switching from V_P to V_F at a constant value of I_P.

$$t_r \simeq \frac{C(V_F-V_P)}{(I_P-I_V)} \simeq \frac{C}{2\ I_P}$$

SOLDERING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
STATIC FORWARD CHARACTERISTIC
OF A TUNNEL DIODE,
and
EQUIVALENT CIRCUIT OF A TUNNEL DIODE
IN THE NEGATIVE-RESISTANCE REGION
shown under Type 1N3847 also apply to the 1N3857

World Radio History

1N3858

Tunnel Diode

GERMANIUM P-ON-N REGION, EPITAXIAL TYPE

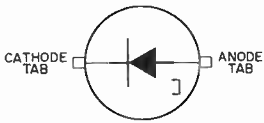
For Switching and Small-Signal Applications Requiring Control (±5%) of Peak-Point Current and Switching Times Greater than 300 Picoseconds

GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	0.270"
Maximum Width	0.130"
Maximum Height	0.055"
Case	Metal and Ceramic

Terminal Diagram (See *Dimensional Outline*):



The arrow indicates direction of forward current flow as indicated by dc ammeter.

SWITCHING SERVICE

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

DC CURRENT:			
Forward	I_F	18 max.	ma
Reverse	I_R	25 max.	ma
DISSIPATION:	P		
At free-air temperatures:			
From −35° to 25° C		10 max.	mw
Above 25° C	*Derate linearly to 0 mw at 100° C*		
FREE-AIR TEMPERATURE RANGE:			
Operating	T_{OPR}	−35 to 100	°C
Storage	T_{STG}	−35 to 100	°C
TAB TEMPERATURE:[a]			
For 3 seconds maximum	T_T	175 max.	°C

Electrical Characteristics:

At free-air temperature = 25° C

		Min.	*Typical*	*Max.*	
Static:[b]					
Peak-Point Current	I_P	9.5	–	10.5	ma
Valley-Point Current	I_V	–	–	1.2	ma
Peak-Point-to-Valley-Point Current Ratio	I_P/I_V	8/1	–	–	
Peak-Point Voltage	V_P	55	–	95	mv
Valley-Point Voltage	V_V	350	–	–	mv
Positive Voltage at peak-point ma. = 10.5	$V_{F'}$	510	–	580	mv

World Radio History

		Min.	*Typical*	*Max.*	
Dynamic:[c]					
Terminal Valley-Point Capacitance[d]	C	–	–	8	pf
Total Series Resistance . .	R_S	–	–	2.5	ohms
Switching Time:					
Rise time[e]	t_r	–	300	–	psec

[a] See *Soldering Considerations.*

[b] See accompanying *Static-Forward-Characteristic* graph.

[c] See accompanying *Equivalent Circuit of a Tunnel Diode in the Negative-Resistance Region.*

[d] Includes case capacitance of 0.8 pf.

[e] Calculated rise time (approximate) for a germanium tunnel diode when switching from V_P to V_F at a constant value of I_P.

$$t_r \simeq \frac{C(V_F - V_P)}{(I_P - I_V)} \simeq \frac{C}{2\ I_P}$$

SOLDERING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
STATIC FORWARD CHARACTERISTIC OF A TUNNEL DIODE,
and
EQUIVALENT CIRCUIT OF A TUNNEL DIODE IN THE NEGATIVE-RESISTANCE REGION
shown under Type 1N3847 also apply to the 1N3858

World Radio History

1N3859

Tunnel Diode

GERMANIUM P-ON-N REGION, EPITAXIAL TYPE

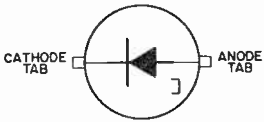
For Switching and Small-Signal Applications Requiring Control (±5%) of Peak-Point Current and Switching Times Greater than 200 Picoseconds

GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	0.270"
Maximum Width	0.130"
Maximum Height	0.055"
Case	Metal and Ceramic

Terminal Diagram (See *Dimensional Outline*):



The arrow indicates direction of forward current flow as indicated by dc ammeter.

SWITCHING SERVICE

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

DC CURRENT:			
Forward	I_F	35 max.	ma
Reverse	I_R	50 max.	ma
DISSIPATION:	P		
At free-air temperatures:			
From −35° to 25° C		20 max.	mw
Above 25° C	*Derate linearly to 0 mw at 100° C*		
FREE-AIR TEMPERATURE RANGE:			
Operating	T_{OPR}	−35 to 100	°C
Storage	T_{STG}	−35 to 100	°C
TAB TEMPERATURE:[a]			
For 3 seconds maximum	T_T	175 max.	°C

Electrical Characteristics:

At free-air temperature = 25° C

		Min.	*Typical*	*Max.*	
Static:[b]					
Peak-Point Current	I_P	19	–	21	ma
Valley-Point Current	I_V	–	–	2.4	ma
Peak-Point-to-Valley-Point Current Ratio	I_P/I_V	8/1	–	–	
Peak-Point Voltage	V_P	65	–	105	mv
Valley-Point Voltage	V_V	365	–	–	mv
Positive Voltage at peak-point ma. = 21	V_{FP}	530	–	600	mv

World Radio History

		Min.	Typical	Max.	
Dynamic:[c]					
Terminal Valley-Point					
Capacitance[d]	C	–	–	10	pf
Total Series Resistance . .	R_S	–	–	2	ohms
Switching Time:					
Rise time[e]	t_r	–	200	–	psec

[a] See *Soldering Considerations*.

[b] See accompanying *Static-Forward-Characteristic* graph.

[c] See accompanying *Equivalent Circuit of a Tunnel Diode in the Negative-Resistance Region*.

[d] Includes case capacitance of 0.8 pf.

[e] Calculated rise time (approximate) for a germanium tunnel diode when switching from V_P to V_F at a constant value of I_P.

$$t_r \simeq \frac{C(V_F - V_P)}{(I_P - I_V)} \simeq \frac{C}{2\ I_P}$$

SOLDERING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
STATIC FORWARD CHARACTERISTIC
OF A TUNNEL DIODE,
and
EQUIVALENT CIRCUIT OF A TUNNEL DIODE
IN THE NEGATIVE-RESISTANCE REGION
shown under Type 1N3847 also apply to the 1N3859

World Radio History

Tunnel Diode

GERMANIUM P-ON-N REGION, EPITAXIAL TYPE

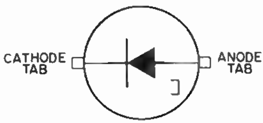
For Switching and Small-Signal Applications Requiring Control (± 5%) of Peak-Point Current and Switching Times Greater than 150 Picoseconds

GENERAL DATA

Mechanical:

Operating Position.	Any
Maximum Overall Length.	0.270"
Maximum Width	0.130"
Maximum Height.	0.055"
Case.	Metal and Ceramic

Terminal Diagram (See *Dimensional Outline*):



The arrow indicates direction of forward current flow as indicated by dc ammeter.

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

DC CURRENT:			
Forward	I_F	85 max.	ma
Reverse	I_R	125 max.	ma
DISSIPATION:	P		
At free-air temperatures:			
From -35° to 25° C.		50 max.	mw
Above 25° C		*Derate linearly to 0 mw at 100° C*	
FREE-AIR TEMPERATURE RANGE:			
Operating	T_{OPR}	-35 to 100	°C
Storage	T_{STG}	-35 to 100	°C
TAB TEMPERATURE:[a]			
For 3 seconds maximum	T_T	175 max.	°C

Electrical Characteristics:

At free-air temperature = 25° C

Static:[b]		*Min.*	*Typical*	*Max.*	
Peak-Point Current.	I_P	47.5	-	52.5	ma
Valley-Point Current.	I_V	-	-	6	ma
Peak-Point-to-Valley-Point Current Ratio	I_P/I_V	8/1	-	-	
Peak-Point Voltage.	V_P	80	-	130	mv
Valley-Point Voltage.	V_V	380	-	-	mv
Positive Voltage at peak-point ma. = 52.5.	V_F'	550	-	620	mv

World Radio History

		Min.	Typical	Max.	
Dynamic:[c]					
Terminal Valley-Point Capacitance[d]	C	–	–	12	pf
Total Series Resistance	R_S	–	–	1.5	ohms
Switching Time:					
Rise time[e]	t_r	–	150	–	psec

[a] See *Soldering Considerations.*

[b] See accompanying *Static-Forward-Characteristic* graph.

[c] See accompanying *Equivalent Circuit of a Tunnel Diode in the Negative-Resistance Region.*

[d] Includes case capacitance of 0.8 pf.

[e] Calculated rise time (approximate) for a germanium tunnel diode when switching from V_P to V_F at a constant value of I_P.

$$t_r \simeq \frac{C(V_F - V_P)}{(I_P - I_V)} \sim \frac{C}{2\ I_P}$$

SOLDERING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
STATIC FORWARD CHARACTERISTIC OF A TUNNEL DIODE,
and
EQUIVALENT CIRCUIT OF A TUNNEL DIODE IN THE NEGATIVE-RESISTANCE REGION
shown under Type 1N3847 also apply to the 1N3860

World Radio History

Tunnel Rectifier

GERMANIUM P-ON-N REGION, EPITAXIAL TYPE

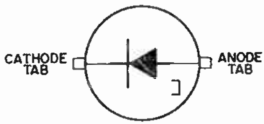
For use as Coupling Device in Memory Systems and other Switching Applications

GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	0.270"
Maximum Width	0.130"
Maximum Height	0.075"
Case	Metal and Ceramic

Terminal Diagram (See *Dimensional Outline*):



The arrow indicates direction of forward current flow as indicated by dc ammeter.

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

DC CURRENT:			
Forward	I_F	10 max.	ma
Reverse	I_R	30 max.	ma
DISSIPATION:	P		
At free-air temperatures:			
From -35° to 25° C.		10 max.	mw
Above 25° C		*Derate linearly to 0 mw at 100° C*	
FREE-AIR TEMPERATURE RANGE:			
Operating	T_{OPR}	-35 to 100	°C
Storage	T_{STG}	-35 to 100	°C
TAB TEMPERATURE:[a]			
For 3 seconds maximum	T_C	175 max.	°C

Electrical Characteristics:

At free-air temperature = 25° C

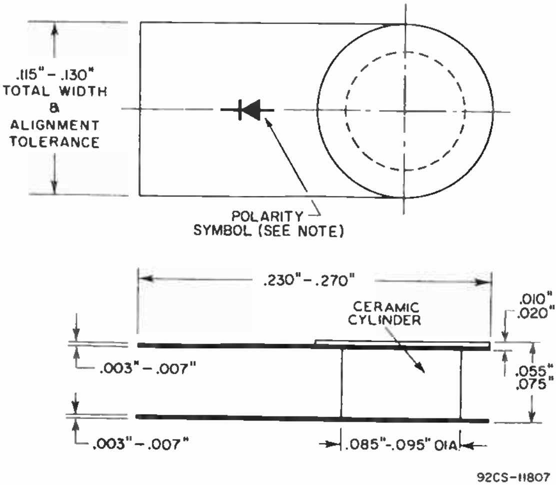
		Min.	*Max.*	
Peak-Point Current	I_P	0.1	1	ma
Reverse Voltage[b] for dc reverse ma. = 10	V_R	-	170	mv
Positive Voltage at peak-point ma. = 1	V_F	400	-	mv
Terminal Valley-Point Capacitance[c]	C	-	6	pf

[a] See *Soldering Considerations*.
[b] See accompanying *Static Characteristic of Tunnel Rectifier* graph.
[c] Includes case capacitance of 0.4 pf.

World Radio History

SOLDERING CONSIDERATIONS

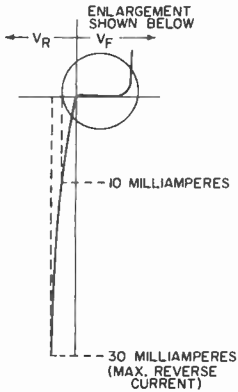
A low-temperature solder, (such as Alpha #111 alloy, rosin-filled, or equivalent) should be used. To minimize soldering time, a pre-tinned circuit board should be used. To protect the junction against overheating, the tunnel rectifier should be held with long-nose piliers.

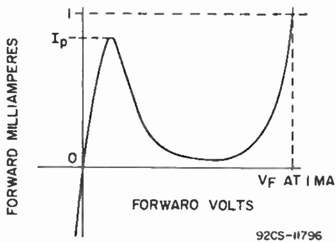


NOTE: ARROW INDICATES DIRECTION OF FORWARD CURRENT FLOW AS INDICATED BY DC AMMETER.

World Radio History

STATIC CHARACTERISTIC OF
A TUNNEL RECTIFIER





World Radio History

World Radio History

1N3862

Tunnel Rectifier

GERMANIUM P-ON-N REGION, EPITAXIAL TYPE

For use as Coupling Device in Memory Systems and other Switching Applications

The 1N3862 is the same as the 1N3861 except for the following items:

Electrical Characteristics:

At free-air temperature = 25° C

		Min.	Max.	
Reverse Voltage:[b]	V_R			
With dc reverse ma. = 10.		–	150	mv
With dc reverse ma. = 30.		–	300	mv
Positive Voltage at peak point ma. = 1. .	V_F	420	–	mv
Terminal Valley-Point Capacitance[c]. . .	C	–	4	pf

[b] See accompanying *Static Characteristic of Tunnel Rectifier* graph.
[c] Includes case capacitance of 0.4 pf.

World Radio History

World Radio History

Tunnel Rectifier

GERMANIUM P-ON-N REGION, EPITAXIAL TYPE

For use as Coupling Device in Memory Systems and other Switching Applications

The 1N3863 is the same as the 1N3861 except for the following items:

Electrical Characteristics:

At free-air temperature = 25° C

		Min.	Max.	
Peak-Point Current.	I_P	0.1	0.5	ma
Reverse Voltage:[b]	V_R			
With dc reverse ma. = 10.		-	150	mv
With dc reverse ma. = 30.		-	300	mv
Positive Voltage at peak point ma. = 1. .	V_F	435	-	mv
Terminal Valley-Point Capacitance[c]. . .	C	-	4	pf

[b] See accompanying *Static Characteristic of Tunnel Rectifier* graph.
[c] Includes case capacitance of 0.4 pf.

World Radio History

World Radio History

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

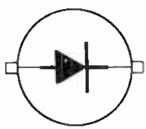
For Industrial and Military Equipment

Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position[a] . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Case:
  Material. . . . . .Insulating
  Material flammability . . . . .Self-Quenching
  Seals . . . . .Hermetic
Weight (Approx.). . . . . 2 oz
Terminal Diagram:



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet

PEAK REVERSE VOLTAGE (Repetitive)	1200 max.	volts
PEAK-TRANSIENT REVERSE VOLTAGE (Non-repetitive, for duration of 5-milliseconds maximum):		
At free-air temperature of +60° to +125° C.	1440 max.	volts
At other free-air temperatures.	See *Peak-Transient Reverse-Voltage Rating Chart*	
RMS SUPPLY VOLTAGE.	840 max.	volts
DC BLOCKING VOLTAGE	1200 max.	volts
AVERAGE FORWARD CURRENT:		
At free-air temperature of 60° C. . . .	850 max.	ma
At free-air temperature of 100° C . . .	350 max.	ma
At other free-air temperatures.	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT.	5 max.	amp

← Indicates a change.

World Radio History

PEAK SURGE CURRENT:[b]		
For one-half cycle, sine wave	15 max.	amp
For one or more cycles, sine wave . . See *Peak-Surge-Current Rating Chart*		
FREE-AIR TEMPERATURE RANGE:		
Operating and storage	-65 to +125	°C

Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum-rated operating conditions.	1.2	volts
Instantaneous Forward Voltage Drop. See *Instantaneous Forward Characteristics Curve*		
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle at maximum ratings)[c].	0.3	ma
DC (At maximum rated dc blocking voltage and any temperature within the operating temperature range).	0.6	ma
Shunt Capacitance:		
Maximum	600	pf
Minimum	350	pf

[a] See *Operating Considerations*.

[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[c] Example: For type CR101 at 60° C free-air temperature, average forward ma. = 850, peak reverse volts = 1200.

OPERATING CONSIDERATIONS

This high-voltage silicon rectifier can be mounted in any position. It is recommended that wherever possible this rectifier be mounted on a vertical surface to prevent an accumulation of dust on the surface between the rectifier terminals.

A *surge-limiting impedance* should always be used in series with the rectifier. The impedance value must be sufficient to limit the surge current to the value specified under the maximum ratings. This impedance may be provided by the power transformer windings, or by an external resistor or choke.

This rectifier is designed to operate at full ratings at altitudes up to 30,000 feet. For operation at altitudes above 10,000 feet, it is recommended that adequate spacing be provided between rectifiers and between rectifiers and other components (including the chassis and enclosure) to help prevent corona. If the applied voltage exceeds 5500 volts peak, the rectifiers should be mounted on 1-1/2-inch standoff insulators.

When several rectifiers are to be operated in series across a supply voltage of 20,000 volts peak or more, the protection afforded by the integral voltage-equalizing networks may not be adequate, depending on the circuit arrangement and the physical layout of the components. Consequently, additional protection against high transient voltages may be required in the design

World Radio History

of the equipment. For additional information on this subject, write to RCA, Commercial Engineering, Somerville, New Jersey.

Because this rectifier operates at voltages which are dangerous, care should be taken in the design and operation of the equipment to prevent personnel from coming in contact with the rectifier.

Connections to the solder lugs of this rectifier should be made with 16-gauge (or smaller diameter) wire. Care should be exercised during the soldering operation to prevent overheating of the rectifier terminals. A clean, well-tinned iron is recommended to keep soldering time to a minimum.

During a period of prolonged heating, for example, during lead unwrapping, a heat sink such as the jaws of a pair of long-nose pliers should be used between the tip of the soldering iron and the rectifier case.

MECHANICAL AND ENVIRONMENTAL TESTS

This silicon rectifier is designed to meet the following rigorous mechanical and environmental tests:

Shock:

MIL-STD-202B, method 202A
MIL-S-19500B, paragraph 40.10
The device is subjected to 5 blows in each of the orientations (X_1, Y_1, and Z_1) with an acceleration of 50 g and a duration of approximately 11 milliseconds.

Vibration Fatigue:

MIL-S-19500B, paragraph 40.1B
The device is subjected to a simple harmonic motion at any single frequency between 40 and 100 cycles per second with a constant peak acceleration of 20 g. The vibration shall be applied for 32 hours minimum in each of the orientations X_1, Y_1, and Z_1 (a total of 96 hours minimum).

Vibration, Variable Frequency:

MIL-S-19500B, paragraph 40.20

Barometric Pressure:

MIL-STD-202B, method 105B, Condition A
(Operation at altitude of 30,000 feet)
MIL-S-19500B, paragraph 40.1

Moisture Resistance:

MIL-STD-202B, method 106A
MIL-S-19500B, paragraph 40.6

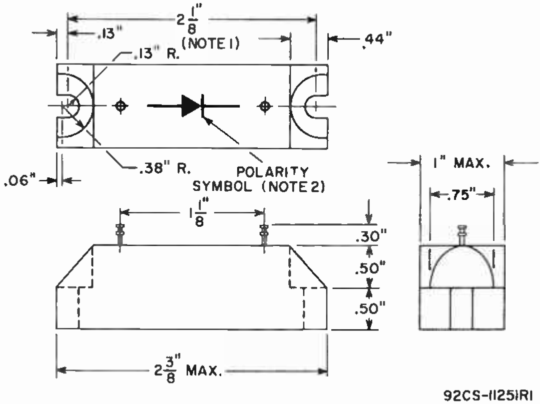
Salt Spray (Corrosion):

MIL-STD-202B, method 101A, Condition A
(Length of test—96 hours)
MIL-S-19500B, paragraph 40.9

Temperature Cycling:

MIL-STD-202B, method 102A, Condition C
MIL-S-19500B, paragraph 40.14

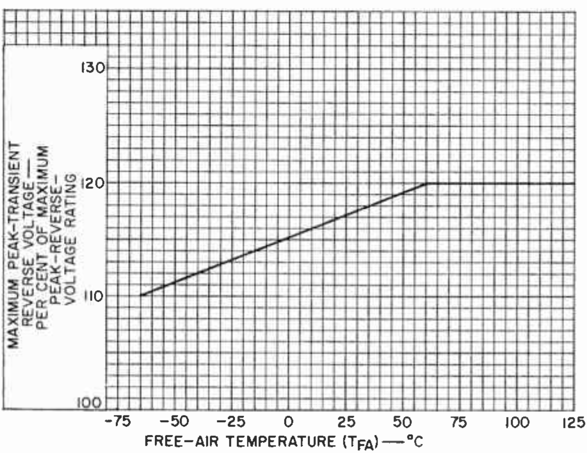
World Radio History



NOTE 1: DISTANCE BETWEEN CENTERS OF MOUNTING HOLES FOR 1/4"-DIAMETER BOLTS.

NOTE 2: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

PEAK-TRANSIENT REVERSE-VOLTAGE RATING CHART



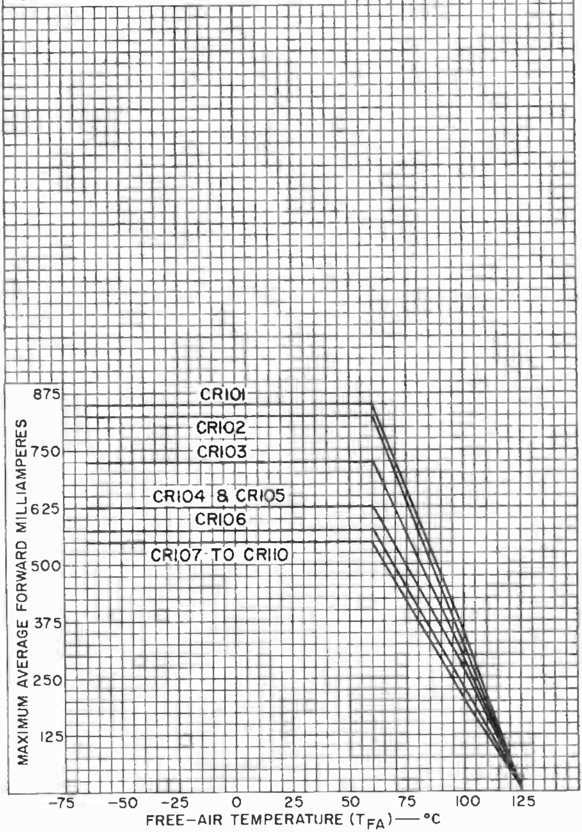
World Radio History

AVERAGE-FORWARD-CURRENT RATING CHART

FOR DC AND POLYPHASE OPERATION, MULTIPLY MAXIMUM-AVERAGE-FORWARD-CURRENT RATING FOR EACH RECTIFIER BY THE FOLLOWING FACTOR:

TYPE OF OPERATION	FACTOR
DIRECT CURRENT	1.10
THREE PHASE	0.89
SIX PHASE	0.68

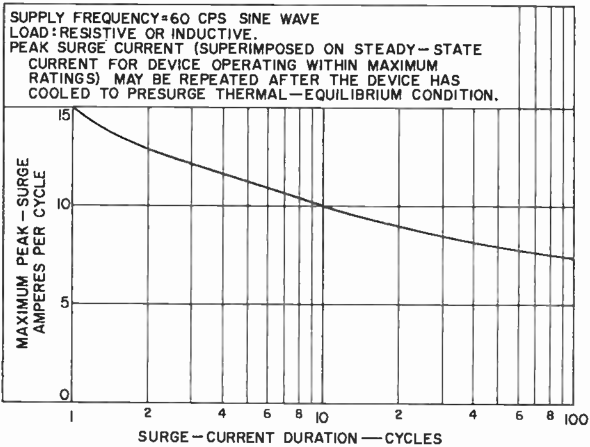
LOAD: RESISTIVE OR INDUCTIVE.



92CM-11794

World Radio History

PEAK-SURGE-CURRENT RATING CHART



92CS-11123R1

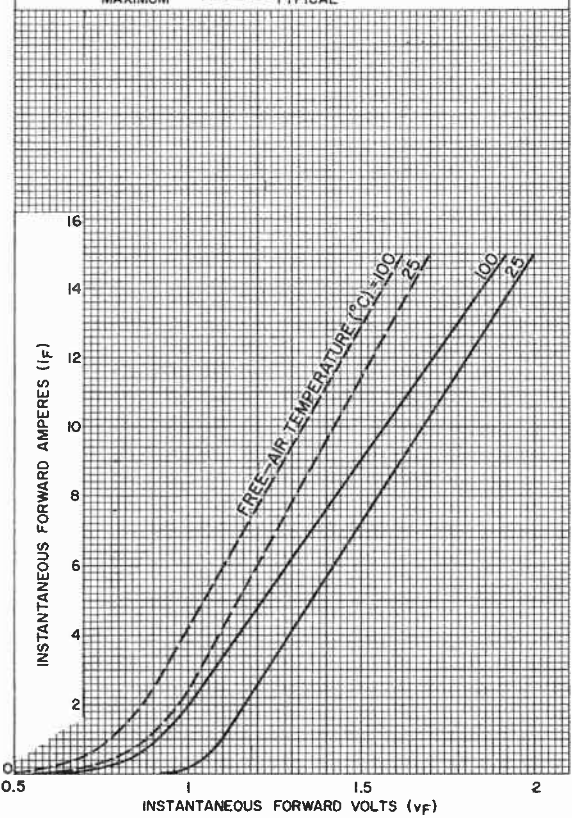
World Radio History

INSTANTANEOUS FORWARD CHARACTERISTICS
Typical and Maximum Values

TO DETERMINE v_F FOR EACH RECTIFIER TYPE: MULTIPLY VALUE GIVEN AT INTERSECTION OF CURVE FOR THE APPROPRIATE TEMPERATURE WITH THE DESIRED VALUE i_F BY THE FOLLOWING FACTOR:

RCA TYPE	FACTOR	RCA TYPE	FACTOR
CR101	2	CR106	10
CR102	4	CR107	12
CR103	5	CR108	13
CR104	7	CR109	15
CR105	8	CR110	16

—— MAXIMUM   — — — TYPICAL



92CM-11122R1

World Radio History

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

For Industrial and Military Equipment

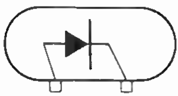
Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position[a]	Any
Dimensions	See *Dimensional Outline*
Case:	
Material	Insulating
Material flammability	Self-Quenching
Seals	Hermetic
Weight (Approx.)	2 oz

Terminal Diagram:



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet

PEAK INVERSE VOLTAGE	1200 max.	volts
RMS SUPPLY VOLTAGE	840 max.	volts
DC BLOCKING VOLTAGE	1200 max.	volts
AVERAGE FORWARD CURRENT:		
At ambient temperature of 60° C	825 max.	ma
At ambient temperature of 100° C	320 max.	ma
At other ambient temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	5 max.	amp
PEAK SURGE CURRENT:[b]		
For one-half cycle, sine wave	15 max.	amp
For one or more cycles	See *Peak-Surge-Current Rating Chart*	
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +125	°C

World Radio History

Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum-rated operating conditions	1.2	volts
Instantaneous Forward Voltage Drop	See *Instantaneous Forward Characteristics Curve*	
Maximum Reverse Current:		
Dynamic (averaged over one complete cycle at maximum ratings)[c]	0.3	ma
DC at maximum rated dc blocking voltage and any temperature within the operating temperature range	0.6	ma
Shunt Capacitance:		
Maximum	600	$\mu\mu f$
Minimum	350	$\mu\mu f$

[a] See *Operating Considerations*.

[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[c] Example: For type CR101 at 60° C ambient temperature, average forward ma. = 825, peak inverse volts = 1200.

OPERATING CONSIDERATIONS

This high-voltage silicon rectifier can be mounted in any position. It is recommended that wherever possible this rectifier be mounted on a vertical surface to prevent an accumulation of dust on the surface between the rectifier terminals.

A *surge-limiting impedance* should always be used in series with the rectifier. The impedance value must be sufficient to limit the surge current to the value specified under the maximum ratings. This impedance may be provided by the power transformer windings, or by an external resistor or choke.

This rectifier is designed to operate at full ratings at altitudes up to 30,000 feet. For operation at altitudes above 10,000 feet, it is recommended that adequate spacing be provided between rectifiers and between rectifiers and other components (including the chassis and enclosure) to help prevent corona. If the applied voltage exceeds 5500 volts peak, the rectifiers should be mounted on 1-1/2-inch standoff insulators.

When several rectifiers are to be operated in series across a supply voltage of 20,000 volts peak or more, the protection afforded by the integral voltage-equalizing networks may not be adequate, depending on the circuit arrangement and the physical layout of the components. Consequently, additional protection against high transient voltages may be required in the design of the equipment. For additional information on this subject, write to RCA, Commercial Engineering, Somerville, New Jersey.

World Radio History

Because this rectifier operates at voltages which are dangerous, care should be taken in the design and operation of the equipment to prevent personnel from coming in contact with the rectifier.

Connections to the solder lugs of this rectifier should be made with 16-gauge (or smaller diameter) wire. Care should be exercised during the soldering operation to prevent over-heating of the rectifier terminals. A clean, well-tinned iron is recommended to keep soldering time to a minimum.

During a period of prolonged heating, for example, during lead unwrapping, a heat sink such as the jaws of a pair of long-nose pliers should be used between the tip of the soldering iron and the rectifier case.

MECHANICAL AND ENVIRONMENTAL TESTS

This silicon rectifier is designed to meet the following rigorous mechanical and environmental tests:

Shock:

MIL-STD-202B, method 202A
MIL-S-19500B, paragraph 40.10
The device is subjected to 5 blows in each of the orientations (X_1, Y_1, and Z_1) with an acceleration of 50 g and a duration of approximately 11 milliseconds.

Vibration Fatigue:

MIL-S-19500B, paragraph 40.18
The device is subjected to a simple harmonic motion at any single frequency between 40 and 100 cycles per second with a constant peak acceleration of 20 g. The vibration shall be applied for 32 hours minimum in each of the orientations X_1, Y_1, and Z_1 (a total of 96 hours minimum).

Vibration, Variable Frequency:

MIL-S-19500B, paragraph 40.20

Barometric Pressure:

MIL-STD-202B, method 105B, Condition A
(Operation at altitude of 30,000 feet)
MIL-S-19500B, paragraph 40.1

Moisture Resistance:

MIL-STD-202B, method 106A
MIL-S-19500B, paragraph 40.6

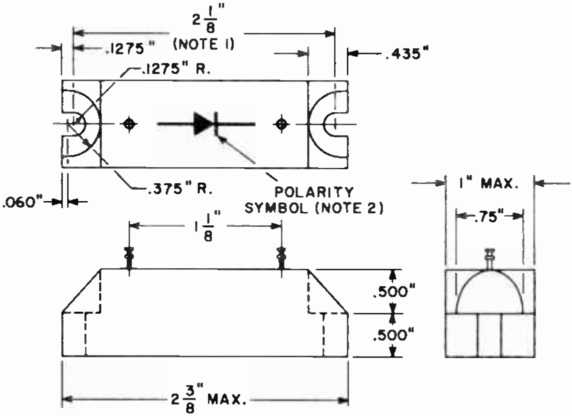
Salt Spray (Corrosion):

MIL-STD-202B, method 101A, Condition A
(Length of test—96 hours)
MIL-S-19500B, paragraph 40.9

Temperature Cycling:

MIL-STD-202B, method 102A, Condition C
MIL-S-19500B, paragraph 40.14

World Radio History



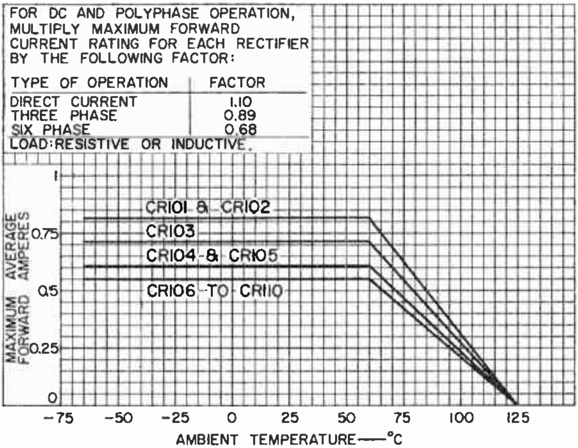
92CS-11251

NOTE 1: DISTANCE BETWEEN CENTERS OF MOUNTING HOLES FOR 1/4"-DIAMETER BOLTS.

NOTE 2: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

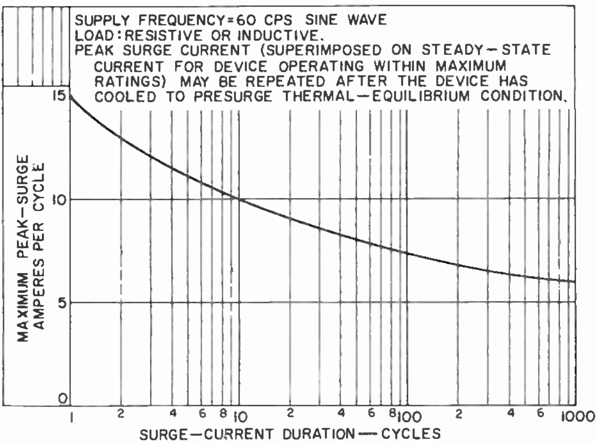
World Radio History

AVERAGE-FORWARD-CURRENT RATING CHART



92CS-11124R1

PEAK-SURGE-CURRENT RATING CHART



92CS-11123

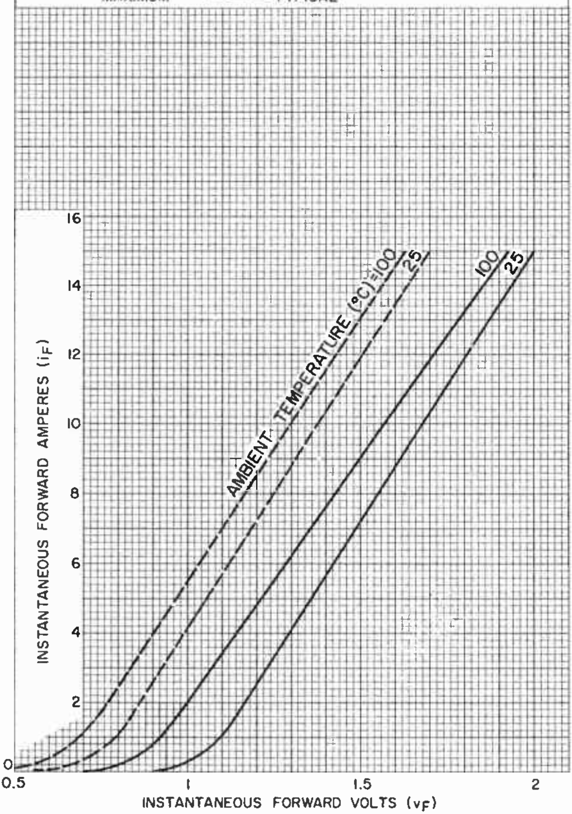
World Radio History

INSTANTANEOUS FORWARD CHARACTERISTICS
Typical and Maximum Values

TO DETERMINE v_F FOR EACH RECTIFIER TYPE: MULTIPLY VALUE GIVEN AT INTERSECTION OF CURVE FOR THE APPROPRIATE TEMPERATURE WITH THE DESIRED VALUE i_F BY THE FOLLOWING FACTOR:

RCA TYPE	FACTOR	RCA TYPE	FACTOR
CR101	2	CR106	10
CR102	4	CR107	12
CR103	5	CR108	13
CR104	7	CR109	15
CR105	8	CR110	16

——— MAXIMUM   — — — TYPICAL



92CM-11122

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

For Industrial and Military Equipment

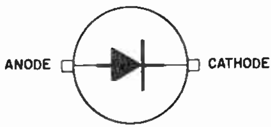
Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position[a]	Any
Dimensions	See *Dimensional Outline*
Case:	
Material	Insulating
Material flammability	Self-Quenching
Seals	Hermetic
Weight (Approx.)	2 oz

Terminal Diagram:



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet

PEAK REVERSE VOLTAGE (Repetitive)	2000 max.	volts
PEAK-TRANSIENT REVERSE VOLTAGE (Non-repetitive, for duration of 5-milliseconds maximum):		
At free-air temperature of +60° to +125° C	2400 max.	volts
At other free-air temperatures	See *Peak-Transient Reverse-Voltage Rating Chart*	
RMS SUPPLY VOLTAGE	1400 max.	volts
DC BLOCKING VOLTAGE	2000 max.	volts
AVERAGE FORWARD CURRENT:		
At free-air temperature of 60° C	825 max.	ma
At free-air temperature of 100° C	325 max.	ma
At other free-air temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	5 max.	amp

← Indicates a change.

World Radio History

PEAK SURGE CURRENT:[b]

For one-half cycle, sine wave	15 max.	amp
For one or more cycles, sine wave . .See *Peak-Surge-Current Rating Chart*		

FREE-AIR TEMPERATURE RANGE:

Operating and storage	-65 to +125	°C

Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum rated operating conditions.	2.4	volts
Instantaneous Forward Voltage Drop. .See *Instantaneous Forward Characteristics Curve*		
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle at maximum ratings)[c].	0.3	ma
DC (At maximum rated dc blocking voltage and any temperature within the operating temperature range).	0.6	ma
Shunt Capacitance:		
Maximum	320	pf
Minimum	175	pf

[a] See *Operating Considerations*.

[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[c] Example: For type CR102 at 60° C free-air temperature, average forward ma. = 825, peak reverse volts = 2000.

OPERATING CONSIDERATIONS,
MECHANICAL AND ENVIRONMENTAL TESTS,
DIMENSIONAL OUTLINE,
RATING CHARTS,
and
CURVES
shown under type CR101 also apply to the CR102

World Radio History

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

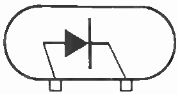
For Industrial and Military Equipment

Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position[a] . . . . Any
Dimensions . . . . See *Dimensional Outline*
Case:
  Material . . . . Insulating
  Material flammability . . . . Self-Quenching
  Seals . . . . Hermetic
Weight (Approx.) . . . . 2 oz
Terminal Diagram:



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet

PEAK INVERSE VOLTAGE	2000 max.	volts
RMS SUPPLY VOLTAGE	1400 max.	volts
DC BLOCKING VOLTAGE	2000 max.	volts
AVERAGE FORWARD CURRENT:		
At ambient temperature of 60° C	825 max.	ma
At ambient temperature of 100° C	320 max.	ma
At other ambient temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	5 max.	amp
PEAK SURGE CURRENT:[b]		
For one-half cycle, sine wave	15 max.	amp
For one or more cycles	See *Peak-Surge-Current Rating Chart*	
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +125	°C

World Radio History

Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum rated operating conditions. . .	2.4	volts
Instantaneous Forward Voltage Drop . See *Instantaneous Forward Characteristics Curve*		
Maximum Reverse Current:		
Dynamic (averaged over one complete cycle at maximum ratings)[c].	0.3	ma
DC at maximum rated dc blocking voltage and any temperature within the operating temperature range	0.6	ma
Shunt Capacitance:		
Maximum	320	$\mu\mu$f
Minimum	175	$\mu\mu$f

[a] See *Operating Considerations*.

[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[c] Example: For type CR102 at 60° C ambient temperature, average forward ma. = 825, peak inverse volts = 2000.

**OPERATING CONSIDERATIONS,
MECHANICAL AND ENVIRONMENTAL TESTS,
DIMENSIONAL OUTLINE,
RATING CHARTS,
and
CURVES
Shown under Type CR101 also apply to the CR102**

World Radio History

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

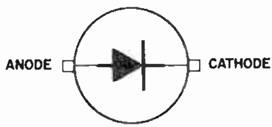
For Industrial and Military Equipment

Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position* . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Case:
  Material. . . . . .Insulating
  Material flammability . . . . .Self-Quenching
  Seals . . . . Hermetic
Weight (Approx.). . . . . 2.1 oz ←
Terminal Diagram: ←



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet

PEAK REVERSE VOLTAGE (Repetitive) . . . . . 3000 max. volts
PEAK-TRANSIENT REVERSE VOLTAGE ←
  (Non-repetitive, for duration of 5-milliseconds maximum):
  At free-air temperatures of +60° to +125° C. 3600 max. volts
  At other free-air temperatures. . . . . .See *Peak-Transient Reverse-Voltage Rating Chart*
RMS SUPPLY VOLTAGE. . . . . 2100 max. volts
DC BLOCKING VOLTAGE . . . . 3000 max. volts
AVERAGE FORWARD CURRENT: ←
  At free-air temperature of 60° C. . . . . 725 max. ma
  At free-air temperature of 100° C . . . . 300 max. ma
  At other free-air temperatures. . . . . See *Average-Forward-Current Rating Chart*
PEAK RECURRENT CURRENT. . . . . 5 max. amp

← Indicates a change.

World Radio History

PEAK SURGE CURRENT:[b]		
For one-half cycle, sine wave.	15 max.	amp
For one or more cycles, sine wave. .	See *Peak-Surge-Current Rating Chart*	
FREE-AIR TEMPERATURE RANGE:		
Operating and storage.	-65 to +125	°C

Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum rated operating conditions	3	volts
Instantaneous Forward Voltage Drop .	See *Instantaneous Forward Characteristics Curve*	
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle at maximum ratings)[c]	0.3	ma
DC (At maximum rated dc blocking voltage and any temperature within the operating temperature range) . . .	0.6	ma
Shunt Capacitance:		
Maximum.	250	pf
Minimum.	140	pf

[a] See *Operating Considerations*.

[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[c] Example: For type CR103 at 60° C free-air temperature, average forward ma. = 725, peak reverse volts = 3000.

**OPERATING CONSIDERATIONS,
MECHANICAL AND ENVIRONMENTAL TESTS,
DIMENSIONAL OUTLINE,
RATING CHARTS,
and
CURVES
shown under type CR101 also apply to the CR103**

World Radio History

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

For Industrial and Military Equipment

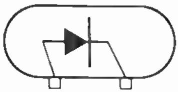
Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position[a]	Any
Dimensions	See *Dimensional Outline*
Case:	
Material	Insulating
Material flammability	Self-Quenching
Seals	Hermetic
Weight (Approx.)	2 oz

Terminal Diagram:



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet

PEAK INVERSE VOLTAGE	3000 max.	volts
RMS SUPPLY VOLTAGE	2100 max.	volts
DC BLOCKING VOLTAGE	3000 max.	volts
AVERAGE FORWARD CURRENT:		
At ambient temperature of 60° C	715 max.	ma
At ambient temperature of 100° C	275 max.	ma
At other ambient temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	5 max.	amp
PEAK SURGE CURRENT:[b]		
For one-half cycle, sine wave	15 max.	amp
For one or more cycles	See *Peak-Surge-Current Rating Chart*	
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +125	°C

World Radio History

Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum rated operating conditions. . .	3	volts
Instantaneous Forward Voltage Drop . See *Instantaneous Forward Characteristics Curve*		
Maximum Reverse Current:		
Dynamic (averaged over one complete cycle at maximum ratings)[c].	0.3	ma
DC at maximum rated dc blocking voltage and any temperature within the operating temperature range	0.6	ma
Shunt Capacitance:		
Maximum	250	μμf
Minimum	140	μμf

[a] See *Operating Considerations*.

[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[c] Example: For type CR103 at 60° C ambient temperature, average forward ma. = 715, peak inverse volts = 3000.

OPERATING CONSIDERATIONS,
MECHANICAL AND ENVIRONMENTAL TESTS,
DIMENSIONAL OUTLINE,
RATING CHARTS,
and
CURVES
Shown under Type CR101 also apply to the CR103

World Radio History

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

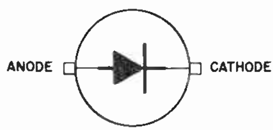
For Industrial and Military Equipment

Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position[a] . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Case:
  Material. . . . . .Insulating
  Material flammability . . . . .Self-Quenching
  Seals . . . . .Hermetic
Weight (Approx.). . . . . 3 oz ←
Terminal Diagram: ←



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet

PEAK REVERSE VOLTAGE (Repetitive)	4000 max.	volts
PEAK-TRANSIENT REVERSE VOLTAGE (Non-repetitive, for duration of 5-milliseconds maximum): ←		
At free-air temperature of +60° to +125° C.	4800 max.	volts
At other free-air temperatures.	See *Peak Transient Reverse Voltage Rating Chart*	
RMS SUPPLY VOLTAGE.	2800 max.	volts
DC BLOCKING VOLTAGE	4000 max.	volts
AVERAGE FORWARD CURRENT: ←		
At free-air temperature of 60° C. . . .	625 max.	ma
At free-air temperature of 100° C . . .	275 max.	ma
At other free-air temperatures. . . .	See *Average-Forward-Current Rating Chart*	

← Indicates a change.

PEAK RECURRENT CURRENT.	5 max.	amp
PEAK SURGE CURRENT:[b]		
For one-half cycle, sine wave	15 max.	amp
For one or more cycles, sine wave . .	See *Peak-Surge-Current Rating Chart*	
FREE-AIR TEMPERATURE RANGE:		
Operating and storage	-65 to +125	°C

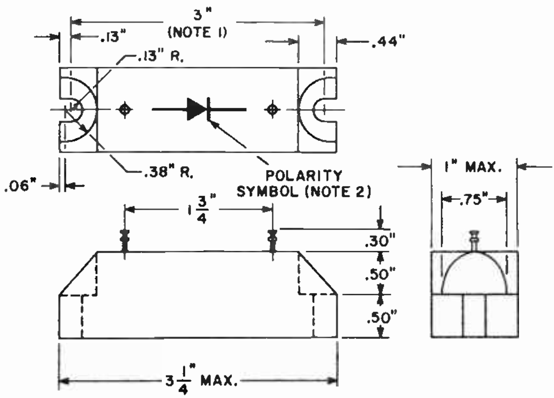
Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum rated operating conditions.	4.2	volts
Instantaneous Forward Voltage Drop. .	See *Instantaneous Forward Characteristics Curve*	
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle at maximum ratings)[c].	0.3	ma
DC (At maximum rated dc blocking voltage and any temperature within the operating temperature range). . .	0.6	ma
Shunt Capacitance:		
Maximum	175	pf
Minimum	100	pf

[a] See *Operating Considerations.*

[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[c] Example: For type CR104 at 60° C free-air temperature, average forward ma. = 625, peak reverse volts = 4000.



92CS-11243R1

NOTE 1: DISTANCE BETWEEN CENTERS OF MOUNTING HOLES FOR 1/4"-DIAMETER BOLTS.

NOTE 2: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

World Radio History

OPERATING CONSIDERATIONS,
MECHANICAL AND ENVIRONMENTAL TESTS,
RATING CHARTS,
and
CURVES
shown under type CR101 also apply to the CR104

World Radio History

World Radio History

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

For Industrial and Military Equipment

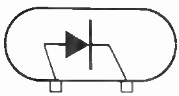
Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position[a]	Any
Dimensions	See *Dimensional Outline*
Case:	
Material	Insulating
Material flammability	Self-Quenching
Seals	Hermetic
Weight (Approx.)	2.9 oz

Terminal Diagram:



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet

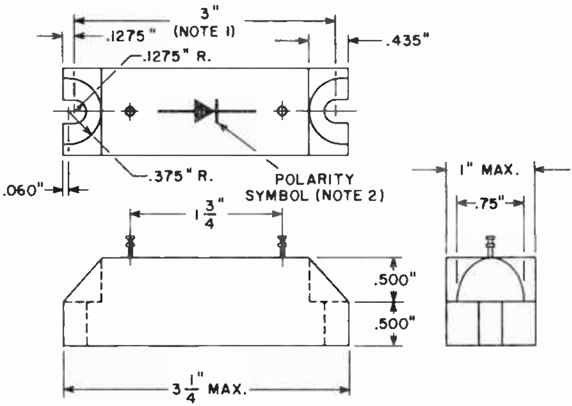
PEAK INVERSE VOLTAGE	4000 max.	volts
RMS SUPPLY VOLTAGE	2800 max.	volts
DC BLOCKING VOLTAGE	4000 max.	volts
AVERAGE FORWARD CURRENT:		
At ambient temperature of 60° C	605 max.	ma
At ambient temperature of 100° C	235 max.	ma
At other ambient temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	5 max.	amp
PEAK SURGE CURRENT:[b]		
For one-half cycle, sine wave	15 max.	amp
For one or more cycles	See *Peak-Surge-Current Rating Chart*	
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +125	°C

World Radio History

Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum rated operating conditions. . .	4.2	volts
Instantaneous Forward Voltage Drop	See *Instantaneous Forward Characteristics Curve*	
Maximum Reverse Current:		
Dynamic (averaged over one complete cycle at maximum ratings)[c].	0.3	ma
DC at maximum rated dc blocking voltage and any temperature within the operating temperature range	0.6	ma
Shunt Capacitance:		
Maximum	175	μμf
Minimum	100	μμf

[a] See *Operating Considerations.*
[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.
[c] Example: For type CR104 at 60° C ambient temperature, average forward ma. = 605, peak inverse volts = 4000.



92CS-11243

NOTE 1: DISTANCE BETWEEN CENTERS OF MOUNTING HOLES FOR 1/4"-DIAMETER BOLTS.

NOTE 2: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

**OPERATING CONSIDERATIONS,
MECHANICAL AND ENVIRONMENTAL TESTS,
RATING CHARTS,
and
CURVES
Shown under Type CR101 also apply to type CR104**

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

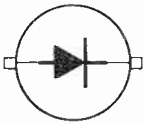
For Industrial and Military Equipment

Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position[a]	Any
Dimensions	See *Dimensional Outline*
Case:	
Material	Insulating
Material flammability	Self-Quenching
Seals	Hermetic
Weight (Approx.)	3.1 oz ←
Terminal Diagram:	←



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet

PEAK REVERSE VOLTAGE (Repetitive)	5000 max.	volts
PEAK-TRANSIENT REVERSE VOLTAGE (Non-repetitive, for duration of 5-milliseconds maximum): ←		
At free-air temperature of +60° to +125° C.	6000 max.	volts
At other free-air temperatures	See *Peak Transient Reverse Voltage Rating Chart*	
RMS SUPPLY VOLTAGE	3500 max.	volts
DC BLOCKING VOLTAGE	5000 max.	volts
AVERAGE FORWARD CURRENT: ←		
At free-air temperature of 60° C.	625 max.	ma
At free-air temperature of 100° C	275 max.	ma
At other free-air temperatures	See *Average-Forward-Current Rating Chart*	

←Indicates a change.

World Radio History

PEAK RECURRENT CURRENT.	5 max.	amp
PEAK SURGE CURRENT:[b]		
For one-half cycle, sine-wave	15 max.	amp
For one or more cycles, sine wave . .	See *Peak-Surge-Current Rating Chart*	
FREE-AIR TEMPERATURE RANGE:		
Operating and storage	-65 to +125	°C

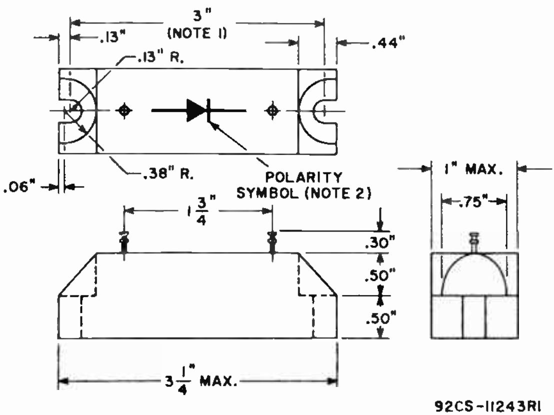
Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum rated operating conditions.	4.8	volts
Instantaneous Forward Voltage Drop. .	See *Instantaneous Forward Characteristics Curve*	
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle at maximum ratings)[c].	0.3	ma
DC (At maximum rated dc blocking voltage and any temperature within the operating temperature range). . .	0.6	ma
Shunt Capacitance:		
Maximum	160	pf
Minimum	85	pf

[a] See *Operating Considerations*.

[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[c] Example: For type CR105 at 60° C free-air temperature, average forward ma. = 625, peak reverse volts = 5000.



NOTE 1: DISTANCE BETWEEN CENTERS OF MOUNTING HOLES FOR 1/4"-DIAMETER BOLTS.

NOTE 2: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

World Radio History

OPERATING CONSIDERATIONS,
MECHANICAL AND ENVIRONMENTAL TESTS,
RATING CHARTS,
and
CURVES
shown under type CR101 also apply to the CR105

World Radio History

World Radio History

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

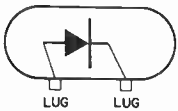
For Industrial and Military Equipment

Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position[a]	Any
Dimensions	See *Dimensional Outline*
Case:	
Material	Insulating
Material flammability	Self-Quenching
Seals	Hermetic
Weight (Approx.)	2.9 oz
Terminal Diagram:	



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet

PEAK INVERSE VOLTAGE	5000 max.	volts
RMS SUPPLY VOLTAGE	3500 max.	volts
DC BLOCKING VOLTAGE	5000 max.	volts
AVERAGE FORWARD CURRENT:		
At ambient temperature of 60° C	605 max.	ma
At ambient temperature of 100° C	235 max.	ma
At other ambient temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	5 max.	amp
PEAK SURGE CURRENT:[b]		
For one-half cycle, sine-wave	15 max.	amp
For one or more cycles	See *Peak-Surge-Current Rating Chart*	
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +125	°C

World Radio History

CR105

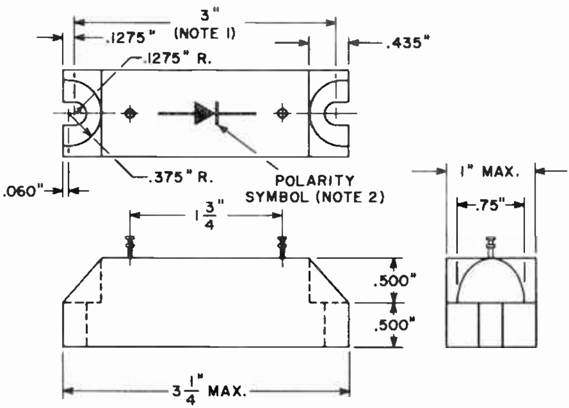
Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum rated operating conditions. . .	4.8	volts
Instantaneous Forward Voltage Drop . See *Instantaneous Forward Characteristics Curve*		
Maximum Reverse Current:		
Dynamic (averaged over one complete cycle at maximum ratings)[c].	0.3	ma
DC at maximum rated dc blocking voltage and any temperature within the operating temperature range	0.6	ma
Shunt Capacitance:		
Maximum	160	μμf
Minimum	85	μμf

[a] See *Operating Considerations*.

[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[c] Example: For type CR105 at 60° C ambient temperature, average forward ma. = 605, peak inverse volts = 5000.



92CS-11243

NOTE 1: DISTANCE BETWEEN CENTERS OF MOUNTING HOLES FOR 1/4"-DIAMETER BOLTS.

NOTE 2: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

OPERATING CONSIDERATIONS,
MECHANICAL AND ENVIRONMENTAL TESTS,
RATING CHARTS,
and
CURVES
Shown under Type CR101 also apply to the CR105

World Radio History

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

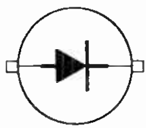
For Industrial and Military Equipment

Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position[a] . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Case:
  Material. . . . . .Insulating
  Material flammability . . . . .Self-Quenching
  Seals . . . . .Hermetic
Weight (Approx.). . . . . 4.2 oz
Terminal Diagram: ←



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet.

PEAK REVERSE VOLTAGE (Repetitive)	6000 max.	volts
PEAK-TRANSIENT REVERSE VOLTAGE ←		
(Non-repetitive, for duration of 5-milliseconds maximum):		
At free-air temperature of +60° to +125° C .	4200 max.	volts
At other free-air temperatures.	See *Peak Transient Reverse Voltage Rating Chart*	
RMS SUPPLY VOLTAGE.	4200 max.	volts
DC BLOCKING VOLTAGE	6000 max.	volts
AVERAGE FORWARD CURRENT: ←		
At free-air temperature of 60° C.	575 max.	ma
At free-air temperature of 100° C.	225 max.	ma
At other free-air temperatures.	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT.	5 max.	amp

← Indicates a change.

World Radio History

PEAK SURGE CURRENT:[b]
For one-half cycle, sine wave . . . . . 15 max. amp
For one or more cycles, sine wave . . See *Peak-Surge-Current Rating Chart*

FREE-AIR TEMPERATURE RANGE:
Operating and Storage . . . . -65 to +125 °C

Characteristics:

Maximum Full-Cycle Average Forward Voltage
Drop at maximum rated operating conditions. . . 6 volts
Instantaneous Forward Voltage Drop. . See *Instantaneous Forward Characteristics Curve*

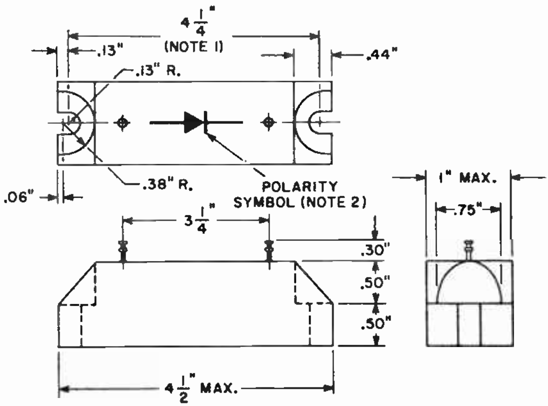
Maximum Reverse Current:
Dynamic (Averaged over one complete cycle at maximum ratings)[c]. . . . . 0.3 ma
DC (At maximum rated dc blocking voltage and any temperature within the operating temperature range). . . . . 0.6 ma

Shunt Capacitance:
Maximum . . . . 125 pf
Minimum . . . . 70 pf

[a] See *Operating Considerations.*

[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[c] Example: For type CR106 at 60° C free-air temperature, average forward ma. = 575, peak reverse volts = 6000.



92CS-11249R1

NOTE 1: DISTANCE BETWEEN CENTERS OF MOUNTING HOLES FOR 1/4"-DIAMETER BOLTS.

NOTE 2: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

World Radio History

OPERATING CONSIDERATIONS,
MECHANICAL AND ENVIRONMENTAL TESTS,
RATING CHARTS,
and
CURVES
shown under type CR101 also apply to the CR106

World Radio History

World Radio History

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

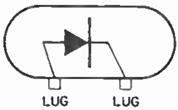
For Industrial and Military Equipment

Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position[a] . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Case:
  Material. . . . . .Insulating
  Material flammability . . . . .Self-Quenching
  Seals . . . . .Hermetic
Weight (Approx.). . . . . 4.2 oz
Terminal Diagram:



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet.

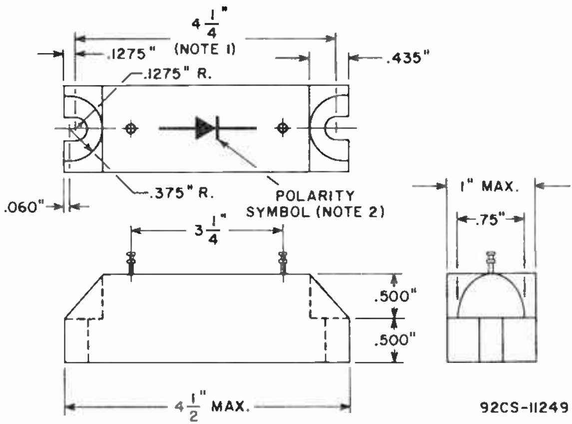
PEAK INVERSE VOLTAGE.	6000 max.	volts
RMS SUPPLY VOLTAGE.	4200 max.	volts
DC BLOCKING VOLTAGE	6000 max.	volts
AVERAGE FORWARD CURRENT:		
At ambient temperature of 60° C	550 max.	ma
At ambient temperature of 100° C	210 max.	ma
At other ambient temperatures . See *Average-Forward-Current Rating Chart*		
PEAK RECURRENT CURRENT.	5 max.	amp
PEAK SURGE CURRENT:[b]		
For one-half cycle, sine wave	15 max.	amp
For one or more cycles. See *Peak-Surge-Current Rating Chart*		
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +125	°C

World Radio History

Characteristics:

Maximum Full-Cycle Average Forward Voltage
Drop at maximum rated operating conditions. . . 6 volts
Instantaneous Forward Voltage Drop . See *Instantaneous Forward Characteristics Curve*
Maximum Reverse Current:
Dynamic (averaged over one complete cycle at maximum ratings)[c]. . . . . 0.3 ma
DC at maximum rated dc blocking voltage and any temperature within the operating temperature range . . . . 0.6 ma
Shunt Capacitance:
Maximum . . . . 125 $\mu\mu f$
Minimum . . . . 70 $\mu\mu f$

[a] See *Operating Considerations*.
[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.
[c] Example: For type CR106 at 60° C ambient temperature, average forward ma. = 550, peak inverse volts = 6000.



NOTE 1: DISTANCE BETWEEN CENTERS OF MOUNTING HOLES FOR 1/4"-DIAMETER BOLTS.

NOTE 2: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

OPERATING CONSIDERATIONS,
MECHANICAL AND ENVIRONMENTAL TESTS,
RATING CHARTS,
and
CURVES
Shown under Type CR101 also apply to the CR106

World Radio History

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

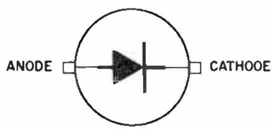
For Industrial and Military Equipment

Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position[a] . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Case:
  Material. . . . . .Insulating
  Material flammability . . . . .Self-Quenching
  Seals . . . . .Hermetic
Weight (Approx.). 4.4 oz ←
Terminal Diagram: ←



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet

PEAK REVERSE VOLTAGE (Repetitive) . . . . 7000 max. volts
PEAK-TRANSIENT REVERSE VOLTAGE ←
  (Non-repetitive, for duration of 5-milliseconds maximum):
  At free-air temperature of +60° to +125° C. . . . . 8400 max. volts
  At other free-air temperatures. . . . . .See *Peak Transient Reverse Voltage Rating Chart*
RMS SUPPLY VOLTAGE. . . . . 4900 max. volts
DC BLOCKING VOLTAGE . . . . 7000 max. volts
AVERAGE FORWARD CURRENT:
  At free-air temperature of 60° C. . . . 550 max. ma
  At free-air temperature of 100° C . . . 210 max. ma
  At other free-air temperatures. . . . .See *Average-Forward-Current Rating Chart*

← indicates a change.

World Radio History

PEAK RECURRENT CURRENT.	5 max.	amp
PEAK SURGE CURRENT:[b]		
For one-half cycle, sine wave	15 max.	amp
For one or more cycles, sine wave . .	See *Peak-Surge-Current Rating Chart*	
FREE-AIR TEMPERATURE RANGE:		
Operating and storage	-65 to +125	°C

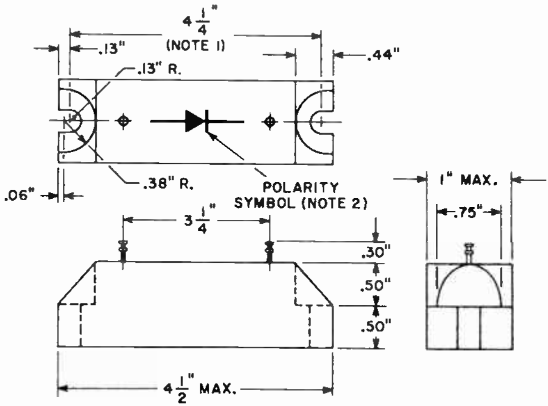
Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum rated operating conditions.	7.2	volts
Instantaneous Forward Voltage Drop. .	See *Instantaneous Forward Characteristics Curve*	
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle at maximum ratings)[c].	0.3	ma
DC (At maximum rated dc blocking voltage and any temperature within the operating temperature range). . .	0.6	ma
Shunt Capacitance:		
Maximum	105	pf
Minimum	60	pf

[a] See *Operating Considerations*.

[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[c] Example: For type CR107 at 60° C free-air temperature, average forward ma. = 550, peak reverse volts = 7000.



92CS-11249R1

NOTE 1: DISTANCE BETWEEN CENTERS OF MOUNTING HOLES FOR 1/4"-DIAMETER BOLTS.

NOTE 2: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

World Radio History

OPERATING CONSIDERATIONS,
MECHANICAL AND ENVIRONMENTAL TESTS,
RATING CHARTS,
and
CURVES
shown under type CR101 also apply to the CR107

World Radio History

World Radio History

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

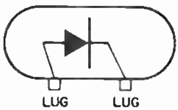
For Industrial and Military Equipment

Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position[a] . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Case:
  Material. . . . . .Insulating
  Material flammability . . . . .Self-Quenching
  Seals . . . . .Hermetic
Weight (Approx.). . . . . 4.2 oz
Terminal Diagram:



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet.

PEAK INVERSE VOLTAGE.	7000 max.	volts
RMS SUPPLY VOLTAGE.	4900 max.	volts
DC BLOCKING VOLTAGE	7000 max.	volts
AVERAGE FORWARD CURRENT:		
At ambient temperature of 60° C	550 max.	ma
At ambient temperature of 100° C	210 max.	ma
At other ambient temperatures . See *Average-Forward-Current Rating Chart*		
PEAK RECURRENT CURRENT.	5 max.	amp
PEAK SURGE CURRENT:[b]		
For one-half cycle, sine wave	15 max.	amp
For one or more cycles. See *Peak-Surge-Current Rating Chart*		
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	−65 to +125	°C

World Radio History

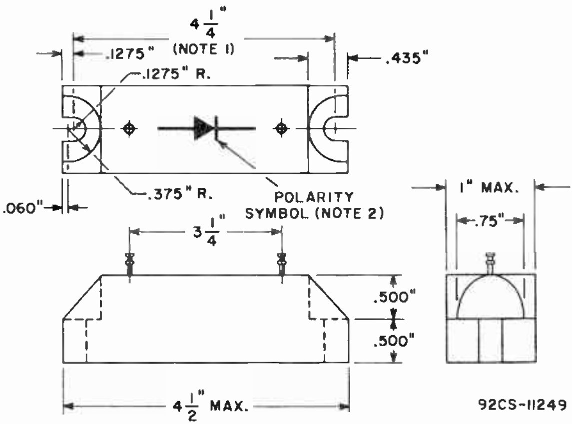
Characteristics:

Maximum Full-Cycle Average Forward Voltage
Drop at maximum rated ooerating conditions. . . 7.2 volts
Instantaneous Forward Voltage Drop .See *Instantaneous Forwara Characteristics Curve*
Maximum Reverse Current:
Dynamic (averaged over one complete cycle at maximum ratings)[c]. . . . . 0.3 ma
DC at maximum rated dc blocking voltage and any temperature within the operating temperature range . . . . 0.6 ma
Shunt Capacitance:
Maximum . . . . 105 $\mu\mu f$
Minimum . . . . 60 $\mu\mu f$

[a] See *Operating Considerations*.

[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[c] Example: For type CR107 at 60° C ambient temperature, average forward ma. = 550, peak inverse volts = 7000.



NOTE 1: DISTANCE BETWEEN CENTERS OF MOUNTING HOLES FOR 1/4"-DIAMETER BOLTS.

NOTE 2: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

**OPERATING CONSIDERATIONS,
MECHANICAL AND ENVIRONMENTAL TESTS,
RATING CHARTS,
and
CURVES
Shown under Type CR101 also apply to the CR107**

World Radio History

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

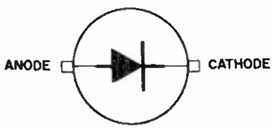
For Industrial and Military Equipment

Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position[a] . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Case:
  Material. . . . . Insulating
  Material flammability . . . . Self-Quenching
  Seals . . . . Hermetic
Weight (Approx.). 4.5 oz
Terminal Diagram:



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet

PEAK REVERSE VOLTAGE (Repetitive)	8000 max.	volts
PEAK-TRANSIENT REVERSE VOLTAGE (Non-repetitive, for duration of 5-milliseconds maximum):		
At free-air temperature of +60° to +125° C.	9600 max.	volts
At other free-air temperatures.	See *Peak Transient Reverse Voltage Rating Chart*	
RMS SUPPLY VOLTAGE.	5600 max.	volts
DC BLOCKING VOLTAGE	8000 max.	volts
AVERAGE FORWARD CURRENT:		
At ambient temperature of 60° C	550 max.	ma
At ambient temperature of 100° C. . . .	210 max.	ma
At other ambient temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT.	5 max.	amp

← Indicates a change.

World Radio History

PEAK SURGE CURRENT:[b]

For one-half cycle, sine wave	15 max.	amp
For one or more cycles, sine wave . .	See *Peak-Surge-Current Rating Chart*	

FREE-AIR TEMPERATURE RANGE:

Operating and storage	-65 to +125	°C

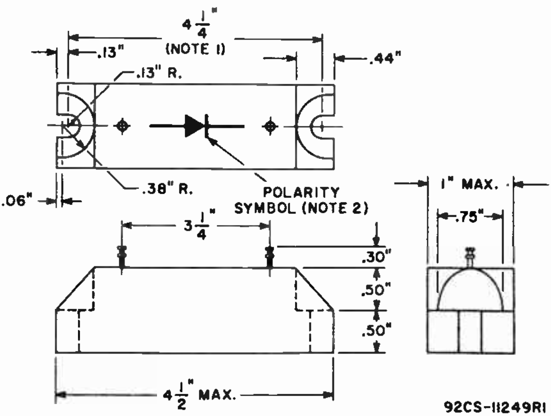
Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum rated operating conditions. . .	7.8	volts
Instantaneous Forward Voltage Drop.	See *Instantaneous Forward Characteristics Curve*	
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle at maximum ratings)[c].	0.3	ma
DC (At maximum rated dc blocking voltage and any temperature within the operating temperature range).	0.6	ma
Shunt Capacitance:		
Maximum	100	pf
Minimum	55	pf

[a] See *Operating Considerations.*

[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[c] Example: For type CR108 at 60° C free-air temperature, average forward ma. = 550, peak reverse volts = 8000.



NOTE 1: DISTANCE BETWEEN CENTERS OF MOUNTING HOLES FOR 1/4"-DIAMETER BOLTS.

NOTE 2: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

OPERATING CONSIDERATIONS,
MECHANICAL AND ENVIRONMENTAL TESTS,
RATING CHARTS,
and
CURVES
shown under type CR101 also apply to the CR108

World Radio History

World Radio History

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

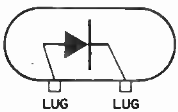
For Industrial and Military Equipment

Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position[a]	Any
Dimensions	See *Dimensional Outline*
Case:	
Material	Insulating
Material flammability	Self-Quenching
Seals	Hermetic
Weight (Approx.)	4.2 oz
Terminal Diagram:	



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet

PEAK INVERSE VOLTAGE	8000 max.	volts
RMS SUPPLY VOLTAGE	5600 max.	volts
DC BLOCKING VOLTAGE	8000 max.	volts
AVERAGE FORWARD CURRENT:		
At ambient temperature of 60° C	550 max.	ma
At ambient temperature of 100° C	210 max.	ma
At other ambient temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	5 max.	amp
PEAK SURGE CURRENT:[b]		
For one-half cycle, sine wave	15 max.	amp
For one or more cycles	See *Peak-Surge-Current Rating Chart*	
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	−65 to +125	°C

World Radio History

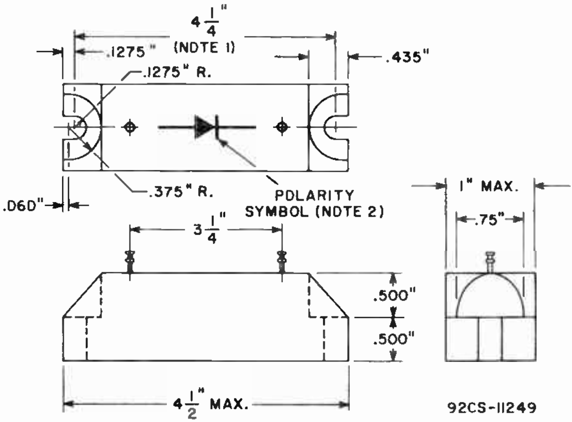
Characteristics:

Maximum Full-Cycle Average Forward Voltage
Drop at maximum rated operating conditions. . . . 7.8 volts
Instantaneous Forward Voltage Drop . See *Instantaneous Forward Characteristics Curve*

Maximum Reverse Current:
Dynamic (averaged over one complete cycle at maximum ratings)[c] . . . . 0.3 ma
DC at maximum rated dc blocking voltage and any temperature within the operating temperature range. . . . . 0.6 ma

Shunt Capacitance:
Maximum. . . . . 100 μμf
Minimum. . . . . 55 μμf

[a] See *Operating Considerations*.
[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.
[c] Example: For type CR108 at 60° C ambient temperature, average forward ma. = 550, peak inverse volts = 8000.



NOTE 1: DISTANCE BETWEEN CENTERS OF MOUNTING HOLES FOR 1/4"-DIAMETER BOLTS.

NOTE 2: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

OPERATING CONSIDERATIONS,
MECHANICAL AND ENVIRONMENTAL TESTS,
RATING CHARTS,
and
CURVES
Shown under Type CR101 also apply to the CR108

World Radio History

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

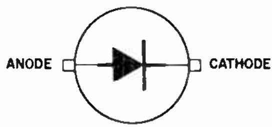
For Industrial and Military Equipment

Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position[a]	Any
Dimensions	See *Dimensional Outline*
Case:	
Material	Insulating
Material flammability	Self-Quenching
Seals	Hermetic
Weight (Approx.)	5.4 oz ←
Terminal Diagram:	←



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet

PEAK REVERSE VOLTAGE (Repetitive)	9000 max.	volts
PEAK-TRANSIENT REVERSE VOLTAGE (Non-repetitive, for duration of 5-milliseconds maximum):		←
At free-air temperature of +60° to +125° C.	10800 max.	volts
At other free-air temperatures	See *Peak Transient Reverse Voltage Rating Chart*	
RMS SUPPLY VOLTAGE	6300 max.	volts
DC BLOCKING VOLTAGE	9000 max.	volts
AVERAGE FORWARD CURRENT:		
At free-air temperature of 60° C.	550 max.	ma
At free-air temperature of 100° C	210 max.	ma
At other free-air temperatures	See *Average-Forward-Current Rating Chart*	

← Indicates a change.

World Radio History

PEAK RECURRENT CURRENT.	5 max.	amp
PEAK SURGE CURRENT:[b]		
For one-half cycle, sine wave	15 max.	amp
For one or more cycles, sine wave . .	See *Peak-Surge-Current Rating Chart*	
FREE-AIR TEMPERATURE RANGE:		
Operating and storage	-65 to +125	°C

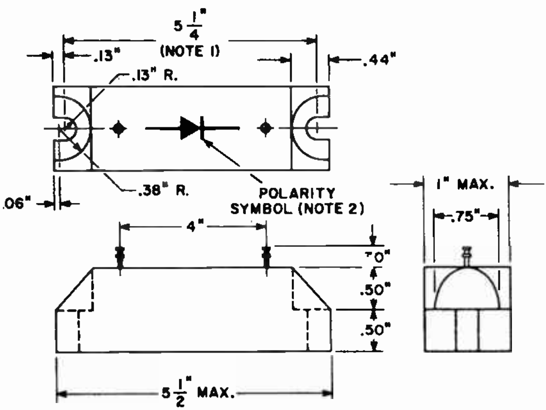
Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum rated operating conditions.	9	volts
Instantaneous Forward Voltage Drop. .	See *Instantaneous Forward Characteristics Curve*	
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle at maximum ratings)[c].	0.3	ma
DC (At maximum rated dc blocking voltage and any temperature within the operating temperature range). . .	0.6	ma
Shunt Capacitance:		
Maximum	90	pf
Minimum	45	pf

[a] See *Operating Considerations*.

[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[c] Example: For type CR109 at 60° C free-air temperature, average forward ma. = 550, peak reverse volts = 9000.



92CS-11250R1

NOTE 1: DISTANCE BETWEEN CENTERS OF MOUNTING HOLES FOR 1/4"-DIAMETER BOLTS.

NOTE 2: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

OPERATING CONSIDERATIONS,
MECHANICAL AND ENVIRONMENTAL TESTS,
RATING CHARTS,
and
CURVES
shown under type CR101 also apply to the CR109

World Radio History

World Radio History

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

For Industrial and Military Equipment

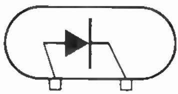
Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position[a]	Any
Dimensions	See *Dimensional Outline*
Case:	
Material	Insulating
Material flammability	Self-Quenching
Seals	Hermetic
Weight (Approx.)	5.3 oz

Terminal Diagram:



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet

PEAK INVERSE VOLTAGE	9000 max.	volts
RMS SUPPLY VOLTAGE	6300 max.	volts
DC BLOCKING VOLTAGE	9000 max.	volts
AVERAGE FORWARD CURRENT:		
At ambient temperature of 60° C	550 max.	ma
At ambient temperature of 100° C	210 max.	ma
At other ambient temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	5 max.	amp
PEAK SURGE CURRENT:[b]		
For one-half cycle, sine wave	15 max.	amp
For one or more cycles	See *Peak-Surge-Current Rating Chart*	
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +125	°C

World Radio History

CR109

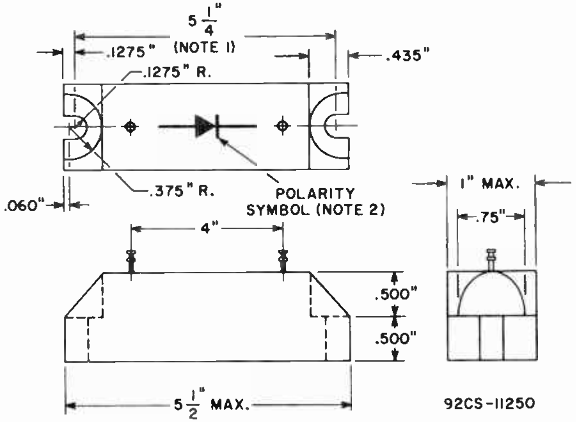
Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum rated operating conditions . . .	9	volts
Instantaneous Forward Voltage Drop	See *Instantaneous Forward Characteristics Curve*	
Maximum Reverse Current:		
Dynamic (averaged over one complete cycle at maximum ratings)[c].	0.3	ma
DC at maximum rated dc blocking voltage and any temperature within the operating temperature range	0.6	ma
Shunt Capacitance:		
Maximum	90	μμf
Minimum	45	μμf

[a] See *Operating Considerations*.

[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[c] Example: For type CR109 at 60° C ambient temperature, average forward ma. = 550, peak inverse volts = 9000.



92CS-11250

NOTE 1: DISTANCE BETWEEN CENTERS OF MOUNTING HOLES FOR 1/4"-DIAMETER BOLTS.

NOTE 2: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

OPERATING CONSIDERATIONS,
MECHANICAL AND ENVIRONMENTAL TESTS,
RATING CHARTS,
and
CURVES
Shown under Type CR101 also apply to the CR109

World Radio History

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

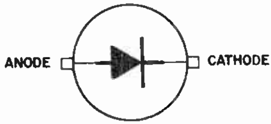
For Industrial and Military Equipment

Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position[a] . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Case:
  Material. .Insulating
  Material flammability . . . . .Self-Quenching
  Seals . . . . .Hermetic
Weight (Approx.). . . . . 5.5 oz ←
Terminal Diagram: ←



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet.

PEAK REVERSE VOLTAGE (Repetitive)	10000 max.	volts
PEAK-TRANSIENT REVERSE VOLTAGE ←		
(Non-repetitive, for duration of 5-milliseconds maximum):		
At free-air temperature of +60° to +125° C.	12000 max.	volts
At other free-air temperatures.	See *Peak Transient Reverse Voltage Rating Chart*	
RMS SUPPLY VOLTAGE.	7000 max.	volts
DC BLOCKING VOLTAGE	10000 max.	volts
AVERAGE FORWARD CURRENT:		
At free-air temperature of 60° C.	550 max.	ma
At free-air temperature of 100° C	210 max.	ma
At other free-air temperatures. . . .	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT.	5 max.	amp

← Indicates a change.

World Radio History

PEAK SURGE CURRENT:[b]

For one-half cycle, sine wave	15 max.	amp
For one or more cycles, sine wave . .	See *Peak-Surge-Current Rating Chart*	

FREE-AIR TEMPERATURE RANGE:

Operating and storage	-65 to +125	°C

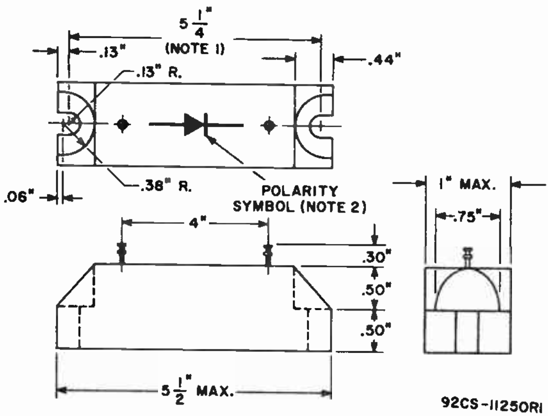
Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum rated operating conditions . .	9.6	volts
Instantaneous Forward Voltage Drop .	See *Instantaneous Forward Characteristics Curve*	
Maximum Reverse Current:		
Dynamic (Averaged over one complete cycle at maximum ratings)[c].	0.3	ma
DC (At maximum rated dc blocking voltage and any temperature within the operating temperature range).	0.6	ma
Shunt Capacitance:		
Maximum	80	pf
Minimum	40	pf

[a] See *Operating Considerations*.

[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[c] Example: For type CR110 at 60° C free-air temperature, average forward ma. = 550, peak reverse volts = 1000.



NOTE 1: DISTANCE BETWEEN CENTERS OF MOUNTING HOLES FOR 1/4"-DIAMETER BOLTS.

NOTE 2: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

World Radio History

OPERATING CONSIDERATIONS,
MECHANICAL AND ENVIRONMENTAL TESTS,
RATING CHARTS,
and
CURVES
shown under type CR101 also apply to the CR110

World Radio History

World Radio History

Silicon Rectifier

With Integral R-C Voltage-Equalizing Network

DIFFUSED-JUNCTION TYPE

For Industrial and Military Equipment

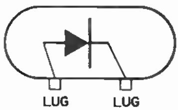
Designed to Meet Stringent Military Mechanical and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position[a]	Any
Dimensions	See *Dimensional Outline*
Case:	
Material	Insulating
Material flammability	Self-Quenching
Seals	Hermetic
Weight (Approx.)	5.3 oz

Terminal Diagram:



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load, and at altitudes up to 30,000 feet.

PEAK INVERSE VOLTAGE	10000 max.	volts
RMS SUPPLY VOLTAGE	7000 max.	volts
DC BLOCKING VOLTAGE	10000 max.	volts
AVERAGE FORWARD CURRENT:		
At ambient temperature of 60° C	550 max.	ma
At ambient temperature of 100° C	210 max.	ma
At other ambient temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	5 max.	amp
PEAK SURGE CURRENT:[b]		
For one-half cycle, sine wave	15 max.	amp
For one or more cycles	See *Peak-Surge-Current Rating Chart*	
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +125	°C

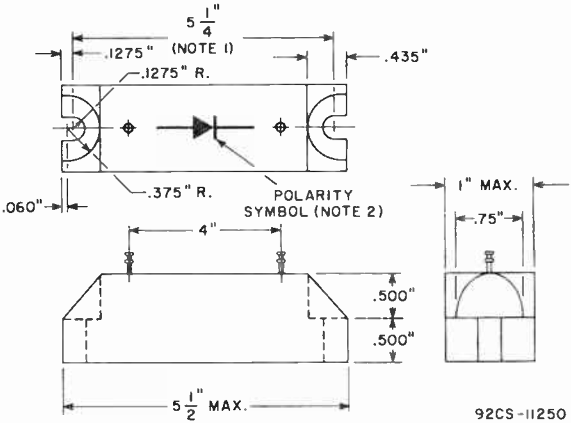
World Radio History

CR110

Characteristics:

Maximum Full-Cycle Average Forward Voltage
Drop at maximum rated operating conditions. . . 9.6 volts
Instantaneous Forward Voltage Drop .See *Instantaneous Forward Characteristics Curve*
Maximum Reverse Current:
Dynamic (averaged over one complete cycle at maximum ratings)[c]. . . . . 0.3 ma
DC at maximum rated dc blocking voltage and any temperature within the operating temperature range . . . . 0.6 ma
Shunt Capacitance:
Maximum . . . . 80 μμf
Minimum . . . . 40 μμf

[a] See *Operating Considerations*.
[b] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.
[c] Example: For type CR110 at 60° C ambient temperature, average forward ma. = 550, peak inverse volts = 10000.



92CS-11250

NOTE 1: DISTANCE BETWEEN CENTERS OF MOUNTING HOLES FOR 1/4"-DIAMETER BOLTS.

NOTE 2: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

OPERATING CONSIDERATIONS,
MECHANICAL AND ENVIRONMENTAL TESTS,
RATING CHARTS,
and
CURVES
Shown under Type CR101 also apply to the CR110

World Radio History

Silicon Rectifier

With Precisely-Matched Cells for Internal Voltage Equalization

DIFFUSED-JUNCTION TYPE

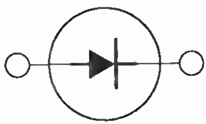
For Industrial and Military Equipment

Designed to Meet Stringent Electrical, Mechanical, and Environmental Specifications

GENERAL DATA

Mechanical:

Operating Position. . . . . Any
Dimensions. . . . . See *Dimensional Outline*
Case:
  Material. . . . . .Insulating
  Material flammability . . . . .Self-Quenching
  Seals . . . . .Hermetic
Weight (Approx.). . . . . 0.32 oz
Terminal Diagram:



The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

HALF-WAVE RECTIFIER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load

PEAK REVERSE VOLTAGE	1500 max.	volts
RMS SUPPLY VOLTAGE	1060 max.	volts
DC BLOCKING VOLTAGE	1500 max.	volts
AVERAGE FORWARD CURRENT:		
At free-air temperature of 60° C	300 max.	ma
At free-air temperature of 100° C	115 max.	ma
At other free-air temperatures	See *Average-Forward-Current Rating Chart*	
PEAK RECURRENT CURRENT	3 max.	amp
PEAK SURGE CURRENT:[a]		
For one-half cycle, sine wave	9 max.	amp
For one or more cycles, sine wave	See *Peak-Surge-Current Rating Chart*	
FREE-AIR TEMPERATURE RANGE:		
Operating and storage	−65 to +125	°C

World Radio History

Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum-rated operating conditions . . . . 1.8 volts

Instantaneous Forward Voltage Drop . See *Instantaneous Forward Characteristics Curve*

Maximum-Reverse Current:

Dynamic (Averaged over one complete cycle at maximum ratings)[b]. . . . . 0.1 ma

DC (At maximum rated dc blocking voltage and any temperature within the operating temperature range) free-air temperature =

25° C . . . . 0.01 ma

100° C. . . . . 0.2 ma

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[b] Example: For type CR201 at 60° C free-air temperature, average forward ma. = 300, peak reverse volts = 1500.

OPERATING CONSIDERATIONS

A *surge-limiting impedance* should always be used in series with the rectifier. The impedance value must be sufficient to limit the surge current to the value specified under the maximum ratings. This impedance may be provided by the power transformer windings, or by an external resistor or choke.

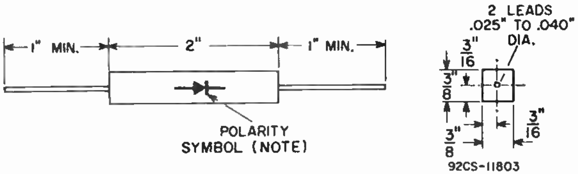
Because this rectifier operates at voltages which are dangerous, care should be taken in the design and operation of the equipment to prevent personnel from coming in contact with the rectifier.

Care should be exercised during the soldering operation to prevent overheating of the rectifier terminals. A clean, well-tinned iron is recommended to keep soldering time to a minimum.

During a period of prolonged heating, for example, during lead unwrapping, a heat sink such as the jaws of a pair of long-nose pliers should be used between the tip of the soldering iron and the rectifier case.

This rectifier should not be used in series arrangements to obtain dc output voltages higher than those obtained from a single unit. For information on special precision-matched units for use in such series arrangements, write to RCA, Commercial Engineering, Somerville, New Jersey.

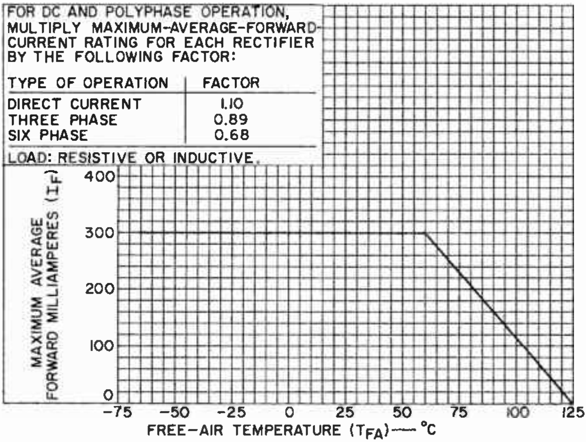
World Radio History



NOTE: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

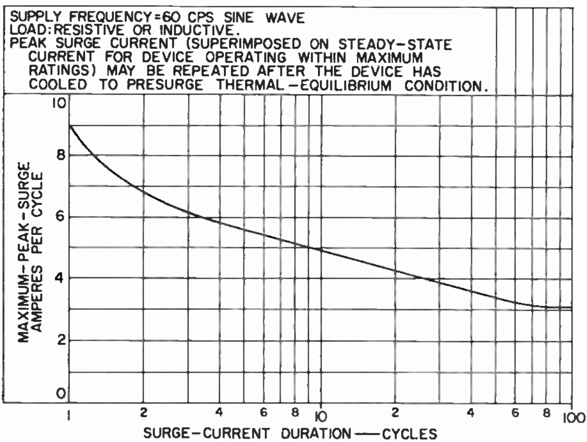
World Radio History

AVERAGE-FORWARD-CURRENT RATING CHART



92CS-11704

PEAK-SURGE-CURRENT RATING CHART



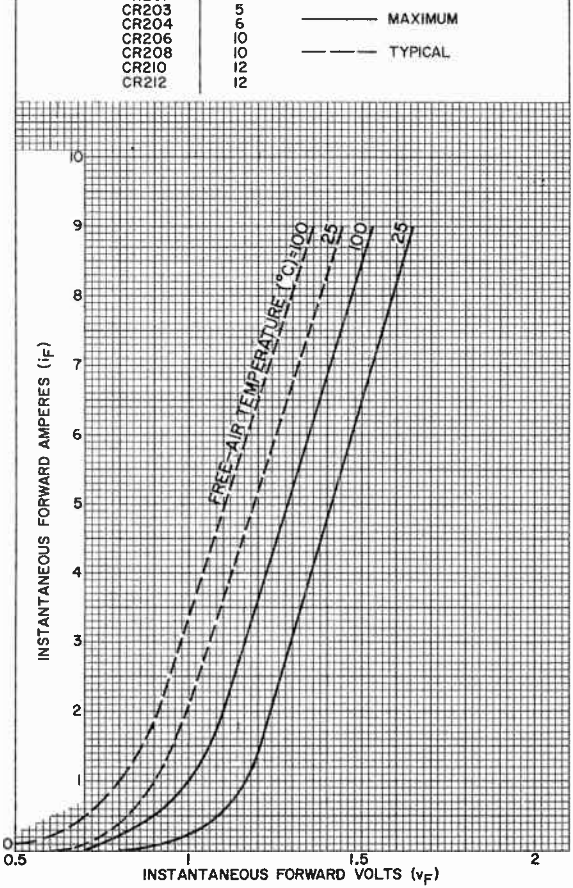
92CS-11706

World Radio History

INSTANTANEOUS FORWARD CHARACTERISTICS
Typical and Maximum Values

TO DETERMINE v_F FOR EACH RECTIFIER TYPE: MULTIPLY VALUE GIVEN AT INTERSECTION OF CURVE FOR THE APPROPRIATE TEMPERATURE WITH THE DESIRED VALUE OF i_F BY THE FOLLOWING FACTOR:

RCA TYPE	FACTOR
CR201	3
CR203	5
CR204	6
CR206	10
CR208	10
CR210	12
CR212	12



92CM-11707

World Radio History

Silicon Rectifier

With Precisely-Matched Cells for Internal Voltage Equalization

DIFFUSED-JUNCTION TYPE

For Industrial and Military Equipment

Designed to Meet Stringent Electrical, Mechanical, and Environmental Specifications

The CR203 is the same as the CR201 except for the following items:

Mechanical:

Dimensions. . . . . See *Dimensional Outline*
Weight (Approx.). 0.55 oz

HALF-WAVE RECTIFIER

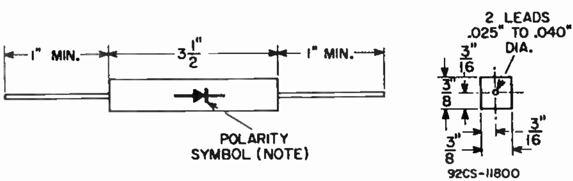
Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load

PEAK REVERSE VOLTAGE.	1500 max.	volts
RMS SUPPLY VOLTAGE.	1060 max.	volts
DC BLOCKING VOLTAGE	1500 max.	volts

Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum-rated operating conditions.	3	volts



NOTE: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

World Radio History

World Radio History

Silicon Rectifier

With Precisely-Matched Cells for Internal Voltage Equalization

DIFFUSED-JUNCTION TYPE

For Industrial and Military Equipment

Designed to Meet Stringent Electrical, Mechanical, and Environmental Specifications

The CR204 is the same as the CR201 except for the following items:

Mechanical:

Dimensions. . . . . See *Dimensional Outline*
Weight (Approx.). . . . . 0.73 oz

HALF-WAVE RECTIFIER

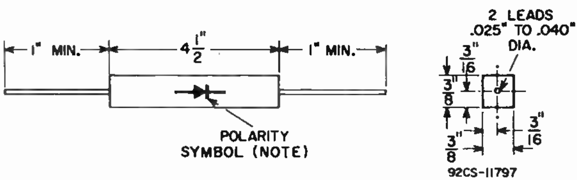
Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load

PEAK REVERSE VOLTAGE	3000 max.	volts
RMS SUPPLY VOLTAGE	2120 max.	volts
DC BLOCKING VOLTAGE	3000 max.	volts

Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum-rated operating conditions	3.6	ma



NOTE: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

World Radio History

World Radio History

Silicon Rectifier

With Precisely-Matched Cells for Internal Voltage Equalization

DIFFUSED-JUNCTION TYPE

For Industrial and Military Equipment

Designed to Meet Stringent Electrical, Mechanical, and Environmental Specifications

The CR206 is the same as the CR201 except for the following items:

Mechanical:

Dimensions. . . . . See *Dimensional Outline*
Weight (Approx.). . . . . 1.20 oz

HALF-WAVE RECTIFIER

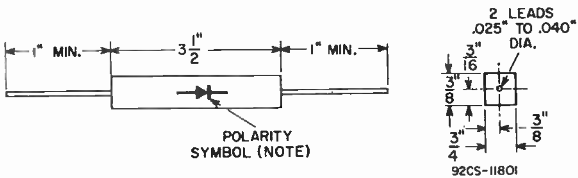
Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load

PEAK REVERSE VOLTAGE.	6000 max.	volts
RMS SUPPLY VOLTAGE.	4240 max.	volts
DC BLOCKING VOLTAGE	6000 max.	volts

Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum-rated operating conditions.	6	volts



NOTE: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

World Radio History

World Radio History

Silicon Rectifier

With Precisely-Matched Cells for Internal Voltage Equalization

DIFFUSED-JUNCTION TYPE

For Industrial and Military Equipment

Designed to Meet Stringent Electrical, Mechanical, and Environmental Specifications

The CR208 is the same as the CR201 except for the following items:

Mechanical:

Dimensions	See *Dimensional Outline*	
Weight (Approx.)	1.20	oz

HALF-WAVE RECTIFIER

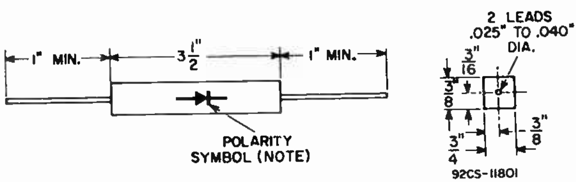
Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load

PEAK REVERSE VOLTAGE	8000 max.	volts
RMS SUPPLY VOLTAGE	5650 max.	volts
DC BLOCKING VOLTAGE	8000 max.	volts

Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum-rated operating conditions	6	volts



NOTE: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

World Radio History

World Radio History

Silicon Rectifier

With Precisely-Matched Cells for Internal Voltage Equalization

DIFFUSED-JUNCTION TYPE

For Industrial and Military Equipment

Designed to Meet Stringent Electrical, Mechanical, and Environmental Specifications

The CR210 is the same as the CR201 except for the following items:

Mechanical:

Dimensions. . . . . See *Dimensional Outline*
Weight (Approx.). . . . . 1.60 oz

HALF-WAVE RECTIFIER

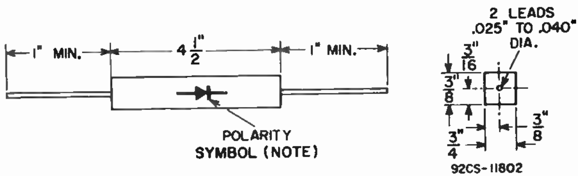
Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load

PEAK REVERSE VOLTAGE.	10000 max.	volts
RMS SUPPLY VOLTAGE.	7070 max.	volts
DC BLOCKING VOLTAGE	10000 max.	volts

Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum-rated operating conditions.	7.2	volts



NOTE: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

World Radio History

World Radio History

Silicon Rectifier

With Precisely-Matched Cells for Internal Voltage Equalization

DIFFUSED-JUNCTION TYPE

For Industrial and Military Equipment

Designed to Meet Stringent Electrical, Mechanical, and Environmental Specifications

The CR212 is the same as the CR201 except for the following items:

Mechanical:

Dimensions. . . . . See *Dimensional Outline*
Weight (Approx.). 1.60 oz

HALF-WAVE RECTIFIER

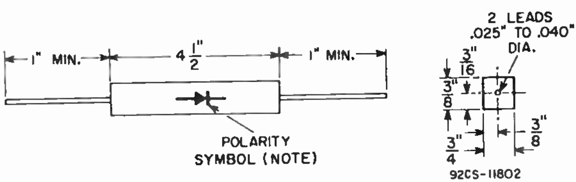
Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For power-supply frequency of 60 cps, single-phase operation, with resistive or inductive load

PEAK REVERSE VOLTAGE.	12000 max.	volts
RMS SUPPLY VOLTAGE.	8480 max.	volts
DC BLOCKING VOLTAGE	12000 max.	volts

Characteristics:

Maximum Full-Cycle Average Forward Voltage Drop at maximum-rated operating conditions.	7.2 max.	volts



NOTE: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

World Radio History

World Radio History

Twin Semiconductor Diode

GERMANIUM DIFFUSED-JUNCTION TYPE

For Switching Applications in Electronic Data-Processing Systems

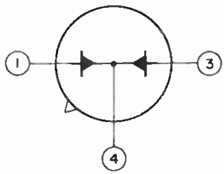
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	Similar to JEDEC No.TO-33 except that lead 2 is omitted
Case	Welded, Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Diode Unit No.1
Lead 3 - Diode Unit No.2



Lead 4 - Common Lead for Diode Units No.1 & No.2

The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

SWITCHING SERVICE

Values are for Each Unit

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

At free-air temperature of 25° C unless otherwise specified

DC REVERSE VOLTAGE	-20 max.	volts
DC FORWARD CURRENT[a]	40 max.	ma
FREE-AIR TEMPERATURE RANGE:		
Operating and storage	-65 to +85	°C
LEAD TEMPERATURE:		
For 10 seconds maximum	230 max.	°C

ELECTRICAL CHARACTERISTICS

Values are for each unit and at free-air temperature of 25° C unless otherwise specified

		Min.	*Max.*	
DC Forward Voltage for dc forward ma. =	V_F			
5		–	0.4	volt
9		–	0.55	volt

[a] See accompanying *Rating Chart.*

World Radio History

Reverse Breakdown Voltage for dc reverse µa = −200.	BV_R	−20	–	volts
DC Forward Current for dc forward volts = 1	I_F	40	–	ma
DC Reverse Current at free-air temperature of 55° C, for dc reverse volts =	I_R			
−2.		–	−15	µa
−10		–	−75	µa
Reverse Recovery Time[b] for dc reverse volts = −6, dc forward ma. = 20, recovery to a reverse impedance (ohms) =	t_{rr}			
35000		–	0.25	µsec
82000		–	0.3	µsec

[b] See accompanying *Reverse-Recovery-Time Measurement Circuit*.

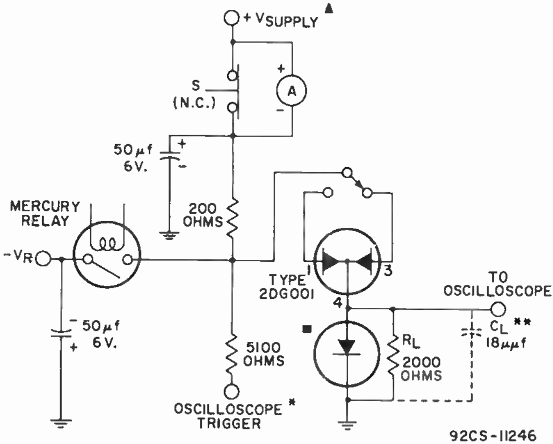
OPERATING CONSIDERATIONS

It is recommended that this device not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the device or its associated circuitry.

The *flexible leads* of this device are usually soldered to the circuit elements. Soldering of the leads may be made close to the stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the device.

World Radio History

REVERSE-RECOVERY-TIME MEASUREMENT CIRCUIT



NOTE: THE STRAY CAPACITANCE ACROSS THE SOCKET FOR THE TWIN DIODE UNIT UNDER TEST MUST BE LESS THAN 2 µµf.

* TEKTRONIX TYPE 545 OSCILLOSCOPE WITH TYPE H PLUG-IN VERTICAL AMPLIFIER AND TYPE P6000 PROBE, OR EQUIVALENT.

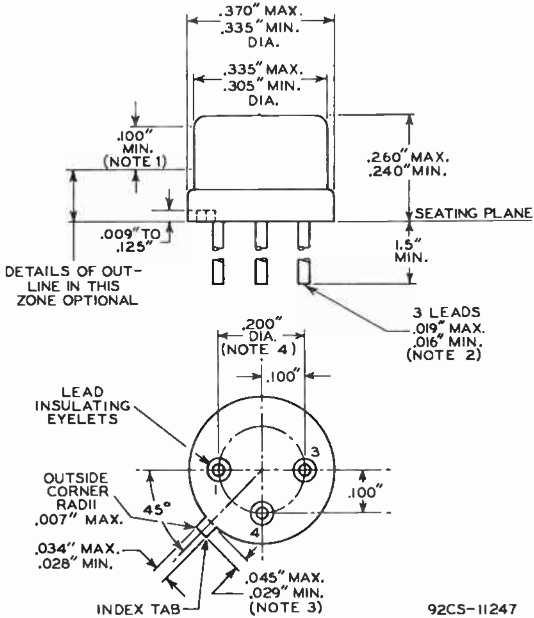
** C_L REPRESENTS THE TOTAL CAPACITANCE ACROSS R_L — THAT IS, THE SUM OF THE OSCILLOSCOPE-PROBE CAPACITANCE AND THE STRAY CAPACITANCE. THE STRAY CAPACITANCE ACROSS R_L MUST BE LESS THAN 6 µµf.

■ SILICON ULTRA-FAST SWITCHING DIODE WITH 0.5-mµsec MAXIMUM REVERSE RECOVERY TIME WHEN SWITCHING FROM 10 MA. FORWARD CURRENT TO -6 VOLTS REVERSE VOLTAGE.

▲ WITH RELAY OUT AND SWITCH (S) OPEN, ADJUST V_{SUPPLY} TO OBTAIN SPECIFIED FORWARD CURRENT (I_F).

World Radio History

SIMILAR TO JEDEC No. TO-33
except lead 2 is omitted



NOTE 1: THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE VARIATION IN ACTUAL DIAMETER WITHIN THE ZONE SHALL NOT EXCEED 0.010".

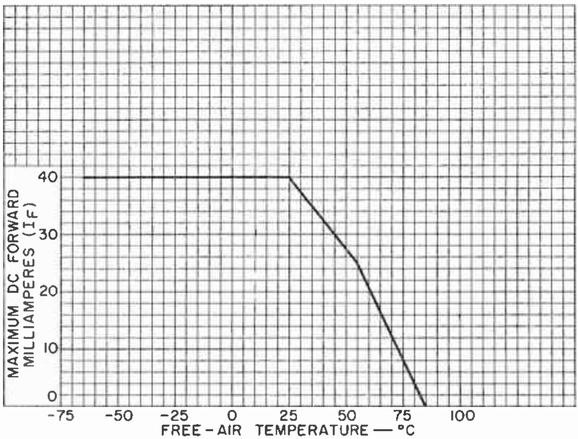
NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE SEATING PLANE. BETWEEN 0.25" AND 1.5" A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 3: MEASURED FROM MAXIMUM DIAMETER OF THE ACTUAL DEVICE.

NOTE 4: LEADS HAVING MAXIMUM DIAMETER (0.019") MEASURED IN GAUGING PLANE 0.054" + 0.001" − 0.000" BELOW THE SEATING PLANE OF THE DEVICE SHALL BE WITHIN 0.007" OF THEIR TRUE LOCATIONS RELATIVE TO A MAXIMUM-WIDTH TAB.

World Radio History

RATING CHART



92CS-11198

World Radio History

World Radio History

2N32

RCA

2N32

POINT-CONTACT TRANSISTOR

GERMANIUM TYPE FOR PULSE OR SWITCHING APPLICATIONS

DATA

General:

Maximum Overall Length	0.660"
Maximum Seated Length	0.445"
Width	0.320" ±.020"
Maximum Depth	0.240"
Case	Plastic
Base	Small-Oblong Linotetrar 3-Pin
Mounting Position	Any

PULSE or SWITCHING SERVICE

Voltage values are given with respect to base connection

Maximum Ratings, ***Absolute Values:***

COLLECTOR:		
DC Voltage	-40 max.	volts
DC Current	-8 max.	ma
Dissipation	50 max.	mw
EMITTER:		
DC Voltage	-40 max.	volts
DC Current	3 max.	ma
AMBIENT TEMPERATURE	40 max.	°C

Characteristics at Ambient Temperature of 25°C:

With input circuit between emitter and base connection, and output circuit between collector and base connection

DC Collector Voltage	-25	volts
DC Emitter Current°	0.5	ma
Current Amplification Factor	2.2	
Resistance:		
Open-Circuit Input	400	ohms
Open-Circuit Output	31000	ohms
Feedback	140	ohms
Power Gain#	21	db
Frequency:		
For Voltage-gain cutoff†	0.9	Mc
For alpha cutoff††	2.7	Mc

Minimum Circuit Values:

Emitter-Circuit Resistance	1000 min.	ohms

° Obtained by adjusting a variable resistor in series with power supply to give the desired current.

\# With collector load resistance of 10000 ohms, signal-source impedance of 500 ohms, and signal frequency of 5000 cycles per second.

† Measured at a point 3 decibels down from the low-frequency value (100 kc) and with collector load resistance of 20000 ohms, signal-source impedance of 300 ohms, and signal voltage of 25 millivolts rms. The cutoff frequency is defined as the frequency at which the output voltage has dropped to 0.7 of its low-frequency value.

††, see next page.

World Radio History

2N32

POINT-CONTACT TRANSISTOR

†† Measured at a point 3 decibels down from its low-frequency value (100 Kc). The cutoff frequency is defined as the frequency at which the current amplification factor has dropped to 0.7 of its low-frequency value.

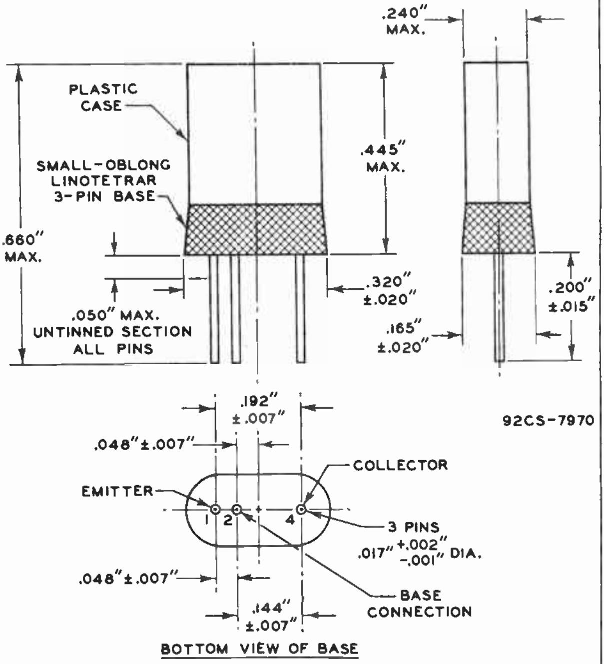
The 2N32 should not be inserted into or withdrawn from its socket with the power "on" because high transient currents may cause permanent damage to the transistor.

World Radio History

RCA

2N32

POINT-CONTACT TRANSISTOR



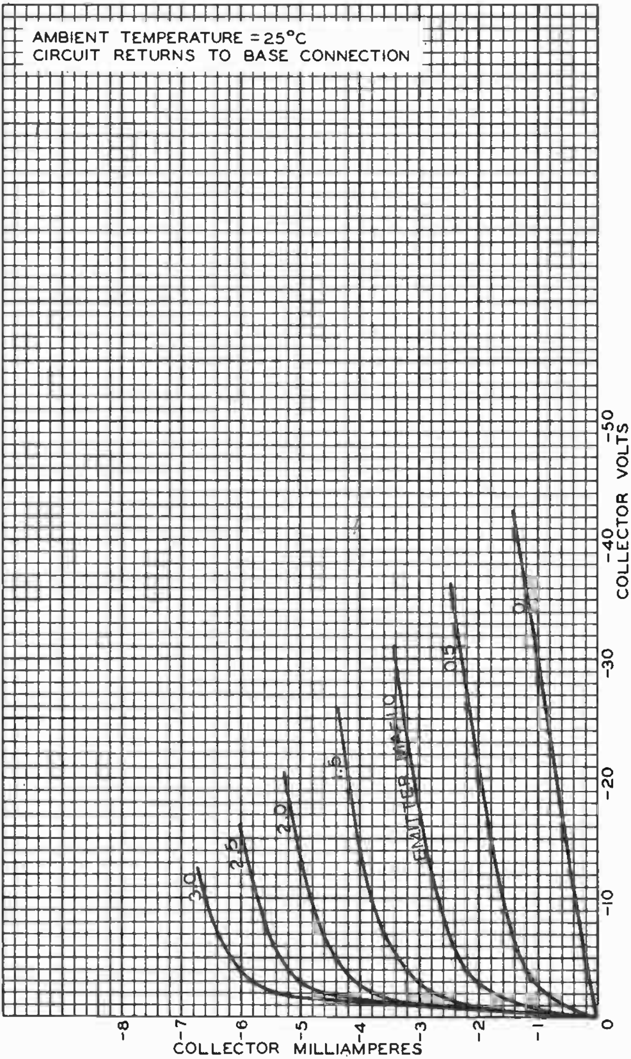
PIN-SPACING TOLERANCES ARE NOT CUMULATIVE

World Radio History

RCA

2N32

AVERAGE COLLECTOR CHARACTERISTICS



World Radio History

RCA

2N33

POINT-CONTACT TRANSISTOR

GERMANIUM TYPE FOR OSCILLATOR APPLICATIONS UP TO 50 Mc

DATA

General:

Maximum Overall Length	0.660"
Maximum Seated Length	0.445"
Width	0.320" ± .020"
Maximum Depth	0.240"
Case	Plastic
Base	Small-Oblong Linotetrar 3-Pin
Mounting Position	Any

VHF OSCILLATOR SERVICE

Voltage values are given with respect to base connection

Maximum Ratings, ***Absolute Values:***

COLLECTOR:		
DC Voltage	-8.5 max.	volts
DC Current	-7 max.	ma
Dissipation	30 max.	mw
EMITTER:		
DC Current	0.8 max.	ma
AMBIENT TEMPERATURE	40 max.	°C

Typical Operation in Accompanying 50-Mc Oscillator Test Circuit:

COLLECTOR:		
DC Supply Voltage	-8	volts
DC Current	-3.3	ma
DC Emitter Current	0.3	ma
Useful Power Output (Approx.)	1.0	mw

The 2N33 should not be inserted into or withdrawn from its socket with the power "on" because high transient currents may cause permanent damage to the transistor.

OUTLINE DIMENSIONS and TERMINAL CONNECTIONS for Type 2N33 are the same as those shown for Type 2N32

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World Radio History

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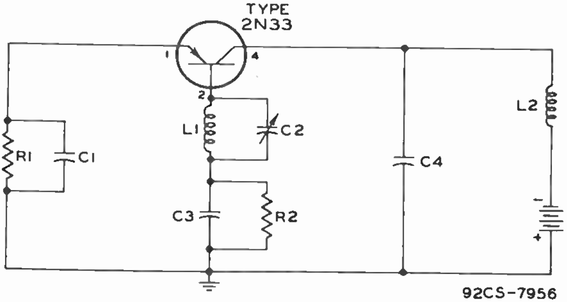
2N33
POINT-CONTACT TRANSISTOR

50-Mc Oscillator Test Circuit



C1: 1 $\mu\mu$f, ceramic, 25 volts
C2: 4 to 30 $\mu\mu$f, ceramic adjustable, 25 volts
C3: 270 $\mu\mu$f, mica, 25 volts
C4: 470 $\mu\mu$f, mica, 25 volts
L1: 0.46 μh tank inductance
L2: 1 mh rf choke
R1: 5100 ohms, 0.5 watt
R2: 1000 ohms, 0.5 watt

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World Radio History

RCA

2N34

JUNCTION TRANSISTOR

P-N-P GERMANIUM TYPE
FOR LOW-POWER, LOW-FREQUENCY APPLICATIONS

DATA

General:

Maximum Overall Length	0.885"
Maximum Seated Length	0.670"
Width	0.320" ± 0.020"
Depth	0.165" ± 0.020"
Case	Plastic
Base	Small-Oblong Linotetrar 3-Pin
Mounting Position	Any

AUDIO-FREQUENCY AMPLIFIER SERVICE

Voltages are given with respect to base connection

Maximum Ratings, ***Absolute Values*****:**

COLLECTOR:		
DC Voltage	-25 max.	volts
DC Current	-8 max.	ma
Dissipation	50 max.	mw
EMITTER:		
DC Current	8 max.	ma
AMBIENT TEMPERATURE	50 max.	°C

Characteristics at Ambient Temperature of 25°C:

With input circuit between base connection and emitter, and output circuit between collector and emitter

Collector:		
DC Voltage	-6	volts
DC Current	-10▲	μamp
DC Emitter Current●	1	ma
DC Base-Connection Current	-25	μamp
Current Amplification Factor (Approx.):		
Between Emitter and Collector	0.98	
Between Base Connection and Collector	40	
Power Gain#	40	db

▲ With collector voltage of -12 volts and emitter current of 0 milliamperes.

● Obtained by adjusting a variable resistor in series with the power supply to give the desired current.

\# With collector load resistance of 30000 ohms, signal-source impedance of 500 ohms, and signal frequency of 5000 cycles per second.

The 2N34 should not be inserted into or withdrawn from its socket with the power "on" because high transient currents may cause permanent damage to the transistor.

JUNE 1, 1953 TENTATIVE DATA

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World Radio History

2N34

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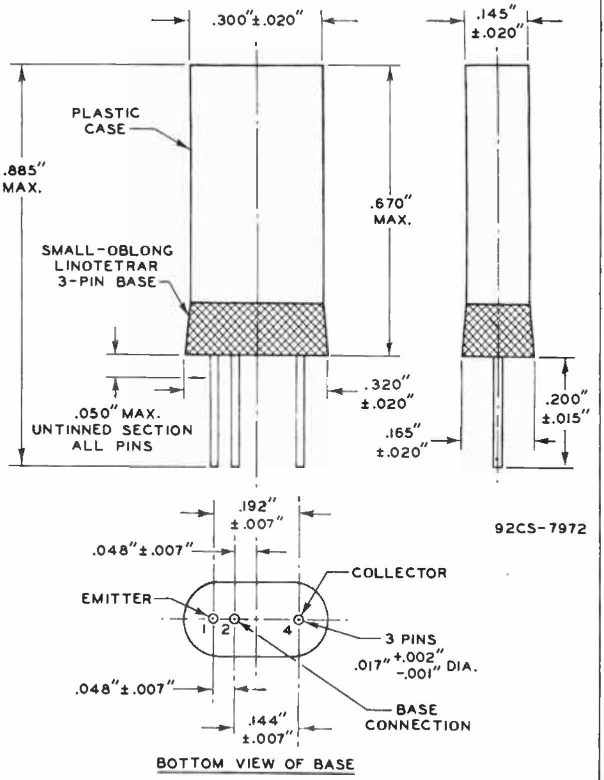
2N34

JUNCTION TRANSISTOR



PIN-SPACING TOLERANCES ARE NOT CUMULATIVE

TUBE DEPARTMENT
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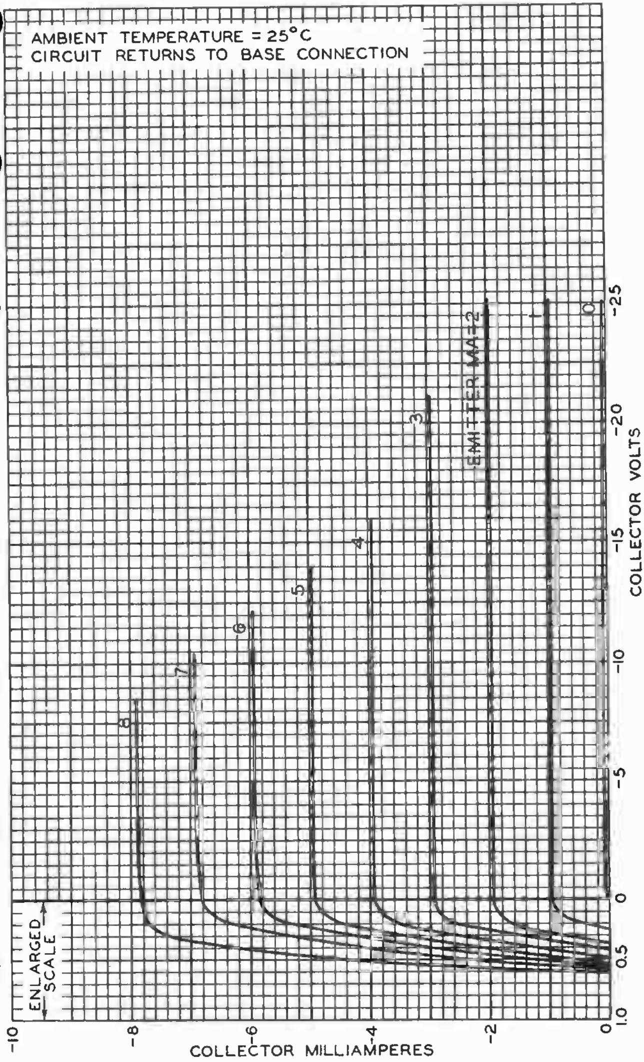
World Radio History

2N34

2N34

AVERAGE COLLECTOR CHARACTERISTICS



APR. 8, 1953

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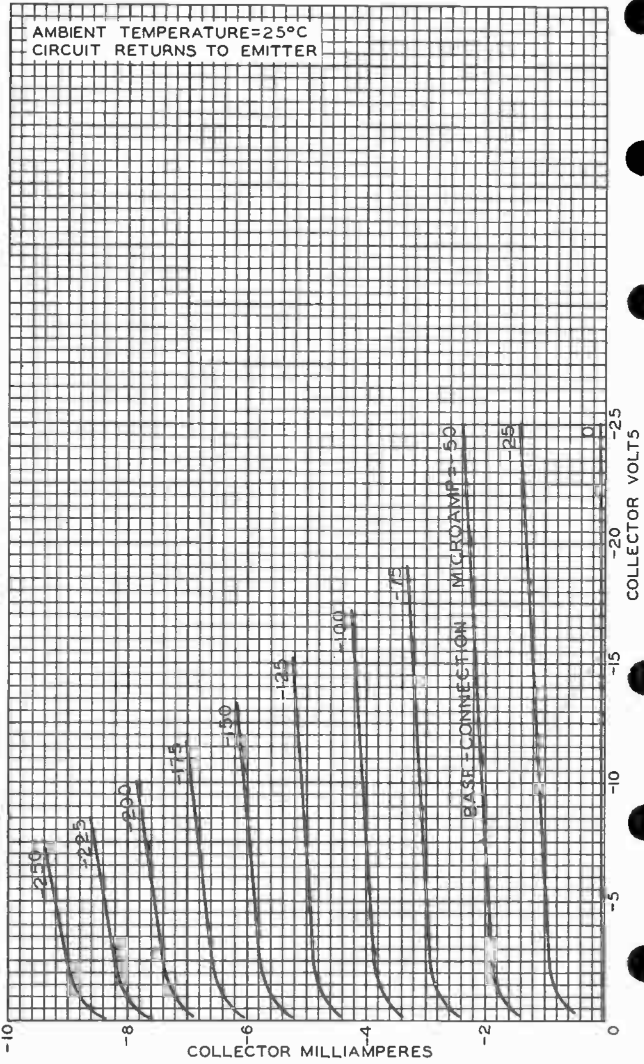
92CM-7962

2N34

2N34

AVERAGE COLLECTOR CHARACTERISTICS



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World Radio History

RCA

2N35

JUNCTION TRANSISTOR

N-P-N GERMANIUM TYPE

FOR LOW-POWER, LOW-FREQUENCY APPLICATIONS

DATA

General:

Maximum Overall Length	0.885"
Maximum Seated Length	0.670"
Width	0.320" ± 0.020"
Depth	0.165" ± 0.020"
Case	Plastic
Base	Small-Oblong Linotetrar 3-Pin
Mounting Position	Any

AUDIO-FREQUENCY AMPLIFIER SERVICE

Voltages are given with respect to base connection

Maximum Ratings, ***Absolute Values:***

COLLECTOR:		
DC Voltage	25 max.	volts
DC Current	8 max.	ma
Dissipation	50 max.	mw
EMITTER:		
DC Current	-8 max.	ma
AMBIENT TEMPERATURE	50 max.	°C

Characteristics at Ambient Temperature of 25°C:

With input circuit between base connection and emitter, and output circuit between collector and emitter

Collector:		
DC Voltage	6	volts
DC Current	10 ▲▲	µamp
DC Emitter Current●	-1	ma
DC Base-Connection Current	25	µamp
Current Amplification Factor (Approx.):		
Between Emitter and Collector	0.98	
Between Base Connection and Collector	40	
Power Gain#	40	db

▲▲ With collector voltage of 12 volts and emitter current of 0 milliamperes.

● Obtained by adjusting a variable resistor in series with the power supply to give the desired current.

With collector load resistance of 30000 ohms, signal-source impedance of 500 ohms, and signal frequency of 5000 cycles per second.

The 2N35 should not be inserted into or withdrawn from its socket with the power "on" because high transient currents may cause permanent damage to the transistor.

OUTLINE DIMENSIONS and TERMINAL CONNECTIONS for Type 2N35 are the same as those shown for Type 2N34

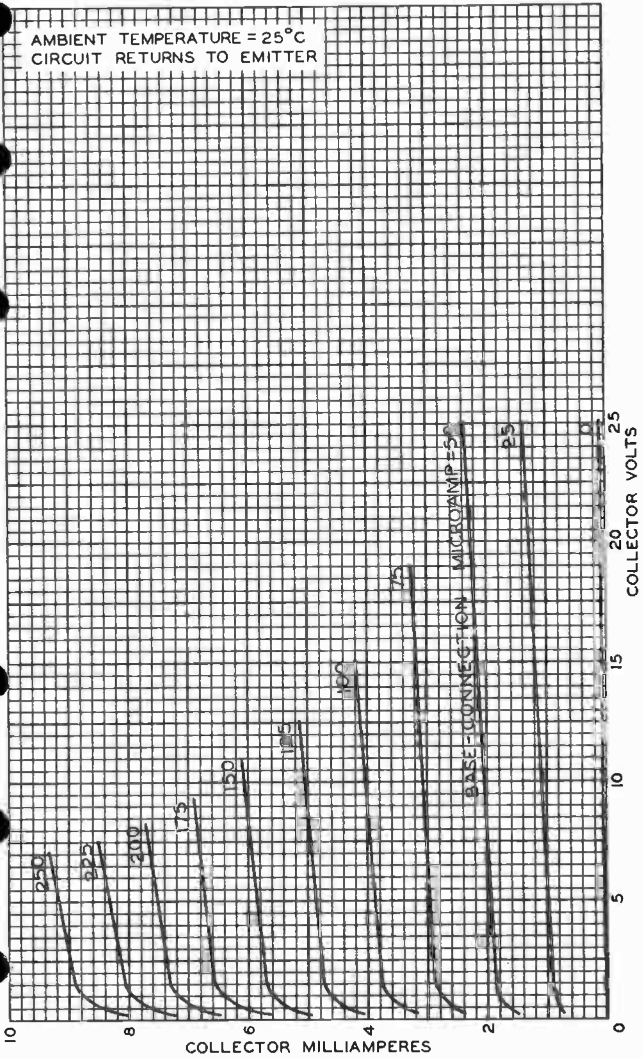
World Radio History

World Radio History

RCA

2N35

AVERAGE COLLECTOR CHARACTERISTICS



APR. 7, 1953

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92CM-7959

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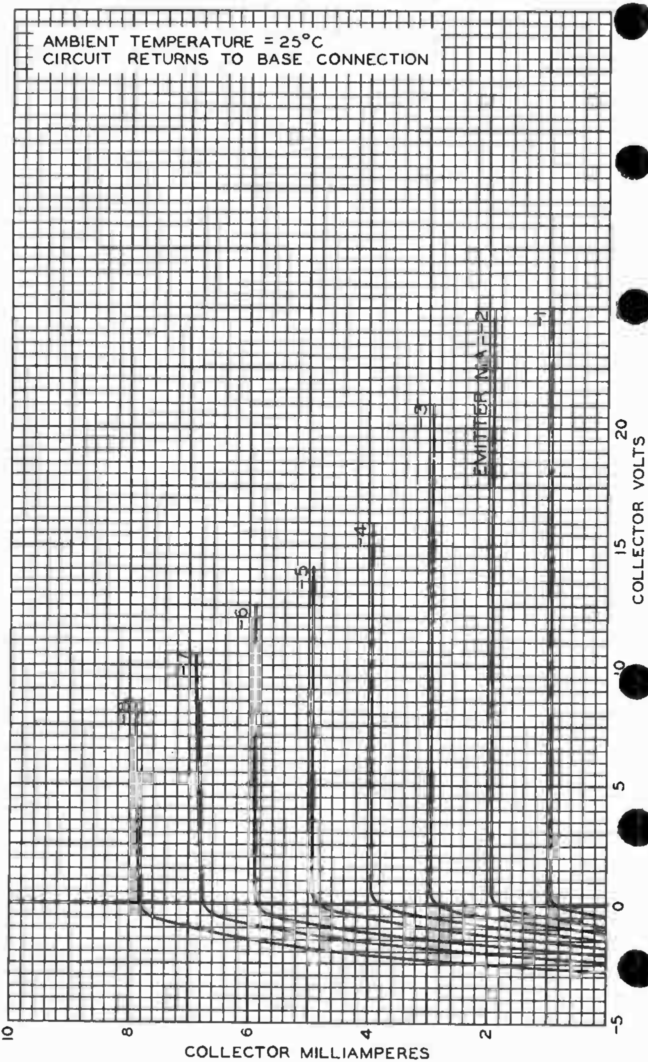
2N35

AVERAGE COLLECTOR CHARACTERISTICS



APR. 7, 1953

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92CM-7960

World Radio History

2N77

JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For small-signal audio-frequency applications

GENERAL DATA

Electrical:

Minimum DC Collector-to-Base Voltage for dc collector current of -20 μamp with emitter open, and at ambient temperature of 25°C	-30	volts
Maximum DC Collector Current for dc collector-to-base voltage of -12 volts with emitter open, and at ambient temperature of 25°C	-10	μamp

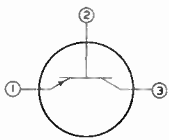
Mechanical:

Mounting Position	Any
Maximum Length (Excluding flexible leads)	0.405"
Maximum Diameter.	0.240"
Case.	Metal, Insulated
Envelope Seals.	Hermetic
Leads, Flexible	3
Length.	1.5" ± 0.015"
Orientation and diameter.	*See Dimensional Outline at front of this Section*

BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector (Adjacent to red dot on side of envelope)

AUDIO-FREQUENCY AMPLIFIER -- Class A

Maximum Ratings, ***Absolute Values:***

DC COLLECTOR-TO-BASE VOLTAGE.	-25 max.	volts
DC COLLECTOR CURRENT.	-15 max.	ma
DC EMITTER CURRENT.	15 max.	ma
COLLECTOR DISSIPATION	35 max.	mw
AMBIENT TEMPERATURE (During operation). . .	50 max.	°C
STORAGE-TEMPERATURE RANGE	-55 to +70	°C

Characteristics, ***At Ambient Temperature of 25°C:***

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-4	volts
DC Collector Current.	-0.7	ma
Power Gain:		
With load resistance = 0.1 megohm, and input resistance = 1980 ohms. . . .	44.1	db
With load resistance = 2670 ohms, and input resistance = 2670 ohms. . . .	34.5	db

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World Radio History

2N77

2N77

JUNCTION TRANSISTOR

Noise Factor:		
Measured with a noise diode and thermocouple voltmeter with load resistance = 20,000 ohms, generator resistance = 1000 ohms, and equivalent noise bandwidth = 12.3 kc with geometric mean of 300 cps	6.5	db
Small-Signal T Parameters:*		
DC Collector-to-Emitter Voltage (V_{CE})	-4	volts
DC Collector Current (I_C)	-0.7	ma
Emitter Resistance (r_e)	23	ohms
Base Resistance (r_b)	1430	ohms
Mutual Resistance (r_m)	3.86	megohms
Collector Resistance (r_c)	3.93	megohms
Current Transfer Ratio (α_f)■	-55	
Small-Signal Hybrid-π Parameters:*		
DC Collector-to-Emitter Voltage (V_{CE})	-4	volts
DC Collector Current (I_C)	-0.7	ma
Resistance $r_{bb'}$	240	ohms
Conductance $g_{b'e}$	407	μmhos
Conductance g_{ce}	6.8	μmhos
Conductance $g_{b'c}$	0.13	μmho
Capacitance $C_{b'e}$	5000	μμf
Capacitance $C_{b'c}$	40	μμf
Intrinsic Transconductance (g_m)	22300	μmhos
Frequency● for unity power amplification	1.7	Mc
Small-Signal H Parameters:*		
DC Collector-to-Emitter Voltage (V_{CE})	-4	volts
DC Collector Current (I_C)	-0.7	ma
Input Resistance, output circuit shorted (h_i)	2720	ohms
Reverse Voltage Transfer Ratio, input circuit open (h_r)	3.23×10^{-4}	
Forward Current Transfer Ratio, output circuit shorted (h_f)	55	
Output Conductance, input circuit open (h_o)	14	μmhos
Common-Base Circuit, Emitter Input		
DC Collector-to-Base Voltage	-4	volts
DC Collector Current	-0.7	ma
Power Gain:		
With load resistance = 0.5 megohm, and input resistance = 215 ohms	32.5	db
Frequency at which the current transfer ratio drops to one-half the square root of two times its value at 1 kc	700	kc

■ Measured at 1 kc.

*,●: See next page.

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RCA

2N77
JUNCTION TRANSISTOR

Common-Collector Circuit, Base Input

DC Emitter-to-Collector Voltage	4	volts
DC Emitter Current.	0.7	ma
Power Gain:		
With load resistance = 10,000 ohms,		
and input resistance = 0.5 megohm	17	db

* As derived from corresponding equivalent circuit shown under type 2N104.

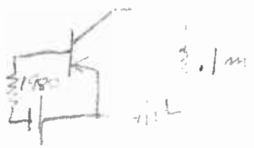
• This frequency (figure of merit) may be calculated from the equation

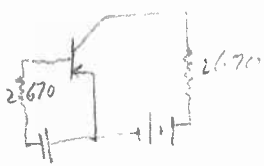
$$f = \frac{1}{4\pi}\sqrt{\frac{g_m}{r_{bb'}\ C_{b'c}\ C_{b'e}}}$$

OPERATING CONSIDERATIONS

The 2N77 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N77 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.





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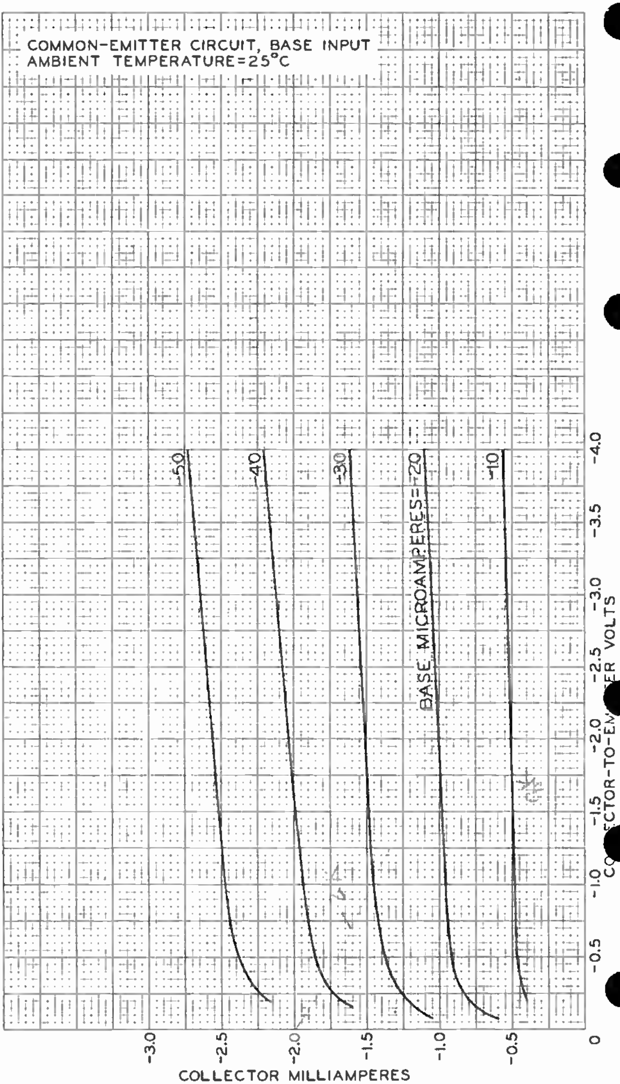
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

2N77

2N77

AVERAGE COLLECTOR CHARACTERISTICS



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92CM-8589R1

World Radio History

2N77

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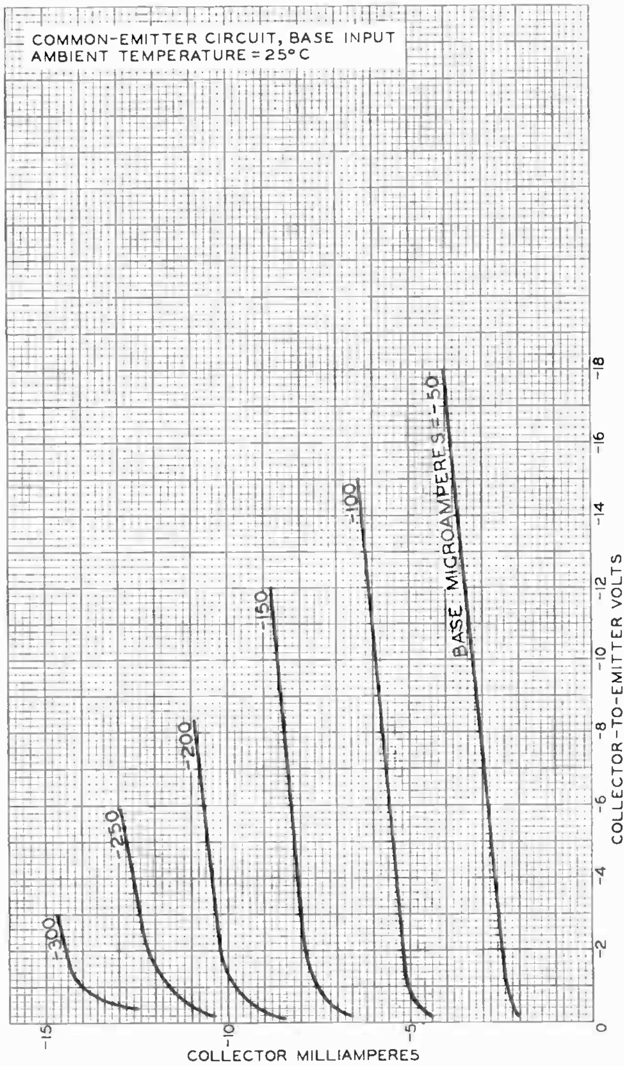
2N77

AVERAGE COLLECTOR CHARACTERISTICS



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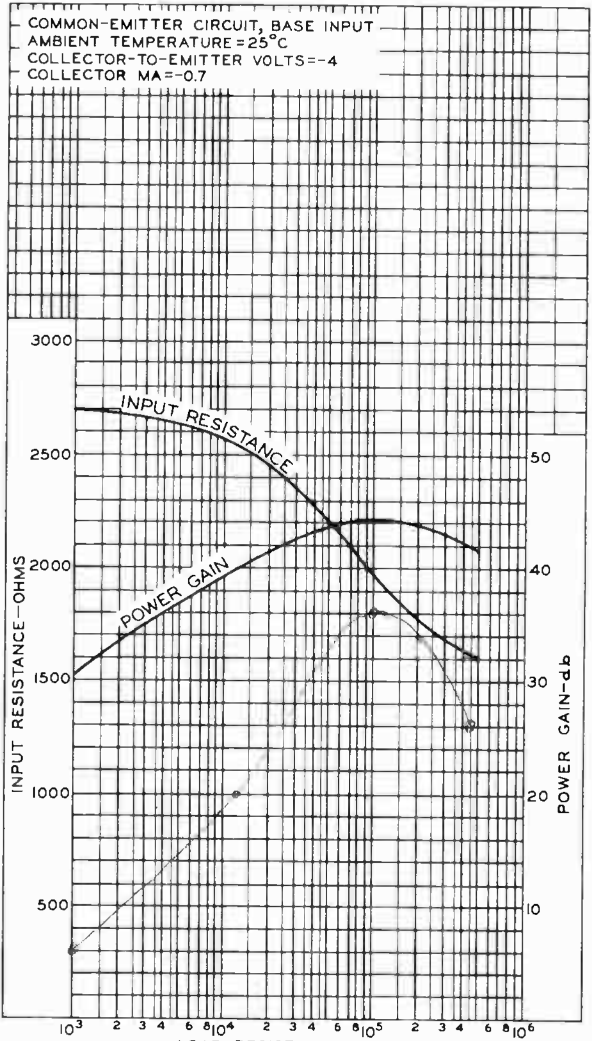
92CM-8592R1

World Radio History

2N77

2N77
OPERATION CHARACTERISTICS



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92CM-8590R1

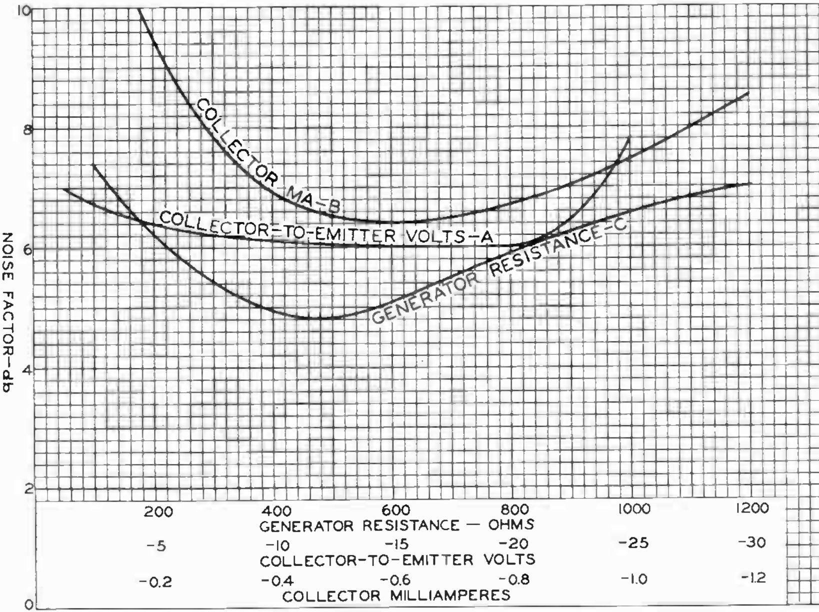
World Radio History

2N77

TYPICAL NOISE CHARACTERISTICS

COMMON-EMITTER CIRCUIT, BASE INPUT
AMBIENT TEMPERATURE = 25°C
MEASURED WITH A NOISE DIODE AND THERMOCOUPLE VOLTMETER WITH LOAD RESISTANCE = 20000 OHMS AND EQUIVALENT NOISE BANDWIDTH = 12.3 KC WITH GEOMETRIC MEAN OF 300 CPS

CURVE	GENERATOR RESISTANCE (OHMS)	COLLECTOR-TO-EMITTER VOLTS	COLLECTOR MA
A	1000	—	-0.7
B	1000	-4	—
C	—	-4	-0.7

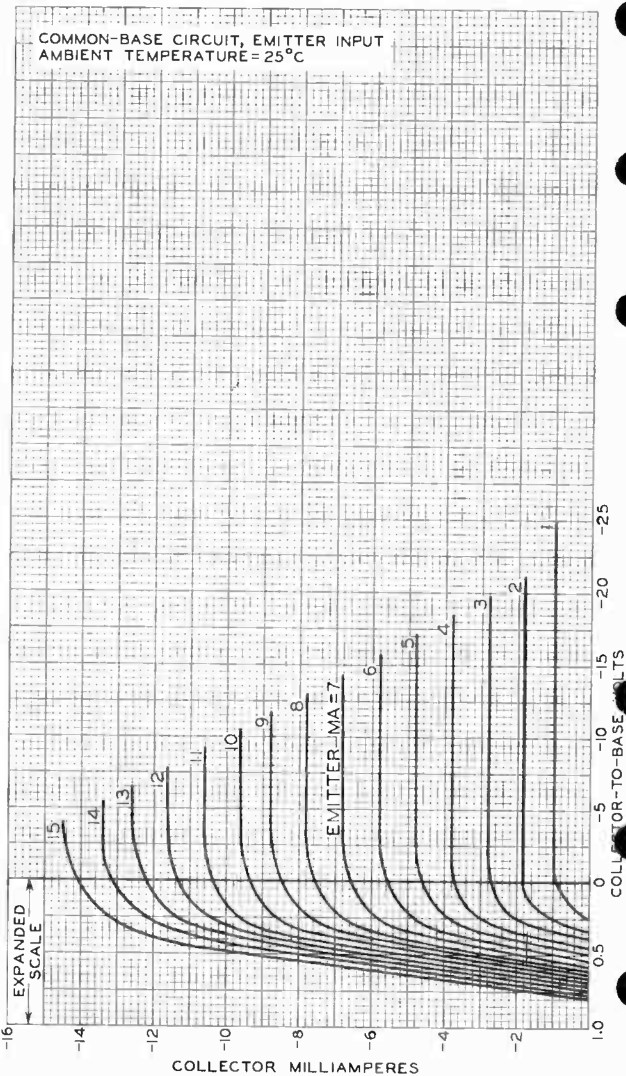


92CM-8591R1

2N77

2N77

AVERAGE COLLECTOR CHARACTERISTICS



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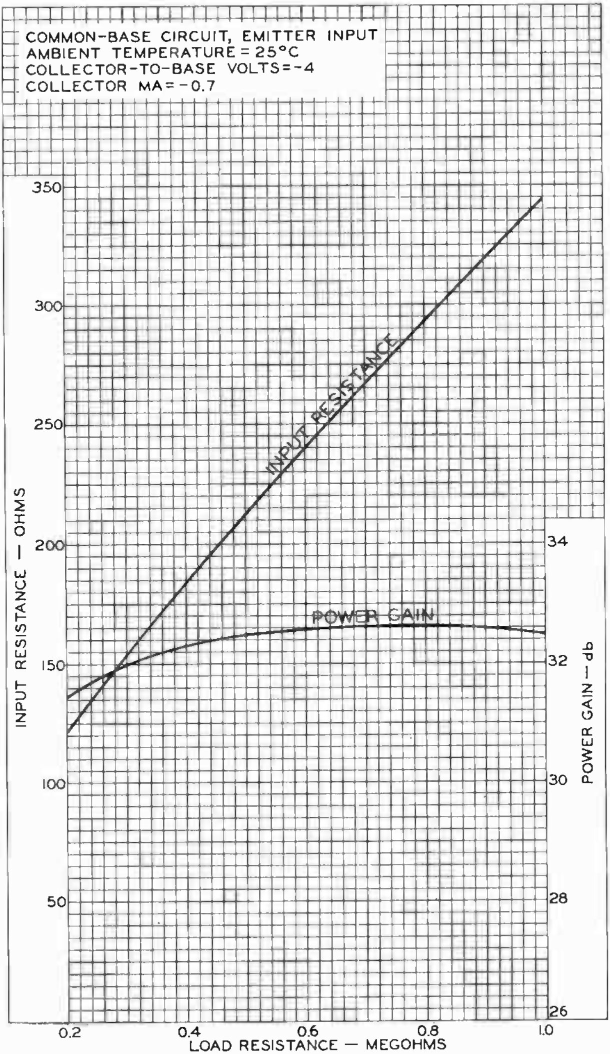
92CM-8587R1

World Radio History

2N77

OPERATION CHARACTERISTICS



92CM-8588R1

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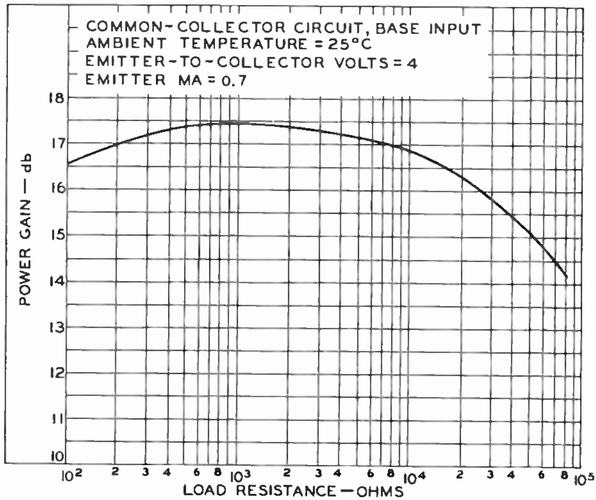
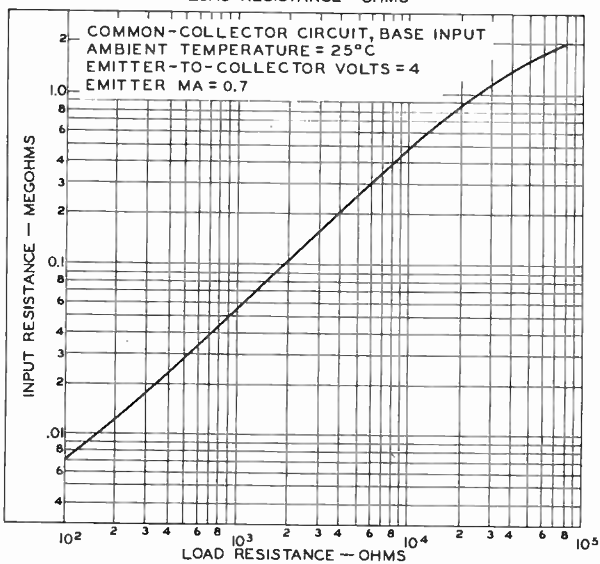
2N77

2N77

OPERATION CHARACTERISTICS





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92CM-8594R1

World Radio History

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2N104

JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For small-signal audio-frequency applications

GENERAL DATA

Electrical:

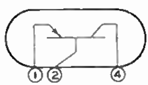
Minimum DC Collector-to-Base Voltage for dc collector current of −20 μamp with emitter open, and at ambient temperature of 25°C	−30	volts
Maximum DC Collector Current for dc collector-to-base voltage of −12 volts with emitter open, and at ambient temperature of 25°C	−10	μamp
Maximum DC Emitter Current for dc emitter-to-base voltage of −12 volts with collector open, and at ambient temperature of 25°C	−10	μamp
Junction Temperature Rise (In free air) .	0.4	°C/mw

Mechanical:

Mounting Position	Any
Maximum Overall Length.	0.697"
Maximum Seated Length	0.495"
Maximum Diameter.	0.260"
Dimensional Outline	*See front of this Section*
Case.	Metal, Insulated
Envelope Seals.	Hermetic
Base.	Small-Round Linotetrar 3-Pin (JETEC No.E3-25)

Pin 1 - Emitter

Pin 2 - Base



Pin 4 - Collector

AUDIO-FREQUENCY AMPLIFIER -- Class A

Maximum Ratings, ***Absolute Values:***

DC COLLECTOR-TO-BASE VOLTAGE.	−30 max.	volts
DC COLLECTOR CURRENT.	−50 max.	ma
DC EMITTER CURRENT.	50 max.	ma
TRANSISTOR DISSIPATION.	*See Rating Chart*	
AMBIENT TEMPERATURE (During operation). . .	70 max.	°C
STORAGE-TEMPERATURE RANGE	−55 to +85	°C

Characteristics, ***At Ambient Temperature of 25°C:***

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	−4	−6	volts
DC Collector Current.	−0.7	−1	ma
Power Gain:			
With load resistance = 20,000 ohms, and input resistance = 1400 ohms. . .	–	41	db

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World Radio History

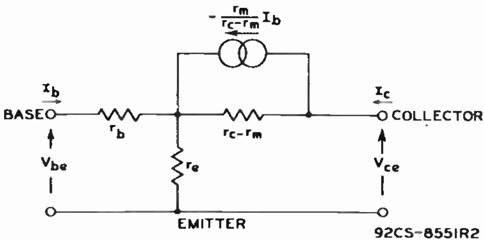
2N104

JUNCTION TRANSISTOR

Noise Factor:			
Measured with a noise diode and thermocouple voltmeter with load resistance = 20,000 ohms, generator resistance = 518 ohms, and equivalent noise bandwidth = 12.3 kc with geometric mean of 300 cps	6.5	-	db

Small-Signal T Paramenters:

Derived from the accompanying one-generator equivalent circuit, and applicable to that portion of the audio-frequency range in which internal capacitance effects may be neglected



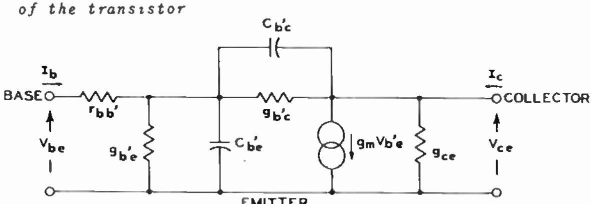
92CS-8551R2

For conditions where $-r_m/(r_c-r_m) \cong -(r_m+r_e)/(r_c-r_m+r_e) = \alpha_f$:

DC Collector-to-Emitter Voltage (V_{CE}).	-3	-6	volts
DC Collector Current (I_C).	-0.2	-1	ma
Emitter Resistance (r_e).	155	21.7	ohms
Base Resistance (r_b)	960	690	ohms
Mutual Resistance (r_m)	2.86	1.93	megohms
Collector Resistance (r_c).	2.95	1.974	megohms
Current Transfer Ratio (α_f)■	-32	-44	

Small-Signal Hybrid-π Parameters:

Derived from the accompanying one-generator equivalent circuit, and applicable over the useful frequency range of the transistor



92CS-8553R2

■ Measured at 1 kc.

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World Radio History

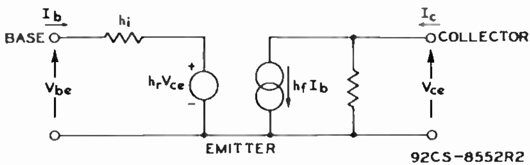
2N104

JUNCTION TRANSISTOR

DC Collector-to-Emitter Voltage (V_{CE})	-3	-6	volts
DC Collector Current (I_C)	-0.2	-1	ma
Resistance $r_{bb'}$	300	290	ohms
Conductance $g_{b'e}$	174	727	µmhos
Conductance g_{ce}	1.28	6.62	µmhos
Conductance $g_{b'c}$	0.3	0.36	µmho
Capacitance $C_{b'e}$	1225	6900	µµf
Capacitance $C_{b'c}$	36	40	µµf
Intrinsic Transconductance (g_m)	5540	32000	µmhos
Frequency• for unity power amplification	1.6	1.6	Mc

Small-Signal H Parameters:

Derived from accompanying two-generator equivalent circuit, and applicable to that portion of the audio-frequency range in which internal capacitance effects may be neglected



92CS-8552R2

DC Collector-to-Emitter Voltage (V_{CE})	-3	-6	volts
DC Collector Current (I_C)	-0.2	-1	ma
Input Resistance, output circuit shorted (h_i)	6040	1667	ohms
Reverse Voltage Transfer Ratio, input circuit open (h_r)	17.2×10^{-4}	4.95×10^{-4}	
Forward Current Transfer Ratio, output circuit shorted (h_f)	32	44	
Output Conductance, input circuit open (h_o)	11.1	22.8	µmhos

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-3	-6	volts
DC Collector Current	-0.2	-1	ma
Power Gain: With load resistance = 0.5 megohm, and input resistance = 170 ohms	-	32.4	db
Frequency at which the current transfer ratio drops to one-half the square root of two times its value at 1 kc	530	700	kc

•: See next page.

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2N104

JUNCTION TRANSISTOR

Common-Collector Circuit, Base Input

DC Emitter-to-Collector Voltage.	3	volts
DC Emitter Current	0.2	ma
Power Gain:		
With load resistance = 18,000 ohms, and input resistance = 0.5 megohm. . . .	14.3	db

• This frequency (figure of merit) may be calculated from the equation

$$f = \frac{1}{4\pi}\sqrt{\frac{g_m}{r_{bb'}\ C_{b'c}\ C_{b'e}}}$$

OPERATING CONSIDERATIONS

The 2N104 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

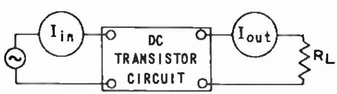
TRANSISTOR DISSIPATION RATING CHART

The Transistor Dissipation Rating Chart may be used to determine, for a particular circuit application, the maximum allowable transistor dissipation. On this chart, solid boundary lines ABC, DEF, and GHI are the loci of the maximum allowable dissipation for operating ambient temperatures of 25°C, 50°C, and 70°C, respectively. The dashed curves for the various values of circuit stability factor represent conditions where the maximum allowable dissipation is current limited by the maximum dc collector current rating of -50 milliamperes.

It is recommended that the 50°C-ambient-temperature curve be used in commercial applications, and the 70°C curve for industrial applications. The 25°C curve should not be used unless the equipment is operated under closely controlled ambient-temperature conditions.

To use this chart it is only necessary to know the dc collector-to-emitter voltage, dc collector current, ambient temperature after equipment warm-up, and the circuit stability factor, S_F.

The circuit stability factor is equal to the dc-circuit current gain of the transistor (between collector and base) plus one. It may be measured empirically from the arrangement shown at left. If a current, I_{in}, of 1 microampere dc is passed through the transistor circuit, the value of I_{out} in microamperes measured plus one is equal to the circuit stability factor.



where I_{in} = *input current*
I_{out} = *output current*
and R_L = *load resistance*

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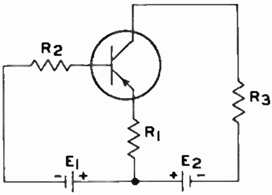
World Radio History

2N104
JUNCTION TRANSISTOR

For conditions where the base spreading resistance, $r_{bb'}$, is much less than the external emitter- or base-circuit resistance, and where the forward current transfer ratio, α_f, is much greater than 1, the circuit stability factor may also be calculated for three commonly-used dc circuit configurations from the formulas below:

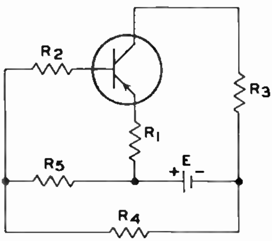
CIRCUIT A



Two-battery-operated stage

$$S_F = \frac{|\alpha_f|(R_1 + R_2)}{R_2 + |\alpha_f| R_1}$$

CIRCUIT B



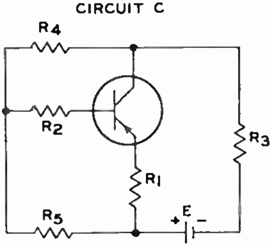
Single-battery-operated stage

$$S_F = \frac{|\alpha_f|(R_1 + R_{eq})}{R_{eq} + |\alpha_f| R_1}$$

where

$$R_{eq} = R_2 + \frac{R_4 R_5}{R_4 + R_5}$$

CIRCUIT C



Single-battery-operated stage with degenerative feedback

$$S_F = \frac{|\alpha_f|(P + Q)}{Q + |\alpha_f| P}$$

where

$$P = R_1(R_3 + R_4 + R_5) + R_3 R_5$$

$$Q = R_2(R_3 + R_4 + R_5) + R_4 R_5$$

World Radio History

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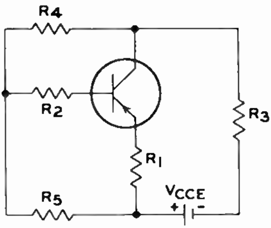
2N104

JUNCTION TRANSISTOR

For example, in the following dc equivalent circuit for a typical commercial application employing common-emitter circuit, base input, it is desired to determine if the transistor will be operating within dissipation rating if the dc collector-to-emitter voltage is -6 volts, the dc collector current is -1 milliampere, and the ambient temperature after equipment warm-up is 50°C. Under these conditions, the transistor dissipation is approximately equal to the collector dissipation $V_{CE} \times I_C$, or 6 milliwatts.



Circuit components:
R_1 = 270 ohms
R_2 = 1000 ohms
R_3 = 9000 ohms
R_4 = 43000 ohms
R_5 = 3900 ohms

(1) By use of the curve showing the variation of the forward current transfer ratio, α_f, with ambient temperature, for an ambient temperature of 50°C, a value of α_f equal to -56 is obtained.

(2) Using formulas shown for circuit C,

$$P = 270(9000 + 43000 + 3900) + (9000)(3900)$$
$$P = 5.02 \times 10^7 \text{ ohms}^2$$
$$Q = 1000(9000 + 43000 + 3900) + (43000)(3900)$$
$$Q = 22.4 \times 10^7 \text{ ohms}^2$$
$$S_F = \frac{56\left[(5.02 \times 10^7) + (22.4 \times 10^7)\right]}{(22.4 \times 10^7) + 56\,(5.02 \times 10^7)}$$
$$S_F = 5.06$$

(3) Referring to the dissipation chart, for an abscissa ($S_F \times V_{CE}$ = 5.06 x -6) of -30.4 and an ambient temperature of 50°C, the maximum dissipation rating is 55 milliwatts. Since the actual transistor dissipation of 6 milliwatts is well within the maximum dissipation, the transistor is being operated with a considerable degree of safety.

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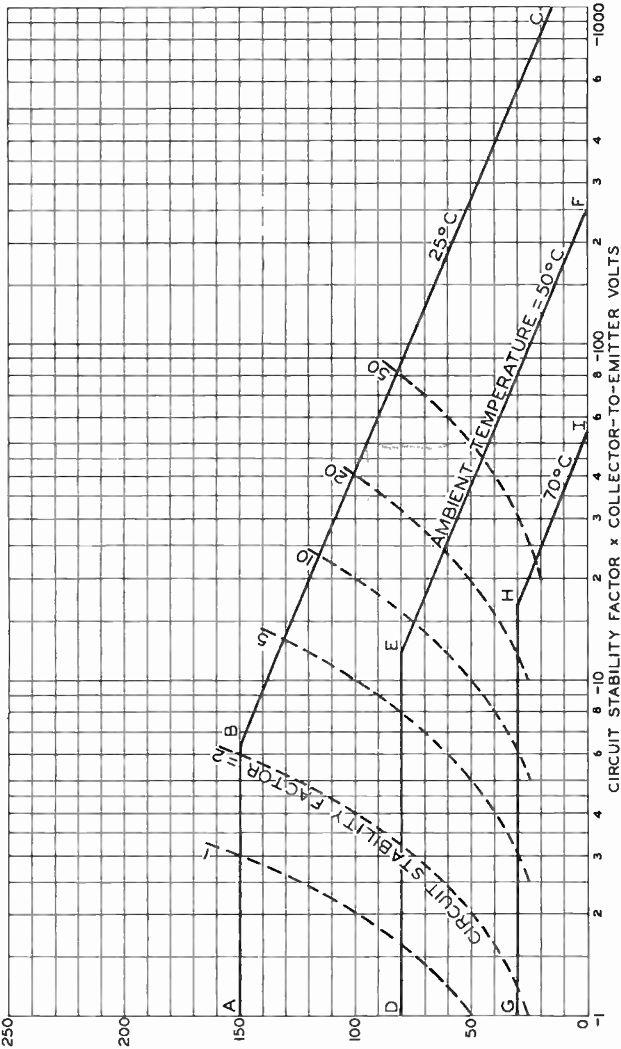
TRANSISTOR DISSIPATION RATING CHART



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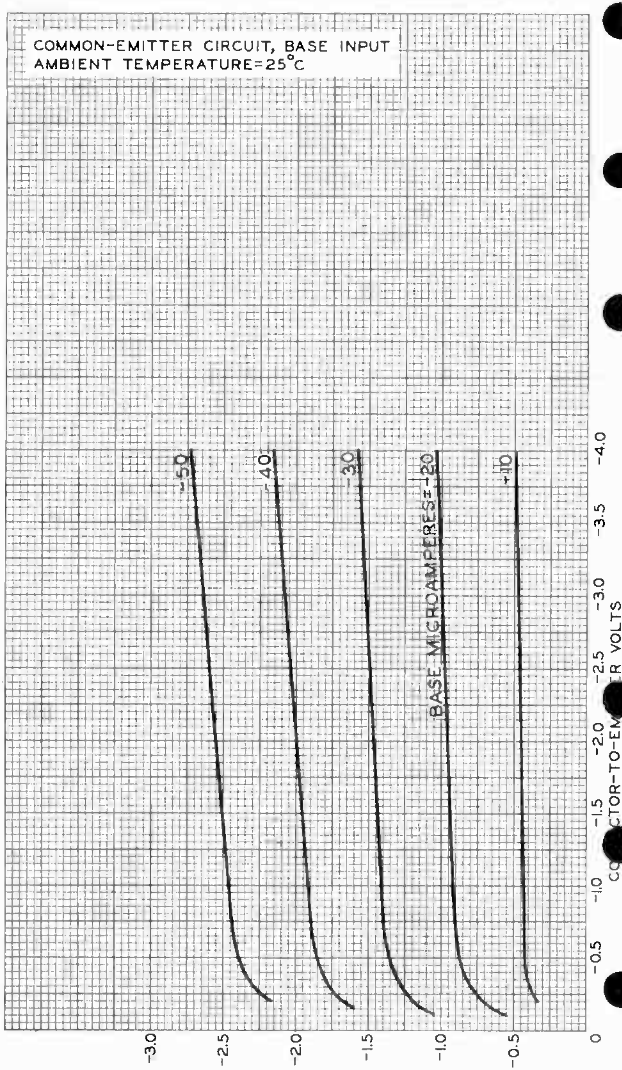
World Radio History

2N104

2N104

AVERAGE COLLECTOR CHARACTERISTICS



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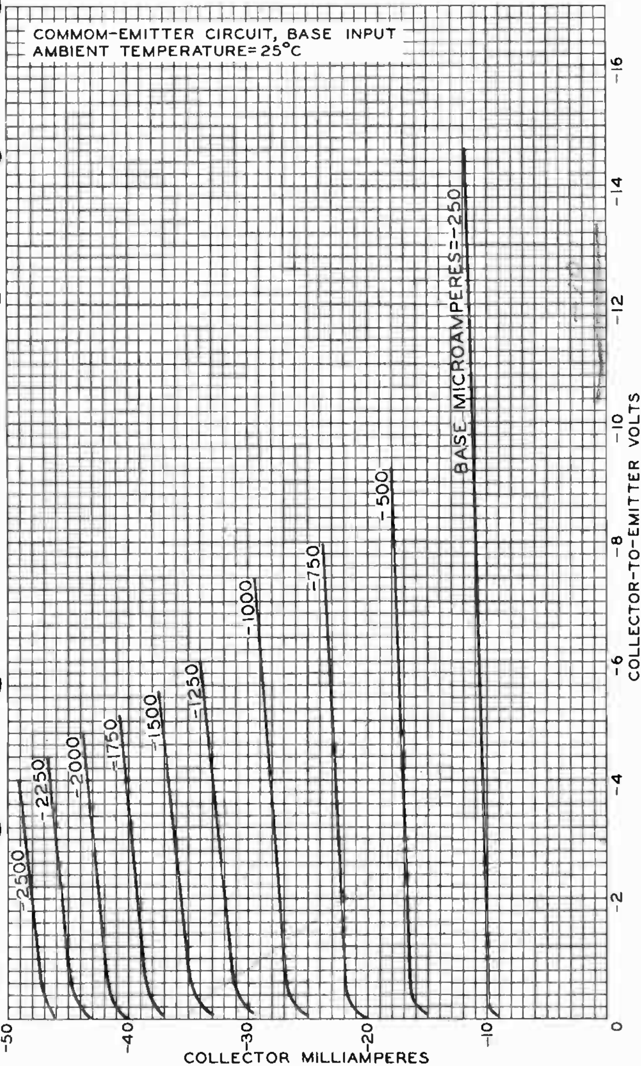
92CM-8524R1

2N104

2N104

AVERAGE COLLECTOR CHARACTERISTICS



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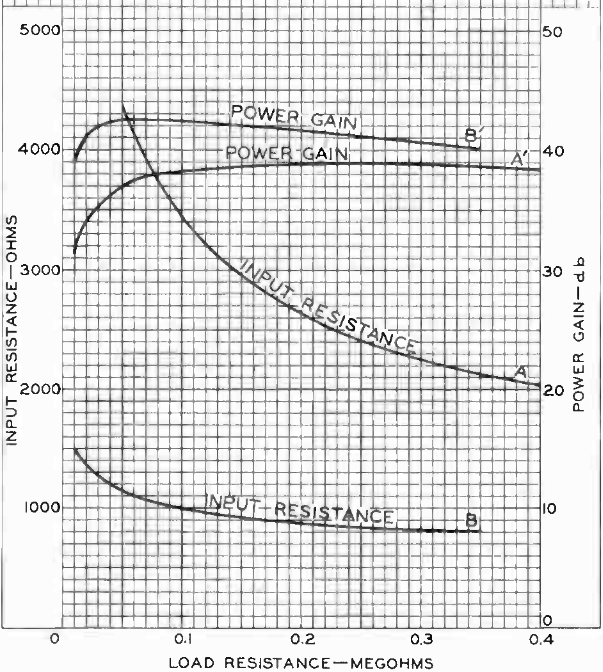
2N104

OPERATION CHARACTERISTICS

COMMON-EMITTER CIRCUIT, BASE INPUT
AMBIENT TEMPERATURE=25°C

CURVE	COLLECTOR-TO-EMITTER VOLTS	COLLECTOR MA
A & A′	-3	-0.2
B & B′	-6	-1



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92CM-8518R2

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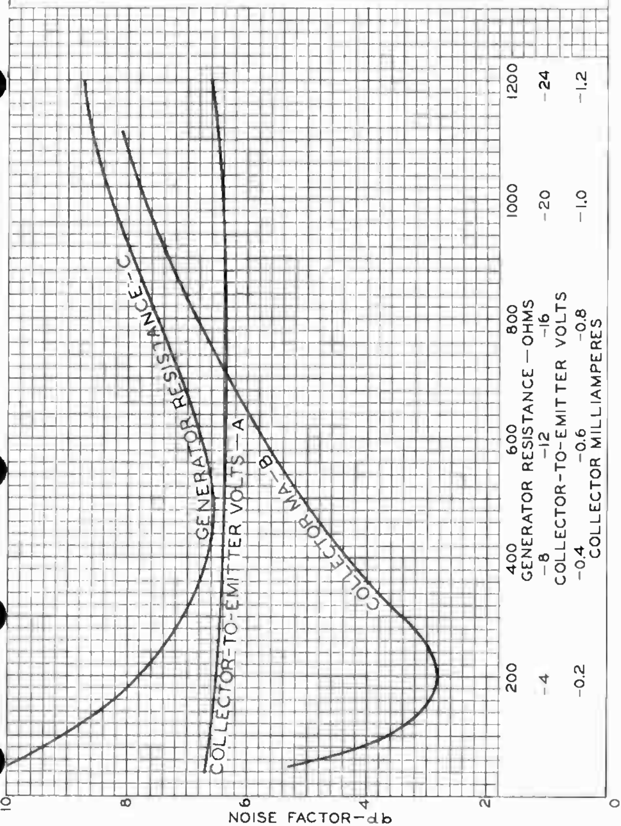
2N104

TYPICAL NOISE CHARACTERISTICS

COMMON-EMITTER CIRCUIT, BASE INPUT
AMBIENT TEMPERATURE = 25°C
MEASURED WITH A NOISE DIODE AND THERMOCOUPLE VOLTMETER WITH LOAD RESISTANCE = 20000 OHMS AND EQUIVALENT NOISE BANDWIDTH = 12.3 KC WITH GEOMETRIC MEAN OF 300 CPS

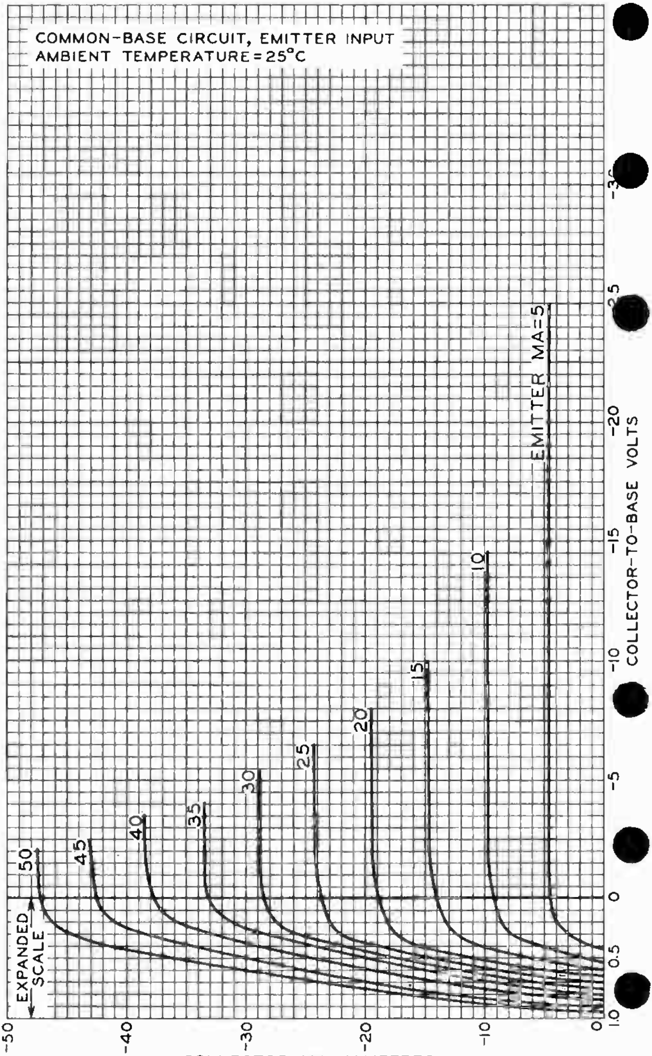
CURVE	GENERATOR RESISTANCE (OHMS)	COLLECTOR-TO-EMITTER VOLTS	COLLECTOR MA
A	518	—	-0.7
B	518	-4	—
C	—	-4	-0.7



2N104

2N104

AVERAGE COLLECTOR CHARACTERISTICS



92CM-8515R1

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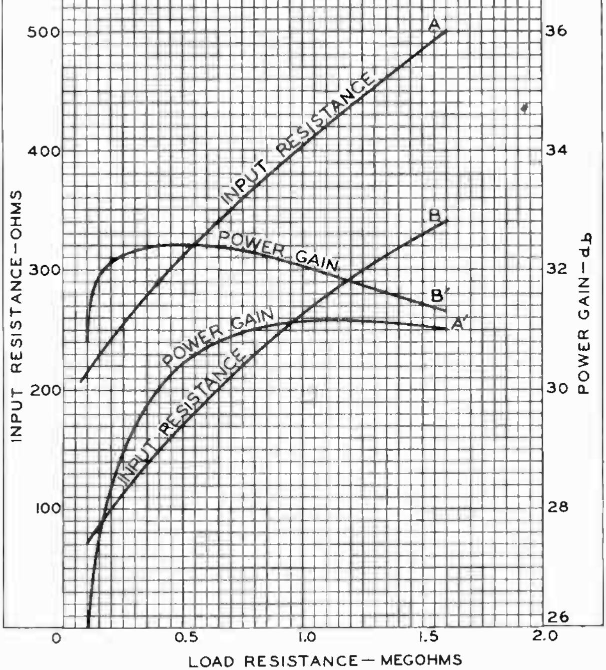
2N104

OPERATION CHARACTERISTICS

COMMON-BASE CIRCUIT, EMITTER INPUT
AMBIENT TEMPERATURE=25°C

CURVE	COLLECTOR-TO-BASE VOLTS	COLLECTOR MA
A & A′	-3	-0.2
B & B′	-6	-1



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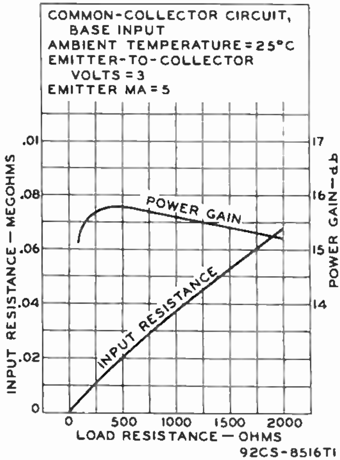
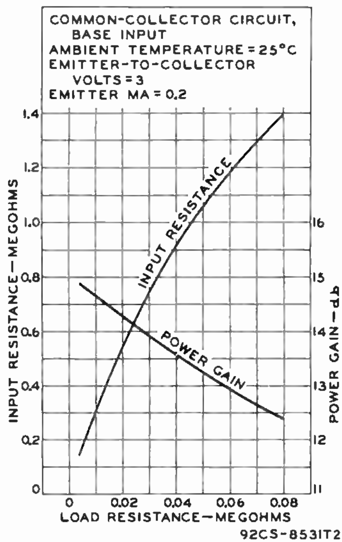
2N104
OPERATION CHARACTERISTICS





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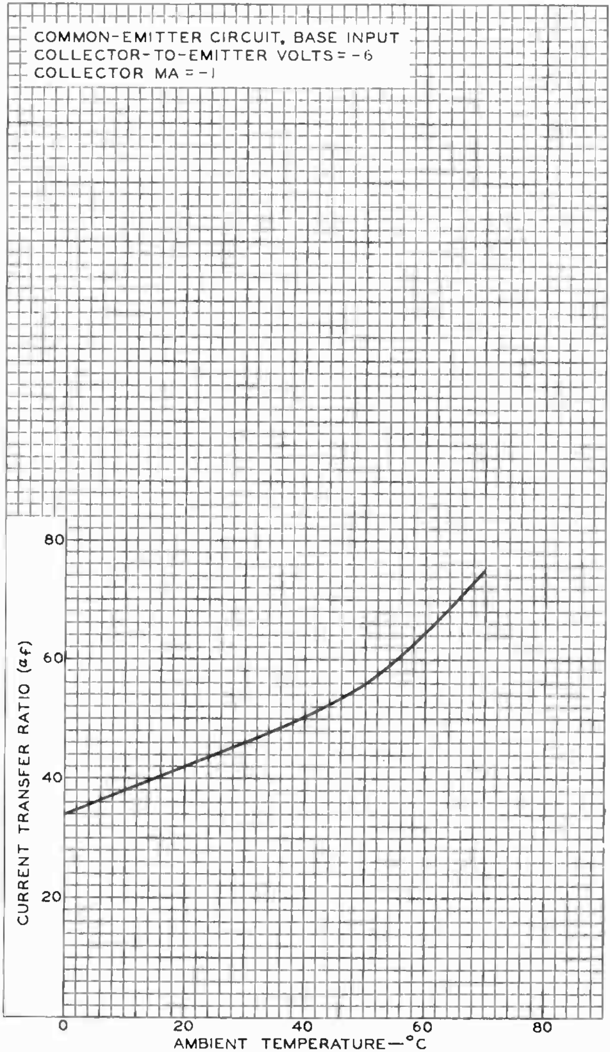
2N104

AVERAGE CHARACTERISTIC



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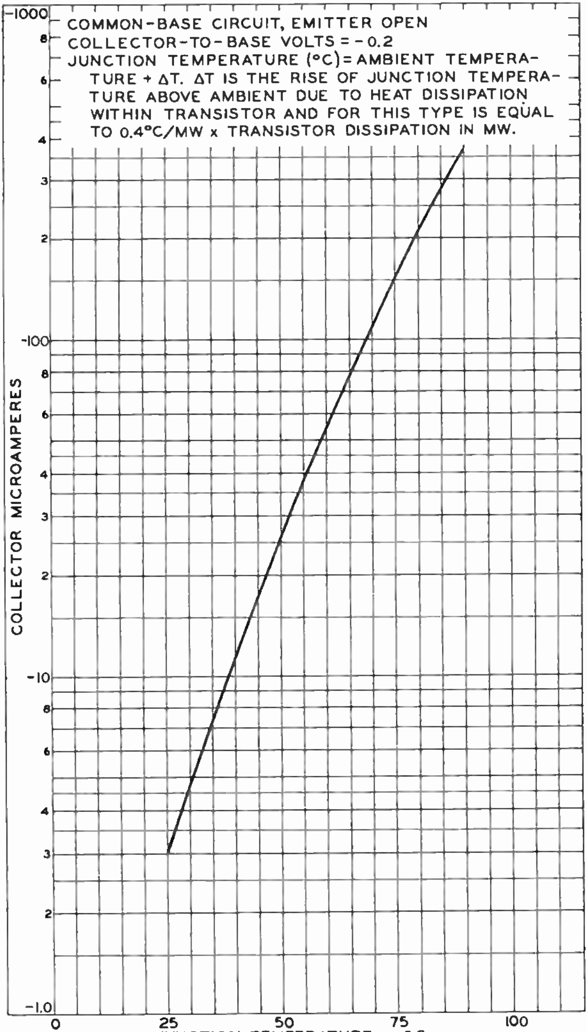
2N104

2N104

OPERATION CHARACTERISTIC



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92CM-8532R1

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2N105

JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For small-signal audio-frequency applications

GENERAL DATA

Electrical:

Minimum DC Collector-to-Base Voltage for dc collector current of −10 μamp with emitter open, and at ambient temperature of 25°C	−35	volts
Maximum DC Collector Current for dc collector-to-base voltage of −12 volts with collector open, and at ambient temperature of 25°C	−5	μamp

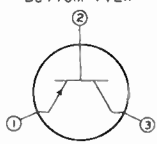
Mechanical:

Mounting Position . . . . Any
Maximum Length (Excluding flexible leads) . . . . 0.255"
Maximum Diameter. . . . . 0.135"
Case. . . . . .Metal, Insulated
Envelope Seals. . . . . Hermetic
Leads, Flexible 3
  Length. . . . . 1.5" ± 0.015"
  Orientation and diameter. . . . . . . *See Dimensional Outline at front of this Section*

BOTTOM VIEW

Lead 1 – Emitter

Lead 2 – Base



Lead 3 – Collector (Red band)

AUDIO-FREQUENCY AMPLIFIER -- Class A

Maximum Ratings, ***Absolute Values:***

DC COLLECTOR-TO-BASE VOLTAGE.	−25 max.	volts
DC COLLECTOR CURRENT.	−15 max.	ma
DC EMITTER CURRENT.	15 max.	ma
COLLECTOR DISSIPATION	35 max.	mw
AMBIENT TEMPERATURE (During operation). . .	50 max.	°C
STORAGE-TEMPERATURE RANGE	−55 to +70	°C

Characteristics, ***At Ambient Temperature of 25°C:***

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	−1.3	−4	volts
DC Collector Current.	−0.3	−0.7	ma
Power Gain:			
With load resistance = 4700 ohms, and input resistance = 4700 ohms. .	32.5	–	db
With load resistance = 20,000 ohms, and input resistance = 2300 ohms. .	–	42	db

6-56

TENTATIVE DATA 1

World Radio History

2N105

2N105

JUNCTION TRANSISTOR

Noise Factor:

Measured with a noise diode and thermocouple voltmeter with load resistance = 20,000 ohms, generator resistance = 1000 ohms, and equivalent noise bandwidth = 12.3 kc with geometric mean of 300 cps

Maximum value	16.5	-	db
Typical value	7.5	-	db

Small-Signal T Parameters:*

DC Collector-to-Emitter Voltage (V_{CE})	-1.3	-4	volts
DC Collector Current (I_C)	-0.3	-0.7	ma
Emitter Resistance (r_e)	73	34	ohms
Base Resistance (r_b)	1400	976	ohms
Mutual Resistance (r_m)	3.66	3.39	megohms
Collector Resistance (r_c)	3.74	3.45	megohms
Current Transfer Ratio (α_f)■	-45	-55	

Small-Signal Hybrid-π Parameters:*

DC Collector-to-Emitter Voltage (V_{CE})	-1.3	-4	volts
DC Collector Current (I_C)	-0.3	-0.7	ma
Resistance $r_{bb'}$	260	250	ohms
Conductance $g_{b'e}$	220	380	µmhos
Conductance g_{ce}	3.1	4.5	µmhos
Conductance $g_{b'c}$	0.20	0.21	µmho
Capacitance $C_{b'e}$	2500	4500	µµf
Capacitance $C_{b'c}$	27	17	µµf
Intrinsic Transconductance (g_m)	10000	21000	µmhos
Frequency● for unity power amplification	1.9	2.6	Mc

Small-Signal H Parameters:*

DC Collector-to-Emitter Voltage (V_{CE})	-1.3	-4	volts
DC Collector Current (I_C)	-0.3	-0.7	ma
Input Resistance, output circuit shorted (h_i)	4800	2880	ohms
Reverse Voltage Transfer Ratio, input circuit open (h_r)	9.1×10^{-4}	5.5×10^{-4}	
Forward Current Transfer Ratio, output circuit shorted (h_f)	45	55	
Output Conductance, input circuit open (h_o)	12.4	16.3	µmhos

* As derived from corresponding equivalent circuit shown under type 2N104.

■ Measured at 1 kc.

●: See next page.

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2N105

JUNCTION TRANSISTOR

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage.	-4	volts
DC Collector Current.	-0.7	ma
Power Gain:		
With load resistance = 0.5 megohm, and input resistance = 180 ohms	33.2	db
Frequency at which the current transfer ratio drops to one-half the square root of two times its value at 1 kc . . .	700	kc

Common-Collector Circuit, Base Input

DC Emitter-to-Collector Voltage	1.3	volts
DC Emitter Current.	0.3	ma
Power Gain:		
With load resistance = 13,000 ohms, and input resistance = 0.5 megohm	16	db

• This frequency (figure of merit) may be calculated from the equation

$$f = \frac{1}{4\pi}\sqrt{\frac{g_m}{r_{bb'}\ C_{b'c}\ C_{b'e}}}$$

OPERATING CONSIDERATIONS

The 2N105 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N105 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

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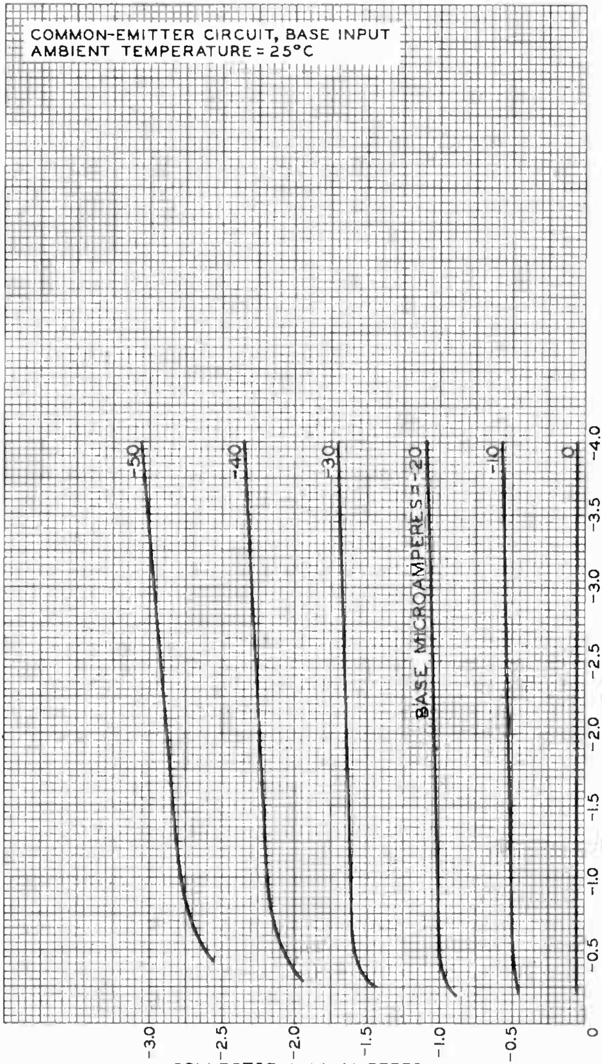
2N105

AVERAGE COLLECTOR CHARACTERISTICS



92CM-8571R1

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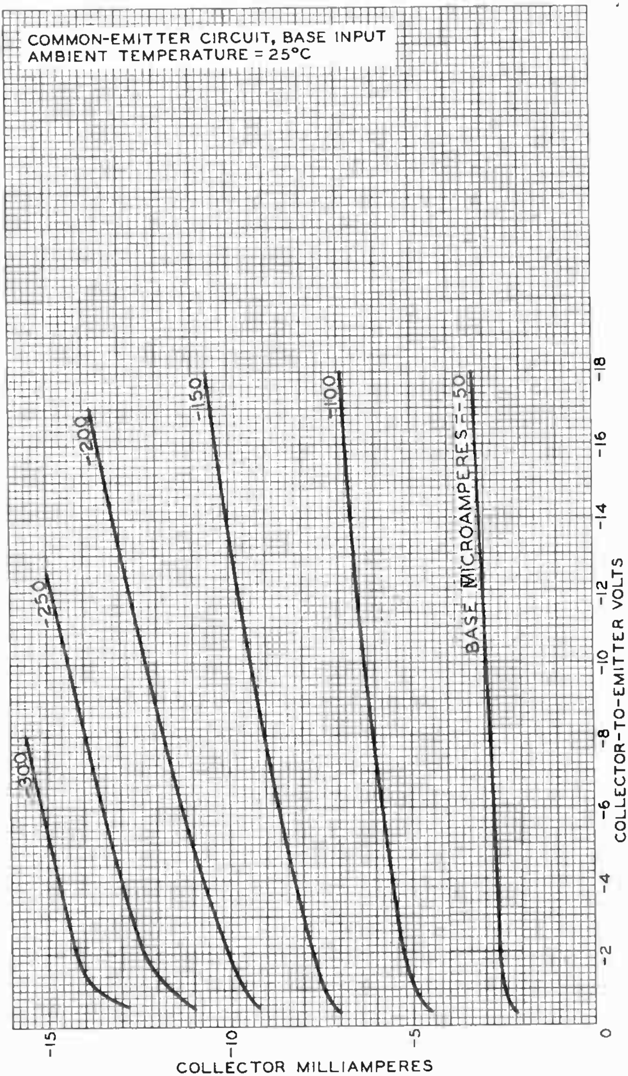
2N105

AVERAGE COLLECTOR CHARACTERISTICS



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92CM-8572R1

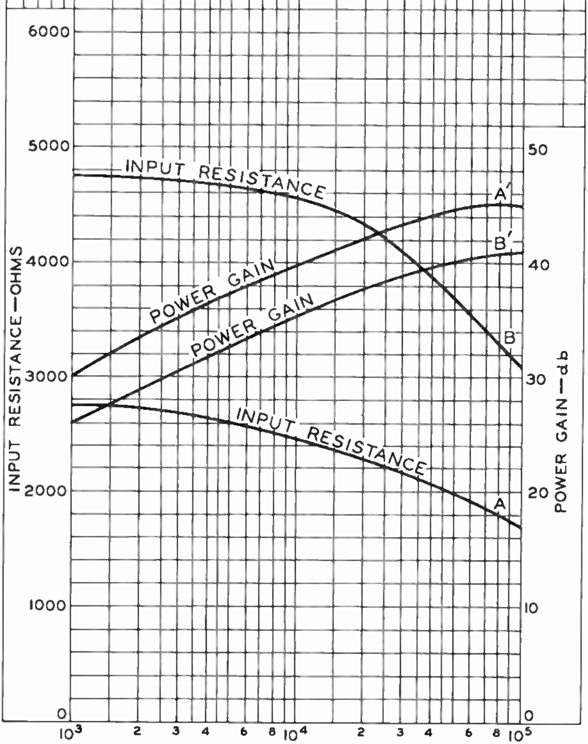
2N105

2N105

OPERATION CHARACTERISTICS

COMMON-EMITTER CIRCUIT, BASE INPUT
AMBIENT TEMPERATURE = 25°C

CURVE	COLLECTOR-TO-EMITTER VOLTS	COLLECTOR MA
A & A′	-4	-0.7
B & B′	-1.3	-0.3



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92CM-8582R1

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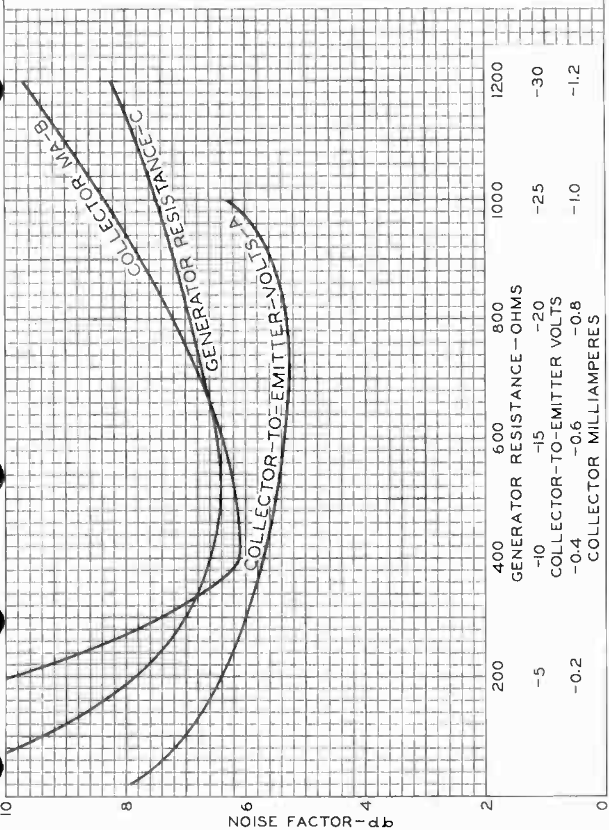
2N105

TYPICAL NOISE CHARACTERISTICS

COMMON-EMITTER CIRCUIT, BASE INPUT
AMBIENT TEMPERATURE = 25°C
MEASURED WITH A NOISE DIODE AND THERMOCOUPLE VOLTMETER WITH LOAD RESISTANCE = 20000 OHMS AND EQUIVALENT NOISE BANDWIDTH = 12.3 KC WITH GEOMETRIC MEAN OF 300 CPS

CURVE	GENERATOR RESISTANCE (OHMS)	COLLECTOR-TO-EMITTER VOLTS	COLLECTOR MA
A	1000	—	−0.3
B	1000	−1.3	—
C	—	−1.3	−0.3



2N105

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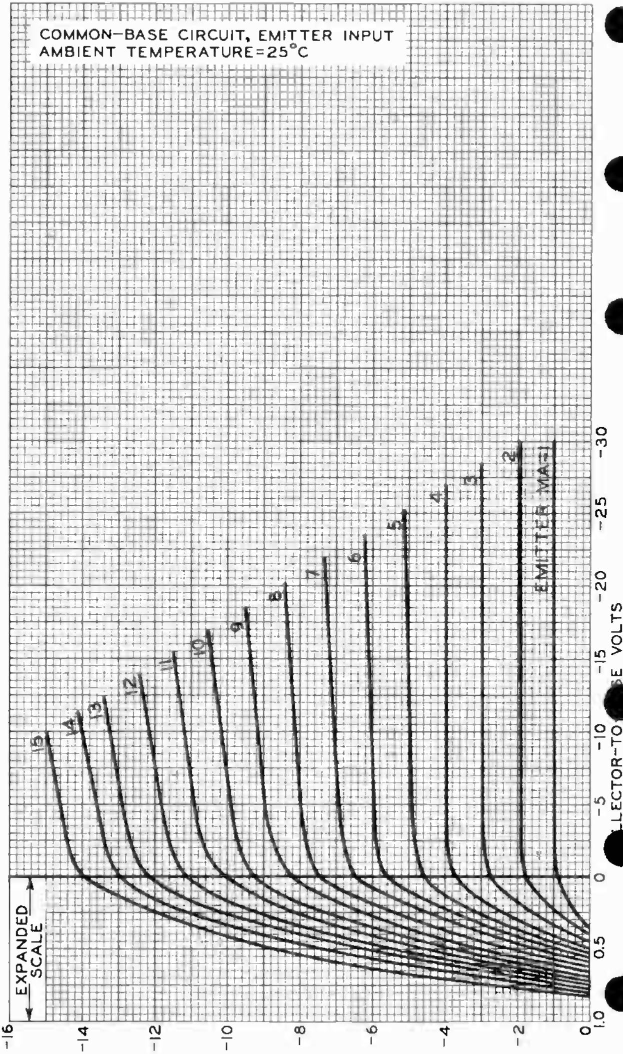
AVERAGE COLLECTOR CHARACTERISTICS



92CM-8580RI

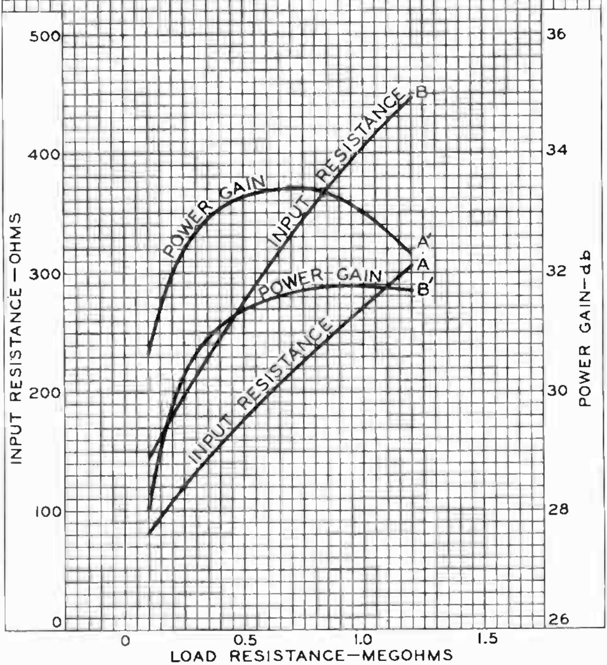
World Radio History

2N105

OPERATION CHARACTERISTICS

COMMON-BASE CIRCUIT, EMITTER INPUT
AMBIENT TEMPERATURE = 25°C

CURVE	COLLECTOR-TO-BASE VOLTS	COLLECTOR MA
A & A′	-4	-0.7
B & B′	-1.3	-0.3



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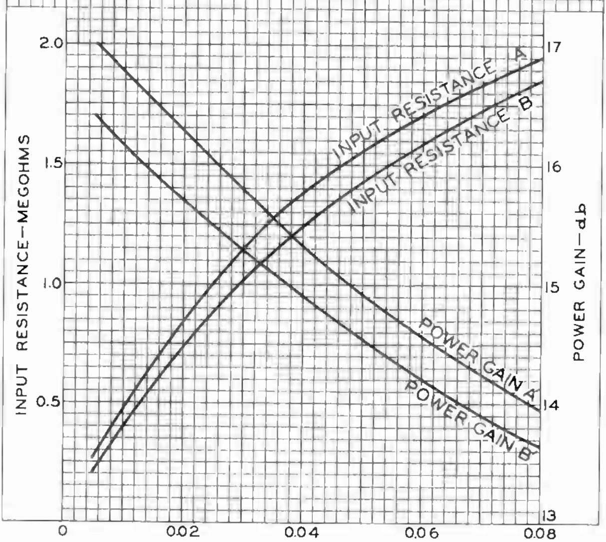
92CM-8576R1

2N105

OPERATION CHARACTERISTICS



CURVE	EMITTER-TO-COLLECTOR VOLTS	EMITTER MA
A & A′	4	0.7
B & B′	1.3	0.3

92CM-8574R1

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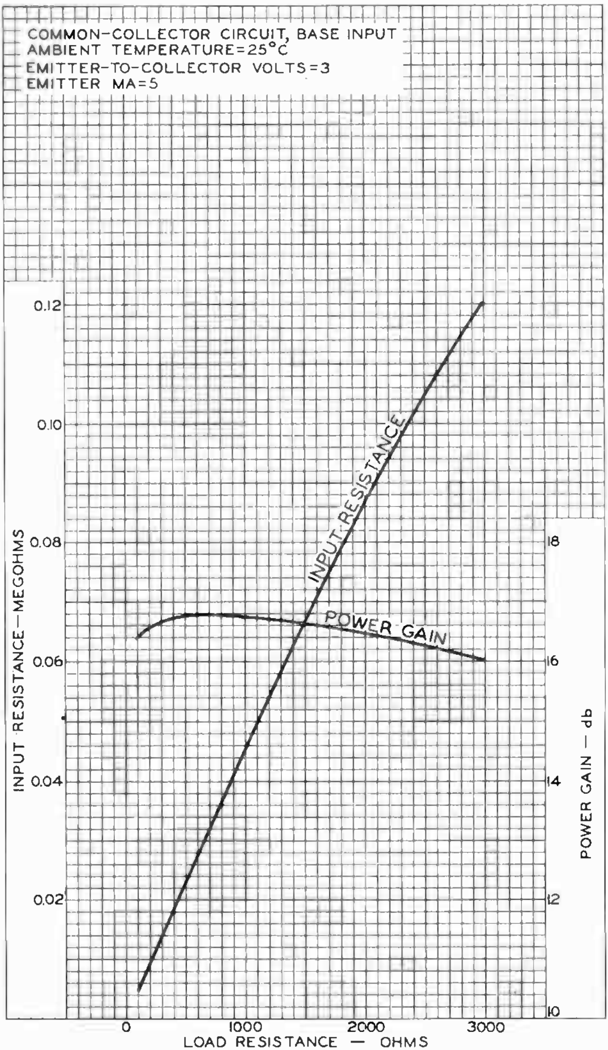
2N105

OPERATION CHARACTERISTICS



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92CM-8573R1

World Radio History

World Radio History

2N109

JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For large-signal audio-frequency applications

GENERAL DATA

Electrical:

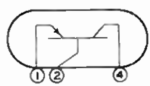
Maximum DC Collector Current for dc collector-to-base voltage of -25 volts with emitter open, and at ambient temperature of 25°C.	-10	μamp
Maximum DC Emitter Current for dc emitter-to-base voltage of -25 volts with collector open, and at ambient temperature of 25°C.	-10	μamp

Mechanical:

Mounting Position.	Any
Maximum Overall Length	0.697"
Maximum Seated Length.	0.495"
Maximum Diameter	0.260"
Dimensional Outline.	*See front of this Section*
Case	Metal, Insulated
Envelope Seals	Hermetic
Base	Small-Round Linotetrar 3-Pin (JETEC No. E3-25)

Pin 1 - Emitter

Pin 2 - Base



Pin 4 - Collector

AUDIO-FREQUENCY AMPLIFIER -- Class B

Maximum Ratings, ***Absolute Values:***

PEAK COLLECTOR-TO-BASE VOLTAGE	-25 max.	volts
DC COLLECTOR-TO-BASE VOLTAGE (For inductive load).	-12 max.	volts
PEAK COLLECTOR CURRENT	-70 max.	ma
AVERAGE COLLECTOR CURRENT.	-35 max.	ma
PEAK EMITTER CURRENT	70 max.	ma
AVERAGE EMITTER CURRENT.	35 max.	ma
COLLECTOR DISSIPATION.	50 max.	mw
AMBIENT TEMPERATURE (During operation) . . .	50 max.	°C
STORAGE-TEMPERATURE RANGE.	-55 to +85	°C

Characteristics, ***At Ambient Temperature of 25°C:***

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage.	-1	volt
DC Collector Current	-50	ma
Large-Signal DC Current Transfer Ratio . . .	70	

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RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

RCA

2N109
JUNCTION TRANSISTOR

Typical Push-Pull Operation, *At Ambient Temperature of 25°C:*
Common-Emitter Circuit, Base Input
Unless otherwise specified, values are for 2 transistors

DC Collector-to-Emitter Supply Voltage .	-4.5	-9	volts
DC Base-to-Emitter Voltage	-0.15	-0.15	volt
Peak Collector Current (Per transistor).	-35	-40	ma
Zero-Signal DC Collector Current (Per transistor).	-2	-2	ma
Max.-Signal DC Collector Current (Per transistor).	-11.5	-13	ma
Signal-Source Impedance (Base to base)	1500	1500	ohms
Load Impedance (Collector to collector)	400	800	ohms
Signal Frequency	1	1	kc
Circuit Efficiency	60	69	%
Power Gain	30	33	db
Total Harmonic Distortion.	7	7	%
Max.-Signal Power Output	75	160	mw

OPERATING CONSIDERATIONS

The 2N109 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

In class B service, when the 2N109 is operated at ambient temperatures other than 25°C, the base-to-emitter voltage should be reduced or increased by approximately 0.002 volt for each degree the ambient temperature is above or below 25°C, respectively. When this transistor is operated under varying ambient temperatures, some form of temperature compensation may be used in the base-to-emitter circuit to hold the operating point constant.

TENTATIVE DATA

SEMICONDUCTOR DIVISION
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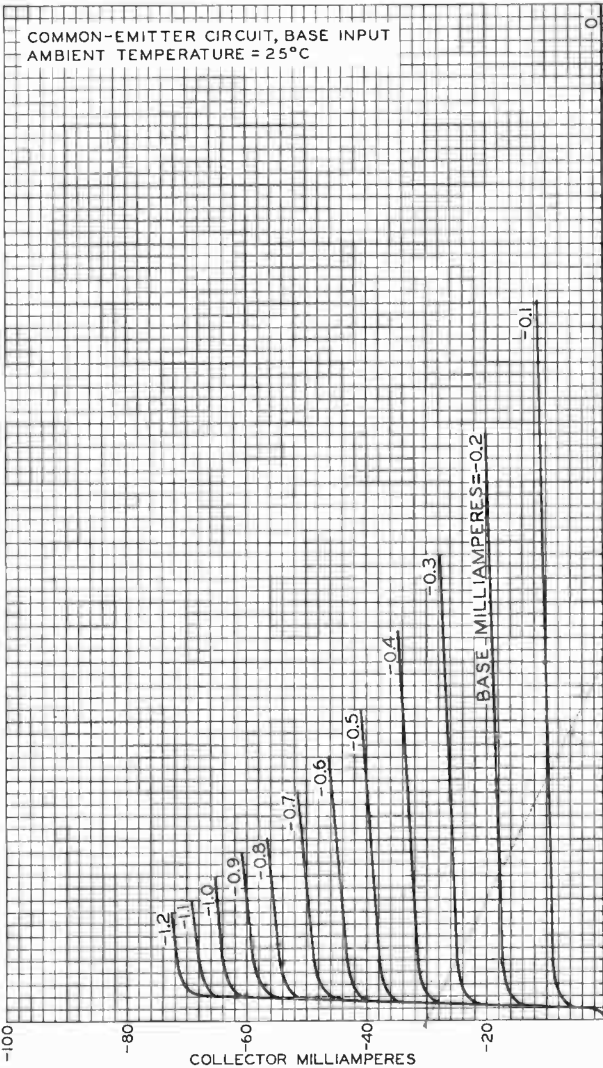
World Radio History

RCA

2N109

AVERAGE COLLECTOR CHARACTERISTICS



92CM-8599R2

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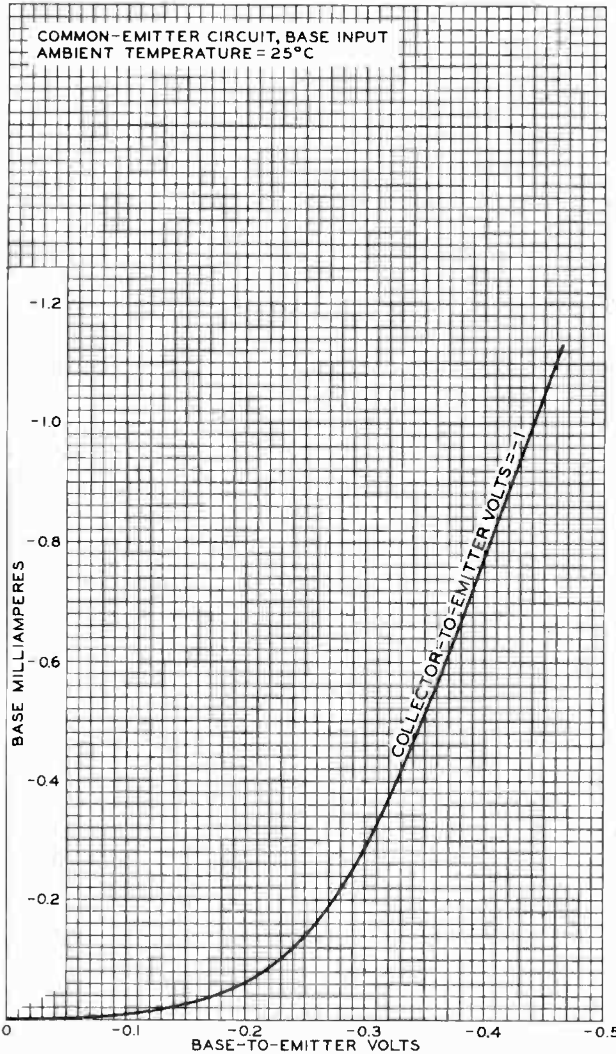
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

2N109

2N109

AVERAGE BASE CHARACTERISTIC



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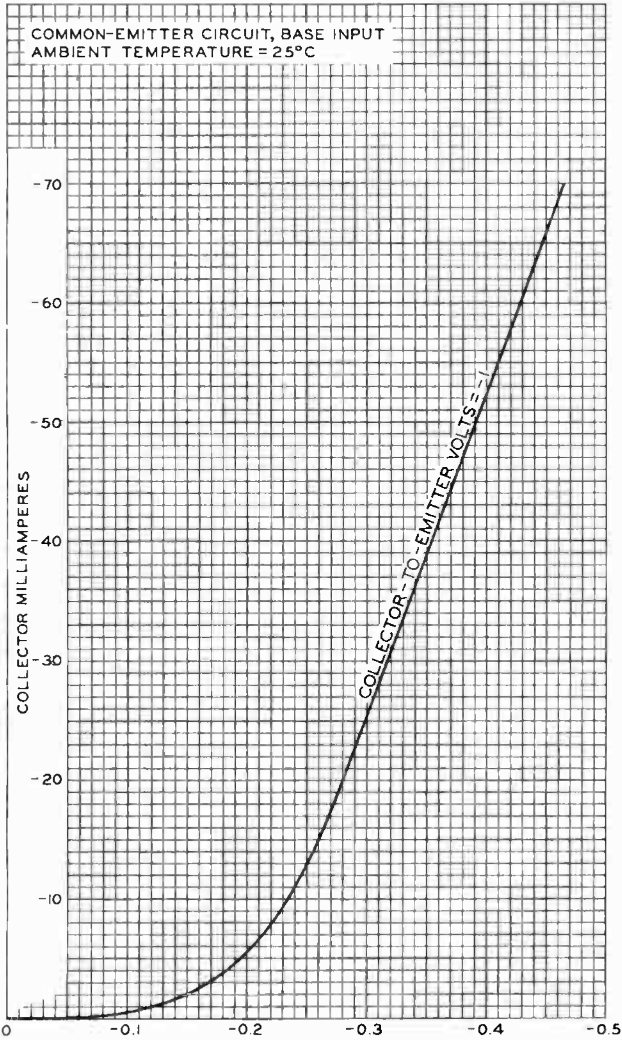
92CM-8602R2

2N109

2N109

AVERAGE CHARACTERISTIC



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RADIO CORPORATION OF AMERICA SOMERVILLE, NEW JERSEY

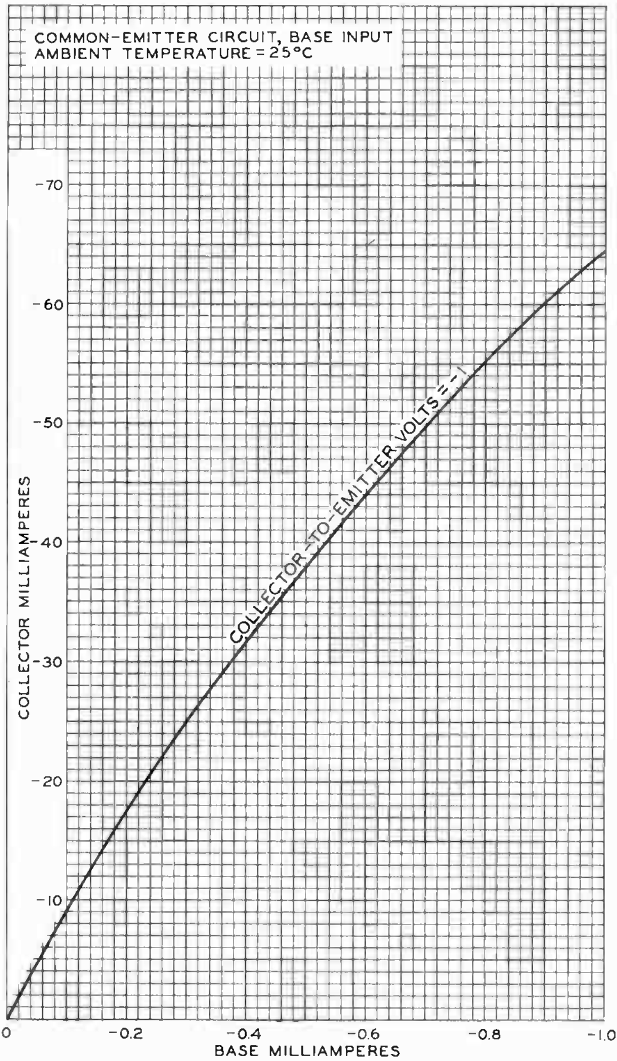
92CM-8598R2

World Radio History

2N109

2N109

AVERAGE CHARACTERISTIC



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92CM-8600R2

World Radio History

RCA

2N139

JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For 455-kc intermediate-frequency applications

GENERAL DATA

Electrical:

Minimum DC Collector-to-Base Voltage for dc collector current of -10 μamp with emitter open, and at ambient temperature of 25°C	-16	volts
Maximum DC Collector Current for dc collector-to-base voltage of -12 volts with emitter open, and at ambient temperature of 25°C	-6	μamp
Maximum DC Emitter Current for dc emitter-to-base voltage of -12 volts with collector open, and at ambient temperature of 25°C	-40	μamp

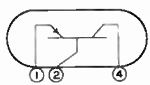
Mechanical:

Mounting Position . . . . Any
Maximum Overall Length. . . . . 0.697"
Maximum Seated Length . . . . 0.495"
Maximum Diameter. 0.260"
Dimensional Outline . . . . *See front of this Section*
Case. . . . . .Metal, Insulated
Envelope Seals. . . . . .Hermetic
Base. . . . . . . Small-Round Linotetrar 3-Pin (JETEC No.E3-25)

Pin 1 - Emitter

Pin 2 - Base

Pin 4 - Collector



INTERMEDIATE-FREQUENCY AMPLIFIER SERVICE

Maximum Ratings, ***Absolute Values:***

DC COLLECTOR-TO-BASE VOLTAGE.	-16 max.	volts
DC EMITTER-TO-BASE VOLTAGE.	-12 max.	volts
DC COLLECTOR CURRENT.	-15 max.	ma
DC EMITTER CURRENT.	15 max.	ma
COLLECTOR DISSIPATION	35 max.	mw
AMBIENT TEMPERATURE (During operation). . .	70 max.	°C
STORAGE-TEMPERATURE RANGE	-55 to +85	°C

Characteristics, ***At Ambient Temperature of 25°C:***

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-9	-9	volts
DC Collector Current.	-0.5	-1	ma
Current Transfer Ratio (α_f)■.	-45	-48	

■: See next page.

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

2N139

2N139

JUNCTION TRANSISTOR

Small-Signal Hybrid-π Parameters:*

DC Collector-to-Emitter Voltage (V_{CE})	-9	-9	volts
DC Collector Current (I_C)	-0.5	-1	ma
Resistance $r_{bb'}$	85	75	ohms
Conductance $g_{b'e}$	425	800	μmhos
Conductance g_{ce}	4.6	8.6	μmhos
Conductance $g_{b'c}$	0.22	0.25	μmho
Capacitance $C_{b'e}$	900	1560	μμf
Capacitance $C_{b'c}$	9.5	9.5	μμf
Intrinsic Transconductance (g_m)	19300	38600	μmhos
Frequency• for unity power amplification	13	14	Mc

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-9	-9	volts
DC Collector Current	-0.5	-1	ma
Current Transfer Ratio■	0.978	0.980	
Frequency at which the current transfer ratio drops to one-half the square root of two times its value at 1 kc.	4.5	4.7	Mc

Typical Operation, *At Ambient Temperature of 25°C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-9	-9	volts
DC Collector Current	-0.5	-1	ma
Input Resistance	1000	500	ohms
Output Resistance	70000	30000	ohms
Spot Noise Factor▲	4.5	4.5	db
Maximum Power Gain▲	38	37	db
Useful Power Gain	27.6§	30.4†	db

* As derived from corresponding equivalent circuit shown under type 2N104.

• This frequency (figure of merit) may be calculated from the equation

$$f = \frac{1}{4\pi}\sqrt{\frac{g_m}{r_{bb'}\, C_{b'c}\, C_{b'e}}}$$

■ Measured at 1 kc.

▲ Measured in a single-tuned unilateralized circuit matched to the generator and load impedances for maximum transfer of power. Transformer insertion losses not included. (Unilateralization is a special case of neutralization in which the resistive as well as the reactive feedback parameters are balanced out. Unilateralization changes a bilateral network into a unilateral network).

§ A transformer insertion loss of 10.4 db is included in this figure.

† A transformer insertion loss of 6.6 db is included in the figure.

OPERATING CONSIDERATIONS

The 2N139 should not be connected into or disconnected from circuits with the power are because high transient currents may cause permanent damage to the transistor.

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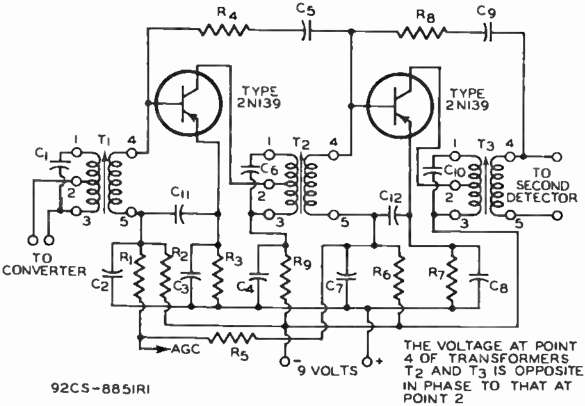
World Radio History

RCA

2N139

JUNCTION TRANSISTOR

TYPICAL 455-KC INTERMEDIATE-FREQUENCY AMPLIFIER CIRCUIT



C1 C6 C10: 220 µµf
C2: 50 µf
C3 C4 C8: 0.05 µf
C5: 75 µµf
C7: 25 µf
C9: 33 µµf
C11 C12: 0.1 µf
R1: 12000 ohms

R2: 0.15 megohm
R3 R7: 820 ohms
R4: 560 ohms
R5: 18000 ohms
R6: 0.1 megohm
R8: 2000 ohms
R9: 560 ohms

Transformer:	T1	T2	T3	
Reflected resistance of primary between terminals 2 and 3 with secondary terminated.	206000	29000	10900	ohms
Reflected resistance of secondary with primary terminated.	1000	500	1000	ohms
Turns ratios:				
Terminals 1 and 3 to terminals 2 and 3.	1.17	2.48	3.16	
Terminals 1 and 3 to terminals 4 and 5.	16.8	18.9	10.43	
Terminals 2 and 3 to terminals 4 and 5.	14.35	7.62	3.3	
Core Material.	Ferrite	Ferrite	Ferrite	
Unloaded Q (mounted in chassis). . . .	110	61	110	
Loaded Q (mounted in chassis).	35	35	35	

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World Radio History

2N139

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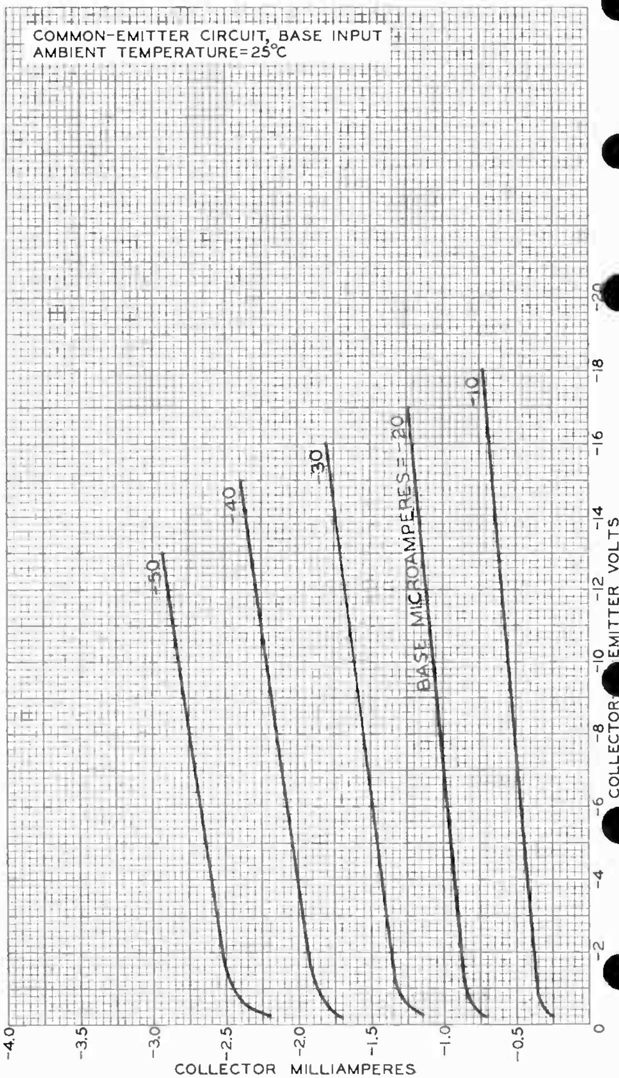
2N139

AVERAGE COLLECTOR CHARACTERISTICS



92CM-8849R1

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RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

2N140

2N140

JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For 540 to 1600 kc converter applications

GENERAL DATA

Electrical:

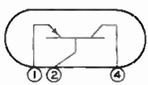
Minimum DC Collector-to-Base Voltage for dc collector current of −10 μamp with emitter open, and at ambient temperature of 25°C	−16	volts
Maximum DC Collector Current for dc collector-to-base voltage of −12 volts with emitter open, and at ambient temperature of 25°C	−6	μamp
Maximum DC Emitter Current for dc emitter-to-base voltage of −12 volts with collector open, and at ambient temperature of 25°C	−40	μamp

Mechanical:

Mounting Position	Any
Maximum Overall Length.	0.697"
Maximum Seated Length	0.495"
Maximum Diameter.	0.260"
Dimensional Outline	*See front of this Section*
Case.	Metal, Insulated
Envelope Seals.	Hermetic
Base.	Small-Round Linotetrar 3-Pin (JETEC No.E3-25)

Pin 1 - Emitter

Pin 2 - Base



Pin 4 - Collector

CONVERTER SERVICE

Maximum Ratings, ***Absolute Values:***

DC COLLECTOR-TO-BASE VOLTAGE.	−16 max.	volts
DC EMITTER-TO-BASE VOLTAGE.	−12 max.	volts
DC COLLECTOR CURRENT.	−15 max.	ma
DC EMITTER CURRENT.	15 max.	ma
COLLECTOR DISSIPATION	35 max.	mw
AMBIENT TEMPERATURE (During operation). . .	70 max.	°C
STORAGE-TEMPERATURE RANGE	−55 to +85	°C

Characteristics, ***At Ambient Temperature of 25°C:***

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	−9	volts
DC Collector Current.	−0.6	ma
Current Transfer Ratio (α_f)■.	−48	

■: See next page.

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World Radio History

2N140

2N140

JUNCTION TRANSISTOR

Small-Signal Hybrid-π Parameters:*

DC Collector-to-Emitter Voltage (V_{CE})	-9	volts
DC Collector Current (I_C)	-0.6	ma
Resistance $r_{bb'}$	85	ohms
Conductance $g_{b'e}$	480	µmhos
Conductance g_{ce}	5.4	µmhos
Conductance $g_{b'c}$	0.23	µmho
Capacitance $C_{b'e}$	650	µµf
Capacitance $C_{b'c}$	9.5	µµf
Intrinsic Transconductance (g_m)	22600	µmhos
Frequency for unity power amplification●	16.5	Mc

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-9	volts
DC Collector Current	-0.6	ma
Current Transfer Ratio■	0.980	
Frequency at which the current transfer ratio drops to one-half the square root of two times its value at 1 kc	7	Mc

Typical Operation, *At Ambient Temperature of 25°C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-9	volts
DC Collector Current	-0.6	ma
Input Resistance	600	ohms
Output Resistance	75000	ohms
RMS Base-to-Emitter Oscillator Injection Voltage	100	mv
Signal Frequency	1	Mc
Useful Conversion Power Gain	30	db

* As derived from corresponding equivalent circuit shown under type 2N104.

■ Measured at 1 kc.

● This frequency (figure of merit) may be calculated from the equation

$$f = \frac{1}{4\pi}\sqrt{\frac{g_m}{r_{bb'}\ C_{b'c}\ C_{b'e}}}$$

OPERATING CONSIDERATIONS

The 2N140 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

TENTATIVE DATA

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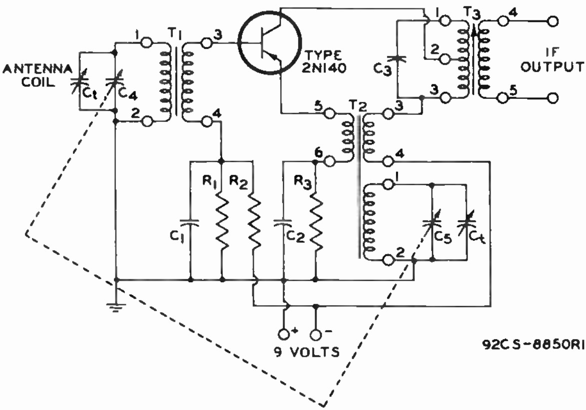
World Radio History

RCA

2N140

JUNCTION TRANSISTOR

TYPICAL SELF-EXCITED CONVERTER CIRCUIT



C1: 0.05 µf
C2: 0.04 µf
C3: 220 µµf
C4: 12 to 230 µµf (variable)
C5: 10 to 105 µµf (variable)
C_t: 2 to 20 µµf (variable)
R1: 6800 ohms
R2: 18000 ohms
R3: 3900 ohms

T1: RF Transformer; low-loss ferrite core; unloaded Q (mounted in chassis), 212 at 1 Mc. Primary: 75 turns of 7/41 Litz wire space wound (spacing equal to diameter of wire) in single layer and centered on core; reflected resistance with secondary terminated, 0.3 megohm; inductance (approx.), 353 microhenries. Secondary: 4.5 turns of No.34 SSE wire wound on ground end of core.

T2: Oscillator Transformer; low-loss ferrite core; unloaded Q (mounted in chassis), 100 at 1.455 Mc. Primary: 133 turns of 7/41 Litz wire between terminals 1 and 2; inductance (approx.); 207 microhenries. Secondary: 10 turns of No.34 SSE wire between terminals 3 and 4; 4 turns of No.34 SSE wire between terminals 5 and 6.

T3: IF Transformer; ferrite core; unloaded Q (mounted in chassis), 110 at 455 kc; loaded Q (mounted in chassis), 35 at 455 kc. Turns ratios: terminals 1 and 3 to terminals 2 and 3, 1.17; terminals 2 and 3 to terminals 4 and 5, 14.35; terminals 1 and 3 to terminals 4 and 5, 16.8. Primary: reflected resistance with secondary terminated, 0.206 megohm. Secondary: reflected resistance with primary terminated, 1000 ohms.

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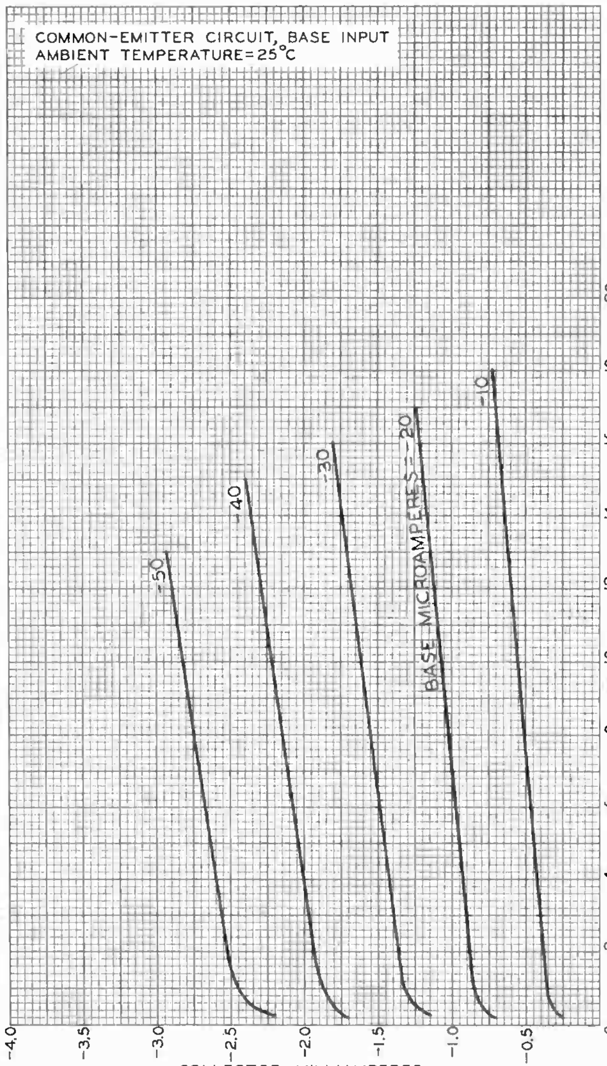
World Radio History

2N140

2N140

AVERAGE COLLECTOR CHARACTERISTICS



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92CM-9015

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

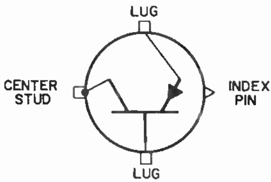
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No. TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE: With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	-60 max.	volts
EMITTER-TO-BASE VOLTAGE	-40 max.	volts
COLLECTOR CURRENT	-15 max.	amp
EMITTER CURRENT	15 max.	amp
BASE CURRENT	-4 max.	amp
TRANSISTOR DISSIPATION:[a] ←		
At case temperatures[b] of 25° C or below	150 max.	watts
CASE TEMPERATURE[b] RANGE: ←		
Operating and storage	-65 to +100	°C

Typical Operation:

In a common-emitter, base-input, power-switching circuit at case temperature[b] of 25° C

DC Supply Voltage	-12	volts
DC Base-Bias Voltage	6	volts
"On" DC Collector Current	-12	amp
"Turn-On" Base Current	-2	amp
"Turn-Off" Base Current	0	amp

← indicates a change.

World Radio History

Switching Time:

Rise time	15	μsec
Fall time	15	μsec

[a] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

[b] Measured at any point on sealing surface.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and at case temperature[b] of 25° C unless otherwise specified

		Min.	Typical	Max.	
DC Collector-to Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = -0.3.	BV_{CES}	-50	-	-	volts
With base open:	BV_{CEO}				
For dc collector amperes = -0.3. . . .		-	-50	-	volts
For dc collector amperes = -1[c]		-45	-	-	volts
DC Base-to-Emitter Voltage for dc collector-to-emitter volts = -2, dc collector amperes = -5. .	V_{BE}	-	-0.65	-	volt
DC Collector-to-Emitter Saturation Voltage for dc collector amperes = -12, dc base amperes = -2.	$V_{CE(sat)}$	-	-0.3	-0.7	volt
DC Emitter Voltage for dc collector volts = -80, dc emitter current = 0. .	V_{EB}	-	-0.15	-1	volt
DC Punch-Through Voltage. .	V_{PT}	-60	-	-	volts
DC Emitter-Cutoff Current for dc emitter volts = -40, dc collector current = 0	I_{EBO}	-	-1	-4	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = -2, dc emitter current = 0		-	-100	-	μa
With dc collector volts = -60, dc emitter current = 0		-	-2	-4	μa
With dc collector volts = -60, dc emitter current = 0, case temperature[b] = 71° C. .		-	-	-15	ma

→ Indicates a change.

World Radio History

DC Current Transfer Ratio for dc collector-to-emitter volts = -2, dc collector amperes =	h_{FE}				
-5		35	-	70	
-12		-	25	-	
Beta-Cutoff Frequency for dc collector-to-emitter volts = -6, dc collector amperes = -5	f_{ae}	-	10	-	kc
Thermal Resistance:					
Junction-to-case	R_T	-	0.35	0.5	°C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds		-	0.075	-	watt-sec/°C
Thermal Time Constant . . .	τ_1	-	26.25	-	msec

[b] Measured at any point on seating surface.
[c] Tested by sweep method to prevent excessive heating of collector junction.

PERFORMANCE TESTS

This transistor type is designed to pass the environmental tests specified in Military Specification MIL-S-19500B.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

Electrical connection can be made to the base and emitter lugs by means of clips or by soldering directly to the lugs. When soldering connections are made to the lugs, care should be taken to conduct excessive heat away from the lug seals, otherwise the heat of the soldering operation will crack the glass seals of the lugs and damage the transistor.

This transistor is provided with a single-ended stud for mounting to a heat sink and for electrical connection to the collector. (See accompanying *Suggested Mounting Arrangement*). Electrical connection to the base and to the emitter is made to their respective lugs.

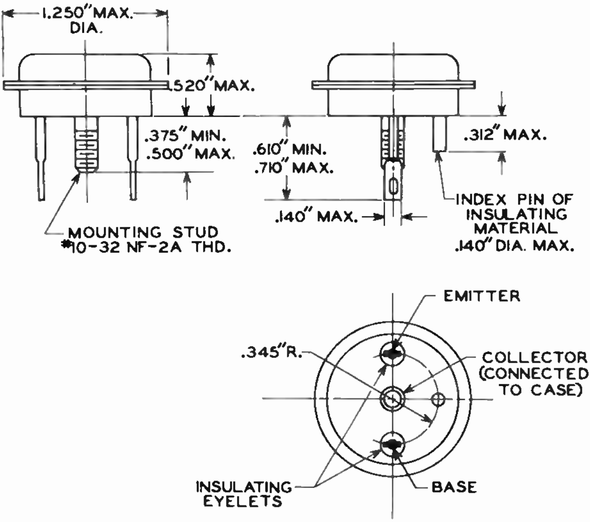
It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

The maximum torque on mounting stud should not exceed 12 inch-pounds.

← Indicates a change.

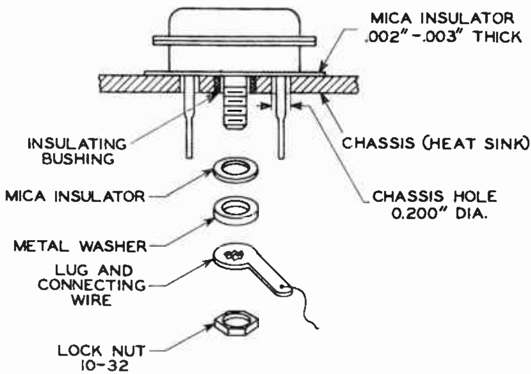
World Radio History

JEDEC No. TO-36



92CM-10612R1

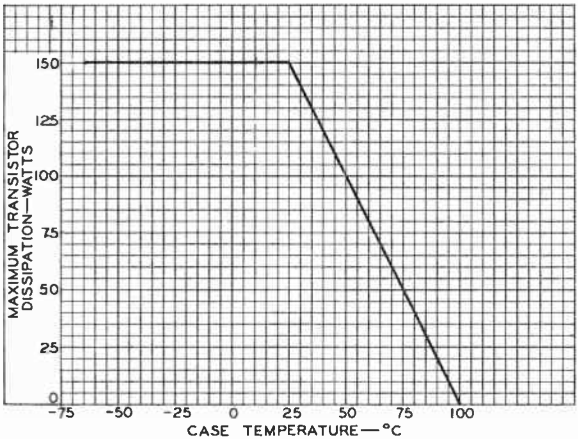
SUGGESTED MOUNTING ARRANGEMENT



92CS-10624R1

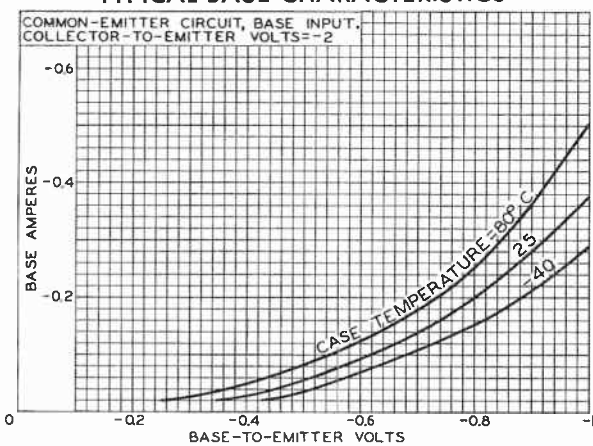
World Radio History

RATING CHART



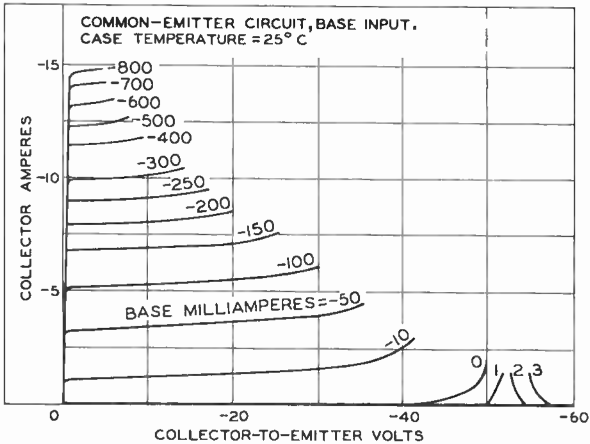
92CS-10702R1

TYPICAL BASE CHARACTERISTICS



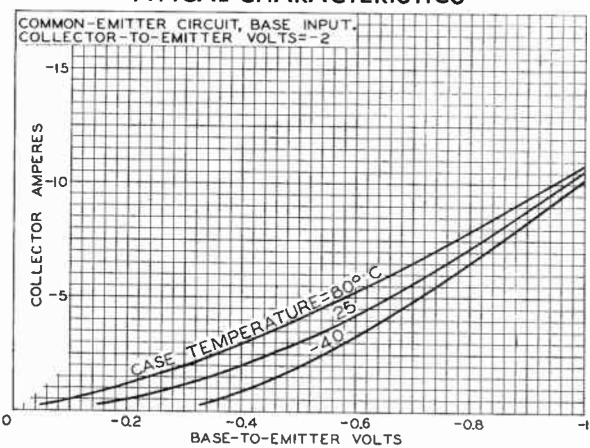
92CS-10703

TYPICAL COLLECTOR CHARACTERISTICS



92CS-10722

TYPICAL CHARACTERISTICS



92CS-10709

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service in Industrial and Military Applications

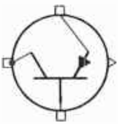
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	1.230"
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No. TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	-60 max.	volts
EMITTER-TO-BASE VOLTAGE	-40 max.	volts
COLLECTOR CURRENT	-15 max.	amp
EMITTER CURRENT	15 max.	amp
BASE CURRENT	-4 max.	amp
TRANSISTOR DISSIPATION:▲		
At case temperature of 25° C	70 max.	watts
CASE-TEMPERATURE RANGE:		
Continuous operation	-65 to +95	°C
Intermittent operation	-65 to +100	°C
Storage	-65 to +100	°C

Typical Operation:

In a common-emitter, base-input, power-switching circuit at case temperature of 25° C

DC Supply Voltage	-12	volts
DC Base-Bias Voltage	6	volts
"On" DC Collector Current	-12	amp
"Turn-On" Base Current	-2	amp
"Turn-Off" Base Current	0	amp

World Radio History

Switching Time:		
Rise time	15	μsec
Fall time	15	μsec

▲ See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in *General Section*.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and case temperature of 25° C unless otherwise specified

		Min.	*Typical*	*Max.*	
DC Collector-to-Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = -0.3	BV_{CES}	-50	–	–	volts
With base open:	BV_{CEO}				
For dc collector amperes = -0.3		–	-50	–	volts
For dc collector amperes = -1•		-45	–	–	volts
DC Base-to-Emitter Voltage* for dc collector-to-emitter volts = -2, dc collector amperes = -5	V_{BE}	–	-0.65	–	volt
DC Collector-to-Emitter Saturation Voltage* for dc collector amperes = -12, base amperes = -2	V_{CE}	–	-0.3	-1	volt
DC Emitter Voltage for dc collector volts = -60, emitter amperes = 0	V_{EB}	–	-0.15	-1	volt
DC Punch-Through Voltage	V_P	-60	–	–	volts
DC Emitter-Cutoff Current for dc emitter volts = -40, dc collector amperes = 0	I_{EBO}	–	-1	-8	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = -2, dc emitter amperes = 0		–	-100	–	μa
With dc collector volts = -60, dc emitter amperes = 0		–	-2	-8	μa
With dc collector volts = -60, dc emitter amperes = 0, case temperature = 71° C		–	–	-15	ma
DC Current Transfer Ratio*	h_{FE}				
for dc collector-to-emitter volts = -2, dc collector amperes =					
-5		35	–	70	
-12		–	25	–	

World Radio History

Beta-Cutoff Frequency* for dc collector-to-emitter volts = -6, dc collector amperes = -5.	$f_{\alpha e}$	-	10	-	kc
Thermal Resistance: Junction-to-case.	R_T	-	0.7	1	°C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds.		-	0.075	-	watt-sec/°C
Thermal Time Constant	τ_1	-	52.5	-	msec

● Sweep voltage used to perform test.

* Measured in a common-emitter, base-input circuit.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

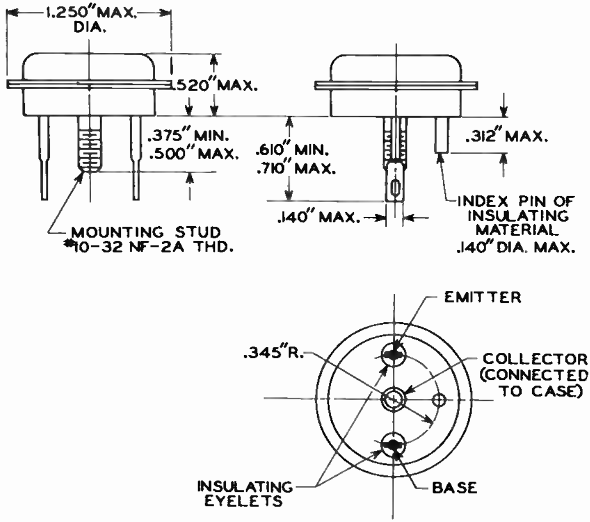
Electrical connection can be made to the base and emitter terminals by means of clips or by soldering directly to the terminals. When soldering connections are made to the terminals, care should be taken to conduct excessive heat away from the terminal seals, otherwise the heat of the soldering operation will crack the glass seals of the terminals and damage the transistor.

This transistor is provided with a single-ended stud for mounting to a heat sink and for electrical connection to the collector. (See accompanying *Suggested Mounting Arrangement*). Electrical connection to the base and to the emitter is made to their respective terminals.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

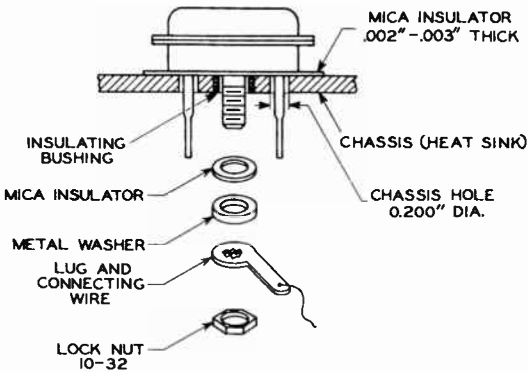
The maximum torque on mounting stud should not exceed 12 inch-pounds.

World Radio History



92CM-10612RI

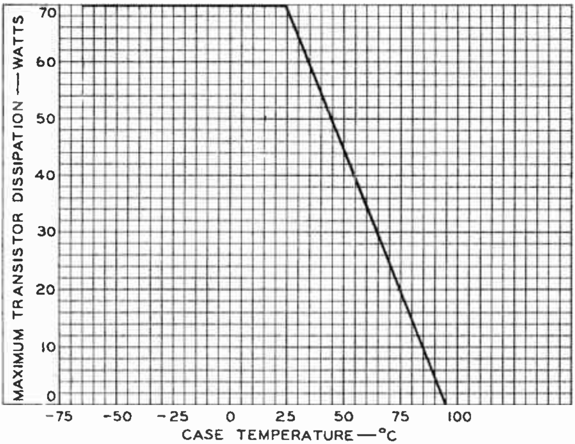
SUGGESTED MOUNTING ARRANGEMENT



92CS-10624RI

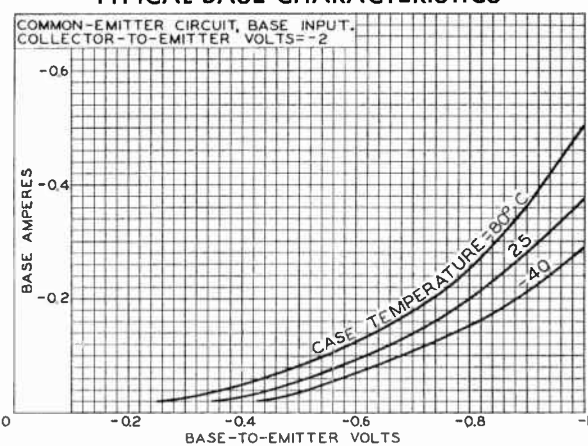
World Radio History

RATING CHART



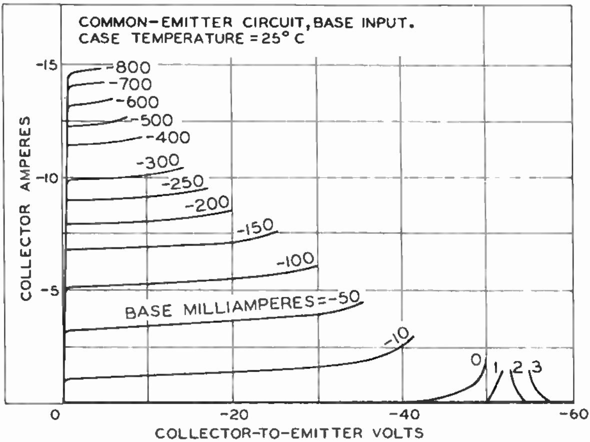
92CS-10701

TYPICAL BASE CHARACTERISTICS



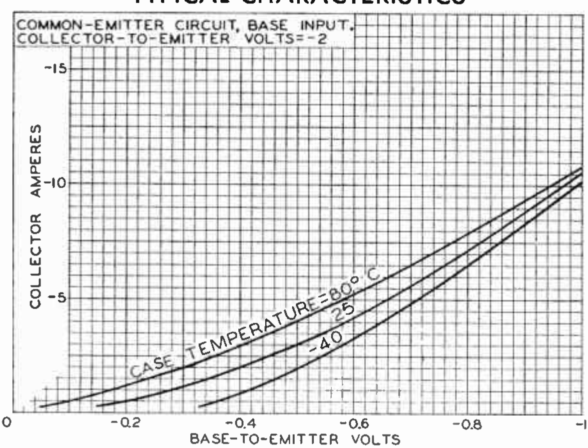
92CS-10703

TYPICAL COLLECTOR CHARACTERISTICS



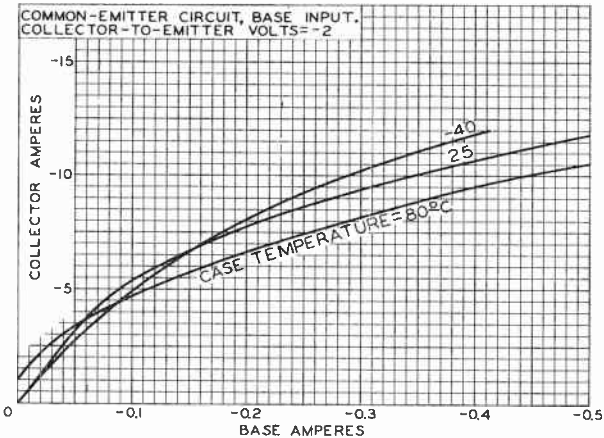
92CS-10722

TYPICAL CHARACTERISTICS



92CS-10709

TYPICAL CHARACTERISTICS



92CS-10712

World Radio History

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service in Industrial and Military Applications

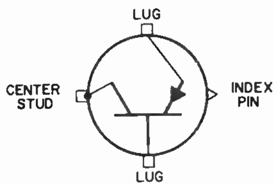
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No. TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	-80 max.	volts
EMITTER-TO-BASE VOLTAGE	-60 max.	volts
COLLECTOR CURRENT	-15 max.	amp
EMITTER CURRENT	15 max.	amp
BASE CURRENT	-4 max.	amp
TRANSISTOR DISSIPATION:[a] ←		
At case temperatures[b] of 25° C or below	150 max.	watts
CASE-TEMPERATURE[b] RANGE: ←		
Operating and storage	-65 to +100	°C

Typical Operation:

In a common-emitter, base-input, power-switching circuit at case temperature[b] of 25° C

DC Supply Voltage	-12	volts
DC Base-Bias Voltage	6	volts
"On" DC Collector Current	-12	amp
"Turn-On" Base Current	-2	amp
"Turn-Off" Base Current	0	amp

← Indicates a change.

World Radio History

Switching Time:

Rise time	15	µsec
Fall time	15	µsec

[a] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

[b] Measured at any point on seating surface.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and at case temperature[b] *of 25° C unless otherwise specified*

		Min.	Typical	Max.	
DC Collector-to-Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = -0.3.	BV_{CES}	-70	–	–	volts
With base open: For dc collector amperes = -1[c]	BV_{CEO}	-55	–	–	volts
DC Base-to-Emitter Voltage for dc collector-to-emitter volts = -2, dc collector amperes = -5. .	V_{BE}	–	-0.65	-0.9	volt
DC Collector-to-Emitter Saturation Voltage for dc collector amperes = -12, dc base amperes = -2. . .	$V_{CE(sat)}$	–	-0.3	-0.7	volt
DC Emitter Voltage for dc collector volts = -80, dc emitter current = 0. .	V_{EB}	–	–	-1	volt
DC Punch-Through Voltage. .	V_{PT}	-80	–	–	volts
DC Emitter-Cutoff Current for dc emitter volts = -60, dc collector current = 0	I_{EBO}	–	-1	-4	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = 2, dc emitter current = 0		–	-100	–	µa
With dc collector volts = -80, dc emitter current = 0		–	-2	-4	ma
With dc collector volts = -80, dc emitter current = 0, case temperature[b] = 71° C . .		–	–	-15	ma
DC Current Transfer Ratio for dc collector-to-emitter volts = -2, dc collector amperes =	h_{FE}				
-5.		25	–	50	
-12		–	20	–	

→ Indicates a change.

World Radio History

Beta-Cutoff Frequency for dc collector-to-emitter volts = -6, dc collector amperes = -5.	$f_{\alpha e}$	-	10	-	kc
Thermal Resistance:					
Junction-to-case.	R_T	-	0.35	0.5	°C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds.		-	0.075	-	watt-sec/°C
Thermal Time Constant . . .	τ_i	-	26.25	-	msec

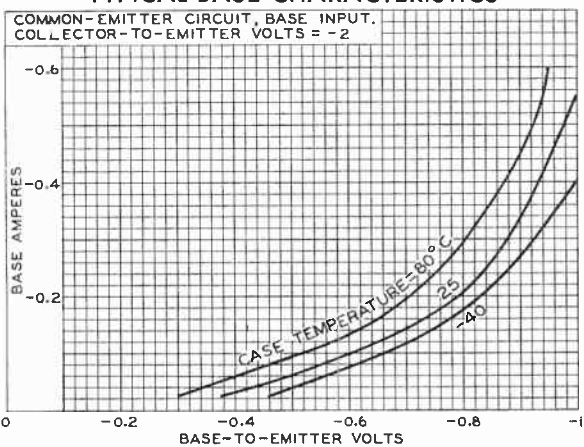
b Measured at any point on seating surface.

c Tested by sweep method to prevent excessive heating of collector junction.

PERFORMANCE TESTS,
OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
and
RATING CHART
shown under Type 2N173 also apply to the 2N174 ←

← Indicates a change.

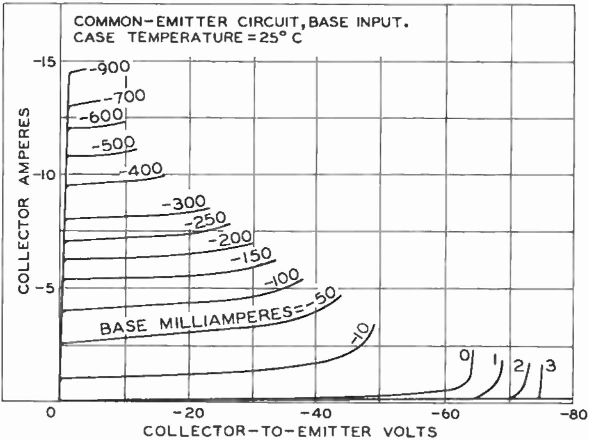
TYPICAL BASE CHARACTERISTICS



92CS-10706

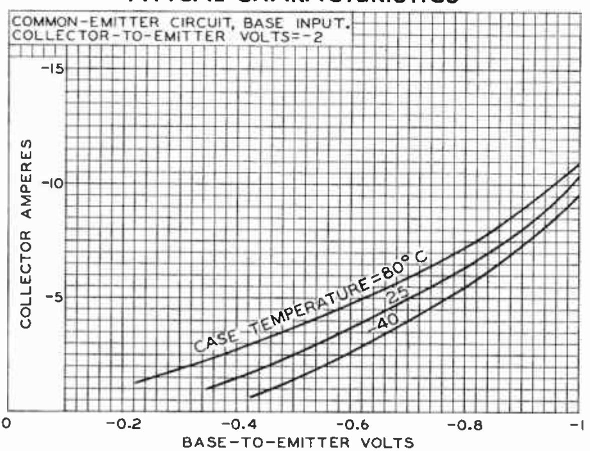
World Radio History

TYPICAL COLLECTOR CHARACTERISTICS



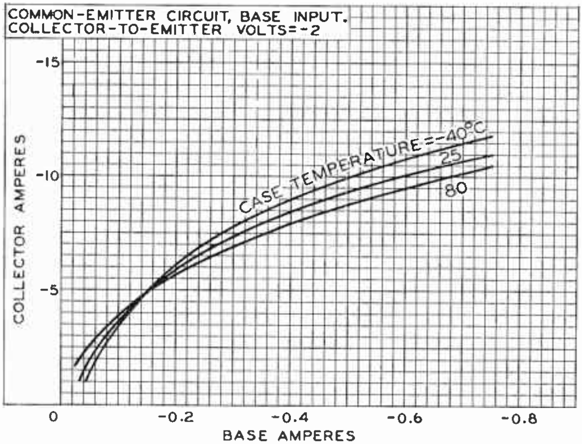
92CS-10736

TYPICAL CHARACTERISTICS



92CS-10710

TYPICAL CHARACTERISTICS



92CS-10711

World Radio History

World Radio History

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

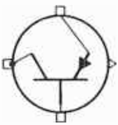
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	1.230"
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No. TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	-80 max.	volts
EMITTER-TO-BASE VOLTAGE	-60 max.	volts
COLLECTOR CURRENT	-15 max.	amp
EMITTER CURRENT	15 max.	amp
BASE CURRENT	-4 max.	amp
TRANSISTOR DISSIPATION:▲		
At case temperature of 25° C	87.5 max.	watts
CASE-TEMPERATURE RANGE:		
Continuous operation	-65 to +95	°C
Intermittent operation	-65 to +100	°C
Storage	-65 to +100	°C

Typical Operation:

In a common-emitter, base-input, power-switching circuit at case temperature of 25° C

DC Supply Voltage	-12	volts
DC Base-Bias Voltage	6	volts
"On" DC Collector Current	-12	amp
"Turn-On" Base Current	-2	amp
"Turn-Off" Base Current	0	amp

World Radio History

Switching Time:

Rise time	15	µsec
Fall time	15	µsec

▲ See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in *General Section.*

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and case temperature of 25° C unless otherwise specified

		Min.	Typical	Max.	
DC Collector-to-Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = -0.3.	BV_{CES}	-70	-	-	volts
With base open:	BV_{CEO}				
For dc collector amperes = -1•		-55	-	-	volts
DC Base-to-Emitter Voltage★ for dc collector-to-emitter volts = -2, dc collector amperes = -5. .	V_{BE}	-	-0.65	-0.9	volt
DC Collector-to-Emitter Saturation Voltage★ for dc collector amperes = -12, base amperes = -2.	V_{CE}	-	-0.3	-0.9	volt
DC Emitter Voltage for dc collector volts = -80, emitter amperes = 0	V_{EB}	-	-	-1	volt
DC Punch-Through Voltage. .	V_P	-80	-	-	volts
DC Emitter-Cutoff Current for dc emitter volts = -60, dc collector amperes = 0	I_{EBO}	-	-1	-8	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = 2, dc emitter amperes = 0		-	-100	-	µa
With dc collector volts = -80, dc emitter amperes = 0		-	-2	-8	ma
With dc collector volts = -80, dc emitter amperes = 0, case temperature = 71° C . .		-	-	-15	ma
DC Current Transfer Ratio★ for dc collector-to-emitter volts = -2, dc collector amperes =	h_{FE}				
-5.		25	-	50	
-12		-	20	-	

World Radio History

Beta-Cutoff Frequency* for dc collector-to-emitter volts = -6, dc collector amperes = -5.	f_{ae}	-	10	-	kc
Thermal Resistance:					
Junction-to-case.	R_T	-	0.5	0.8	°C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds.		-	0.075	-	watt-sec/°C
Thermal Time Constant	τ_1	-	37.5	-	msec

● Sweep voltage used to perform test.
★ Measured in a common-emitter, base-input circuit.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

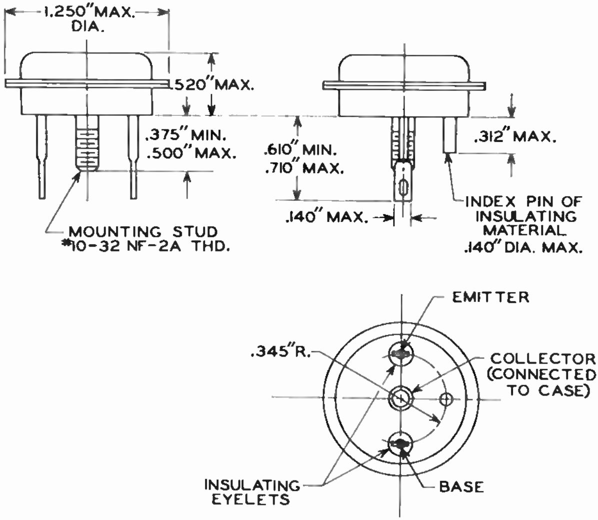
Electrical connection can be made to the base and emitter terminals by means of clips or by soldering directly to the terminals. When soldering connections are made to the terminals, care should be taken to conduct excessive heat away from the terminal seals, otherwise the heat of the soldering operation will crack the glass seals of the terminals and damage the transistor.

This transistor is provided with a single-ended stud for mounting to a heat sink and for electrical connection to the collector. (See accompanying *Suggested Mounting Arrangement*). Electrical connection to the base and to the emitter is made to their respective terminals.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

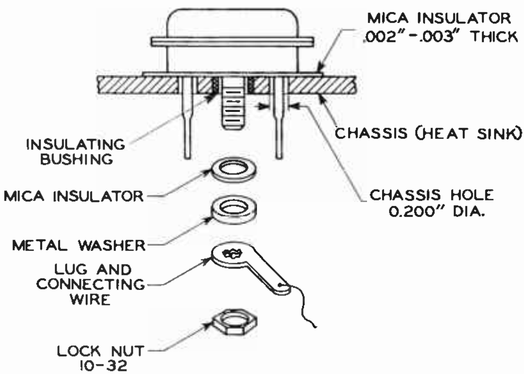
The maximum torque on mounting stud should not exceed 12 inch-pounds.

World Radio History



92CM-10612R1

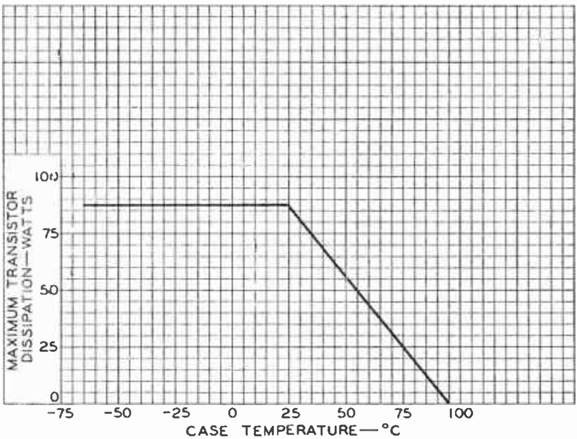
SUGGESTED MOUNTING ARRANGEMENT



92CS-10624R1

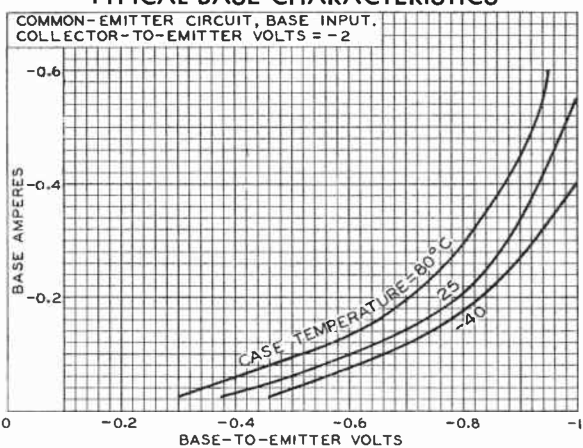
World Radio History

RATING CHART



92CS-10702

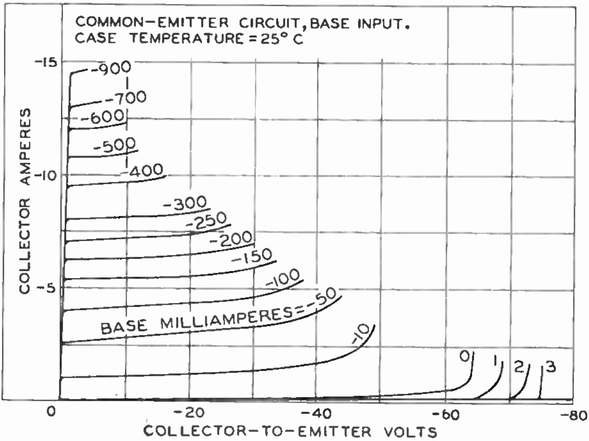
TYPICAL BASE CHARACTERISTICS



92CS-10706

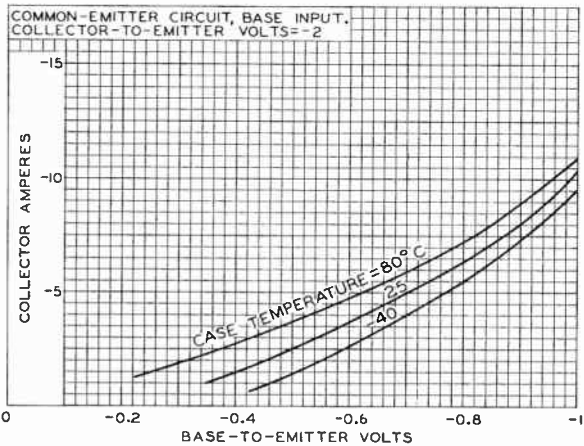
World Radio History

TYPICAL COLLECTOR CHARACTERISTICS



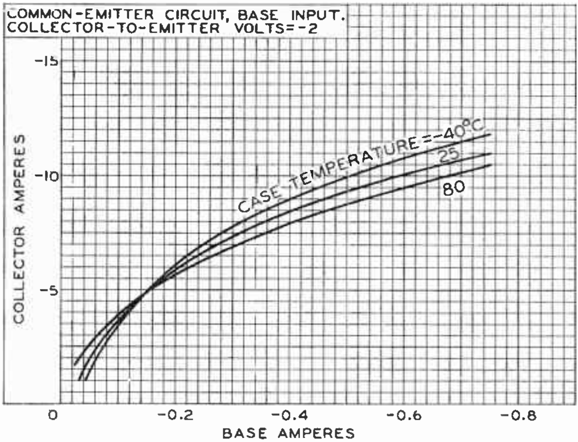
92CS-10736

TYPICAL CHARACTERISTICS



92CS-10710

TYPICAL CHARACTERISTICS



92CS-10711

World Radio History

World Radio History

2N175

JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For low-noise audio-frequency applications

GENERAL DATA

Electrical:

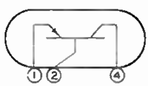
Maximum DC Collector Current for dc collector-to-base voltage of -25 volts with emitter open, and at ambient temperature of 25°C.	-12	μamp
Maximum DC Emitter Current for dc emitter-to-base voltage of -12 volts with collector open, and at ambient temperature of 25°C.	-12	μamp

Mechanical:

Mounting Position.	Any
Maximum Overall Length	0.697"
Maximum Seated Length.	0.495"
Maximum Diameter	0.260"
Dimensional Outline.	*See front of this Section*
Case	Metal, Insulated
Envelope Seals	Hermetic
Base	Small-Round Linotetrar 3-Pin (JETEC No.E3-25)

Pin 1 - Emitter

Pin 2 - Base



Pin 4 - Collector

AUDIO-FREQUENCY AMPLIFIER -- Class A

Maximum Ratings, ***Absolute Values:***

DC COLLECTOR-TO-BASE VOLTAGE	-10 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-10 max.	volts
DC COLLECTOR CURRENT	-2 max.	ma
DC EMITTER CURRENT	2 max.	ma
COLLECTOR DISSIPATION.	20 max.	mw
AMBIENT TEMPERATURE (During operation) . .	50 max.	°C
STORAGE-TEMPERATURE RANGE.	-55 to +85	°C

Characteristics, ***At Ambient Temperature of 25°C:***

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage.	-4	volts
DC Collector Current	-0.5	ma
Power Gain: With load resistance = 0.07 megohm, and input resistance = 2000 ohms	43	db
Noise Factor: Measured with a noise diode and thermocouple voltmeter with load resistance = 20,000 ohms, generator resistance = 1000 ohms, and equivalent noise bandwidth = 12.3 kc with geometric mean of 300 cps: Maximum value.	6	db

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

RCA

2N175

JUNCTION TRANSISTOR

Small-Signal T Parameters:*

DC Collector-to-Emitter Voltage (V_{CE})	-4	volts
DC Collector Current (I_C)	-0.5	ma
Emitter Resistance (r_e)	37.7	ohms
Base Resistance (r_b)	1085	ohms
Mutual Resistance (r_m)	2.82	megohms
Collector Resistance (r_c)	2.86	megohms
Current Transfer Ratio (α_f)■	-65	

Small-Signal Hybrid-π Parameters:*

DC Collector-to-Emitter Voltage (V_{CE})	-4	volts
DC Collector Current (I_C)	-0.5	ma
Resistance $r_{bb'}$	190	ohms
Conductance $g_{b'e}$	296	µmhos
Conductance g_{ce}	6.6	µmhos
Conductance $g_{b'c}$	0.279	µmho
Capacitance $C_{b'e}$	3900	µµf
Capacitance $C_{b'c}$	36	µµf
Intrinsic Transconductance (g_m)	19200	µmhos
Frequency● for unity power amplification	2.06	Mc

Small-Signal H Parameters:*

DC Collector-to-Emitter Voltage (V_{CE})	-4	volts
DC Collector Current (I_C)	-0.5	ma
Input Resistance, output circuit shorted (h_i)	3570	ohms
Reverse Voltage Transfer Ratio, input circuit open (h_r)	9.44×10^{-4}	
Forward Current Transfer Ratio, output circuit shorted (h_f)	65	
Output Conductance, input circuit open (h_o)	25	µmhos

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-4	volts
DC Collector Current	-0.5	ma
Frequency at which the current transfer ratio drops to one-half the square root of two times its value at 1 kc.	0.85	Mc

OPERATING CONSIDERATIONS

The 2N175 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

* As derived from corresponding equivalent circuit shown under type 2N104.

■ Measured at 1 kc.

● This frequency (figure of merit) may be calculated from the equation

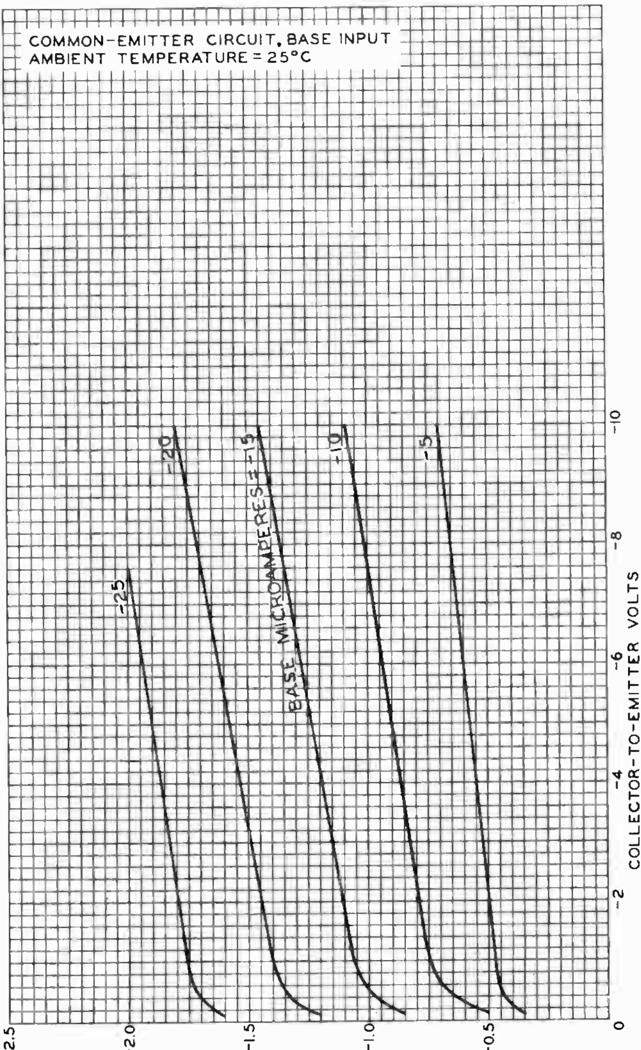
$$f = \frac{1}{4\pi}\sqrt{\frac{g_m}{r_{bb'}\,C_{b'c}\,C_{b'e}}}$$

World Radio History

2N175

2N175

AVERAGE COLLECTOR CHARACTERISTICS



SEMICONDUCTOR DIVISION
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92CM-8914R1

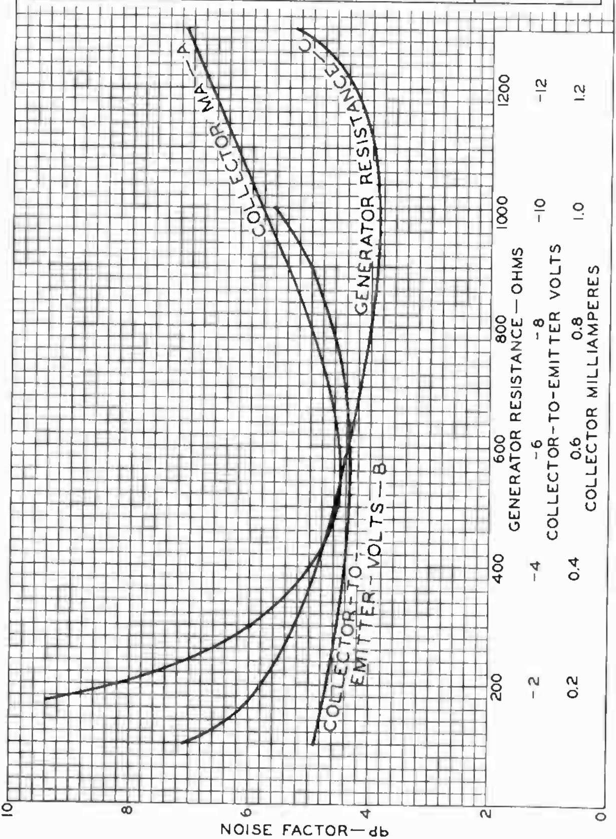
RCA

2N175

TYPICAL NOISE CHARACTERISTICS

COMMON-EMITTER CIRCUIT, BASE INPUT
AMBIENT TEMPERATURE = 25°C
MEASURED WITH A NOISE DIODE AND THERMOCOUPLE VOLTMETER WITH LOAD RESISTANCE = 20000 OHMS AND EQUIVALENT NOISE BANDWIDTH = 12.3 KC WITH GEOMETRIC MEAN OF 300 CPS

CURVE	GENERATOR RESISTANCE (OHMS)	COLLECTOR-TO-EMITTER VOLTS	COLLECTOR MA
A	1000	-4	—
B	1000	—	-0.5
C	—	-4	-0.5



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RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

92CM-8913R1

2N206
JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For small-signal audio-frequency applications

GENERAL DATA

Electrical, *At Ambient Temperature of 25°C:*

Maximum DC Collector Current for dc collector-to-base voltage of -30 volts with emitter open	-10	µamp
Maximum DC Emitter Current for dc emitter-to-base voltage of -12 volts with collector open	-10	µamp
Junction Temperature Rise (In free air)	0.3	°C/mw

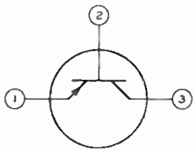
Mechanical:

Mounting Position	Any
Maximum Length (Excluding flexible leads)	0.405"
Maximum Diameter	0.240"
Case	Metal, Insulated
Envelope Seals	Hermetic
Leads, Flexible	3
Length	1.5" ± 0.015"
Orientation and diameter	*See Dimensional Outline*

BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector (Adjacent to red dot on side of envelope)

AUDIO-FREQUENCY AMPLIFIER -- Class A

Maximum Ratings, *Absolute Values:*

DC COLLECTOR-TO-BASE VOLTAGE	-30 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-12 max.	volts
DC COLLECTOR CURRENT	-50 max.	ma
DC EMITTER CURRENT	50 max.	ma
COLLECTOR DISSIPATION (At ambient temperature of 25°C)	75 max.	mw
AMBIENT TEMPERATURE (During operation)	71 max.	°C
STORAGE-TEMPERATURE RANGE	-65 to +85	°C

Characteristics, *At Ambient Temperature of 25°C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-5	volts
DC Collector Current	-1	ma
Power Gain: With load resistance = 20,000 ohms, and input resistance = 1200 ohms	46	db

Noise Factor:
Measured with a noise diode and thermocouple voltmeter with load resistance

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RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

RCA

2N206

JUNCTION TRANSISTOR

= 20,000 ohms, generator resistance = 1000 ohms, and equivalent noise bandwidth = 12.3 kc with geometric mean of 300 cps. . . . . 9 db

Small-Signal T Parameters:*

DC Collector-to-Emitter Voltage (V_{CE}) .	-3	-5	volts
DC Collector Current (I_C)	-0.2	-1	ma
Emitter Resistance (r_e)	104	21	ohms
Base Resistance (r_b).	1270	580	ohms
Mutual Resistance (r_m).	3.25	1.78	megohms
Collector Resistance (r_c)	3.34	1.82	megohms
Current Transfer Ratio (α_f)■	-33	-47	

Small-Signal Hybrid-π Parameters:*

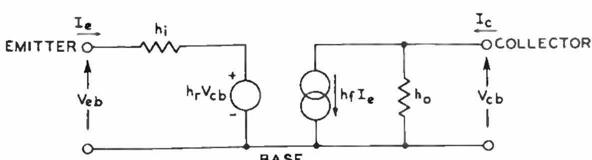
DC Collector-to-Emitter Voltage (V_{CE}) .	-3	-5	volts
DC Collector Current (I_C)	-0.2	-1	ma
Resistance $r_{bb'}$	210	200	ohms
Conductance $g_{b'e}$	225	710	μmhos
Conductance g_{ce}	2.3	7.6	μmhos
Conductance $g_{b'c}$	0.27	0.4	μmho
Capacitance $C_{b'e}$	2380	9400	μμf
Capacitance $C_{b'c}$	48	35	μμf
Intrinsic Transconductance (g_m)	7430	33400	μmhos

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage.	-3	-5	volts
DC Collector Current.	-0.2	-1	ma
Power Gain: With load resistance = 0.5 megohm, and input resistance = 140 ohms. .	-	35	db
Frequency at which the current transfer ratio drops to one-half the square root of two times its value at 1 kc.	620	780	kc

Small-Signal H Parameters:

Derived from accompanying two-generator equivalent circuit, and applicable to that portion of the audio-frequency range in which internal capacitance effects may be neglected



92CS-9087

* As derived from corresponding equivalent circuit shown under type 2N104.

■ Measured at 1 kc.

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2N206

JUNCTION TRANSISTOR

DC Collector-to-Base Voltage (V_{CB})	-3	-5	volts
DC Collector Current (I_C). . . .	-0.2	-1	ma
Input Resistance, output circuit shorted (h_i)	137	33	ohms
Reverse Voltage Transfer Ratio, input circuit open (h_r).	3.8×10^{-4}	3.2×10^{-4}	
Forward Current Transfer Ratio, output circuit shorted (h_f)	-0.974	-0.980	
Output Conductance, input circuit open (h_o).	0.3	0.55	μmhos

Common-Collector Circuit, Base Input

DC Emitter-to-Collector Voltage.	3	volts
DC Emitter Current	0.2	ma
Power Gain: With load resistance = 18,000 ohms, and input resistance = 0.56 megohm	30	db

OPERATING CONSIDERATIONS

The 2N206 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N206 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N206, the temperature of the solder should not exceed 230°C for a maximum immersion period of 10 seconds.

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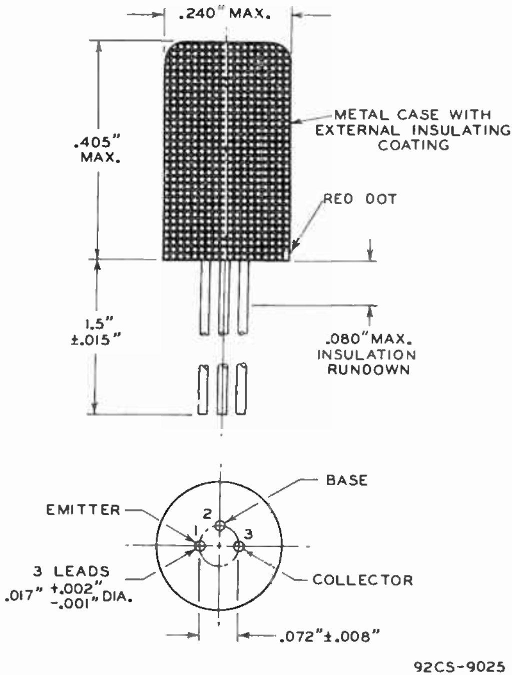
World Radio History

2N206

JUNCTION TRANSISTOR



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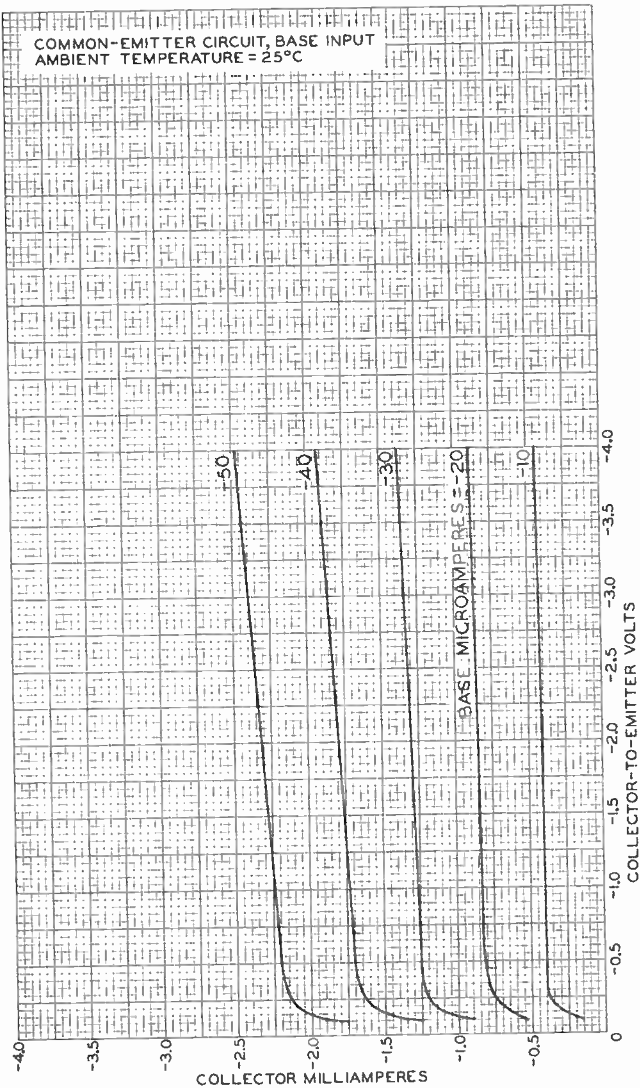
2N206

AVERAGE COLLECTOR CHARACTERISTICS



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92CM-9049

World Radio History

2N206

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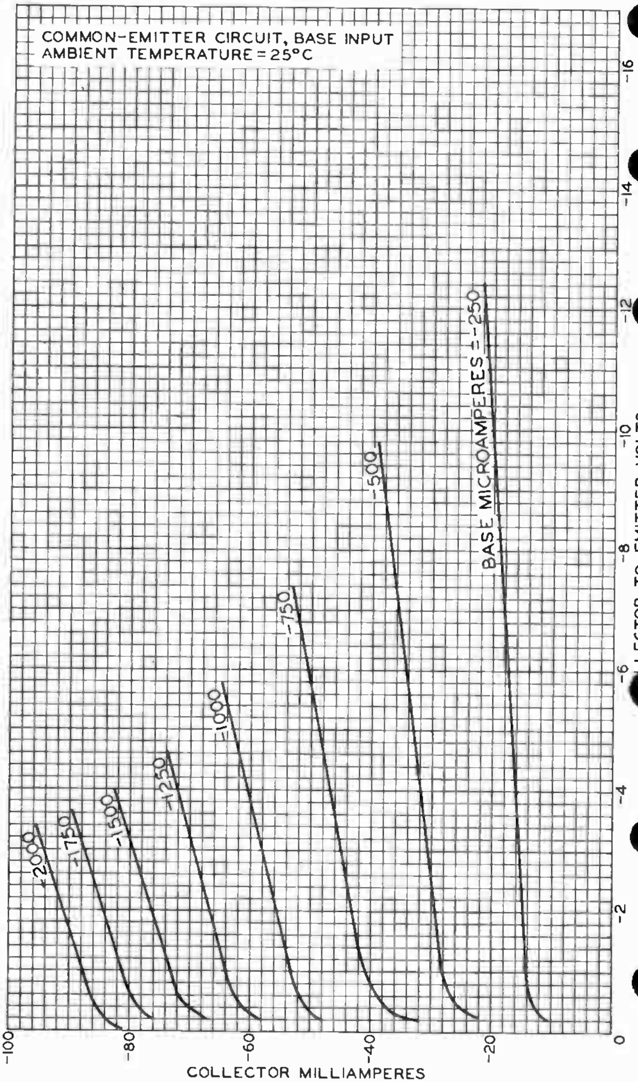
2N206

AVERAGE COLLECTOR CHARACTERISTICS



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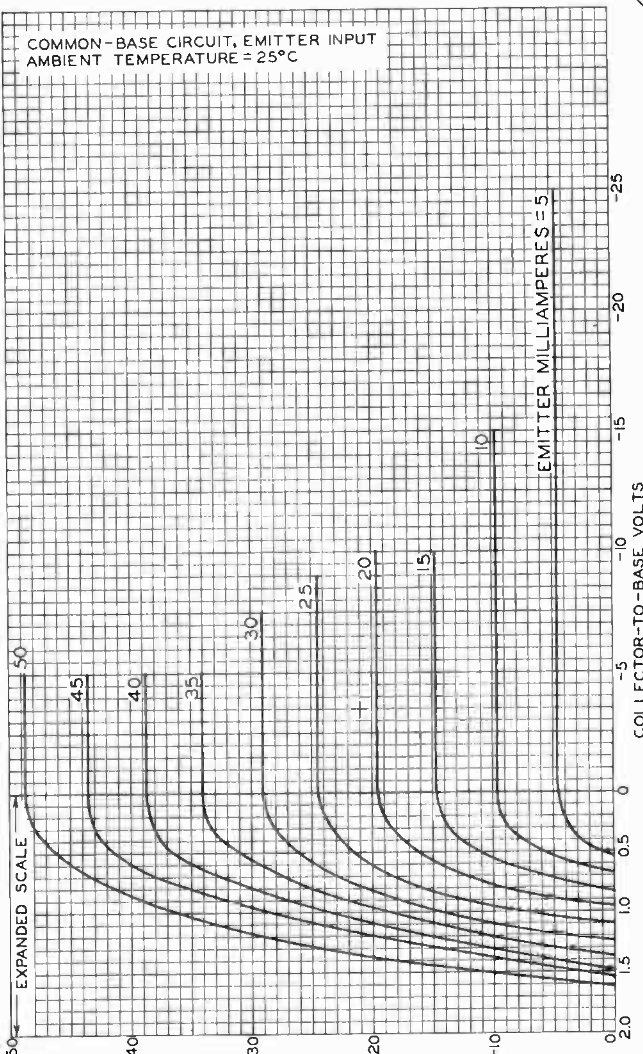
92CM-9050

World Radio History

2N206

2N206

AVERAGE COLLECTOR CHARACTERISTICS



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92CM-9051

World Radio History

2N215

JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For small-signal audio-frequency applications

The 2N215 is the same as the 2N104 except for the following items:

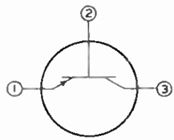
Mechanical:

Maximum Length (Excluding flexible leads). . . . . 0.455"
Leads, Flexible. 3
Length . . . . 1.5" ± 0.015"
Orientation and diameter . . . .*See Dimensional Outline*

BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector (Adjacent to red dot on side of envelope)

OPERATING CONSIDERATIONS

The 2N215 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N215 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N215, the temperature of the solder should not exceed 230°C for a maximum immersion period of 10 seconds.

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World Radio History

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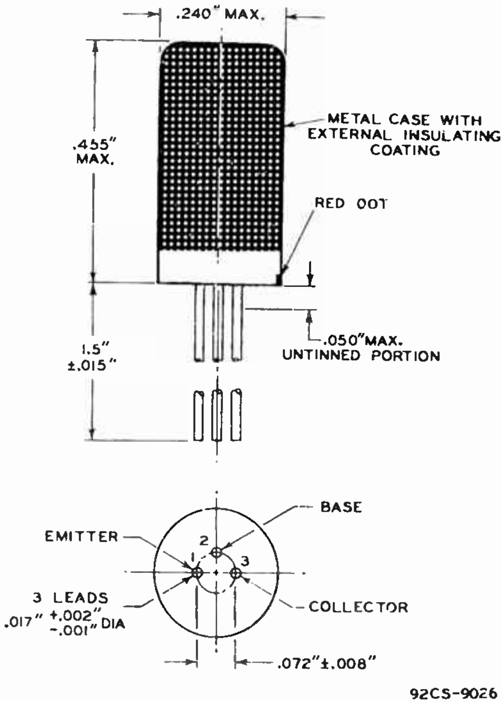
2N215

JUNCTION TRANSISTOR



World Radio History

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2N217
JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For large-signal audio-frequency applications

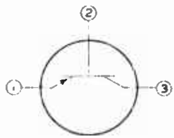
The 2N217 is the same as the 2N109 except for the following items:

Mechanical:

Maximum Length (Excluding flexible leads) . . . . 0.405"
Leads, Flexible 3
  Length . . . . 1.5" ± 0.015"
  Orientation and diameter . . . . . . *See Dimensional Outline*

BOTTOM VIEW

Lead 1 - Emitter



Lead 3 - Collector (Adjacent to red dot on side of envelope)

Lead 2 - Base

OPERATING CONSIDERATIONS

The 2N217 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N217 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N217, the temperature of the solder should not exceed 230°C for a maximum immersion period of 10 seconds.

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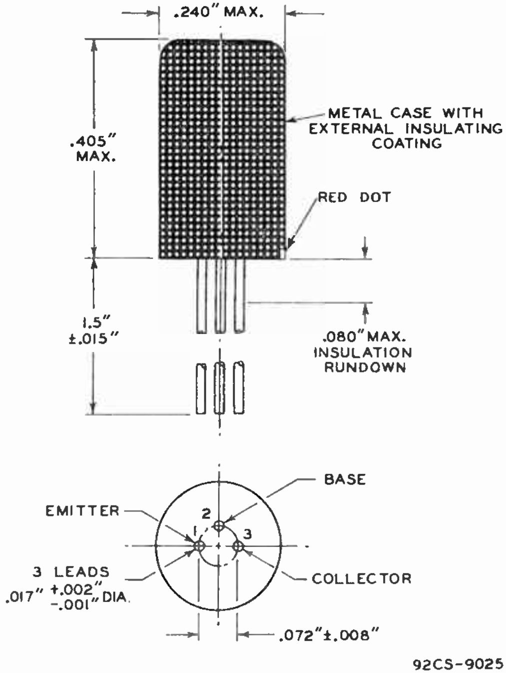
2N217
JUNCTION TRANSISTOR



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World Radio History

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2N218
JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For 455-kc intermediate-frequency applications

The 2N218 is the same as the 2N139 except for the following items:

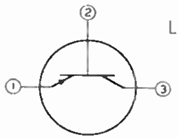
Mechanical:

Maximum Length (Excluding flexible leads) . . . . 0.405"
Leads, Flexible 3
  Length. . . . . 1.5" ± 0.015"
  Orientation and diameter. . . . . . . *See Dimensional Outline*

BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector (Adjacent to red dot on side of envelope)

OPERATING CONSIDERATIONS

The 2N218 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N218 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N218, the temperature of the solder should not exceed 230°C for a maximum immersion period of 10 seconds.

World Radio History

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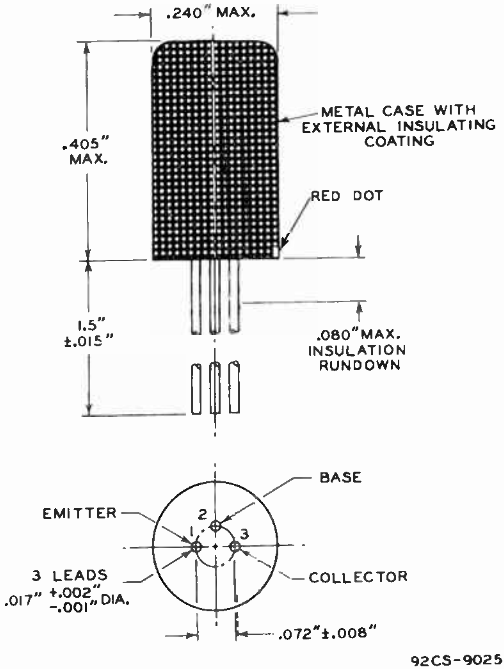
2N218

JUNCTION TRANSISTOR



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World Radio History

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2N219
JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For 540 to 1600 kc converter applications

The 2N219 is the same as the 2N140 except for the following items:

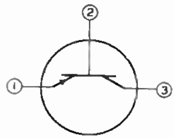
Mechanical:

Maximum Length (Excluding flexible leads) . . . . 0.405"
Leads, Flexible 3
  Length. . . . . 1.5" ± 0.015"
  Orientation and diameter. . . . . . . *See Dimensional Outline*

BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector (Adjacent to red dot on side of envelope)

OPERATING CONSIDERATIONS

The 2N219 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N219 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N219, the temperature of the solder should not exceed 230°C for a maximum immersion period of 10 seconds.

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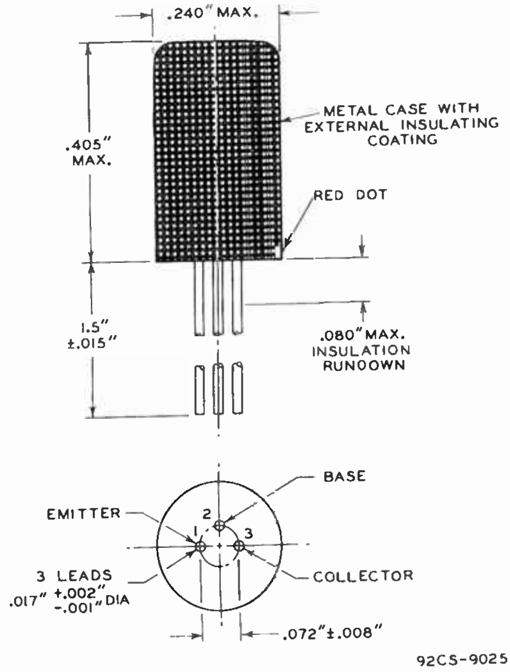
World Radio History

2N219

JUNCTION TRANSISTOR



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World Radio History

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2N220

JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For low-noise audio-frequency applications

The 2N220 is the same as the 2N175 except for the following items:

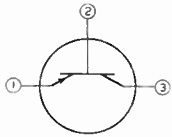
Mechanical:

Maximum Length (Excluding flexible leads)	0.405"
Leads, Flexible	3
Length	1.5" ± 0.015"
Orientation and diameter	*See Dimensional Outline*

BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector (Adjacent to red dot on side of envelope)

OPERATING CONSIDERATIONS

The 2N220 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

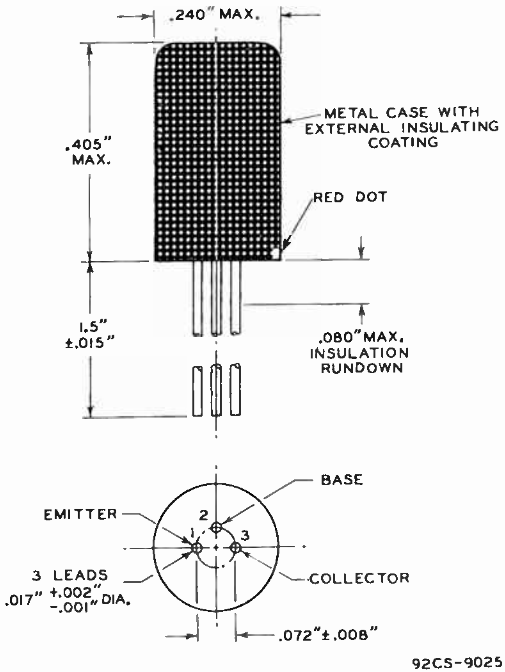
The flexible leads of the 2N220 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N220, the temperature of the solder should not exceed 230°C for a maximum immersion period of 10 seconds.

World Radio History

2N220

JUNCTION TRANSISTOR



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World Radio History

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2N247

DRIFT TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For radio-frequency amplifier applications

GENERAL DATA

Electrical, *At Ambient Temperature of 25°C:*

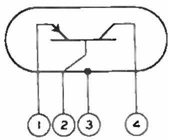
Minimum DC Collector-to-Base Voltage for dc collector current of -50 μamp with emitter open	-40	volts
Maximum DC Collector Current for dc collector-to-base voltage of -1 volt with emitter open	-10	μamp
Maximum DC Collector Current for dc collector-to-base voltage of -30 volts with emitter open	-16	μamp
Minimum DC Emitter-to-Base Voltage for dc emitter current of -50 μamp with collector open	-1	volt

Mechanical:

Mounting Position	Any
Maximum Length (Excluding flexible leads)	0.375"
Maximum Diameter	0.360"
Case	Metal, Insulated
Envelope Seals	Hermetic
Leads, Flexible	4
Minimum length	1.5"
Orientation and diameter	*See Dimensional Outline*

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Interlead Shield, Metal Case

Lead 4 - Collector

RADIO-FREQUENCY AMPLIFIER -- Class A

Maximum Ratings, *Absolute Values:*

DC COLLECTOR-TO-BASE VOLTAGE	-35 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-1 max.	volt
DC COLLECTOR CURRENT	-10 max.	ma
DC EMITTER CURRENT	10 max.	ma
COLLECTOR DISSIPATION (At ambient temperatures up to 71°C)	35 max.	mw
AMBIENT TEMPERATURE (During operation)	71 max.	°C
STORAGE-TEMPERATURE RANGE	-55 to +85	°C

Characteristics, *At Ambient Temperature of 25°C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-9	volts
DC Collector Current	-1	ma
Current Transfer Ratio (α_f)■	-60	

■: See next page.

World Radio History

2N247

RCA

2N247

DRIFT TRANSISTOR

Small-Signal Hybrid-π Parameters:*

DC Collector-to-Emitter Voltage (V_{CE})	-9	volts
DC Collector Current (I_C)	-1	ma
Resistance $r_{bb'}$	40	ohms
Conductance $g_{b'e}$	640	μmhos
Conductance g_{ce} (Approx.)	0	μmhos
Conductance $g_{b'c}$ (Approx.)	0	μmho
Capacitance $C_{b'e}$	200	μμf
Capacitance $C_{b'c}$	1.7	μμf
Interlead Capacitance between collector and base leads with interlead shield connected to ground and all leads cut to 5/16"	0.003	μμf
Intrinsic Transconductance (g_m)	37000	μmhos
Frequency● for unity power amplification	132	Mc

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-9	volts
DC Collector Current	-1	ma
Current Transfer Ratio (α_f)■	0.984	
Frequency at which the current transfer ratio drops to one-half the square root of two times its value at 1 kc.	30	Mc

Typical Operation, *At Ambient Temperature of 25°C:*

Common-Emitter Circuit, Base Input

At frequency of	*1.5*	*10.7*	*Mc*
DC Collector-to-Emitter Voltage	-9	-9	volts
DC Collector Current	-1	-1	ma
DC Base-to-Emitter Voltage	-0.2	-0.2	volt
Input Resistance, output circuit shorted	1350	170	ohms
Output Resistance, input circuit shorted	70000	4500	ohms
Power Gain▲	45	24	db

* As derived from corresponding equivalent circuit shown under type 2N104.

● This frequency (figure of merit) may be calculated from the equation

$$f = \frac{1}{4\pi}\sqrt{\frac{g_m}{r_{bb'}\,C_{b'c}\,C_{b'e}}}$$

■ Measured at 1 kc.

▲ Measured in a single-tuned unilateralized circuit matched to the generator and load impedances for maximum transfer of power. Transformer insertion losses not included.

OPERATING CONSIDERATIONS

The 2N247 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

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World Radio History

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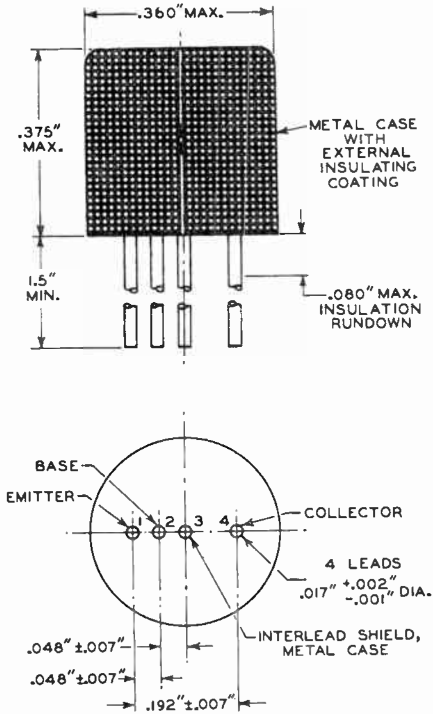
2N247

DRIFT TRANSISTOR

The *flexible leads* of the 2N247 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N247, the temperature of the solder should not exceed 230°C for a maximum immersion period of 10 seconds.



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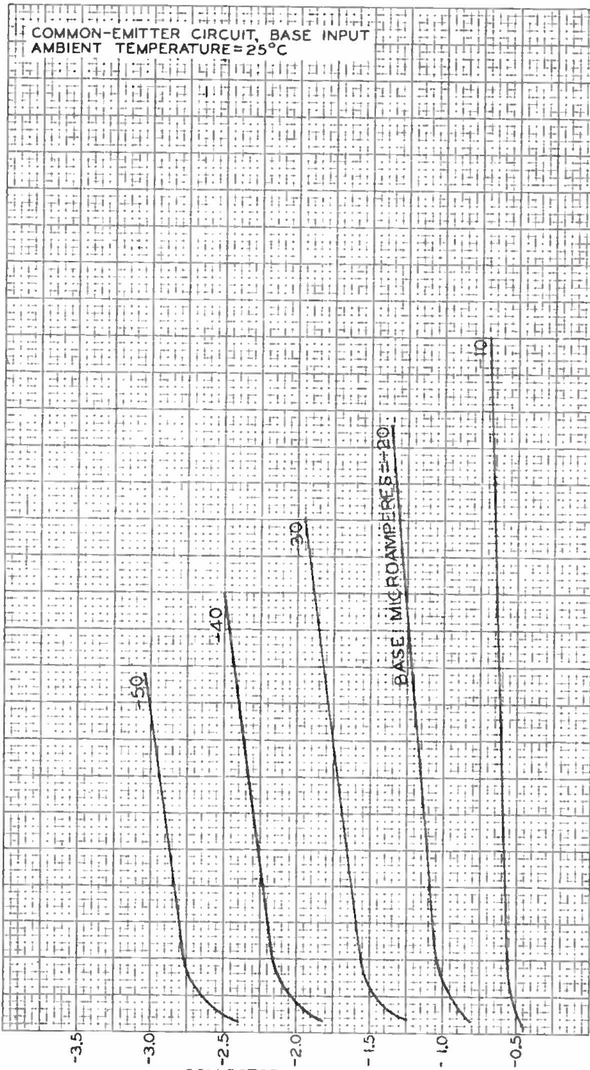
World Radio History

2N247

2N247

AVERAGE COLLECTOR CHARACTERISTICS



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92CM-9107

World Radio History

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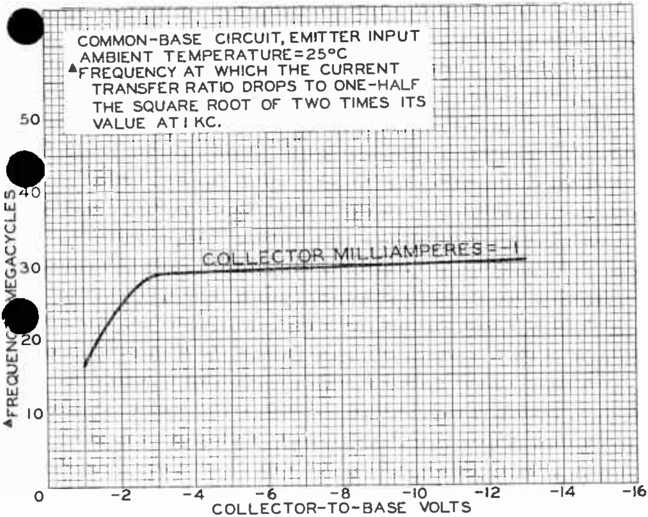
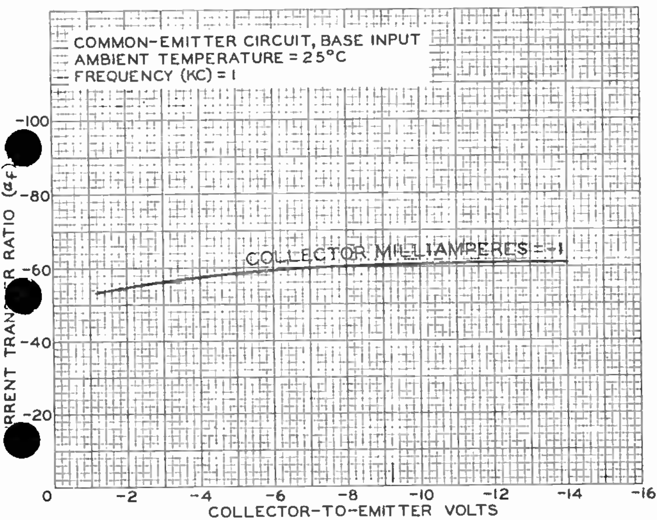
2N247

2N247

AVERAGE CHARACTERISTICS





SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

92CM-9106R1

World Radio History

2N247

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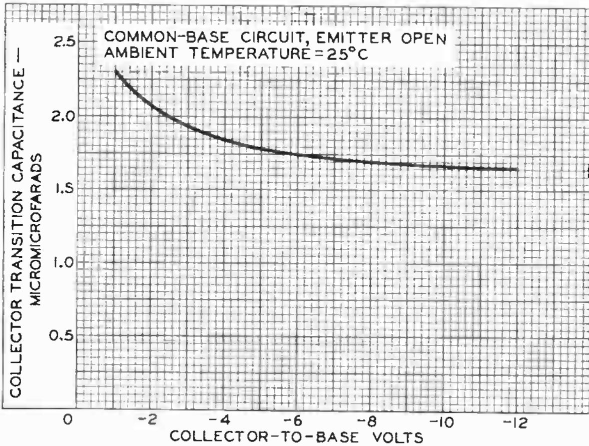
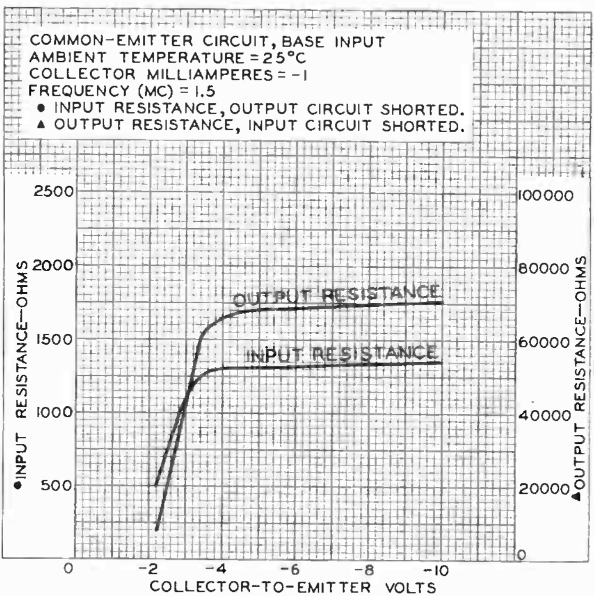
2N247

AVERAGE CHARACTERISTICS





World Radio History

2N269

Transistor

GERMANIUM P-N-P ALLOY-JUNCTION TYPE

For Computer Switching Applications

GENERAL DATA

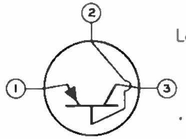
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.410"
Maximum Diameter	0.240"
Dimensional Outline	JEDEC No.TO-1
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector (Adjacent to red dot on side of case)

SWITCHING SERVICE

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	-25 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With dc emitter-to-base volts = -1	-24 max.	volts
EMITTER-TO-BASE VOLTAGE	-12 max.	volts
COLLECTOR CURRENT	-100 max.	ma
EMITTER CURRENT	100 max.	ma
TRANSISTOR DISSIPATION:[a]		
At ambient temperature of 25° C or below	120 max.	mw
At ambient temperature of 55° C	35 max.	mw
At ambient temperature of 71° C	10 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +85	°C
LEAD TEMPERATURE:		
For 10 seconds maximum	255 max.	°C

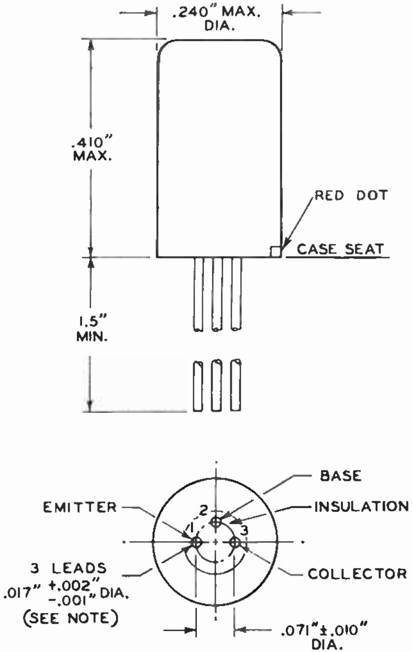
ELECTRICAL CHARACTERISTICS
and
OPERATING CONSIDERATIONS
shown under Type 2N404 also apply to the 2N269

[a] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

← indicates a change.

World Radio History

JEDEC No.TO-1

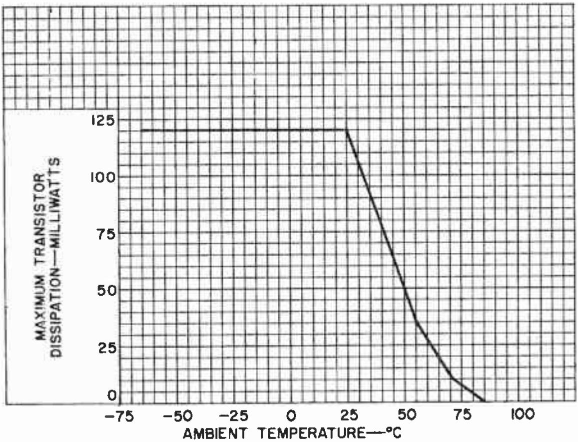


92CS-9148R6

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

RATING CHART



92CS-10908R1

World Radio History

World Radio History

2N269

RCA

2N269
JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For "on-off" control applications

GENERAL DATA

Electrical:

Minimum DC Collector-to-Base Voltage for dc collector current of -20 μa with emitter open, and at ambient temperature of 25 °C.	-25	volts
Minimum DC Emitter-to-Base Voltage for dc emitter current of -20 μa with collector open, and at ambient temperature of 25 °C.	-12	volts
Maximum DC Emitter-to-Base Voltage for dc collector-to-base voltage of -20 volts, emitter load resistance of 11 megohms, emitter-to-base supply voltage of 0 volts, and at ambient temperature of 25 °C.	-1	volt
Maximum DC Collector Current for dc collector-to-base voltage of -2.5 volts with emitter open, and at ambient temperature of:		
25 °C	-2.5	μa
80 °C	-50	μa
Maximum DC Collector Current for dc collector-to-base voltage of -12 volts with emitter open, and at ambient temperature of:		
25 °C	-4	μa
80 °C	-60	μa
Maximum DC Emitter Current for dc emitter-to-base voltage of -2.5 volts with collector open, and at ambient temperature of:		
25 °C	-2.5	μa
80 °C	-50	μa
Maximum Junction-Temperature Rise (With transistor in free air)	0.35	°C/mw
Minimum Junction-Temperature Change which will cause collector current to double with dc collector-to-base voltage equal to or greater than -2.5 volts with emitter open.	10	°C
Maximum Collector-to-Base Capacitance for dc collector-to-base voltage of -6 volts with emitter open, and at ambient temperature of 25 °C	20	μμf

Mechanical:

Mounting Position	Any
Maximum Length (Excluding flexible leads)	0.405"
Maximum Diameter.	0.240"

World Radio History

RCA

2N269

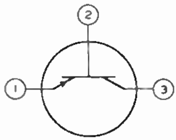
JUNCTION TRANSISTOR

Case	Metal, Insulated
Envelope Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	*See Dimensional Outline*

BOTTOM VIEW

Lead 1 – Emitter

Lead 2 – Base



Lead 3 – Collector (Adjacent to red dot on side of envelope)

LOW-LEVEL SWITCHING SERVICE

Maximum Ratings, ***Absolute Values:***

PEAK COLLECTOR-TO-BASE VOLTAGE	-25 max.	volts
DC COLLECTOR-TO-BASE VOLTAGE	-20 max.	volts
PEAK EMITTER-TO-BASE VOLTAGE	-12 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-9 max.	volts
COLLECTOR CURRENT (DC or Peak)	-100 max.	ma
EMITTER CURRENT (DC or Peak)	100 max.	ma
TRANSISTOR DISSIPATION:*		
At ambient temperatures up to 55 °C	35 max.	mw
At ambient temperature of 71 °C	10 max.	mw
AMBIENT TEMPERATURE (During operation)	71 max.	°C
STORAGE-TEMPERATURE RANGE	-65 to +85	°C

Characteristics, ***At Ambient Temperature of 25 °C:***

Common-Emitter Circuit, Base Input

DC Collector Current	-12	-24	ma
DC Base Current	-0.342	-0.858	ma
Maximum DC Collector-to-Emitter Voltage	-0.15	-0.2	volt
Maximum DC Base-to-Emitter Voltage	-0.35	-0.4	volt

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-6	volts
DC Emitter Current	1	ma
Minimum Frequency at which the current transfer ratio is 0.707 (or $1/\sqrt{2}$) of its value at 1 kc.	4	Mc

* The maximum transistor-dissipation rating is reduced 1.56 milliwatts for each degree centigrade the ambient temperature is increased above 55 °C.

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RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

2N269

JUNCTION TRANSISTOR

OPERATING CONSIDERATIONS

The 2N269 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N269 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N269, the temperature of the solder should not exceed 230 °C for a maximum immersion period of 10 seconds.

The accompanying curves may be used to determine the typical maximum (or minimum) value of one transistor parameter when two other transistor parameters are known. For example, using the BASE CHARACTERISTIC curve, if a base-to-emitter voltage of -0.35 volt (A) is applied to the 2N269 with the collector-to-base voltage equal to 0, a typical minimum base-current value of -1.25 milliamperes (a) will be obtained. Similarly, for a base current of -4 milliamperes (B) flowing through the base circuit with the collector-to-base voltage equal to 0, a typical maximum base-to-emitter-voltage value of -0.45 (b) will be obtained.

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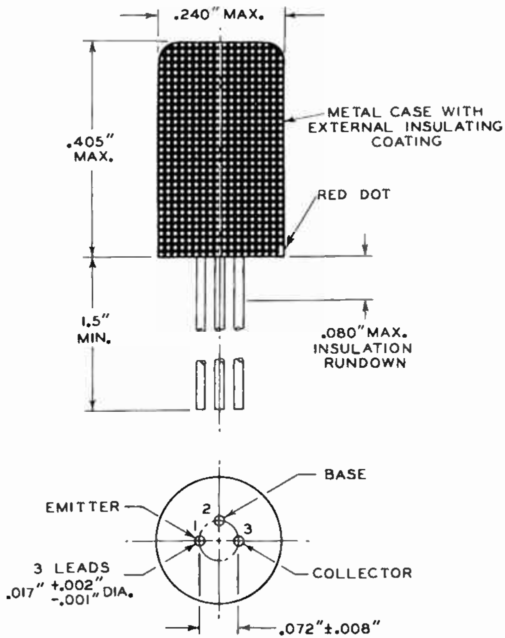
World Radio History

2N269

2N269

JUNCTION TRANSISTOR



92CS-9147

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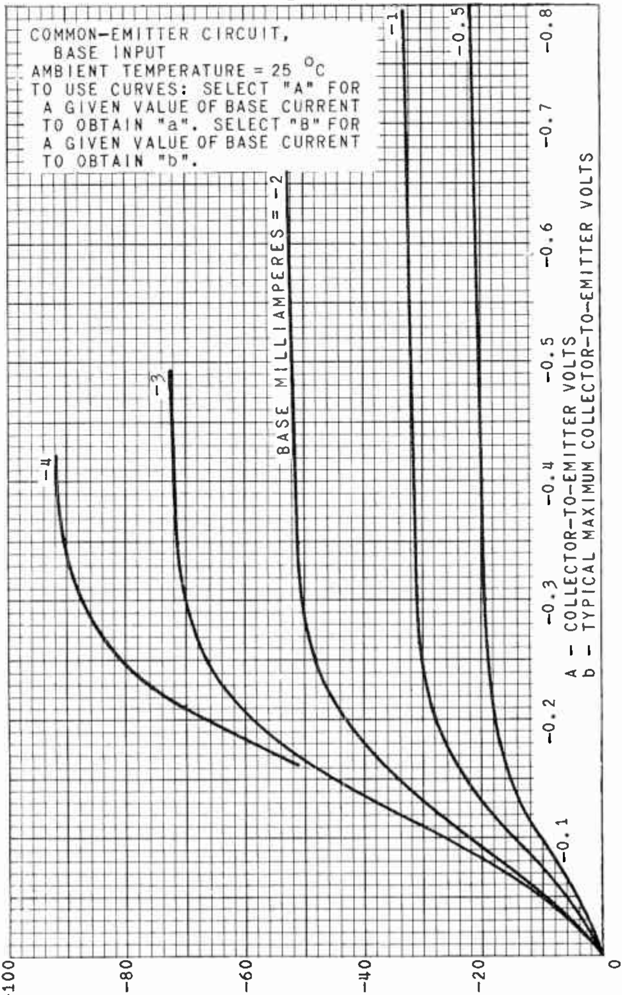
World Radio History

RCA

2N269
COLLECTOR CHARACTERISTICS
For Switching Applications



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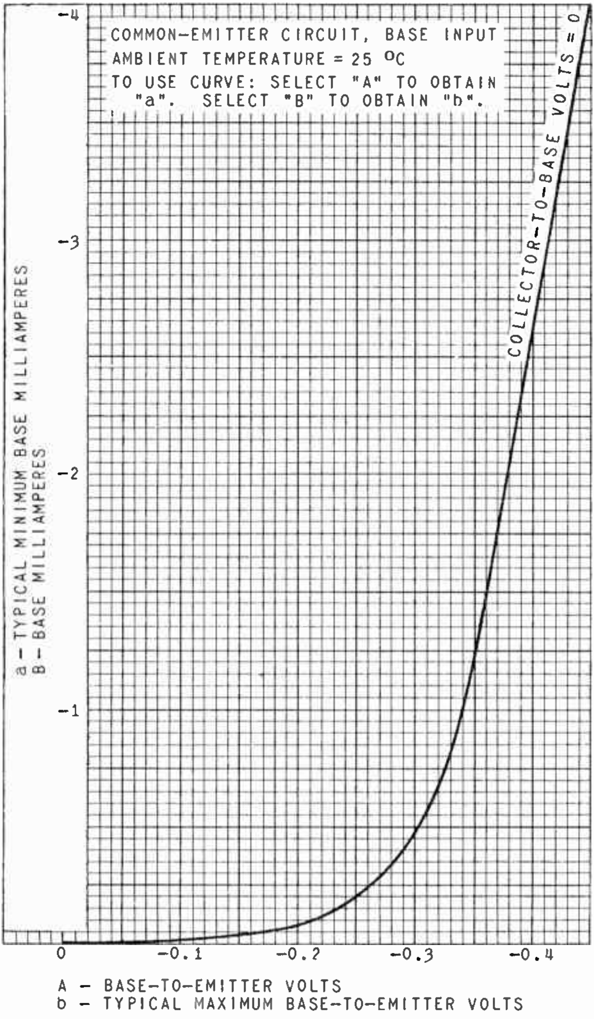
92CS-9150

2N269

2N269
BASE CHARACTERISTIC
For Switching Applications



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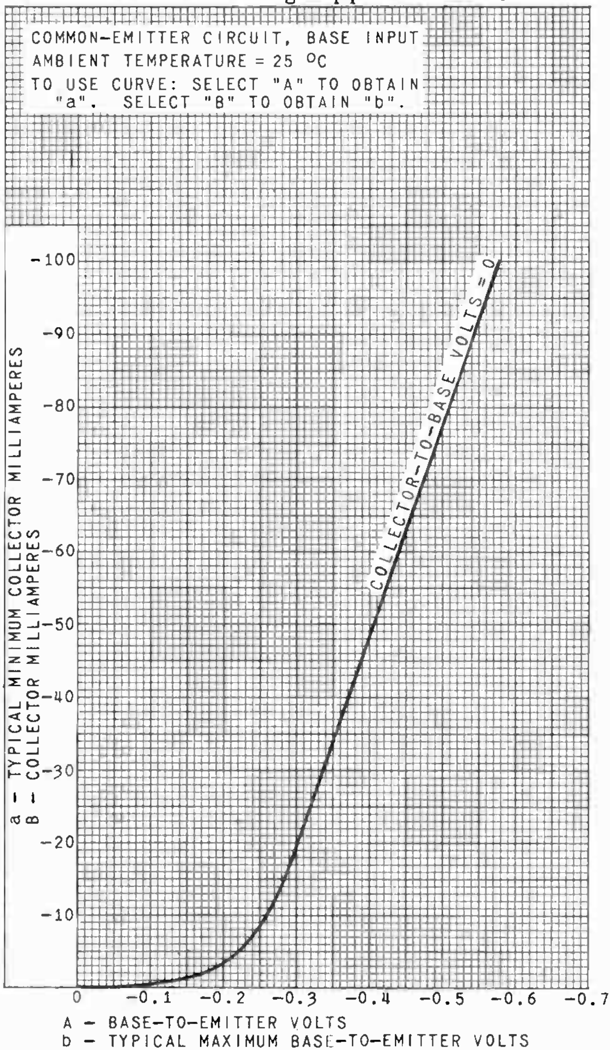
92CS-9151

World Radio History

2N269
TRANSFER CHARACTERISTIC
For Switching Applications



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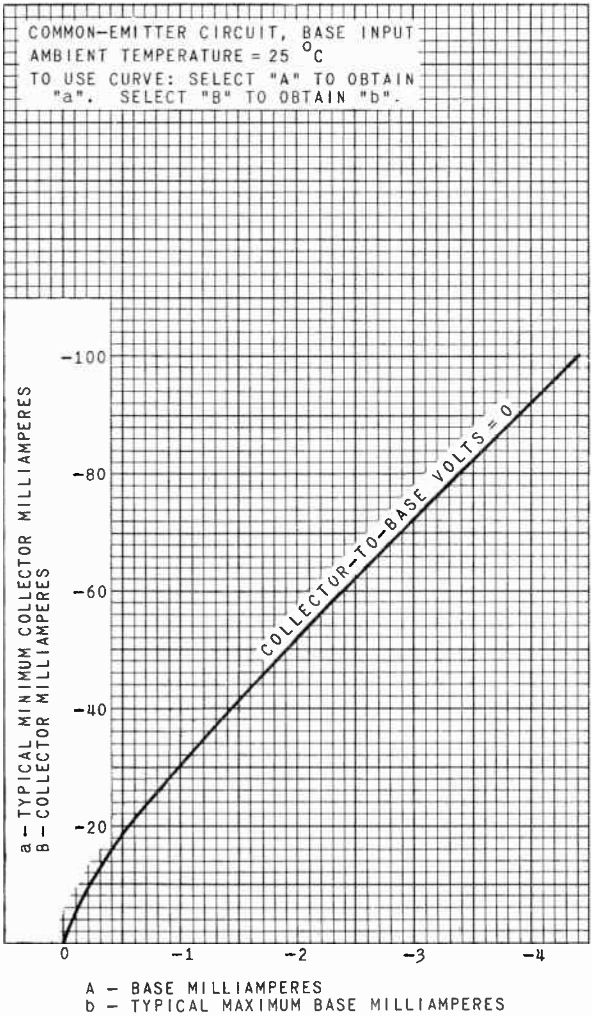
92CS-9152

2N269
CURRENT-TRANSFER CHARACTERISTIC
For Switching Applications



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92CS-9153R1

World Radio History

RCA

2N270

JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For large-signal audio-frequency applications

GENERAL DATA

Electrical:

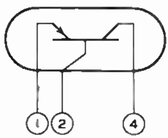
Maximum DC Collector Current for dc collector-to-base voltage of -25 volts with emitter open, and at ambient temperature of 25 °C.	-10	μa
Maximum DC Emitter Current for dc emitter-to-base voltage of -12 volts with collector open, and at ambient temperature of 25 °C.	-10	μa
Maximum Junction-Temperature Rise (With transistor in free air)	0.24	°C/mw

Mechanical:

Mounting Position	Any
Maximum Length (Excluding flexible leads)	0.375"
Maximum Diameter.	0.360"
Case.	Metal, Insulated
Envelope Seals.	Hermetic
Leads, Flexible	3
Minimum length.	1.5"
Orientation and diameter.	*See Dimensional Outline*

Lead 1 - Emitter

Lead 4 - Collector



Lead 2 - Base

AUDIO-FREQUENCY AMPLIFIER -- Class A

Maximum Ratings, ***Absolute Values:***

PEAK COLLECTOR-TO-BASE VOLTAGE.	-25 max.	volts
DC COLLECTOR-TO-BASE VOLTAGE (For inductive load)	-12 max.	volts
PEAK COLLECTOR CURRENT.	-150 max.	ma
DC COLLECTOR CURRENT.	-75 max.	ma
PEAK EMITTER CURRENT.	150 max.	ma
DC EMITTER CURRENT.	75 max.	ma
COLLECTOR DISSIPATION (At ambient temperatures up to 50 °C)	150 max.	mw
AMBIENT TEMPERATURE (During operation). . .	50 max.	°C
STORAGE-TEMPERATURE RANGE	-65 to +85	°C

Characteristics, ***At Ambient Temperature of 25 °C:***

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-1	volt
DC Collector Current.	-150	ma
Large-Signal DC Current Transfer Ratio. . .	70	

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

2N270

2N270

JUNCTION TRANSISTOR

Typical Operation, *At Ambient Temperature of 25 °C:*

Common-Emitter Circuit, Base Input

DC Supply Voltage	9	volts
Emitter Resistor	100	ohms
Emitter Bypass Capacitor	50	μf
DC Collector Current	-19	ma
DC Base-to-Emitter Voltage	-0.19	volt
Input Resistance	400	ohms
Load Impedance	400	ohms
Signal Frequency	1	kc
Power Gain⧫	35	db
Total Harmonic Distortion	10▲ max.	%
Max.-Signal Power Output⧫	60	mw

AUDIO-FREQUENCY AMPLIFIER -- Class B

Maximum Ratings, *Absolute Values:*

PEAK COLLECTOR-TO-BASE VOLTAGE	-25 max.	volts
DC COLLECTOR-TO-BASE VOLTAGE (for inductive load)	-12 max.	volts
PEAK COLLECTOR CURRENT	-150 max.	ma
DC COLLECTOR CURRENT	-75 max.	ma
PEAK EMITTER CURRENT	150 max.	ma
DC EMITTER CURRENT	75 max.	ma
COLLECTOR DISSIPATION (At ambient temperatures up to 50 °C)	150 max.	mw
AMBIENT TEMPERATURE (During operation)	50 max.	°C
STORAGE-TEMPERATURE RANGE	-65 to +85	°C

Characteristics, *At Ambient Temperature of 25 °C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-1	volt
DC Collector Current	-150	ma
Large-Signal DC Current Transfer Ratio	70	

Typical Push-Pull Operation, *At Ambient Temperature of 25 °C:*

Common-Emitter Circuit, Base Input

Unless otherwise specified, values are for 2 transistors

DC Supply Voltage	12	volts
Emitter Resistor	5	ohms
DC Base-to-Emitter Voltage (Zero signal)	-0.11	volt
Peak Collector Current (Per transistor)	-110	ma
Zero-Signal DC Collector Current (Per transistor)	-2	ma
Max.-Signal DC Collector Current (Per transistor)	-35	ma
Signal-Source Impedance (Base to base)	4000	ohms

▲ This value is 4 per cent maximum at max.-signal power output of 10 milliwatts.

⧫: See next page.

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RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

2N270

JUNCTION TRANSISTOR

Load Impedance (Collector to collector)	600		ohms
Signal Frequency	1		kc
Circuit Efficiency	75		%
Power Gain♦	32		db
Total Harmonic Distortion	10■	max.	%
Max.-Signal Power Output♦	500		mw

♦ Measured at the primary of the output transformer.

■ This value is 5 per cent maximum at max.-signal power output of 10 milliwatts.

OPERATING CONSIDERATIONS

The 2N270 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

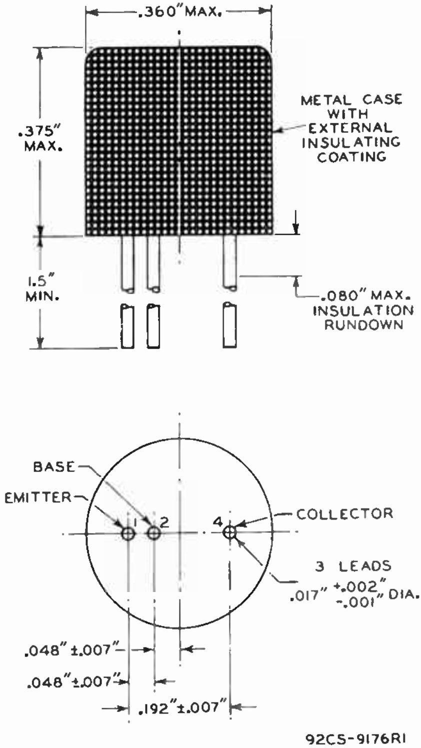
The *flexible leads* of the 2N270 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N270, the temperature of the solder should not exceed 230 °C for a maximum immersion period of 10 seconds.

In class B service, when the 2N270 is operated at ambient temperatures other than 25 °C, the base-to-emitter voltage should be reduced or increased by approximately 0.002 volt for each degree the ambient temperature is above or below 25 °C, respectively. When this transistor is operated under varying ambient temperatures, some form of temperature compensation may be used in the base-to-emitter circuit to hold the operating point constant.

World Radio History

2N270
JUNCTION TRANSISTOR



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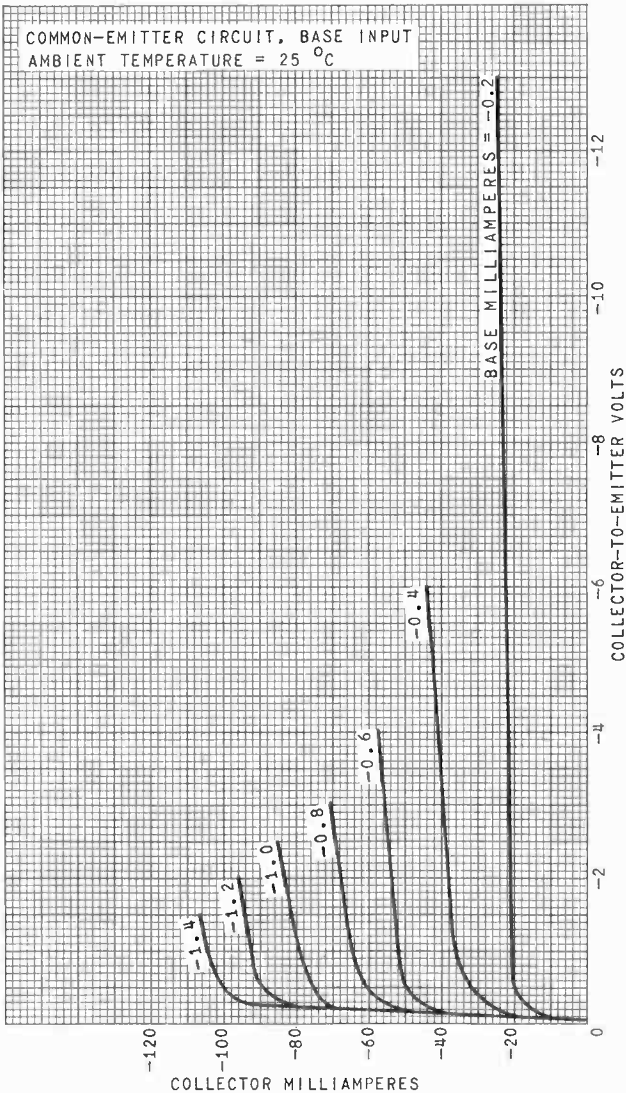
World Radio History

2N270

AVERAGE COLLECTOR CHARACTERISTICS



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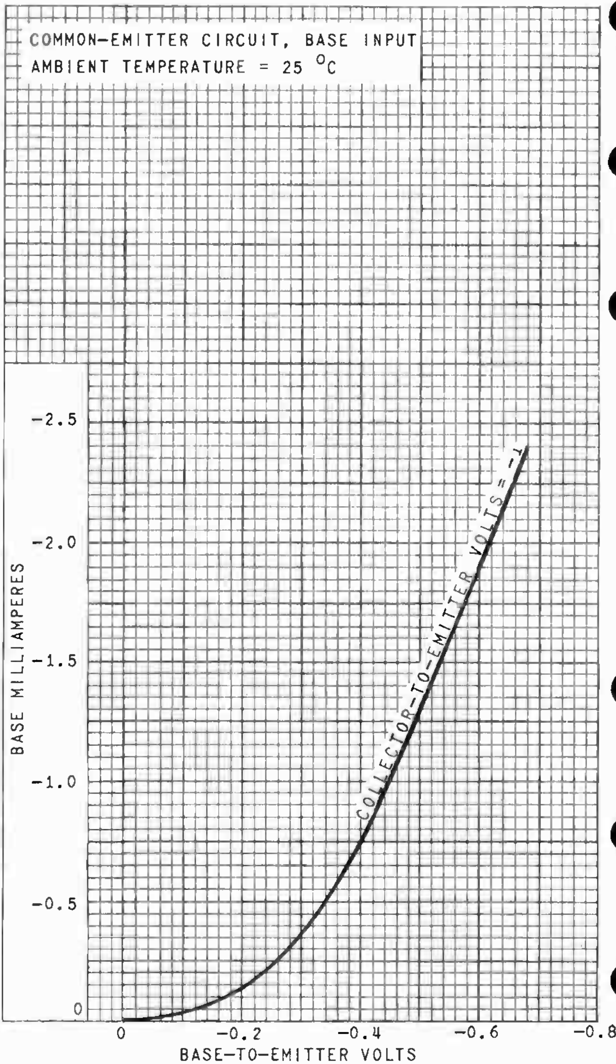
92CS-9182

World Radio History

2N270

2N270

AVERAGE BASE CHARACTERISTIC



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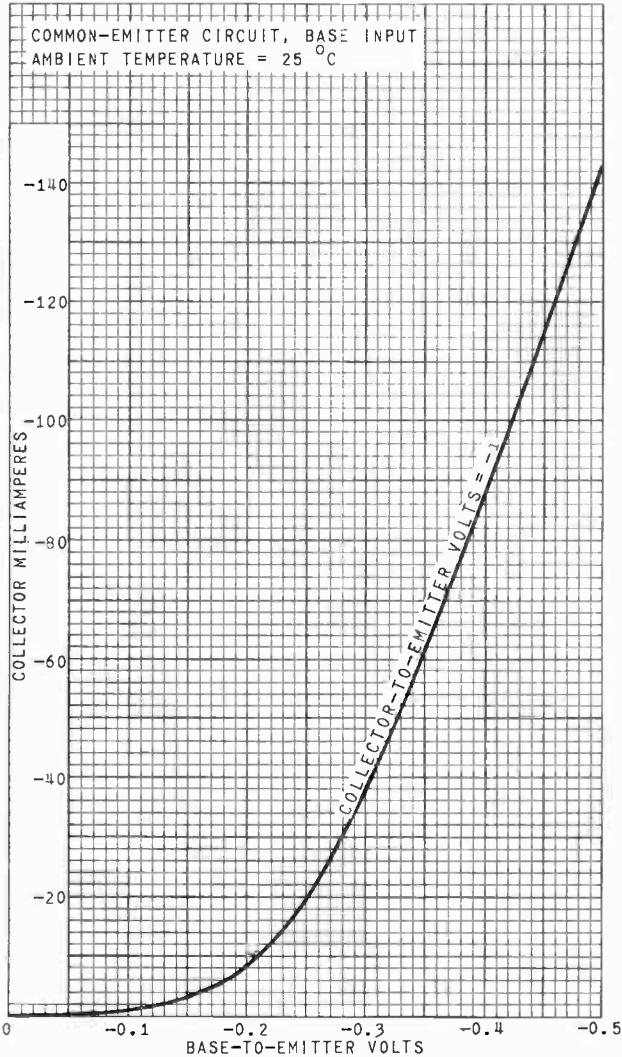
92CS-9180

RCA

2N270

2N270

AVERAGE TRANSFER CHARACTERISTIC



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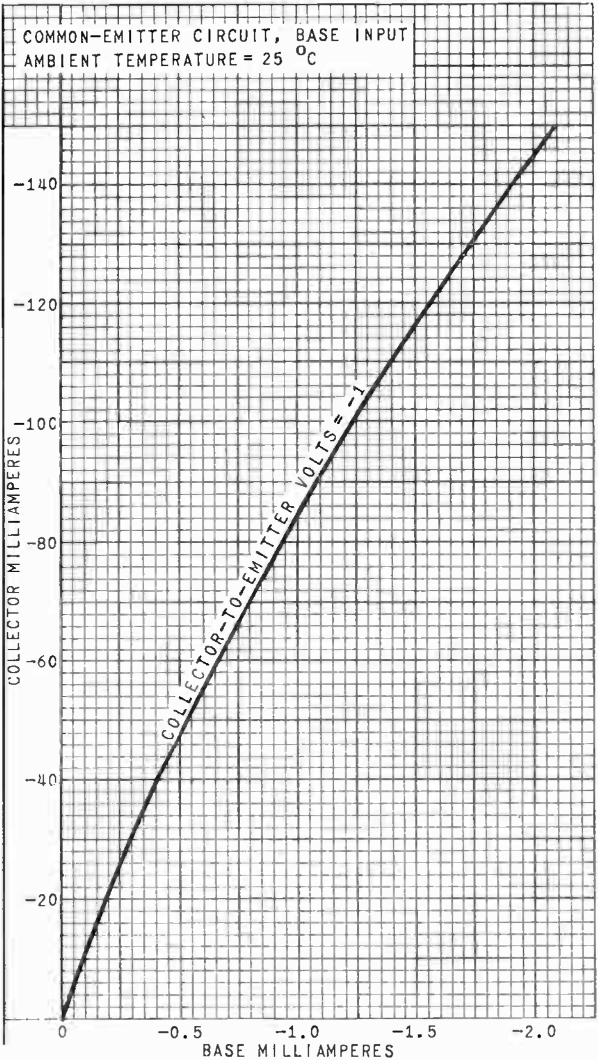
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

92CS-9181

World Radio History

2N270

AVERAGE CURRENT-TRANSFER CHARACTERISTIC



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92CS-9179

World Radio History

RCA

2N274

DRIFT TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For radio-frequency amplifier applications

GENERAL DATA

Electrical, *At Ambient Temperature of 25° C:*

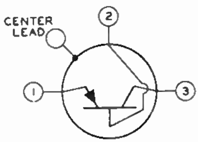
Minimum DC Collector-to-Base Voltage for dc collector current of -50 μa with emitter open.	-40	volts
Maximum DC Collector Current for dc collector-to-base voltage of -1 volt with emitter open	-10	μa
Maximum DC Collector Current for dc collector-to-base voltage of -12 volts with emitter open.	-16	μa
Minimum DC Emitter-to-Base Voltage for dc emitter current of -50 μa with collector open	-0.5	volt

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads).	0.405"
Maximum Diameter	0.240"
Case	Metal
Envelope Seals	Hermetic
Leads, Flexible.	4
Minimum length	1.5"
Orientation and diameter	*See Dimensional Outline*

BOTTOM VIEW

Lead 1 - Emitter
Center Lead - Interlead Shield, Metal Case



Lead 2 - Base
Lead 3 - Collector (Adjacent to red dot on side of case)

RADIO-FREQUENCY AMPLIFIER — Class A

Maximum Ratings, *Absolute Values:*

DC COLLECTOR-TO-BASE VOLTAGE	-35 max.	volts
DC EMITTER-TO-BASE VOLTAGE..	-0.5 max.	volt
DC COLLECTOR CURRENT	-10 max.	ma
DC EMITTER CURRENT	10 max.	ma
COLLECTOR DISSIPATION (At ambient temperatures up to 71° C).	35 max.	mw
AMBIENT TEMPERATURE (During operation) . .	71 max.	°C
STORAGE-TEMPERATURE RANGE.	-65 to +85	°C

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage.	-9	volts
DC Emitter Current	1	ma
Forward Current Transfer Ratio■.	-60	

■: See next page.

World Radio History

RCA

2N274

DRIFT TRANSISTOR

Small-Signal Hybrid-π Parameters:*

DC Collector-to-Emitter Voltage (V_{CE}) . . .	-9	volts
DC Emitter Current (I_E)	1	ma
Resistance $r_{bb'}$	40	ohms
Conductance $g_{b'e}$	640	μmhos
Conductance g_{ce} (Approx.)	0	μmhos
Conductance $g_{b'c}$ (Approx.)	0	μmhos
Capacitance $C_{b'e}$	200	μμf
Capacitance $C_{b'c}$	1.7	μμf
Interlead Capacitance between collector and base leads with interlead shield connected to ground and all leads cut to 5/16"	0.094	μμf
Intrinsic Transconductance (g_m)	37000	μmhos
Frequency● for unity power amplification .	132	Mc

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-9	volts
DC Emitter Current	1	ma
Forward Current Transfer Ratio■	0.984	
Frequency at which the forward current transfer ratio drops to 0.707 times its value at 1 kc	30	Mc

Typical Operation, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

At frequency of	*1.5*	*10.7*	*Mc*
DC Collector-to-Emitter Voltage. . . .	-9	-9	volts
DC Emitter Current	1	1	ma
DC Base-to-Emitter Voltage	-0.2	-0.2	volt
Input Resistance, AC output circuit shorted.	1350	170	ohms
Output Resistance, AC input circuit shorted.	70000	4500	ohms
Power Gain▲.	45	24	db

■ Measured at 1 kc.

* As derived from corresponding equivalent circuit shown under type 2N104.

● This frequency (figure of merit) may be calculated from the equation

$$f = \frac{1}{4\pi}\sqrt{\frac{g_m}{r_{bb'} \cdot C_{b'c}\, C_{b'e}}}$$

▲ Measured in a single-tuned unilateralized circuit matched to the generator and load impedances for maximum transfer of power. Transformer insertion losses not included.

OPERATING CONSIDERATIONS

The 2N274 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

World Radio History

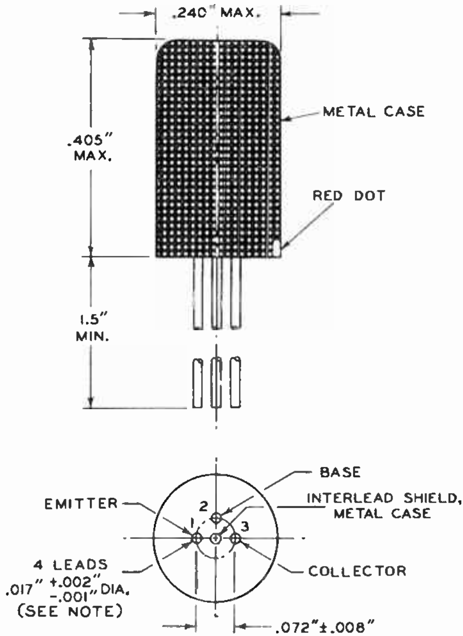
RCA

2N274

DRIFT TRANSISTOR

The *flexible leads* of the 2N274 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N274, the temperature of the solder should not exceed 230° C for a maximum immersion period of 10 seconds.



92CS-9266R1

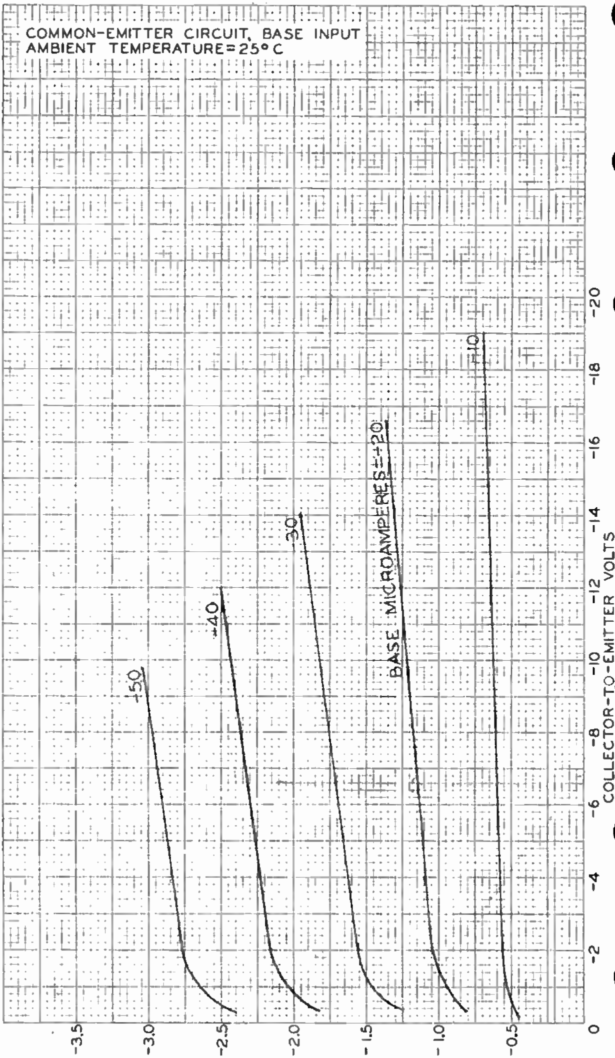
NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE PLANE OF THE ACTUAL BOTTOM OF THE BASE. BETWEEN 0.250" AND 1.50", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

2N274

2N274

AVERAGE COLLECTOR CHARACTERISTICS



SEMICONDUCTOR DIVISION

RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

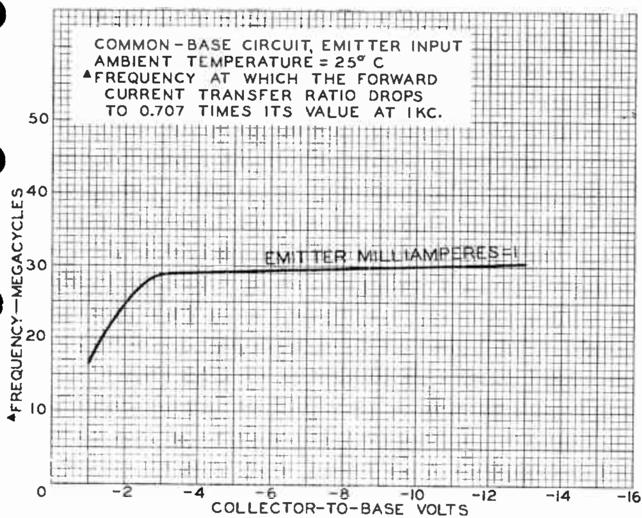
92CM-9107

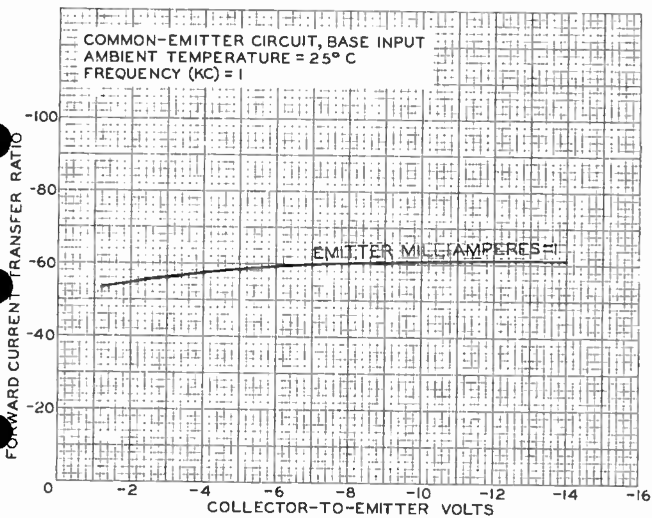
World Radio History

RCA

2N274

AVERAGE CHARACTERISTICS





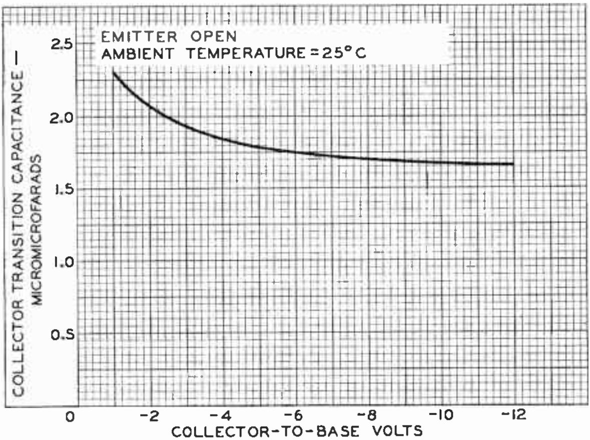
World Radio History

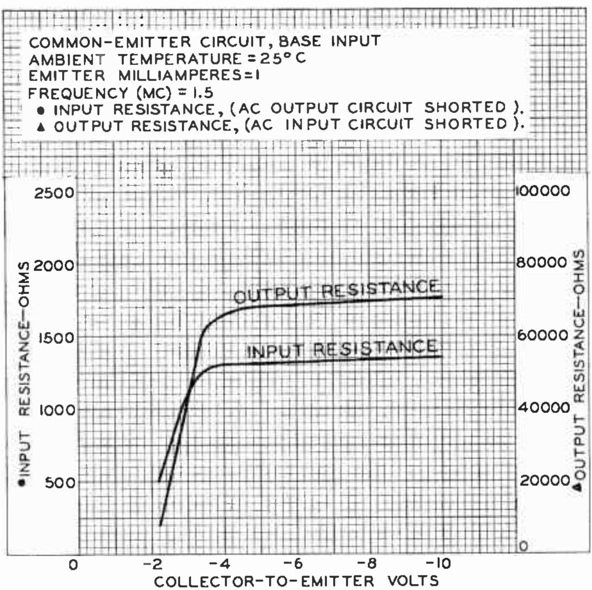
2N274

RCA

2N274

AVERAGE CHARACTERISTICS





World Radio History

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

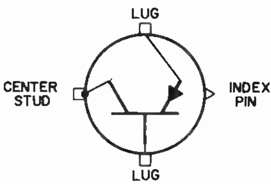
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No.TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	-40 max.	volts
EMITTER-TO-BASE VOLTAGE	-20 max.	volts
COLLECTOR CURRENT	-15 max.	amp
EMITTER CURRENT	15 max.	amp
BASE CURRENT	-4 max.	amp
TRANSISTOR DISSIPATION:[a]		
At case temperatures[b] of 25° C or below	150 max.	watts
CASE-TEMPERATURE[b] RANGE:		
Operating and storage	-65 to +100	°C

Typical Operation:

In a common-emitter, base-input, power-switching circuit at case temperature[b] of 25° C

DC Supply Voltage	-12	volts
DC Base-Bias Voltage	6	volts
"On" DC Collector Current	-12	amp
"Turn-On" Base Current	-2	amp
"Turn-Off" Base Current	0	amp

← Indicates a change.

World Radio History

Switching Time:

Rise time	15	μsec
Fall time	15	μsec

[a] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

[b] Measured at any point on seating surface.

→ ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and at case temperature[b] of 25° C unless otherwise specified

		Min.	*Typical*	*Max.*	
DC Collector-to-Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = -0.3.	BV_{CES}	-40	-	-	volts
With base open:	BV_{CEO}				
For dc collector amperes = -0.3. . . .		-	-40	-	volts
For dc collector amperes = -1[c]		-25	-	-	volts
DC Base-to-Emitter Voltage for dc collector-to-emitter volts = -2, dc collector amperes = -5. .	V_{BE}	-	-0.65	-	volt
DC Collector-to-Emitter Saturation Voltage for dc collector amperes = -12, dc base amperes = -2 .	$V_{CE(sat)}$	-	-0.3	-	volt
DC Emitter Voltage for dc collector volts = -40, dc emitter current = 0. .	V_{EB}	-	-	-1	volt
DC Punch-Through Voltage. .	V_{PT}	-40	-	-	volts
DC Emitter-Cutoff Current for dc emitter volts = -20, dc collector current = 0	I_{EBO}	-	-1	-4	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = -2, dc emitter current = 0		-	-100	-	μa
With dc collector volts = -40, dc emitter current = 0		-	-2	-4	ma
With dc collector volts = -40, dc emitter current = 0, case temperature[b] = 71° C. .		-	-	-15	ma
DC Current Transfer Ratio for dc collector-to-emitter volts = -2, dc collector amperes =	h_{FE}				
-5.		35	-	70	
-12		-	25	-	

→ Indicates a change.

World Radio History

Beta-Cutoff Frequency for dc collector-to-emitter volts = -6, dc collector amperes = -5.	$f_{\alpha e}$	-	10	-	kc
Thermal Resistance: Junction-to-case.	R_T	-	0.35	0.5	°C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds.		-	0.075	-	watt-sec/°C
Thermal Time Constant . . .	τ_1	-	26.25	-	msec

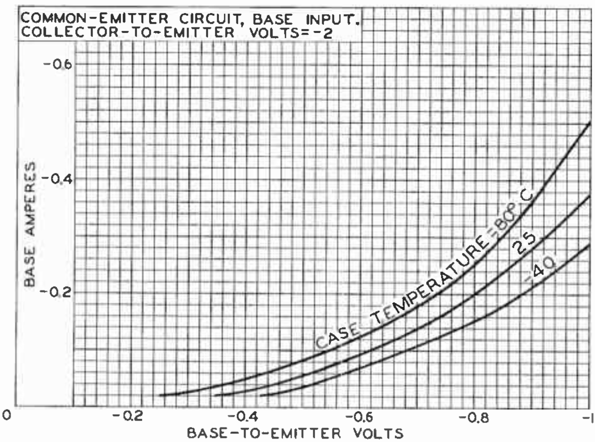
[b] Measured at any point on seating surface.

[c] Tested by sweep method to prevent excessive heating of collector junction.

PERFORMANCE TESTS,
OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
and
RATING CHART
shown under Type 2N173 also apply to the 2N277 ←

← Indicates a change.

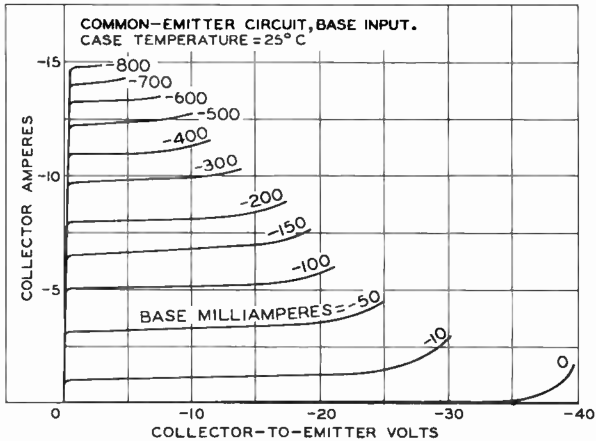
TYPICAL BASE CHARACTERISTICS



92CS-10703

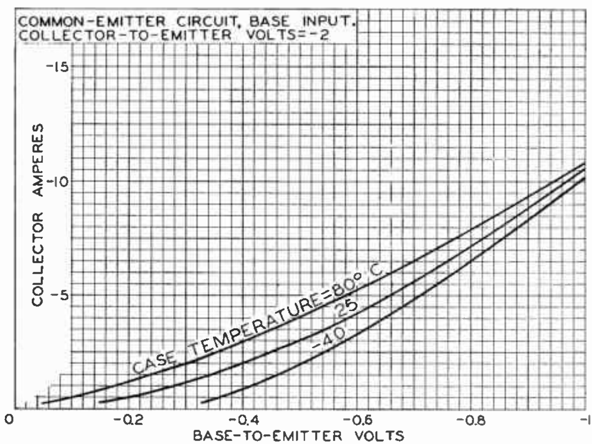
World Radio History

TYPICAL COLLECTOR CHARACTERISTICS



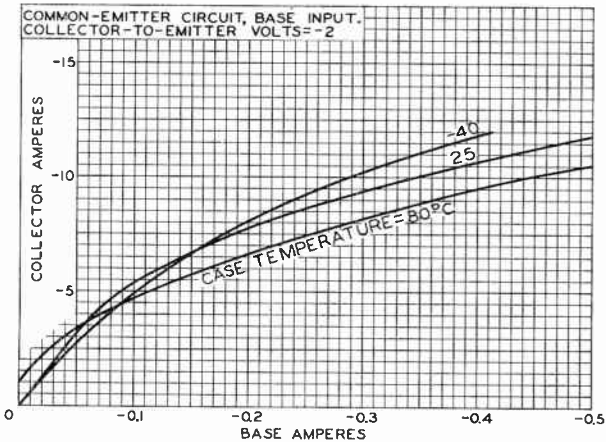
92CS-10725

TYPICAL CHARACTERISTICS



92CS-10709

TYPICAL CHARACTERISTICS



92CS-10712

World Radio History

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

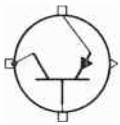
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	1.230"
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No.TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	-40 max.	volts
EMITTER-TO-BASE VOLTAGE	-20 max.	volts
COLLECTOR CURRENT	-15 max.	amp
EMITTER CURRENT	15 max.	amp
BASE CURRENT	-4 max.	amp
TRANSISTOR DISSIPATION:▲		
At case temperature of 25° C	70 max.	watts
CASE-TEMPERATURE RANGE:		
Continuous operation	-65 to +95	°C
Intermittent operation	-65 to +100	°C
Storage	-65 to +100	°C

Typical Operation:

In a common-emitter, base-input, power-switching circuit at case temperature of 25° C

DC Supply Voltage	-12	volts
DC Base-Bias Voltage	6	volts
"On" DC Collector Current	-12	amp
"Turn-On" Base Current	-2	amp
"Turn-Off" Base Current	0	amp

World Radio History

Switching Time:

Rise time	15	μsec
Fall time	15	μsec

▲ See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in *General Section*.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and case temperature of 25° C unless otherwise specified

		Min.	Typical	Max.	
DC Collector-to-Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = -0.3. . . .	BV_{CES}	-40	-	-	volts
With base open:	BV_{CEO}				
For dc collector amperes = -0.3. . .		-	-40	-	volts
For dc collector amperes = -1● . . .		-25	-	-	volts
DC Base-to-Emitter Voltage* for dc collector-to-emitter volts = -2, dc collector amperes = -5. .	V_{BE}	-	-0.65	-	volt
DC Collector-to-Emitter Saturation Voltage* for dc collector amperes = -12, base amperes = -2. .	V_{CE}	-	-0.3	-	volt
DC Emitter Voltage for dc collector volts = -40, emitter amperes = 0	V_{EB}	-	-	-1	volt
DC Punch-Through Voltage. .	V_P	-40	-	-	volts
DC Emitter-Cutoff Current for dc emitter volts = -20, dc collector amperes = 0	I_{EBO}	-	-1	-8	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = -2, dc emitter amperes = 0		-	-100	-	μa
With dc collector volts = -40, dc emitter amperes = 0		-	-2	-8	ma
With dc collector volts = -40, dc emitter amperes = 0, case temperature = 71° C . .		-	-	-15	ma
DC Current Transfer Ratio* for dc collector-to-emitter volts = -2, dc collector amperes =	h_{FE}				
-5.		35	-	70	
-12		-	25	-	

World Radio History

Beta-Cutoff Frequency* for dc collector-to-emitter volts = -6, dc collector amperes = -5.	$f_{\alpha e}$	-	10	-	kc
Thermal Resistance: Junction-to-case.	R_T	-	0.7	1	°C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds.		-	0.075	-	watt-sec/°C
Thermal Time Constant . . .	τ_1	-	52.5	-	msec

● Sweep voltage used to perform test.
★ Measured in a common-emitter, base-input circuit.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

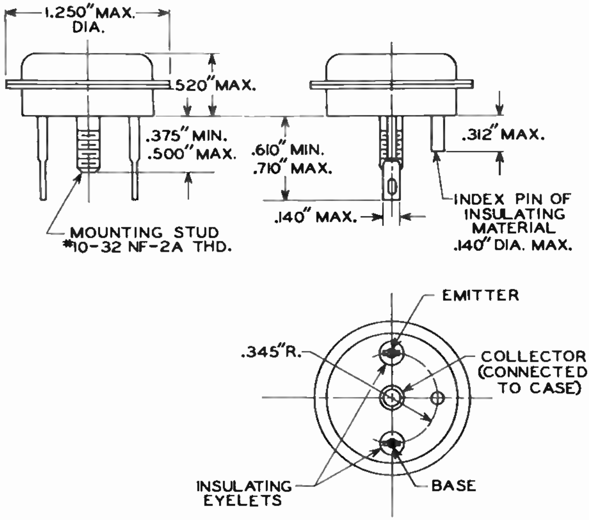
Electrical connection can be made to the base and emitter terminals by means of clips or by soldering directly to the terminals. When soldering connections are made to the terminals, care should be taken to conduct excessive heat away from the terminal seals, otherwise the heat of the soldering operation will crack the glass seals of the terminals and damage the transistor.

This transistor is provided with a single-ended stud for mounting to a heat sink and for electrical connection to the collector. (See accompanying *Suggested Mounting Arrangement*). Electrical connection to the base and to the emitter is made to their respective terminals.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

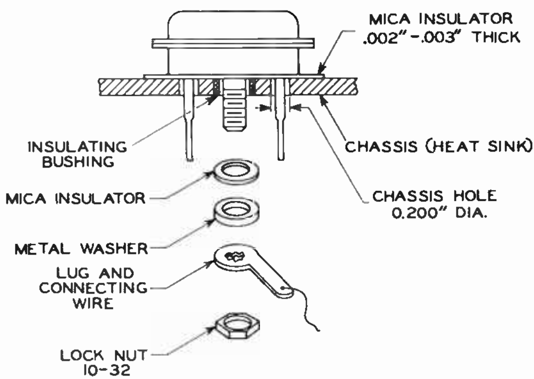
The maximum torque on mounting stud should not exceed 12 inch-pounds.

World Radio History



92CM-10612R1

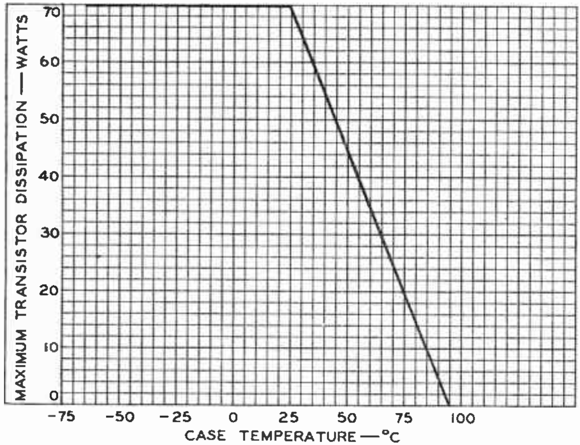
SUGGESTED MOUNTING ARRANGEMENT



92CS-10624R1

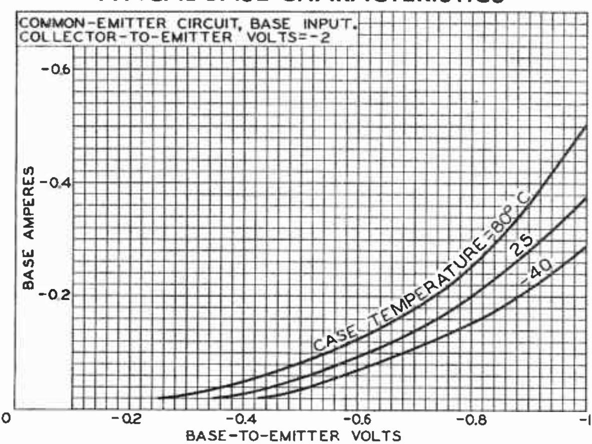
World Radio History

RATING CHART



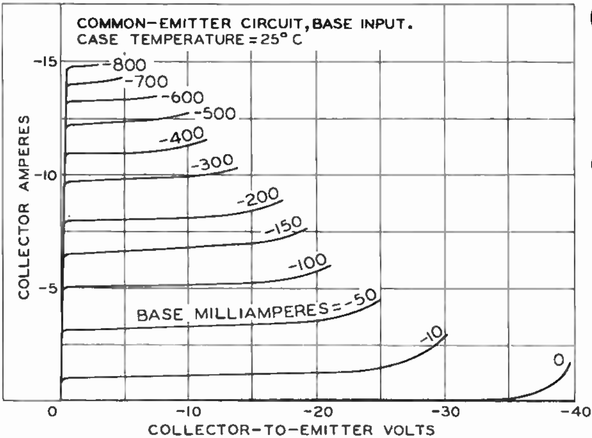
92CS-10701

TYPICAL BASE CHARACTERISTICS



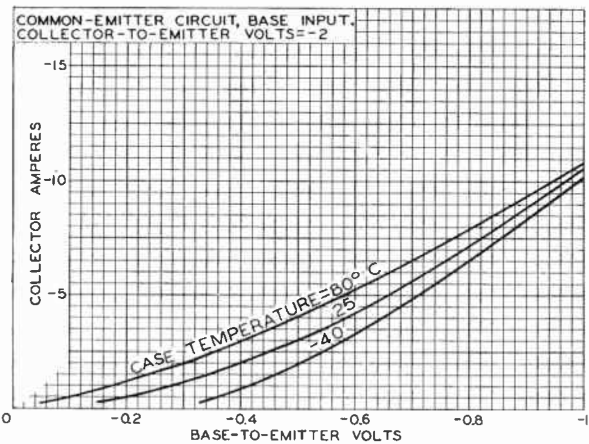
92CS-10703

TYPICAL COLLECTOR CHARACTERISTICS



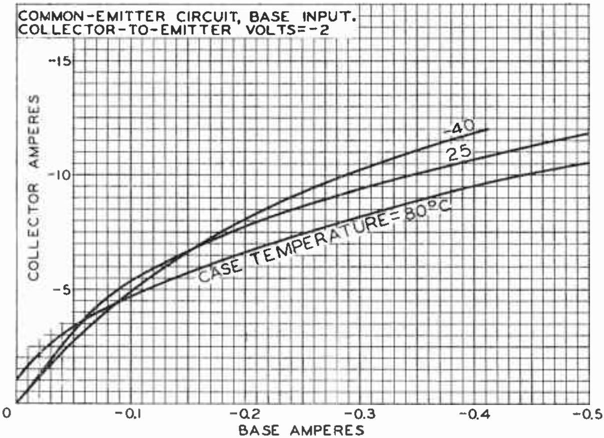
92CS-10725

TYPICAL CHARACTERISTICS



92CS-10709

TYPICAL CHARACTERISTICS



92CS-10712

World Radio History

World Radio History

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

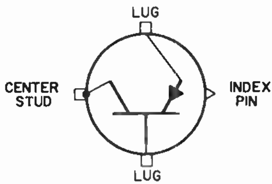
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No. TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	-50 max.	volts
EMITTER-TO-BASE VOLTAGE	-30 max.	volts
COLLECTOR CURRENT	-15 max.	amp
EMITTER CURRENT	15 max.	amp
BASE CURRENT	-4 max.	amp
TRANSISTOR DISSIPATION:[a] ←		
At case temperatures[b] of 25° C or below	150 max.	watts
CASE-TEMPERATURE[b] RANGE: ←		
Operating and storage	-65 to +100	°C

Typical Operation:

In a common-emitter, base-input, power-switching circuit at case temperature[b] of 25° C

DC Supply Voltage	-12	volts
DC Base-Bias Voltage	6	volts
"On" DC Collector Current	-12	amp
"Turn-On" Base Current	-2	amp
"Turn-Off" Base Current	0	amp

← Indicates a change.

World Radio History

Switching Time:

Rise time	15	μsec
Fall time	15	μsec

[a] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in *General Section*.

[b] Measured at any point on seating surface.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and at case temperature[b] *of 25° C unless otherwise specified*

		Min.	Typical	Max.	
DC Collector-to-Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = -0.3	BV_{CES}	-45	-	-	volts
With base open:	BV_{CEO}				
For dc collector amperes = -0.3 . . .		-	-45	-	volts
For dc collector amperes = -1[c]. . . .		-30	-	-	volts
DC Base-to-Emitter Voltage for dc collector-to-emitter volts = -2, dc collector amperes = -5	V_{BE}	-	-0.65	-	volt
DC Collector-to-Emitter Saturation Voltage for dc collector amperes = -12, dc base amperes = -2	V_{CE}(sat)	-	-0.3	-0.7	volt
DC Emitter Voltage for dc collector volts = -50, dc emitter current = 0.	V_{EB}	-	-	-1	volt
DC Punch-Through Voltage .	V_{PT}	-50	-	-	volts
DC Emitter-Cutoff Current for dc emitter volts = -30, dc collector current = 0.	I_{EBO}	-	-1	-4	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = -2, dc emitter current = 0.		-	-100	-	μa
With dc collector volts = -50, dc emitter current = 0.		-	-2	-4	ma
With dc collector volts = -50, dc emitter current = 0, case temperature[b] = 71° C .		-	-	-15	ma

→ indicates a change.

World Radio History

DC Current Transfer Ratio for dc collector-to-emitter volts = -2, dc collector amperes =	h_{FE}				
-5.		35	-	70	
-12		-	25	-	
Beta-Cutoff Frequency for dc collector-to-emitter volts = -6, dc collector amperes = -5 . .	$f_{\alpha e}$	-	10	-	kc
Thermal Resistance: Junction-to-case.	R_T	-	0.35	0.5	^{o}C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds.		-	0.075	-	watt-sec/^{o}C
Thermal Time Constant . . .	$\mathcal{T}_1$	-	52.5	-	msec

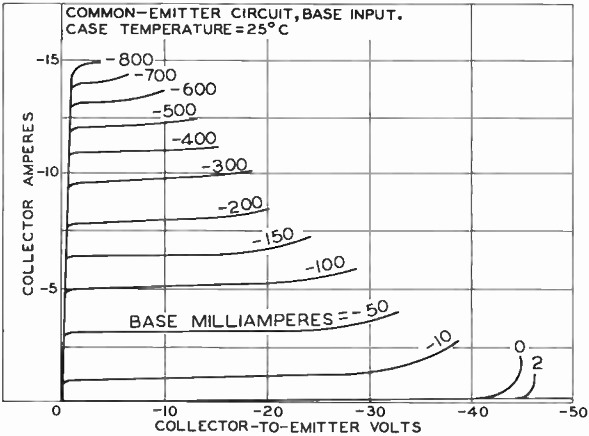
[b] Measured at any point on seating surface.
[c] Tested by sweep method to prevent excessive heating of collector junction.

**PERFORMANCE TESTS,
OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHART,
TYPICAL BASE-CHARACTERISTICS CURVES,
and
TYPICAL CHARACTERISTICS CURVES
shown under Type 2N173 also apply to the 2N278** ←

← Indicates a change.

World Radio History

TYPICAL COLLECTOR CHARACTERISTICS



92CS-10738

World Radio History

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service in Industrial and Military Applications

GENERAL DATA

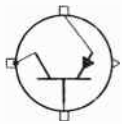
Mechanical:

Operating Position	Any
Maximum Overall Length	1.230"
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No. TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW

CENTER STUD



INDEX PIN

INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	-50 max.	volts
EMITTER-TO-BASE VOLTAGE	-30 max.	volts
COLLECTOR CURRENT	-15 max.	amp
EMITTER CURRENT	15 max.	amp
BASE CURRENT	-4 max.	amp
TRANSISTOR DISSIPATION:▲		
At case temperature of 25° C	70 max.	watts
CASE-TEMPERATURE RANGE:		
Continuous operation	-65 to +95	°C
Intermittent operation	-65 to +100	°C
Storage	-65 to +100	°C

Typical Operation:

In a common-emitter, base-input, power-switching circuit at case temperature of 25° C

DC Supply Voltage	-12	volts
DC Base-Bias Voltage	6	volts
"On" DC Collector Current	-12	amp
"Turn-On" Base Current	-2	amp
"Turn-Off" Base Current	0	amp

World Radio History

Switching Time:

Rise time	15	μsec
Fall time	15	μsec

▲ See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart in General Section.*

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and case temperature of 25° C unless otherwise specified

		Min.	*Typical*	*Max.*	
DC Collector-to-Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = -0.3. . . .	BV_{CES}	-45	-	-	volts
With base open:	BV_{CEO}				
For dc collector amperes = -0.3. . .		-	-45	-	volts
For dc collector amperes = -1• . . .		-30	-	-	volts
DC Base-to-Emitter Voltage* for dc collector-to-emitter volts = -2, dc collector amperes = -5.	V_{BE}	-	-0.65	-	volts
DC Collector-to-Emitter Saturation Voltage* for dc collector amperes = -12, base amperes = -2.	V_{CE}	-	-0.3	-1	volt
DC Emitter Voltage for dc collector volts = -50, emitter amperes = 0	V_{EB}	-	-	-1	volt
DC Punch-Through Voltage.	V_P	-50	-	-	volts
DC Emitter-Cutoff Current for dc emitter volts = -30, dc collector amperes = 0	I_{EBO}	-	-1	-8	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = -2, dc emitter amperes = 0		-	-100	-	μa
With dc collector volts = -50, dc emitter amperes = 0		-	-2	-8	ma
With dc collector volts = -50, dc emitter amperes = 0, case temperature = 71° C .		-	-	-15	ma

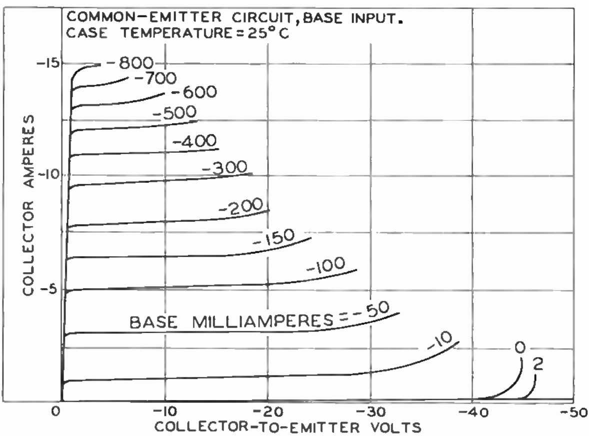
World Radio History

		Min.	Typ.	Max.	
DC Current Transfer Ratio* for dc collector-to-emitter volts = -2, dc collector amperes =	h_{FE}				
-5		35	-	70	
-12.		-	25	-	
Beta-Cutoff Frequency* for dc collector-to-emitter volts = -6, dc collector amperes = -5 .	f_{ae}	-	10	-	kc
Thermal Resistance: Junction-to-case	R_T	-	0.7	1	^{o}C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds		-	0.075	-	watt-sec/^{o}C
Thermal Time Constant. . .	τ_1	-	52.5	-	msec

● Sweep voltage used to perform test.
* Measured in a common-emitter, base-input circuit.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHART,
TYPICAL BASE-CHARACTERISTICS CURVES,
and TYPICAL CHARACTERISTICS CURVES,
shown under Type 2N277 also apply to the 2N278

TYPICAL COLLECTOR CHARACTERISTICS



92CS-10738

World Radio History

World Radio History

RCA

2N301
POWER TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For audio-frequency power applications

GENERAL DATA

Electrical, *For Mounting-Flange Temperature of 25 °C:*

Minimum DC Collector-to-Base Voltage for dc collector current of -1 milliampere with emitter open	-40	volts
Minimum DC Emitter-to-Base Voltage for dc emitter current of -1 milliampere with collector open.	-12	volts
Maximum DC Collector Current for dc collector-to-base voltage of -12 volts with emitter open	-220	μa
Maximum DC Collector Current for dc collector-to-base voltage of -0.5 volt with emitter open.	-50	μa

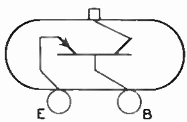
Mechanical:

Mounting Position	Any
Maximum Overall Length.	0.875"
Maximum Seated Length	0.475"
Maximum Length of Mounting Flange	1.562"
Maximum Width of Mounting Flange.	1.031"
Case.	Plated Steel, Insulated
Mounting Flange	Copper
Envelope Seals.	Hermetic

Terminal Connections *(See Dimensional Outline):*

E - Emitter

B - Base



MOUNTING FLANGE - Collector

AUDIO-FREQUENCY POWER AMPLIFIER -- Class A

Maximum Ratings, *Absolute Values:*

PEAK COLLECTOR-TO-BASE VOLTAGE.	-40 max.	volts
DC COLLECTOR-TO-BASE VOLTAGE (For inductive load)	-20 max.	volts
DC EMITTER-TO-BASE VOLTAGE.	-12 max.	volts
PEAK COLLECTOR CURRENT.	-2 max.	amp
DC COLLECTOR CURRENT.	-1 max.	amp
PEAK EMITTER CURRENT.	2 max.	amp
DC EMITTER CURRENT.	1 max.	amp
TRANSISTOR DISSIPATION:		
*For continuous operation:**		
For mounting-flange temperatures up to 55 °C	12 max.	watts
For mounting-flange temperature of 71 °C.	5.5 max.	watts

* The maximum transistor-dissipation rating is reduced 0.4 watt for each degree centigrade the mounting-flange temperature is increased above 55 °C.

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

2N301

2N301

POWER TRANSISTOR

For intermittent operation:●

For mounting-flange temperature of 80 °C.	7.5 max.	watts
MOUNTING-FLANGE TEMPERATURE (During operation).	85 max.	°C
STORAGE-TEMPERATURE RANGE	-65 to +85	°C

Characteristics, *For Mounting-Flange Temperature of 25 °C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-1.5	-1.5	volts
DC Collector Current.	-0.5	-1	amp
Signal Frequency.	1	-	kc
Input Resistance.	23	37	ohms
Current Transfer Ratio.	-75	-	
Large-Signal DC Current Transfer Ratio	-	70	

Typical Operation▲**,** *At Ambient Temperature of 55 °C:*

Common-Emitter Circuit, Base Input

DC Supply Voltage	14.4	volts
DC Collector-to-Emitter Voltage	-13.6	volts
Emitter Resistor (Unbypassed)	1	ohm
DC Base-to-Emitter Voltage.	-0.24	volt
DC Collector Current:		
Peak.	-0.8	amp
Zero-signal	-0.4	amp
Signal-Source Impedance	50	ohms
Load Impedance.	34	ohms
Signal Frequency.	400	cps
Circuit Efficiency♦	47	%
Power Gain♦	32.5	db
Total Harmonic Distortion	10 max.	%
Max.-Signal Power Output♦	2.7	watts

AUDIO-FREQUENCY POWER AMPLIFIER -- Class B

Maximum Ratings, *Absolute Values:*

PEAK COLLECTOR-TO-BASE VOLTAGE.	-40 max.	volts
DC COLLECTOR-TO-BASE VOLTAGE (For inductive load)	-20 max.	volts
DC EMITTER-TO-BASE VOLTAGE.	-12 max.	volts
PEAK COLLECTOR CURRENT.	-2 max.	amp
DC COLLECTOR CURRENT.	-1 max.	amp
PEAK EMITTER CURRENT.	2 max.	amp
DC EMITTER CURRENT.	1 max.	amp

▲ An aluminum chassis 7" x 11" x 1/16" mounted horizontally in free air is used as a heat sink.

●, ♦: See next page.

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RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

RCA

2N301

POWER TRANSISTOR

TRANSISTOR DISSIPATION:		
*For continuous operation:**		
For mounting-flange temperatures up to 55 °C	12 max.	watts
For mounting-flange temperature of 71 °C.	5.5 max.	watts
For intermittent operation:●		
For mounting-flange temperature of 80 °C.	7.5 max.	watts
MOUNTING-FLANGE TEMPERATURE (During operation).	85 max.	°C
STORAGE-TEMPERATURE RANGE	-65 to +85	°C

Characteristics, *For Mounting-Flange Temperature of 25 °C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-1.5	-1.5	volts
DC Collector Current.	-0.5	-1	amp
Signal Frequency.	1	-	kc
Input Resistance.	23	37	ohms
Current Transfer Ratio.	-75	-	
Large-Signal DC Current Transfer Ratio	-	70	

Typical Push-Pull Operation■, *At Ambient Temperature of 55 °C:*

Common-Emitter Circuit, Base Input

Unless otherwise specified, values are for 2 transistors

DC Supply Voltage	14.4	volts
DC Base-to-Emitter Voltage (Zero signal)	-0.13	volt
Peak Collector Current (Per transistor) . .	-2	amp
Zero-Signal DC Collector Current (Per transistor)	-0.05	amp
Max.-Signal DC Collector Current (Per transistor)	-0.64	amp
Signal-Source Impedance (Base to base)	60	ohms
Load Impedance (Collector to collector).	24	ohms
Signal Frequency.	400	cps
Circuit Efficiency♦	67	%
Power Gain♦	30	db
Total Harmonic Distortion	10 max.	%
Max.-Signal Power Output♦	12	watts

● The term "intermittent" is used to identify [illegible] in which no operating or "on" period exceeds [illegible] period is followed by an "off" period [illegible] at least [illegible] greater duration.

* The maximum transistor-dissipation rating is [illegible] degree centigrade the mounting-flange temperature [illegible].

♦, ■: See next page.

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

RCA

2N301

POWER TRANSISTOR

♦ Measured at the primary of the output transformer.

■ An aluminum chassis 7" x 11" x 1/16" mounted horizontally in free air is used as a heat sink. A 1/8" anodized-alumirum insulator is mounted between the mounting flange of each transistor and the chassis.

OPERATING CONSIDERATIONS

The *base and emitter pins* of the 2N301 fit the Loranger Mfg. Corp. Socket No.2149, or equivalent. When a socket is not used, connections can be soldered directly to the base and emitter pins. Soldering of the connections to the pins may be made close to the pin seals provided care is taken to conduct excessive heat away from the pin seals. Otherwise, the heat of the soldering operation will crack the glass seals of the pins and damage the transistor.

Depending upon application, electrical connection to the collector is made either directly to the chassis or to the mounting lug *(See Suggested Mounting Arrangement)*. Under no circumstances should a connection be soldered to the mounting flange because the heat of the soldering operation will permanently damage the transistor.

In most applications, the metal chassis may be used as a heat sink. Depending upon the application, the chassis (heat sink) may be connected either to the positive or negative terminal of the voltage supply. In applications where the chassis is connected to the positive terminal of the voltage supply, it will be necessary to use a 1/8" anodized-aluminum insulator having high thermal conductivity or a 0.002" mica insulator between the mounting flange and the chassis. An aluminum washer should be drilled or punched to provide the two mounting holes and the clearance holes for the emitter and base pins. The burrs should then be removed from the washer and the washer finally anodized. To insure the anodized insulating layer is not destroyed during mounting, it will also be necessary to remove the burrs from the holes in the chassis. Furthermore, to prevent a short circuit between the mounting bolt and the chassis, it is important that a fiber washer be used between the bolt and the chassis. *(See Suggested Mounting Arrangement)*.

The 2N301 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

In *class A service* when the chassis is connected to the negative terminal of the voltage supply, the mounting flange may be directly fastened to the chassis. In this class of service, degeneration in the biasing circuit may cause reduced power gain. To minimize degeneration, it is necessary to provide positive feedback in the input circuit. To insure stable operation and low distortion, it

World Radio History

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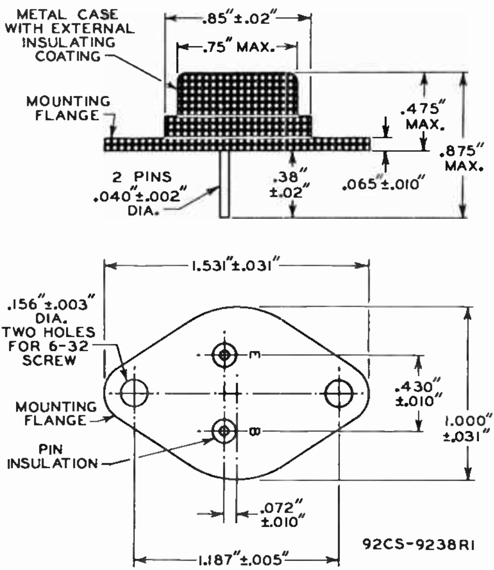
2N301

POWER TRANSISTOR

is necessary to provide some degeneration in the emitter circuit. This degeneration may be provided by the use of an unbypassed 1-ohm resistor in the emitter circuit.

In *class B service*, when the 2N301 is operated at mounting-flange temperatures other than 25 °C, the base-to-emitter voltage should be reduced or increased by approximately 0.002 volt for each degree the mounting-flange temperature is above or below 25 °C, respectively. When this transistor is operated under varying mounting-flange temperatures, some form of temperature compensation may be used in the base-to-emitter circuit to hold the operating point constant.

In *class B push-pull service*, it is necessary to insulate the mounting flange (collector terminal) of each transistor from the chassis and from the mounting flange of the other in order to prevent short circuiting the collector load. The *Suggested Mounting Arrangement* will insure good electrical contact and maximum transfer of heat.



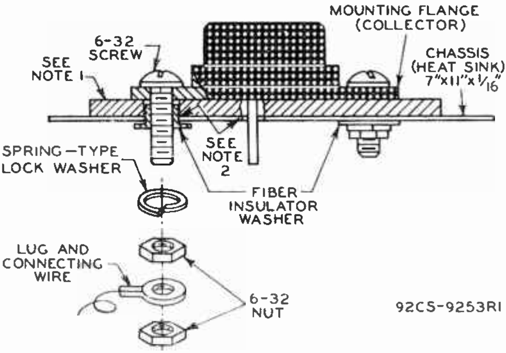
E=EMITTER
B=BASE
MOUNTING FLANGE=COLLECTOR

World Radio History

2N301

POWER TRANSISTOR

SUGGESTED MOUNTING ARRANGEMENT



NOTE 1: 0.002" MICA INSULATOR OR ALUMINUM INSULATOR 1/8" THICK, DRILLED OR PUNCHED WITH BURRS REMOVED, AND THEN ANODIZED.

NOTE 2: REMOVE BURRS FROM CHASSIS HOLES.

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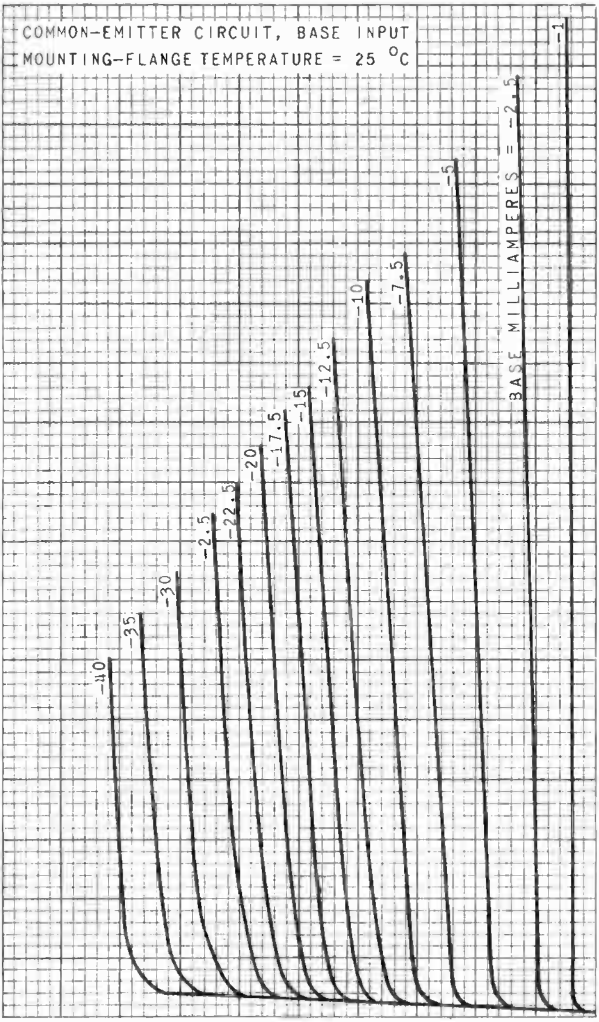
World Radio History

2N301
AVERAGE COLLECTOR CHARACTERISTICS



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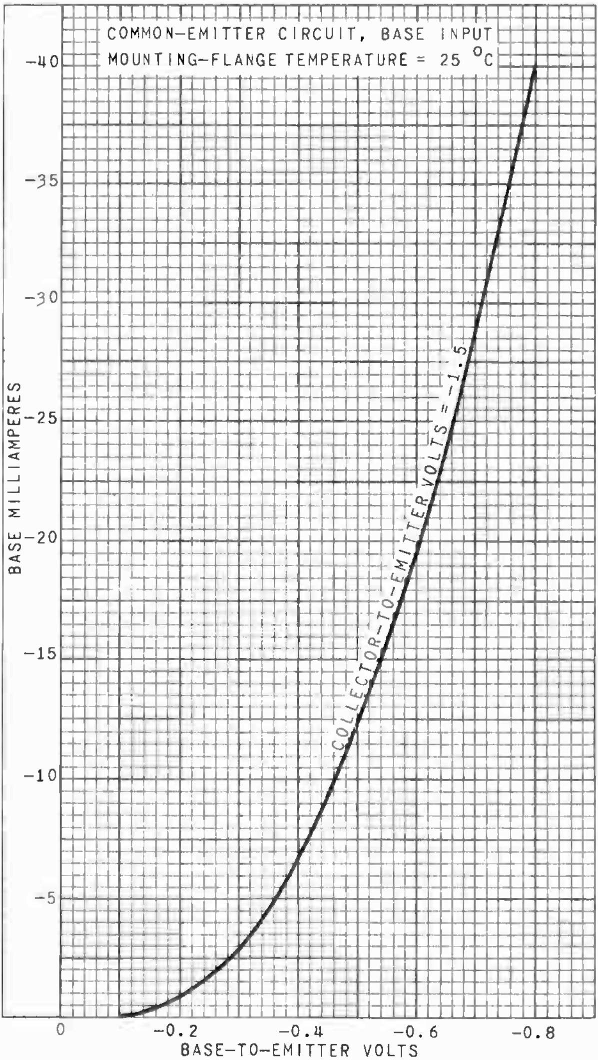
2N301

AVERAGE BASE CHARACTERISTIC



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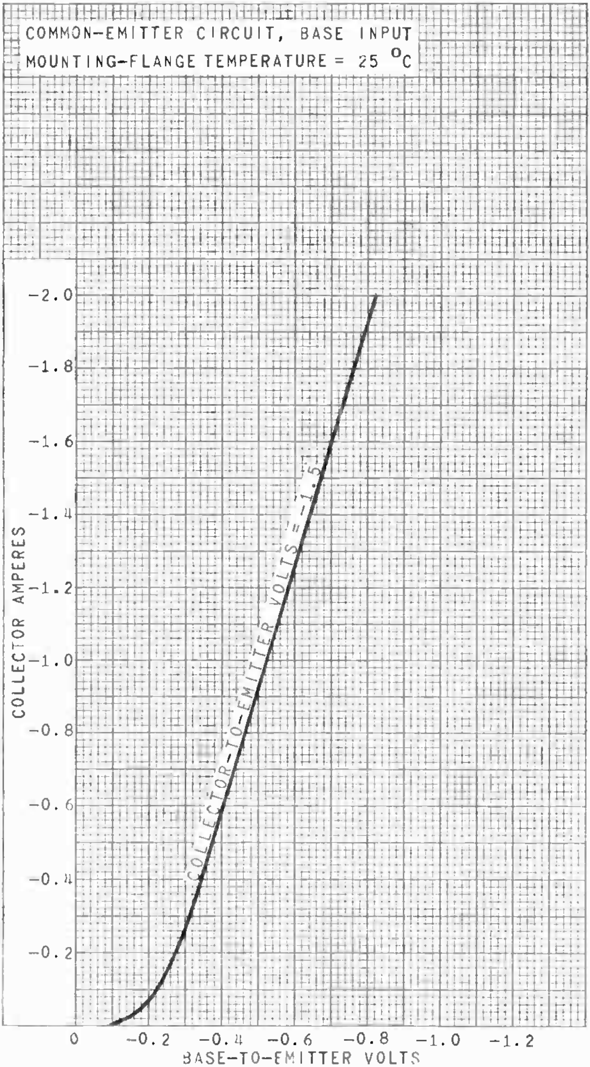
2N301

2N301
AVERAGE TRANSFER CHARACTERISTIC



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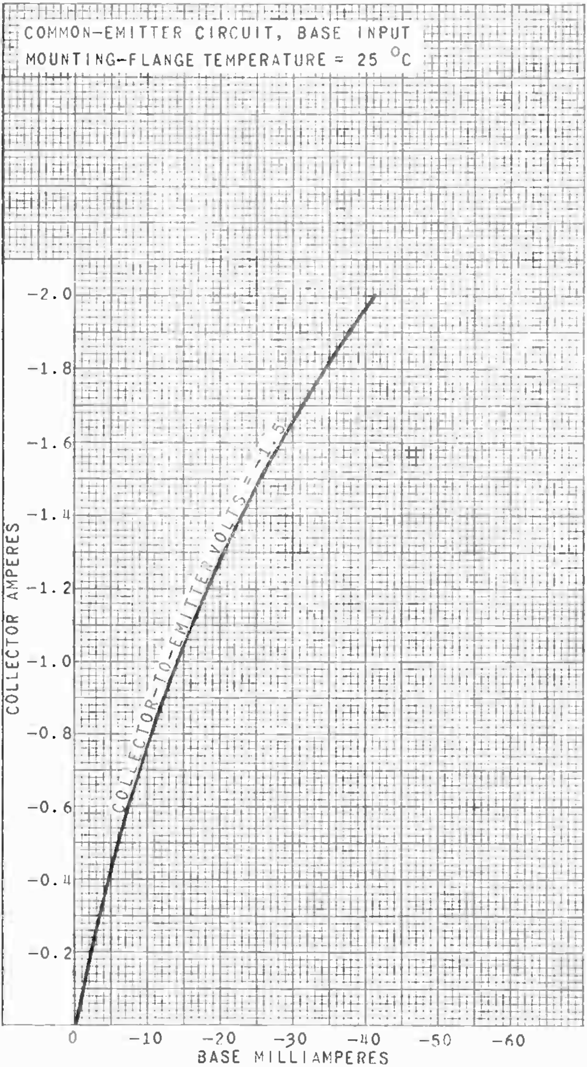
World Radio History

2N301

2N301

AVERAGE CURRENT-TRANSFER CHARACTERISTIC



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World Radio History

RCA

2N301-A
POWER TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For audio-frequency power applications

The 2N301-A is the same as the 2N301 except for the following items:

Electrical, *For Mounting-Flange Temperature of 25 °C:*

Minimum DC Collector-to-Base Voltage for dc collector current of -1 milliampere with emitter open	-60	volts

AUDIO-FREQUENCY POWER AMPLIFIER -- Class A and Class B

Maximum Ratings, *Absolute Values:*

PEAK COLLECTOR-TO-BASE VOLTAGE	-60 max.	volts
DC COLLECTOR-TO-BASE VOLTAGE (For inductive load).	-30 max.	volts

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RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

World Radio History

2N370

DRIFT TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For radio-frequency amplifier applications

GENERAL DATA

Electrical:

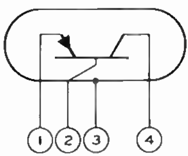
Maximum DC Collector Current for dc collector-to-base voltage of −12 volts with emitter open, and at ambient temperature of 25° C	−20	μa
Maximum DC Emitter Current for dc emitter-to-base voltage of −1.5 volts with collector open, and at ambient temperature of 25° C	−50	μa
Interlead Capacitance between collector and base leads with interlead shield connected to ground and all leads cut to 5/16"	0.003	μμf

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.375"
Maximum Diameter	0.360"
Case	Metal
Envelope Seals	Hermetic
Leads, Flexible	4
Minimum length	1.5"
Orientation and diameter	*See Dimensional Outline*

Lead 1 – Emitter

Lead 2 – Base



Lead 3 – Interlead Shield, Metal Case

Lead 4 – Collector

RADIO-FREQUENCY AMPLIFIER — Class A

Maximum Ratings, ***Absolute Values:***

DC COLLECTOR-TO-BASE VOLTAGE	−20 max.	volts
DC EMITTER-TO-BASE VOLTAGE	−1.5 max.	volts
DC COLLECTOR CURRENT	−10 max.	ma
DC EMITTER CURRENT	10 max.	ma
COLLECTOR DISSIPATION:		
At ambient temperature of 25° C	80 max.	mw
At ambient temperature of 55° C	40 max.	mw
At ambient temperature of 71° C	20 max.	mw
AMBIENT TEMPERATURE (During operation)	71 max.	°C
STORAGE-TEMPERATURE RANGE	−65 to +85	°C

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RCA

2N370

DRIFT TRANSISTOR

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-12	volts
DC Emitter Current	1	ma
Current Transfer Ratio (α_f)■	-60	
Frequency for unity power amplification	132	Mc

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-12	volts
DC Emitter Current	1	ma
Current Transfer Ratio (α_f)■	0.984	
Frequency at which the current transfer ratio drops to 0.707 times its value at 1 kc.	30	Mc

Typical Operation, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

At frequency of	*1.5*	*10*	*20*	*Mc*
DC Collector-to-Emitter Voltage	-12	-12	-12	volts
DC Emitter Current	1	1	1	ma
Input Resistance	1750	200	100	ohms
Output Resistance	180000	18000	11000	ohms
Maximum Power Gain▲	50.5	26.2	17	db
Maximum Useful Power Gain (In an unneutralized circuit)	31	17.6	12.5	db
Intrinsic Transconductance	37800	21400	13700	μmhos
Collector Transition Capacitance	1.7	1.7	1.7	μμf

■ Measured at 1 kc.

▲ Measured in a single-tuned unilateralized circuit matched to the generator and load impedances for maximum transfer of power. Transformer insertion losses not included.

OPERATING CONSIDERATIONS

The 2N370 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N370 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N370, the temperature of the solder should not exceed 230° C for a maximum immersion period of 10 seconds.

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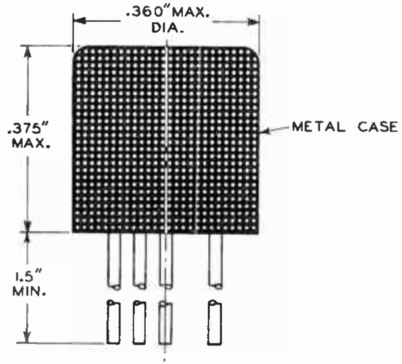
TENTATIVE DATA

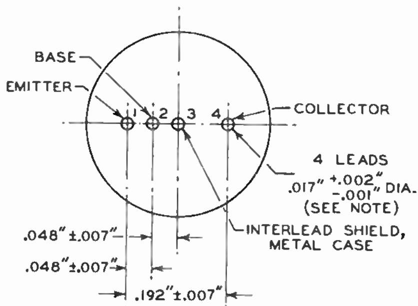
World Radio History

RCA

2N370

DRIFT TRANSISTOR





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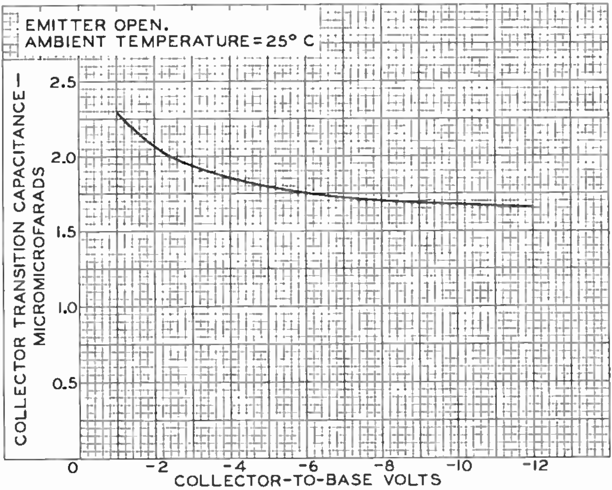
NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE BASE SEAT. BETWEEN 0.250" AND 1.50", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

2N370

2N370

AVERAGE CHARACTERISTIC



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World Radio History

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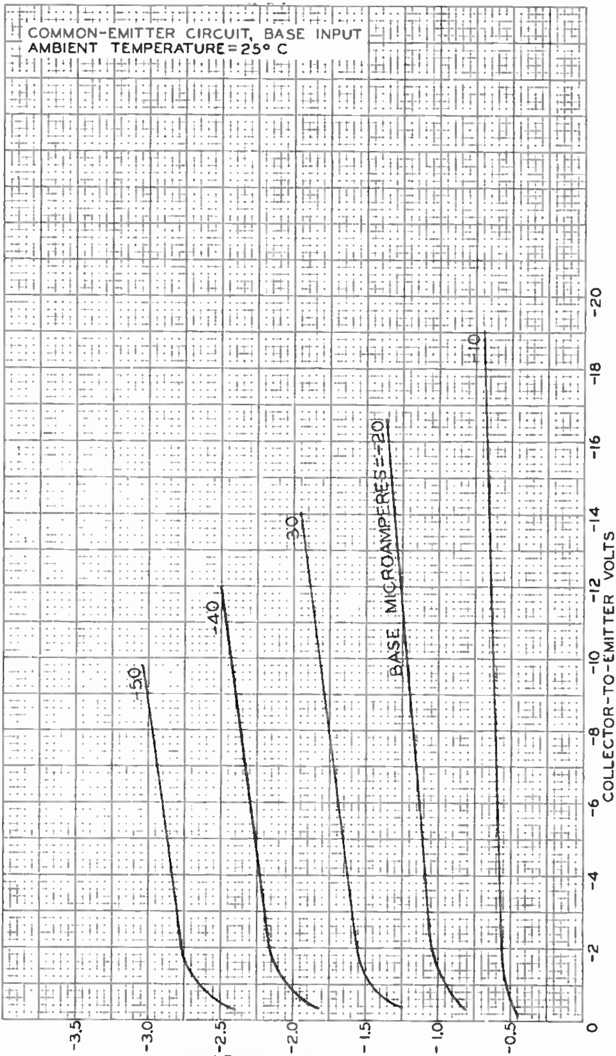
2N370

2N370

AVERAGE COLLECTOR CHARACTERISTICS



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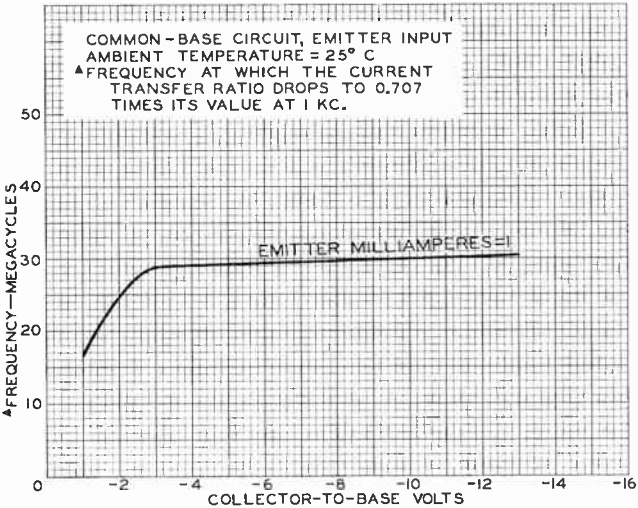
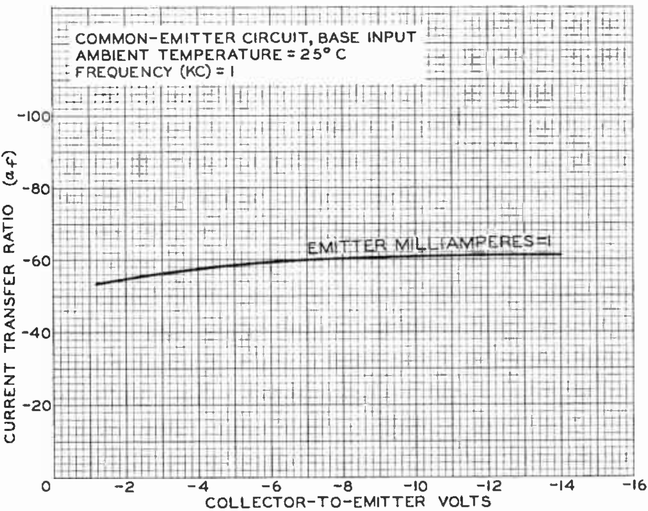
World Radio History

2N370

2N370

AVERAGE CHARACTERISTICS





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World Radio History

2N371

2N371

DRIFT TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For radio-frequency oscillator applications

GENERAL DATA

Electrical:

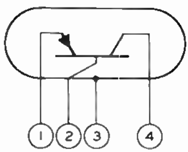
Maximum DC Collector Current for dc collector-to-base voltage of -12 volts with emitter open, and at ambient temperature of 25° C.	-20	μa
Maximum DC Emitter Current for dc emitter-to-base voltage of -0.5 volt with collector open, and at ambient temperature of 25° C	-50	μa
Interlead Capacitance between collector and base leads with interlead shield connected to ground and all leads cut to 5/16"	0.003	μμf

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.375"
Maximum Diameter	0.360"
Case	Metal
Envelope Seals	Hermetic
Leads, Flexible	4
Minimum length	1.5"
Orientation and diameter	*See Dimensional Outline*

Lead 1 – Emitter

Lead 2 – Base



Lead 3 – Interlead Shield, Metal Case

Lead 4 – Collector

RADIO-FREQUENCY OSCILLATOR

Maximum Ratings, *Absolute Values:*

DC COLLECTOR-TO-BASE VOLTAGE	-20 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-0.5 max.	volt
DC COLLECTOR CURRENT	-10 max.	ma
DC EMITTER CURRENT	10 max	ma
COLLECTOR DISSIPATION:		
At ambient temperature of 25° C	80 max.	mw
At ambient temperature of 55° C	40 max.	mw
At ambient temperature of 71° C	20 max.	mw
AMBIENT TEMPERATURE (During operation)	71 max.	°C
STORAGE-TEMPERATURE RANGE	-65 to +85	°C

World Radio History

RCA

2N371

DRIFT TRANSISTOR

Characteristics, *At Ambient Temperature of 25° C:*

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage.	-12	volts
DC Emitter Current.	1	ma
Current Transfer Ratio (α_f)■.	0.984	
Frequency at which the current transfer ratio drops to 0.707 times it value at 1 kc	30	Mc

Typical Operation:

The 2N371 can produce an oscillator-injection voltage which will provide optimum mixing in a typical rf tuner circuit.

In an oscillator stage utilizing the 2N371 and operating at 22 Mc, if the collector-supply voltage drops from -12 to -8 volts, the frequency provided by this stage will deviate from 22 Mc by less than 7 kc.

■ Measured at 1 kc.

OPERATING CONSIDERATIONS

The 2N371 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N371 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N371, the temperature of the solder should not exceed 230° C for a maximum immersion period of 10 seconds.

DIMENSIONAL OUTLINE and CURVES
shown for Type 2N370 also apply to the 2N371

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RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

2N372

DRIFT TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For radio-frequency mixer applications

GENERAL DATA

Electrical:

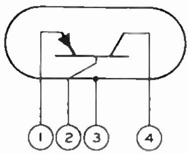
Maximum DC Collector Current for dc collector-to-base voltage of −12 volts with emitter open, and at ambient temperature of 25° C	−20	μa
Maximum DC Emitter Current for dc emitter-to-base voltage of −0.5 volt with collector open, and at ambient temperature of 25° C	−50	μa
Interlead Capacitance between collector and base leads with interlead shield connected to ground and all leads cut to 5/16"	0.003	μμf

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads).	0.375"
Maximum Diameter	0.360"
Case	Metal
Envelope Seals	Hermetic
Leads, Flexible.	4
Minimum length	1.5"
Orientation and diameter	*See Dimensional Outline*

Lead 1 – Emitter

Lead 2 – Base



Lead 3 – Interlead Shield, Metal Case

Lead 4 – Collector

RADIO-FREQUENCY MIXER

Maximum Ratings, ***Absolute Values:***

DC COLLECTOR-TO-BASE VOLTAGE	−20 max.	volts
DC EMITTER-TO-BASE VOLTAGE	−0.5 max.	volt
DC COLLECTOR CURRENT	−10 max.	ma
DC EMITTER CURRENT	10 max.	ma
COLLECTOR DISSIPATION:		
At ambient temperature of 25° C.	80 max.	mw
At ambient temperature of 55° C.	40 max.	mw
At ambient temperature of 71° C.	20 max.	mw
AMBIENT TEMPERATURE (During operation) . .	71 max.	°C
STORAGE-TEMPERATURE RANGE.	−65 to +85	°C

TENTATIVE DATA

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RCA

2N372

DRIFT TRANSISTOR

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-12	volts
DC Emitter Current	1	ma
Current Transfer Ratio (α_f)■	-60	
Frequency for unity power amplification	132	Mc

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-12	volts
DC Emitter Current	1	ma
Current Transfer Ratio (α_f)■	0.984	
Frequency at which the current transfer ratio drops to 0.707 times its value at 1 kc.	30	Mc

Typical Operation, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

At frequency of	*1.5*	*10*	*20*	*Mc*
DC Collector-to-Emitter Voltage	-12	-12	-12	volts
DC Emitter Current	1	1	1	ma
Input Resistance	1750	200	100	ohms
Output Resistance	180000	18000	11000	ohms
Maximum Power Gain▲	50.5	26.2	17	db
Maximum Useful Power Gain (In an unneutralized circuit)	31	17.6	12.5	db
Intrinsic Transconductance	37800	21400	13700	μmhos
Collector Transition Capacitance	1.7	1.7	1.7	μμf

■ Measured at 1 kc.

▲ Measured in a single-tuned unilateralized circuit matched to the generator and load impedances for maximum transfer of power. Transformer insertion losses not included.

OPERATING CONSIDERATIONS

The 2N372 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N372 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N372, the temperature of the solder should not exceed 230° C for a maximum immersion period of 10 seconds.

DIMENSIONAL OUTLINE and CURVES
shown for Type 2N370 also apply to the 2N372

TENTATIVE DATA

World Radio History

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

For Industrial and Military Applications

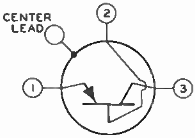
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.405"
Maximum Diameter	0.240"
Dimensional Outline	JEDEC No. TO-44
Case	Metal
Seals	Hermetic
Leads, Flexible	4
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter
Center Lead – Interlead Shield, Case



Lead 2 – Base
Lead 3 – Collector (Adjacent to red dot on side of case)

INDUSTRIAL SERVICE

Such as in rf, if, oscillator, mixer, converter, and low-level video-amplifier circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE (Emitter open)	-40 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE (Base-to-emitter volts = 0.5)	-40 max.	volts
EMITTER-TO-BASE VOLTAGE	-0.5 max.	volt
COLLECTOR CURRENT	-10 max.	ma
EMITTER CURRENT	10 max.	ma
TRANSISTOR DISSIPATION:[a]		
At ambient temperature of 25° C for operation in free air	120 max.	mw
At case temperature of 25° C for operation with heat sink	240 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +100	°C

Typical Operation:

In accompanying video-amplifier circuit with ambient temperature range of -65 to +55° C

DC Collector-to-Emitter Voltage	-12	volts
DC Emitter Current	5.8	ma
Source Impedance	150	ohms
Capacitive Load	16	μμf

World Radio History

Frequency-Response Range:		
Minimum.	20	cps
Maximum.	10	Mc
Pulse-Rise Time.	0.035	μsec
Voltage Gain	26	db
Maximum Peak-to-Peak Output Voltage.	20	volts

[a] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Voltage values are given with respect to base unless otherwise specified. Ambient temperature = 25° C.

		Min.	Typical	Max.	
DC Collector Breakdown Voltage for dc collector μa = −50, dc emitter ma. = 0.	BV_{CBO}	−40	−80	−	volts
Punch-Through Voltage for dc emitter volts = −0.5.	V_P	−40	−80	−	volts
DC Collector-Cutoff Current for dc collector volts = −12, dc emitter ma. = 0. .	I_{CBO}	−	−4	−12	μa
DC Emitter-Cutoff Current for dc emitter volts = −0.5, collector open . . .	I_{EBO}	−	−1	−12	μa
Small-Signal Current Transfer Ratio for dc collector-to-emitter volts = −12, dc emitter ma. = 1.5, signal frequency of 1 kc .	h_{fe}	20	60	175	
→ Alpha-Cutoff Frequency for dc collector volts = −12, dc emitter ma. = 1.5 . . .	f_{ab}	−	100	−	Mc
Input Resistance:[b]	R_{in}				
With dc collector volts = −12, dc emitter ma. = 1.5, signal frequency of 50 Mc		−	30	−	ohms
With dc collector-to-emitter volts = −12, dc emitter ma. = 1.5, signal frequency of 30 Mc .		−	50	−	ohms
With dc collector-to-emitter volts = −12, dc emitter ma. = 1.5, signal frequency of 12.5 Mc.		−	250	−	ohms
Output Resistance:[c]	R_{out}				
With dc collector volts = −12, dc emitter ma. = 1.5, signal frequency of 50 Mc.		−	5000	−	ohms

→ Indicates a change.

World Radio History

With dc collector-to-emitter volts = -12, dc emitter ma. = 1.5, signal frequency of 30 Mc.		-	5000	-	ohms
With dc collector-to-emitter volts = -12, dc emitter ma. = 1.5, signal frequency of 12.5 Mc.		-	16000	-	ohms
Collector-to-Base Capacitance for dc collector volts = -12, dc emitter ma. = 0.	C_{ob}	-	2	3	$\mu\mu$f
Power Gain:[d]	PG				
With dc collector volts = -12, dc emitter ma. = 1.5, signal frequency of 50 Mc. . . .		15	18	21	db
With dc collector-to-emitter volts = -12, dc emitter ma. = 1.5, signal frequency of 30 Mc.		16	20	24	db
With dc collector-to-emitter volts = -12, dc emitter ma. = 1.5, signal frequency of 12.5 Mc.		24	28	32	db
Thermal Resistance:	R_T				
Between junction and case		-	-	0.31	°C/watt
Between junction and free air		-	-	0.62	°C/watt

[b] AC output-circuit shorted.

[c] AC input-circuit shorted.

[d] Measured in a single-tuned unilateralized circuit matched to the generator and load impedance for maximum transfer of power (transformer-insertion losses not included).

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

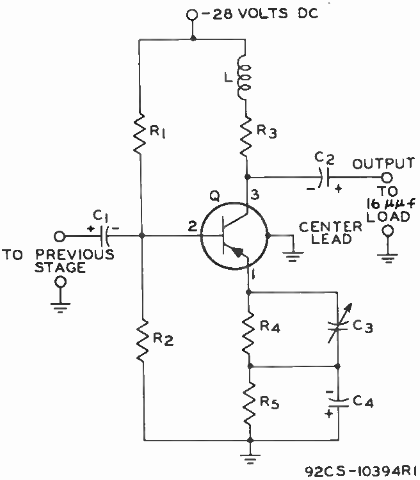
The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

World Radio History

When dip soldering is employed in the assembly of printed circuitry using this transistor, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds.

This transistor utilizes shielding to minimize interlead capacitance and coupling to adjacent circuit components. This shielding is provided by a fourth lead which is internally connected to the case. For optimum performance, it is recommended that this lead be connected to the chassis ground.

VIDEO-AMPLIFIER CIRCUIT



C_1: 25 μf, 12 volts
C_2: 25 μf, 25 volts
C_3: 100 to 300 μμf (variable)
C_4: 100 μf, 12 volts
L: 30 μh
Q: Transistor type 2N384
R_1: 20,000 ohms, 0.25 watt
R_2: 3600 ohms, 0.25 watt
R_3: 2000 ohms, 0.25 watt
R_4: 62 ohms, 0.25 watt
R_5: 620 ohms, 0.25 watt

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World Radio History

Transistor

GERMANIUM P-N-P ALLOY-JUNCTION TYPE

For "On-Off" Control Applications
in Industrial and Military Equipment

The 2N398B is a Direct Replacement for Type 2N398

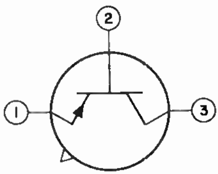
GENERAL DATA

Mechanical:

Dimensions. . . . . See *Outline TO-5* in General Section

Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter
Lead 2 – Base



Lead 3 – Collector

SWITCHING SERVICE

For direct "on-off" control of high-voltage, low-power devices such as neon indicators, relays, incandescent-lamp indicators, and indicating counters of electronic computers

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:			
With emitter open	V_{CBO}	-105 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:			
With base short-circuited to emitter.	V_{CES}	-105 max.	volts
EMITTER-TO-BASE VOLTAGE:			
With collector open	V_{EBO}	-50 max.	volts
COLLECTOR CURRENT	I_C	-100 max.	ma
EMITTER CURRENT	I_E	100 max.	ma
TRANSISTOR DISSIPATION:	P_T		
At free-air temperatures:			
From -65° to 25° C.		50 max.	mw
At 55° C.		10 max.	mw
TEMPERATURE RANGE:			
Operating	T_{OPR}	-65 to 55	°C
Storage	T_{STG}	-65 to 85	°C
LEAD TEMPERATURE:[a]			
For 10 seconds maximum.	T_L	230 max.	°C

[a] Measured 1/16" ± 1/32" along lead down from seating plane.

← Indicates a change.

World Radio History

ELECTRICAL CHARACTERISTICS

Free-air temperature = 25° C

		Min.	Max.	
DC Collector-to-Emitter Reach-Through Voltage[b]	V_{RT}	-105	-	volts
DC Collector-to-Base Breakdown Voltage for dc collector ma. = -0.05, emitter current = 0	BV_{CBO}	-105	-	volts
DC Emitter-to-Base Breakdown Voltage for dc emitter ma. = -0.05, collector current = 0	BV_{EBO}	-50	-	volts
DC Base-to-Emitter Saturation Voltage for dc collector ma. = -5, dc base ma. = -0.25	$V_{BE(sat)}$	-	-0.4	volt
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = -5, dc base ma. = -0.25	$V_{CE(sat)}$	-	-0.35	volt
DC Collector-Cutoff Current: For emitter current = 0, dc collector-to-base volts =	I_{CBO}			
-2.5		-	-14	μa
-150		-	-50	μa
→ DC Collector Current for dc collector-to-emitter voltage = -105, base short-circuited to emitter	I_{CES}	-	-600	μa
DC Emitter-Cutoff Current for dc emitter-to-base volts = -50, collector current = 0	I_{EBO}	-	-50	μa
DC Forward-Current Transfer Ratio for dc collector-to-emitter volts = -0.35, dc collector ma. = -5	h_{FE}	20	-	

[b] The dc collector-to-emitter reach-through voltage is determined by connecting a high-impedance voltmeter (11 megohms or greater) between the emitter and base, and measuring the collector-to-base voltage which causes the emitter to assume an emitter-to-base floating voltage of -1 volt.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the seating plane provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the seals of the leads and damage the transistor.

→ Indicates a change.

World Radio History

2N398

2N398
JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For high-voltage "on-off" control applications

GENERAL DATA

Mechanical:

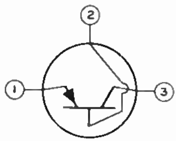
Operating Position	Any
Maximum Length (Excluding flexible leads)	0.250"
Maximum Diameter	0.360"
Case	Metal
Envelope Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	*See Dimensional Outline*

BOTTOM VIEW

Lead 1 – Emitter

Lead 2 – Base

Lead 3 – Collector



SWITCHING SERVICE

Maximum Ratings, ***Absolute Values:***

COLLECTOR-TO-BASE VOLTAGE	–105 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE	–105 max.	volts
EMITTER-TO-BASE VOLTAGE	–50 max.	volts
COLLECTOR CURRENT	–100 max.	ma
EMITTER CURRENT	100 max.	ma
TRANSISTOR DISSIPATION:		
At ambient temperature of 25° C.	50 max.	mw
At ambient temperature of 55° C.	10 max.	mw
AMBIENT TEMPERATURE (During operation)	55 max.	°C
STORAGE-TEMPERATURE RANGE	–65 to +85	°C

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Voltage values are given with respect to the base unless otherwise specified. Ambient temperature = 25° C.

	Typical Values	*Range Values Min.*	*Max.*	
DC Collector Breakdown Voltage (BV_{CBO}) with dc collector current (I_C) = –50 μa, dc emitter current (I_E) = 0	–150	–105	-	volts
DC Collector Cutoff Current (I_{CBO}) with dc collector voltage (V_C) = –2.5 volts, dc emitter current (I_E) = 0.	–6	-	–14	μa

SEMICONDUCTOR DIVISION

RADIO CORPORATION OF AMERICA SOMERVILLE, NEW JERSEY

World Radio History

RCA

2N398

JUNCTION TRANSISTOR

	Typical Values	Range Values Min.	Range Values Max.	
DC Emitter Breakdown Voltage (BV_{EBO}) with dc emitter current (I_E) = -50 μa, dc collector current (I_C) = 0 .	-75	-50	-	volts
DC Collector-to-Emitter (Punch-Through) Voltage* . .	-150	-105	-	volts
DC Collector-to-Emitter Saturation Voltage (V_{CE}) with dc collector current (I_C) = -5 ma., dc base current (I_B) = 0.25 ma.. . .	-0.20	-	-0.35	volt
DC Base-to-Emitter Saturation Voltage (V_{BE}) with dc collector current (I_C) = -5 ma., dc base current (I_B) = -0.25 ma.	-0.30	-	-0.40	volt
Large-Signal DC Current Transfer Ratio (α_{fe}) with dc collector current (I_C) = -5 ma., dc collector-to-emitter voltage (V_{CE}) = -0.35 volt	60	20	-	

* The dc collector-to-emitter (punch-through) voltage is determined by connecting a high-impedance voltmeter (11 megohms or greater) between the emitter and base and measuring the collector-to-base voltage which causes the emitter to assume an emitter-to-base floating voltage of -1 volt.

OPERATING CONSIDERATIONS

The 2N398 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

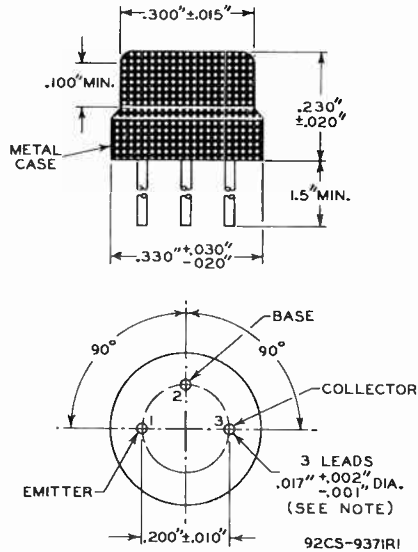
The *flexible leads* of the 2N398 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N398, the temperature of the solder should not exceed 230° C for a maximum immersion period of 10 seconds.

RCA

2N398

JUNCTION TRANSISTOR



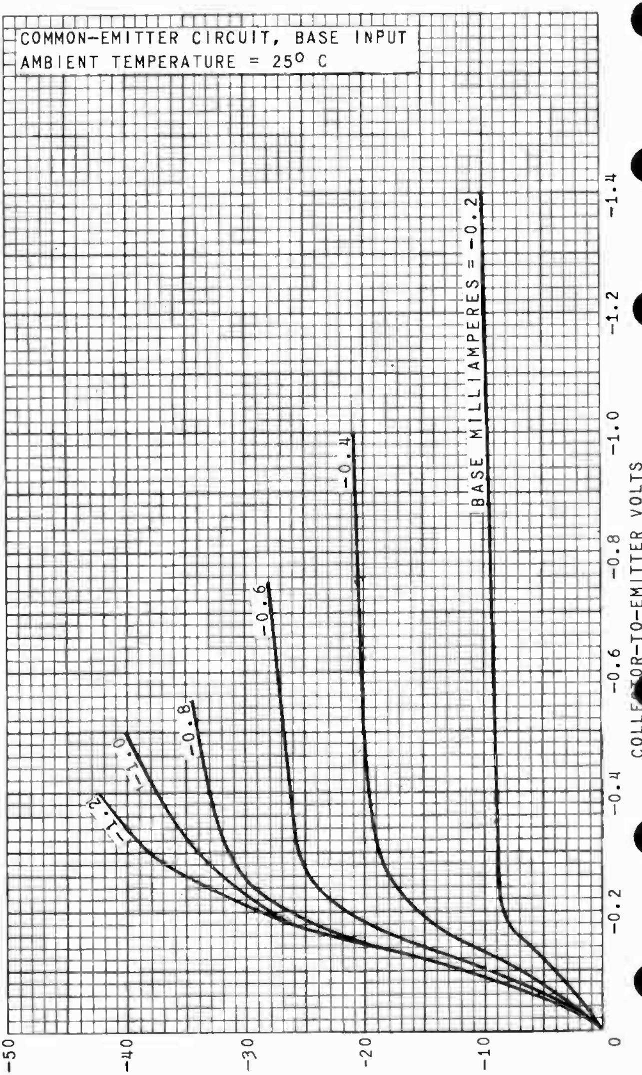
NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE PLANE OF THE ACTUAL BOTTOM OF THE BASE. BETWEEN 0.250" AND 1.50", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

2N398

2N398
AVERAGE COLLECTOR CHARACTERISTICS



92CS-9382

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

Transistor

GERMANIUM P-N-P ALLOY-JUNCTION TYPE

For "On-Off" Control Applications
in Industrial and Military Equipment

The 2N398B is a Direct Replacement for Type 2N398A

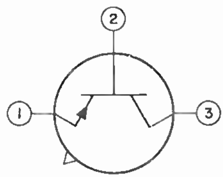
GENERAL DATA

Mechanical:

Dimensions. . . . . See *Outline TO-5* in General Section

Terminal Diagram: BOTTOM VIEW ←

Lead 1 - Emitter
Lead 2 - Base



Lead 3 - Collector

SWITCHING SERVICE

For direct "on-off" control of high-voltage, low-power devices such as neon indicators, relays, incandescent-lamp indicators, and indicating counters of electronic computers

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:			
With emitter open	V_{CBO}	-105 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:			
With base short-circuited to emitter.	V_{CES}	-105 max.	volts ←
EMITTER-TO-BASE VOLTAGE:			
With collector open	V_{EBO}	-50 max.	volts
COLLECTOR CURRENT	I_C	-200 max.	ma
EMITTER CURRENT	I_E	200 max.	ma
TRANSISTOR DISSIPATION:	P_T		
At free-air temperatures:			
From -65° to 25° C.		150 max.	mw
Above 25° C		*Derate linearly 2*	*mw/$^{\circ}$C*
TEMPERATURE RANGE:			
Operating	T_{OPR}	-65 to 100	$^{\circ}$C
Storage	T_{STG}	-65 to 100	$^{\circ}$C
LEAD TEMPERATURE:[a]			
For 3 seconds maximum	T_L	250 max.	$^{\circ}$C

[a] Measured 1/16" ± 1/32" along lead down from seating plane.

← Indicates a change.

World Radio History

ELECTRICAL CHARACTERISTICS

Free-air temperature = 25° C

		Min.	Max.	
DC Collector-to-Emitter Reach-Through Voltage[b]	V_{RT}	-105	-	volts
DC Collector-to-Base Breakdown Voltage for dc collector ma. = -0.05, emitter current = 0	BV_{CBO}	-105	-	volts
DC Emitter-to-Base Breakdown Voltage for dc emitter ma. = -0.05, collector current = 0	BV_{EBO}	-50	-	volts
DC Base-to-Emitter Saturation Voltage for dc collector ma. = -5, dc base ma. = -0.25	$V_{BE(sat)}$	-	-0.4	volt
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = -5, dc base ma. = -0.25	$V_{CE(sat)}$	-	-0.35	volt
DC Collector-Cutoff Current for emitter current = 0, dc collector-to-base volts =	I_{CBO}			
-2.5		-	-14	μa
-150		-	-50	μa
→ DC Collector Current for dc collector-to-emitter voltage = -105, base short-circuited to emitter	I_{CES}	-	-600	μa
DC Emitter-Cutoff Current for dc emitter-to-base volts = -50, collector current = 0	I_{EBO}	-	-50	μa
DC Forward-Current Transfer Ratio for dc collector-to-emitter volts = -0.35, dc collector ma. = -5	h_{FE}	20	-	
Small-Signal Short-Circuit Forward-Current Transfer Ratio for dc collector-to-emitter volts = -6, dc collector ma. = -1, frequency (kc) = 1	h_{fe}	20	-	
Thermal Resistance: Junction-to-free air	θ_{JFA}	-	0.5	°C/mw

[b] The dc collector-to-emitter reach-through voltage is determined by connecting a high-impedance voltmeter (11 megohms or greater) between the emitter and base, and measuring the collector-to-base voltage which causes the emitter to assume an emitter-to-base floating voltage of -1 volt.

→ Indicates a change.

World Radio History

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the seating plane provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the seals of the leads and damage the transistor.

World Radio History

World Radio History

Transistor

GERMANIUM P-N-P ALLOY-JUNCTION TYPE
For "On-Off" Control Applications

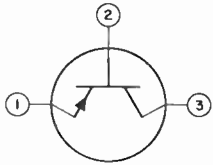
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No. TO-5
Case	Welded, Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector



SWITCHING SERVICE

For direct high-voltage control of "on-off" devices such as neon indicators, relays, incandescent-lamp indicators, and indicating counters of electronic computers

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:		
With emitter open	-105 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With base open	-105 max.	volts
EMITTER-TO-BASE VOLTAGE:		
With collector open	-50 max.	volts
COLLECTOR CURRENT	-200 max.	ma
EMITTER CURRENT	200 max.	ma
TRANSISTOR DISSIPATION:[a]		
At free-air temperature of 25° C or below	150 max.	mw
FREE-AIR TEMPERATURE RANGE:		
Operating and storage	-65 to +100	°C
LEAD TEMPERATURE:		
For 3 seconds maximum[b]	250 max.	°C

[a] See accompanying *Rating Chart*.
[b] Measured 1/16" ± 1/32" down from seating plane.

World Radio History

2N398A

ELECTRICAL CHARACTERISTICS

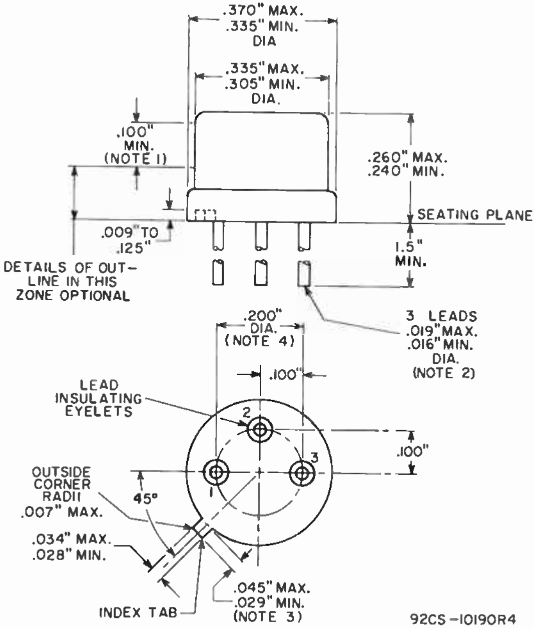
Voltage values are given with respect to base unless otherwise specified. Free-air temperature of 25° C.

		Min.	Max.	
DC Collector-to-Emitter Reach-Through Voltage[c]	V_{RT}	-105	-	volts
DC Base-to-Emitter Saturation Voltage for dc collector ma. = -5, dc base ma. = 0.25	$V_{BE(sat)}$	-	-0.4	volt
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = -5, dc base ma. = -0.25	$V_{CE(sat)}$	-	-0.35	volt
DC Collector-Cutoff Current for dc emitter ma. = 0, dc collector-to-base volts =	I_{CBO}			
-2.5		-	-14	μa
-105		-	-50	μa
DC Emitter-Cutoff Current for dc emitter volts = -50, dc collector ma. = 0	I_{EBO}	-	-50	μa
DC Current Transfer Ratio for dc collector-to-emitter volts = -0.35, dc collector ma. = -5	h_{FE}	20	-	
Small-Signal Current Transfer Ratio for dc collector-to-emitter volts = -6, dc collector ma. = -1	h_{fe}	20	-	
Thermal Resistance: Junction-to-free air	θ_{J-FA}	-	0.5	°C/mw

[c] The dc collector-to-emitter reach-through voltage is determined by connecting a high-impedance voltmeter (11 megohms or greater) between the emitter and base, and measuring the collector-to-base voltage which causes the emitter to assume an emitter-to-base floating voltage of -1 volt.

World Radio History

JEDEC No. TO-5



92CS-10190R4

NOTE 1: THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE VARIATION IN ACTUAL DIAMETER WITHIN THE ZONE SHALL NOT EXCEED 0.010".

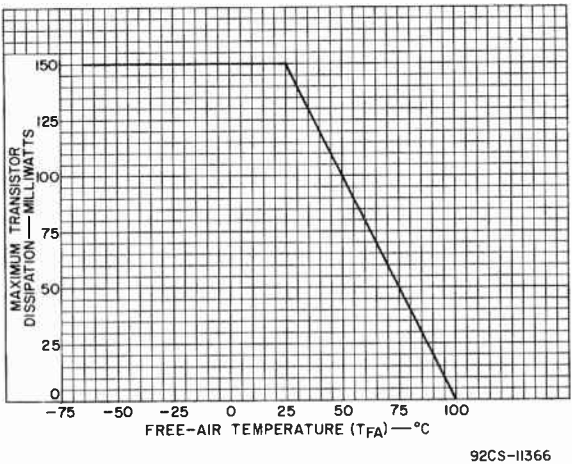
NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE SEATING PLANE. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 3: MEASURED FROM MAXIMUM DIAMETER OF THE ACTUAL DEVICE.

NOTE 4: LEADS HAVING MAXIMUM DIAMETER (0.019") MEASURED IN GAUGING PLANE OF 0.054" + 0.001" - 0.000" BELOW THE SEATING PLANE OF THE DEVICE SHALL BE WITHIN 0.007" OF THEIR TRUE LOCATIONS RELATIVE TO A MAXIMUM-WIDTH TAB.

World Radio History

RATING CHART



World Radio History

2N398B

Transistor

GERMANIUM P-N-P ALLOY-JUNCTION TYPE

For "On-Off" Control Applications in Industrial and Military Equipment

The 2N398B is Unilaterally Interchangeable with Types 2N398 and 2N398A

GENERAL DATA

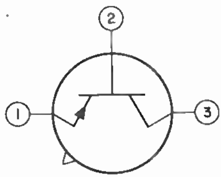
Mechanical:

Dimensions. . . . . See *Outline TO-5* in General Section

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector

SWITCHING SERVICE

For direct "on-off" control of high-voltage, low-power devices such as neon indicators, relays, incandescent-lamp indicators, and indicating counters of electronic computers

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:			
With emitter open	V_{CBO}	-105 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:			
With base short-circuited to emitter.	V_{CES}	-105 max.	volts
EMITTER-TO-BASE VOLTAGE:			
With collector open	V_{EBO}	-75 max.	volts
COLLECTOR CURRENT	I_C	-200 max.	ma
EMITTER CURRENT	I_E	200 max.	ma
TRANSISTOR DISSIPATION:	P_T		
At free-air temperatures:			
From -65° to 25° C.		250 max.	mw
Above 25° C		*Derate linearly 3.33*	*mw/°C*
TEMPERATURE RANGE:			
Operating	T_{OPR}	-65 to 100	°C
Storage	T_{STG}	-65 to 100	°C
LEAD TEMPERATURE:[a]			
For 10 seconds maximum.	T_L	250 max.	°C

[a] Measured 1/16" ± 1/32" along lead down from seating plane.

World Radio History

2N398B

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, free-air temperature = 25° C

		Min.	*Max.*	
DC Collector-to-Emitter Reach-Through Voltage[b]	V_{RT}	-105	-	volts
DC Collector-to-Base Breakdown Voltage for dc collector ma. = -0.025, emitter current = 0	BV_{CBO}	-105	-	volts
DC Emitter-to-Base Breakdown Voltage for dc emitter ma. = -0.05, collector current = 0	BV_{EBO}	-75	-	volts
DC Base-to-Emitter Saturation Voltage for dc collector ma. = -5, dc base ma. = -0.25	$V_{BE(sat)}$	-	-0.3	volt
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = -5, dc base ma. = -0.25	$V_{CE(sat)}$	-	-0.25	volt
DC Collector-Cutoff Current:	I_{CBO}			
With dc collector-to-base volts = -2.5, emitter current = 0		-	-6	μa
With dc collector-to-base volts = -105, emitter current = 0, free-air temperature =				
25° C.		-	-25	μa
71° C.		-	-300	μa
DC Collector Current for dc collector-to-emitter voltage = -105, base short-circuited to emitter	I_{CES}	-	-300	μa
DC Collector Current for dc collector-to-emitter volts = -55, base-to-emitter resistance (ohms) = 10000	I_{CER}	-	-300	μa
DC Emitter-Cutoff Current for collector current = 0, dc emitter-to-base volts =	I_{EBO}			
-2.5		-	-6	μa
-75		-	-50	μa
DC Forward-Current Transfer Ratio for dc collector-to-emitter volts = -0.25, dc collector ma. = -5	h_{FE}	20	-	
Small-Signal Short-Circuit Forward-Current Transfer Ratio for dc collector-to-emitter volts = -6, dc collector ma. = -1, frequency (kc) = 1	h_{fe}	40	-	

[b] The dc collector-to-emitter reach-through voltage is determined by connecting a high-impedance voltmeter (11 megohms or greater) between the emitter and base, and measuring the collector-to-base voltage which causes the emitter to assume an emitter-to-base floating voltage of -1 volt.

World Radio History

		Min.	Max.	
Small-Signal Short-Circuit Forward-Current Transfer Ratio Cutoff Frequency for dc collector-to-base volts = -6, dc emitter ma. = 1	f_{hfb}	1	-	Mc
Thermal Resistance: Junction-to-free air.	θ_{JFA}	-	0.3	°C/mw

PERFORMANCE TESTS AND SPECIAL RATINGS

This transistor type is tested in strict accordance with rigid procedures conforming to the environmental, life, and mechanical requirements of Military Specification MIL-S-19500B.

Moisture Resistance:

This test is performed on a sample lot of transistors from each production run. The transistors are subjected to temperature cycling during this moisture-resistance test to provide alternate periods of condensation and drying. Increased effectiveness is also obtained by the use of a high temperature which intensifies the effects of humidity. At the end of the test, the transistors in the sample lot are required to meet the limits for BV_{CBO}, BV_{EBO}, and h_{FE} as shown under *Characteristics Endpoint Values*.

Salt Atmosphere:

This test is performed on a sample lot of transistors from each production run. The transistors are placed in a test chamber through which a salt atmosphere fog (at a temperature of 35° C) is passed for 24 + 2 - 0 hours. The fog concentration and velocity are adjusted so that the rate of salt deposition in the test area is 10000 to 50000 mg/meter²/day. At the end of the test, the transistors in the sample lot are required to meet the limits for BV_{CBO}, BV_{EBO}, and h_{FE} as shown under *Characteristics Endpoint Values*.

Temperature Cycling:

Cycles of Intermittent Operation. . . . . . 10 min. cycles

This test is performed on a sample lot of transistors from each production run. The transistors undergo 10 temperature cycles from -65 ± 3° C to + 100 ± 3° C. At the end of the test, the transistors in the sample lot are required to meet the established limits for I_{CBO} and h_{FE} as shown under *Characteristics Endpoint Values*.

Thermal Shock:

Temperature Extremes. . . . . +100 to 0 °C

This test is performed on a sample lot of transistors from each production run. The transistors are completely immersed in water at a high temperature (100 ± 3° C) for not less than 15 seconds and then are immediately plunged into water at a low temperature (0 ± 3° C). At the end of the test, the transistors in the sample lot are required to meet the limits for I_{CBO} and h_{FE} as shown under *Characteristics Endpoint Values*.

World Radio History

Operating Life Performance:

This test is performed on a sample lot of transistors from each production run. The transistors are operated at a transistor dissipation of 150 mw (with $V_{CC} = -100$ v) in the accompanying *Operating-Life Test Circuit*, and at a free-air temperature of 25 ± 3° C. At the end of 1000 hours, the transistors in the sample lot are required to meet the limits for I_{CBO}, h_{FE}, BV_{CBO}, and BV_{EBO} as shown under *Characteristics Endpoint Values*.

Storage Life Performance (High Temperature):

This test is performed on a sample lot of transistors from each production run. The transistors are placed in a chamber at a temperature of 100 ± 3° C for a period of 1000 hours. At the end of 1000 hours, the transistors in the sample lot are required to meet the limits for I_{CBO}, h_{FE}, BV_{CBO}, and BV_{EBO} as shown under *Characteristics Endpoint Values*.

Constant Acceleration:

Centrifugal Acceleration. . . . . 10000 max. g

This test is performed on a sample lot of transistors from each production run. The transistors are rigidly mounted with suitable protection for the leads. A centrifugal acceleration of 10000 g is applied to the transistors for one minute in each of the orientations X_1, Y_1, and Z_1. The acceleration is increased to 10000 g in not less than 20 seconds and then decreased gradually to zero in not less than 20 seconds. At the end of the test, the transistors in the sample lot are required to meet the limits for BV_{CBO}, BV_{EBO}, and h_{FE} as shown under *Characteristics Endpoint Values*.

Lead Fatigue:

Two leads of each transistor in the sample lot are subjected to a pull of 16 ± 1 ounces for three 90° arcs of the case (movement of the case, without torsion, to a position perpendicular to the pull axis and return to normal). All arcs on a single lead are in the same direction and in the same plane. The lead under test is restricted so that the bend starts 3/32 ± 1/32 inch from the case. Breakage of one or more of the leads under these test conditions constitutes failure.

Shock:

Impact Acceleration . . . . 1500 max. g

This test is performed on a sample lot of transistors from each production run. The transistors are rigidly mounted with suitable protection for the leads. An impact of 1500 g maximum is applied to the transistors by means of an impact testing machine. During this test, the transistors are subjected to five blows each with an acceleration of 1500 g and a duration of approximately 0.5 msec, in each of the orientations X_1, Y_1, Y_2, and Z_1. At the end of the test, the transistors in the sample lot are required to meet the limits for BV_{CBO}, BV_{EBO}, and h_{FE} as shown under *Characteristics Endpoint Values*.

World Radio History

Solderability:

This test is performed on a sample lot of transistors from each production run. The transistor leads are immersed in a flux composed of 25% (by weight) water-white resin and 75% isopropyl alcohol (90%) for a minimum of 5 seconds and then are dipped into molten solder (60% tin, and 40% lead, at 230 ± 5° C) for 5 ± 1/2 seconds. At the end of the test, the transistors in the sample lot are required to meet the limits for BV_{CBO}, BV_{EBO}, and h_{FE} as shown under *Characteristics Endpoint Values*.

Variable-Frequency Vibration Performance:

100 to 2000 cps at a Constant Peak Acceleration of 20 g

This test is performed on a sample lot of transistors from each production run. The transistors are rigidly mounted on a vibration platform and subjected to vibration in each of the orientations X_1, Y_1, and Z_1 over a frequency range of 100 to 2000 cycles per second with approximately logarithmic variation of frequency and a constant peak acceleration of 20 g. The entire frequency range from 100 to 2000 cycles per second is covered in not less than four minutes. At the end of the test, the transistors in the sample lot are required to meet the limits for BV_{CBO}, BV_{EBO}, and h_{FE} as shown under *Characteristics Endpoint Values*.

Vibration Fatigue:

Vibrational Acceleration . . . . 20 max. g

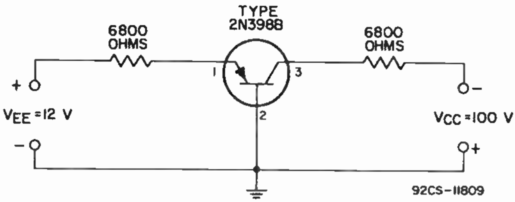
This test is performed on a sample lot of transistors from each production run. The transistors are supplied with the required test voltages while rigidly mounted on a vibration platform. The transistors are then subjected to a simple harmonic motion at any single frequency between 40 and 100 cycles per second with a constant peak acceleration of 20 g. The vibration is applied for 32 hours minimum in each of the orientations X_1, Y_1, and Z_1 (for a total time of 96 hours minimum). At the end of the test, the transistors are required to meet the limits for I_{CBO} and h_{FE} as shown under *Characteristics Endpoint Values*.

CHARACTERISTICS ENDPOINT VALUES

Characteristic	Test Conditions	LIMITS Min.	LIMITS Max.	Units
I_{CBO}	V_{CB} = -2.5 volts I_E = 0	-	-10	μa
h_{FE}	V_{CE} = -0.25 volt I_C = -5 ma	15.5	-	
BV_{CBO}	I_C = -25 μa I_E = 0	-90	-	volts
BV_{EBO}	I_E = -50 μa I_C = 0	-60	-	volts

World Radio History

OPERATING-LIFE TEST CIRCUIT



OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the seating plane provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the seals of the leads and damage the transistor.

World Radio History

Transistor

GERMANIUM P-N-P ALLOY-JUNCTION TYPE
For Computer Switching Applications

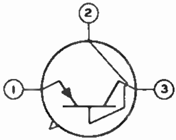
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No.TO-5
Case	Welded, Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter
Lead 2 – Base



Lead 3 – Collector

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	-25 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With dc emitter-to-base volts = -1	-24 max.	volts
EMITTER-TO-BASE VOLTAGE	-12 max.	volts
COLLECTOR CURRENT	-100 max.	ma
EMITTER CURRENT	100 max.	ma
TRANSISTOR DISSIPATION:[a]		
At ambient temperature of 25° C or below	150 max.	mw
At ambient temperature of 55° C	75 max.	mw
At ambient temperature of 71° C	35 max.	mw
AMBIENT TEMPERATURE RANGE:		
Operating	-65 to +85	°C
Storage	-65 to +100	°C
LEAD TEMPERATURE:		
For 10 seconds maximum	255 max.	°C

[a] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

← Indicates a change.

World Radio History

→ ## ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and at ambient temperature of 25° C unless otherwise specified

		Min.	Typical	Max.	
DC Collector Breakdown Voltage for dc collector ma. = -0.02, dc emitter ma. = 0	BV_{CBO}	-25	-40	-	volts
DC Punch-Through Voltage for dc emitter volts = -1 .	V_P	-24	-40	-	volts
DC Emitter Breakdown Voltage for dc emitter ma. = -0.02, dc collector ma. = 0.	BV_{EBO}	-12	-35	-	volts
DC Collector-to-Emitter Saturation Voltage:	$V_{CE(sat)}$				
With dc collector ma. = -12, dc base ma. = -0.4. .		-	-0.1	-0.15	volt
With dc collector ma. = -24, dc base ma. = -1 . .		-	-0.12	-0.2	volt
DC Base-to-Emitter Saturation Voltage:	$V_{BE(sat)}$				
With dc collector ma. = -12, dc base ma. = -0.4 .		-	-0.25	-0.35	volt
With dc collector ma. = -24, dc base ma. = -1 . .		-	-0.32	-0.4	volt
DC Collector-Cutoff Current for dc collector volts = -12, dc emitter ma. = 0, ambient temperature =	I_{CBO}				
25° C		-	-2	-5	μa
80° C		-	-45	-90	μa
DC Emitter-Cutoff Current for dc emitter volts = -2.5, dc collector ma. = 0.	I_{EBO}	-	-1	-	μa
Collector-to-Base Capacitance for dc collector volts = -6, dc collector ma. = 0	C_{ob}	-	12	20	μμf

→ Indicates a change.

World Radio History

DC Current Transfer Ratio:	h_{FE}				
With dc collector-to-emitter volts = -0.2, dc collector ma. = -24. . . .		24	40	-	
With dc collector-to-emitter volts = -0.15, dc collector ma. = -12. . . .		30	50	-	
Alpha-Cutoff Frequency for dc collector volts = -6, dc collector ma. = -1. . . .	$f_{\alpha b}$	4	13	-	Mc
Stored Base Charge for dc collector ma. = -10, dc base ma. = -1	Q_S	-	800	1400	$\mu\mu$coulombs
Thermal Time Constant.	τ_1	-	10	-	msec
Thermal Resistance:					
Junction-to-free air	R_T	-	-	500	^{o}C/watt

PERFORMANCE TESTS ←

This transistor type is tested in accordance with Military Specification MIL-S-19500B.

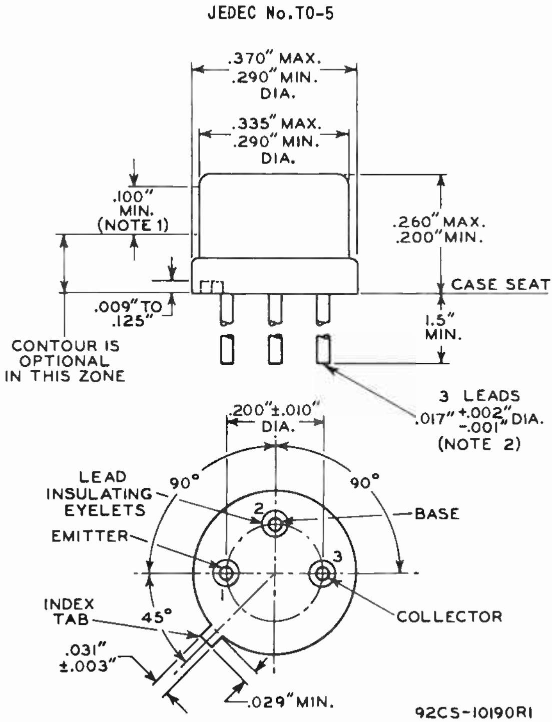
OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the seals of the leads and damage the transistor.

← Indicates a change.

World Radio History

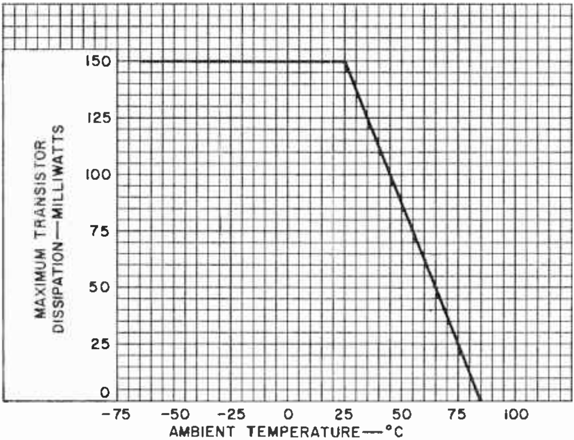


NOTE 1: THE DIAMETER IN THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE TOTAL VARIATION IN ACTUAL DIAMETER FROM THE TRUE DIAMETER, DUE TO TAPER AND OUT OF ROUND WITHIN THIS ZONE, WILL NOT EXCEED 0.010".

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

worldradiohistory

RATING CHART

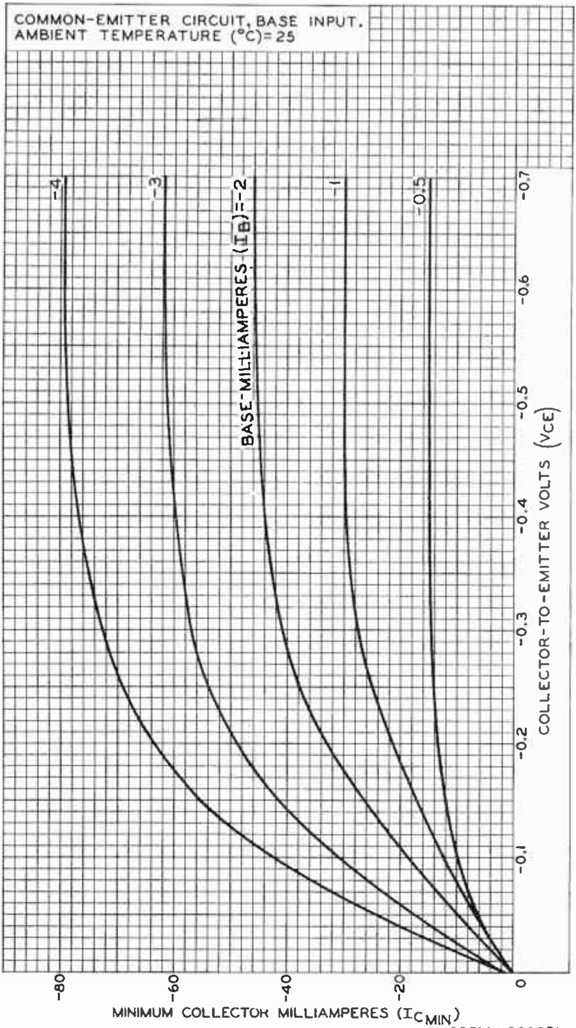


92CS-10907R1

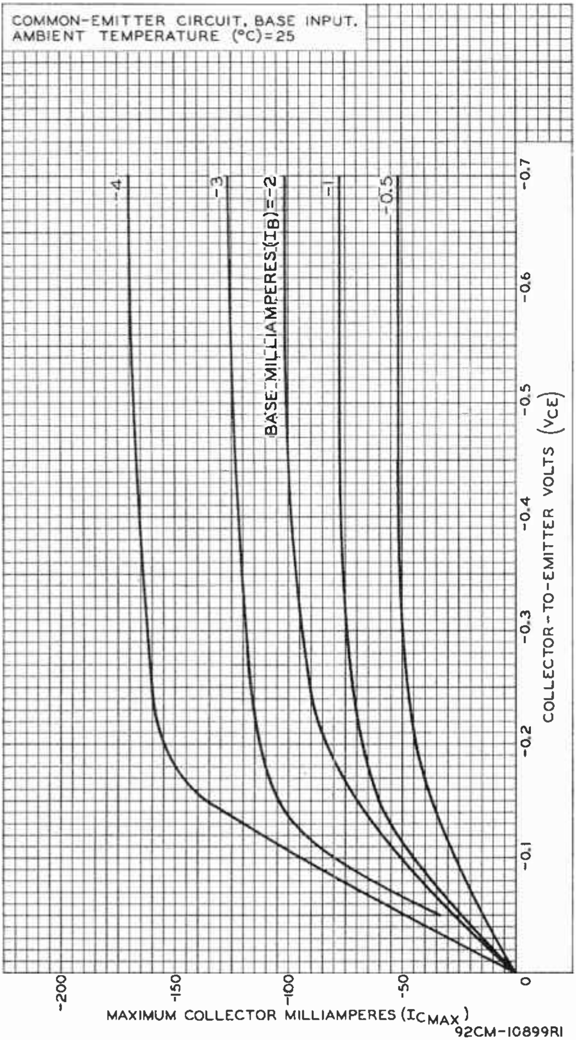
The following curves give the maximum and/or minimum characteristics values for this transistor. These curves were obtained from transistors at the extremes of the characteristics range in a 25-unit sample taken from a large number of production runs.

World Radio History

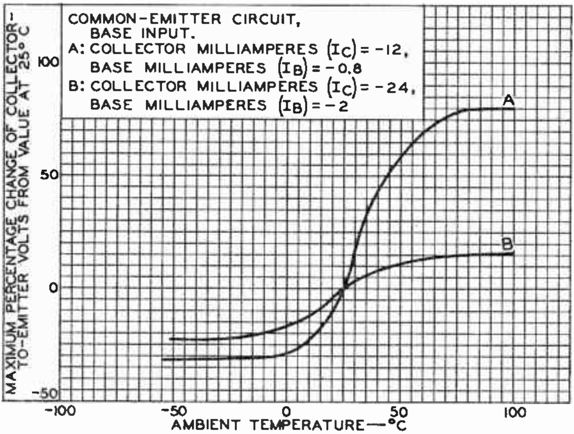
MINIMUM COLLECTOR CHARACTERISTICS



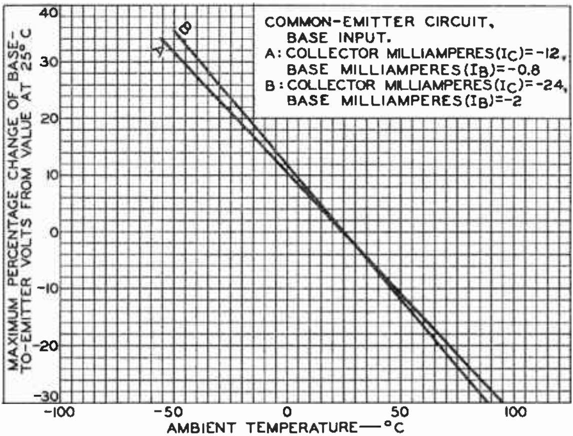
MAXIMUM COLLECTOR CHARACTERISTICS



MAXIMUM CHARACTERISTICS



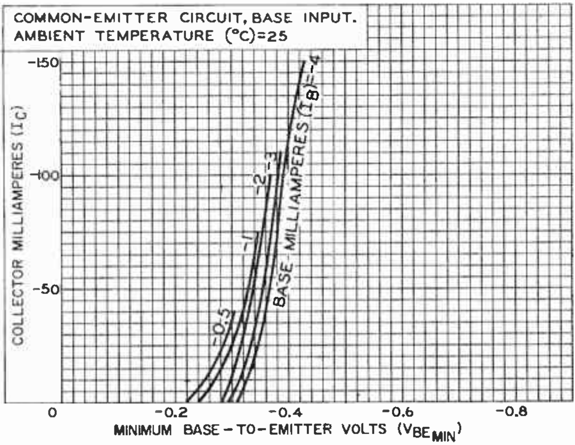
92CS-10895R1



92CS-10889R1

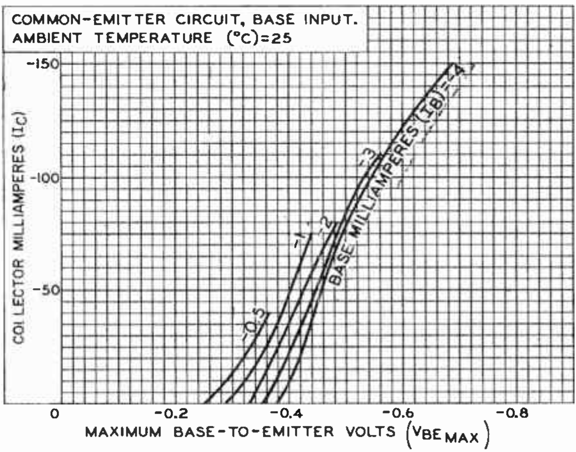
World Radio History

MINIMUM CHARACTERISTICS



92CS-10888R1

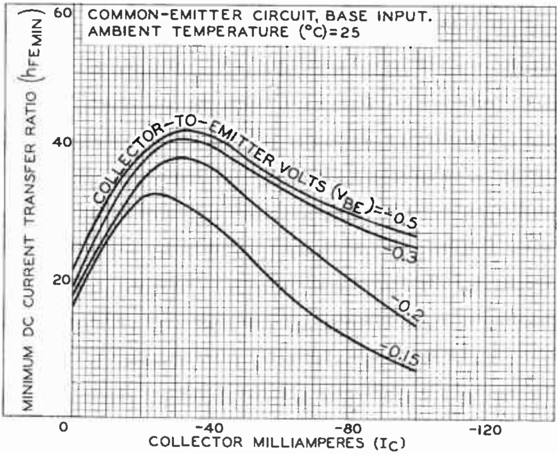
MAXIMUM CHARACTERISTICS



92CS-10887R1

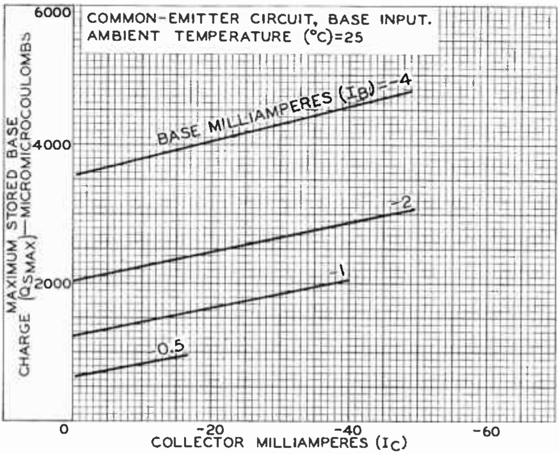
World Radio History

MINIMUM DC-CURRENT-TRANSFER-RATIO CHARACTERISTICS



92CS-10891R1

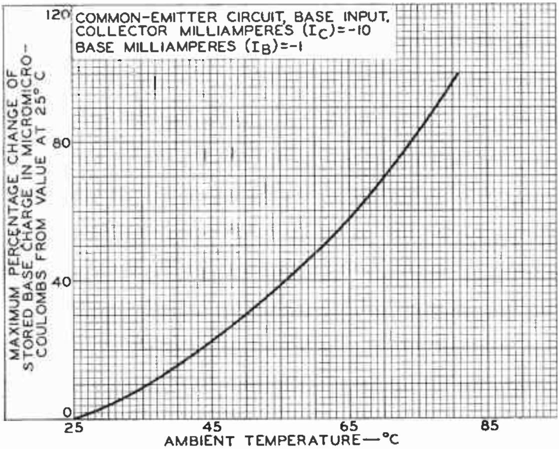
MAXIMUM STORED-BASE-CHARGE CHARACTERISTICS



92CS-10892R1

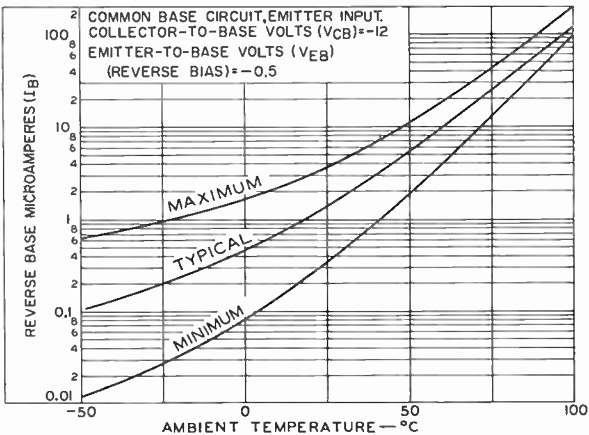
World Radio History

MAXIMUM CHARACTERISTIC



92CS-10893R1

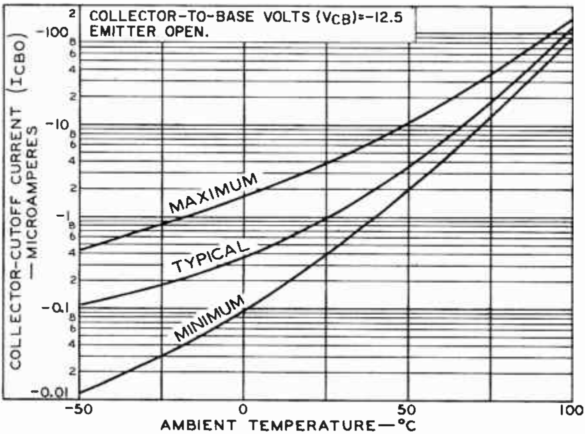
REVERSE-BASE-CURRENT CHARACTERISTICS



92CS-10884R1

World Radio History

COLLECTOR-CUTOFF-CURRENT CHARACTERISTICS



92CS-10885R1

World Radio History

2N404A

Transistor

GERMANIUM P-N-P ALLOY-JUNCTION TYPE
For Computer Switching Applications

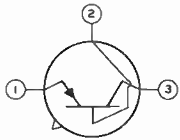
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No. TO-5
Case	Welded, Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter
Lead 2 - Base



Lead 3 - Collector

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	-40 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With dc emitter-to-base volts = -1	-35 max.	volts
EMITTER-TO-BASE VOLTAGE	-25 max.	volts
COLLECTOR CURRENT	-150 max.	ma
EMITTER CURRENT	150 max.	ma
TRANSISTOR DISSIPATION:[a]		
At ambient temperature of 25° C	150 max.	mw
At ambient temperature of 55° C	90 max.	mw
At ambient temperature of 71° C	60 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +100	°C
LEAD TEMPERATURE:		
For immersion in molten solder for 10 seconds maximum	255 max.	°C

[a] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

World Radio History

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and ambient temperature of 25° C unless otherwise specified

Characteristic	Symbol	Min.	Typical	Max.	Units
DC Collector Breakdown Voltage for dc collector ma. = -0.02, dc emitter current = 0.	BV_{CBO}	-40	-	-	volts
DC Emitter Breakdown Voltage for dc emitter ma. = -0.02, dc collector current = 0. . .	BV_{EBO}	-25	-	-	volts
DC Punch-Through Voltage for dc emitter volts = -1.	V_{PT}	-35	-	-	volts
DC Base-to-Emitter Saturation Voltage:	$V_{BE(sat)}$				
For dc collector ma. = -12, dc base ma. = -0.4.		-	-	-0.35	volt
For dc collector ma. = -24, dc base ma. = -1.		-	-	-0.4	volt
DC Collector-to-Emitter Saturation Voltage:	$V_{CE(sat)}$				
For dc collector ma. = -12, dc base ma. = -0.4.		-	-	-0.15	volt
For dc collector ma. = -24, dc base ma. = -1.		-	-	-0.2	volt
Stored Base Charge (See accompanying *Test Circuit*)	Q_S	-	-	1400	$\mu\mu$coulombs
DC Collector-Cutoff Current for dc collector volts = -12, dc emitter current = 0, ambient temperature of:	I_{CBO}				
25° C		-	-	-5	μa
80° C		-	-	-90	μa
Alpha-Cutoff Frequency for dc collector volts = -6, dc collector ma. = -1.	f_{ab}	4	-	-	Mc
DC Current Transfer Ratio:	h_{FE}				
For dc collector-to-emitter volts = -0.15, dc collector ma. = -12		30	-	-	
For dc collector-to-emitter volts = -0.2, dc collector ma. = -24		24	-	-	

World Radio History

Collector-to-Base Capacitance for dc collector volts = -6, dc emitter current = -1, frequency (Mc) = 2.	C_{op}	-	-	20	μμf
Thermal Time Constant . .	τ_1	-	10	-	msec
Thermal Resistance:					
Collector junction to free ambient air. . . .	R_T	-	-	500	°C/watt

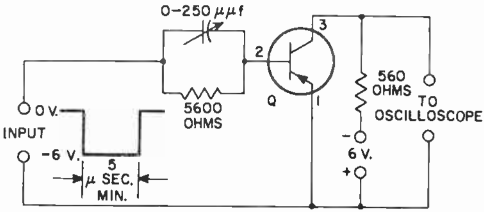
OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

This transistor is intended for use in single-side printed circuit boards and in conventional wire-in type circuits. If this transistor is used in double-side printed-circuit boards or in printed-circuit boards utilizing eyelets, it may be necessary to use an insulating washer or similar standoff device made of good dielectric material to prevent the solder from shorting the leads to each other or to the board.

STORED-BASE-CHARGE TEST CIRCUIT

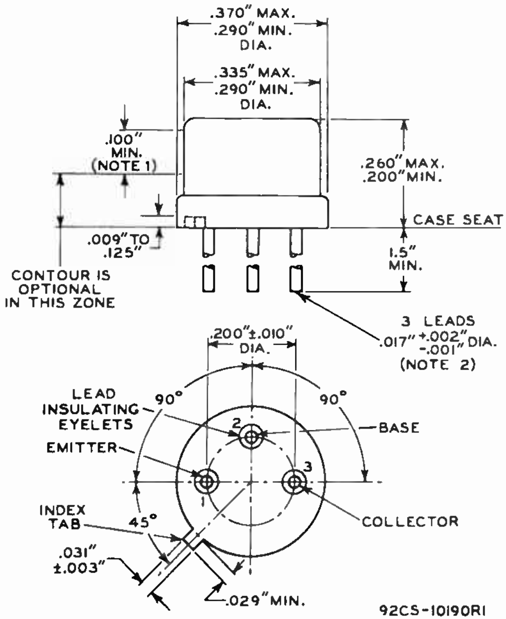


92CS-11042R1

Q: Transistor type 2N404A

World Radio History

JEDEC No.TO-5



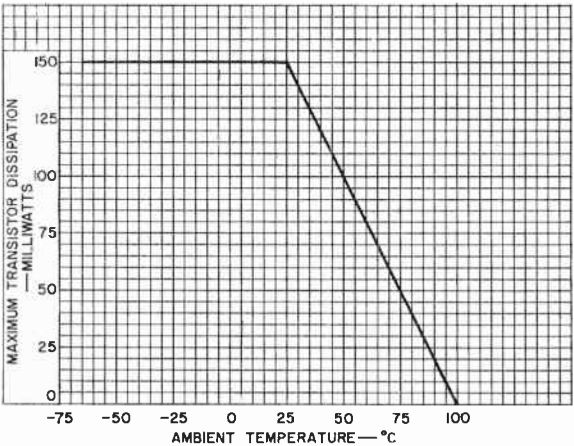
92CS-10190R1

NOTE 1: THE DIAMETER IN THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE TOTAL VARIATION IN ACTUAL DIAMETER FROM THE TRUE DIAMETER, DUE TO TAPER AND OUT OF ROUND WITHIN THIS ZONE, WILL NOT EXCEED 0.010".

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

RATING CHART



92CS-11044R1

World Radio History

World Radio History

2N404

JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For "on-off" control applications

GENERAL DATA

Mechanical:

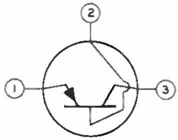
Operating Position.	Any
Maximum Length (Excluding flexible leads)	0.250"
Maximum Diameter.	0.360"
Case.	Metal
Envelope Seals.	Hermetic
Leads, Flexible	3
Minimum length.	1.5"
Orientation and diameter.	*See Dimensional Outline*

BOTTOM VIEW

Lead 1 - Emitter

Lead 3 - Collector

Lead 2 - Base



SWITCHING SERVICE

Maximum Ratings, *Absolute Values:*

COLLECTOR-TO-BASE VOLTAGE	-25 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE.	-24 max.	volts
EMITTER-TO-BASE VOLTAGE	-12 max.	volts
COLLECTOR CURRENT	-100 max.	ma
EMITTER CURRENT	100 max.	ma
COLLECTOR DISSIPATION *(See Rating Chart):*		
At ambient temperature of 25° C	120 max.	mw
At ambient temperature of 55° C	35 max.	mw
At ambient temperature of 71° C	10 max.	mw
AMBIENT TEMPERATURE (During operation). . .	85 max.	°C
STORAGE-TEMPERATURE RANGE	-65 to +85	°C

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Voltage values are given with respect to the base and ambient temperature = 25° C, unless otherwise specified

	Typical Values	Range Values Min.	Range Values Max.	
DC Collector Breakdown Voltage with dc collector current = -20 μa, dc emitter current = 0.	-40	-25	-	volts
DC Collector Cutoff Current with dc collector voltage = -12 volts, dc emitter current = 0 .	-2	-	-5	μa

World Radio History

RCA

2N404

JUNCTION TRANSISTOR

	Typical Values	Range Values Min.	Max.	
DC Collector Cutoff Current with dc collector voltage = −12 volts, dc emitter current = 0, and ambient temperature = 80° C .	−45	−	−90	μa
DC Emitter Breakdown Voltage with dc emitter current = −20 μa, dc collector current = 0 .	−35	−12	−	volts
DC Emitter Cutoff Current with dc emitter voltage = −2.5 volts, dc collector current = 0.	−1	−	−2.5	μa
DC Collector-to-Emitter (Punch-Through) Voltage*. .	−40	−24	−	volts
DC Collector-to-Emitter Saturation Voltage with dc collector current = −12 ma., dc base current = 0.4 ma.. .	−0.10	−	−0.15	volt
DC Base-to-Emitter Saturation Voltage with dc collector current = −12 ma., dc base current = −0.4 ma.	−0.25	−	−0.35	volt
DC Collector-to-Emitter Saturation Voltage with dc collector current = −24 ma., dc base current = 1 ma.. . . .	−0.12	−	−0.2	volt
DC Base-to-Emitter Saturation Voltage with dc collector current = −24 ma., dc base current = 1 ma..	−0.32	−	−0.4	volt

*: See next page.

World Radio History

RCA

2N404

JUNCTION TRANSISTOR

	Typical Values	Range Values Min.	Max.	
Stored Base Charge with dc collector current = -10 ma., dc base current = 1 ma.	800	-	1400	μμcoulombs
Alpha-Cutoff Frequency with dc collector voltage = -6 volts, dc emitter current = 1 ma.	12	4	-	Mc
Collector Capacitance with dc collector voltage = -6 volts, dc emitter current = 0.	12	-	20	μμf
Junction Temperature Rise (In free air) .	0.28	-	0.35	°C/mw

* The dc collector-to-emitter (punch-through) voltage may be determined by connecting a high-impedance voltmeter (11 megohms or greater) between the emitter and base and measuring the collector-to-base voltage which causes the emitter to assume an emitter-to-base floating voltage of -1 volt. In making this test, care must be taken not to exceed the maximum collector-to-base voltage rating.

OPERATING CONSIDERATIONS

The 2N404 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N404 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N404, the temperature of the solder should not exceed 230° C for a maximum immersion period of 10 seconds.

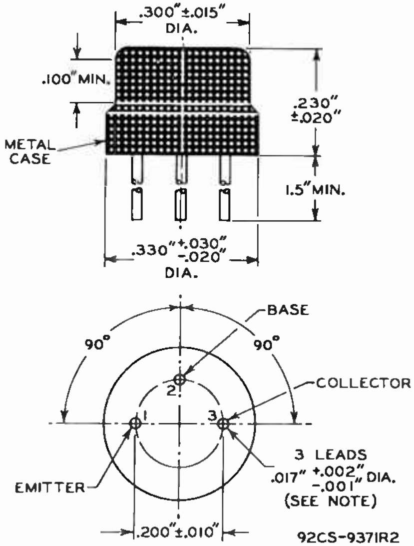
World Radio History

2N404

RCA

2N404

JUNCTION TRANSISTOR



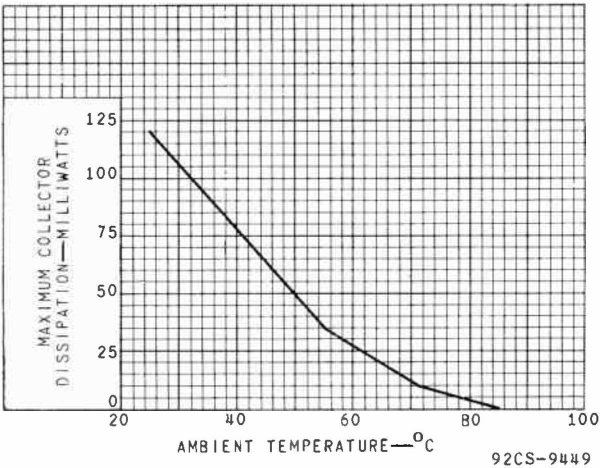
NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE BASE SEAT. BETWEEN 0.250" AND 1.50", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

2N404

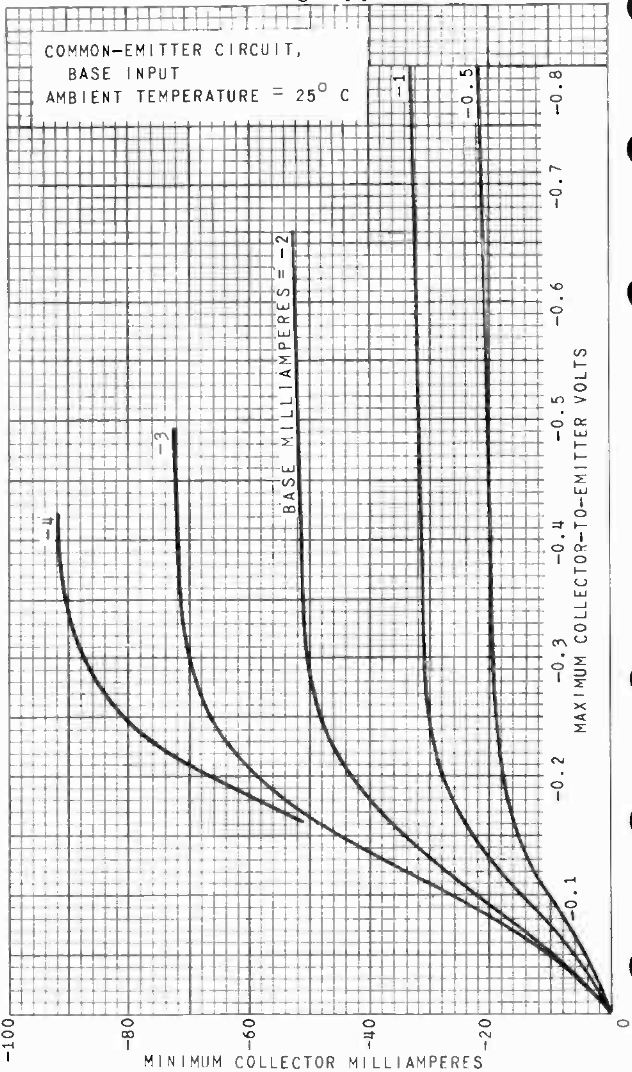
COLLECTOR-DISSIPATION RATING CHART



World Radio History

RCA

2N404
RANGE OF COLLECTOR CHARACTERISTICS
For Switching Applications



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RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

92CS-9451

World Radio History

RCA

2N405
JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For audio-frequency driver-amplifier applications

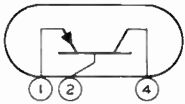
The 2N405 is the same as the 2N406 except for the following items:

Mechanical:

Maximum Overall Length.	0.697"
Maximum Seated Length	0.495"
Maximum Diameter.	0.260"
Base.	Small-Round Linotetrar 3-Pin (JETEC No.E3-25)

Pin 1 - Emitter

Pin 2 - Base



Pin 4 - Collector

OPERATING CONSIDERATIONS

The 2N405 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

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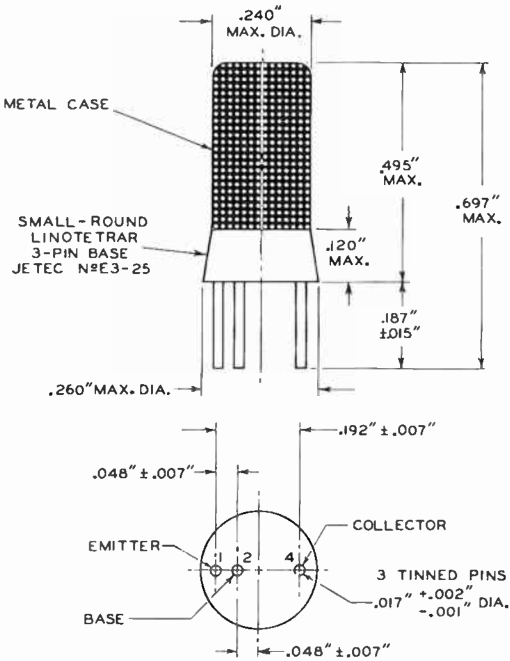
World Radio History

2N405
JUNCTION TRANSISTOR



PIN-SPACING TOLERANCES ARE NOT CUMULATIVE

92CS-8550R3

World Radio History

RCA

2N406
JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For audio-frequency driver-amplifier applications

GENERAL DATA

Electrical, *At Ambient Temperature of 25° C:*

Maximum DC Collector Current for dc collector-to-base voltage of -12 volts with emitter open.	-14	μa
Maximum DC Emitter Current for dc emitter-to-base voltage of -2.5 volts with collector open	-14	μa

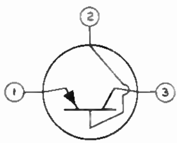
Mechanical:

Operating Position .Any
Maximum Length (Excluding flexible leads). . . . . 0.405"
Maximum Diameter . . . . 0.240"
Dimensional Outline. . . . . .JETEC No.TO-1
Case. . . . . .Metal
Envelope Seals . . . . Hermetic
Leads, Flexible. 3
  Minimum length . . . . 1.5"
  Orientation and diameter . . . .*See Dimensional Outline*

BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector (Adjacent to red dot on side of case)

AUDIO-FREQUENCY DRIVER-AMPLIFIER — Class A

Maximum Ratings, *Absolute Values:*

COLLECTOR-TO-BASE VOLTAGE (DC + Peak AC) .	-20	max.	volts
COLLECTOR-TO-EMITTER VOLTAGE (DC + Peak AC).	-18	max.	volts
EMITTER-TO-BASE VOLTAGE (DC + Peak AC) . .	-2.5	max.	volts
DC COLLECTOR CURRENT	-35	max.	ma
DC EMITTER CURRENT	35	max.	ma
COLLECTOR DISSIPATION:			
At ambient temperature of 25° C	150	max.	mw
At ambient temperature of 55° C	50	max.	mw
At ambient temperature of 71° C	20	max.	mw
AMBIENT TEMPERATURE (During operation) . .	71	max.	°C
STORAGE-TEMPERATURE RANGE.	-65 to +85		°C

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage.	-6	volts
DC Emitter Current	1	ma

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SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

RCA

2N406

JUNCTION TRANSISTOR

Power Gain:		
With load resistance = 8500 ohms, and input resistance = 750 ohms	43	db
Small-Signal T Parameters:*		
DC Collector-to-Emitter Voltage (V_{CE})	−6	volts
DC Emitter Current (I_E)	1	ma
Emitter Resistance (r_e)	17	ohms
Base Resistance (r_b)	500	ohms
Mutual Resistance (r_m)	2.04	megohms
Collector Resistance (r_c)	2.1	megohms
Current Transfer Ratio (α_f)■	−35	
Small-Signal Hybrid-π Parameters:*		
DC Collector-to-Emitter Voltage (V_{CE})	−6	volts
DC Emitter Current (I_E)	1	ma
Resistance $r_{bb'}$	120	ohms
Conductance $g_{b'e}$	1070	μmhos
Conductance g_{ce}	6.5	μmhos
Conductance $g_{b'c}$	0.295	μmho
Capacitance $C_{b'e}$	9430	μμf
Capacitance $C_{b'c}$	40	μμf
Intrinsic Transconductance (g_m)	37500	μmhos
Small-Signal H Parameters:*		
DC Collector-to-Emitter Voltage (V_{CE})	−6	volts
DC Emitter Current (I_E)	1	ma
Input Resistance, ac output circuit shorted (h_i)	1115	ohms
Reverse Voltage Transfer Ratio, input circuit open (h_r)	2.93×10^{-4}	
Forward Current Transfer Ratio, ac output circuit shorted (h_f)	35	
Output Conductance, input circuit open (h_o)	17.2	μmhos
Common-Base Circuit, Emitter Input		
DC Collector-to-Base Voltage	−6	volts
DC Emitter Current	1	ma
Frequency at which the current transfer ratio drops to 0.707 times its value at 1 kc	650	Mc

* As derived from corresponding equivalent circuit shown under type 2N104.
■ Measured at 1 kc.

OPERATING CONSIDERATIONS

The 2N406 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N406 are usually soldered to the circuit elements. Soldering of the leads may be made

World Radio History

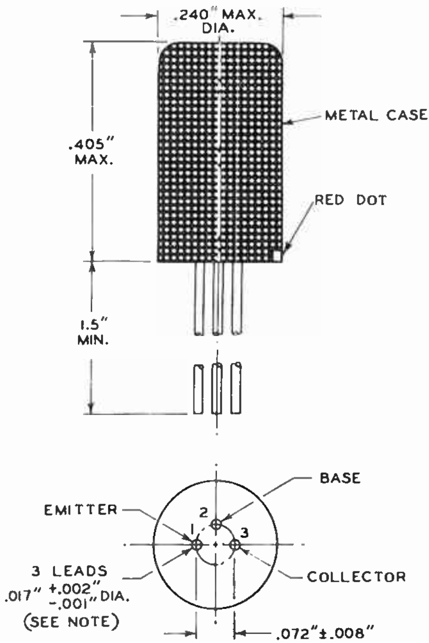
RCA

2N406

JUNCTION TRANSISTOR

close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N406, the temperature of the solder should not exceed 230° C for a maximum immersion period of 10 seconds.



92CS-9148R2

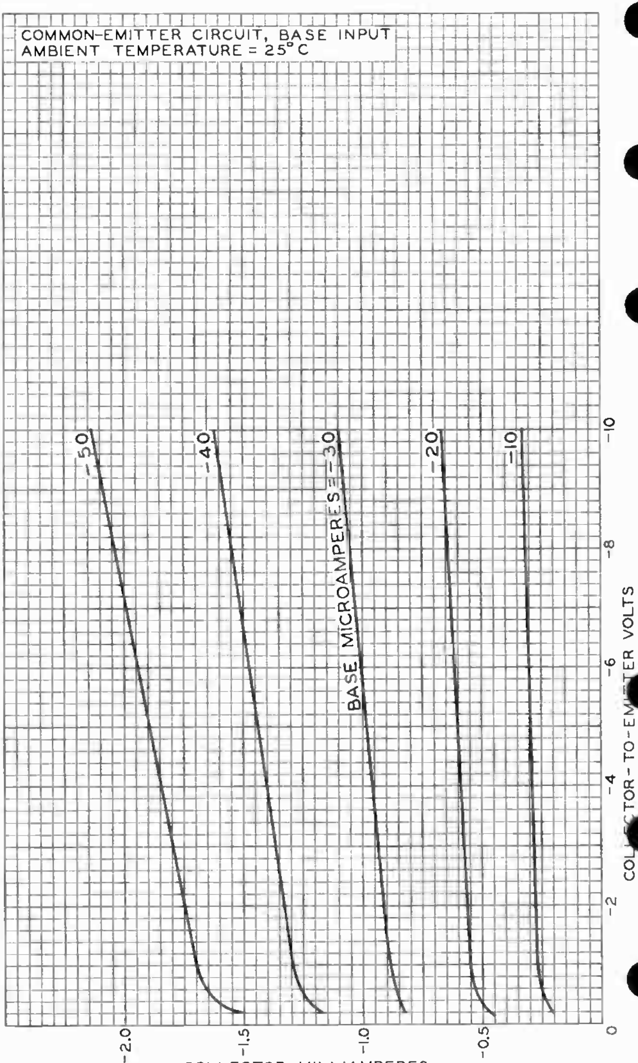
NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE BASE SEAT. BETWEEN 0.250" AND 1.50", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

2N406

2N406

AVERAGE COLLECTOR CHARACTERISTICS



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92CM-9464RI

World Radio History

RCA

2N407
JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

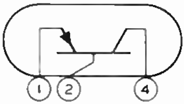
For large-signal audio-frequency applications

The 2N407 is the same as the 2N408 except for the following items:

Mechanical:

Maximum Overall Length. . . . . 0.697"
Maximum Seated Length . . . . 0.495"
Maximum Diameter. . . . . 0.260"
Base. . . . . . . Small-Round Linotetrar 3-Pin (JETEC No.E3-25)

Pin 1 - Emitter
Pin 2 - Base
Pin 4 - Collector



OPERATING CONSIDERATIONS

The 2N407 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

In class B service, when the 2N407 is operated at ambient temperatures other than 25° C, the base-to-emitter voltage should be reduced or increased by approximately 0.002 volt for each degree the ambient temperature is above or below 25° C, respectively. When this transistor is operated under varying ambient temperatures, some form of temperature compensation may be used in the base-to-emitter circuit to hold the operating point constant.

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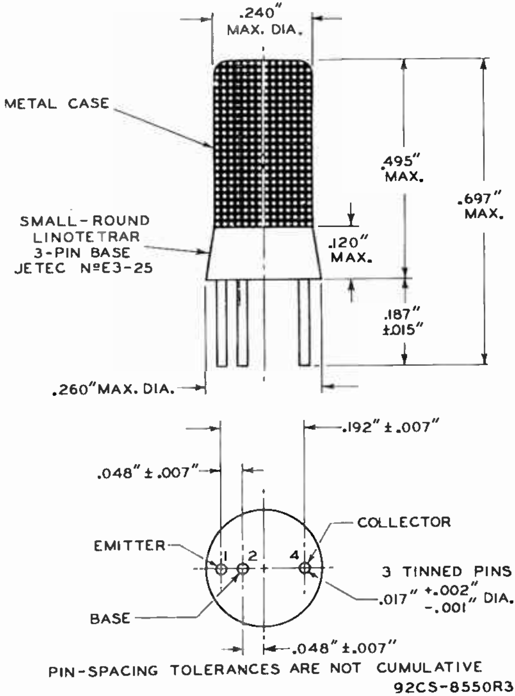
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

2N407

JUNCTION TRANSISTOR



SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

RCA

2N408

JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For large-signal audio-frequency applications

GENERAL DATA

Electrical, *At Ambient Temperature of 25° C:*

Maximum DC Collector Current for dc collector-to-base voltage of −12 volts with emitter open	−14	μa
Maximum DC Emitter Current for dc emitter-to-base voltage of −2.5 volts with collector open	−14	μa

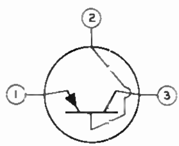
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.405"
Maximum Diameter	0.204"
Dimensional Outline	JETEC No. TO-1
Case	Metal
Envelope Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	*See Dimensional Outline*

BOTTOM VIEW

Lead 1 – Emitter

Lead 2 – Base



Lead 3 – Collector (Adjacent to red dot on side of case)

AUDIO-FREQUENCY AMPLIFIER — Class B

Maximum Ratings, *Absolute Values:*

COLLECTOR-TO-BASE VOLTAGE	−20 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE	−18 max.	volts
EMITTER-TO-BASE VOLTAGE	−2.5 max.	volts
COLLECTOR CURRENT	−70 max.	ma
EMITTER CURRENT	70 max.	ma
COLLECTOR DISSIPATION:		
At ambient temperature of 25° C	150 max.	mw
At ambient temperature of 55° C	50 max.	mw
At ambient temperature of 71° C	20 max.	mw
AMBIENT TEMPERATURE (During operation)	71 max.	°C
STORAGE-TEMPERATURE RANGE	−65 to +85	°C

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	−1	volt
DC Collector Current	−50	ma
Large-Signal DC Current Transfer Ratio	65	

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

TENTATIVE DATA

World Radio History

RCA

2N408

JUNCTION TRANSISTOR

Typical Push-Pull Operation, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

Unless otherwise specified, values are for 2 transistors

DC Collector-to-Emitter Supply Voltage	-4.5	-9	volts
DC Base-to-Emitter Voltage	-0.15	-0.15	volt
Peak Collector Current (Per transistor)	-35	-40	ma
Zero-Signal DC Collector Current (Per transistor)	-2	-2	ma
Max.-Signal DC Collector Current (Per transistor)	-11.5	-13	ma
Signal-Source Impedance (Base to base)	1500	1500	ohms
Load Impedance (Collector to collector)	400	800	ohms
Signal Frequency	1	1	kc
Circuit Efficiency	60	69	%
Power Gain	30	33	db
Total Harmonic Distortion	10 max.	10 max.	%
Max.-Signal Power Output	75	160	mw

OPERATING CONSIOERATIONS

The 2N408 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

In class B service, when the 2N408 is operated at ambient temperatures other than 25° C, the base-to-emitter voltage should be reduced or increased by approximately 0.002 volt for each degree the ambient temperature is above or below 25° C, respectively. When this transistor is operated under varying ambient temperatures, some form of temperature compensation may be used in the base-to-emitter circuit to hold the operating point constant.

The *flexible leads* of the 2N408 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N408, the temperature of the solder should not exceed 230° C for a maximum immersion period of 10 seconds.

Curves shown under Type 2N109 also apply to the 2N408

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TENTATIVE DATA

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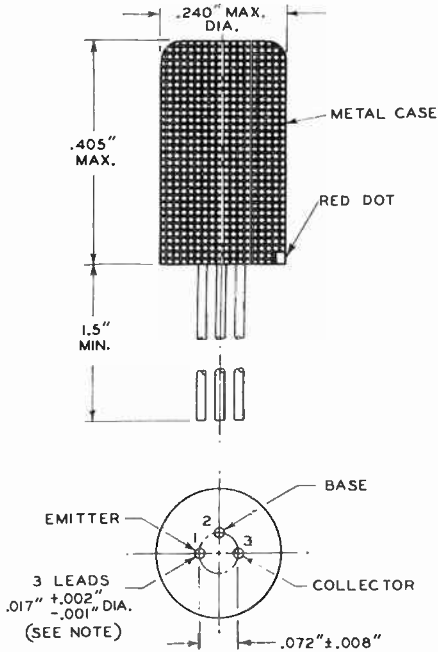
2N408

RCA 2N408

JUNCTION TRANSISTOR



92CS-9148R2

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE BASE SEAT. BETWEEN 0.250" AND 1.50", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE NEW JERSEY

World Radio History

World Radio History

RCA

2N409

JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For 455-kc intermediate-frequency applications

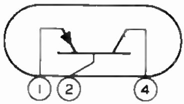
The 2N409 is the same as the 2N410 except for the following items:

Mechanical:

Maximum Overall Length.	0.697"
Maximum Seated Length	0.495"
Maximum Diameter.	0.260"
Base. . . . . . . Small-Round Linotetrar 3-Pin (JETEC No.E3-25)	

Pin 1 - Emitter

Pin 4 - Collector



Pin 2 - Base

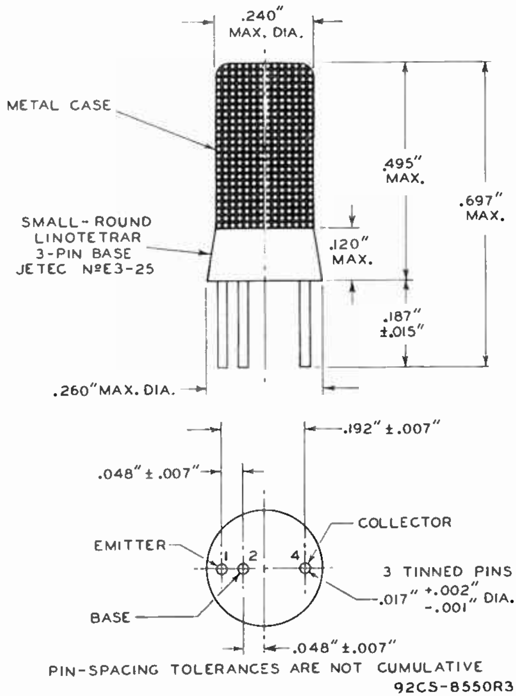
OPERATING CONSIDERATIONS

The 2N409 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

World Radio History

2N409

JUNCTION TRANSISTOR



SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

2N410

2N410
JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For 455-kc intermediate-frequency applications

GENERAL DATA

Electrical, *At Ambient Temperature of 25° C:*

Minimum DC Collector-to-Base Voltage for dc collector current of -10 μa with emitter open.	-13	volts
Maximum DC Collector Current for dc collector-to-base voltage of -13 volts with emitter open.	-10	μa
Maximum DC Emitter Current for dc emitter-to-base voltage of -0.5 volt with collector open	-12	μa

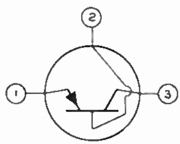
Mechanical:

Operating Position . . . . .Any
Maximum Length (Excluding flexible leads). . . . . 0.405"
Maximum Diameter . . . . 0.240"
Dimensional Outline. . . . . .JETEC No.TO-1
Case . . . . .Metal
Envelope Seals . . . . Hermetic
Leads, Flexible. 3
  Minimum length . . . . 1.5"
  Orientation and diameter . . . . . . *See Dimensional Outline*

BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector (Adjacent to red dot on side of case)

INTERMEDIATE-FREQUENCY AMPLIFIER

Maximum Ratings, *Absolute Values:*

DC COLLECTOR-TO-BASE VOLTAGE	-13 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-0.5 max.	volt
DC COLLECTOR CURRENT	-15 max.	ma
DC EMITTER CURRENT	15 max.	ma
COLLECTOR DISSIPATION:		
At ambient temperature of 25° C.	80 max.	mw
At ambient temperature of 55° C.	35 max.	mw
At ambient temperature of 71° C.	10 max.	mw
AMBIENT TEMPERATURE (During operation) . .	71 max.	°C
STORAGE-TEMPERATURE RANGE.	-65 to +85	°C

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

2N410

2N410

JUNCTION TRANSISTOR

Characteristics, *At Ambient Temperature of 25° C:*			
Common-Emitter Circuit, Base Input			
DC Collector-to-Emitter Voltage	-9	-9	volts
DC Emitter Current	0.5	1	ma
Current Transfer Ratio■	-45	-48	
Small-Signal Hybrid-π Parameters:*			
DC Collector-to-Emitter Voltage (V_{CE})	-9	-9	volts
DC Emitter Current (I_E)	0.5	1	ma
Resistance $r_{bb'}$	85	75	ohms
Conductance $g_{b'e}$	425	800	μmhos
Conductance g_{ce}	4.6	8.6	μmhos
Conductance $g_{b'c}$	0.22	0.25	μmho
Capacitance $C_{b'e}$	540	1100	μμf
Capacitance $C_{b'c}$	9.5	9.5	μμf
Intrinsic Transconductance (g_m)	19300	38600	μmhos
Frequency● for unity power amplification	13	14	Mc
Common-Base Circuit, Emitter Input			
DC Collector-to-Base Voltage	-9	-9	volts
DC Emitter Current	0.5	1	ma
Current Transfer Ratio■	0.978	0.980	
Frequency at which the current transfer ratio drops to 0.707 times its value at 1 kc	6.8	6.7	Mc
Typical Operation, *At Ambient Temperature of 25° C:*			
Common-Emitter Circuit, Base Input			
DC Collector-to-Emitter Voltage	-9	-9	volts
DC Emitter Current	0.5	1	ma
Input Resistance	1000	500	ohms
Output Resistance	70000	30000	ohms
Spot Noise Factor▲	4.5	4.5	db
Maximum Power Gain▲	38.8	37.8	db
Useful Power Gain	28.4§	30.4†	db

* As derived from corresponding equivalent circuit shown under type 2N104.

● This frequency (figure of merit) may be calculated from the equation

$$f = \frac{1}{4\pi}\sqrt{\frac{g_m}{r_{bb'}\, C_{b'c}\, C_{b'e}}}$$

■ Measured at 1 kc.

▲ Measured in a single-tuned unilateralized circuit matched to the generator and load impedances for maximum transfer of power. Transformer insertion losses not included. (Unilateralization is a special case of neutralization in which the resistive as well as the reactive feedback parameters are balanced out. Unilateralization changes a bilateral network into a unilateral network).

§ A transformer insertion loss of 10.4 db is included in this figure.

† A transformer insertion loss of 6.6 db is included in the figure.

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

2N410

JUNCTION TRANSISTOR

OPERATING CONSIDERATIONS

The 2N410 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N410 are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N410, the temperature of the solder should not exceed 230° C for a maximum immersion period of 10 seconds.

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RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

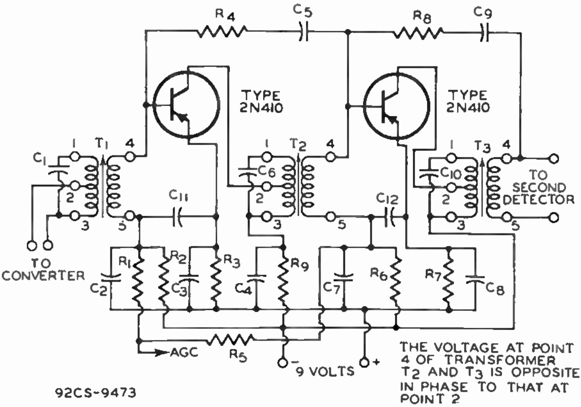
World Radio History

RCA

2N410

JUNCTION TRANSISTOR

TYPICAL 455-KC INTERMEDIATE-FREQUENCY AMPLIFIER CIRCUIT



NOTE: THE DESIGN OF THIS CIRCUIT PROVIDES STABLE OPERATION AND INTERCHANGEABILITY OF RCA-2N410 TRANSISTORS.

C1 C6 C10: 220 $\mu\mu$f
C2: 50 μf
C3 C4 C8: 0.05 μf
C5: 75 $\mu\mu$f
C7: 25 μf
C9: 33 $\mu\mu$f
C11 C12: 0.1 μf
R1: 12000 ohms
R2: 0.15 megohm
R3 R7: 820 ohms
R4: 560 ohms
R5: 18000 ohms
R6: 0.1 megohm
R8: 2000 ohms
R9: 560 ohms

Transformer:	T1	T2	T3	
Reflected resistance of primary between terminals 2 and 3 with secondary terminated	206000	29000	10900	ohms
Reflected resistance of secondary with primary terminated	1000	500	1000	ohms
Turns ratios:				
Terminals 1 and 3 to terminals 2 and 3	1.17	2.48	3.16	
Terminals 1 and 3 to terminals 4 and 5	16.8	18.9	10.43	
Terminals 2 and 3 to terminals 4 and 5	14.35	7.62	3.3	
Core Material	Ferrite	Ferrite	Ferrite	
Unloaded Q (mounted in chassis)	110	61	110	
Loaded Q (mounted in chassis)	35	35	35	

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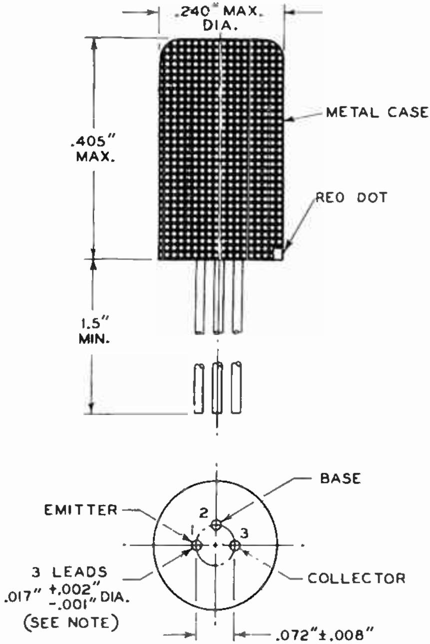
World Radio History

RCA

2N410

JUNCTION TRANSISTOR



92CS-9148R2

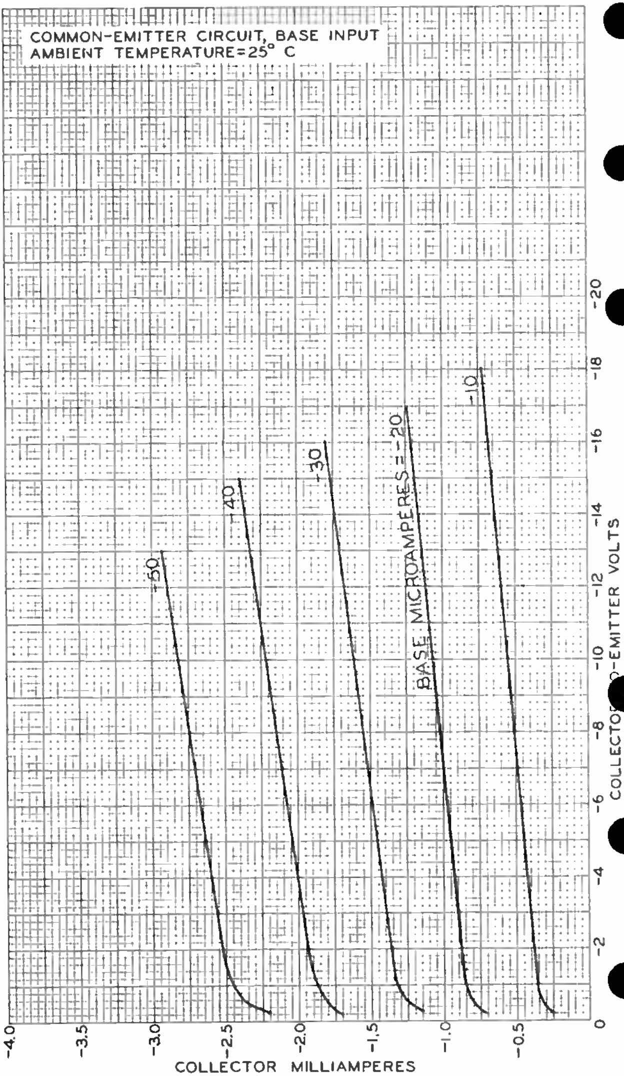
NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE BASE SEAT. BETWEEN 0.250" AND 1.50", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

RCA

2N410

AVERAGE COLLECTOR CHARACTERISTICS



92CM-8849R1

World Radio History

RCA

2N411

JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

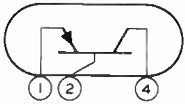
For 540- to 1600-kc converter applications

The 2N411 is the same as the 2N412 except for the following items:

Mechanical:

Maximum Overall Length. . . . . 0.697"
Maximum Seated Length . . . . 0.495"
Maximum Diameter. . . . . 0.260"
Base. . . . . . . Small-Round Linotetrar 3-Pin (JETEC No.E3-25)

Pin 1 - Emitter
Pin 2 - Base
Pin 4 - Collector



OPERATING CONSIDERATIONS

The 2N411 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

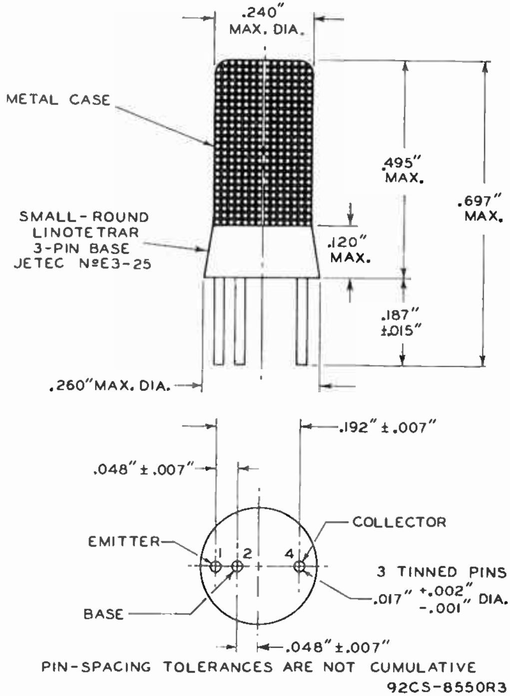
SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

RCA

2N411

JUNCTION TRANSISTOR



SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

2N412

JUNCTION TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For 540- to 1600-kc converter applications

GENERAL DATA

Electrical, ***At Ambient Temperature of 25° C:***

Minimum DC Collector-to-Base Voltage for dc collector current of -10 μa with emitter open.	-13	volts
Maximum DC Collector Current for dc collector-to-base voltage of -13 volts with emitter open	-10	μa
Maximum DC Emitter Current for dc emitter-to-base voltage of -0.5 volt with collector open	-12	μa

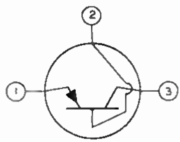
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads).	0.405"
Maximum Diameter	0.240"
Dimensional Outline.	JETEC No.TO-1
Case	Metal
Envelope Seals	Hermetic
Leads, Flexible.	3
Minimum length	1.5"
Orientation and diameter	*See Dimensional Outline*

BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector (Adjacent to red dot on side of case)

CONVERTER SERVICE

Maximum Ratings, ***Absolute Values:***

DC COLLECTOR-TO-BASE VOLTAGE	-13 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-0.5 max.	volt
DC COLLECTOR CURRENT	-15 max.	ma
DC EMITTER CURRENT	15 max.	ma
COLLECTOR DISSIPATION:		
At ambient temperature of 25° C.	80 max.	mw
At ambient temperature of 55° C.	35 max.	mw
At ambient temperature of 71° C.	10 max.	mw
AMBIENT TEMPERATURE (During operation) . .	71 max.	°C
STORAGE-TEMPERATURE RANGE.	-65 to +85	°C

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

RCA

2N412

JUNCTION TRANSISTOR

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage.	-9	volts
DC Emitter Current	0.6	ma
Current Transfer Ratio■.	75	

Small-Signal Hybrid-π Parameters:*

DC Collector-to-Emitter Voltage (V_{CE}). . .	-9	volts
DC Emitter Current (I_E).	0.6	ma
Resistance $r_{bb'}$.	85	ohms
Conductance $g_{b'e}$	480	μmhos
Conductance g_{ce}.	5.4	μmhos
Conductance $g_{b'c}$	0.23	μmho
Capacitance $C_{b'e}$	650	μμf
Capacitance $C_{b'c}$	9.5	μμf
Intrinsic Transconductance (g_m).	22600	μmhos
Frequency● for unity power amplification .	16.5	Mc

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-9	volts
DC Emitter Current	0.6	ma
Current Transfer Ratio■.	0.987	
Frequency at which the current transfer ratio drops to 0.707 times its value at 1 kc.	10	Mc

Typical Operation, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage.	-9	volts
DC Emitter Current	0.6	ma
Input Resistance	700	ohms
Output Resistance.	75000	ohms
RMS Base-to-Emitter Oscillator Injection Voltage.	100	mv
Signal Frequency	1	Mc
Useful Conversion Power Gain	32	db

■ Measured at 1 kc.
* As derived from corresponding equivalent circuit shown under type 2N104.
● This frequency (figure of merit) may be calculated from the equation

$$f = \frac{1}{4\pi}\sqrt{\frac{g_m}{r_{bb'}\ C_{b'c}\ C_{b'e}}}$$

OPERATING CONSIDERATIONS

The 2N412 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N412 are usually soldered to the circuit elements. Soldering of the leads may be made

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

RCA

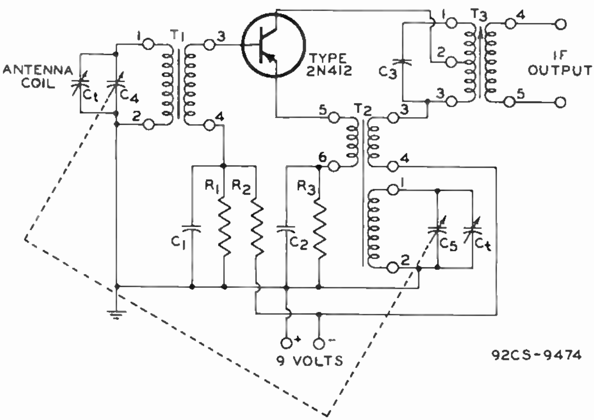
2N412

JUNCTION TRANSISTOR

close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using the 2N412, the temperature of the solder should not exceed 230° C for a maximum immersion period of 10 seconds.

TYPICAL SELF-EXCITED CONVERTER CIRCUIT



C1: 0.05 μf	C_t: 2 to 20 $\mu\mu f$ (variable)
C2: 0.04 μf	R1: 6800 ohms
C3: 220 $\mu\mu f$	R2: 18000 ohms
C4: 12 to 230 $\mu\mu f$ (variable)	R3: 3900 ohms
C5: 10 to 105 $\mu\mu f$ (variable)	

T1: RF Transformer; low-loss ferrite core; unloaded Q (mounted in chassis), 212 at 1 Mc. Primary: 75 turns of 7/41 Litz wire space wound (spacing equal to diameter of wire) in single layer and centered on core; reflected resistance with secondary terminated, 0.3 megohm; inductance (approx.), 353 microhenries. Secondary: 4.5 turns of No.34 SSE wire wound on ground end of core.

T2: Oscillator Transformer; low-loss ferrite core; unloaded Q (mounted in chassis), 100 at 1455 kc. Primary: 133 turns of 7/41 Litz wire between terminals 1 and 2; inductance (approx.); 207 microhenries. Secondary: 10 turns of No.34 SSE wire between terminals 3 and 4; 4 turns of No.34 SSE wire between terminals 5 and 6.

T3: See next page.

World Radio History

RCA

2N412

JUNCTION TRANSISTOR

T3: IF Transformer; ferrite core; unloaded Q (mounted in chassis), 110 at 455 kc; loaded Q (mounted in chassis), 35 at 455 kc. Turns ratios: terminals 1 and 3 to terminals 2 and 3, 1.17; terminals 2 and 3 to terminals 4 and 5, 14.35; terminals 1 and 3 to terminals 4 and 5, 16.8. Primary: reflected resistance with secondary terminated, 0.206 megohm. Secondary: reflected resistance with primary terminated, 1000 ohms.

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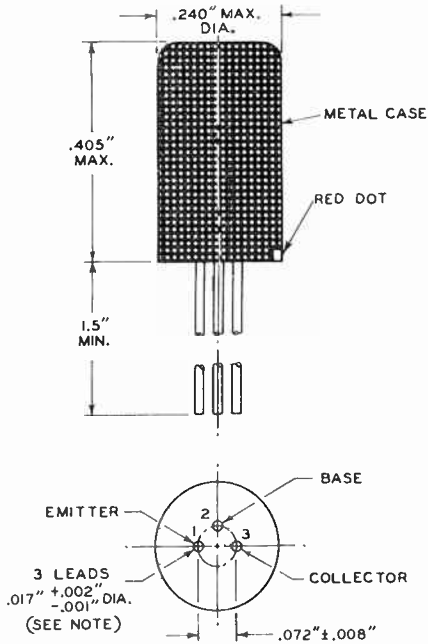


92CS-9148R2

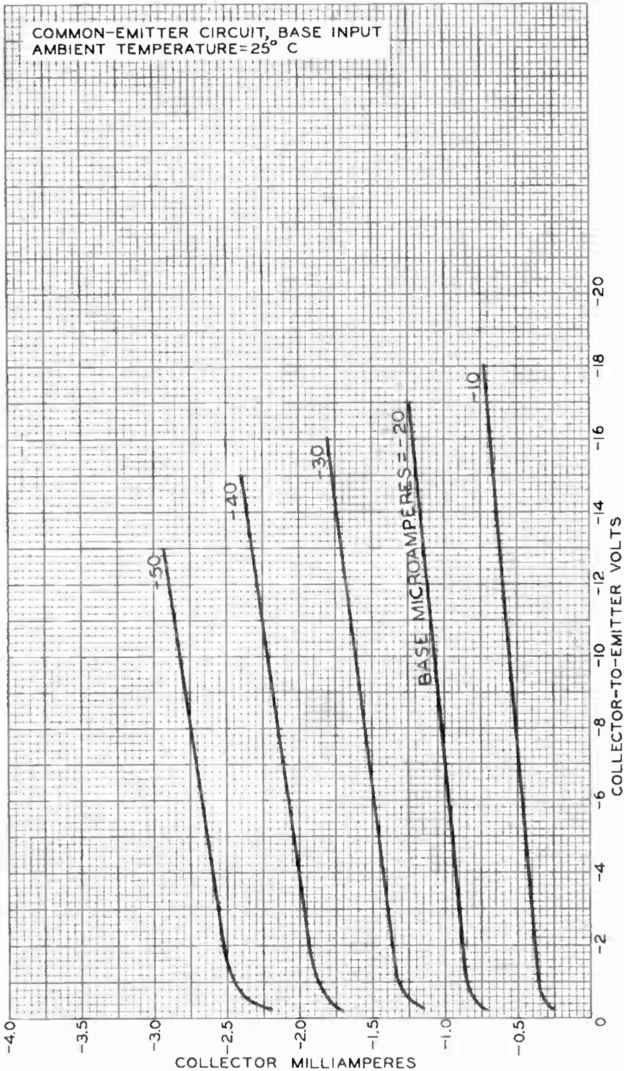
NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE BASE SEAT. BETWEEN 0.250" AND 1.50", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

RCA

2N412

AVERAGE COLLECTOR CHARACTERISTICS



92CM-8849RI

SEMICONDUCTOR DIVISION
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World Radio History

World Radio History

Junction Transistor

GERMANIUM P-N-P ALLOY TYPE

For Medium-Speed Switching Service in Commercial and Military Data-Processing Systems

GENERAL DATA

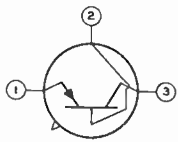
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No.TO-5
Case	Welded, Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector

SWITCHING SERVICE

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	-30 max.	volts
EMITTER-TO-BASE VOLTAGE	-20 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
Base-to-emitter volts = 1	-20 max.	volts
Base open	-15 max.	volts
PEAK COLLECTOR CURRENT	-400 max.	ma
DC COLLECTOR CURRENT	-200 max.	ma
TRANSISTOR DISSIPATION:[a]		
At ambient temperature of 25° C	150 max.	mw
At ambient temperature of 55° C	75 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +85	°C
LEAD TEMPERATURE:		
For immersion in molten solder for 10 seconds maximum	240 max.	°C

[a] See accompanying *Rating Chart*.

World Radio History

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to the base unless otherwise specified. Ambient temperature of 25° C.

		Min.	Typical	Max.	
DC Collector-Cutoff Current for dc collector volts = -12, emitter open. . . .	I_{CBO}	-	-2	-5	µa
DC Emitter-Cutoff Current for dc emitter volts = -12, collector open . . .	I_{EBO}	-	-2	-5	µa
Small-Signal Current Transfer Ratio for dc collector-to-emitter volts = -6, dc emitter ma. = 1, frequency of 1 kc.	h_{fe}	-	80	-	
Small-Signal Open-Circuit Reverse-Voltage Transfer Ratio for dc collector volts = -6, dc emitter ma. = 1, frequency of 1 kc.	h_{rb}	-	0.5×10^{-3}	-	
Alpha-Cutoff Frequency for dc collector volts = -6, dc emitter ma. = 1.	f_{ab}	-	8	-	Mc
Small-Signal Short-Circuit Input Impedance for dc collector volts = -6, dc emitter ma. = 1, frequency of 1 kc.	h_{ib}	-	30	-	ohms
Extrinsic Base Resistance for dc collector-to-emitter volts = -6, dc emitter ma. = 1, frequency of 6 Mc.	$r_{bb'}$	-	120	-	ohms
Collector-to-Base Capacitance for dc collector volts = -6, dc emitter ma. = 1	C_{ob}	-	11	-	µµf
Power Gain for dc collector-to-emitter volts = -6, dc emitter ma. = 1, frequency of 1.5 Mc.	PG	-	16	-	db
Noise Factor for dc collector-to-emitter voltage = -6, dc emitter ma. = 1, frequency of 1.5 Mc . . .	NF	-	6	-	db

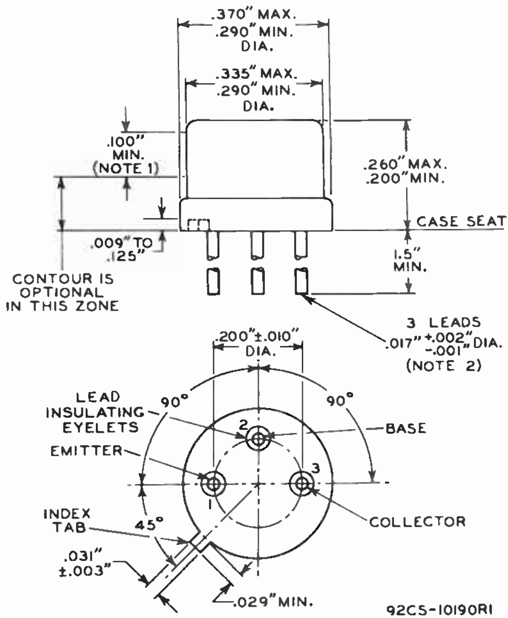
OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

World Radio History

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

JEDEC No. TO-5

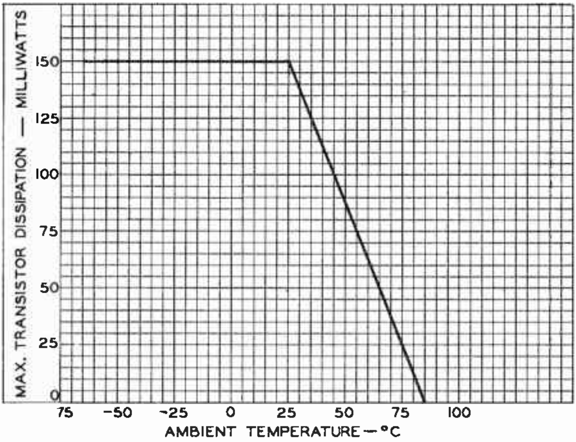


NOTE 1: THE DIAMETER IN THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE TOTAL VARIATION IN ACTUAL DIAMETER FROM THE TRUE DIAMETER, DUE TO TAPER AND OUT OF ROUND WITHIN THIS ZONE, WILL NOT EXCEED 0.010".

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

RATING CHART



92CS-10232R1

World Radio History

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service in Industrial and Military Applications

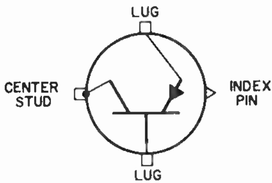
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No.TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE: With emitter-to-base reverse biased (DC emitter-to-base volts = -1.5)	-40 max.	volts
EMITTER-TO-BASE VOLTAGE	-20 max.	volts
COLLECTOR CURRENT	-15 max.	amp
EMITTER CURRENT	15 max.	amp
BASE CURRENT	-4 max.	amp
TRANSISTOR DISSIPATION:[a] ← At case temperatures[b] of 25° C or below	150 max.	watts
CASE-TEMPERATURE[b] RANGE: ← Operating and storage	-65 to +100	°C

Typical Operation:

In a common-emitter, base-input, power-switching circuit at case temperature[b] *of 25° C*

DC Supply Voltage	-12	volts
DC Base-Bias Voltage	6	volts
"On" DC Collector Current	-12	amp
"Turn-On" Base Current	-2	amp
"Turn-Off" Base Current	0	amp

← Indicates a change.

World Radio History

Switching Time:

Rise time	15	μsec
Fall time	15	μsec

[a] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

[b] Measured at any point on seating surface.

→ ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and at case temperature[b] *of 25° C unless otherwise specified*

		Min.	Typical	Max.	
DC Collector-to-Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = -0.3.	BV_{CES}	-40	-	-	volts
With base open:	BV_{CEO}				
For dc collector amperes = -0.3. . . .		-	-40	-	volts
For dc collector amperes = -1[c]		-25	-	-	volts
DC Base-to-Emitter Voltage for dc collector-to-emitter volts = -2, dc collector amperes = -5. .	V_{BE}	-	-0.65	-	volt
DC Collector-to-Emitter Saturation Voltage for dc collector amperes = -12, dc base amperes = -2.	V_{CE} (sat)	-	-0.3	-	volt
DC Emitter Voltage for dc collector volts = -40, dc emitter current = 0. .	V_{EB}	-	-	-1	volt
DC Punch-Through Voltage. .	V_{PT}	-40	-	-	volts
DC Emitter-Cutoff Current for dc emitter volts = -20, dc collector current = 0	I_{EBO}	-	-1	-4	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = -2, dc emitter current = 0		-	-100	-	μa
With dc collector volts = -40, dc emitter current = 0		-	-2	-4	ma
With dc collector volts = -40, dc emitter current = 0, case temperature[b] = 71° C . .		-	-	-15	ma

→ Indicates a change.

World Radio History

DC Current Transfer Ratio for dc collector-to-emitter volts = -2, dc collector amperes =	h_{FE}				
-5.		20	-	40	
-12		-	20	-	
Beta-Cutoff Frequency for dc collector-to-emitter volts = -6, dc collector amperes = -5.	$f_{\alpha e}$	-	10	-	kc
Thermal Resistance: Junction-to-case.	R_T	-	0.35	0.5	°C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds.		-	0.075	-	watt-sec/°C
Thermal Time Constant . . .	τ_l	-	26.25	-	msec

[b] Measured at any point on seating surface.
[c] Tested by sweep method to prevent excessive heating of collector junction.

PERFORMANCE TESTS

This transistor type is designed to pass the environmental tests specified in Military Specification MIL-S-19500B.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

Electrical connection can be made to the base and emitter lugs by means of clips or by soldering directly to the lugs. When soldering connections are made to the lugs, care should be taken to conduct excessive heat away from the lug seals, otherwise the heat of the soldering operation will crack the glass seals of the lugs and damage the transistor.

This transistor is provided with a single-ended stud for mounting to a heat sink and for electrical connection to the collector. (See accompanying *Suggested Mounting Arrangement*). Electrical connection to the base and to the emitter is made to their respective lugs.

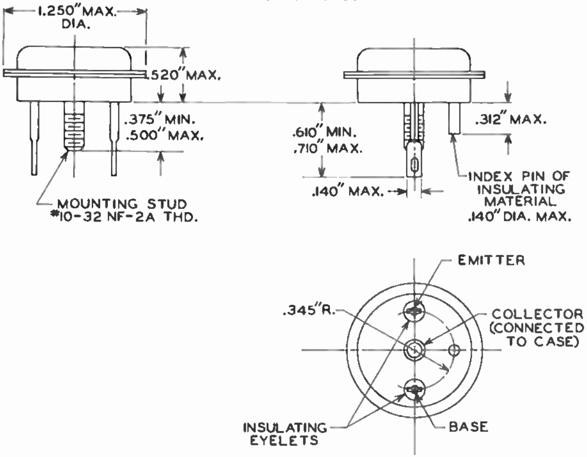
It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

The maximum torque on mounting stud should not exceed 12 inch-pounds.

← Indicates a change.

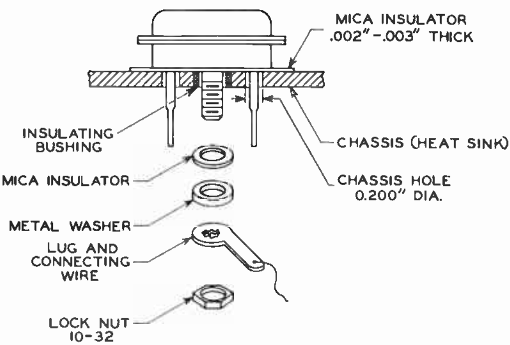
World Radio History

JEDEC No. TO-36



92CM-10612R1

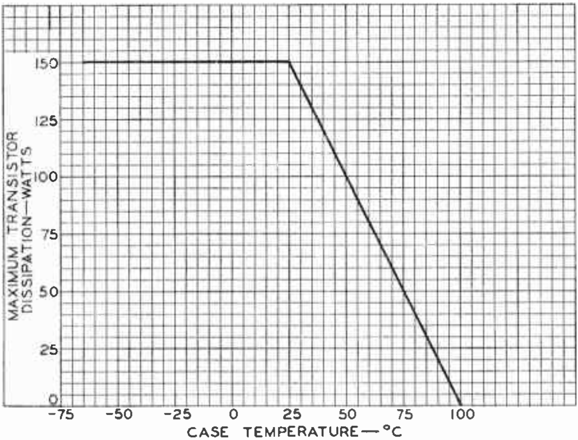
SUGGESTED MOUNTING ARRANGEMENT



92CS-10624R1

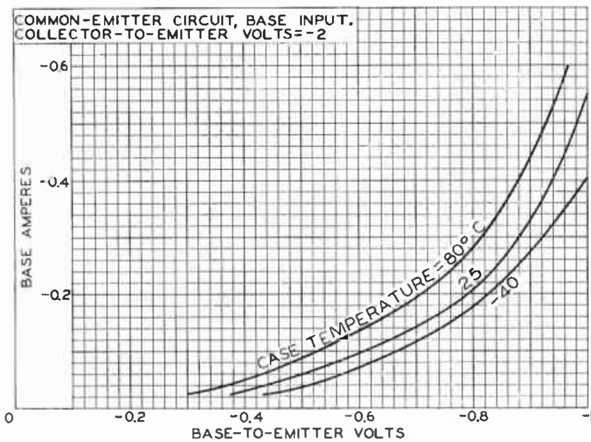
World Radio History

RATING CHART



92CS-10702R1

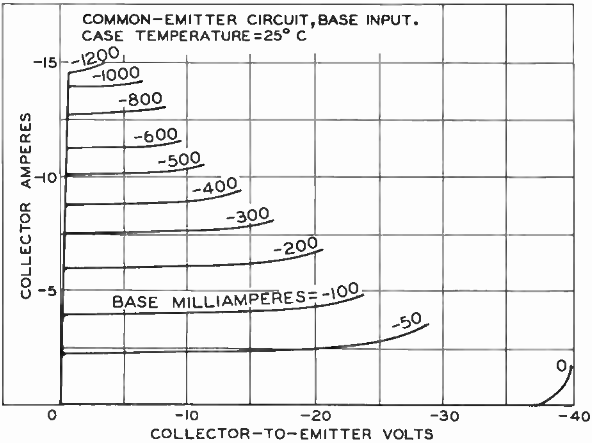
TYPICAL BASE CHARACTERISTICS



92CS-10717

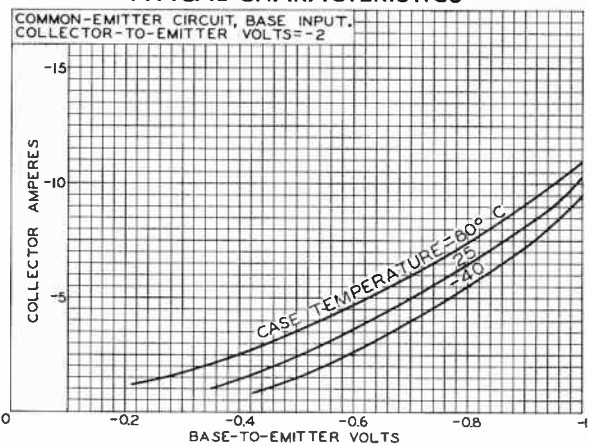
World Radio History

TYPICAL COLLECTOR CHARACTERISTICS



92CS-10732

TYPICAL CHARACTERISTICS



92CS-10720

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

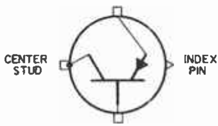
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	1.230"
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No.TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = -1.5)	-40 max.	volts
EMITTER-TO-BASE VOLTAGE	-20 max.	volts
COLLECTOR CURRENT	-15 max.	amp
EMITTER CURRENT	15 max.	amp
BASE CURRENT	-4 max.	amp
TRANSISTOR DISSIPATION:		
At case temperature of 25° C	70 max.	watts
CASE-TEMPERATURE RANGE:		
Continuous operation	-65 to +95	°C
Intermittent operation	-65 to +100	°C
Storage	-65 to +100	°C

Typical Operation:

In a common-emitter, base-input, power-switching circuit at case temperature of 25° C

DC Supply Voltage	-12	volts
DC Base-Bias Voltage	6	volts
"On" DC Collector Current	-12	amp
"Turn-On" Base Current	-2	amp
"Turn-Off" Base Current	0	amp

World Radio History

Switching Time:

Rise time	15	μsec
Fall time	15	μsec

▲ See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in *General Section*.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and case temperature of 25° C unless otherwise specified

		Min.	*Typical*	*Max.*	
DC Collector-to-Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = -0.3.	BV_{CES}	-40	-	-	volts
With base open:	BV_{CEO}				
For dc collector amperes = -0.3. . .		-	-40	-	volts
For dc collector amperes = -1• . . .		-25	-	-	volts
DC Base-to-Emitter Voltage* for dc collector-to-emitter volts = -2, dc collector amperes = -5. .	V_{BE}	-	-0.65	-	volt
DC Collector-to-Emitter Saturation Voltage* for dc collector amperes = -12, base amperes = -2.	V_{CE}	-	-0.3	-	volt
DC Emitter Voltage for dc collector volts = -40, dc emitter amperes = 0. .	V_{EB}	-	-	-1	volt
DC Punch-Through Voltage. .	V_P	-40	-	-	volts
DC Emitter-Cutoff Current for dc emitter volts = -20, dc collector amperes = 0	I_{EBO}	-	-1	-8	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = -2, dc emitter amperes = 0		-	-100	-	μa
With dc collector volts = -40, dc emitter amperes = 0		-	-2	-8	ma
With dc collector volts = -40, dc emitter amperes = 0, case temperature = 71° C . .		-	-	-15	ma

World Radio History

DC Current Transfer Ratio* for dc collector-to-emitter volts = -2, dc collector amperes =	h_{FE}				
-5		20	-	40	
-12		-	20	-	
Beta-Cutoff Frequency* for dc collector-to-emitter volts = -6, dc collector amperes = -5	$f_{\alpha e}$	-	10	-	kc
Thermal Resistance: Junction-to-case	R_T	-	0.7	1	°C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds		-	0.075	-	watt-sec/°C
Thermal Time Constant	τ_1	-	52.5	-	msec

● Sweep voltage used to perform test.

★ Measured in a common-emitter, base-input circuit.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

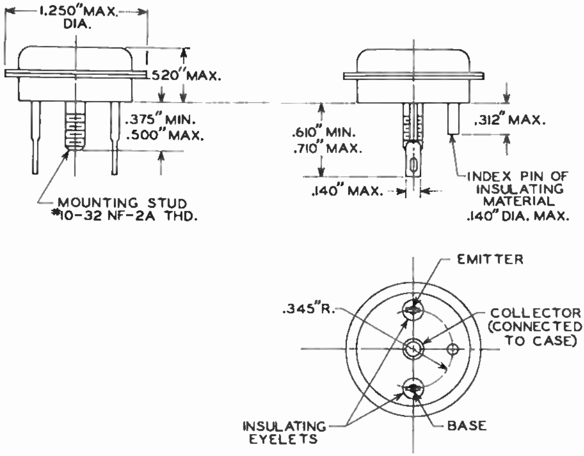
Electrical connection can be made to the base and emitter terminals by means of clips or by soldering directly to the terminals. When soldering connections are made to the terminals, care should be taken to conduct excessive heat away from the terminal seals, otherwise the heat of the soldering operation will crack the glass seals of the terminals and damage the transistor.

This transistor is provided with a single-ended stud for mounting to a heat sink and for electrical connection to the collector. (See accompanying *Suggested Mounting Arrangement*). Electrical connection to the base and to the emitter is made to their respective terminals.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

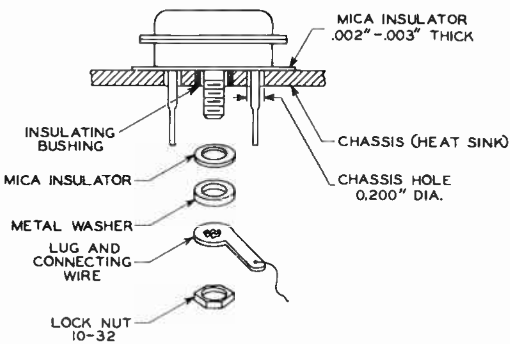
The maximum torque on mounting stud should not exceed 12 inch-pounds.

World Radio History



92CM-10612R1

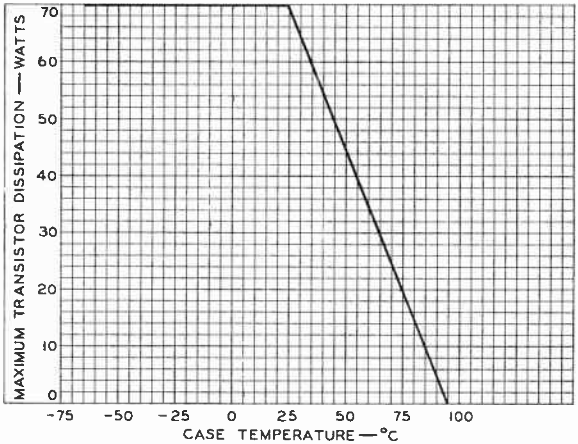
SUGGESTED MOUNTING ARRANGEMENT



92CS-10624R1

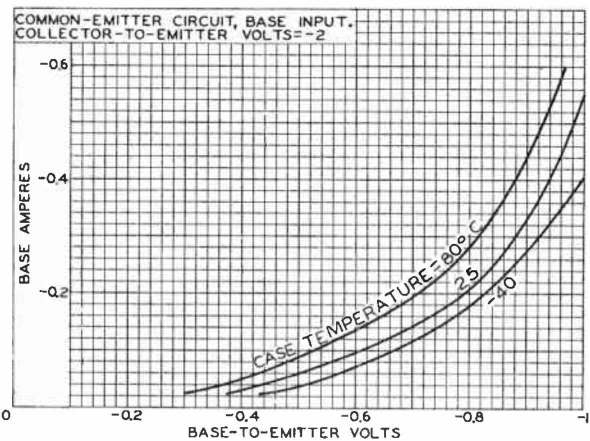
World Radio History

RATING CHART



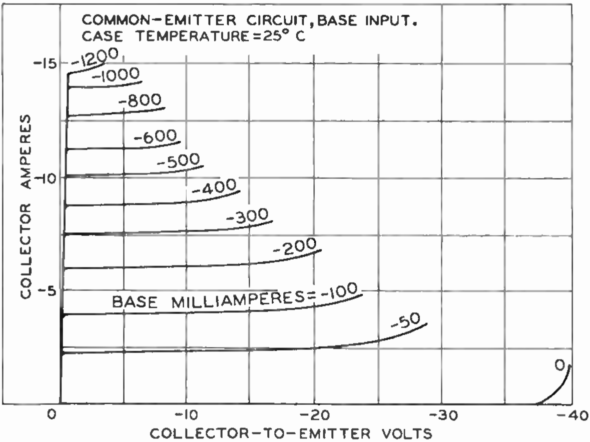
92CS-10701

TYPICAL BASE CHARACTERISTICS



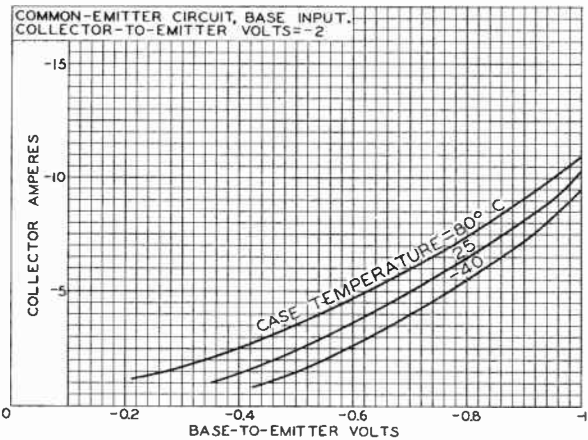
92CS-10717

TYPICAL COLLECTOR CHARACTERISTICS



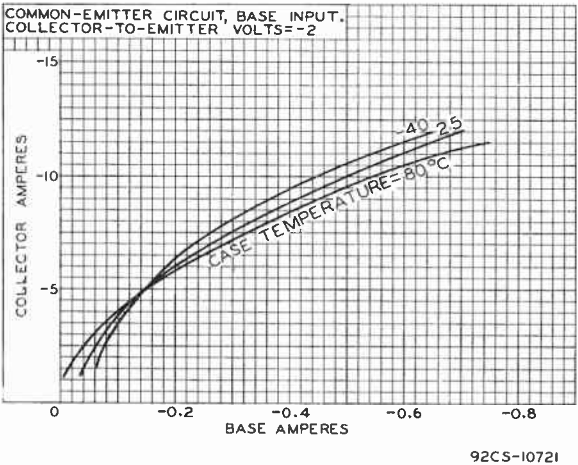
92CS-10732

TYPICAL CHARACTERISTICS



92CS-10720

TYPICAL CHARACTERISTICS



World Radio History

World Radio History

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service in Industrial and Military Applications

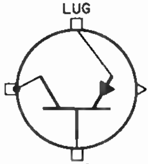
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No. TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = -1.5)	-50 max.	volts
EMITTER-TO-BASE VOLTAGE	-30 max.	volts
COLLECTOR CURRENT	-15 max.	amp
EMITTER CURRENT	15 max.	amp
BASE CURRENT	-4 max.	amp
TRANSISTOR DISSIPATION:[a] ←		
At case temperatures[b] of 25° C or below	150 max.	watts
CASE-TEMPERATURE[b] RANGE: ←		
Operating and storage	-65 to +100	°C

Typical Operation:

In a common-emitter, base-input, power-switching circuit at case temperature[b] of 25° C

DC Supply Voltage	-12	volts
DC Base-Bias Voltage	6	volts
"On" DC Collector Current	-12	amp
"Turn-On" Base Current	-2	amp
"Turn-Off" Base Current	0	amp

← Indicates a change.

World Radio History

Switching Time:

Rise time	15	μsec
Fall time	15	μsec

[a] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

[b] Measured at any point on seating surface.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and at case temperature[b] of 25° C unless otherwise specified

		Min.	*Typical*	*Max.*	
DC Collector-to-Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = -0.3.	BV_{CES}	-45	-	-	volts
With base open:	BV_{CEO}				
For dc collector amperes = -0.3. . . .		-	-45	-	volts
For dc collector amperes = -1[c]		-30	-	-	volts
DC Base-to-Emitter Voltage for dc collector-to-emitter volts = -2, dc collector amperes = -5.	V_{BE}	-	-0.65	-	volt
DC Collector-to-Emitter Saturation Voltage for dc collector amperes = -12, dc base amperes = -2.	$V_{CE(sat)}$	-	-0.3	-	volt
DC Emitter Voltage for dc collector volts = -50, dc emitter current = 0	V_{EB}	-	-	-1	volt
DC Punch-Through Voltage. .	V_{PT}	-50	-	-	volts
DC Emitter-Cutoff Current for dc emitter volts = -30, dc collector current = 0	I_{EBO}	-	-1	-4	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = -2, dc emitter current = 0		-	-100	-	μa
With dc collector volts = -50, dc emitter current = 0		-	-2	-4	ma
With dc collector volts = -50, dc emitter current = 0, case temperature[b] = 71° C. .		-	-	-15	ma

→ indicates a change.

World Radio History

DC Current Transfer Ratio for dc collector-to-emitter volts = -2, dc collector amperes =	h_{FE}				
-5.		20	-	40	
-12		-	20	-	
Beta-Cutoff Frequency for dc collector-to-emitter volts = -6, dc collector amperes = -5.	f_{ae}	-	10	-	kc
Thermal Resistance: Junction-to-case.	R_T	-	0.35	0.5	°C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds.		-	0.075	-	watt-sec/°C
Thermal Time Constant	$\mathcal{T}_I$	-	26.25	-	msec

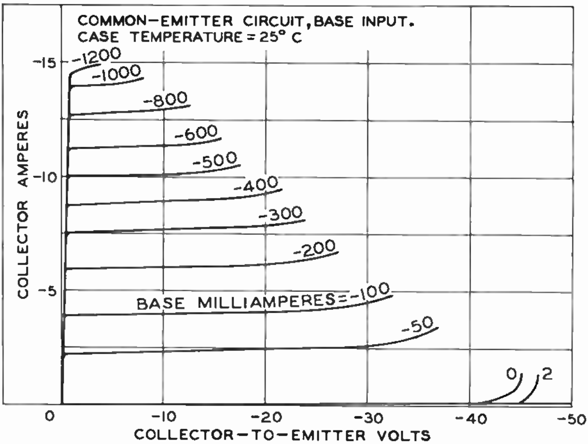
[b] Measured at any point on seating surface.
[c] Tested by sweep method to prevent excessive heating of collector junction.

**PERFORMANCE TESTS,
OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHART,
TYPICAL BASE-CHARACTERISTICS CURVES,
and
TYPICAL CHARACTERISTICS CURVES
shown under Type 2N441 also apply to the 2N442**

→ Indicates a change.

World Radio History

TYPICAL COLLECTOR CHARACTERISTICS



92CS-10739

World Radio History

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

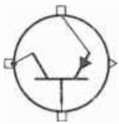
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	1.230"
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No. TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = -1.5)	-50 max.	volts
EMITTER-TO-BASE VOLTAGE	-30 max.	volts
COLLECTOR CURRENT	-15 max.	amp
EMITTER CURRENT	15 max.	amp
BASE CURRENT	-4 max.	amp
TRANSISTOR DISSIPATION:▲		
At case temperature of 25° C	70 max.	watts
CASE-TEMPERATURE RANGE:		
Continuous operation	-65 to +95	°C
Intermittent operation	-65 to +100	°C
Storage	-65 to +100	°C

Typical Operation:

In a common-emitter, base-input, power-switching circuit at case temperature of 25° C

DC Supply Voltage	-12	volts
DC Base-Bias Voltage	6	volts
"On" DC Collector Current	-12	amp
"Turn-On" Base Current	-2	amp
"Turn-Off" Base Current	0	amp

World Radio History

2N442

Switching Time:			
Rise time		15	μsec
Fall time		15	μsec

▲ See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in *General Section*.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and case temperature of 25° C unless otherwise specified

		Min.	Typical	Max.	
DC Collector-to-Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = -0.3. . . .	BV_{CES}	-45	-	-	volts
With base open:	BV_{CEO}				
For dc collector amperes = -0.3. . .		-	-45	-	volts
For dc collector amperes = -1● . . .		-30	-	-	volts
DC Base-to-Emitter Voltage★ for dc collector-to-emitter volts = -2, dc collector amperes = -5.	V_{BE}	-	-0.65	-	volt
DC Collector-to-Emitter Saturation Voltage★ for dc collector amperes = -12, base amperes = -2.	V_{CE}	-	-0.3	-	volt
DC Emitter Voltage for dc collector volts = -50, dc emitter amperes = 0	V_{EB}	-	-	-1	volt
DC Punch-Through Voltage.	V_P	-50	-	-	volts
DC Emitter-Cutoff Current for dc emitter volts = -30, dc collector amperes = 0	I_{EBO}	-	-1	-8	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = -2, dc emitter amperes = 0		-	-100	-	μa
With dc collector volts = -50, dc emitter amperes = 0		-	-2	-8	ma
With dc collector volts = -50, dc emitter amperes = 0, case temperature = 71° C .		-	-	-15	ma

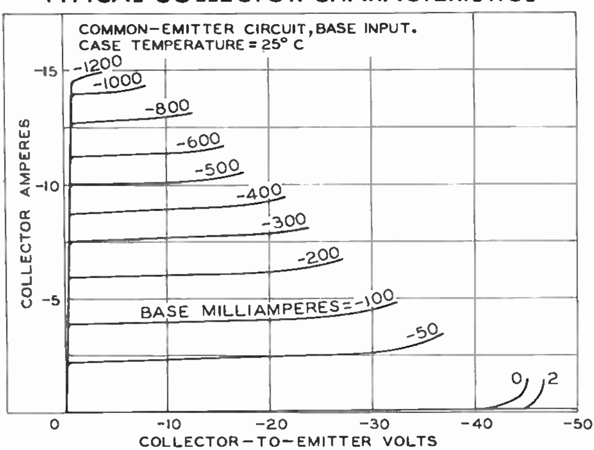
World Radio History

DC Current Transfer Ratio* for dc collector-to-emitter volts = -2, dc collector amperes =	h_{FE}				
-5		20	-	40	
-12.		-	20	-	
Beta-Cutoff Frequency* for dc collector-to-emitter volts = -6, dc collector amperes = -5 .	f_{ae}	-	10	-	kc
Thermal Resistance:					
Junction-to-case	R_T	-	0.7	1	°C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds		-	0.075	-	watt-sec/°C
Thermal Time Constant. . .	τ_1	-	52.5	-	msec

● Sweep voltage used to perform test.
★ Measured in a common-emitter, base-input circuit.

**OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHART,
TYPICAL BASE-CHARACTERISTICS CURVES,
and TYPICAL CHARACTERISTICS CURVES
shown under Type 2N441 also apply to the 2N442**

TYPICAL COLLECTOR CHARACTERISTICS



92CS-10739

World Radio History

World Radio History

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service in Industrial and Military Applications

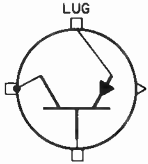
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No. TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = -1.5)	-60 max.	volts
EMITTER-TO-BASE VOLTAGE	-40 max.	volts
COLLECTOR CURRENT	-15 max.	amp
EMITTER CURRENT	15 max.	amp
BASE CURRENT	-4 max.	amp
TRANSISTOR DISSIPATION:[a] ←		
At case temperatures[b] of 25° C or below	150 max.	watts
CASE-TEMPERATURE[b] RANGE: ←		
Operating and storage	-65 to +100	°C

Typical Operation:

In a common-emitter, base-input, power-switching circuit at case temperature[b] of 25° C

DC Supply Voltage	-12	volts
DC Base-Bias Voltage	6	volts
"On" DC Collector Current	-12	amp
"Turn-On" Base Current	-2	amp
"Turn-Off" Base Current	0	amp

← Indicates a change.

World Radio History

Switching Time:				
Rise time		15		μsec
Fall time		15		μsec

[a] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.
[b] Measured at any point on seating surface.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and at case temperature[b] *of 25° C unless otherwise specified*

		Min.	*Typical*	*Max.*	
DC Collector-to-Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = -0.3. . . .	BV_{CES}	-50	-	-	volts
With base open:	BV_{CEO}				
For dc collector amperes = -0.3. . .		-	-55	-	volts
For dc collector amperes = -1[c] . . .		-45	-	-	volts
DC Base-to-Emitter Voltage for dc collector-to-emitter volts = -2, dc collector amperes = -5 . .	V_{BE}	-	-0.65	-0.9	volt
DC Collector-to-Emitter Saturation Voltage for dc collector amperes = -12, dc base amperes = -2.	V_{CE} (sat)	-	-0.3	-1	volt
DC Emitter Voltage for dc collector volts = -60, dc emitter current = 0.	V_{EB}	-	-	-1	volt
DC Punch-Through Voltage.	V_{PT}	-60	-	-	volts
DC Emitter-Cutoff Current for dc emitter volts = -40, dc collector current = 0	I_{EBO}	-	-1	-4	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = -2, dc emitter current = 0		-	-100	-	μa
With dc collector volts = -60, dc emitter current = 0		-	-2	-4	ma
With dc collector volts = -60, dc emitter current = 0, case temperature[b] = 71° C .		-	-	-15	ma

→ Indicates a change.

World Radio History

DC Current Transfer Ratio for dc collector-to-emitter volts = -2, dc collector amperes =	h_{FE}				
-5.		20	-	40	
-12		-	20	-	
Beta-Cutoff Frequency for dc collector-to-emitter volts = -6, dc collector amperes = -5.	$f_{\alpha e}$	-	10	-	kc
Thermal Resistance:					
Junction-to-case. . . .	R_T	-	0.35	0.5	^{o}C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds		-	0.075	-	watt-sec/^{o}C
Thermal Time Constant . .	τ_1	-	26.25	-	msec

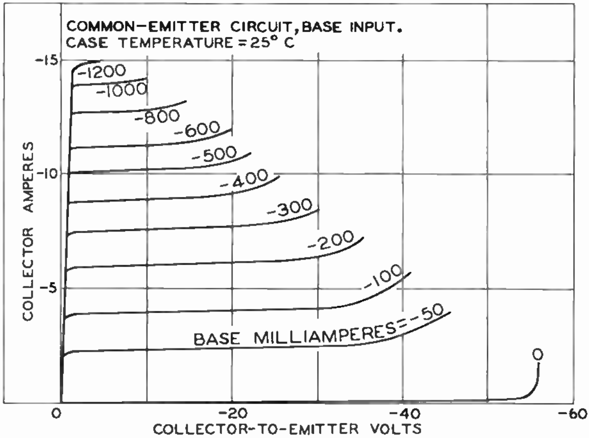
[b] Measured at any point on sealing surface.
[c] Tested by sweep method to prevent excessive heating of collector junction.

PERFORMANCE TESTS,
OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHART,
TYPICAL BASE-CHARACTERISTICS CURVES,
and
TYPICAL CHARACTERISTICS CURVES
shown under Type 2N441 also apply to the 2N443

← Indicates a change.

World Radio History

TYPICAL COLLECTOR CHARACTERISTICS



92CS-10729

World Radio History

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

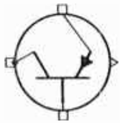
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	1.230"
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No. TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, *Absolute Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = -1.5)	-60 max.	volts
EMITTER-TO-BASE VOLTAGE	-40 max.	volts
COLLECTOR CURRENT	-15 max.	amp
EMITTER CURRENT	15 max.	amp
BASE CURRENT	-4 max.	amp
TRANSISTOR DISSIPATION:▲		
At case temperature of 25° C	70 max.	watts
CASE-TEMPERATURE RANGE:		
Continuous operation	-65 to +95	°C
Intermittent operation	-65 to +100	°C
Storage	-65 to +100	°C

Typical Operation:

In a common-emitter, base-input, power-switching circuit at case temperature of 25° C

DC Supply Voltage	-12	volts
DC Base-Bias Voltage	6	volts
"On" DC Collector Current	-12	amp
"Turn-On" Base Current	-2	amp
"Turn-Off" Base Current	0	amp

World Radio History

Switching Time:

Rise time	15	µsec
Fall time	15	µsec

▲ See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in *General Section*.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and case temperature of 25° C unless otherwise specified

		Min.	*Typical*	*Max.*	
DC Collector-to-Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = −0.3. . . .	BV_{CES}	−50	–	–	volts
With base open:	BV_{CEO}				
For dc collector amperes = −0.3. . .		–	−55	–	volts
For dc collector amperes = −1● . . .		−45	–	–	volts
DC Base-to-Emitter Voltage* for dc collector-to-emitter volts = −2, dc collector amperes = −5 . .	V_{BE}	–	−0.65	−0.9	volt
DC Collector-to-Emitter Saturation Voltage* for dc collector amperes = −12, base amperes = −2.	V_{CE}	–	−0.3	−1	volt
DC Emitter Voltage for dc collector volts = −60, dc emitter amperes = 0.	V_{EB}	–	–	−1	volt
DC Punch-Through Voltage.	V_P	−60	–	–	volts
DC Emitter-Cutoff Current for dc emitter volts = −40, dc collector amperes = 0	I_{EBO}	–	−1	−8	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = −2, dc emitter amperes = 0		–	−100	–	µa
With dc collector volts = −60, dc emitter amperes = 0		–	−2	−8	ma
With dc collector volts = −60, dc emitter amperes = 0, case temperature = 71° C .		–	–	−15	ma

World Radio History

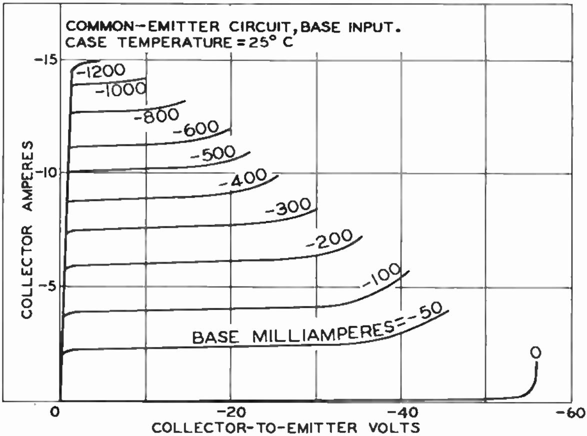
DC Current Transfer Ratio* for dc collector-to-emitter volts = -2, dc collector amperes =	h_{FE}				
-5.		20	-	40	
-12		-	20	-	
Beta-Cutoff Frequency* for dc collector-to-emitter volts = -6, dc collector amperes = -5.	$f_{\alpha e}$	-	10	-	kc
Thermal Resistance: Junction-to-case. . . .	R_T	-	0.7	1	^{o}C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds		-	0.075	-	watt-sec/^{o}C
Thermal Time Constant . .	τ_1	-	52.5	-	msec

• Sweep voltage used to perform test.
* Measured in a common-emitter, base-input circuit.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHART,
TYPICAL BASE-CHARACTERISTICS CURVES,
and TYPICAL CHARACTERISTICS CURVES
shown under Type 2N441 also apply to the 2N443

World Radio History

TYPICAL COLLECTOR CHARACTERISTICS



92CS-10729

World Radio History

2N497

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For Medium-Power Switching and Amplifier Service in Industrial and Military Applications

GENERAL DATA

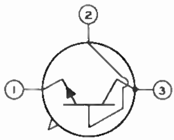
Mechanical:

Operating Position. . . . . Any
Maximum Length (Excluding flexible leads) . . . . 0.260"
Maximum Diameter. . . . . 0.370"
Dimensional Outline . . . . JEDEC No.TO-5
Case. . . . . Metal
Seals . . . . .Hermetic
Leads, Flexible 3
  Minimum length. . . . . 1.5"
  Orientation and diameter. . . . . . See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector, Case

INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and servo-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE.	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With base open	60 max.	volts
EMITTER-TO-BASE VOLTAGE.	8 max.	volts
TRANSISTOR DISSIPATION:[a]		
At case temperature of 25° C	4 max.	watts
At case temperature of 100° C.	2.28 max.	watts
CASE-TEMPERATURE RANGE:		
Operating and storage.	-65 to +200	°C

[a] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base unless otherwise specified. Ambient temperature of 25° C.

		Min.	Typical	Max.	
DC Collector Breakdown Voltage for dc collector ma. = 0.1, dc emitter ma. = 0.	BV_{CBO}	60	-	-	volts

World Radio History

		Min.	Typical	Max.	
DC Collector-to-Emitter Breakdown Voltage for dc collector ma. = 0.25, dc base ma. = 0. . . .	BV_{CEO}	60	-	-	volts
DC Emitter Breakdown Voltage for dc emitter ma. = 0.25, dc collector ma. = 0. . .	BV_{EBO}	8	-	-	volts
DC Collector-Cutoff Current for dc collector volts = 30, dc emitter ma. = 0. . . .	I_{CBO}	-	-	10	μa
DC Current Transfer Ratio for dc collector-to-emitter volts = 10, dc collector ma. = 200 .	h_{FE}	12	-	36	
Input Resistance for dc collector-to-emitter volts = 10, dc collector ma. = 200 . . .	h_{IE}	-	-	500	ohms
DC Collector-to-Emitter Saturation Resistance for dc collector ma. = 200, dc base ma. = 20. .	R_S	-	-	25	ohms
Thermal Resistance:	R_T				
Between junction and case		-	-	43.75	°C/watt
Between junction and free air		-	-	200	°C/watt
Thermal Time Constant. .	τ_1	-	10	-	msec

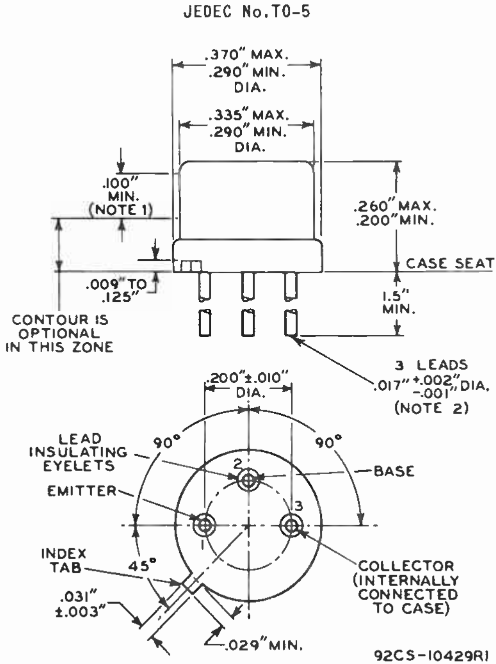
OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

It is to be noted that the case of this transistor operates at the collector voltage. Consideration, therefore, should be given to the possibility of shock hazard, if the case of this transistor is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

World Radio History

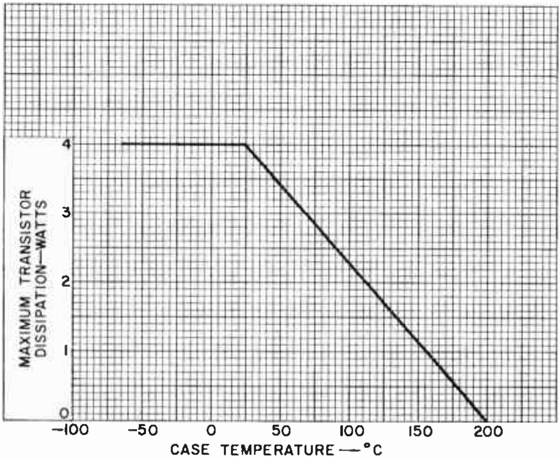


NOTE 1: THE DIAMETER IN THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE TOTAL VARIATION IN ACTUAL DIAMETER FROM THE TRUE DIAMETER, DUE TO TAPER AND OUT OF ROUND WITHIN THIS ZONE, WILL NOT EXCEED 0.010".

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

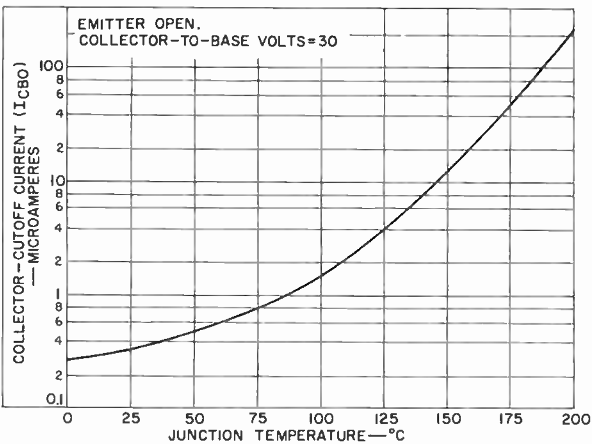
World Radio History

RATING CHART



92CS—10854

TYPICAL OPERATION CHARACTERISTIC



92CS-10841

World Radio History

RCA

2N544

DRIFT TRANSISTOR

GERMANIUM P-N-P ALLOY TYPE

For radio-frequency amplifier applications

GENERAL DATA

Electrical, ***At Ambient Temperature of 25° C:***

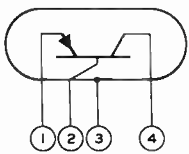
Minimum DC Collector-to-Base Voltage for dc collector current of -50 μa with emitter open.	-18	volts
Maximum DC Collector Current for dc collector-to-base voltage of -12 volts with emitter open.	-4	μa
Maximum DC Emitter Current for dc emitter-to-base voltage of -1 volt with collector open	-12	μa
Interlead Capacitance between collector and base leads with interlead shield connected to ground and all leads cut to 5/16"	0.03	$\mu\mu f$

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads).	0.375"
Maximum Diameter	0.360"
Case	Metal
Envelope Seals	Hermetic
Leads, Flexible.	4
Minimum length	1.5"
Orientation and diameter	*See Dimensional Outline*

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Interlead Shield, Metal Case

Lead 4 - Collector

RADIO-FREQUENCY AMPLIFIER — Class A

Maximum Ratings, ***Absolute Values:***

COLLECTOR-TO-BASE VOLTAGE (DC + Peak AC) .	-18 max.	volts
EMITTER-TO-BASE VOLTAGE (DC + Peak AC) . .	-1 max.	volt
DC COLLECTOR CURRENT	-10 max.	ma
DC EMITTER CURRENT	10 max.	ma
COLLECTOR DISSIPATION:		
At ambient temperature of 25° C.	80 max.	mw
At ambient temperature of 55° C.	50 max.	mw
At ambient temperature of 71° C.	35 max.	mw
AMBIENT TEMPERATURE (During operation) . .	71 max.	°C
STORAGE-TEMPERATURE RANGE.	-65 to +85	°C

SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

2N544

RCA

2N544

DRIFT TRANSISTOR

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-12	volts
DC Emitter Current	1	ma
Current Transfer Ratio (α_f)■	-60	

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-12	volts
DC Emitter Current	1	ma
Current Transfer Ratio (α_f)■	0.984	
Alpha-Cutoff Frequency	30	Mc

Typical Operation, *At Ambient Temperature of 25° C:*

At frequency of	*1.5*	*1.5*	*1.5*	*Mc*
DC Collector-to-Emitter Voltage	-6	-9	-12	volts
DC Emitter Current	0.5	0.5	0.5	ma
Input Resistance, ac output circuit shorted	1300	1700	2100	ohms
Output Resistance, ac input circuit shorted	0.11	0.18	0.28	megohm
Intrinsic Transconductance	18900	18900	18900	µmhos
Collector-to-Base Capacitance	1.85	1.65	1.55	µµf
Maximum Power Gain▲	41.1	44.4	47.3	db
Useful Power Gain:				
In neutralized circuit	30.4	30.4	30.4	db
In unneutralized circuit	25.1	25.1	25.1	db

■ Measured at 1 kc.

▲ Measured in a single-tuned unilateralized circuit matched to the generator and load impedances for maximum transfer of power. Transformer insertion losses not included.

OPERATING CONSIDERATIONS

The 2N544 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of the 2N544 are usually soldered to the circuits elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

The 2N544 utilizes shielding to minimize interlead capacitance and to minimize coupling to adjacent circuit components. This shielding is provided by lead 3 (center lead) situated between the collector lead and the base lead and internally connected to the metal case. For optimum performance, it is recommended that lead 3 be connected to the circuit ground.

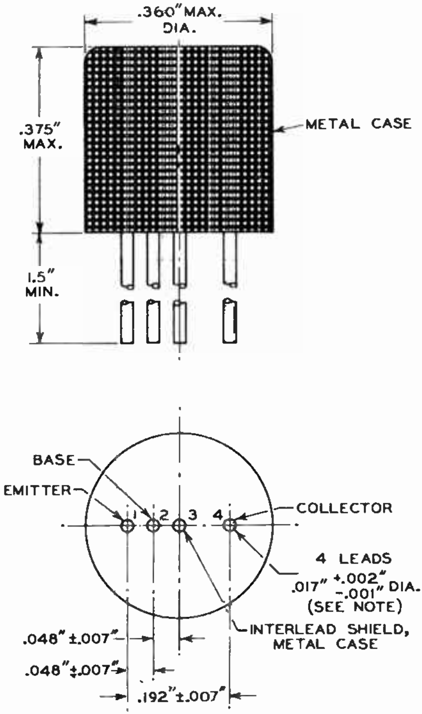
When dip soldering is employed in the assembly of printed circuitry using the 2N544, the temperature of the solder should not exceed 230° C for a maximum immersion period of 10 seconds.

World Radio History

RCA

2N544

DRIFT TRANSISTOR



92CS-9122R3

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE BASE SEAT. BETWEEN 0.250" AND 1.50", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

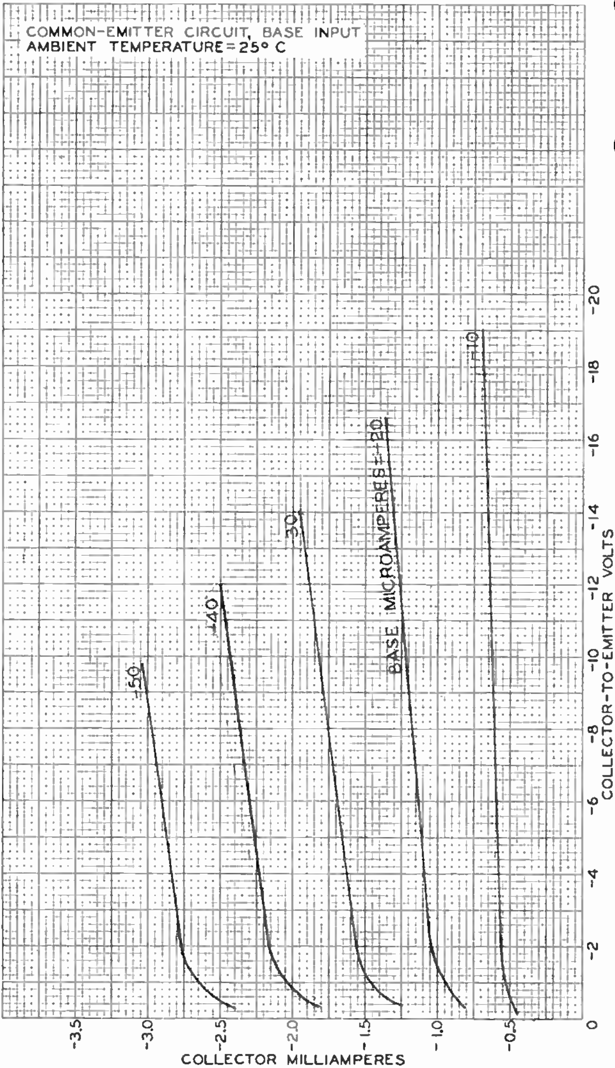
SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

2N544

2N544

AVERAGE COLLECTOR CHARACTERISTICS



92CM-9107

SEMICONDUCTOR DIVISION

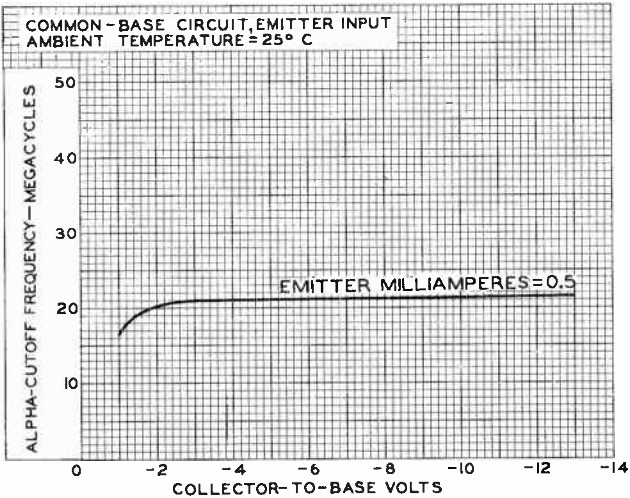
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

World Radio History

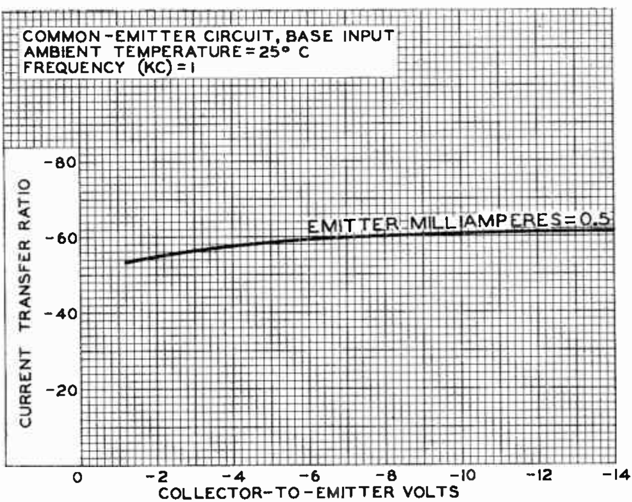
2N544

2N544

AVERAGE CHARACTERISTICS



92CS-9514



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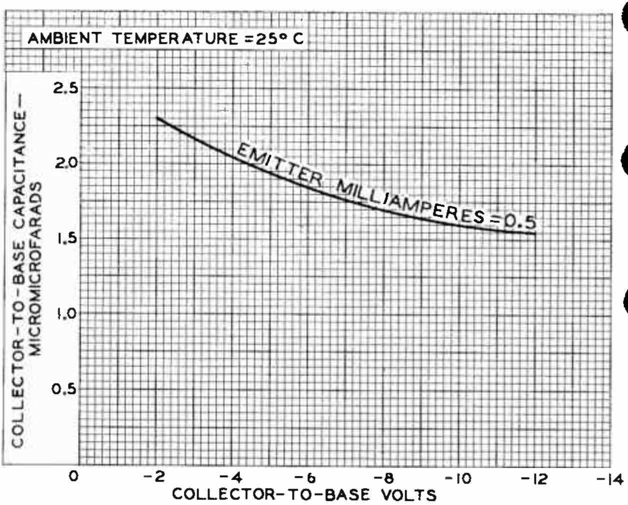
SEMICONDUCTOR DIVISION
RADIO CORPORATION OF AMERICA, SOMERVILLE, NEW JERSEY

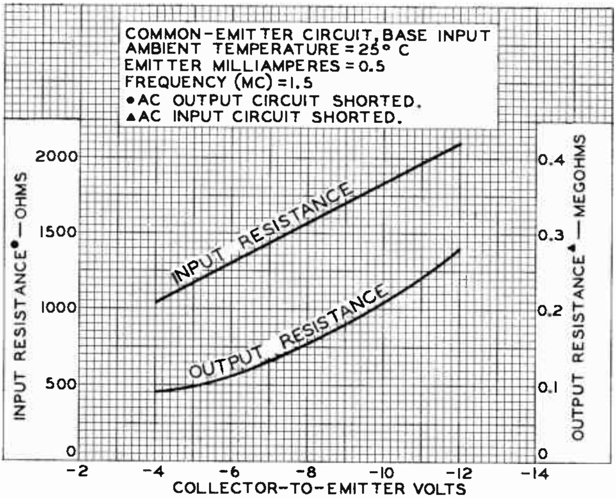
World Radio History

2N544

AVERAGE CHARACTERISTICS



92CS-9516



92CS-9517

World Radio History

Junction Transistor

GERMANIUM P-N-P ALLOY TYPE

For Medium-Speed Switching Service in Commercial and Military Data-Processing Systems

GENERAL DATA

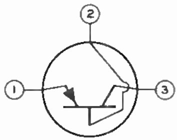
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No. TO-9
Case	Welded, Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	-20	max.	volts
COLLECTOR-TO-EMITTER VOLTAGE: ←			
With emitter-to-base reverse biased (DC emitter-to-base volts = 1)	-14	max.	volts
EMITTER-TO-BASE VOLTAGE	-12	max.	volts
COLLECTOR CURRENT	-400	max.	ma
EMITTER CURRENT	400	max.	ma
TRANSISTOR DISSIPATION:[a]			
At ambient temperature of 25° C	120	max.	mw
At ambient temperature of 55° C	35	max.	mw
At ambient temperature of 71° C	10	max.	mw
AMBIENT TEMPERATURE (During operation)	71	max.	°C
STORAGE-TEMPERATURE RANGE	-65 to +85		°C
LEAD TEMPERATURE: ←			
For immersion in molten solder for 10 seconds maximum	255	max.	°C

Typical Operation:

In typical inverter circuit at ambient temperature of 25° C

"On" Collector Current	-200	ma
"Turn-On" Base Current (I_{B_1})	-20	ma
"Turn-Off" Base Current (I_{B_2})	20	ma

← indicates a change.

World Radio History

➜ "Turn-On" Time	0.6	μsec
"Turn-Off" Time	0.6	μsec

[a] See *Transistor-Dissipation Rating Chart* in General Section.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base unless otherwise specified. Ambient temperature of 25° C.

		Min.	*Typical*	*Max.*	
DC Collector Breakdown Voltage for dc collector ma. = -0.02, dc emitter ma. = 0	BV_{CBO}	-20	-30	-	volts
DC Emitter Breakdown Voltage for emitter ma. = 0.02, dc collector ma. = 0	BV_{EBO}	-12	-20	-	volts
DC Punch-Through Voltage	V_P	-15	-25	-	volts
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = -400, dc base ma. = -40	V_{CE}	-	-0.2	-0.3	volt
➜ DC Base-to-Emitter Voltage for dc collector ma. = -400, dc base ma. = -40	V_{BE}	-	-0.65	-1.2	volts
DC Collector-Cutoff Current for dc collector volts = -12, dc emitter ma. = 0	I_{CBO}	-	-3	-5	μa
➜ DC Emitter-Cutoff Current for dc emitter volts = -6, dc collector ma. = 0	I_{EBO}	-	-3	-	μa
DC Current Transfer Ratio for dc collector-to-emitter volts = -0.3, dc collector ma. = -400	h_{FE}	10	15	-	
Alpha-Cutoff Frequency for dc collector volts = -6, dc emitter ma. = 1	f_{ab}	3	5	-	Mc
➜ Thermal Resistance between collector junction and free air	R_T	-	-	500	°C/watt
➜ Thermal Time Constant	τ_I	-	15	-	msec

OPERATING CONSIDERATIONS

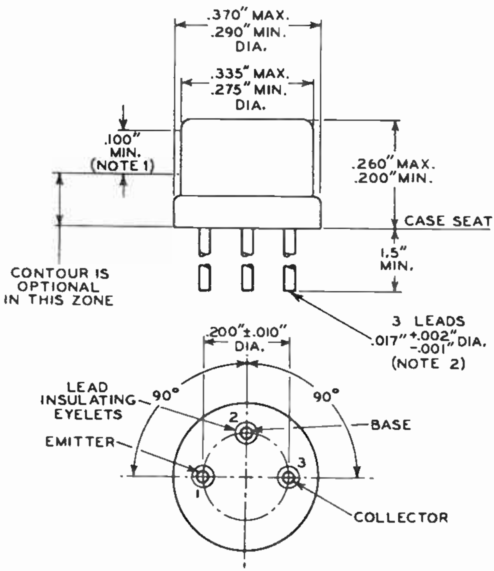
It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

➜ Indicates a change.

World Radio History

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

JEDEC No.TO-9



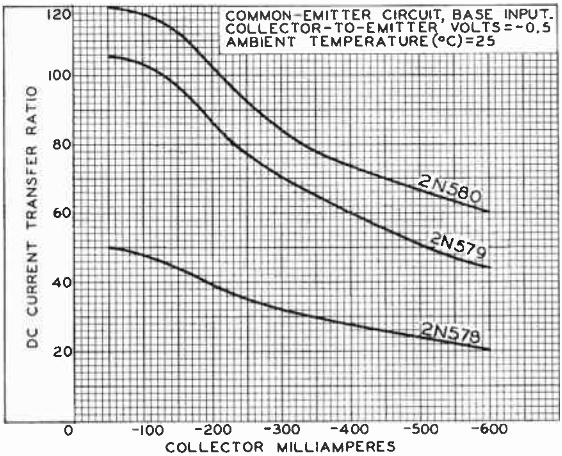
92CS-9371R7

NOTE 1: THE DIAMETER IN THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE TOTAL VARIATION IN ACTUAL DIAMETER FROM THE TRUE DIAMETER, DUE TO TAPER AND OUT OF ROUND WITHIN THIS ZONE, WILL NOT EXCEED 0.010".

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

TYPICAL CHARACTERISTICS



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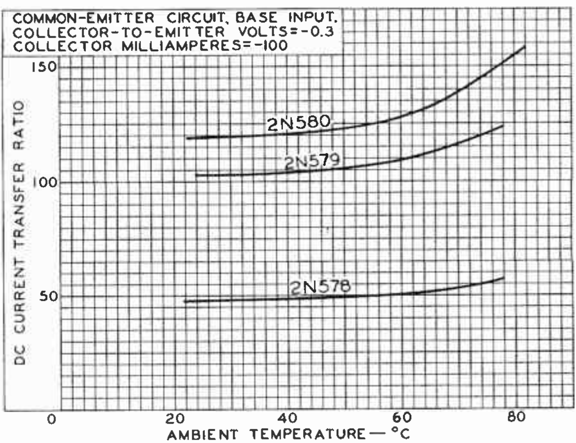
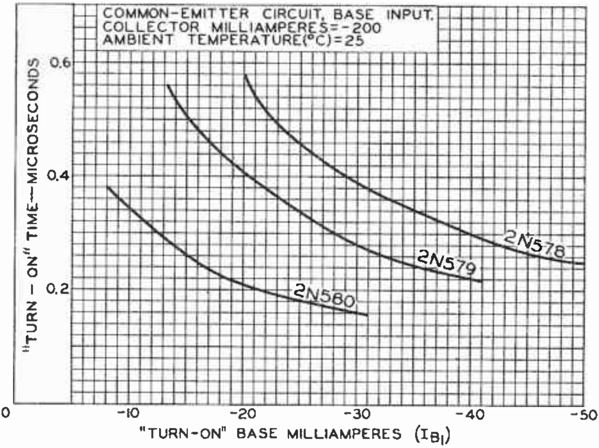


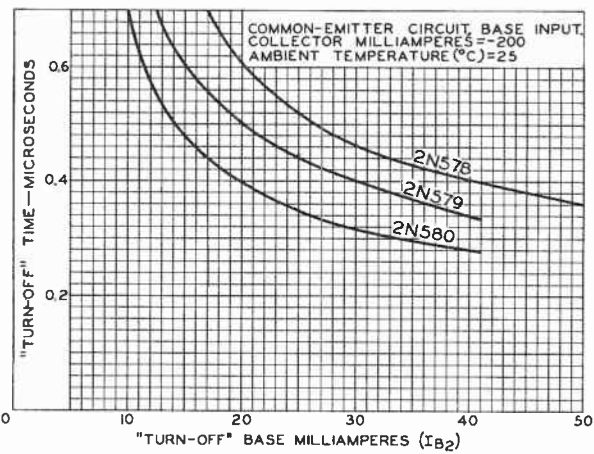
92CS-10862RI

World Radio History

TYPICAL CHARACTERISTICS



92CS-10863R1



92CS-10864

World Radio History

Junction Transistor

GERMANIUM P-N-P ALLOY TYPE

For Medium-Speed Switching Service in Commercial and Military Data-Processing Systems

The 2N579 is the same as the 2N578 except for the following items:

Typical Operation:

In typical inverter circuit at ambient temperature of 25° C

"On" Collector Current	-200	ma
"Turn-On" Base Current (I_{B1})	-20	ma
"Turn-Off" Base Current (I_{B2})	20	ma
"Turn-On" Time	0.4	μsec
"Turn-Off" Time	0.5	μsec

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base unless otherwise specified. Ambient temperature of 25 ° C.

		Min.	Typical	Max.	
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = -400, dc base ma. = -20	V_{CE}	-	-0.2	-0.3	volt
DC Base-to-Emitter Voltage for dc collector ma. = -400, dc base ma. = -20.	V_{BE}	-	-0.63	-1.1	volts
DC Current Transfer Ratio for dc collector-to-emitter volts = -0.3, dc collector ma. = -400.	h_{FE}	20	30	-	
Alpha-Cutoff Frequency for dc collector volts = -6, dc emitter ma. = 1	f_{ab}	5	8	-	Mc

CURVES

for the 2N579 are given on the multitype curve sheet under Type 2N578

World Radio History

World Radio History

Junction Transistor

GERMANIUM P-N-P ALLOY TYPE

For Medium-Speed Switching Service in Commercial and Military Data-Processing Systems

The 2N580 is the same as the 2N578 except for the following items:

Typical Operation:

In typical inverter circuit at ambient temperature of 25° C

"On" Collector Current	-200	ma
"Turn-On" Base Current (I_{B1})	-20	ma
"Turn-Off" Base Current (I_{B2})	20	ma
"Turn-On" Time	0.2	µsec
"Turn-Off" Time	0.4	µsec

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base unless otherwise specified. Ambient temperature of 25° C.

		Min.	*Typical*	*Max.*	
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = -400, dc base ma. = -13.3	V_{CE}	-	-0.2	-0.3	volt
DC Base-to-Emitter Voltage for dc collector ma. = -400, dc base ma. = -13.3	V_{BE}	-	-0.6	-1	volt
DC Current Transfer Ratio for dc collector-to-emitter volts = -0.3, dc collector ma. = -400	h_{FE}	30	45	-	
Alpha-Cutoff Frequency for dc collector volts = -6, dc emitter ma. = 1	f_{ab}	10	15	-	Mc

CURVES

for the 2N580 are given on the multi-type curve sheet under Type 2N578

World Radio History

World Radio History

Transistor

GERMANIUM P-N-P ALLOY-JUNCTION TYPE

For Computer Switching Applications

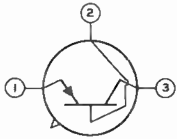
GENERAL DATA

Mechanical: ←

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No.TO-5
Case	Welded, Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter
Lead 2 - Base



Lead 3 - Collector

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:*** ←

COLLECTOR-TO-BASE VOLTAGE	-18 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With dc emitter-to-base volts = -1	-15 max.	volts
EMITTER-TO-BASE VOLTAGE	-10 max.	volts
COLLECTOR CURRENT	-100 max.	ma
EMITTER CURRENT	100 max.	ma
TRANSISTOR DISSIPATION:[a]		
At ambient temperature of 25° C or below	150 max.	mw
At ambient temperature of 55° C	75 max.	mw
At ambient temperature of 71° C	35 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating	-65 to +85	°C
Storage	-65 to +100	°C
LEAD TEMPERATURE:		
For 10 seconds maximum	255 max.	°C

[a] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

← Indicates a change.

World Radio History

2N581

→ ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base unless otherwise specified. Ambient temperature of 25° C.

		Min.	*Typical*	*Max.*	
DC Collector Breakdown Voltage for dc collector ma. = -0.02, dc emitter ma. = 0. .	BV_{CBO}	-18	-30	-	volts
DC Punch-Through Voltage for dc emitter volts = -1.	V_P	-15	-25	-	volts
DC Emitter Breakdown Voltage for dc emitter ma. = -0.02, dc collector ma. = 0.	BV_{EBO}	-10	-25	-	volts
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = -20, dc base ma. = -1.	$V_{CE(sat)}$	-0.2	-0.3	-	volt
DC Base-to-Emitter Saturation Voltage for dc collector ma. = -20, dc base ma. = -1.	$V_{BE(sat)}$	-	-0.35	-0.5	volt
DC Collector-Cutoff Current for dc collector volts = -12, dc emitter ma. = 0. .	I_{CBO}	-	-3	-10	μa
DC Emitter-Cutoff Current for dc emitter volts = -2.5, dc collector ma. = 0 .	I_{EBO}	-	-1	-	μa
Collector-to-Base Capacitance for dc collector volts = -6, dc collector ma. = 0 .	C_{ob}	-	12	20	μμf
DC Current Transfer Ratio for dc collector-to-emitter volts = -0.3, dc collector ma. = -20 .	h_{FE}	20	30	-	
Alpha-Cutoff Frequency for dc collector volts = -6, dc collector ma. = -1 . . .	f_{ab}	4	8	-	Mc
Stored Base Charge for dc collector ma. = -20, dc base ma. = -2.	Q_S	-	1700	2400	μμcoulombs
Thermal Time Constant .	$\mathcal{T}_I$	-	10	-	msec
Thermal Resistance: Junction-to-free air.	R_T	-	-	500	°C/watt

→ Indicates a change.

World Radio History

PERFORMANCE TESTS

This transistor type is tested in accordance with Military Specification MIL-S-19500B.

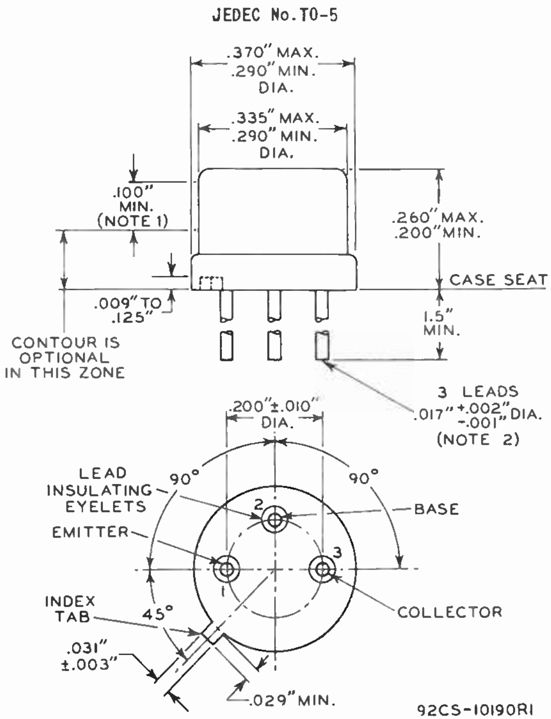
OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the seals of the leads and damage the transistor.

← Indicates a change.

World Radio History

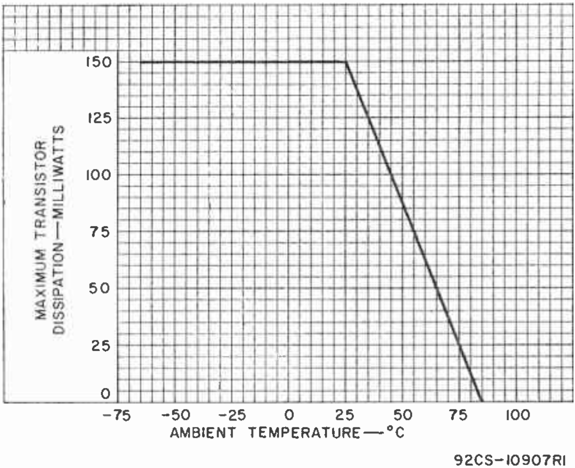


NOTE 1: THE DIAMETER IN THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE TOTAL VARIATION IN ACTUAL DIAMETER FROM THE TRUE DIAMETER, DUE TO TAPER AND OUT OF ROUND WITHIN THIS ZONE, WILL NOT EXCEED 0.010".

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

RATING CHART



World Radio History

World Radio History

Transistor

GERMANIUM P-N-P ALLOY-JUNCTION TYPE

For Computer Switching Applications

GENERAL DATA

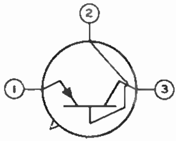
Mechanical: ←

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No.TO-5
Case	Welded, Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:*** ←

COLLECTOR-TO-BASE VOLTAGE	-25 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With dc emitter-to-base volts = -1	-14 max.	volts
EMITTER-TO-BASE VOLTAGE	-12 max.	volts
COLLECTOR CURRENT	-100 max.	ma
EMITTER CURRENT	100 max.	ma
TRANSISTOR DISSIPATION:[a]		
At ambient temperature of 25° C or below	150 max.	mw
At ambient temperature of 55° C	75 max.	mw
At ambient temperature of 71° C	35 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating	-65 to +85	°C
Storage	-65 to +100	°C
LEAD TEMPERATURE:		
For 10 seconds maximum	255 max.	°C

[a] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

← Indicates a change.

World Radio History

→ ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and at ambient temperature of 25° C unless otherwise specified

	Symbol	Min.	Typical	Max.	
DC Collector Breakdown Voltage for dc collector ma. = -0.02, dc emitter ma. = 0. . .	BV_{CBO}	-25	-30	-	volts
DC Punch-Through Voltage for dc emitter volts = -1.	V_P	-14	-30	-	volts
DC Emitter Breakdown Voltage for dc emitter ma. = -0.02, dc collector ma. = 0 . . .	BV_{EBO}	-12	-30	-	volts
DC Collector-to-Emitter Saturation Voltage:	$V_{CE(sat)}$				
With dc collector ma. = -24, dc base ma. = -0.6.		-	-0.12	-0.2	volt
With dc collector ma. = -100, dc base ma. = -5.		-	-0.2	-0.3	volt
DC Base-to-Emitter Saturation Voltage:	$V_{BE(sat)}$				
With dc collector ma. = -24, dc base ma. = -0.6.		-	-0.3	-0.4	volt
With dc collector ma. = -100, dc base ma. = -5.		-	-0.6	-0.8	volt
DC Collector-Cutoff Current for dc collector volts = -12, dc emitter ma. = 0, ambient temperature =	I_{CBO}				
25° C		-	-2	-5	µa
80° C		-	-45	-90	µa
DC Emitter-Cutoff Current for dc emitter volts = -2.5, dc collector ma. = 0	I_{EBO}	-	-1	-	µa
Collector-to-Base Capacitance for dc collector volts = -6, dc collector ma. = 0.	C_{ob}	-	12	20	µµf
DC Current Transfer Ratio:	h_{FE}	-			
With dc collector-to-emitter volts = -0.2, dc collector ma. = -24		40	60	-	

→ indicates a change.

World Radio History

With dc collector-to-emitter volts = -0.3, dc collector ma. = -100.		20	25	-	
Alpha-Cutoff Frequency for dc collector volts = -6, dc collector ma. = -1.	$f_{\alpha b}$	14	18	-	Mc
Stored Base Charge for dc collector ma. = -24, dc base ma. = -1.2	Q_S	-	800	1200	$\mu\mu$coulombs
Thermal Time Constant . .	τ_I	-	10	-	msec
Thermal Resistance: Junction-to-free air. .	R_T	-	-	500	^{o}C/watt

PERFORMANCE TESTS

This transistor type is tested in accordance with Military Specification MIL-S-19500B.

OPERATING CONSIDERATIONS

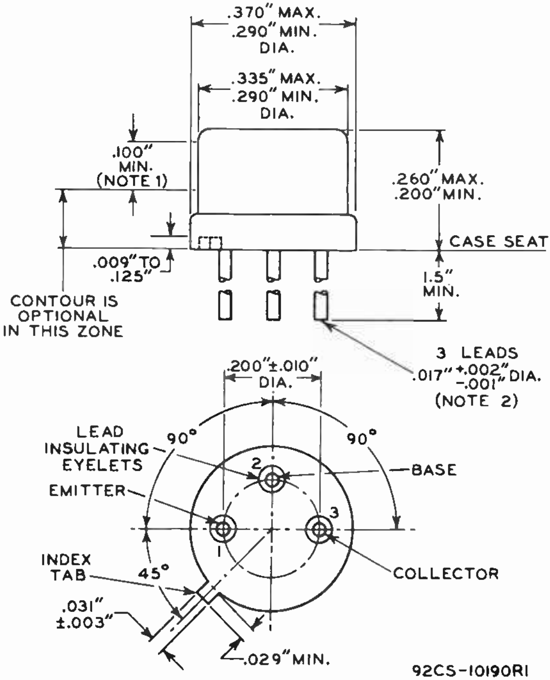
It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the seals of the leads and damage the transistor.

← Indicates a change.

World Radio History

JEDEC No. TO-5



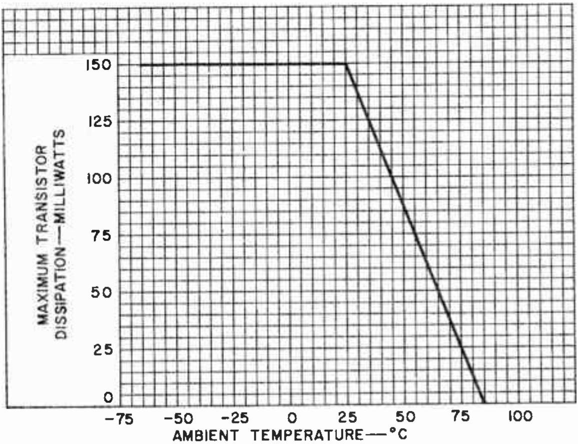
92CS-10190R1

NOTE 1: THE DIAMETER IN THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE TOTAL VARIATION IN ACTUAL DIAMETER FROM THE TRUE DIAMETER, DUE TO TAPER AND OUT OF ROUND WITHIN THIS ZONE, WILL NOT EXCEED 0.010".

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

RATING CHART



92CS-10907RI

World Radio History

World Radio History

Transistor

GERMANIUM P-N-P ALLOY-JUNCTION TYPE

For Computer Switching Applications

GENERAL DATA

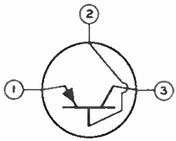
Mechanical: ←

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.410"
Maximum Diameter	0.240"
Dimensional Outline	JEDEC No.TO-1
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector (Adjacent to red dot on side of case)

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:*** ←

COLLECTOR-TO-BASE VOLTAGE	-18 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With dc emitter-to-base volts = -1	-15 max.	volts
EMITTER-TO-BASE VOLTAGE	-10 max.	volts
COLLECTOR CURRENT	-100 max.	ma
EMITTER CURRENT	100 max.	ma
TRANSISTOR DISSIPATION:[a]		
At ambient temperature of 25° C or below	120 max.	mw
At ambient temperature of 55° C	35 max.	mw
At ambient temperature of 71° C	10 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +85	°C
LEAD TEMPERATURE:		
For 10 seconds maximum	255 max.	°C

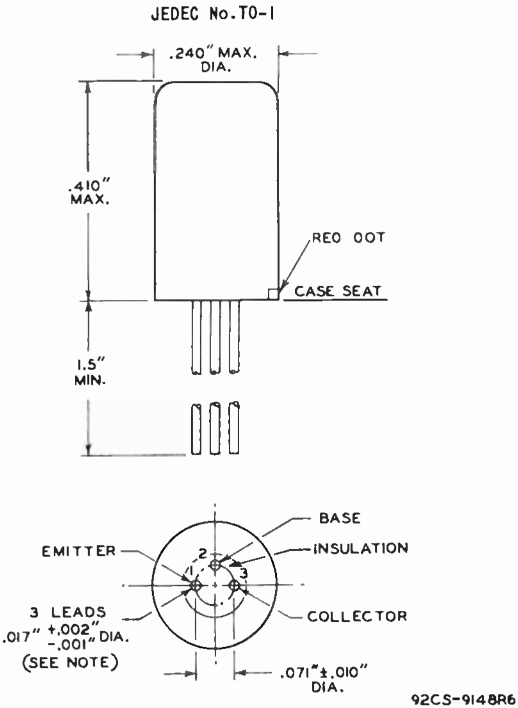
ELECTRICAL CHARACTERISTICS and OPERATING CONSIDERATIONS ←

shown under Type 2N581 also apply to the 2N583

[a] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

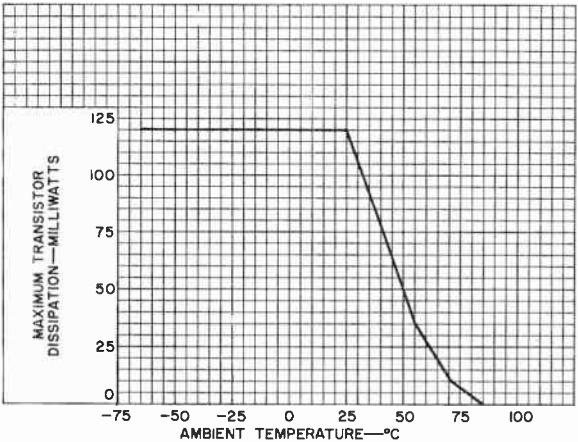
← Indicates a change.

WorldRadioHistory



NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

RATING CHART



92CS—10908R1

World Radio History

World Radio History

2N584

Transistor

GERMANIUM P-N-P ALLOY-JUNCTION TYPE
For Computer Switching Applications

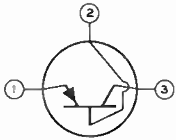
GENERAL DATA

Mechanical:

Operating Position . . . . Any
Maximum Length (Excluding flexible leads) . . . . 0.410"
Maximum Diameter. . . . . 0.240"
Dimensional Outline . . . . JEDEC No. TO-1
Case. . . . . Metal
Seals . . . . .Hermetic
Leads, Flexible 3
  Minimum length. . . . . 1.5"
  Orientation and diameter. . . . . . . See *Dimensional Outline*
Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter

Lead 2 – Base



Lead 3 – Collector (Adjacent to red dot on side of case)

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

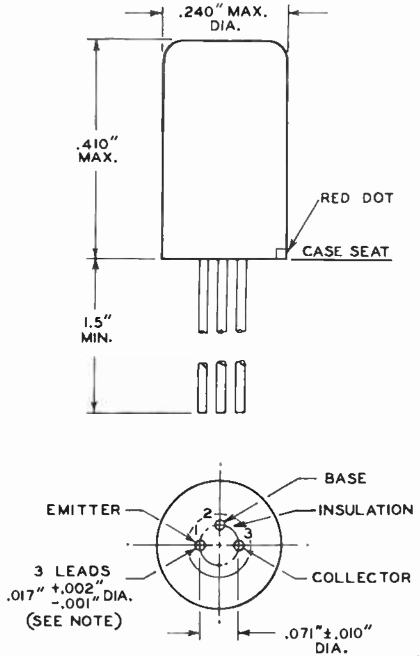
COLLECTOR-TO-BASE VOLTAGE	-25 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With dc emitter-to-base volts = -1. . . .	-14 max.	volts
EMITTER-TO-BASE VOLTAGE	-12 max.	volts
COLLECTOR CURRENT	-100 max.	ma
EMITTER CURRENT	100 max.	ma
TRANSISTOR DISSIPATION:[a]		
At ambient temperature of 25° C or below.	120 max.	mw
At ambient temperature of 55° C	35 max.	mw
At ambient temperature of 71° C	10 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +85	°C
LEAD TEMPERATURE:		
For 10 seconds maximum.	255 max.	°C

ELECTRICAL CHARACTERISTICS
and
OPERATING CONSIDERATIONS
shown under Type 2N582 also apply to the 2N584

[a] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

← Indicates a change.

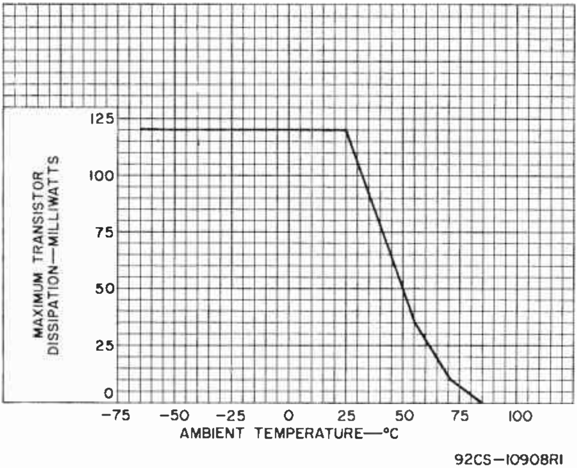
JEDEC No. TO-1



92CS-9148R6

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

RATING CHART



World Radio History

World Radio History

2N656

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For Medium-Power Switching and Amplifier Service in Industrial and Military Applications

The 2N656 is the same as the 2N497 except for the following item:

ELECTRICAL CHARACTERISTICS

		Min.	*Typical*	*Max.*
DC Current Transfer Ratio for dc collector-to-emitter volts = 10, dc collector ma. = 200	h_{FE}	30	–	90

World Radio History

World Radio History

Transistor

SILICON N-P-N DOUBLE-DIFFUSED-JUNCTION TYPE

For Switching Service in Commercial and Military Data-Processing Systems

GENERAL DATA

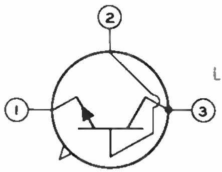
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No. TO-5
Case	Welded, Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector, Case

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE with emitter open	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With external base-to-emitter resistor (ohms) $\leq$ 10	40 max.	volts
EMITTER-TO-BASE VOLTAGE with collector open	5 max.	volts
COLLECTOR CURRENT	500 max.	ma
TRANSISTOR DISSIPATION:[a]		
At case temperature[b] of 25° C or below	2 max.	watts
At free-air temperature of 25° C or below	0.6 max.	watt
OPERATING TEMPERATURE RANGE:		
Case[b] or free air	-65 to +175	°C
LEAD TEMPERATURE:[c]		
For 10 seconds maximum	255 max.	°C

[a] See accompanying *Rating Chart*.
[b] Measured at center of seating surface.
[c] Measured 1/16" ± 1/32" down from seating surface.

World Radio History

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and free-air temperature of 25° C unless otherwise specified

	Symbol	Min.	Typical	Max.	
DC Collector Breakdown Voltage for dc collector ma. = 0.1, emitter open. .	BV_{CBO}	60	75	–	volts
DC Collector-to-Emitter Voltage for dc collector ma. = 100[d], external base-to-emitter resistor (ohms) = 10.	V_{CER}	40	50	–	volts
DC Emitter Breakdown Voltage for dc emitter ma. = 0.1, collector open	BV_{EBO}	5	7.5	–	volts
DC Base-to-Emitter Saturation Voltage for dc collector ma. = 150, dc base ma. = 15	$V_{BE(sat)}$	–	1	1.3	volts
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = 150, dc base ma. = 15	$V_{CE(sat)}$	–	0.9	1.5	volts
DC Collector Cutoff Current for dc collector volts = 30, dc emitter ma. = 0, free-air temperature =	I_{CBO}				
25° C.		–	0.01	1	μa
150° C		–	1	100	μa
Collector-to-Base Capacitance for dc collector volts = 10, dc emitter ma. = 0.	C_{ob}	–	20	35	μμf
DC-Pulse Forward-Current Transfer Ratio for dc collector-to-emitter volts = 10, dc collector ma. = 150, pulse duration (msec) ≤ 12, duty factor ≤ 0.02 . .	h_{FE}	20	40	60	
Small-Signal Forward-Current Transfer Ratio for dc collector-to-emitter volts = 10, dc collector ma. = 50, frequency of 20 Mc. .	h_{fe}	2	4	–	
Gain-Bandwidth Product[e]. . .	f_T	–	80	–	Mc

[d] Pulsed to prevent excessive heating of collector junction.

[e] Frequency at which small-signal forward current transfer ratio is equal to 1.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

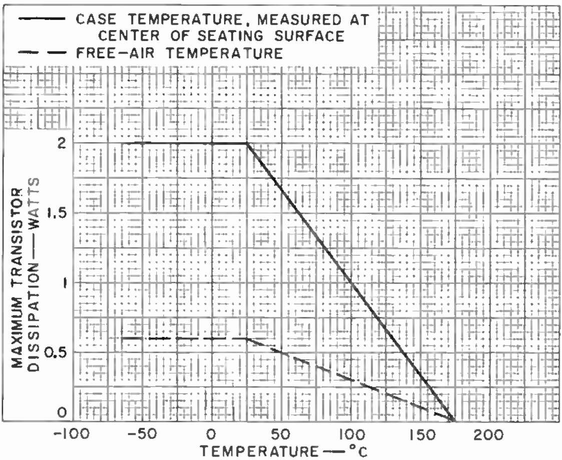
World Radio History

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the seals of the leads and damage the transistor.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

This transistor is intended for use in socketed, single-side printed-circuit boards and in conventional wire-in-type circuits. If this transistor is used in double-side printed-circuit boards or in printed-circuit boards utilizing eyelets, it may be necessary to use an insulating washer or similar standoff device made of good dielectric material to prevent the solder from shorting the leads to each other or to the boards, and to prevent the collector from shorting to ground.

RATING CHART



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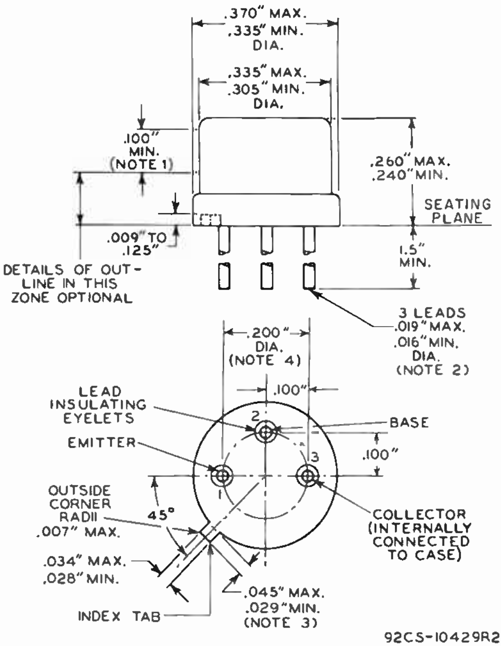
World Radio History

JEDEC No.TO-5



NOTE 1: THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE VARIATION IN ACTUAL DIAMETER WITHIN THE ZONE SHALL NOT EXCEED 0.010".

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE SEATING PLANE. BETWEEN 0.25" AND 1.5" A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 3: MEASURED FROM MAXIMUM DIAMETER OF THE ACTUAL DEVICE.

NOTE 4: LEAOS HAVING MAXIMUM OIAMETER (0.019") MEASUREO IN GAUGING PLANE 0.054" ± 0.001" - 0.000" BELOW THE SEATING PLANE OF THE OEVICE SHALL BE WITHIN 0.007" OF THEIR TRUE LOCATIONS RELATIVE TO A MAXIMUM-WIOTH TAB.

World Radio History

Transistor

SILICON N-P-N DOUBLE-DIFFUSED-JUNCTION TYPE

For Switching Service in Commercial and Military Data-Processing Systems

The 2N697 is the same as the 2N696 except for the following items:

ELECTRICAL CHARACTERISTICS

		Min.	Typical	Max.	
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = 150, dc base ma. = 15. . . .	$V_{CE}(sat)$	-	0.8	1.5	volts
DC-Pulse Forward-Current Transfer Ratio for dc collector-to-emitter volts = 10, dc collector ma. = 150, pulse duration (msec) ≤ 12, duty factor ≤ 0.02. . .	h_{FE}	40	75	120	
Small-Signal Forward Current Transfer Ratio for dc collector-to-emitter volts = 10, dc collector ma. = 150, frequency of 20 Mc. . .	h_{fe}	2.5	5	-	
Gain Bandwidth Product[a] .	f_T	-	100	-	Mc

[a] Frequency at which small-signal forward current transfer ratio is equal to 1.

World Radio History

World Radio History

Mesa Transistor

GERMANIUM P-N-P DIFFUSED-BASE TYPE

For Logic-Circuit Applications in Commercial and Military Data-Processing Equipment

GENERAL DATA

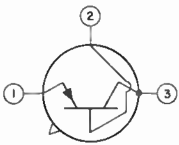
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.210"
Maximum Diameter	0.230"
Dimensional Outline	JEDEC No. TO-18
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	0.500"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter

Lead 2 – Base



Lead 3 – Collector, Case

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	-15 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE	-15 max.	volts
EMITTER-TO-BASE VOLTAGE	-3.5 max.	volts
COLLECTOR CURRENT	-50 max.	ma
EMITTER CURRENT	50 max.	ma
TRANSISTOR DISSIPATION:		
Operation in free air (See *Rating Chart*):		
At ambient temperature of 25° C	150 max.	mw
At ambient temperature of 55° C	90 max.	mw
At ambient temperature of 71° C	58 max.	mw
Operation with heat sink:		
At case temperature of 25° C[a]	300 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +100	°C
LEAD TEMPERATURE:		
For immersion in molten solder for 10 seconds maximum	230 max.	°C

[a] For case temperatures above 25° C, reduce the dissipation by 4 milliwatts/°C.

World Radio History

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base unless otherwise specified. Ambient temperature of 25° C.

		Min.	Typical	Max.	
DC Collector Breakdown Voltage for dc collector ma. = -0.1, emitter current = 0.	BV_{CBO}	-15	-	-	volts
DC Emitter Breakdown Voltage for dc emitter ma. = -0.1, collector current = 0.	BV_{EBO}	-3.5	-	-	volts
DC Collector-to-Emitter Breakdown Voltage for dc emitter volts = 0, dc collector ma. = -0.1	BV_{CES}	-15	-	-	volts
DC Base-to-Emitter Voltage for dc collector ma. = -10, dc base ma. = -0.4. . .	V_{BE}	-0.34	-	-0.44	volt
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = -10, dc base ma. = -0.4	$V_{CE(sat)}$	-	-	-0.3	volt
DC Collector-Cutoff Current for dc collector volts = -5, emitter current = 0 .	I_{CBO}	-	-	-3	μa
Small-Signal Current Transfer Ratio for dc collector-to-emitter volts = -5, dc collector ma. = -10, frequency (Mc) = 100.	h_{fe}	-	3	-	
DC Current Transfer Ratio for dc collector-to-emitter volts = -0.3, dc collector ma. = -10 .	h_{FE}	25	-	-	
Collector Transition Capacitance for dc collector volts = -10, emitter current = 0, frequency (Mc) = 1.	C_{TC}	-	5	-	μμf
Emitter Transition Capacitance for dc emitter volts = -2, collector current = 0, frequency (Mc) = 1.	C_{TE}	-	3.5	-	μμf

World Radio History

"Turn-On" Time (Delay time + rise time) for dc collector-to-emitter supply volts = -3.5, "turn-on" base ma. = -1, collector resistor (ohms) = 300, dc "off" base-to-emitter volts = 0.5	$t_d + t_r$	-	-	75	mμsec
Storage Time for dc collector-to-emitter supply volts = -3.5, "turn-on" base ma. = -1, "turn-off" base ma. = 0.25, collector resistor (ohms) = 300	t_s	-	-	100	mμsec
Fall Time for dc collector-to-emitter supply volts = -3.5, "turn-on" base ma. = -1, "turn-off" base ma. = 0.25, collector resistor (ohms) = 300	t_f	-	-	100	mμsec

PERFORMANCE TESTS

This transistor type is tested in accordance with Military Specification MIL-S-19500B.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

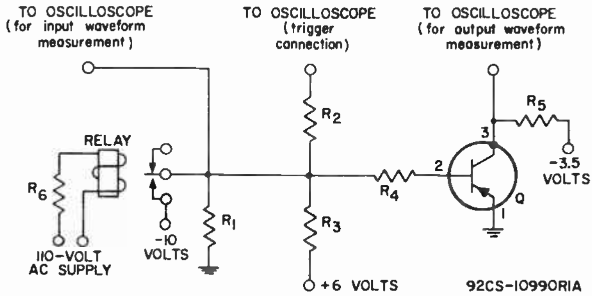
The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

This transistor is intended for use in single-side printed-circuit boards and in conventional wire-in-type circuits. If this transistor is used in double-side printed-circuit boards or in printed-circuit boards utilizing eyelets, it may be necessary to use an insulating washer or similar standoff device made of good dielectric material to prevent the solder from shorting the leads to each other or to the board, and to prevent the collector from shorting to ground.

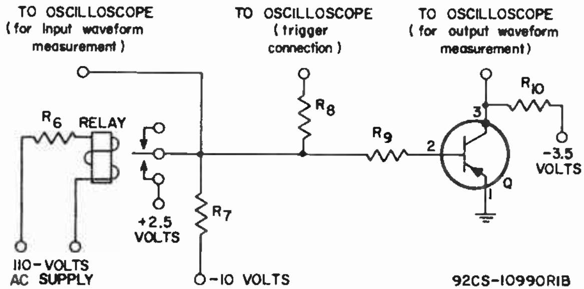
It is to be noted that the case of this transistor operates at the collector voltage. Consideration, therefore, should be given to the possibility of shock hazard, if the case of this transistor is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

World Radio History

SWITCHING-TIME TEST CIRCUITS



(a) "Turn-On" Time Measurement Circuit



(b) "Turn-Off" Time Measurement Circuit

Q: Transistor type 2N705	R_6: 7500 ohms, 0.1 watt
R_1: 1000 ohms, 0.5 watt	R_7: 200 ohms, 0.1 watt
R_2: 5100 ohms, 0.5 watt	R_8: 5100 ohms, 0.5 watt
R_3: 11,000 ohms, 0.5 watt	R_9: 10,000 ohms, 0.5 watt
R_4: 10,000 ohms, 0.5 watt	R_{10}: 300 ohms, 0.5 watt
R_5: 300 ohms, 0.5 watt	

Relay: C.P. Clare mercury relay model HG-2A-1004, or equivalent

Oscilloscope: Tektronix model 545, or equivalent

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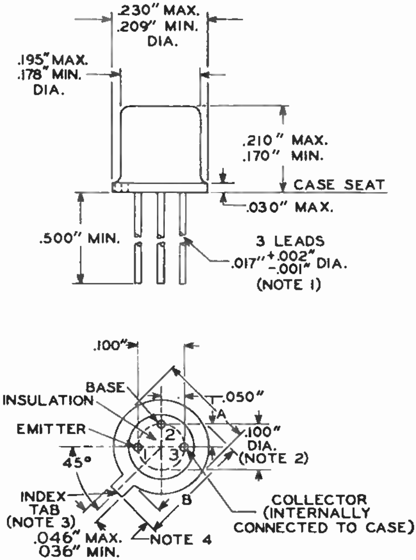
JEDEC No.TO-18



92CS-10605R1

NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" TO THE END OF THE LEAD A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

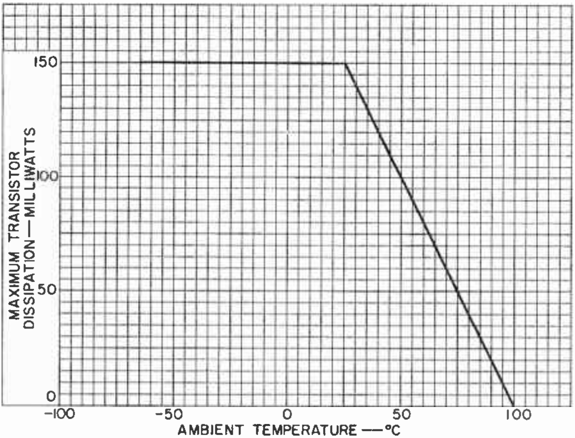
NOTE 2: MAXIMUM DIAMETER LEADS AT A GAUGING PLANE 0.054" + 0.001" - 0.000" BELOW CASE SEAT TO BE WITHIN 0.007" OF THEIR TRUE LOCATION RELATIVE TO MAXIMUM WIDTH TAB AND TO THE MAXIMUM 0.230" DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS USED, MEASUREMENT WILL BE MADE AT CASE SEAT.

NOTE 3: FOR VISUAL ORIENTATION ONLY.

NOTE 4: TAB LENGTH TO BE 0.028" MINIMUM AND 0.048" MAXIMUM, AND WILL BE DETERMINED BY SUBTRACTING DIAMETER "A" FROM DIMENSION "B".

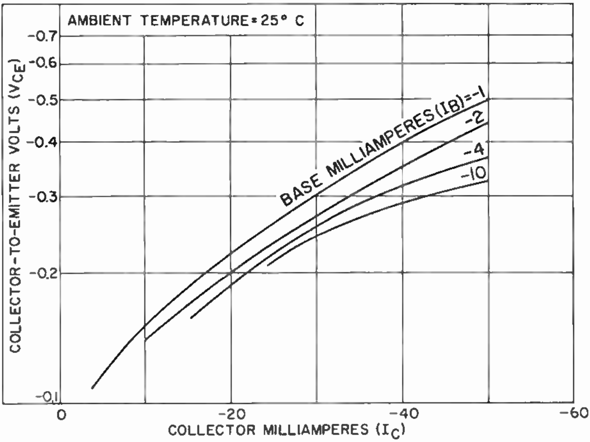
World Radio History

RATING CHART



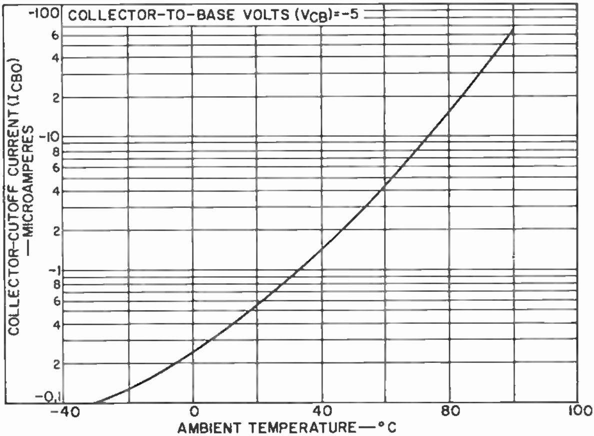
92CS-10968

TYPICAL COLLECTOR CHARACTERISTICS

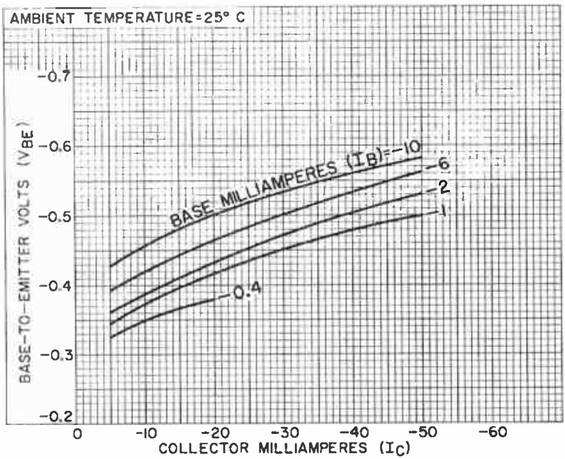


92CS-10971

TYPICAL CHARACTERISTICS



92CS-10976



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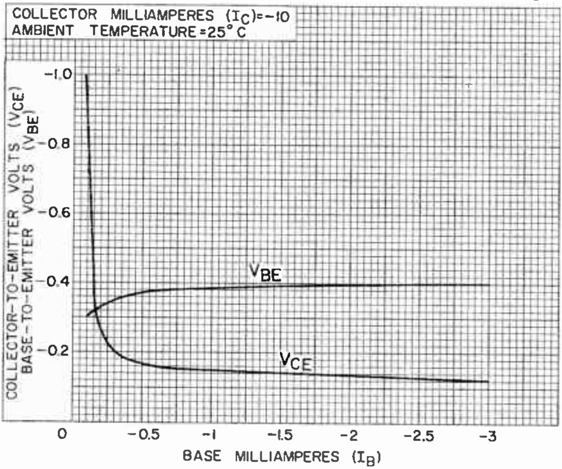
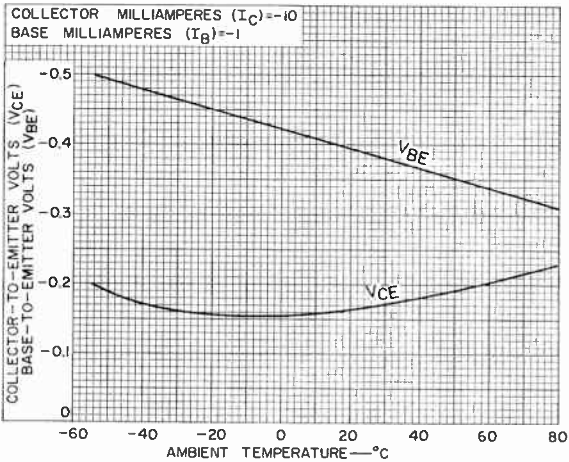
TYPICAL SATURATION-VOLTAGE CHARACTERISTICS



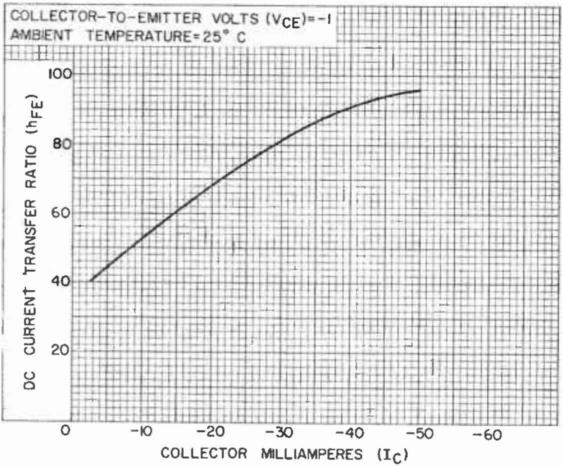
92CS-10972



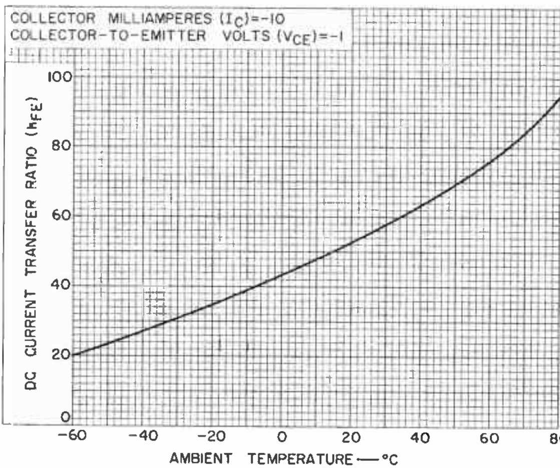
92CS-10986

World Radio History

TYPICAL DC-CURRENT-TRANSFER-RATIO CHARACTERISTICS

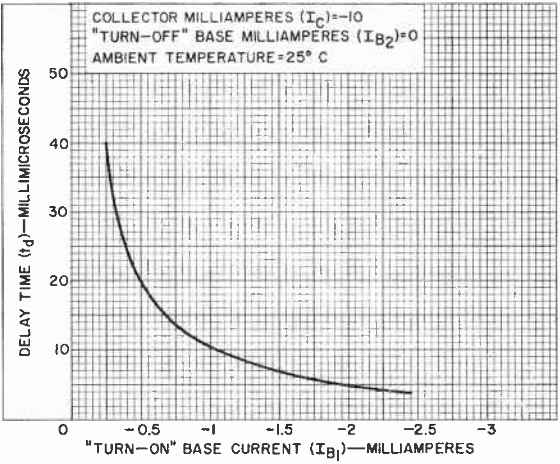


92CS-10974

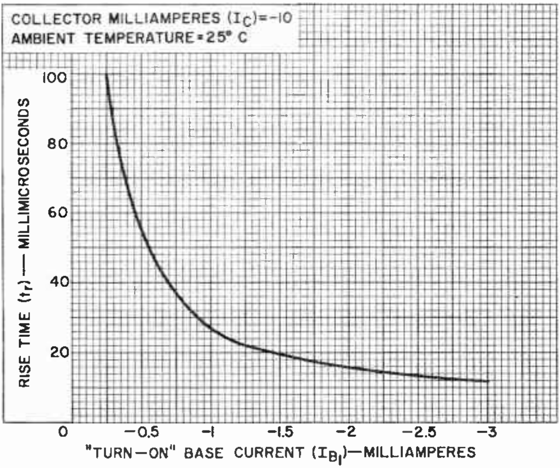


92CS-10988

TYPICAL CHARACTERISTICS

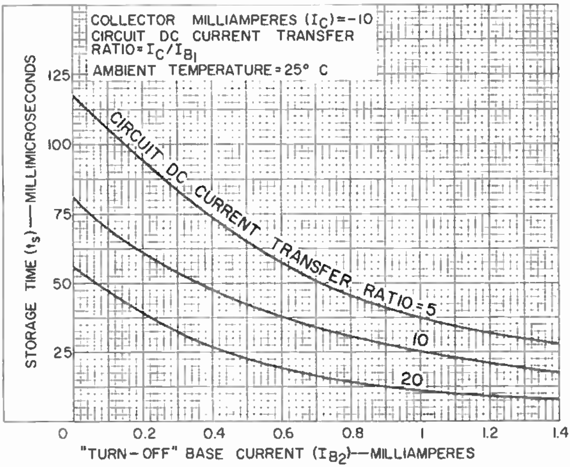


92CS-10984

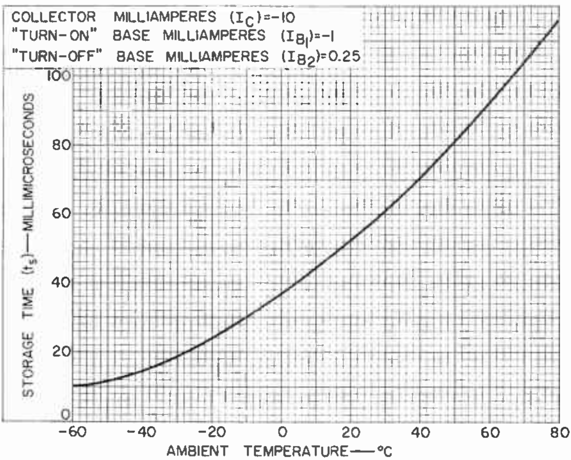


92CS-10985

TYPICAL STORAGE-TIME CHARACTERISTICS



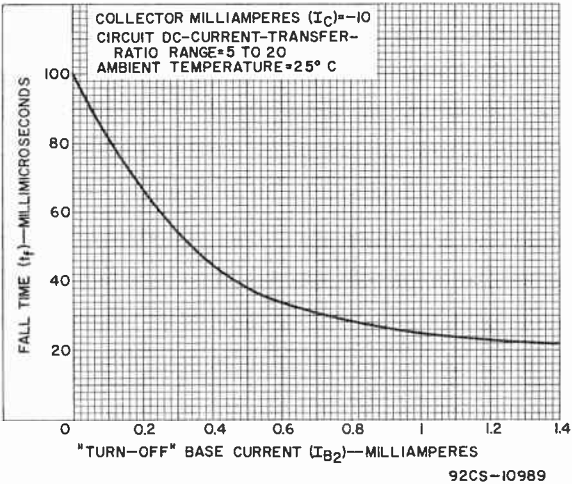
92CS-10975

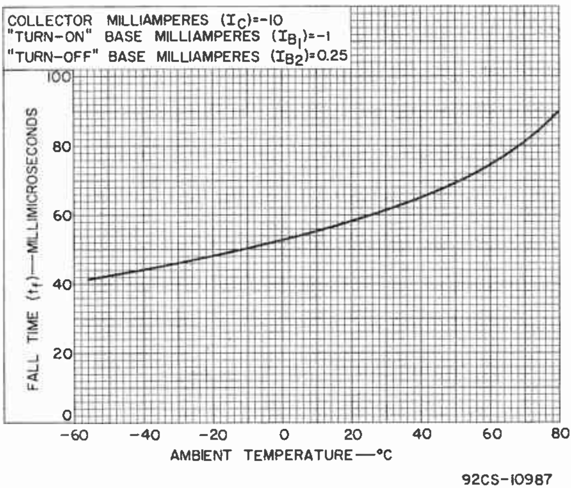


92CS-10973

World Radio History

TYPICAL FALL-TIME CHARACTERISTICS





World Radio History

2N706

Mesa Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE
For Switching Applications

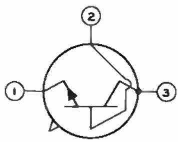
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.210"
Maximum Diameter	0.230"
Dimensional Outline	JEDEC No.TO-18
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	0.500"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter
Lead 2 – Base



Lead 3 – Collector, Case

SWITCHING SERVICE

Maximum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	25 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With external resistor (ohms) = 10 between base and emitter	20 max.	volts
EMITTER-TO-BASE VOLTAGE	3 max.	volts
TRANSISTOR DISSIPATION (See *Rating Chart*):		
Operation in free air:		
At ambient temperature of 25° C	0.3 max.	watt
Operation with heat sink:		
At case temperature of 25° C	1 max.	watt
At case temperature of 100° C	0.5 max.	watt
JUNCTION TEMPERATURE	175 max.	°C

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and ambient temperature of 25° C unless otherwise specified

		Min.	Typical	Max.	
DC Base-to-Emitter Saturation Voltage for dc collector ma. = 10, dc base ma. = 1	$V_{BE(sat)}$	–	0.75	0.9	volt

World Radio History

DC Collector-to-Emitter Saturation Voltage for dc collector ma. = 10, dc base ma. = 1	V_{CE}	-	0.3	0.6	volt
DC Collector-Cutoff Current for dc collector volts = 15, emitter open, ambient temperature =	I_{CBO}				
25° C		-	0.005	0.5	μa
150° C.		-	3.5	30	μa
Collector-to-Base Capacitance for dc collector volts = 10, emitter open.	C_{ob}	-	5	6	μμf
DC-Pulse Current Transfer Ratio for dc collector-to-emitter volts = 1, dc collector ma. = 10, pulse duration (msec) ≦ 12, duty factor ≦ 0.02.	h_{FE}	20	-	-	
Small-Signal Current Transfer Ratio for dc collector-to-emitter volts = 15, dc collector ma. = 10, frequency of 100 Mc.	h_{fe}	2	4	-	
Gain-Bandwith Product . . .	GBW	-	400	-	Mc
Storage Time for dc collector ma. = 10, "turn-on" base ma. (I_{B1}) = 10, "turn-off" base ma. (I_{B2}) = -10	t_s	-	16	60	mμsec

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using this transistor, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds.

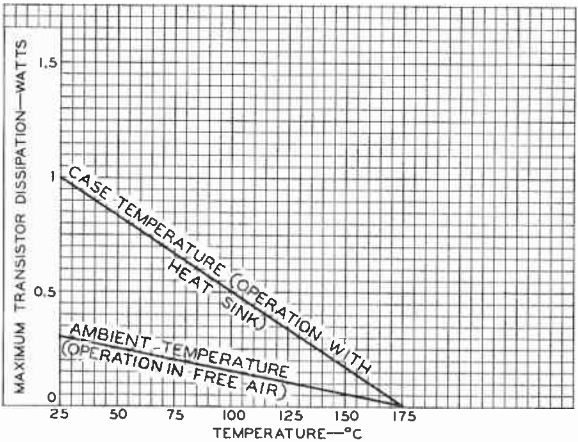
This transistor is intended for use in single-side printed-circuit boards and in conventional wire-in-type circuits. If this transistor is used in double-side printed-circuit boards or in printed-circuit boards utilizing eyelets, it may be necessary to use as insulating washer or similar standoff device made of good dielectric material to prevent the solder

World Radio History

from shorting the leads to each other or to the board, and to prevent the collector from shorting to ground.

It is to be noted that the case of this transistor operates at the collector voltage. Consideration, therefore, should be given to the possibility of shock hazard, if the case of this transistor is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

RATING CHART



92CS-10602

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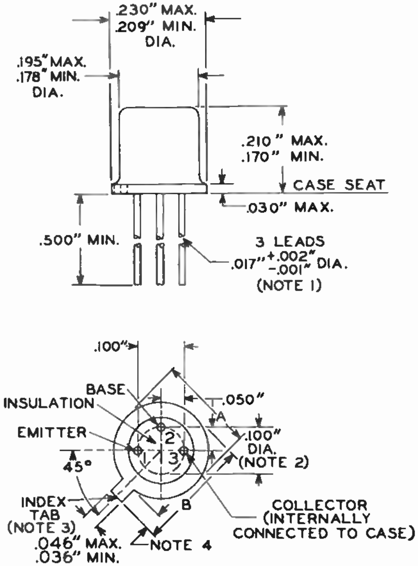


92CS-10605R1

NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" TO THE END OF THE LEAD A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 2: MAXIMUM DIAMETER LEADS AT A GAUGING PLANE 0.054" + 0.001" - 0.000" BELOW CASE SEAT TO BE WITHIN 0.007" OF THEIR TRUE LOCATION RELATIVE TO MAXIMUM WIDTH TAB AND TO THE MAXIMUM 0.230" DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS USED, MEASUREMENT WILL BE MADE AT CASE SEAT.

NOTE 3: FOR VISUAL ORIENTATION ONLY.

NOTE 4: TAB LENGTH TO BE 0.028" MINIMUM AND 0.048" MAXIMUM, AND WILL BE DETERMINED BY SUBTRACTING DIAMETER "A" FROM DIMENSION "B".

World Radio History

Mesa Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE
For Switching Applications

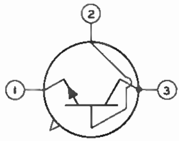
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.210"
Maximum Diameter	0.230"
Dimensional Outline	JEDEC No. TO-18
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	0.500"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter
Lead 2 – Base



Lead 3 – Collector, Case

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	25 max.	volts
COLLECTOR TO EMITTER VOLTAGE:		
With external resistor (ohms) = 10 between base and emitter	20 max.	volts
EMITTER-TO-BASE VOLTAGE	5 max.	volts
COLLECTOR DISSIPATION:		
Operation in free air:		
At ambient temperature of 25° C	0.3 max.	watt
Operation with heat sink:		
At case temperature of 100° C	1 max.	watt
JUNCTION TEMPERATURE	175 max.	°C
AMBIENT-TEMPERATURE RANGE:		
Storage	-65 to +175	°C

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and ambient temperature of 25° C unless otherwise specified

		Min.	*Typical*	*Max.*	
DC Base-to-Emitter Saturation Voltage for dc collector ma. = 10, dc base ma. = 1	$V_{BE(sat)}$	0.7	–	0.9	volt

World Radio History

2N706-A

DC Collector-to-Emitter Saturation Voltage for dc collector ma. = 10, dc base ma. = 1.	V_{CE}	–	–	0.6	volt
DC Collector-Cutoff Current for dc collector volts = 15, emitter open, ambient temperature =	I_{CBO}				
25° C		–	–	0.5	μa
150° C.		–	–	30	μa
DC Current Transfer Ratio for collector-to-emitter volts = 1, dc collector ma. = 10.	h_{FE}	20	–	60	
Small-Signal Current Transfer Ratio for dc collector-to-emitter volts = 10, dc collector ma. = 10, frequency of 100 Mc .	h_{fe}	2	–	–	
"Turn-On" Time for dc collector supply volts = 3, "turn-on" base ma. (I_{B_1}) = 3, "turn-off" base ma. (I_{B_2}) = -1 . . .		–	–	40	mμsec
"Turn-Off" Time for dc collector supply volts = 3, "turn-on" base ma. (I_{B_1}) = 3, "turn-off" base ma. (I_{B_2}) = -1 . . .		–	–	75	mμsec
Storage Time for dc collector ma. = 10, "turn-on" base ma. (I_{B_1}) = 10, "turn-off" base ma. (I_{B_2}) = 10.	t_s	–	–	25	mμsec

OPERATING CONSIDERATIONS
and DIMENSIONAL OUTLINE
shown under Type 2N706 also apply to the 2N706-A

World Radio History

Transistor

SILICON N-P-N DOUBLE-DIFFUSED-JUNCTION PLANAR TYPE

For Switching and Amplifier Applications
in Industrial and Military Equipment

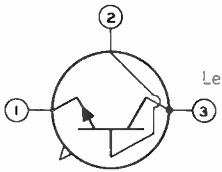
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.210"
Maximum Diameter	0.230"
Dimensional Outline	JEDEC No.TO-18
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	0.500"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter
Lead 2 - Base



Lead 3 - Collector, Case

SWITCHING SERVICE

Maximum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:		
With emitter open	40 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With external resistor (ohms) ≤ 10 between base and emitter	20 max.	volts
With base open	15 max.	volts
EMITTER-TO-BASE VOLTAGE:		
With collector open	5 max.	volts
TRANSISTOR DISSIPATION:[a]		
At case temperature[b] of 25° C or below	1.2 max.	watts
At case temperature[b] of 100° C	0.68 max.	watt
At free-air temperature of 25° C or below	0.36 max.	watt
TEMPERATURE RANGE:		
Storage	-65 to +300	°C
Operating (Junction)	200 max.	°C
LEAD TEMPERATURE:[c]		
For 10 seconds maximum	300 max.	°C

[a] See accompanying *Rating Chart*.
[b] Measured at center of seating plane.
[c] Measured 1/16" ± 1/32" down from seating plane.

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ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and free-air temperature of 25° C unless otherwise specified.

Characteristic	Symbol	Min.	Max.	Unit
DC Collector Breakdown Voltage for dc collector ma. = 0.001, emitter ma. = 0 . . .	BV_{CBO}	40	-	volts
DC Emitter Breakdown Voltage for dc emitter ma. = 0.1, collector ma. = 0.	BV_{EBO}	5	-	volts
DC Collector-to-Emitter Sustaining Voltage:				
With dc collector pulsed ma. = 30, external base-to-emitter resistor (ohms) ≤ 10.	$V_{CER(sus)}$	20	-	volts
With dc collector pulsed ma. = 30, base open. . . .	$V_{CEO(sus)}$	15	-	volts
DC Base-to-Emitter Saturation Voltage:	$V_{BE(sat)}$			
With dc collector ma. = 10, dc base ma. = 1, free-air temperature = 25° C. .		0.72	0.8	volt
With dc collector ma. = 7, dc base ma. = 0.7, free-air temperature = -55° C .		-	0.9	volt
DC Collector-to-Emitter Saturation Voltage:	$V_{CE(sat)}$			
With dc collector ma. = 10, dc base ma. = 1, free-air temperature = 25° C. .		-	0.4	volt
With dc collector ma. = 7, dc base ma. = 0.7, free-air temperature range = -55 to +125° C		-	0.4	volt
DC Collector-Cutoff Current for dc collector volts = 20, dc emitter ma. = 0, free-air temperature =	I_{CBO}			
25° C.		-	0.025	µa
150° C		-	15	µa
DC Collector Current for base-to-emitter forward bias volts = 0.25, dc collector volts = 20, free-air temperature = 125° C . .	I_{CEX}	-	10	µa
DC Emitter-Cutoff Current for dc base-to-emitter volts = 4, dc collector ma. = 0.	I_{EBO}	-	0.08	µa

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Base-Spreading Resistance[d] for dc collector-to-emitter volts = 10, dc collector ma. = 10, frequency (Mc) = 300	$r_{b'}$	-	50	ohms
Collector-to-Base Capacitance for dc collector volts = 10, dc emitter ma. = 0 . . .	C_{ob}	-	6	$\mu\mu$f
Small-Signal Current Transfer Ratio for dc collector-to-emitter volts = 10, dc collector ma. = 10, frequency (Mc) = 100	h_{fe}	3	-	
DC Current Transfer Ratio:	h_{FE}			
With dc collector-to-emitter volts = 1, free-air temperature = 25° C, dc collector ma. =				
10		30	120	
0.5.		15	-	
With dc collector-to-emitter volts = 1, dc collector ma. = 10, free-air temperature = -55° C .		15	-	
Storage Time[e] for dc collector supply volts = 10, collector resistor (ohms) = 1000, "turn-on" and "turn-off" base ma. = 10 each, dc collector ma. = 10	t_s	-	25	mμsec
Thermal Resistance:	R_T			
Junction-to-case		-	145	°C/watt
Junction-to-free air		-	480	°C/watt

[d] Base-Spreading Resistance ($r_{b'}$) is the product of R_e and h_{ie} (small-signal value of the short-circuit input impedance).

[e] See accompanying *Storage-Time-Measurement Circuit*.

OPERATING CONSIDERATIONS

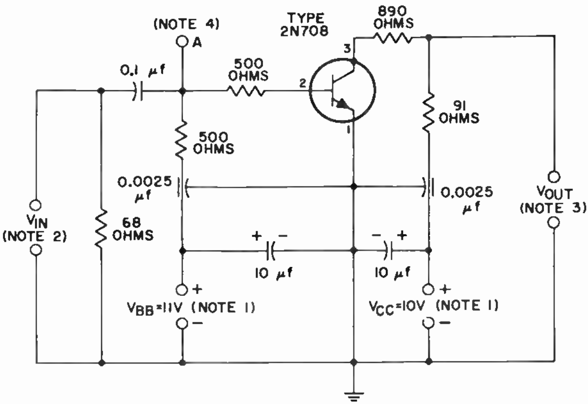
It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the seating plane provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

It is to be noted that the case of this transistor operates at the collector voltage. Consideration, therefore, should be given to the possibility of shock hazard, if the case of this transistor is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

World Radio History

STORAGE-TIME-MEASUREMENT CIRCUIT



92CS-11228

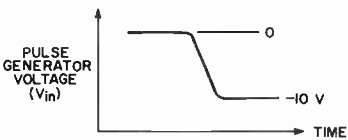
NOTE 1: WITH CERTAIN TYPES OF POWER SUPPLIES, IT MAY BE NECESSARY TO CONNECT 25-μf DECOUPLING CAPACITORS ACROSS THE POWER-SUPPLY TERMINALS FOR V_{CC} AND V_{BB}.

NOTE 2: INPUT VOLTAGE (V_{IN}) OBTAINED FROM MERCURY-RELAY TYPE PULSE GENERATOR HAVING AN OUTPUT IMPEDANCE OF 50 OHMS.

NOTE 3: THE ASSOCIATED INPUT AND OUTPUT WAVEFORMS SHOWN SHOULD BE MONITORED BY MEANS OF A SAMPLING OSCILLOSCOPE HAVING AN INPUT IMPEDANCE OF 50 OHMS.

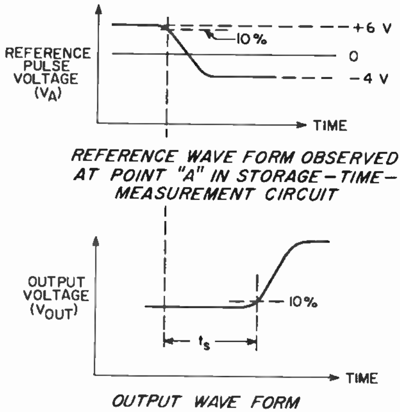
NOTE 4: TEST POINT FOR OBSERVATION OF REFERENCE PULSE VOLTAGE (V_A).

ASSOCIATED WAVE FORMS



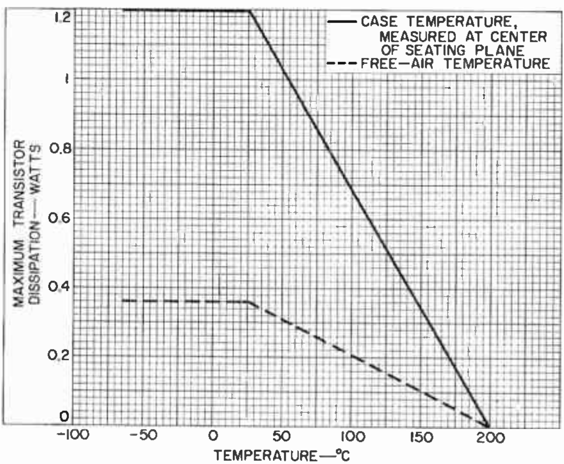
RISE TIME < 1 mμSEC
PULSE DURATION ≥ 300 mμ SEC
DUTY FACTOR < 0.02

INPUT WAVE FORM



92CS-11224

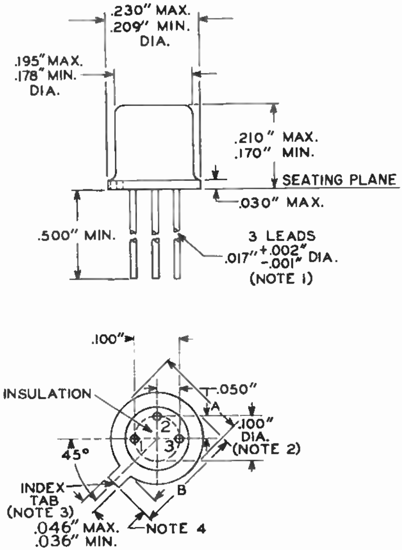
RATING CHART



92CS-11231

World Radio History

JEDEC No.TO-18



92CS-10605R1

NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE SEATING PLANE. BETWEEN 0.25" TO THE END OF THE LEAD, A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 2: MAXIMUM DIAMETER LEADS AT A GAUGING PLANE 0.054" + 0.001" - 0.000" BELOW SEATING PLANE TO BE WITHIN 0.007" OF THEIR TRUE LOCATION RELATIVE TO MAXIMUM WIDTH TAB AND TO THE MAXIMUM 0.230" DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

NOTE 3: FOR VISUAL ORIENTATION ONLY.

NOTE 4: TAB LENGTH TO BE 0.028" MINIMUM AND 0.048" MAXIMUM, AND WILL BE DETERMINED BY SUBTRACTING DIAMETER "A" FROM DIMENSION "B".

Transistor

SILICON N-P-N EPITAXIAL-PLANAR TYPE

For Ultra-High-Speed Logic-Circuit Switching Applications in Commercial and Military Data-Processing Systems. The 2N2475 is a Direct Replacement for Type 2N709.

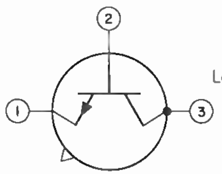
GENERAL DATA

Mechanical:

Dimensions. . . . . .See *Outline TO-18* in General Section

Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter
Lead 2 – Base



Lead 3 – Collector, Case

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:			
With emitter open	V_{CBO}	15 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:			
With base open.	V_{CEO}	6 max.	volts
EMITTER-TO-BASE VOLTAGE:			
With collector open	V_{EBO}	4 max.	volts
COLLECTOR CURRENT	I_C	Limited by power dissipation	
TRANSISTOR DISSIPATION:[a]	P		
At case temperature[b] of 100° C or below		500 max.	mw
At free-air temperature of 25° C or below.		300 max.	mw
TEMPERATURE RANGE:			
Junction (Operating).	T_J	-65 to +200	°C
Storage	T_{STG}	-65 to +300	°C
LEAD TEMPERATURE:[c]			
For 10 seconds maximum.	T_L	300 max.	°C

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, free-air temperature = 25° C

		Min.	Typical	Max.	
DC Collector Breakdown Voltage for dc collector ma. = 0.01, dc emitter current = 0 . . .	BV_{CBO}	15	30	–	volts

[a] See accompanying *Rating Chart.*
[b] Measured at center of seating plane.
[c] Measured 1/16" ± 1/32" along lead, down from seating plane.

		Min.	Typical	Max.	
DC Emitter Breakdown Voltage for dc collector current = 0, dc emitter ma. = 0.01	BV_{EBO}	4	7	-	volts
DC Collector-to-Emitter Sustaining Voltage[d] for dc pulsed collector ma. = 10, dc base current = 0	$V_{CEO}(sus)$	6	10	-	volts
DC Base-to-Emitter Saturation Voltage for dc collector ma. = 3, dc base ma. = 0.15.	$V_{BE}(sat)$	0.7	0.77	0.85	volt
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = 3, dc base ma. = 0.15.	$V_{CE}(sat)$	-	0.26	0.3	volt
DC Collector-Cutoff Current for dc collector-to-base volts = 5, dc emitter current = 0, free-air temperature =	I_{CBO}				
25° C.		-	0.002	0.05	μa
150° C		-	0.9	5	μa
Emitter-to-Base Capacitance for dc emitter-to-base volts = -0.5, dc collector current = 0, frequency (kc) = 140 (Approx.).	C_{ib}	-	1.8	2	pf
Collector-to-Base Capacitance for dc collector-to-base volts = 5, dc emitter current = 0, frequency (kc) = 140 (Approx.).	C_{ob}	-	2.1	3	pf
DC Forward-Current Transfer Ratio:	h_{FE}				
With dc collector-to-emitter volts = 1, dc pulsed collector ma. = 30		15	43	-	
With dc collector-to-emitter volts = 0.5, dc pulsed collector ma. = 10		20	53	120	
With dc collector-to-emitter volts = 0.5, dc pulsed collector ma. = 10, free-air temperature = -55° C .		10	29	-	

World Radio History

Small-Signal Short-Circuit Forward-Current Transfer Ratio for dc collector-to-emitter volts = 4, dc collector ma. = 5, signal frequency (Mc) = 100.	h_{fe}	6	8	-	
Switching Time:					
Storage time[e] for dc collector ma. = 5, turn-on dc base ma. = 5, turn-off dc base ma. = -5	t_s	-	4.1	6	nsec
Turn-On time[f] (Delay time + rise time) for dc collector ma. = 10, turn-on dc base ma. = 2, turn-off dc base ma. = -1	t_{on}	-	6.4	15	nsec
Turn-Off time[f] (Storage time + fall time) for dc collector ma. = 10, turn-on dc base ma. = 1, turn-off dc base ma. = -1	t_{off}	-	8.3	15	nsec

[d] The Collector-to-Emitter Sustaining Voltage [$V_{CEO}(sus)$] with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1: voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[e] See accompanying *Storage-Time-Measurement Circuit.*

[f] See accompanying *Turn-On-Time and Turn-Off-Time Measurement Circuit.*

OPERATING CONSIDERATIONS,
RATING CHART,
STORAGE-TIME MEASUREMENT CIRCUIT,
TURN-ON-TIME AND TURN-OFF-TIME MEASUREMENT CIRCUIT,
and ASSOCIATED WAVE FORMS
shown under type 2N2475 also apply to the 2N709

World Radio History

Mesa Transistor

GERMANIUM P-N-P DIFFUSED-BASE TYPE

For Logic-Circuit Applications in Commercial and Military Data-Processing Equipment

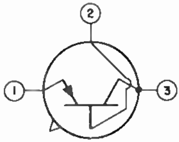
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.210"
Maximum Diameter	0.230"
Dimensional Outline	JEDEC No. TO-18
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	0.500"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter
Lead 2 – Base



Lead 3 – Collector, Case

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	-15 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE	-15 max.	volts
EMITTER-TO-BASE VOLTAGE	-2 max.	volts
COLLECTOR CURRENT	-50 max.	ma
EMITTER CURRENT	50 max.	ma
TRANSISTOR DISSIPATION:		
Operation in free air (See *Rating Chart*):		
At ambient temperature of 25° C	150 max.	mw
At ambient temperature of 55° C	90 max.	mw
At ambient temperature of 71° C	58 max.	mw
Operation with heat sink:		
At case temperature of 25° C[a]	300 max.	mw
AMBIENT TEMPERATURE RANGE:		
Operating and storage	-65 to +100	°C
LEAD TEMPERATURE:		
For immersion in molten solder for 10 seconds maximum	230 max.	°C

[a] For case temperatures above 25° C, reduce the dissipation by 4 milliwatts/°C.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base unless otherwise specified. Ambient temperature of 25° C.

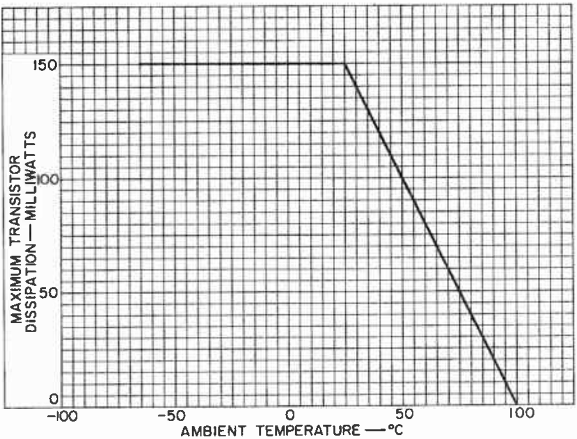
		Min.	Typical	Max.	
DC Collector Breakdown Voltage for dc collector ma. = -0.1, emitter current = 0 . . .	BV_{CBO}	-15	-	-	volts
DC Emitter Breakdown Voltage for dc emitter ma. = -0.1, collector current = 0. . . .	BV_{EBO}	-2	-	-	volts
DC Collector-to-Emitter Breakdown Voltage for dc emitter volts = 0, dc collector ma. = -0.1.	BV_{CES}	-15	-	-	volts
DC Base-to-Emitter Voltage for dc collector ma. = -10, dc base ma. = -0.4	V_{BE}	-0.34	-	-0.5	volt
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = -10, dc base ma. = -0.4.	$V_{CE(sat)}$	-	-	-0.5	volt
DC Collector-Cutoff Current for dc collector volts = -5, emitter current = 0	I_{CBO}	-	-	-3	μa
Small-Signal Current Transfer Ratio for dc collector-to-emitter volts = -5, dc collector ma. = -10, frequency (Mc) = 100.	h_{fe}	-	3	-	
DC Current Transfer Ratio for dc collector-to-emitter volts = -0.5, dc collector ma. = -10. .	h_{FE}	25	-	-	
Collector Transition Capacitance for dc collector volts = -10, emitter current = 0, frequency (Mc) = 1	C_{TC}	-	5	-	μμf
Emitter Transition Capacitance for dc emitter volts = -2, collector current = 0, frequency (Mc) = 1	C_{TE}	-	3.5	-	μμf

"Turn-On" Time (Delay time + rise time) for dc collector-to-emitter supply volts = -3.5, "turn-on" base ma. = -1, collector resistor (ohms) = 300, dc "off" base-to-emitter volts = 0.5	$t_d + t_r$	–	–	75	mμsec
Storage Time for dc collector-to-emitter supply volts = -3.5, "turn-on" base ma. = -1, "turn-off" base ma. = 0.25, collector resistor (ohms) = 300	t_s	–	–	100	mμsec
Fall Time for dc collector-to-emitter supply volts = -3.5, "turn-on" base ma. = -1, "turn-off" base ma. = 0.25, collector resistor (ohms) = 300	t_f	–	–	100	mμsec

PERFORMANCE TESTS,
OPERATING CONSIDERATIONS,
SWITCHING-TIME TEST CIRCUITS,
and
DIMENSIONAL OUTLINE
shown under Type 2N705 also apply to the 2N710

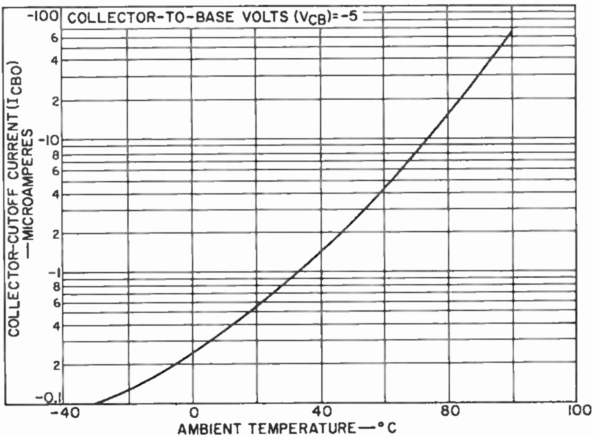
World Radio History

RATING CHART



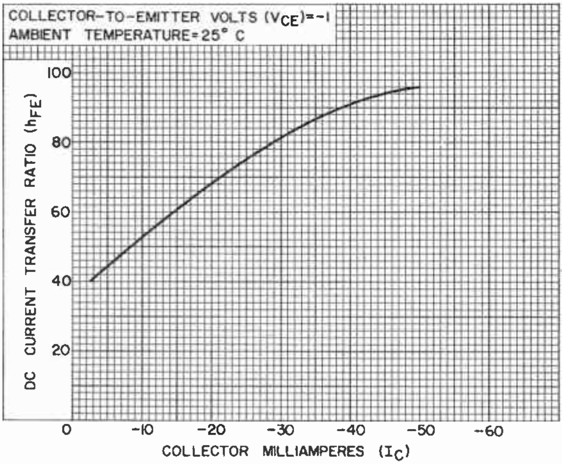
92CS-10968

TYPICAL COLLECTOR-CUTOFF-CURRENT CHARACTERISTIC

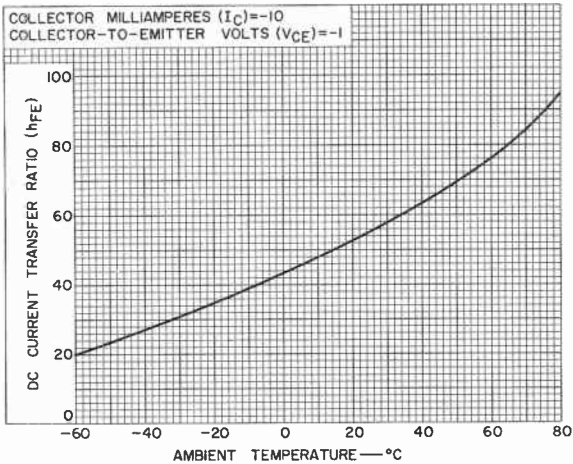


92CS-10976

TYPICAL DC-CURRENT-TRANSFER-RATIO CHARACTERISTICS

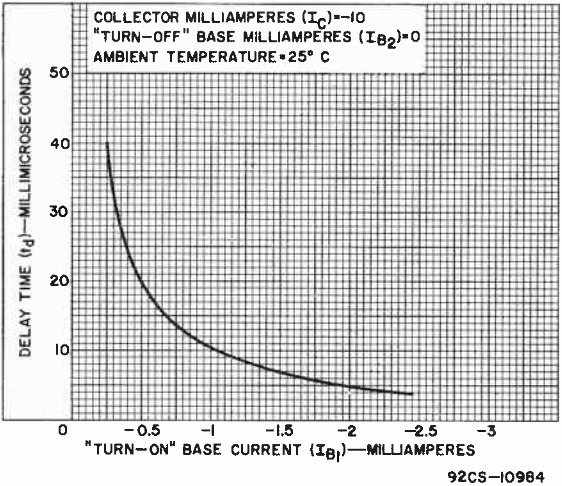


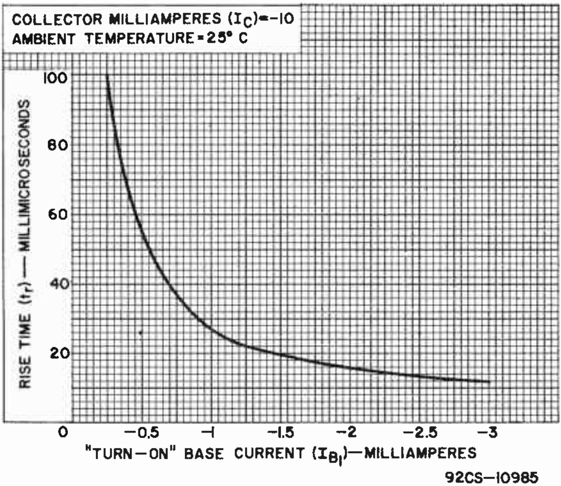
92CS-10974



92CS-10988

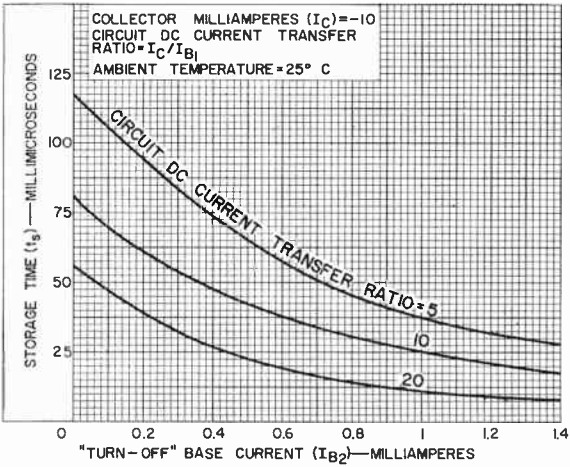
TYPICAL CHARACTERISTICS



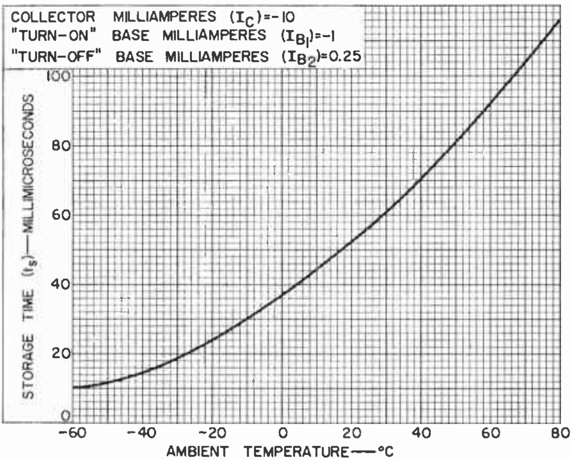


World Radio History

TYPICAL STORAGE-TIME CHARACTERISTICS



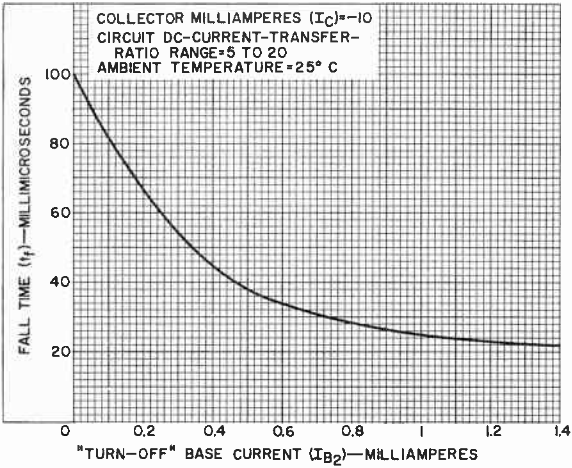
92CS-10975



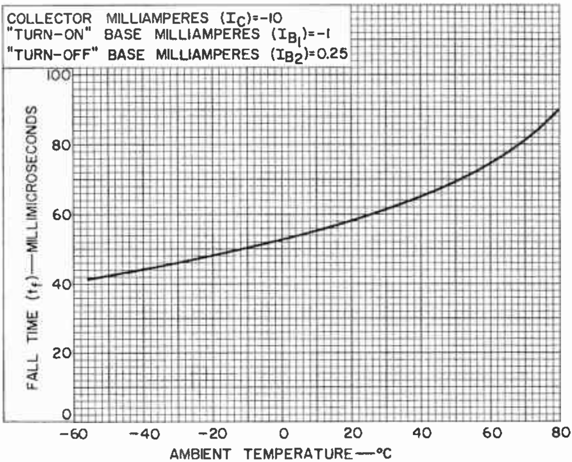
92CS-10973

World Radio History

TYPICAL FALL-TIME CHARACTERISTICS



92CS-10989



92CS-10987

Mesa Transistor

GERMANIUM P-N-P DIFFUSED-BASE TYPE

For Logic-Circuit Applications in Commercial and Military Data-Processing Equipment

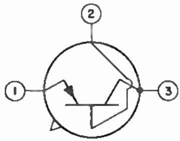
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.210"
Maximum Diameter	0.230"
Dimensional Outline	JEDEC No. TO-18
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	0.500"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter
Lead 2 - Base



Lead 3 - Collector, Case

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	-12 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE	-12 max.	volts
EMITTER-TO-BASE VOLTAGE	-1 max.	volt
COLLECTOR CURRENT	-100 max.	ma
EMITTER CURRENT	100 max.	ma
TRANSISTOR DISSIPATION:		
Operation in free air (See *Rating Chart*):		
At ambient temperature of 25° C	150 max.	mw
At ambient temperature of 55° C	90 max.	mw
At ambient temperature of 71° C	58 max.	mw
Operation with heat sink:		
At case temperature of 25° C[a]	300 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +100	°C
LEAD TEMPERATURE:		
For immersion in molten solder for 10 seconds maximum	230 max.	°C

[a] For case temperatures above 25° C, reduce the dissipation by 4 milliwatts/°C.

World Radio History

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base unless otherwise specified. Ambient temperature of 25° C.

		Min.	Typical	Max.	
DC Collector Breakdown Voltage for dc collector ma. = -0.1, emitter current = 0	BV_{CBO}	-12	-	-	volts
DC Emitter Breakdown Voltage for dc emitter ma. = -0.1, collector current = 0	BV_{EBO}	-1	-	-	volt
DC Collector-to-Emitter Breakdown Voltage for dc emitter volts = 0, dc collector ma. = -0.1 .	BV_{CES}	-12	-	-	volts
DC Base-to-Emitter Voltage for dc collector ma. = -10, dc base ma. = -0.4.	V_{BE}	-0.34	-	-0.5	volt
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = -10, dc base ma. = -0.5. . . .	$V_{CE(sat)}$	-	-	-0.5	volt
DC Collector-Cutoff Current for dc collector volts = -5, emitter current = 0	I_{CBO}	-	-	-3	µa
Small-Signal Current Transfer Ratio for dc collector-to-emitter volts = -5, dc collector ma. = -10, frequency (Mc) = 100.	h_{fe}	-	2	-	
DC Current Transfer Ratio for dc collector-to-emitter volts = -0.5, dc collector ma. = -10. .	h_{FE}	20	-	-	
Collector Transition Capacitance for dc collector volts = -10, emitter current = 0, frequency (Mc) = 1.	C_{TC}	-	5	-	µµf
Emitter Transition Capacitance for dc emitter volts = -2, collector current = 0, frequency (Mc) = 1.	C_{TE}	-	4	-	µµf

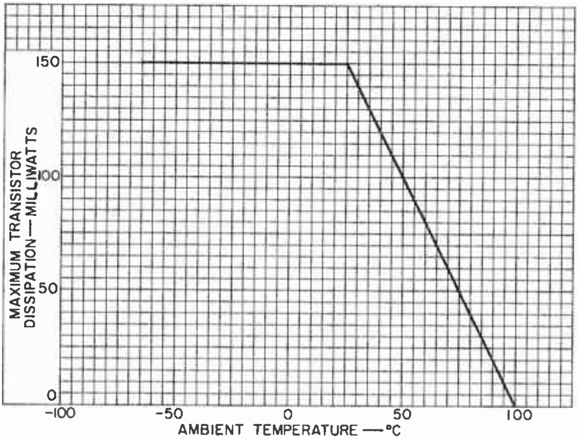
World Radio History

"Turn-On" Time (Delay time + rise time) for dc collector-to-emitter supply volts = -3.5, "turn-on" base ma. = -1, collector resistor (ohms) = 300, dc "off" base-to-emitter volts = 0.5 . . .	$t_d + t_r$	–	–	100	mμsec
Storage Time for dc collector-to-emitter supply volts = -3.5, "turn-on" base ma. = -1, "turn-off" base ma. = 0.25, collector resistor (ohms) = 300	t_s	–	–	200	mμsec
Fall Time for dc collector-to-emitter supply volts = -3.5, "turn-on" base ma. = -1, "turn-off" base ma. = 0.25, collector resistor (ohms) = 300	t_f	–	–	150	mμsec

PERFORMANCE TESTS,
OPERATING CONSIDERATIONS,
SWITCHING-TIME TEST CIRCUITS,
and
DIMENSIONAL OUTLINE
shown under Type 2N705 also apply to the 2N711

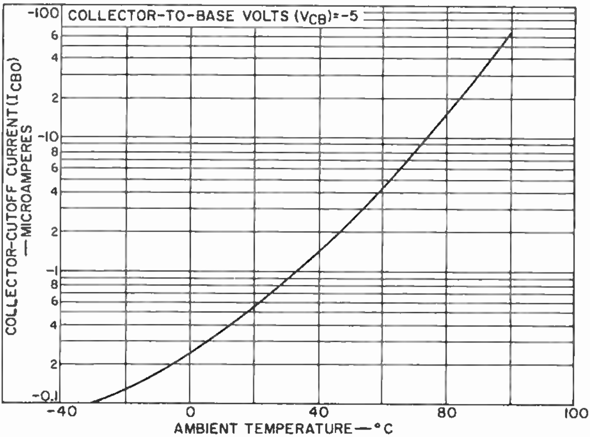
WorldRadioHistory

RATING CHART



92CS-10968

TYPICAL COLLECTOR-CUTOFF-CURRENT CHARACTERISTIC



92CS-10976

Mesa Transistor

GERMANIUM P-N-P DIFFUSED-JUNCTION TYPE

For High-Speed Switching Service in Commercial and Military Data-Processing Systems

The 2N794 is the same as the 2N1300 except for the following items:

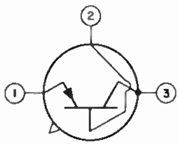
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.210"
Maximum Diameter	0.230"
Dimensional Outline	JEDEC No. TO-18
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	0.500"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



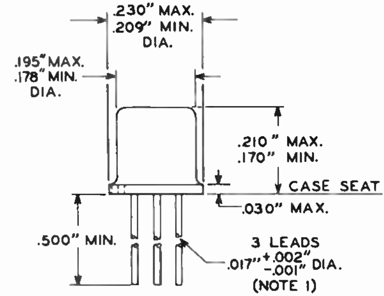
Lead 3 - Collector, Case

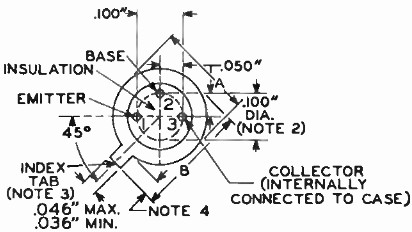
OPERATING CONSIDERATIONS

It is to be noted that the case of this transistor operates at the collector voltage. Consideration, therefore, should be given to the possibility of shock hazard, if the case of this transistor is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

World Radio History

JEDEC No.TO-18





92CS-10605R1

NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" TO THE END OF THE LEAD A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 2: MAXIMUM DIAMETER LEADS AT A GAUGING PLANE 0.054" + 0.001" - 0.000" BELOW CASE SEAT TO BE WITHIN 0.007" OF THEIR TRUE LOCATION RELATIVE TO MAXIMUM WIDTH TAB AND TO THE MAXIMUM 0.230" DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS USED, MEASUREMENT WILL BE MADE AT CASE SEAT.

NOTE 3: FOR VISUAL ORIENTATION ONLY.

NOTE 4: TAB LENGTH TO BE 0.028" MINIMUM AND 0.048" MAXIMUM, AND WILL BE DETERMINED BY SUBTRACTING DIAMETER "A" FROM DIMENSION "B".

World Radio History

Mesa Transistor

GERMANIUM P-N-P DIFFUSED-JUNCTION TYPE

For High-Speed Switching Service in Commercial and Military Data-Processing Systems

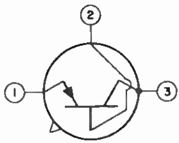
The 2N795 is the same as the 2N1301 except for the following items:

Mechanical:

Operating Position . . . . Any
Maximum Length (Excluding flexible leads) . . . . 0.210"
Maximum Diameter. . . . . 0.230"
Dimensional Outline . . . . .JEDEC No.TO-18
Case. . . . . Metal
Seals . . . . .Hermetic
Leads, Flexible 3
Minimum length. . . . . 0.500"
Orientation and diameter. . . . . . See *Dimensional Outline*
Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



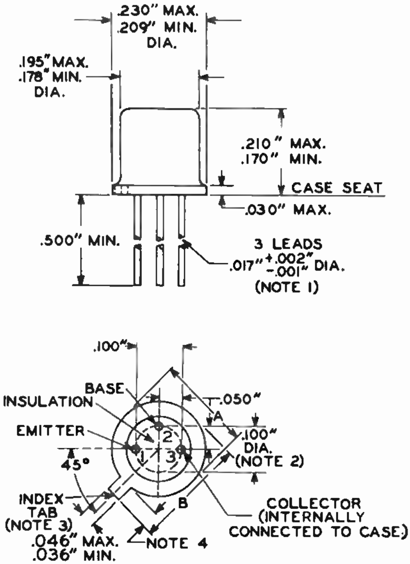
Lead 3 - Collector, Case

OPERATING CONSIDERATIONS

It is to be noted that the case of this transistor operates at the collector voltage. Consideration, therefore, should be given to the possibility of shock hazard, if the case of this transistor is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

World Radio History

JEDEC No.TO-18



92CS-10605RI

NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" TO THE END OF THE LEAD A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 2: MAXIMUM DIAMETER LEADS AT A GAUGING PLANE 0.054" + 0.001" - 0.000" BELOW CASE SEAT TO BE WITHIN 0.007" OF THEIR TRUE LOCATION RELATIVE TO MAXIMUM WIDTH TAB AND TO THE MAXIMUM 0.230" DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS USED, MEASUREMENT WILL BE MADE AT CASE SEAT.

NOTE 3: FOR VISUAL ORIENTATION ONLY.

NOTE 4: TAB LENGTH TO BE 0.028" MINIMUM AND 0.048" MAXIMUM, AND WILL BE DETERMINED BY SUBTRACTING DIAMETER "A" FROM DIMENSION "B".

World Radio History

Mesa Transistor

GERMANIUM P-N-P DIFFUSED-JUNCTION TYPE

For High-Speed Switching Service in Commercial and Military Data-Processing Systems

The 2N796 is the same as the 2N1683 except for the following items:

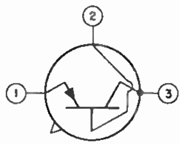
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.210"
Maximum Diameter	0.230"
Dimensional Outline	JEDEC No.TO-18
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	0.500"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



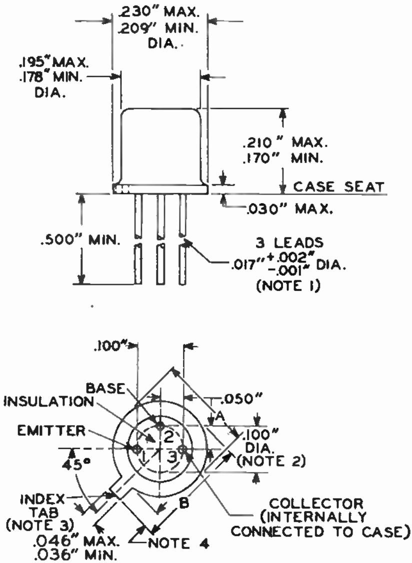
Lead 3 - Collector, Case

OPERATING CONSIDERATIONS

It is to be noted that the case of this transistor operates at the collector voltage. Consideration, therefore, should be given to the possibility of shock hazard, if the case of this transistor is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

World Radio History

JEDEC No.TO-18



92CS-10605R1

NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" TO THE END OF THE LEAD A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 2: MAXIMUM DIAMETER LEADS AT A GAUGING PLANE 0.054" + 0.001" - 0.000" BELOW CASE SEAT TO BE WITHIN 0.007" OF THEIR TRUE LOCATION RELATIVE TO MAXIMUM WIDTH TAB AND TO THE MAXIMUM 0.230" DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS USED, MEASUREMENT WILL BE MADE AT CASE SEAT.

NOTE 3: FOR VISUAL ORIENTATION ONLY.

NOTE 4: TAB LENGTH TO BE 0.028" MINIMUM AND 0.048" MAXIMUM, AND WILL BE DETERMINED BY SUBTRACTING DIAMETER "A" FROM DIMENSION "B".

World Radio History

Transistor

GERMANIUM P-N-P DIFFUSED-JUNCTION EPITAXIAL-MESA TYPE

For Switching Applications in Industrial and Military Equipment

GENERAL DATA

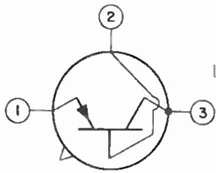
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.210"
Maximum Diameter	0.230"
Dimensional Outline	JEDEC No. TO-18
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	0.500"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector, Case

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:		
With emitter open	-15 max.	volts
COLLECTOR-TO-EMITTER:		
With external resistor (ohms) ≤ 10 between base and emitter	-15 max.	volts
EMITTER-TO-BASE:		
With collector open	-2.5 max.	volts
COLLECTOR CURRENT	-200 max.	ma
TRANSISTOR DISSIPATION:[a]		
At case temperature[b] of 25° C or below	300 max.	mw
At free-air temperature of 25° C or below	150 max.	mw
TEMPERATURE RANGE:		
Storage	-65 to +100	°C
Operating (Junction)	100 max.	°C
LEAD TEMPERATURE:		
For 10 seconds maximum[c]	240 max.	°C

[a] See accompanying *Rating Chart*.
[b] Measured at center of seating plane.
[c] Measured 1/16" ± 1/32" down from seating plane.

World Radio History

2N828

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base unless otherwise specified. Free-air temperature of 25° C.

		Min.	Max.	
DC Collector Breakdown Voltage for dc collector ma. = -0.1, emitter ma. = 0.	BV_{CBO}	-15	-	volts
DC Collector-to-Emitter Breakdown Voltage for dc base-to-emitter volts = 0, dc collector ma. = -0.1, external base-to-emitter resistance (ohms) = 0 .	BV_{CES}	-15	-	volts
DC Emitter Breakdown Voltage for dc collector ma. = 0, dc emitter ma. = -0.1	BV_{EBO}	-2.5	-	volts
DC Base-to-Emitter Saturation Voltage for dc collector ma. = -10, dc base ma. = -1.	$V_{BE}(sat)$	0.34	0.44	volt
DC Collector-to-Emitter Saturation Voltage:	$V_{CE}(sat)$			
With dc collector ma. = -10, dc base ma. = -1		-	-0.2	volt
With dc collector ma. = -50, dc base ma. = -5		-	-0.25	volt
DC Collector-Cutoff Current for dc collector volts = -6, dc emitter ma. = 0.	I_{CBO}	-	-3	μa
Collector-to-Base Capacitance for dc collector volts = -6, dc emitter ma. = 0, frequency (kc) = 100	C_{ob}	-	6	μμf
DC Current Transfer Ratio for dc collector-to-emitter volts = -0.3, dc collector ma. = -10 .	h_{FE}	25	-	
Small-Signal Current Transfer Ratio for dc collector-to-emitter volts = -1, dc collector ma. = -10, frequency (Mc) = 100	h_{fe}	3	-	
Gain-Bandwidth Product for dc collector-to-emitter volts = -1, dc collector ma. = -10 . .	f_T	300	-	Mc
Switching Time[d] for the following conditions unless otherwise specified, with dc collector-to-emitter supply volts = -3, dc collector ma.[e] = -10, "turn-on" base ma. = -1, "turn-off" base ma. = 0.25, external collector resistance (including "sampling" resistor of 20 ohms) of 300 ohms:				

"Turn-On" Time (Delay time + rise time) for dc collector-to-emitter supply volts = -3.5, dc base-to-emitter (off) volts = 1.25	$t_d + t_r$	-	70	mμsec
Storage Time	t_s	-	50	mμsec
Fall Time	t_f	-	50	mμsec
Saturation Stored-Charge Time Constant[f] for dc collector-to-emitter supply volts = -10, dc collector ma.[e] = -10, "turn-on" base ma. = -10, "turn-off" base ma. = 10, external collector resistance (including "sampling" resistor of 20 ohms) of 1000 ohms	τ_s	-	25	mμsec

[d] See accompanying *Switching-Time Measurement Circuit.*

[e] The dc collector-to-emitter supply volts adjusted to give dc collector milliamperes of -10.

[f] See accompanying *Saturation Stored-Charge Time Constant Measurement Circuit.*

PERFORMANCE TESTS

This transistor type meets mechanical and environmental requirements of Military Specification MIL-S-19500B.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

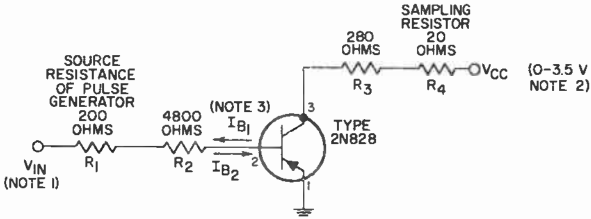
The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the seating plane provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the seals of the leads and damage the transistor.

This transistor is intended for use in single-side printed-circuit boards and in conventional wire-in-type circuits. If this transistor is used in double-side printed-circuit boards or in printed-circuit boards utilizing eyelets, it may be necessary to use an insulating washer or similar standoff device made of good dielectric material to prevent the solder from shorting the leads to each other or to the board, and to prevent the collector from shorting to ground.

It is to be noted that the case of this transistor operates at the collector voltage. Consideration, therefore, should be given to the possibility of shock hazard, if the case of this transistor is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

World Radio History

SWITCHING-TIME MEASUREMENT CIRCUIT



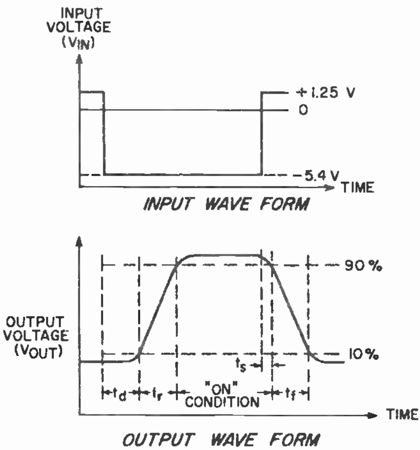
92CS-11308

NOTE 1: TEST CIRCUIT PROVIDED BY THE TEKTRONIX TYPE R PLUG-IN UNIT (FOR TEKTRONIX MODEL 541 OSCILLOSCOPE) FOR THE MEASUREMENT OF SWITCHING TIME. THE TYPE R UNIT PROVIDES THE INPUT VOLTAGE (V_{IN}) AND THE COLLECTOR-SUPPLY VOLTAGE (V_{CC}). RESISTORS R_1 AND R_4 ARE INCLUDED IN THE TYPE R UNIT; RESISTORS R_2 AND R_3 ARE WIRED TO THE ASSOCIATED WIRING BOARD.

NOTE 2: V_{CC} IS ADJUSTED FOR I_C = -10 MA.

NOTE 3: I_{B_1} = "TURN-ON" BASE CURRENT = -1 MA.
I_{B_2} = "TURN-OFF" BASE CURRENT = 0.25 MA.

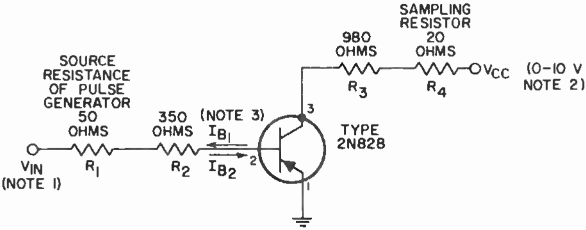
ASSOCIATED WAVE FORMS



92CS-11312

World Radio History

SATURATION STORED-CHARGE TIME CONSTANT MEASUREMENT CIRCUIT



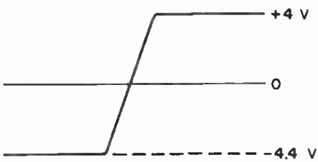
92CS-11309

NOTE 1: TEST CIRCUIT PROVIDED BY THE TEKTRONIX TYPE R PLUG-IN UNIT (FOR TEKTRONIX MODEL 541 OSCILLOSCOPE) FOR THE MEASUREMENT OF τ_S. THE TYPE R UNIT PROVIDES THE INPUT VOLTAGE (V_{IN}) AND THE COLLECTOR-SUPPLY VOLTAGE (V_{CC}). RESISTORS R_1 AND R_4 ARE INCLUDED IN THE TYPE R UNIT; RESISTORS R_2 AND R_3 ARE WIRED TO THE ASSOCIATED WIRING BOARD.

NOTE 2: V_{CC} IS ADJUSTED FOR I_C = -10 MA.

NOTE 3: I_{B1} = "TURN-ON" BASE CURRENT = -10 MA.
I_{B2} = "TURN-OFF" BASE CURRENT = 10 MA.

ASSOCIATED WAVE FORM



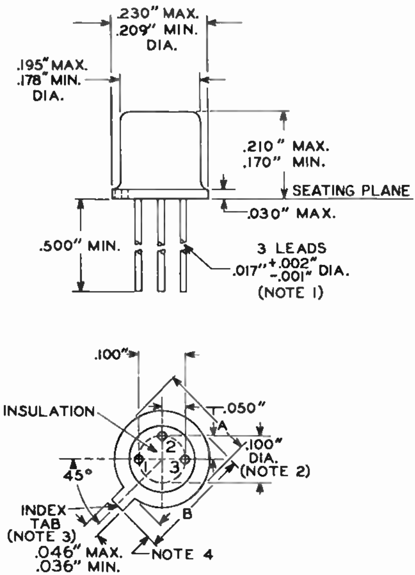
INPUT WAVE FORM

92CS-11311

World Radio History

2N828

JEDEC No.TO-18



92CS-10605R2

NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE SEATING PLANE. BETWEEN 0.25" TO THE END OF THE LEAD A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

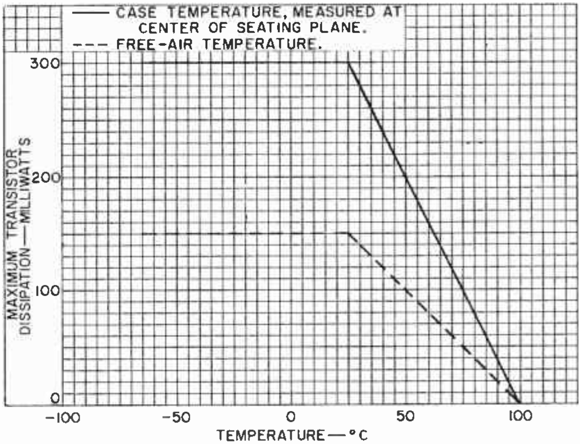
NOTE 2: MAXIMUM DIAMETER LEADS AT A GAUGING PLANE 0.054" + 0.001" - 0.000" BELOW SEATING PLANE TO BE WITHIN 0.007" OF THEIR TRUE LOCATION RELATIVE TO MAXIMUM WIDTH TAB AND TO THE MAXIMUM 0.230" DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

NOTE 3: FOR VISUAL ORIENTATION ONLY.

NOTE 4: TAB LENGTH TO BE 0.028" MINIMUM AND 0.048" MAXIMUM, AND WILL BE DETERMINED BY SUBTRACTING DIAMETER "A" FROM DIMENSION "B".

World Radio History

RATING CHART



92CS-11307R1

World Radio History

World Radio History

Transistor

GERMANIUM P-N-P DOUBLE-DIFFUSED-JUNCTION TYPE

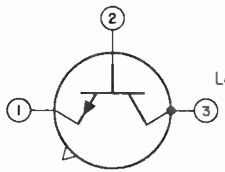
For High-Speed Logic-Circuit Switching Applications in Commercial and Military Data-Processing Systems. The 2N955A is a Direct Replacement for Type 2N955.

GENERAL DATA

Mechanical:

Dimensions . . . . See *Outline TO-18* in General Section
Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter
Lead 2 - Base



Lead 3 - Collector, Case

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:			
With emitter open.	V_{CBO}	12 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:			
With base open	V_{CEO}	8 max.	volts ←
EMITTER-TO-BASE VOLTAGE:			
With collector open.	V_{EBO}	2 max.	volts
COLLECTOR CURRENT.	I_C	100 max.	ma
TRANSISTOR DISSIPATION:[a]	P		
At free-air temperature of 25° C or below		150 max.	mw
TEMPERATURE RANGE:			
Junction (Operating)	T_J	-65 to +100	°C
Storage.	T_{STG}	-65 to +100	°C
LEAD TEMPERATURE:[b]			
For 10 seconds maximum	T_L	230 max.	°C

ELECTRICAL CHARACTERISTICS

Free-air temperature = 25° C

		Min.	*Typical*	*Max.*	
DC Collector-to-Base Breakdown Voltage for dc collector ma. = 0.1, dc emitter current = 0. . .	BV_{CBO}	12	25	-	volts

[a] See accompanying *Rating Chart*.
[b] Measured 1/16" ± 1/32" along lead, down from seating plane.

← Indicates a change.

WorldRadioHistory

2N955

		Min.	Typical	Max.	
DC Collector-to-Emitter Breakdown Voltage for dc collector ma. = 5, dc emitter current = 0.	BV_{CEO}	8	15	–	volts
DC Emitter-to-Base Breakdown Voltage for dc collector current = 0, dc emitter ma. = 0.1.	BV_{EBO}	2	6	–	volts
DC Collector-to-Emitter Reach-Through Voltage for dc collector-to-base volts = 12, dc emitter-to-base floating potential (volts) = 1.	V_{RT}	11	–	–	volts
DC Collector-to-Emitter Latching Voltage for dc collector ma. = 100, external base-to-emitter resistance (ohms) = 1000.	V_{CERL}[c]	9	–	–	volts
DC Base-to-Emitter Saturation Voltage for dc collector ma. = 30, dc base ma. = 1. . . .	$V_{BE(sat)}$	0.3	0.45	0.6	volt
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = 30, dc base ma. = 1. . . .	$V_{CE(sat)}$	–	0.35	0.5	volt
DC Collector-Cutoff Current for dc collector volts = 5, dc emitter current = 0. .	I_{CBO}	–	0.6	5	μa
Input Capacitance for dc emitter-to-base volts = -0.5, dc collector current = 0, signal frequency (kc) = 100.	C_{ib}	–	6	10	pf
Output Capacitance for dc collector-to-base volts = 5, dc emitter current = 0, frequency (kc) = 100	C_{ob}	–	4	6	pf
DC Forward-Current Transfer Ratio for dc collector-to-base volts = 0.5, dc collector ma. = 30. . . .	h_{FE}	30	50	–	

Small-Signal Short-Circuit Forward Current Transfer Ratio for dc collector-to-emitter volts = 5, dc collector ma. = 20, signal frequency (Mc) = 100.	h_{fe}	–	10	–	
Total Stored Charge for dc collector ma. = 30, dc base ma. = 1.5. . . .	Q_s[d]	–	90	–	pc
Switching Time for dc collector supply volts = 5, dc collector ma. = 30:					
Delay time for dc base supply volts = -0.5, dc base-to-emitter volts = -0.5, turn-on dc base ma. = 4. . . .	t_d[e]	–	4.5	–	nsec
Rise time for dc base supply volts = -0.5, dc base-to-emitter volts = -0.5, turn-on dc base ma. = 4. . . .	t_r[e]	–	6.5	10	nsec
Storage time for dc base supply volts = 5, turn-on dc base ma. = 1.5, turn-off dc base ma. = -3	t_s[f]	–	18	–	nsec
Fall time for dc base supply volts = 5, turn-on dc base ma. = 1.5, turn-off dc base ma. = -3	t_f[f]	–	8	–	nsec
Total turn-off time for dc base supply volts = 5, turn-on dc base ma. = 1.5, total stored charge (pf) = 125.	t_{Q_s}[d]	–	9	15	nsec

[c] See accompanying *DC Collector-to-Emitter Latching-Voltage (V_{CERL}) Measurement Circuit.*

[d] See accompanying *Total-Stored-Charge (Q_s) and Total Turn-Off Time (t_{Q_s}) Measurement Circuit.*

[e] See accompanying *Delay-Time (t_d) and Rise-Time (t_r) Measurement Circuit.*

[f] See accompanying *Storage-Time (t_s) and Fall-Time (t_f) Measurement Circuit.*

World Radio History

OPERATING CONSIDERATIONS,
DC COLLECTOR-TO-EMITTER LATCHING VOLTAGE (V_{CERL})
MEASUREMENT CIRCUIT,
TOTAL-STORED-CHARGE (Q_s) and TOTAL TURN-OFF TIME (t_{Qs})
MEASUREMENT CIRCUIT,
DELAY-TIME (t_d) and RISE-TIME (t_r) MEASUREMENT CIRCUIT,
STORAGE-TIME (t_s) and FALL-TIME (t_f) MEASUREMENT CIRCUIT,
and
RATING CHART
shown under type 2N955A also apply to the 2N955

World Radio History

Transistor

GERMANIUM N-P-N DOUBLE-DIFFUSED-JUNCTION MESA TYPE

For Logic-Circuit Applications in Commercial
and Military Data-Processing Equipment

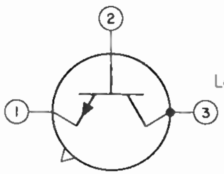
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.210"
Maximum Diameter	0.230"
Dimensional Outline	JEDEC No. TO-18
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	0.500"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter
Lead 2 - Base



Lead 3 - Collector,
Case

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:		
With emitter open	12 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With base open	11 max.	volts
EMITTER-TO-BASE VOLTAGE:		
With collector open	2 max.	volts
COLLECTOR CURRENT	100 max.	ma
TRANSISTOR DISSIPATION:[a]		
At free-air temperature of 25° C or below	150 max.	mw
FREE-AIR TEMPERATURE RANGE:		
Operating and storage	-65 to +100	°C
LEAD TEMPERATURE:		
For 10 seconds maximum[b]	230 max.	°C

[a] See accompanying *Rating Chart*.
[b] Measured 1/16" ± 1/32" down from seating plane.

World Radio History

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base unless otherwise specified. Free-air temperature of 25° C.

		Min.	Typical	Max.	
DC Collector Breakdown Voltage for dc collector ma. = 0.1, dc emitter ma. = 0	BV_{CBO}	12	25	-	volts
DC Emitter Breakdown Voltage for dc collector ma. = 0, dc emitter ma. = 0.1	BV_{EBO}	2	5	-	volts
DC Collector-to-Emitter Reach-Through Voltage .	V_{RT}	11	-	-	volts
DC Collector-to-Emitter Latching Voltage for dc collector ma. = 100, external base-to-emitter resistance (ohms) = 1000	V_{CERL}[c]	9	-	-	volts
DC Base-to-Emitter Saturation Voltage for dc collector ma. = 30, dc base ma. = 1	$V_{BE(sat)}$	0.3	0.45	0.6	volt
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = 30, dc base ma. = 1	$V_{CE(sat)}$	-	0.35	0.5	volt
DC Collector-Cutoff Current for dc collector volts = 5, dc emitter ma. = 0	I_{CBO}	-	2	5	μa
Input Capacitance for dc emitter volts = 0.5, dc collector ma. = 0 . . .	C_{ib}	-	7	10	pf
Output Capacitance for dc collector volts = 5, dc emitter ma. = 0 . . .	C_{ob}	-	4	6	pf
Small-Signal Current Transfer Ratio for dc collector-to-emitter volts = 5, dc collector ma. = 20, frequency (Mc) = 100.	h_{fe}	-	10	-	
DC Current Transfer Ratio for dc collector-to-emitter volts = 0.5, dc collector ma. = 30. .	h_{FE}	30	60	-	
Total Stored Charge for dc collector ma. = 30, dc base ma. = 1.5 . . .	Q_s[d]	-	90	125	pc

World Radio History

Delay Time:	t_d				
[e]With dc collector supply volts = 5, dc base supply volts = -0.5, "off" dc base-to-emitter volts = -0.5, dc collector ma. = 30, "on" dc base ma. = 4.		–	4.5	–	nsec
[f]With dc collector supply volts = 3.5, dc base supply volts = -6, "off" dc base-to-emitter volts = -0.5, dc collector ma. = 10, "on" dc base ma. = 1.		–	11	–	nsec
Rise Time:	t_r				
[e]With dc collector supply volts = 5, dc base supply volts = -0.5, "off" dc base-to-emitter volts = -0.5, dc collector ma. = 30, "on" dc base ma. = 4.		–	6.5	10	nsec
[f]With dc collector supply volts = 3.5, dc base supply volts = -6, "off" dc base-to-emitter volts = -0.5, dc collector ma. = 10, "on" dc base ma. = 1.		–	20	–	nsec
Storage Time:	t_s				
[g]With dc collector supply volts = 5, dc base supply volts = 5, dc collector ma. = 30, "on" dc base ma. = 1.5, "off" dc base ma. = -3		–	18	–	nsec
[h]With dc collector supply volts = 3.5, dc base supply volts = 10, dc collector ma. = 10, "on" dc base ma. = 1, "off" dc base ma. = -0.25. .		–	45	–	nsec

World Radio History

		Min.	Typical	Max.	
Fall Time:	t_f				
[g]With dc collector supply volts = 5, dc base supply volts = 5, dc collector ma. = 30, "on" dc base ma. = 1.5, "off" dc base ma. = -3		–	8	–	nsec
[h]With dc collector supply volts = 3.5, dc base supply volts = 10, dc collector ma. = 10, "on" dc base ma. = 1, "off" dc base ma. = -0.25 . . .		–	50	–	nsec
Total Turn-Off Time for total stored charge (pc) = 125, dc collector supply volts = 5, dc base supply volts = 5, dc collector ma. = 30, "on" dc base ma. = 1.5	t_{Q_S} [d]	–	9	15	nsec

[c] See accompanying *DC Collector-to-Emitter Latching-Voltage (V_{CERL}) Measurement Circuit.*
[d] See accompanying *Total-Stored-Charge (Q_S) and Total Turn-Off Time (t_{Q_S}) Measurement Circuit.*
[e] See accompanying *Delay-Time (t_d) and Rise-Time (t_r) Measurement Circuit.*
[f] See accompanying *Alternate-Delay-Time and Rise-Time Measurement Circuit.*
[g] See accompanying *Storage-Time (t_s) and Fall-Time (t_f) Measurement Circuit.*
[h] See accompanying *Alternate-Storage-Time and Fall-Time Measurement Circuit.*

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the seating plane provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the seals of the leads and damage the transistor.

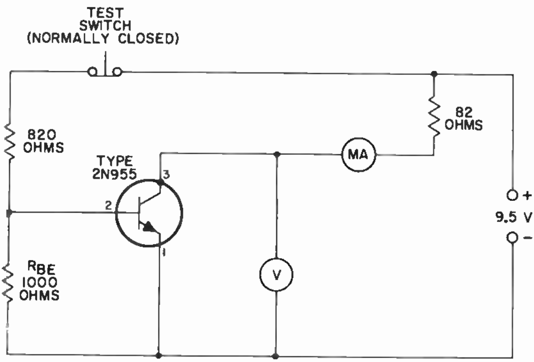
This transistor is intended for use in single-side printed-circuit boards and in conventional wire-in-type circuits. If this transistor is used in double-side printed-circuit boards or in printed-circuit boards utilizing eyelets, it may be necessary to use an insulating washer or similar standoff device made of good dielectric material to prevent the solder

World Radio History

from shorting the leads to each other or to the board, and to prevent the collector from shorting to ground.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

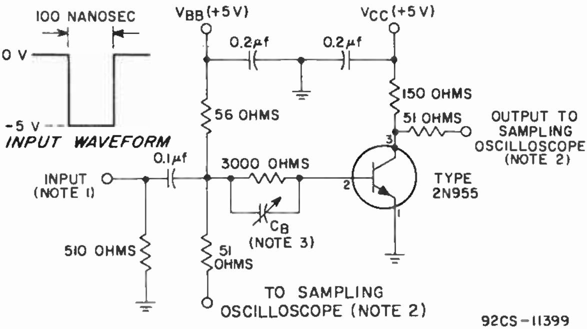
DC COLLECTOR-TO-EMITTER LATCHING-VOLTAGE (V_{CERL}) MEASUREMENT CIRCUIT



92CS-11398

World Radio History

TOTAL-STORED-CHARGE (Q_s) AND TOTAL TURN-OFF TIME (t_{Q_s}) MEASUREMENT CIRCUIT



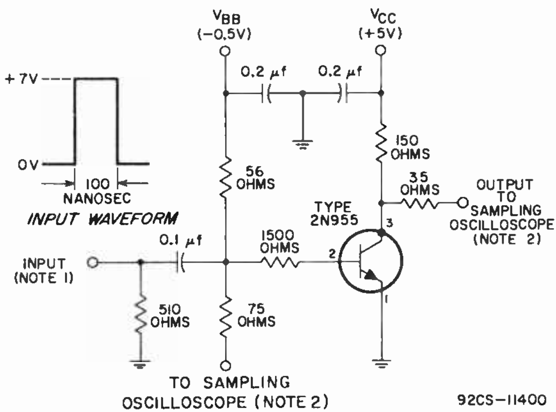
92CS-11399

NOTE 1: FROM TEKTRONIX TYPE 110 MERCURY PULSER, OR EQUIVALENT.

NOTE 2: HEWLETT-PACKARD TYPE 185A, OR EQUIVALENT.

NOTE 3: FOR MEASUREMENT OF Q_S, C_B IS A CALIBRATED VARIABLE CAPACITOR HAVING A RANGE OF APPROXIMATELY 3.5 TO 35 MICROMICROFARADS. FOR MEASUREMENT OF t_{Q_S}, C_B IS A FIXED CAPACITOR HAVING A VALUE OF 27 MICROMICROFARADS ± 2 PER CENT.

DELAY-TIME (t_d) AND RISE-TIME (t_r) MEASUREMENT CIRCUIT



92CS-11400

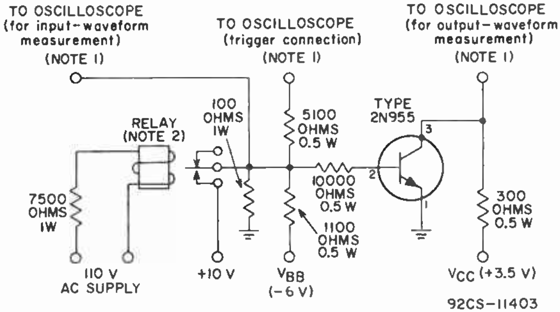
World Radio History

NOTE 1: FROM TEKTRONIX TYPE 110 MERCURY PULSER, OR EQUIVALENT.

NOTE 2: HEWLETT-PACKARD TYPE 185A, OR EQUIVALENT.

ALTERNATE-DELAY-TIME AND RISE-TIME MEASUREMENT CIRCUIT

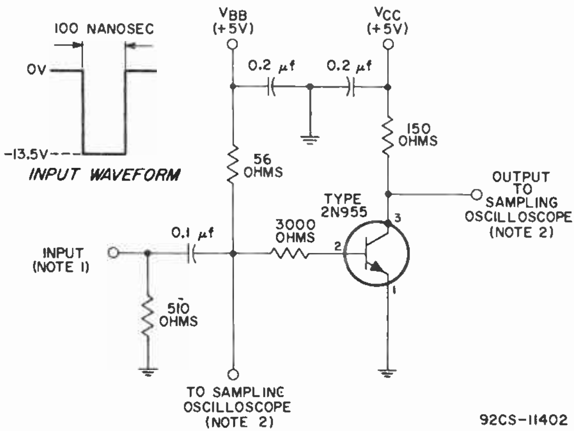
NOTE: Except for supply-voltage polarities, this circuit is identical with that used to measure "Turn-On" Time (Delay time + rise time) for Type 2N705.



NOTE 1: TEKTRONIX TYPE 545, OR EQUIVALENT.

NOTE 2: C.P. CLARE MERCURY RELAY TYPE HG-2A-1004, OR EQUIVALENT.

STORAGE-TIME (t_s) AND FALL-TIME (t_f) MEASUREMENT CIRCUIT



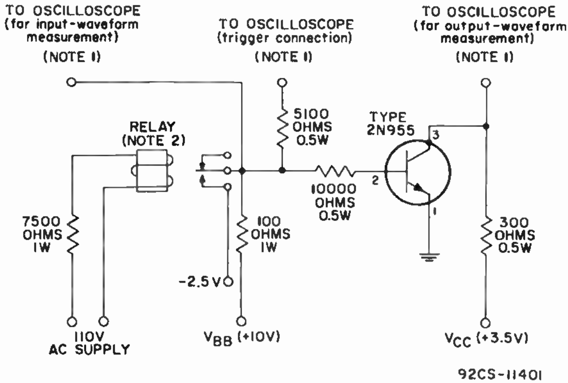
World Radio History

NOTE 1: FROM TEKTRONIX TYPE 110 MERCURY PULSER, OR EQUIVALENT.

NOTE 2: HEWLETT-PACKARD TYPE 185A, OR EQUIVALENT.

ALTERNATE-STORAGE-TIME AND FALL-TIME MEASUREMENT CIRCUIT

NOTE: Except for supply-voltage polarities, this circuit is identical with that used to measure "Turn-Off" Storage Time and "Turn-Off" Fall Time for Type 2N705.

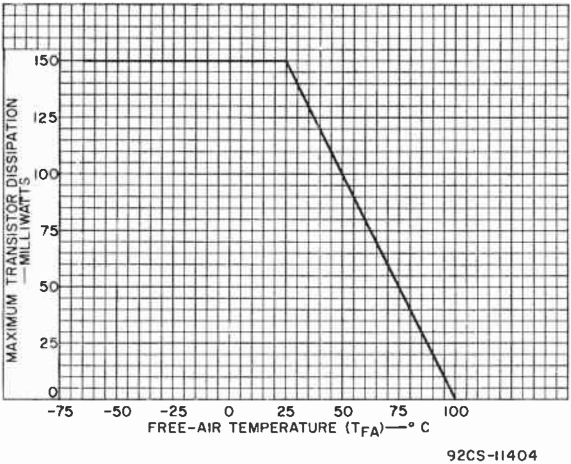


NOTE 1: TEKTRONIX TYPE 545, OR EQUIVALENT.

NOTE 2: C.P. CLARE MERCURY RELAY TYPE HG-2A-1004, OR EQUIVALENT.

World Radio History

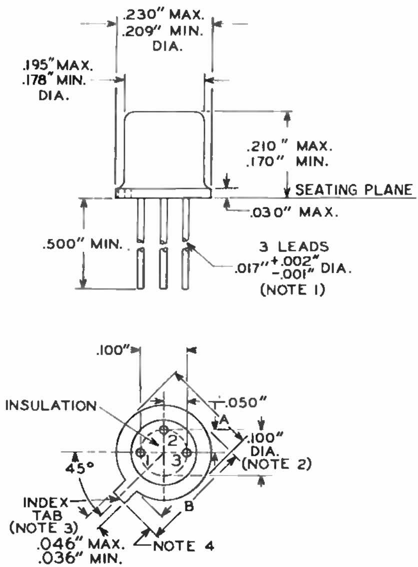
RATING CHART



World Radio History

2N955

JEDEC No. TO-18



92CS-10605R2

NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE SEATING PLANE. BETWEEN 0.25" TO THE END OF THE LEAD, A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 2: MAXIMUM DIAMETER LEADS AT A GAUGING PLANE 0.054" + 0.001" - 0.000" BELOW SEATING PLANE TO BE WITHIN 0.007" OF THEIR TRUE LOCATION RELATIVE TO MAXIMUM WIDTH TAB AND TO THE MAXIMUM 0.230" DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

NOTE 3: FOR VISUAL ORIENTATION ONLY.

NOTE 4: TAB LENGTH TO BE 0.028" MINIMUM AND 0.048" MAXIMUM, AND WILL BE DETERMINED BY SUBTRACTING DIAMETER "A" FROM DIMENSION "B".

World Radio History

Transistor

GERMANIUM P-N-P DOUBLE-DIFFUSED-JUNCTION TYPE

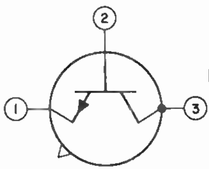
For High-Speed Logic-Circuit Switching Applications in Commercial and Military Data-Processing Systems. The 2N955A is Unilaterally Interchangeable with Type 2N955.

GENERAL DATA

Mechanical:

Dimensions. . . . . .See *Outline TO-18* in General Section
Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter
Lead 2 - Base



Lead 3 - Collector, Case

SWITCHING SERVICE

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE:			
With emitter open	V_{CBO}	12 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:			
With base open.	V_{CEO}	8 max.	volts
EMITTER-TO-BASE VOLTAGE:			
With collector open	V_{EBO}	2 max.	volts
COLLECTOR CURRENT	I_C	100 max.	ma
TRANSISTOR DISSIPATION:[a]	P		
At free-air temperature of 25° C or below		150 max.	mw
TEMPERATURE RANGE:			
Junction (Operating).	T_J	-65 to +100	°C
Storage	T_{STG}	-65 to +100	°C
LEAD TEMPERATURE:[b]			
For 10 seconds maximum.	T_L	230 max.	°C

[a] See accompanying *Rating Chart*.
[b] Measured 1/16" ± 1/32" along lead, down from seating plane.

World Radio History

ELECTRICAL CHARACTERISTICS

Free-air temperature = 25° C

Characteristic	Symbol	Min.	Typical	Max.	Unit
DC Collector-to-Base Breakdown Voltage for dc collector ma. = 0.1, dc emitter current = 0.	BV_{CBO}	12	25	-	volts
DC Collector-to-Emitter Breakdown Voltage for dc collector ma. = 5, dc emitter current = 0.	BV_{CEO}	8	15	-	volts
DC Emitter-to-Base Breakdown Voltage for dc collector current = 0, dc emitter ma. = 0.1	BV_{EBO}	2	6	-	volts
DC Collector-to-Emitter Reach-Through Voltage for dc collector-to-base volts = 12, dc emitter-to-base floating potential (volts) = 1	V_{RT}	11	-	-	volts
DC Collector-to-Emitter Latching Voltage for dc collector ma. = 100, external base-to-emitter resistance (ohms) = 1000	$V_{CERL}{}^{c}$	9	-	-	volts
DC Base-to-Emitter Saturation Voltage for dc collector ma. = 30, dc base ma. = 1	$V_{BE(sat)}$	0.3	0.45	0.6	volt
DC Collector-to-Emitter Saturation Voltage:	$V_{CE(sat)}$				
With dc collector ma. = 30, dc base ma. = 1		-	0.22	0.3	volt
With dc collector ma. = 100, dc base ma. = 5		-	0.45	0.6	volt
DC Collector-Cutoff Current for dc collector volts = 5, dc emitter current = 0 . .	I_{CBO}	-	0.6	5	μa
Input Capacitance for dc emitter-to-base volts = -0.5, dc collector current = 0, signal frequency (kc) = 100	C_{ib}	-	6	10	pf

World Radio History

Output Capacitance for dc collector-to-base volts = 5, dc emitter current = 0, frequency (kc) = 100.	C_{ob}	-	4	6	pf
DC Forward-Current Transfer Ratio for dc collector-to-base volts = 0.3, dc collector ma. = 30	h_{FE}	30	50	-	
Small-Signal Short-Circuit Forward Current Transfer Ratio for dc collector-to-emitter volts = 5, dc collector ma. = 20, signal frequency (Mc) = 100 . . .	h_{fe}	-	10	-	
Total Stored Charge for dc collector ma. = 30, dc base ma. = 1.5 . . .	Q_s [d]	-	45	65	pc
Collector-to-Base Time Constant for dc collector supply volts = 3.5, dc collector-to-base volts = 3, dc emitter ma. = 10, frequency (Mc) = 31.9. . .	$r_{b'}C_c$ [e]	-	150	250	psec
Switching Time for dc collector supply volts = 5, dc collector ma. = 30:					
Delay time for dc base supply volts = -0.5, dc base-to-emitter volts = -0.5, turn-on dc base ma. = 4 . . .	t_d [f]	-	4.5	-	nsec
Rise time for dc base supply volts = -0.5, dc base-to-emitter volts = -0.5, turn-on dc base ma. = 4.	t_r [f]	-	6.5	10	nsec
Storage time for dc base supply volts = 5, turn-on dc base ma. = 1.5, turn-off dc base ma. = -3.	t_s [g]	-	5	-	nsec
Fall time for dc base supply volts = 5, turn-on dc base ma. = 1.5, turn-off dc base ma. = -3.	t_f [g]	-	8	-	nsec

World Radio History

Total turn-off time for dc base supply volts = 5, turn-on dc base ma. = 1.5, total stored charge (pf) = 65	t_{Q_S}[d]	–	6	10	nsec

[c] See accompanying *DC Collector-to-Emitter Latching-Voltage (VCERL) Measurement Circuit.*

[d] See accompanying *Total-Stored-Charge (Qs) and Total Turn-Off Time (t_{Q_S}) Measurement Circuit.*

[e] See accompanying *Collector-to-Base Time-Constant Measurement Circuit.*

[f] See accompanying *Delay-Time (t_d) and Rise-Time (t_r) Measurement Circuit.*

[g] See accompanying *Storage-Time (t_s) and Fall-Time (t_f) Measurement Circuit.*

OPERATING CONSIDERATIONS

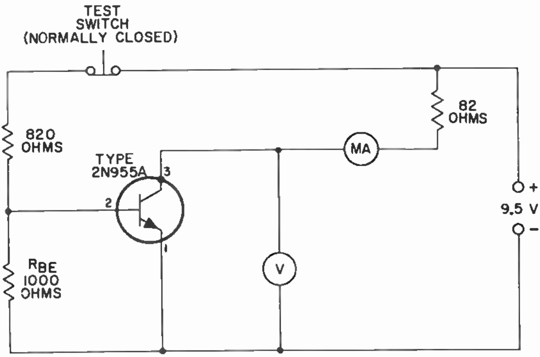
It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the seating plane provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the seals of the leads and damage the transistor.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

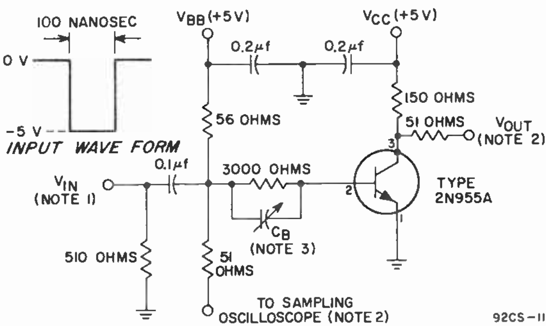
World Radio History

DC COLLECTOR-TO-EMITTER LATCHING-VOLTAGE (V_{CERL}) MEASUREMENT CIRCUIT



92CS-11398R1

TOTAL-STORED-CHARGE (Q_s) AND TOTAL TURN-OFF TIME (t_{Q_s}) MEASUREMENT CIRCUIT



92CS-11399R1

NOTE 1: FROM A PULSE GENERATOR HAVING R_g = 50 OHMS AND t_r < 1 NANOSECOND.

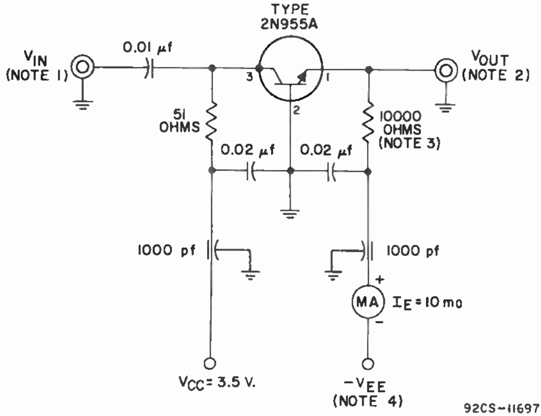
NOTE 2: SAMPLING OSCILLOSCOPE INPUT IMPEDANCE = 1 MEGOHM SHUNTED WITH 3 PICOFARADS, t_r = 0.35 NANOSECOND.

NOTE 3: FOR MEASUREMENT OF Q_s, C_B IS A CALIBRATED VARIABLE CAPACITOR HAVING A RANGE OF APPROXIMATELY 3.5 TO 35 PICOFARADS. FOR MEASUREMENT OF t_{Q_s}, C_B IS A FIXED CAPACITOR HAVING A VALUE OF:

FOR 2N955A, 14 pf ± 2 PER CENT
FOR 2N955, 27 pf ± 2 PER CENT

World Radio History

COLLECTOR-TO-BASE TIME-CONSTANT ($r_b'C_c$) MEASUREMENT CIRCUIT



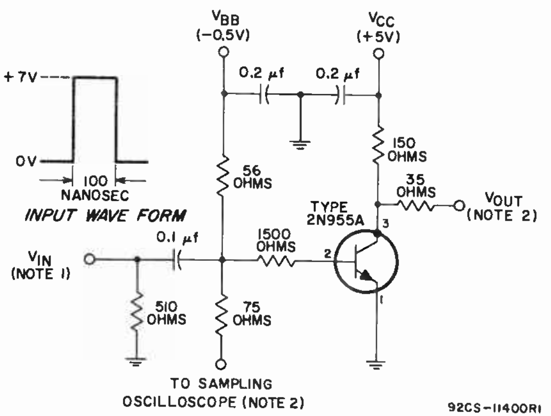
NOTE 1: V_{IN} = 0.5 RMS VOLTS, FREQUENCY = 31.9 Mc, SIGNAL GENERATOR IMPEDANCE = 50 OHMS.

NOTE 2: V_{OUT} MEASURED WITH RF VOLTMETER, $r_b'C_c = 10\ V_{OUT}$, WHERE $r_b'C_c$ IS IN PICOSECONDS AND V_{OUT} IS IN MILLIVOLTS.

NOTE 3: HIGH-FREQUENCY TYPE.

NOTE 4: ADJUSTED FOR AN EMITTER CURRENT OF 10 MILLIAMPERES.

DELAY-TIME (t_d) AND RISE-TIME (t_r) MEASUREMENT CIRCUIT

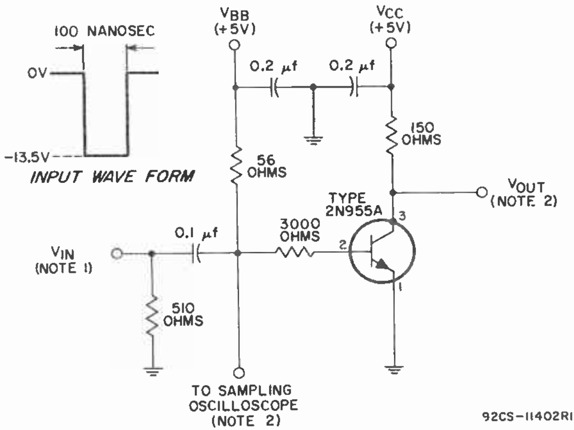


World Radio History

NOTE 1: FROM A PULSE GENERATOR HAVING R_g = 50 OHMS AND t_r < 1 NANOSECOND.

NOTE 2: SAMPLING OSCILLOSCOPE INPUT IMPEDANCE = 1 MEGOHM SHUNTED WITH 3 PICOFARADS, t_r = 0.35 NANOSECOND.

STORAGE-TIME (t_s) AND FALL-TIME (t_f) MEASUREMENT CIRCUIT

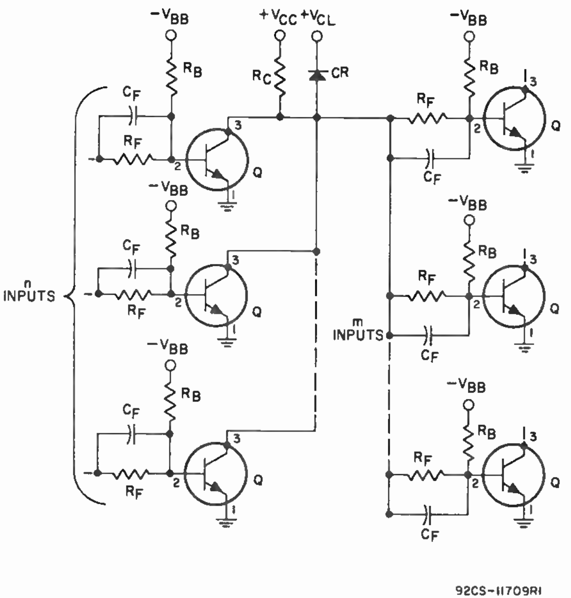


NOTE 1: FROM A PULSE GENERATOR HAVING R_g = 50 OHMS AND t_r < 1 NANOSECOND.

NOTE 2: SAMPLING OSCILLOSCOPE INPUT IMPEDANCE = 1 MEGOHM SHUNTED WITH 3 PICOFARADS, t_r = 0.35 NANOSECOND.

World Radio History

RCTL CIRCUIT FOR MEASUREMENT OF PROPAGATION DELAY PER STAGE



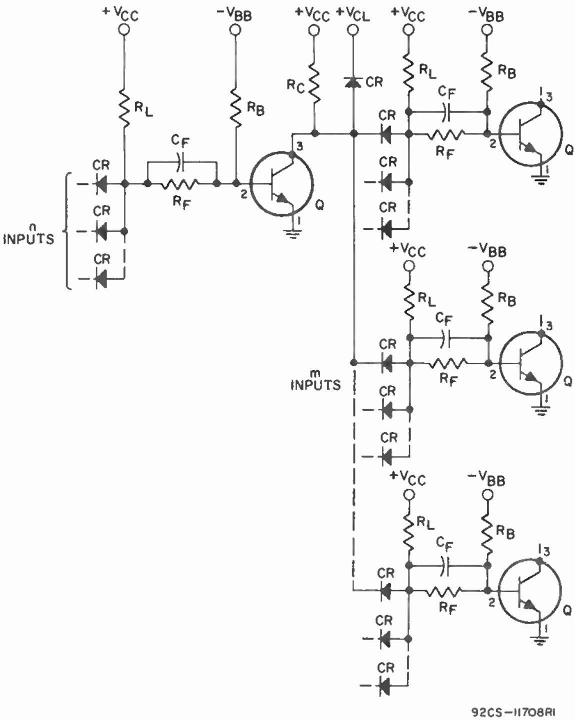
m = n = 5

C_F = 27 pf	R_B = 39000 ohms	V_{BB} = 15 volts
C_R = Type 1N955	R_C = 510 ohms	V_{CC} = 15 volts
Q = Type 2N955A	R_F = 2000 ohms	V_{CL} = 5 volts

NOTE: ALL CAPACITANCE, RESISTANCE, AND VOLTAGE VALUES HAVE ±5 PER CENT TOLERANCE. OPERATING TEMPERATURE RANGE = 0° to 55° C.

World Radio History

DTL CIRCUIT FOR MEASUREMENT OF PROPAGATION DELAY PER STAGE



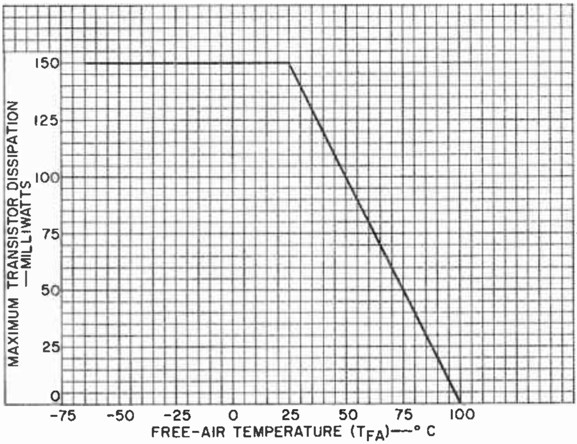
m = n = 4

C_F = 30 pf	R_B = 24000 ohms	V_{BB} = 15 volts
C_R = Type 1N955	R_C = R_L = 2000 ohms	V_{CC} = 15 volts
Q = Type 2N955A	R_F = 1800 ohms	V_{CL} = 5 volts

NOTE: ALL CAPACITANCE, RESISTANCE, AND VOLTAGE VALUES HAVE ±5 PER CENT TOLERANCE. OPERATING TEMPERATURE RANGE = 0° to 55° C.

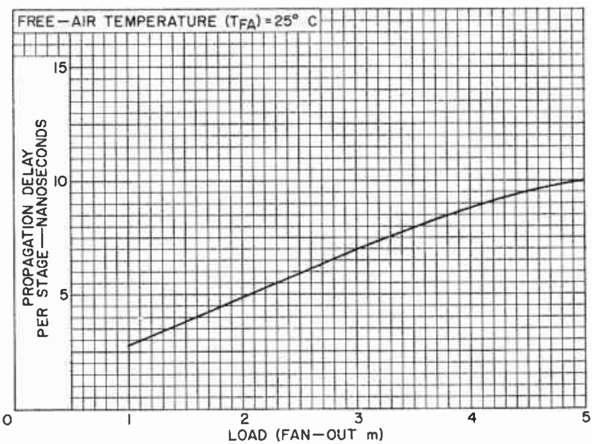
World Radio History

RATING CHART



92CS-11404

TYPICAL OPERATION CHARACTERISTIC IN ACCOMPANYING RCTL CIRCUIT



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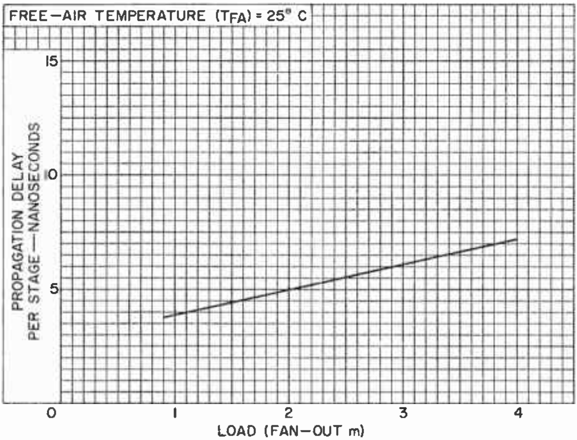
World Radio History

TYPICAL OPERATION CHARACTERISTIC IN ACCOMPANYING DTL CIRCUIT



92CS–11711

World Radio History

World Radio History

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

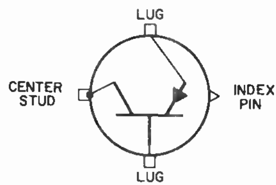
For Power Switching and Amplifier Service in Industrial and Military Applications

GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No. TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):
BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, *Absolute Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = -1.5)	-80 max.	volts
EMITTER-TO-BASE VOLTAGE	-40 max.	volts
COLLECTOR CURRENT	-15 max.	amp
EMITTER CURRENT	15 max.	amp
BASE CURRENT	-4 max.	amp
TRANSISTOR DISSIPATION:[a] ←		
At case temperatures[b] of 25° C or below	150 max.	watts
CASE-TEMPERATURE[b] RANGE: ←		
Operating and storage	-65 to +100	°C

Typical Operation:

In a common emitter, base-input, power-switching circuit at case temperature[b] of 25° C

DC Supply Voltage	-12	volts
DC Base-Bias Voltage	6	volts
"On" DC Collector Current	-12	amp
"Turn-On" Base Current	-2	amp
"Turn-Off" Base Current	0	amp

← Indicates a change.

World Radio History

Switching Time:			
Rise time.	15	μsec
Fall time.	15	μsec

[a] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

[b] Measured at any point on seating surface.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and at case temperature[b] of 25° C unless otherwise specified

		Min.	*Typical*	*Max.*	
DC Collector-to-Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = -0.3	BV_{CES}	-70	-	-	volts
With base open:	BV_{CEO}				
For dc collector amperes = -0.3 . .		-	-60	-	volts
For dc collector amperes = -1[c]. . .		-55	-	-	volts
DC Base-to-Emitter Voltage for dc collector-to-emitter volts = -2, dc collector amperes = -5. .	V_{BE}	-	-0.65	-0.9	volt
DC Collector-to-Emitter Saturation Voltage for dc collector amperes = -12, dc base amperes = -2	V_{CE} (sat)	-	-0.3	-0.7	volt
DC Emitter Voltage for dc collector volts = -80, dc emitter current = 0.	V_{EB}	-	-0.15	-1	volt
DC Punch-Through Voltage.	V_{PT}	-80	-	-	volts
DC Emitter-Cutoff Current for dc emitter volts = -40, dc collector current = 0 . .	I_{EBO}	-	-1	-4	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = -2, dc emitter current = 0.		-	100	-	μa
With dc collector volts = -80, dc emitter current = 0.		-	-2	-4	ma

→ indicates a change.

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With dc collector volts = -80, dc emitter current = 0, case temperature[b] = 71° C.		-	-	-15	ma
DC Current Transfer Ratio for dc collector-to-emitter volts = -2, dc collector amperes =	h_{FE}				
-5		35	-	70	
-12.		-	25	-	
Beta-Cutoff Frequency for dc collector-to-emitter volts = -6, dc collector amperes = -5	$f_{\alpha e}$	-	10	-	kc
Thermal Resistance:					
Junction-to-case . . .	R_T	-	0.35	0.5	°C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds. . . .		-	0.075	-	watt-sec/°C
Thermal Time Constant. .	τ_1	-	26.25	-	msec

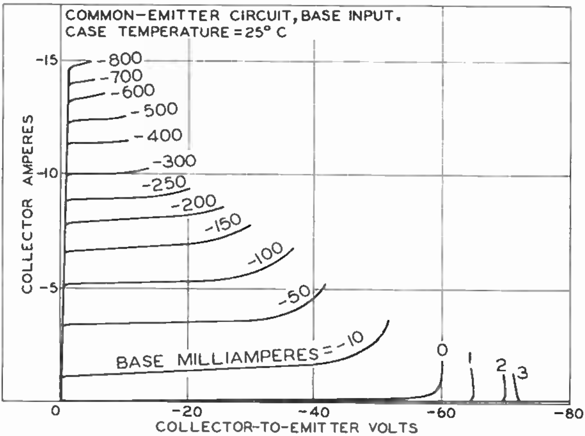
[b] Measured at any point on seating surface.
[c] Tested by sweep method to prevent excessive heating of collector junction.

**PERFORMANCE TESTS,
OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHART,
TYPICAL BASE-CHARACTERISTICS CURVES,
and
TYPICAL CHARACTERISTICS CURVES
shown under Type 2N173 also apply to the 2N1099** ←

← Indicates a change.

World Radio History

TYPICAL COLLECTOR CHARACTERISTICS



92CS-10733

World Radio History

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service in Industrial and Military Applications

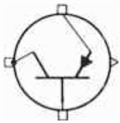
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	1.230"
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No. TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, *Absolute Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = -1.5)	-80 max.	volts
EMITTER-TO-BASE VOLTAGE	-40 max.	volts
COLLECTOR CURRENT	-15 max.	amp
EMITTER CURRENT	15 max.	amp
BASE CURRENT	-4 max.	amp
TRANSISTOR DISSIPATION:▲		
At case temperature of 25° C	87.5 max.	watts
CASE-TEMPERATURE RANGE:		
Continuous operation	-65 to +95	°C
Intermittent operation	-65 to +100	°C
Storage	-65 to +100	°C

Typical Operation:

In a common emitter, base-input, power-switching circuit at case temperature of 25° C

DC Supply Voltage	-12	volts
DC Base-Bias Voltage	6	volts
"On" DC Collector Current	-12	amp
"Turn-On" Base Current	-2	amp
"Turn-Off" Base Current	0	amp

World Radio History

Switching Time:

Rise time.		15	µsec
Fall time.		15	µsec

▲ See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart in General Section.*

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and case temperature of 25° C unless otherwise specified

		Min.	*Typical*	*Max.*	
DC Collector-to-Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = -0.3	BV_{CES}	-70	-	-	volts
With base open:	BV_{CEO}				
For dc collector amperes = -0.3 . .		-	-60	-	volts
For dc collector amperes = -1●. . .		-55	-	-	volts
DC Base-to-Emitter Voltage★ for dc collector-to-emitter volts = -2, dc collector amperes = -5. .	V_{BE}	-	-0.65	-0.9	volt
DC Collector-to-Emitter Saturation Voltage★ for dc collector amperes = -12, base amperes = -2	V_{CE}	-	-0.3	-0.7	volt
DC Emitter Voltage for dc collector volts = -80, dc emitter amperes = 0.	V_{EB}	-	-0.15	-1	volt
DC Punch-Through Voltage.	V_P	-80	-	-	volts
DC Emitter-Cutoff Current for dc emitter volts = -40, dc collector amperes = 0 . .	I_{EBO}	-	-1	-8	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = -2, dc emitter amperes = 0.		-	100	-	µa
With dc collector volts = -80, dc emitter amperes = 0.		-	-2	-8	ma

World Radio History

With dc collector volts = -80, dc emitter amperes = 0, case temperature = 71° C.		-	-	-15	ma
DC Current Transfer Ratio* for dc collector-to-emitter volts = -2, dc collector amperes =	h_{FE}				
-5		35	-	70	
-12.		-	25	-	
Beta-Cutoff Frequency* for dc collector-to-emitter volts = -6, dc collector amperes = -5	$f_{\alpha e}$	-	10	-	kc
Thermal Resistance: Junction-to-case . . .	R_T	-	0.5	0.8	°C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds. . . .		-	0.075	-	watt-sec/°C
Thermal Time Constant. .	τ_1	-	37.5	-	msec

● Sweep voltage used to perform test.
★ Measured in a common-emitter, base-input circuit.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

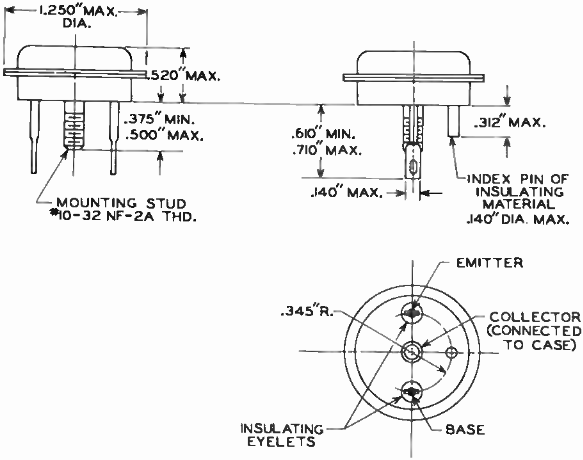
Electrical connection can be made to the base and emitter terminals by means of clips or by soldering directly to the terminals. When soldering connections are made to the terminals, care should be taken to conduct excessive heat away from the terminal seals, otherwise the heat of the soldering operation will crack the glass seals of the terminals and damage the transistor.

This transistor is provided with a single-ended stud for mounting to a heat sink and for electrical connection to the collector. (See accompanying *Suggested Mounting Arrangement*). Electrical connection to the base and to the emitter is made to their respective terminals.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

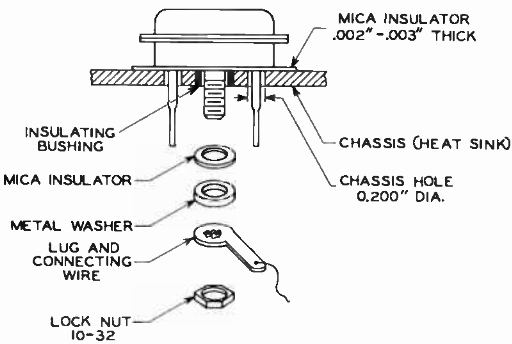
The maximum torque on mounting stud should not exceed 12 inch-pounds.

World Radio History



92CM-10612R1

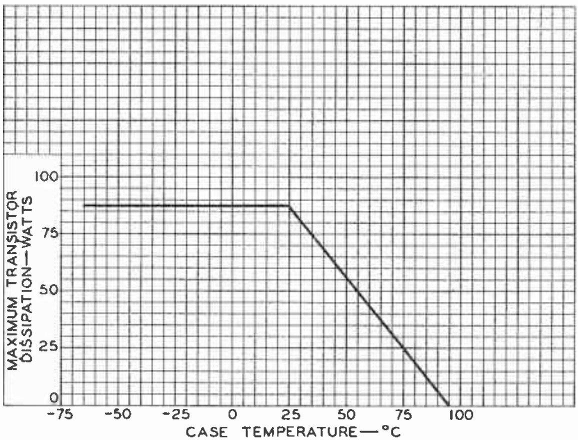
SUGGESTED MOUNTING ARRANGEMENT



92CS-10624R1

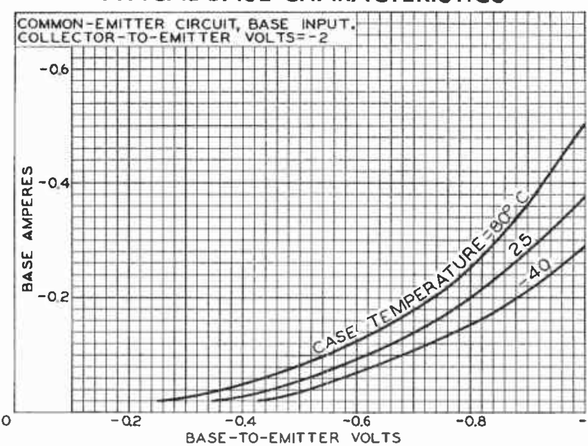
World Radio History

RATING CHART



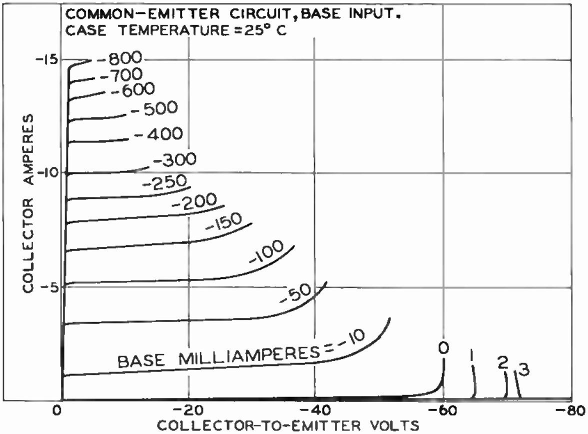
92CS-10702

TYPICAL BASE CHARACTERISTICS



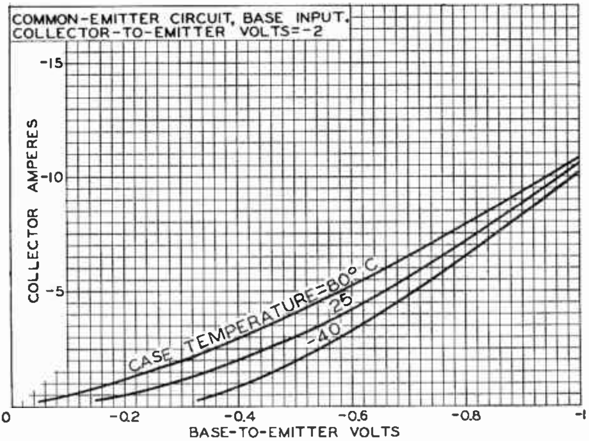
92CS-10703

TYPICAL COLLECTOR CHARACTERISTICS



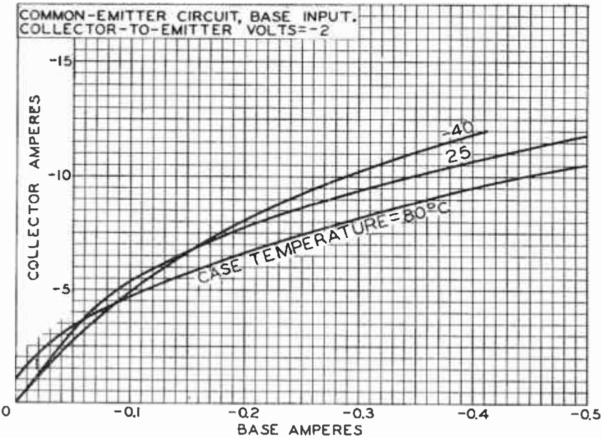
92CS-10733

TYPICAL CHARACTERISTICS



92CS-10709

TYPICAL CHARACTERISTICS



92CS-10712

World Radio History

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

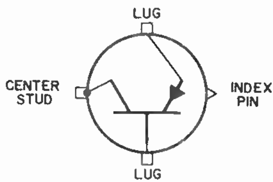
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No.TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = -1.5)	-100 max.	volts
EMITTER-TO-BASE VOLTAGE	-80 max.	volts
COLLECTOR CURRENT	-15 max.	amp
EMITTER CURRENT	15 max.	amp
BASE CURRENT	-4 max.	amp
TRANSISTOR DISSIPATION:[a]		
At case temperatures[b] of 25° C or below	150 max.	watts ←
CASE-TEMPERATURE[b] RANGE:		←
Operating and storage	-65 to +100	°C

Typical Operation:

In a common-emitter, base-input, power-switching circuit at case temperature[b] of 25° C

DC Supply Voltage	-12	volts
DC Base-Bias Voltage	6	volts
"On" DC Collector Current	-12	amp
"Turn-On" Base Current	-2	amp
"Turn-Off" Base Current	0	amp

← Indicates a change.

World Radio History

Switching Time:

Rise time	15	μsec
Fall time	15	μsec

[a] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

[b] Measured at any point on seating surface.

→ ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and at case temperature[b] *of 25° C unless otherwise specified*

		Min.	Typical	Max.	
DC Collector-to-Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = -0.3. . . .	BV_{CES}	-80	-	-	volts
With base open: For dc collector amperes = -1[c] . . .	BV_{CEO}	-65	-	-	volts
DC Base-to-Emitter Voltage for dc collector-to-emitter volts = -2, dc collector amperes = -5.	V_{BE}	-	-0.65	-0.9	volt
DC Collector-to-Emitter Saturation Voltage for dc collector amperes = -12, dc base amperes=-2.	V_{CE} (sat)	-	-0.3	-0.7	volt
DC Emitter Voltage for dc collector volts = -100, dc emitter current = 0	V_{EB}	-	-	-1	volt
DC Punch-Through Voltage .	V_{PT}	-100	-	-	volts
DC Emitter-Cutoff Current for dc emitter volts = -80, dc collector current = 0	I_{EBO}	-	-1	-4	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = -2, dc emitter current = 0		-	100	-	μa
With dc collector volts = -100, dc emitter current = 0		-	-2	-4	ma
With dc collector volts = -100, dc emitter current = 0, case temperature[b] = 71° C.		-	-	-15	ma

→ Indicates a change.

World Radio History

DC Current Transfer Ratio for dc collector-to-emitter volts = -2, dc collector amperes =	h_{FE}				
-5.		25	-	50	
-12		-	20	-	
Beta-Cutoff Frequency for dc collector-to-emitter volts = -6, dc collector amperes = -5.	$f_{\alpha e}$	-	10	-	kc
Thermal Resistance: Junction-to-case.	R_T	-	0.35	0.5	°C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds.		-	0.075	-	watt-sec/°C
Thermal Time Constant	τ_1	-	26.25	-	msec

[b] Measured at any point on seating surface.
[c] Tested be sweep method to prevent excessive heating of collector junction.

PERFORMANCE TESTS

This transistor type is designed to pass the environmental tests specified in Military Specification MIL-S-19500B.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

Electrical connection can be made to the base and emitter lugs by means of clips or by soldering directly to the lugs. When soldering connections are made to the lugs, care should be taken to conduct excessive heat away from the lug seals, otherwise the heat of the soldering operation will crack the glass seals of the lugs and damage the transistor.

This transistor is provided with a single-ended stud for mounting to a heat sink and for electrical connection to the collector. (See accompanying *Suggested Mounting Arrangement*). Electrical connection to the base and to the emitter is made to their respective lugs.

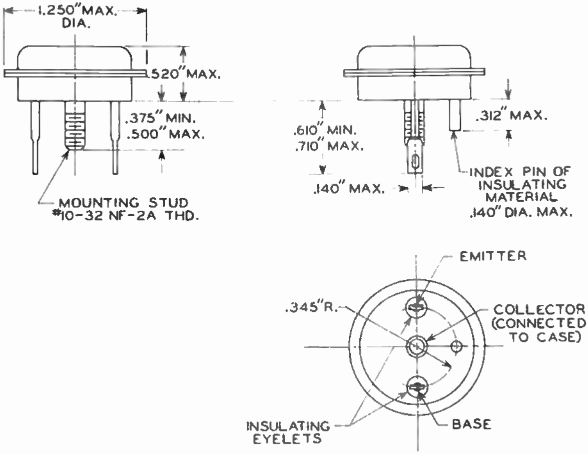
It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

The maximum torque on mounting stud should not exceed 12 inch-pounds.

← indicates a change.

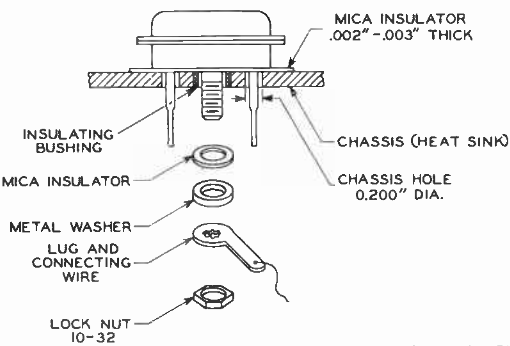
World Radio History

JEDEC No. TO-36



92CM-10612R1

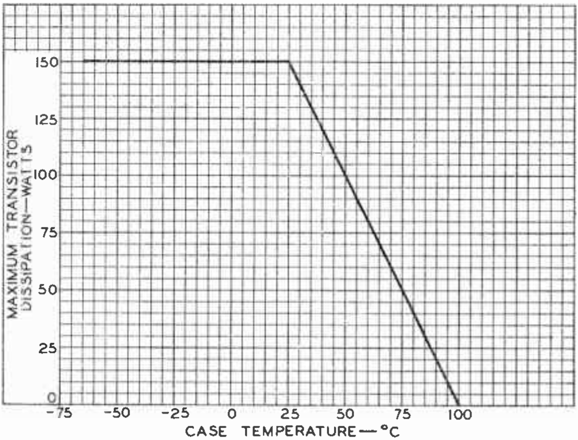
SUGGESTED MOUNTING ARRANGEMENT



92CS-10624R1

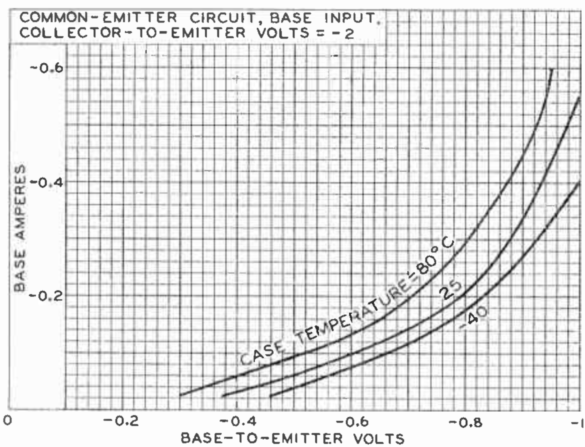
World Radio History

RATING CHART



92CS-10702R1

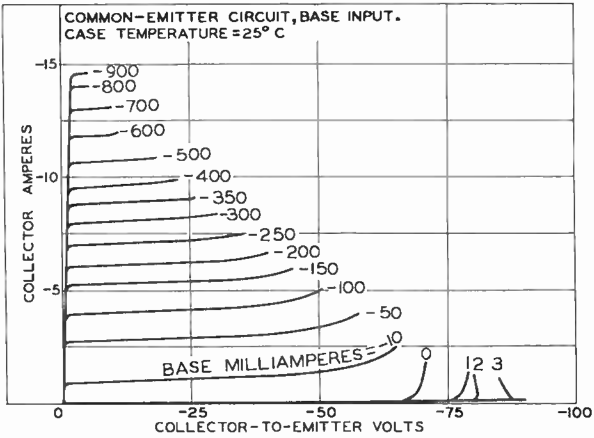
TYPICAL BASE CHARACTERISTICS



92CS-10706

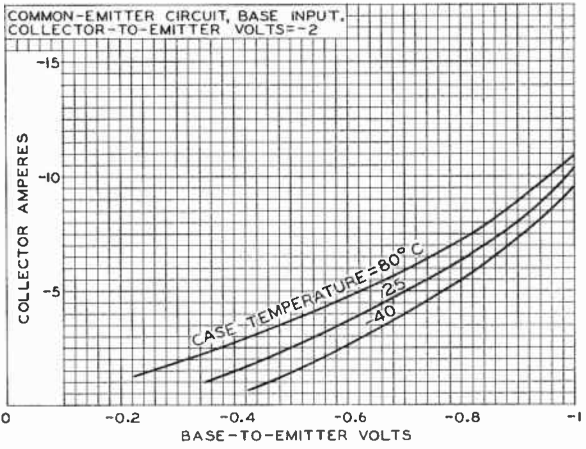
World Radio History

TYPICAL COLLECTOR CHARACTERISTICS



92CS-10724

TYPICAL CHARACTERISTICS



92CS-10710

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

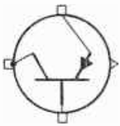
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	1.230"
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No. TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = -1.5)	-100 max.	volts
EMITTER-TO-BASE VOLTAGE	-80 max.	volts
COLLECTOR CURRENT	-15 max.	amp
EMITTER CURRENT	15 max.	amp
BASE CURRENT	-4 max.	amp
TRANSISTOR DISSIPATION:▲		
At case temperature of 25° C	87.5 max.	watts
CASE-TEMPERATURE RANGE:		
Continuous operation	-65 to +95	°C
Intermittent operation	-65 to +100	°C
Storage	-65 to +100	°C

Typical Operation:

In a common-emitter, base-input, power-switching circuit at case temperature of 25° C

DC Supply Voltage	-12	volts
DC Base-Bias Voltage	6	volts
"On" DC Collector Current	-12	amp
"Turn-On" Base Current	-2	amp
"Turn-Off" Base Current	0	amp

World Radio History

Switching Time:

Rise time	15	μsec
Fall time	15	μsec

▲ See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in *General Section*.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and case temperature of 25° C unless otherwise specified

		Min.	*Typical*	*Max.*	
DC Collector-to-Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = -0.3. . . .	BV_{CES}	-80	-	-	volts
With base open: For dc collector amperes = -1• . . .	BV_{CEO}	-65	-	-	volts
DC Base-to-Emitter Voltage* for dc collector-to-emitter volts = -2, dc collector amperes = -5.	V_{BE}	-	-0.65	-0.9	volt
DC Collector-to-Emitter Saturation Voltage* for dc collector amperes = -12, base amperes = -2.	V_{CE}	-	-0.3	-0.7	volt
DC Emitter Voltage for dc collector volts = -100, dc emitter amperes = 0	V_{EB}	-	-	-1	volt
DC Punch-Through Voltage.	V_P	-100	-	-	volts
DC Emitter-Cutoff Current for dc emitter volts = -80, dc collector amperes = 0	I_{EBO}	-	-1	-8	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = -2, dc emitter amperes = 0		-	100	-	μa
With dc collector volts = -100, dc emitter amperes = 0		-	-2	-8	ma
With dc collector volts = -100, dc emitter amperes = 0, case temperature = 71° C .		-	-	-15	ma

World Radio History

DC Current Transfer Ratio★ for dc collector-to-emitter volts = -2, dc collector amperes =	h_{FE}				
-5		25	-	50	
-12.		-	20	-	
Beta-Cutoff Frequency★ for dc collector-to emitter volts = -6, dc collector amperes = -5. . .	f_{ae}	-	10	-	kc
Thermal Resistance: Junction-to-case	R_T	-	0.5	0.8	°C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds		-	0.075	-	watt-sec/°C
Thermal Time Constant. . .	τ_1	-	37.5	-	msec

● Sweep voltage used to perform test.
★ Measured in a common-emitter, base-input circuit.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

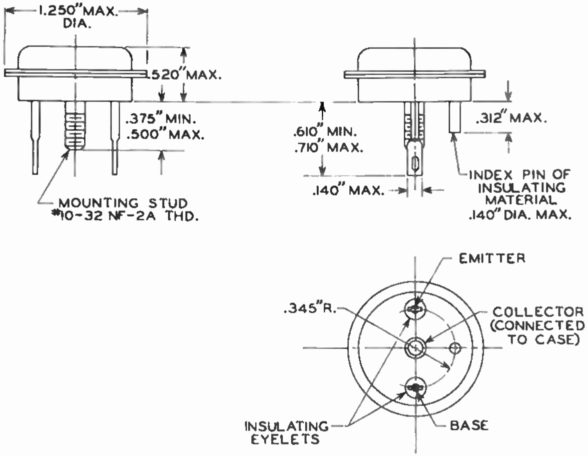
Electrical connection can be made to the base and emitter terminals by means of clips or by soldering directly to the terminals. When soldering connections are made to the terminals, care should be taken to conduct excessive heat away from the terminal seals, otherwise the heat of the soldering operation will crack the glass seals of the terminals and damage the transistor.

This transistor is provided with a single-ended stud for mounting to a heat sink and for electrical connection to the collector. (See accompanying *Suggested Mounting Arrangement*). Electrical connection to the base and to the emitter is made to their respective terminals.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

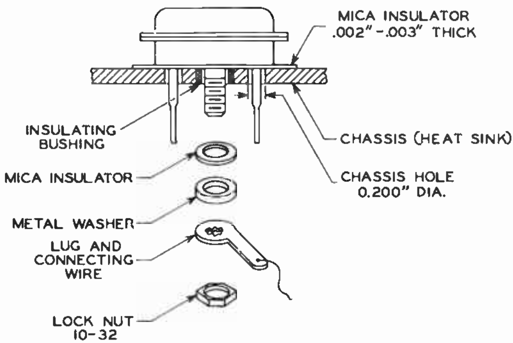
The maximum torque on mounting stud should not exceed 12 inch-pounds.

World Radio History



92CM-10612R1

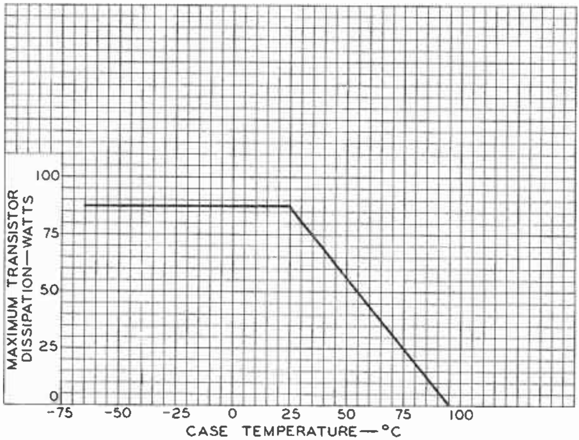
SUGGESTED MOUNTING ARRANGEMENT



92CS-10624R1

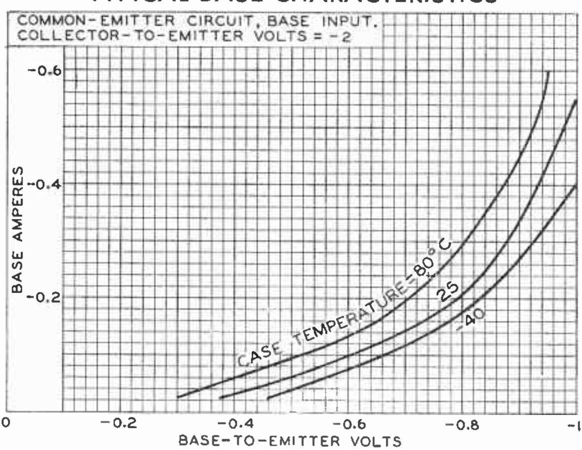
World Radio History

RATING CHART



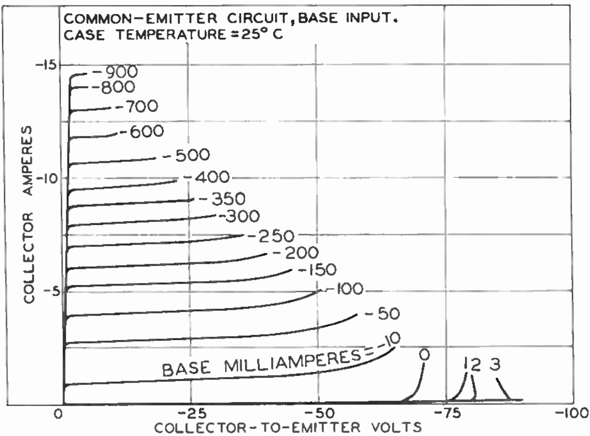
92CS-10702

TYPICAL BASE CHARACTERISTICS



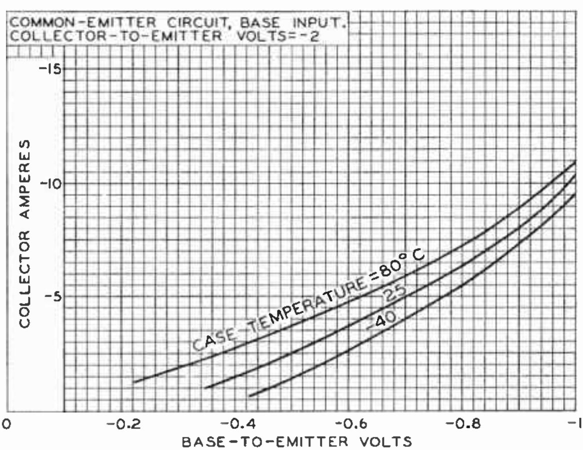
92CS-10706

TYPICAL COLLECTOR CHARACTERISTICS



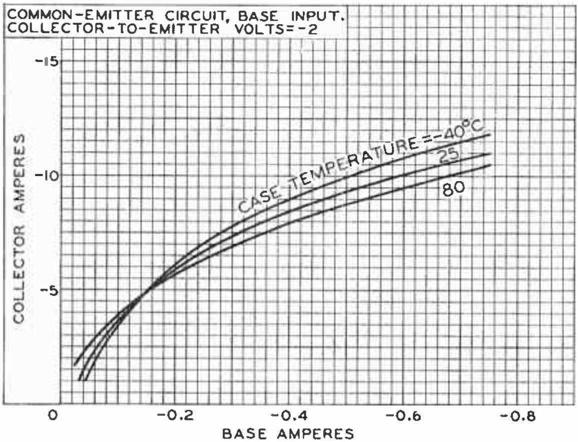
92CS-10724

TYPICAL CHARACTERISTICS



92CS-10710

TYPICAL CHARACTERISTICS



92CS-10711

World Radio History

World Radio History

Bidirectional Transistor

GERMANIUM N-P-N ALLOY TYPE

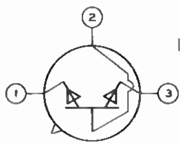
For Medium-Speed Switching Service in Industrial and Military Data-Processing Systems

GENERAL DATA

Mechanical:

Operating Position. . . . . Any
Maximum Length (Excluding flexible leads) . . . . 0.260"
Maximum Diameter. . . . . 0.370"
Dimensional Outline . . . . JEDEC No.TO-5
Case. . . . . Welded, Metal
Seals . . . . .Hermetic
Leads, Flexible 3
  Minimum length. . . . . 1.5"
  Orientation and diameter. . . . . . See *Dimensional Outline*
Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter (Or Collector)
Lead 2 – Base
Lead 3 – Collector (Or Emitter)



SWITCHING SERVICE

Such as in bidirectional switching, core-driver, and ac-signal-relay circuits

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	25 max.	volts
EMITTER-TO-BASE VOLTAGE	25 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
Base-to-emitter volts = −1.	20 max.	volts
Base open	18 max.	volts
COLLECTOR CURRENT	±400 max.	ma
EMITTER CURRENT	±400 max.	ma
TRANSISTOR DISSIPATION:▲		
At ambient temperature of 25° C	120 max.	mw
At ambient temperature of 55° C	35 max.	mw
At ambient temperature of 71° C	10 max.	mw
AMBIENT TEMPERATURE (During operation)	71 max.	°C
STORAGE-TEMPERATURE RANGE	−65 to +85	°C

Typical Operation:

In accompanying typical inverter circuit at ambient temperature of 25° C

"On" Collector Current	200	ma
"Turn-On" Base Current (I_{B_1})	20	ma
"Turn-Off" Base Current (I_{B_2})	−20	ma

World Radio History

Switching Time:

Delay time (t_d)	0.05	μsec
Rise time (t_r)	0.35	μsec
Storage time (t_s)	0.45	μsec
Fall time (t_f)	0.2	μsec

▲ *See accompanying Rating Chart and also Transistor-Dissipation Rating Chart in General Section.*

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Voltage values are given with respect to the case unless otherwise specified. Ambient temperature of 25° C.

		Min.	*Typical*	*Max.*	
DC Collector Breakdown Voltage for dc collector μa = -50, emitter open.	BV_{CBO}	25	35	-	volts
DC Punch-Through Voltage for dc emitter volts = 1	V_P	20	35	-	volts
DC Base-to-Emitter Voltage for dc collector ma. = 200, dc base ma. = 10	V_{BE}	-	1	1.5	volts
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = 200, dc base ma. = 10.	V_{CE}	-	0.1	0.3	volt
DC Collector-Cutoff Current for dc collector volts = 12, emitter open.	I_{CBO}	-	3	10	μa
DC Current Transfer Ratio for dc collector-to-emitter volts = 0.3, dc collector ma. = 200	h_{FE}	20	40	-	
Alpha-Cutoff Frequency for dc collector volts = 6, dc collector ma. = 1	$f_{\alpha b}$	4.5	7	-	Mc
Collector-to-Base Capacitance for dc collector volts = 6, dc collector ma. = 0.	C_{ob}	-	19	-	μμf
Thermal Time Constant . . .	$\mathcal{T}_I$	-	12	-	msec
Thermal Resistance between collector junction and free air . .	R_T	-	-	500	°C/watt

World Radio History

OPERATING CONSIDERATIONS

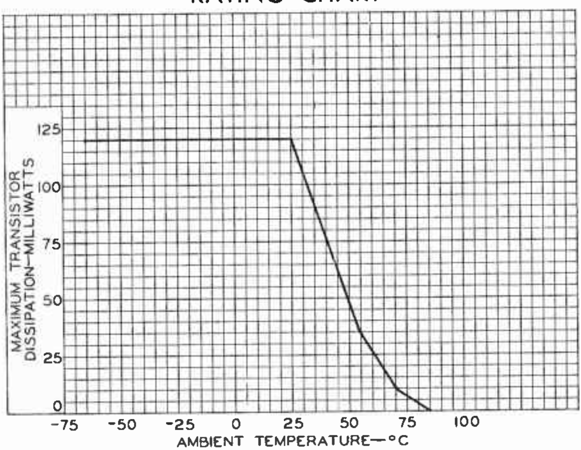
It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using this transistor, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds.

This transistor is intended for use in single-side printed circu't boards and in conventional wire-in type circuits. If this transistor is used in double-side printed-circuit boards or in printed-circuit boards utilizing eyelets, it may be necessary to use an insulating washer or similar standoff device made of good dielectric material to prevent the solder from shorting the leads to each other or to the board.

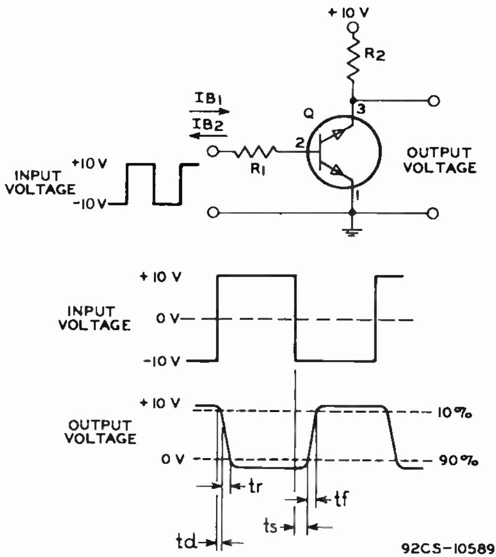
RATING CHART



92CS-10573R1

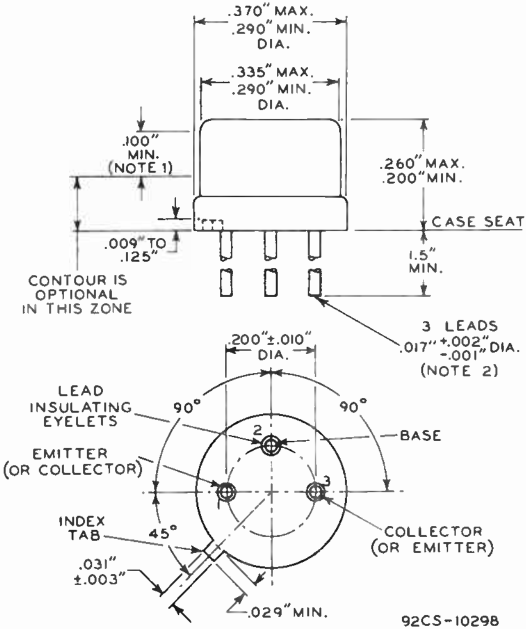
World Radio History

TYPICAL INVERTER CIRCUIT
AND ASSOCIATED WAVE FORMS



Q: Transistor type 2N1169
R_1: 500 ohms, 0.5 watt
R_2: 50 ohms, 0.5 watt

World Radio History

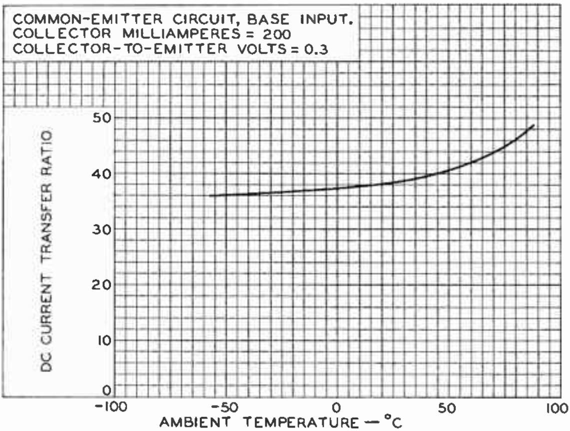


NOTE 1: THE DIAMETER IN THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE TOTAL VARIATION IN ACTUAL DIAMETER FROM THE TRUE DIAMETER, DUE TO TAPER AND OUT OF ROUND WITHIN THIS ZONE, WILL NOT EXCEED 0.010".

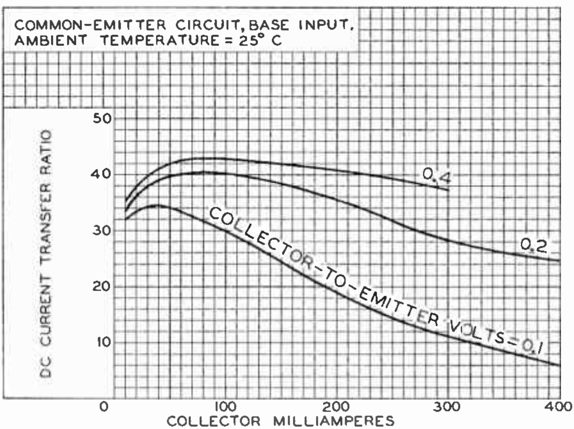
NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

TYPICAL OPERATION CHARACTERISTICS



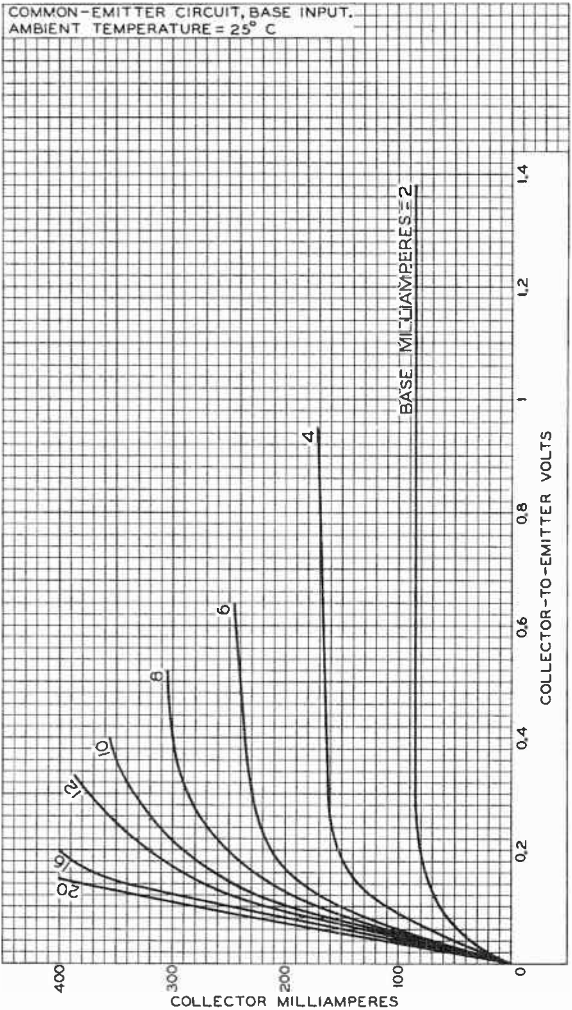
92CS-10293



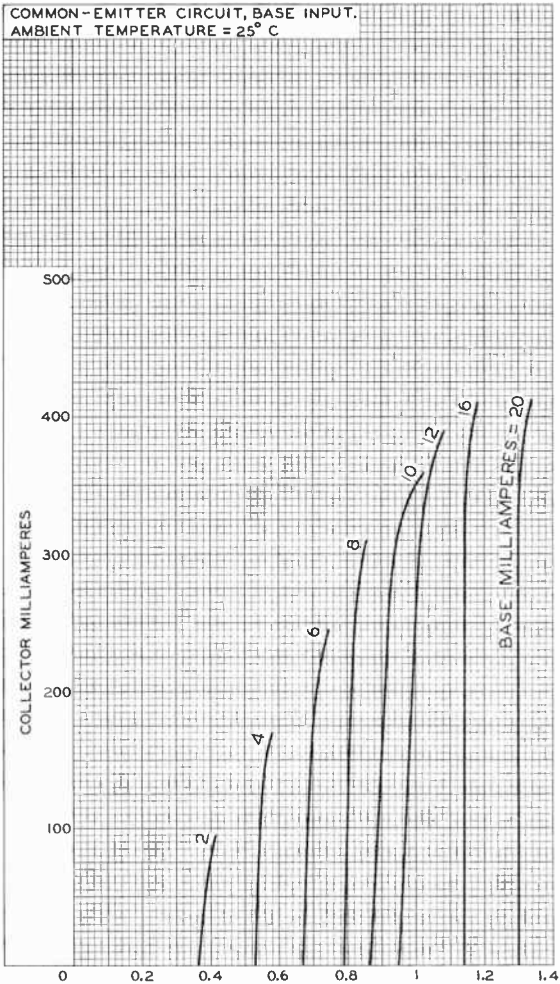
92CS-10287

World Radio History

TYPICAL COLLECTOR CHARACTERISTICS



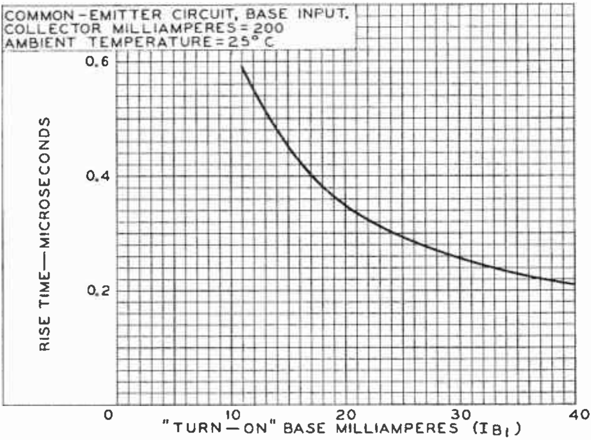
TYPICAL TRANSFER CHARACTERISTICS



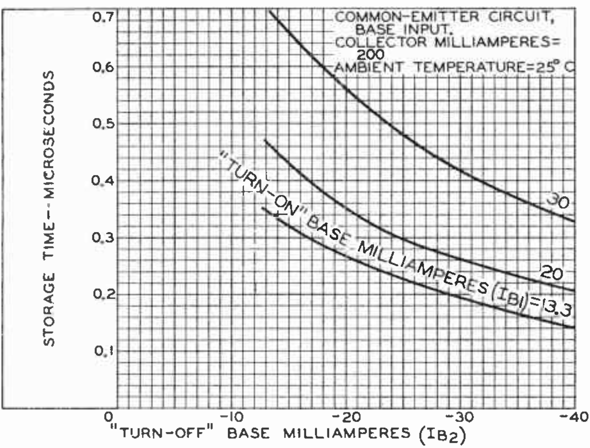
92CM-10292

World Radio History

TYPICAL OPERATION CHARACTERISTICS

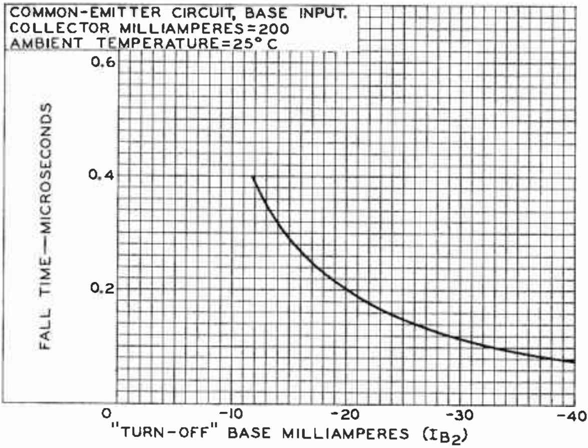


92CS-10591



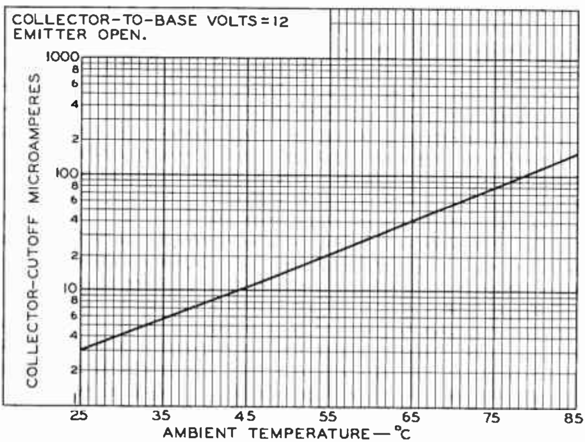
92CS-10294

TYPICAL OPERATION CHARACTERISTIC



92CS-10295

TYPICAL COLLECTOR-CUTOFF-CURRENT CHARACTERISTIC



92CS-10296

World Radio History

Bidirectional Transistor

GERMANIUM N-P-N ALLOY TYPE

For Medium-Speed Switching Service in Industrial and Military Data-Processing Systems

The 2N1170 is the same as the 2N1169 except for the following items:

SWITCHING SERVICE

Such as in bidirectional switching, core-driver, and ac-signal-relay circuits

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	40 max.	volts
EMITTER-TO-BASE VOLTAGE	40 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
Base-to-emitter volts = −1	39 max.	volts
Base open	20 max.	volts

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

		Min.	*Typical*	*Max.*	
DC Collector Breakdown Voltage for dc collector μa = −50, emitter open	BV_{CBO}	40	50	–	volts
DC Punch-Through Voltage for dc emitter volts = 1	V_P	39	50	–	volts
DC Collector-Cutoff Current for dc collector volts = 12, emitter open	I_{CBO}	–	3	8	μa

World Radio History

World Radio History

Mesa Transistor

GERMANIUM P-N-P DIFFUSED-JUNCTION TYPE

For High-Speed Switching Service in Commercial and Military Data-Processing Systems

GENERAL DATA

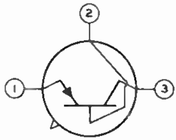
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No. TO-5
Case	Welded, Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	-13 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE	-12 max.	volts
EMITTER-TO-BASE VOLTAGE[a]	-1 max.	volt
COLLECTOR CURRENT	-100 max.	ma
EMITTER CURRENT	100 max.	ma
TRANSISTOR DISSIPATION:[b]		
At ambient temperature of 25° C	150 max.	mw
At ambient temperature of 55° C	75 max.	mw
At ambient temperature of 71° C	35 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +85	°C
LEAD TEMPERATURE:		←
For immersion in molten solder for 10 seconds maximum	255 max.	°C

Typical Operation: ←

In an inverter circuit at ambient temperature of 25° C

Collector-to-Emitter Voltage	-5	volts
Base Resistor	5000	ohms
Collector Resistor	500	ohms
"Turn-On" Base Voltage	-5	volts
"Turn-Off" Base Voltage	5	volts

← indicates a change.

World Radio History

"On" Collector Current.	-10	ma
"Turn-On" Base Current.	-0.66	ma
"Turn-Off" Base Current	0.66	ma
Switching Time:		
Delay time (t_d)	0.14	μsec
Rise time (t_r).	0.16	μsec
Storage time (t_s)	0.14	μsec
Fall time (t_f).	0.11	μsec

[a] This rating may be exceeded and the emitter-to-base junction operated in the breakdown condition provided the emitter dissipation is limited to 30 milliwatts at 25° C. For ambient temperatures above 25° C, the dissipation should be reduced by 0.5 milliwatt/°C.

[b] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Voltage values are given with respect to base unless otherwise specified. Ambient temperature of 25° C.

		Min.	Typical	Max.	
DC Collector Breakdown Voltage for dc collector ma. = -0.02, emitter open.	BV_{CBO}	-13	-30	-	volts
DC Collector-to-Emitter Breakdown Voltage . .	BV_{CERL}	-12	-25	-	volts
DC Emitter Breakdown Voltage for dc emitter ma. = -0.1, collector open.	BV_{EBO}	-1	-3	-	volts
DC Punch-Through Voltage.	V_P	-12	-30	-	volts
DC Base-to-Emitter Voltage for dc collector ma. = -40, dc base ma. = -1. . . .	V_{BE}	-	-0.3	-0.4	volt
DC Collector-Cutoff Current for collector volts = -6, emitter open.	I_{CBO}	-	-1	-3	μa
→ Collector Capacitance for dc collector volts = -6, emitter open.	C_C	-	8	12	μμf
DC Current Transfer Ratio for dc collector-to-emitter volts = -0.3, dc collector ma. = -10	h_{FE}	30	50	-	
Gain-Bandwidth Product[c] for collector-to-emitter volts = -3, collector ma. = -10 . .	GBW	25	40	-	Mc

→ indicates a change.

World Radio History

Thermal Resistance:					
Junction-to-free air. .	R_T	–	–	400	°C/watt
Total Stored Charge for dc collector ma. = -10, dc base ma. = -1. . . .	Q_S	–	250	400	$\mu\mu$coulombs
Thermal Time Constant . .	τ_I	–	10	–	msec

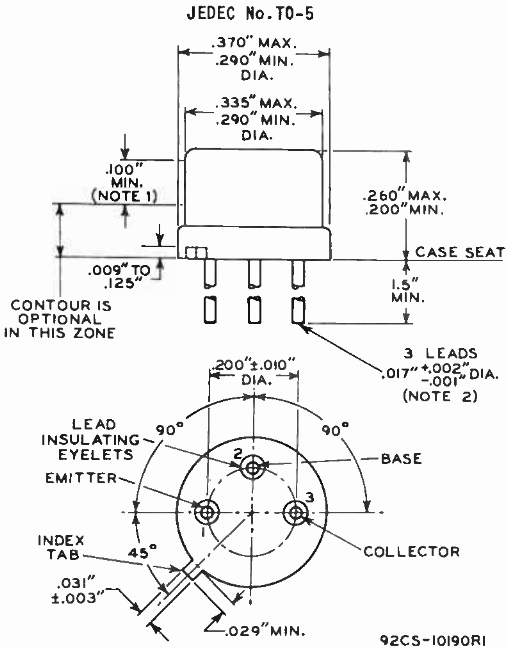
[c] Frequency at which the current transfer ratio is equal to 1.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

World Radio History

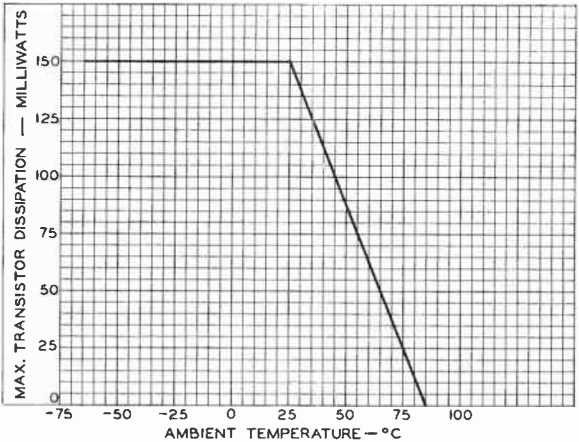


NOTE 1: THE DIAMETER IN THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE TOTAL VARIATION IN ACTUAL DIAMETER FROM THE TRUE DIAMETER, DUE TO TAPER AND OUT OF ROUND WITHIN THIS ZONE, WILL NOT EXCEED 0.010".

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

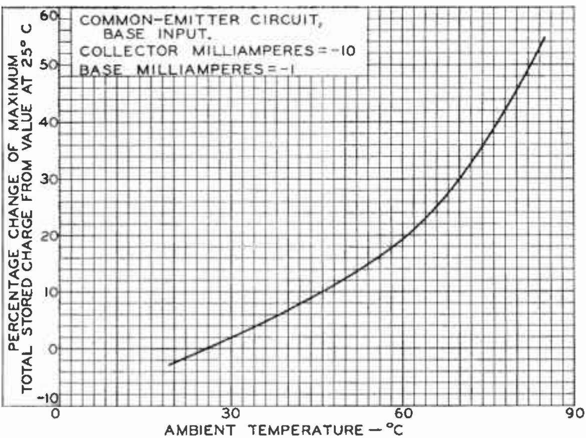
World Radio History

RATING CHART



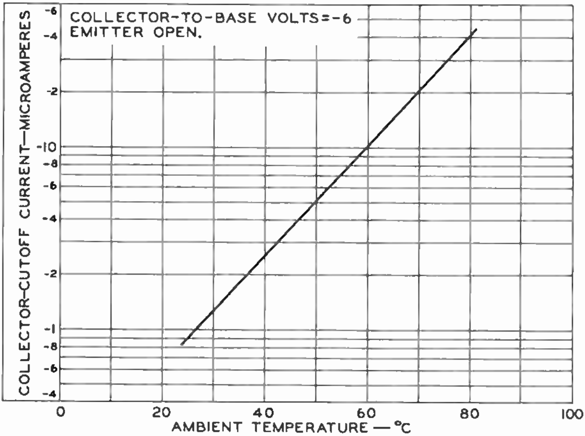
92CS-10232R1

OPERATION CHARACTERISTIC



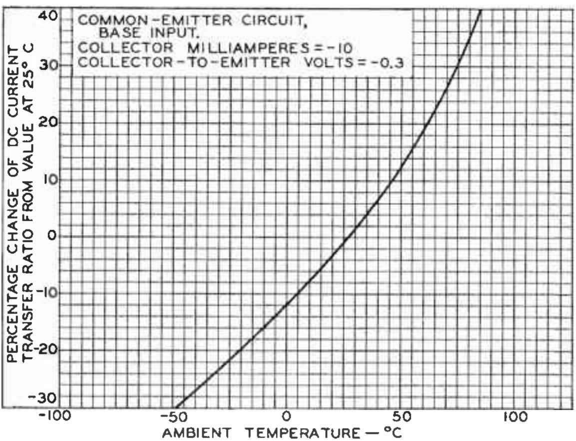
92CS-10226R1

TYPICAL COLLECTOR-CUTOFF-CURRENT CHARACTERISTIC



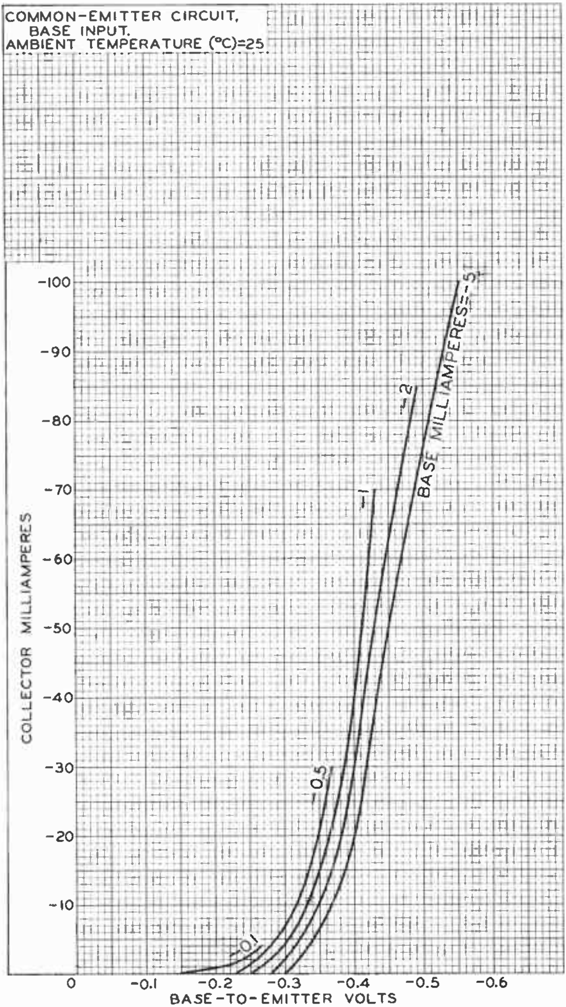
92CS-10213R1

TYPICAL CHARACTERISTIC



92CS-10199R3

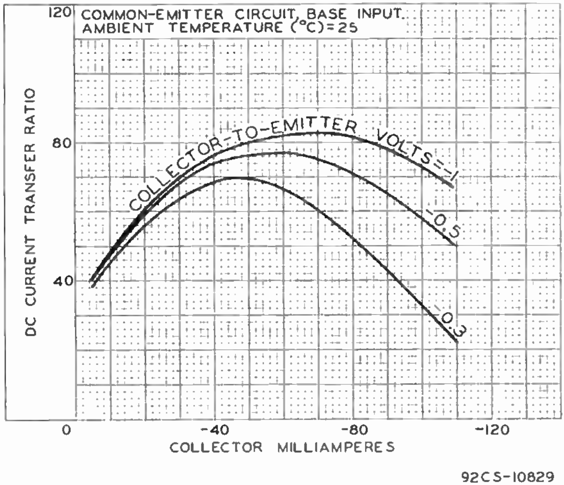
TYPICAL TRANSFER CHARACTERISTICS



92CM-10229

World Radio History

TYPICAL DC CURRENT-TRANSFER-RATIO CHARACTERISTICS



World Radio History

Mesa Transistor

GERMANIUM P-N-P DIFFUSED-JUNCTION TYPE

For High-Speed Switching Service in Commercial and Military Data-Processing Systems

GENERAL DATA

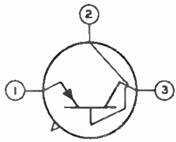
Mechanical:

Operating Position.	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter.	0.370"
Dimensional Outline	JEDEC No.TO-5
Case.	Welded, Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length.	1.5"
Orientation and diameter.	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	-13 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE.	-12 max.	volts
EMITTER-TO-BASE VOLTAGE[a].	-4 max.	volts
COLLECTOR CURRENT	-100 max.	ma
EMITTER CURRENT	100 max.	ma
TRANSISTOR DISSIPATION:[b]		
At ambient temperature of 25° C	150 max.	mw
At ambient temperature of 55° C	75 max.	mw
At ambient temperature of 71° C	35 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +85	°C
LEAD TEMPERATURE:		
For immersion in molten solder for 10 seconds maximum.	255 max.	°C

Typical Operation:

In an inverter circuit at ambient temperature of 25° C

Collector-to-Emitter Voltage.	-5	volts
Base Resistor	2400	ohms
Collector Resistor.	120	ohms
"Turn-On" Base Voltage.	-5	volts

← Indicates a change.

World Radio History

"Turn-Off" Base Voltage.	5	volts
"On" Collector Current	-40	ma
"Turn-On" Base Current	-2	ma
"Turn-Off" Base Current.	2	ma
Switching Time:		
Delay time (t_d).	0.08	μsec
Rise time (t_r)	0.07	μsec
Storage time (t_s).	0.12	μsec
Fall time (t_f)	0.07	μsec

[a] This rating may be exceeded and the emitter-to-base junction operated in the breakdown condition provided the emitter dissipation is limited to 30 milliwatts at 25° C. For ambient temperatures above 25° C, the dissipation should be reduced by 0.5 milliwatt/°C.

[b] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base unless otherwise specified. Ambient temperature of 25° C.

		Min.	*Typical*	*Max.*	
DC Collector Breakdown Voltage for dc collector ma. = -0.02, emitter open.	BV_{CBO}	-13	-30	-	volts
DC Collector-to-Emitter Breakdown Voltage.	BV_{CERL}	-12	-25	-	volts
DC Emitter Breakdown Voltage for dc emitter ma. = -0.1, collector open . . .	BV_{EBO}	-4	-6	-	volts
DC Punch-Through Voltage.	V_P	-12	-30	-	volts
→ DC Base-to-Emitter Voltage for dc collector ma. = -40, dc base ma. = -1 . .	V_{BE}	-	-0.4	-0.6	volt
DC Collector-Cutoff Current for collector volts = -6, emitter open	I_{CBO}	-	-1	-3	μa
→ Collector Capacitance for dc collector volts = -6, emitter open	C_C	-	8	12	μμf
DC Current Transfer Ratio:	h_{FE}				
With dc collector-to-emitter volts = -0.3, dc collector ma. = -10. . .		30	50	-	

→ Indicates a change.

World Radio History

With dc collector-to-emitter volts = -0.5, dc collector ma. = -40.		40	75	-	
Gain-Bandwidth Product[c] for dc collector-to-emitter volts = -3, dc collector ma. = -10 . .	GBW	35	60	-	Mc
Thermal Resistance: Junction-to-free air . . .	R_T	-	-	400	°C/watt
Total Stored Charge: With dc collector ma. = -10, dc base ma. = -0.4.		-	225	325	$\mu\mu$coulombs
With dc collector ma. = -40, dc base ma. = -1.6.		-	600	800	$\mu\mu$coulombs
Thermal Time Constant. . . .	τ_I	-	10	-	msec

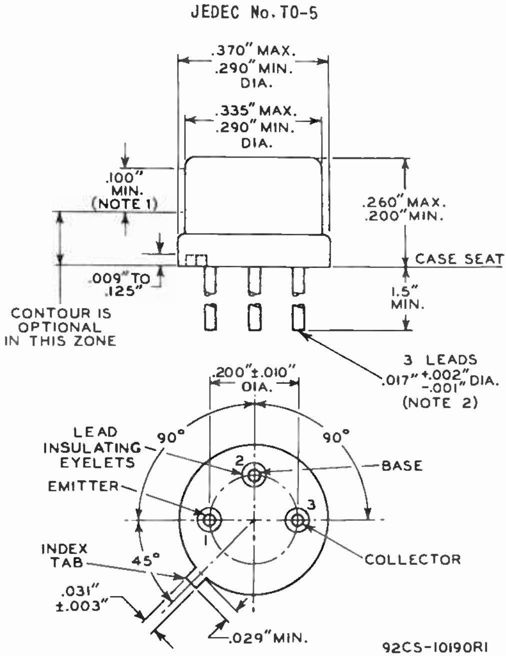
[c] Frequency at which the current transfer ratio is equal to 1.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

World Radio History



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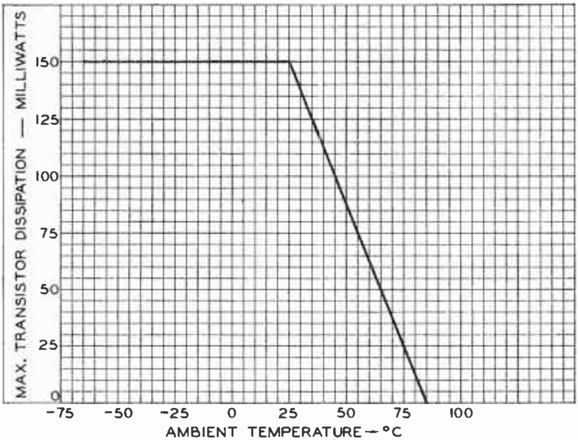
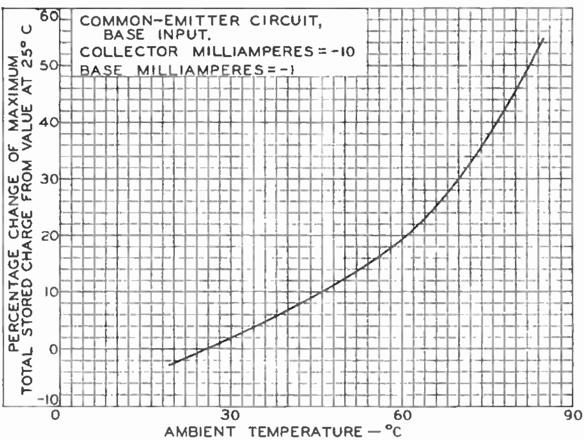
World Radio History

RATING CHART



92CS-10232RI

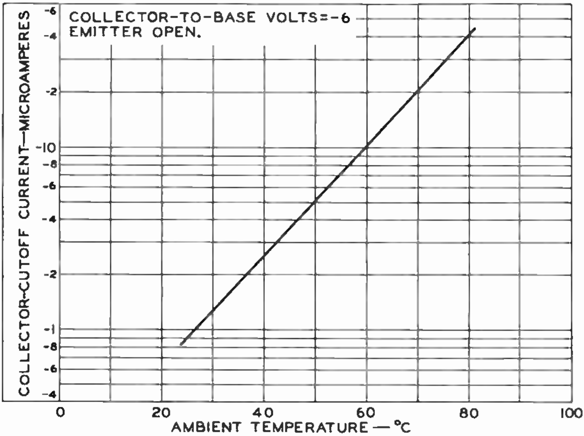
OPERATION CHARACTERISTIC



92CS-10226RI

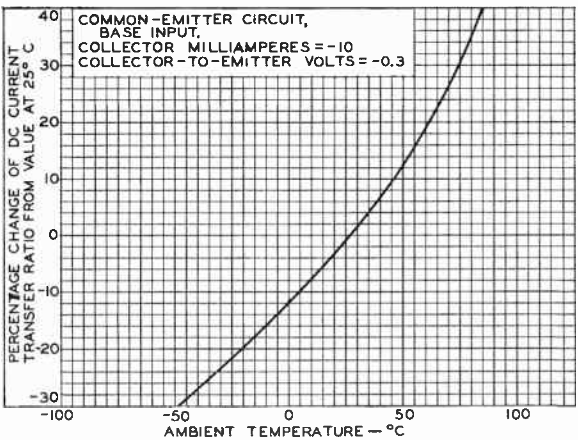
World Radio History

TYPICAL COLLECTOR-CUTOFF-CURRENT CHARACTERISTIC



92CS-10213R1

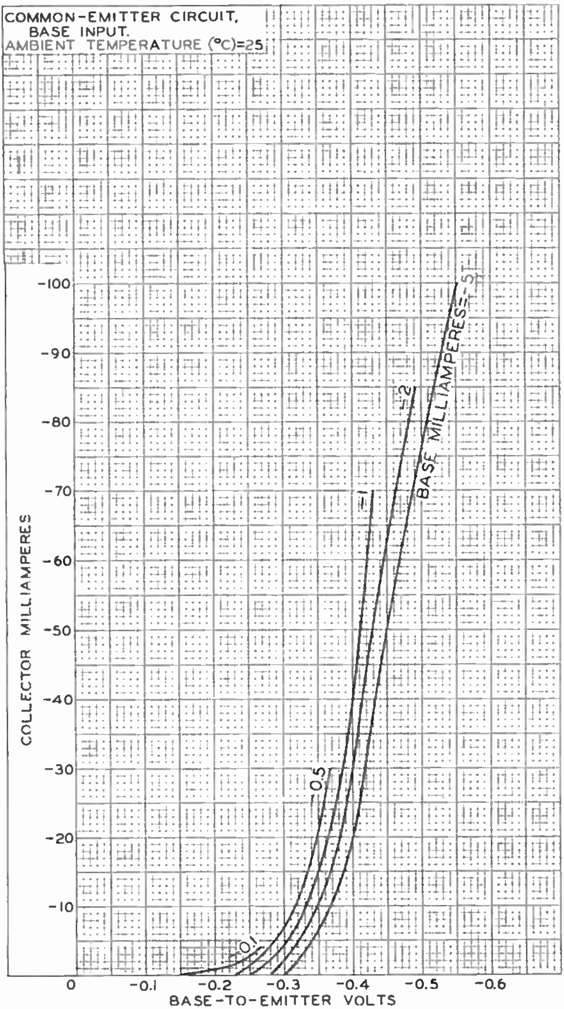
TYPICAL CHARACTERISTIC



92CS-10199R3

World Radio History

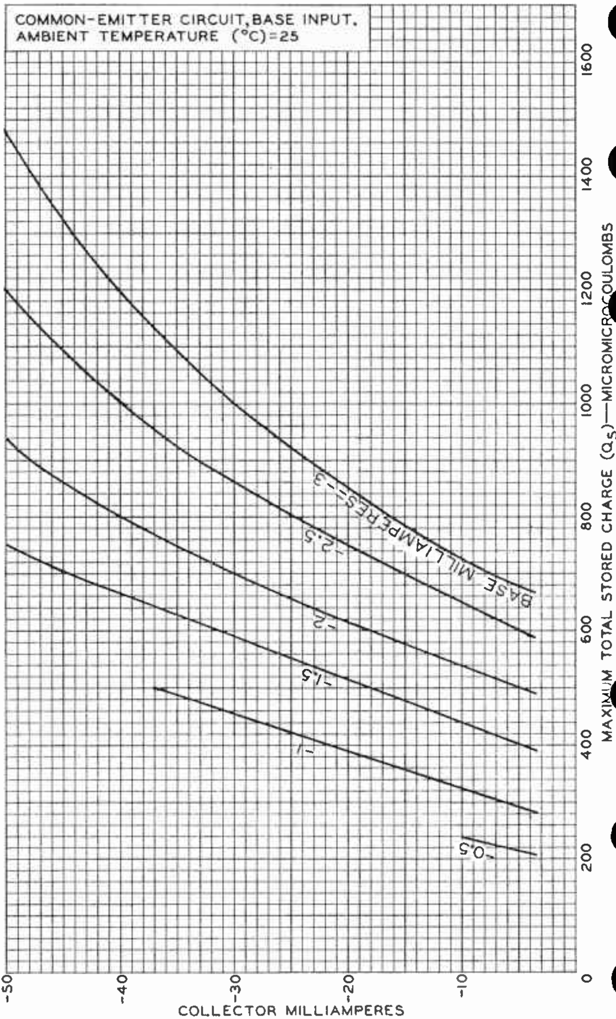
TYPICAL TRANSFER CHARACTERISTICS



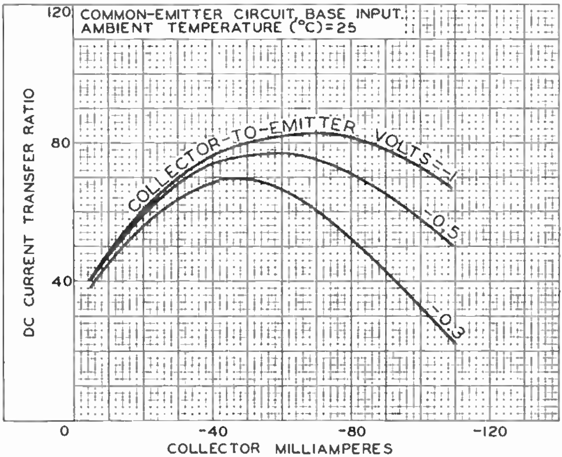
92CM-10229

World Radio History

MAXIMUM TOTAL-STORED-CHARGE CHARACTERISTICS



TYPICAL DC CURRENT-TRANSFER-RATIO CHARACTERISTICS



92CS-10829

World Radio History

World Radio History

Bidirectional Transistor

GERMANIUM P-N-P ALLOY TYPE

For Medium-Speed Switching Service in Industrial and Military Data-Processing Systems

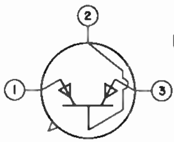
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No.TO-5
Case	Welded, Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter (Or Collector)
Lead 2 - Base



Lead 3 - Collector (Or Emitter)

SWITCHING SERVICE

Such as in bidirectional switching, core-driver, and ac-signal-relay circuits

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	-20 max.	volts
EMITTER-TO-BASE VOLTAGE	-20 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
Base-to-emitter volts = 1	-20 max.	volts
COLLECTOR CURRENT	±400 max.	ma
EMITTER CURRENT	±400 max.	ma
TRANSISTOR DISSIPATION:[a]		
At ambient temperature of 25° C	120 max.	mw
At ambient temperature of 55° C	35 max.	mw
At ambient temperature of 71° C	10 max.	mw
AMBIENT TEMPERATURE (During operation)	71 max.	°C
STORAGE-TEMPERATURE RANGE	-65 to +85	°C

Typical Operation:

In accompanying typical inverter circuit at ambient temperature of 25° C

"On" Collector Current	200	ma
"Turn-On" Base Current (I_{B1})	-20	ma
"Turn-Off" Base Current (I_{B2})	20	ma

World Radio History

Switching Time:

Delay time (t_d)	0.05	µsec
Rise time (t_r).	0.55	µsec
Storage time (t_s)	0.7	µsec
Fall time (t_f).	0.25	µsec

[a] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to the base unless otherwise specified. Ambient temperature of 25° C.

		Min.	*Typical*	*Max.*	
DC Collector Breakdown Voltage for dc collector µa = -50, emitter open.	BV_{CBO}	-21	-35	-	volts
DC Punch-Through Voltage for dc emitter volts = -1. . . .	V_P	-20	-35	-	volts
DC Base-to-Emitter Voltage for dc collector ma. = -400, dc base ma. = -26.7 . . .	V_{BE}	-	-1	-1.5	volts
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = -400, dc base ma. = -26.7	V_{CE}	-	-0.2	-0.3	volt
DC Collector-Cutoff Current for dc collector volts = -12, emitter open.	I_{CBO}	-	-2.5	-6	µa
DC Current Transfer Ratio for dc collector-to-emitter volts = -0.3, dc collector ma. = -400.	h_{FE}	15	30	-	
Alpha-Cutoff Frequency for dc collector volts = -6, dc emitter ma. = 1	f_{ab}	3	6	-	Mc
Collector-to-Base Capacitance for dc collector volts = 6, dc emitter ma. = 0	C_{ob}	-	20	30	µµf
Thermal Time Constant . . .	$\mathcal{T}_1$	-	12	-	msec
Thermal Resistance between collector junction and free air . .	R_T	-	-	500	°C/watt

World Radio History

OPERATING CONSIDERATIONS

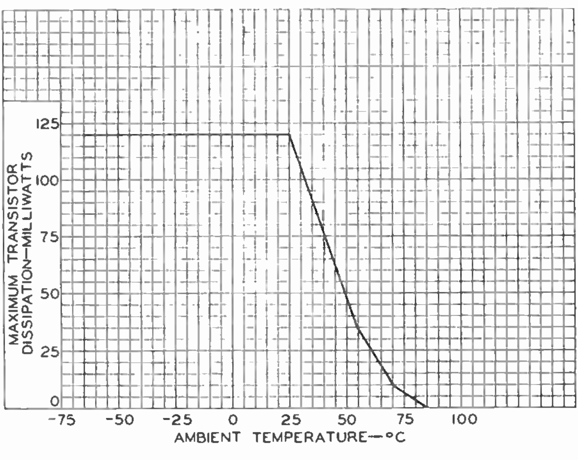
It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using this transistor, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds.

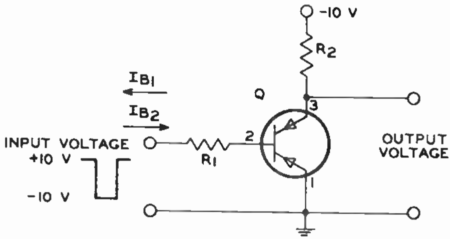
This transistor is intended for use in single-side printed circuit boards and in conventional wire-in type circuits. If this transistor is used in double-side printed-circuit boards or in printed-circuit boards utilizing eyelets, it may be necessary to use an insulating washer or similar standoff device made of good dielectric material to prevent the solder from shorting the leads to each other or to the board.

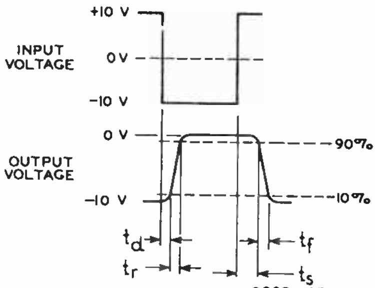
RATING CHART



World Radio History

TYPICAL INVERTER CIRCUIT
AND ASSOCIATED WAVEFORMS

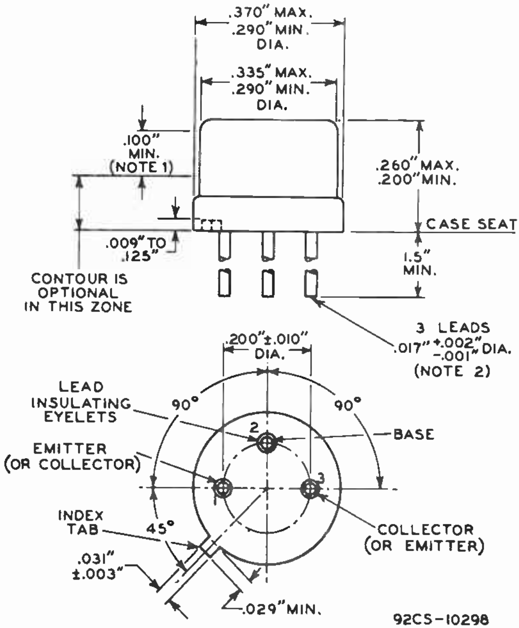




Q: Transistor type 2N1319
R_1: 500 ohms, 0.5 watt
R_2: 50 ohms, 0.5 watt

World Radio History

JEDEC No. TO-5

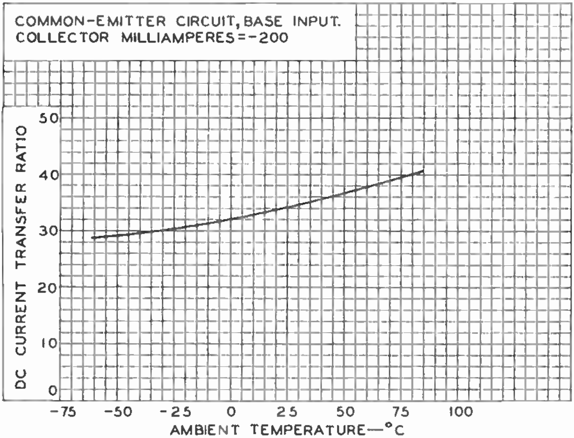


NOTE 1: THE DIAMETER IN THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE TOTAL VARIATION IN ACTUAL DIAMETER FROM THE TRUE DIAMETER, DUE TO TAPER AND OUT OF ROUND WITHIN THIS ZONE, WILL NOT EXCEED 0.010".

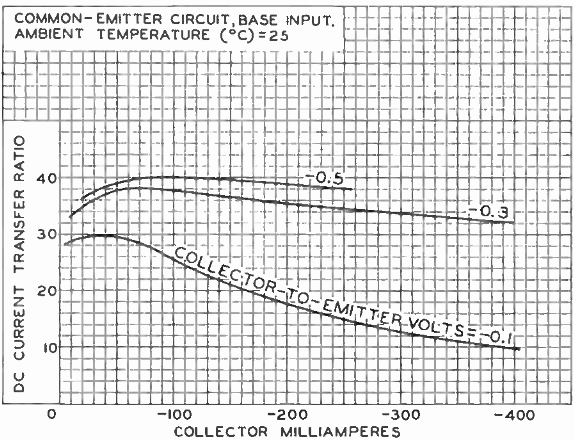
NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD D'AMETER IS NOT CONTROLLED.

World Radio History

TYPICAL OPERATION CHARACTERISTICS



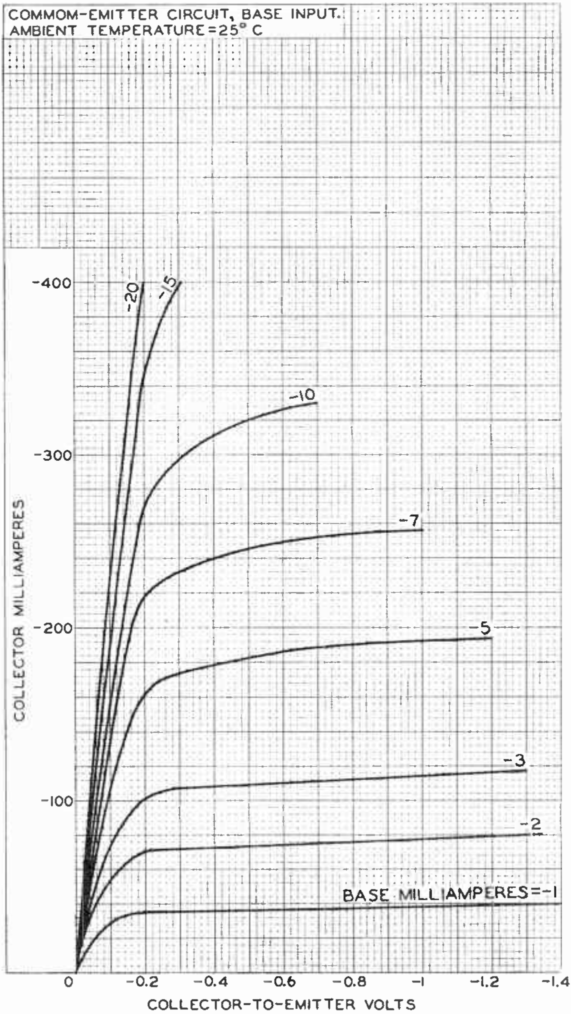
92CS-10572



92CS-10564

World Radio History

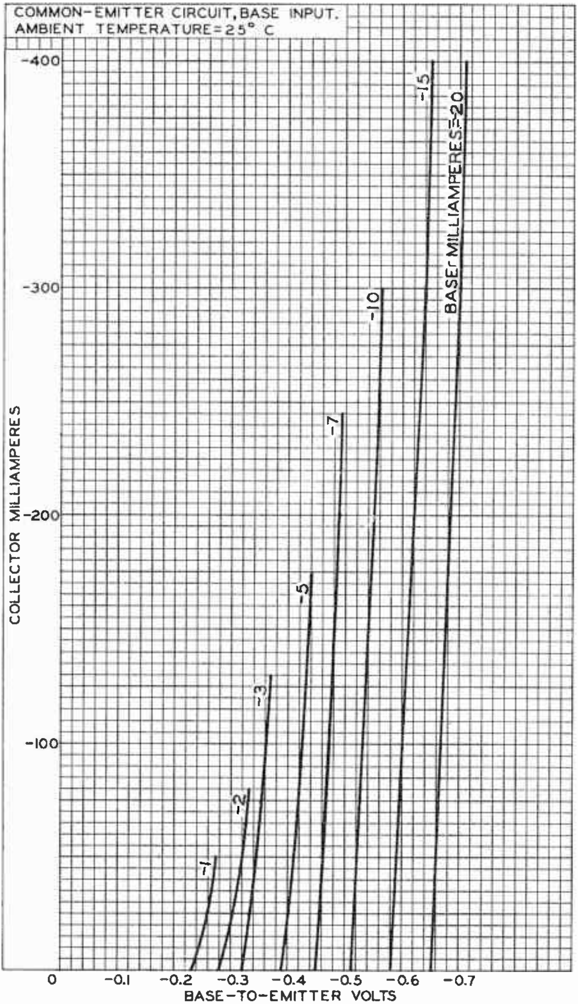
TYPICAL COLLECTOR CHARACTERISTICS



92CM-10567

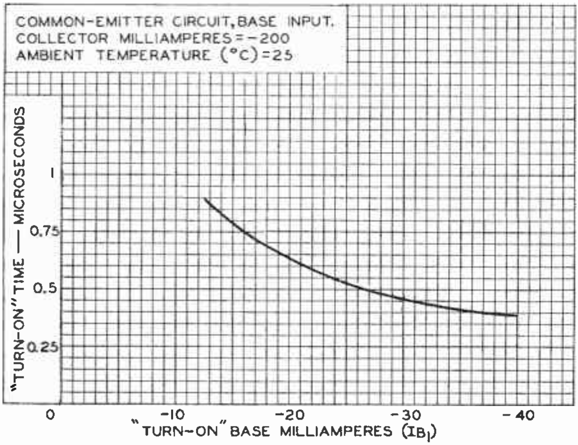
World Radio History

TYPICAL TRANSFER CHARACTERISTICS

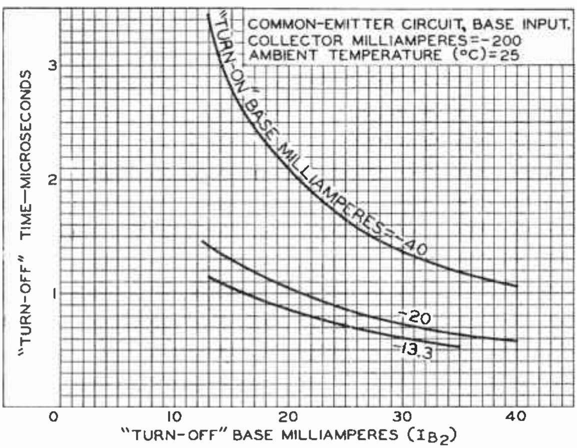


92CM-10563

TYPICAL OPERATION CHARACTERISTICS

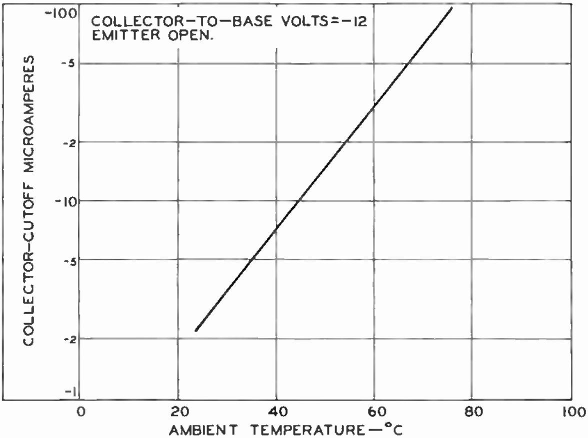


92CS-10570R1



92CS-10571R1

TYPICAL COLLECTOR-CUTOFF-CURRENT CHARACTERISTIC



92CS-10566R1

World Radio History

2N1358

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

The 2N1358 is the same as the 2N174 except for the following items:

ELECTRICAL CHARACTERISTICS ←

Voltage values are given with respect to base and at case temperature[a] of 25° C unless otherwise specified

		Min.	Typical	Max.	
DC Collector-to-Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = -0.3.	BV_{CES}	-70	-	-	volts
With base open, dc collector amperes = -0.3.	BV_{CEO}	-40	-	-	volts
DC Base-to-Emitter Voltage:	V_{BE}				
With dc collector volts = -2, dc collector amperes = -1.2.		-	0.35	0.5	volt
With dc collector-to-emitter volts = -2, dc collector amperes = -5. .		-	-0.65	-0.9	volt
DC Collector-to-Emitter Saturation Voltage for dc collector amperes = -12, dc base amperes = -2. . . .	$V_{CE(sat)}$	-	-0.3	-0.7	volt
DC Emitter Voltage for dc collector volts = -80, dc collector current = 0 . . .	V_{EB}	-	-0.15	-1	volt
DC Punch-Through Voltage. . .	V_{PT}	-80	-	-	volts
DC Emitter-Cutoff Current:	I_{EBO}				
With dc emitter volts = -30, dc collector current = 0, case temperature[a] = 71° C.		-	-4	-6	ma
With dc emitter volts = -60, dc collector current = 0.		-	-1	-4	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = -2, dc emitter current = 0		-	-100	-200	µa
With dc collector volts = -30, dc emitter current = 0, case temperature[a] = 71° C		-	-4	-6	ma
With dc collector volts = -80, dc emitter current = 0		-	-2	-4	ma

← Indicates a change.

World Radio History

With dc collector volts = -80, dc emitter current = 0, case temperature[a] = 71° C.		–	–	-15	ma
DC Current Transfer Ratio for dc collector-to-emitter volts = -2, dc collector amperes =	h_{FE}				
-5		25	35	–	
-1.2		40	55	80	
Beta-Cutoff Frequency for dc collector volts = -12, dc collector amperes = -1. .	$f_{\alpha e}$	100	–	–	kc
Thermal Resistance:					
Junction-to-case	R_T	–	0.35	0.5	°C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds		–	0.075	–	watt-sec/°C
Thermal Time Constant.	τ_I	–	26.25	–	msec

[a] Measured at any point on seating surface.

World Radio History

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

The 2N1358 is the same as the 2N174 except for the following items:

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and case temperature of 25° C unless otherwise specified

		Min.	Typical	Max.	
DC Collector-to-Emitter Breakdown Voltage:					
With base connected to emitter, dc collector amperes = -0.3.	BV_{CES}	-70	–	–	volts
With base open, dc collector amperes = -0.3.	BV_{CEO}	-40	–	–	volts
DC Base-to-Emitter Voltage:*	V_{BE}				
With dc collector volts = -2, dc collector amperes = -1.2.		–	0.35	0.5	volt
With dc collector-to-emitter volts = -2, dc collector amperes = -5. .		–	-0.65	-0.9	volt
DC Collector-to-Emitter Saturation Voltage* for dc collector amperes = -12, base amperes = -2	V_{CE}	–	-0.3	-0.7	volt
DC Emitter Voltage for dc collector volts = -80, dc collector amperes = 0 . . .	V_{EB}	–	-0.15	-1	volt
DC Punch-Through Voltage. . .	V_P	-80	–	–	volts
DC Emitter-Cutoff Current:	I_{EBO}				
With dc emitter volts = -30, dc collector amperes = 0, case temperature = 71° C.		–	-4	-6	ma
With dc emitter volts = -60, dc collector amperes = 0.		–	-1	-8	ma
DC Collector-Cutoff Current:	I_{CBO}				
With dc collector volts = -2, dc emitter amperes = 0		–	-100	-200	μa
With dc collector volts = -30, dc emitter amperes = 0, case temperature = 71° C		–	-4	-6	ma
With dc collector volts = -80, dc emitter amperes = 0		–	-2	-8	ma

World Radio History

With dc collector volts = -80, dc emitter amperes = 0, case temperature = 71° C.		-	-	-15	ma
DC Current Transfer Ratio* for dc collector-to-emitter volts = -2, dc collector amperes =	h_{FE}				
-5		25	35	-	
-1.2		40	55	80	
Beta-Cutoff Frequency* for dc collector volts = -12, dc collector amperes = -1. .	$f_{\alpha e}$	100	-	-	kc
Thermal Resistance:					
Junction-to-case	R_T	-	0.5	0.8	$^{\circ}$C/watt
Thermal Capacity for pulse duration of 1 to 10 milliseconds		-	0.075	-	watt-sec/$^{\circ}$C
Thermal Time Constant.	τ_1	-	37.5	-	msec

* Measured in a common-emitter, base-input circuit.

World Radio History

2N1384

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

For High-Speed Switching Circuits in Industrial and Military Electronic Computers

GENERAL DATA

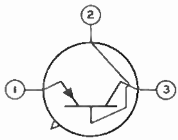
Mechanical:

Operating Position.	Any
Maximum Length (Excluding flexible leads)	0.390"
Maximum Diameter.	0.370"
Dimensional Outline	JEDEC No.TO-11
Case.	Welded, Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length.	1.5"
Orientation and diameter.	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector

SWITCHING SERVICE

Such as in memory-core-driver, pulse-amplifier, inverter, flip-flop, and logic-gate circuits

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	-30 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE.	-30 max.	volts
EMITTER-TO-BASE VOLTAGE[a].	-1 max.	volt
COLLECTOR CURRENT	-500 max.	ma
EMITTER CURRENT	500 max.	ma
TRANSISTOR DISSIPATION:[b]		
At ambient temperature of 25° C	240 max.	mw
At ambient temperature of 55° C	120 max.	mw
At ambient temperature of 71° C	56 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +85	°C

Typical Operation:

In an inverter circuit at ambient temperature of 25° C

"On" Collector Current.	-200	ma
"Turn-On" Base Current.	-20	ma
"Turn-Off" Base Current	20	ma
Switching Time:		
Delay time (t_d)	0.02	μsec
Rise time (t_r).	0.08	μsec

World Radio History

Storage time (t_s)	0.25	µsec
Fall time (t_f).	0.1	µsec

[a] This rating may be exceeded and the emitter-to-base junction operated in the breakdown condition provided the emitter dissipation is limited to 30 milliwatts at 25° C. For ambient temperatures above 25° C, reduce the dissipation by 0.5 milliwatt/°C.

[b] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to the base unless otherwise specified. Ambient temperature of 25° C.

		Min.	Typical	Max.	
DC Collector Breakdown Voltage for dc collector µa = -100 with emitter open . .	BV_{CBO}	-30	-55	-	volts
DC Collector-to-Emitter Breakdown Voltage		-30	-40	-	volts
DC Emitter Breakdown Voltage for dc emitter µa = -100 with collector open. .	BV_{EBO}	-1	-3	-	volts
DC Punch-Through Voltage for dc emitter volts = -1. .	V_P	-30	-50	-	volts
→ DC Base-to-Emitter Voltage for dc collector ma. = -200, dc base ma. = -10 . .	V_{BE}	-	-0.6	-0.9	volt
→ DC Collector-Cutoff Current for dc collector volts = -3 with emitter open . .	I_{CBO}	-	-4	-8	µa
DC Current Transfer Ratio for dc collector-to-emitter volts = -0.5, dc collector ma. = -200.	h_{FE}	20	50	-	
Gain-Bandwidth Product[c] for collector-to-emitter volts = -3, collector ma. = -10 .	GBW	20	35	-	Mc
Thermal Time Constant. .	τ_1	-	14	-	msec
Thermal Resistance between collector junction and free air.	R_T	-	-	250	°C/watt
Stored Base Charge for dc collector ma. = -10, dc base ma. = -1.	Q_S	-	600	800	µµcoulombs

[c] Frequency at which the current transfer ratio is equal to 1.

→ indicates a change.

World Radio History

OPERATING CONSIDERATIONS

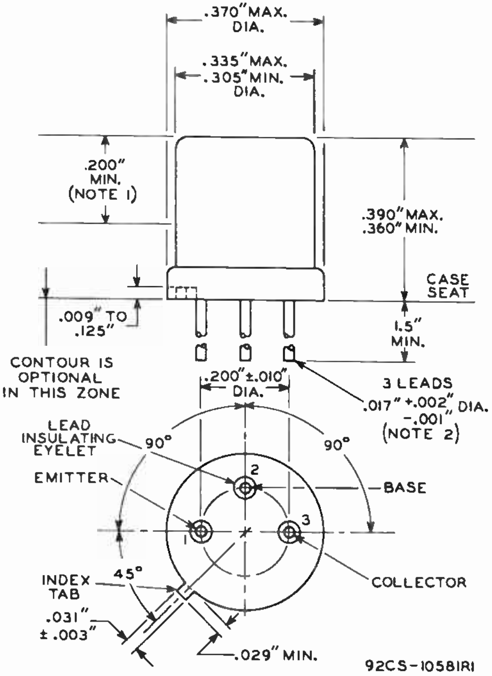
It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using this transistor, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds.

This transistor is intended for use in single-side printed circuit boards and in conventional wire-in type circuits. If this transistor is used in double-side printed-circuit boards or in printed-circuit boards utilizing eyelets, it may be necessary to use an insulating washer or similar standoff device made of good dielectric material to prevent the solder from shorting the leads to each other or to the board.

World Radio History

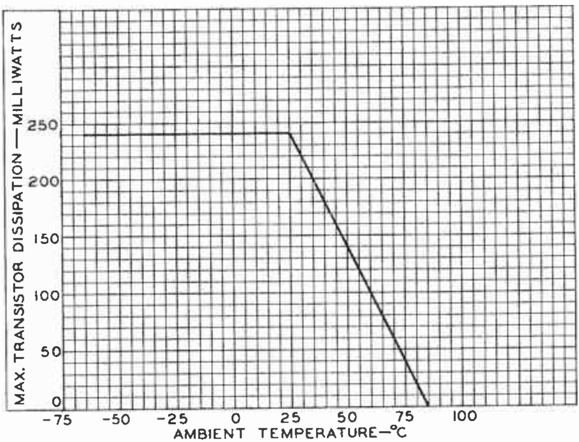


NOTE 1: THE DIAMETER IN THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE TOTAL VARIATION IN ACTUAL DIAMETER FROM THE TRUE DIAMETER, DUE TO TAPER AND OUT OF ROUND WITHIN THIS ZONE WILL NOT EXCEED 0.010".

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

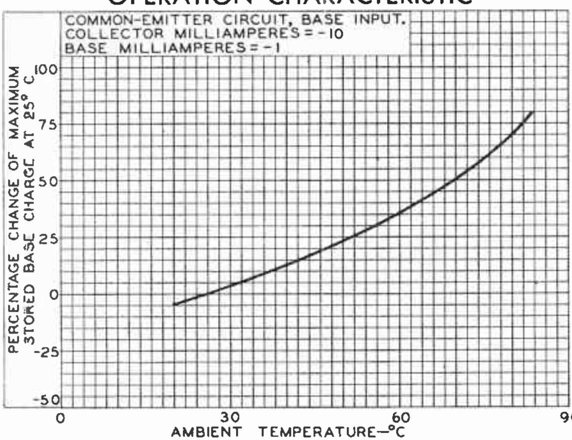
World Radio History

RATING CHART



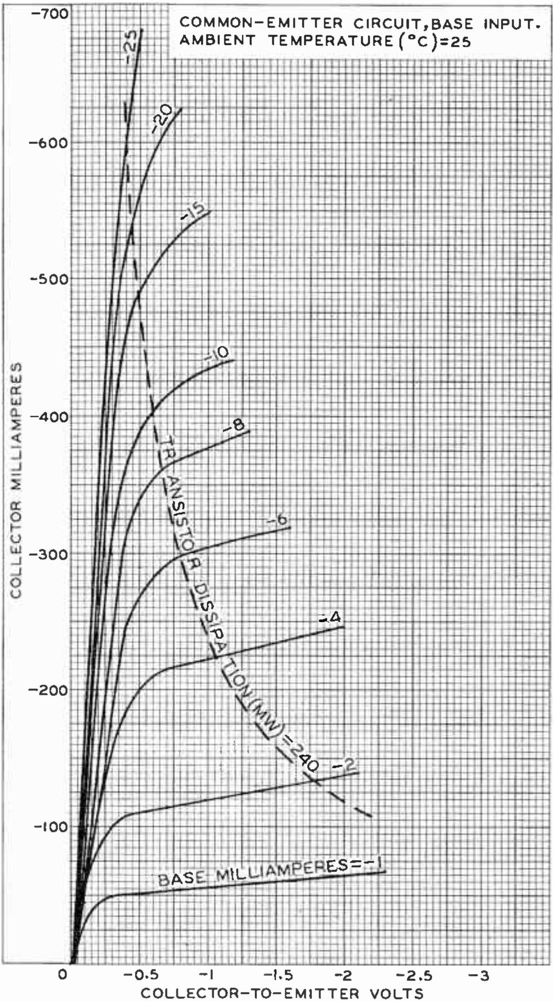
92CS-10565R1

OPERATION CHARACTERISTIC



92CS-10578

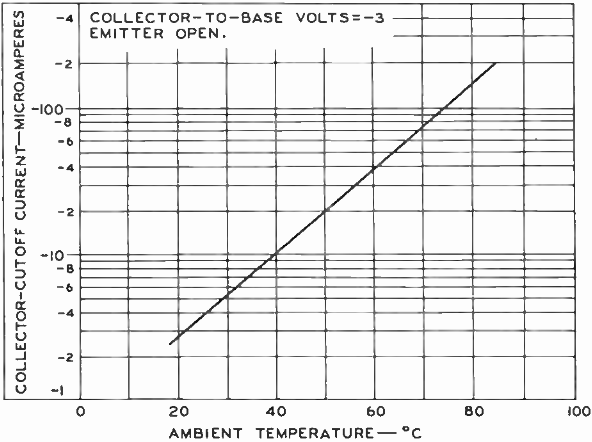
TYPICAL COLLECTOR CHARACTERISTICS



92CM-10580

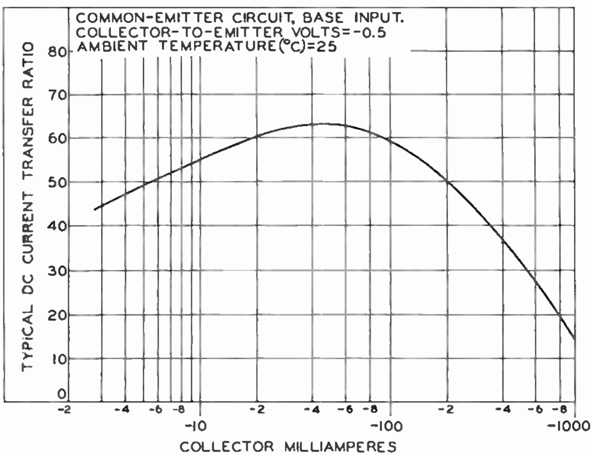
World Radio History

TYPICAL COLLECTOR-CUTOFF-CURRENT CHARACTERISTIC



92CS-10568

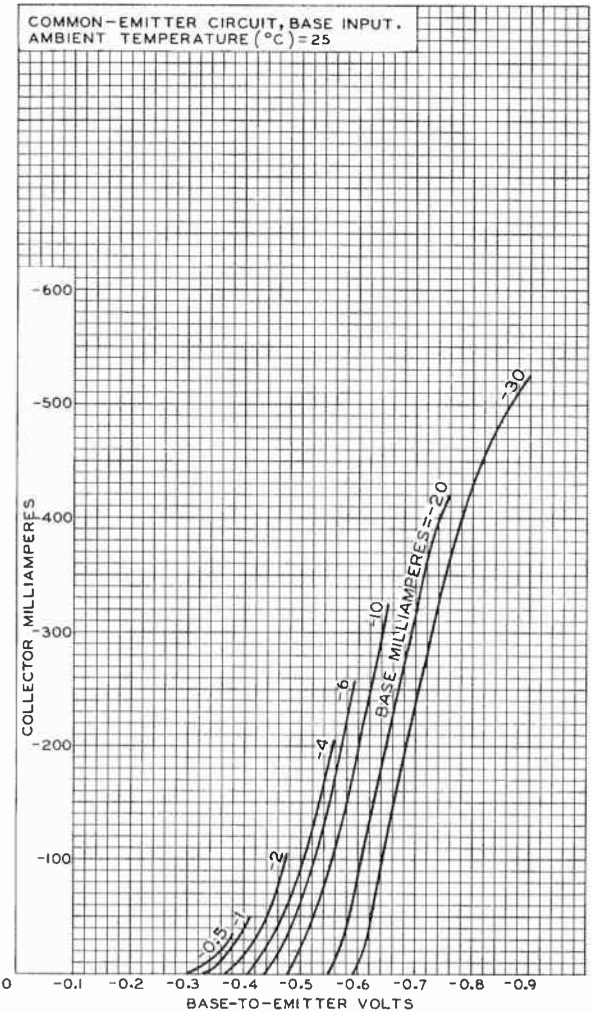
TYPICAL DC CURRENT-TRANSFER-RATIO CHARACTERISTIC



92CS-10579R1

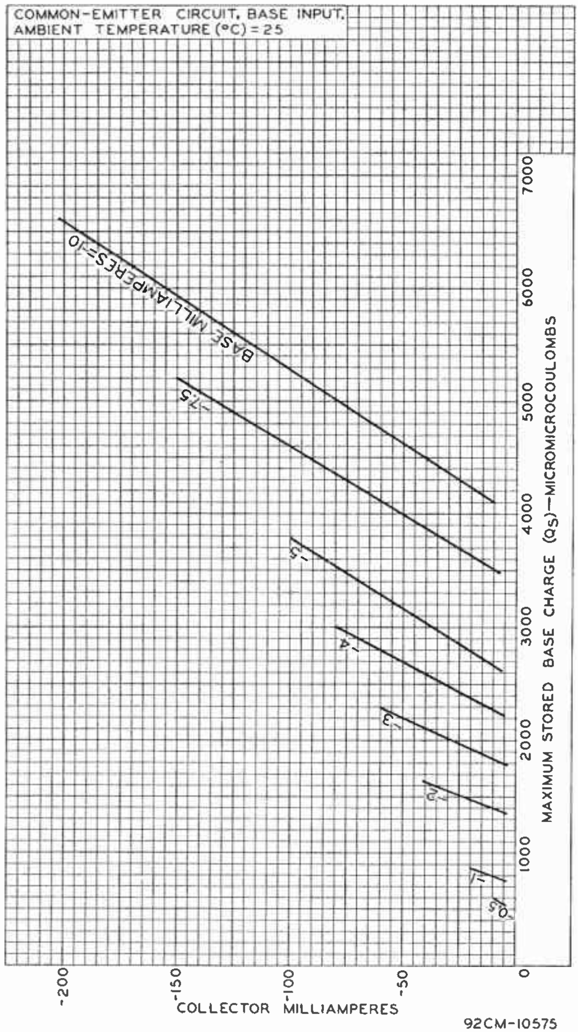
World Radio History

TYPICAL TRANSFER CHARACTERISTICS



92CM-10574R2

MAXIMUM STORED-BASE-CHARGE CHARACTERISTICS



World Radio History

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service in Industrial and Military Applications

The 2N1412 is the same as the 2N1100 except for the following items:

INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

EMITTER-TO-BASE VOLTAGE. . . . . −60 max. volts

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and at case temperature[a] of 25° C unless otherwise specified

		Min.	*Typical*	*Max.*	
DC Base-to-Emitter Voltage for dc collector-to-emitter volts = −2, dc collector amperes = −5	V_{BE}	-	−0.65	−0.8	volt
DC Emitter-Cutoff Current for dc emitter volts = −60, dc collector current = 0. . . .	I_{EBO}	-	−1	−4	ma

[a] Measured at any point on seating surface.

← Indicates a change.

World Radio History

World Radio History

Power Transistor

GERMANIUM P-N-P ALLOY TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

The 2N1412 is the same as the 2N1100 except for the following items:

INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and audio-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

EMITTER-TO-BASE VOLTAGE. . . . . −60 max. volts

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and case temperature of 25° C unless otherwise specified

		Min.	*Typical*	*Max.*	
DC Base-to-Emitter Voltage* for dc collector-to-emitter volts = −2, dc collector amperes = −5	V_{BE}	−	−0.65	−0.8	volt
DC Emitter-Cutoff Current for dc emitter volts = −60, dc collector amperes = 0. . .	I_{EBO}	−	−1	−8	ma

* Measured in a common-emitter, base-input circuit.

World Radio History

World Radio History

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

For High-Speed Switching Service in Commercial and Military Data-Processing Systems

GENERAL DATA

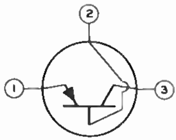
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No. TO-9
Case	Welded, Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter

Lead 2 – Base



Lead 3 – Collector

SWITCHING SERVICE

Such as in inverter, flip-flop, and logic-gate circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	-30 max.	volts
EMITTER-TO-BASE VOLTAGE	-1 max.	volt
COLLECTOR CURRENT	-100 max.	ma
EMITTER CURRENT	100 max.	ma
TRANSISTOR DISSIPATION:[a]		
At ambient temperature of 25° C	120 max.	mw
At ambient temperature of 55° C	60 max.	mw
At ambient temperature of 71° C	28 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +85	°C
LEAD TEMPERATURE:		
For immersion in molten solder for 10 seconds maximum	255 max.	°C

[a] For ambient temperatures above 25° C, reduce the dissipation by 2 mw/°C.

World Radio History

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base unless otherwise specified. Ambient temperature of 25° C.

		Min.	Max.	
DC Collector Breakdown Voltage for dc collector ma. = -0.1, emitter open.	BV_{CBO}	-30	-	volts
DC Collector-to-Emitter Breakdown Voltage for dc emitter ma. = -1, base open	BV_{CEO}	-20	-	volts
Reach-Through Voltage for dc emitter ma. = -0.025.	V_{RT}	-20	-	volts
DC Emitter Breakdown Voltage for dc emitter ma. = -0.05, collector open.	BV_{EBO}	-1	-	volt
DC Base-to-Emitter Voltage for dc collector ma. = -10, dc base ma. = -0.5	V_{BE}	-	-0.6	volt
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = -10, dc base ma. = -1.	$V_{CE(sat)}$	-	-0.25	volt
DC Collector-Cutoff Current for dc collector volts = -7, emitter open.	I_{CBO}	-	-10	μa
DC Current Transfer Ratio for dc collector-to-emitter volts = -1, dc collector ma. = -10 .	h_{FE}	20	-	
"Turn-On" Time[b] (Rise time plus delay time).	t_{on}	-	100	mμsec
"Turn-Off" Time[b] (Storage time plus fall time)	t_{off}	-	85	mμsec

[b] See accompanying *Switching-Time Test Circuit* and *Associated Wave Forms*.

OPERATING CONSIDERATIONS

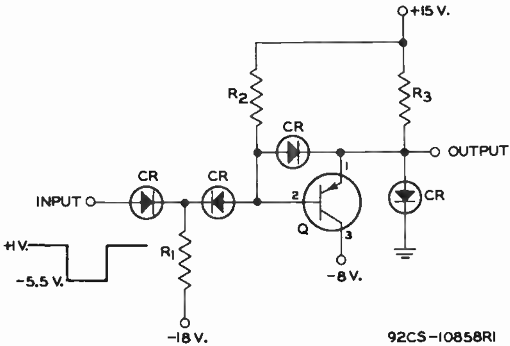
It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

This transistor is intended for use in single-side printed-circuit boards and in conventional wire-in type circuits. If this transistor is used in double-side printed-circuit boards or in printed-circuit boards utilizing eyelets, it may be necessary to use an insulating washer or similar standoff device made of good dielectric material to prevent the solder from shorting the leads to each other or to the board.

World Radio History

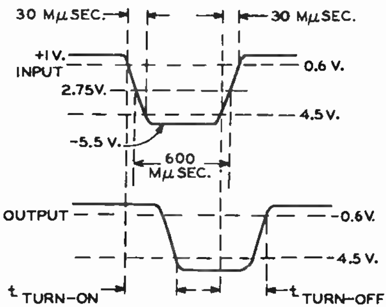
SWITCHING-TIME TEST CIRCUIT



92CS-10858RI

CR: Semiconductor diode type 1N198-B (NOTE 2)
Q: Transistor type 2N1450
R_1: 22,600 ohms ± 1%, 0.5 watt
R_2: 82,500 ohms ± 1%, 0.5 watt
R_3: 10,000 ohms ± 1%, 0.5 watt

ASSOCIATED WAVE FORMS



92CS-10860RI

NOTE 1: TOLERANCE FOR SUPPLY VOLTAGES IS ± 1%. ALL RESISTORS ARE CARBON-COMPOSITION TYPES.

NOTE 2: THE 1N198-B SEMICONDUCTOR DIODES USED IN THIS CIRCUIT MUST SATISFY THE FOLLOWING REVERSE-RECOVERY CRITERIA AS SPECIFIED IN JAN-256 TEST CIRCUIT 14.5-2 EIA STANDARD RS-231, J14-F3, DECEMBER, 1959.

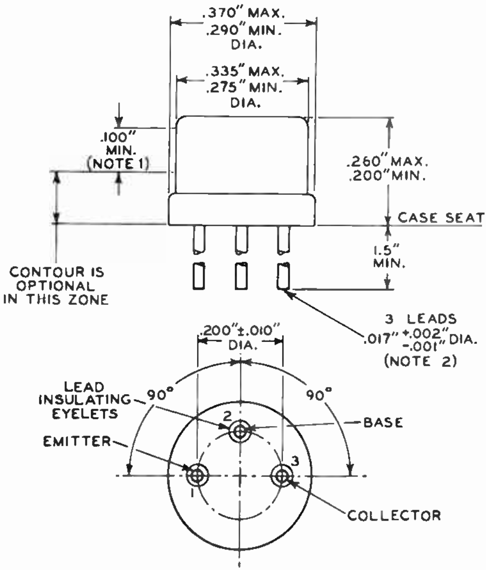
World Radio History

THE MAXIMUM TRANSIENT VOLTAGE DEVELOPED BY THE DIODE ACROSS A 2000-OHM LOAD RESISTANCE MUST BE LESS THAN 0.3 VOLT. UNDER THESE CONDITIONS, THE PEAK REVERSE CURRENT SHALL NOT EXCEED 0.15 MILLIAMPERE AND THE REVERSE RESISTANCE SHALL NOT BE LESS THAN 40,000 OHMS.

AT 0.3 MICROSECOND AFTER THE DIODE HAS BEEN SWITCHED AS DISCUSSED IN NOTE 2, THE REVERSE RESISTANCE OF THE DIODE SHALL NOT BE LESS THAN 100,000 OHMS AND THE REVERSE CURRENT NOT MORE THAN 0.06 MA.

NOTE 3: IN THIS CIRCUIT, THE MAXIMUM LENGTH OF THE BASE LEAD OF THE TRANSISTOR SHALL BE 1 INCH, THE EMITTER LEAD 2 INCHES.

JEDEC No.TO-9



92CS-9371R7

NOTE 1: THE DIAMETER IN THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE TOTAL VARIATION IN ACTUAL DIAMETER FROM THE TRUE DIAMETER, DUE TO TAPER AND OUT OF ROUND WITHIN THIS ZONE WILL NOT EXCEED 0.010".

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For Power Switching and Amplifier Service in Industrial and Military Applications

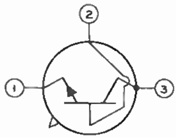
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No.TO-5
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter
Lead 2 - Base



Lead 3 - Collector, Case

INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and servo-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	60 max.	volts
With base open (Sustaining voltage)[a]	40 max.	volts
EMITTER-TO-BASE VOLTAGE	12 max.	volts
COLLECTOR CURRENT	1.5 max.	amp
EMITTER CURRENT	-1.75 max.	amp
BASE CURRENT	1 max.	amp
TRANSISTOR DISSIPATION:[b] ←		
At case temperature of 25° C	5 max.	watts
At case temperature of 100° C	2.86 max.	watts ←
CASE-TEMPERATURE RANGE:[c]		
Operating and storage	-65 to +200	°C

Characteristics:

At case temperature of 25° C[c]

Small-Signal Current Transfer Ratio (h_{fe}) with dc collector-to-emitter volts = 4, dc collector ma. = 5	50

← Indicates a change.

World Radio History

Alpha-Cutoff Frequency (f_{ab}) with dc collector-to-base volts = 28, dc collector ma. = 5.	1.5	Mc
Collector-to-Base Capacitance (C_{ob}) with dc collector-to-base volts = 40 . . .	150	$\mu\mu f$
Thermal Time Constant (τ_1)	10	msec

Typical Operation:

In accompanying typical power-switching circuit at case temperature[c] of 25° C

DC Supply Voltage (B_2)	12	volts
DC Base-Bias Voltage (B_1).	-8.5	volts
"On" DC Collector Current.	200	ma
"Turn-On" Base Current (I_{B1})	20	ma
"Turn-Off" Base Current (I_{B2}).	-8.5	ma
Generator Resistance	50	ohms
Switching Time:		
Delay time (t_d).	0.2	μsec
Rise time (t_r)	1	μsec
Storage time (t_s).	0.6	μsec
Fall Time (t_f)	1	μsec

[a] The Collector-to-Emitter Sustaining Voltage (V_{CEO}(sus)) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[b] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

[c] Measured at center of seating surface.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Voltage values are given with respect to base and case temperature[c] of 25° C unless otherwise specified

		Min.	*Max.*	
Collector-to-Emitter Voltage:				
With emitter reverse bias volts = 1.5, dc collector ma. = 0.25	V_{CEX}	60	-	volts
With base open (Sustaining voltage), dc collector ma. = 50, dc base ma. = 0.	V_{CEO}[a] (sus)	40	-	volts
Base-to-Emitter Voltage for dc collector-to-emitter volts = 4, dc collector ma. = 200.	V_{BE}	-	3	volts
→ Collector-Cutoff Current for dc collector volts = 30, dc emitter ma. = 0, case temperature =	I_{CBO}			
25° C.		-	10	μa
150° C		-	500	μa

→ indicates a change.

Emitter-Cutoff Current for dc emitter volts = 12, dc collector ma. = 0	I_{EBO}	–	10	μa
DC Current Transfer Ratio for dc collector-to-emitter volts = 4, dc collector ma. = 200.	h_{FE}	20	60	
DC Collector-to-Emitter Saturation Resistance for dc collector ma. = 200, dc base ma. = 20.	R_S	–	7	ohms
Thermal Resistance:	R_T			
Junction-to-case		–	35	°C/watt
Junction-to-free air		–	200	°C/watt

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[c] Measured at center of seating surface.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using this transistor, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds.

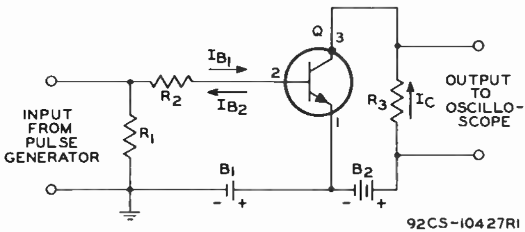
This transistor is intended for use in single-side printed-circuit boards and in conventional wire-in-type circuits. If this transistor is used in double-side printed-circuit boards or in printed-circuit boards utilizing eyelets, it may be necessary to use an insulating washer or similar standoff device made of good dielectric material to prevent the solder from shorting the leads to each other or to the board, and to prevent the collector from shorting to ground.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

← Indicates a change.

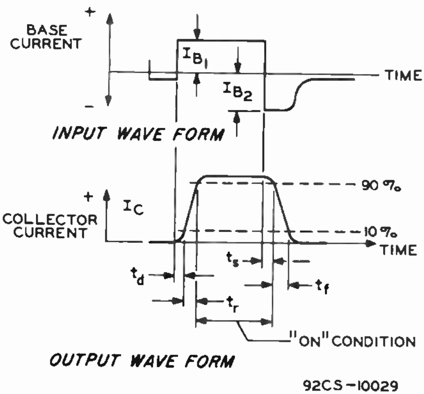
World Radio History

TYPICAL POWER-SWITCHING CIRCUIT



B_1: 8.5 volts
B_2: 12 volts
Q: Transistor type 2N1479
R_1: 50 ohms, 1 watt
R_2: 700 ohms, 1 watt
R_3: 59 ohms, 2 watts

ASSOCIATED WAVE FORMS



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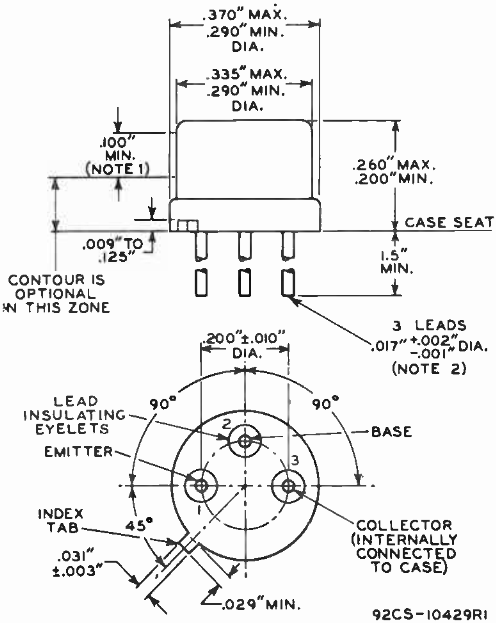
JEDEC No.TO-5

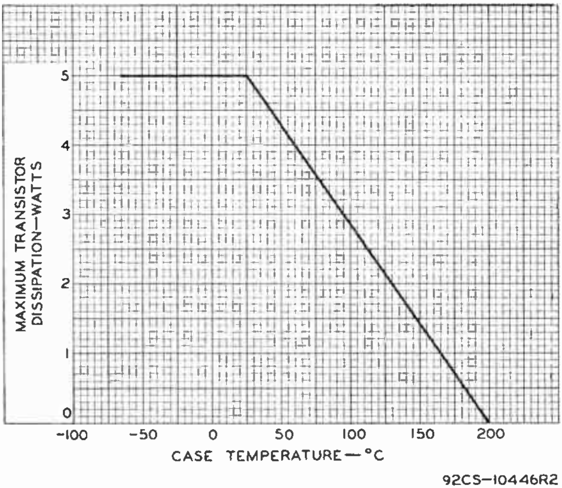


NOTE 1: THE DIAMETER IN THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE TOTAL VARIATION IN ACTUAL DIAMETER FROM THE TRUE DIAMETER, DUE TO TAPER AND OUT OF ROUND WITHIN THIS ZONE, WILL NOT EXCEED 0.010".

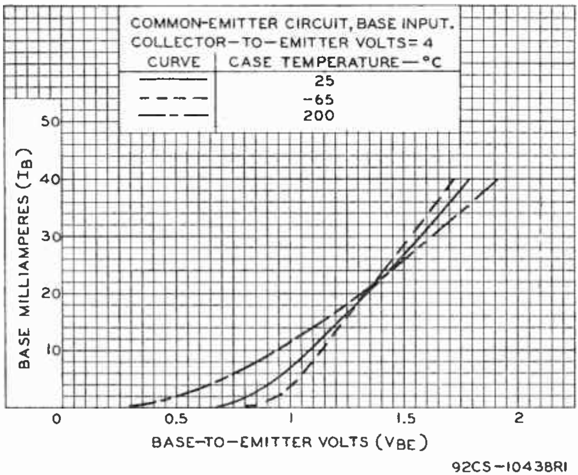
NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

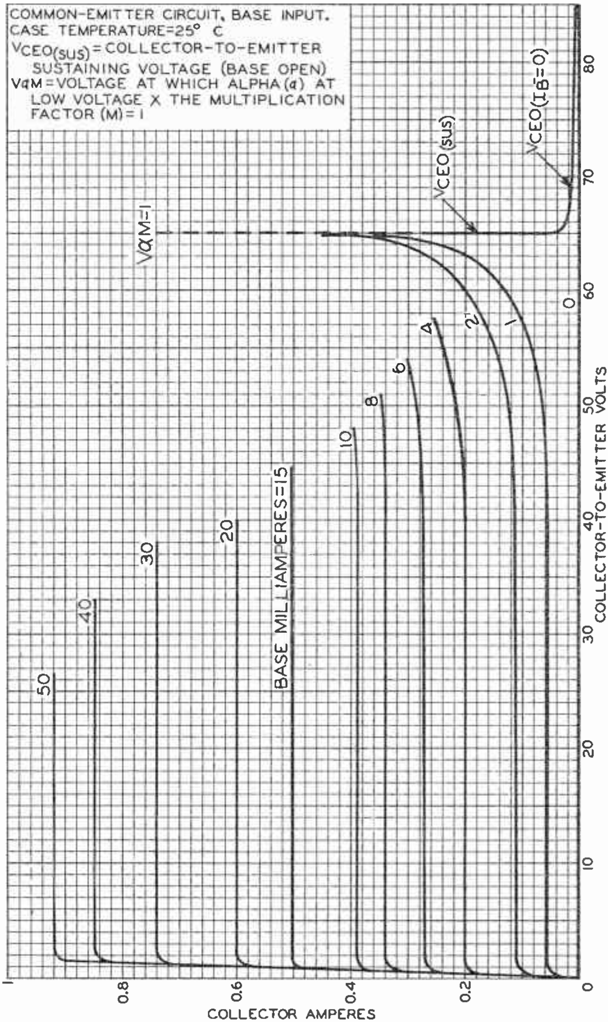
RATING CHART



TYPICAL BASE CHARACTERISTICS

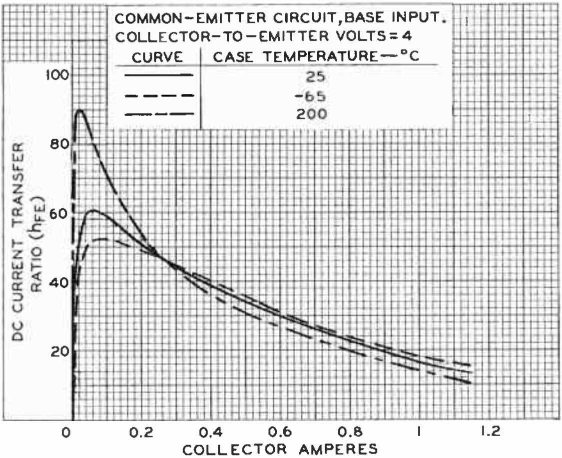


TYPICAL COLLECTOR CHARACTERISTICS

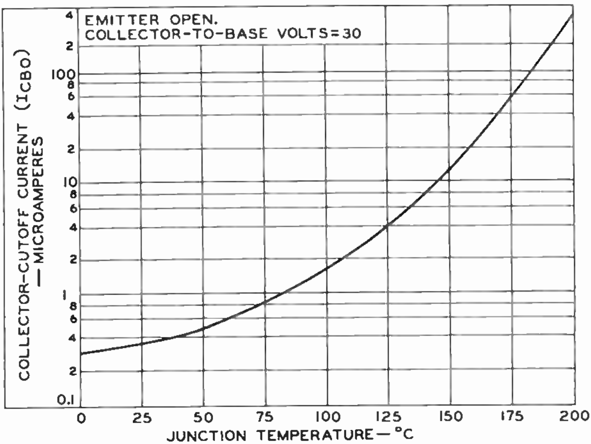


92CM-10453

TYPICAL OPERATION CHARACTERISTICS



92CS-10450R1



92CS-10881

World Radio History

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

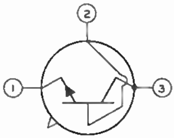
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No. TO-5
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter
Lead 2 – Base



Lead 3 – Collector, Case

INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and servo-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	60 max.	volts
With base open (Sustaining voltage)[a]	40 max.	volts
EMITTER-TO-BASE VOLTAGE	12 max.	volts
COLLECTOR CURRENT	1.5 max.	amp
EMITTER CURRENT	-1.75 max.	amp
BASE CURRENT	1 max.	amp
TRANSISTOR DISSIPATION:[b] ←		
At case temperature of 25° C	5 max.	watts
At case temperature of 100° C	2.86 max.	watts
CASE-TEMPERATURE RANGE:[c] ←		
Operating and storage	-65 to +200	°C

Characteristics:

At case temperature of 25° C

Small-Signal Current Transfer Ratio (h_{fe}) with dc collector-to-emitter volts = 4, dc collector ma. = 5	50

← Indicates a change.

World Radio History

2N1481

Alpha-Cutoff Frequency (f_{ab}) with dc collector-to-base volts = 28, dc collector ma. = 5.	1.5	Mc
Collector-to-Base Capacitance (C_{ob}) with dc collector-to-base volts = 40.	150	μμf
Thermal Time Constant (τ_1).	10	msec

Typical Operation:

In accompanying typical power-switching circuit at case temperature of 25° C

DC Supply Voltage (B_2).	12	volts
DC Base-Bias Voltage (B_1)	-8.5	volts
"On" DC Collector Current	200	ma
"Turn-On" Base Current (I_{B1}).	20	ma
"Turn-Off" Base Current (I_{B2})	-8.5	ma
Generator Resistance.	50	ohms
Switching Time:		
Delay time (t_d)	0.2	μsec
Rise time (t_r).	1	μsec
Storage time (t_s)	0.6	μsec
Fall time (t_f).	1	μsec

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO}(sus)$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1: voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[b] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

[c] Measured at center of seating surface.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Voltage values are given with respect to base and case temperature of 25° C unless otherwise specified

		Min.	*Max.*	
Collector-to-Emitter Voltage:				
With emitter reverse bias volts = 1.5, dc collector ma. = 0.25.	V_{CEX}	60	-	volts
With base open (Sustaining voltage), dc collector ma. = 50, dc base ma. = 0 .	V_{CEO}[a] (sus)	40	-	volts
Base-to-Emitter Voltage for dc collector-to-emitter volts = 4, dc collector ma. = 200 .	V_{BE}	-	3	volts
→ Collector-Cutoff Current for dc collector volts = 30, dc emitter ma. = 0, case temperature =	I_{CBO}			
25° C		-	10	μa
150° C.		-	500	μa
Emitter-Cutoff Current for dc emitter volts = 12, dc collector ma. = 0	I_{EBO}	-	10	μa

→ Indicates a change.

World Radio History

DC Current Transfer Ratio for dc collector-to-emitter volts = 4, dc collector ma. = 200	h_{FE}	35	100	
DC Collector-to-Emitter Saturation Resistance for dc collector ma. = 200, dc base ma. = 10	R_S	-	7	ohms
Thermal Resistance:	R_T			
Junction-to-case.		-	35	^{o}C/watt
Junction-to-free air.		-	200	^{o}C/watt

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO}(sus)$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity (αM = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

OPERATING CONSIDERATIONS,
TYPICAL POWER-SWITCHING CIRCUIT,
DIMENSIONAL OUTLINE,
RATING CHART,
and CURVES
shown under Type 2N1479 also apply to the 2N1481

← Indicates a change.

World Radio History

World Radio History

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

GENERAL DATA

Mechanical:

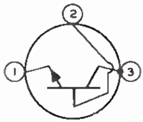
Operating Position	Any
Maximum Overall Length	0.770"
Maximum Seated Length	0.330"
Maximum Diameter	0.650"
Dimensional Outline	JEDEC No. TO-8
Case	Metal
Seals	Hermetic

Terminal Diagram:

BOTTOM VIEW

Pin 1 – Emitter

Pin 2 – Base



Pin 3 – Collector, Case

INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and servo-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	60 max.	volts
With base open (Sustaining voltage)[a]	40 max.	volts
EMITTER-TO-BASE VOLTAGE	12 max.	volts
COLLECTOR CURRENT	3 max.	amp
EMITTER CURRENT	-3.5 max.	amp
BASE CURRENT	1.5 max.	amp
TRANSISTOR DISSIPATION:[b]		
At case temperature of 25° C.	25 max.	watts
At case temperature of 100° C.	14.1 max.	watts
CASE-TEMPERATURE RANGE:[c]		
Operating and storage	-65 to +200	°C

Characteristics:

	At case temperature of 25° C[c]	
Alpha-Cutoff Frequency (f_{ab}) with dc collector-to-base volts = 28, dc collector ma. = 5	1.25	Mc

← Indicates a change.

Collector-to-Base Capacitance (C_{ob}) with dc collector-to-base volts = 40.	175	$\mu\mu$f
Thermal Time Constant (τ_1).	10	msec

Typical Operation:

In accompanying typical power-switching circuit at case temperature[c] of 25° C

DC Supply Voltage (B_2).	12	volts
DC Base-Bias Voltage (B_1)	-8.5	volts
"On" DC Collector Current	750	ma
"Turn-On" Base Current (I_{B1}).	65	ma
"Turn-Off" Base Current (I_{B2})	-35	ma
Generator Resistance.	50	ohms
Switching Time:		
Delay time (t_d)	0.2	μsec
Rise time (t_r).	1	μsec
Storage time (t_s)	0.8	μsec
Fall time (t_f).	1.1	μsec

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V\alpha_M$ = 1: voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[b] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

[c] Measured at center of sealing surface.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Voltage values are given with respect to base and case temperature[c] of 25° C unless otherwise specified

		Min.	*Max.*	
Collector-to-Emitter Voltage:				
With emitter reverse bias volts = 1.5, dc collector ma. = 0.25.	V_{CEX}	60	-	volts
With base open (Sustaining voltage), dc collector ma. = 100, dc base ma. = 0.	$V_{CEO(sus)}$[a]	40	-	volts
Base-to-Emitter Voltage for dc collector-to-emitter volts = 4, dc collector ma. = 750	V_{BE}	-	3.5	volts
→ Collector-Cutoff Current for dc collector volts = 30, dc emitter ma. = 0, case temperature =	I_{CBO}			
25° C		-	15	μa
150° C.		-	750	μa
Emitter-Cutoff Current for dc emitter volts = 12, dc emitter ma. = 0	I_{EBO}	-	15	μa
→ DC Current Transfer Ratio for dc collector-to-emitter volts = 4, dc collector ma. = 750 . .	h_{FE}	20	60	

→ Indicates a change.

World Radio History

DC Collector-to-Emitter Saturation Resistance for dc collector ma. = 750, dc base ma. = 75	R_S	-	2.67	ohms
Thermal Resistance:	R_T			
Junction-to-case.		-	7	^{o}C/watt
Junction-to-free air.		-	100	^{o}C/watt

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V\alpha M$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[c] Measured at center of seating surface.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

Electrical connection can be made to the collector, base, and emitter pins by means of clips or by soldering directly to the pins. Soldering of connections to the pins may be made close to the pin seals provided care is taken to conduct excessive heat away from the pin seal, otherwise the heat of the soldering operation will crack the glass seals of the pins and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using this transistor, the temperature of the solder should not exceed 235° C for a maximum immersion period of 10 seconds. Furthermore, the pins should not be dip soldered closer than 1/32" from the transistor case.

Under no circumstances should the case be soldered to the heat sink because the heat of the soldering operation will permanently damage the transistor.

It is important that this transistor be securely fastened to a heat sink. A mounting clamp is provided for this purpose.

The chassis (heat sink) may be connected either to the positive or negative terminal of the voltage supply. In applications where the chassis is connected to the negative terminal of the voltage supply, it will be necessary to use an anodized-aluminum insulator having high thermal conductivity, or a 0.002" mica insulator between the transistor case and the chassis. The insulator should extend beyond the mounting clamp (See *Suggested Mounting Arrangement*). An aluminum washer should be drilled or punched to provide the two mounting holes, and the clearance holes for the collector, emitter, and base pins. The burrs should then be removed from the washer and the washer finally anodized. To insure that the anodized insulating layer is not destroyed during mounting,

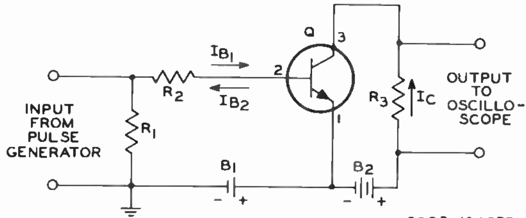
← Indicates a change.

World Radio History

it will also be necessary to remove the burrs from the holes in the chassis. Furthermore, to prevent a short circuit between the mounting bolt and the chassis, it is important that an insulating washer be used between the bolt and the chassis.

It is to be noted that the case of this transistor operates at the collector voltage. Consideration therefore, should be given to the possibility of shock hazard if the case of this transistor is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

TYPICAL POWER-SWITCHING CIRCUIT

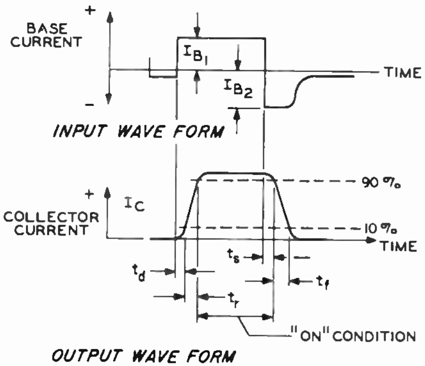


92CS-10427R1

B_1: 8.5 volts
B_2: 12 volts
Q: Transistor type 2N1483

R_1: 50 ohms, 1 watt
R_2: 220 ohms, 1 watt
R_3: 15.9 ohms, 2 watts

ASSOCIATED WAVE FORMS



92CS-10029

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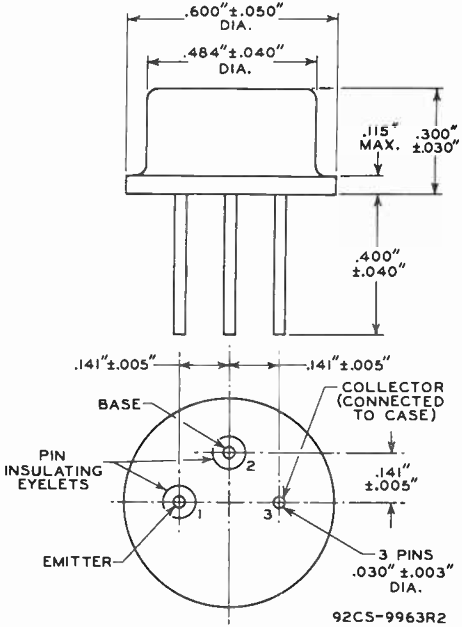
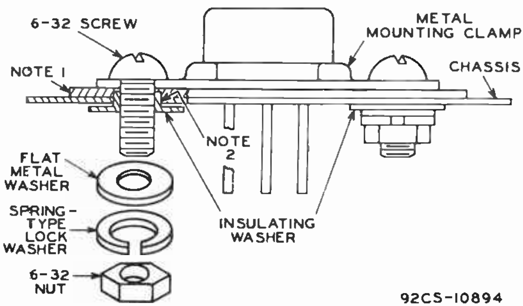
JEDEC No.TO-8



92CS-9963R2

SUGGESTED MOUNTING ARRANGEMENT



92CS-10894

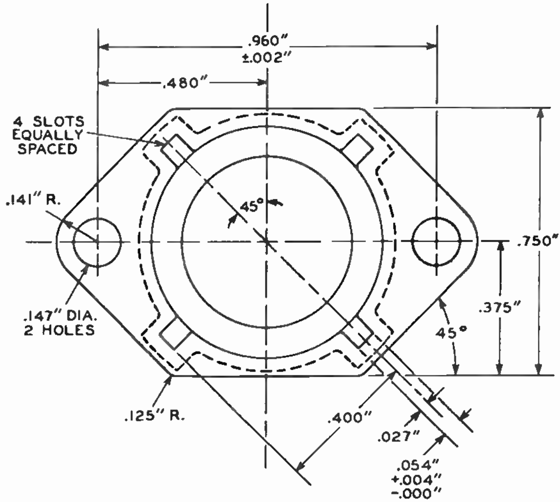
NOTE 1: 0.002" MICA INSULATOR OR ANODIZED ALUMINUM INSULATOR (DRILLED, OR PUNCHED WITH BURRS REMOVED).

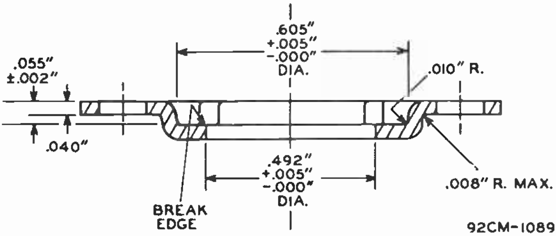
NOTE 2: REMOVE BURRS FROM CHASSIS HOLES.

World Radio History

MOUNTING CLAMP

Supplied with Each Transistor

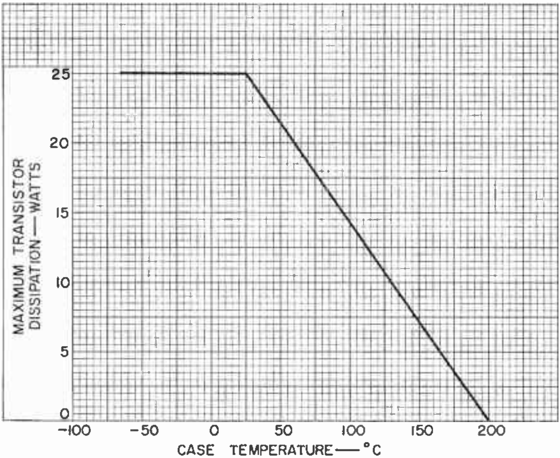




92CM-10890

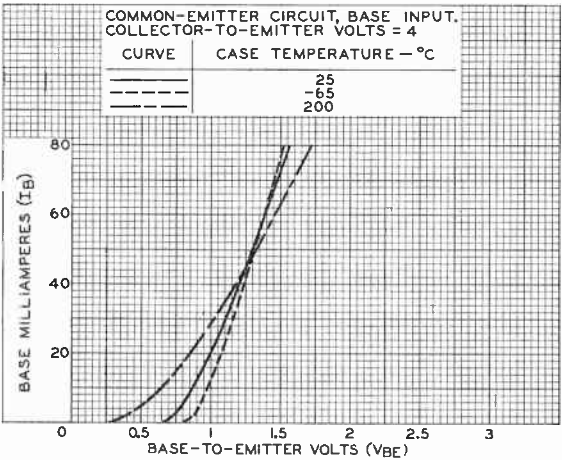
World Radio History

RATING CHART



92CS-10442R2

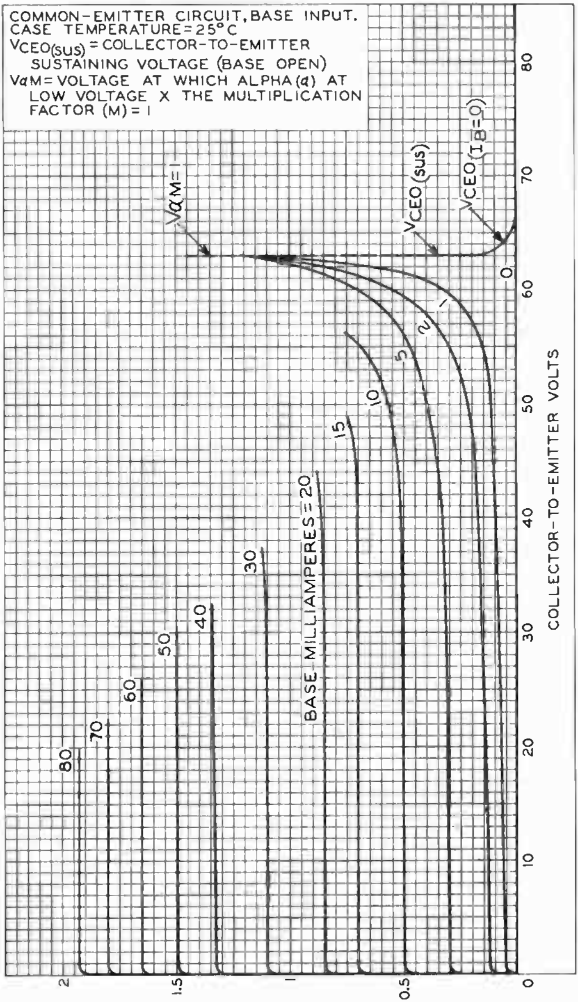
TYPICAL BASE CHARACTERISTICS



92CS-10443R3

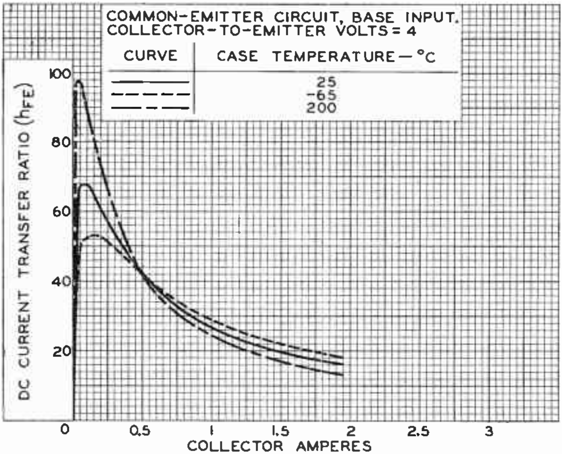
World Radio History

TYPICAL COLLECTOR CHARACTERISTICS

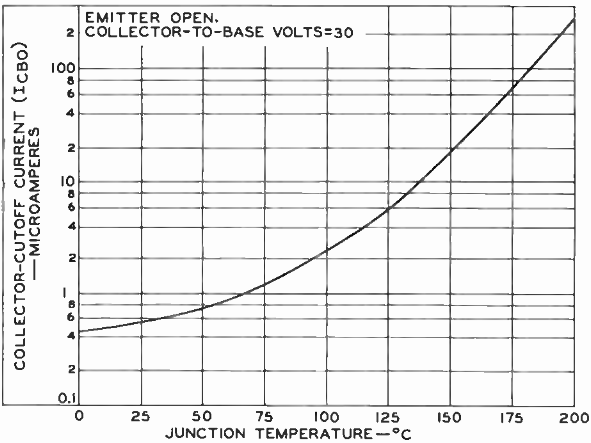


92CM-10445R1

TYPICAL OPERATION CHARACTERISTICS



92CS-10444R2



92CS-10882

World Radio History

World Radio History

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

GENERAL DATA

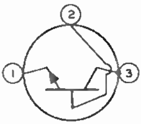
Mechanical:

Operating Position	Any
Maximum Overall Length	0.770"
Maximum Seated Length	0.330"
Maximum Diameter	0.650"
Dimensional Outline	JEDEC No. TO-8
Case	Metal
Seals	Hermetic

Terminal Diagram:

BOTTOM VIEW

Pin 1 - Emitter
Pin 2 - Base



Pin 3 - Collector, Case

INDUSTRIAL SERVICE

Such as dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and servo-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	60 max.	volts
With base open (Sustaining voltage)[a]	40 max.	volts
EMITTER-TO-BASE VOLTAGE	12 max.	volts
COLLECTOR CURRENT	3 max.	amp
EMITTER CURRENT	-3.5 max.	amp
BASE CURRENT	1.5 max.	amp
TRANSISTOR DISSIPATION:[b]		
At case temperature of 25° C	25 max.	watts
At case temperature of 100° C	14.1 max.	watts
CASE TEMPERATURE RANGE:[c]		
Operating and storage	-65 to +200	°C

Characteristics:

At case temperature of 25° C[c]

Alpha-Cutoff Frenquency (f_{ab}) with dc collector-to-base volts = 28, dc collector ma. = 5	1.25	Mc

←Indicates a change.

World Radio History

Collector-to-Base Capacitance (C_{ob}) with dc collector-to-base volts = 40.	175	$\mu\mu$f
Thermal Time Constant (τ_1).	10	msec

Typical Operation:

In accompanying typical power-switching circuit at case temperature[c] of 25° C

DC Supply Voltage (B_2).	12	volts
DC Base-Bias Voltage (B_1)	-8.5	volts
"On" DC Collector Current	750	ma
"Turn-On" Base Current (I_{B1}).	65	ma
"Turn-Off" Base Current (I_{B2})	-35	ma
Generator Resistance.	50	ohms
Switching Time:		
Delay time (t_d)	0.2	μsec
Rise time (t_r).	1	μsec
Storage time (t_s)	0.8	μsec
Fall time (t_f).	1.1	μsec

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO}(sus)$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[b] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

[c] Measured at center of seating surface.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Voltage values are given with respect to base and case temperature[c] of 25° C unless otherwise specified

		Min.	*Max.*	
Collector-to-Emitter Voltage:				
With emitter reverse bias volts = 1.5, dc collector ma. = 0.25.	V_{CEX}	60	-	volts
With base open (Sustaining voltage), dc collector ma. = 100, dc base ma. = 0	V_{CEO}[a] (sus)	40	-	volts
Base-to-Emitter Voltage for dc collector-to-emitter volts = 4, dc collector ma. = 750	V_{BE}	-	2.5	volts
→ Collector-Cutoff Current for dc collector volts = 30, dc emitter ma. = 0, case temperature =	I_{CBO}			
25° C		-	15	μa
150° C.		-	750	μa
Emitter-Cutoff Current for dc emitter volts = 12, dc emitter ma. = 0.	I_{EBO}	-	15	μa

→ indicates a change.

World Radio History

DC Current Transfer Ratio for dc collector-to-emitter volts = 4, dc collector ma. = 750.	h_{FE}	35	100	
DC Collector-to-Emitter Saturation Resistance for dc collector ma. = 750, dc base ma. = 40.	R_S	-	1	ohm
Thermal Resistance:	R_T			
Junction-to-case		-	7	°C/watt
Junction-to-free air . . .		-	100	°C/watt

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[c] Measured at center of seating surface.

OPERATING CONSIDERATIONS,
TYPICAL POWER-SWITCHING CIRCUIT,
DIMENSIONAL OUTLINE,
RATING CHART,
and CURVES
shown under Type 2N1483 also apply to the 2N1485

← Indicates a change.

World Radio History

World Radio History

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

GENERAL DATA

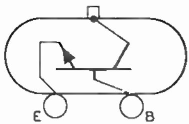
Mechanical:

Operating Position	Any
Maximum Overall Length	0.865"
Maximum Seated Length	0.390"
Maximum Length of Mounting Flange	1.550"
Maximum Width of Mounting Flange	1.015"
Case	Metal
Mounting Flange	Metal
Seals	Hermetic
Socket	Loranger Mfg. Corp. No. 2149, or equivalent

Terminal Diagram (See *Dimensional Outline*):

E - Emitter

B - Base



MOUNTING FLANGE-
Collector,
Case

INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and servo-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	60 max.	volts
With base open (Sustaining voltage)[a]	40 max.	volts
EMITTER-TO-BASE VOLTAGE	10 max.	volts
COLLECTOR CURRENT	6 max.	amp
EMITTER CURRENT	-8 max.	amp
BASE CURRENT	3 max.	amp
TRANSISTOR DISSIPATION:[b]		
At mounting-flange temperature of 25° C.	75 max.	watts
At mounting-flange temperature of 100° C.	43 max.	watts
MOUNTING-FLANGE TEMPERATURE RANGE:[c]		
Operating and storage	-65 to +200	°C

Characteristics:

At mounting-flange temperature of 25° C[c]

Alpha-Cutoff Frequency (f_{ab}) with dc collector-to-base volts = 12, dc collector ma. = 100	1	Mc

← indicates a change.

World Radio History

2N1487

Collector-to-Base Capacitance (C_{ob}) with dc collector-to-base volts = 40	200	μμf
Thermal Time Constant (τ_1)	12	msec

Typical Operation:

In accompanying typical power-switching circuit at mounting-flange temperature[c] of 25° C

DC Supply Voltage (B_2)	12	volts
DC Base-Bias Voltage (B_1)	-8.5	volts
"On" DC Collector Current	1.5	amp
"Turn-On" Base Current (I_{B_1})	0.3	amp
"Turn-Off" Base Current (I_{B_2})	-0.15	amp
Generator Resistance	50	ohms
Switching Time:		
Delay Time (t_d)	0.2	μsec
Rise Time (t_r)	1	μsec
Storage Time (t_s)	1	μsec
Fall Time (t_f)	1.2	μsec

a The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

b See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

c Measured at center of seating surface.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Voltage values are given with respect to base and mounting-flange temperature[c] of 25° C unless otherwise specified

		Min.	*Max.*	
Collector-to-Emitter Voltage:				
With emitter reverse bias volts = 1.5, dc collector ma. = 0.5	V_{CEX}	60	-	volts
With base open (Sustaining voltage), dc collector ma. = 100, dc base ma. = 0	$V_{CEO(sus)}$[a]	40	-	volts
Base-to-Emitter Voltage for dc collector-to-emitter volts = 4, dc collector amperes = 1.5	V_{BE}	-	3.5	volts
→ Collector-Cutoff Current for dc collector volts = 30, dc emitter ma. = 0, mounting-flange temperature =	I_{CBO}			
25° C		-	25	μa
150° C		-	1000	μa
Emitter-Cutoff Current for dc emitter volts = 10, dc collector ma. = 0	I_{EBO}	-	25	μa
→ DC Current Transfer Ratio for dc collector-to-emitter volts = 4, dc collector amperes = 1.5	h_{FE}	15	45	

→ Indicates a change.

World Radio History

DC Collector-to-Emitter Saturation Resistance for dc collector amperes = 1.5, dc base ma. = 300. . . . . R_S — 2 ohms

Thermal Resistance: Junction-to-mounting-flange. . R_T — 2.33 °C/watt ←

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity (αM = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[c] Measured at center of sealing surface.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

This transistor utilizes the Loranger Mfg. Corp. socket No.2149, or equivalent. Electrical connection can also be made to the base and emitter pins by soldering directly to the pins. Soldering of connections to the pins may be made close to the pin seals provided care is taken to conduct excessive heat away from the pin seal, otherwise the heat of the soldering operation will crack the glass seals of the pins and damage the transistor.

Under no circumstances should the mounting flange be soldered to the heat sink because the heat of the soldering operation will permanently damage the transistor.

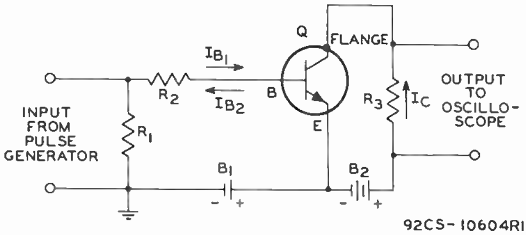
It is important that the mounting flange which serves as the collector terminal be securely fastened to a heat sink. Depending on the application, the chassis (heat sink) may be connected either to the positive or negative terminal of the voltage supply.

In applications where the chassis is connected to the negative terminal of the voltage supply, it will be necessary to use an anodized-aluminum insulator having high thermal conductivity, or a 0.002" mica insulator between the mounting flange and the chassis. An aluminum washer should be drilled or punched to provide the two mounting holes, and the clearance holes for the emitter and base pins. The burrs should then be removed from the washer and the washer finally anodized. To insure that the anodized insulating layer is not destroyed during mounting, it will also be necessary to remove the burrs from the holes in the chassis. Furthermore, to prevent a short circuit between the mounting bolt and the chassis, it is important that an insulating washer be used between the bolt and the chassis (See *Suggested Mounting Arrangement*).

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

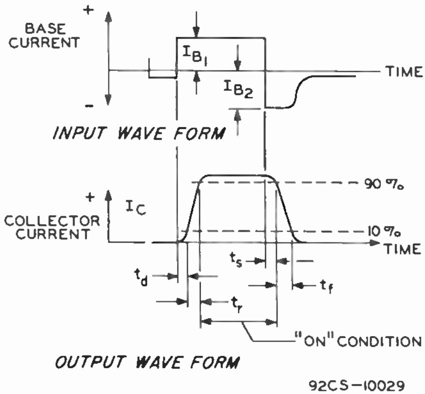
← Indicates a change.

TYPICAL POWER-SWITCHING CIRCUIT



B_1 = 8.5 volts
B_2 = 12 volts
Q = Transistor type 2N1487
R_1 = 50 ohms, 1 watt
R_2 = 30 ohms, 1 watt
R_3 = 7.8 ohms, 2 watts

ASSOCIATED WAVE FORMS



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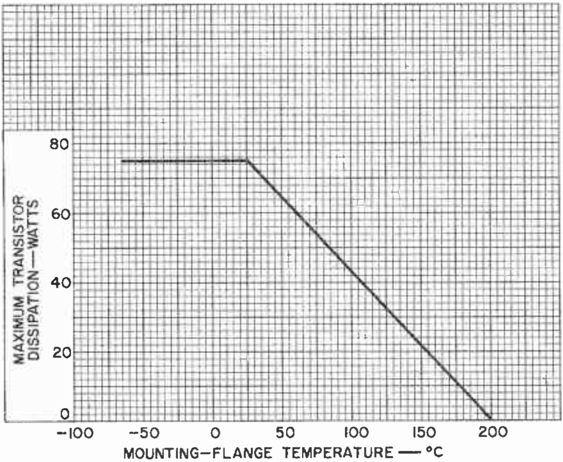
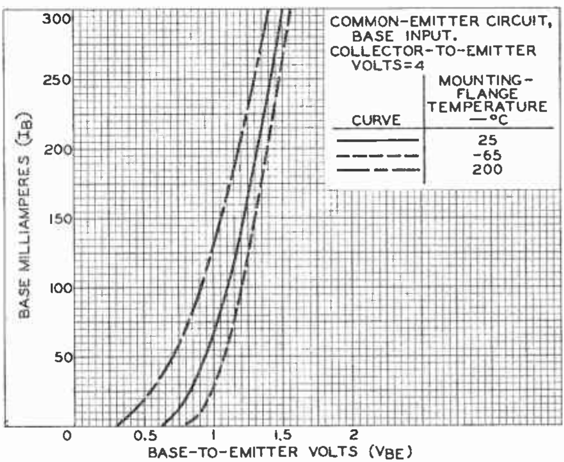
RATING CHART



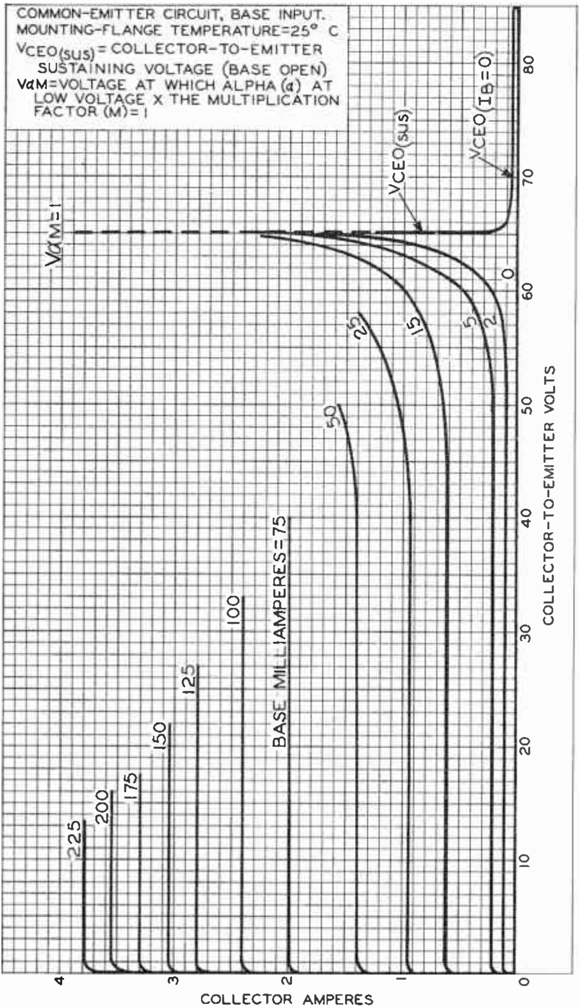
92CS-11088

TYPICAL BASE CHARACTERISTICS



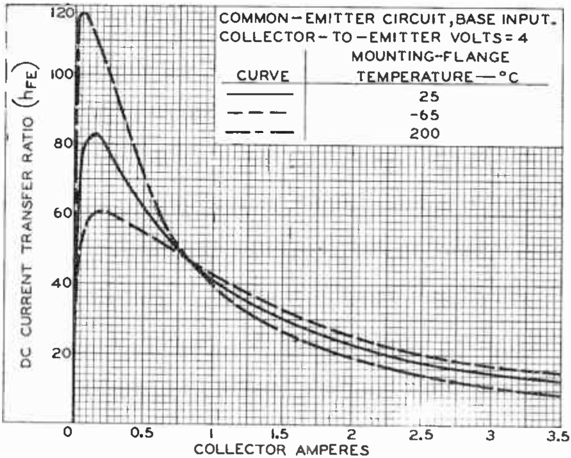
92CS-10451R2

TYPICAL COLLECTOR CHARACTERISTICS

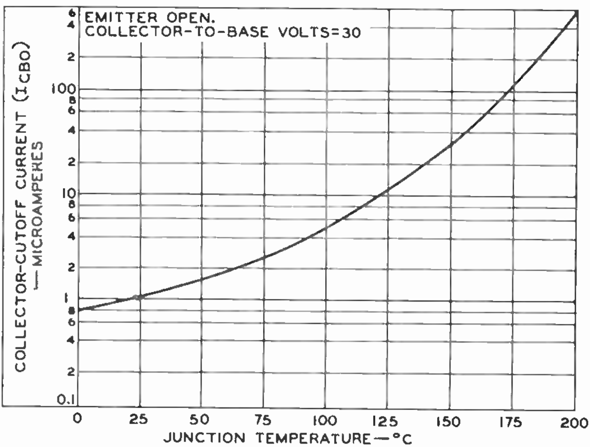


92CM-10447

TYPICAL OPERATION CHARACTERISTICS



92CS-10454R1



92CS-10883

World Radio History

World Radio History

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For Power Switching and Amplifier Service in Industrial and Military Applications

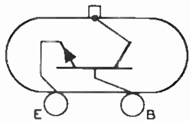
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	0.865"
Maximum Seated Length	0.390"
Maximum Length of Mounting Flange	1.550"
Maximum Width of Mounting Flange	1.015"
Case	Metal
Mounting Flange	Metal
Seals	Hermetic
Socket	Loranger Mfg. Corp. No. 2149, or equivalent

Terminal Diagram (See *Dimensional Outline*):

E - Emitter
B - Base



MOUNTING FLANGE-
Collector,
Case

INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and servo-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	60 max.	volts
With base open (Sustaining voltage)[a]	40 max.	volts
EMITTER-TO-BASE VOLTAGE	10 max.	volts
COLLECTOR CURRENT	6 max.	amp
EMITTER CURRENT	-8 max.	amp
BASE CURRENT	3 max.	amp
TRANSISTOR DISSIPATION:[b] ←		
At mounting-flange temperature of 25° C	75 max.	watts
At mounting-flange temperature of 100° C	43 max.	watts
MOUNTING-FLANGE TEMPERATURE RANGE:[c] ←		
Operating and storage	-65 to +200	°C

Characteristics:

At mounting-flange temperature of 25° C[c]

Alpha-Cutoff Frequency (f_{ab}) with dc collector-to-base volts = 12, dc collector ma. = 100	1	Mc

← Indicates a change.

Collector-to-Base Capacitance (C_{ob}) with dc collector-to-base volts = 40.	200	$\mu\mu$f
Thermal Time Constant (τ_1).	12	msec

Typical Operation:

In accompanying typical power-switching circuit at mounting-flange temperature of 25° C

DC Supply Voltage (B_2).	12	volts
DC Base-Bias Voltage (B_1)	-8.5	volts
"On" DC Collector Current	1.5	amp
"Turn-On" Base Current (I_{B1}).	0.3	amp
"Turn-Off" Base Current (I_{B2})	-0.15	amp
Generator Resistance.	50	ohms
Switching Time:		
Delay Time (t_d)	0.2	μsec
Rise Time (t_r).	1	μsec
Storage Time (t_s)	1	μsec
Fall Time (t_f).	1.2	μsec

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity $V_{\alpha M} = 1$; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[b] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

[c] Measured at center of seating surface.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Voltage values are given with respect to base and mounting-flange temperature[c] of 25° C unless otherwise specified

		Min.	*Max.*	
Collector-to-Emitter Voltage:				
With emitter reverse bias volts = 1.5, dc collector ma. = 0.5.	V_{CEX}	60	-	volts
With base open (Sustaining voltage), dc collector ma. = 100, dc base ma. = 0.	$V_{CEO(sus)}$[a]	40	-	volts
Base-to-Emitter Voltage for dc collector-to-emitter volts = 4, dc collector amperes = 1.5. . .	V_{BE}	-	2.5	volts
→ Collector-Cutoff Current for dc collector volts = 30, dc emitter ma. = 0, mounting-flange temperature =	I_{CBO}			
25° C.		-	25	μa
150° C		-	1000	μa
Emitter-Cutoff Current for dc emitter volts = 10, dc collector ma. = 0	I_{EBO}	-	25	μa

→ Indicates a change.

DC Current Transfer Ratio for dc collector-to-emitter volts = 4, dc collector amperes = 1.5.	h_{FE}	25	75	
DC Collector-to-Emitter Saturation Resistance for dc collector amperes = 1.5, dc base ma. = 100.	R_S	–	0.67	ohms
Thermal Resistance: Junction-to-mounting-flange	R_T	–	2.33	^oC/watt ←

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO}(sus)$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1: voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[c] Measured at center of seating surface.

OPERATING CONSIDERATIONS,
TYPICAL POWER SWITCHING CIRCUIT,
RATING CHART,
and CURVES
shown under Type 2N1487 also apply to the 2N1489

← indicates a change.

World Radio History

2N1491

Mesa Transistor

SILICON N-P-N DOUBLE-DIFFUSED-JUNCTION TYPE

For Very High Frequency Amplifier and Oscillator Service in Industrial and Military Applications

GENERAL DATA

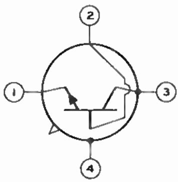
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No. TO-12
Case	Welded, Metal
Seals	Hermetic
Leads, Flexible	4
Minimum length	0.500"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter

Lead 2 – Base



Lead 3 – Collector, Case

Lead 4 – *Internally connected to case*

INDUSTRIAL SERVICE

Such as large-signal power-amplifier, video-amplifier, and oscillator circuits

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	30 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased	30 max.	volts
EMITTER-TO-BASE VOLTAGE	1 max.	volt
COLLECTOR CURRENT	50 max.	ma
EMITTER CURRENT	-50 max.	ma
TRANSISTOR DISSIPATION (See *Rating Chart*):		
Operation in free air:		
At ambient temperature of 25° C	0.5 max.	watt
At ambient temperature of 100° C	0.25 max.	watt
Operation with heat sink:		
At case temperature of 25° C	3 max.	watts
At case temperature of 100° C	1.5 max.	watts
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +175	°C

WorldRadioHistory

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base unless otherwise specified. Ambient temperature of 25° C.

Characteristic	Symbol	Min.	Typical	Max.	Unit
DC Collector Breakdown Voltage for dc collector ma. = 0.1, dc emitter current = 0	BV_{CBO}	30	–	–	volts
DC Emitter-Cutoff Current for dc emitter volts = 0.5, dc collector current = 0	I_{EBO}	–	–	100	μa
DC Collector-Cutoff Current for dc collector volts = 12, dc emitter current = 0	I_{CBO}	–	–	10	μa
Collector-to-Base and Stem Capacitance for dc collector volts = 30, dc emitter current = 0		–	–	5	μμf
Small-Signal Current Transfer Ratio:	h_{fe}				
For dc collector-to-emitter volts = 20, dc collector ma. = 15, signal frequency of 1 kc.		15	50	200	
For dc collector-to-emitter volts = 30, dc collector ma. = 15, signal frequency of 100 Mc.		–	1.8	–	
Alpha-Cutoff Frequency for dc collector volts = 30, dc collector ma. = 15	f_{ab}	–	250	–	Mc
Power Gain at 70 Mc for dc collector volts = 20, dc emitter ma. = -15, power output (mw) = 10	PG	13	15	–	db
→ Thermal Resistance: Junction-to-case	R_T	–	–	50	°C/watt

OPERATING CONSIDERATIONS

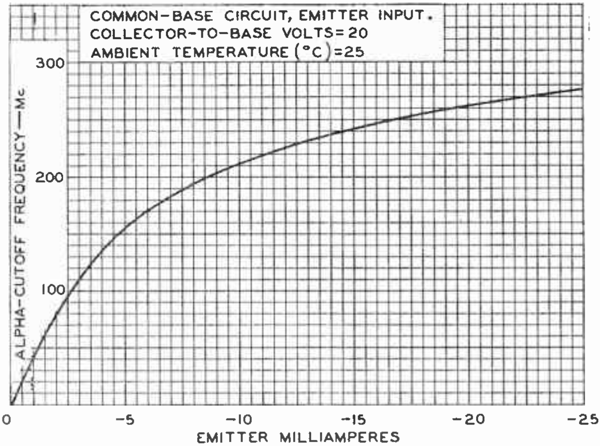
It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using this transistor, the temperature of the solder

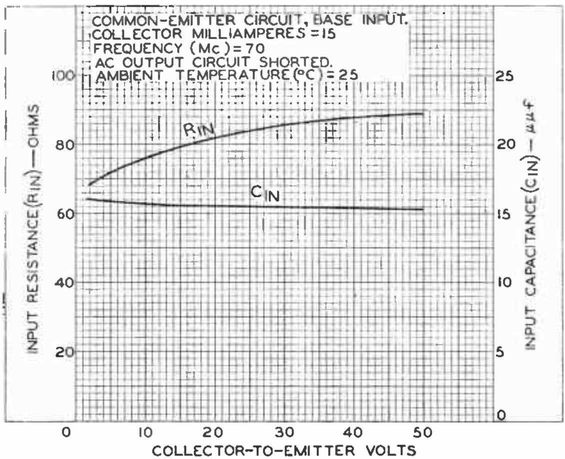
→ indicates a change.

TYPICAL CHARACTERISTIC



92CS-10510

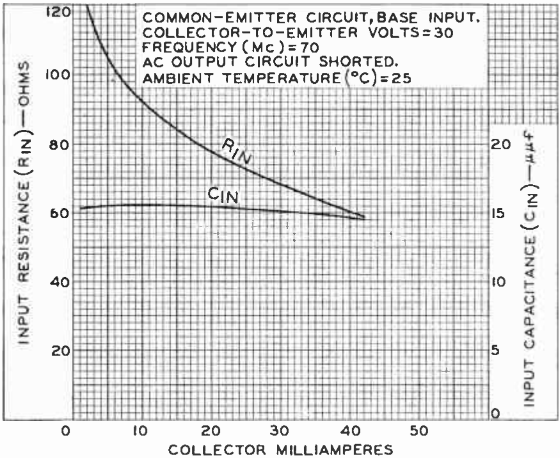
PERFORMANCE CHARACTERISTICS



92CS-10523

2N1491

PERFORMANCE CHARACTERISTICS



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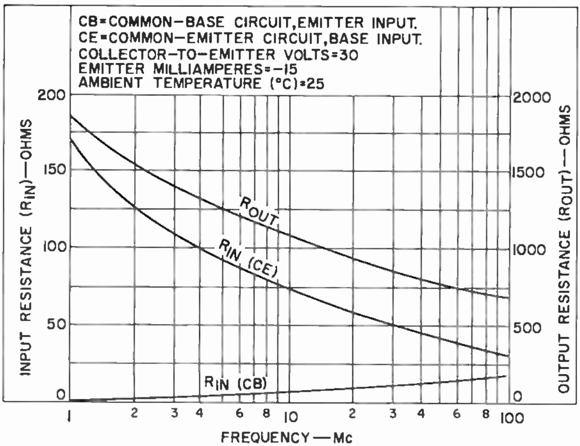

92CS-10514R1

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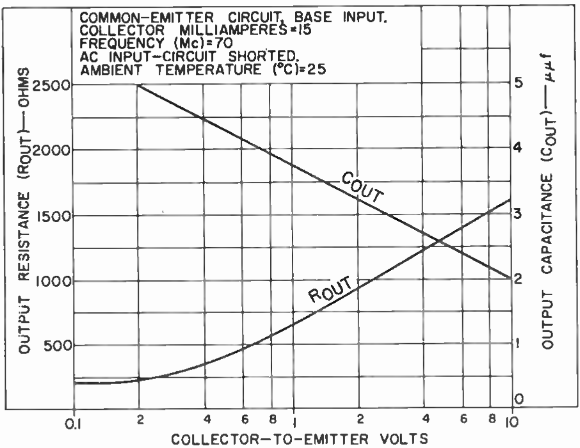
PERFORMANCE CHARACTERISTICS



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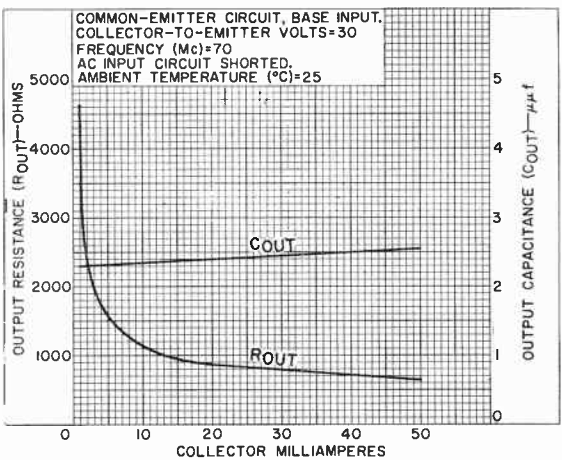

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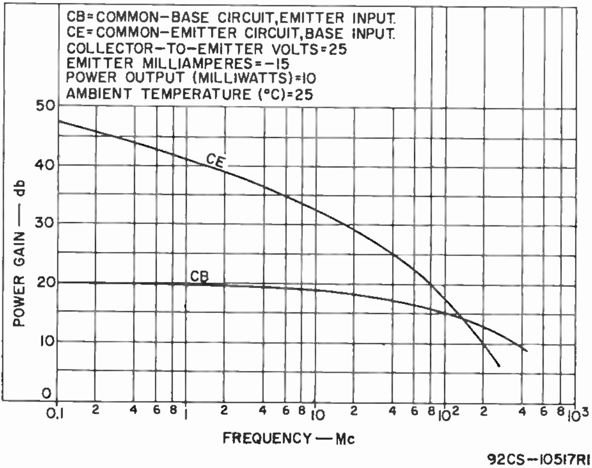
World Radio History

PERFORMANCE CHARACTERISTICS



World Radio History

Mesa Transistor

SILICON N-P-N DOUBLE-DIFFUSED-JUNCTION TYPE

For Very High Frequency Amplifier and Oscillator Service in Industrial and Military Applications

The 2N1492 is the same as the 2N1491 except for the following items:

INDUSTRIAL SERVICE

Such as large-signal power-amplifier, video-amplifier, and oscillator circuits

Maximum Ratings, *Absolute-Maximum Values:*

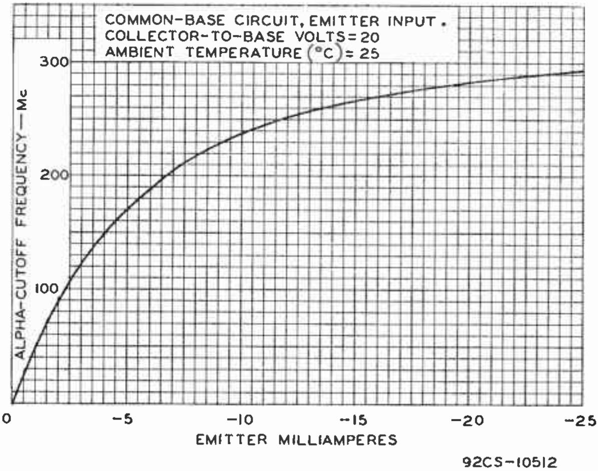
COLLECTOR-TO-BASE VOLTAGE.	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased. . . .	60 max.	volts
EMITTER-TO-BASE VOLTAGE.	2 max.	volts

ELECTRICAL CHARACTERISTICS

		Min.	*Typical*	*Max.*	
DC Collector Breakdown Voltage for dc collector ma. = 0.1, dc emitter current = 0.	BV_{CBO}	60	–	–	volts
Alpha-Cutoff Frequency for dc collector volts = 30, dc collector ma. = 15	f_{ab}	–	275	–	Mc
Power Gain at 70 Mc for dc collector volts = 30, dc emitter ma. = -15, power output (mw) = 100. .	PG	13	15	–	db

World Radio History

TYPICAL CHARACTERISTIC



World Radio History

Mesa Transistor

SILICON N-P-N DOUBLE-DIFFUSED-JUNCTION TYPE

For Very High Frequency Amplifier and Oscillator Service in Industrial and Military Applications

The 2N1493 is the same as the 2N1491 except for the following items:

INDUSTRIAL SERVICE

Such as large-signal power-amplifier, video-amplifier, and oscillator circuits

Maximum Ratings, *Absolute-Maximum Values:*

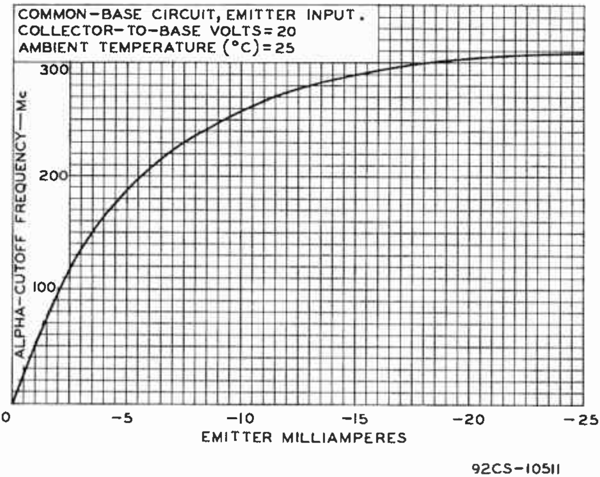
COLLECTOR-TO-BASE VOLTAGE	100 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE With emitter-to-base reverse biased	100 max.	volts
EMITTER-TO-BASE VOLTAGE	4.5 max.	volts

ELECTRICAL CHARACTERISTICS

		Min.	*Typical*	*Max.*	
DC Collector Breakdown Voltage for dc collector ma. = 0.1, dc emitter current = 0	BV_{CBO}	100	-	-	volts
Alpha-Cutoff Frequency for dc collector volts = 30, dc collector ma. = 15	f_{ab}	-	300	-	Mc
Power Gain at 70 Mc:	PG				
For dc collector volts = 20, dc emitter ma. = -15, power output (mw) = 10		-	16	-	db
For dc collector volts = 30, dc emitter ma. = -15, power output (mw) = 100		-	16	-	db
For dc collector volts = 50, dc emitter ma. = -25, power output (mw) = 500		10	12	-	db

World Radio History

TYPICAL CHARACTERISTIC



World Radio History

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

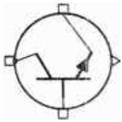
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	1.230"
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No. TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and servo-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	60 max.	volts
With base open (Sustaining voltage)[a]	40 max.	volts
EMITTER-TO-BASE VOLTAGE	10 max.	volts
COLLECTOR CURRENT	6 max.	amp
EMITTER CURRENT	-8 max.	amp
BASE CURRENT	3 max.	amp
TRANSISTOR DISSIPATION:[b] ←		
At case temperature of 25° C	75 max.	watts
At case temperature of 100° C	43 max.	watts
CASE-TEMPERATURE RANGE:[c] ←		
Operating and storage	-65 to +200	°C

Characteristics:

At case temperature of 25° C[c]

Alpha-Cutoff Frequency ($f_{\alpha b}$) with dc collector-to-base volts = 12, dc collector ma. = 100	1	Mc

← Indicates a change.

World Radio History

Collector-to-Base Capacitance (C_{ob}) with dc collector-to-base volts = 40.	200	$\mu\mu$f
Thermal Time Constant (τ_1).	12	msec

Typical Operation:

In accompanying typical power-switching circuit at case temperature[c] of 25° C

DC Supply Voltage (B_2).	12	volts
DC Base-Bias Voltage (B_1)	-8.5	volts
"On" DC Collector Current	1.5	amp
"Turn-On" Base Current (I_{B1}).	0.3	amp
"Turn-Off" Base Current (I_{B2})	-0.15	amp
Generator Resistance.	50	ohms
Switching Time:		
Delay time (t_d)	0.2	μsec
Rise time (t_r).	1	μsec
Storage time (t_s)	1	μsec
Fall time (t_f).	1.2	μsec

[a] The collector-to-emitter sustaining voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity.

[b] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

[c] Measured at intersection of seating surface with the stud.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Voltage values are given with respect to base and case temperature[c] of 25°C unless otherwise specified

		Min.	*Max.*	
Collector-to-Emitter Voltage:				
With emitter reverse-bias volts = 1.5, dc collector ma. = 0.5	V_{CEX}	60	-	volts
With base open (Sustaining voltage), dc collector ma. = 100, dc base ma. = 0.	$V_{CEO(sus)}$[a]	40	-	volts
Base-to-Emitter Voltage for dc collector-to-emitter volts = 4, dc collector amperes = 1.5 .	V_{BE}	-	3.5	volts
→ Collector-Cutoff Current for dc collector volts = 30, dc emitter ma. = 0, case temperature =	I_{CBO}			
25° C		-	25	μa
150° C.		-	1000	μa
Emitter-Cutoff Current for dc emitter volts = 10, dc collector ma. = 0	I_{EBO}	-	25	μa
→ DC Current Transfer Ratio for dc collector-to-emitter volts = 4, dc collector amperes = 1.5	h_{FE}	15	45	

→ Indicates a change.

World Radio History

DC Collector-to-Emitter Saturation Resistance for dc collector amperes = 1.5, dc base ma. = 300	R_S	–	2 ohms
Thermal Resistance: Junction-to-case.	R_T	–	2.33 °C/watt ←

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1: voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[c] Measured at intersection of seating surface with the stud.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

Electrical connection can be made to the base and emitter terminals by means of clips or by soldering directly to the terminals. When soldering connections are made to the terminals, care should be taken to conduct excessive heat away from the terminal seals, otherwise the heat of the soldering operation will crack the glass seals of the terminals and damage the transistor.

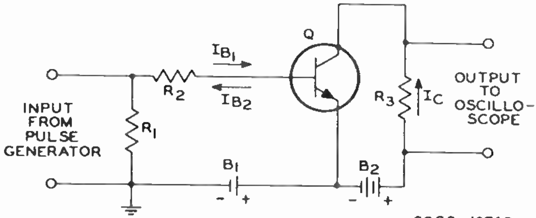
This transistor is provided with a single-ended stud for mounting to a heat sink and for electrical connection to the collector. (See accompanying *Suggested Mounting Arrangement*). Electrical connection to the base and to the emitter is made to their respective terminals.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

← Indicates a change.

World Radio History

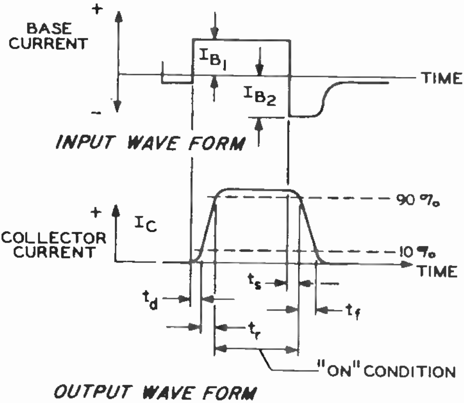
TYPICAL POWER-SWITCHING CIRCUIT



92CS-10763

B_1: 8.5 volts
B_2: 12 volts
Q: Transistor type 2N1511
R_1: 50 ohms, 1 watt
R_2: 30 ohms, 1 watt
R_3: 7.8 ohms, 2 watts

ASSOCIATED WAVE FORMS



92CS-10029

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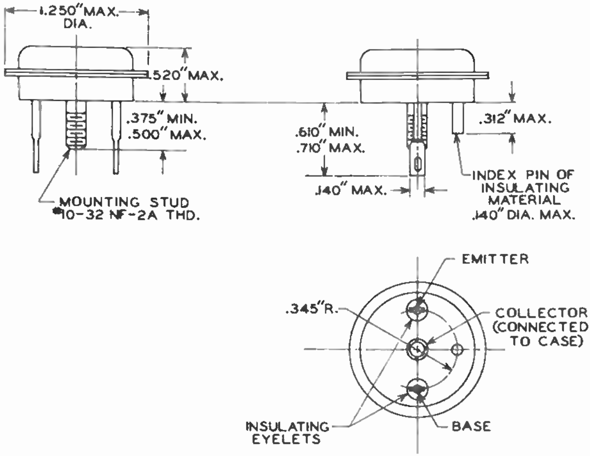
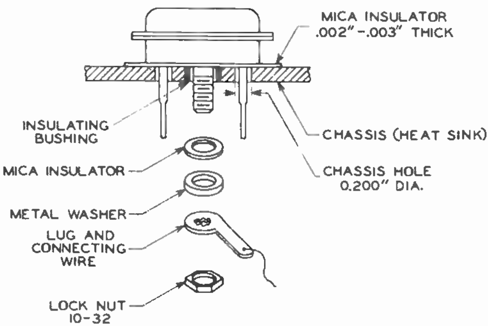
World Radio History



92CM-10612R1

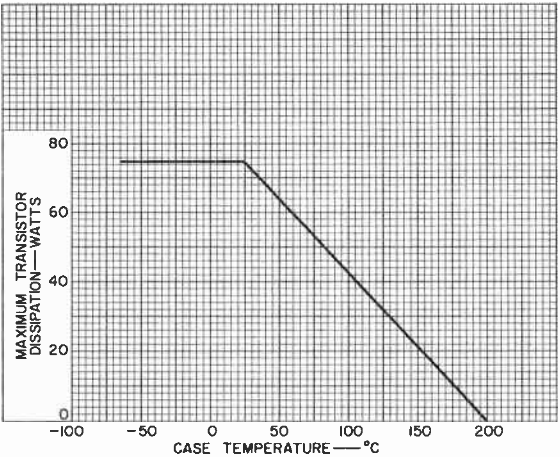
SUGGESTED MOUNTING ARRANGEMENT



92CS-10624R1

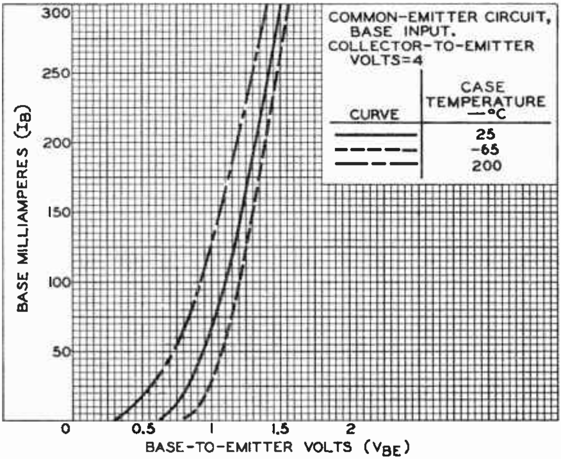
World Radio History

RATING CHART



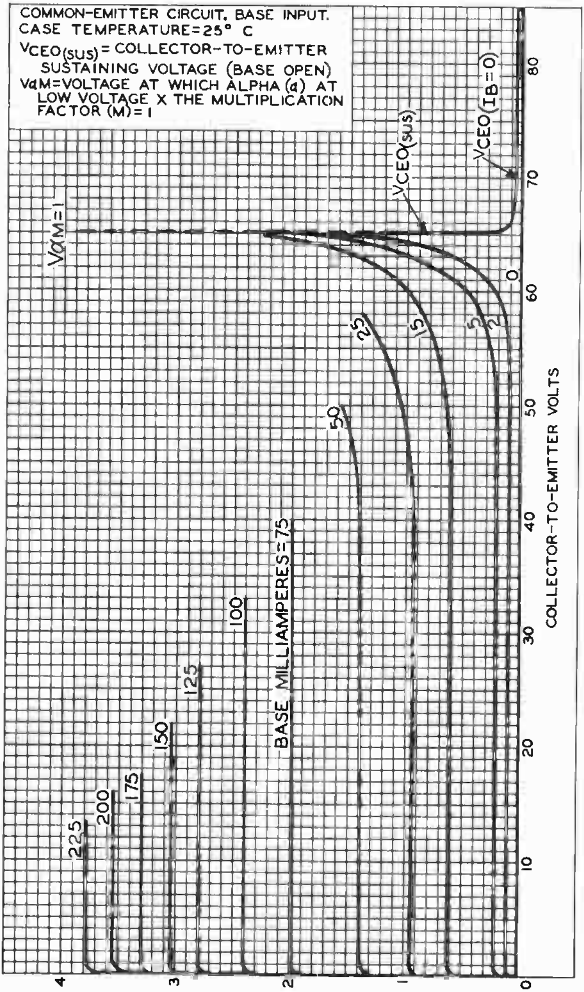
92CS-10769R1

TYPICAL BASE CHARACTERISTICS



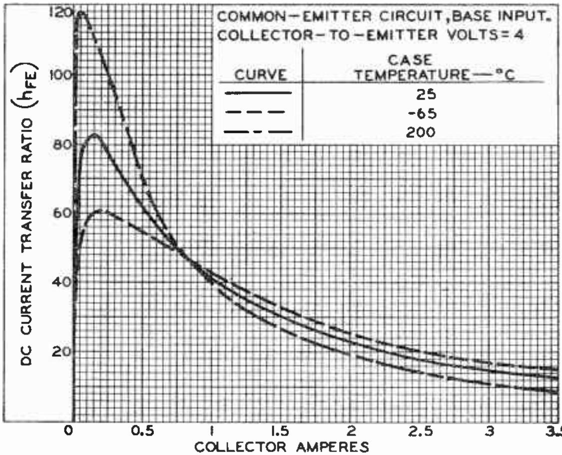
92CS-10771R1

TYPICAL COLLECTOR CHARACTERISTICS

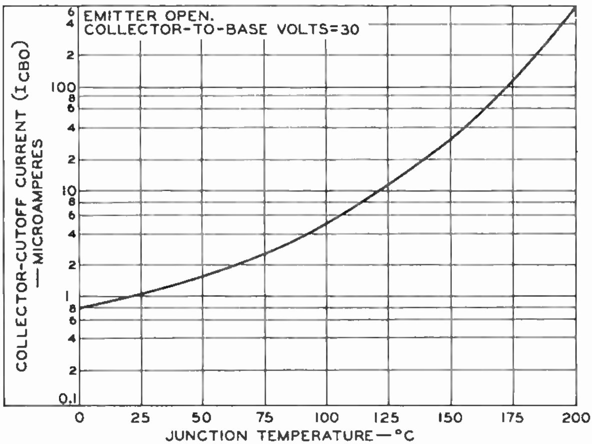


92CM-10773

TYPICAL OPERATION CHARACTERISTICS



92CS-10772R1



92CS-10883

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For High-Power Switching and Amplifier Service in Industrial and Military Applications

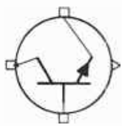
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	1.230"
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No.TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and servo-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	60 max.	volts
With base open (Sustaining voltage)▲	40 max.	volts
EMITTER-TO-BASE VOLTAGE	10 max.	volts
COLLECTOR CURRENT	6 max.	amp
EMITTER CURRENT	-8 max.	amp
BASE CURRENT	3 max.	amp
TRANSISTOR DISSIPATION:●		
At case temperature of 25° C	60 max.	watts
At case temperature of 100° C	30 max.	watts
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +175	°C

Characteristics:

At case temperature of 25° C

Alpha-Cutoff Frequency ($f_{\alpha b}$) with dc collector-to-base volts = 12, dc collector ma. = 100	1	Mc

World Radio History

2N1511

Collector-to-Base Capacitance (C_{ob}) with dc collector-to-base volts = 40.	200	μμf
Thermal Time Constant (τ_I).	12	msec

Typical Operation:

In accompanying typical power-switching circuit at case temperature of 25° C

DC Supply Voltage (B_2).	12	volts
DC Base-Bias Voltage (B_1)	-8.5	volts
"On" DC Collector Current	1.5	amp
"Turn-On" Base Current (I_{B1}).	0.3	amp
"Turn-Off" Base Current (I_{B2})	-0.15	amp
Generator Resistance.	50	ohms
Switching Time:		
Delay time (t_d)	0.2	μsec
Rise time (t_r).	1	μsec
Storage time (t_s)	1	μsec
Fall time (t_f).	1.2	μsec

▲ The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V\alpha_M$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity.

● *See accompanying Rating Chart and also Transistor-Dissipation Rating Chart in General Section.*

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Voltage values are given with respect to base and case temperature of 25° C unless otherwise specified

		Min.	Max.	
Collector-to-Emitter Voltage:				
With emitter reverse-bias volts = 1.5, dc collector ma. = 0.5	V_{CEX}	60	-	volts
With base open (Sustaining voltage), dc collector ma. = 100, dc base ma. = 0.	$V_{CEO(sus)}$ ▲	40	-	volts
Base-to-Emitter Voltage for dc collector-to-emitter volts = 4, dc collector amperes = 1.5 .	V_{BE}	-	3.5	volts
Collector-Cutoff Current for dc collector volts = 30, dc emitter ma. = 0, case temperature =	I_{CBO}			
25° C		-	25	μa
175° C.		-	1000	μa
Emitter-Cutoff Current for dc emitter volts = 10, dc collector ma. = 0	I_{EBO}	-	25	μa
DC Current Transfer Ratio for dc collector-to-emitter volts = 4, dc collector amperes = 1.5	h_{FE}	10	50	

World Radio History

DC Collector-to-Emitter Saturation Resistance for dc collector amperes = 1.5, dc base ma. = 300	R_S	–	2	ohms
Thermal Resistance: Junction-to-case.	R_T	–	2.5	^oC/watt

▲ The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

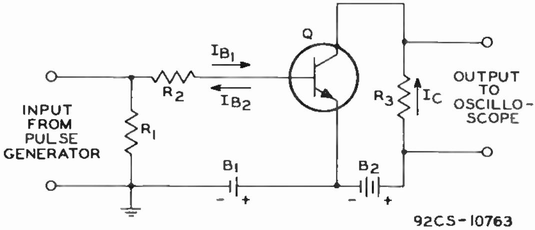
Electrical connection can be made to the base and emitter terminals by means of clips or by soldering directly to the terminals. When soldering connections are made to the terminals, care should be taken to conduct excessive heat away from the terminal seals, otherwise the heat of the soldering operation will crack the glass seals of the terminals and damage the transistor.

This transistor is provided with a single-ended stud for mounting to a heat sink and for electrical connection to the collector. (See *accompanying Suggested Mounting Arrangement*). Electrical connection to the base and to the emitter is made to their respective terminals.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

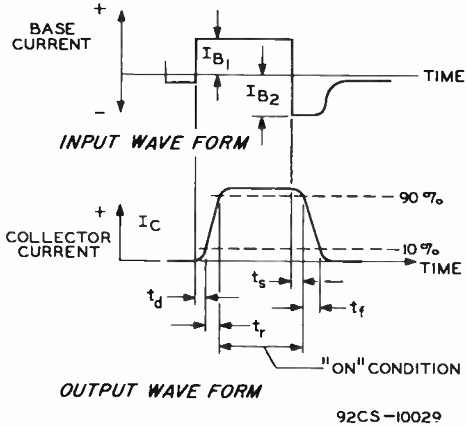
World Radio History

TYPICAL POWER-SWITCHING CIRCUIT



B_1: 8.5 volts
B_2: 12 volts
Q: Transistor type 2N1511
R_1: 50 ohms, 1 watt
R_2: 30 ohms, 1 watt
R_3: 7.8 ohms, 2 watts

ASSOCIATED WAVE FORMS



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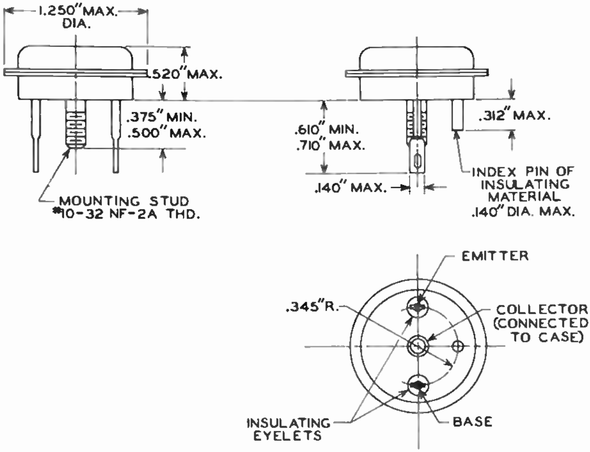
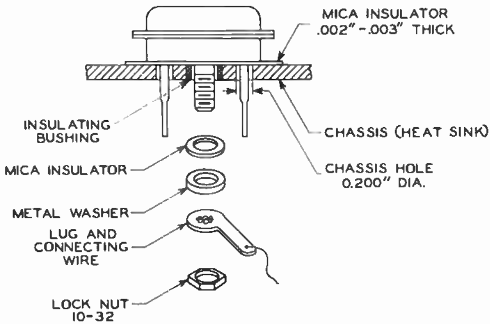


92CM-10612R1

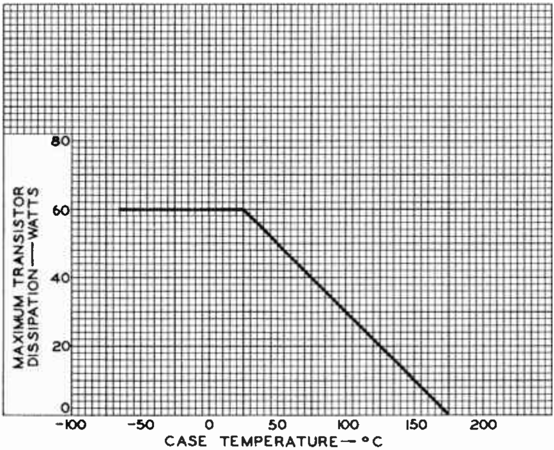
SUGGESTED MOUNTING ARRANGEMENT



92CS-10624R1

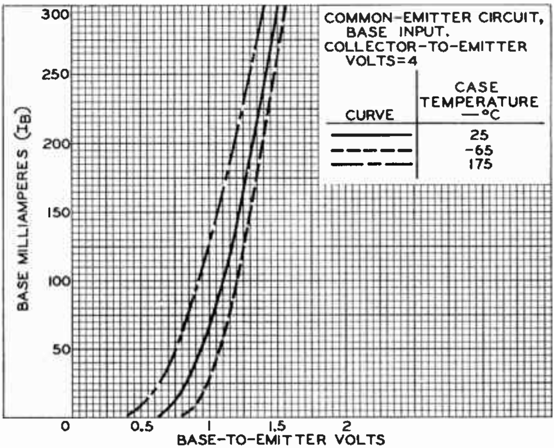
World Radio History

RATING CHART



92CS-10769

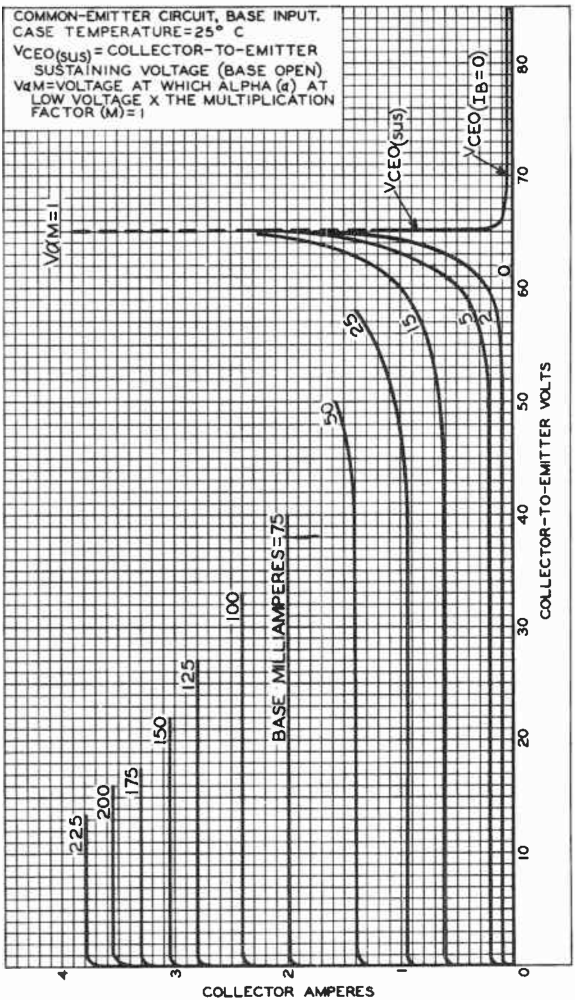
TYPICAL BASE CHARACTERISTICS



92CS-10771

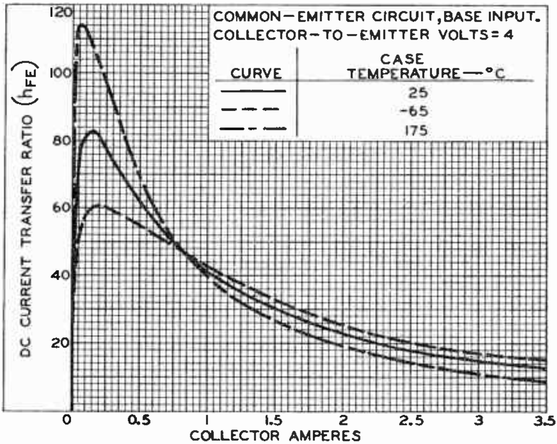
World Radio History

TYPICAL COLLECTOR CHARACTERISTICS

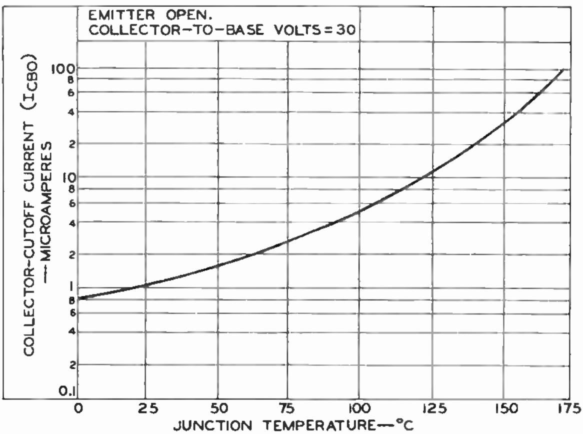


92CM-10773

TYPICAL OPERATION CHARACTERISTICS



92CS-10772



92CS-10449

World Radio History

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For High-Power Switching and Amplifier Service in Industrial and Military Applications

The 2N1512 is the same as the 2N1511 except for the following items:

INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and servo-amplifier, relay- and solenoid-actuating circuits

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	100 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5). . . .	100 max.	volts
With base open (Sustaining voltage)▲. . .	55 max.	volts

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

		Min.	*Max.*	
Collector-to-Emitter Voltage:				
With emitter reverse-bias volts = 1.5, dc collector ma. = 0.5	V_{CEX}	100	-	volts
With base open (Sustaining voltage), dc collector ma. = 100, dc base ma. = 0	$V_{CEO(sus)}$▲	55	-	volts

▲ The Collector-to-Emitter Sustaining voltage ($V_{CEO}(sus)$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V\alpha M$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

World Radio History

World Radio History

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

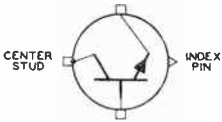
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	1.230"
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No. TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and servo-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, *Absolute Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	60 max.	volts
With base open (Sustaining voltage)[a]	40 max.	volts
EMITTER-TO-BASE VOLTAGE	10 max.	volts
COLLECTOR CURRENT	6 max.	amp
EMITTER CURRENT	−8 max.	amp
BASE CURRENT	3 max.	amp
TRANSISTOR DISSIPATION:[b] ←		
At case temperature of 25° C	75 max.	watts
At case temperature of 100° C	43 max.	watts
CASE-TEMPERATURE RANGE:[c] ←		
Operating and storage	−65 to +200	°C

Characteristics:

At case temperature of 25° C[c]

Alpha-Cutoff Frequency ($f_{\alpha b}$) with dc collector-to-base volts = 12, dc collector ma. = 100	1	Mc
Collector-to-Base Capacitance (C_{ob}) with dc collector-to-base volts = 40	200	$\mu\mu$f
Thermal Time Constant (τ_1)	12	msec

← Indicates a change.

World Radio History

Typical Operation:

In accompanying typical power switching circuit at case temperature[c] of 25° C

DC Supply Voltage (B_2)	12	volts
DC Base-Bias Voltage (B_1)	-8.5	volts
"On" DC Collector Current	1.5	amp
"Turn-On" Base Current (I_{B_1})	0.3	amp
"Turn-Off" Base Current (I_{B_2})	-0.15	amp
Generator Resistance	50	ohms
Switching Time:		
Delay time (t_d)	0.2	µsec
Rise time (t_r)	1	µsec
Storage time (t_s)	1	µsec
Fall time (t_f)	1.2	µsec

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V\alpha M$ = 1; voltage at which the product of alpha (α), at low voltage times the multiplication factor (M) equals unity).

[b] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

[c] Measured at intersection of sealing surface with the stud.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Voltage values are given with respect to base and case temperature[c] of 25° C unless otherwise specified

		Min.	Max.	
Collector-to-Emitter Voltage:				
With emitter reverse-bias volts = 1.5, dc collector ma. = 0.5	V_{CEX}	60	-	volts
With base open (Sustaining voltage), dc collector ma. = 100, dc base ma. = 0	$V_{CEO(sus)}$[a]	40	-	volts
Base-to-Emitter Voltage for dc collector-to-emitter volts = 4, dc collector amperes = 1.5	V_{BE}	-	2.5	volts
→ Collector-Cutoff Current for dc collector volts = 30, dc emitter ma. = 0, case temperature =	I_{CBO}			
25° C		-	25	µa
150° C		-	1000	µa
Emitter-Cutoff Current for dc emitter volts = 10, dc collecter ma. = 0	I_{EBO}	-	25	µa
DC Current Transfer Ratio for dc collector-to-emitter volts = 4, dc collector amperes = 1.5	h_{FE}	25	75	

→ Indicates a change.

World Radio History

DC Collector-to-Emitter Saturation Resistance for dc collector amperes = 1.5, dc base ma. = 100.	R_S	–	0.67	ohms
Thermal Resistance: Junction-to-case	R_T	–	2.33	°C/watt ←

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[c] Measured at intersection of seating surface with the stud.

OPERATING CONSIDERATIONS,
TYPICAL POWER SWITCHING CIRCUIT,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHART,
and CURVES,
shown under Type 2N1511 also apply to the 2N1513

← Indicates a change.

World Radio History

World Radio History

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For High-Power Switching and Amplifier Service in Industrial and Military Applications

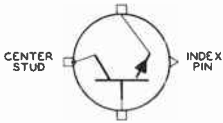
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	1.230"
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No. TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and servo-amplifier, relay- and solenoid-actuating circuits

Maximum and Minimum Ratings, ***Absolute Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)▲	60 max.	volts
With base open (Sustaining voltage)	40 max.	volts
EMITTER-TO-BASE VOLTAGE	10 max.	volts
COLLECTOR CURRENT	6 max.	amp
EMITTER CURRENT	-8 max.	amp
BASE CURRENT	3 max.	amp
TRANSISTOR DISSIPATION:●		
At case temperature of 25° C	60 max.	watts
At case temperature of 100° C	30 max.	watts
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +175	°C

Characteristics:

At case temperature of 25° C

Alpha-Cutoff Frequency ($f_{\alpha b}$) with dc collector-to-base volts = 12, dc collector ma. = 100	1	Mc
Collector-to-Base Capacitance (C_{ob}) with dc collector-to-base volts = 40	200	$\mu\mu f$
Thermal Time Constant (τ_1)	12	msec

World Radio History

Typical Operation:

In accompanying typical power switching circuit at case temperature of 25° C		
DC Supply Voltage (B_2)	12	volts
DC Base-Bias Voltage (B_1)	-8.5	volts
"On" DC Collector Current	1.5	amp
"Turn-On" Base Current (I_{B_1})	0.3	amp
"Turn-Off" Base Current (I_{B_2})	-0.15	amp
Generator Resistance	50	ohms
Switching Time:		
Delay time (t_d)	0.2	μsec
Rise time (t_r)	1	μsec
Storage time (t_s)	1	μsec
Fall time (t_f)	1.2	μsec

▲ The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V\alpha M$ = 1; voltage at which the product of alpha (α), at low voltage times the multiplication factor (M) equals unity).

● *See accompanying Rating Chart and also Transistor-Dissipation Rating Chart in General Section.*

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Voltage values are given with respect to base and case temperature of 25° C unless otherwise specified

		Min.	*Max.*	
Collector-to-Emitter Voltage:				
With emitter reverse-bias volts = 1.5, dc collector ma. = 0.5	V_{CEX}	60	-	volts
With base open (Sustaining voltage), dc collector ma. = 100, dc base ma. = 0	$V_{CEO(sus)}$▲	40	-	volts
Base-to-Emitter Voltage for dc collector-to-emitter volts = 4, dc collector amperes = 1.5	V_{BE}	-	2.5	volts
Collector-Cutoff Current for dc collector volts = 30, dc emitter ma. = 0, case temperature =	I_{CBO}			
25° C		-	25	μa
175° C		-	1000	μa
Emitter-Cutoff Current for dc emitter volts = 10, dc collecter ma. = 0	I_{EBO}	-	25	μa
DC Current Transfer Ratio for dc collector-to-emitter volts = 4, dc collector amperes = 1.5	h_{FE}	25	75	

World Radio History

DC Collector-to-Emitter Saturation Resistance for dc collector amperes = 1.5, dc base ma. = 100.	R_S	-	0.67	ohms
Thermal Resistance: Junction-to-case	R_T	-	2.5	^{o}C/watt

▲ The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

**OPERATING CONSIDERATIONS,
TYPICAL POWER SWITCHING CIRCUIT,
DIMENSIONAL OUTLINE,
SUGGESTED MOUNTING ARRANGEMENT,
RATING CHART,
and CURVES,
shown under Type 2N1511 also apply to the 2N1513**

World Radio History

World Radio History

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For High-Power Switching and Amplifier Service in Industrial and Military Applications

The 2N1514 is the same as the 2N1513 except for the following items:

INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and servo-amplifier, relay- and solenoid-actuating circuits

Maximum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE.	100 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	100 max.	volts
With base open (Sustaining voltage)▲ . . .	55 max.	volts

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

		Min.	*Max.*	
Collector-to-Emitter Voltage:				
With emitter reverse-bias volts = 1.5, dc collector ma. = 0.5	V_{CEX}	100	-	volts
With base open (Sustaining voltage), dc collector ma. = 100, dc base ma. = 0	$V_{CEO(sus)}$▲	55	-	volts

▲ The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

World Radio History

World Radio History

2N1524

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

For Intermediate-Frequency-Amplifier Applications in Battery-Operated AM Radio Receivers

GENERAL DATA

Electrical:

Minimum DC Collector-to-Base Voltage for dc emitter-to-base volts = −0.5, dc collector μa = −50, ambient temperature = 25° C.	−24	volts
Maximum DC Collector-Cutoff Current (I_{CBO}) for dc collector-to-base volts = −12, emitter open, ambient temperature = 25° C. . .	−16	μa
Maximum DC Emitter-Cutoff Current (I_{EBO}) for dc emitter-to-base volts = −0.5, collector open, ambient temperature = 25° C. .	−16	μa
Junction-Temperature Rise (In free air).	0.4	°C/mw

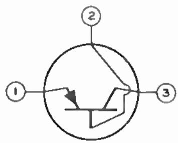
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads).	0.410"
Maximum Diameter	0.240"
Dimensional Outline.	JEDEC No.TO-1
Case	Metal
Seals.	Hermetic
Leads, Flexible.	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter

Lead 2 – Base



Lead 3 – Collector (Adjacent to red dot on side of case)

INTERMEDIATE-FREQUENCY AMPLIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

DC COLLECTOR-TO-BASE VOLTAGE.	−24 max.	volts
DC EMITTER-TO-BASE VOLTAGE.	−0.5 max.	volt
DC COLLECTOR CURRENT.	−10 max.	ma
DC EMITTER CURRENT.	10 max.	ma
TRANSISTOR DISSIPATION:		
At ambient temperature of 25° C	80 max.	mw
At ambient temperature of 55° C	50 max.	mw
At ambient temperature of 71° C	35 max.	mw
AMBIENT TEMPERATURE (During operation). . .	71 max.	°C
STORAGE-TEMPERATURE RANGE	−65 to +85	°C

World Radio History

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	−12	volts
DC Emitter Current	1	ma
Small-Signal Current Transfer Ratio at 1 kc.	60	

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	−12	volts
DC Emitter Current	1	ma
Small-Signal Current Transfer Ratio at 1 kc.	0.983	
Alpha-Cutoff Frequency	33	Mc

Typical Operation: *At Ambient Temperature of 25° C:*

In a common-emitter, base input, single-stage, 455-kc intermediate-frequency amplifier circuit

DC Supply Voltage	−6	−9	−12	volts
DC Collector-to-Emitter Voltage	−5.7	−8.5	−11	volts
DC Emitter Current	1	1	1	ma
Input Resistance	1300	1350	1550	ohms
Output Resistance	0.31	0.415	0.525	megohm
Collector-to-Base Capacitance (C_{ob})	2.2▲	2.1▲	2▲	μμf
Maximum Power Gain●	51	52.4	54.4	db
Useful Power Gain:				
In neutralized circuit	33	33	33	db
In unneutralized circuit	29.7	30	30.2	db

In a common-emitter, base input, two-stage, 455-kc intermediate-frequency amplifier circuit

DC Supply Voltage	−6	−6	−9	−9	−12	−12	volts
DC Collector-to-Emitter Voltage	−5.7	−5.7	−8.5	−8.5	−11	−11	volts
DC Emitter Current	1	0.65	1	0.65	1	0.65	ma
Input Resistance	1300	2100	1350	2200	1550	2500	ohms
Output Resistance	0.31	0.49	0.415	0.65	0.525	0.82	megohm
Collector-to-Base Capacitance (C_{ob})	2.2▲	2.2▲	2.1▲	2.1▲	2▲	2▲	μμf
Maximum Power Gain●	50.9	51.3	52.4	52.8	54	54.3	db
Useful Power Gain:							
In neutralized circuit	31.2	30	31.2	30	31.2	30	db
In unneutralized circuit	28.1	26.6	28.2	26.7	28.3	26.8	db

▲ Maximum variation from this value is 1.4 μμf.

● Measured in a single-tuned unilateralized circuit matched to the generator and load impedance for maximum transfer of power (transformer-insertion losses not included).

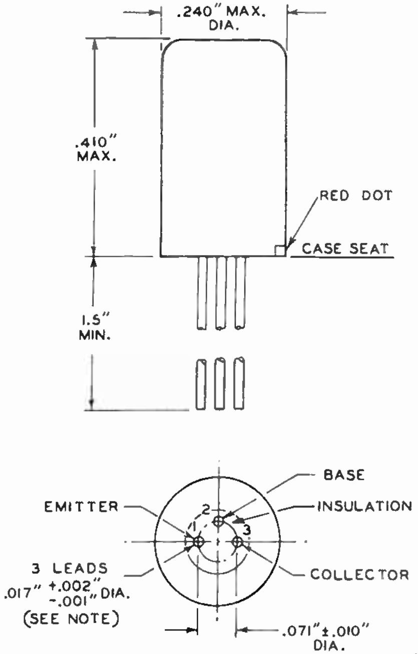
OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using this transistor, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds.

World Radio History

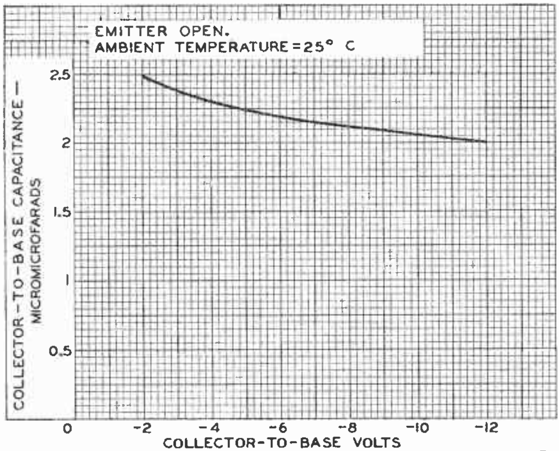


92CS-9148R6

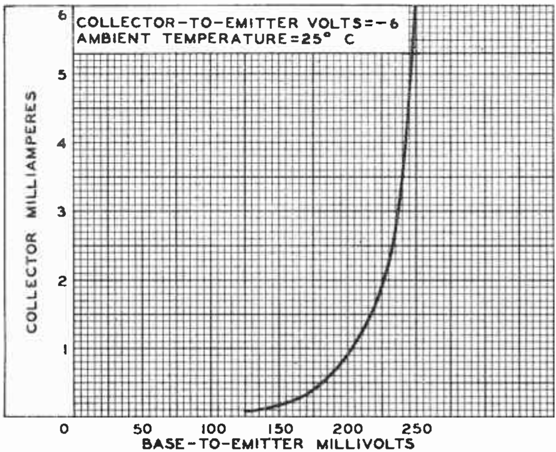
NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

TYPICAL CHARACTERISTICS



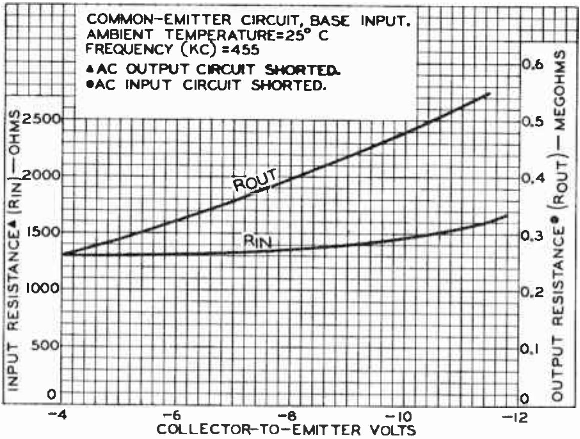
92CS-9820RI



92CS-10679

World Radio History

TYPICAL CHARACTERISTICS



92CS-10770

World Radio History

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

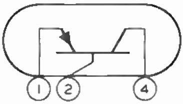
For Intermediate-Frequency-Amplifier Applications in Battery-Operated AM Radio Receivers

The 2N1525 is the same as the 2N1524 except for the following items:

Mechanical:

Maximum Overall Length. 0.697"
Maximum Seated Length . . . . 0.495"
Maximum Diameter. . . . . 0.260"
Dimensional Outline . . . . .JEDEC No.TO-40
Case. . . . . Metal and Plastic
Terminal Diagram:

Pin 1 - Emitter
Pin 2 - Base

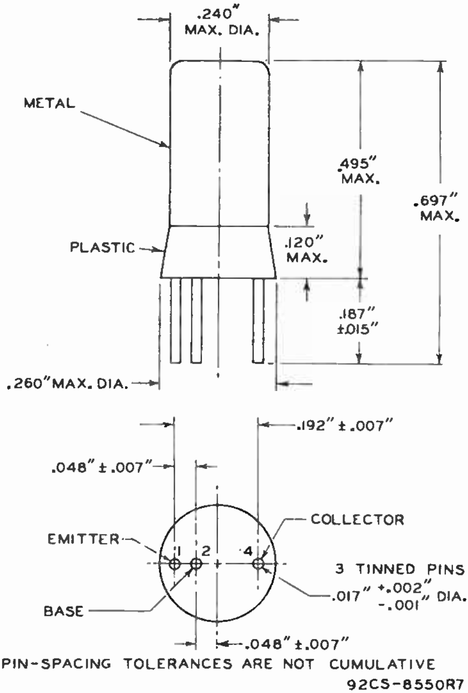


Pin 4 - Collector

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

World Radio History



World Radio History

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

For Converter Applications in Battery-Operated AM Radio Receivers

GENERAL DATA

Electrical:

Minimum DC Collector-to-Base Voltage for dc emitter-to-base volts = -0.5, dc collector μa = -50, ambient temperature = 25° C.	-24	volts
Maximum DC Collector-Cutoff Current (I_{CBO}) for dc collector-to-base volts = -12, emitter open, ambient temperature = 25° C.	-16	μa
Maximum DC Emitter-Cutoff Current (I_{EBO}) for dc emitter-to-base volts = -0.5, collector open, ambient temperature = 25° C.	-16	μa
Junction-Temperature Rise (In free air)	0.4	°C/mw

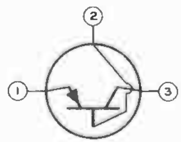
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.410"
Maximum Diameter	0.240"
Dimensional Outline	JEDEC No. TO-1
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector (Adjacent to red dot on side of case)

CONVERTER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

DC COLLECTOR-TO-BASE VOLTAGE	-24 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-0.5 max.	volt
DC COLLECTOR CURRENT	-10 max.	ma
DC EMITTER CURRENT	10 max.	ma

World Radio History

TRANSISTOR DISSIPATION:		
At ambient temperature of 25° C.	80 max.	mw
At ambient temperature of 55° C.	50 max.	mw
At ambient temperature of 71° C.	35 max.	mw
AMBIENT TEMPERATURE (During operation) . . .	71 max.	°C
STORAGE-TEMPERATURE RANGE.	-65 to +85	°C

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage.	-12	volts
DC Emitter Current	1	ma
Small-Signal Current Transfer Ratio at 1 kc. .	130	

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-12	volts
DC Emitter Current	1	ma
Small-Signal Current Transfer Ratio at 1 kc. .	0.992	
Alpha-Cutoff Freouency	33	Mc

Typical Operation, *At Ambient Temperature of 25° C:*

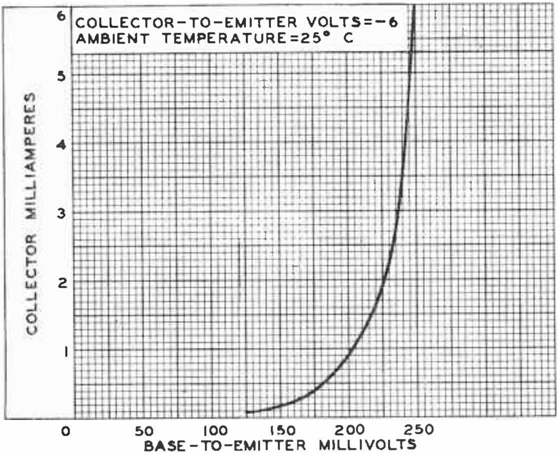
In a common-emitter, base input, self-excited, 1.5 Mc-converter circuit

DC Supply Voltage.	-6	-9	-12	volts
DC Collector-to-Emitter Voltage.	-5	-8	-11	volts
DC Emitter Current	0.65	0.65	0.65	ma
Input Resistance	1850	1950	2150	ohms
Output Resistance.	0.19	0.28	0.48	megohm
RMS Base-to-Emitter Oscillator-Injection Voltage	100	100	100	mv
Conversion Power Gain:				
Maximum available.	44.2	46.1	48.9	db
Useful	34.2	34.5	35.8	db

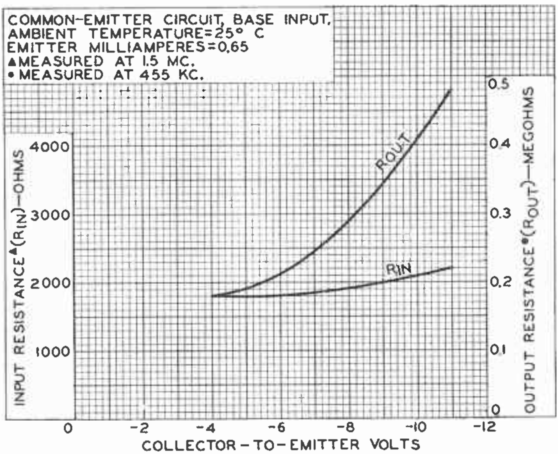
**OPERATING CONSIDERATIONS
and DIMENSIONAL OUTLINE
shown under Type 2N1524 also apply to the 2N1526**

World Radio History

TYPICAL CHARACTERISTICS



92CS-10679



92CS-10583R1

World Radio History

World Radio History

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

For Converter Applications in
Battery-Operated AM Radio Receivers

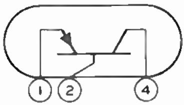
The 2N1527 is the same as the 2N1526 except for the following items:

Mechanical:

Maximum Length	0.697"
Maximum Seated Length	0.495"
Maximum Diameter	0.260"
Dimensional Outline	JEDEC No. TO-40
Case	Metal and Plastic

Terminal Diagram:

Pin 1 – Emitter
Pin 2 – Base



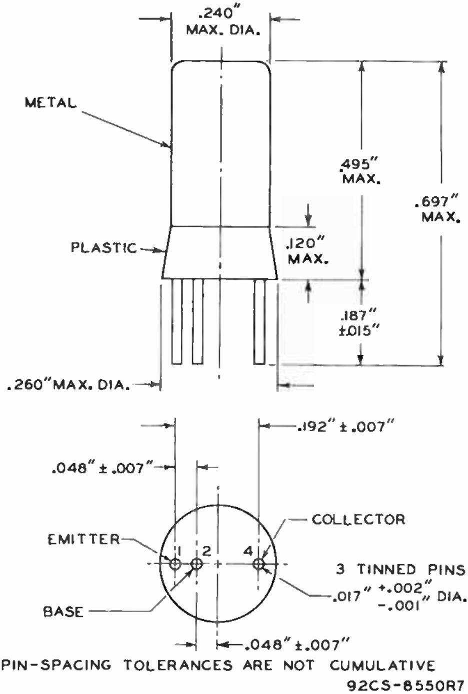
Pin 4 – Collector

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

RADIO CORPORATION OF AMERICA
Semiconductor & Materials Division Somerville, N. J.

World Radio History



World Radio History

Transistor

SILICON N-P-N DOUBLE-DIFFUSED-JUNCTION PLANAR TYPE

For Industrial and Military Applications

The 2N2102, having Higher Ratings, is a Direct Replacement for Type 2N1613

GENERAL DATA

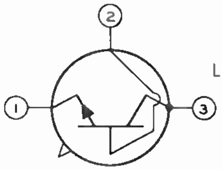
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No.TO-5
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter

Lead 2 – Base



Lead 3 – Collector, Case

INDUSTRIAL SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:		
With emitter open	75 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With external resistance (ohms) ≤ 10 between base and emitter	50 max.	volts
EMITTER-TO-BASE VOLTAGE:		
With collector open	7 max.	volts
COLLECTOR CURRENT	1 max.	amp
TRANSISTOR DISSIPATION:[a]		
At case temperature[b] of 25° C or below	3 max.	watts
At free-air temperature of 25° C or below	0.8 max.	watt
TEMPERATURE RANGE:		
Storage	-65 to +300	°C
Operating (Junction)	-65 to +200	°C
LEAD TEMPERATURE:[c]		
For 10 seconds maximum	255 max.	°C

[a] See accompanying *Rating Chart*.
[b] Measured at center of seating plane.
[c] Measured 1/16" ± 1/32" down from seating plane.

World Radio History

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and at case temperature[b] of 25° C unless otherwise specified

		Min.	Max.	
DC Collector Breakdown Voltage for dc collector ma. = 0.1, dc emitter ma. = 0.	BV_{CBO}	75	-	volts
DC Emitter Breakdown Voltage for dc collector ma. = 0, dc emitter ma. = 0.25	BV_{EBO}	7	-	volts
DC Collector-to-Emitter Reach-Through Voltage for dc emitter volts = 1.5, dc collector ma. = 0.1.	V_{RT}	75	-	volts
DC Collector-to-Emitter Sustaining Voltage for dc collector ma. = 100: With external base-to-emitter resistance (ohms) ≤ 10	$V_{CER(sus)}$	50	-	volts
DC Base-to-Emitter Saturation Voltage for dc collector ma. = 150, dc base ma. = 15. . . .	$V_{BE(sat)}$	-	1.3	volts
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = 150, dc base ma. = 15.	$V_{CE(sat)}$	-	1.5	volts
DC Collector-Cutoff Current for dc collector volts = 60, dc emitter ma. = 0, case temperature[b] =	I_{CBO}			
25° C.		-	0.01	μa
150° C		-	10	μa
DC Emitter-Cutoff Current for dc base volts = 5, dc collector ma. = 0.	I_{EBO}	-	0.01	μa
Input Resistance at frequency of 1 kc:	h_{ib}			
With dc collector-to-emitter volts = 5, dc collector ma. = 1.		24	34	ohms
With dc collector-to-emitter volts = 10, dc collector ma. = 5.		4	8	ohms
Input Capacitance for dc emitter volts = 0.5, dc collector ma. = 10	C_{ib}	-	80	μμf
Output Capacitance for dc collector volts = 10, dc emitter ma. = 0.	C_{ob}	-	25	μμf

World Radio History

Output Conductance at frequency of 1 kc:	h_{ob}			
With dc collector-to-emitter volts = 5, dc collector ma. = 1.		0.1	0.5	µmho
With dc collector-to-emitter volts = 10, dc collector ma. = 5 . .		0.1	1	µmho
Small-Signal Forward Current Transfer Ratio:	h_{fe}			
With dc collector-to-emitter volts = 5, dc collector ma. = 1, frequency (kc) = 1.		30	100	
With dc collector-to-emitter volts = 10, dc collector ma. = 5, frequency (kc) = 1.		35	150	
With dc collector-to-emitter volts = 10, dc collector ma. = 50, frequency (Mc) = 20		3	-	
DC-Pulse Forward-Current Transfer Ratio for dc collector-to-emitter volts = 10, pulse width (µsec) = 300, duty factor of 0.018, dc collector ma. =	h_{FE}			
150.		40	120	
500.		20	-	
DC Forward Current Transfer Ratio:	h_{FE}			
With dc collector-to-emitter volts = 10, dc collector ma. =				
0.1.		20	-	
10		35	-	
With dc collector-to-emitter volts = 10, dc collector ma. = 10, case temperature[b] of -55° C		20	-	
Voltage-Feedback Ratio at frequency of 1 kc:	h_{rb}			
With dc collector-to-emitter volts = 5, dc collector ma. = 1.		-	3×10^{-4}	
With dc collector-to-emitter volts = 10, dc collector ma. = 5. . . .		-	3×10^{-4}	

World Radio History

Noise Figure for signal frequency of 1 kc, circuit bandwidth of 15 kc, generator resistance (ohms) = 1000, dc collector-to-emitter volts = 10, dc collector ma. = 0.3.	NF	–	12	db
Total Switching Time[d] (Delay time + rise time + fall time).	$t_d+t_r+t_f$	–	30	mμsec
Thermal Resistance:	R_T			
Junction-to-case.		–	58.3	°C/watt
Junction-to-free air. . . .		–	291.5	°C/watt

[b] Measured at center of seating plane.
[d] See accompanying *Total-Switching-Time Measurement Circuit*.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

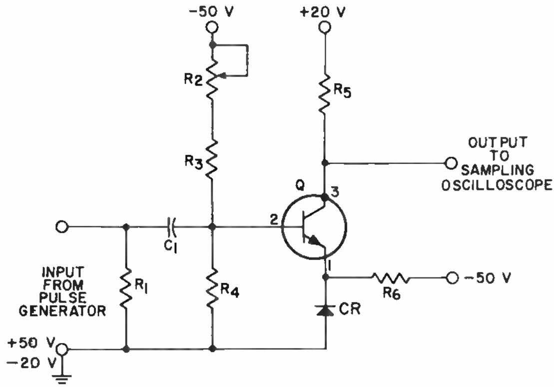
The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the seating plane provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

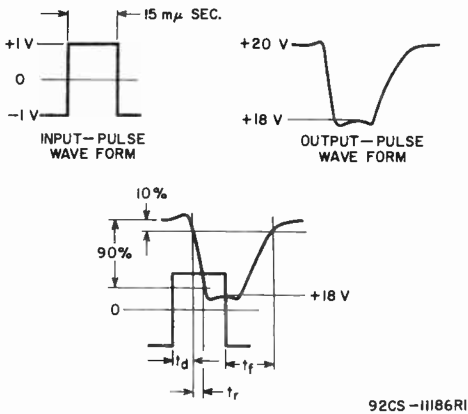
This transistor is intended for socketed, single-side printed-circuit boards and in conventional wire-in type circuits. If this transistor is used in double-side printed-circuit boards or in printed-circuit boards utilizing eyelets, it may be necessary to use an insulating washer or similar standoff device made of good dielectric material to prevent the solder from shorting the leads to each other or to the board, and to prevent the collector from shorting to ground.

It is to be noted that the case of this transistor operates at the collector voltage. Consideration, therefore, should be given to the possibility of shock hazard, if the case of this transistor is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

World Radio History

TOTAL-SWITCHING-TIME MEASUREMENT CIRCUIT
AND ASSOCIATED WAVE FORMS

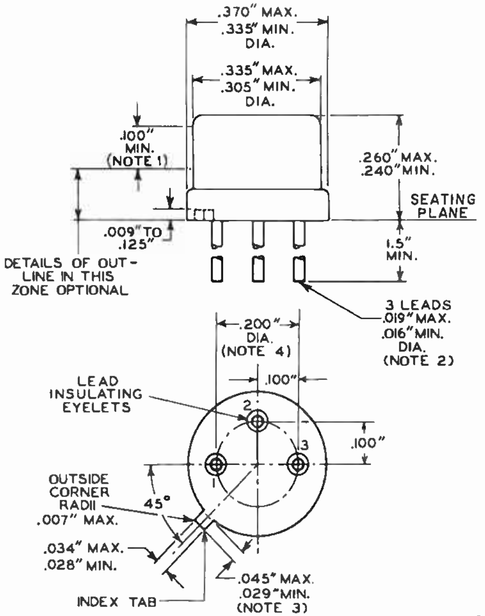




C_1:	0.01 μf	R_2:	1000 ohms
CR:	Semiconductor diode type 1N3064	R_3:	4700 ohms
		R_4:	100 ohms
Q:	Transistor type 2N1613	R_5:	40 ohms
R_1:	100 ohms	R_6:	1000 ohms, 5 watts

World Radio History

JEDEC No.TO-5



92CS-10429R3

NOTE 1: THIS ZONE IS CONTROLLEO FOR AUTOMATIC HANOLING. THE VARIATION IN ACTUAL OIAMETER WITHIN THE ZONE SHALL NOT EXCEEO 0.010".

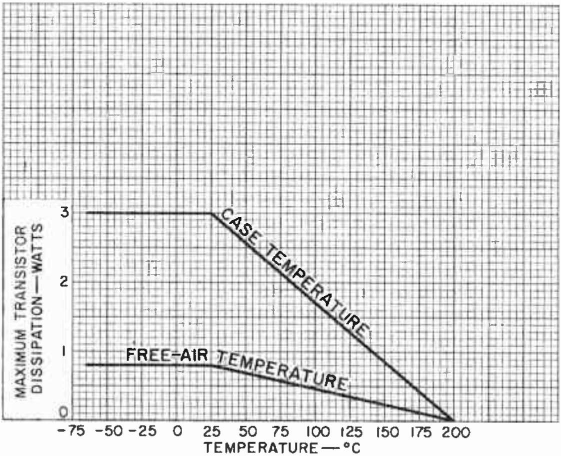
NOTE 2: THE SPECIFIEO LEAO OIAMETER APPLIES IN THE ZONE BETWEEN 0.05" ANO 0.25" FROM THE SEATING PLANE. BETWEEN 0.25" ANO 1.5" A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAO OIAMETER IS NOT CONTROLLEO.

NOTE 3: MEASUREO FROM MAXIMUM OIAMETER OF THE ACTUAL DEVICE.

NOTE 4: LEADS HAVING MAXIMUM DIAMETER (0.019") MEASUREO IN GAUGING PLANE 0.054" + 0.001" − 0.000" BELOW THE SEATING PLANE OF THE OEVICE SHALL BE WITHIN 0.007" OF THEIR TRUE LOCATIONS RELATIVE TO A MAXIMUM-WIDTH TAB.

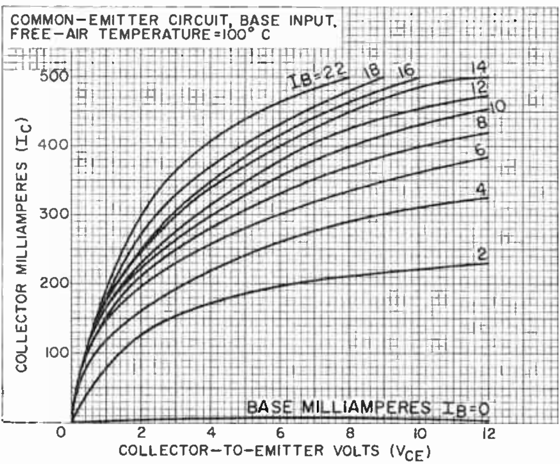
World Radio History

RATING CHART



92CS-11173R1

TYPICAL COLLECTOR CHARACTERISTICS

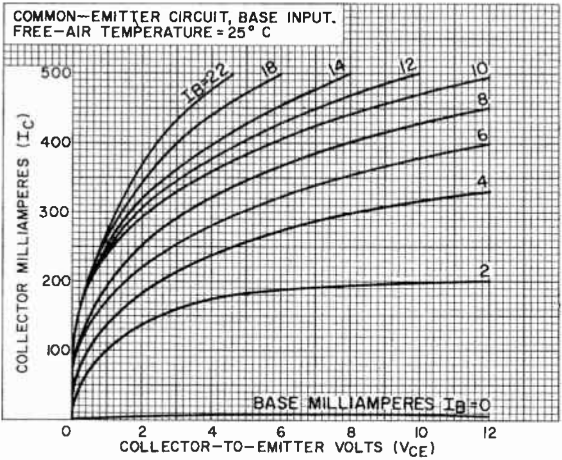


92CS-11180

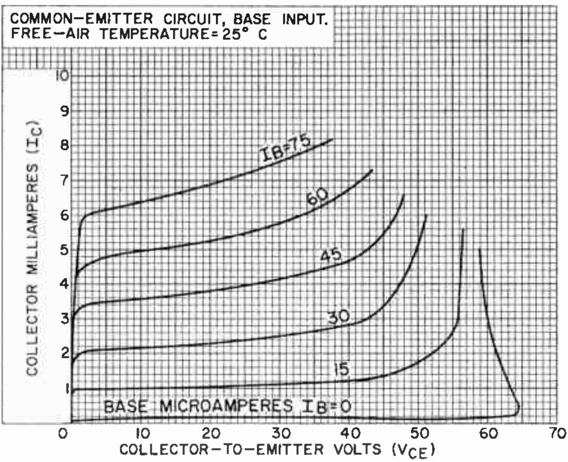
World Radio History

World Radio History

TYPICAL COLLECTOR CHARACTERISTICS

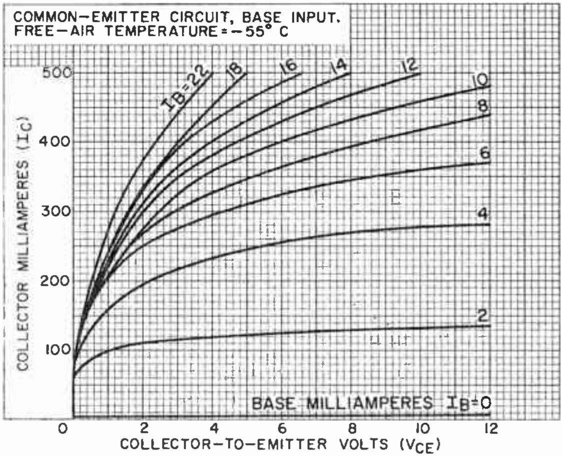


92CS-11189



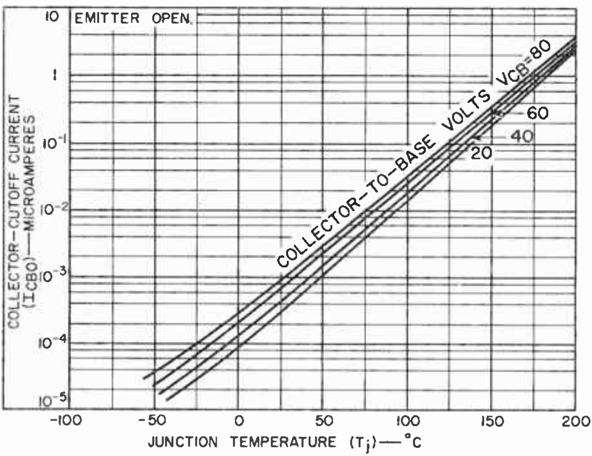
92CS-11178

TYPICAL COLLECTOR CHARACTERISTICS



92CS-11191

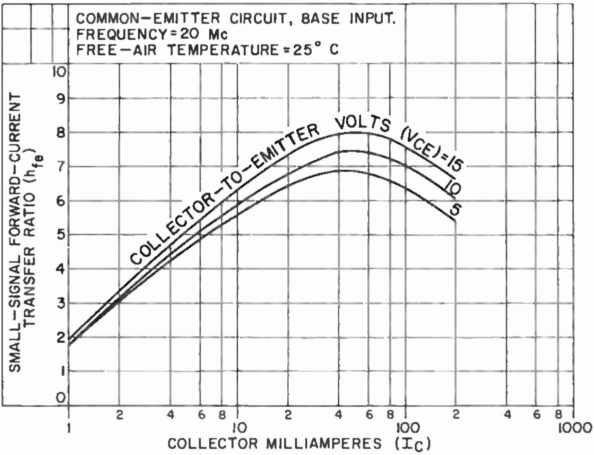
TYPICAL COLLECTOR-CUTOFF-CURRENT CHARACTERISTICS



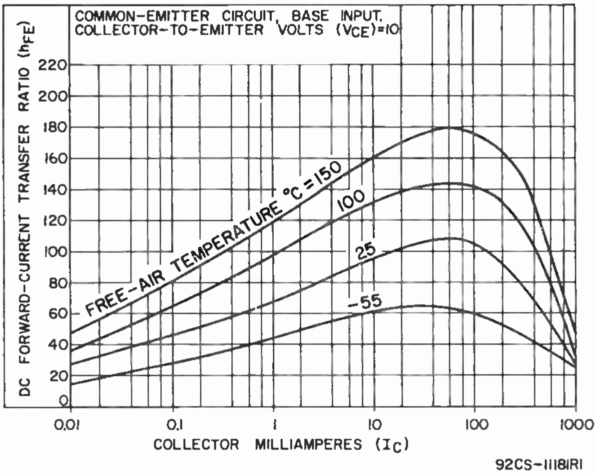
92CS-11170

World Radio History

TYPICAL SMALL-SIGNAL FORWARD-CURRENT TRANSFER-RATIO CHARACTERISTICS

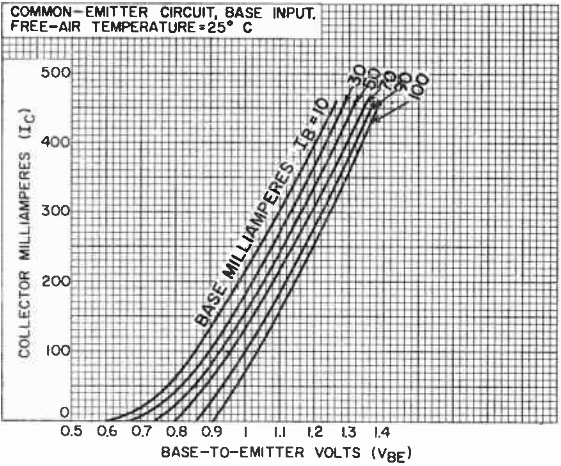


TYPICAL DC FORWARD-CURRENT TRANSFER-RATIO CHARACTERISTICS



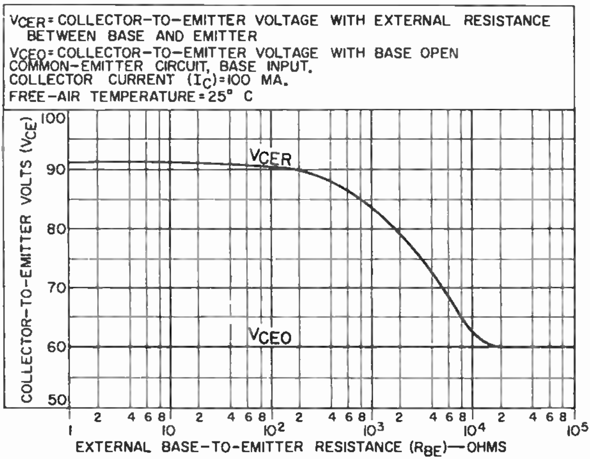
World Radio History

TYPICAL TRANSFER CHARACTERISTICS



92CS-11185

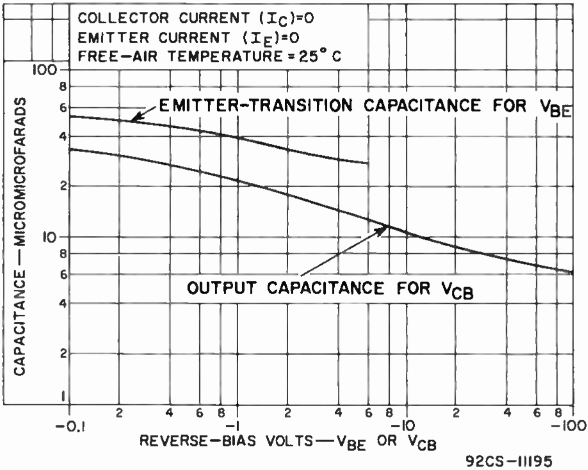
TYPICAL COLLECTOR-TO-EMITTER VOLTAGE CHARACTERISTICS



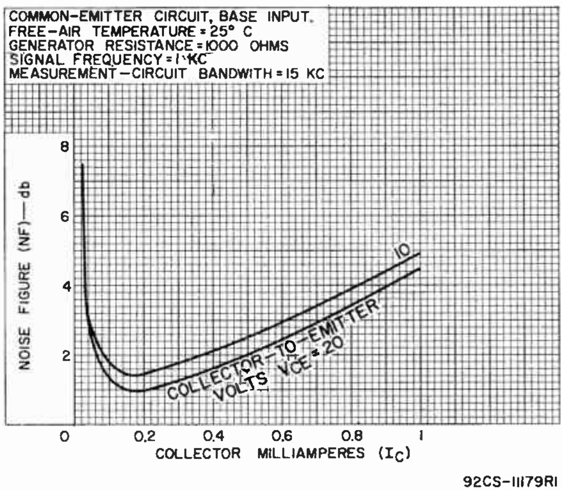
92CS-11192R1

World Radio History

TYPICAL EMITTER-TRANSITION-CAPACITANCE AND OUTPUT-CAPACITANCE CHARACTERISTICS



TYPICAL AF NOISE-FIGURE CHARACTERISTICS



World Radio History

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

For Radio-Frequency-Amplifier Applications
in Battery-Operated AM Radio Receivers

GENERAL DATA

Electrical:

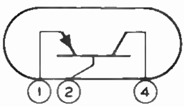
Minimum DC Collector-to-Base Breakdown Voltage (BV_{CBO}) for dc collector μa = -50, emitter open, ambient temperature = 25° C.	-34	volts
Maximum DC Collector-Cutoff Current (I_{CBO}) for dc collector-to-base volts = -12, emitter open, ambient temperature = 25° C.	-16	μa
Maximum DC Emitter-Cutoff Current (I_{EBO}) for dc emitter-to-base volts = -0.5, collector open, ambient temperature = 25° C	-16	μa
Maximum Junction-Temperature Rise (In free air)	0.4	°C/mw

Mechanical:

Operating Position	Any
Maximum Overall Length	0.697"
Maximum Seated Length	0.495"
Maximum Diameter	0.260"
Dimensional Outline	JEDEC No.TO-40
Case	Metal and Plastic
Seals	Hermetic

Terminal Diagram:

Pin 1 - Emitter
Pin 2 - Base



Pin 4 - Collector

RADIO-FREQUENCY AMPLIFIER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

DC COLLECTOR-TO-BASE VOLTAGE	-34 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-0.5 max.	volt
DC COLLECTOR CURRENT	-10 max.	ma
DC EMITTER CURRENT	10 max.	ma
TRANSISTOR DISSIPATION:		
At ambient temperature of 25° C.	80 max.	mw
At ambient temperature of 55° C.	50 max.	mw
At ambient temperature of 71° C.	35 max.	mw

World Radio History

AMBIENT TEMPERATURE (During operation) . . .	71 max.	°C
STORAGE-TEMPERATURE RANGE	-65 to +85	°C

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-12	volts
DC Collector Current.	1	ma
Small-Signal Current Transfer Ratio at 1 kc	80	

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage.	-12	volts
DC Emitter Current.	1	ma
Small-Signal Current Transfer Ratio at 1 kc	0.987	
Alpha-Cutoff Frequency.	45	Mc

Typical Operation, *At Ambient Temperature of 25° C:*

In a Common-Emitter Circuit, Base Input at a signal frequency of 1.5 Mc

DC Supply Voltage	-6	-9	-12	volts
DC Collector-to-Emitter Voltage	-5.7	-8.5	-11	volts
DC Emitter Current.	1	1	1	ma
Input Resistance, ac output circuit shorted	520	750	1000	ohms
Output Resistance, ac input circuit shorted	0.065	0.11	0.18	megohm
Extrinsic Transconductance. .	36000	36000	36000	μmhos
Collector-to-Base Capacitance (C_{ob})	2.2▲	2.1▲	2▲	μμf
Maximum Power Gain●	40.4	44.3	47.7	db
Useful Power Gain: In unneutralized circuit. .	25.3	25.5	25.6	db

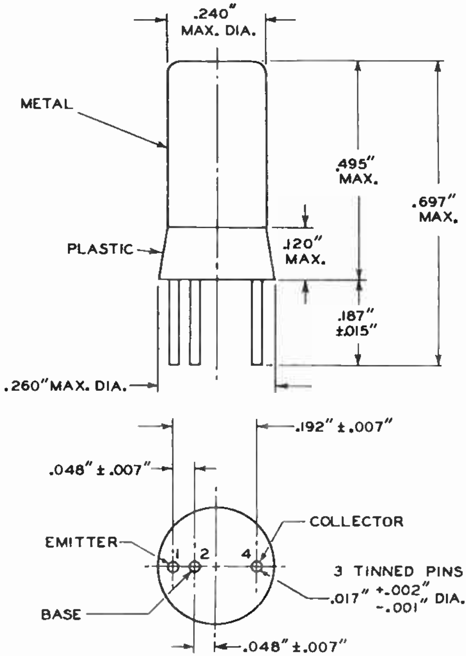
▲ Maximum variation from this value is 0.9 μμf.

● Measured in a single-tuned unilateralized circuit matched to the generator and load impedance for maximum transfer of power (transformer-insertion losses not included).

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

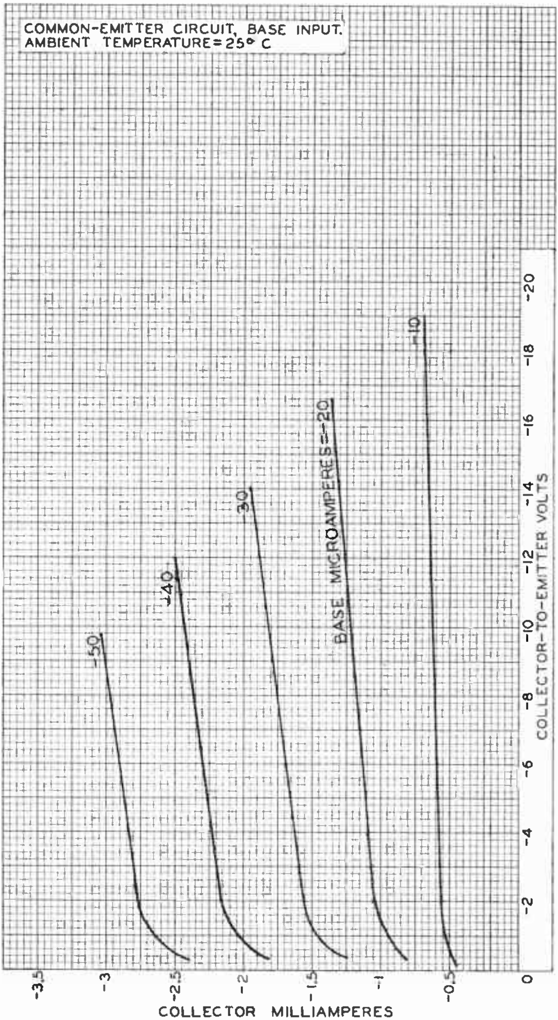
World Radio History



PIN-SPACING TOLERANCES ARE NOT CUMULATIVE
92CS-8550R7

World Radio History

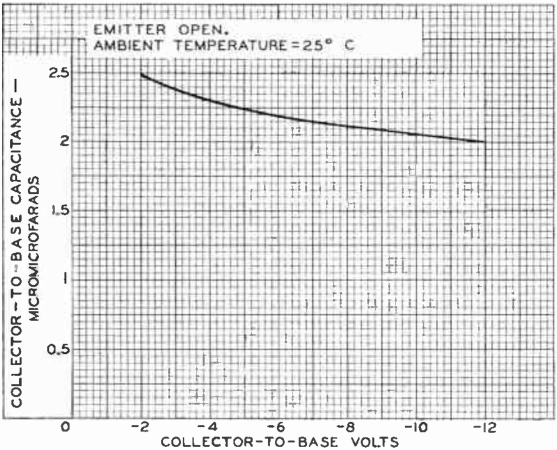
TYPICAL COLLECTOR CHARACTERISTICS



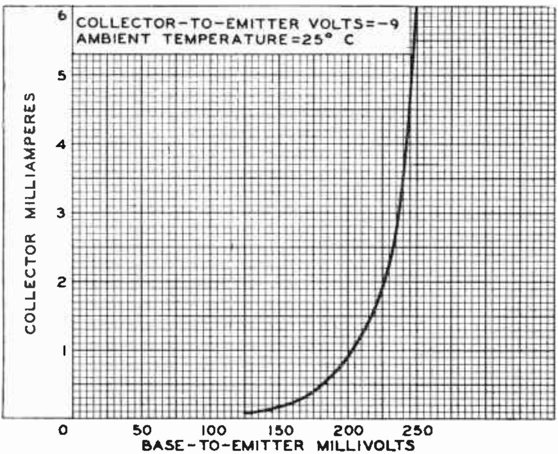
92CM-9107

World Radio History

TYPICAL CHARACTERISTICS

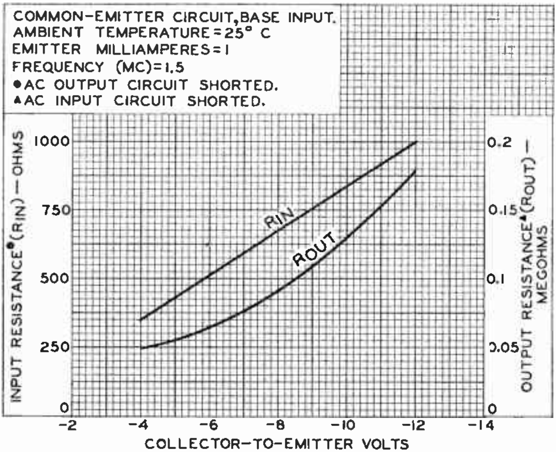


92CS-9820R1



92CS-10678

TYPICAL CHARACTERISTICS



92CS-10561R1

World Radio History

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

For Radio-Frequency-Amplifier Applications in Battery-Operated Radio Receivers

The 2N1632 is the same as the 2N1631 except for the following items:

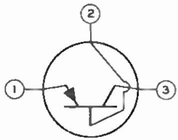
Mechanical:

Maximum Length (Excluding flexible leads). . . . . 0.410"
Maximum Diameter . . . . 0.260"
Dimensional Outline. . . . . JEDEC No. TO-1
Case . . . . Metal
Leads, Flexible. 3
  Minimum length . . . . 1.5"
  Orientation and diameter . . . . . . See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector (Adjacent to red dot on side of case)

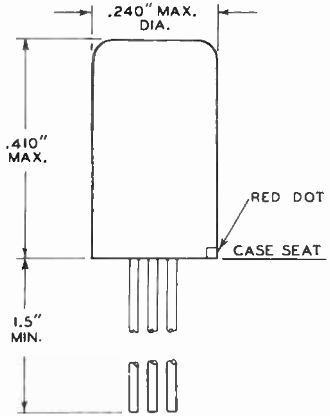
OPERATING CONSIDERATIONS

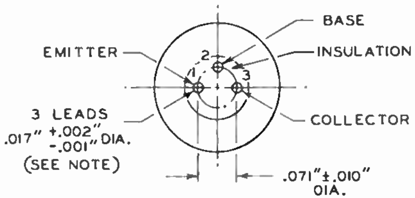
It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using this transistor, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds.

World Radio History





92CS-9148R6

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

For Intermediate-Frequency-Amplifier Applications in Battery-Operated AM Radio Receivers

GENERAL DATA

Electrical:

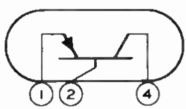
Minimum DC Collector-to-Base Breakdown Voltage (BV_{CBO}) for dc collector μa = -50, emitter open, ambient temperature = 25° C.	-34	volts
Maximum DC Collector-Cutoff Current (I_{CBO}) for dc collector-to-base volts = -12, emitter open, ambient temperature = 25° C.	-16	μa
Maximum DC Emitter-Cutoff Current (I_{EBO}) for dc emitter-to-base volts = -0.5, collector open, ambient temperature = 25° C.	-16	μa
Maximum Junction-Temperature Rise (In free air)	0.4	°C/mw

Mechanical:

Operating Position	Any
Maximum Overall Length	0.697"
Maximum Seated Length	0.495"
Maximum Diameter	0.260"
Dimensional Outline	JEDEC No. TO-40
Case	Metal and Plastic
Seals	Hermetic

Terminal Diagram:

Pin 1 – Emitter
Pin 2 – Base



Pin 4 – Collector

INTERMEDIATE-FREQUENCY AMPLIFIER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

DC COLLECTOR-TO-BASE VOLTAGE	-34 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-0.5 max.	volt
DC COLLECTOR CURRENT	-10 max.	ma
DC EMITTER CURRENT	10 max.	ma
TRANSISTOR DISSIPATION:		
At ambient temperature of 25° C.	80 max.	mw
At ambient temperature of 55° C.	50 max.	mw
At ambient temperature of 71° C.	35 max.	mw
AMBIENT TEMPERATURE (During operation)	71 max.	°C
STORAGE-TEMPERATURE RANGE	-65 to +85	°C

World Radio History

2N1633

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-12	volts
DC Emitter Current	1	ma
Small-Signal Current Transfer Ratio at 1 kc	75	

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-12	volts
DC Emitter Current	1	ma
Small-Signal Current Transfer Ratio at 1 kc	0.986	
Alpha-Cutoff Frequency	40	Mc

Typical Operation, *At Ambient Temperature of 25° C:*

In a common-emitter, base-input, single-stage, 455-kc intermediate-frequency-amplifier circuit

DC Supply Voltage	-6	-9	-12	volts
DC Collector-to-Emitter Voltage	-5.7	-8.5	-11	volts
DC Emitter Current	1	1	1	ma
Input Resistance, ac output circuit shorted	1500	1550	1800	ohms
Output Resistance, ac input circuit shorted	0.35	0.475	0.6	megohm
Collector-to-Base Capacitance (C_{ob})	2.2▲	2.1▲	2▲	μμf
Maximum Power Gain●	52.6	53.8	55.7	db
Maximum Useful Power Gain:				
In neutralized circuit	36.7	36.7	36.7	db
In unneutralized circuit	31.2	31.3	31.4	db

In a common-emitter, base-input, two-stage, 455-kc intermediate-frequency-amplifier circuit

DC Supply Voltage	-6	-6	-9	-9	-12	-12	volts
DC Collector-to-Emitter Voltage	-5.7	-5.7	-8.5	-8.5	-11	-11	volts
DC Emitter Current	0.5	1	0.5	1	0.5	1	ma
Input Resistance, ac output circuit shorted	2800	1500	3000	1550	3400	1800	ohms
Output Resistance, ac input circuit shorted	0.7	0.35	0.9	0.475	1.2	0.6	megohms
Collector-to-Base Capacitance (C_{ob})	2.2▲	2.2▲	2.1▲	2.1▲	2▲	2▲	μμf
Maximum Power Gain●	52.2	52.6	53.3	53.8	55.6	55.7	db

World Radio History

Useful Power Gain:							
In neutralized circuit. . .	32.4	35.2	32.4	35.2	32.4	35.2	db
In unneutralized circuit. . .	27.7	29.7	27.9	29.8	28	29.9	db

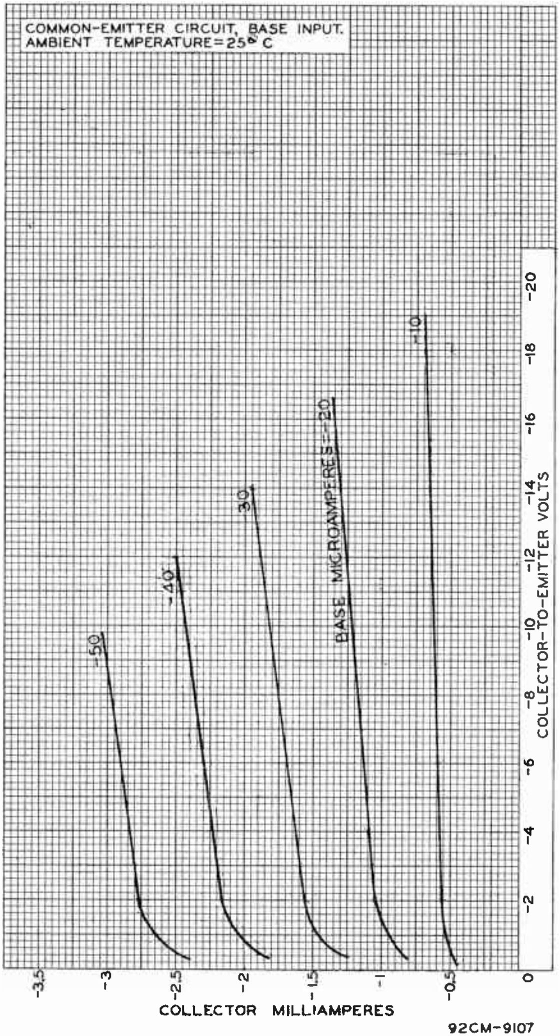
▲ Maximum variation from this value is 0.9 $\mu\mu$f.

● Measured in a single-tuned unilateralized circuit matched to the generator and load impedance for maximum transfer of power (transformer-insertion losses not included).

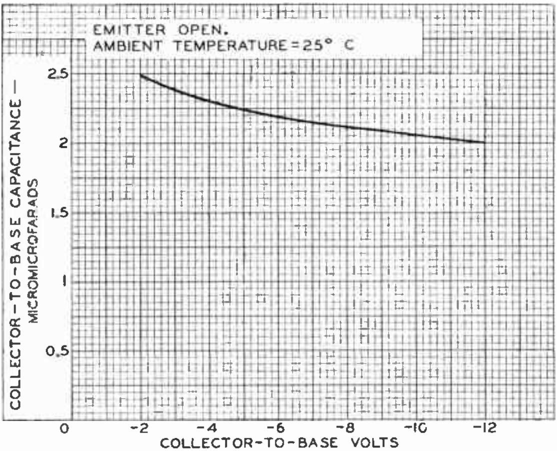
OPERATING CONSIDERATIONS
and DIMENSIONAL OUTLINE
shown under type 2N1631 also apply to the 2N1633

World Radio History

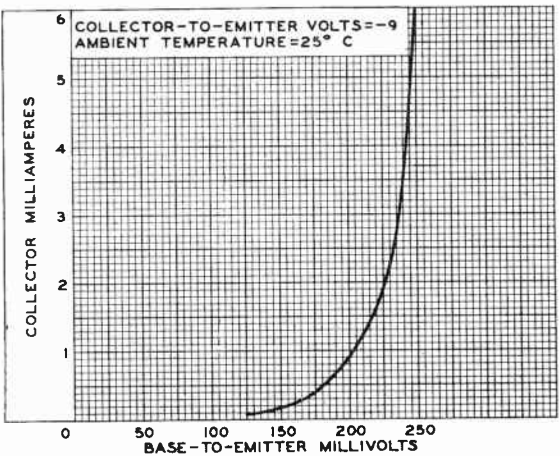
TYPICAL COLLECTOR CHARACTERISTICS



TYPICAL CHARACTERISTICS

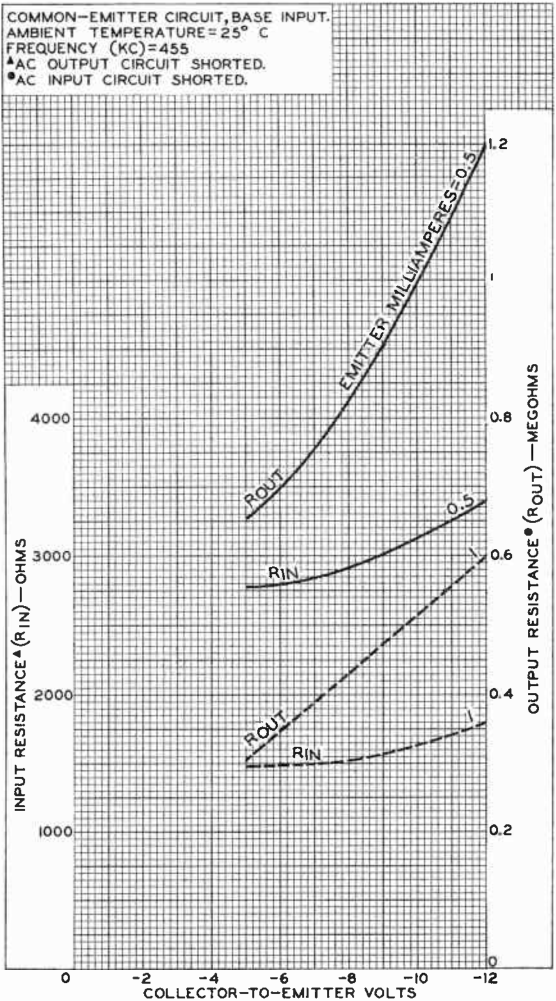


92CS-9820R1



92CS-10678

TYPICAL CHARACTERISTICS



92CM-10562R1

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

For Intermediate-Frequency-Amplifier Applications in Battery-Operated Radio Receivers

The 2N1634 is the same as the 2N1633 except for the following items:

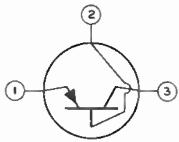
Mechanical:

Maximum Length (Excluding flexible leads). . . . . 0.410"
Maximum Diameter . . . . 0.260"
Dimensional Outline. . . . . .JEDEC No. TO-1
Case . . . . .Metal
Leads, Flexible. 3
Minimum length . . . . 1.5"
Orientation and diameter . . . . . .See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector (Adjacent to red dot on side of case)

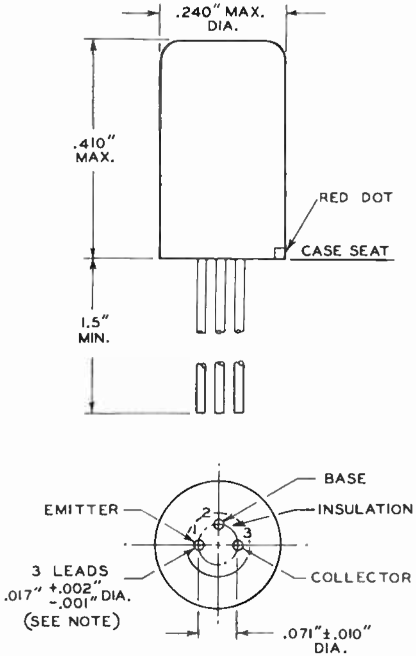
OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using this transistor, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds.

World Radio History



92CS-9148R6

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

For Converter Applications in
Battery-Operated AM Radio Receivers

GENERAL DATA

Electrical:

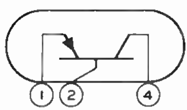
Minimum DC Collector-to-Base Breakdown Voltage (BV_{CBO}) for dc collector μa = -50, emitter open, ambient temperature = 25° C.	-34	volts
Maximum DC Collector-Cutoff Current (I_{CBO}) for dc collector-to-base volts = -12, emitter open, ambient temperature = 25° C.	-16	μa
Maximum DC Emitter-Cutoff Current (I_{EBO}) for dc emitter-to-base volts = -0.5, collector open, ambient temperature = 25° C.	-16	μa
Maximum Junction-Temperature Rise (In free air)	0.4	°C/mw

Mechanical:

Operating Position	Any
Maximum Overall Length	0.697"
Maximum Seated Length	0.495"
Maximum Diameter	0.260"
Dimensional Outline	JEDEC No. TO-40
Case	Metal and Plastic
Seals	Hermetic

Terminal Diagram:

Pin 1 - Emitter
Pin 2 - Base



Pin 4 - Collector

CONVERTER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

DC COLLECTOR-TO-BASE VOLTAGE	-34 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-0.5 max.	volt
DC COLLECTOR CURRENT	-10 max.	ma
DC EMITTER CURRENT	10 max.	ma
TRANSISTOR DISSIPATION:		
At ambient temperature of 25° C.	80 max.	mw
At ambient temperature of 55° C.	50 max.	mw
At ambient temperature of 71° C.	35 max.	mw

World Radio History

AMBIENT TEMPERATURE (During operation). . .	71 max.	°C
STORAGE-TEMPERATURE RANGE	-65 to +85	°C

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage	-12	volts
DC Emitter Current.	1	ma
Small-Signal Current Transfer Ratio at 1 kc	75	

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage.	-12	volts
DC Emitter Current.	1	ma
Small-Signal Current Transfer Ratio at 1 kc	0.986	
Alpha-Cutoff Frequency.	45	Mc

Typical Operation, *At Ambient Temperature of 25° C:*

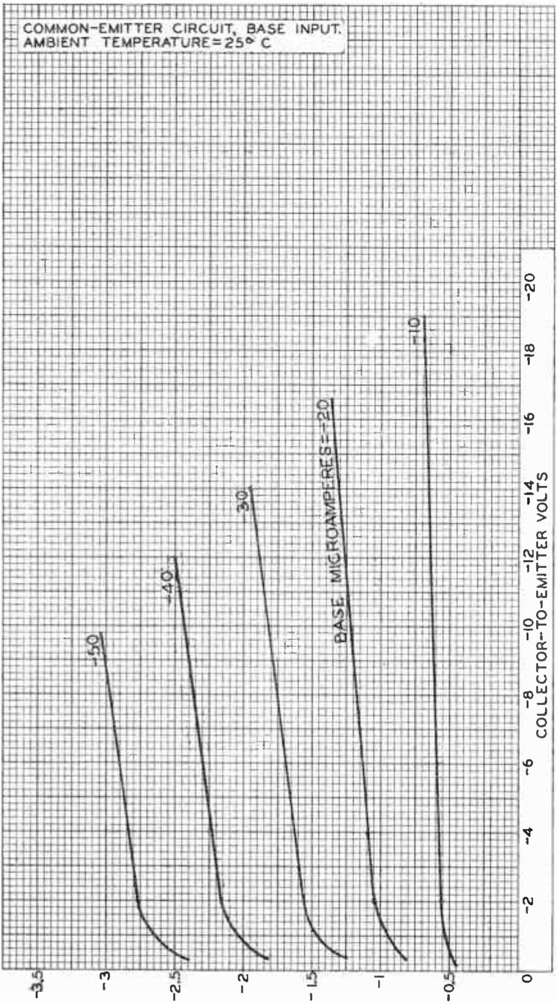
In a common-emitter, base-input, self-excited, 1-Mc converter circuit

DC Supply Voltage	-9	volts
DC Collector-to-Emitter Voltage	-8.5	volts
DC Emitter Current.	0.65	ma
Input Resistance.	2000	ohms
Output Resistance	0.3	megohm
RMS Base-to-Emitter Oscillator-Injection Voltage.	100	mv
Conversion Power Gain	36	db

OPERATING CONSIDERATIONS and DIMENSIONAL OUTLINE shown under Type 2N1631 also apply to the 2N1635

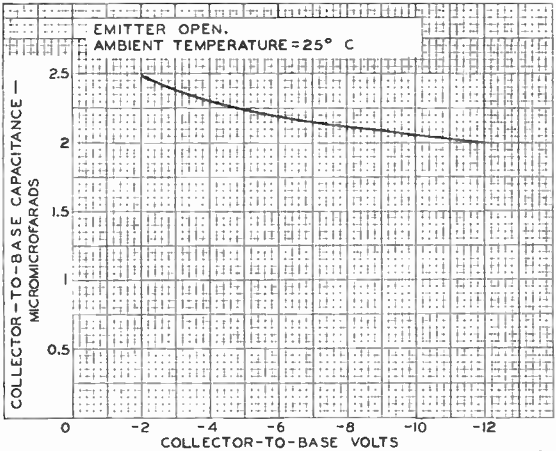
World Radio History

TYPICAL COLLECTOR CHARACTERISTICS

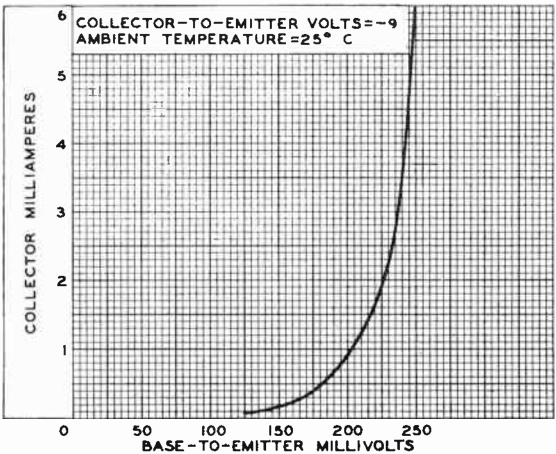


92CM-9107

TYPICAL CHARACTERISTICS



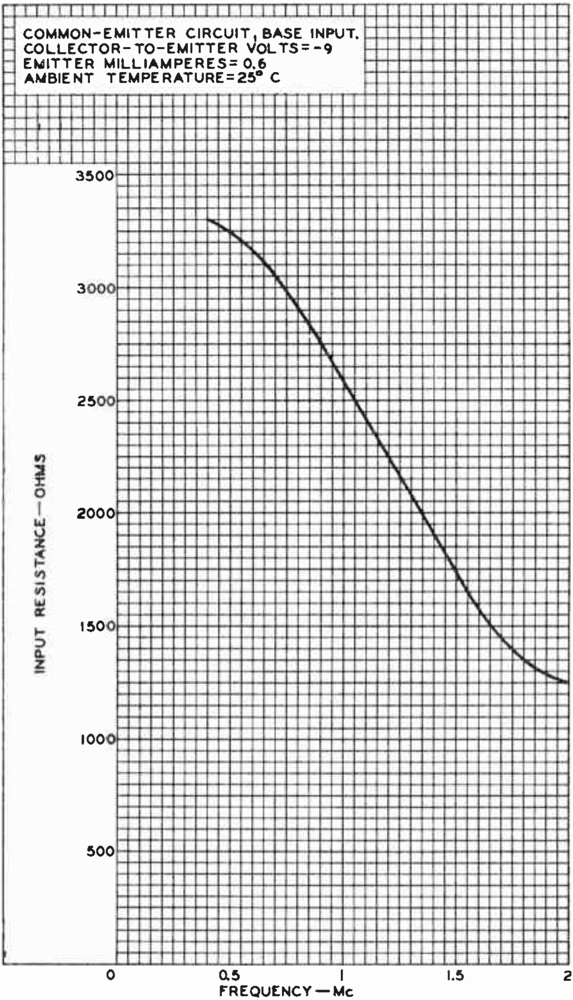
92CS-9820R1



92CS-10678

World Radio History

TYPICAL CHARACTERISTIC



92CM-10682

World Radio History

World Radio History

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

For Converter Application in Battery-Operated AM Radio Receivers

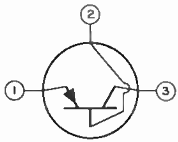
The 2N1636 is the same as the 2N1635 except for the following items:

Mechanical:

Maximum Length (Excluding flexible leads). . . . . 0.410"
Maximum Diameter . . . . 0.260"
Dimensional Outline. . . . . .JEDEC No. TO-1
Case . . . . .Metal
Leads, Flexible. 3
Minimum length . . . . 1.5"
Orientation and diameter . . . . . . .See *Dimensional Outline*
Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector (Adjacent to red dot on side of case)

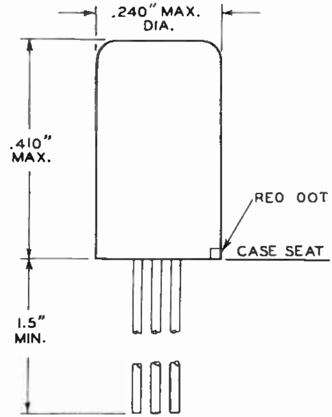
OPERATING CONSIDERATIONS

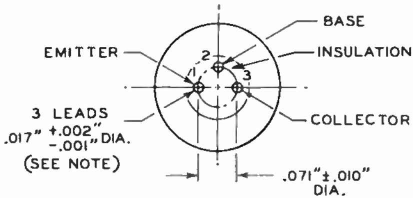
It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using this transistor, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds.

World Radio History





92CS-9148R6

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

2N1637

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

For Radio-Frequency-Amplifier Applications in AM Automobile-Radio Receivers

GENERAL DATA

Electrical:

Minimum DC Collector-to-Base Breakdown Voltage (BV_{CBO}) for dc collector μa = -50, emitter open, ambient temperature of 25° C.	-34	volts
Maximum DC Collector-Cutoff Current (I_{CBO}) for dc collector-to-base volts = -12, emitter open, ambient temperature of 25° C.	-5	μa
Maximum DC Emitter-Cutoff Current (I_{EBO}) for dc emitter-to-base volts = -1.5, collector open, ambient temperature of 25° C.	-15	μa
Maximum Junction-Temperature Rise (In free air)	0.4	°C/mw

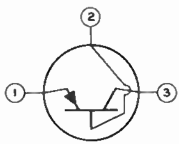
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.410"
Maximum Diameter	0.240"
Dimensional Outline	JEDEC No. TO-1
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector (Adjacent to red dot on side of case)

RADIO-FREQUENCY AMPLIFIER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

DC COLLECTOR-TO-BASE VOLTAGE	-34 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-1.5 max.	volts
DC COLLECTOR CURRENT	-10 max.	ma
DC EMITTER CURRENT	10 max.	ma

RADIO CORPORATION OF AMERICA
Semiconductor & Materials Division Somerville, N. J.

World Radio History

TRANSISTOR DISSIPATION:		
At ambient temperature of 25° C.	80 max.	mw
At ambient temperature of 55° C.	50 max.	mw
At ambient temperature of 71° C.	35 max.	mw
AMBIENT TEMPERATURE (During operation) . .	71 max.	°C
STORAGE-TEMPERATURE RANGE.	-65 to +85	°C

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage.	-12	volts
DC Collector Current	-1	ma
Collector-to-Base Capacitance (C_{ob}).	2▲	$\mu\mu$f
Small-Signal Current Transfer Ratio at 1 kc.	80	

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-12	volts
DC Collector Current	-1	ma
Small-Signal Current Transfer Ratio at 1 kc.	0.987	
Alpha-Cutoff Frequency	45	Mc

Typical Operation, *At Ambient Temperature of 25° C:*

In a common-emitter circuit, base input at a signal frequency of 1.5 Mc

DC Collector-to-Emitter Voltage.	-5.5	-11.2	volts
DC Emitter Current	1	1	ma
Input Resistance, ac output circuit shorted.	520	1000	ohms
Output Resistance, ac input circuit shorted.	0.065	0.18	megohm
Maximum Power Gain	40.4	47.7	db
Maximum Usful Power Gain:			
In unneutralized circuit	25.3	25.6	db

▲ Maximum variation from this value is 0.9 $\mu\mu$f.

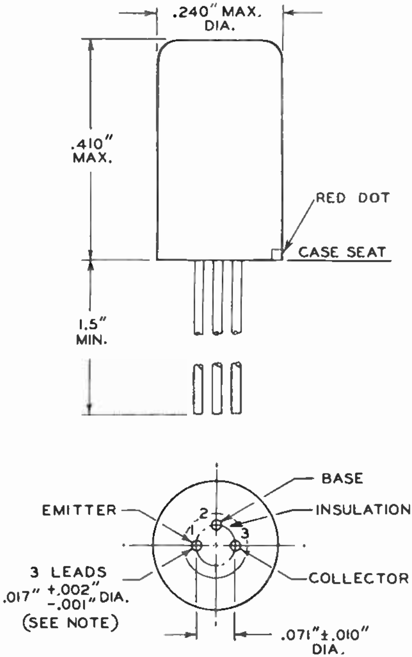
OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using this transistor, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds.

World Radio History



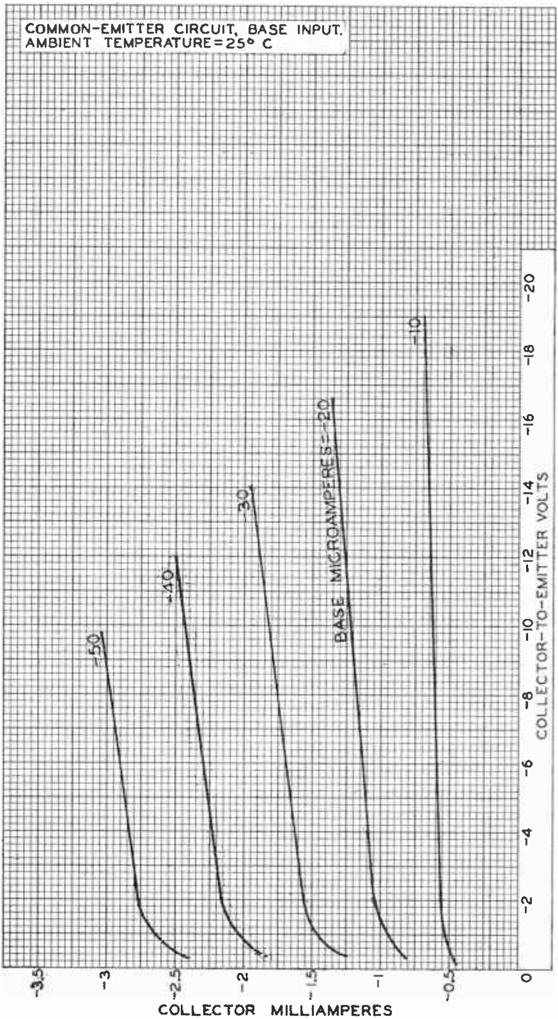
92CS-9148R6

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

2N1637

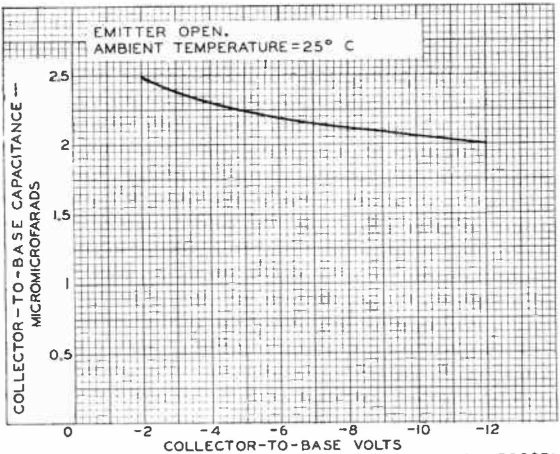
AVERAGE COLLECTOR CHARACTERISTICS



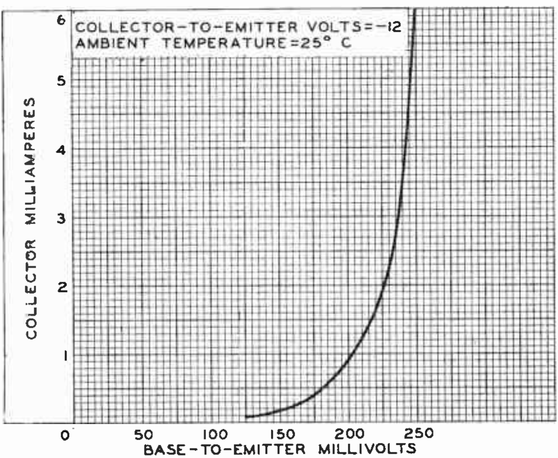
92CM-9107

World Radio History

TYPICAL CHARACTERISTICS

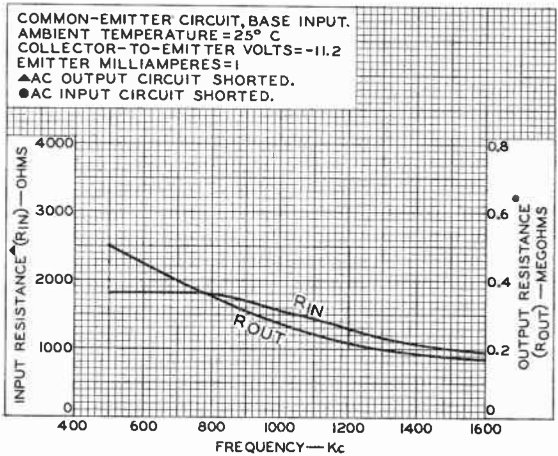


92CS-9820R1



92CS-10556R1

TYPICAL CHARACTERISTICS



92CS-10587R1

World Radio History

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

For Intermediate-Frequency-Amplifier Applications in AM Automobile-Radio Receivers

GENERAL DATA

Electrical:

Minimum DC Collector-to-Base Breakdown Voltage (BV_{CBO}) for dc collector μa = -50, emitter open, ambient temperature = 25° C.	-34	volts
Maximum DC Collector-Cutoff Current (I_{CBO}) for dc collector-to-base volts = -12, emitter open, ambient temperature = 25° C.	-7	μa
Maximum DC Emitter-Cutoff Current (I_{EBO}) for dc emitter-to-base volts = -0.5, collector open, ambient temperature = 25° C	-8	μa
Maximum Junction-Temperature Rise (In free air)	0.4	°C/mw

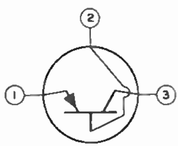
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.410"
Maximum Diameter	0.240"
Dimensional Outline	JEDEC No. TO-1
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector (Adjacent to red dot on side of case)

INTERMEDIATE-FREQUENCY AMPLIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

DC COLLECTOR-TO-BASE VOLTAGE	-34 max.	volts
DC EMITTER-TO-BASE VOLTAGE	-0.5 max.	volt
DC COLLECTOR CURRENT	-10 max.	ma
DC EMITTER CURRENT	10 max.	ma

World Radio History

TRANSISTOR DISSIPATION:		
At ambient temperature of 25° C.	80 max.	mw
At ambient temperature of 55° C.	50 max.	mw
At ambient temperature of 71° C.	35 max.	mw
AMBIENT TEMPERATURE (During operation) . .	71 max.	°C
STORAGE-TEMPERATURE RANGE.	-65 to +85	°C

Characteristics, *At Ambient Temperature of 25° C:*

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage.	-12	volts
DC Collector Current	-1	ma
Collector-to-Base Capacitance (C_{ob}). . . .	2▲	$\mu\mu$f
Small-Signal Current Transfer Ratio at 1 kc.	75	

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-12	volts
DC Collector Current	-1	ma
Small-Signal Current Transfer Ratio at 1 kc.	0.986	
Alpha-Cutoff Frequency	40	Mc

Typical Operation, *At Ambient Temperature of 25° C:*

In a common-emitter, base-input, single-stage, 262.5-kc intermediate-frequency-amplifier circuit

DC Collector-to-Emitter Voltage	-5	-11	volts
DC Emitter Current	1.6	2	ma
Input Resistance	1800	1400	ohms
Output Resistance.	0.47	0.72	megohm
Maximum Power Gain	58.6	61.5	db
Useful Power Gain:			
In unneutralized circuit	35	36.6	db

▲ Maximum variation from this value is 0.9 $\mu\mu$f.

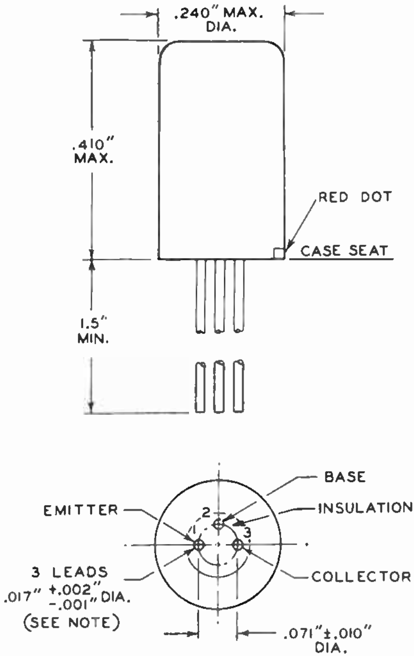
OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using this transistor, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds.

World Radio History

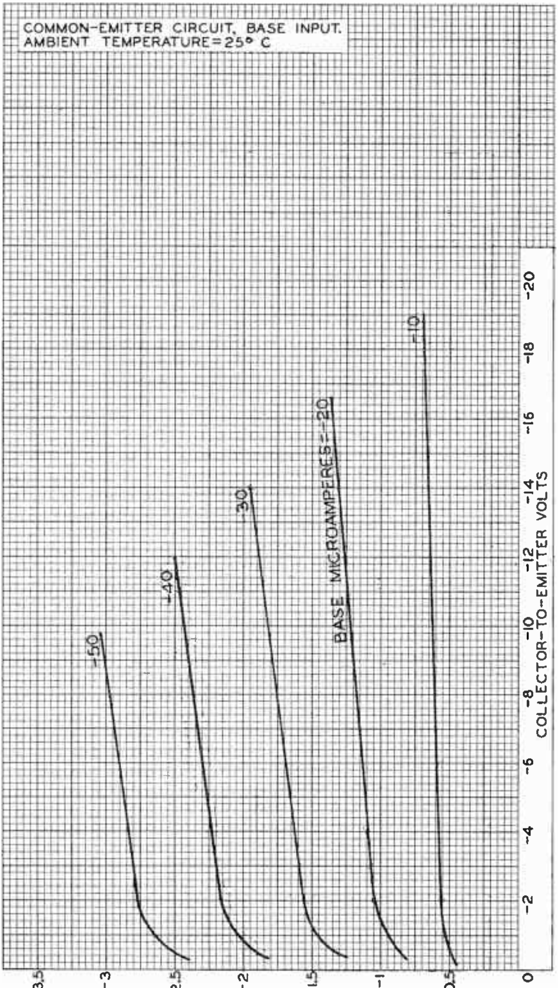


92CS-9148R6

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

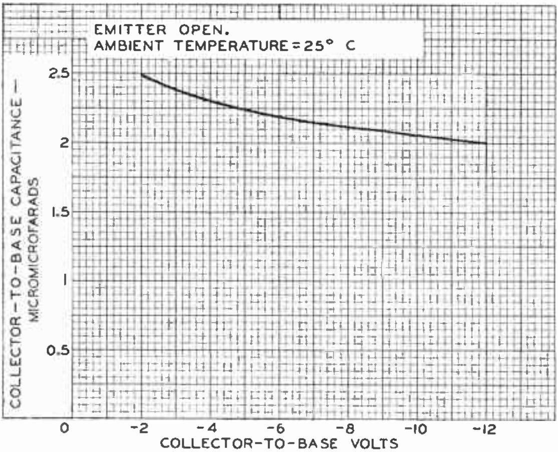
World Radio History

AVERAGE COLLECTOR CHARACTERISTICS

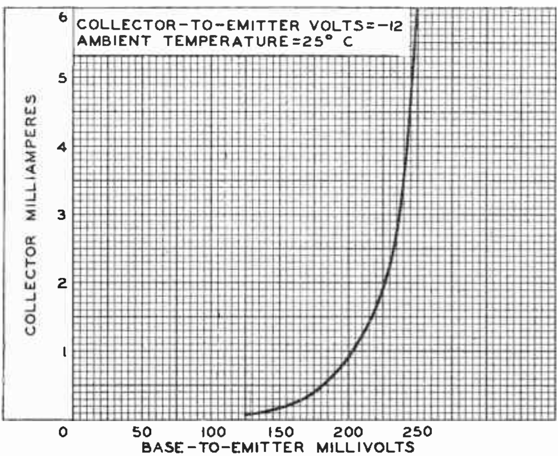


92CM-9107

TYPICAL CHARACTERISTICS



92CS-9820R1



92CS-10556R1

World Radio History

World Radio History

2N1639

Drift-Field Transistor

GERMANIUM P-N-P ALLOY TYPE

For Converter Applications in AM Automobile-Radio Receivers

GENERAL DATA

Electrical:

Minimum DC Collector-to-Base Breakdown Voltage (BV_{CBO}) for dc collector μa = −50, emitter open, ambient temperature = 25° C.	−34	volts
Maximum DC Collector-Cutoff Current (I_{CBO}) for dc collector-to-base volts = −12, emitter open, ambient temperature = 25° C.	−7	μa
Maximum DC Emitter-Cutoff Current (I_{EBO}) for dc emitter-to-base volts = −0.5, collector open, ambient temperature = 25° C.	−8	μa
Maximum Junction-Temperature Rise (In free air)	0.4	°C/mw

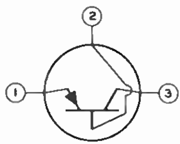
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.410"
Maximum Diameter	0.240"
Dimensional Outline	JEDEC No. TO-1
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter

Lead 2 – Base



Lead 3 – Collector (Adjacent to red dot on side of case)

CONVERTER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

DC COLLECTOR-TO-BASE VOLTAGE	−34 max.	volts
DC EMITTER-TO-BASE VOLTAGE	−0.5 max.	volt
DC COLLECTOR CURRENT	−10 max.	ma
DC EMITTER CURRENT	10 max.	ma

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TRANSISTOR DISSIPATION:		
At ambient temperature of 25° C.	80 max.	mw
At ambient temperature of 55° C.	50 max.	mw
At ambient temperature of 71° C.	35 max.	mw
AMBIENT TEMPERATURE (During operation) . . .	71 max.	°C
STORAGE-TEMPERATURE RANGE.	-65 to +85	°C

Characteristics, ***At Ambient Temperature of 25° C:***

Common-Emitter Circuit, Base Input

DC Collector-to-Emitter Voltage.	-12	volts
DC Collector Current	-1	ma
Collector-to-Base Capacitance (C_{ob}).	2▲	μμf
Small-Signal Current Transfer Ratio at 1 kc.	75	

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	-12	volts
DC Collector Current	-1	ma
Small-Signal Current Transfer Ratio at 1 kc.	0.986	
Alpha-Cutoff Frequency	45	Mc

Typical Operation, ***At Ambient Temperature of 25° C:***

In a common-emitter, base input, 1.5-Mc converter circuit

DC Collector-to-Emitter Voltage.	-5	-11	volts
DC Emitter Current	0.65	0.65	ma
Input Resistance	1850	2200	ohms
Output Resistance at 262.5 kc.	0.1	0.2	megohm
RMS Base-to-Emitter Oscillator-Injection Voltage	100	100	mv
Useful Conversion Power Gain	35.4	37	db

▲ Maximum variation from this value is 0.9 μμf.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
and CURVES
shown under Type 2N1638 also apply to the 2N1639

World Radio History

Mesa Transistor

GERMANIUM P-N-P DIFFUSED-JUNCTION TYPE

For High-Speed Switching Service in Commercial and Military Data-Processing Systems

GENERAL DATA

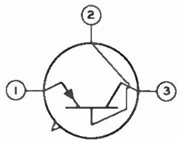
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No.TO-5
Case	Welded, Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector

SWITCHING SERVICE

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	-13 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE	-12 max.	volts
EMITTER-TO-BASE VOLTAGE[a]	-4 max.	volts
COLLECTOR CURRENT	-100 max.	ma
EMITTER CURRENT	100 max.	ma
TRANSISTOR DISSIPATION:[b]		
At ambient temperature of 25° C	150 max.	mw
At ambient temperature of 55° C	75 max.	mw
At ambient temperature of 71° C	35 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating and storage	-65 to +85	°C
LEAD TEMPERATURE: ←		
For immersion in molten solder for 10 seconds maximum	255 max.	°C

Typical Operation: ←

In an inverter circuit at ambient temperature of 25° C

Collector-to-Emitter Voltage	-5	volts
Base Resistor	3000	ohms
Collector Resistor	120	ohms
"Turn-On" Base Voltage	-5	volts
"Turn-Off" Base Voltage	5	volts
"On" Collector Current	-40	ma

← Indicates a change.

World Radio History

"Turn-On" Base Current	-1.6	ma
"Turn-Off" Base Current	1.6	ma
Switching Time:		
Delay time (t_d)	0.07	μsec
Rise time (t_r).	0.06	μsec
Storage time (t_s)	0.08	μsec
Fall time (t_f).	0.05	μsec

[a] This rating may be exceeded and the emitter-to-base junction operated in the breakdown condition provided the emitter dissipation is limited to 30 milliwatts at 25° C. For ambient temperatures above 25° C, the dissipation should be reduced by 0.5 milliwatt/°C.

[b] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base unless otherwise specified. Ambient temperature of 25° C.

		Min.	*Typical*	*Max.*	
DC Collector Breakdown Voltage for dc collector ma. = -0.02, emitter open .	BV_{CBO}	-13	-30	-	volts
DC Collector-to-Emitter Breakdown Voltage.	BV_{CERL}	-12	-25	-	volts
DC Emitter Breakdown Voltage for dc emitter ma. = -0.1, collector open . . .	BV_{EBO}	-4	-6	-	volts
DC Punch-Through Voltage.	V_P	-12	-30	-	volts
DC Base-to-Emitter Voltage for dc collector ma. = -40, dc base ma. = -1 . .	V_{BE}	-	-0.4	-0.6	volt
DC Collector-Cutoff Current for collector volts = -6, emitter open	I_{CBO}	-	-1	-3	μa
→ Collector Capacitance for dc collector volts = -6, emitter open	C_C	-	B	12	μμf
DC Current Transfer Ratio:	h_{FE}				
With dc collector-to-emitter volts = -0.3, dc collector ma. = -10. . .		50	75	-	
With dc collector-to-emitter volts = -0.5, dc collector ma. = -40. . .		50	85	-	

→ Indicates a change.

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Gain-Bandwidth Product[c] for dc collector-to-emitter volts = -3, dc collector ma. = -10	GBW	50	80	-	Mc
Thermal Resistance:					
Junction-to-free air.	R_T	-	-	400	°C/watt
Total Stored Charge:	Q_S				
With dc collector ma. = -10, dc base ma. = -0.4. .		-	110	160	μμcoulombs
With dc collector ma. = -40, dc base ma. = -1.6.		-	200	410	μμcoulombs
Thermal Time Constant	τ_1	-	10	-	msec

[c] Frequency at which the current transfer ratio is equal to 1.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

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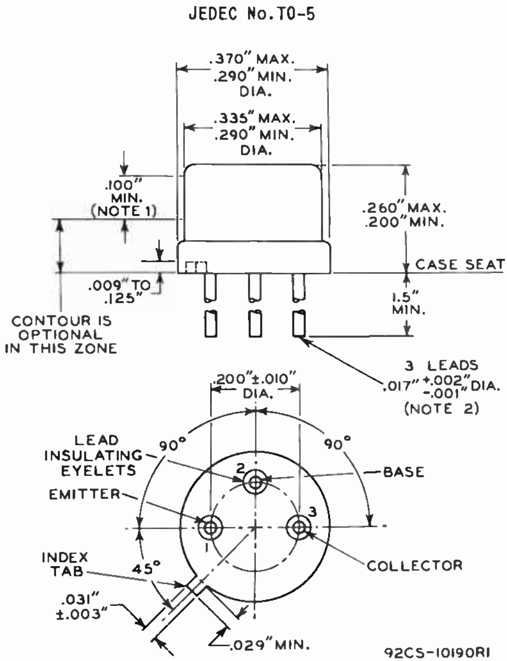
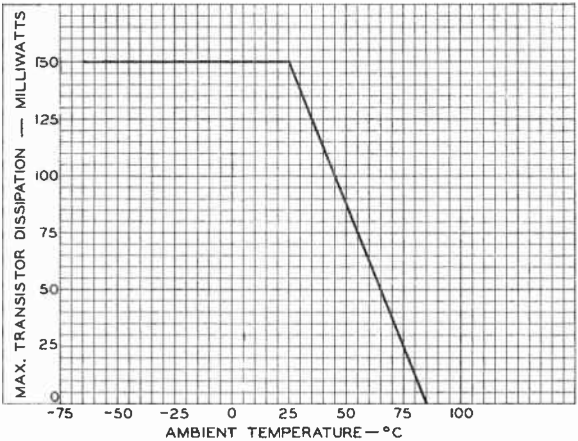


NOTE 1: THE DIAMETER IN THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE TOTAL VARIATION IN ACTUAL DIAMETER FROM THE TRUE DIAMETER, DUE TO TAPER AND OUT OF ROUND WITHIN THIS ZONE, WILL NOT EXCEED 0.010".

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

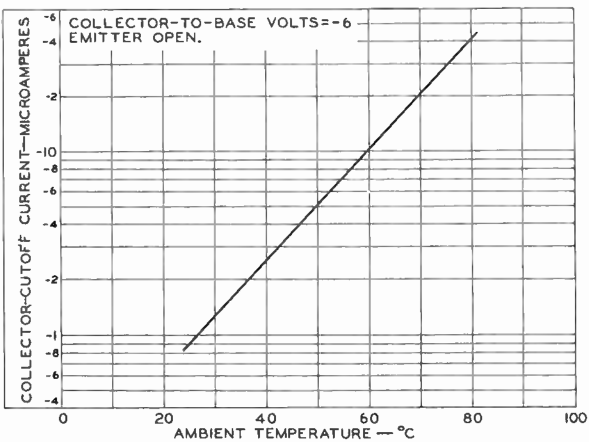
World Radio History

RATING CHART



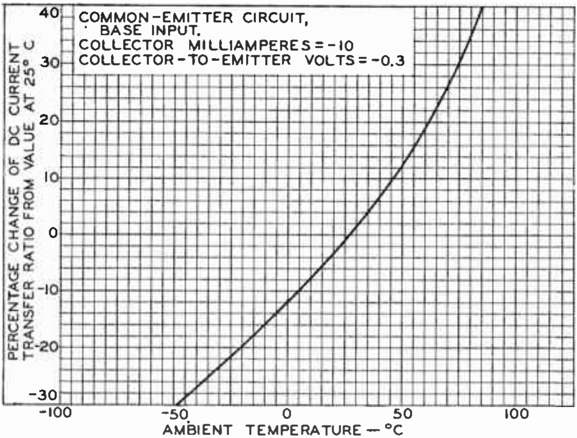
92CS-10232R1

TYPICAL COLLECTOR-CUTOFF-CURRENT CHARACTERISTIC



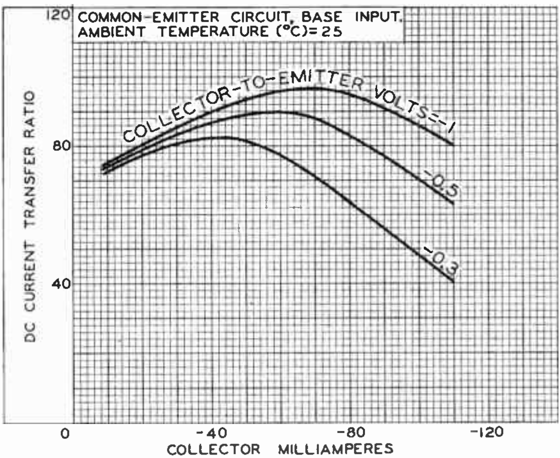
92CS-10213R1

TYPICAL CHARACTERISTIC



92CS-10199R3

TYPICAL DC CURRENT-TRANSFER-RATIO CHARACTERISTICS



92CS-10830

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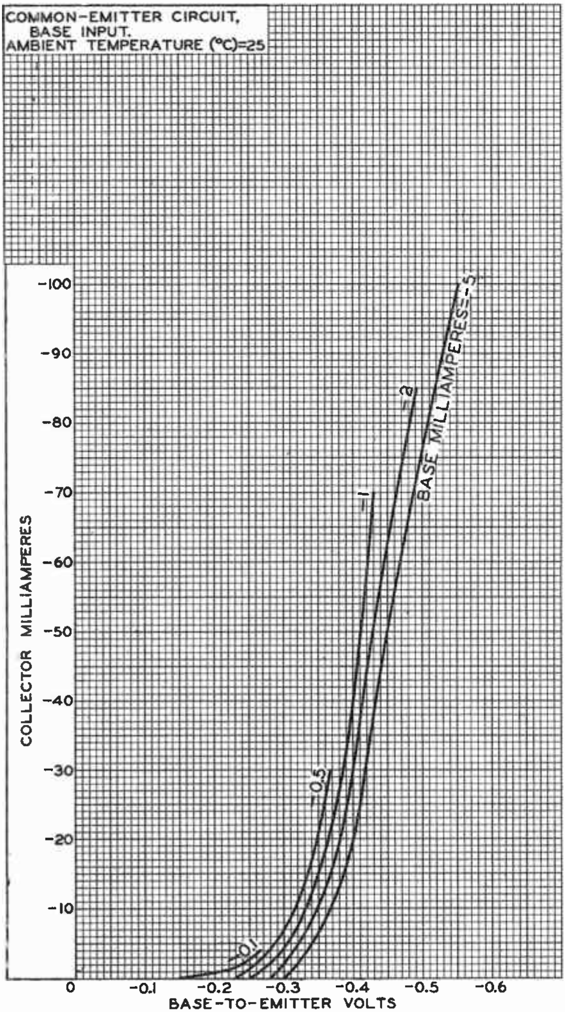
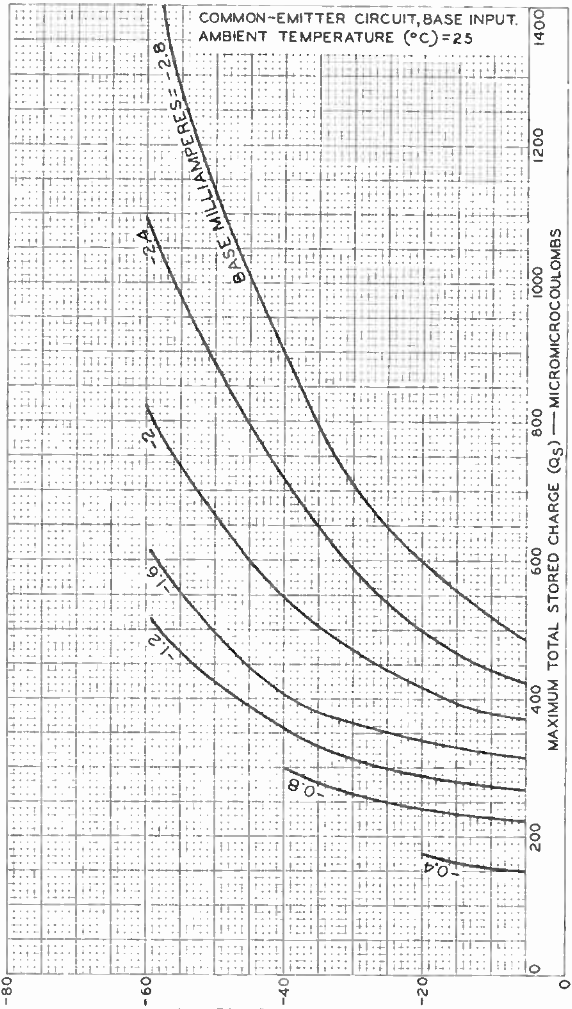
TYPICAL TRANSFER CHARACTERISTICS



92CM-10229

MAXIMUM TOTAL-STORED-CHARGE CHARACTERISTICS



92CM-10815

World Radio History

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE
For Industrial Applications

GENERAL DATA

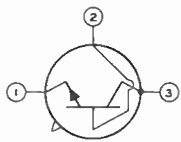
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No. TO-5
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector, Case

INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and servo-amplifier, and relay-actuating circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	60 max.	volts
With base open (Sustaining voltage)[a]	40 max.	volts
EMITTER-TO-BASE VOLTAGE	6 max.	volts
COLLECTOR CURRENT	1 max.	amp
BASE CURRENT	0.75 max.	amp
TRANSISTOR DISSIPATION:[b]		
At case temperature of 25° C or below	5 max.	watts
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +200	°C
LEAD TEMPERATURE:		
1/16" ± 1/32" from case for 10 seconds maximum	255 max.	°C

Characteristics:

At case temperature of 25° C

Small-Signal Current Transfer Ratio (h_{fe}) for dc collector-to-emitter volts = 4, dc collector ma. = 5	40

World Radio History

Alpha-Cutoff Frequency (f_{ab}) for dc collector-to-base volts = 28, dc collector ma. = 5.	1.2	Mc
Collector-to-Base Capacitance(C_{ob}) for dc collector-to-base volts = 40.	150	$\mu\mu$f
Thermal Time Constant (τ_1)	10	msec

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[b] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and case temperature of 25° C unless otherwise specified

		Min.	*Max.*	
DC Collector-to-Emitter Voltage:				
With emitter reverse bias volts = 1.5, dc collector ma. = 0.5.	V_{CEX}	60	-	volts
With base open (Sustaining voltage), dc collector ma. = 50, dc base ma. = 0. . .	$V_{CEO(sus)}$[a]	40	-	volts
DC Base-to-Emitter Voltage for dc collector-to-emitter volts = 4, dc collector ma. = 100.	V_{BE}	-	2	volts
DC Collector-Cutoff Current for dc collector volts = 30, dc emitter ma. = 0, case temperature =	I_{CBO}			
25° C.		-	75	μa
150° C		-	1000	μa
DC Emitter-Cutoff Current for dc emitter volts = 6, dc collector ma. = 0	I_{EBO}	-	25	μa
DC Current Transfer Ratio for dc collector-to-emitter volts = 4, dc collector ma. = 100.	h_{FE}	20	80	
DC Collector-to-Emitter Saturation Resistance for dc collector ma. = 100, dc base ma. = 10.	R_S	-	10	ohms
Thermal Resistance:	R_T			
Junction-to-case		-	35	°C/watt
Junction-to-free air		-	200	°C/watt

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

World Radio History

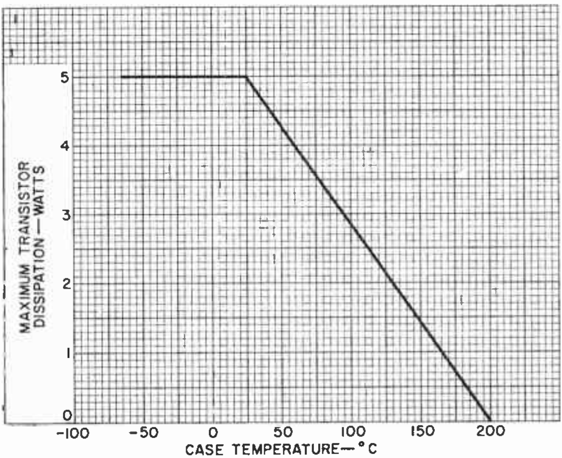
OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

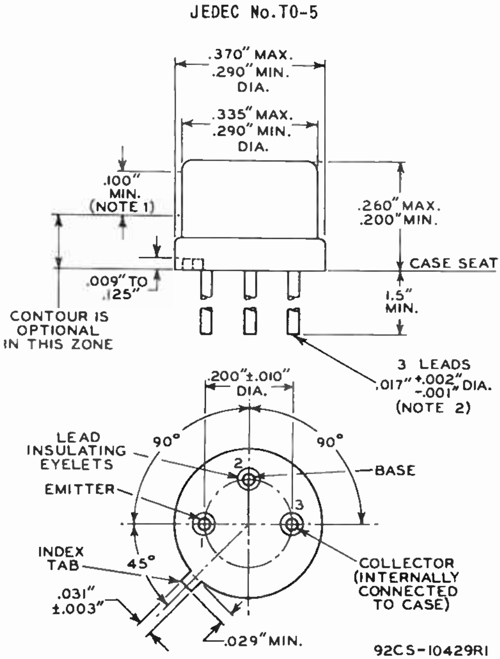
It is to be noted that the case of this transistor operates at the collector voltage. Consideration, therefore, should be given to the possibility of shock hazard, if the case of this transistor is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

RATING CHART



92CS-11019

World Radio History



NOTE 1: THE DIAMETER IN THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE TOTAL VARIATION IN ACTUAL DIAMETER FROM THE TRUE DIAMETER, DUE TO TAPER AND OUT OR ROUND WITHIN THIS ZONE, WILL NOT EXCEED 0.010".

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE CASE SEAT. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

2N1701

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For Industrial Applications

GENERAL DATA

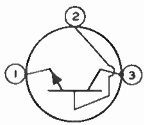
Mechanical:

Operating Position	Any
Maximum Overall Length	0.770"
Maximum Seated Length	0.330"
Maximum Diameter	0.650"
Dimensional Outline	JEDEC No.TO-8
Case	Metal
Seals	Hermetic

Terminal Diagram: BOTTOM VIEW

Pin 1 - Emitter

Pin 2 - Base



Pin 3 - Collector, Case

INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and servo-amplifier, and relay-actuating circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	60 max.	volts
With base open (Sustaining voltage)[a]	40 max.	volts
EMITTER-TO-BASE VOLTAGE	6 max.	volts
COLLECTOR CURRENT	2.5 max.	amp
BASE CURRENT	1 max.	amp
TRANSISTOR DISSIPATION:[b]		
At case temperature of 25° C or below	25 max.	watts
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +175	°C
PIN TEMPERATURE:		
1/16" ± 1/32" from case for 10 seconds maximum	235 max.	°C

Characteristics:

At case temperature of 25° C

Alpha-Cutoff Frequency (f_{ab}) for dc collector-to-base volts = 28, dc collector ma. = 5	1	Mc
Collector-to-Base Capacitance (C_{ob}) with dc collector-to-base volts = 40	175	μμf
Thermal Time Constant (τ_1)	10	msec

World Radio History

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[b] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and case temperature of 25° C unless otherwise specified

		Min.	Max.	
DC Collector-to-Emitter Voltage:				
With emitter reverse bias volts = 1.5, dc collector ma. = 0.75	V_{CEX}	60	-	volts
With base open (Sustaining voltage), dc collector ma. = 100, dc base ma. = 0	$V_{CEO(sus)}$[a]	40	-	volts
DC Base-to-Emitter Voltage for dc collector-to-emitter volts = 4, dc collector ma. = 300	V_{BE}	-	3	volts
DC Collector-Cutoff Current for dc collector volts = 30, dc emitter ma. = 0, case temperature =	I_{CBO}			
25° C		-	100	μa
150° C		-	1500	μa
DC Emitter-Cutoff Current for dc emitter volts = 6, dc emitter ma. = 0	I_{EBO}	-	50	μa
DC Current Transfer Ratio for dc collector-to-emitter volts = 4, dc collector ma. = 300	h_{FE}	20	80	
DC Collector-to-Emitter Saturation Resistance for dc collector ma. = 300, dc base ma. = 30	R_S	-	5	ohms
Thermal Resistance:	R_T			
Junction-to-case		-	7	°C/watt
Junction-to-free air		-	100	°C/watt

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

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Electrical connection can be made to the collector, base, and emitter pins by means of clips or by soldering directly to the pins. Soldering of connections to the pins may be made close to the pin seals provided care is taken to conduct excessive heat away from the pin seal, otherwise the heat of the soldering operation will crack the glass seals of the pins and damage the transistor.

Under no circumstances should the case be soldered to the heat sink because the heat of the soldering operation will permanently damage the transistor.

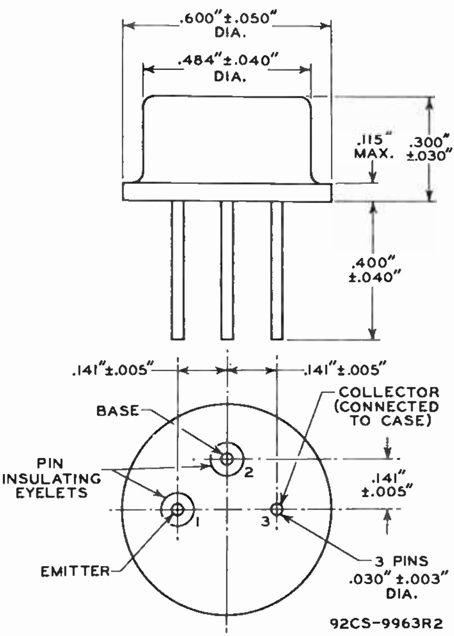
It is important that this transistor be securely fastened to a heat sink. A mounting clamp is provided for this purpose.

The chassis (heat sink) may be connected either to the positive or negative terminal of the voltage supply. In applications where the chassis is connected to the negative terminal of the voltage supply, it will be necessary to use an anodized-aluminum insulator having high thermal conductivity, or a 0.002" mica insulator between the transistor case and the chassis. The insulator should extend beyond the mounting clamp (See *Suggested Mounting Arrangement*). An aluminum washer should be drilled or punched to provide the two mounting holes, and the clearance holes for the collector, emitter, and base pins. The burrs should then be removed from the washer and the washer finally anodized. To insure that the anodized insulating layer is not destroyed during mounting, it will also be necessary to remove the burrs from the holes in the chassis. Furthermore, to prevent a short circuit between the mounting bolt and the chassis, it is important that an insulating washer be used between the bolt and the chassis.

It is to be noted that the case of this transistor operates at the collector voltage. Consideration therefore, should be given to the possibility of shock hazard if the case of this transistor is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

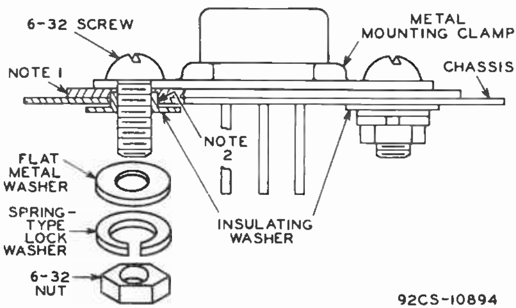
World Radio History

JEDEC No. TO-8



World Radio History

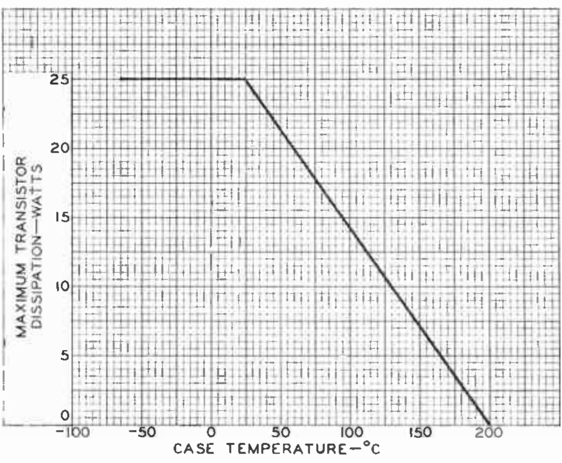
SUGGESTED MOUNTING ARRANGEMENT



NOTE 1: 0.002" MICA INSULATOR OR ANODIZED ALUMINUM INSULATOR (DRILLED, OR PUNCHED WITH BURRS REMOVED).

NOTE 2: REMOVE BURRS FROM CHASSIS HOLES.

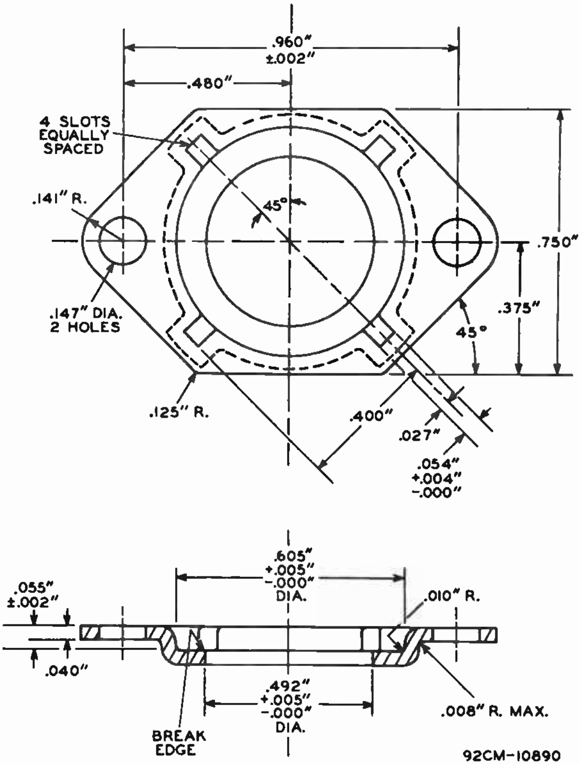
RATING CHART



World Radio History

MOUNTING CLAMP

Supplied with Each Transistor



92CM-10890

World Radio History

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For Industrial Applications

GENERAL DATA

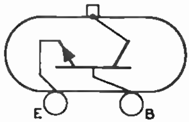
Mechanical:

Operating Position	Any
Maximum Overall Length	0.865"
Maximum Seated Length	0.390"
Maximum Length of Mounting Flange	1.550"
Maximum Width of Mounting Flange	1.015"
Case	Metal
Mounting Flange	Metal
Seals	Hermetic
Socket	Loranger Mfg. Corp. No.2149, or equivalent

Terminal Diagram (See *Dimensional Outline*):

E - Emitter

B - Base



MOUNTING FLANGE-
Collector,
Case

INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and servo-amplifier, and relay-actuating circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	60 max.	volts
With base open (Sustaining voltage)[a]	40 max.	volts
EMITTER-TO-BASE VOLTAGE	6 max.	volts
COLLECTOR CURRENT	5 max.	amp
BASE CURRENT	2.5 max.	amp
TRANSISTOR DISSIPATION:[b]		
At mounting-flange temperature of 25° C or below	75 max.	watts
MOUNTING-FLANGE TEMPERATURE RANGE:		
Operating and storage	-65 to +200	°C

Characteristics:

At mounting-flange temperature of 25° C

Alpha-Cutoff Frequency (f_{ab}) with dc collector-to-base volts = 28, dc collector ma. = 5	1	Mc
Collector-to-Base Capacitance (C_{ob}) with dc collector-to-base volts = 40	200	$\mu\mu$f
Thermal Time Constant (τ_1)	12	msec

World Radio History

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[b] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and mounting-flange temperature of 25° C unless otherwise specified

		Min.	Max.	
DC Collector-to-Emitter Voltage:				
With emitter reverse bias volts = 1.5, dc collector ma. = 1	V_{CEX}	60	-	volts
With base open (Sustaining voltage), dc collector ma. = 100, dc base ma. = 0.	$V_{CEO(sus)}$[a]	40	-	volts
DC Base-to-Emitter Voltage for dc collector-to-emitter volts = 4, dc collector ma. = 800 . . .	V_{BE}	-	4	volts
DC Collector-Cutoff Current for dc collector volts = 30, dc emitter ma. = 0, mounting-flange temperature =	I_{CBO}			
25° C		-	200	μa
150° C.		-	2000	μa
DC Emitter-Cutoff Current for dc emitter volts = 6, dc collector ma. = 0	I_{EBO}	-	100	μa
DC Current Transfer Ratio for dc collector-to-emitter volts = 4, dc collector ma. = 800	h_{FE}	1.5	60	
DC Collector-to-Emitter Saturation Resistance for dc collector ma. = 800, dc base ma. = 80.	R_S	-	4	ohms
Thermal Resistance:				
Junction-to-mounting-flange . . .	R_T	-	2.33	°C/watt

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

World Radio History

This transistor utilizes the Loranger Mfg. Corp. socket No.2149, or equivalent. Electrical connection can also be made to the base and emitter pins by soldering directly to the pins. Soldering of connections to the pins may be made close to the pin seals provided care is taken to conduct excessive heat away from the pin seal, otherwise the heat of the soldering operation will crack the glass seals of the pins and damage the transistor.

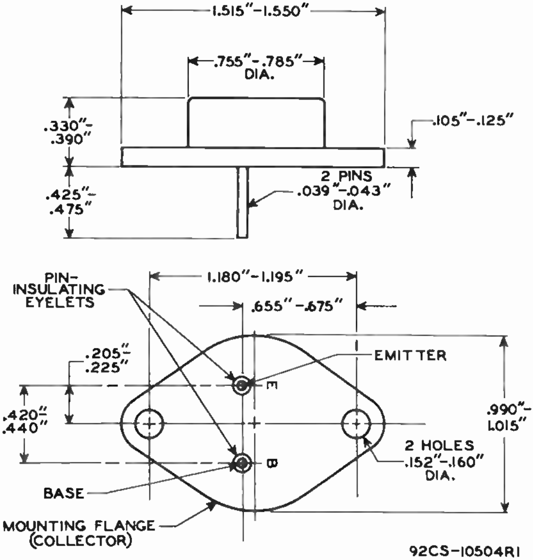
Under no circumstances should the mounting flange be soldered to the heat sink because the heat of the soldering operation will permanently damage the transistor.

It is important that the mounting flange which serves as the collector terminal be securely fastened to a heat sink. Depending on the application, the chassis (heat sink) may be connected either to the positive or negative terminal of the voltage supply.

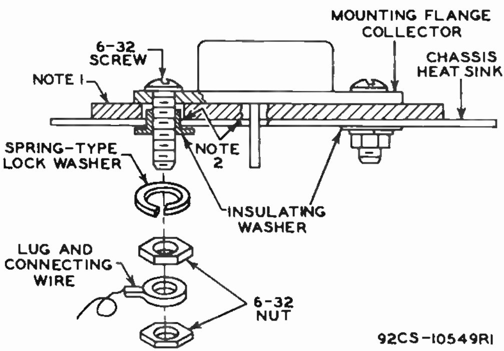
In applications where the chassis is connected to the negative terminal of the voltage supply, it will be necessary to use an anodized-aluminum insulator having high thermal conductivity, or a 0.002" mica insulator between the mounting flange and the chassis. An aluminum washer should be drilled or punched to provide the two mounting holes, and the clearance holes for the emitter and base pins. The burrs should then be removed from the washer and the washer finally anodized. To insure that the anodized insulating layer is not destroyed during mounting, it will also be necessary to remove the burrs from the holes in the chassis. Furthermore, to prevent a short circuit between the mounting bolt and the chassis, it is important that an insulating washer be used between the bolt and the chassis (See *Suggested Mounting Arrangement*).

It is to be noted that the case of this transistor operates at the collector voltage. Consideration, therefore, should be given to the possibility of shock hazard, if the case of this transistor is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

World Radio History



SUGGESTED MOUNTING ARRANGEMENT

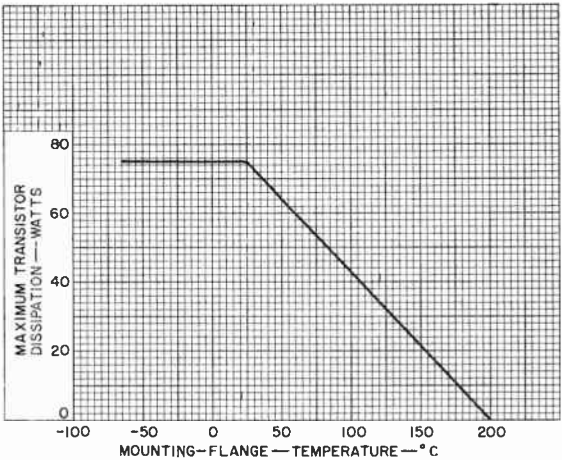


NOTE 1: 0.002" MICA INSULATOR OR ANODIZED-ALUMINUM INSULATOR (DRILLED, OR PUNCHED WITH BURRS REMOVED).

NOTE 2: REMOVE BURRS FROM CHASSIS HOLES.

World Radio History

RATING CHART



92CS-11015

World Radio History

World Radio History

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For Industrial Applications

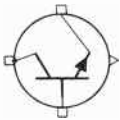
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Overall Length	1.230"
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No. TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and servo-amplifier, and relay-actuating circuits

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	60 max.	volts
With base open (Sustaining voltage)[a]	40 max.	volts
EMITTER-TO-BASE VOLTAGE	6 max.	volts
COLLECTOR CURRENT	5 max.	amp
BASE CURRENT	2.5 max.	amp
TRANSISTOR DISSIPATION:[b]		
At case temperature of 25° C or below	75 max.	watts
CASE-TEMPERATURE RANGE:		
Operating and storage	-65 to +200	°C

Characteristics:

At case temperature of 25° C

Alpha-Cutoff Frequency (f_{ab}) with dc collector-to base volts = 28, dc collector ma. = 5	1	Mc
Collector-to-Base Capacitance (C_{ob}) with dc collector-to-base volts = 40	200	$\mu\mu$f
Thermal Time Constant (τ_{1})	12	msec

World Radio History

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity.

[b] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and case temperature of 25° C unless otherwise specified

		Min.	Max.	
DC Collector-to-Emitter Voltage:				
With emitter reverse-bias volts = 1.5, dc collector ma. = 1	V_{CEX}	60	-	volts
With base open (Sustaining voltage), dc collector ma. = 100, dc base ma. = 0	$V_{CEO(sus)}$[a]	40	-	volts
DC Base-to-Emitter Voltage for dc collector-to-emitter volts = 4, dc collector ma. = 800	V_{BE}	-	4	volts
DC Collector-Cutoff Current for dc collector volts = 30, dc emitter ma. = 0, case temperature =				
25° C		-	200	μa
150° C		-	2000	μa
DC Emitter-Cutoff Current for dc emitter volts = 6, dc collector ma. = 0	I_{EBO}	-	100	μa
DC Current Transfer Ratio for dc collector-to-emitter volts = 4, dc collector ma. = 800	h_{FE}	15	60	
DC Collector-to-Emitter Saturation Resistance for dc collector ma. = 800, dc base ma. = 80	R_S	-	4	ohms
Thermal Resistance:				
Junction-to-case	R_T	-	2.33	°C/watt

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

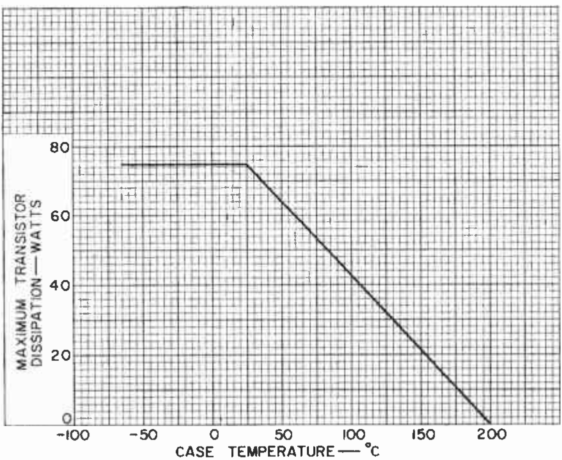
World Radio History

Electrical connection can be made to the base and emitter terminals by means of clips or by soldering directly to the terminals. When soldering connections are made to the terminals, care should be taken to conduct excessive heat away from the terminal seals, otherwise the heat of the soldering operation will crack the glass seals of the terminals and damage the transistor.

This transistor is provided with a single-ended stud for mounting to a heat sink and for electrical connection to the collector. (See accompanying *Suggested Mounting Arrangement*). Electrical connection to the base and to the emitter is made to their respective terminals.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

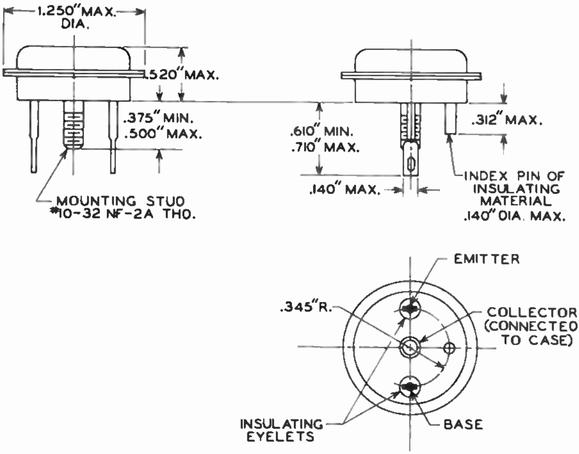
RATING CHART



92CS-11016

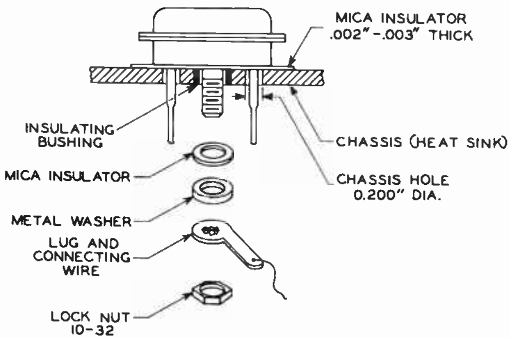
World Radio History

JEDEC No. TO-36



92CM-10612R1

SUGGESTED MOUNTING ARRANGEMENT



92CS-10624R1

World Radio History

Transistor

SILICON N-P-N DOUBLE-DIFFUSED-JUNCTION EPITAXIAL-PLANAR TYPE

For Switching Applications in
Industrial and Military Equipment

GENERAL DATA

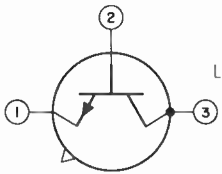
Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.080"
Maximum Diameter	0.230"
Dimensional Outline	JEDEC No. TO-46
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	0.500"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter

Lead 2 - Base



Lead 3 - Collector, Case

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:			
With emitter open	V_{CBO}	25 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:			
With external resistance between base and emitter (ohms) = 1000, load resistance (ohms) = 100	V_{CERL}	20 max.	volts
EMITTER-TO-BASE VOLTAGE:			
With collector open	V_{EBO}	3 max.	volts
COLLECTOR CURRENT	I_C	0.2 max.	amp
TRANSISTOR DISSIPATION:[a]			
At case temperature[b] of 25° C or below		1 max.	watt
At free-air temperature of 25° C or below		0.3 max.	watt
TEMPERATURE RANGE:			
Storage		-65 to +300	°C
Operating		-65 to +175	°C
LEAD TEMPERATURE:[c]			
For 10 seconds maximum		235 max.	°C

[a] See accompanying *Rating Chart*.

World Radio History

[b] Measured at center of seating plane.
[c] Measured 1/16" ± 1/32" down from seating plane.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and free-air temperature of 25° C unless otherwise specified

		Max.	Max.	
DC Collector Breakdown Voltage for dc collector ma. = 0.1, emitter ma. = 0.	BV_{CBO}	25	–	volts
DC Emitter Breakdown Voltage for dc emitter ma. = 0.1, collector ma. = 0.	BV_{EBO}	3	–	volts
→ DC Collector-to-Emitter Latching Voltage[d] for external resistance between base and emitter (ohms) = 1000, load resistance (ohms) = 100.	V_{CERL}	20	–	volts
DC Base-to-Emitter Saturation Voltage for dc collector ma. = 10, dc base ma. = 1.	$V_{BE(sat)}$	0.7	0.9	volt
DC Collector-to-Emitter Saturation Voltage:	$V_{CE(sat)}$			
With dc collector ma. = 10, dc base ma. = 1.		–	0.22	volt
With dc collector ma. = 50, dc base ma. = 5.		–	0.35	volt
DC Collector-Cutoff Current for dc collector volts = 15, emitter ma. = 0, free-air temperature =	I_{BCO}			
25° C.		–	0.025	μa
150° C		–	15	μa
DC Collector Current for base-to-emitter forward bias volts = 0.35, dc collector-to-emitter volts = 10, free-air temperature = 100° C	I_{CEX}	–	15	μa
→ Collector-to-Base Capacitance for dc collector volts = 10, emitter ma. = 0, frequency (kc) = 140	C_{ob}	–	6	pf
DC Current Transfer Ratio for dc collector to emitter volts = 1, dc collector ma. = 10	h_{FE}	20	–	
Small-Signal Current Transfer Ratio for dc collector-to-emitter volts = 10, dc collector ma. = 10, frequency (Mc) = 100	h_{fe}	2	–	

→ Indicates a change.

World Radio History

Storage Time[e] for dc collector supply volts = 10, collector resistance (ohms) = 1000, turn-on and turn-off dc base ma. = 10 each, dc collector ma. = 10.	t_s	–	25	nsec
Turn-On Time[f] (Delay time + rise time) for dc collector supply volts = 3, turn-on dc base ma. = 3, turn-off dc base ma. = 1, dc collector ma. = 10	$t_d + t_r$	–	40	nsec
Turn-Off Time[f] (Storage time + fall-time) for dc collector supply volts = 3, turn-on dc base ma. = 3, turn-off dc base ma. = 1, dc collector ma. = 10.	$t_s + t_f$		75	nsec

[d] For description of this test, write to Commercial Engineering, Semiconductor & Materials Division, RCA, Somerville, New Jersey.

[e] See accompanying *Storage-Time-Measurement Circuit*.

[f] See accompanying *Turn-On-Time and Turn-Off-Time Measurement Circuit*.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

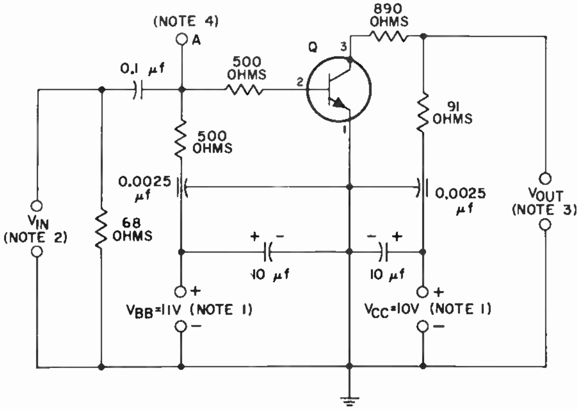
The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the seating plane provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

← Indicates a change.

World Radio History

STORAGE-TIME-MEASUREMENT CIRCUIT



92CS-11226R2

Q: Transistor type 2N1708

NOTE 1: WITH CERTAIN TYPES OF POWER SUPPLIES, IT MAY BE NECESSARY TO CONNECT 25-μf DECOUPLING CAPACITORS ACROSS THE POWER-SUPPLY TERMINALS FOR V_{CC} AND V_{BB}.

NOTE 2: INPUT VOLTAGE (V_{IN}) OBTAINED FROM MERCURY-RELAY-TYPE PULSE GENERATOR HAVING AN OUTPUT IMPEDANCE OF 50 OHMS.

NOTE 3: THE ASSOCIATED INPUT AND OUTPUT WAVE FORMS SHOWN SHOULD BE MONITORED BY MEANS OF A SAMPLING OSCILLOSCOPE HAVING AN INPUT IMPEDANCE OF 50 OHMS.

NOTE 4: TEST POINT FOR OBSERVATION OF REFERENCE PULSE VOLTAGE (V_A).

2N1708

Transistor

SILICON N-P-N DOUBLE-DIFFUSED-JUNCTION EPITAXIAL-PLANAR TYPE

For Switching Applications in Industrial and Military Equipment

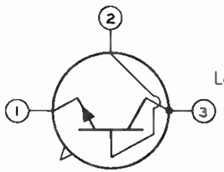
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.080"
Maximum Diameter	0.230"
Dimensional Outline	JEDEC No. TO-46
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	0.500"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter
Lead 2 - Base



Lead 3 - Collector, Case

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:		
With emitter open	25 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With external resistor (ohms) = 10 between base and emitter	20 max.	volts
EMITTER-TO-BASE VOLTAGE:		
With collector open	3 max.	volts
COLLECTOR CURRENT	0.2 max.	amp
TRANSISTOR DISSIPATION:[a]		
At case temperature[b] of 25° C or below	1 max.	watt
At free-air temperature of 25° C or below	0.3 max.	watt
TEMPERATURE RANGE:		
Storage	-65 to +300	°C
Operating	-65 to +175	°C
LEAD TEMPERATURE:[c]		
For 10 seconds maximum	235 max.	°C

[a] See accompanying *Rating Chart*.
[b] Measured at center of seating plane.
[c] Measured 1/16" ± 1/32" down from seating plane.

World Radio History

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and free-air temperature of 25° C unless otherwise specified.

Characteristic	Symbol	Min.	Max.	Unit
DC Collector Breakdown Voltage for dc collector ma. = 0.1, emitter ma. = 0	BV_{CBO}	25	-	volts
DC Collector-to-Emitter Breakdown Voltage for dc collector ma. = 50, external base-to-emitter resistor (ohms) = 10	BV_{CER}	20	-	volts
DC Emitter Breakdown Voltage for dc emitter ma. = 0.1, collector ma. = 0	BV_{EBO}	3	-	volts
DC Base-to-Emitter Saturation Voltage for dc collector ma. = 10, dc base ma. = 1	$V_{BE(sat)}$	0.7	0.9	volt
DC Collector-to-Emitter Saturation Voltage:	$V_{CE(sat)}$			
With dc collector ma. = 10, dc base ma. = 1		-	0.22	volt
With dc collector ma. = 50, dc base ma. = 5		-	0.35	volt
DC Collector-Cutoff Current for dc collector volts = 15, emitter ma. = 0, free-air temperature =	I_{BCO}			
25° C		-	0.025	μa
150° C		-	15	μa
DC Collector Current for base-to-emitter forward bias volts = 0.35, dc collector-to-emitter volts = 10, free-air temperature = 100° C	I_{CEX}	-	15	μa
Collector-to-Base Capacitance for dc collector volts = 10, emitter ma. = 0, frequency (kc) = 140	C_{ob}	-	6	μμf
Small-Signal Current Transfer Ratio for dc collector-to-emitter volts = 10, dc collector ma. = 10, frequency (Mc) = 100	h_{fe}	2	-	
DC Current Transfer Ratio for dc collector to emitter volts = 1, dc collector ma. = 10	h_{FE}	20	-	
Storage Time[d] for dc collector supply volts = 10, collector resistor (ohms) = 1000, "turn-on" and "turn-off" base ma. = 10 each, dc collector ma. = 10	t_s	-	25	mμsec

[d] See accompanying *Storage-Time-Measurement Circuit.*

World Radio History

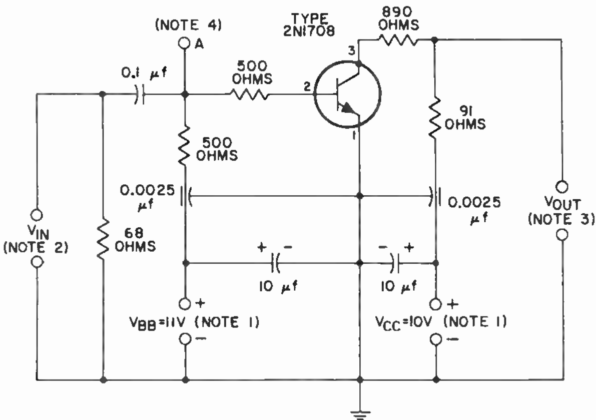
OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the seating plane provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

STORAGE-TIME-MEASUREMENT CIRCUIT



92CS—11226

NOTE 1: WITH CERTAIN TYPES OF POWER SUPPLIES, IT MAY BE NECESSARY TO CONNECT 25-μf DECOUPLING CAPACITORS ACROSS THE POWER-SUPPLY TERMINALS FOR V_{CC} AND V_{BB}.

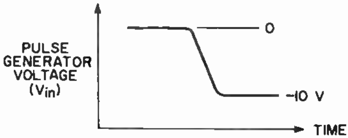
NOTE 2: INPUT VOLTAGE (V_{IN}) OBTAINED FROM MERCURY-RELAY-TYPE PULSE GENERATOR HAVING AN OUTPUT IMPEDANCE OF 50 OHMS.

NOTE 3: THE ASSOCIATED INPUT AND OUTPUT WAVEFORMS SHOWN BELOW SHOULD BE MONITORED BY MEANS OF A SAMPLING OSCILLOSCOPE HAVING AN INPUT IMPEDANCE OF 50 OHMS.

NOTE 4: TEST POINT FOR OBSERVATION OF REFERENCE PULSE VOLTAGE (V_A).

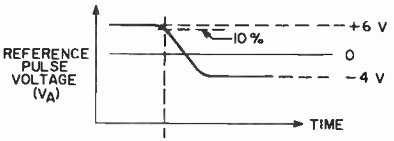
World Radio History

ASSOCIATED WAVE FORMS

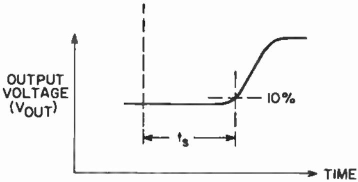


RISE TIME < 1 mμSEC
PULSE DURATION ≥ 300 mμSEC
DUTY FACTOR < 0.02

INPUT WAVE FORM



REFERENCE WAVE FORM OBSERVED AT POINT "A" IN STORAGE-TIME-MEASUREMENT CIRCUIT

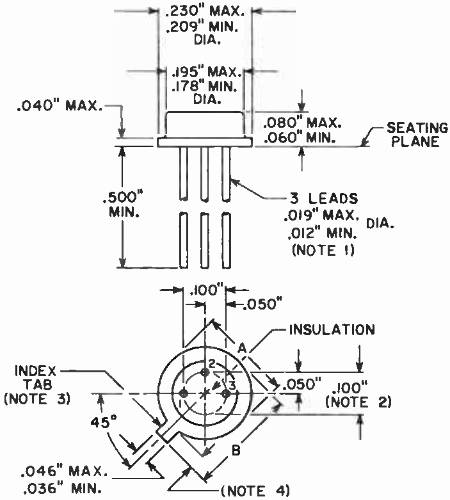


OUTPUT WAVE FORM

92CS-11224

World Radio History

JEDEC No.TO-46



92CS-11225

NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE SEATING PLANE. BETWEEN 0.25" TO THE END OF THE LEAD, A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

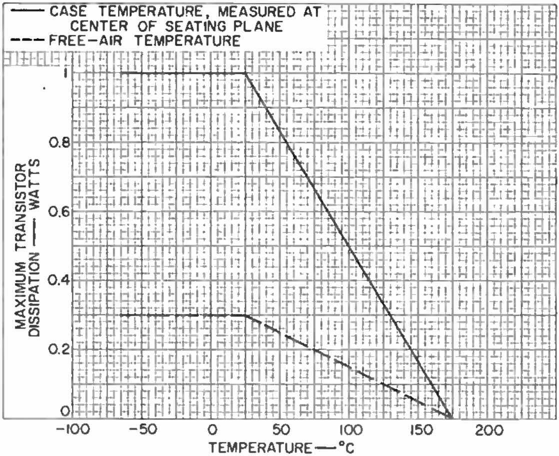
NOTE 2: MAXIMUM DIAMETER LEADS AT A GAUGING PLANE 0.054" + 0.001" - 0.000" BELOW SEATING PLANE TO BE WITHIN 0.007" OF THEIR TRUE LOCATION RELATIVE TO MAXIMUM WIDTH TAB AND TO THE 0.230" MAXIMUM DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS NOT USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

NOTE 3: INDEX TAB FOR VISUAL ORIENTATION ONLY.

NOTE 4: TAB LENGTH TO BE 0.028" MINIMUM - 0.048" MAXIMUM AND WILL BE DETERMINED BY SUBTRACTING DIAMETER "A" FROM DIMENSION "B".

World Radio History

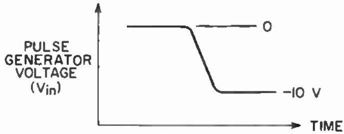
RATING CHART



92CS-11223

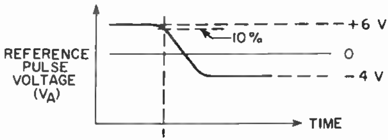
World Radio History

ASSOCIATED WAVE FORMS

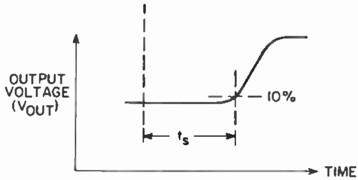


RISE TIME < 1 mμSEC
PULSE DURATION ≥ 300mμ SEC
DUTY FACTOR < 0.02

INPUT WAVE FORM



REFERENCE WAVE FORM OBSERVED AT POINT "A" IN STORAGE-TIME-MEASUREMENT CIRCUIT

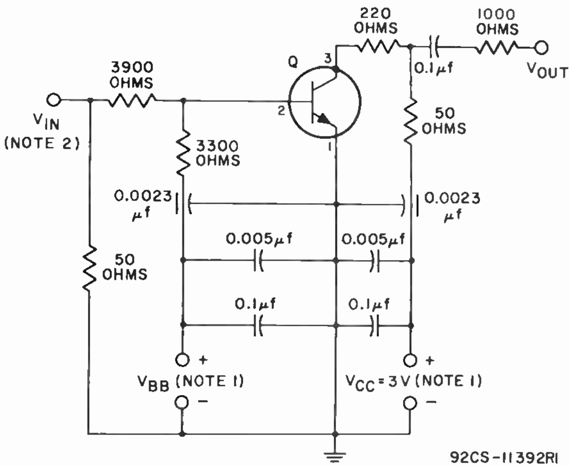


OUTPUT WAVE FORM

92CS-11224

World Radio History

TURN-ON-TIME AND TURN-OFF-TIME MEASUREMENT CIRCUIT



Q: Transistor type 2N1708

NOTE 1: WITH CERTAIN TYPES OF POWER SUPPLIES, IT MAY BE NECESSARY TO CONNECT 25-μf DECOUPLING CAPACITORS ACROSS THE POWER-SUPPLY TERMINALS FOR V_{CC} AND V_{BB}.

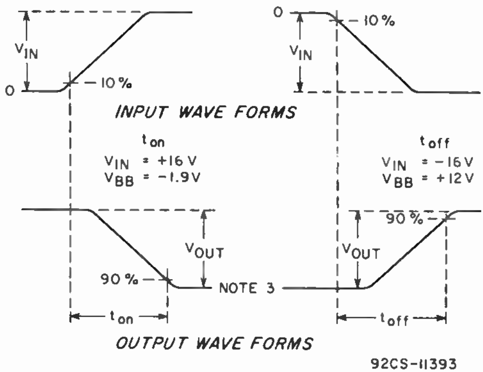
NOTE 2: INPUT VOLTAGE (V_{IN}) OBTAINED FROM MERCURY-RELAY TYPE PULSE GENERATOR HAVING AN OUTPUT IMPEDANCE OF 50 OHMS.

NOTE 3: INPUT AND OUTPUT WAVE FORMS, SHOWN ON NEXT PAGE, SHOULD BE MONITORED BY MEANS OF A SAMPLING OSCILLOSCOPE HAVING AN INPUT IMPEDANCE OF 50 OHMS.

NOTE 4: ALL RESISTANCE VALUES HAVE ± 1% TOLERANCE.

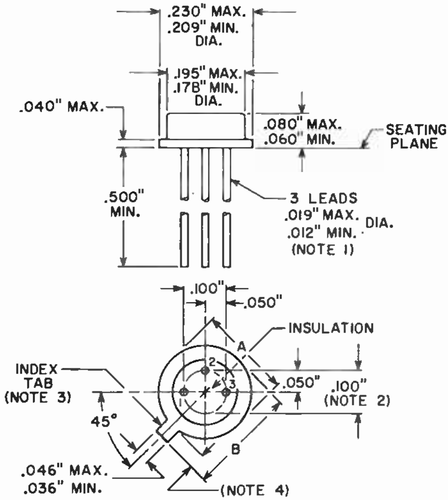
World Radio History

ASSOCIATED WAVE FORMS



World Radio History

JEDEC No. TO-46



NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE SEATING PLANE. BETWEEN 0.25" TO THE END OF THE LEAD, A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

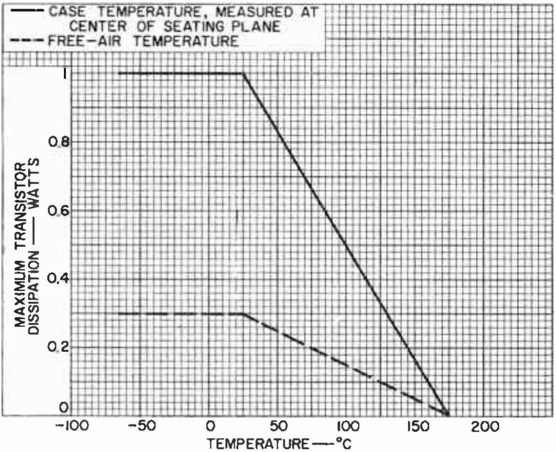
NOTE 2: MAXIMUM DIAMETER LEADS AT A GAUGING PLANE 0.054" + 0.001" - 0.000" BELOW SEATING PLANE TO BE WITHIN 0.007" OF THEIR TRUE LOCATION RELATIVE TO MAXIMUM WIDTH TAB AND TO THE 0.230" MAXIMUM DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS NOT USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

NOTE 3: INDEX TAB FOR VISUAL ORIENTATION ONLY.

NOTE 4: TAB LENGTH TO BE 0.028" MINIMUM - 0.048" MAXIMUM AND WILL BE DETERMINED BY SUBTRACTING DIAMETER "A" FROM DIMENSION "B".

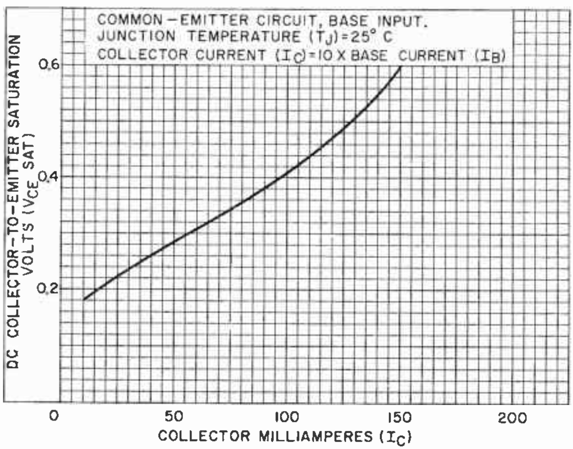
World Radio History

RATING CHART



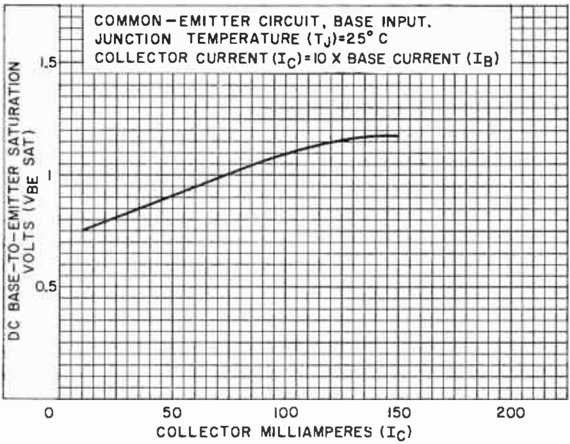
92CS-11223

TYPICAL DC COLLECTOR-TO-EMITTER SATURATION-VOLTAGE CHARACTERISTIC

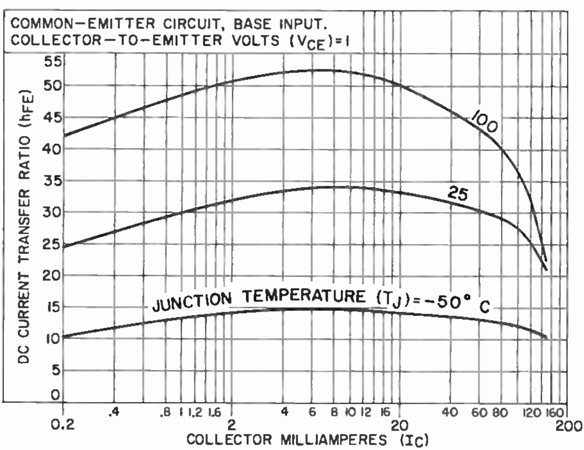


92CS-11377

TYPICAL DC BASE-TO-EMITTER SATURATION-VOLTAGE CHARACTERISTIC

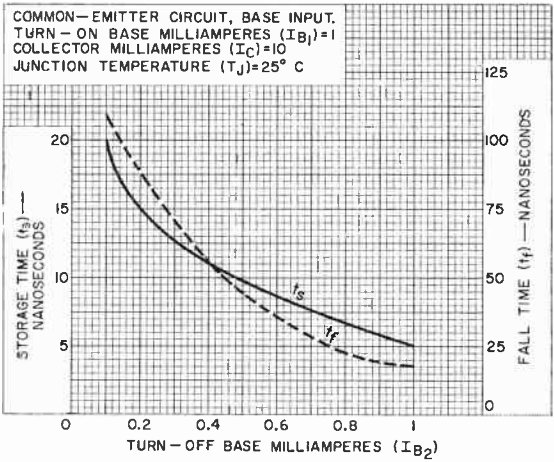


TYPICAL DC CURRENT-TRANSFER-RATIO CHARACTERISTICS

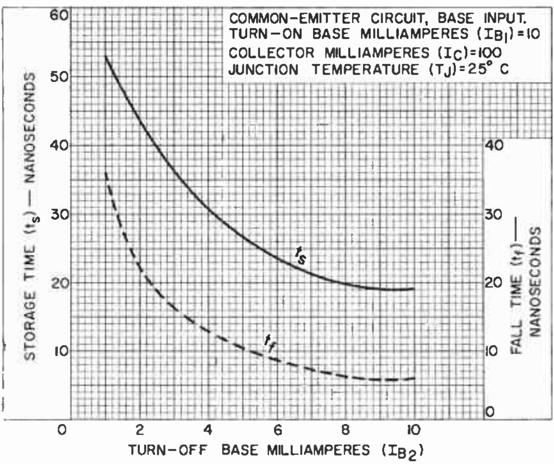


World Radio History

TYPICAL STORAGE-TIME AND FALL-TIME CHARACTERISTICS



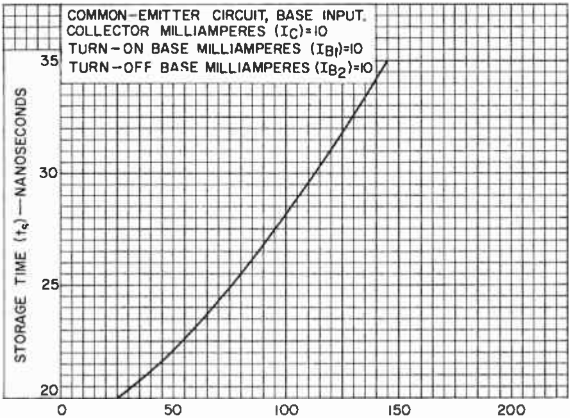
92CS—11380



92CS—11379

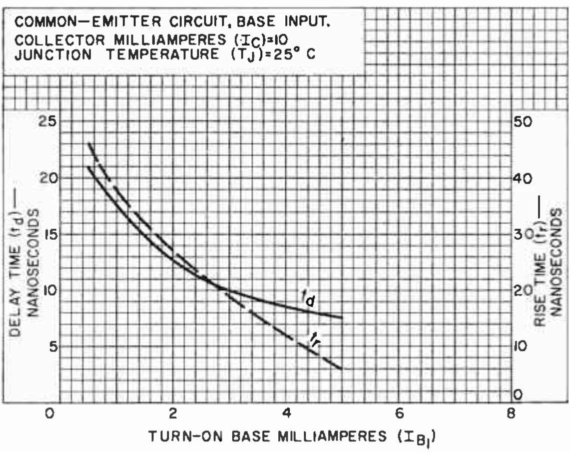
World Radio History

TYPICAL STORAGE-TIME CHARACTERISTIC



92CS-11385

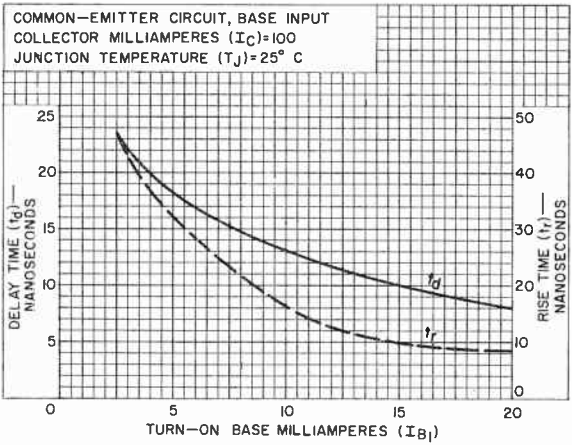
TYPICAL DELAY-TIME AND RISE-TIME CHARACTERISTICS



92CS-11384

World Radio History

TYPICAL DELAY-TIME AND RISE-TIME CHARACTERISTICS



92CS—11389

World Radio History

World Radio History

Power Transistor

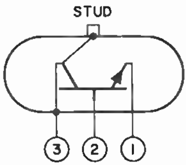
SILICON N-P-N DIFFUSED-JUNCTION TYPE
For Industrial Applications

Mechanical:

Operating Position	Any
Maximum Length	See *Dimensional Outline*
Maximum Diameter	0.460"
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Maximum length	1.525"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram (See *Dimensional Outline*):

Lead 1 - Emitter
Lead 2 - Base



Lead 3 - Collector, Case
STUD - Collector, Case

INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and servo-amplifier, and relay-actuating circuits

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5)	60 max.	volts
With base open (Sustaining voltage)[a]	40 max.	volts
EMITTER-TO-BASE VOLTAGE	12 max.	volts
COLLECTOR CURRENT	3 max.	amp
EMITTER CURRENT	-3.5 max.	amp
BASE CURRENT	1.5 max.	amp
TRANSISTOR DISSIPATION:[b]		
At case temperature of 25° C[c]	40 max.	watts
At case temperature of 100° C[c]	22.9 max.	watts
CASE-TEMPERATURE RANGE:[c]		
Operating and storage	-65 to +200	°C
LEAD TEMPERATURE:[d]		
For 10 seconds maximum	255 max.	°C

Characteristics:

At case temperature of 25° C[c]

Alpha-Cutoff Frequency (f_{ab}) with dc collector-to-base volts = 28, dc collector ma. = 5	1.25	Mc

World Radio History

Collector-to-Base Capacitance (C_{ob}) with dc collector-to-base volts = 40. .	175	μμf
Thermal Time Constant (τ_1).	10	msec

Typical Operation:

In accompanying typical power-switching circuit at case temperature[c] of 25° C

DC Supply Voltage (B_2).	12	volts
DC Base-Bias Voltage (B_1)	-8.5	volts
"On" DC Collector Current	750	ma
"Turn-On" Base Current (I_{B1}).	65	ma
"Turn-Off" Base Current (I_{B2})	-35	ma
Generator Resistance.	50	ohms
Switching Time:		
Delay time (t_d)	0.2	μsec
Rise time (t_r).	1	μsec
Storage time (t_s)	0.8	μsec
Fall time (t_f).	1.1	μsec

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V\alpha M$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[b] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

[c] Measured at any point on seating plane of pedestal.

[d] Measured 1/16" ± 1/32" down from case.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and at case temperature[c] of 25° C unless otherwise specified

		Min.	Max.	
Collector-to-Emitter Voltage:				
With emitter reverse bias volts = 1.5, dc collector ma. = 0.25.	V_{CEX}	60	-	volts
With base open (Sustaining voltage), dc collector ma. = 100, dc base ma. = 0.	$V_{CEO(sus)}$[a]	40	-	volts
Base-to-Emitter Voltage for dc collector-to-emitter volts = 4, dc collector ma. = 750	V_{BE}	-	2.5	volts
Collector-Cutoff Current for dc collector volts = 30, dc emitter ma. = 0, case temperature[c] =	I_{CBO}			
25° C		-	15	μa
150° C.		-	750	μa
Emitter-Cutoff Current for dc emitter volts = 12, dc emitter ma. = 0	I_{EBO}	-	15	μa

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DC Current Transfer Ratio for dc collector-to-emitter volts = 4, dc collector ma. = 750	h_{FE}	35	100	
DC Collector-to-Emitter Saturation Resistance for dc collector ma. = 750, dc base ma. = 40	R_S	–	1	ohm
Thermal Resistance:	R_T			
Junction-to-case.		–	4.375	°C/watt
Junction-to-free air. . . .		–	175	°C/watt

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO}(sus)$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[c] Measured at any point on seating plane of pedestal.

OPERATING CONSIDERATIONS

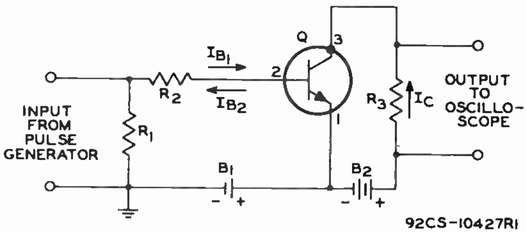
It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the seals of the leads and damage the transistor.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

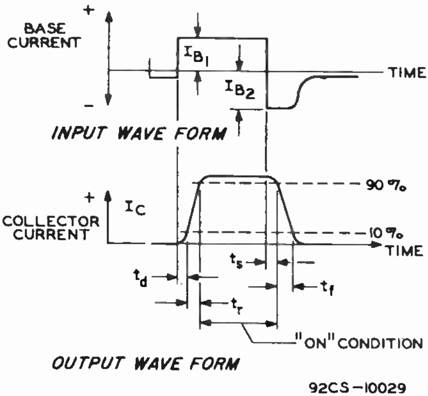
World Radio History

TYPICAL POWER-SWITCHING CIRCUIT



B_1:	8.5 volts	R_1:	50 ohms, 1 watt
B_2:	12 volts	R_2:	220 ohms, 1 watt
Q:	Transistor type 2N1768	R_3:	15.9 ohms, 2 watts

ASSOCIATED WAVE FORMS



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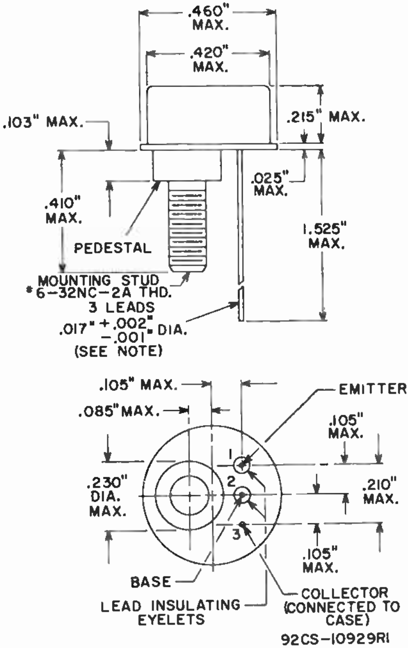
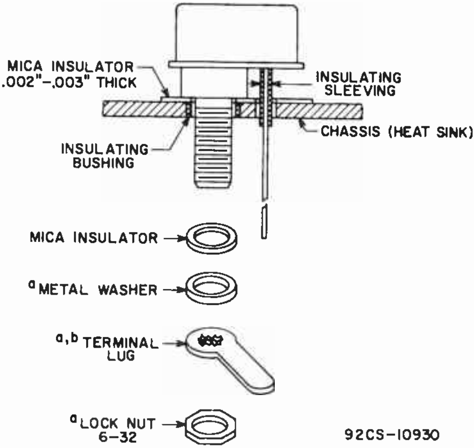


NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE BOTTOM OF THE CASE. BETWEEN 0.25" AND THE END OF THE LEAD, A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

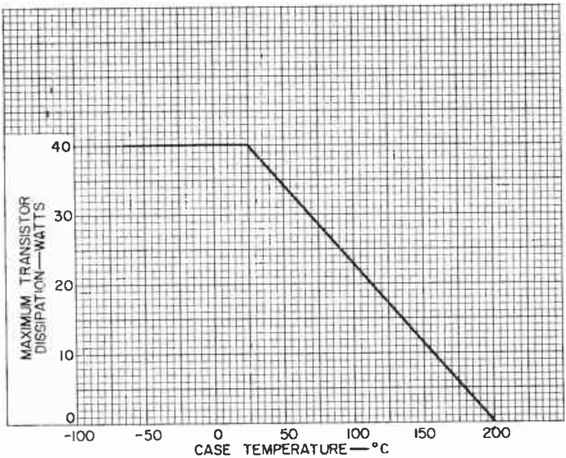
SUGGESTED MOUNTING ARRANGEMENT



[a] Supplied with each transistor.

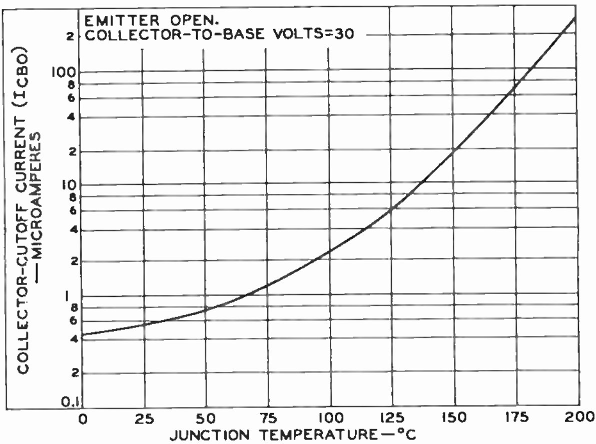
[b] Shakeproof Division, Illinois Tool Works, Cat. No. 2102-6.

RATING CHART



92CS-10928

TYPICAL COLLECTOR-CUTOFF-CURRENT CHARACTERISTIC



92CS-10882

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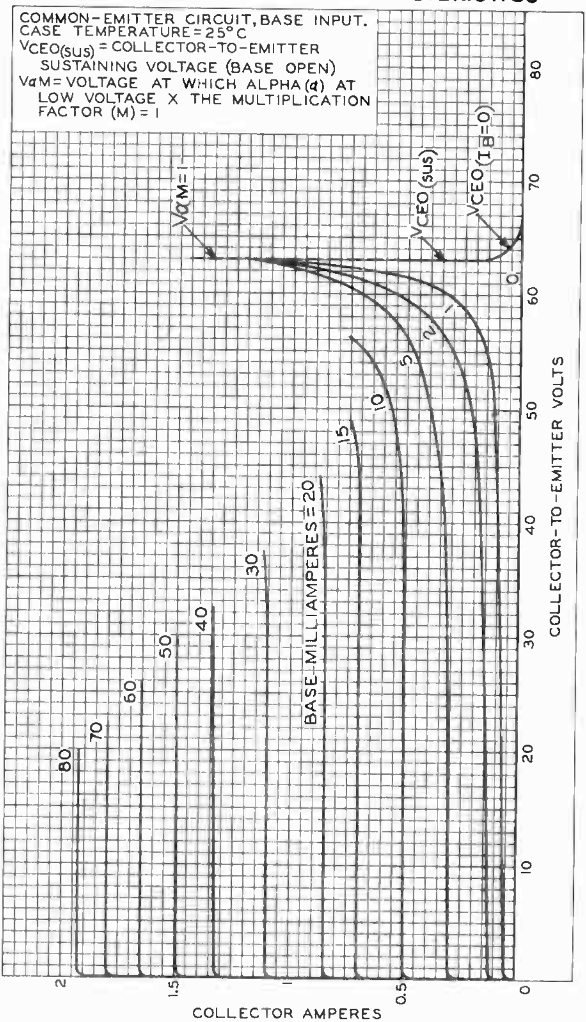
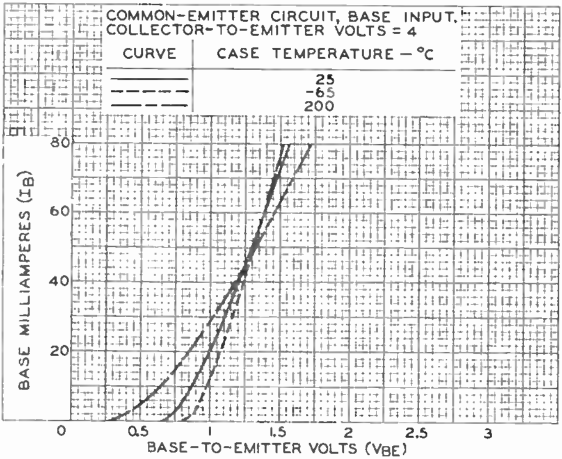
TYPICAL COLLECTOR CHARACTERISTICS



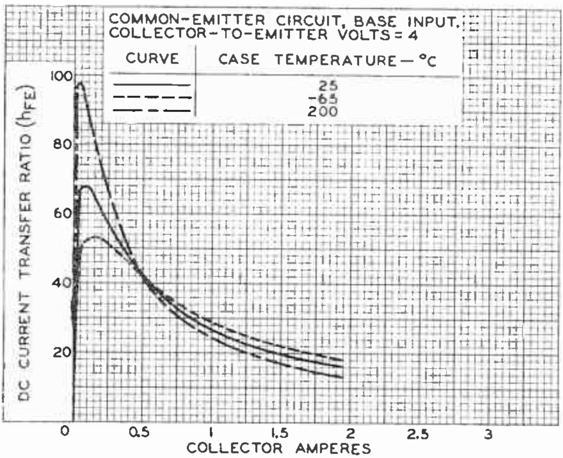
92CM-10445R1

TYPICAL BASE CHARACTERISTICS



92CS-10443R3

TYPICAL DC-CURRENT-TRANSFER-RATIO CHARACTERISTICS



92CS-10444R2

World Radio History

World Radio History

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For Industrial Applications

The 2N1769 is the same as the 2N1768 except for the following items:

INDUSTRIAL SERVICE

Such as is dc-to-dc converter, inverter, chopper, voltage- and current-regulator, dc- and servo-amplifier, and relay-actuating circuits

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	100 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With emitter-to-base reverse biased (DC emitter-to-base volts = 1.5). . .	100 max.	volts
With base open (Sustaining voltage)[a]. .	55 max.	volts

ELECTRICAL CHARACTERISTICS

		Min.	*Max.*	
Collector-to-Emitter Voltage:				
With emitter reverse bias volts = 1.5, dc collector ma. = 0.25.	V_{CEX}	100	-	volts
With base open (Sustaining voltage), dc collector ma. = 100, dc base ma. = 0	V_{CEO}[a](sus)	55	-	volts

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO}(sus)$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

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Transistor

GERMANIUM P-N-P DIFFUSED-JUNCTION MESA TYPE

For High-Speed Saturated Switching Applications in Commercial and Military Data-Processing Systems

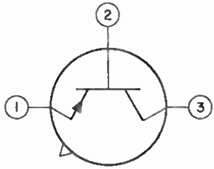
GENERAL DATA

Mechanical:

Dimensions. . . . . See *Outline TO-5* in General Section

Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter
Lead 2 – Base
Lead 3 – Collector



SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:			
With emitter open	V_{CBO}	–18 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:			
With base open.	V_{CEO}	–6 max.	volts
EMITTER-TO-BASE VOLTAGE:[a]			
With collector open	V_{EBO}	–2 max.	volts
COLLECTOR CURRENT	I_C	–100 max.	ma
TRANSISTOR DISSIPATION:[b]			
At free-air temperature of 25° C or below.	P	150 max.	mw
EMITTER-TO-BASE DISSIPATION:			
With emitter-to-base reverse bias dc volts = –2, free-air temperature of 25° C or below		25 max.	mw
FREE-AIR TEMPERATURE RANGE:			
Junction (Operating).	T_J	–55 to +85	°C
Storage	T_{STG}	–55 to +85	°C
LEAD TEMPERATURE:[c]			
For 10 seconds maximum.	T_L	235 max.	°C

[a] This rating may be exceeded and the emitter-to-base junction operated in the breakdown condition provided the emitter-to-base dissipation is limited to 25 milliwatts at 25° C. For free-air temperatures above 25° C, reduce the dissipation.

[b] See accompanying *Rating Chart* and *Transistor-Dissipation Rating Chart* in General Section.

[c] Measured 1/16" ± 1/32" along lead, down from seating plane.

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ELECTRICAL CHARACTERISTICS

Unless otherwise specified, free-air temperature = 25° C

Characteristic	Symbol	Min.	Max.	Unit
DC Collector-to-Base Breakdown Voltage for dc collector ma. = -0.025, dc emitter current = 0	BV_{CBO}	-18	-	volts
DC Collector-to-Emitter Breakdown Voltage for base-to-emitter reverse bias dc volts = -0.15, dc collector ma. = -0.025	BV_{CEV}	-18	-	volts
DC Emitter-to-Base Breakdown Voltage for dc emitter ma. = -0.1, dc collector current = 0	BV_{EBO}	-2	-	volts
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = -6, dc base ma. = -0.2	$V_{CE(sat)}$	-	-0.2	volt
DC Base-to-Emitter Voltage for dc collector ma. = -6, dc base ma. = -0.2	V_{BE}	-	-0.4	volt
DC Collector-Cutoff Current:	I_{CBO}			
With dc collector-to-base volts = -15, dc emitter current = 0		-	-4.2	μa
With dc collector-to-base volts = -18, dc emitter current = 0, free-air temperature = 60		-	-35	μa
DC Emitter-Cutoff Current for dc emitter-to-base volts = -2, dc collector current = 0	I_{EBO}	-	-100	μa
DC Forward-Current Transfer Ratio:	h_{FE}			
With dc collector-to-emitter volts = -1, dc base ma. = -0.2		30	400	
With dc collector-to-emitter volts = -0.4, dc collector ma. = -6		30	-	
Switching Time:				
Turn-on time[d]	t_{on}	-	0.8	μsec
Turn-off time[e]	t_{off}	-	0.9	μsec
Storage time[e]	t_s	-	0.8	μsec

[d] See accompanying *Turn-On-Time (t_{on}) Measurement Circuit.*

[e] See accompanying *Turn-Off-Time (t_{off})* and *Storage-Time (t_s) Measurement Circuit.*

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the seating plane provided care is taken to conduct

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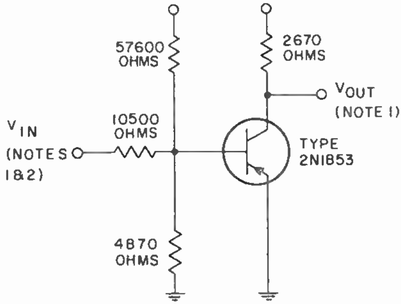
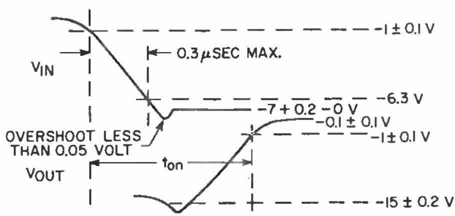
excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the seals of the leads and damage the transistor.

This transistor is intended for use in single-side printed-circuit boards and in conventional wire-in type circuits. If this transistor is used in double-side printed-circuit boards or in printed-circuit boards utilizing eyelets, it may be necessary to use an insulating washer or similar standoff device made of good dielectric material to prevent the solder from shorting the leads to each other or to the board, and to prevent the base from shorting to ground.

TURN-ON-TIME MEASUREMENT CIRCUIT AND ASSOCIATED WAVE FORMS





92CS-11717

NOTE 1: INPUT AND OUTPUT WAVE FORMS (V_{IN} AND V_{OUT}) SHOULD BE MONITORED BY MEANS OF A SAMPLING OSCILLOSCOPE HAVING A RISE TIME OF LESS THAN 15 NANOSECONDS, A PROBE CAPACITANCE OF NOT MORE THAN 12 PF, AND A SHUNT RESISTANCE OF NOT LESS THAN 10 MEGOHMS.

NOTE 2: INPUT VOLTAGE (V_{IN}) OBTAINED FROM A MERCURY-RELAY TYPE PULSE GENERATOR HAVING AN OUTPUT IMPEDANCE OF 100 OHMS.

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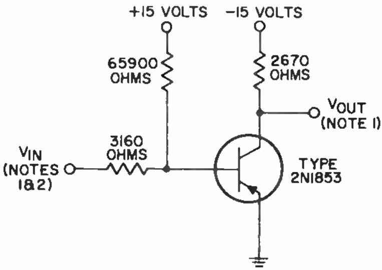
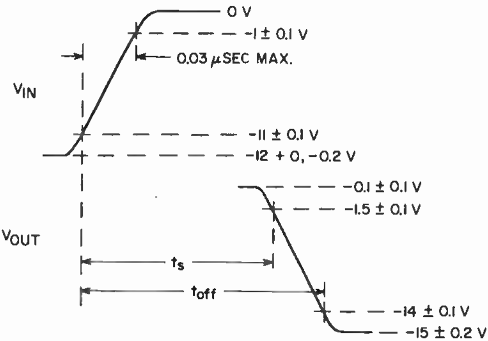
TURN-OFF-TIME AND STORAGE-TIME MEASUREMENT CIRCUIT AND ASSOCIATED WAVE FORMS





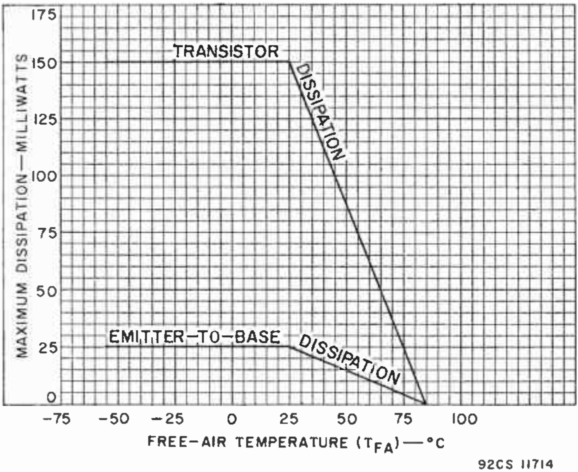
92CS-11718

NOTE 1: INPUT AND OUTPUT WAVE FORMS (V_{IN} AND V_{OUT}) SHOULD BE MONITORED BY MEANS OF A SAMPLING OSCILLOSCOPE HAVING A RISE TIME OF LESS THAN 15 NANOSECONDS, A PROBE CAPACITANCE OF NOT MORE THAN 12 PF, AND A SHUNT RESISTANCE OF NOT LESS THAN 10 MEGOHMS.

NOTE 2: INPUT VOLTAGE (V_{IN}) OBTAINED FROM A MERCURY-RELAY TYPE PULSE GENERATOR HAVING AN OUTPUT IMPEDANCE OF 100 OHMS.

World Radio History

RATING CHART



World Radio History

World Radio History

Transistor

GERMANIUM P-N-P DIFFUSED-JUNCTION MESA TYPE

For High-Speed Saturated Switching Applications in Commercial and Military Data-Processing Systems

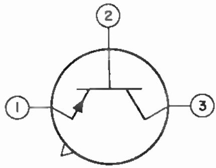
GENERAL DATA

Mechanical:

Dimensions. . . . . See *Outline TO-5* in General Section

Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter
Lead 2 – Base
Lead 3 – Collector



SWITCHING SERVICE

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE:			
With emitter open	V_{CBO}	-18 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:			
With base open.	V_{CEO}	-6 max.	volts
EMITTER-TO-BASE VOLTAGE:[a]			
With collector open	V_{EBO}	-2 max.	volts
COLLECTOR CURRENT	I_C	-100 max.	ma
TRANSISTOR DISSIPATION:[b]			
At free-air temperature of 25° C or below.	P	150 max.	mw
EMITTER-TO-BASE DISSIPATION:			
With emitter-to-base reverse bias dc volts = -2, free-air temperature of 25° C or below. .		25 max.	mw
FREE-AIR TEMPERATURE RANGE:			
Junction (Operating).	T_J	-55 to +85	°C
Storage	T_{STG}	-55 to +85	°C
LEAD TEMPERATURE:[c]			
For 10 seconds maximum.	T_L	235 max.	°C

[a] This rating may be exceeded and the emitter-to-base junction operated in the breakdown condition provided the emitter-to-base dissipation is limited to 25 milliwatts at 25° C. For free-air temperatures above 25° C, reduce the dissipation.

[b] See accompanying *Rating Chart* and *Transistor-Dissipation Rating Chart* in General Section.

[c] Measured 1/16" ± 1/32" along lead, down from seating plane.

World Radio History

2N1854

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, free-air temperature = 25° C

Characteristic	Symbol	Min.	Max.	Unit
DC Collector-to-Base Breakdown Voltage for dc collector ma. = -0.025, dc emitter current = 0	BV_{CBO}	-18	-	volts
DC Collector-to-Emitter Breakdown Voltage for base-to-emitter reverse bias dc volts = -0.2, dc collector ma. = -0.025 . .	BV_{CEV}	-18	-	volts
DC Emitter-to-Base Breakdown Voltage for dc emitter ma. = -0.1, dc collector current = 0	BV_{EBO}	-2	-	volts
DC Collector-to-Emitter Latching Voltage[d] for dc collector supply volts = -18, emitter-to-base resistance (ohms) = 1000, load resistance (ohms) = 178 . . .	V_{CERL}	-17	-	volts
DC Collector-to-Emitter Saturation Voltage:	$V_{CE(sat)}$			
With dc collector ma. = -20, dc base ma. = -0.66		-	-0.25	volt
With dc collector ma. = -20, dc base ma. = -0.5.		-	-0.3	volt
With dc collector ma. = -80, dc base ma. = -2.7, free-air temperature = 55° C		-	-0.7	volt
DC Base-to-Emitter Voltage for dc collector ma. = -20, dc base ma. = -0.5.	V_{BE}	-	-0.8	volt
DC Collector-Cutoff Current: With dc collector-to-base volts = -15, dc emitter current = 0, free-air temperature =	I_{CBO}			
25° C		-	-4.2	μa
65° C		-	-40	μa
DC Emitter-Cutoff Current for dc emitter-to-base volts = -2, dc collector current = 0. . .	I_{EBO}	-	-100	μa
Output Capacitance for dc collector-to-base volts = -10, dc emitter current = 0	C_{ob}	-	12	pf
DC Forward-Current Transfer Ratio:	h_{FE}			
With dc collector-to-emitter volts = -0.5, dc collector ma. = -20		40	-	
With dc collector-to-emitter volts = -0.75, dc collector ma. = -100.		25	-	
With dc collector-to-emitter volts = -1, dc collector ma. = -50		-	400	

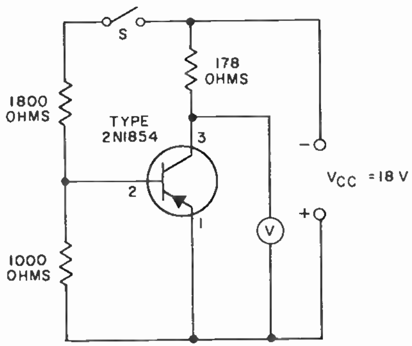
World Radio History

Gain-Bandwidth Product for dc collector-to-emitter volts = -1, dc collector ma. = -10, small-signal short-circuit forward-current transfer ratio = 5	f_T	40	-	Mc
Charge Storage Time:[e]	t_{Qs}			
With dc collector ma. = -20, turn-on dc base ma. = -1.5.		-	60	nsec
With dc collector ma. = -80, turn-on dc base ma. = -4.5.		-	80	nsec

[d] See accompanying *Collector-to-Emitter Latching-Voltage Measurement Circuit.*

[e] See accompanying *Charge-Storage-Time Measurement Circuit.*

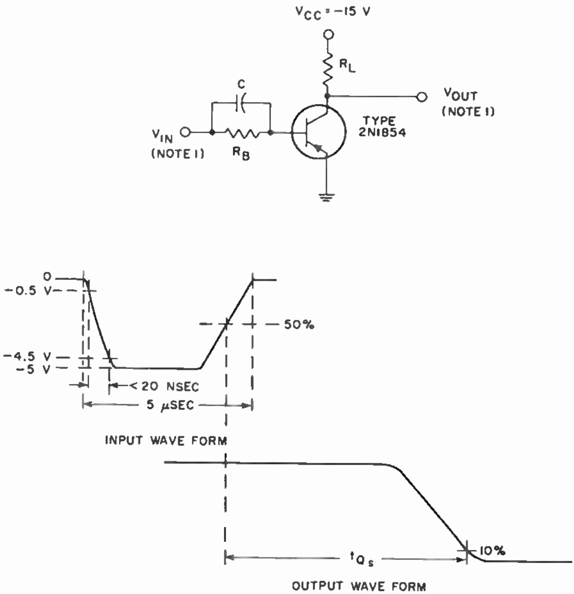
COLLECTOR-TO-EMITTER LATCHING-VOLTAGE MEASUREMENT CIRCUIT



92CS 11715R1

THE TRANSISTOR IS INSERTED IN THE CIRCUIT WITH SWITCH (S) OPEN. THE SWITCH IS THEN CLOSED AND IMMEDIATELY REOPENED. THE RESULTING COLLECTOR-TO-EMITTER VOLTAGE IS THE "LATCHING" VOLTAGE, V_{CERL}.

CHARGE-STORAGE-TIME MEASUREMENT CIRCUIT AND ASSOCIATED WAVE FORMS



92CS 11720

For dc collector ma. = -20
- C: 150 pf
- I_{B_1}: Turn-on dc base ma. = -1.5
- R_B: 3300 ohms
- R_L: 750 ohms

For dc collector ma. = -80
- C: 510 pf
- I_{B_1}: Turn-on dc base ma. = -4.5
- R_B: 1100 ohms
- R_L: 189 ohms

NOTE 1: INPUT AND OUTPUT WAVE FORMS (V_{IN} AND V_{OUT}) SHOULD BE MONITORED BY MEANS OF A SAMPLING OSCILLOSCOPE HAVING A RISE TIME OF LESS THAN 15 NANOSECONDS, A PROBE CAPACITANCE OF NOT MORE THAN 12 PF, AND A SHUNT RESISTANCE OF NOT LESS THAN 10 MEGOHMS.

OPERATING CONSIDERATIONS
and
RATING CHART
shown under type 2N1853 also apply to the 2N1854

World Radio History

Power Transistor

GERMANIUM, P-N-P, DIFFUSED-COLLECTOR, GRADED-BASE, DRIFT-FIELD TYPE

For Industrial and Consumer-Product Applications

GENERAL DATA

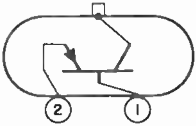
Mechanical:

Operating Position	Any
Maximum Seated Length	0.440"
Maximum Length of Mounting Flange	1.562"
Maximum Width of Mounting Flange	1.031"
Case	Metal
Mounting Flange	Metal
Seals	Hermetic
Socket	Loranger Mfg. Corp. No.2149, or equivalent

Terminal Diagram (See *Dimensional Outline*):

Pin 1 - Base

Pin 2 - Emitter



MOUNTING FLANGE - Collector, Case

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

In such applications as high-power, high-speed switches in dc-to-dc converters, inverters, and computers for data-processing equipment, as ultrasonic oscillators, and as large-signal, wide-band linear amplifiers

COLLECTOR-TO-BASE VOLTAGE	-60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With base open	-40 max.	volts
EMITTER-TO-BASE VOLTAGE	-1 max.	volt
COLLECTOR CURRENT	-10 max.	amp
BASE CURRENT	-3 max.	amp
TRANSISTOR DISSIPATION:		
For mounting-flange temperatures[a] up to 25° C	50 max.	watts
For mounting-flange temperatures[a] above 25° C	See *Rating Chart*	
MOUNTING-FLANGE TEMPERATURE[a] RANGE:		
Operating and storage	-55 to +100	°C
PIN TEMPERATURE:[b]		
For 10 seconds maximum	255 max.	°C

[a] Measured at center of seating surface.
[b] Measured 1/16" ± 1/32" down from plane of seating surface.

World Radio History

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base unless otherwise specified. Mounting-flange temperature[a] of 25° C.

		Min.	Typical	Max.	
DC Collector Breakdown Voltage for dc collector ma. = -10, emitter current = 0 . .	BV_{CBO}	-60	-80	-	volts
DC Collector-to-Emitter Breakdown Voltage for dc collector ma. = -100, base current = 0. . . .	BV_{CEO}	-40	-55	-	volts
DC Emitter Breakdown Voltage for dc emitter ma. = -5, collector current = 0	BV_{EBO}	-1	-2	-	volts
DC Base-to-Emitter Voltage for dc collector-to-emitter volts = -2, dc collector ma. = -1000	V_{BE}	-	-0.38	-0.5	volt
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = -1000, dc base ma. = -50	$V_{CE(sat)}$	-	-0.3	-1	volt
DC Collector-Cutoff Current for dc collector volts = -40, emitter current = 0 . .	I_{CBO}	-	-150	-500	μa
DC Collector-Cutoff Saturation Current for dc collector volts = -0.5, emitter current = 0	$I_{CBO(sat)}$	-	-65	-100	μa
DC Emitter-Cutoff Current for dc emitter volts = -0.5, collector current = 0	I_{EBO}	-	-1	-	ma
DC Current Transfer Ratio for dc collector-to-emitter volts = -2, dc collector ma. = -1000 .	h_{FE}	50	90	150	
Forward Current-Transfer-Ratio Cutoff Frequency for dc collector-to-emitter volts = -5, dc collector ma. = -500. .	f_{hfe}	-	75	-	kc
Gain-Bandwidth Product for dc collector-to-emitter volts = -5, dc collector ma. = -500.	f_T	5	7.5	-	Mc

World Radio History

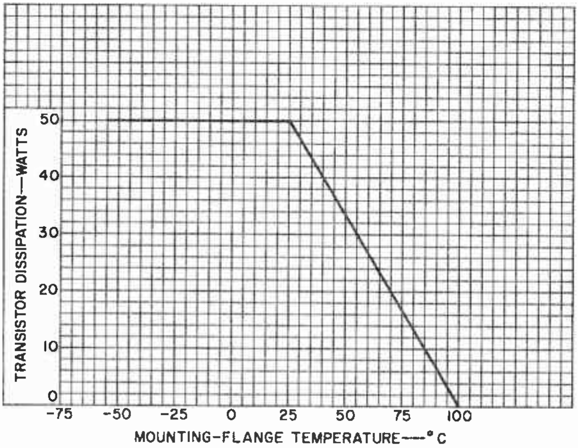
DC Forward Conductance (I_C/V_{BE}) for dc collector-to-emitter volts = -2, dc collector ma. = -1000. . .	G_{FE}	2	4	-	mhos
Thermal Resistance: Junction-to-mounting flange.	R_T	-	-	1.5	°C/watt

[a] Measured at center of seating surface.

OPERATING CONSIDERATIONS,
DIMENSIONAL OUTLINE,
and
SUGGESTED MOUNTING ARRANGEMENT
shown under type **2N1906** also apply to the **2N1905**

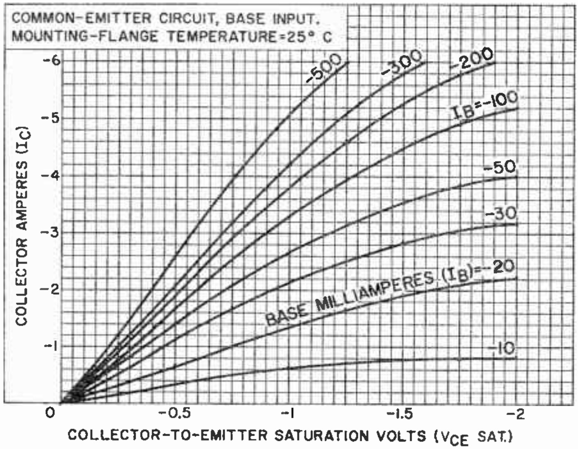
World Radio History

RATING CHART



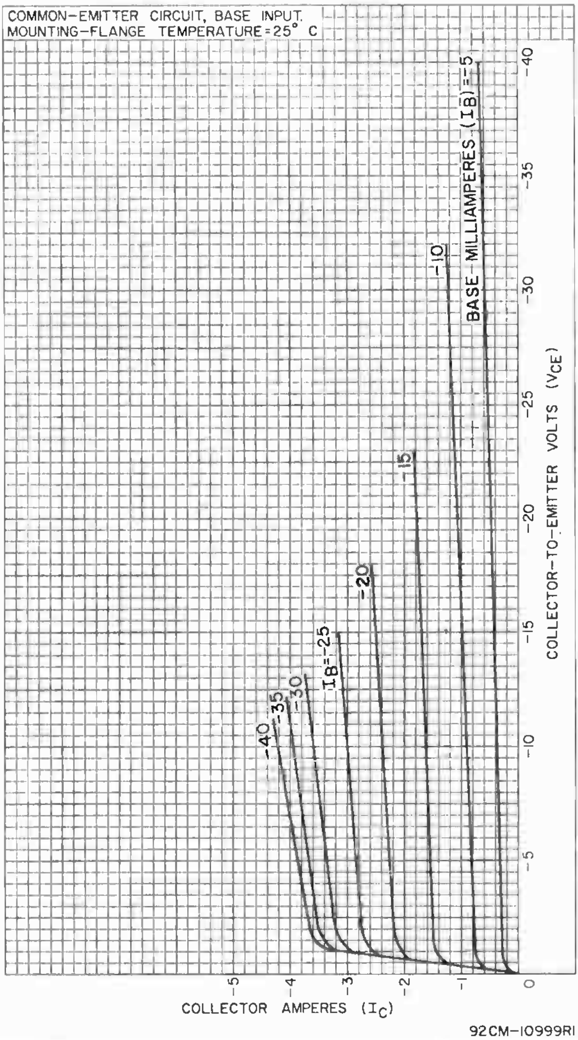
92CS-10991

TYPICAL COLLECTOR-TO-EMITTER SATURATION-VOLTAGE CHARACTERISTICS

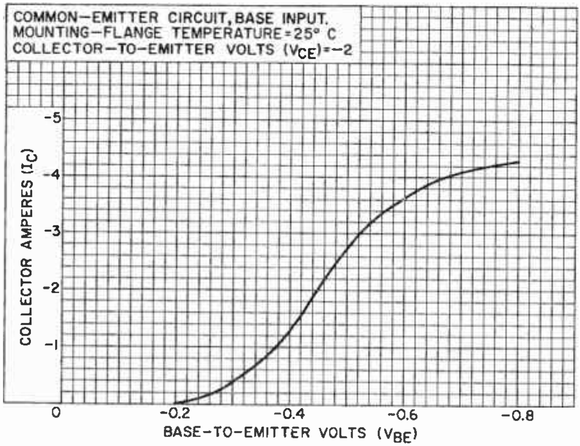


92CS-10997

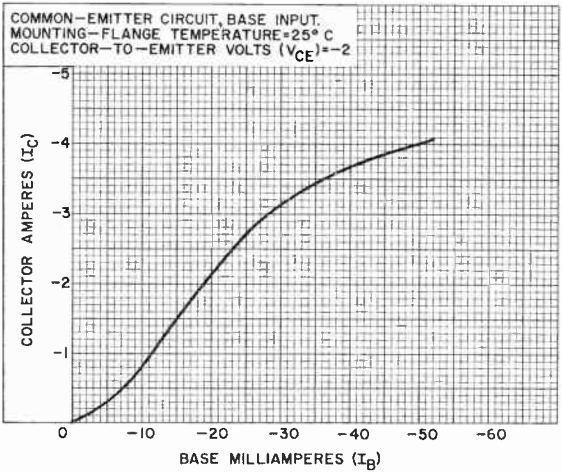
TYPICAL COLLECTOR CHARACTERISTICS



TYPICAL CHARACTERISTICS



92CS-10995



92CS–10993

World Radio History

Power Transistor

GERMANIUM, P-N-P, DIFFUSED-COLLECTOR,
GRADED-BASE, DRIFT-FIELD TYPE

For Industrial and Consumer-Product Applications

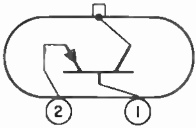
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Seated Length	0.440"
Maximum Length of Mounting Flange	1.562"
Maximum Width of Mounting Flange	1.031"
Case	Metal
Mounting Flange	Metal
Seals	Hermetic
Socket	Loranger Mfg. Corp. No. 2149, or equivalent

Terminal Diagram (See *Dimensional Outline*):

Pin 1 - Base
Pin 2 - Emitter



MOUNTING FLANGE - Collector, Case

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

In such applications as high-power, high-speed switches in dc-to-dc converters, inverters, and computers for data-processing equipment, as ultrasonic oscillators, and as large-signal, wide-band linear amplifiers

COLLECTOR-TO-BASE VOLTAGE	-100 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With base open	-40 max.	volts
EMITTER-TO-BASE VOLTAGE	-1 max.	volt
COLLECTOR CURRENT	-10 max.	amp
BASE CURRENT	-3 max.	amp
TRANSISTOR DISSIPATION:		
For mounting-flange temperatures[a] up to 25° C	50 max.	watts
For mounting-flange temperatures[a] above 25° C	See *Rating Chart*	
MOUNTING-FLANGE TEMPERATURE[a] RANGE:		
Operating and storage	-55 to +100	°C
PIN TEMPERATURE:[b]		
For 10 seconds maximum	255 max.	°C

Typical Operation:

In accompanying typical "on-off" power switching circuit at mounting-flange temperature[a] of 25° C

DC Supply Voltage (V_{CC})	5	12.5	12.5	volts
"On" Collector Current	-1	-2.5	-5	amp
"Turn-On" Base Current (I_{B1})	-	-0.25	-0.25	amp
"Turn-Off" Base Current (I_{B2})	-	0.25	0.25	amp

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Pulse-Generator Open-Circuit Voltage (E)	2	-	-	volts
Base-Bias Resistor (R_1)	75	5	5	ohms
"Speed-Up" Capacitor (C_1)	0.1	-	-	µf
Load Resistor (R_2)	5	5	2.5	ohms
Generator Impedance	5	5	5	ohms
Switching Time:				
Delay time (t_d)	0.1	0.1	0.1	µsec
Rise time (t_r)	0.1	0.4	0.9	µsec
Storage time (t_s)	1	7	7	µsec
Fall time (t_f)	0.6	1	2	µsec

[a] Measured at center of seating surface.
[b] Measured 1/16" ± 1/32" down from plane of seating surface.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base unless otherwise specified. Mounting-flange temperature[a] of 25° C.

		Min.	Typical	Max.	
DC Collector Breakdown Voltage for dc collector ma. = -10, emitter current = 0	BV_{CBO}	-100	-130	-	volts
DC Collector-to-Emitter Breakdown Voltage for dc collector ma. = -100, base current = 0	BV_{CEO}	-40	-55	-	volts
DC Emitter Breakdown Voltage for dc emitter ma. = -5, collector current = 0	BV_{EBO}	-1	-2	-	volts
DC Base-to-Emitter Voltage for dc collector-to-emitter volts = -2, dc collector ma. = -5000	V_{BE}	-	-0.6	-0.9	volt
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = -5000, dc base ma. = -250	$V_{CE(sat)}$	-	-0.75	-1	volt
DC Collector-Cutoff Current for dc collector volts = -40, emitter current = 0	I_{CBO}	-	-150	-500	µa
DC Collector-Cutoff Saturation Current for dc collector volts = -0.5, emitter current = 0	$I_{CBO(sat)}$	-	-65	-100	µa
DC Emitter-Cutoff Current for dc emitter volts = -0.5, collector current = 0	I_{EBO}	-	-1	-	ma

World Radio History

DC Current Transfer Ratio for dc collector-to-emitter volts = -2, dc collector ma. = -5000. . .	h_{FE}	75	125	200	
Forward Current-Transfer-Ratio Cutoff Frequency for dc collector-to-emitter volts = -5, dc collector ma. = -500.	f_{hfe}	-	75	-	kc
Gain-Bandwidth Product for dc collector-to-emitter volts = -5, dc collector ma. = -500.	f_T	5	7.5	-	Mc
DC Forward Conductance (I_C/V_{BE}) for dc collector-to-emitter volts = -2, dc collector ma. = -5000. . .	G_{FE}	5.5	8.3	-	mhos
Thermal Resistance: Junction-to-mounting flange.	R_T	-	-	1.5	°C/watt

[a] Measured at center of seating surface.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

This transistor utilizes the Loranger Mfg. Corp. socket No.2149, or equivalent. Electrical connection can also be made to the base and emitter pins by soldering directly to the pins. Soldering of connections to the pins may be made close to the pin seals provided care is taken to conduct excessive heat away from the pin seal, otherwise the heat of the soldering operation will crack the glass seals of the pins and damage the transistor.

Under no circumstances should the mounting flange be soldered to the heat sink because the heat of the soldering operation will permanently damage the transistor.

It is important that the mounting flange which serves as the collector terminal be securely fastened to a heat sink. Depending on the application, the chassis (heat sink) may be connected either to the positive or negative terminal of the voltage supply.

In applications where the chassis is connected to the negative terminal of the voltage supply, it will be necessary to use an anodized-aluminum insulator having high thermal conductivity, or a 0.002" mica insulator between the mounting flange and the chassis. An aluminum washer should be drilled or punched to provide the two mounting holes, and the clearance holes for the emitter and base pins. The burrs should then

World Radio History

be removed from the washer and the washer finally anodized. To insure that the anodized insulating layer is not destroyed during mounting, it will also be necessary to remove the burrs from the holes in the chassis. Furthermore, to prevent a short circuit between the mounting bolt and the chassis, it is important that an insulating washer be used between the bolt and the chassis (See *Suggested Mounting Arrangement*).

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

To prevent damage to the transistor by thermal runaway, an external resistance may be placed in the emitter or collector circuit. The minimum value of this resistance may be obtained from the following equation:

$$R_{min.} = \frac{E^2}{4\left(P_o + \frac{25}{K}\right)}$$

where:

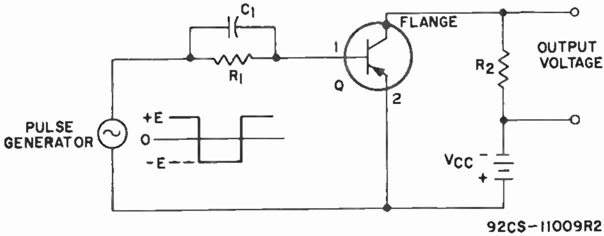
E = DC collector supply voltage (Volts)

P_o = Collector-to-emitter voltage x collector current at desired operating point (Watts)

K = Thermal resistance — transistor and heat sink (°C/watt)

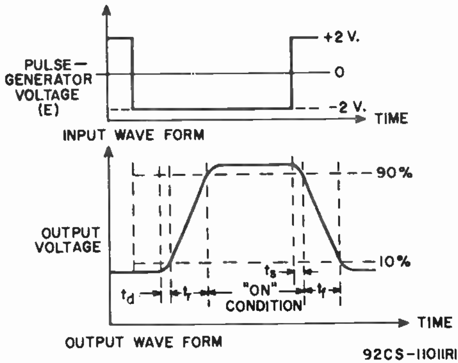
World Radio History

TYPICAL "ON-OFF" POWER SWITCHING CIRCUIT

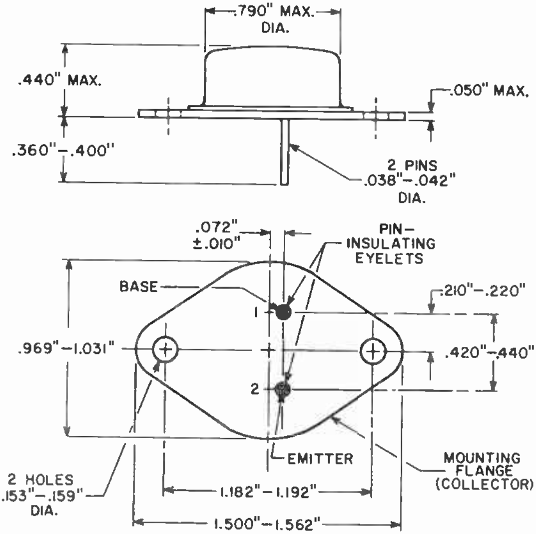


Q: Transistor type 2N1906

ASSOCIATED WAVE FORMS

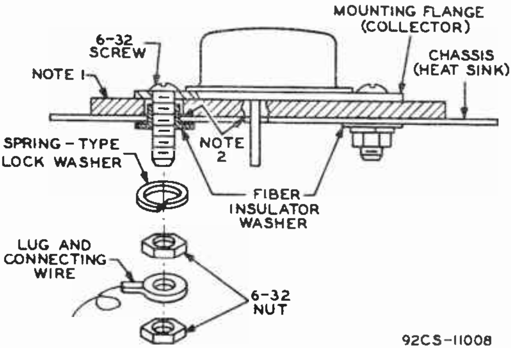


World Radio History



92CS–11000R1

SUGGESTED MOUNTING ARRANGEMENT



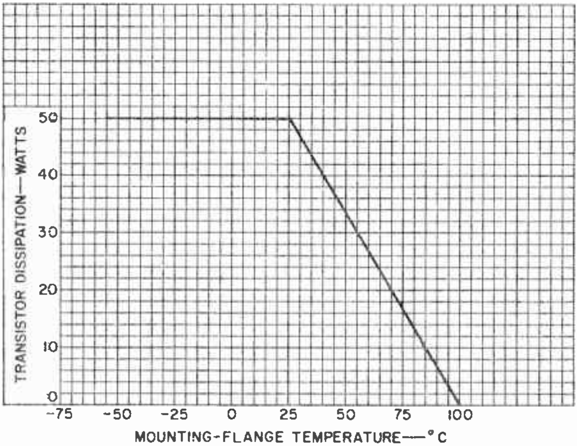
92CS–11008

NOTE 1: 0.002" MICA INSULATOR OR ANODIZED ALUMINUM INSULATOR (DRILLED OR PUNCHED WITH BURRS REMOVED).

NOTE 2: REMOVE BURRS FROM CHASSIS HOLES.

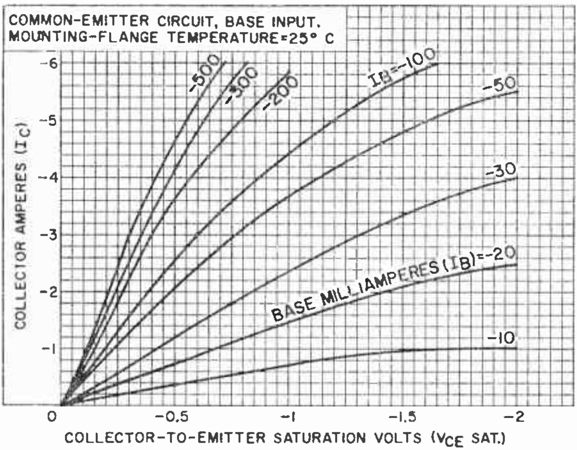
World Radio History

RATING CHART



92CS-10991

TYPICAL COLLECTOR-TO-EMITTER SATURATION-VOLTAGE CHARACTERISTICS



92CS-10998

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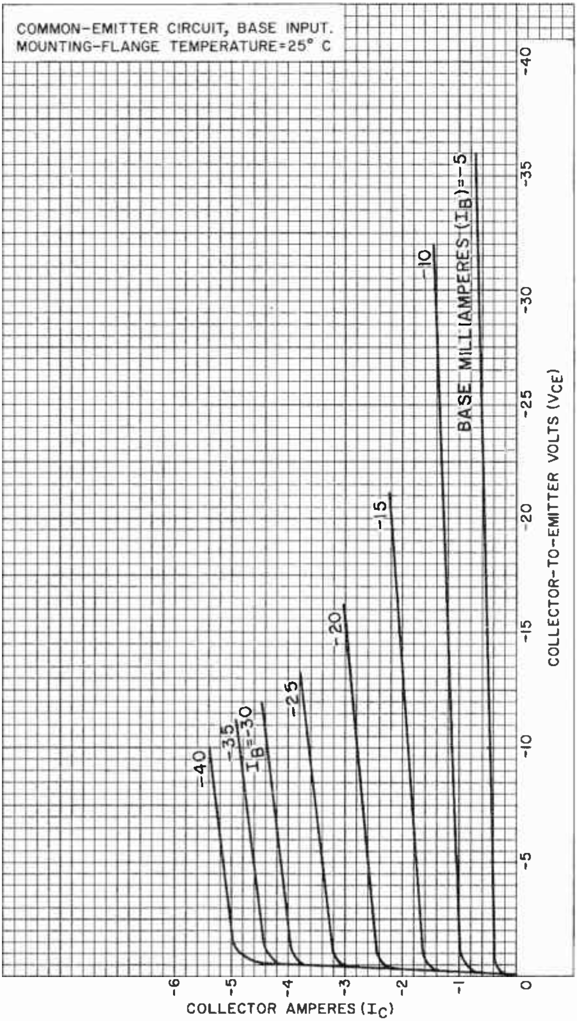
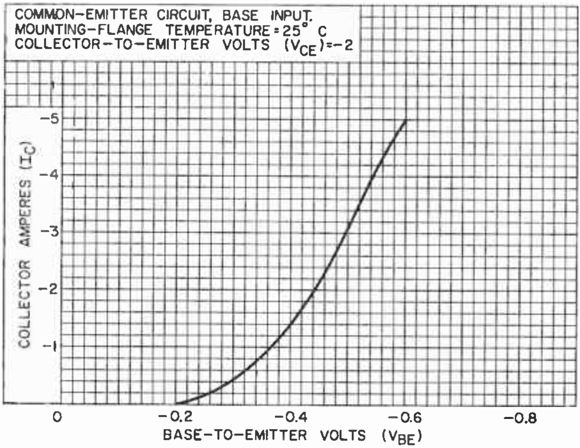
TYPICAL COLLECTOR CHARACTERISTICS

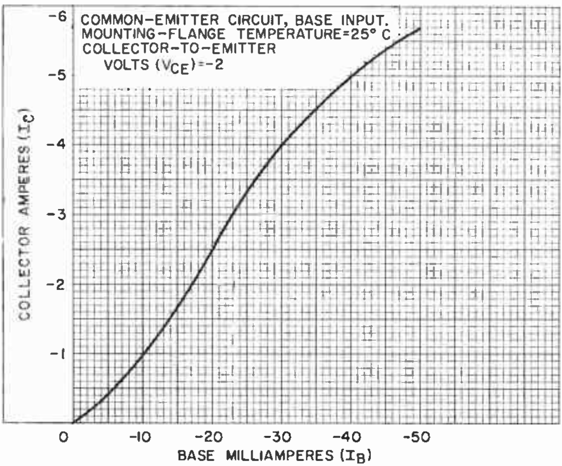


92CM-10996R1

TYPICAL CHARACTERISTICS



92CS-10994



92CS-10992

World Radio History

World Radio History

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For Power Switching and Amplifier Service
in Industrial and Military Applications

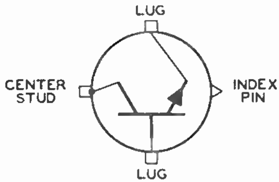
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Seated Length	0.520"
Maximum Diameter	1.250"
Dimensional Outline	JEDEC No.TO-36
Case	Welded, Metal
Seals	Hermetic

Terminal Diagram (See *Dimensional Outline*):

BOTTOM VIEW



INDUSTRIAL SERVICE

Such as dc-to-dc converter, inverter, chopper, relay-control, oscillator, regulator, pulse-amplifier, and class A and class B push-pull-amplifier circuits

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	100 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With base open (Sustaining voltage)[a]	50 max.	volts
EMITTER-TO-BASE VOLTAGE	10 max.	volts
COLLECTOR CURRENT	10 max.	amp
EMITTER CURRENT	-13 max.	amp
BASE CURRENT	6 max.	amp
TRANSISTOR DISSIPATION:[b]		
At case temperature[c] of 25° C or below	150 max.	watts
At case temperatures[c] above 25° C	See *Rating Chart*	
CASE-TEMPERATURE RANGE:[c]		
Operating and storage	-65 to +200	°C
LUG TEMPERATURE:[d]		
For 10 seconds maximum	235 max.	°C

Characteristics:

	At case temperature of 25° C[c]	
Forward Current-Transfer-Ratio Cutoff-Frequency ($f_{\alpha e}$)	25	kc

World Radio History

Collector-to-Base Capacitance (C_{ob}) with dc collector-to-base volts = 40. . .	400	$\mu\mu f$
Thermal Time Constant (τ_1).	30	msec

Typical Operation:

In accompanying pulse-response test circuit at case temperature[c] of 25° C

Collector Supply Voltage (V_{CC}).	24	volts
DC Base-Bias Voltage (V_{BB}).	-6	volts
"On" DC Collector Current	10	amp
"Turn-On" Base Current (I_{B1}).	2	amp
Base Resistance (R_{B1})	10	ohms
Base Resistance (R_{B2})	10	ohms
Collector Resistance (R_C)	2	ohms
Switching Time:		
"Turn-on" time [Relay time (t_d) + rise time (t_r)]	4	μsec
"Turn-off" time [Storage time (t_s) + fall time (t_f)]	7	μsec

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{CE}M$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[b] See accompanying *Rating Chart* and also *Transistor-Dissipation Rating Chart* in General Section.

[c] Measured at intersection of seating surface with mounting stud.

[d] Measured 1/16" ± 1/32" down from seating surface.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and at case temperature[c] of 25° C unless otherwise specified

		Min.	*Max.*	
DC Collector-to-Emitter Voltage:				
With emitter reverse-bias volts = 1.5, dc collector ma. = 2	V_{CEX}	-	100	volts
With base open (Sustaining voltage), dc collector ma. = 200, dc base ma. = 0.	$V_{CEO(sus)}$[a]	-	50	volts
DC Base-to-Emitter Voltage for dc collector-to-emitter volts = 4, dc collector amperes = 5 . . .	V_{BE}	-	2.2	volts
DC Collector-Cutoff Current for dc collector volts = 30, dc emitter ma. = 0, case temperature =	I_{CBO}			
25° C		-	50	μa
150° C.		-	2	ma
DC Emitter-Cutoff Current for dc emitter volts = 10, dc collector ma. = 0	I_{EBO}	-	50	μa

World Radio History

DC Forward-Current Transfer Ratio for dc collector-to-emitter volts = 4, dc collector amperes =	h_{FE}			
5		15	50	
10.		7.5	-	
Collector-to-Emitter Saturation Resistance for dc collector amperes = 5, dc base amperes = 0.5	R_S	-	0.25	ohm
Thermal Resistance: Junction-to-case.	R_T	-	1.17	^{o}C/watt

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO(sus)}$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[c] Measured at intersection of seating surface with mounting stud.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

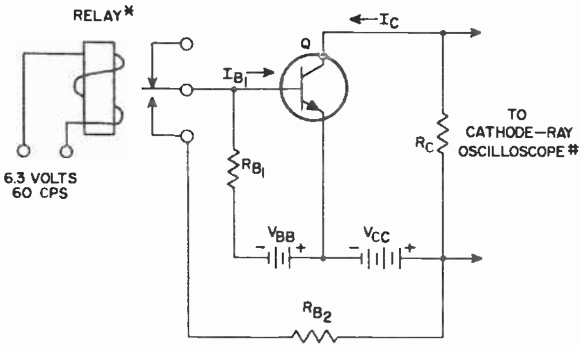
Electrical connection can be made to the base and emitter lugs by means of clips or by soldering directly to the lugs. When soldering connections are made to the lugs, care should be taken to conduct excessive heat away from the lug seals, otherwise the heat of the soldering operation will crack the glass seals of the lugs and damage the transistor.

This transistor is provided with a single-ended stud for mounting to a heat sink and for electrical connection to the collector. (See accompanying *Suggested Mounting Arrangement*). Electrical connection to the base and to the emitter is made to their respective lugs.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

World Radio History

PULSE-RESPONSE TEST CIRCUIT



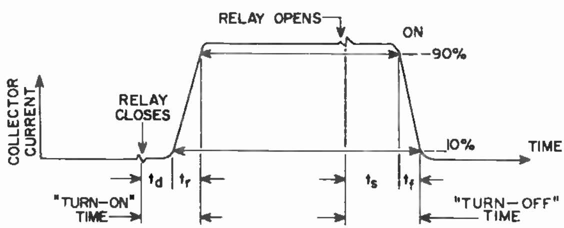
*C.P. CLARE TYPE HGP-1028
OR EQUIVALENT

TEKTRONIX TYPE 545
OR EQUIVALENT

92CS-11125R1

Q: Transistor type 2N2015

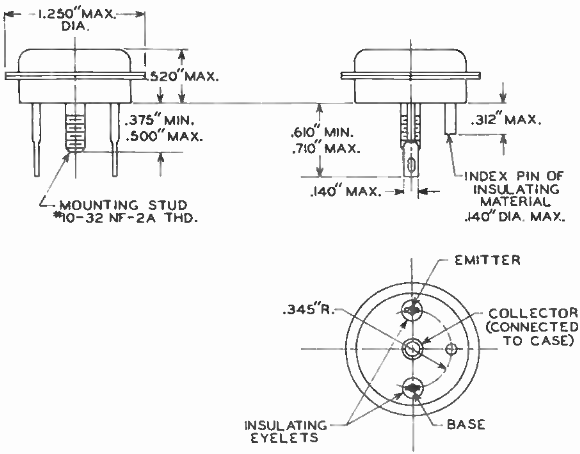
ASSOCIATED WAVE FORM



92CS-11126R1

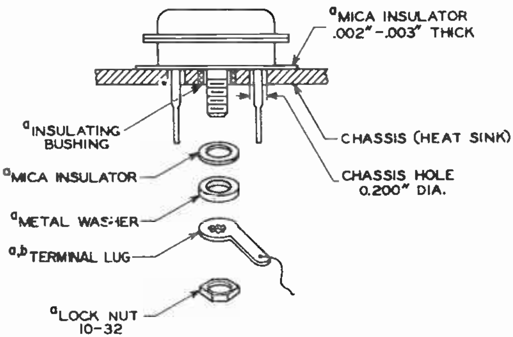
World Radio History

JEDEC No. TO-36



92CM-10612R1

SUGGESTED MOUNTING ARRANGEMENT



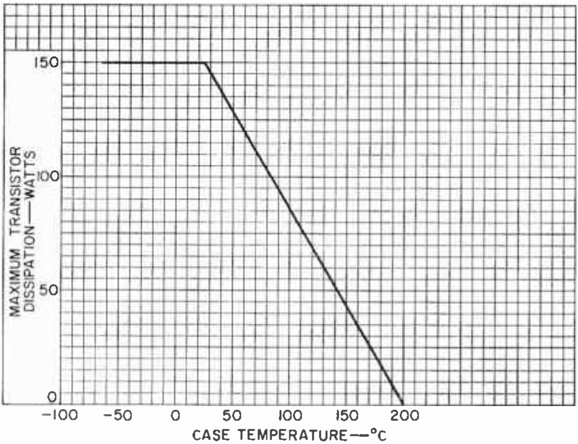
92CS-11133

[a] SUPPLIED WITH EACH TRANSISTOR.

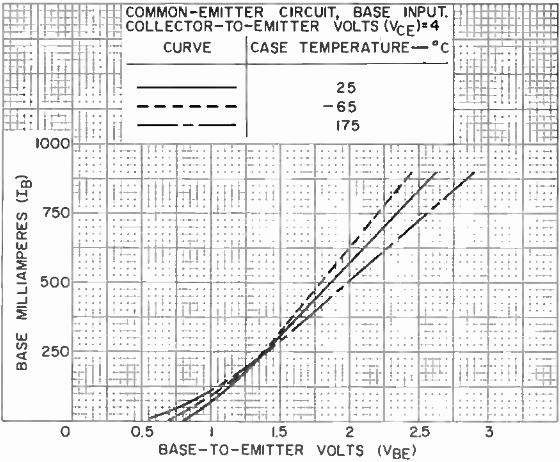
[b] SHAKEPROOF DIVISION, ILLINOIS TOOL WORKS, CATALOG No. 2102-6.

World Radio History

RATING CHART

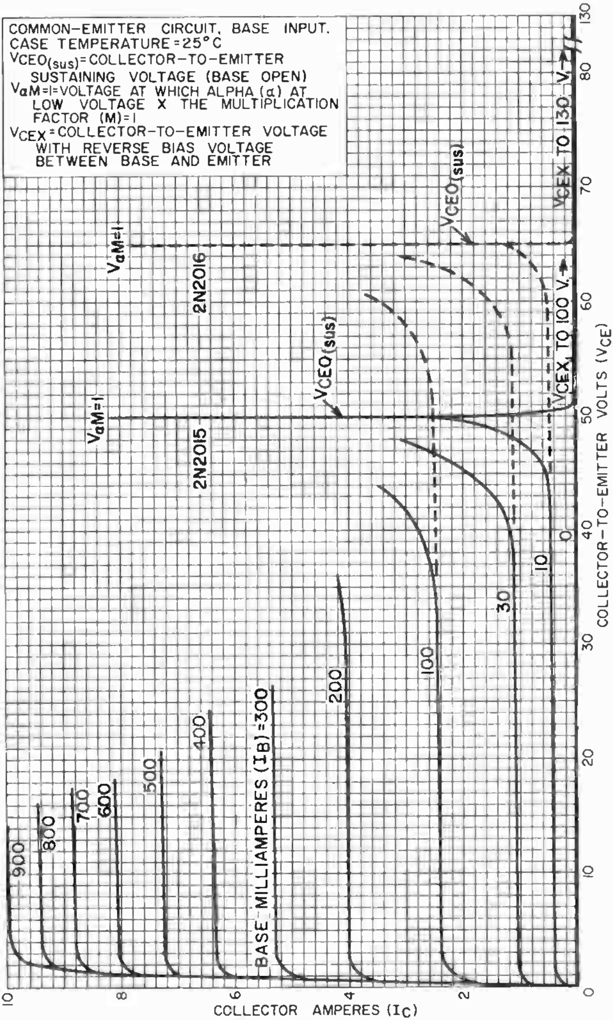


TYPICAL BASE CHARACTERISTICS



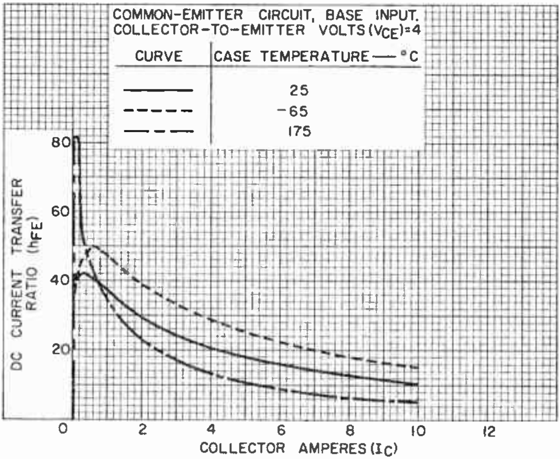
World Radio History

TYPICAL COLLECTOR CHARACTERISTICS

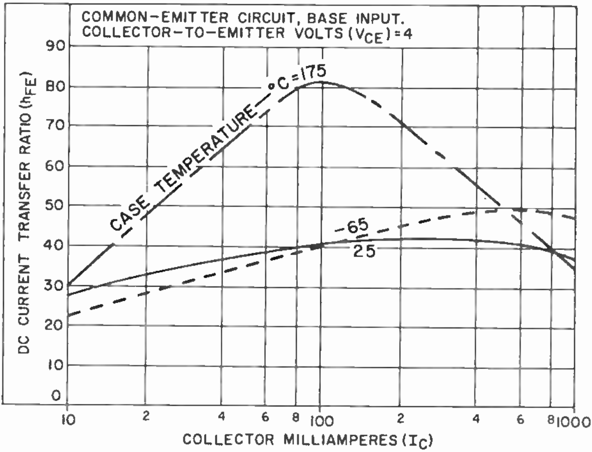


92CM-11092R1

TYPICAL DC-CURRENT-TRANSFER-RATIO CHARACTERISTICS



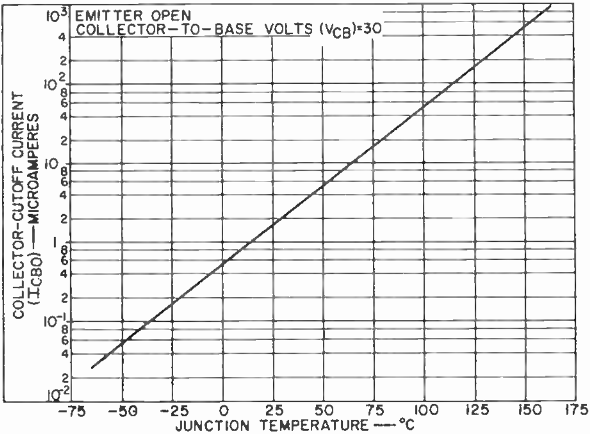
92CS-11090



92CS-11095

World Radio History

TYPICAL COLLECTOR-CUTOFF-CURRENT CHARACTERISTIC



92CS–11094

World Radio History

World Radio History

Power Transistor

SILICON N-P-N DIFFUSED-JUNCTION TYPE

For Power Switching and Amplifier Service in Industrial and Military Applications

The 2N2016 is the same as the 2N2015 except for the following items:

INDUSTRIAL SERVICE

Such as in dc-to-dc converter, inverter, chopper, relay-control, oscillator, regulator, pulse-amplifier, and class A and class B push-pull-amplifier circuits

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	130 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With base open (Sustaining voltage)[a]. .	65 max.	volts

ELECTRICAL CHARACTERISTICS

		Min.	*Max.*	
DC Collector-to-Emitter Voltage:				
With emitter reverse-bias volts = 1.5, dc collector ma. = 2	V_{CEX}	-	130	volts
With base open (Sustaining voltage), dc collector ma. = 200, dc base current = 0	$V_{CEO}{}^{a}(sus)$	-	65	volts

[a] The Collector-to-Emitter Sustaining Voltage ($V_{CEO}(sus)$) with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1: voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

World Radio History

World Radio History

Transistor

SILICON N-P-N TRIPLE-DIFFUSED-JUNCTION PLANAR TYPE
For Industrial and Military Applications
The 2N2102 is Unilaterally Interchangeable with Type 2N1613

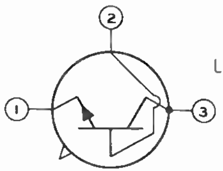
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No.TO-5
Case	Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter
Lead 2 – Base
Lead 3 – Collector, Case



INDUSTRIAL SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:		
With emitter open	120 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With external resistance (ohms) ≤ 10 between base and emitter	80 max.	volts
With base open	65 max.	volts
EMITTER-TO-BASE VOLTAGE:		
With collector open	7 max.	volts
COLLECTOR CURRENT	1 max.	amp
TRANSISTOR DISSIPATION:[a]		
At case temperature[b] of 25° C or below	5 max.	watts
At free-air temperature of 25° C or below	1 max.	watt
TEMPERATURE RANGE:		
Storage	-65 to +300	°C
Operating (Junction)	-65 to +200	°C
LEAD TEMPERATURE:[c]		
For 10 seconds maximum	300 max.	°C

[a] See accompanying *Rating Chart*.
[b] Measured at center of seating plane.
[c] Measured 1/16" ± 1/32" down from seating plane.

World Radio History

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and at case temperature[b] of 25° C unless otherwise specified

		Min.	Max.	
DC Collector Breakdown Voltage for dc collector ma. = 0.1, dc emitter ma. = 0.	BV_{CBO}	120	–	volts
DC Emitter Breakdown Voltage for dc collector ma. = 0, dc emitter ma. = 0.1 .	BV_{EBO}	7	–	volts
DC Collector-to-Emitter Reach-Through Voltage for dc emitter volts = 1.5, dc collector ma. = 0.1.	V_{RT}	120	–	volts
DC Collector-to-Emitter Sustaining Voltage for dc collector ma. = 100:				
With external base-to-emitter resistance (ohms) ≤ 10.	$V_{CER}(sus)$	80	–	volts
With base ma. = 0. . . .	$V_{CEO}(sus)$	65	–	volts
DC Base-to-Emitter Saturation Voltage for dc collector ma. = 150, dc base ma. = 15.	$V_{BE}(sat)$	–	1.1	volts
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = 150, dc base ma. = 15	$V_{CE}(sat)$	–	0.5	volt
DC Collector-Cutoff Current for dc collector volts = 60, dc emitter ma. = 0, case temperature[b] =	I_{CBO}			
25° C.		–	0.002	μa
150° C		–	2	μa
DC Emitter-Cutoff Current for dc base volts = 5, dc collector ma. = 0 . .	I_{EBO}	–	0.002	μa
Input Resistance at frequency of 1 kc:	h_{ib}			
With dc collector-to-emitter volts = 5, dc collector ma. = 1 .		24	34	ohms
With dc collector-to-emitter volts = 10, dc collector ma. = 5 .		4	8	ohms
Input Capacitance for dc emitter volts = 0.5, dc collector ma. = 10 . . .	C_{ib}	–	80	μμf

World Radio History

Output Capacitance for dc collector volts = 10, dc emitter ma. = 0.	C_{ob}	–	15	μμf
Output Conductance at frequency of 1 kc:	h_{ob}			
With dc collector-to-emitter volts = 5, dc collector ma. = 1		0.1	0.5	μmho
With dc collector-to-emitter-volts = 10, dc collector ma. = 5.		0.1	1	μmho
Small-Signal Forward Current Transfer Ratio:	h_{fe}			
With dc collector-to-emitter volts = 5, dc collector ma. = 1, frequency (kc) = 1		30	100	
With dc collector-to-emitter volts = 10, dc collector ma. = 5, frequency (kc) = 1		35	150	
With dc collector-to-emitter volts = 10, dc collector ma. = 50, frequency (Mc) = 20. . . .		3	–	
DC-Pulse Forward-Current Transfer Ratio for dc collector-to-emitter volts = 10, pulse duration (μsec) = 300, duty factor of 0.018, dc collector ma. =	h_{FE}			
150.		40	120	
500.		25	–	
1000		10	–	
DC Forward Current Transfer Ratio:	h_{FE}			
With dc collector-to-emitter volts = 10, dc collector ma. =				
0.01		10	–	
0.1.		20	–	
10		35	–	
With dc collector-to-emitter volts = 10, dc collector ma. = 10, case temperature[b] of -55° C.		20	–	
Voltage-Feedback Ratio at frequency of 1 kc:	h_{rb}			
With dc collector-to-emitter volts = 5, dc collector ma. = 1.		–	3×10^{-4}	
With dc collector-to-emitter volts = 10, dc collector ma. = 5.		–	3×10^{-4}	

World Radio History

Noise Figure for signal frequency of 1 kc, circuit bandwidth of 15 kc, generator resistance (ohms) = 1000, dc collector-to-emitter volts = 10, dc collector ma. = 0.3.	NF	–	6	db
Total Switching Time[d] (Delay time + rise time + fall time).	$t_d+t_r+t_f$	–	30	$m\mu sec$
Thermal Resistance:	R_T			
Junction-to-case.		–	35	°C/watt
Junction-to-free air.		–	175	°C/watt

[b] Measured at center of seating plane.
[d] See accompanying *Total-Switching-Time Measurement Circuit.*

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

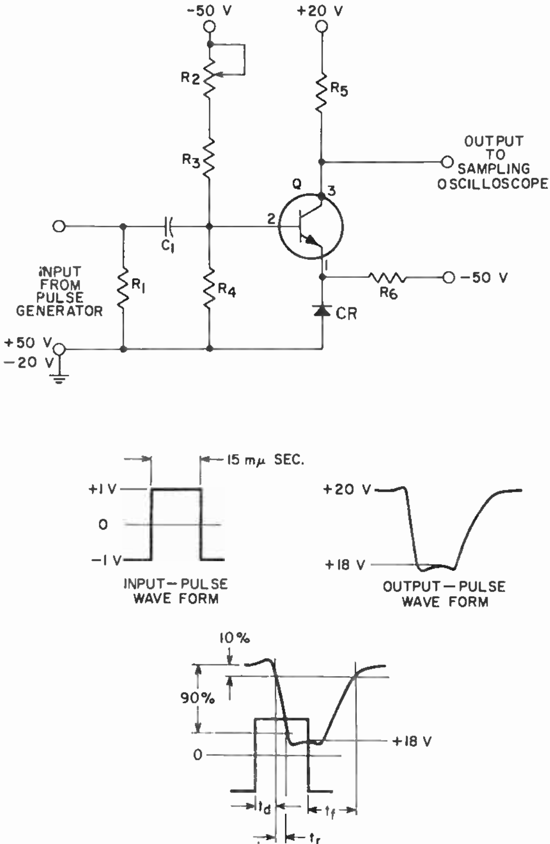
The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the seating plane provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

This transistor is intended for socketed, single-side printed-circuit boards and in conventional wire-in type circuits. If this transistor is used in double-side printed-circuit boards or in printed-circuit boards utilizing eyelets, it may be necessary to use an insulating washer or similar standoff device made of good dielectric material to prevent the solder from shorting the leads to each other or to the board, and to prevent the collector from shorting to ground.

It is to be noted that the case of this transistor operates at the collector voltage. Consideration, therefore, should be given to the possibility of shock hazard, if the case of this transistor is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

World Radio History

TOTAL-SWITCHING-TIME MEASUREMENT CIRCUIT
AND ASSOCIATED WAVE FORMS



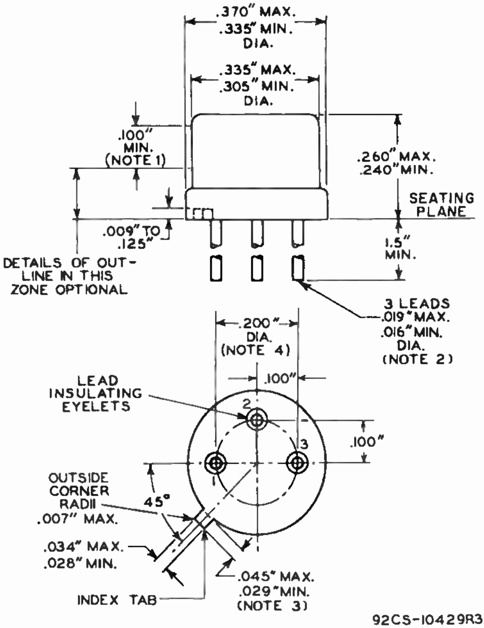
92CS-11186R1

C1: 0.01 μf
CR: Semiconductor diode type 1N3064
Q: Transistor type 2N2102
R1: 100 ohms

R2: 1000 ohms
R3: 4700 ohms
R4: 100 ohms
R5: 40 ohms
R6: 1000 ohms, 5 watts

World Radio History

JEDEC No.TO-5



NOTE 1: THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE VARIATION IN ACTUAL DIAMETER WITHIN THE ZONE SHALL NOT EXCEED 0.010".

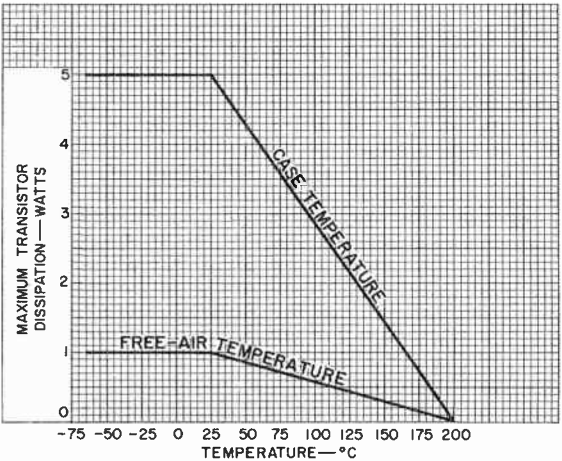
NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE SEATING PLANE. BETWEEN 0.25" AND 1.5" A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 3: MEASURED FROM MAXIMUM DIAMETER OF THE ACTUAL DEVICE.

NOTE 4: LEADS HAVING MAXIMUM DIAMETER (0.019") MEASURED IN GAUGING PLANE 0.054" + 0.001" - 0.000" BELOW THE SEATING PLANE OF THE DEVICE SHALL BE WITHIN 0.007" OF THEIR TRUE LOCATIONS RELATIVE TO A MAXIMUM-WIDTH TAB.

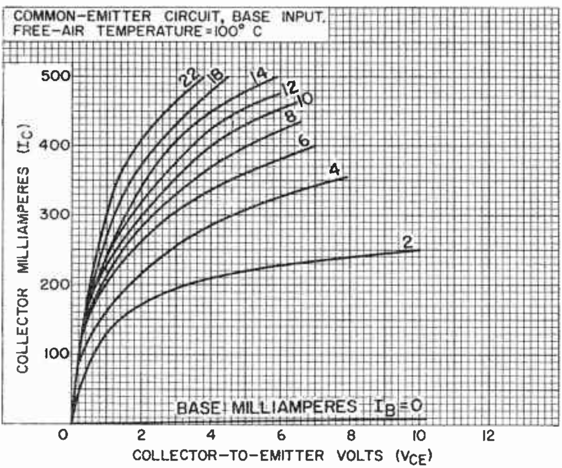
World Radio History

RATING CHART



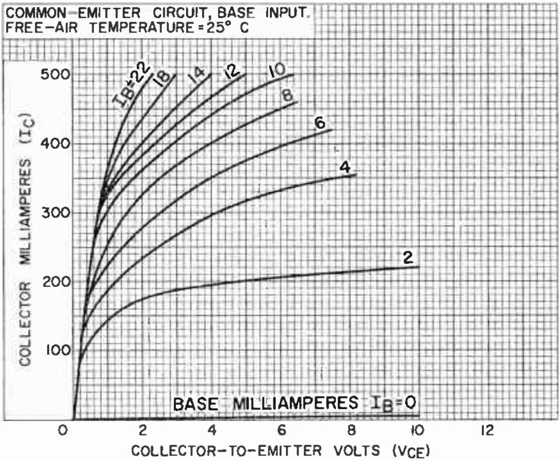
92CS-11172R1

TYPICAL COLLECTOR CHARACTERISTICS

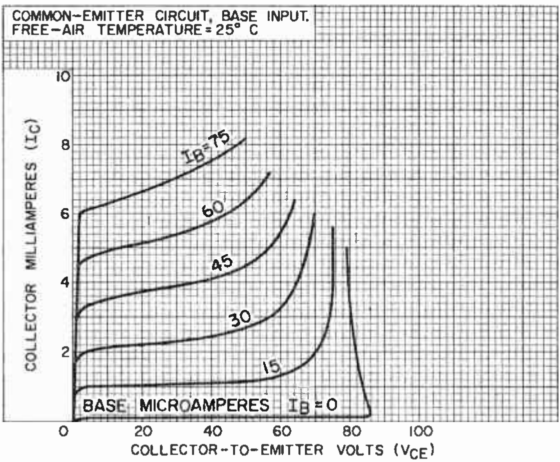


92CS-11177

TYPICAL COLLECTOR CHARACTERISTICS



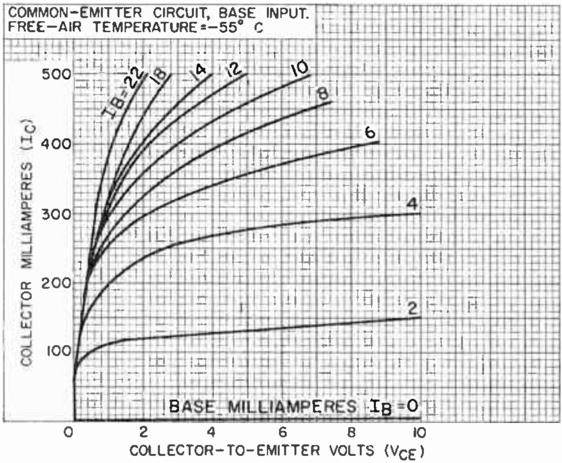
92CS-11176



92CS-11175

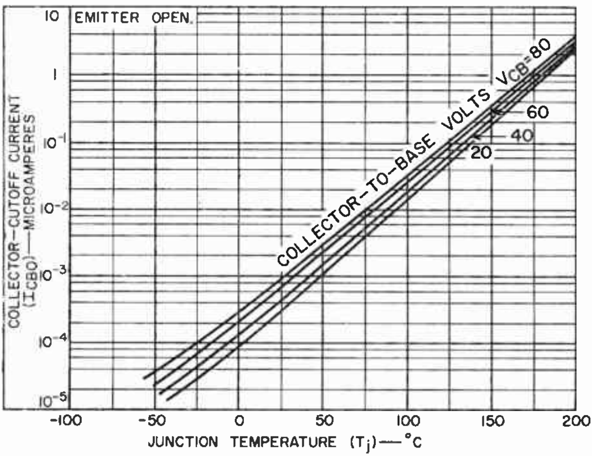
World Radio History

TYPICAL COLLECTOR CHARACTERISTICS



92CS-11190

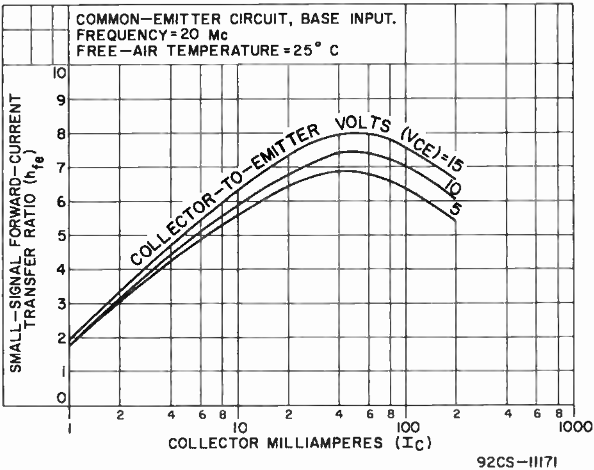
TYPICAL COLLECTOR-CUTOFF-CURRENT CHARACTERISTICS



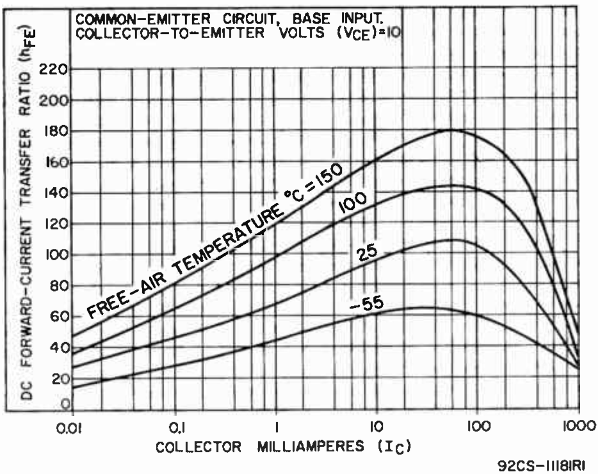
92CS-11170

World Radio History

TYPICAL SMALL-SIGNAL FORWARD-CURRENT TRANSFER-RATIO CHARACTERISTICS

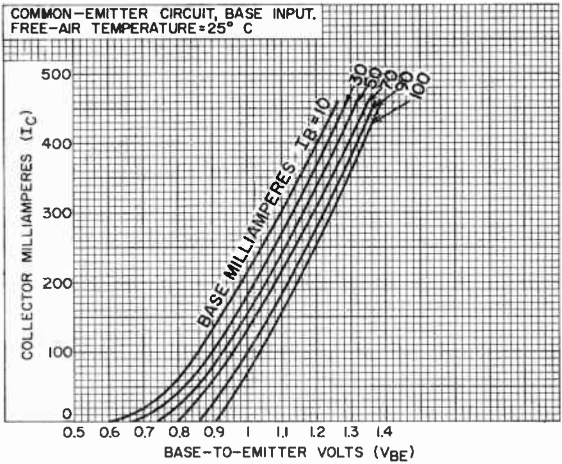


TYPICAL DC FORWARD-CURRENT TRANSFER-RATIO CHARACTERISTICS



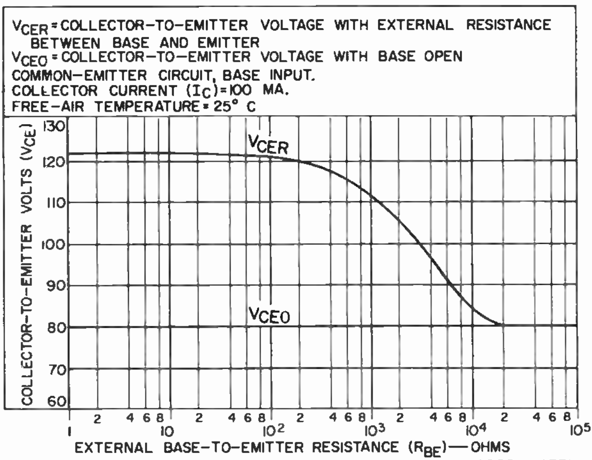
World Radio History

TYPICAL TRANSFER CHARACTERISTICS



92CS-11185

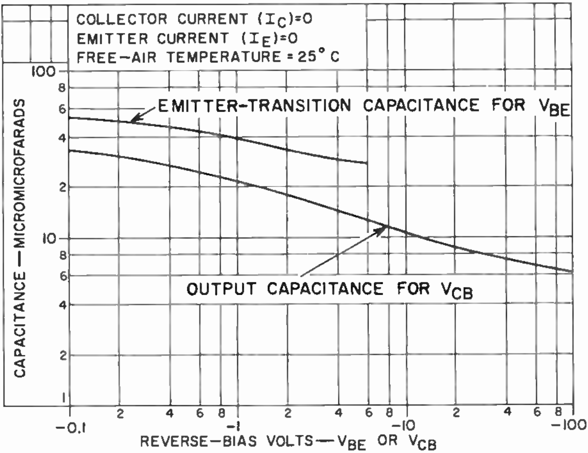
TYPICAL COLLECTOR-TO-EMITTER-VOLTAGE CHARACTERISTICS



92CS-11193R1

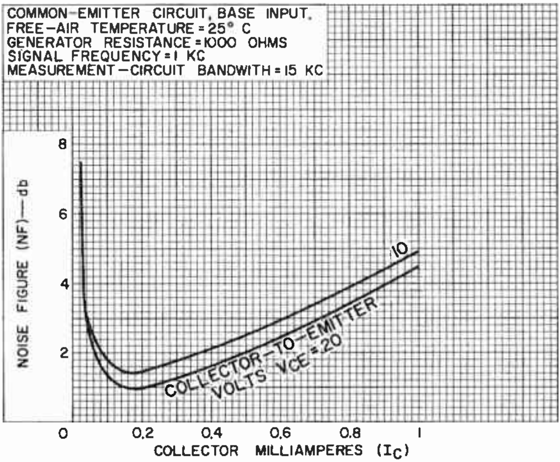
World Radio History

TYPICAL EMITTER-TRANSITION-CAPACITANCE AND OUTPUT-CAPACITANCE CHARACTERISTICS



92CS-11195

TYPICAL AF NOISE-FIGURE CHARACTERISTICS



92CS-11179R1

World Radio History

Transistor

SILICON N-P-N DOUBLE-DIFFUSED-JUNCTION EPITAXIAL-PLANAR TYPE

For Switching Applications in
Industrial and Military Equipment

The 2N2205 is the same as the 2N1708 except for the following items:

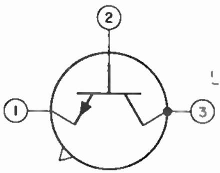
GENERAL DATA

Mechanical:

Operating Position. . . . . Any
Maximum Length (Excluding flexible leads) . . . . 0.210"
Maximum Diameter. . . . . 0.230"
Dimensional Outline . . . . .JEDEC No.TO-18
Case. . . . . Metal
Seals . . . . .Hermetic
Leads, Flexible 3
  Minimum length. . . . . 0.500"
  Orientation and diameter. . . . . . See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

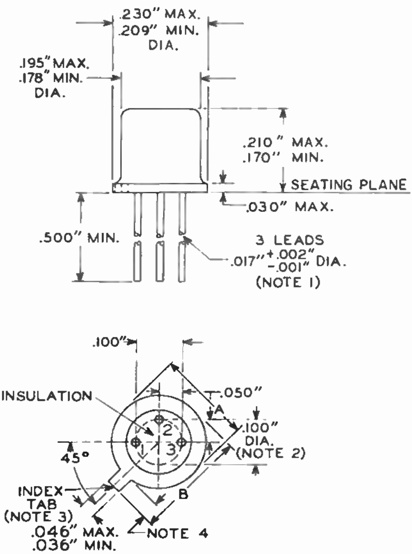
Lead 1 - Emitter
Lead 2 - Base



Lead 3 - Collector, Case

World Radio History

JEDEC No. TO-18



92CS-10605R2

NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE SEATING PLANE. BETWEEN 0.25" TO THE END OF THE LEAD A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 2: MAXIMUM DIAMETER LEADS AT A GAUGING PLANE 0.054" + 0.001" – 0.000" BELOW SEATING PLANE TO BE WITHIN 0.007" OF THEIR TRUE LOCATION RELATIVE TO MAXIMUM WIDTH TAB AND TO THE MAXIMUM 0.230" DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

NOTE 3: FOR VISUAL ORIENTATION ONLY.

NOTE 4: TAB LENGTH TO BE 0.028" MINIMUM AND 0.048" MAXIMUM, AND WILL BE DETERMINED BY SUBTRACTING DIAMETER "A" FROM DIMENSION "B".

World Radio History

2N2206

Transistor

SILICON N-P-N DOUBLE-DIFFUSED-JUNCTION EPITAXIAL-PLANAR TYPE

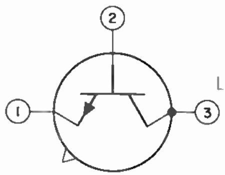
For Switching Applications in
Industrial and Military Equipment

GENERAL DATA

Mechanical:

Operating Position . . . . Any
Maximum Length (Excluding flexible leads) . . . . 0.080"
Maximum Diameter. . . . . 0.230"
Dimensional Outline . . . . .JEDEC No.TO-46
Case. . . . . Metal
Seals . . . . .Hermetic
Leads, Flexible 3
  Minimum length. . . . . 0.500"
  Orientation and diameter. . . . . . . See *Dimensional Outline*
Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter
Lead 2 - Base



Lead 3 - Collector,
Case

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:			
With emitter open	V_{CBO}	25 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:			
With external resistance between base and emitter (ohms) = 1000, load resistance (ohms) = 100	V_{CERL}	20 max.	volts
EMITTER-TO-BASE VOLTAGE:			
With collector open	V_{EBO}	3 max.	volts
COLLECTOR CURRENT	I_C	Limited by power dissipation	
TRANSISTOR DISSIPATION:[a]			
At case temperature[b] of 25° C or below.		1 max.	watt
At free-air temperature of 25° C or below.		0.3 max.	watt
TEMPERATURE RANGE:			
Storage		-65 to +300	°C
Operating		-65 to +175	°C
LEAD TEMPERATURE:[c]			
For 10 seconds maximum.		235 max.	°C

[a] See accompanying *Rating Chart*.

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[b] Measured at center of seating plane.
[c] Measured 1/16" ± 1/32" down from seating plane.

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and free-air temperature of 25° C unless otherwise specified

		Min.	Max.	
DC Collector Breakdown Voltage for dc collector ma. = 0.1, emitter ma. = 0	BV_{CBO}	25	-	volts
DC Emitter Breakdown Voltage for dc emitter ma. = 0.1, collector ma. = 0	BV_{EBO}	3	-	volts
DC Collector-to-Emitter Latching Voltage[d] for external resistance between base and emitter (ohms) = 1000, load resistance (ohms) = 100 . . .	V_{CERL}	20	-	volts
DC Base-to-Emitter Saturation Voltage for dc collector ma. = 10, dc base ma. = 1	$V_{BE(sat)}$	0.7	0.9	volt
DC Collector-to-Emitter Saturation Voltage:	$V_{CE(sat)}$			
With dc collector ma. = 10, dc base ma. = 1		-	0.22	volt
With dc collector ma. = 50, dc base ma. = 5		-	0.35	volt
DC Collector-Cutoff Current for dc collector volts = 15, emitter ma. = 0, free-air temperature =	I_{BCO}			
25° C		-	0.025	μa
150° C.		-	15	μa
DC Collector Current for base-to-emitter forward bias volts = 0.35, dc collector-to-emitter volts = 10, free-air temperature = 100° C.	I_{CEX}	-	15	μa
Collector-to-Base Capacitance for dc collector volts = 10, emitter ma. = 0, frequency (kc) = 140.	C_{ob}	-	6	pf
DC Current Transfer Ratio for dc collector to emitter volts = 1, dc collector ma. = 10.	h_{FE}	40	120	
Small-Signal Current Transfer Ratio for dc collector-to-emitter volts = 10, dc collector ma. = 10, frequency (Mc) = 100	h_{fe}	2	-	

World Radio History

Storage Time[e] for dc collector supply volts = 10, collector resistance (ohms) = 1000, turn-on and turn-off dc base ma. = 10 each, dc collector ma. = 10.	t_s	-	35	μsec
Turn-On Time[f] (Delay time + rise time) for dc collector supply volts = 3, turn-on dc base ma. = 3, turn-off dc base ma. = 1, dc collector ma. = 10	$t_d + t_r$	-	40	μsec
Turn-Off Time[f] (Storage time + fall-time) for dc collector supply volts = 3, turn-on dc base ma. = 3, turn-off dc base ma. = 1, dc collector ma. = 10	$t_s + t_f$	-	75	μsec

[d] For description of this test, write Commercial Engineering, Semiconductor & Materials Division, RCA, Somerville, New Jersey.

[e] See accompanying *Storange-Time-Measurement Circuit.*

[f] See accompanying *Turn-On-Time and Turn-Off-Time Measurement Circuit.*

OPERATING CONSIDERATIONS

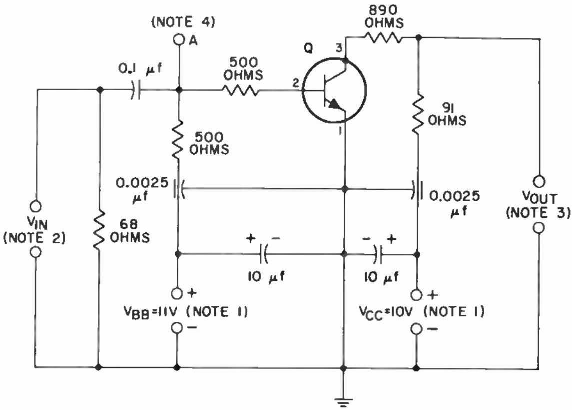
It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the seating plane provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

World Radio History

STORAGE-TIME-MEASUREMENT CIRCUIT



92CS-11226R2

Q: Transistor type 2N2206

NOTE 1: WITH CERTAIN TYPES OF POWER SUPPLIES, IT MAY BE NECESSARY TO CONNECT 25-μf DECOUPLING CAPACITORS ACROSS THE POWER-SUPPLY TERMINALS FOR V_{CC} AND V_{BB}.

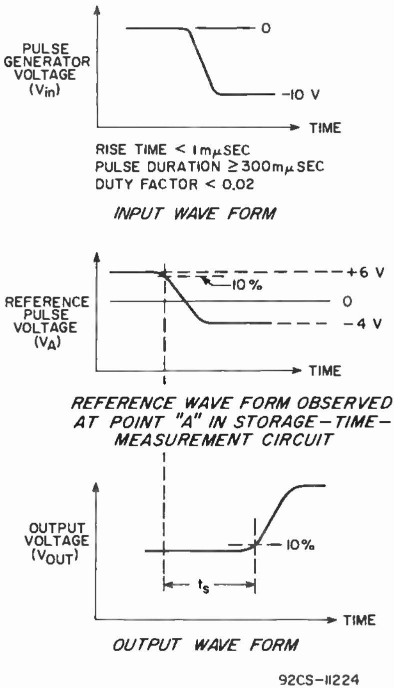
NOTE 2: INPUT VOLTAGE (V_{IN}) OBTAINED FROM MERCURY-RELAY TYPE PULSE GENERATOR HAVING AN OUTPUT IMPEDANCE OF 50 OHMS.

NOTE 3: THE ASSOCIATED INPUT AND OUTPUT WAVE FORMS SHOWN SHOULD BE MONITORED BY MEANS OF A SAMPLING OSCILLOSCOPE HAVING AN INPUT IMPEDANCE OF 50 OHMS.

NOTE 4: TEST POINT FOR OBSERVATION OF REFERENCE PULSE VOLTAGE (V_A).

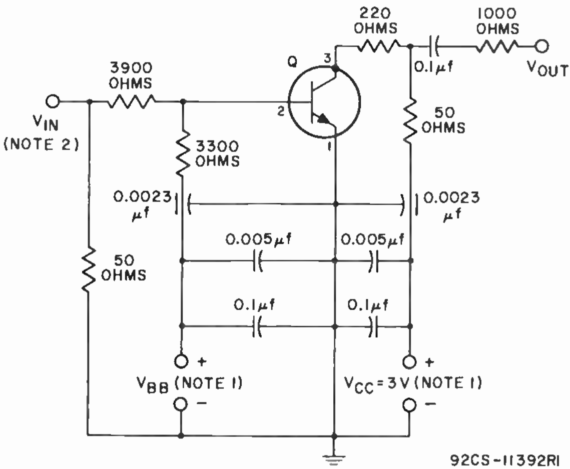
World Radio History

ASSOCIATED WAVE FORMS



World Radio History

TURN-ON-TIME AND TURN-OFF-TIME MEASUREMENT CIRCUIT



92CS-11392R1

Q: Transistor type 2N2206

NOTE 1: WITH CERTAIN TYPES OF POWER SUPPLIES, IT MAY BE NECESSARY TO CONNECT 25-µf DECOUPLING CAPACITORS ACROSS THE POWER-SUPPLY TERMINALS FOR V_{CC} AND V_{BB}.

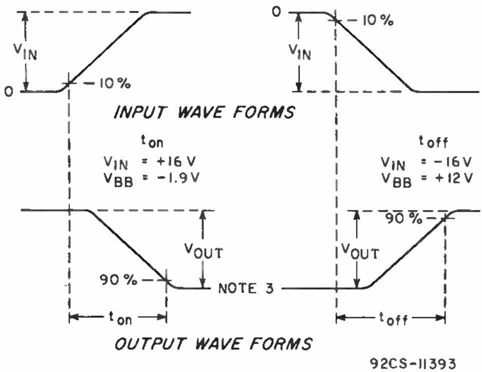
NOTE 2: INPUT VOLTAGE (V_{IN}) OBTAINED FROM MERCURY-RELAY TYPE PULSE GENERATOR HAVING AN OUTPUT IMPEDANCE OF 50 OHMS.

NOTE 3: INPUT AND OUTPUT WAVE FORMS, SHOWN ON NEXT PAGE, SHOULD BE MONITORED BY MEANS OF A SAMPLING OSCILLOSCOPE HAVING AN INPUT IMPEDANCE OF 50 OHMS.

NOTE 4: ALL RESISTANCE VALUES HAVE ± 1% TOLERANCE.

World Radio History

ASSOCIATED WAVE FORMS



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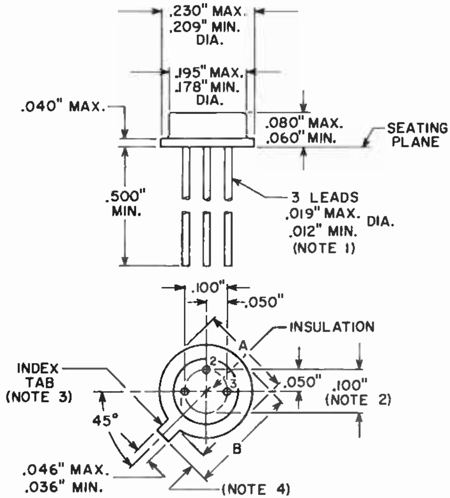
JEDEC No. TO-46



NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE SEATING PLANE. BETWEEN 0.25" TO THE END OF THE LEAD, A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 2: MAXIMUM DIAMETER LEADS AT A GAUGING PLANE 0.054" + 0.001" - 0.000" BELOW SEATING PLANE TO BE WITHIN 0.007" OF THEIR TRUE LOCATION RELATIVE TO MAXIMUM WIDTH TAB AND TO THE 0.230" MAXIMUM DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS NOT USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

NOTE 3: INDEX TAB FOR VISUAL ORIENTATION ONLY.

NOTE 4: TAB LENGTH TO BE 0.028" MINIMUM - 0.048" MAXIMUM AND WILL BE DETERMINED BY SUBTRACTING DIAMETER "A" FROM DIMENSION "B".

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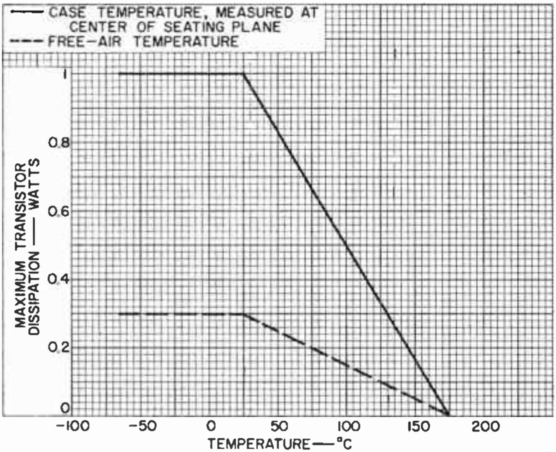
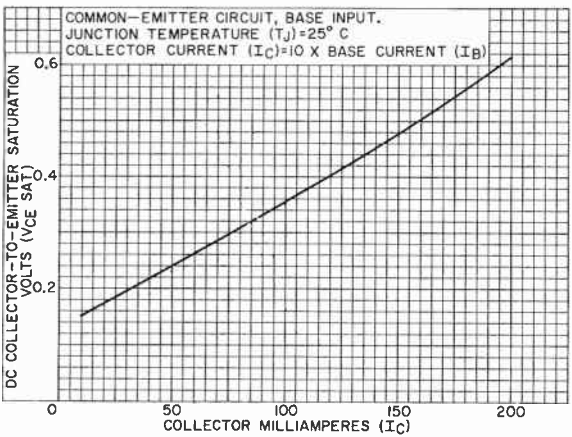
RATING CHART



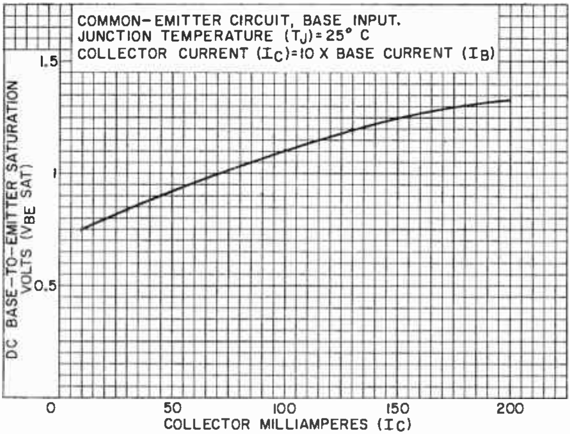
92CS-11223

TYPICAL DC COLLECTOR-TO-EMITTER SATURATION-VOLTAGE CHARACTERISTIC



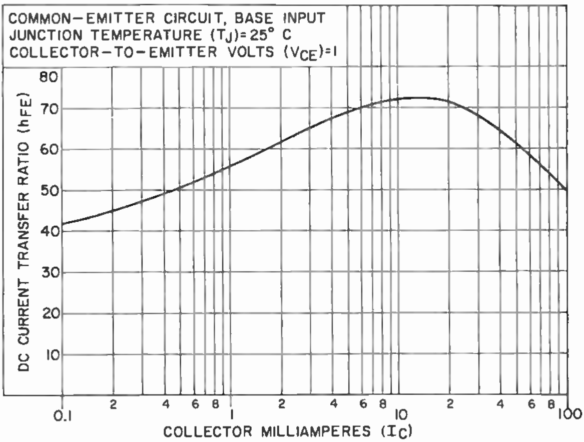
92CS-11428

TYPICAL DC BASE-TO-EMITTER SATURATION-VOLTAGE CHARACTERISTIC



92CS-11418

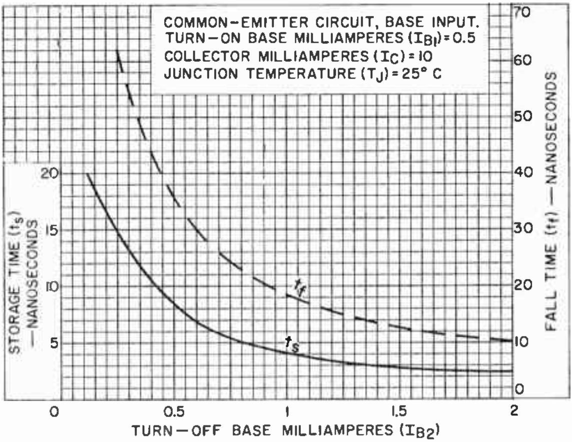
TYPICAL DC CURRENT-TRANSFER-RATIO CHARACTERISTIC



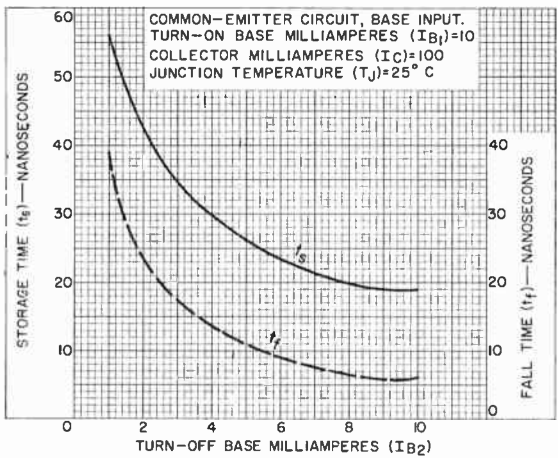
92CS-11431

World Radio History

TYPICAL STORAGE-TIME AND FALL-TIME CHARACTERISTICS



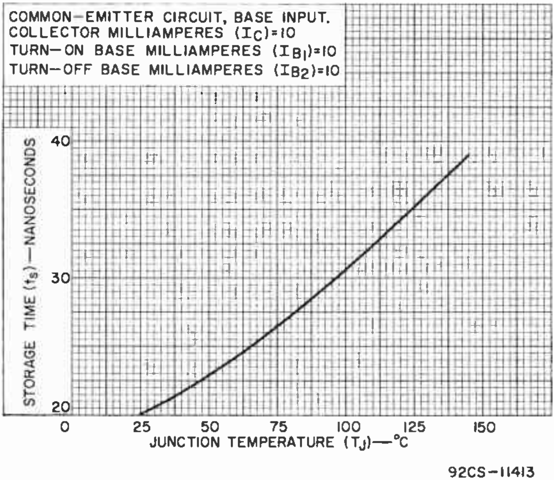
92CS-11427



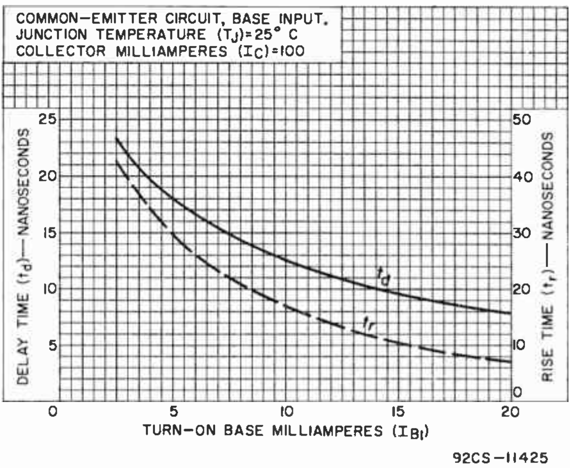
92CS-11424

World Radio History

TYPICAL STORAGE-TIME CHARACTERISTIC



TYPICAL DELAY-TIME AND RISE-TIME CHARACTERISTICS



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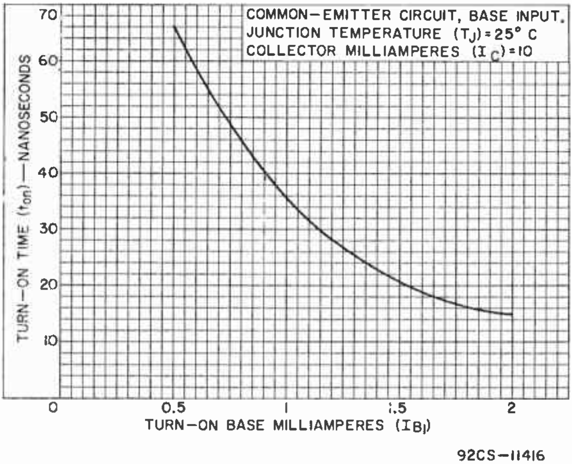
TYPICAL TURN-ON-TIME CHARACTERISTIC



World Radio History

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Transistor

GERMANIUM P-N-P DIFFUSED-BASE MESA TYPE

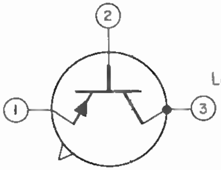
For IF- and RF-Amplifier Applications in the 5-to-50 Mc Range in Industrial and Military Equipment

GENERAL DATA

Mechanical:

Dimensions. . . . . See *Outline TO-18* in General Section
Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter
Lead 2 – Base



Lead 3 – Collector, Case

RADIO-FREQUENCY AMPLIFIER

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE:			
With emitter open	V_{CBO}	-25 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:			
With base open.	V_{CEO}	-15 max.	volts
EMITTER-TO-BASE VOLTAGE:			
With collector open	V_{EBO}	-1 max.	volt
COLLECTOR CURRENT	I_C	100 max.	ma
TRANSISTOR DISSIPATION:	P		
At free-air temperature of 25° C or below		100 max.	mw
At free-air temperature above 25° C		*Derate linearly 1.33*	*mw/°C*
TEMPERATURE RANGE:			
Junction (Operating).	T_J	-65 to +100	°C
Storage	T_{STG}	-65 to +100	°C
LEAD TEMPERATURE:[a]			
For 10 seconds maximum.	T_L	235 max.	°C

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, free-air temperature = 25° C

		Min.	*Typical*	*Max.*	
DC Collector-to-Base Breakdown Voltage for dc collector ma. = -0.1, emitter current = 0.	BV_{CBO}	-25	–	–	volts

[a] Measured 1/16" ± 1/32" along lead down from seating plane.

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		Min.	Typical	Max.	
DC Collector-to-Emitter Breakdown Voltage for dc collector ma. = -0.1, base current = 0	BV_{CEO}	-15	-	-	volts
DC Emitter-to-Base Breakdown Voltage for dc emitter ma. = -0.1, collector current = 0	BV_{EBO}	-1	-	-	volt
DC Collector-Cutoff Current for dc collector-to-base volts = -12, emitter current = 0.	I_{CBO}	-	-	-10	μa
Base Spreading Resistance for dc collector-to-emitter volts = -10, dc collector ma. = -1, frequency (Mc) = 250	$r_{bb'}$	-	-	250	ohms
Real Part of Small-Signal Short-Circuit Input Impedance for dc collector-to-emitter volts = -9, dc collector ma. = -1, frequency (Mc) = 250.	$h_{ie(real)}$	50	-	250	ohms
Output Capacitance for dc collector-to-base volts = -10, emitter current = 0, frequency (kc) = 140 . .	C_{ob}	-	-	3.5	pf
DC Forward-Current Transfer Ratio for dc collector-to-emitter volts = -10, dc collector ma. = -1.	h_{FE}	25	-	150	
Small-Signal Short-Circuit Forward-Current Transfer Ratio for dc collector-to-emitter volts = -6, dc collector ma. = -1, frequency (kc) = 1	h_{fe}	20	-	28	
Small-Signal Power Gain for dc collector-to-emitter volts = -9, dc collector ma. = -1, frequency (Mc) = 30 .	G_{pe}	10	-	-	db

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OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the seating plane provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the seals of the leads and damage the transistor.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

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World Radio History

Transistor

SILICON N-P-N EPITAXIAL-PLANAR TYPE

For Ultra-High-Speed Logic-Circuit Switching Applications in Commercial and Military Data-Processing Systems

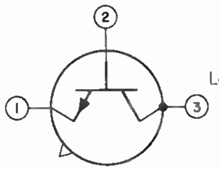
GENERAL DATA

Mechanical:

Dimensions. . . . . Similar to JEDEC No. TO-18

Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter
Lead 2 – Base



Lead 3 – Collector, Case

SWITCHING SERVICE

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE:			
With emitter open	V_{CBO}	15 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:			
With base open.	V_{CEO}	6 max.	volts
EMITTER-TO-BASE VOLTAGE:			
With collector open	V_{EBO}	4 max.	volts
COLLECTOR CURRENT	I_C	Limited by power dissipation	
TRANSISTOR DISSIPATION:[a]	P		
At case temperature[b] of 100° C or below		500 max.	mw
At free-air temperature of 25° C or below.		300 max.	mw
TEMPERATURE RANGE:			
Junction (Operating).	T_J	–65 to +200	°C
Storage	T_{STG}	–65 to +300	°C
LEAD TEMPERATURE:[c]			
For 10 seconds maximum.	T_L	300 max.	°C

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, free-air temperature = 25° C

		Min.	Typical	Max.	
DC Collector Breakdown Voltage for dc collector ma. = 0.01, dc emitter current = 0. . .	BV_{CBO}	15	30	–	volts

[a] See accompanying *Rating Chart*.
[b] Measured at center of seating plane.
[c] Measured 1/16" ± 1/32" along lead, down from seating plane.

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Characteristic	Symbol	*Min.*	*Typical*	*Max.*	Unit
DC Emitter Breakdown Voltage for dc collector current = 0, dc emitter ma. = 0.01. .	BV_{EBO}	4	7	-	volts
DC Collector-to-Emitter Sustaining Voltage[d] for dc pulsed collector ma. = 10, dc base current = 0	$V_{CEO}(sus)$	6	10	-	volts
DC Base-to-Emitter Saturation Voltage for dc collector ma. = 20, dc base ma. = 0.66.	$V_{BE}(sat)$	0.8	0.9	1	volt
DC Collector-to-Emitter Saturation Voltage for dc collector ma. = 20, dc base ma. = 0.66.	$V_{CE}(sat)$	-	0.28	0.4	volt
DC Collector-Cutoff Current for dc collector-to-base volts = 5, dc emitter current = 0, free-air temperature =	I_{CBO}				
25^{o} C		-	0.002	0.05	μa
150^{o} C.		-	0.9	5	μa
Emitter-to-Base Capacitance for dc emitter-to-base volts = -0.5, dc collector current = 0, frequency (kc) = 140 (Approx.)	C_{ib}	-	2	2.5	pf
Collector-to-Base Capacitance for dc collector-to-base volts = 5, dc emitter current = 0, frequency (kc) = 140 (Approx.)	C_{ob}	-	2.4	3	pf
DC Forward-Current Transfer Ratio:	h_{FE}				
With dc collector-to-emitter volts = 0.3, dc collector ma. = 1		20	40	-	
With dc collector-to-emitter volts = 0.5, dc pulsed collector ma. = 50.		20	36	-	
With dc collector-to-emitter volts = 0.4, dc pulsed collector ma. = 20.		30	50	150	
With dc collector-to-emitter volts = 0.4, dc pulsed collector ma. = 20, free-air temperature = -55^{o} C.		15	24	-	
Small-Signal Short-Circuit Forward-Current Transfer Ratio for dc collector-to-emitter volts = 2, dc collector ma. = 20, signal frequency (Mc) = 100. . . .	h_{fe}	6	8	-	

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Switching Time:					
Storage time[e] for dc collector ma. = 5, turn-on dc base ma. = 5, turn-off dc base ma. = -5. . .	t_s	-	3.2	6	nsec
Turn-On time[f] (Delay time + rise time) for dc collector ma. = 20, turn-on dc base ma. = 1, turn-off dc base ma. = -1.	t_{on}	-	7.3	20	nsec
Turn-Off time[f] (Storage time + fall time) for dc collector ma. = 20, turn-on dc base ma. = 1, turn-off dc base ma. = -1. . .	t_{off}	-	9	15	nsec

[d] The Collector-to-Emitter Sustaining Voltage [V_{CEO}(sus)] with the base open is that value of voltage which remains relatively constant over a wide range of collector currents, and approximates the collector voltage at which the effective alpha of the device is equal to unity ($V_{\alpha M}$ = 1; voltage at which the product of alpha (α), at low voltage, times the multiplication factor (M) equals unity).

[e] See accompanying *Storage-Time-Measurement Circuit*.

[f] See accompanying *Turn-On-Time and Turn-Off-Time Measurement Circuit*.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the seating plane provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the seals of the leads and damage the transistor.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

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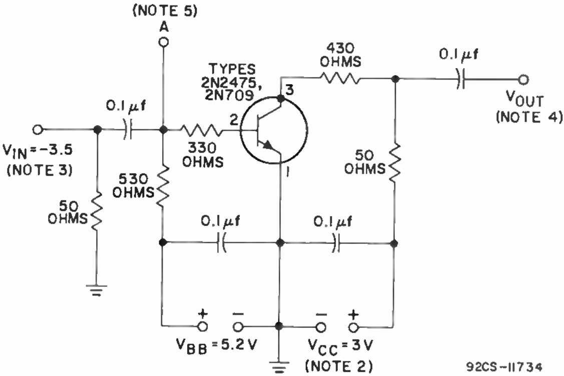
STORAGE-TIME MEASUREMENT CIRCUIT



NOTE 1: ALL RESISTANCE VALUES HAVE ± 1 PER CENT TOLERANCE.

NOTE 2: WITH CERTAIN TYPES OF POWER SUPPLIES, IT MAY BE NECESSARY TO CONNECT 25-μf DECOUPLING CAPACITORS ACROSS THE POWER-SUPPLY TERMINALS FOR V_{CC} AND V_{BB}.

NOTE 3: INPUT VOLTAGE (V_{IN}) OBTAINED FROM MERCURY-RELAY TYPE PULSE GENERATOR HAVING AN OUTPUT IMPEDANCE OF 50 OHMS. V_{IN} RISE TIME < 1 NSEC; PULSE DURATION > 300 NSEC; AND DUTY FACTOR < 0.02.

NOTE 4: INPUT AND OUTPUT WAVE FORMS SHOWN SHOULD BE MONITORED BY MEANS OF A SAMPLING OSCILLOSCOPE HAVING A RISE TIME < 0.5 NSEC; INPUT CAPACITANCE OF PROBE ≤ 2.5 pf WITH SHUNT RESISTANCE > 1000 OHMS.

NOTE 5: TEST POINT FOR OBSERVATION OF REFERENCE PULSE VOLTAGE (V_A).

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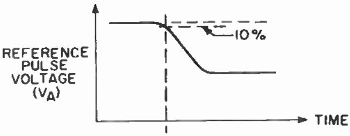
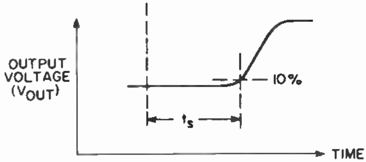
ASSOCIATED WAVE FORMS



REFERENCE WAVE FORM OBSERVED AT POINT "A" IN STORAGE-TIME MEASUREMENT CIRCUIT



OUTPUT WAVE FORM

92CS-11728R1

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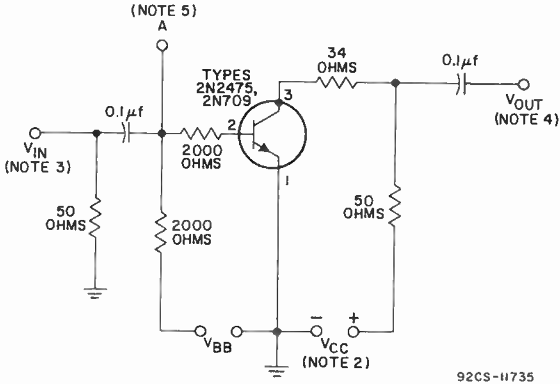
TURN-ON-TIME AND TURN-OFF-TIME MEASUREMENT CIRCUIT



2N2475		2N709	
t_{on}	t_{off}	t_{on}	t_{off}
V_{BB}: −1 volt	V_{BB}: +5 volts	V_{BB}: −1 volt	V_{BB}: +5 volts
V_{IN}: +4 volts	V_{IN}: −4 volts	V_{IN}: +6 volts	V_{IN}: −4 volts
V_{CC}: +1.8 volts	V_{CC}: +1.8 volts	V_{CC}: +1 volt	V_{CC}: +1 volt

NOTE 1: ALL RESISTANCE VALUES HAVE ± 1 PER CENT TOLERANCE.

NOTE 2: WITH CERTAIN TYPES OF POWER SUPPLIES, IT MAY BE NECESSARY TO CONNECT 25-μf DECOUPLING CAPACITORS ACROSS THE POWER-SUPPLY TERMINALS FOR V_{CC} AND V_{BB}.

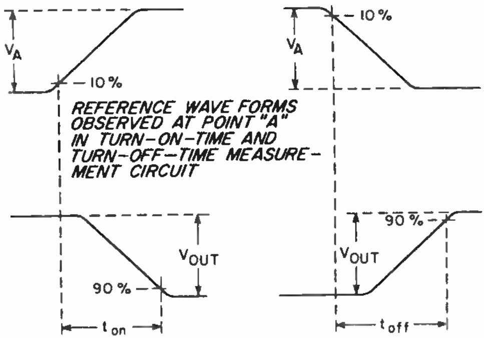
NOTE 3: INPUT VOLTAGE (V_{IN}) OBTAINED FROM MERCURY-RELAY TYPE PULSE GENERATOR HAVING AN OUTPUT IMPEDANCE OF 50 OHMS. V_{IN} RISE TIME < 1 NSEC; PULSE DURATION > 300 NSEC; AND DUTY FACTOR < 0.02.

NOTE 4: INPUT AND OUTPUT WAVE FORMS SHOWN SHOULD BE MONITORED BY MEANS OF A SAMPLING OSCILLOSCOPE HAVING A RISE TIME < 0.5 NSEC; INPUT CAPACITANCE OF PROBE ≤ 2.5 pf WITH SHUNT RESISTANCE > 1000 OHMS.

NOTE 5: TEST POINT FOR OBSERVATION OF REFERENCE PULSE VOLTAGE (V_A).

World Radio History

ASSOCIATED WAVE FORMS

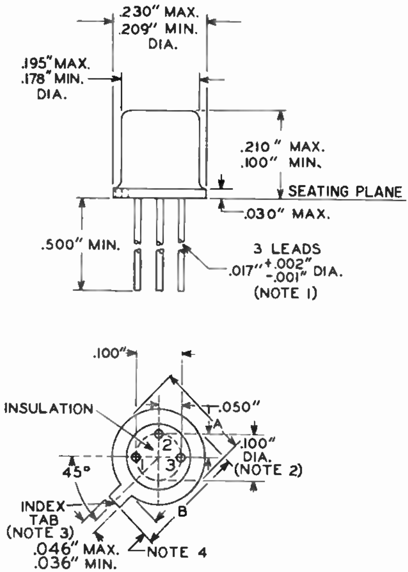


OUTPUT WAVE FORMS

92CS-11729R1

World Radio History

SIMILAR TO JEDEC No.TO-18



92CS-11739

NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE SEATING PLANE. BETWEEN 0.25" TO THE END OF THE LEAD, A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

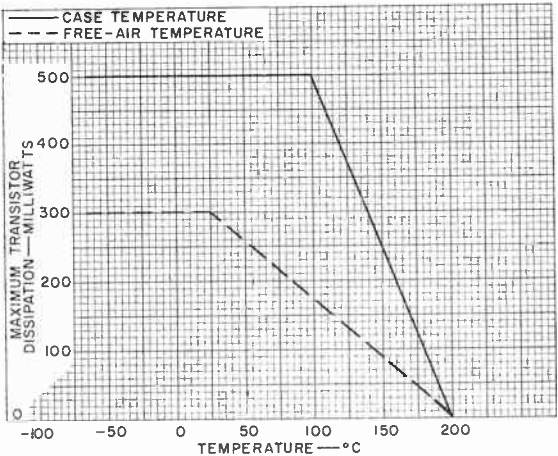
NOTE 2: MAXIMUM DIAMETER LEADS AT A GAUGING PLANE 0.054" + 0.001" - 0.000" BELOW SEATING PLANE TO BE WITHIN 0.007" OF THEIR TRUE LOCATION RELATIVE TO MAXIMUM WIDTH TAB AND TO THE MAXIMUM 0.230" DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

NOTE 3: FOR VISUAL ORIENTATION ONLY.

NOTE 4: TAB LENGTH TO BE 0.028" MINIMUM AND 0.048" MAXIMUM, AND WILL BE DETERMINED BY SUBTRACTING DIAMETER "A" FROM DIMENSION "B".

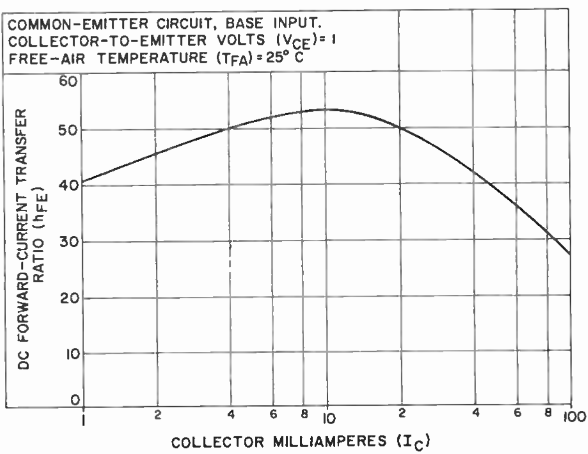
World Radio History

RATING CHART



92CS-11733R1

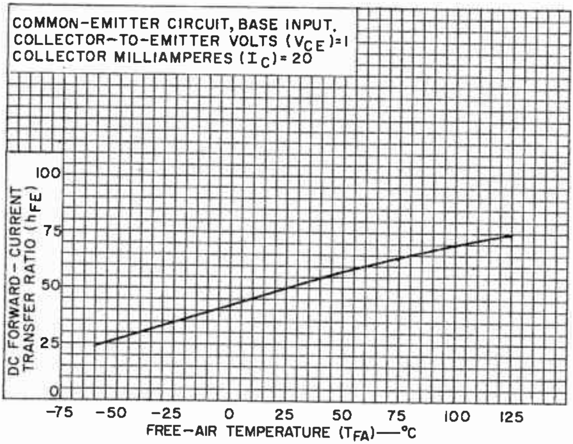
TYPICAL DC FORWARD-CURRENT-TRANSFER-RATIO CHARACTERISTIC



92CS-11731

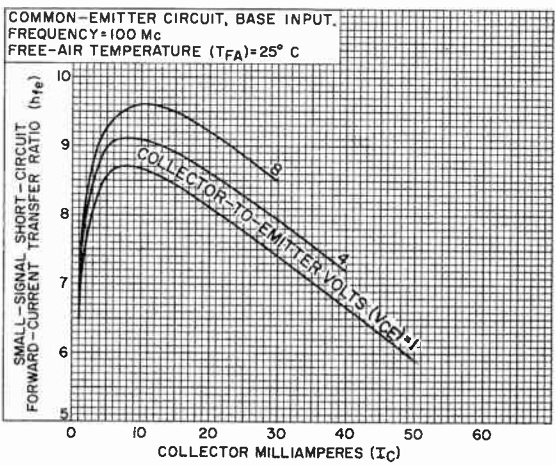
World Radio History

TYPICAL DC FORWARD-CURRENT-TRANSFER-RATIO CHARACTERISTIC



92CS-11724

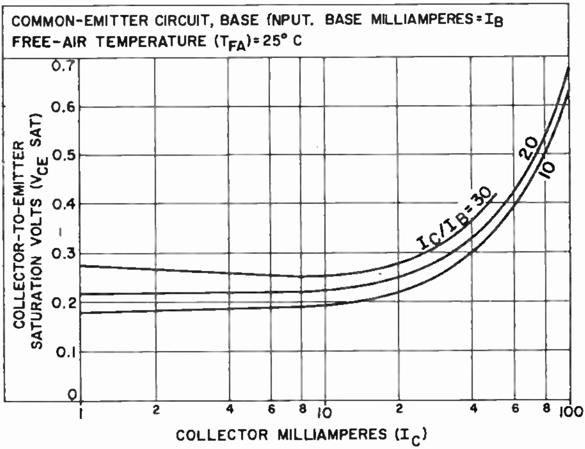
TYPICAL SMALL-SIGNAL SHORT-CIRCUIT FORWARD-CURRENT TRANSFER-RATIO CHARACTERISTICS



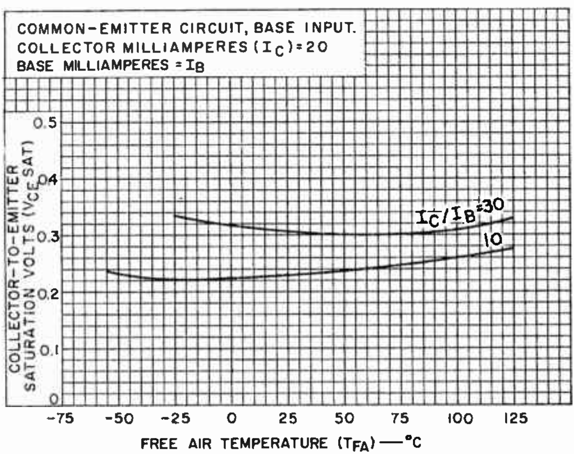
92CS-11725

World Radio History

TYPICAL COLLECTOR-TO-EMITTER SATURATION-VOLTAGE CHARACTERISTICS



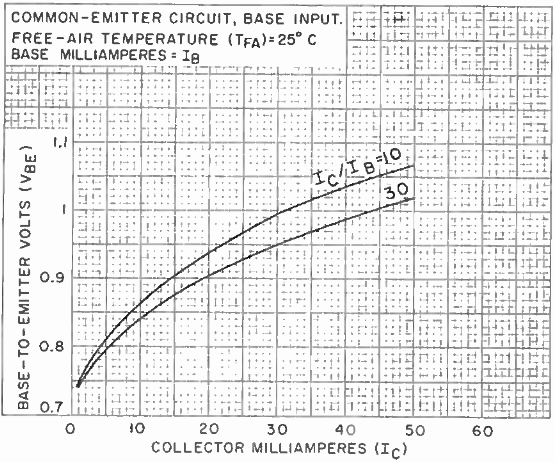
92CS-11732



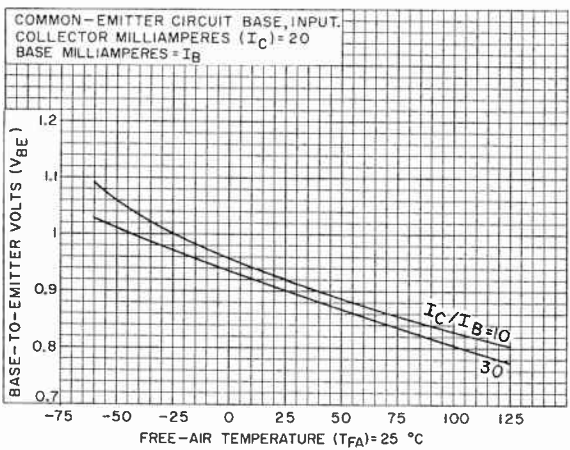
92CS-11730

World Radio History

TYPICAL BASE-TO-EMITTER VOLTAGE CHARACTERISTICS

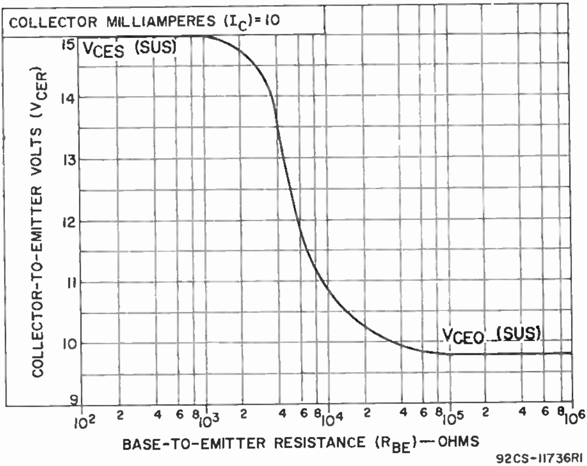


92CS-11727



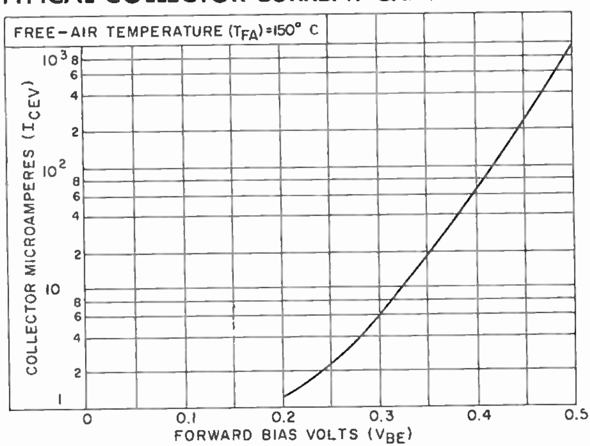
92CS-11726

TYPICAL COLLECTOR-TO-EMITTER VOLTAGE CHARACTERISTICS



92CS-11736R1

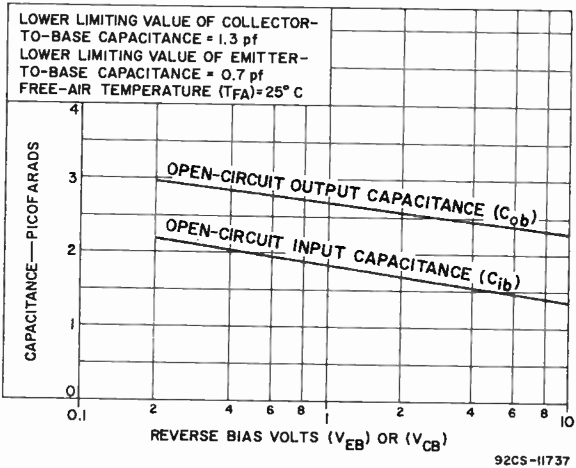
TYPICAL COLLECTOR-CURRENT CHARACTERISTIC



92CS-11738

World Radio History

TYPICAL INPUT- AND OUTPUT-CAPACITANCE CHARACTERISTICS



World Radio History

Transistor

SILICON N-P-N DOUBLE-DIFFUSED-JUNCTION EPITAXIAL-PLANAR TYPE

For High-Speed, High-Current Switching in Core-Driving and Line-Driving Applications in Data-Processing Systems

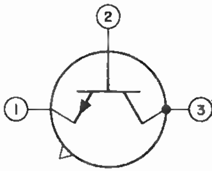
GENERAL DATA

Mechanical:

Dimensions. . . . . See *Outline TO-5* in General Section

Terminal Diagram: BOTTOM VIEW

Lead 1 – Emitter
Lead 2 – Base



Lead 3 – Collector, Case

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:			
With emitter open	V_{CBO}	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:			
With base open.	V_{CEO}	20 max.	volts
EMITTER-TO-BASE VOLTAGE:			
With collector open	V_{EBO}	5 max.	volts
COLLECTOR CURRENT	I_C	Limited by power dissipation	
TRANSISTOR DISSIPATION:[a]	P		
At case temperature[b] of 25° C or below.		2 max.	watts
At free-air temperature of 25° C or below.		0.6 max.	watt
TEMPERATURE RANGE:			
Junction (Operating).	T_J	-65 to +200	°C
Storage	T_{STG}	-65 to +300	°C
LEAD TEMPERATURE:[c]			
For 10 seconds maximum.	T_L	235 max.	°C

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, free-air temperature = 25° C

		Min.	*Max.*	
DC Collector-to-Base Breakdown Voltage for dc collector μa = 10, emitter current = 0 . . .	BV_{CBO}	60	–	volts

[a] See accompanying *Rating Chart*.
[b] Measured at center of seating plane.
[c] Measured 1/16" ± 1/32" along lead down from seating plane.

World Radio History

2N2476

		Min.	Max.	
DC Collector-to-Emitter Breakdown Voltage for pulse dc collector ma. = 50[d], base current = 0	BV_{CEO}	20	–	volts
DC Emitter-to-Base Breakdown Voltage for dc emitter ma. = 0.1, collector current = 0	BV_{EBO}	5	–	volts
DC Base-to-Emitter Voltage for dc collector ma. = 150, dc base ma. = 7.5.	V_{BE}	–	1	volt
DC Collector-to-Emitter Saturation Voltage:	$V_{CE}(sat)$			
With dc collector ma. = 150, dc base ma. = 7.5		–	0.4	volt
With dc collector ma. = 500, dc base ma. = 50.		–	0.75	volt
DC Collector-Cutoff Current for dc collector-to-base volts = 30, emitter current = 0, free-air temperature =	I_{CBO}			
25° C		–	0.2	μa
150° C.		–	200	μa
DC Emitter-Cutoff Current for dc emitter-to-base volts = 5, collector current = 0	I_{EBO}	–	100	μa
Output Capacitance for dc collector-to-base volts = 10, emitter current = 0, frequency (kc) = 140.	C_{ob}	–	10	pf
DC Forward-Current Transfer Ratio for dc collector-to-emitter volts = 0.4, dc collector ma. = 150.	h_{FE}	20	–	
Small-Signal Short-Circuit Forward-Current Transfer Ratio for dc collector-to-emitter volts = 10, dc collector ma. = 50, frequency (Mc) = 100. . .	h_{fe}	2.5	–	
Switching Time:				
Storage time[e] for dc collector supply volts = 6.4, collector resistance (ohms) = 40, turn-on dc base ma. = 15, turn-off dc base ma. = -15, dc collector ma. = 150	t_s	–	25	nsec
Turn-on time[f] (Delay time + rise time) for dc collector supply volts = 6.4, turn-on dc base ma. = 15, dc collector ma. = 150	t_{on}	–	25	nsec
Turn-off time[e] (Storage time + fall time) for dc collector supply volts = 6.4, turn-on dc base ma. = 15, turn-off dc base ma. = -15, dc collector ma. = 150	t_{off}	–	45	nsec

World Radio History

[d] Pulse duration $\leq$ 400 μsec, duty factor = 0.03.
[e] See accompanying *Storage-Time and Turn-Off-Time Measurement Circuit*.
[f] See accompanying *Turn-On-Time Measurement Circuit*.

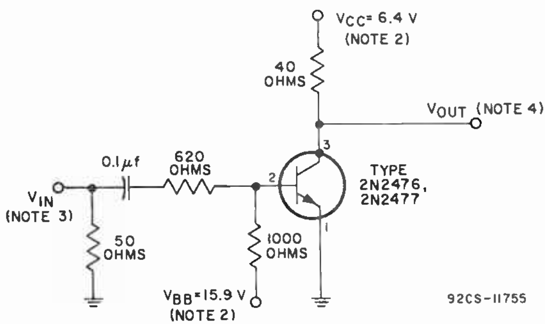
OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the seating plane provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the seals of the leads and damage the transistor.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

STORAGE-TIME AND TURN-OFF-TIME MEASUREMENT CIRCUIT



NOTE 1: ALL RESISTANCE VALUES HAVE ± 1 PER CENT TOLERANCE.

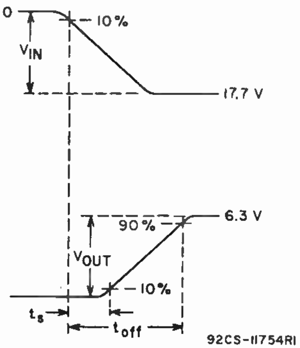
NOTE 2: WITH CERTAIN TYPES OF POWER SUPPLIES, IT MAY BE NECESSARY TO CONNECT 25-μf DECOUPLING CAPACITORS ACROSS THE POWER-SUPPLY TERMINALS FOR V_{CC} AND V_{BB}.

NOTE 3: INPUT VOLTAGE (V_{IN}) OBTAINED FROM MERCURY-RELAY TYPE PULSE GENERATOR HAVING AN OUTPUT IMPEDANCE OF 50 OHMS. V_{IN} RISE TIME < 2 NANOSECONDS; PULSE DURATION > 150 NANOSECONDS; DUTY FACTOR < 0.02.

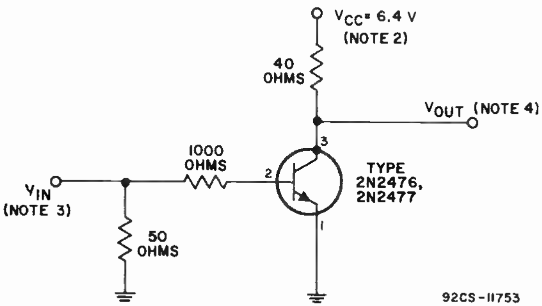
NOTE 4: THE ASSOCIATED INPUT AND OUTPUT WAVE FORMS SHOWN SHOULD BE MONITORED BY MEANS OF A SAMPLING OSCILLOSCOPE HAVING A RISE TIME < 0.5 NANOSECOND; INPUT CAPACITANCE OF PROBE < 2.5 PICOFARADS WITH SHUNT RESISTANCE OF 1 MEGOHM.

World Radio History

ASSOCIATED WAVE FORMS



TURN-ON-TIME MEASUREMENT CIRCUIT



NOTE 1: ALL RESISTANCE VALUES HAVE ± 1 PER CENT TOLERANCE.

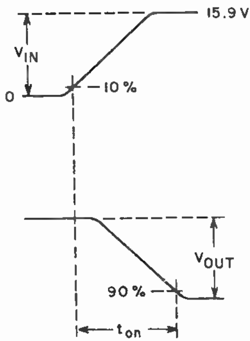
NOTE 2: WITH CERTAIN TYPES OF POWER SUPPLIES, IT MAY BE NECESSARY TO CONNECT 25-μf DECOUPLING CAPACITORS ACROSS THE POWER-SUPPLY TERMINALS FOR V_{CC} AND V_{BB}.

NOTE 3: INPUT VOLTAGE (V_{IN}) OBTAINED FROM MERCURY-RELAY TYPE PULSE GENERATOR HAVING AN OUTPUT IMPEDANCE OF 50 OHMS. V_{IN} RISE TIME < 2 NANOSECONDS; PULSE DURATION > 150 NANOSECONDS AND DUTY FACTOR < 0.02.

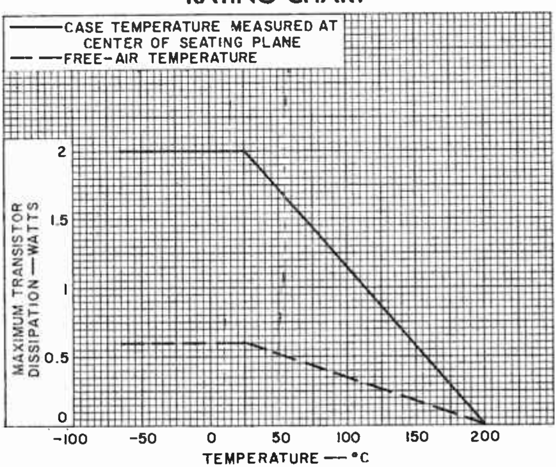
NOTE 4: THE ASSOCIATED INPUT AND OUTPUT WAVE FORMS SHOWN SHOULD BE MONITORED BY MEANS OF A SAMPLING OSCILLOSCOPE HAVING A RISE TIME < 0.5 NANOSECOND; INPUT CAPACITANCE OF PROBE < 2.5 PICOFARADS WITH SHUNT RESISTANCE OF 1 MEGOHM.

World Radio History

ASSOCIATED WAVE FORMS



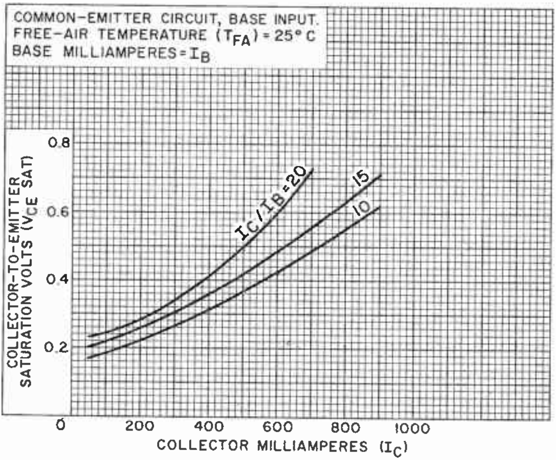
RATING CHART



92CS-11751R1

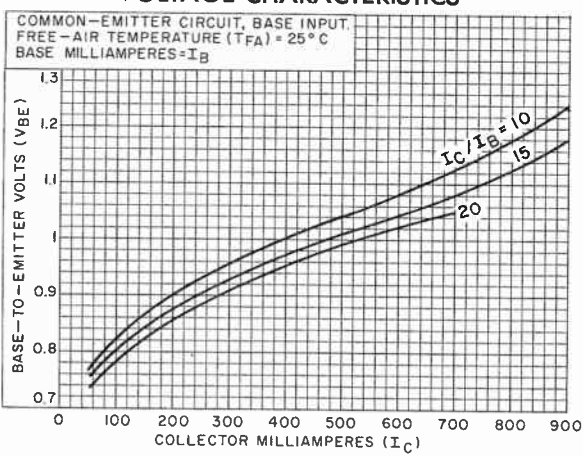
World Radio History

TYPICAL COLLECTOR-TO-EMITTER SATURATION-VOLTAGE CHARACTERISTICS



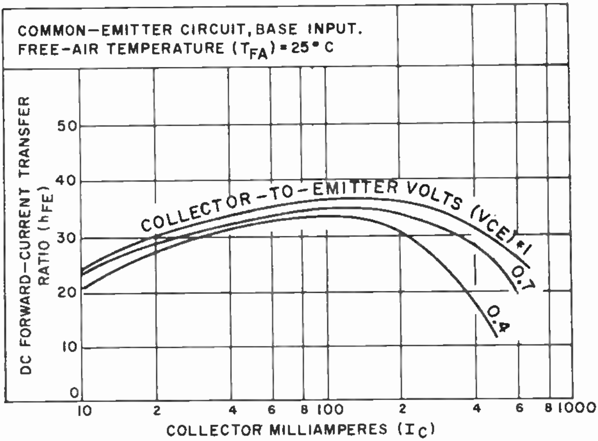
92CS-11768

TYPICAL BASE-TO-EMITTER VOLTAGE CHARACTERISTICS

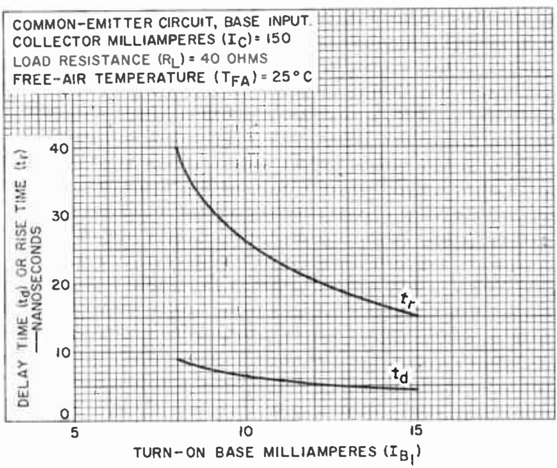


92CS-11767

TYPICAL DC FORWARD-CURRENT TRANSFER-RATIO CHARACTERISTICS

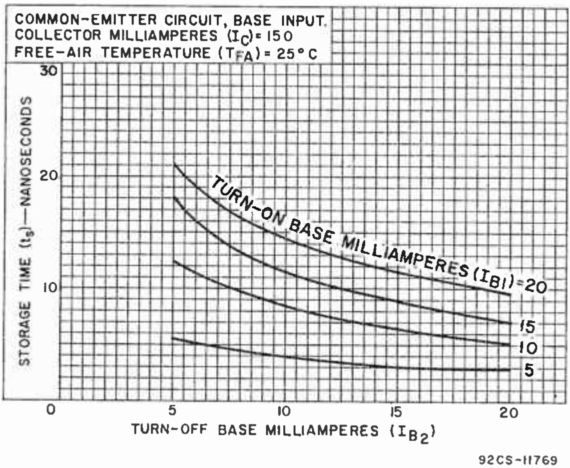


TYPICAL DELAY-TIME AND RISE-TIME CHARACTERISTICS



World Radio History

TYPICAL STORAGE-TIME CHARACTERISTICS



World Radio History

2N2477

Transistor

SILICON N-P-N DOUBLE-DIFFUSED-JUNCTION EPITAXIAL-PLANAR TYPE

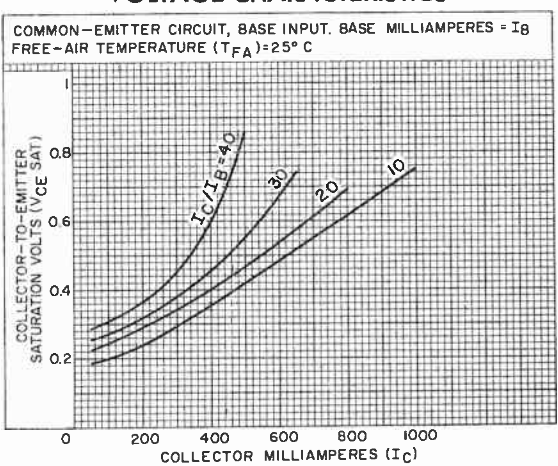
For High-Speed, High-Current Switching in Core-Driving and Line-Driving Applications in Data-Processing Systems

The 2N2477 is the same as the 2N2476 except for the following items:

ELECTRICAL CHARACTERISTICS

		Min.	Max.	
DC Base-to-Emitter Voltage for dc collector ma. = 150, dc base ma. = 3.75	V_{BE}	–	0.95	volt
DC Collector-to-Emitter Saturation Voltage:	$V_{CE}(sat)$			
With dc collector ma. = 150, dc base ma. = 3.75.		–	0.4	volt
With dc collector ma. = 500, dc base ma. = 50.		–	0.65	volt
DC Forward-Current Transfer Ratio for dc collector-to-emitter volts = 0.4, dc collector ma. = 150	h_{FE}	40	–	

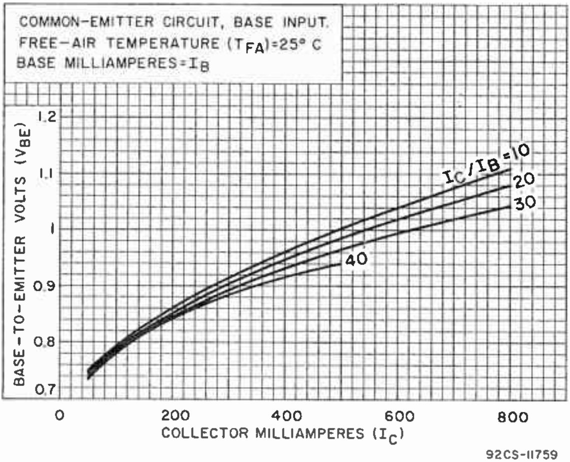
TYPICAL COLLECTOR-TO-EMITTER SATURATION-VOLTAGE CHARACTERISTICS



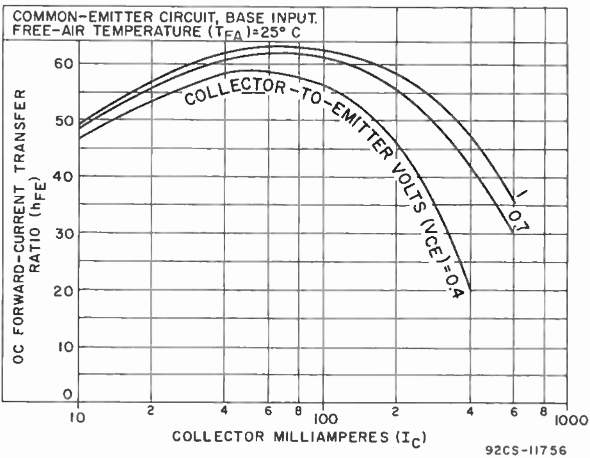
92CS-11758

World Radio History

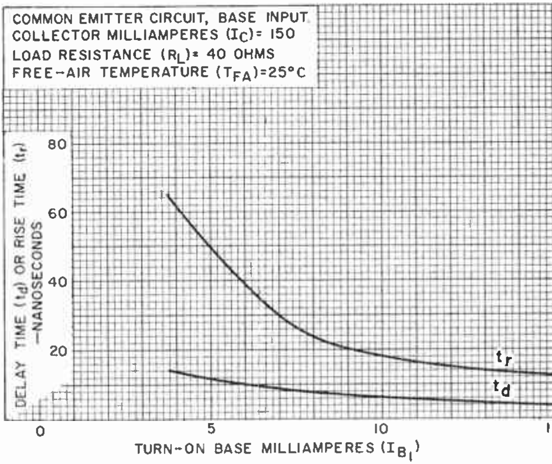
TYPICAL BASE-TO-EMITTER VOLTAGE CHARACTERISTICS



TYPICAL DC FORWARD-CURRENT TRANSFER-RATIO CHARACTERISTICS

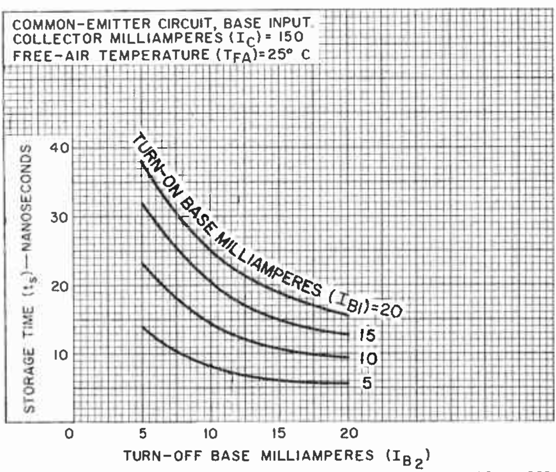


TYPICAL DELAY-TIME AND RISE-TIME CHARACTERISTICS



92CS-11760

TYPICAL STORAGE-TIME CHARACTERISTICS



92CS-11757

World Radio History

World Radio History

Transistor

GERMANIUM N-P-N DIFFUSED-BASE MESA TYPE

For Low-Power RF-Amplifier Applications in the VHF Range in Industrial and Military Equipment

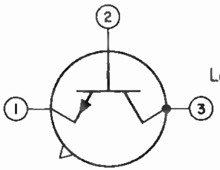
GENERAL DATA

Mechanical:

Dimensions. . . . . .See *Outline TO-18* in General Section

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter
Lead 2 - Base



Lead 3 - Collector, Case

RADIO-FREQUENCY AMPLIFIER

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE:			
With emitter open	V_{CBO}	20 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:			
With base open.	V_{CEO}	12 max.	volts
EMITTER-TO-BASE VOLTAGE:			
With collector open	V_{EBO}	3 max.	volts
COLLECTOR CURRENT	I_C	100 max.	ma
TRANSISTOR DISSIPATION:	P		
At free-air temperature of 25° C or below.		150 max.	mw
At free-air temperature above 25° C		*Derate linearly 2 mw/°C*	
TEMPERATURE RANGE:			
Junction (Operating).	T_J	-65 to +100	°C
Storage	T_{STG}	-65 to +100	°C
LEAD TEMPERATURE:[a]			
For 10 seconds maximum.	T_L	235 max.	°C

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, free-air temperature = 25° C

		Min.	*Typical*	*Max.*	
DC Collector-to-Base Breakdown Voltage for dc collector ma. = 0.1, emitter current = 0 . . .	BV_{CBO}	20	-	-	volts

[a] Measured 1/16" ± 1/32" along lead down from seating plane.

World Radio History

2N2482

		Min.	Typical	Max.	
DC Collector-to-Emitter Breakdown Voltage for dc collector ma. = 2, base short-circuited to emitter.	BV_{CES}	15	-	-	volts
DC Emitter-to-Base Breakdown Voltage for dc emitter ma. = 0.1, collector current = 0 . .	BV_{EBO}	3	-	-	volts
DC Collector-Cutoff Current for dc collector-to-base volts = 6, emitter current = 0, free air temperature =	I_{CBO}				
25° C		-	-	5	μa
80° C		-	-	90	μa
Base Spreading Resistance for dc collector-to-emitter volts = 6, dc collector ma. = 10, frequency (Mc) = 250. . .	$r_{bb'}$	-	30	-	ohms
Output Capacitance for dc collector-to-base volts = 6, emitter current = 0, frequency (kc) = 140. . .	C_{ob}	-	-	4.5	pf
DC Forward-Current Transfer Ratio for dc collector-to-emitter volts = 6, dc collector ma. = 2	h_{FE}	25	-	200	
Small-Signal Short-Circuit Forward-Current Transfer Ratio:	h_{fe}				
With dc collector-to-emitter volts = 6, dc collector ma. = 2, frequency (kc) = 1. . .		15	-	175	
With dc collector-to-emitter volts = 10, dc collector ma. = 10, frequency (Mc) = 100. .		6	10	-	
With dc collector-to-emitter volts = 1.7, dc collector ma. = 85, frequency (Mc) = 100. .		3	-	-	
Noise Figure for dc collector-to-emitter volts = 6, dc collector ma. = 2, frequency (Mc) =	NF				
30.		-	5	-	db
100		-	6	-	db

World Radio History

Small-Signal Power Gain:	G_{pe}				
With dc collector-to-emitter volts = 6, dc collector ma. = 2, frequency (Mc) =					
30.		–	25	–	db
100[b].		–	12	–	db
With dc collector-to-emitter volts = 12, dc collector ma. = 10, frequency (Mc) = 200. .		–	8	–	db
Collector-to-Base Time Constant for dc collector-to-base volts = 6, dc collector ma. = 2, frequency (Mc) = 31.9 . .	$r_b{}'C_c$	–	–	0.3	nsec
Power Output as class A amplifier[c] for dc collector-to-emitter volts = 12, dc collector ma. = 30, signal input (mw) = 6.5, frequency (Mc) = 70.		–	150	–	mw

[b] Circuit is neutralized and matched.
[c] See accompanying *Power-Output-Measurement Circuit*.

OPERATING CONSIDERATIONS

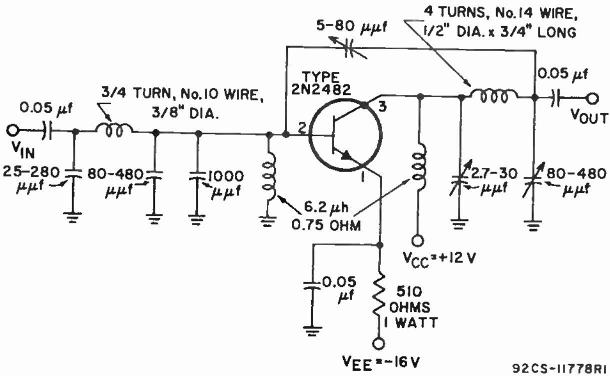
It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the seating plane provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the seals of the leads and damage the transistor.

It is to be noted that the case of this transistor operates at the collector voltage. Because of the possibility of shock hazard when the case of this transistor is at a voltage appreciably above or below ground potential, suitable precautionary measures should be taken.

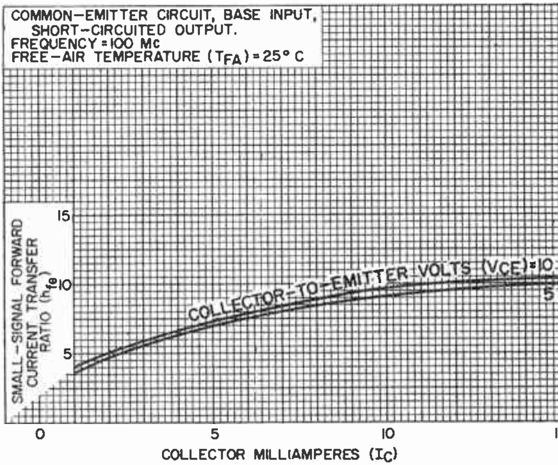
World Radio History

POWER-OUTPUT-MEASUREMENT CIRCUIT



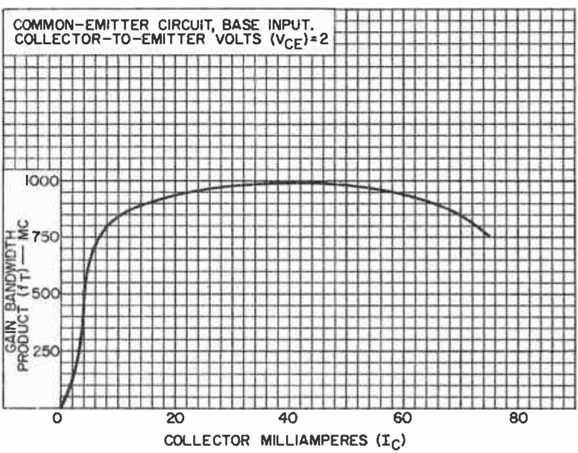
World Radio History

TYPICAL SMALL-SIGNAL SHORT-CIRCUIT FORWARD-CURRENT TRANSFER RATIO CHARACTERISTIC



92CS-11777

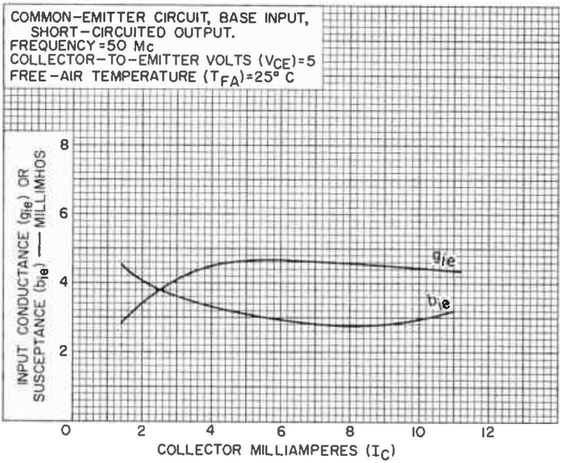
TYPICAL GAIN-BANDWIDTH-PRODUCT CHARACTERISTIC



92CS-11773

World Radio History

TYPICAL SMALL-SIGNAL "Y" PARAMETER CHARACTERISTICS



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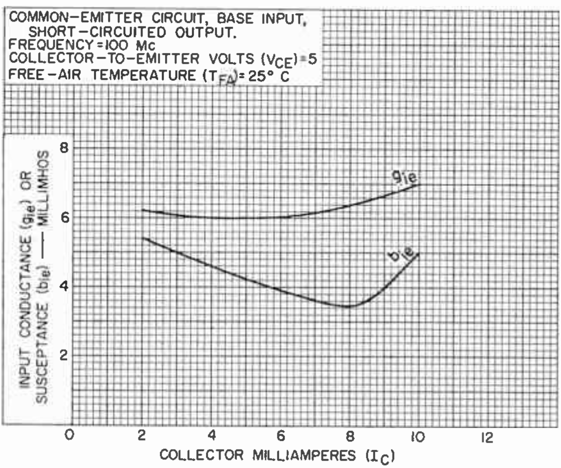

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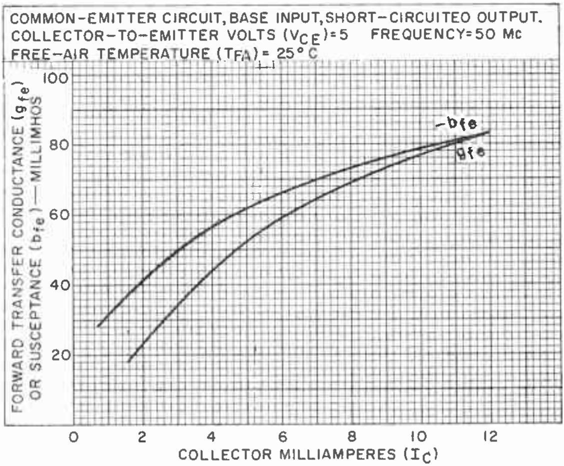
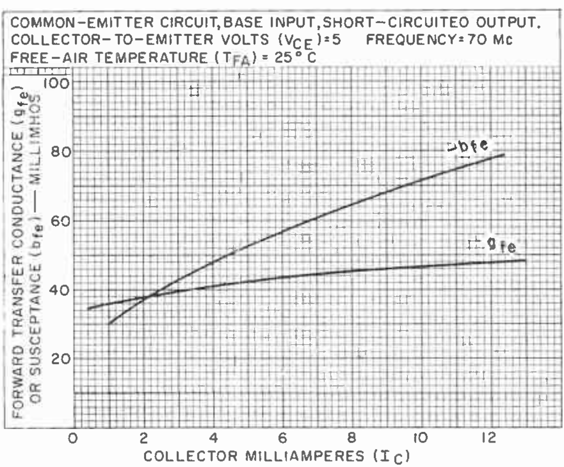
World Radio History

TYPICAL SMALL-SIGNAL "Y" PARAMETER CHARACTERISTICS



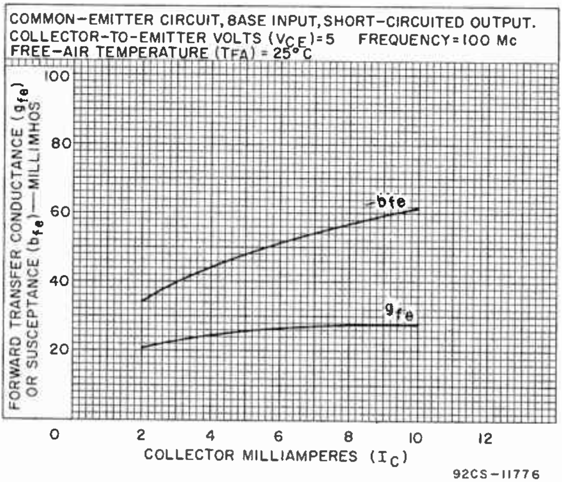
92CS-11775

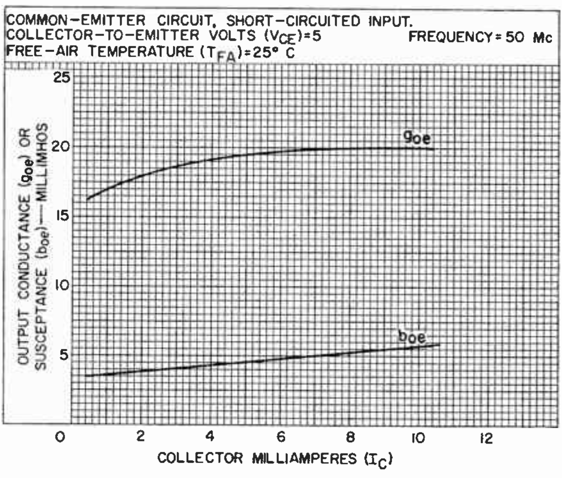


92CS-11774

World Radio History

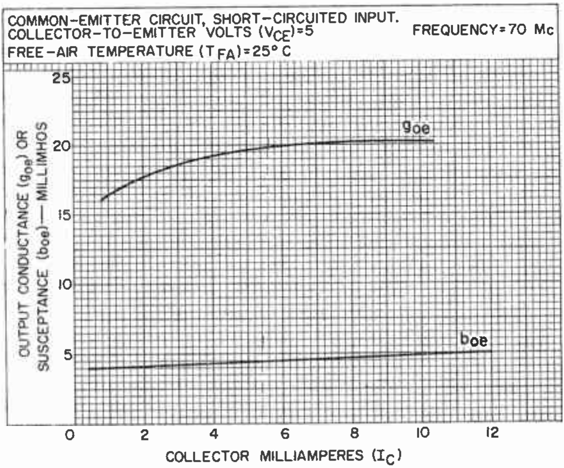
TYPICAL SMALL-SIGNAL "Y" PARAMETER CHARACTERISTICS





World Radio History

TYPICAL SMALL-SIGNAL "Y" PARAMETER CHARACTERISTICS



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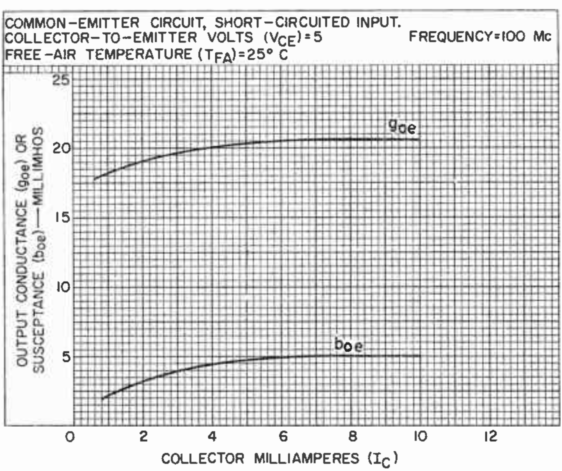

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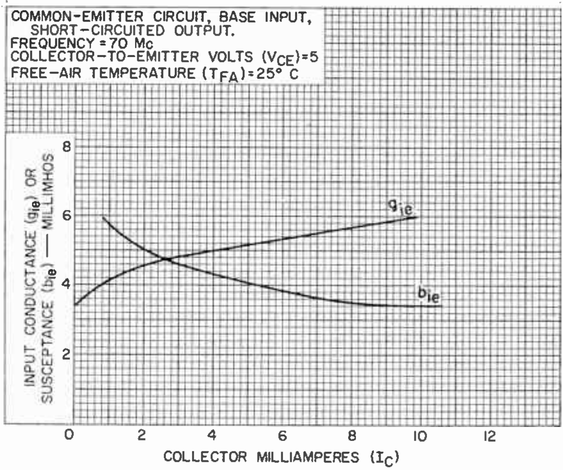
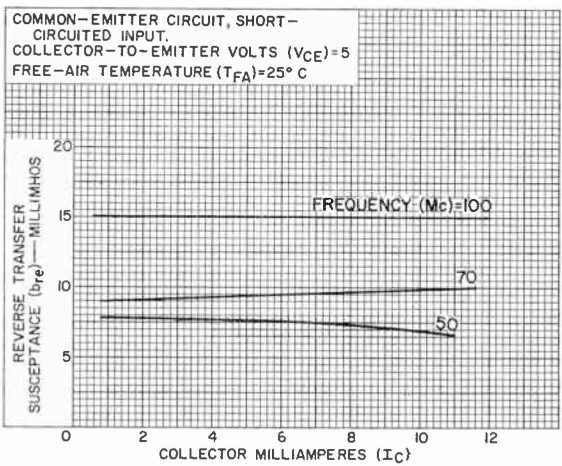
World Radio History

TYPICAL SMALL-SIGNAL "Y" PARAMETER CHARACTERISTICS



92CS-11766



92CS-11763

World Radio History

Triple Semiconductor Diode

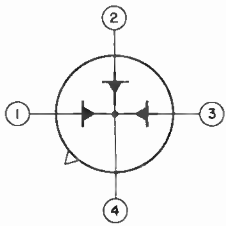
GERMANIUM DIFFUSED-JUNCTION TYPE

For Switching Applications in Electronic Data-Processing Systems

The 3DG001 is the same as the 2DG001 except for the following items:

Mechanical:

Dimensional Outline. . . . . .Similar to JEDEC No.TO-33
Leads, Flexible. 4
  Minimum length . . . . 1.5"
  Orientation and diameter . . . . . . .See *Dimensional Outline*
Terminal Diagram: BOTTOM VIEW

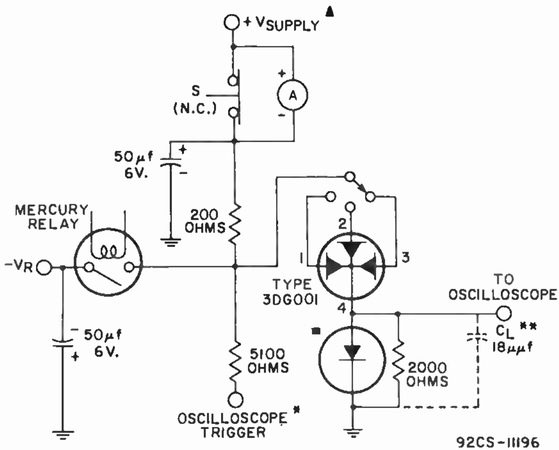


Lead 1 – Diode Unit No.1
Lead 2 – Diode Unit No.3
Lead 3 – Diode Unit No.2
Lead 4 – Common Lead for Diode Units No.1, No.2, & No.3

The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

World Radio History

REVERSE-RECOVERY-TIME MEASUREMENT CIRCUIT



NOTE: THE STRAY CAPACITANCE ACROSS THE SOCKET FOR THE MULTIPLE-DIODE UNIT UNDER TEST MUST BE LESS THAN 2 $\mu\mu f$.

* TEKTRONIX TYPE 545 OSCILLOSCOPE WITH TYPE H PLUG-IN VERTICAL AMPLIFIER AND TYPE P6000 PROBE, OR EQUIVALENT.

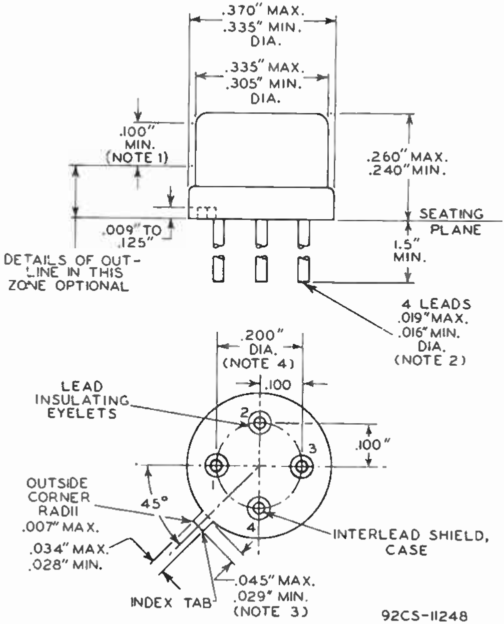
** C_L REPRESENTS THE TOTAL CAPACITANCE ACROSS R_L — THAT IS, THE SUM OF THE OSCILLOSCOPE-PROBE CAPACITANCE AND THE STRAY CAPACITANCE. THE STRAY CAPACITANCE ACROSS R_L MUST BE LESS THAN 6 $\mu\mu f$.

■ SILICON ULTRA-FAST SWITCHING DIODE WITH 0.5-mμsec MAXIMUM REVERSE RECOVERY TIME WHEN SWITCHING FROM 10 MA. FORWARD CURRENT TO –6 VOLTS REVERSE VOLTAGE.

▲ WITH RELAY OUT AND SWITCH (S) OPEN, ADJUST V_{SUPPLY} TO OBTAIN SPECIFIED FORWARD CURRENT (I_F).

World Radio History

SIMILAR TO JEDEC No. TO-33



NOTE 1: THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE VARIATION IN ACTUAL DIAMETER WITHIN THE ZONE SHALL NOT EXCEED 0.010".

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE SEATING PLANE. BETWEEN 0.25" AND 1.5" A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 3: MEASURED FROM MAXIMUM DIAMETER OF THE ACTUAL DEVICE.

NOTE 4: LEADS HAVING MAXIMUM DIAMETER (0.019") MEASURED IN GAUGING PLANE 0.054" + 0.001" − 0.000" BELOW THE SEATING PLANE OF THE DEVICE SHALL BE WITHIN 0.007" OF THEIR TRUE LOCATIONS RELATIVE TO A MAXIMUM-WIDTH TAB.

World Radio History

World Radio History

Drift-Field Transistor

With Two Emitters

GERMANIUM P-N-P ALLOY TYPE

For Applications Requiring Control of an Output Current by Signals from Two Sources

GENERAL DATA

Electrical:

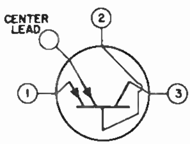
Maximum DC Collector-to-Base Voltage (V_{CB}) with emitter No.1 and emitter No.2 connected together, for dc emitter-to-base volts = -0.5, dc collector μa = -50, ambient temperature = 25° C.	-34	volts
Maximum DC Collector-Cutoff Current (I_{CBO}) for dc collector-to-base volts = -12, emitter No.1 and emitter No.2 open, ambient temperature = 25° C.	-16	μa
Maximum DC Emitter-Cutoff Current (I_{EBO}) with emitter No.1 and emitter No.2 connected together, for dc emitter-to-base volts = -0.5, collector open, ambient temperature = 25° C.	-16	μa
Thermal Resistance (R_T):		
In free air	400	°C/watt
With infinite heat sink	100	°C/watt
Intrinsic Base Resistance ($r_{bb'}$)	55	ohms
Collector-to-Base Capacitance (C_{ob})	3.8	μμf

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.405"
Maximum Diameter	0.240"
Dimensional Outline	JEDEC No. TO-44
Case	Metal
Seals	Hermetic
Leads, Flexible	4
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter No.1
Center Lead - Emitter No.2



Lead 2 - Base
Lead 3 - Collector (Adjacent to red dot on side of case)

World Radio History

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

DC COLLECTOR-TO-BASE VOLTAGE	−34 max.	volts
DC EMITTER-No.1-TO-BASE VOLTAGE	−0.5 max.	volt
DC EMITTER-No.2-TO-BASE VOLTAGE	−0.5 max.	volt
DC COLLECTOR CURRENT	−20 max.	ma
DC EMITTER CURRENT (Emitter No.1 & Emitter No.2)	20 max.	ma
TRANSISTOR DISSIPATION:▲		
At ambient temperature of 25° C	80 max.	mw
At ambient temperature of 55° C	50 max.	mw
At ambient temperature of 71° C	35 max.	mw
AMBIENT TEMPERATURE (During operation)	71 max.	°C
STORAGE-TEMPERATURE RANGE	−65 to +85	°C

Characteristics, *At Ambient Temperature of 25° C:*

Common-Base Circuit, Emitter Input

DC Collector-to-Base Voltage	−12	volts
Small-Signal Current Transfer Ratio at 1 kc for:		
Emitter-No.1 ma. = 1 and Emitter-No.2 ma. = 0.	0.985	
Emitter-No.1 ma. = 0 and Emitter-No.2 ma. = 1.	0.985	
Alpha-Cutoff Frequency	40	Mc

Typical Operation, *At Ambient Temperature of 25° C:*

In accompanying common-base, emitter-input, 1-Mc, capacitor-tuned, mixer-oscillator circuit

DC Collector-to-Base Voltage	−4.4	volts
DC Emitter-No.1 (Signal-Emitter) Current	1	ma
DC Emitter-No.2 (Oscillator-Emitter) Current	0.5	ma
Input Impedance (Signal Emitter)	25	ohms
Oscillator Voltage at Emitter No.2	80	mv
Conversion Power Gain (1 Mc to 455 kc) for emitter-No.1-to-collector load impedance (megohms) = 0.3	26	db

In accompanying common-base, emitter-input, 1-Mc, inductance-tuned mixer-oscillator circuit

DC Collector-to-Base Voltage	−10.5	volts
DC Emitter-No.1 (Signal-Emitter) Current	1.1	ma
DC Emitter-No.2 (Oscillator-Emitter) Current	0.42	ma
Input Impedance (Signal Emitter)	23	ohms
Oscillator Voltage at Emitter No.2	145	mv
Conversion Power Gain (1 Mc to 262.5 kc) for emitter-No.1-to-collector load impedance (megohms) = 0.346	27	db

▲ See accompanying *Rating Chart*.

World Radio History

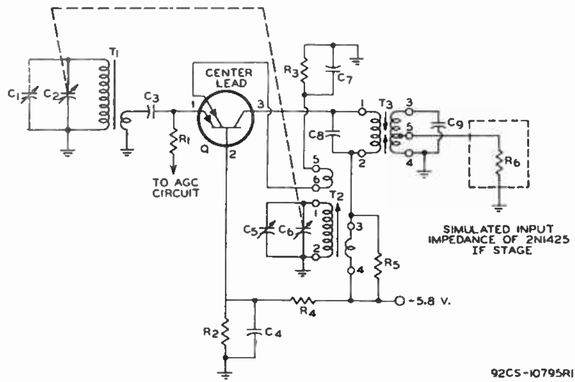
OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation will crack the seals of the leads and damage the transistor.

When dip soldering is employed in the assembly of printed circuitry using this transistor, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds.

CAPACITOR-TUNED MIXER-OSCILLATOR CIRCUIT



C_1,
C_5: Trimmer capacitors, 2-to-14 $\mu\mu f$
C_2: Antenna tuning capacitor, 7-to-158 $\mu\mu f$, ganged with C_6
C_3: 0.5 μf, paper, 6 volts
C_4: 0.47 μf, paper, 6 volts
C_6: Oscillator tuning capacitor, 7-to-78 $\mu\mu f$, ganged with C_2
C_7: 0.005 μf, paper, 6 volts
C_8: 36 $\mu\mu f$, silver mica, 500 volts
C_9: 40 $\mu\mu f$, silver mica, 500 volts

Q: Transistor type 3746
R_1: 1200 ohms, 0.5 watt
R_2: 4700 ohms, 0.5 watt
R_3: 2200 ohms, 0.5 watt
R_4: 12,000 ohms, 0.5 watt
R_5: 3300 ohms, 0.5 watt
R_6: 1800 ohms
T_1: Antenna transformer
T_2: Oscillator transformer
T_3: Intermediate-frequency transformer

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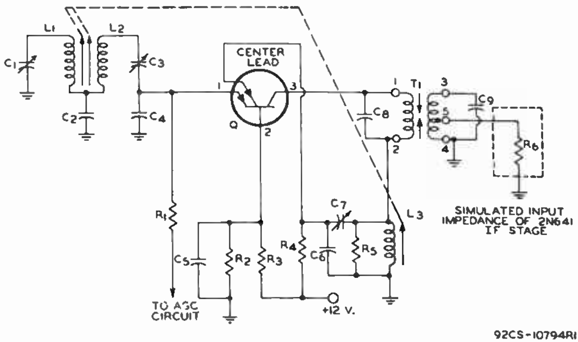
World Radio History

INDUCTANCE-TUNED MIXER-OSCILLATOR CIRCUIT



C_1: Trimmer capacitor, 50 μμf approx.
C_2: 0.01 μf, paper, 15 volts
C_3: Trimmer capacitor, 110 μμf approx.
C_4: 0.005 μf, paper, 15 volts
C_5: 0.2 μf, paper, 15 volts
C_6: 0.0033 μf, paper, 15 volts
C_7: Padder capacitor, 550 μμf approx.
C_8: 47 μμf, silver mica, 500 volts
C_9: 50 μμf, silver mica, 500 volts
L_1,
L_2: Antenna-transformer windings

L_3: Oscillator coil
Q: Transistor type 3746
R_1: 1500 ohms, 0.5 watt
R_2: 22000 ohms, 0.5 watt
R_3: 5600 ohms, 0.5 watt
R_4: 4700 ohms, 0.5 watt
R_5: 3300 ohms, 0.5 watt
R_6: 1400 ohms
T_1: Intermediate-frequency transformer

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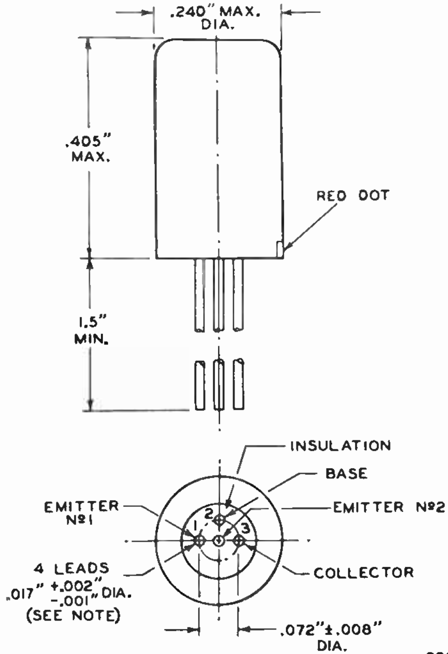
World Radio History

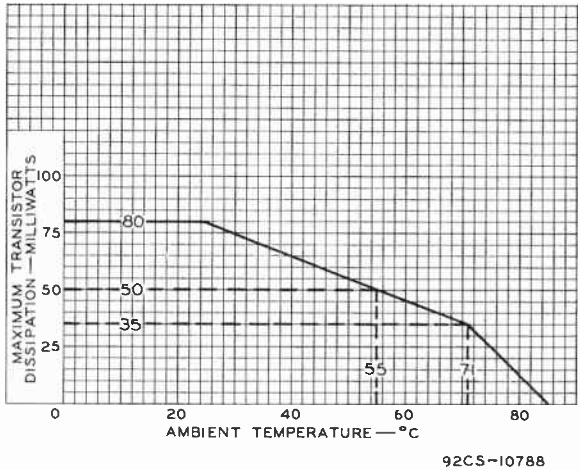


92CS-10798

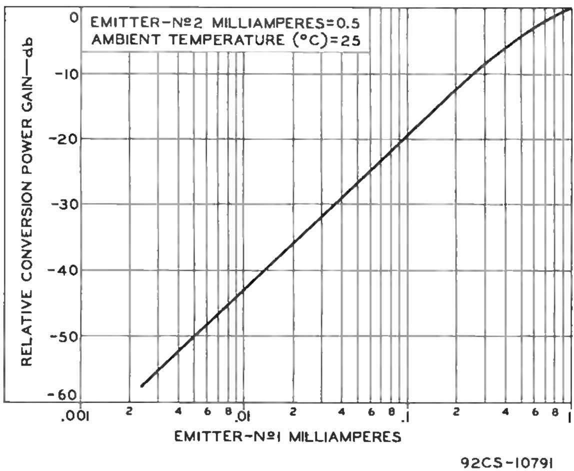
NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE PLANE OF THE ACTUAL BOTTOM OF THE CASE. BETWEEN 0.25" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

World Radio History

RATING CHART

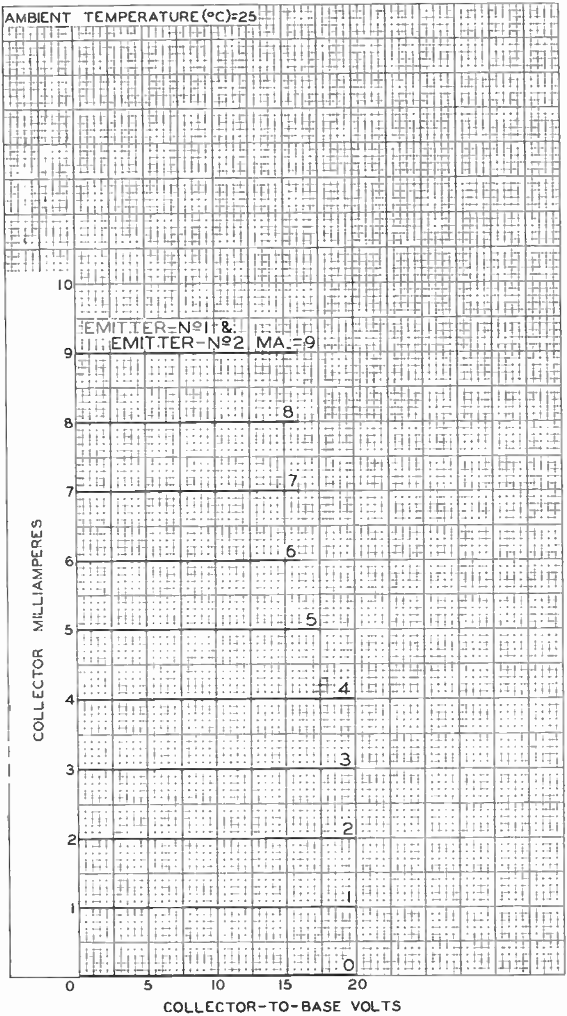


PERFORMANCE CHARACTERISTIC



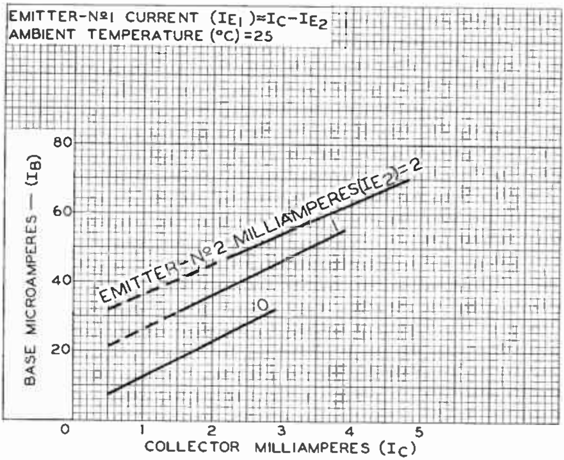
World Radio History

TYPICAL COLLECTOR CHARACTERISTICS
Common-Base Circuit



92CM-10793R1

TYPICAL CHARACTERISTICS



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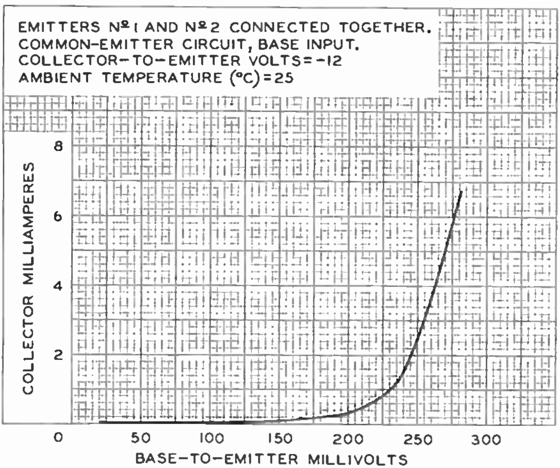


92CS-10796

World Radio History

Transistor

PREMIUM TYPE

GERMANIUM P-N-P ALLOY-JUNCTION TYPE

For Critical Computer Switching Applications

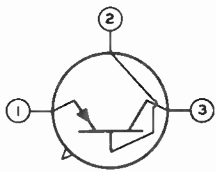
GENERAL DATA

Mechanical:

Operating Position	Any
Maximum Length (Excluding flexible leads)	0.260"
Maximum Diameter	0.370"
Dimensional Outline	JEDEC No. TO-5
Case	Welded, Metal
Seals	Hermetic
Leads, Flexible	3
Minimum length	1.5"
Orientation and diameter	See *Dimensional Outline*

Terminal Diagram: BOTTOM VIEW

Lead 1 - Emitter
Lead 2 - Base



Lead 3 - Collector

SWITCHING SERVICE

Maximum and Minimum Ratings, ***Absolute-Maximum Values:***

COLLECTOR-TO-BASE VOLTAGE	-25 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With dc emitter-to-base volts = -1	-24 max.	volts
EMITTER-TO-BASE VOLTAGE	-12 max.	volts
COLLECTOR CURRENT	-200 max.	ma
EMITTER CURRENT	200 max.	ma
TRANSISTOR DISSIPATION:[a]		
At ambient temperature of 25° C	150 max.	mw
At ambient temperature of 55° C	75 max.	mw
At ambient temperature of 71° C	35 max.	mw
AMBIENT-TEMPERATURE RANGE:		
Operating	-65 to +85	°C
Storage	-65 to +100	°C
LEAD TEMPERATURE:		
For 10 seconds maximum	235 max.	°C

[a] See accompanying *Rating Chart*.

World Radio History

ELECTRICAL CHARACTERISTICS

Voltage values are given with respect to base and ambient temperature of 25° C unless otherwise specified

	Symbol	Min.	Typical	Max.	
DC Collector Breakdown Voltage for dc collector μa = -20, dc emitter current = 0	BV_{CBO}	-25	-45	-	volts
DC Emitter Breakdown Voltage for dc emitter μa = -20, dc collector current = 0.	BV_{EBO}	-12	-30	-	volts
DC Emitter Floating Potential for dc collector volts = -25, dc emitter current = 0.	V_{EBF}	-	-	-1	volt
DC Base-to-Emitter Saturation Voltage:	$V_{BE(sat)}$				
With dc collector ma. = -12, dc base ma. = -0.4		-	-0.3	-0.35	volt
With dc collector ma. = -24, dc base ma. = -1.		-	-0.32	-0.4	volt
DC Collector-to-Emitter Saturation Voltage:	$V_{CE(sat)}$				
With dc collector ma. = -12, dc base ma. = -0.4		-	-0.1	-0.15	volt
With dc collector ma. = -24, dc base ma. = -1.		-	-0.12	-0.2	volt
DC Collector-Cutoff Current for dc collector volts = -12, dc emitter current = 0, ambient temperature of:	I_{CBO}				
25° C		-	-2	-5	μa
80° C		-	-45	-90	μa
DC Emitter Cutoff Current for emitter volts = -2.5, dc collector current = 0.	I_{EBO}	-	-1	-2.5	μa
DC Current Transfer Ratio:	h_{FE}				
For dc collector-to-emitter volts = -0.15, dc collector ma. = -12		30	45	-	
For dc collector-to-emitter volts = -0.2, dc collector ma. = -24		24	40	-	

World Radio History

Alpha-Cutoff Frequency for dc collector volts = -6, dc collector ma. = -1 . . . f_{ab}	4	12	-	Mc
Output Capacitance for dc collector volts = -6, dc emitter current = 0. . . . . . . C_{ob}	-	15	20	$\mu\mu$f
Input Capacitance for dc emitter volts = -6, dc collector current = 0 . . . . . C_{ib}	-	10	20	$\mu\mu$f
Stored Base Charge for dc collector ma. = 10, dc base ma. = 1 . . . . Q_s	-	1000	1400	$\mu\mu$coulombs

PERFORMANCE TESTS

This transistor type is tested in strict accordance with rigid procedures conforming with the mechanical, environmental and life requirements of Military Specification MIL-S-19500B.

OPERATING CONSIDERATIONS

It is recommended that this transistor not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

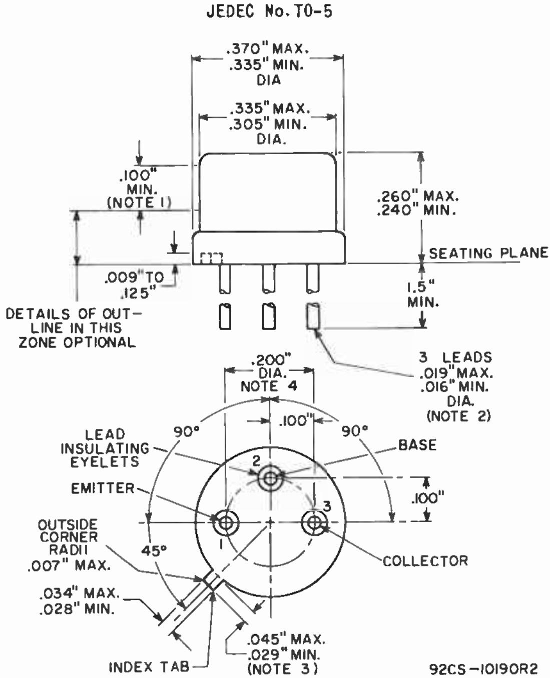
The *flexible leads* of this transistor are usually soldered to the circuit elements. Soldering of the leads may be made close to the glass stem provided care is taken to conduct excessive heat away from the lead seal. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the transistor.

This transistor is intended for use in socketed, single-side printed circuit boards and in conventional wire-in type circuits. If this transistor is used in double-side printed-circuit boards or in printed-circuit boards utilizing eyelets, it may be necessary to use an insulating washer or similar standoff device made of good dielectric material to prevent the solder from shorting the leads to each other or to the board.

FOR ADDITIONAL INFORMATION ON THIS TYPE, WRITE FOR TECHNICAL BULLETIN AVAILABLE FROM:

Commercial Engineering
Semiconductor & Materials Division
RCA
Somerville, New Jersey

World Radio History



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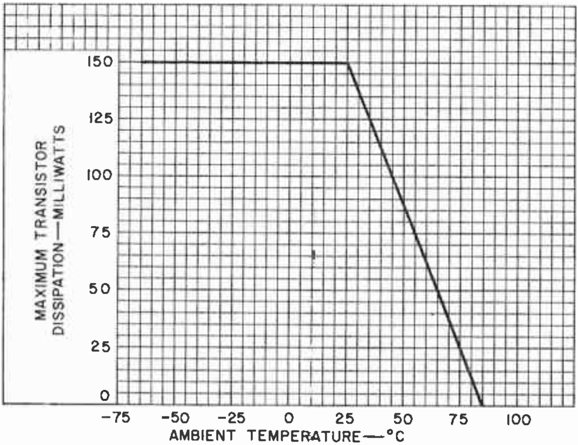
NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.05" AND 0.25" FROM THE SEATING PLANE. BETWEEN 0.25" AND 1.5" A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 3: MEASURED FROM MAXIMUM DIAMETER OF THE ACTUAL DEVICE.

NOTE 4: LEADS HAVING MAXIMUM DIAMETER (0.019") MEASURED IN GAUGING PLANE 0.054" + 0.001" - 0.000" BELOW THE SEATING PLANE OF THE DEVICE SHALL BE WITHIN 0.007" OF THEIR TRUE LOCATIONS RELATIVE TO A MAXIMUM-WIDTH TAB.

World Radio History

RATING CHART



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