BROADCAST EQUIPMENT

BTE 10B FM Multiplex Exciter
and
BTX-1A Subcarrier Generator

RADIO CORPORATION OF AMERICA

INDUSTRIAL ELECTRONIC PRODUCTS, CAMDEN, N. J.

IB 30262

EQUIPMENT LOST OR DAMAGED IN TRANSIT

When delivering the equipment to you, the truck driver or carrier's agent will present a receipt for your signature. Do not sign it until you have (a) inspected the containers for visible signs of damage and (b) counted the containers and compared with the amount shown on the shipping papers. If a shortage or if evidence of damage is noted, insist that notation to that effect be made on the shipping papers before you sign them.

Further, after receiving the equipment, unpack it and inspect thoroughly for concealed damage. If concealed damage is discovered, immediately notify the carrier, confirming the notification in writing, and secure an inspection report. This item should be unpacked and inspected for damage WITHIN 15 DAYS after receipt.

Report all shortages and damages to RCA, Broadcast and Television Department, Camden 2, N. J.

Radio Corporation of America will file all claims for loss and damage on this equipment so long as the inspection report is obtained. Disposition of the damaged item will be furnished by RCA.

REPLACEMENT PARTS AND ENGINEERING SERVICE

RCA field engineering service is available at current rates. Requests for field engineering service may be addressed to your RCA Broadcast Field Representative or the RCA Service Company, Inc., Broadcast Service Division, Camden, N. J. Telephone: WOodlawn 3-8000.

When ordering replacement parts, please give symbol, description, and stock number of each item ordered.

The part which will be supplied against an order for a replacement item may not be an exact duplicate of the original part. However, it will be a satisfactory replacement differing only in minor mechanical or electrical characteristics. Such differences will in no way impair the operation of the equipment.

The following tabulations list service parts and electron tube ordering instructions according to your geographical location.

SERVICE PARTS

LOCATION	ORDER SERVICE PARTS FROM:
Continental United States, Alaska and Hawaii	Service Parts Order Service, Bldg. 60, 19th & Federal Sts., Camden 5, New Jersey or through your nearest RCA Regional Office. Emergency orders may be telephoned, telegraphed, or teletyped to RCA Emergency Service, Bldg 60, Camden, N. J. (Telephone: WO 3-8000).
Dominion of Canada	RCA Victor Company Limited, 1001 Lenoir Street, Montreal, Quebec or through your local Sales Representative or his office.
Outside of Continental United States, Alaska, Hawaii and the Dominion of Canada	RCA International Division, Clark, N. J., U.S.A. or through your local Sales Representative.

ELECTRON TUBES

LOCATION	ORDER ELECTRON TUBES FROM:
Continental United States, Alaska and Hawaii	Local RCA Tube Distributor.
Dominion of Canada	RCA Victor Company Limited, 1001 Lenoir Street, Montreal, Quebec or through your local Sales Representative or his office.
Outside of Continental United States, Alaska, Hawaii and the Dominion of Canada	Local RCA Tube Distributor or from: Tube Department RCA International Division 30 Rockefeller Plaza New York 20, New York, U.S.A.

RETURN OF ELECTRON TUBES

If for any reason, it is desired to return tubes, please return them through your local RCA tube distributor, RCA Victor Co. Ltd., or RCA International Div., depending on your location.

PLEASE DO NOT RETURN TUBES DIRECTLY TO RCA WITHOUT AUTHORIZATION AND SHIPPING INSTRUCTIONS.

It is important that complete information regarding each tube (including type, serial number, hours of service and reason for its return) be given.

When tubes are returned, they should be shipped to the address specified on the Return Authorization form. A copy of the Return Authorization and also a Service Report for each tube should be packed with the tubes.

LIST OF RCA REGIONAL OFFICES

Atlanta 3, Georgia
1121 Rhodes-Haverty Bldg.
134 Peachtree St. N.W.
JAckson 4-7703

Boston 16, Mass.
Room 2301, John Hancock Bldg.
200 Berkley St.
HUbbard 2-1700

Chicago 54, Ill.
1186 Merchandise Mart Plaza
DElaware 7-0700

Cleveland 15, Ohio
1600 Keith Bldg.
CHerry 1-3450

Dallas 35, Texas
7901 Empire Freeway
FLeetwood 2-3911

Hollywood 28, Calif.
RCA Bldg., 1560 N. Vine St.
HOllywood 9-2154

Kansas City 6, Missouri
340 Home Savings Bldg.
HArrison 1-6480

New York 20, New York
36 W. 49th St.
JUdson 6-3800

Branch—San Francisco 2, Calif.
420 Taylor St.
ORdway 3-8027

Seattle, Washington
2250 First Ave., S.
MAin 2-8350

INSTRUCTIONS

BTE-10B FM Multiplex Exciter and BTX-1A Subcarrier Generator

RADIO CORPORATION OF AMERICA
COMMERCIAL ELECTRONIC PRODUCTS, CAMDEN, N. J.

PRINTED IN U.S.A.
DU 577-519

IB-30262

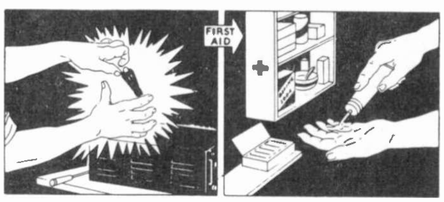
FIRST AID

WARNING!

Operation of electronic equipment involves the use of high voltages which are dangerous to life. Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside the equipment with voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors, etc. To avoid casualties, ALWAYS DISCHARGE AND GROUND CIRCUITS PRIOR TO TOUCHING THEM.

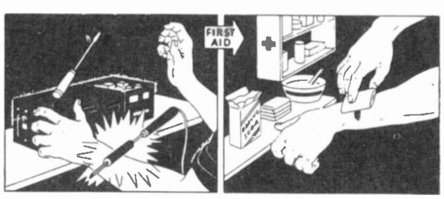
ABOUT FIRST AID

Personnel engaged in the installation, operation and maintenance of this equipment or similar equipment are urged to become familiar with the following rules both in theory and in the practical application thereof. It is the duty of every radioman to be prepared to give adequate First Aid and thereby prevent avoidable loss of life.



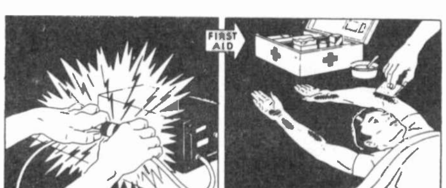
FIRST DEGREE BURN

SKIN REDDENED. Temporary treatment—Apply baking soda or Unguentine.



SECOND DEGREE BURN

SKIN BLISTERED. Temporary treatment—Apply baking soda, wet compress, white petroleum jelly, foille jelly, olive oil, or tea.



THIRD DEGREE BURN

FLESH CHARRED. Temporary treatment—Apply baking soda, wet compress, white petroleum jelly, or foille spray. Treat for severe shock.

BACK PRESSURE—ARM LIFT METHOD OF ARTIFICIAL RESPIRATION

(Courtesy of the American Red Cross)

1. Position of the subject (See Fig. 1)

Place the subject in the face down, prone position. Bend his elbows and place the hands one upon the other. Turn his face to one side, placing the cheek upon his hands.

FIGURE 1

2. Position of the operator (See Fig. 2)

Kneel on either the right or left knee at the head of the subject facing him. Place the knee at the side of the subject's head close to the forearm. Place the opposite foot near the elbow. If it is more comfortable, kneel on both knees, one on either side of the subject's head. Place your hands upon the flat of the subject's back in such a way that the heels lie just below a line running between the armpits. With the tips of the thumbs just touching, spread the fingers downward and outward.

FIGURE 2

3. Compression phase (See Fig. 3)

Rock forward until the arms are approximately vertical and allow the weight of the upper part of your body to exert slow, steady, even pressure downward upon the hands. This forces air out of the lungs. Your elbows should be kept straight and the pressure exerted almost directly downward on the back.

FIGURE 3

4. Position for expansion phase (See Fig. 4)

Release the pressure, avoiding a final thrust, and commence to rock slowly backward. Place your hands upon the subject's arms just above his elbows.

5. Expansion phase (See Fig. 5)

Draw his arms upward and toward you. Apply just enough lift to feel resistance and tension at the subject's shoulders. Do not bend your elbows, and as you rock backward the subject's arms will be drawn toward you. Then lower the arms to the ground. This completes the full cycle. The arm lift expands the chest by pulling on the chest muscles, arching the back, and relieving the weight on the chest.

THE CYCLE SHOULD BE REPEATED 12 TIMES PER MINUTE AT A STEADY, UNIFORM RATE. THE COMPRESSION AND EXPANSION PHASES SHOULD OCCUPY ABOUT EQUAL TIME; THE RELEASE PERIODS BEING OF MINIMUM DURATION.

FIGURE 4

Additional related directions:

It is all important that artificial respiration, when needed, be started quickly. There should be a slight inclination of the body in such a way that fluid drains better from the respiratory passage. The head of the subject should be extended, not flexed forward, and the chin should not sag lest obstruction of the respiratory passages occur. A check should be made to ascertain that the tongue or foreign objects are not obstructing the passages. These aspects can be cared for when placing the subject into position or shortly thereafter, between cycles. A smooth rhythm in performing artificial respiration is desirable, but split-second timing is not essential. Shock should receive adequate attention, and the subject should remain recumbent after resuscitation until seen by a physician or until recovery seems assured.

FIGURE 5

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BTX-1A Subcarrier Generator

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BTE-10B FM Multiplex Exciter

BTX-1A Subcarrier Generator

LIST OF EQUIPMENT
BTE-10B FM Exciter (ES-27278)

Quantity		*Reference*
1	FM Exciter Unit	MI-34501
1	Crystal Unit (Spare to be ordered separately)	MI-34509*
1	Set of Operating Tubes	MI-34510
	Set of FCC Spare Tubes (Not supplied—to be ordered separately)	MI-34515
2	Instruction Books	IB-30262

* See table of crystals and frequencies.

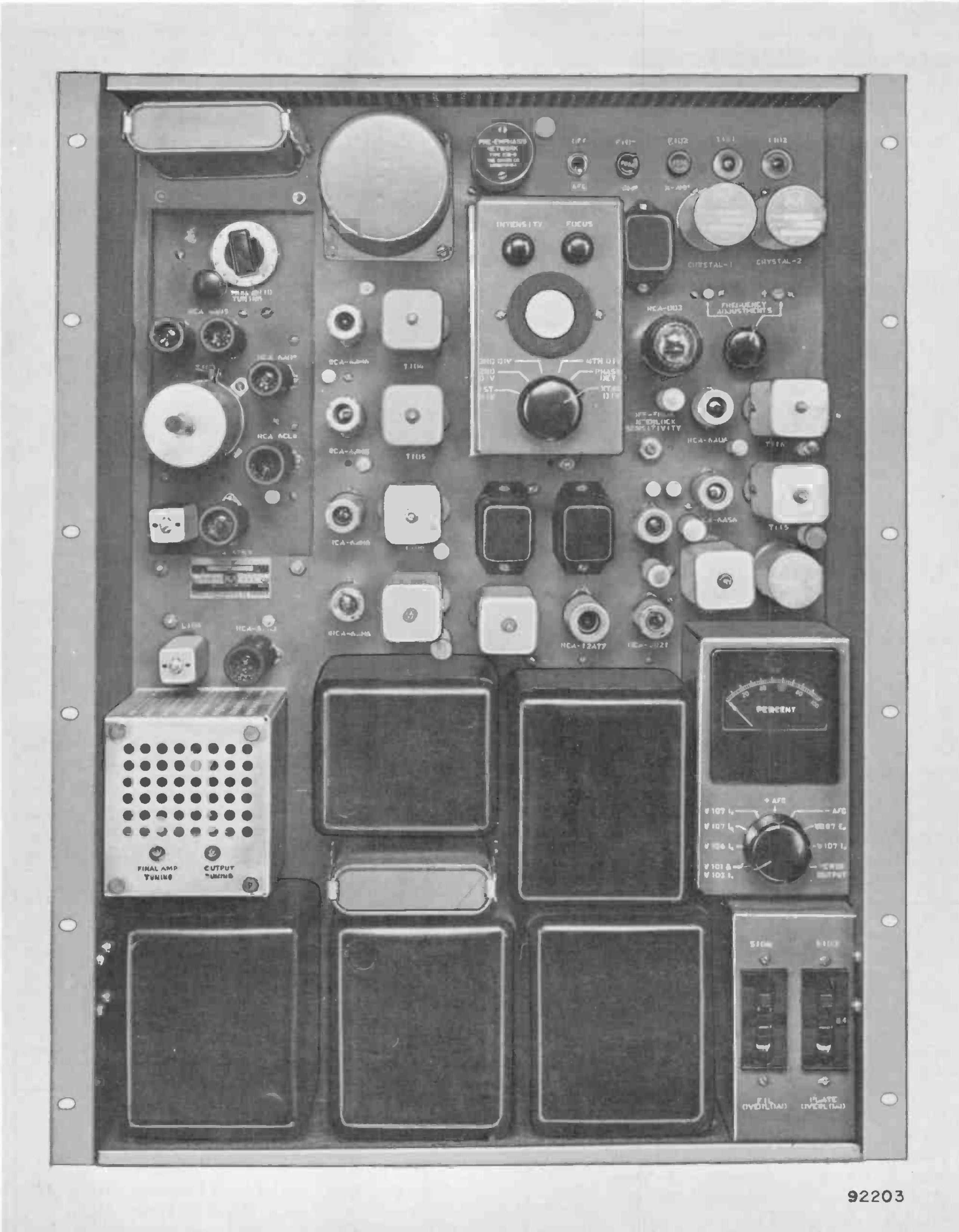


Figure 1—BTE-10B FM Multiplex Exciter

TECHNICAL SUMMARY

ELECTRICAL CHARACTERISTICS

Type of Emission	F3
Frequency Range	88–108 mc/s
Power Output	10 watts
Output Impedance	50 ohms
Frequency Deviation for 100% mod.	±75 kc/s
Modulation Capability	±100 kc/s min.
Carrier Frequency Stability	±1000 cps max.
Audio Input Impedance	600/150 ohms
Audio Input Level (100% mod.)	+10 ±2 dbm[1]
Audio Frequency Response (50–15000 cps)	±1 db max.[2]
Harmonic Distortion (50–15000 cps)	50–100: 1.5% max.[3]
	100–7500: 1% max.
	7500–15000: 1.5% max.
FM Noise Level (referred to 100% FM mod.)	−65 db max.
AM Noise Level (referred to carrier voltage)	−50 db max.
Sub-carrier Input Level (30% mod. of carrier)	5v max.[4]
Sub-carrier Input Impedance	10,000 ohms
Sub-carrier Center Frequency Range	30–67 kc/s
Main-to-Sub-channel Crosstalk	−53 db[5]
Sub-to-Main-channel Crosstalk	−65 db[6]
Power Line Requirements	240/208 or 117 V, single phase 50/60 cps
Slow Voltage Variations	±5%
Power Consumption	300 watts, Approx.
Crystal Heaters	117 volts, 50–60 cps, 10 watts each
Altitude	7500 ft., max.
Ambient Temperature Range	0–45°C

MECHANICAL SPECIFICATIONS

	Height	*Width*	*Depth*
Overall Dimensions	24½″	19″	11″
Weight	80 lbs.		

[1]Level measured at input (J101) using 400 cps tone.

[2]Audio frequency response referred to 75 μs pre-emphasis curve.

[3]Distortion includes all harmonics up to 30 kc/s and is measured following a standard 75 μs de-emphasis network.

[4]Subcarrier modulation percentage can be brought to 50% if required.

[5]Reference shall be ±7.5 kc/s deviation of the subcarrier by a 400 cps tone. Main channel modulation 85% by 50–15000 cps tones.

[6]Reference shall be ±75 kc deviation of the main carrier by a 400 cps tone. Sub-channel modulated 100% (±7.5 kc/s) by 50–6000 cps tones. Subcarrier modulated 30% on main carrier.

TUBE COMPLEMENT

Symbol	*Type*	*Function*	*Symbol*	*Type*	*Function*
V101	6AQ5	Reactance Modulator	V109	6AH6	Frequency Divider (1/4)
V102	6AQ5	Reactance Modulator	V110	6AH6	Frequency Divider (1/4)
V103	6AQ5	Master Oscillator	V111	6AH6	Frequency Divider (1/5)
V104	6CL6	Subcarrier Modulator	V112	6AU6	Crystal Oscillator
V105	5763	Frequency Tripler	V113	6AH6	Crystal Frequency Divider (1/5)
V106	5763	Frequency Tripler	V114	12AT7	Cathode Follower
V107	6146	Frequency Doubler and Power Amplifier	V115	6AS6	Off-Frequency Detector
			V116	2D21	Off-Frequency Control
			V117	OD3	Voltage Regulator
V108	6AH6	Frequency Divider (1/3)	V118	1EP1	Cathode Ray Tube

BTE-10B EXCITER CRYSTALS

MI No.*	Carrier Frequency (MC)	Crystal Frequency (KC)	MI No.*	Carrier Frequency (MC)	Crystal Frequency (KC)
34509-1	88.1	101.9676	34509-51	98.1	113.5417
-2	88.3	102.1991	-52	98.3	113.7731
-3	88.5	102.4306	-53	98.5	114.0046
-4	88.7	102.6620	-54	98.7	114.2361
-5	88.9	102.8935	-55	98.9	114.4676
-6	89.1	103.1250	-56	99.1	114.6991
-7	89.3	103.3565	-57	99.3	114.9306
-8	89.5	103.5880	-58	99.5	115.1620
-9	89.7	103.8194	-59	99.7	115.3935
-10	89.9	104.0509	-60	99.9	115.6250
-11	90.1	104.2824	-61	100.1	115.8565
-12	90.3	104.5139	-62	100.3	116.0880
-13	90.5	104.7454	-63	100.5	116.3194
-14	90.7	104.9769	-64	100.7	116.5509
-15	90.9	105.2083	-65	100.9	116.7824
-16	91.1	105.4398	-66	101.1	117.0139
-17	91.3	105.6713	-67	101.3	117.2454
-18	91.5	105.9028	-68	101.5	117.4769
-19	91.7	106.1343	-69	101.7	117.7083
-20	91.9	106.3657	-70	101.9	117.9383
-21	92.1	106.5972	-71	102.1	118.1713
-22	92.3	106.8287	-72	102.3	118.4028
-23	92.5	107.0602	-73	102.5	118.6343
-24	92.7	107.2917	-74	102.7	118.8657
-25	92.9	107.5231	-75	102.9	119.0972
-26	93.1	107.7546	-76	103.1	119.3287
-27	93.3	107.9861	-77	103.3	119.5602
-28	93.5	108.2176	-78	103.5	119.7917
-29	93.7	108.4491	-79	103.7	120.0231
-30	93.9	108.6806	-80	103.9	120.2546
-31	94.1	108.9120	-81	104.1	120.4861
-32	94.3	109.1435	-82	104.3	120.7176
-33	94.5	109.3750	-83	104.5	120:9491
-34	94.7	109.6065	-84	104.7	121.1806
-35	94.9	109.8380	-85	104.9	121.4120
-36	95.1	110.0694	-86	105.1	121.6435
-37	95.3	110.3009	-87	105.3	121.8750
-38	95.5	110.5324	-88	105.5	122.1065
-39	95.7	110.7639	-89	105.7	122.3380
-40	95.9	110.9954	-90	105.9	122.5694
-41	96.1	111.2269	-91	106.1	122.8009
-42	96.3	111.4583	-92	106.3	123.0324
-43	96.5	111.6898	-93	106.5	123.2639
-44	96.7	111.9213	-94	106.7	123.4954
-45	96.9	112.1528	-95	106.9	123.7268
-46	97.1	112.3843	-96	107.1	123.9583
-47	97.3	112.6157	-97	107.3	124.1898
-48	97.5	112.8472	-98	107.5	124.4213
-49	97.7	113.0787	-99	107.7	124.6528
-50	97.9	113.3102	-100	107.9	124.8843

* Suffixes 1 to 100 designate channel number. Add 200 to suffix to get FCC channel number, e.g., MI-34509-75 designates FCC channel 275, frequency 102.9 mc.

DESCRIPTION

The RCA BTE-10B is a frequency modulated exciter which will provide an r-f output of ten watts at any specified frequency in the 88 to 108 megacycle band. The compact unit incorporates a subcarrier modulator stage which can be fed from a subcarrier generator such as the RCA BTX-1A to provide for multiplexing one or two subcarriers on the main FM channel. Thus, it is designed especially to provide for various applications of FM multiplex such as background music, and, if it should become authorized, stereophonic sound.

The BTE-10B is the exciter used in the RCA BTF-5B 5KW FM Transmitter. It can be used to replace the exciter units of previous RCA FM transmitters, or any other FM transmitters where an exciter power output of ten watts is adequate. The unit incorporates features which make it easy to adjust, easy to maintain and very reliable in operation.

All r-f multipliers, including the output stage, employ single-tuned circuits. The exciter can be housed in a standard cabinet rack together with a subcarrier generator. Employing miniature tubes throughout, the BTE-10B is a self-contained unit with built-in power supplies and an oscilloscope to facilitate alignment.

The BTE-10B when properly adjusted, and used in conjunction with the BTX-1A Subcarrier Generator, will provide subchannel performance comparable to the main FM channel with regard to signal-to-noise ratio and distortion. The frequency response of the subcarrier will be somewhat limited when programming the subcarrier separately.

R-f multiplier and power amplifier stages of the BTE-10B use relatively broadband, single-tuned circuits, thus simplifying adjustment. A built-in meter can be switched to read the following voltages and currents: Modulator cathode current; second and third multiplier grid currents; PA cathode and plate current; AFC control voltage; and plate voltage.

The monitor oscilloscope incorporated in the exciter simplifies adjustment and maintenance of the AFC frequency dividers. A switch permits instantaneous checking and adjustment of all five dividers, and a check of the control action of the phase detector. Displays are in the form of Lissajous' figures, with the advantage that lock-in of the dividers can be observed easily. Checks can be made during operation without disturbing the AFC circuit in any way. This type display requires no synchronization or other adjustments.

Power supplies employ semiconductor rectifiers. The high voltage regulated supply which furnishes d-c plate and screen voltage utilizes a bridge type germanium rectifier. Modulator and oscillator filaments are supplied by a d-c supply employing a full wave silicon rectifier.

All components of the BTE-10B are mounted on a vertical chassis. Special hinge-type mounting pins at the bottom corners permit the top of the chassis to be swung out for access to the wiring and circuit components on the underneath side.

CIRCUITS

A block diagram of the BTE-10B Exciter is shown in figure 2. Circuits consist of: A master oscillator which operates at 1/18th of the carrier frequency; two reactance modulators to provide modulation for the main channel; a third reactance modulator for the subcarrier; three frequency multipliers including the output stage to bring the output frequency up to the 88 to 108 mc range; automatic frequency control circuitry; and power supplies to furnish a-c and d-c voltages for these stages.

The master oscillator is a 6AQ5 Hartley type oscillator which operates at a frequency between approximately five and six mc., depending upon the desired output frequency. The plates of the two 6AQ5 reactance modulators are connected to the oscillator plate, and the grids, which are in push-pull, are inductively coupled to the plate tank. R-f voltages on the two modulator grids are 180 degrees out of phase with respect to each other, and each is 90 degrees out of phase with the oscillator plate. Thus, one tube appears as a capacitive reactance and the other appears as an inductive reactance across the oscillator tank. The magnitude of the reactive component presented to the tank coil varies with the audio voltage applied to the modulator grids, and the frequency of the oscillator is varied accordingly. The mean frequency is controlled by the bias voltage applied to one grid. This bias voltage is supplied by the automatic frequency control circuit to be described in a later paragraph.

The third reactance modulator, an RCA Type 6CL6, provides for modulation of the subcarrier on the main r-f carrier. This reactance tube is coupled to only a part of the oscillator coil since the required deviation of the r-f carrier by the subcarrier is small.

Use of the pushpull modulator and the inductive coupling circuit results in a highly linear operation with very low harmonic distortion. Each tube is

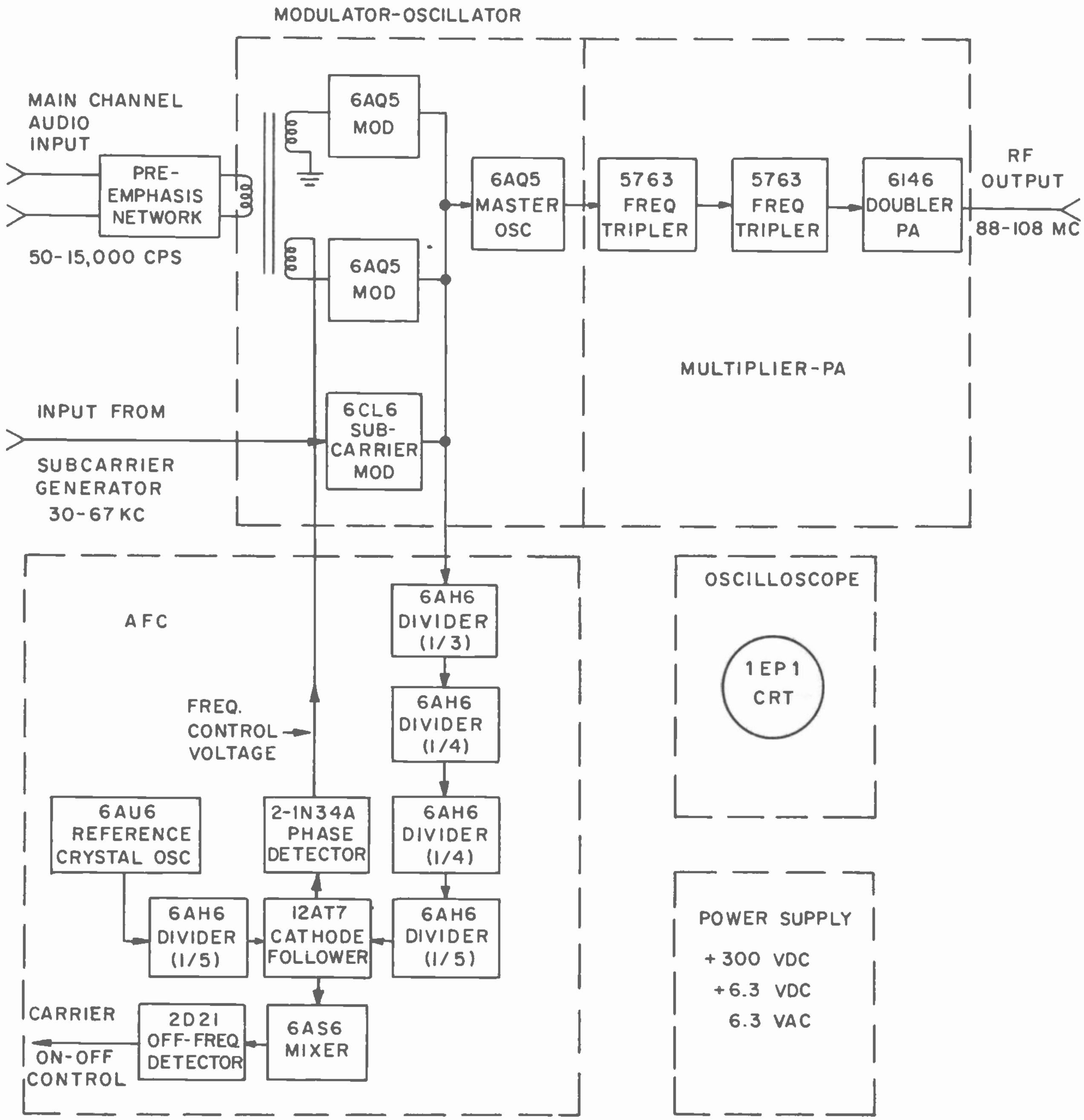


Figure 2—Block Diagram, BTE-10B FM Exciter

almost a pure reactance, and loading of the oscillator is greatly reduced, providing better AFC action. Moreover, the pushpull modulator automatically balances out temperature and supply-voltage changes. Modulating circuits are very effectively decoupled, thus minimizing the possibility of cross-talk between the main channel and subchannel, and vice versa.

Automatic Frequency Control

The automatic frequency control circuitry of the BTE-10B Exciter is characterized by a long record of dependable operation. A phase detector is used to develop a control voltage which establishes and maintains a phase lock between a reference crystal oscillator and the derived signal. Thus the system

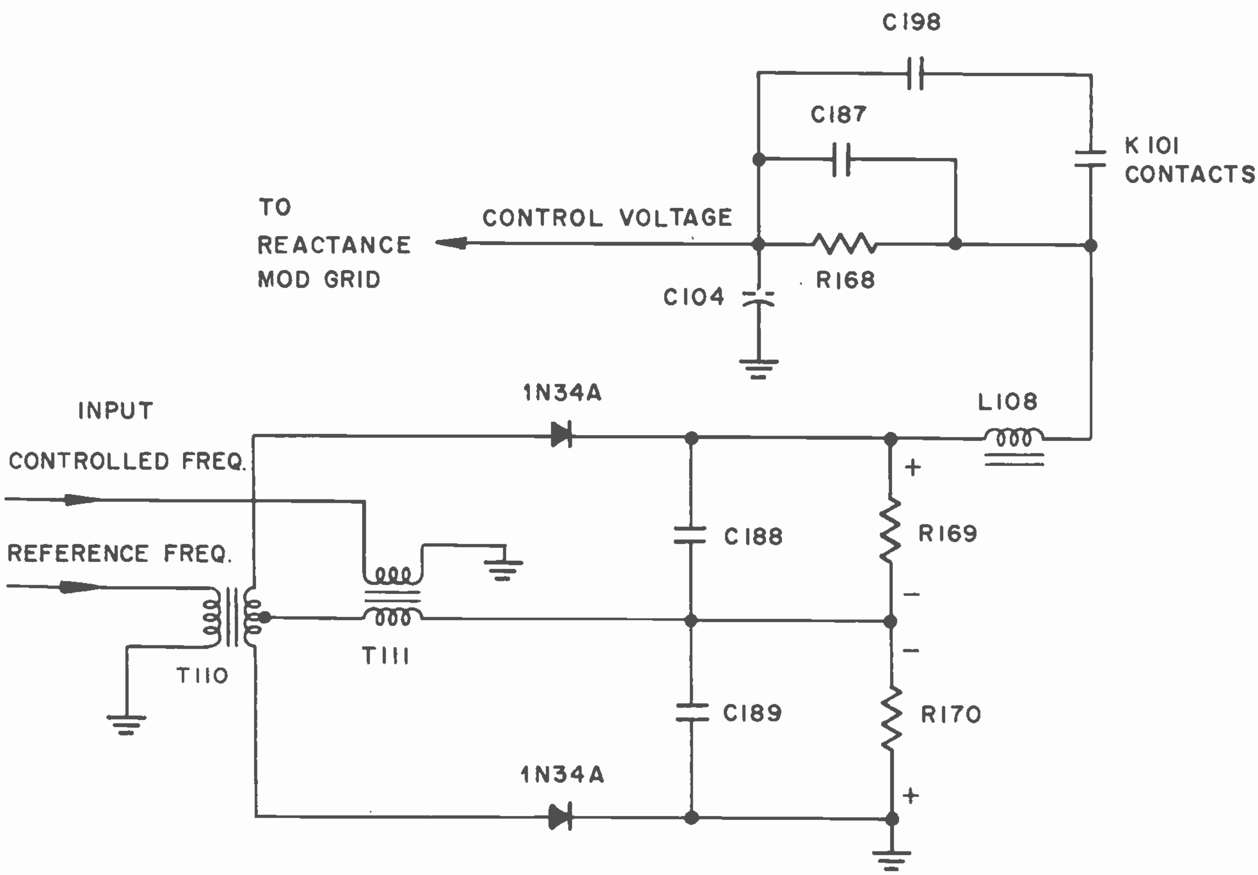


Figure 3—Simplified Schematic, BTE-10B Phase Detector

is actually an automatic phase control system which achieves a stability precisely matching that of the crystal reference source. To confine the phase deviations of the master oscillator signal to within range of the phase detector, and in order not to exceed the possible speed of the low pass network in the AFC circuit, the master oscillator frequency and swing must be reduced. This is accomplished in locked-oscillator type dividers with an overall division of 240. Thus the maximum phase deviation at the lowest audio frequency is ±28 degrees (at ±100 kc deviation of the final frequency), and well within the limits of linearity of the phase detector.

The limited pull-in range normally associated with precise frequency control is overcome by the use of an off-frequency circuit which extends the pull-in range to ±400 kc (at the final frequency), and simultaneously provides a safeguard against uncontrolled and possible off-frequency operation.

Circuits of the AFC system are diagrammed in figure 2. A small r-f voltage is fed from the master oscillator circuit to the divider chain where it is divided by 240 to a range of 20 to 25 kc. It should be noted that, at the same time, deviation due to modulation is reduced from a maximum of ±5 kc to ±20 cps. From the dividers, this voltage is fed through a cathode follower to a phase detector employing two 1N34A diodes. A reference voltage of the same frequency, fed into the phase detector, is obtained by dividing by five the frequency of the reference crystal oscillator.

Operation of the phase detector is illustrated in the simplified diagram of figure 3, and by the vector diagram of figure 4. Assuming that the master oscillator is exactly on frequency, with no correction bias applied to its grid, the two input signals applied to T110 and T111 therefore are of the same frequency but 90 degrees out of phase. The reference frequency signal is applied to T110, and the voltage developed across the top half of the secondary is represented by vector BA in figure 4 (a), while the voltage across the lower half is represented by vector BC. These two voltages are equal in magnitude and 180 degrees out of phase. The controlled frequency signal is applied to T111, and the voltage developed across its secondary is represented by vector BD, which is 90 degrees out of phase with each of the other two. The voltage impressed across each 1N34A crystal rectifier and its associated load (R169 and R170) is then the vector sum of the series voltages E_1 and E_2 respectively. Since the magnitudes of E_1 and E_2 are equal, the d-c voltages across R169 and R170 will be equal and of the polarity shown. Hence, the voltage as measured from the top of R169 to ground will be zero.

If, however, the frequency of the master oscillator should *decrease,* the relative phase of the two input signals and their vector relationships will change as shown in figure 4 (b). Since the magnitude of E_1 is now greater than that of E_2, the d-c voltage across R169 will be greater than that across R170 and a net *positive* correction voltage appearing at the top of R169 will be applied to the reactance tube grid, correcting the frequency. Accordingly, if the oscillator frequency should *increase,* the vector relationships change as shown in figure 4 (c), and a net *negative* correcting voltage is applied to the reactance tube grid. Thus any departure from the 90-degree phase relationship between the two signals is instantaneously corrected by a proper error voltage. High frequency components of the input signals are filtered out of the control voltage by the capacitors C188 and C189 and the choke L108.

The network consisting of capacitors C104, C187, C198 and resistor R168 extends the control range of the phase detector beyond the ±90 degree phase difference limit that would otherwise be imposed, by feeding a small amount of the beat frequency back to the reactance tube grid. This beat frequency then causes the master oscillator frequency to swing in both directions at the difference frequency rate. The amount of frequency deviation is proportional to the amplitude of the signal at the reactance tube grid; and in order to produce sufficient swing without objectionable audio frequency feedback, capacitor C187 is made small and is paralleled by a larger capacitor C198 which is switched in only when the master oscillator is "hunting." The switching is done automatically by the off-frequency detector described in a later paragraph.

If the signal at the reactance tube grid is sinusoidal, there will be no d-c component and the mean frequency of the master oscillator will remain unchanged. However, the beat frequency at the phase detector output, when it is not locked in, is non-symmetrical and has a d-c component of the proper polarity to change the mean frequency of the master oscillator toward its correct frequency.

To illustrate how the non-symmetrical waveform is developed, take an example in which the frequency of the master oscillator is such as to produce a signal at T111 which is 0.1 kc low. A difference frequency

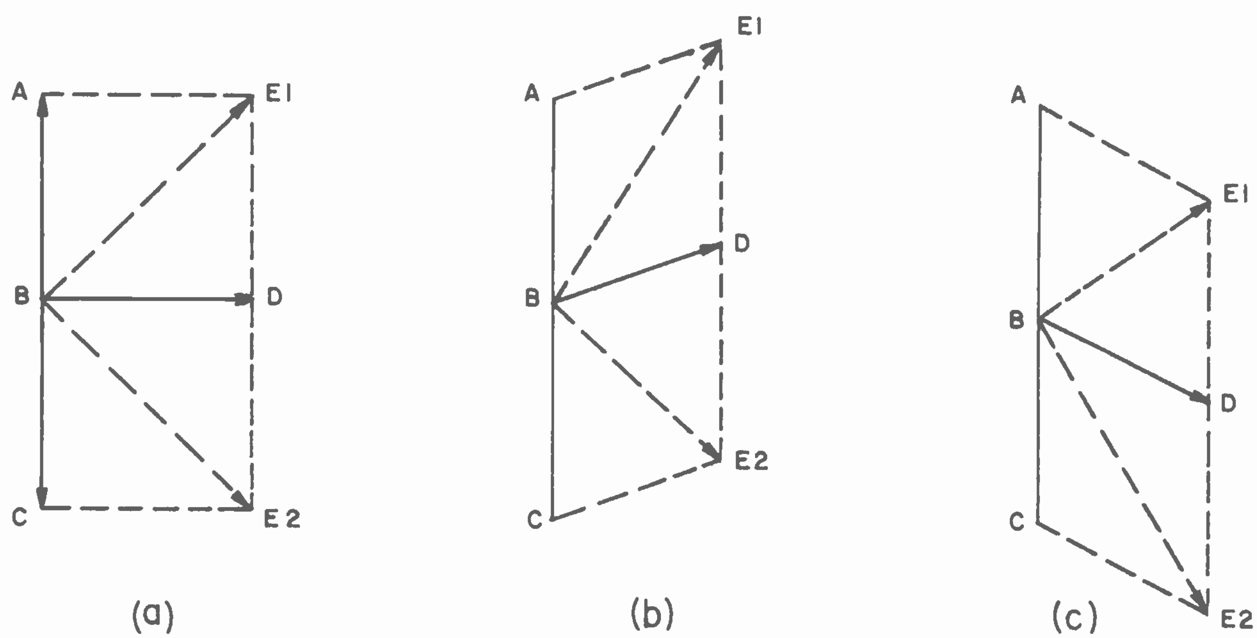


Figure 4—Phase Detector Signal Voltages

of 0.1 kc will be fed to the reactance tube grid, and the master oscillator will then swing above and below the tuned frequency one hundred times per second. The dashed line curve of figure 5 (a) is the waveform of the beat frequency which would appear at the junction of L108 and R168 if C104 were shorted. If this waveform was fed back to the reactance tube through a blocking capacitor, the solid line waveform would appear at the same point. Note that the solid line waveform is slightly distorted so that its axis no longer represents zero d-c voltage.

The positive peak of the solid line waveform in figure 5 (a) is produced as the master oscillator frequency swings further away from its frequency, and the negative peak is produced as it approaches its correct frequency. As the controlled frequency approaches the reference frequency, the beat becomes increasingly slower, and the distorted waveform is produced. The d-c component produced across C104 is of such polarity as to change the master oscillator frequency toward its correct frequency.

Figures 5 (b) through (d) are the same as (a) except for the frequency of the beat. Note that as the beat frequency becomes lower, the distortion becomes greater, producing a correspondingly increasing d-c component. The waveforms shown can be produced by blocking the d-c component from the reactance tube and by tuning the master oscillator for the desired beat frequency. However, when the d-c component is fed to the reactance tube grid, the beat frequency automatically decreases until it is zero. The system is then "locked in" and the d-c voltage maintains that condition.

Off-Frequency Detector

Protection against loss of control by the automatic frequency control system, and possible off-frequency operation, is provided by the off-frequency detector circuit shown in figure 6. V115 is a 6AS6 mixer stage which is fed from the last divider in each chain as shown in figure 2. The plate load of the stage is by-passed by capacitor C193, which is a low impedance to the beating frequencies and to the sum of the beating frequencies, eliminating these signals in the output.

When the master oscillator is on frequency there is no difference frequency produced in. V115, and therefore the output of the stage is zero. If for any reason a difference occurs in the two beating frequencies, however, the difference frequency component appears across the plate load and hence across the thyratron grid resistor R172. If the positive half of this alternating voltage exceeds the fixed cathode bias applied to the thyratron V116, the tube conducts, energizing relay K101. One (normally closed) set of contacts on relay K101 operates the transmitter interlock circuit, preventing plate power from being applied to the PA; another set of contacts (normally open) switches in the feedback capacitor C198 shown in figure 3 for purposes previously described.

Sensitivity of the circuit is adjusted by the thyratron bias resistor R174. This adjustment is set so that the low modulating frequencies will not trigger the thyratron but so that the beat frequencies will cause it to fire.

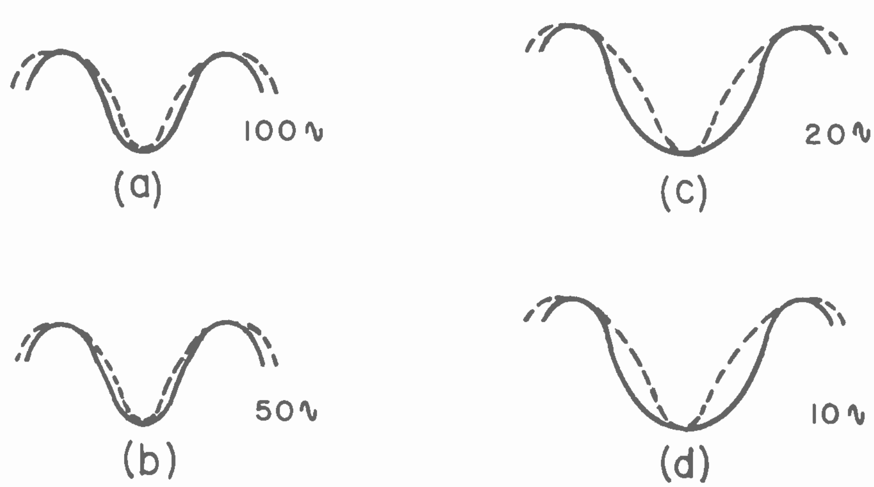


Figure 5—Phase Detector Output Waveforms

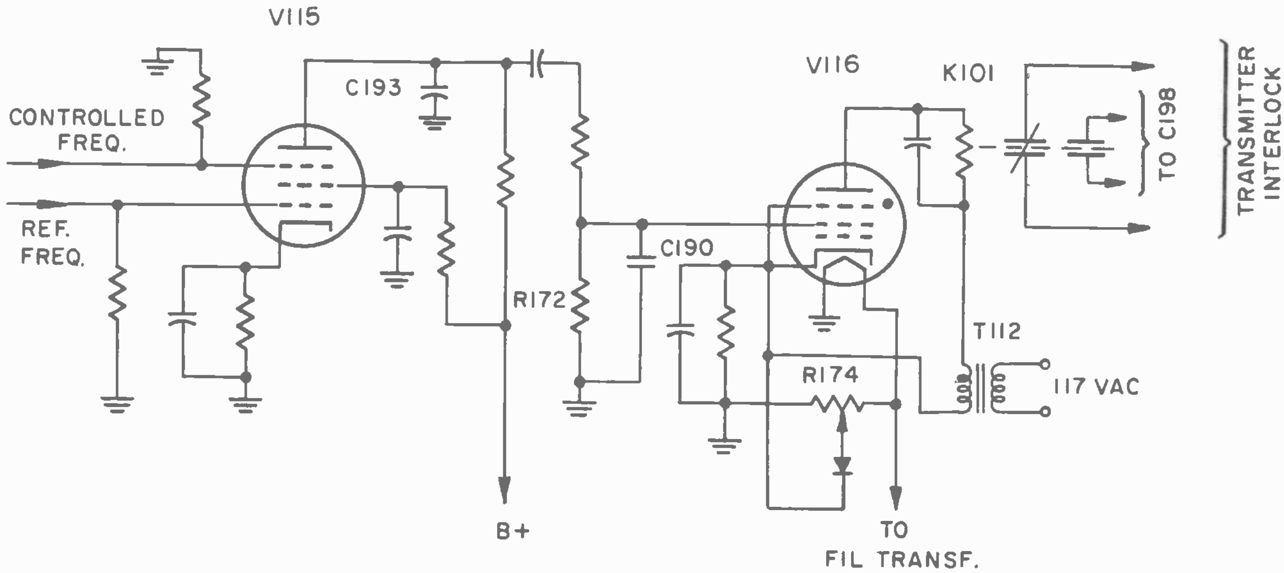


Figure 6—Simplified Schematic, Off-Frequency Detector

INSTALLATION

Carefully unpack and inspect the equipment to make certain that no damage has been incurred during shipment. Any damages or shortages should be immediately reported to RCA and to the transportation company in order that lost or damaged material may be recovered.

The equipment is shipped complete in one container, excepting tubes and crystals which are packed separately. All internal wiring is done at the factory, only external cables and wiring need be prepared and connected to the equipment at installation. Reference should be made to the interconnection diagram which designates the cables and wiring to be used and the proper connections.

A-C Power Line Connections

The primaries of the plate transformer (T113) and the filament transformer (T114) are each tapped for operation from either 120-volt or 240-volt single-phase a-c lines. The equipment is shipped with the taps set for 240-volt use. *The crystal heaters must be connected only to a 120-volt a-c source.* Particular care must be taken to insure that proper connections are made before power is applied to the equipment. Reference should be made to the overall schematic diagram and to the table for making connections. *If 240 volts is used, be sure not to disconnect T112 (black leads) from the 120-volt terminals 4 and 2 of T113.*

The a-c overload switch (S104) can be used as a "Power Off-On" switch, if desired, and the d-c overload switch (S103) for "Standby" plate switching. The connections of these circuit-breakers are shown in the overall schematic diagram.

Tubes should be inserted in their proper sockets by reference to the type number designations printed near the appropriate sockets. Crystal Units MI-34509

TRANSFORMER PRIMARY TAPS

Power Line Voltage:	106	117	128	197	208	219	229	240	251
Taps to be Used:	3–4	2–4	1–4	3–5	2–5	1–5	3–6	2–6	1–6
	Tap C of "AC OVERLOAD" Circuit Breaker			Tap B of "AC OVERLOAD" Circuit Breaker					

should be inserted into the sockets marked "CRYSTAL 1" and "CRYSTAL 2."

After tubes and crystals are in place, and all connections are properly made, a-c power can be applied to the equipment. Allow sufficient time for tubes and the crystals heaters to reach operating temperature before following the tune-up procedure below. Indicators DS101 and DS102 will light when the crystal oven heaters are on.

Tune-Up Procedure

The oscilloscope patterns illustrated in these pages were obtained on the built-in CRO during tune-up of an exciter unit. These patterns should be considered as typical of those to be expected; slight deviations from these displays may occur in individual units.

1. With the equipment operating and indicators "DS101" and "DS102" extinguished, indicating that the crystal heaters have reached operating temperature, switch "AFC-OFF" switch to "OFF" position. With the CRO Switch (S106) in any position, advance the "INTENSITY" control (R185) clockwise until a trace appears on the face of the tube (V118). Then adjust "FOCUS" (R183) for proper sharpness. Switch meter-switch (S102) to "V107 E_p" position and check plate voltage. (Reading should be between 54 and 66.) Turn "OFF-FREQUENCY INTERLOCK SENSITIVITY" (R176) to extreme clockwise position.

2. Turn CRO switch to "XTAL DIV" position. Adjust top screw of L112 for maximum horizontal size of CRT pattern. (1/8" to 3/16" will be satisfactory).

3. Adjust top screw of T115 to obtain stationary Lissajous' figure indicating a division ratio of 1/5. (Pattern should have five left-hand loops and five right-hand loops.) Adjust top screw of T109 for maximum vertical size of pattern. See figure 7 a.

4. Set the master oscillator to the approximate operating frequency which is 1/18 of the final carrier frequency. E.g., 88.1 mc corresponds to 4`94 kc master oscillator frequency. Use grid-dipper, calibrated receiver or frequency meter. Use bottom screw of T103 to make this adjustment setting the top (fine) adjustment to a mid-position.

5. Turn CRO-Switch to "1ST DIV" position and adjust T104 for a stationary Lissajous' figure and a division ratio of 1/3. See figure 7 b.

NOTE: Too high an inductance, when the adjusting screw is all the way in, means a low frequency and a possible division ratio of 1/4 or 1/5 or more. Too low an inductance may result in a 1/2 division ratio.

6. Turn CRO-Switch to "2ND DIV" position and adjust T105 for a stationary Lissajous' figure and a division ratio of 1/4 (figure 7 c).

7. Turn CRO-Switch to "3RD DIV" position and adjust T106 for a stationary Lissajous' figure and a division ratio of 1/4 (figure 7 d).

8. Turn CRO-Switch to "4TH DIV" position and adjust T107 for a stationary Lissajous' figure and a division ratio of 1/5. Adjust T108 for maximum horizontal size of pattern (figure 7 e).

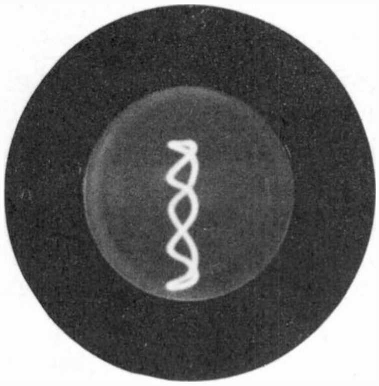
9. Turn CRO-Switch to "PHASE DET" position. A square of medium brightness should be seen representing an unstationary Lissajous' circle. The rate of change of the circle depends on the frequency-difference between the reference signal and the divided master oscillator signal. Rotate the bottom screw of T103 slowly in both directions trying to find the point where both signals agree in frequency resulting in a slowly changing Lissajous' circle. During the variation of T103 make sure as you change frequency that all dividers (T104–T107) are still locked in. If a nearly stationary circle cannot be obtained, try again starting on a somewhat higher or lower frequency.

10. If a slowly changing circle was obtained, switch meter switch (S102) to "V101 & V102 I_k" position and adjust "MODULATOR GRID TUNING" (C105) for peak indication. Slight resetting of T103 bottom adjustment may be required to obtain slowly moving Lissajous' circle. Then switch "AFC" switch (S101) to "ON" position. The circle should "jump" into a completely stationary circle now. (See figure 7 f.) In addition to the CRO the phase detector output voltage can be observed also on the built-in meter, with the meter switch in "+ or −AFC" position. With AFC on, both positions should give nearly zero readings. With AFC off, frequency differences at the phase detector up to a few cps can be observed with the meter.

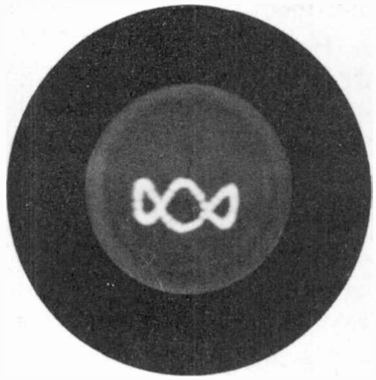
11. A more sensitive adjustment of "MODULATOR GRID TUNING" (C105) can be made by applying 50 cps at approximately +10 db to the audio input connector (J101), and adjusting C105 for maximum indication on the modulation percentage meter of a modulation monitor.

12. Tune L104 to maximum indication of the meter (M101) with meter switch (S102) in "I_c V106" position.

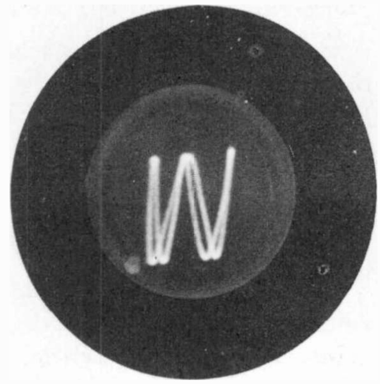
13. Steps 11 and 12 may slightly change the master oscillator frequency. So, AFC should be switched off and with CRO switch in "PHASE DET" position the circle should be made near-stationary by tuning



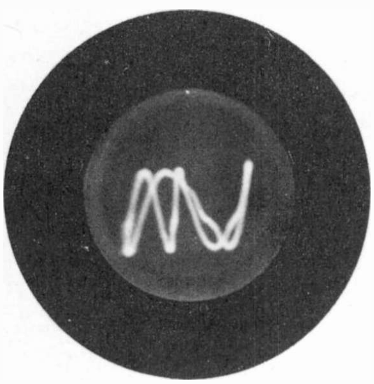
(a) Switch Position: "XTAL DIV." (1/5)



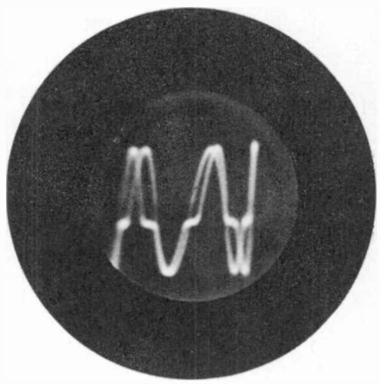
(b) Switch Position: "1st DIV." (1/3)



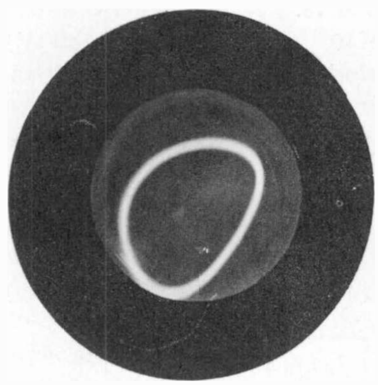
(c) Switch Position: "2nd DIV." (1/4)



(d) Switch Position: "3rd DIV." (1/4)



(e) Switch Position: "4th DIV." (1/5)



(f) Switch Position: "PHASE DET."

Figure 7—BTE-10B Oscilloscope Patterns

T103 with the fine control knob on top of the can. Then throw "AFC-OFF" switch back to "AFC" position.

NOTE: T104 to T107 stay locked in over a certain frequency range. It is desirable to have T104-T107 adjusted so that they normally operate in the middle of their lock-in range. In order to assure this, switch CRO-Switch to "1ST DIV" position. Now turn tuning screw on top of T104 to the left until the divider unlocks (Lissajous' figure gets "fuzzy"). Start turning screw to the right and observe the number of revolutions until it unlocks at the other end of the range. Turn screw back half the number of revolutions counted. Repeat this for T105, T106, T107, and T115.

14. Tune L105 to maximum indication of meter, meter switch in "I_c V107" position.

15. Tune C137 "PLATE TUNING" to dip on meter, meter switch in "I_k V107" or better in "I_p V107" position. Adjust C139 "OUTPUT TUNING" to obtain proper grid current in following amplifier or desired output, then retune C137 for dip or maximum output. (If a Micromatch or Reflectometer is used in the output transmission line, the developed DC voltage may be fed into the exciter via pin 8, of plug T105 and indicated on the meter, meter switch in "POWER OUTPUT" position.)

16. Adjust the sensitivity of the off-frequency detector (V116) as described in the following paragraphs.* Then proceed with Steps 17, 18 and 19.

* This adjustment is important to assure sufficient pull-in range of the exciter.

"OFF-FREQUENCY INTERLOCK" Adjustment

Sensitivity of the off-frequency detector (V116) is controlled by the setting of the "OFF-FREQUENCY INTERLOCK SENSITIVITY" potentiometer (R174) in the cathode circuit of this stage. Proper adjustment can be obtained by use of either a 35 cps or 50 cps tone source, although the methods differ slightly as follows:

Using a 35-cycle tone, modulate the exciter 130%. An input signal of approximately +13 db is required. Turn R174 counter-clockwise until relay K101 is energized, as observed by listening for the closing of the relay or by operation of the PA plate or screen cutout. The point at which relay K101 is energized will be the correct setting for R174.

If a 35 cps source is not available, an alternate method using a 50-cycle tone source may be used. Modulate the exciter 130% with the 50-cycle tone, and turn R174 counter-clockwise to the point where K101 is energized. Note this setting. Then turn R174 clockwise until K101 is de-energized, noting this setting. Then set R174 halfway between these energized and de-energized positions, which will be the correct adjustment. Check for proper off-frequency control action by switching the "AFC SWITCH" (S101) to "OFF" and slightly detuning the vernier control on the top of T103. This should energize relay K101. Retune T103 to original setting.

17. Set CRO-Switch (S106) to "PHASE DET" position and reduce "INTENSITY" (R185) to prevent burn-in of the pattern.

18. If multiplex operation is intended, adjust exciter for minimum interchannel crosstalk as follows:

(a) *Subchannel to main channel crosstalk.* (See measuring setup in figure 8.) Modulate the main channel using a 400 cps tone. Set switch S in position 1 and set distortion analyzer to indicate 0 db. Remove main channel modulation. Now apply subcarrier modulation (15 to 30%, depending upon application and choice), and modulate subcarrier 100% (±7.5 kc) with 400 cps tone. Read crosstalk on distortion analyzer and touch up "MODULATOR GRID TUNING" (C105) to further reduce crosstalk. For modulation frequencies from 50–6000 cps, crosstalk should not be more than −65 db.

NOTE: A suitable filter must be used following the FM monitor to prevent the subcarrier from getting into the distortion analyzer.

(b) *Main Channel to Subchannel Crosstalk.* Modulate the subcarrier 100% (±7.5 kc) with a 400 cps tone. (See measuring setup in figure 8.) Switch S to

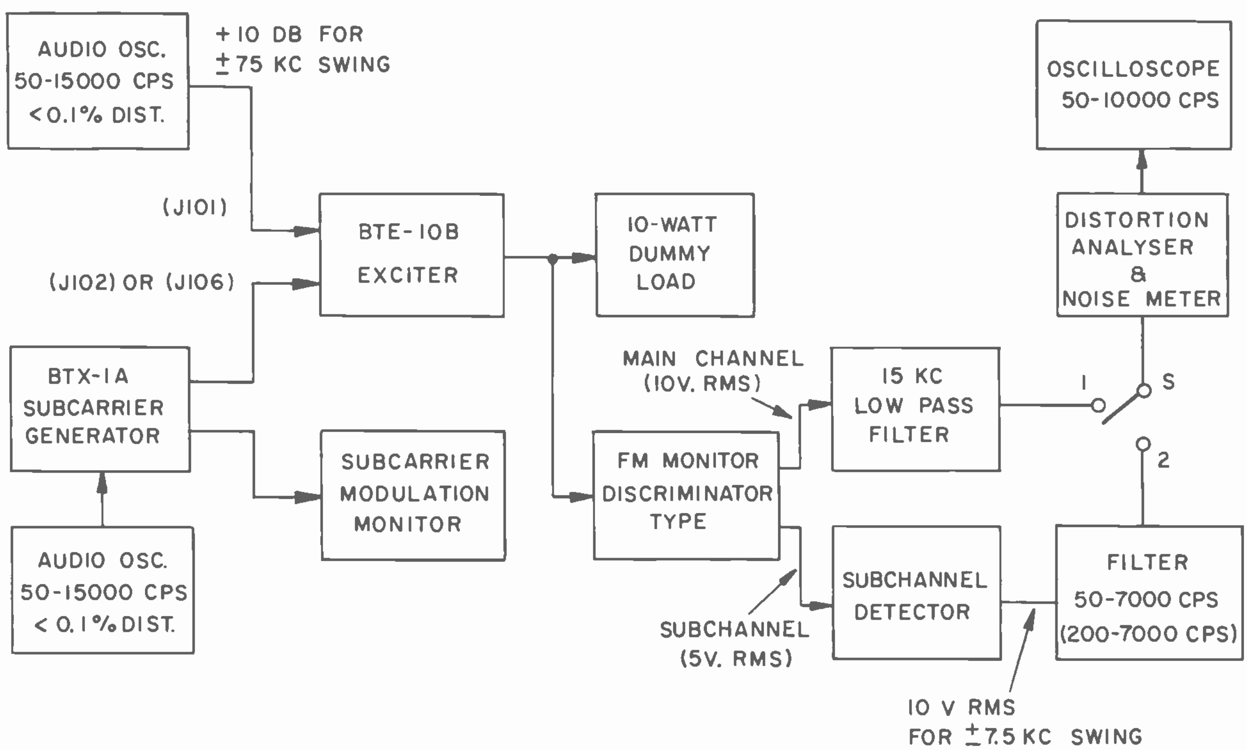


Figure 8—Crosstalk Measuring Setup

position 2. (Note: The filter after the subchannel detector may be omitted.) Set the distortion analyzer to 0 db. Modulate the main channel 85% (100% minus the subcarrier modulation) with a 400 cps tone and read crosstalk. Make adjustments on the following in the order given to reduce crosstalk: FM monitor discriminator and IF coils (if discriminator type monitor is used; input voltage to subchannel detector; L104; L105; "PLATE TUNING" (C137); and "OUTPUT TUNING" (C139). Apply frequencies from 50 to 15000 cps to the main channel at 85% modulation and observe crosstalk. Crosstalk above 5 kc can be reduced by slight touch up of L104. "MODULATOR GRID TUNING" (C105) is the only control in the exciter that will affect subchannel to main channel crosstalk; and L104, L105, and to a much lesser extent C105, C137 and C139 are the only controls to affect main channel to subchannel crosstalk.

19. Finally, using the station frequency monitor tune the crystal "FREQUENCY ADJUSTMENT" trimmer capacitors (C205) and (C206) to the assigned center frequency.

NOTE: Frequency can be changed slightly by adjustment of L112 also.

20. Reduce "INTENSITY" (R185) as much as possible to prevent CRT "burn-in".

OPERATION

In daily operation of the equipment, the crystal heaters should be left on continuously. Then after application of power to the exciter, and allowing a short warm-up period, performance can be checked by observing the patterns on the oscilloscope while the exciter is on the air.

The oscillograms shown with the tuning procedure in the "INSTALLATION" section of this book represent the desired adjustment of the various stages of the exciter for proper operation of the AFC system. These oscilloscope patterns may be observed during regular operation without affecting performance of the exciter.

The 75 μs pre-emphasis network is a plug-in unit and can be removed if it is desired to apply pre-emphasis at some other point in the system. If this unit is removed, an 18 db pad should be inserted in place of the pre-emphasis network. Such an attenuator can be made up in accordance with figure 9. Numbers on the diagram identify the octal pins of the socket XZ101. Use of ±5% tolerance, ½ watt resistors is recommended.

Output Frequency Conversion

A conversion coil (MI-34501-2) is supplied with the exciter to modify the last stage to a straight-through amplifier, providing an output frequency in the range of 44 to 54 mcs. If the exciter is to be used with previously designed FM transmitters incorporating a frequency doubler, this modification should be made in the exciter.

If it is necessary that the exciter operate on one-half of the final frequency, modification of the output stage should be made in accordance with the following procedure using the conversion kit, MI-34501:

1. Remove all power from the exciter unit. Remove the cover enclosing components of the final stage, and remove the 6146 tube (V107).

2. Unsolder the r-f choke (L107) from the feed-through capacitor (C146), and remove units that hold the plate component mounting bracket in place. The bracket can then be turned to gain access to screws holding the plate coil (L106). Remove this coil, and install the new coil (MI-34501, Item 2) in its place.

3. Put mounting bracket back in place, making sure all mounting screws are tight. Re-solder L107 and C146 in such a way that there will be at least ½-inch clearance between L107 and the cover when the cover is in position.

4. Reinsert tube V107 in its socket, and install the

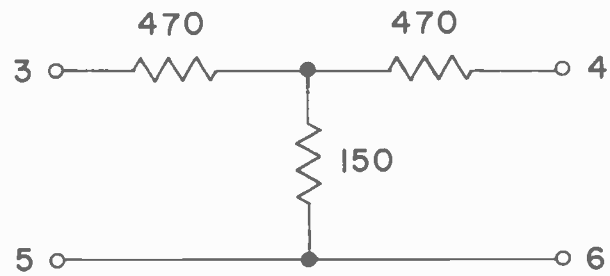


Figure 9—Schematic, 18 db Attenuator

cover in place. This completes the modification. Filament and plate power can now be applied. With the modification made, power output will be between 10 and 15 watts.

NOTE: In an emergency, the RCA 6146 (V107) may be replaced by an RCA 2E26, at somewhat reduced power output, should the latter tube be more readily available. No change in connections is required.

Use of Control Tones

The exciter can be modulated by control tones if desired. These control tones, which are generally in the range between 20 kc and 35 kc, should be fed into one of the subcarrier input jacks (J106) on the exciter. With approximately 5 volts as measured at this point, 30% modulation of the main carrier will be obtained.

MAINTENANCE

With normal care, no maintenance should be required except a periodic check of all tubes and replacement of defective ones with new tubes of the same type.

Failure of automatic frequency control due to the failure of a tube or other component will be evidenced by operation of the relay K101 in the off-frequency detector circuit, opening the contacts (Terminals No. 5 and No. 6 of J105) that control the PA stage of the transmitter. If failure is due to a defective tube, proper operation of the exciter will be restored by replacement of the defective tube without need for readjustment. However, if replacement of circuit components is made, it will be necessary to realign the exciter following the procedure for tuning presented under "INSTALLATION."

Emergency Operation

Provision is made for maintaining frequency control should tubes or components associated with the automatic frequency control fail. The operator will be warned of the loss of control by loss of carrier, or by the erratic performance of the carrier frequency monitor.

Tube or component failure can be found in some cases by switching the meter switch (S102) through each of its positions until an abnormal reading is found identifying the difficulty. The oscilloscope switch (S106) may also be helpful in locating trouble in the AFC circuits.

If the master oscillator is functioning, the output carrier frequency can be controlled manually as follows, until such time as repairs can be made:

1. Remove the 2D21 "OFF-FREQUENCY" control tube (V116).
2. Turn the "AFC-OFF" switch (S101) to "OFF".
3. Slowly rotate the top adjustment screw of T103 in first one direction and then the other to bring the output frequency to its assigned value as indicated by the frequency monitor.

Stability of the master oscillator without AFC is such that after sufficient warm-up it maintains frequency to ±1 kc (at the final frequency) for short periods of time. Possible drift can be corrected by adjustment of T103 top screw.

NOTE: The voltage of the filament d-c power supply will vary with load. Therefore, care should be taken not to remove more than two of the tubes having d-c on the filament. Otherwise, damage to the remaining d-c heated tubes or to C202 may result.

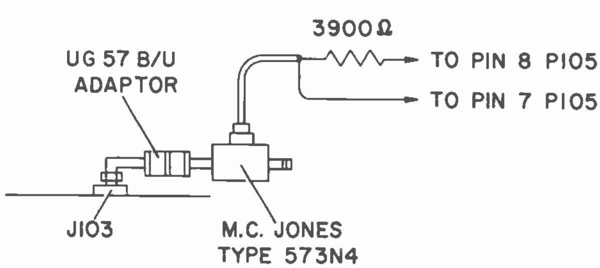


Figure 10—Connections for Measuring Power Output

TYPICAL TUBE SOCKET VOLTAGES*

BTE-10B FM Exciter

Tube		*Pin No.*										
Symbol	*Type*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
V101	6AQ5	.2	15.5	0	6.4	150	150	.2	—	—	—	—
V102	6AQ5	0[1]	15.5	0	6.4	150	150	0[1]	—	—	—	—
V103	6AQ5	−17	0	0	6.4	150	70	−17	—	—	—	—
V104	6CL6	7.6	0	150	0	6.4	150	7.6	150	0	—	—
V105	5763	320	—	10	0	6.0	270	10	−25	−25	—	—
V106	5763	320	—	10	0	5.9AC	270	10	−2.2[2]	−2.2[2]	—	—
V107	6146	48	6.3AC	225	48	−2.8[3]	48	0	0	—	—	—
V108	6AH6	−4.5	75	0	6.3AC	75	75	0	—	—	—	—
V109	6AH6	−8	90	0	6.3AC	90	90	0	—	—	—	—
V110	6AH6	−13	95	0	6.3AC	95	95	0	—	—	—	—
V111	6AH6	−7	100	0	6.4	100	100	0	—	—	—	—
V112	6AU6	−9.5	0	0	6.3AC	145	70	0	—	—	—	—
V113	6AH6	−7	88	0	6.4	88	−7	0	—	—	—	—
V114	12AT7	240	.5	4.3	0	0	240	−1	4.2	6.4	—	—
V115	6AS6	0	2.2	0	6.3AC	120	85	0	—	—	—	—
V116	2D21	0 / 1.5AC[4]	2.7[5]	0	6.3AC	2.7[5]	145AC[4] / −100	2.7[5]	—	—	—	—
V117	OD3	—[6]	2.4	—	150	150	—	—	—	—	—	—
V118	1EP1	0	6.3AC	2.5[7]	9	80[8]	—[6]	320	320	—[9]	320	—

* Voltages measured with VTVM against ground; values are positive except where marked otherwise.

[1]May vary ±1V due to AFC. If more than +1V or −1V, correct setting of T103.

[2]Measure at junction of R126 and R127.

[3]Measure at junction of R130 and R131.

[4]Figures above line: relay de-energized; below line: relay energized.

[5]Depends on setting of R174, Typical value shown.

[6]Do not take reading.

[7]Depends on setting of R185. Typical value shown.

[8]Depends on setting of R183. Typical value shown.

[9]Reading difficult, due to large value of R187 and R188.

Power Output Measurements

Power output indications can be obtained conveniently by use of the meter (M101) and a suitable coupler such as the M. C. Jones Micromatch. With the meter switch (S102) in the "POWER OUTPUT" position, the positive terminal of the meter is connected to Pin No. 7 (ground) of P105 and the negative terminal to Pin No. 8 of P105. Readings obtained will depend upon the type of coupler used. With a Jones Type 573N4 and a UG57B/U adaptor, a 3900-ohm resistor in series with the meter will provide mid-scale reading of the meter at ten watts output. Connections should be made as shown in figure 10.

TYPICAL METER READINGS

Meter (M101) Position	*Function*	*Reading*	
		88 mc	*108 mc*
V101 & V102 I_k	Modulators	63	64
V106 I_c	2d Freq. Tripler	39	35
V107 I_c	Doubler & PA	41	35
V107 I_k	Doubler & PA	68	66
+AFC	Control Voltage	<10	<10
−AFC	Control Voltage	<10	<10
V107 E_p	Doubler & PA	62	62
V107 I_p	Doubler & PA	49	48
POWER OUTPUT	PA	(see text)	

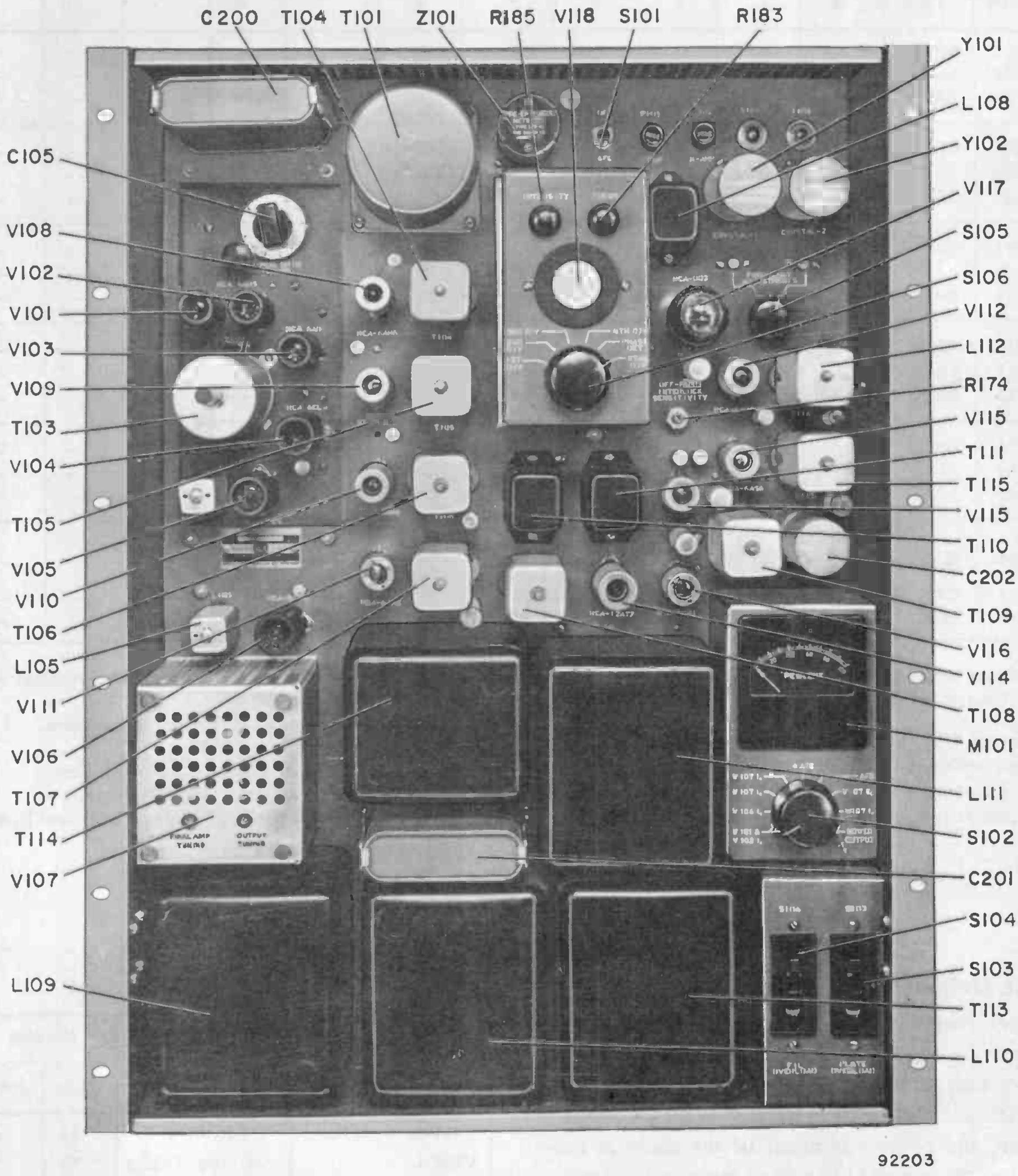


Figure 11—BTE-10B FM Exciter, Front View

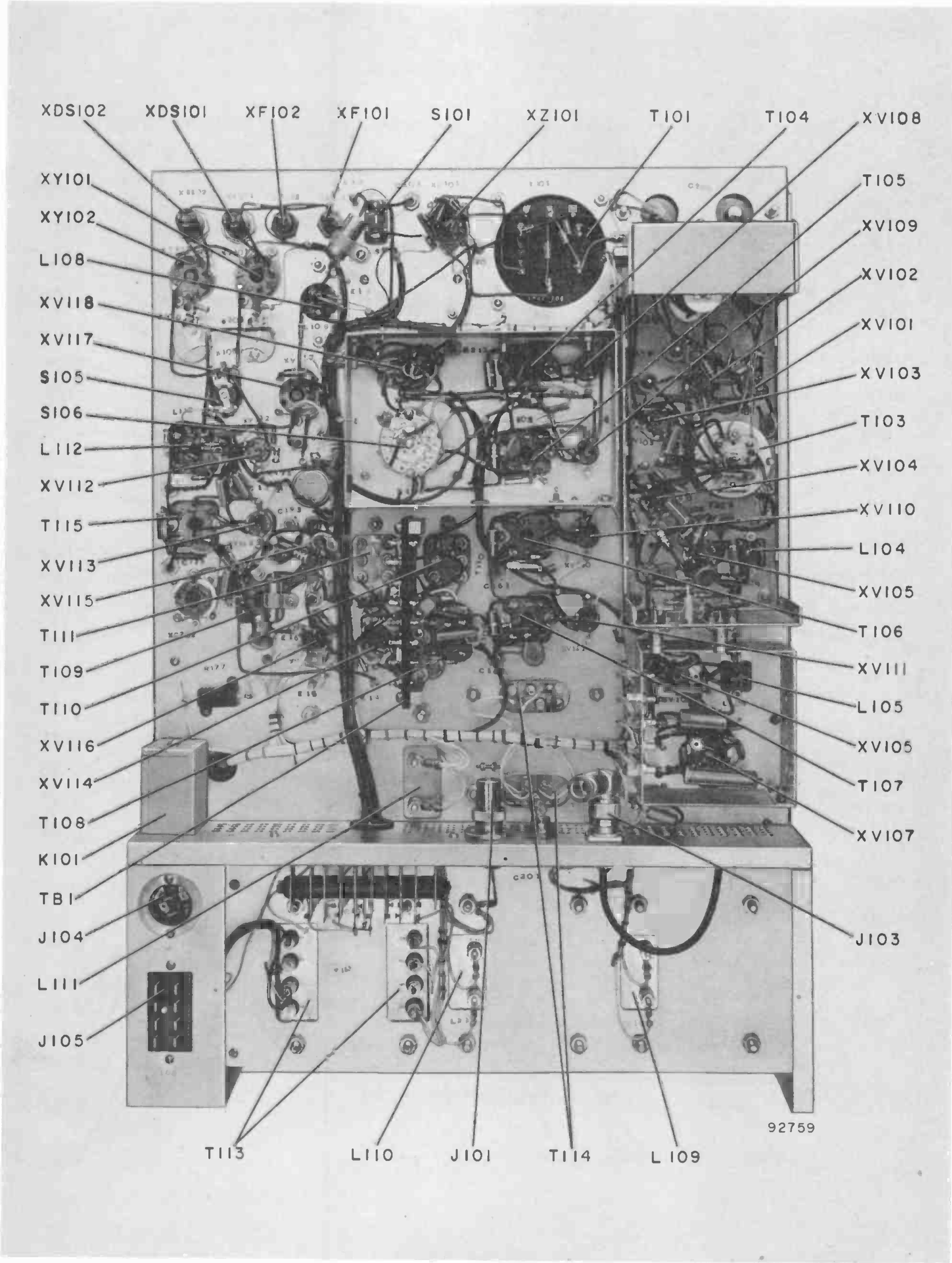


Figure 12—BTE-10B FM Exciter, Rear View

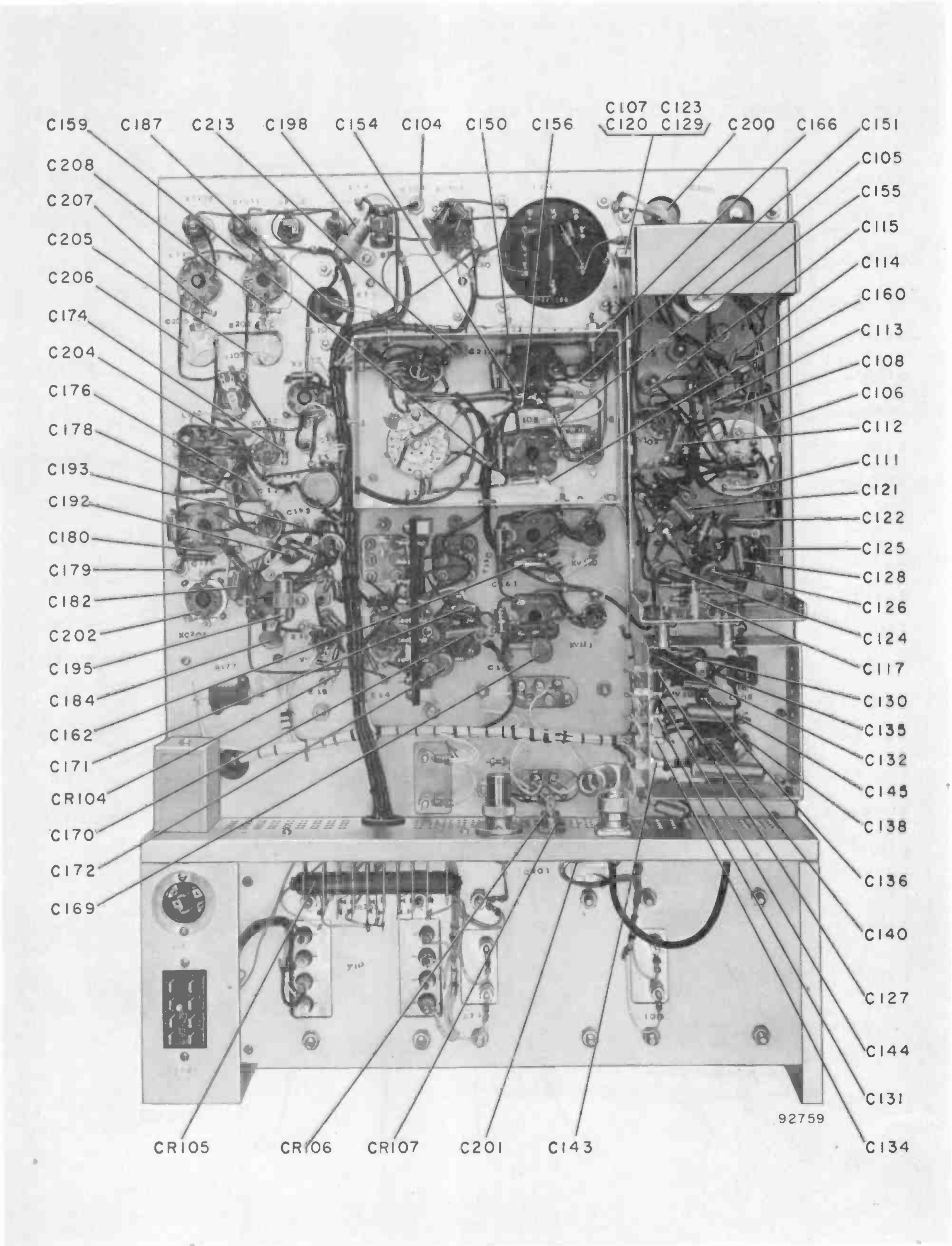


Figure 13—BTE-10B FM Exciter, Rear View

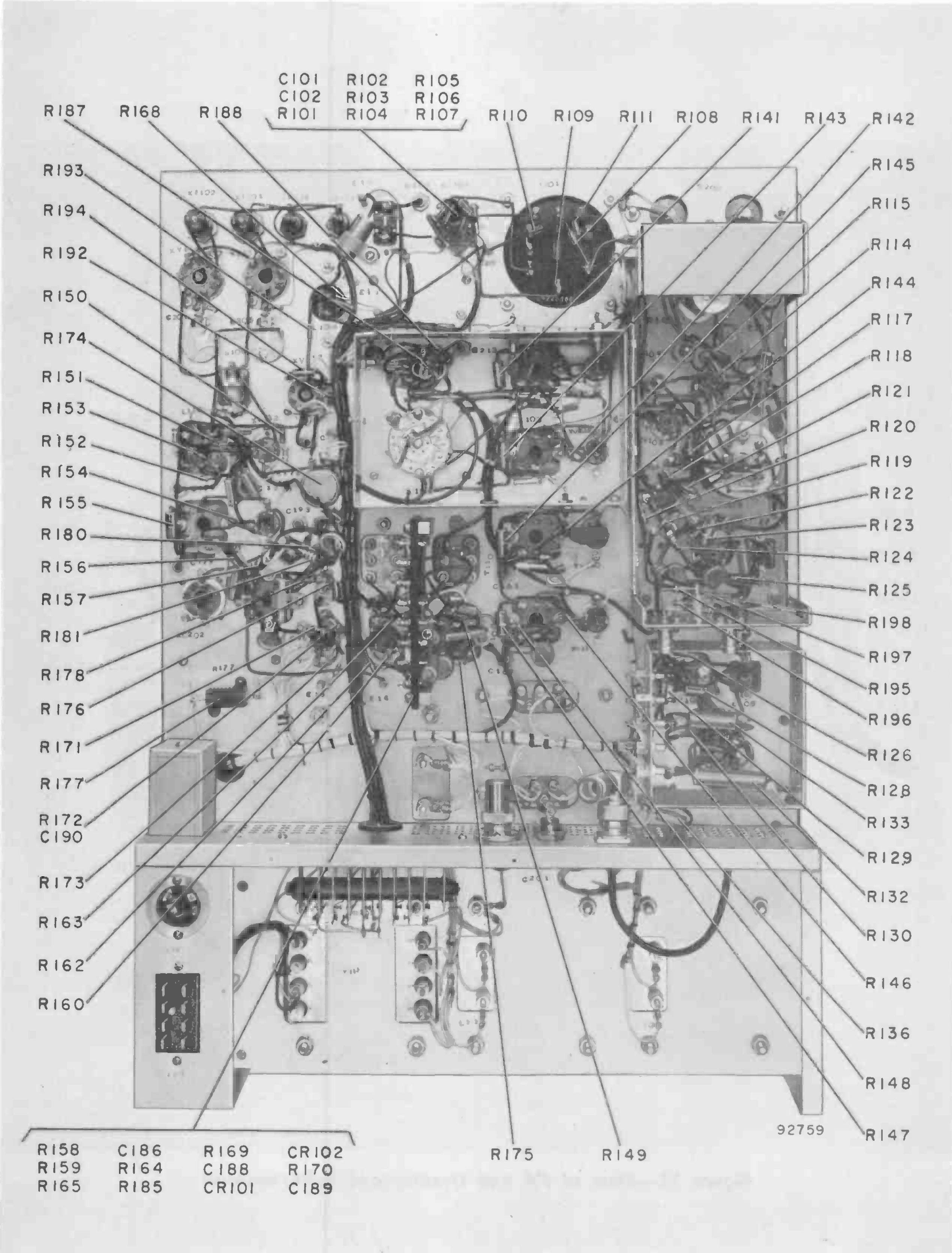


Figure 14—BTE-10B FM Exciter, Rear View

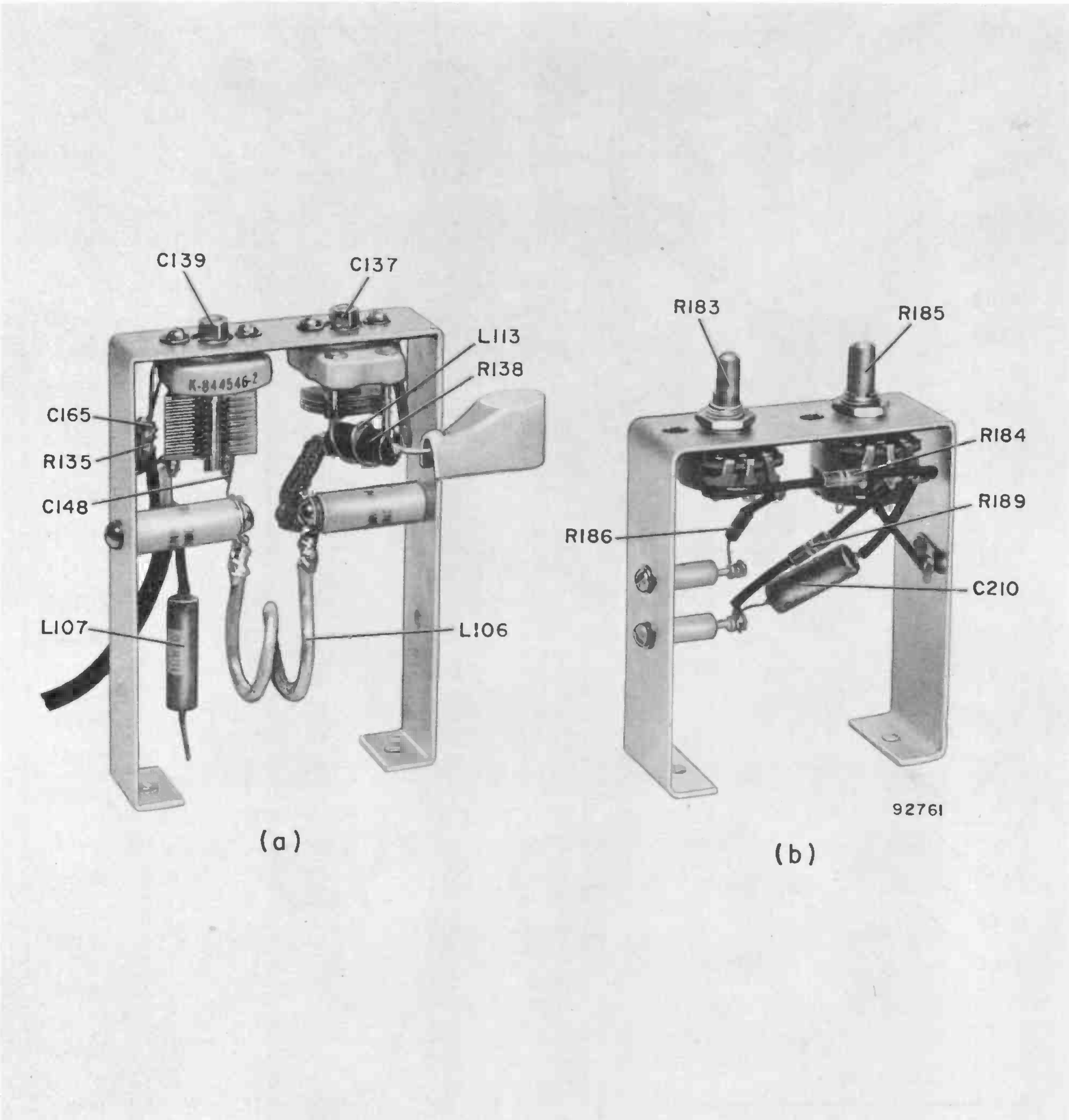


Figure 15—View of PA and Oscilloscope Subassemblies

BTX-1A Subcarrier Generator
ES-27295

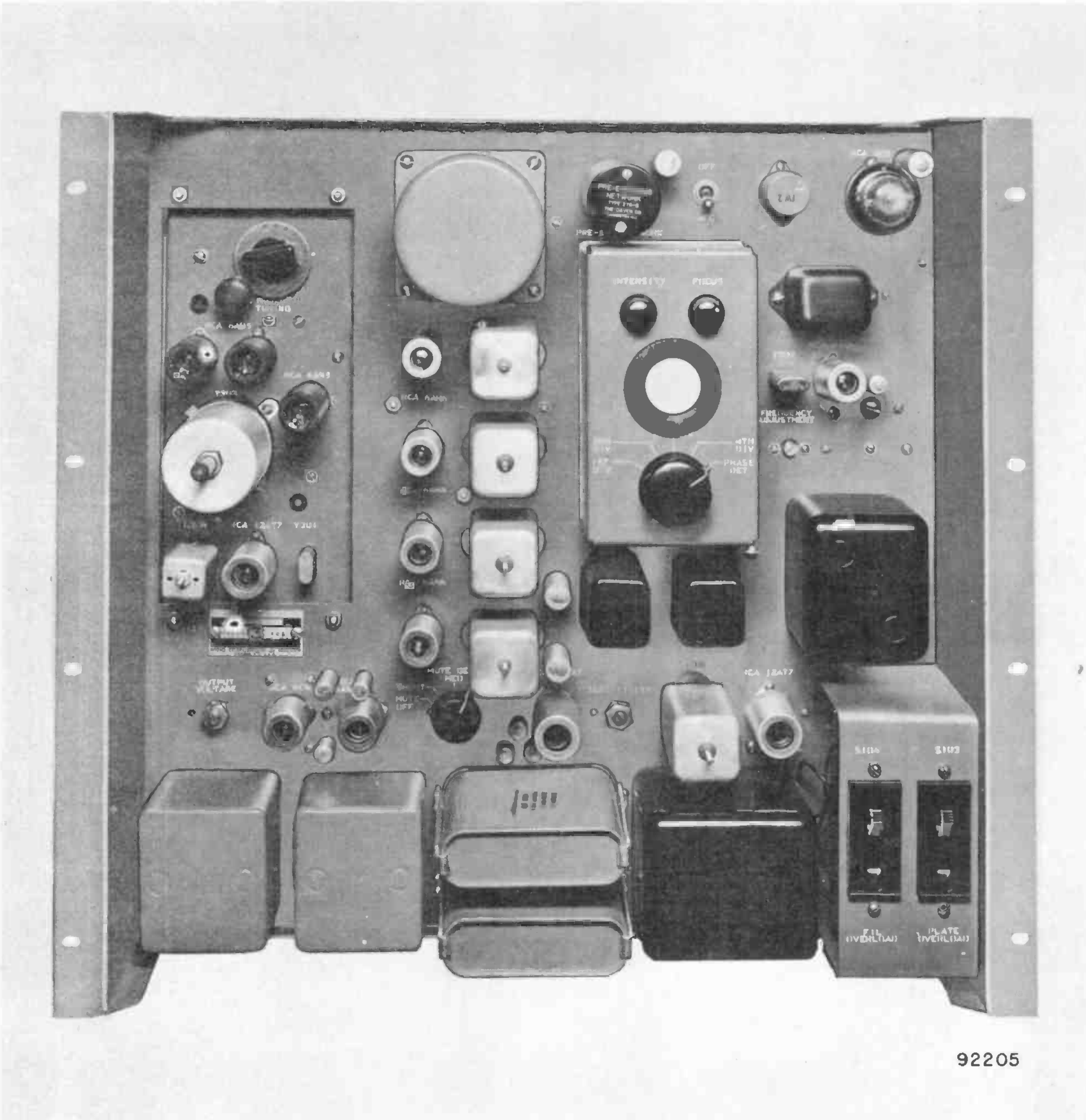


Figure 16—BTX-1A Subcarrier Generator

LIST OF EQUIPMENT
BTX-1A Subcarrier Generator (ES-27295)

Quantity		*Reference*
1	Subcarrier Generator Unit	MI-34500
1	Set of Operating Tubes	MI-34514
	Set of FCC Spare Tubes (Not supplied—to be ordered separately)	MI-34519
1	Crystal Unit (To specified subcarrier frequency)	MI-34520*

* See table of crystals and frequencies.

TECHNICAL SUMMARY

ELECTRICAL CHARACTERISTICS

Type of Modulation	FM
Center Frequency Range of Sub-carrier	30–67 kc/s
Output Voltage	5V min.
Source Resistance	Approx. 400 ohms, cathode follower
Frequency Deviation (100% sub-carrier mod.)	±7.5 kc/s
Modulation Capability	±25 kc/s
Carrier Frequency Stability	±500 cps
Audio Input Impedance	600/150 ohms
Audio Input Level (100% mod.)	+10 ±2 dbm[1]
Audio Frequency Response (50–6000 cps)[4]	±1 db max.[2]
Harmonic Distortion (50–6000 cps)	1.5% max.[3]
FM Noise Level (referred to 100% mod.)	−60 db max.
AM Noise Level (referred to carrier)	−50 db max.
Power Line Requirements:	
Line	240/208 or 117 V, single phase 50/60 cps
Slow Voltage Variation	±5%
Power Consumption (approx.)	100 watts
Altitude	7500 ft. max.
Ambient Temperature Range	0–45°C

MECHANICAL SPECIFICATIONS

	Height	*Width*	*Depth*
Overall Dimensions	17½″	19″	10″
Weight	40 lbs.		

[1]Level measured at input (J301) using 400 cps tone.
[2]Audio frequency response referred to 75 μs pre-emphasis curve.
[3]Distortion includes all harmonics up to 30 kc/s and is measured following a standard 75 μs de-emphasis network.
[4]For use in a stereophonic system the subchannel frequency response is 50–15,000 cps. No changes need be made in the BTE-10B Exciter.

TUBE COMPLEMENT

Symbol	*Type*	*Function*	*Symbol*	*Type*	*Function*
V301	6AQ5	Reactance Modulator	V308	6AH6	Frequency Divider (1/4)
V302	6AQ5	Reactance Modulator	V309	6AH6	Frequency Divider (1/4)
V303	6AQ5	Master Oscillator	V310	6AH6	Frequency Divider (1/5)
V304	12AT7	Crystal Oscillator No. 1	V311	6AU6	Crystal Oscillator No. 2
V305	6AS6	Mixer	V312	12AT7	Cathode Follower
V306	6C4	Cathode Follower	V313	12AX7	Subcarrier Muting
V307	6AH6	Frequency Divider (1/3)	V314	OD3	Voltage Regulator
			V315	1EP1	Cathode Ray Tube

BTX-1A CRYSTALS (CR 18/U)

MI No.	*Subcarrier Freq. (kc)*	*Crystal Freq. (kc)*
34520-67	67	4613.000
34520-58	58	4622.000
34520-42	42	4638.000
34520-32	32.5	4647.500

Calculate crystal frequencies as follows:

$f_{crystal} = 4680 - f_{sub}$

where: $f_{crystal}$ = crystal freq. in kc.
f_{sub} = subcarrier freq. in kc.
4680 = center freq. of master oscillator.

DESCRIPTION

The BTX-1A Subcarrier Generator is designed to provide a frequency-modulated r-f signal having a center frequency in the range of 30 to 67 kc. The BTX-1A when used with the RCA BTE-10B FM Exciter makes possible the multiplexing of up to three program channels on a single r-f carrier.

Using this system of multiplexing, one audio channel containing material to be broadcast to the general public frequency modulates the carrier in the conventional way to produce the main FM program channel, which can be received on a standard FM receiver. Then, onto this carrier is modulated a second waveform in the supersonic range containing a second audio channel, which may be used for background music, stereophonic broadcasts or other purposes that may be authorized by the FCC. This second channel can be received only by use of a multiplex receiver. If desired, the system can be further expanded by use of another BTX-1A to modulate the second channel with a third audio channel to provide a second subchannel.

Although at this time no standards have been established, certain subcarrier center frequencies are commonly used, namely: 32.5; 42; 58; and 67 kc. The BTX-1A and BTE-10B equipments will operate on any of these frequencies, as well as on other frequencies that it may be practical to designate in the future.

Frequency deviation of the subcarrier by the second audio source is chosen to be ±7.5 kc, which is referred to as 100% subchannel modulation. Certain rules have been prescribed by the FCC covering multiplex operation (Subsidiary Communication Authorization). These rules, which are not considered final, limit the instantaneous frequency of the subcarrier to the frequency range of from 20–75 kc. Furthermore, the modulation of the main r-f carrier by the subcarrier or subcarriers is not to be more than 30% of the maximum deviation of 75 kc permitted on the r-f carrier, or ±22.5 kc. Because these regulations may be changed in the future, certain allowances are made in the BTX-1A and BTE-10B equipments to accommodate the possible changes.

Quality of reception on properly aligned and properly tuned standard FM receivers is not adversely affected by the presence of the supersonic carriers or their modulation. However, severe non-uniformity in group delay response, discriminator misalignment and off-center tuning at the receiver can result in disturbance to main channel reception.

All components of the BTX-1A are mounted on a vertical chassis designed for standard rack mounting. Miniature tubes are employed in all stages except in the power supply which utilizes an OD3 voltage regulator and germanium rectifiers in a bridge circuit. A built-in monitor oscilloscope permits instantaneous check and adjustment of the five AFC frequency dividers, and a check of the control action of the phase detector. Displays are in the form of Lissajous' figures, with the advantage that lock-in of the dividers can be observed easily. Checks can be made during operation without disturbing the AFC circuit in any way. This type display requires no synchronization or other adjustments.

Circuits

Circuits of the BTX-1A Subcarrier Generator are shown in the block diagram of figure 17. These consist of a master oscillator, pushpull reactance modulators, crystal oscillator, automatic frequency control circuitry, subcarrier muting stage, mixer, cathode-follower output stage, alignment oscilloscope, and a power supply.

The master oscillator is a Hartley type oscillator which employs a 6AQ5 and operates on a center frequency of 4.68 mc, which is 32.5 to 67 kc higher than that of the crystal oscillator, depending upon the crystal used and the output frequency desired. The two 6AQ5 reactance modulators are connected to the oscillator plate, and the pushpull grids are inductively coupled to the plate tank. R-f voltages on the two modulator grids are 180 degrees out of phase with respect to each other, and each is 90 degrees out of phase with the oscillator plate. Thus one tube appears as a capacitive reactance and the other appears as an inductive reactance across the oscillator tank. The magnitude of the reactive component presented to the tank coil varies with the audio voltage applied to the modulator grids, and the frequency of the oscillator is varied accordingly. The mean frequency is controlled by the bias voltage applied to one grid. This bias voltage is supplied by the automatic frequency control circuit to be described in a later paragraph.

Modulated output from the master oscillator and the r-f output from the 12AT7 crystal oscillator are fed into a 6AS6 mixer. This stage supplies the modulated beat frequency in the range of 30 to 67 kc, and is connected to a 6C4 cathode follower.

The purpose of the 12AX7 subcarrier muting stage is to disable the mixer and thus suppress subcarrier

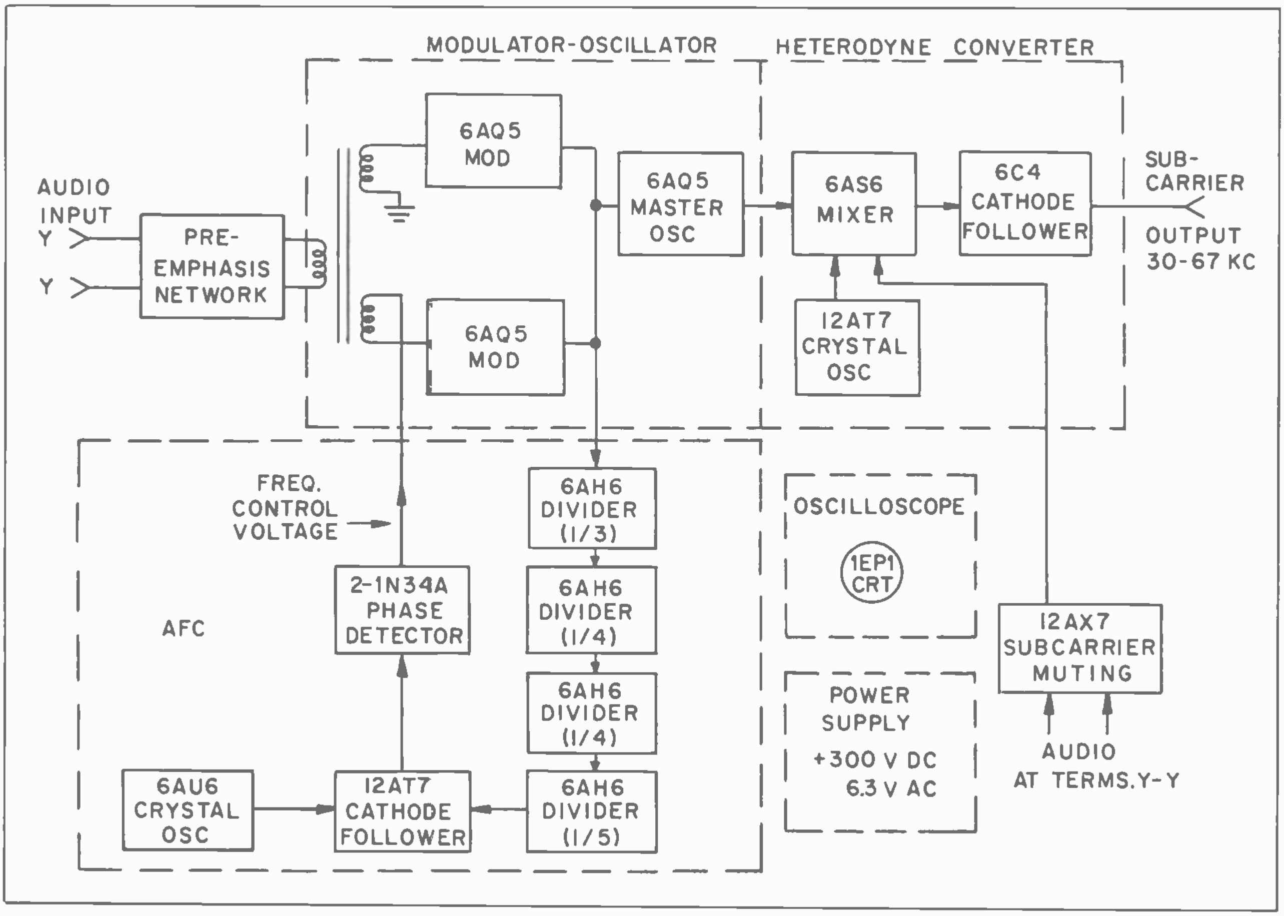


Figure 17—Block Diagram, BTX-1A Subcarrier Generator

output when no audio voltage is present at the audio input terminals of the generator. Operation of this stage is such that with no audio voltage present at the input, the plate of the second half of the 12AX7 clamps the grid voltage of the 6AS6 to a very low value, reducing output of the mixer to zero. Audio applied to the input of the muting stage, however, is amplified in the first half of the 12AX7, rectified by a 1N38A crystal and applied as bias to disable the clamping section of the tube. A 5-position switch (S302) provides for switching the muting stage in and out of the circuit, and also provides for selection of three different values of time delay before muting takes place.

Use of the pushpull modulator and the inductive coupling circuit results in highly linear operation with low harmonic distortion. Each tube is almost a pure reactance, and loading of the oscillator is greatly reduced, providing better AFC action. Moreover, the pushpull modulator automatically balances out temperature and supply voltage changes.

Automatic Frequency Control

Automatic frequency control circuitry used in the BTX-1A is very similar to that of the BTE-10B FM Exciter. Reference should be made to that section of this book for a detailed explanation of these circuits and their operation.

A phase detector is used to develop a control voltage which establishes and maintains a phase lock between a reference crystal oscillator and the derived signal. Thus, the system is actually an automatic phase control system which achieves a stability precisely matching that of the crystal reference source.

Circuits of the AFC system are diagrammed in figure 17. A small r-f voltage is fed from the master oscillator to the divider chain where it is divided by 240 to a frequency of 19.5 kc. It should be noted that at the same time deviation due to modulation is reduced from a maximum of ±7.5 kc to ±31 cps. From the dividers this voltage is fed through a cathode follower to a phase detector employing two 1N34A diodes. A reference voltage of the same frequency is obtained from 6AU6 reference crystal oscillator and also fed into the phase detector.

INSTALLATION

Carefully unpack and inspect the equipment to make certain that no damage has been incurred during shipment. The enclosed packing lists should be checked against items received to insure that quantities are correct. Any damages or shortages should be immediately reported to RCA and to the transportation company in order that lost or damaged material may be recovered.

The BTX-1A Subcarrier Generator is shipped complete in one packing case, excepting tubes and crystal which are packed separately. All internal wiring is completed at the factory, only external cables and wiring need be prepared and connected to the equipment at installation. Reference should be made to the interconnection diagram which designates cables and wiring to be used and the proper connections.

A-C Power Line Connections

The primaries of the filament transformer (T313) and the plate transformer (T312) are each tapped for operation from either 120-volt or 240-volt single-phase a-c lines. Particular care must be taken, therefore, to insure that proper connections are made to these transformers before power is applied to the equipment. Reference should be made to the overall schematic and interconnection diagram in making these connections. The equipment is shipped with the taps connected for 240-volt a-c line operation. The table below gives the transformer taps for various line voltages.

The a-c overload switch (S304) can be used as a "power Off-On" switch, if desired, and the d-c overload switch (S303) for standby plate switching. The connections of these circuit breakers in the BTX-1A are shown on the overall schematic diagram.

Tubes should be inserted in their proper sockets by reference to the type number designations printed near the appropriate sockets. Crystal Unit MI-34520 should be inserted into its socket. The low frequency crystal, in the larger (HC13/U) holder, is inserted into the XY302 socket; the high frequency crystal, in the HC6/U holder, should be inserted into the XY301 socket.

After tubes and crystals are in place, and all connections are properly made, a-c power can be applied to the equipment. Allow two or three minutes time for tubes to warm up before following the tune-up procedure given below.

Tune-Up Procedure

The oscilloscope patterns presented here were obtained on the built-in CRO during an initial tune-up of a subcarrier generator unit. These patterns should be considered as typical of those to be expected; slight deviations from these displays may occur in individual units.

1. With the equipment operating, switch the "AFC-OFF" switch to the "OFF" position, and the subcarrier switch (S302) to the "MUTE OFF" position. With the CRO switch (S305) in any position, advance "INTENSITY" (R375) clockwise until trace appears on the face of V315. Then adjust "FOCUS" (R373) for proper sharpness.

2. By adjustment of the screw on the bottom of T303, set the master oscillator frequency to 240 times the frequency of the Y302 (low frequency) crystal, using a grid dipper, calibrated receiver or a frequency meter. (Center frequency of master oscillator should be 4680 kc.)

3. Turn CRO switch (S305) to "1ST DIV" position and adjust T304 for a stationary Lissajous' figure and a division ratio of 1/3. (See figure 18 a.)

NOTE: Too high an inductance, when the adjusting screw is all the way in means a low frequency and a possible division ratio of 1/4 or 1/5 or more. Too low an inductance may result in a 1/2 division ratio.

TRANSFORMER PRIMARY TAPS

Power Line Voltage:	106	117	128	197	208	219	229	240	251
Taps to be Used:	3–4	2–4	1–4	3–5	2–5	1–5	3–6	2–6	1–6
	Tap B of "AC OVERLOAD" Circuit Breaker			Tap C of "AC OVERLOAD" Circuit Breaker					

4. Turn CRO-Switch to "2ND DIV" position and adjust T305 for a stationary Lissajous' figure and a division ratio of 1/4. (See figure 18 b.)

5. Turn CRO-Switch to "3RD DIV" position and adjust T306 for a stationary Lissajous' figure and a division ratio of 1/4. (See figure 18 c.)

6. Turn CRO-Switch to "4TH DIV" position and adjust T307 for a stationary Lissajous' figure and a division ratio of 1/5. Adjust T308 for maximum horizontal size of pattern. (See figure 18 d.)

7. Turn CRO-Switch to "PHASE DET" position. A square of medium brightness should be seen representing an unstationary Lissajous' circle. The rate of change of the circle depends on the frequency-difference between the reference signal and the divided master oscillator signal. Rotate the bottom screw of T303 slowly in both directions trying to find the point where both signals agree in frequency resulting in a slowly changing Lissajous' circle. During the variation of T303 make sure as you change frequency that all dividers (T304–T307) are still locked in. If a nearly stationary circle cannot be obtained, try again starting on a somewhat higher or lower frequency.

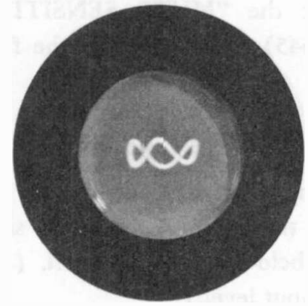
8. If a slowly changing circle was obtained, adjust "MODULATOR GRID TUNING" (C305) for maximum indication on test point J304 (located next to C305 tuning knob), using a volt-ohmmeter or V.T.V.M. A more sensitive adjustment may be made by applying 50 cps at approximately +10 db to the audio input connector (J301) and adjusting "MODULATOR GRID TUNING" (C305) for maximum indication on the modulation percentage meter of a modulation monitor. Slight re-setting of T303 bottom adjustment may be required to again obtain a slowly moving Lissajous' circle.

9. Throw "AFC OFF" switch (S301) into "AFC" position. The circle should "jump" into a completely stationary circle now. (See figure 18 e.)

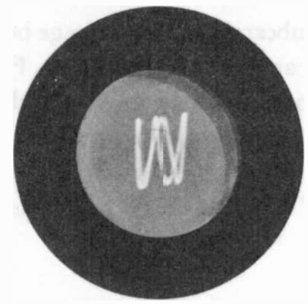
10. Turn "OUTPUT VOLTAGE" (R340) to the extreme clockwise position and switch S302 to the "MUTE OFF" position. Then tune L303 for maximum output voltage using an a-c V.T.V.M. on output connector J302, or measure d-c voltage at test point J305 (next to Y301) and tune L303 for maximum.

11. Adjust "FREQUENCY ADJUSTMENT" (C357) using external frequency meter, counter or multiplex monitor. Subcarrier frequency should be as specified ±500 cps.

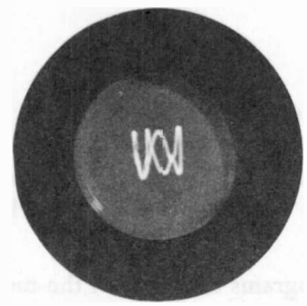
12. Reduce "INTENSITY" (R375) as much as possible to prevent CRT burn-in.



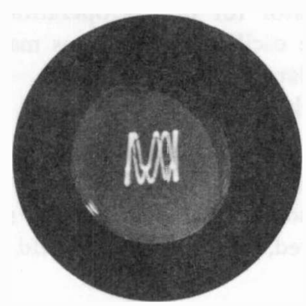
(a) Switch Position: "1st DIV." (1/3)



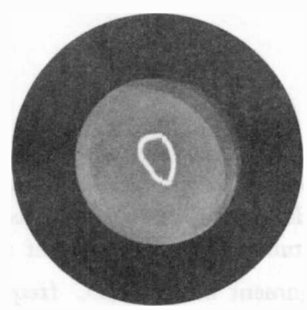
(b) Switch Position: "2nd DIV." (1/4)



(c) Switch Position: "3rd DIV." (1/4)



(d) Switch Position: "4th DIV." (1/5)



(e) Switch Position: "PHASE DET."

Figure 18—BTX-1A Oscilloscope Patterns

13. Adjust the "MUTE SENSITIVITY" potentiometer (R345) as described in the following paragraphs:

"MUTE SENSITIVITY" Adjustment

The muting control tube (V313) will mute the subcarrier if the level of the audio signal drops 40 db or more below the 100% level. (100% is equal to +10 db input level.)

However, the sensitivity of V313 can be adjusted to mute the subcarrier at any voltage between +10 db and −30 db at the input terminals. For example, to set the muting sensitivity to a −20 db level (30 db below 100%), apply a 400-cycle tone of −20 db to the audio input jack (J301) and advance the "MUTE SENSITIVITY" control (R345) from an extreme counterclockwise position until subcarrier appears at the output jack (J302).

The optimum position of the muting switch (S302), which provides for selection of various time delay periods before muting action takes place, should be selected to suit local requirements.

It may become desirable to extend the frequency response of the subcarrier generator to from 50 cps to 15,000 cps at a maximum deviation of ±1 db, e.g., for transmission of stereophonic information on the subchannel. To accomplish this, two 15,000-ohm, ½-watt resistors should be connected between terminals 4 and 14, and between 10 and 13, of T301. (For comparison, see T101 of the BTE-10B Exciter.) With these resistors in place, ±7.5 kc deviation of the subcarrier at 400 cps will be obtained with a +14 db input signal.

OPERATION

After the circuits of the BTX-1A are aligned in accordance with the tune-up procedure given under "INSTALLATION", regular checks on performance can be made conveniently using the built-in oscilloscope.

The oscillograms shown with the tuning procedure represent the desired adjustment of the various stages of the generator for proper operation of the AFC system. These oscilloscope patterns may be observed during regular operation without affecting performance of the generator.

The 75 μs pre-emphasis network is a plug-in unit and can be removed if it is desired to apply pre-emphasis at some other point in the system. If this unit is removed, an 18 db pad should be inserted in place of the pre-emphasis network. Such an attenuator can be made up in accordance with figure 9. Numbers on the diagram identify the octal pins of the socket XZ301. Use of ±5% tolerance, ½-watt resistors is recommended.

The five-position subcarrier muting switch (S302) controls the automatic muting stage (V313) and provides for selection of "Short", "Medium" and "Long" periods of time delay before the action of the muting stage takes place. The optimum setting for this control, which can be obtained by experiment, depends upon the type of program material used and individual requirements. The muting stage is removed from the circuit when S302 is in the "MUTE-OFF" position.

MAINTENANCE

With normal care, no maintenance of the BTX-1A Subcarrier Generator should be required except a periodic check of all tubes, and replacement of weak or defective tubes with new ones of the same type.

Initial alignment of the AFC frequency dividers using the built-in oscilloscope is described under "INSTALLATION". Replacement of components other than tubes in the generator will ordinarily require re-alignment in accordance with the procedure given.

Manual frequency control can be maintained should tubes or other components in the AFC circuits fail. Turn the "AFC-OFF" switch (S301) to "OFF", and slowly rotate the top screw of the oscillator coil (T303) to bring the center frequency to its assigned value, as indicated by a frequency monitor.

TYPICAL TUBE SOCKET VOLTAGES*

BTX-1A Subcarrier Generator

Tube		*Pin No.*										
Symbol	*Type*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
V301	6AQ5	0	16	0	6.3AC	150	150	0	—	—	—	—
V302	6AQ5	0[1]	16	0	6.3AC	150	150	0	—	—	—	—
V303	6AQ5	−13	0	0	6.3AC	150	42	−13	—	—	—	—
V304	12AT7	150	0	1.3	0	0	175	−19	1.2	6.3AC	—	—
V305	6AS6	70[2]	75[2]	0	6.3AC	155[2]	145[2]	70[2]	—	—	—	—
V306	6C4	230	—	0	6.3AC	230	31	50	—	—	—	—
V307	6AH6	−4.5	75	0	6.3AC	75	75	0	—	—	—	—
V308	6AH6	−7.8	95	0	6.3AC	95	95	0	—	—	—	—
V309	6AH6	−10	95	0	6.3AC	95	95	0	—	—	—	—
V310	6AH6	−7.2	95	0	6.3AC	95	95	0	—	—	—	—
V311	6AU6	−2[3]	0	0	6.3AC	145	85	0	—	—	—	—
V312	12AT7	170	0	4.2	0	0	170	−3	3	6.3AC	—	—
V313	12AX7	30[4]	0	0	0	0	95	0[5]	.3	6.3AC	—	—
V314	OD3	—	3	—	—	—	150	—	—	—	—	—
V315	1EP1	0	6.3AC	2.5[6]	9	85[7]	—[8]	340	340	—[8]	340	—

* Voltages measured with VTVM against ground; values are positive except where marked otherwise.

[1] May vary ±1V due to AFC. If more than +1V or −1V, correct setting of T303.

[2] S302 in "MUTE OFF" position.

[3] May vary due to loading by measuring device.

[4] S302 in "MUTE SHORT, MED OR LONG DELAY" position.

[5] No input to J301 or R345 in extreme CCW position.

[6] Depends on setting of R375. Typical value shown.

[7] Depends on setting of R373. Typical value shown.

[8] Reading difficult due to high value of R377 and R378.

V.T.V.M. TEST POINT READINGS:

J304 .... 4.7; J305 .... −2

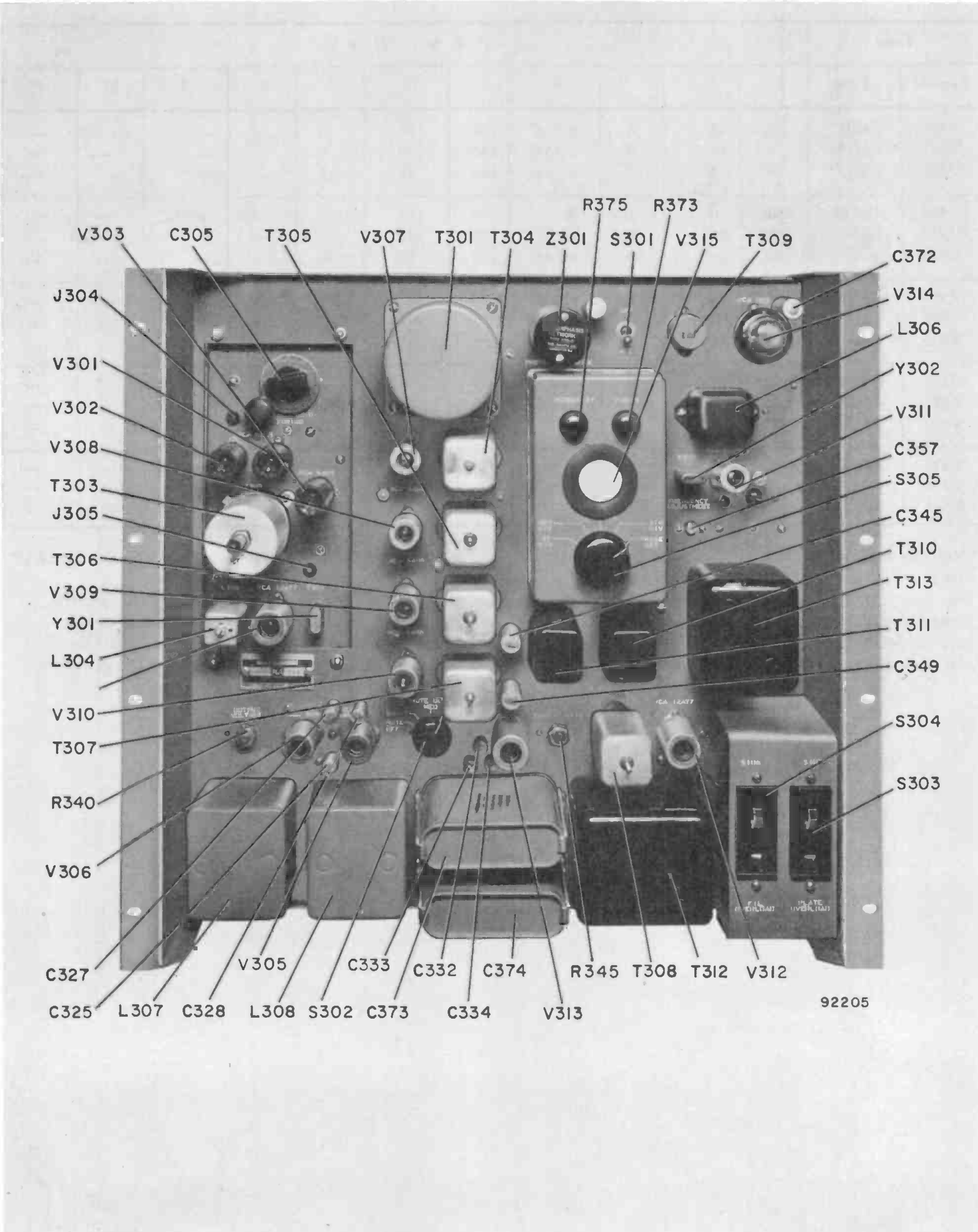


Figure 19—BTX-1A Subcarrier Generator, Front View

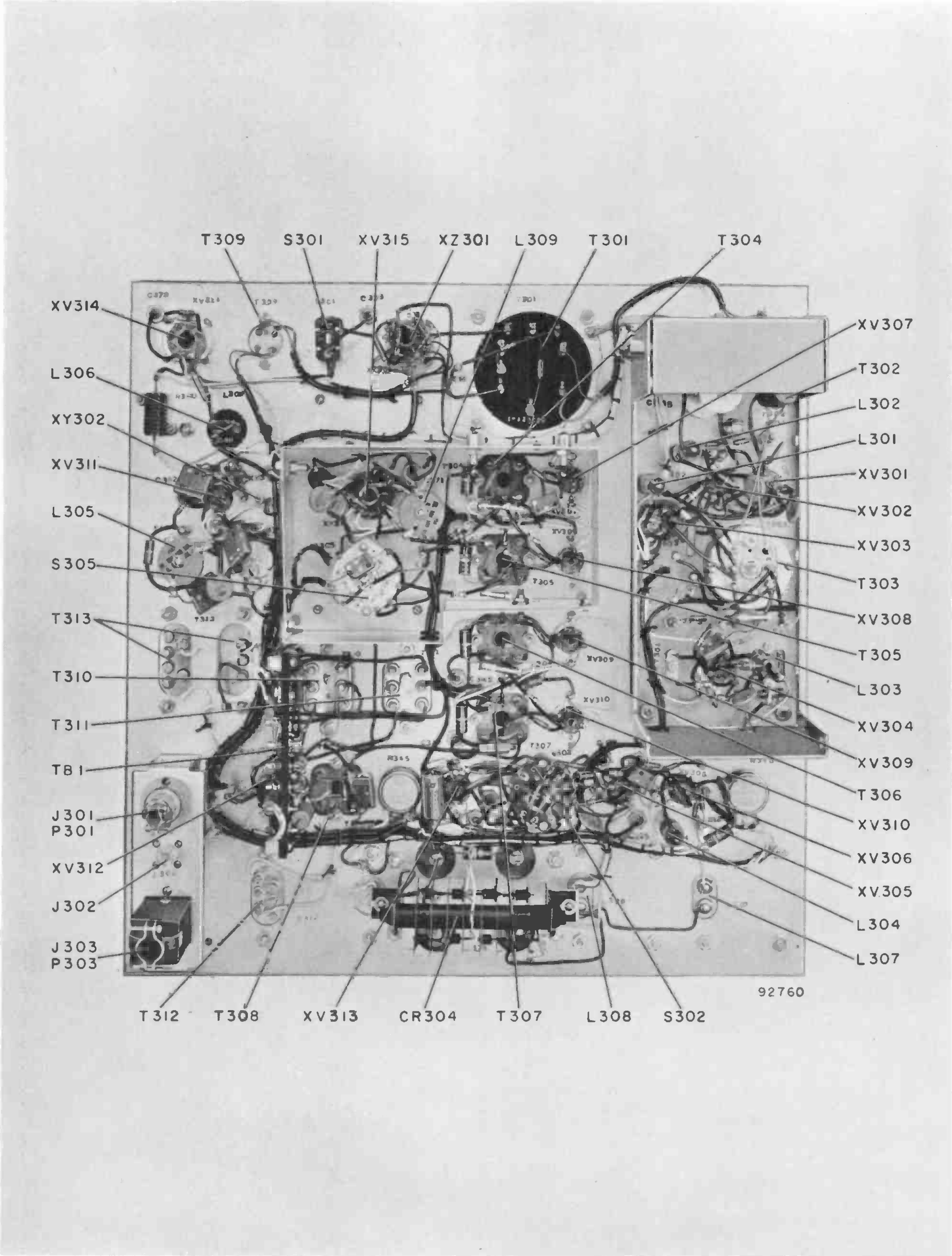


Figure 20—BTX-1A Subcarrier Generator, Rear View

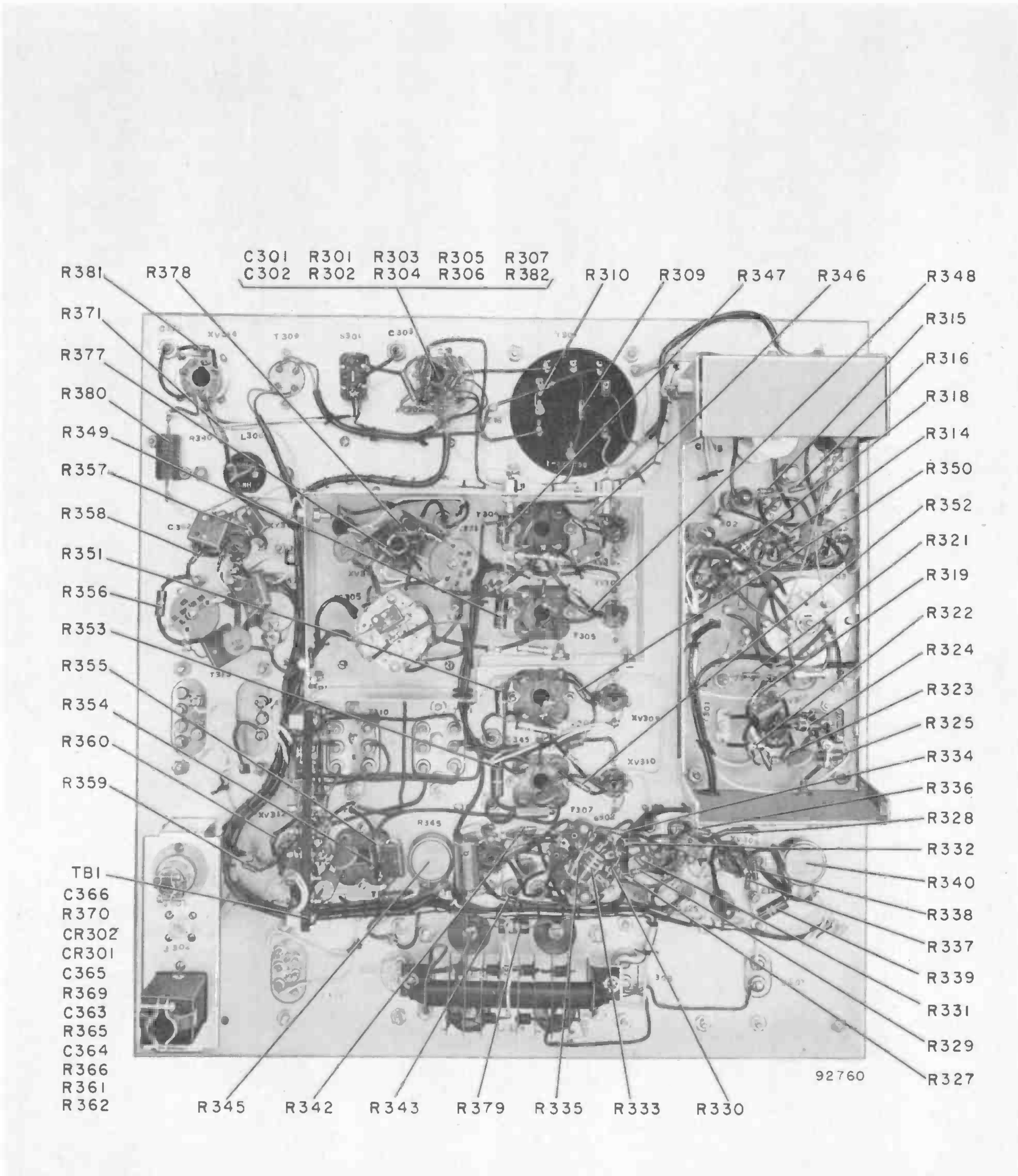


Figure 21—BTX-1A Subcarrier Generator, Rear View

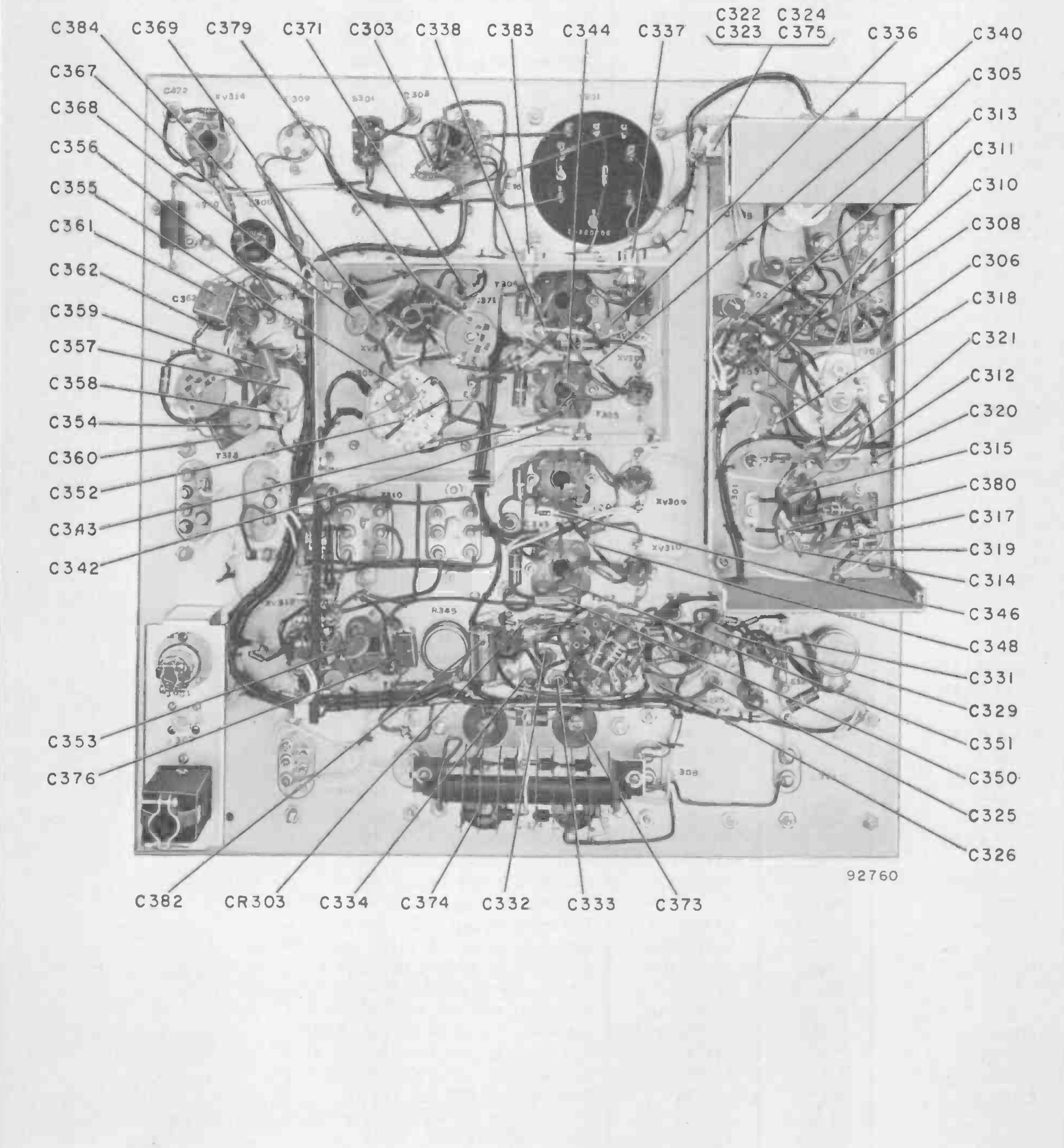


Figure 22—BTX-1A Subcarrier Generator, Rear View

EXCITER, MI-34501

Symbol No.	*Stock No.*	*Drawing No.*	*Description*
			CAPACITORS:
C101,C102	211170	737883-15	Paper, 0.015 µf ±10%, 100 v
C103	39636	727856-131	Mica, 220 µµf ±10%, 500 v
C104	211169	737863-87	Paper, 1 µf ±20%, 100 v
C105	45362	882321-1	Variable, 6-140 µµf
C106	73960	990167-19	Ceramic, 0.01 µf +100 -0%, 500 v
C107	99177	8825449-1	Feed-thru, 0.001 µf, 500 v
C108	73960	990167-19	Ceramic, 0.01 µf +100 -0%, 500 v
C109,C110	77865	90575-309	Ceramic, 10 µµf ±1 µµf, 500 v
C111	217541	90575-129	Ceramic, 68 µµf ±2.5%, 500 v
C112	53119	727856-145	Mica, 820 µµf ±10%, 300 v
C113 to C115	73960	990167-19	Ceramic, 0.01 µf +100
C116	217537	737863-25	Paper, 0.1 µf ±10%, 100 v
C117	39636	727856-131	Mica, 220 µµf ±10%, 500 v
C118	77252	990167-13	Ceramic, 0.001 µf +100 -0%, 500 v
C119	57517	90575-315	Ceramic, 18 µµf ±10%, 500 v
C120	99177	8825449-1	Feed-thru, 0.001 µf, 500 v
C121	39636	727856-131	Mica, 220 µµf ±10%, 500 v
C122	73960	990167-19	Ceramic, 0.01 µf +100 -0%, 500 v
C123	99177	8824449-1	Feed-thru, 0.001 µf, 500 v
C124	73960	990167-19	Ceramic, 0.01 µf +100 -0%, 500 v
C125	217565	458528-203	Ceramic, 110 µµf ±5%, 500 v
C126	73960	990167-19	Ceramic, 0.01 µf +100 0%, 500 v
C127	99177	8825449-1	Feed-thru, 0.001 µf, 500 v
C128	39638	727856-133	Mica, 270 µµf ±10%, 500 v
C129	99177	8825449-1	Feed-thru, 0.001 µf, 500 v
C130	73960	990167-19	Ceramic, 0.01 µf +100 -0%, 500 v
C131	99177	8825449-1	Feed-thru, 0.001 µf, 500 v
C132	73960	990167-19	Ceramic, 0.01 µf +100 -0%, 500 v
C133	93056	90595-359	Ceramic, 5 µµf ±1 µµf, 500 v
C134	99177	8825449-1	Feed-thru, 0.001 µf 500 v
C135	73960	990167-19	Ceramic, 0.01 µf +100 -0%, 500 v
C136	39638	727856-133	Mica, 270 µµf ±10%, 500 v
C137	43369	844546-10	Variable, 4-25 µµf
C138	73960	990167-19	Ceramic, 0.01 µf +100 -0%, 500 v
C139	43368	844546-2	Variable, 5-75 µµf
C140	73960	990167-19	Ceramic, 0.01 µf +100 -0%, 500 v
C141,C142	73473	990167-17	Ceramic, 0.0047 µf +100 -0%, 500 v
C143,C144	99177	8825449-1	Feed-thru, 0.001 µf, 500 v
C145	73960	990167-19	Ceramic, 0.01 µf +100 -0%, 500 v
C146,C147	99177	8824449-1	Feed-thru, 0.001 µf, 500 v
C148	77953	990167-15	Ceramic, 2200 µµf +100 -0%, 500 v
C149	77865	90575-309	Ceramic, 10 µµf ±1 µµf, 500 v
C150	99177	8825449-1	Feed-thru, 0.001 µf, 500 v
C151	78261	90575-217	Ceramic, 22 µµf ±5%, 500 v
C152,C153	73960	990167-19	Ceramic, 0.01 µf +100 -0%, 500 v
C154	90022	90575-227	Ceramic, 56 µµf ±5%, 500 v
C155,C156	93056	90575-359	Ceramic, 5 µµf ±1 µµf 500 v
C157	73960	990167-19	Ceramic, 0.01 µf +100 -0%, 500 v
C158	90022	90575-227	Ceramic, 56 µµf ±5%, 500 v
C159	78928	90575-404	Ceramic, 1.5 µµf ±0.25 µµf, 500 v
C160	77865	90575-309	Ceramic, 10 µµf ±1 µµf, 500 v
C161	206332	737863-375	Paper, 0.1 µf ±20%, 400 v
C162	44700	90575-335	Ceramic, 120 µµf ±10%, 500 v
C163	79992	90575-405	Ceramic, 2 µµf, ±0.25 µµf, 500 v
C164	77865	90575-309	Ceramic, 10 µµf ±1 µµf, 500 v
C165	76739	90575-321	Ceramic, 33 µµf ±10%, 500 v
C166	99177	8825449-1	Feed-thru, 0.001 µf, 500 v
C167	213643	737863-381	Paper, 0.33 µf ±20%, 400 v
C168	39648	727856-243	Mica, 680 µµf ±5%, 500 v
C169	73960	990167-19	Ceramic, 0.01 µf +100 -0%, 500 v

Symbol No.	Stock No.	Drawing No.	Description
C170	99667	727860-248	Mica, 1100 μμf ±5%, 300 v
C171	77865	90575-309	Ceramic, 10 μμf ±1 μμf, 500 v
C172	73960	990167-19	Ceramic, 0.01 μf +100 −0%, 500 v
C173	206332	737863-375	Paper, 0.1 μf ±20%, 400 v
C174	78913	90575-225	Ceramic, 47 μμf ±5%, 500 v
C175	206332	737863-375	Paper, 0.1 μf ±20%, 400 v
C176	39640	727856-235	Mica, 330 μμf ±5%, 500 v
C177	77865	90575-309	Ceramic, 10 μμf ±1 μμf 500 v
C178	39626	727856-121	Mica, 82 μμf ±10%, 500 v
C179	213643	737863-381	Paper, 0.33 μf ±20%, 400 v
C180	73960	990167-19	Ceramic, 0.01 μf +100 −0%, 500 v
C181	39648	727856-243	Mica, 680 μμf ±5%, 300 v
C182	99667	727860-248	Mica, 1100 μμf ±5%, 300 v
C183	77865	90575-309	Ceramic, 10 μμf ±1 μμf, 500 v
C184	73960	990167-19	Ceramic, 0.01 μf +100 −0%, 500 v
C185,C186	211171	737883-75	Paper, 0.1 μf ±20%, 100 v
C187 to C189	211170	737883-15	Paper, 0.015 μf ±10%, 100 v
C190	39620	727856-115	Mica, 47 μμf ±10%, 500 v
C191	217539	737863-277	Paper, 0.15 μf ±20%, 300 v
C192	211169	737863-87	Paper, 1 μf ±20%, 100 v
C193	217564	737863-267	Paper, 0.022 μf ±20%, 300 v
C194	206332	737863-375	Paper, 0.1 μf ±20%, 400 v
C195	210909	737883-275	Paper, 0.1 μf ±20%, 300 v
C196	211169	737863-87	Paper, 1 μf ±20%, 100 v
C197	18368	442901-58	Tubular electrolytic, 20 μf +100 −10%, 150 v
C198	210874	737883-83	Paper, 0.47 μf ±20%, 100 v
C199	213643	737863-381	Paper, 0.33 μf ±20%, 400 v
C200,C201	211225	450184-5	Paper, 16 μf, 400 v
C202	211167	735712-6	Electrolytic, 1500 μf, 15 v
C203	64641	727856-236	Mica, 360 μμf ±5%, 500 v
C204	53119	727856-145	Mica, 820 μμf ±10%, 300 v
C205,C206	204066	258851-6	Variable, ceramic, 6-25 μμf
C207,C208	77865	90575-309	Ceramic, 10 μμf ±1 μμf, 500 v
C209	73960	990167-19	Ceramic, 0.01 μf +100 −0%, 500 v
C210	211171	737883-75	Paper, 0.1 μf ±20%, 100 v
C211,C212	73960	990167-19	Ceramic, 0.01 μf +100 −0%, 500 v
C213	210495	737863-371	Paper, 0.047 μf ±20%, 400 v
C214	77865	90575-309	Ceramic, 10 μμf ±1 μμf, 500 v
CR101,CR102	59395	1N34A	Crystal: diode
CR103			Not Used
CR104	59395	1N34A	Crystal: diode
CR105	210347	8908824-4	Rectifier: plate
CR106,CR107	217571	8971903-2	Rectifier: filament
DS101,DS102	101857	872291-9	Lamp: neon
F101,F102	212327	8858508-6	Fuse: 0.5 amp
J101	211510	481799-2	Connector: female
J102	54890	445813-2	Connector: coaxial
J103	92180	433647-1	Receptacle: type N
J104	50780	889482-3	Receptacle
J105	55806	727969-7	Connector: male
J106	54890	445813-2	Connector: coaxial
K101	217572	627511-55	Relay: telephone type
L101	44679	862943-1	Choke: RF
L102	217573	8886161-13	Choke: RF
L103	44679	862943-1	Choke: RF
L104	211238	481715-4	Coil: RF
L105	217361	481715-6	Coil: RF
L106	217570	8959095-501	Coil: (silver plated)
L107	57259	8886161-7	Choke: RF
L108	211164	8917198-1	Choke: RF
L109,L110	210637	476457-1	Reactor: filter

Symbol No.	Stock No.	Drawing No.	Description
L111	210703	476473-1	Reactor: filter
L112	217356	728446-18	Coil: IF
L113	217601	8971986-501	Choke: parasitic
M101	217558	477920-2	Meter: 0-100 microamps, DC
P101	211509	481799-1	Connector: male
P102	214186	427992-1	Connector: coaxial, male
P103	212885	8905991-1	Connector: male, coaxial
P104	32661	878243-1	Connector: female
P105	55808	727969-8	Connector: female
P106	214186	427992-1	Connector: coaxial, male
			RESISTORS:
			Fixed, Composition – Unless Otherwise Specified
R101, R102		82283-141	180 ohm ±5%, ½ w
R103		82283-147	330 ohm ±5%, ½ w
R104, R105		82283-141	180 ohm ±5%, ½ w
R106, R107		82283-133	82 ohm ±5%, ½ w
R108		82283-76	15,000 ohm ±10%, ½ w
R109, R110		82283-66	2200 ohm ±10%, ½ w
R111		82283-76	15,000 ohm ±10%, ½ w
R112, R113		82283-67	2700 ohm ±10%, ½ w
R114		90496-63	1200 ohm ±10%, 1 w
R115		82283-147	330 ohm ±5%, ½ w
R116		82283-77	18,000 ohm ±10%, ½ w
R117		90496-86	100,00 ohm ±10%, 1 w
R118		82283-80	33,000 ohm ±10%, ½ w
R119		82283-79	27,000 ohm ±10%, ½ w
R120		82283-74	10,000 ohm ±10%, ½ w
R121		82283-64	1500 ohm ±10%, ½ w
R122		90496-85	82,000 ohm ±10%, 1 w
R123		99126-55	270 ohm ±10%, 2 w
R124	55186	867970-305	Wire wound, 0.43 ohm ±10%, ½ w
R125		90496-76	15,000 ohm ±10%, 1 w
R126		90496-85	82,000 ohm ±10%, 1 w
R127		82283-163	1500 ohm ±5%, ½ w
R128		99126-55	270 ohm ±10%, 2 w
R129		90496-76	15,000 ohm ±10%, 1 w
R130		90496-79	27,000 ohm ±10%, 1 w
R131		82283-159	1000 ohm ±5%, ½ w
R132	93933	458574-36	Wire wound, 400 ohm ±5%, 10 w
R133	217563	458572-85	Wire wound, 16,000 ohm ±5%, 5 w
R134		90496-121	27 ohm ±5%, 1 w
R135		82283-74	10,000 ohm ±10%, ½ w
R136	217602	99316-3	Wire wound, 5 ohm ±1%, ½ w
R137	55186	867970-305	Wire wound, 0.43 ohm ±10%, ½ w
R138		99126-1	10 ohm ±20%, 2 w
R139	217604	990185-395	Film, 9530 ohm ±1%, ½ w
R140		82283-62	1000 ohm ±10%, ½ w
R141		99126-73	8200 ohm ±10%, 2 w
R142		82283-62	1000 ohm ±10%, ½ w
R143		99126-73	8200 ohm ±10%, 2 w
R144		82283-66	2200 ohm ±10%, ½ w
R145		99126-73	8200 ohm ±10%, 2 w
R146		82283-66	2200 ohm ±10%, ½ w
R147		99126-73	8200 ohm ±10%, 2 w
R148		82283-82	47,000 ohm ±10%, ½ w
R149		82283-84	68,000 ohm ±10%, ½ w
R150		82283-98	1 meg. ±10%, ½ w
R151		82283-86	100,000 ohm ±10%, ½ w
R152		82283-72	6800 ohm ±10%, ½ w

Symbol No.	Stock No.	Drawing No.	Description
R153		82283-56	330 ohm ±10%, ½ w
R154		82283-66	2200 ohm ±10%, ½ w
R155		99126-73	8200 ohm ±10%, 2 w
R156		82283-82	47,000 ohm ±10%, ½ w
R157		82283-84	68,000 ohm ±10%, ½ w
R158	98600	458572-64	Wire wound, 4000 ohm ±5%, 5 w
R159	93466	458572-97	Wire wound, 40,000 ohm ±5%, 5 w
R160 to R162		82283-50	100 ohm ±10%, ½ w
R163		82283-86	100,000 ohm ±10%, ½ w
R164, R165		82283-59	560 ohm ±10%, ½ w
R166		82283-50	100 ohm ±10%, ½ w
R167		82283-86	100,000 ohm ±10%, ½ w
R168		82283-98	1 meg. ±10%, ½ w
R169, R170		82283-183	10,000 ohm ±5%, ½ w
R171		82283-90	220,000 ohm ±10%, ½ w
R172, R173		82283-86	100,000 ohm ±10%, ½ w
R174	56596	458575-108	Variable, carbon, 2500 ohm ±10%, 2 w
R175		82283-92	330,000 ohm ±10%, ½ w
R176		82283-82	47,000 ohm ±10%, ½ w
R177	217546	8914834-3	Wire wound, 2000 ohm, ±3%, 25 w
R178		82283-82	47,000 ohm ±10%, ½ w
R179		82283-92	330,000 ohm ±10%, ½ w
R180		82283-78	22,000 ohm ±10%, ½ w
R181		90496-81	39,000 ohm ±10%, 1 w
R182		82283-61	820 ohm ±10%, ½ w
R183	206044	433196-3	Variable, 0.25 meg. ±10%, 2 w
R184		82283-88	150,000 ohm ±10%, ½ w
R185	68837	433196-34	Variable, 25,000 ohm ±10%, 2 w
R186		82283-98	1 meg. ±10%, ½ w
R187, R188		82283-100	1.5 meg. ±10%, ½ w
R189		82283-95	560,000 ohm ±10%, ½ w
R190	217603	990185-468	Carbon film, 49,900 ohm ±1%, ½ w
R191	214810	990187-668	Film, 4.99 meg. ±1%, 1 w
R192		82283-175	4700 ohm ±5%, ½ w
R193		82283-206	91,000 ohm ±5%, ½ w
R194		90496-50	100 ohm ±10%, 1 w
R195		82283-82	47,000 ohm ±10%, ½ w
R196		82283-74	10,000 ohm ±10%, ½ w
R197		82283-82	47,000 ohm ±10%, ½ w
R198		82283-74	10,000 ohm ±10%, ½ w
S101	211166	8907253-2	Switch: toggle
S102	217560	8436501-1	Switch: rotary
S103	217566	849370-8	Switch: DC, OL
S104	217552	8434096-1	Switch: AC, OL
S105	52980	442389-2	Switch: rotary
S106	217559	8436500-1	Switch: rotary
T101	52685	902022-1	Transformer: input
T102	211180	897903-502	Coil Assembly
T103	51745	727590-507	Coil Assembly
T104	51738	728446-17	Transformer: 42.8 microhenry
T105	211182	728446-13	Transformer: 471 microhenry
T106	211183	728446-14	Transformer: 5652 microhenry
T107 to T109	211184	728446-15	Transformer: 34,500 microhenry
T110, T111	51734	442511-1	Transformer: input
T112	210660	481743-1	Transformer: power
T113	217362	8434093-1	Transformer: plate
T114	217357	8434095-1	Transformer: filament
T115	211184	728446-15	Transformer: 34,500 microhenry
XC202	217561	99390-3	Socket: octal, red

Symbol No.	Stock No.	Drawing No.	Description
XDS101, XDS102		8856946-2	Socket: lamp
	94121		Jewel - only
	56610		Socket - only
XF101, XF102	48894	99088-2	Holder: fuse
XV101 to XV103	94879	737867-18	Socket: 7 pin miniature
XV104 to XV106	94880	737870-18	Socket: 9 pin miniature
XV107	54414	99390-1	Socket: octal
XV108 to XV113	94879	737867-18	Socket: 7 pin miniature
XV114	94880	737870-18	Socket: 9 pin miniature
XV115, XV116	94879	737867-18	Socket: 7 pin miniature
XV117	54414	99390-1	Socket: octal
XV118	217548	8944202-1	Socket: 11 pin
XY101, XY102	75061	746002-7	Socket: crystal
Y101, Y102			Crystal
XZ101	59919	746048-1	Socket: vector
Z101	211381	481755-1	Network: pre-emphasis
			Miscellaneous
	211248	8817922-1	Dial —(C105)
	211244	8917263-1	Drive Unit (Tunes C105)
	213996	69916-10	Knob: 3/4" dia. (for R185)
	30075	737820-507	Knob: 1" dia. (for S105)
	215877	737820-505	Knob: 1-1/2" dia. (for S102 and S106)
	57692	8896313-1	Mount: shock mount
	217574	483884-9	Shield: tube, 7 pin (for 6AQ5)
	215853	483884-12	Shield: tube, 9 pin (for 6CL6, 5763
	53016	99369-1	Shield: tube, 7 pin (for 6AS6)
	54521	99369-2	Shield: tube, 7 pin (for 6AU6)
	56359	8888549-2	Shield: tube, 9 pin (for 12AT7)
SUBCARRIER GENERATOR, MI-34500			
			CAPACITORS:
C301, C302	211170	737883-15	Paper, 0.015 μf ±10%, 100 v
C303	211169	737863-87	Paper, 1 μf ±20%, 100 v
C304	39636	727856-131	Mica, 220 μμf ±10%, 500 v
C305	45362	882321-1	Variable, 6-140 μμf
C306 to C310	73960	990167-19	Ceramic, 0.01 μf +100 −0%, 500 v
C311	53119	727856-145	Mica, 820 μμf ±10%, 300 v
C312	45469	90575-233	Ceramic, 100 μμf ±5%, 500 v
C313, C314	73960	990167-19	Ceramic, 0.01 μf +100 −0%, 500 v
C315	39620	727856-115	Mica, 47 μμf ±10%, 500 v
C316	78913	90575-225	Ceramic, 47 μμf ±5%, 500 v
C317	73960	990167-19	Ceramic, 0.01 μf +100 −0%, 500 v
C318, C319	70935	90575-319	Ceramic, 27 μμf ±10%, 500 v
C320	57517	90575-315	Ceramic, 18 μμf ±10%, 500 v
C321	73960	990167-19	Ceramic, 0.01 μf +100 −0%, 500 v
C322 to C324	99177	8825449-1	Feed-thru, 0.001 μf, 500 v
C325	217537	737863-25	Paper, 0.1 μf ±20%, 100 v
C326	73960	990167-19	Ceramic, 0.01 μf +100 −0%, 500 v
C327, C328	217539	737863-277	Paper, 0.15 μf ±20%, 300 v
C329	102416	727856-147	Mica, 0.001 μf ±10%, 500 v
C330			Not used
C331	73960	990167-19	Ceramic, 0.01 μf +100 −0%, 500 v
C332	217537	737863-25	Paper, 0.1 μf ±20%, 100 v
C333	217540	737863-33	Paper, 0.47 μf ±10%, 100 v
C334	217536	737863-17	Paper, 0.022 μf ±10%, 100 v
C335	73960	990167-19	Ceramic, 0.01 μf +100 −0%, 500 v
C336	96998	727856-107	Mica, 22 μμf ±10%, 500 v
C337	73960	990167-19	Ceramic, 0.01 μf +100 −0%, 500 v
C338	90022	90575-227	Ceramic, 56 μμf ±5%, 500 v

Symbol No.	Stock No.	Drawing No.	Description
C339, C340	93056	90575-359	Ceramic, 5 μμf ±20%, 500 v
C341	73960	990167-19	Ceramic, 0.01 μf +100 -0%, 500 v
C342	90022	90575-227	Ceramic, 56 μμf ±5%, 500 v
C343	78928	90575-404	Ceramic, 1.5 μμf ±.25 μμf, 500 v
C344	77865	90575-309	Ceramic, 10 μμf ±10%, 500 v
C345	217538	737863-275	Paper, 0.1 μf ±20%, 300 v
C346	44700	90575-335	Ceramic, 120 μμf ±10%, 500 v
C347	79992	90575-405	Ceramic, 2 μf ±.25 μμf, 500 v
C348	77865	90575-309	Ceramic, 10 μμf ±10%, 500 v
C349	213643	737863-281	Paper, 0.33 μf ±20%, 300 v
C350	39648	727856-243	Mica, 680 μμf ±10%, 500 v
C351	73960	990167-19	Ceramic, 0.01 μf +100 -0%, 500 v
C352	93056	90575-359	Ceramic, 5 μμf ±20%, 500 v
C353, C354	73960	990167-19	Ceramic, 0.01 μf +100 -0%, 500 v
C355	39620	727856-115	Mica, 47 μμf ±10%, 500 v
C356	95254	727856-117	Mica, 56 μμf ±10%, 500 v
C357	204066	258851-6	Variable, 6-25 μμf
C358	77865	90575-309	Ceramic, 10 μμf ±10%, 500 v
C359	39666	727865-161	Mica, 3900 μμf ±5%, 500 v
C360	39658	727865-153	Mica, 1800 μμf ±5%, 500 v
C361	39656	727865-151	Mica, 1500 μμf ±5%, 500 v
C362	217538	737863-275	Paper, 0.1 μf ±20%, 300 v
C363, C364	211171	737883-75	Paper, 0.1 μf ±20%, 100 v
C365 to C367	211170	737883-15	Paper, 0.015 μf ±10%, 100 v
C368, C369	73960	990167-19	Ceramic, 0.01 μf +100 -0%, 500 v
C370	211171	737883-75	Paper, 0.1 μf ±20%, 100 v
C371	210495	737863-271	Paper, 0.047 μf ±20%, 300 v
C372	217136	737863-283	Paper, 0.47 μf ±20%, 300 v
C373, C374	211225	450184-5	Electrolytic, 16 μf, 400 v
C375	99177	8825449-1	Feed-thru, 0.001 μf, 500 v
C376	39658	727860-153	Mica, 1800 μμf ±5%, 300 v
C377	99177	8825449-1	Feed-thru, 0.001 μf, 500 v
C378	57517	90575-315	Ceramic, 18 μμf ±10%, 500 v
C379	73960	990167-19	Ceramic, 0.01 μf +100 -0%, 500 v
C380	79488	90575-319	Ceramic, 27 μμf ±10%, 500 v
C381	76739	90575-321	Ceramic, 33 μμf ±10%, 500 v
C382	210874	737883-83	Paper, 0.47 μf ±20%, 100 v
C383, C384	99177	8825449-1	Feed-thru, 0.001 μf, 500 v
CR301, CR302	59395	1N34A	Crystal: diode
CR303	206109	1N38A	Crystal: diode
CR304	217547	8908824-2	Rectifier: plate
CR305	217784	1N645	Rectifier: silicon diode
J301	211510	481799-2	Connector: female
J302	54890	445813-2	Connector: coaxial
J303	52107	727969-13	Connector: male
J304, J305	203532	8825493-2	Connector: tip jack
L301, L302	44679	862943-1	Choke: R.F.
L303	211236	481715-2	Coil: R.F.
L304	44679	862943-1	Choke: R.F.
L305	217549	8971938-1	Reactor: 50 millihenry
L306	211164	8917198-1	Reactor: R.F. choke
L307, L308	217533	8436530-1	Reactor: filter
L309	217549	8971938-1	Reactor: 50 millihenry
P301	211509	481799-1	Connector: male
P302	214186	427992-1	Connector: coaxial, male
P303	52108	727969-14	Connector: female
			RESISTORS: *Fixed, Composition — Unless Otherwise specified*
R301, R302		82283-141	180 ohm ±5%, ½ w
R303		82283-133	82 ohm ±5%, ½ w
R304		82283-147	330 ohm ±5%, ½ w
R305, R306		82283-141	180 ohm ±5%, ½ w
R307		82283-133	82 ohm ±5%, ½ w

Symbol No.	Stock No.	Drawing No.	Description
R308			Not used
R309,R310		82283-66	2200 ohm ±10%, ½ w
R311			Not used
R312,R313		82283-67	2700 ohm ±10%, ½ w
R314		90496-63	1200 ohm ±10%, 1 w
R315		82283-147	330 ohm ±5%, ½ w
R316		82283-74	10,000 ohm ±10%, ½ w
R317		82283-77	18,000 ohm ±10%, ½ w
R318		90496-86	100,000 ohm ±10%, 1 w
R319		82283-86	100,000 ohm ±10%, ½ w
R320,R321		82283-74	10,000 ohm ±10%, ½ w
R322,R323		82283-54	220 ohm ±10%, ½ w
R324,R325		90496-74	10,000 ohm ±10%, 1 w
R326		82283-76	15,000 ohm ±10%, ½ w
R327		82283-78	22,000 ohm ±10%, ½ w
R328		82283-80	33,000 ohm ±10%, ½ w
R329		82283-78	22,000 ohm ±10%, ½ w
R330		82283-90	220,000 ohm ±10%, ½ w
R331		82283-54	220 ohm ±10%, ½ w
R332		90496-74	10,000 ohm ±10%, 1 w
R333		82283-80	33,000 ohm ±10%, ½ w
R334		82283-78	22,000 ohm ±10%, ½ w
R335		90496-85	82,000 ohm ±10%, 1 w
R336		82283-81	39,000 ohm ±10%, ½ w
R337		82283-98	1 meg. ±10%, ½ w
R338		82283-64	1500 ohm ±10%, ½ w
R339		99126-74	10,000 ohm ±10%, 2 w
R340	93175	458575-110	Variable, 10,000 ohm ±10%, 2 w
R341		82283-90	220,000 ohm ±10%, ½ w
R342		82283-96	680,000 ohm ±10%, ½ w
R343		82283-86	100,000 ohm ±10%, ½ w
R344		82283-53	180 ohm ±10%, ½ w
R345	98077	458575-113	Variable, 50,000 ohm ±10%, 2 w
R346		82283-62	1000 ohm ±10%, ½ w
R347		99126-73	8200 ohm ±10%, 2 w
R348		82283-62	1000 ohm ±10%, ½ w
R349		99126-73	8200 ohm ±10%, 2 w
R350		82283-66	2200 ohm ±10%, ½ w
R351		99126-73	8200 ohm ±10%, 2 w
R352		82283-66	2200 ohm ±10%, ½ w
R353		99126-73	8200 ohm ±10%, 2 w
R354		82283-82	47,000 ohm ±10%, ½ w
R355		82283-84	68,000 ohm ±10%, ½ w
R356		90496-72	6800 ohm ±10%, 1 w
R357		82283-98	1 meg. ±10%, ½ w
R358		82283-86	100,000 ohm ±10%, ½ w
R359		82283-50	100 ohm ±10%, ½ w
R360		82283-86	100,000 ohm ±10%, ½ w
R361	98600	458572-64	Wire wound, 4000 ohm ±5%, 5 w
R362	93466	458572-97	Wire wound, 40,000 ohm ±5%, 5 w
R363,R364		82283-50	100 ohm ±10%, ½ w
R365,R366		82283-59	560 ohm ±10%, ½ w
R367		82283-50	100 ohm ±10%, ½ w
R368		82283-86	100,000 ohm ±10%, ½ w
R369,R370		82283-183	10,000 ohm ±5%, ½ w
R371,R372		82283-98	1 meg. ±10%, ½ w
R373	53075	433196-3	Variable, 250,000 ohm ±10%, 2 w
R374		82283-88	33,000 ohm ±10%, ½ w
R375	68837	433196-34	Variable, 25,000 ohm ±10%, 2 w
R376		82283-88	33,000 ohm ±10%, ½ w
R377,R378		82283-100	1.5 meg ±10%, ½ w
R379		99126-86	100,000 ohm ±10%, 2 w
R380	210625	8914834-1	Wire wound, 1000 ohm ±3%, 25 w
R381		82283-96	680,000 ohm ±10%, ½ w

Symbol No.	*Stock No.*	*Drawing No.*	*Description*
R382		82283-68	3300 ohm ±10%, ½ w
R383		90496-50	100 ohm ±10%, 1 w
S301	211166	8907253-2	Switch: toggle
S302	217543	8436504-1	Switch: rotary
S303	217749	849370-9	Switch: overload
S304	217750	8434096-2	Switch: overload
S305	217542	8436503-1	Switch: rotary
T301	52685	902022-1	Transformer: input
T302	211180	897903-502	Coil Assembly
T303	217783	727590-508	Coil Assembly
T304	51738	728446-17	Transformer: R.F.
T305	211182	728446-13	Transformer: R.F.
T306	211183	728446-14	Transformer: R.F.
T307, T308	211184	728446-15	Transformer: R.F.
T309	217534	8436502-1	Transformer: audio
T310, T311	51734	442511-1	Transformer: input
T312	217550	8436506-1	Transformer: plate
T313	217535	8436505-1	Transformer: filament
XV301 to XV303	94879	737867-18	Socket: 7 pin miniature
XV304	94880	737870-18	Socket: 9 pin miniature
XV305 to XV311	94879	737867-18	Socket: 7 pin miniature
XV312, XV313	94880	737870-18	Socket: 9 pin miniature
XV314	54414	99390-1	Socket: octal
XV315	217548	8944202-1	Socket: 11 pin
XZ301	59919	746048-1	Socket: vector
Y301			Crystal Unit
Y302	217553	8971943-1	Crystal Unit
XY301, XY302	211175	8885952-3	Socket: crystal
Z301	211381	481755-1	Network: pre-emphasis
			Miscellaneous
	30075	737820-507	Knob: 1" dia. (for S305)
	213996	69916-10	Knob: 3/4" dia. (for R373)
	57692	8896313-1	Mounting: shock
	53016	99369-1	Shield: tube, 7 pin (for V305)
	217574	483884-9	Shield: tube, 7 pin (for V301, 302, 303)
	54521	99369-2	Shield: tube, 7 pin (for V306, V307, V308, V309, V310, V311)
	56359	8888549-2	Shield: tube, 9 pin (for V304, V312, V313)

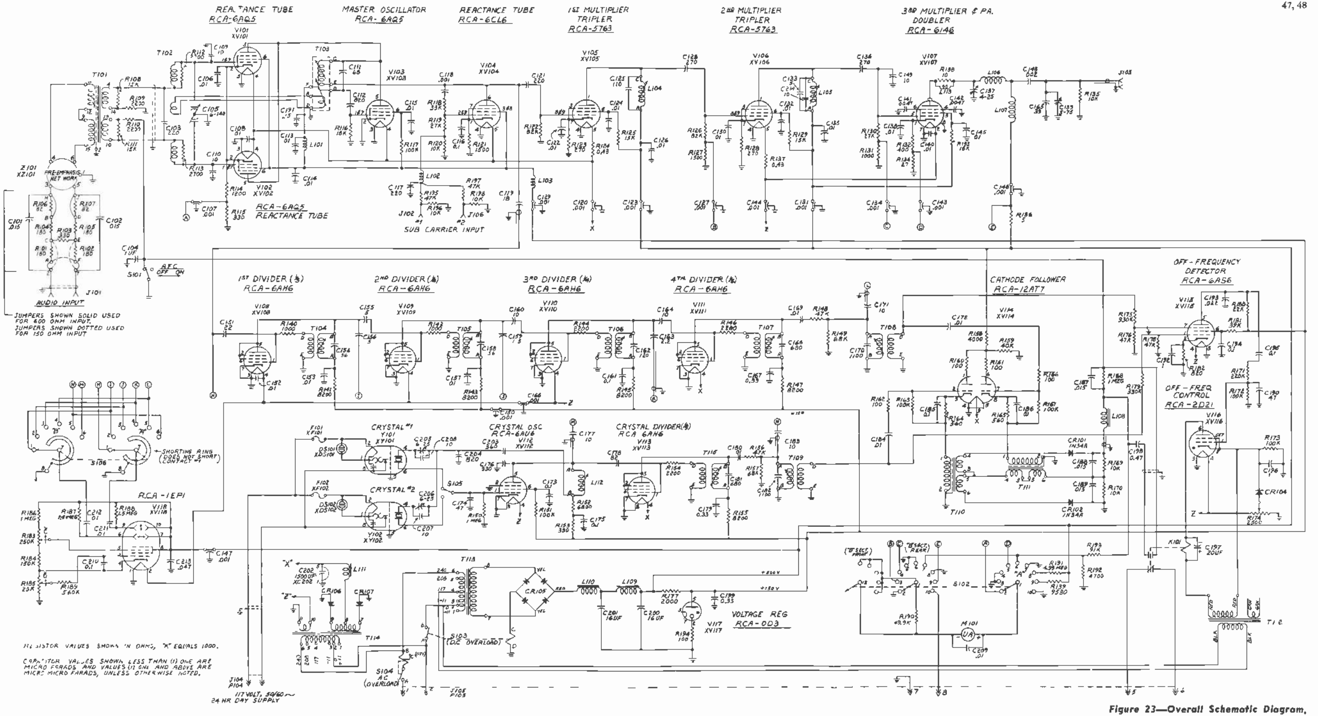
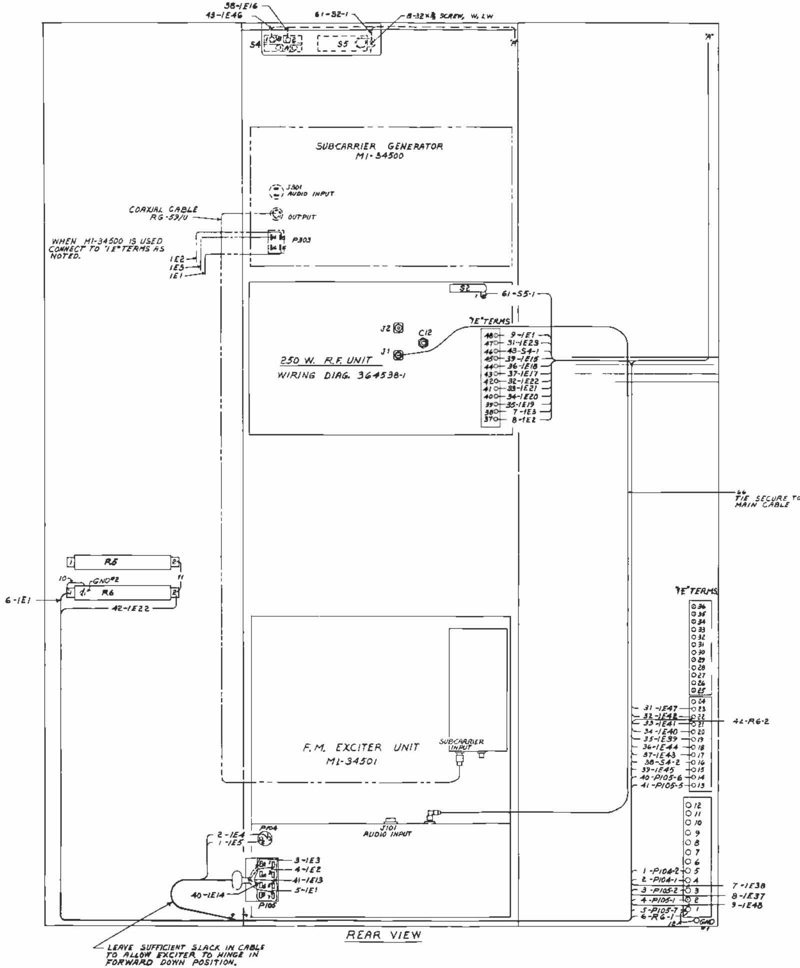


Figure 23—Overall Schematic Diagram, BTE-10B FM Exciter (364351)

WIRE TABLE			WIRE NUMBERS NOT USED
WIRE NOS INCLUSIVE	DESCRIPTION	8959092-501 ITEM NO.	
1 TO 12	WIRE 2010592-33 BLK 300V. #16AWG	69	
31 TO 43	WIRE 2010592-32 BLK 300V. #18AWG	70	
61	WIRE 2010853-141 WHT 15KV.DC #14AWG	71	



NOTES:

1- RUBBER STAMP 3/16 HIGH STANDARD CHARACTERS FOR ELECTRICAL SYMBOLS, USING BLACK PRINTERS INK

2- CABLE WIRES AS SHOWN AND THEN LACE USING CORD ITEM-68.

3- IN MAKING WIRE CONNECTIONS WHERE TERMINALS ARE REQUIRED, USE FOLLOWING TYPES AS BEST SUITED;
99607-2 #10   845462-2 #10
99607-4 #6

(1) FOR LIST OF PARTS SEE 8959092-501

Figure 24—Interconnection Diagram, BTE-10B/BTX-1A (364539)

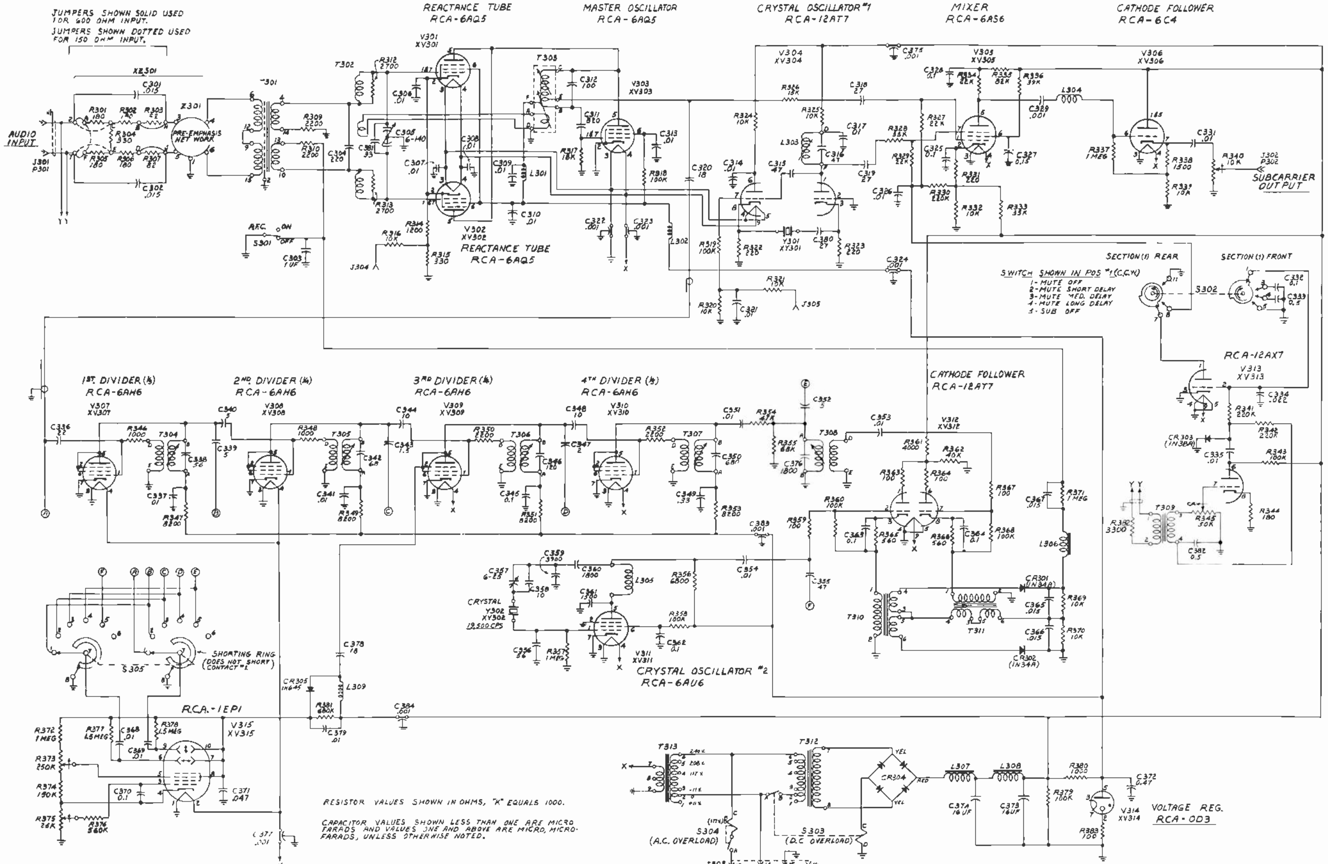


Figure 25—Overall Schematic Diagram, BTX-1A Subcarrier Generator (364378)

RADIO CORPORATION OF AMERICA

INDUSTRIAL ELECTRONIC PRODUCTS, CAMDEN, N. J.