Germanium Crystal Diodes

Compact, Lightweight, Rugged

No Mounting Hardware

No Contact Potential

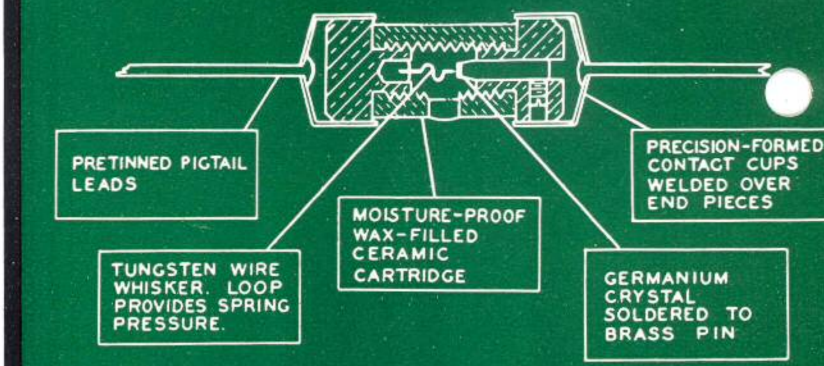
Low Shunt Capacity

No Heater Supply

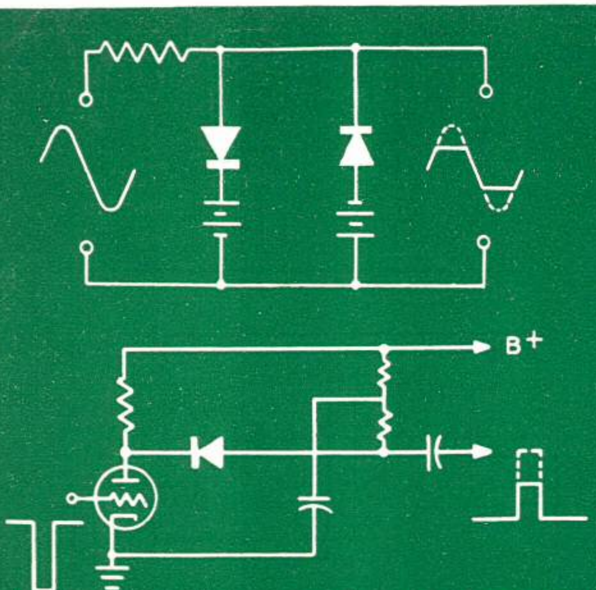
SYLVANIA ELECTRIC

1N34

Sylvania Type 1N34 Crystal Diode was designed with low forward resistance and low shunt capacitance to give superior performance at frequencies up to several hundred megacycles. Small size and pigtail construction permit it to be soldered into place without mounting hardware. No heater supply is required. Contact potential effects are eliminated. Construction of the 1N34 provides a rugged, hermetically-sealed circuit component strongly resistant to thermal shock. It may be operated with both terminals above ground.



Cross sectional view showing crystal construction details.

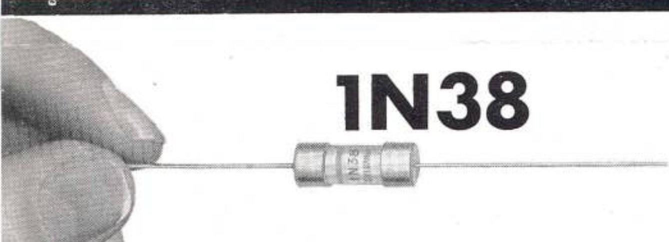


Slicer and video limiter circuits—two of the hundreds of 1N34, 1N38 and 1N39 applications.

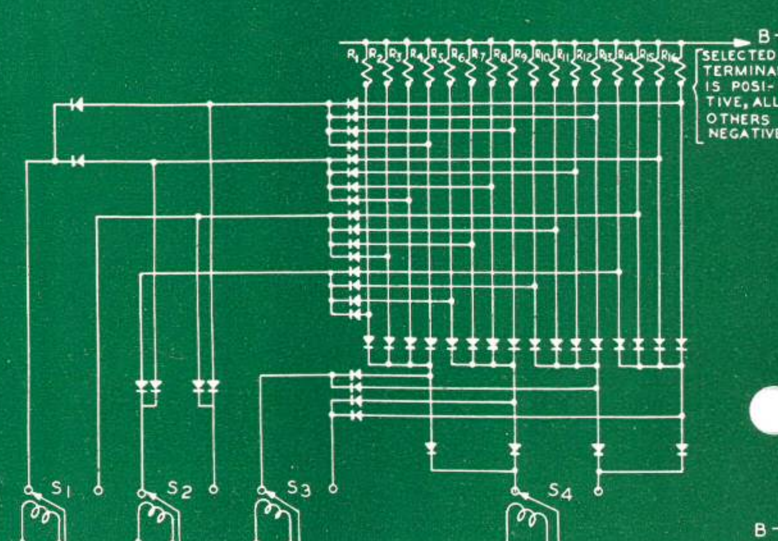
TYPE[1]	Mechanical Specifications (Max.)	Maximum Allowable Inverse Voltage	Peak Anode Current	Ave[rage] An[ode] Cur[rent]
CRYSTAL 1N34	Length .... 3/4" Diameter .... 9/32" Lead Length........ 1 5/8" Lead Connections + Lead .... Anode − Lead .... Cathode (Green band) Mounting Position... Any	60 Volts Max.	150 ma. Max.	40 ma.
CRYSTAL 1N38		100 Volts Max.	150 ma. Max.	40 ma.
CRYSTAL[3] 1N39		200 Volts Max.	150 ma. Max.	40 ma.
DUO-DIODE 1N35	Height............. 25/32" Width............. 29/32" Mount Length..... 1 17/32"	Duo-Diode Type 1N35 consist[illegible] two average value in the forward d[illegible] on sufficiently high to insure a desirable f		
VARISTOR 1N40	Height........... 2 17/32" Diameter.......... 1 5/16"	Varistors 1N40 and 1N41 consist of f balanced within ±2.5% in the forward pair of varistor crystals are matched wi metal radio tube shell with a small wafe connections can be made.		
VARISTOR 1N41	Height (including lugs).... 2 7/16" Length........... 1 15/16" Width (overall).... 1 15/16" Length of Lugs. ... 7/16"			

(1) Inquiries are invited on special requirements. Currentl
For further Varistor data, see Catalog Sheet EC-35A.

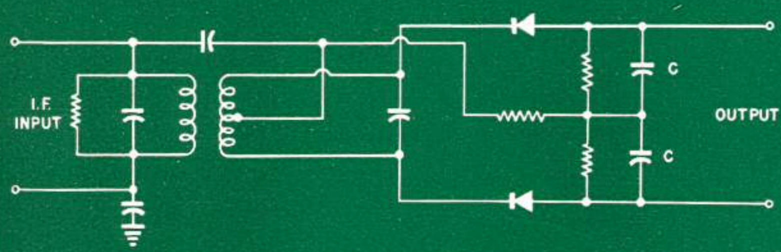
1N38



Type 1N38 Germanium Diode is a rugged, high back voltage crystal particularly valuable wherever low power rectification from zero to several hundred megacycles is desired. It is designed to withstand peak voltages as great as 125 volts in the reverse direction. Like the 1N34, its rectification efficiency decreases only 0.07% per degree temperature rise from 27° to 75° C. It weighs less than a penny and can be mounted in any position.

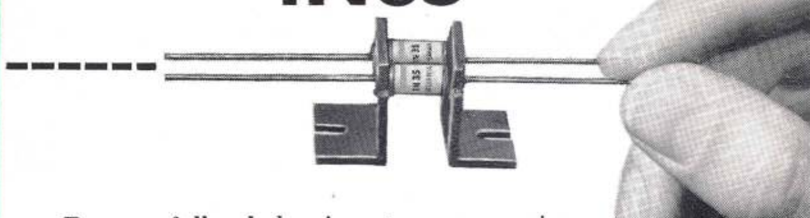


The Crystal Diode Matrix as a high speed selector switch provides another important use for the Sylvania germanium diode family.



The twin-mounted 1N35 Duo-Diode makes possible a highly compact FM discriminator.

1N35



By carefully balancing two germanium crystals and mounting them in a single assembly, Sylvania engineers produced a new crystal duo-diode, Type 1N35. Component diodes are matched for similar values of forward resistance under conditions typical of those in actual use. Resistances are maintained sufficiently high in the back direction to insure a good front-to-back ratio. The 1N35 permits compact packaging and easy portability of balanced circuits requiring full wave rectification, modulation or demodulation.

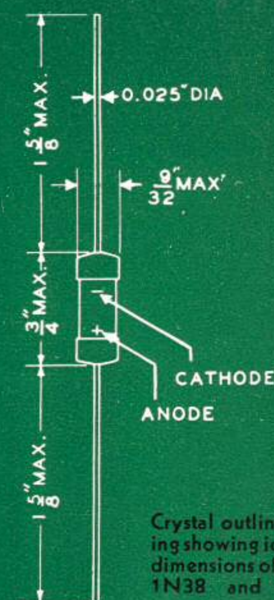
e e t	Forward Current at 1 V.	Transient Surge Current	Back Conduction at 50 V.	Peak Back Voltage[2]	Ambient Temperature Range	Average Shunt Capacity	Average Life
Max.	5.0 ma. Min.	500 ma. Max.	0.8 ma. Max.	75 Volts Min.	−50° to 70°C	1.0 μμfd.	More than 5,000 hours
Max.	4.0 ma. Min.	500 ma. Max.	150 μa. Max.	125 Volts Min.	−50° to 70°C	1.0 μμfd.	
Max.	3.5 ma. Min.	500 ma. Max.	50 μa. Max.	250 Volts Min.	−50° to 70°C	1.0 μμfd.	

ermar crystal diodes, whose resistances are matched within 10% of their
hen ured at 1 volt. Resistances in the back direction are maintained
nt-to-back ratio.

r specially selected and matched germanium diodes whose resistances are
lirection at 1.5 volts. For additional balance, the forward resistances of each
in 3 ohms. In Type 1N40, the plug-in unit, the crystals are mounted in a
octal base. Type 1N41 provides eight lug-type terminals to which soldered

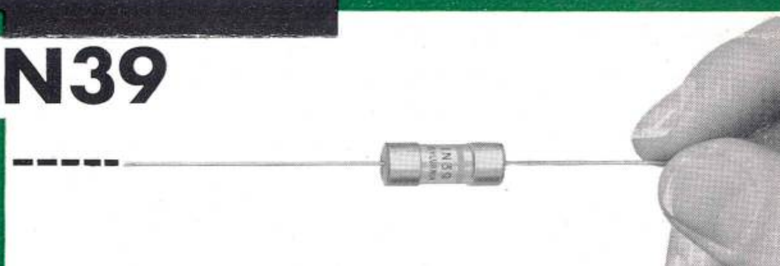
In all circuit diagrams presented herein the arrowhead (➤) of the crystal symbol (➤|) represents the anode or positive lead of the crystal.

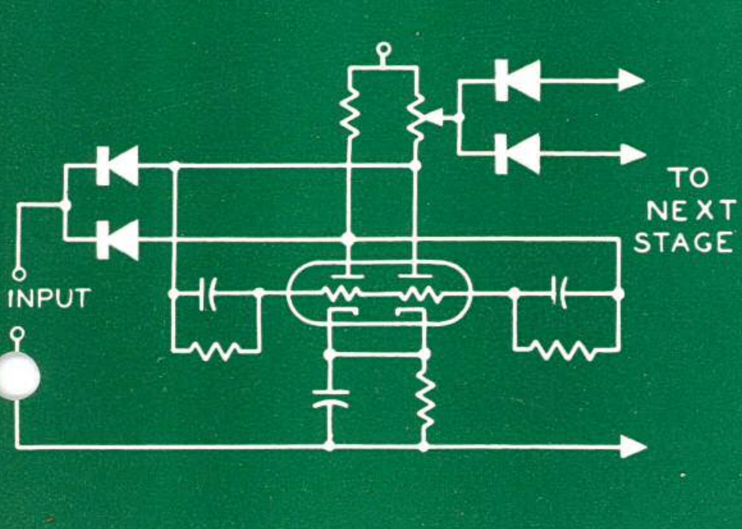
under development is a fourth crystal diode type having an exceptionally high conductivity characteristic.
(2) Reverse voltage for zero dynamic resistance. (3) Tentative Data.



Crystal outline drawing showing identical dimensions of 1N34, 1N38 and 1N39.

1N39





Sylvania germanium crystals are useful as coupling diodes in applications such as this trigger circuit.

For circuits in which the crystal is subjected to exceptionally high back voltages, the Type 1N39 Germanium Diode was developed by Sylvania engineers. Identical in size to the familiar 1N34 and 1N38, Type 1N39 crystals are ideally suited for use in switching, wave-shaping, coupling and damping circuits in which negative voltages as high as 200 volts may be present.

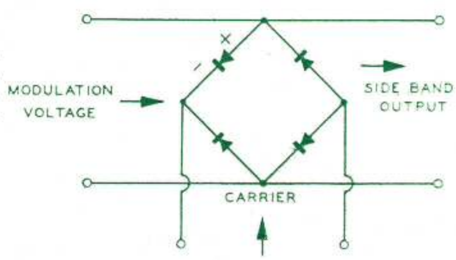
VARISTORS

1N40

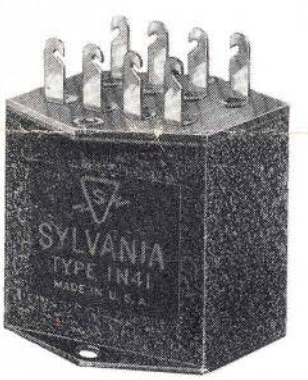
Sylvania Varistors are networks of four carefully selected and matched germanium crystal diodes. They are especially designed for use as ring modulators and bridge circuits in communications modulation and demodulation. They also have applications in many other networks requiring highly polarized non-linear characteristics. Outstanding features are greatly increased frequency range, improved stability, long life and virtual elimination of contact potentials.

In the plug-in unit, Type 1N40, the crystals are mounted in a compact metal radio tube shell with small wafer octal base.

Varistor carrier modulators have many applications in telegraphy and telephony.



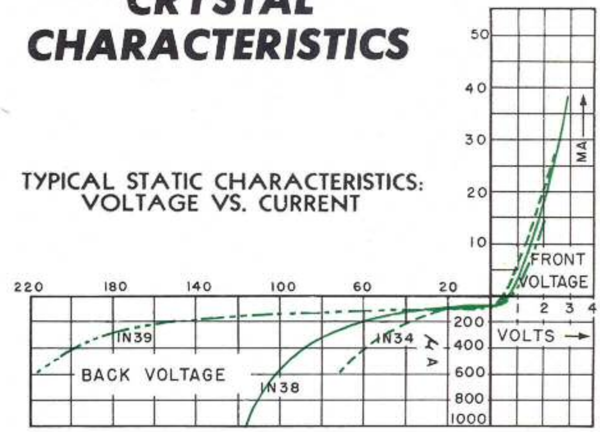
1N41

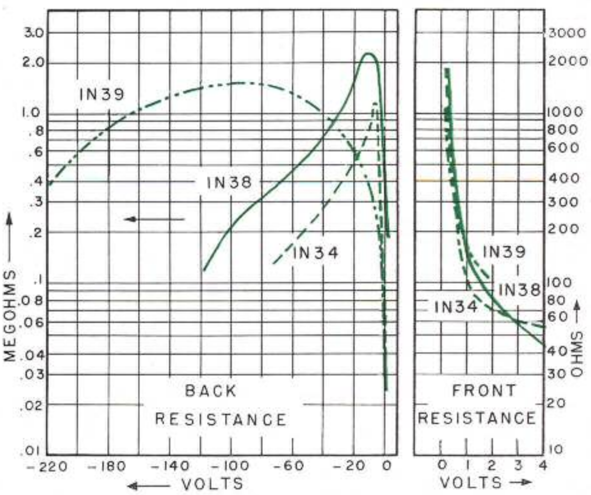


In Type 1N41, the crystals are assembled in a rectangular metal can equipped with eight soldering lugs and adapted for top or sub-panel mounting.

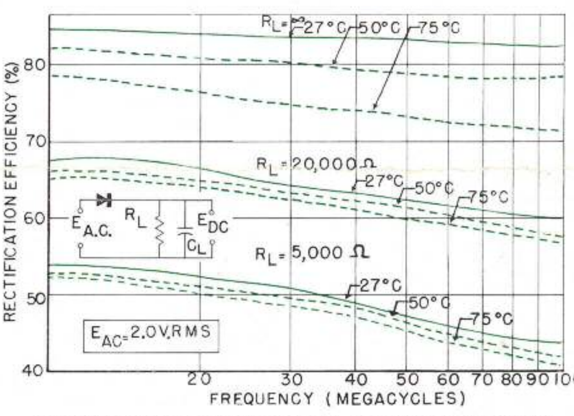
Also under development is a third Varistor type, resistance matched to the same fine balance as the 1N40 and 1N41 but having an exceptionally high back voltage rating.

CRYSTAL CHARACTERISTICS





STATIC RESISTANCE CHARACTERISTICS



RECTIFICATION EFFICIENCY CHARACTERISTICS

SYLVANIA ELECTRIC

DISTRIBUTOR SALES **EMPORIUM, PENNA.**

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11-47

Germanium Crystal Diodes

Compact,

Lightweight, Rugged

No Mounting Hardware

No Contact Potential

Low Shunt Capacity

No Heater Supply

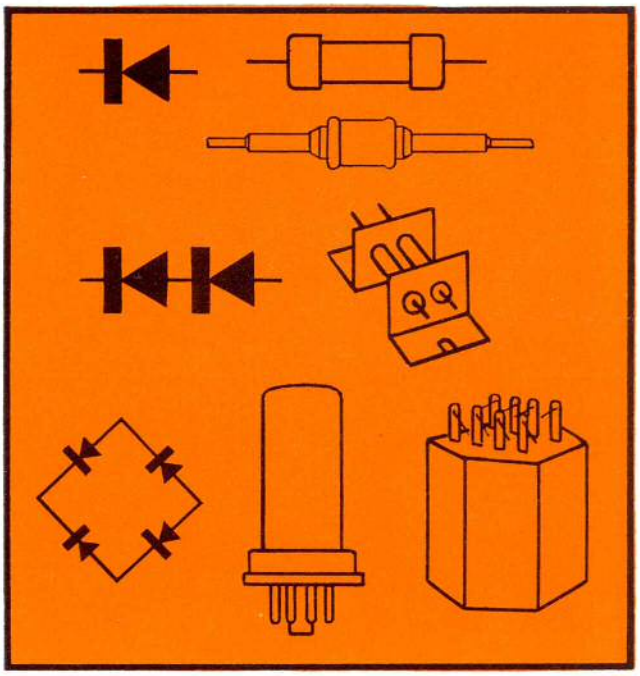
IN34	1N42	IN34A	IN55A
IN35	1N54	IN38A	IN56A
IN38	1N55	IN54A	IN58A
IN39	1N56		
IN40	1N58		
IN41	1N60		
	1N71		

SYLVANIA ELECTRIC

SYLVANIA Germanium Diodes

General Description

Sylvania Germanium Diodes are point contact crystal rectifiers designed for efficient, dependable service as low and medium level detectors in television and radio sets, modulators, harmonic generators, computers, frequency discriminators and hundreds of other applications in radio, television and electronics. They are lightweight, compact, rugged circuit elements. These diodes have low series and shunt capacity, no contact potential and require no heater supply or mounting hardware. Exceptional electrical stability and strong resistance to thermal shock recommend them for many circuit applications.



• Sylvania's line of germanium crystal components includes eight ceramic diodes, six glass diodes, a duo-diode and four varistor networks. Among the fourteen types of Sylvania Germanium Diodes are diodes designed to withstand dc or peak reverse working voltages of up to 50, 60, 100, 150 or 200 volts in the reverse direction. These Sylvania Germanium Diodes exhibit exceptionally high back resistance. They also possess a high forward conduction characteristic making them very efficient rectifiers in both low and high impedance circuits.

• Two major types of Sylvania Germanium Diodes are available for design engineers, experimenters and circuit engineers. The ceramic type diode is ruggedly constructed to insure permanent electrical stability under a wide variety of handling and ambient temperatures. Flexible tinned leads are swaged to nickel end caps which are welded to threaded brass plugs. These plugs are screwed and firmly cemented into a strong ceramic body to provide a thermal reservoir which insulates the pigtails from the active element and permits close soldering.

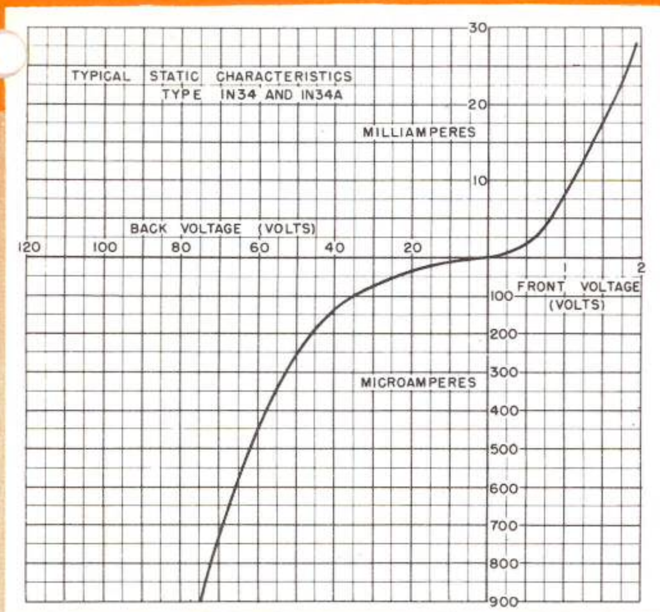
• Sylvania glass constructed germanium diodes are made moisture proof by a unique hermetically sealed glass cartridge construction. The glass diodes are smaller and lighter than the corresponding ceramic types. They have been designed with terminals smaller in diameter than the glass body to eliminate risk of accidental contact in side by side mounting. All of the advantages of the ceramic type have been retained in the new glass type. Electrical characteristics of the glass type diodes are generally the same as the corresponding ceramic types, but their spread is narrower since they are tested to more stringent limits.

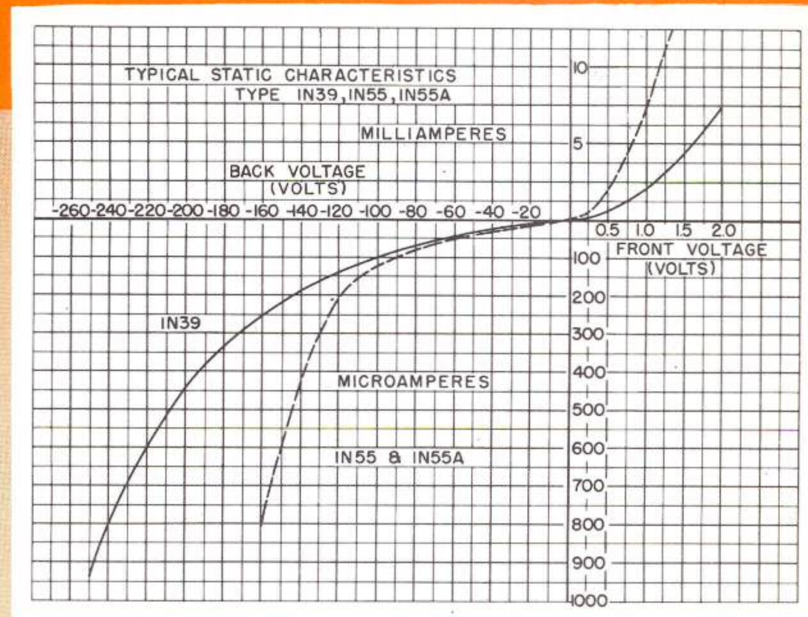
• The duo-diode type 1N35 consists of a pair of diodes mounted in a plastic holder and carefully matched for use in balanced circuits for full-wave rectification, modulation, demodulation or ratio detection. The component diodes are matched for similar values of forward resistance under conditions typical of those in actual use. Resistances are maintained sufficiently high in the back direction to insure a good front-to-back ratio. The Sylvania Type 1N35 duo-diode permits compact packaging and easy portability of balanced circuits.

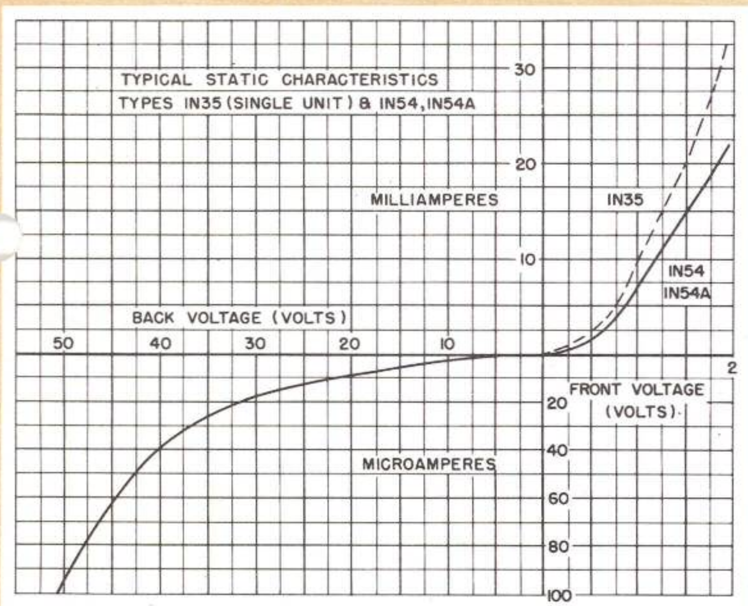
• Sylvania Varistors, Types 1N40, 1N41, 1N42 and 1N71 are networks of four carefully selected and matched diodes designed especially for use as ring modulators or bridge circuits in communications circuits. In the plug-in units, Types 1N40, 1N42 and 1N71, the crystals are mounted in a compact metal radio tube shell. In Type 1N41 the crystals are assembled in a rectangular metal can equipped with eight soldering lugs adapted for top or sub-panel mounting.

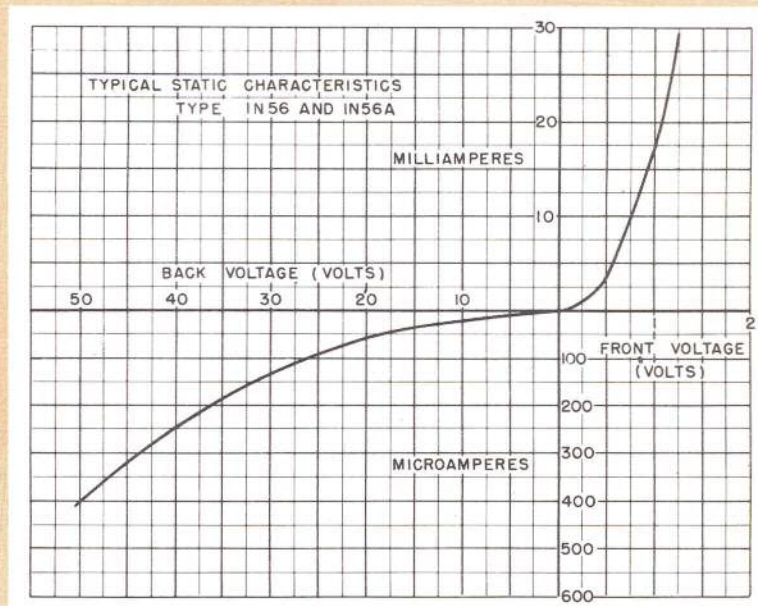
• All Sylvania Germanium Diodes have a nominal shunt capacitance of 1 uuf. These diodes tolerate an ambient temperature range of $-50°C$ to $+75°C$ and have an average life of more than 10,000 hours. The principal electrical characteristics for each of the Sylvania Germanium Diodes will be found in the following table and graphs.

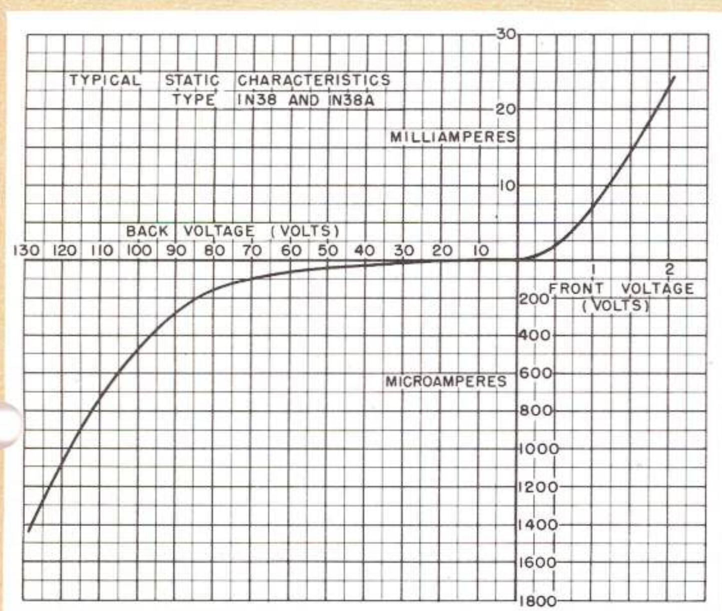
Typical Static Characteristics

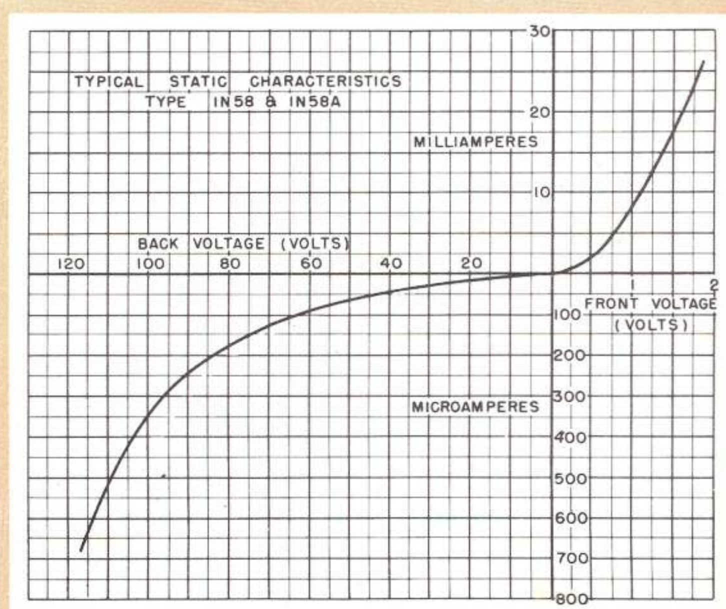












SYLVANIA Germanium Diodes

RATINGS AND

TYPE	DESCRIPTION	CONSTRUCTION	CONTINUOUS REVERSE WORKING VOLTAGE (volts Max.)	REVERSE VOLTAGE For Zero Dynamic Resistance (volts Min.)	FORWARD CURRENT at +1 volt (ma.
1N34	General Purpose Diode	Ceramic	60	75	5.0
1N34A	General Purpose Diode	Glass	60	75	5.0
1N35*	Matched Duo-Diode	Ceramic Duo-Diode	50	75	7.5
1N38	100-Volt Diode	Ceramic	100	120	3.0
1N38A	100-Volt Diode	Glass	100	120	4.0
1N39	200-Volt Diode	Ceramic	200	225	1.5
1N40**	Varistor	Plug-In	25	75	12.75 (@ 1.5 v
1N41**	Varistor	Lug-Type	25	75	12.75 (@ 1.5 v
1N42**	100-Volt Varistor	Plug-In	50	120	12.75 (@ 1.5 v
1N54	High Back Resistance Diode	Ceramic	35	75	5.0
1N54A	High Back Resistance Diode	Glass	50	75	5.0
1N55	150-Volt Diode	Ceramic	150	170	3.0
1N55A	150-Volt Diode	Glass	150	170	4.0
1N56	High Conduction Diode	Ceramic	40	50	15.0
1N56A	High Conduction Diode	Glass	40	50	15.0
1N58	100-Volt Diode	Ceramic	100	120	4.0
1N58A	100-Volt Diode	Glass	100	120	4.0
1N60	Video-Detector Diode	Ceramic	25	30	†
1N71***	Low Impedance Varistor	Plug-In	40	50	15.0

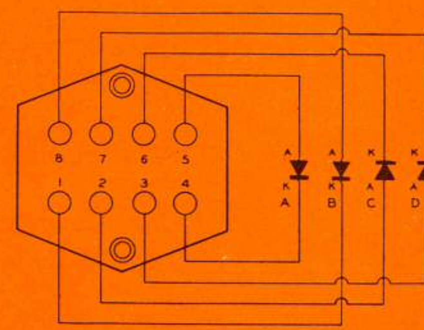
*Units are matched in the forward direction at + 1 volt so that the current flowing through the lower resistance unit is within 10% of that in the higher resistance unit. Ratings shown are for each diode.

**Consists of four specially selected and matched germanium diodes whose resistances are balanced within ± 2.5% in the forward direction at 1.5 volts. For additional balance, the forward resistances of each pair of varistor crystals are matched within three ohms. Ratings shown are for each diode.

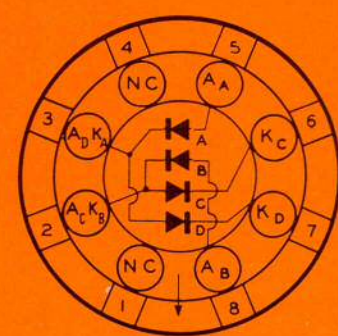
CHARACTERISTICS

.)	AVERAGE ANODE CURRENT (ma. Max.)	RECURRENT PEAK ANODE CURRENT (ma. Max.)	INSTANTANEOUS SURGE CURRENT (ma. Max., 1 sec.)	REVERSE CURRENT (μa Max.)
	50	150	500	50@—10v, 800@—50v
	50	150	500	30@—10v, 500@—50v
	22.5	60	100	10@—10v
	50	150	500	6@—3v, 625@—100v
	50	150	500	5@—3v, 500@—100v
	50	150	500	200@—100v, 800@—200v
lts)	22.5	60	100	40@—10v
lts)	22.5	60	100	40@—10v
lts)	22.5	60	100	6@—3v, 625@—100v
	50	150	500	10@—10v
	50	150	500	7@—10v, 100@—50v
	50	150	500	300@—100v, 800@—150v
	50	150	500	500@—150v
	60	200	1000	300@—30v
	60	200	1000	300@—30v
	50	150	500	800@—100v
	50	150	500	600@—100v
	50	150	500	†
	60	200	1000	300@—30v

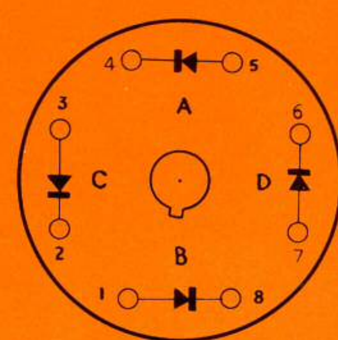
ELECTRICAL CONNECTIONS FOR SYLVANIA VARISTORS TYPES 1N40, 1N41, 1N42 1N71



Type 1N41



Types 1N40 and 1N42



Type 1N71

***Consists of four specially selected diodes whose forward currents are within a range of 1 ma with + 1 volt applied. Ratings shown are for each diode.

†Units are tested in a circuit employing an input of 1.8 volts rms at 40 mc, 70% modulated at 400 cycles. Demodulated output across a 4700 ohm resistor shunted by a 5 $\mu\mu$fd capacitor is a minimum of 1.8 volts peak to peak.

SYLVANIA Germanium Diodes

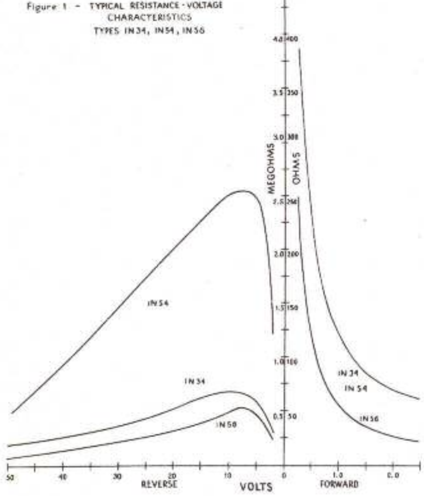
Application Notes

TYPICAL RESISTANCE CHARACTERISTICS

In order to understand which Sylvania Germanium Diode type is best for any given application, and how the circuitry should be arranged to make most efficient use of the diode, it is advisable to consider the curves of the forward and reverse resistance characteristic. • • •

• Figure 1 shows how these differ for three typical Sylvania diodes, the 1N34, 1N54 and 1N56. It can be seen that in general a low forward resistance tends to

Figure 1 - TYPICAL RESISTANCE-VOLTAGE CHARACTERISTICS TYPES 1N34, 1N54, 1N56



be accompanied by a lower reverse resistance. Thus, it is necessary to know what will be the magnitude of the load impedance in order to select a type which will work most efficiently in conjunction with the load. A crystal is said to be operating efficiently when, during the forward part of the applied voltage cycle, a maximum output occurs across the load, and during the reverse half of the cycle, a minimum amount of negative voltage appears across the load. For load impedances which are very high (several hundred thousand ohms or more), a type such as the 1N54 will be most efficient.

• For load impedances of less than ten thousand ohms, the superiority of the 1N56 rapidly becomes evident. This is especially important when the frequency is high, and when the load is not purely resistive, but contains a reactive element. In this case the effective impedance may be so low as to call for the use of a 1N56 to obtain the highest efficiency. • • •

• This will also be more true in the case of applied square waves or pulses than in the case of sine wave signals. Another important use of the typical resistance characteristic curves shown in figure one is based on the fact that maximum resistance occurs at approximately –8 to –12 volts. In some circuits where signal voltage is below this range, it is possible to increase the signal level until its peak value is as much as 50% above this –8 to –12 volt range. Thus, in the case of a 10 volt rms signal, a voltage applied to the diode will during a large fraction of the negative excursion be in the range of the germanium diodes maximum resistance. This, of course, neglects any reverse voltage which may appear across the load, and if the load is of a very high impedance (in the range of the reverse resistance of the germanium diode at the signal level involved) it is then desirable to still further increase the signal level by the necessary factor. • • •

TEMPERATURE CHARACTERISTICS

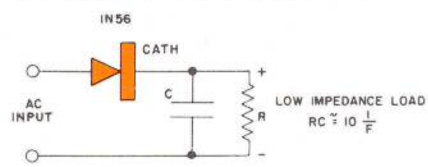
Both the forward and the reverse resistance of a germanium diode decrease as ambient temperature increases. In other words, the resistance curves shown in Figure 1 move down toward the X axis.

• An accurate analysis of the effect of temperature change in various circuits becomes very complicated because of the multiple influence of signal level, load impedance, and diode resistance characteristic. However, it should be noted that because of the compensating effect of an increase in both forward and reverse diode conductances with an increase in temperature, a load impedance can be selected which at a given voltage level will afford something approaching a flat response of rectification efficiency with temperature. • • •

CIRCUIT APPLICATIONS

Figure 2 shows a rectifier circuit for use with low-impedance loads such as a relay coil or current indicating instrument. Employing a type 1N56 high-conductance diode, this circuit is useful at voltages up to 40 volts peak, and is capable of delivering 30 milliamperes short-circuit current to the

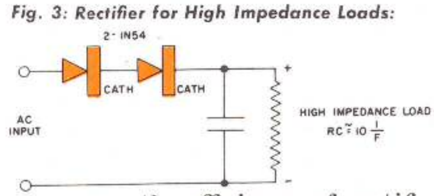
Fig. 2: Rectifier for Low-Impedance Loads:



load, with two volts rms applied. Because of its exceptionally low dynamic impedance, the 1N56 provides high current efficiency with load impedances of 1000 ohms and less. Parallel operation of two or more 1N56 crystals will permit correspondingly greater currents to be handled or will increase the current delivered to the load at low input voltage levels.

Figure 3 illustrates a rectifier circuit useful with load impedances of 500,000 ohms and greater. The effects of diode reverse conduct-

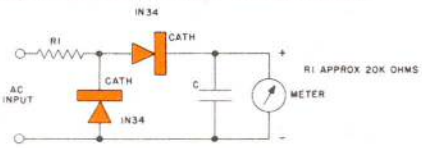
Fig. 3: Rectifier for High Impedance Loads:



ance upon the efficiency of rectification is substantially reduced by operation of two high reverse resistance type 1N54 units in series. Because the reverse dynamic impedance of the 1N54 reaches a maximum of over two megohms at approximately −10 volts, this circuit operates particularly well at input levels of the order of 20 volts rms. • • •

Figure 4 shows a rectifier circuit particularly suited to metering applications for ac measurements up to 1000 volts. Two type 1N34

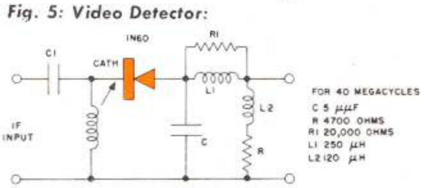
Fig. 4: Rectifier for High Voltage Levels:



diodes are used in a series-shunt arrangement by which the peak inverse voltage is removed from the series rectifier. A series input limiting resistor acts in conjunction with the shunt crystal to clip off the inverse half of the cycle, thus permitting application of input voltages of peak value up to several times rating of the crystal. The circuit shown in Figure 4 may be useful where a wide range of input voltages must be accommodated. • • •

Figure 5 illustrates a video detector circuit for television applications using Sylvania 1N60 germanium diode. The type 1N60 is

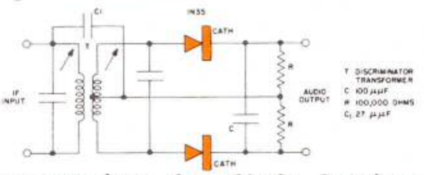
Fig. 5: Video Detector:



especially designed and tested for this type of service, and provides high circuit efficiency and exceptionally good linearity at low signal levels. Low interelectrode and stray circuit capacitances make for improved video response, and increased overall gain is obtained by virtue of reduced capacitive loading of the detector input circuit. With the component values specified, full 4 megacycle video bandwidth is maintained at the output of the detector. • • •

Figure 6 illustrates a balanced discriminator circuit for use in FM and TV receivers and similar applications. The type 1N35

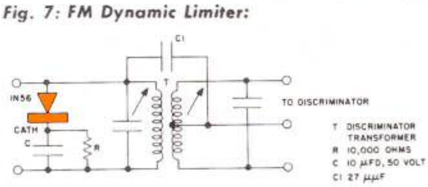
Fig. 6: FM Discriminator:



germanium duo-diode, having matched characteristics, provides good circuit balance because of the similar forward conductances of the individual diodes and the complete elimination of contact potential effects. Unusually high diode reverse resistance permits use of load resistance values as high as 100,000 ohms, thus assuring high efficiency, good detector linearity, and low input circuit loading. • • •

Figure 7 shows an amplitude limiter circuit for use in conjunction with an FM detector for suppression of residual AM in frequency

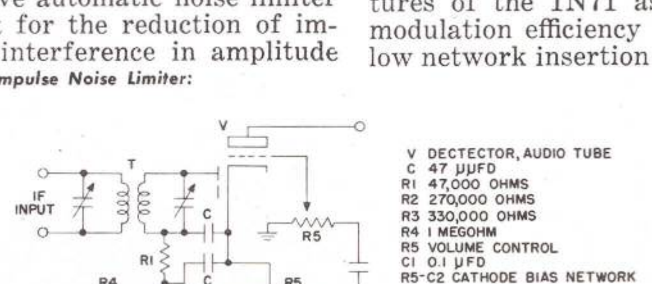
Fig. 7: FM Dynamic Limiter:



modulation receivers. A high conductance type 1N56, because of its exceptionally low dynamic impedance, provides unusually effective limiting, particularly at signal levels of 5 volts and less. Low diode capacitance produces a minimum of reactive loading across the source, thus minimizing the limiter insertion loss at low levels. • • •

Figure 8 illustrates an extremely effective automatic noise limiter circuit for the reduction of impulse interference in amplitude

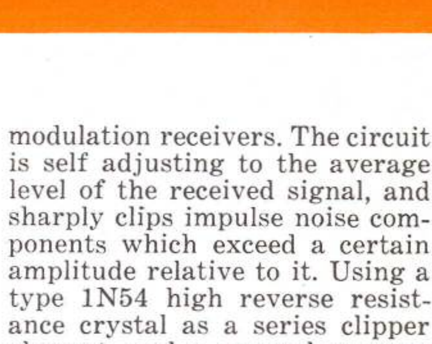
Fig. 8: Impulse Noise Limiter:



modulation receivers. The circuit is self adjusting to the average level of the received signal, and sharply clips impulse noise components which exceed a certain amplitude relative to it. Using a type 1N54 high reverse resistance crystal as a series clipper element, and a general purpose type 1N34 as a shunt clipper element, this circuit requires few components and little space, yet provides an unusually high degree of impulse noise suppression. • • •

Figure 9 shows a type 1N71 varistor network used as a balanced modulator for carrier suppression. The degree of carrier atten-

Fig. 9: Balanced Modulator:



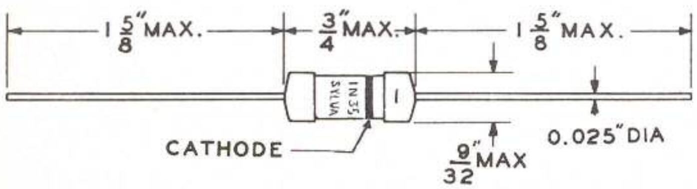
uation obtained with this arrangement is determined by the accuracy of balance within the diode network. Because the 1N71 varistor is made up of four specially selected type 1N56 high conductance crystals whose forward characteristics are closely matched, adequate suppression of undesired carrier components may easily be obtained. In addition, the high conductance features of the 1N71 assure good modulation efficiency because of low network insertion losses. • •

MECHANICAL SPECIFICATIONS

In all Sylvania circuit diagrams showing germanium diodes, the bar of the diode symbol represents the cathode. On each Sylvania Germanium Diode, the cathode side is indicated by a color band and the label "CATH".

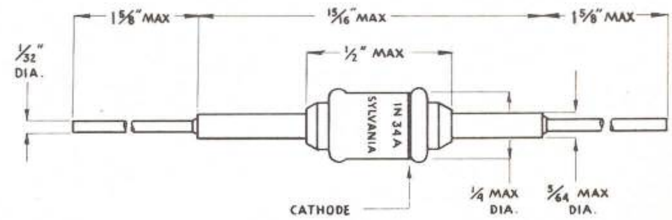
CERAMIC TYPES

Mechanical specifications for all ceramic type of Sylvania Germanium Diodes are identical. The outline drawing below shows the principal dimensions of the Types 1N34, 1N38, 1N54, 1N55, 1N56, 1N58 and 1N60. The Type 1N39 varies slightly in that the cartridge length is 1″ maximum.



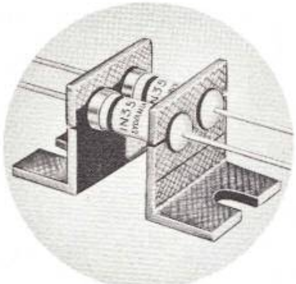
GLASS TYPES

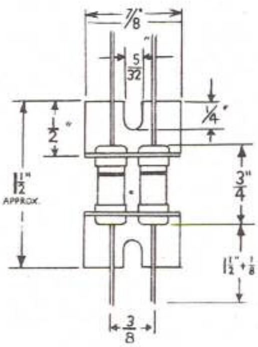
The glass type Germanium Diodes, Types 1N34A, 1N38A, 1N54A, 1N55A, 1N56A, 1N58A, have identical mechanical specifications.

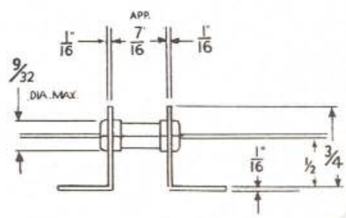


DUO-DIODE TYPE 1N35

The Type 1N35 Duo-Diode consists of two electrically matched germanium diodes assembled in convenient brackets for mounting. Principal dimensions are shown in the outline drawing.

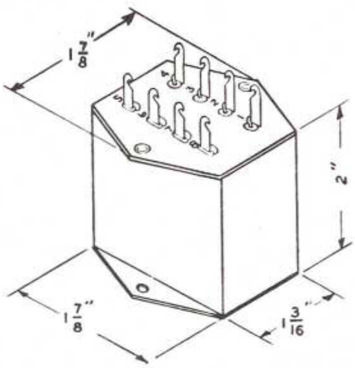






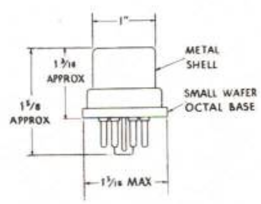
VARISTOR TYPE 1N41

The Type 1N41 Varistor consists of four matched crystals in a rectangular metal can equipped with eight soldering lugs for top or sub-panel mounting. Principal mechanical specifications are shown here.

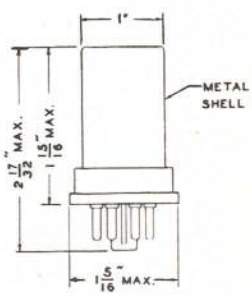


VARISTORS TYPE 1N40, 1N42, and 1N71

Mechanical specifications for the Sylvania Varistors, Types 1N40, 1N41 and 1N71 are shown below. These are supplied in plug-in units mounted in a compact metal radio tube shell.



TYPE IN71



TYPE IN40, IN42

SYLVANIA ELECTRIC

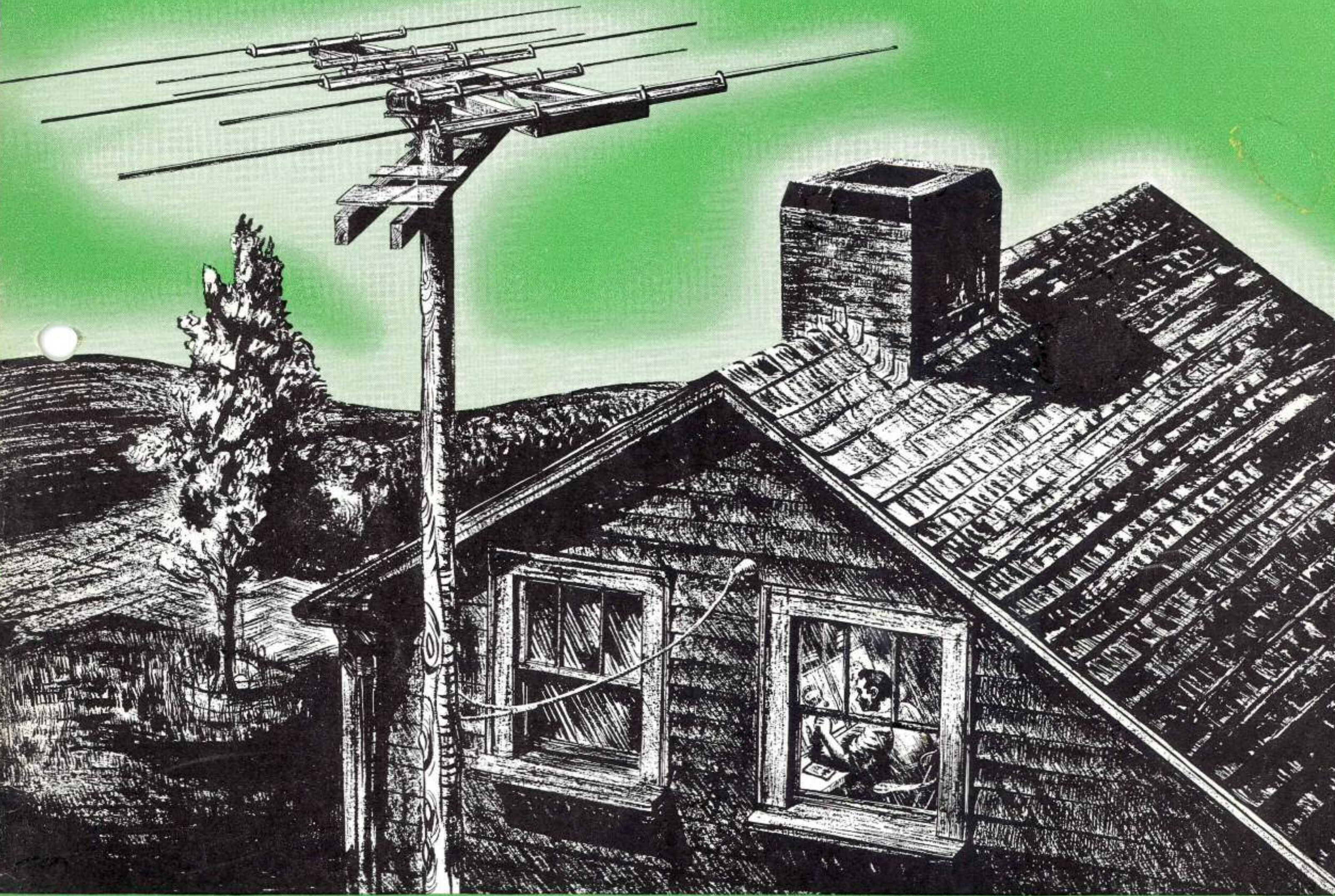
Electronics Division

1740 BROADWAY NEW YORK 19, N. Y.

Printed in U.S.A.

EC-36D

21 CIRCUITS FOR SYLVANIA GERMANIUM CRYSTAL DIODES



RECTIFIERS, DETECTORS, CONTROL CIRCUITS, METERS, WAVE SHAPING CIRCUITS, MODULATORS

13 HAMS WROTE THIS BOOKLET!

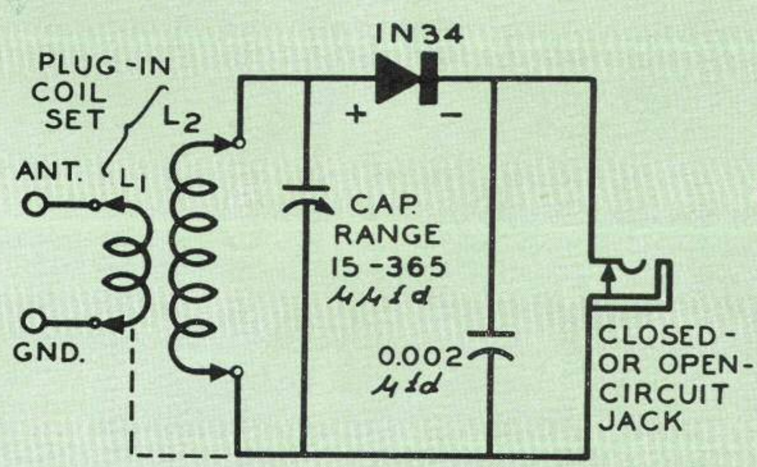
Here at last is a compilation of outstanding practical applications for Sylvania Germanium Crystals 1N34, 1N38, 1N39 and Duo-Diode 1N35. Circuits were designed and tested by leading radio amateurs and submitted in a recent nationwide contest sponsored by Sylvania Electric.

HUNDREDS OF ACTIVE "HAMS" entered Sylvania's "Crystal Kinks" contest and submitted circuits using Sylvania's germanium crystals. A cross section of these circuits is presented herein with appropriate credits to the persons who first submitted them. If you have questions unanswered here, a good "QSO" or postcard to the contributing ham should bring the answers and more circuit suggestions, too.

RECEIVER CIRCUITS

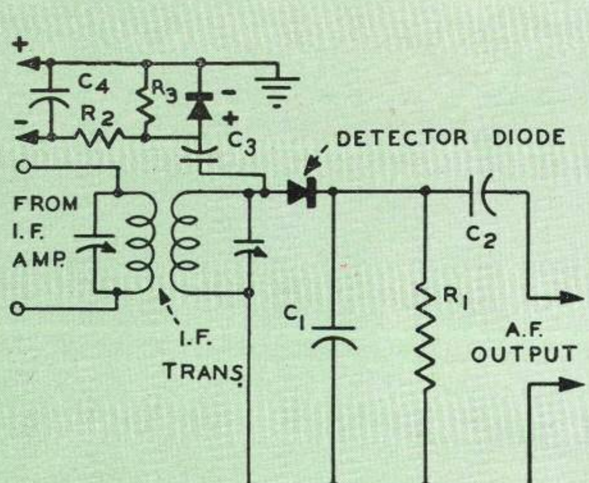
To customer-users constantly on the lookout for the latest ideas, space and weight savings at no sacrifice of quality are increasingly important considerations in modern radio receivers. The receiver circuits pictured here suggest many others where use of Sylvania germanium crystals gains these savings not only in shortwave, but in standard AM broadcast, FM and television receivers.

In all Sylvania circuit diagrams showing germanium crystals, the bar of the crystal symbol represents the cathode. On each Sylvania germanium crystal the cathode side is indicated by a green band and the label "CATH."



SIMPLE EMERGENCY ALL-WAVE PHONE RECEIVER

This simple radiophone or i. c. w. receiver can be made to operate on any frequency up to 100 megacycles. Standard plug-in coils may be used for L_1 (primary) and L_2 ("grid" secondary). This set delivers good audio output with an antenna resonant at the operating frequency, may be built to pocket size, and serves well as an emergency set.

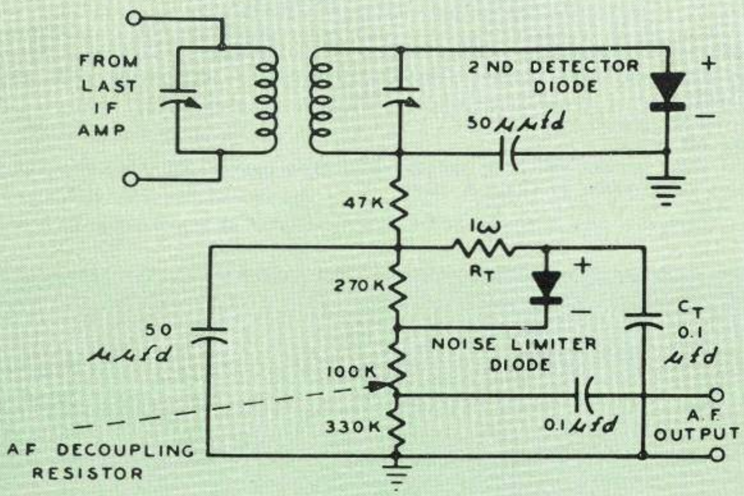


SECOND DETECTOR—A.V.C. CIRCUIT

To a simple half-wave second detector circuit, a second crystal diode circuit has been added to provide automatic volume control voltage. Values of C_1 and R_2 are those commonly found in similar vacuum tube circuits. C_4 and R_2 comprise the A.V.C. filter.

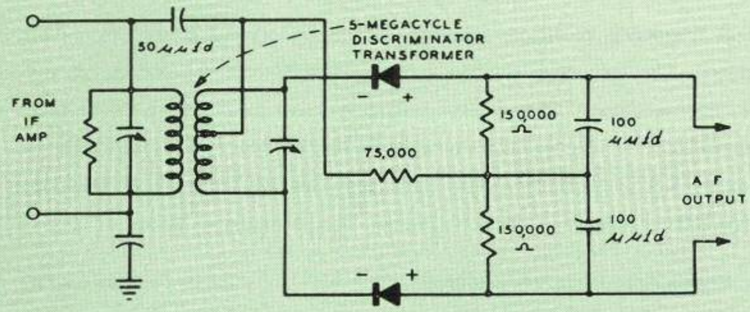
FOR 455 KC. I.F.;

C_1 = 0.002 μfd.
R_1 = 25,000 ohms
C_3 = 0.01 μfd.
C_4 = 0.1 μfd.
R_2 = 1 megohm
R_3 = 10 megohms
C_2 = 0.02 to 0.1 μfd.



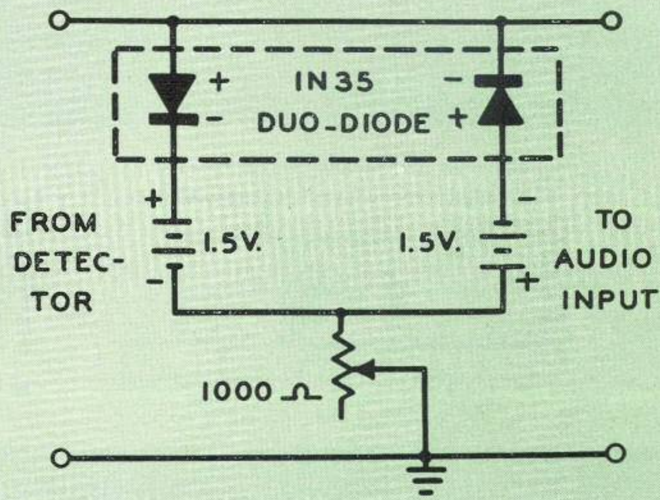
COMBINED NOISE LIMITER AND SECOND DETECTOR

Here is a circuit arrangement of a combined second detector and shunt-type noise limiter employing two crystal diodes. The noise limiter diode effectively short-circuits sharp noise pulses. Contributed by: W. F. Frankart, QST, May 1946, Page 61.



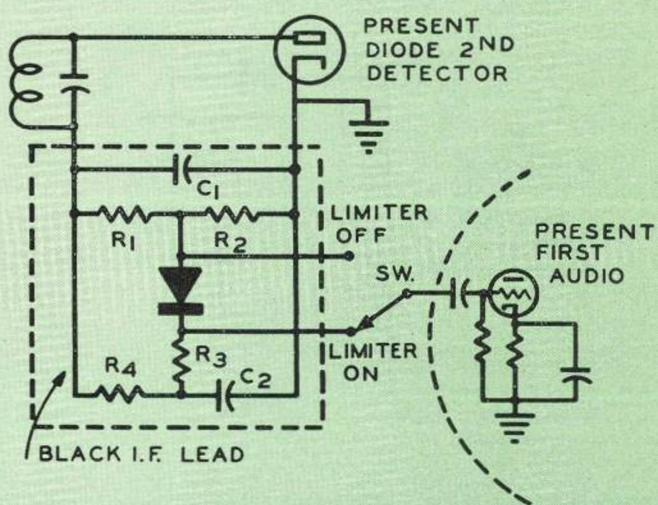
F. M. DISCRIMINATOR

In this conventional F. M. Discriminator, it is recommended that matched crystal diodes, or a Type 1N35 Duo-Diode, be employed.



SIMPLIFIED NOISE LIMITER

This simple noise clipper is especially effective in c.w. reception. Inserted between the detector and first audio stages of a radio receiver, it will reduce noise interference, as well as super-regenerative hiss. In operation, the rheostat is adjusted to clip the hiss level to the point at which the incoming signal just begins to show distortion. Contributed by: Marvin D. Klein, W8VDL, 13646 Cedar Road, University Heights 18, Ohio.



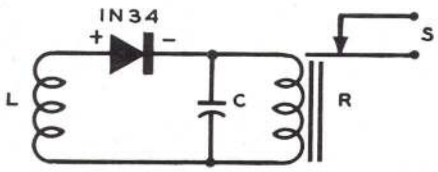
COMPACT SERIES-GATE NOISE LIMITER

Install this highly-efficient, hum-free noise limiter in your present receiver in less than two hours, and enjoy noise-free operation. Contributor suggests building limiter in small, shielded plug-in can. Contributed by: Charles T. Brasfield, Jr., Alabama Power Company, Birmingham 2, Ala.

C_1 =	100 μμfd. mica	R_3 =	820,000 ohms
C_2 =	0.01 μfd. paper	R_4 =	1 megohm
R_1, R_2 =	270,000 ohms	SW =	SPDT toggle switch

TRANSMITTER CIRCUITS

Here are a few crystal diode transmitter circuits that hams say have simplified some of their pet problems. Professional transmitter engineers, too, sent in many crystal circuit ideas. All agreed that these compact heaterless diodes are finding an increasingly warm welcome in ham rigs, transmitter shacks and in two-way radio-telephone systems.



R.F. SWITCHING CIRCUIT

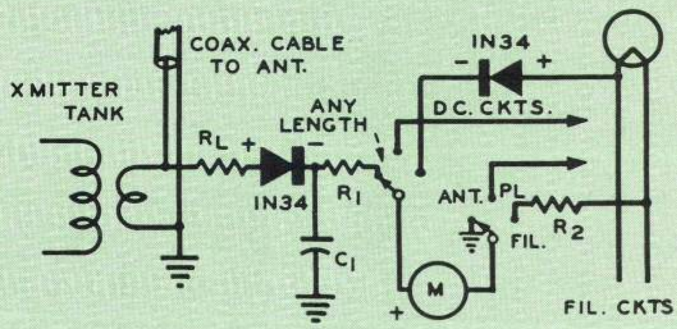
Protect your Class B. Transformer. This kink stops speech when R. F. amplifier fails. Similar circuits can also be used for other purposes such as antenna switching, model plane and train control. Contributed by: R. J. Segerstrom, W6CQ1, Sonora, Calif.

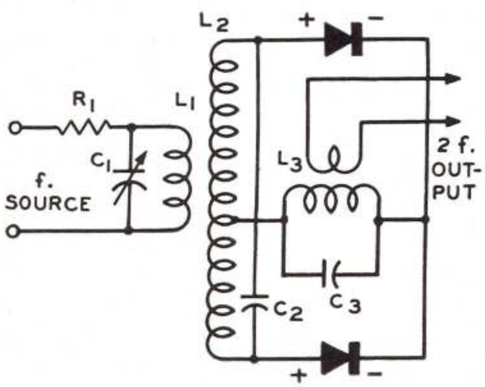
L = Pick-up coil placed near final.
C = 0.001 μfd. mica.
S = Shunt relay across low level speech—preferably across 500 ohm line connecting preamplifier to Class A driver.
R = Normally closed, sensitive relay (0.5 ma. D.C.).

METER SWITCHING CIRCUIT

At last! One meter can be used for all circuits in the amateur transmitter including filament voltage and R.F. antenna current. The diagram shows a greatly simplified meter switching circuit using 1N34 diodes as rectifiers. The multiplier resistance for the R.F. current and filament voltage measurement circuits must be calculated for each individual case. Contributed by: H. Bard, W6EOS, 391 Fifth Avenue, Chula Vista, Calif.

M = D.C. Milliammeter
C_1 = 0.001 μfd
R_2 = Meter multiplier
R_L = Current limiting resistor (50 to 100 K)





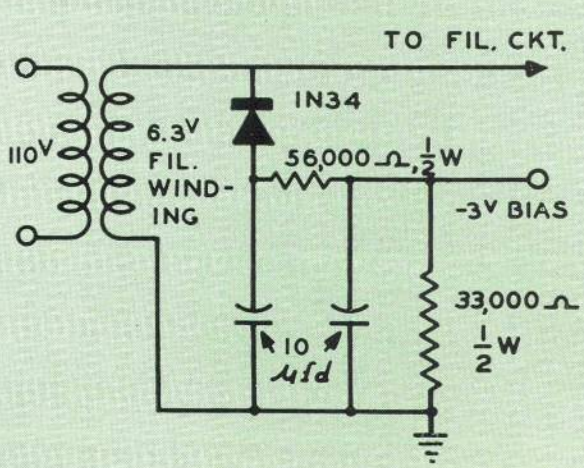
FREQUENCY DOUBLER

Several frequency multiplier circuits employing crystal diodes have been suggested. The frequency doubler circuit shown operates according to full-wave rectifier theory. That is, the output voltage fluctuations are at twice the frequency of the applied voltage. Improved operation is obtained by tuning the L_3C_3 tank to the output frequency. Contributed by: T. W. Swafford, Jr., W5HGU, 3020 W. Commerce Street, San Antonio 7, Texas.

f = Fundamental frequency source
R_1 = Internal resistance of frequency generator
L_1-C_1 = Tuned to f
L_2-C_2 = Tuned to f
L_3-C_3 = Tuned to 2 f

BIAS SUPPLY OPERATED FROM FILAMENT (HEATER) TRANSFORMER WINDING

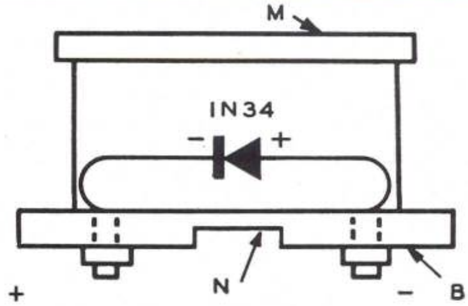
This novel bias supply for Class A audio stage is obtained from the 6.3 volt heater supply. Using a 1N34 Sylvania crystal diode, it furnishes fixed bias without tubes and large transformers. Contributed by: Bayman McWhan, W2GAX, P.O. Box 43, Morris Plains, N. J.

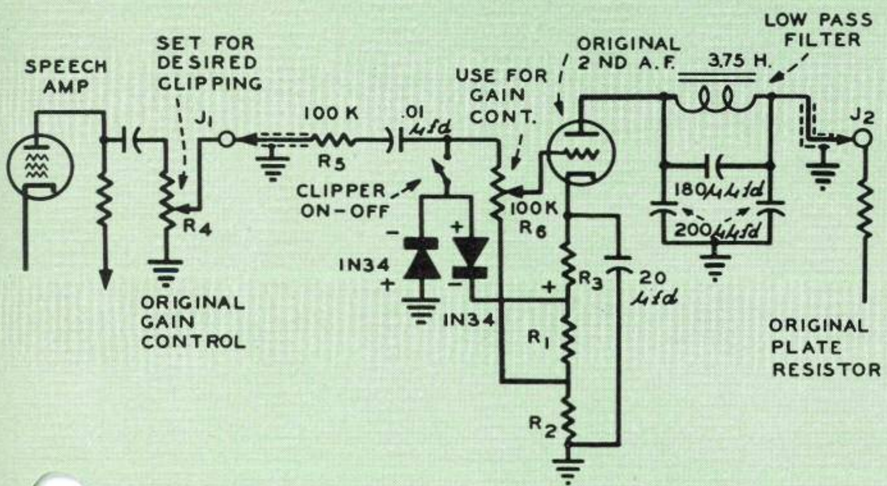


STANDING WAVE INDICATOR FOR POPULAR TWINLEAD R.F. TRANSMISSION LINE

This standing wave indicator couples to the line without any direct connection. A similar device can be constructed for openwire line or, with the use of a probe, for coaxial cable. Contributed by: Richard C. Hopkins, W1GPQ/3, 32 Chesapeake Street, N. W., Washington 20, D. C.

M = 0-100 microampere meter (bakelite case)
N = Notch cut to fit line in use.
B = Polystyrene base (a handle can be used to minimize body effects)





PREMODULATION SPEECH CLIPPER

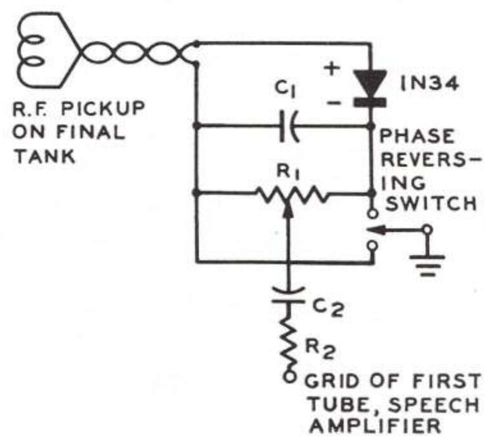
This diode clipper circuit is installed between the first and second speech amplifier stages. Potentiometer R_4 is the clipper control, its setting determining the amount of clipping afforded. Potentiometer R_6 is the amplifier gain control. Threshold voltage for the second crystal diode is obtained from the junction of R_1 and R_3 in the second stage cathode circuit. Contributed by: Ernest E. Overbey, W9GCB, 903 North Neil Street, Champaign, Ill.

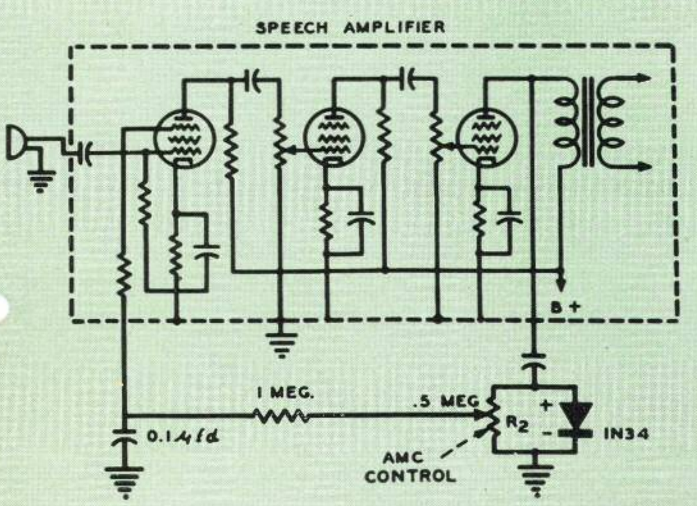
$R_1 = R_2 = 0.4$ x original cathode resistor (approx.)
$R_3 = 0.2$ x original cathode resistor
J_1 = Grid terminal, original tube socket
J_3 = Plate terminal, original tube socket

CARRIER-OPERATED INVERSE FEEDBACK CIRCUIT

This inverse feedback circuit is driven by the modulated R.F. carrier picked up from the transmitter by means of a small link coil. Because of this method of operation, the circuit may be applied to transmitters employing grid and cathode modulation, as well as to plate-modulated outfits. Carrier-operated inverse feedback is used at several leading broadcast stations. When using this system, it is advisable not to include more than one iron-core transformer in the feedback loop. Contributed by: Bruce Parker, 2123 N. Gower Street, Hollywood 28, Calif.

$C_1 = 0.001$ μfd.	R_1 = 100K potentiometer
$C_2 = 0.1$ μfd.	$R_2 = 0.25$ meg.



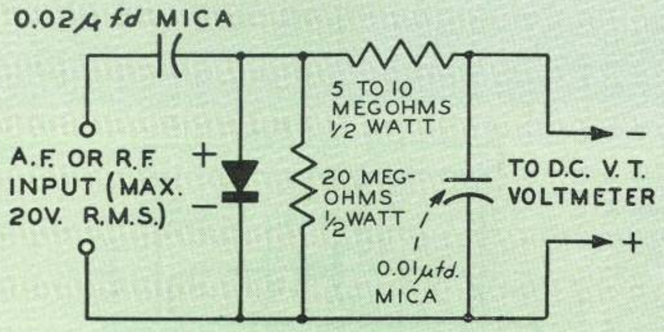


AUTOMATIC MODULATION CONTROL

This a. m. c. circuit is confined to the audio channel of the transmitter. A portion of the audio voltage output of the last tube is rectified by the crystal diode. A portion of the D.C. output of the diode is selected by means of R_2, which is the compression control, and is delivered as additional negative bias to the suppressor of the first audio tube. The latter should be a 6SK7 or pentode having similar characteristics. Contributed by: George W. Yazell, W8YIP, c/o WCFC, 305 Reservoir Road, Beckley, W. Va.

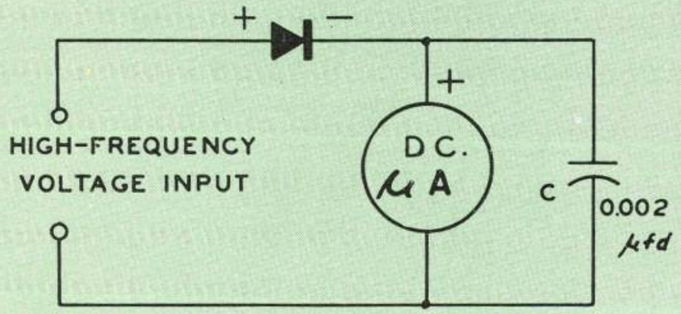
TEST AND CONTROL CIRCUITS

Add to the Sylvania 1N34 a handful of wire, a few resistors and capacitors, and a standard milliammeter and you can have an A.F.-R.F. voltmeter, a field strength meter, a neutralization indicator, a hum tracer, a voltmeter probe, a wave meter or a modulation meter. Use the 1N34 in other compact inexpensive circuits and remote control of model airplanes or other mechanisms is easily achieved. The hams' circuits on these two pages may give you many more ideas.



A.F.—R.F. VOLTMETER PROBE

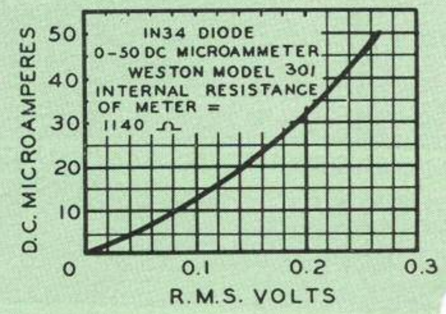
An external A.F. and R.F. probe for use with D.C. vacuum-tube voltmeters is shown in the accompanying circuit diagram. The components shown may be mounted inside a small prod.



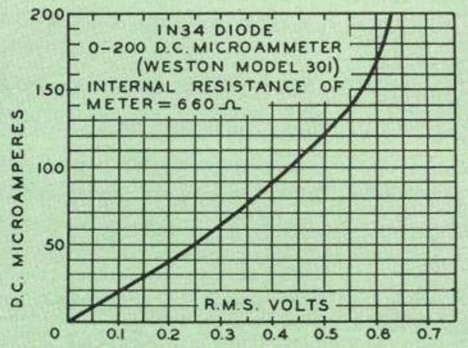
SIMPLE HIGH FREQUENCY, LOW IMPEDANCE VOLTMETER

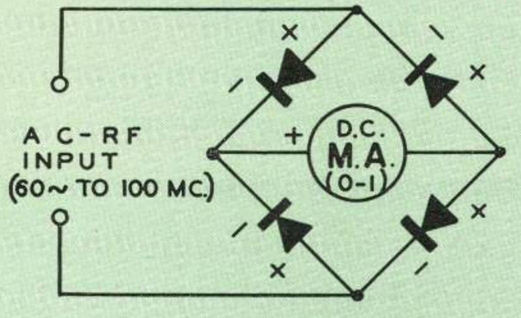
This low-impedance crystal voltmeter is designed for use at audio and radio frequencies from 1000 cycles to 100 megacycles. For inclusion of lower frequencies, size of capacitor C should be changed to larger value (e.g., 0.05 μfd.). Separate meter calibrations must be made. The accompanying graphs give the voltage calibration for two common panel-mounting meters.

Voltage Calibration Curve for Low-Z Crystal Voltmeter Circuit using a Weston Model 301 0-50 D. C. Microammeter.



Voltage Calibration Curve for Low-Z Crystal Voltmeter Circuit using a Weston Model 301 0-200 D. C. Microammeter.

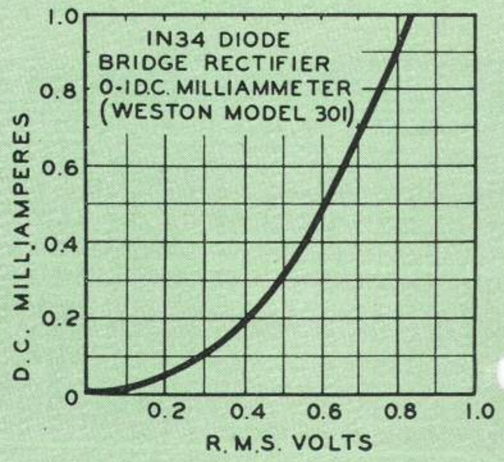


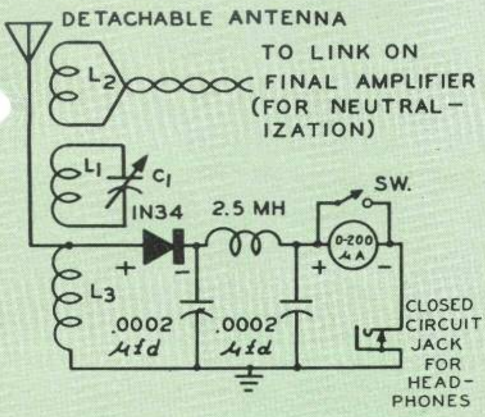


LOW IMPEDANCE, BRIDGE-TYPE A.C. VOLTMETER

The bridge-type crystal voltmeter shown is likewise a low-impedance arrangement which may be employed in the measurement of A.F. and R.F. voltages. Range is from 60 cycles to 100 megacycles.

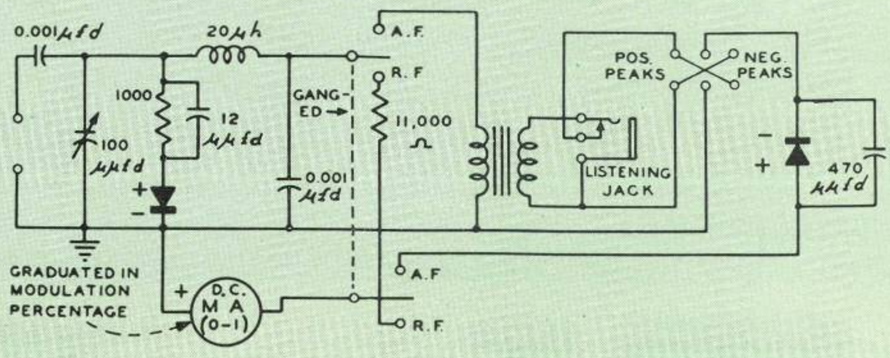
Voltage Calibration Curve for Bridge-Type Voltmeter Using Weston Model 301 0-1 D.C. Milliammeter.





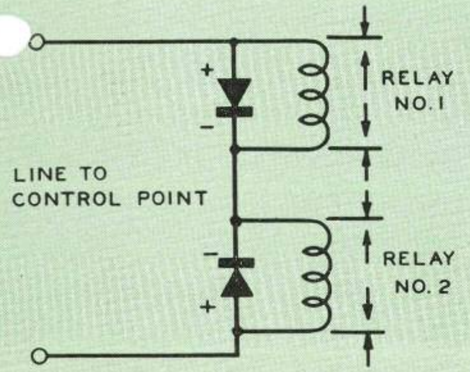
TUNED FIELD STRENGTH METER

While this instrument has been designed specifically as a wide-range field strength meter, it may be employed also as an absorption wavemeter, listening monitor, and neutralization indicator. L_1 and C_1 must resonate to the operating frequency of the transmitter under test. L_2 consists of a few turns loosely coupled to L_1. L_3 should be about the same size as L_1 and coupled fairly tightly to L_1. All coils are wound with the same size wire on the same coil form. Contributed by: Donald J. Trainor, W2OYZ, 14 Vine Street, Nutley, N. J.



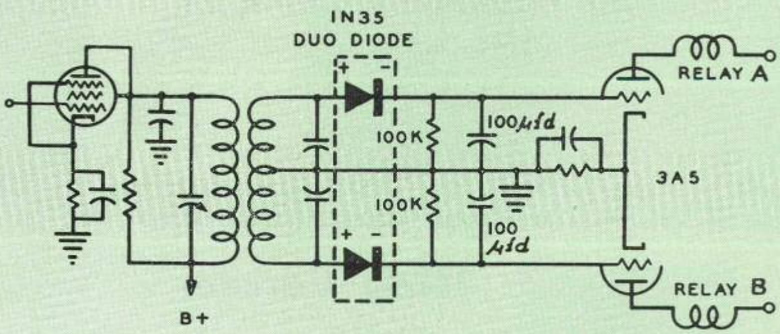
PERCENTAGE MODULATION AND CARRIER SHIFT METER

Here is the circuit schematic for a complete modulation meter. The input terminals of this instrument are link-coupled to the plate tank coil of the modulated transmitter. With the ganged switch thrown to its R.F. position, the coupling between the link pick-up coil and the transmitter is varied, and the 100 μμfd. tuning capacitor is adjusted to deflect the milliammeter to a reference point near full scale. This reading will not change during modulation unless carrier shift is present. If the meter scale has been properly calibrated, modulation percentage will be indicated directly when the first switch is thrown to A.F. *Positive* or *negative* modulation peaks may be measured by throwing the second switch to either POS. PEAKS or NEG. PEAKS.



DUAL RELAY CONTROL

Employing crystal diodes, this control system makes it possible to operate either one of two distant relays over a single-pair line. The crystal diodes shunting the relay coils are connected to the line with one polarity, the diode whose anode is positively impressed passes highest current and picks up the relay across which it is connected. When the battery is reversed, the second relay picks up and the first drops out. A higher battery voltage must be employed to pick up the relay shunted by the back-connected diode. Contributed by: P. F. Fink, WØUNO, 2525 Garland Street, Denver 15, Colo.



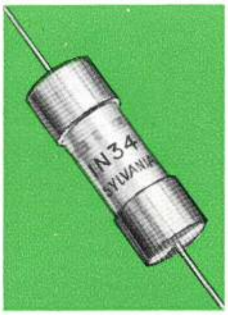
FREQUENCY-CONTROLLED DUAL RELAY SYSTEM

This circuit employs an FM discriminator to obtain ingenious operation of either of two relays at will. This system might be applied to two operations in the control of model aircraft, boats, or other mechanisms. The tuned circuits are aligned so that at a given center frequency, neither relay is actuated. When this adjustment has been made, relay A will be picked up when the transmitter frequency is increased; relay B will be picked up when the frequency is decreased. Contributed by: Clayton R. Roberts, W1MVV, 107 White Street, Springfield, Mass.

Sylvania's Six GERMANIUM CRYSTAL ELEMENTS

This booklet suggests just a few of the hundreds of uses today's radio engineers, "hams," and repairmen are finding for the new Sylvania "1N—" crystal family. These tiny rugged germanium diodes are not only replacing conventional vacuum tube diodes in many circuits, but their low shunt capacitance, heaterless operation and convenient pigtail construction are suggesting many new applications all their own. Satisfied users of the millions of crystal diodes Sylvania has already produced are recording savings in weight, space, time and materials every day.

For detailed electrical and mechanical specifications of Sylvania's Germanium Crystals, write for a free copy of Sylvania Catalog EC-36.

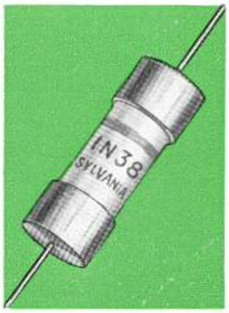


1N34

(Size: 3/4" x 9/32" dia.; 1-5/8" Leads)
Max. Inverse Voltage..........60 Volts
Peak Anode Current............150 ma.
Forward Current at 1 V.......5.0 ma. Min.
Back Conduction at 50 V......0.8 ma. Max.
Ambient Temperature Range* -50° to 70°C
Average Shunt Capacity.......1.0 µµfd.

1N38

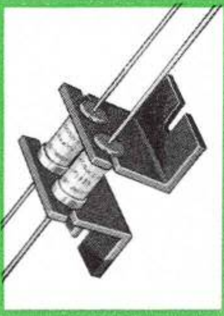
(Size: 3/4" x 9/32" dia.; 1-5/8" Leads)
Max. Inverse Voltage..........100 Volts
Peak Anode Current............150 ma.
Forward Current at 1 V.......4.0 ma. Min.
Back Conduction at 50 V.....150 µa. Max.
Ambient Temperature Range* -50° to 70°C
Average Shunt Capacity.........1.0 µµfd.



*Although the crystals will withstand considerably higher ambient temperatures than 70°C. without deterioration, the rectification efficiency will decrease rapidly and care is required to insure that the circuit design will permit satisfactory performance at temperatures over 70°C.

1N39

(Size: 3/4" x 9/32" dia.; 1-5/8" Leads)
Max. Inverse Voltage.........200 Volts
Peak Anode Current............150 ma.
Forward Current at 1 V.......3.5 ma. Min.
Back Conduction at 50 V......50 µa. Ma.
Ambient Temperature Range* -50° to 70°C
Average Shunt Capacity........1.0 µµfd.



1N35 Duo-Diode

(Two crystal diodes in convenient mount 25/32" x 29/32" x 1-17/32")
Resistance match: Within 10% of average resistance of the two crystals, when measured at 1 volt.

1N40 Varistor

(Four crystal diodes mounted in metal radio tube shell with small wafer octal base, dia. 1-5/16"; height 3-17/32")
Resistance match: ±2.5% in forward direction at 1.5 volts. Each pair of varistor crystals matched within 3 ohms.

1N41 Varistor

(Four crystal diodes mounted in metal can 1-15/16" x 1-15/16" x 2-7/16" with 8 lug-type terminals)
Resistance match: ±2.5% in forward direction at 1.5 volts. Each pair of varistor crystals matched within 3 ohms.

SYLVANIA ELECTRIC

DISTRIBUTOR SALES DIVISION **EMPORIUM, PENNSYLVANIA**

SYLVANIA CRYSTAL DIODES

Among the crystal diodes, the silicon converter crystals were especially developed as first-detectors in super-high-frequency superheterodyne receivers, as in radar. In the same range, the silicon video crystals give good performance as detectors with video or tuned R.F. amplifiers. Although designed as second-detectors in superheterodyne receivers, the high-level germanium crystal diodes serve at frequencies up to 500 Mc. in many common diode applications. They are particularly useful where low values of load resistance occur, as in television or FM reception.

Silicon Crystal Converters

Type No.	Frequency Designed[1] for	Conversion[2] Loss	Output Noise[3] Ratio	Burnout[4] Test	I.F. Impedance (resistive)
1N21B	3,000 Mc.	6.5 db. max.	2.0 max.	B_s=2.0 ergs.	200 - 800 ohms
1N23B	10,000	6.5	2.7	B_s=1.0 erg.	150 - 600
1N25	1,000	8.5	2.5	B_p=30 watts	100 - 400
1N26	25,000	8.5	2.5	B_s=0.1 erg.	300 - 600

Silicon Video Detector Crystals

Type No.	Figure[5] of Merit	Video Impedance	Burnout[4] Test	Carrier Frequency	Video Frequency
1N31	55 min.	6,000 - 24,000 ohms	B_p=0.02 watt	10,000 Mc.	500 c.p.s. - 5 Mc.
1N32	100	5,000 - 20,000	B_p=0.36 watt	3,000	500 c.p.s. - 5 Mc.

Germanium Crystal Diodes

Type No.	Peak Inverse Anode Voltage	Average Anode Current	Peak Anode Current (AC)	Transient Surge Current
1N34	50 volts max.	0 - 22.5 ma.	60 ma. max.	200 ma. max.

Notes:

1. Designed for use at frequencies in these ranges, but in properly-designed circuits may be used at lower frequencies.
2. I.F. output power compared to input R.F. power under standard conditions.
3. Noise (power) under standard conditions referred to the thermal or Johnson noise developed by an equivalent resistance.
4. B_s= total energy in simulated spike of pulse from TR box; this is what might burn out a crystal in radar use.

   B_p= peak pulse power under pulsed conditions.
5. Figure of merit is a measure of the effectiveness of a video crystal as the detector for a video amplifier.

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