SYLVANIA NEWS

JANUARY 1959 VOL. 26, NO. 1

R. A. Humphreys, Technical Editor

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technical SECTION

LIFE TESTING OF TUBES IN TELEVISION RECEIVERS* (Part II)

Under Part I, we discussed the test conditions and procedures used to life test the various television receivers. Analysis of set survival data indicated a marked reduction in tube failures. Now let's consider how tube failure rates vary among TV sets made by different manufacturers.

VARIATIONS IN SET SURVIVAL

This question is quite vividly answered by the curves in Figure 1. Shown here are the expected set survival curves for two generally similar sets made by different manufacturers. These curves are consistent with the curves of other years for the same manufacturers and, therefore, are not peculiar to a certain year. It should be noted here that design of some manufacturer's sets have improved while others have taken the opposite course.

In the past few years, the number of 600-milliampere series-heater receivers has equaled and exceeded the number of transformer-powered receivers. By analyzing the series-heater set failures and computing the expected set survival for each of the past three years, the curves shown in Figure 2 were obtained. It would seem from these curves that there has been no improvement in tubes in the past three years, as was suggested previously. However, when the same curve was constructed for transformer-powered receivers, a different result was obtained. As shown in Figure 3, a four-to-one improvement in expected set survival has resulted in the last three years. The curves shown for the transformer-powered receivers reveal that controls on heater specifications brought on by the series-heater sets have also contributed to improved set survival in transformer-powered receivers.

REDUCTION IN FAILURE CAUSES

To assist the factories in improving tube survival, tube failures were grouped according to frequency of causes. A list of the most frequent causes is given in Table I. From this table it is seen of the four major failure causes, percent failures have been reduced by a factor of three to one, on the average. As of 1957, the big offender is a collection of miscellaneous items of which there are some 22.

Another informative table is found in Table II. This table shows those applications with the highest frequency of failures. Because of the severe requirements placed on these tubes, over 65 percent of all tube failures fell in one of these four

*Based on a paper authored by E. H. Boden, Advanced Applications Engineer, Receiving Tube Operations.

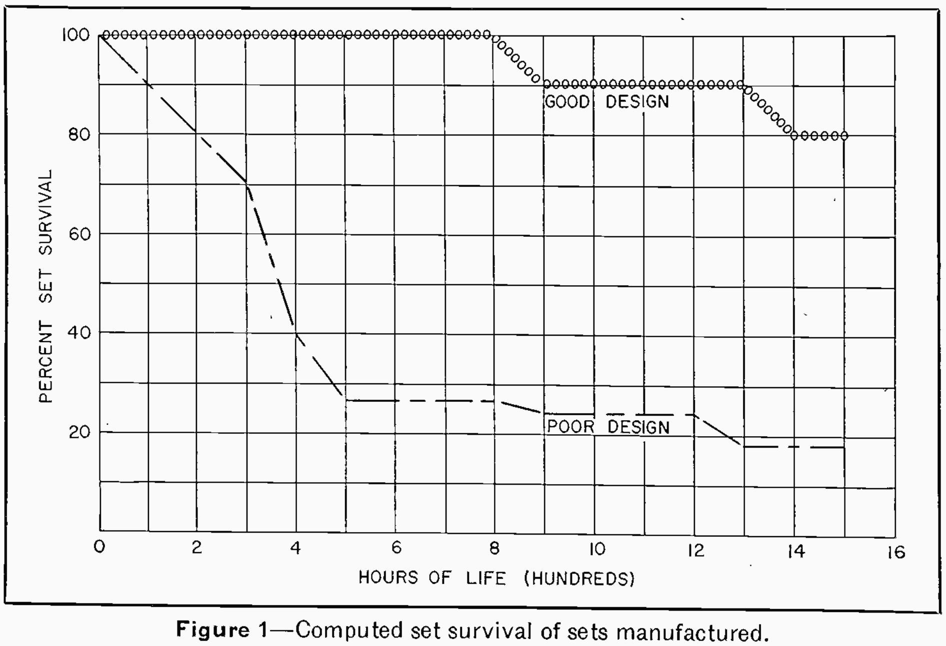


Figure 1—Computed set survival of sets manufactured.

FAILURE CAUSE	1954-55	1955-56	1956-57
OPEN HEATER	1.86	1.78	1.02
SHORT CIRCUITS	2.02	1.17	1.19
OPEN WELDS	0.97	0.67	0.23
GAS	1.50	1.51	0.49
OTHER (22 ITEMS)	1.35	1.37	1.20
TOTAL	7.7	6.5	4.2
NO. OF TUBES TESTED	4250	5953	4886

Table I—Percent failure of tubes tested by cause at the accelerated life condition of 130 volts line.

CIRCUIT	PERCENT TUBE FAILURE BY CIRCUIT		
	July '54-'55	July '55-'56	July '56-'57
HORIZONTAL AMP	25	34	17
VERTICAL AMP	25	29	16
DAMPER	33	17	9
VHF CASCODE AMP	22	18	7

Table II—Percent failures of the tubes tested in the circuits listed at the accelerated life condition of high line voltage.

applications. However, in spite of the high percentage of failures in these applications, a significant improvement in tube survival has been achieved in all four applications.

It should be noted that the percentages listed in the preceding tables represent tube failures under the described accelerated conditions and should *not* be construed to mean that an equal percentage of field failures will occur. As was pointed out previously, the accelerated life conditions are necessary to obtain the maximum information in a minimum of time.

VHF VERSUS VHF-UHF RECEIVERS

At Emporium, Pennsylvania, there are two experimental satellite television stations in operation on Channels 22 and 82. This makes Emporium particularly well suited for the comparison of expected set survival of VHF sets and VHF-UHF sets. As part of the life-test program, a UHF receiver must be capable of satisfactorily receiving off-the-air signals on both Channels 22 and 82. To eliminate as many variables as possible, only VHF-UHF receivers were used for this comparison.

Expected set survival curves for VHF receivers and VHF-UHF receivers, which include data representing failures of the UHF oscillator tubes, were plotted as shown in Figure 4. According to the computed curves, at the completion of 1500 hours there would be 1.2 less receivers surviving because of UHF. Therefore, although there is an additional tube in a UHF receiver, the expected set survival at 1500 hours (one year of operation) is not significantly degraded by the addition of UHF.

While conducting the above mentioned life tests in the VHF-UHF sets, the failure rates of the various types of tuner tubes were carefully tabulated. This data, as shown in Figure 5, substantiates the conjecture that since the UHF oscillator tube has had a "habit of hiding" in some remote corner of the TV chassis, it has not been uncommon to replace this tube, when the chassis is removed from the cabinet for a particular service call, as a Preventive Mainte-

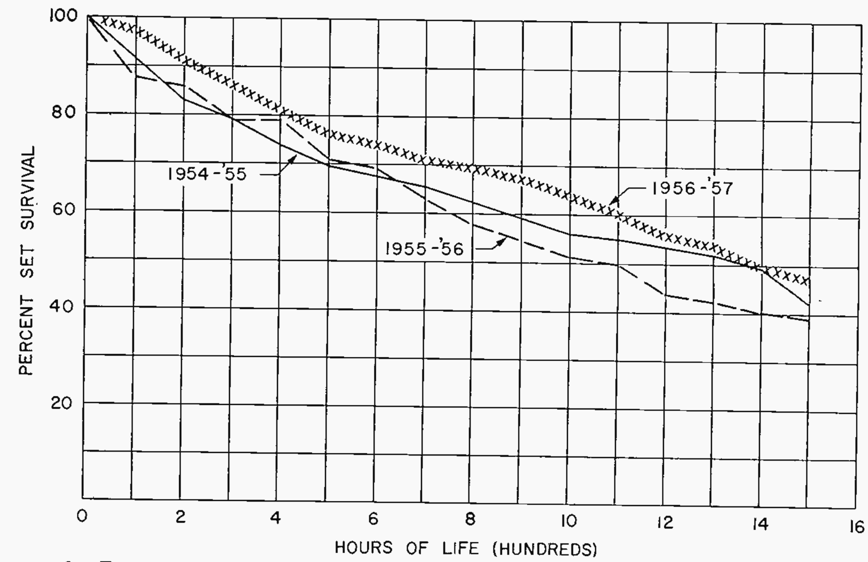


Figure 2—Percent set survival of series-parallel heater string TV sets complemented with Sylvania tubes.

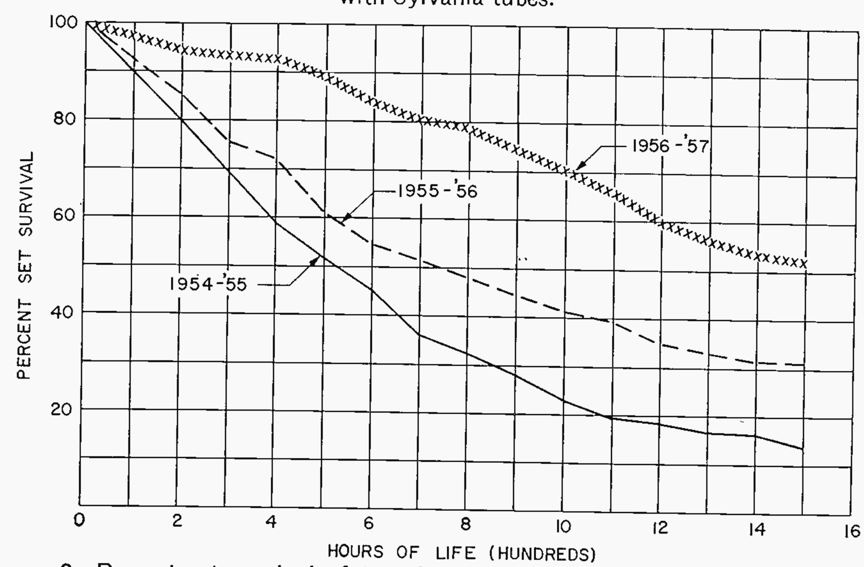


Figure 3—Percent set survival of transformer powered TV sets complemented with Sylvania tubes.

nance measure to preclude a "call-back" at some future date.

CONCLUSIONS

The facts presented above illustrate the extraordinary pains that Sylvania has taken to gather factual data on their product and how it performs under actual field conditions.

Moreover, Sylvania's improved tube performance has brought about a significant increase in set survival over the past few years. For further improvement in set survival, improved tube survival will need to be supported not only by improved set design, but by more enlightening servicing techniques.

It is hoped that the information supplied here will bring about the realization that deterioration of other components in a TV set, over a period of time, can create such adverse operating conditions that even the best tube manufactured will fail in a short length of time.

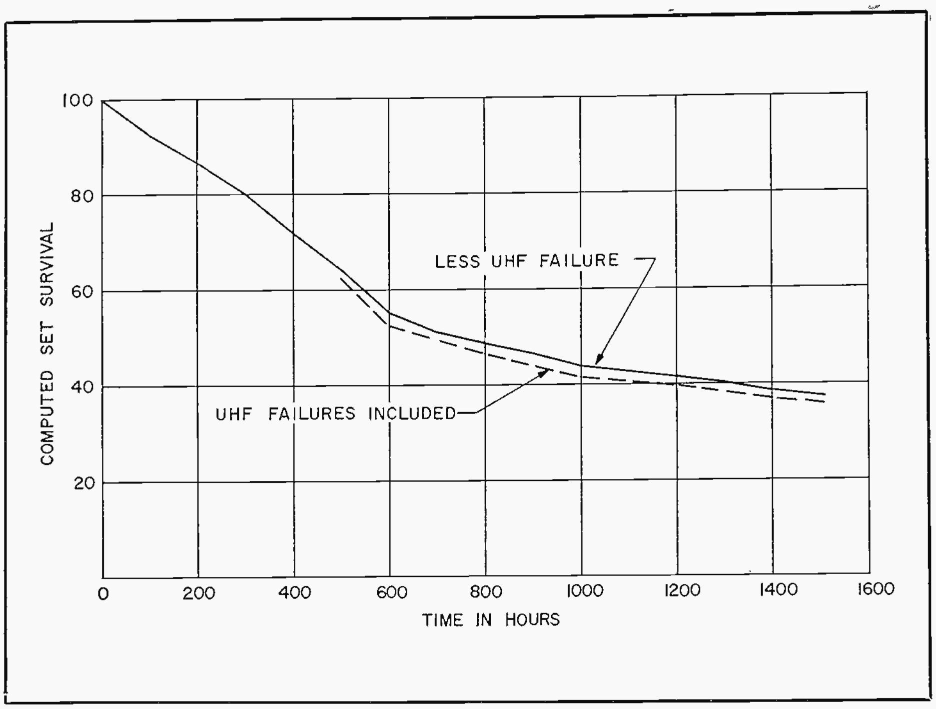


Figure 4—Computed set survival of VHF and VHF-UHF receivers at the accelerated life condition of high line voltage.

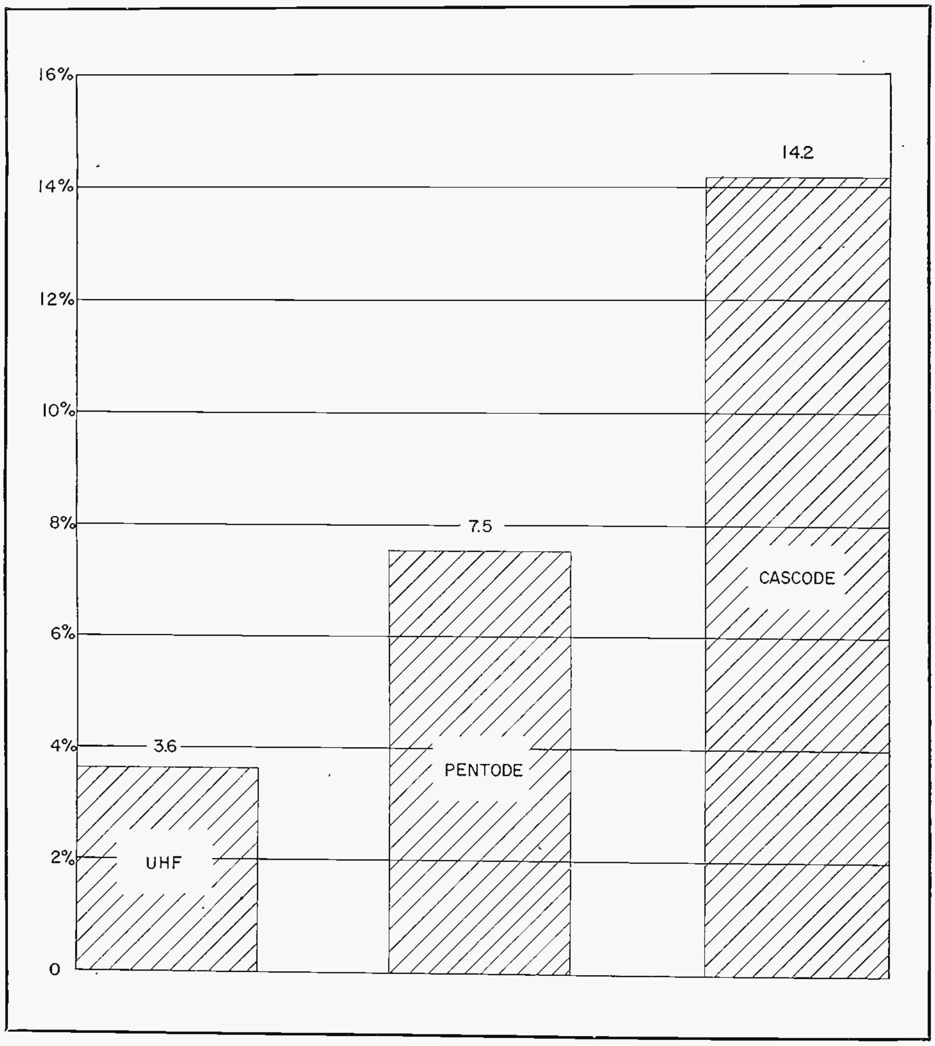


Figure 5—Percent failures of tuner tubes tested at accelerated life conditions.

YOUR SERVICE HINTS WANTED

Attention—Service Dealer readers of SYLVANIA NEWS! What has happened to the Service Hints column over the past year? This column, which is supported by YOU, should include all technical hints believed useful to your fellow Service Dealer.

For each hint accepted, you will receive a certificate worth $10.00 that can be applied against any of the many items listed in Sylvania's Advertising-Merchandising Aids Booklet. These items include: tools, tube caddies, technical manuals, display signs and etc. If you are not familiar with this booklet, pick up a copy at your Sylvania Distributor or write to our Central Advertising Distribution Department, 1100 Main Street, Buffalo 9, New York.

Perhaps you are not quite sure just what comprises a Service Hint. It should be nothing more than a simple method or device used to solve irritating or time-consuming service problems. It could be that you have devised a simple but unique method

Your Service Hints Wanted

(*Continued from page 7*)

for servicing a remote section of a chassis without removing it from the cabinet; maybe you've solved an electrical problem peculiar to a particular chassis—such as a remote component being responsible for the difficulty encountered in the section being serviced.

Any service hint which you feel might be of value to you and your fellow service dealer should be mailed to Sylvania Electric Products Inc., Receiving Tube Operations, in care of the Technical Publications Section located in Emporium, Pennsylvania.

Sylvania is not obligated to return any material submitted for publication, whether or not published.

SERVICE HINTS

THIRD HAND

Most of us who do a good bit of servicing wish occasionally we had the use of a third hand. This can be arranged by simply wrapping a rubber band around the nose of long-nose pliers. The rubber band serves to clamp the pliers to the component, leaving both hands free to complete the necessary repair.

JOHN E. SEKERAK
Erie, Pennsylvania

PCB HOLE CLEANER

To the list of semi-special tools appearing in the recent article "Printed Circuit Service Hints", you might add the common ordinary wooden toothpick. Wetting the toothpick in cold water and inserting it in a hole filled with molten solder results in a nice cool clean hole.

TV TOM
Astoria, N. Y.

NOTICE TO TECH MANUAL SUBSCRIBERS

The great response to Sylvania's 11th edition technical manual has forced us to print record numbers of it. The presses are rolling now and delivery of your new 11th edition will be made during the latter part of February.

SUPPLEMENTARY TUBE TESTER SETTINGS

Listed below are important additions to the roll charts for Sylvania tube tester models 139, 140, 219, 220, and 620. Make sure your charts are completely accurate and up-to-date by adding these important facts, now.

FOR TUBE TESTER MODELS 139 AND 140

TYPE	A	B	C	D	E	F	G	TEST
1J3	1.4	0	2457	0	8	—	69	V
2EN5	2.0	0	—	0	1	—	41	T
	2.0	0	—	0	3	—	41	T
5CR8	5.0	0	9	0	3	35	37	V
	5.0	0	6	0	1	5	32	X
5EH8	5.0	0	4	0	5	3	23	X
	5.0	0	4	0	4	79	85	T
6CA5	6.3	0	5	0	3	26	20	X
	6.3	0	2	0	3	56	20	X
6CY7	6.3	0	3	0	1	6	16	W
	6.3	0	3	0	3	7	64	W
6EH8	6.3	0	4	0	5	3	23	X
	6.3	0	4	0	4	79	27	V
8EB8	7.5	0	—	0	4	79	35	Y
	7.5	0	—	0	5	3	47	T
11CY7	10	0	3	0	1	6	16	W
	10	0	3	0	3	7	65	W
KT66	6.3	0	—	0	1	034	27	Y

FOR TUBE TESTER MODELS 219 AND 220

1J3	1.25	2	13578	59	7	U	9*	—
2EN5	2.0	3	4	35	4	T	2*	5
	2.0	3	4	35	4	T	7*	5
5CR8	5.0	4	58S	32	5	27Y	6	3
	5.0	4	35	32	5	9X	1	8
5EH8	5.0	4	56	27	5	2X	3	1
	5.0	4	15S	41	5	78V	9	6
6CA5	6.3	3	24S	25	4	56X	7	1
	6.3	3	45S	25	4	26X	7	1
6CY7	6.3	4	258	24	5	3X	1	9
	6.3	4	259	57	5	7Y	6	8
6EH8	6.3	4	56	27	5	2X	3	1
	6.3	4	15S	43	5	78V	9	6
8EB8	7.5	4	15S	31	5	78Z	9	6
	7.5	4	56	34	5	2T	3	1
11CY7	12.6	4	258	24	5	3X	1	9
	12.6	4	259	55	5	7Y	6	8
17D4	19.0	7	8	18	8	SZ	5*	3
KT66	6.3	2	7	19	7	045Z	3	8

FOR TUBE TESTER MODEL 620

1J3	1.25	2	13578	60	7	T	0	—
2EN5	2.0	3	4	37	4	S	2	5
	2.0	3	4	37	4	S	7	5
5CR8	7.5A	4	58R	31	5	27X	6	3
	7.5A	4	35	33	5	9W	1	8
5EH8	6.3A	4	56	27	5	2W	3	1
	6.3A	4	15R	40	5	78U	9	6
6CA5	6.3	3	45	26	4	26W	7	1
	6.3	3	24	26	4	56W	7	1
6CY7	6.3	4	258	23	5	3W	1	9
	6.3	4	259	58	5	7X	6	8
6EH8	7.5A*	4	56	27	5	2W	3	1
	7.5A*	4	15R	40	5	78U	9	6
8EB8	12.6A	4	15R	35	5	78Y	9	6
	12.6A	4	56	38	5	2S	3	1
11CY7	12.6A*	4	258	23	5	3W	1	9
	12.6A*	4	259	56	5	7X	6	8
17D4	19.0A*	7	8	19	8	RY	5	3
KT66	6.3	2	7	19	7	045Y	3	8

SYLVANIA NEWS

technical SECTION

FEBRUARY 1959 VOL. 26, NO. 2
R. A. Humphreys, Technical Editor

AUTODYNE CONVERTERS

by E. H. BODEN

Advanced Application Engineer Receiving Tube Operations

INTRODUCTION

In the course of servicing radio and television receivers, the serviceman has familiarized himself with various kinds of frequency conversion circuits. We might say that in general, there are three basic types of frequency conversion circuits. Oscillator-diode such as is found in UHF-TV tuners and converters; oscillator-triode (pentode) such as is found in VHF-TV and FM tuners; and the pentagrid converter which is most generally found in radio-receivers.

Early in the 1930's, both the pentagrid and autodyne converters were developed. At that time, due to the fact that the autodyne circuit had a higher gain than the pentagrid circuit, the autodyne was more widely used than its counterpart. Later, however, when automatic volume control was developed, the autodyne dropped from the scene since the application of AVC voltage only produced "motorboating," or loss of oscillation.

Recently, the autodyne has begun to make a return and is currently being employed in a number of AM receivers. Two of the factors contributing to the return of the autodyne are: (1) With the addition of a diode and a circuit modification, the conversion gain may be changed by the application of AVC voltage; and (2) A change in the listening habits of the Public in general. Most housewives today are content to listen to the local broadcast station; thus receivers are currently being manufactured with little or no AVC.

HOW IT WORKS

An autodyne converter is simply a self-oscillating mixer. That is, all of the elements involved in the generating of the local oscillator signal also take part in the mixing action, and vice versa. One basic form of the autodyne is shown in Figure 1. The received signal is selected by the

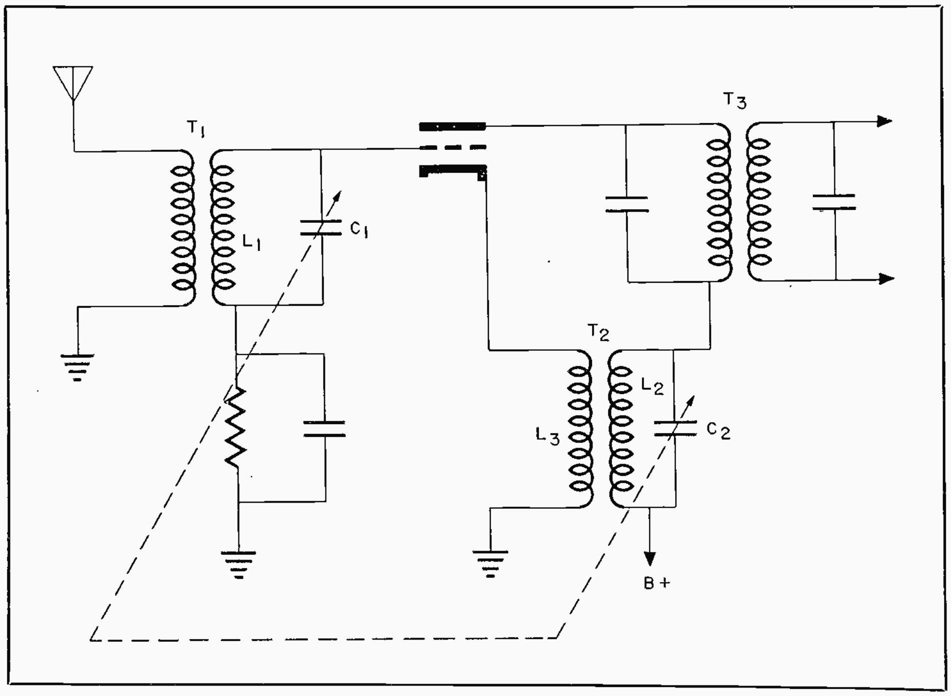


Figure 1. A Basic Autodyne Converter Circuit.

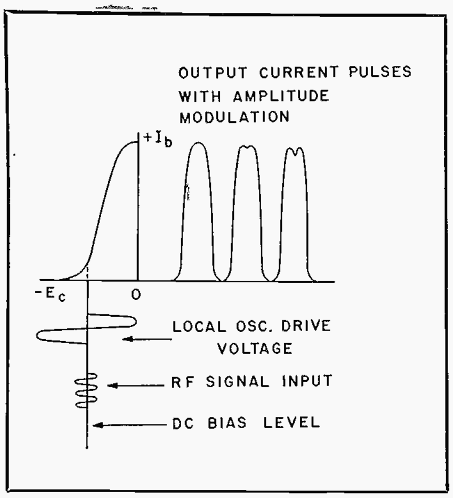


Figure 2. Typical Triode Mixer Transfer Curve.

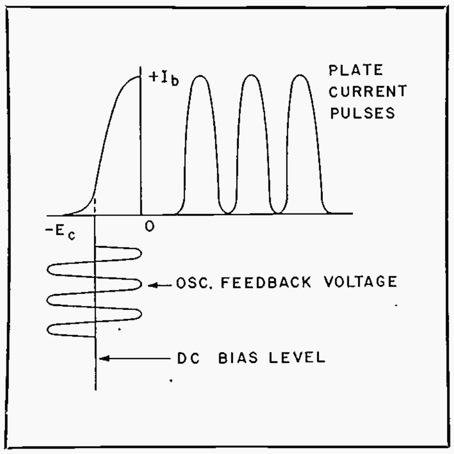


Figure 3. Typical Oscillator Triode Transfer Curve.

tuned circuit (L_1, C_1) in the input transformer T1 and impressed on the control grid of the triode. The triode oscillates at a frequency determined by the tuned circuit (L_2, C_2) in the transformer T2. As a result of the large oscillator voltage and the received signal voltage being combined between the cathode and the grid, the plate circuit produces a signal current which is the received signal converted to a frequency equal to the difference between the received signal frequency and the frequency at which the triode is oscillating. This we call the IF frequency. The IF signal is then coupled out of the circuit by means of transformer T3 which, in turn, delivers the signal to the first IF amplifier stage for further amplification.

TRIODE MIXER

To better understand how it happens that the desired difference signal is produced in such a simple circuit, it would be advantageous for us to review the theory of a simple triode mixer and then a triode oscillator. Following this we will see how the same triode may be made to perform both functions at the same time, as is done by the autodyne circuit.

Let us consider a triode which has impressed on its grid two signals. One, a very large signal produced by a local oscillator, and the other, a small signal which is the received or incoming signal. The local oscillator signal, being large, will cause the plate current to fluctuate between zero and maximum plate current as shown in Figure 2. Likewise, the transconductance will vary from zero to maximum Gm. As a result of the magnitude of the oscillator drive, the plate current and transconductance become a series of pulses. The amplitude of these pulses is modulated by the incoming signal.

As a result of this modulation, the plate of the mixer produces not only pulses at the local oscillator frequency rate and the resultant harmonics, but also side bands above and below the local oscillator signal current and each of its harmonics. Of particular interest to us is the lower side-band which is at a frequency equal to the difference between the local oscillator and the signal frequency. This is better known to us as the IF frequency. This component of the plate current is coupled out of the circuit by a suitable tuned circuit and then amplified in the next stage.

TRIODE OSCILLATOR

Now let us examine a triode oscillator circuit. Here we see the triode working as an amplifier with its output coupled back to its input. This feedback circuit is tuned to a frequency which establishes the proper phase relation between the input and output of the amplifier. As a result of the oscillations becoming larger and larger each time they are fed back and re-amplified, the grid-cathode swing becomes correspondingly larger. After a few oscillations we see that the tube is at maximum gain part of the time and at zero gain part of the time. The average gain is then some point between zero and maximum determined by the developed grid-cathode bias. The developed grid-cathode bias is thus a self-limiting voltage developed by the oscillator action. At this point, the triode is operating as described by the curve in Figure 3.

The reader should now notice the similarity between the curves in Figure 2 and 3. All that is lacking in the oscillator to make it a mixer is an incoming signal. Therefore, a signal may be coupled into the grid-cathode circuit as is done in Figure 1 to, in effect, modulate the developed oscillator bias. Then, as before, the plate circuit will have a signal current at the difference frequency. This difference signal is coupled out of the plate circuit by means of an IF transformer as in Figure 1.

AUTODYNE AND AVC

It was stated earlier that AVC could not be applied to an autodyne converter. The reason for this is that when a tube is working as an oscillator, it is performing two functions —amplification and limiting. Limiting, you will recall, is accomplished by self-biasing. If a DC voltage (AVC) is applied to reduce the gain of the amplifier, the tube automatically reduces the self-biasing voltage by the amount of the DC bias and the gain remains the same. However, as the DC bias increases and becomes larger than the amount of self-bias, the circuit begins to "motorboat." Larger DC bias shuts the tube off completely.

To overcome this difficulty, designers have added a diode to the circuit as shown in Figure 4. In the circuit the triode has only one function — amplification, and the diode performs the limiting action. The secondary of the oscillator tank has two outputs with respect to ground. One, the feedback signal to the amplifier input (cathode), and the other, the diode limiting circuit. Limiting, in this case, is accomplished by loading and not by developing bias voltage. For example, as the oscillation increases, the diode current increases which increases the load on the secondary of the oscillator tank. This, in turn, decreases the coupling between the primary and secondary of the oscillator tank and, therefore,

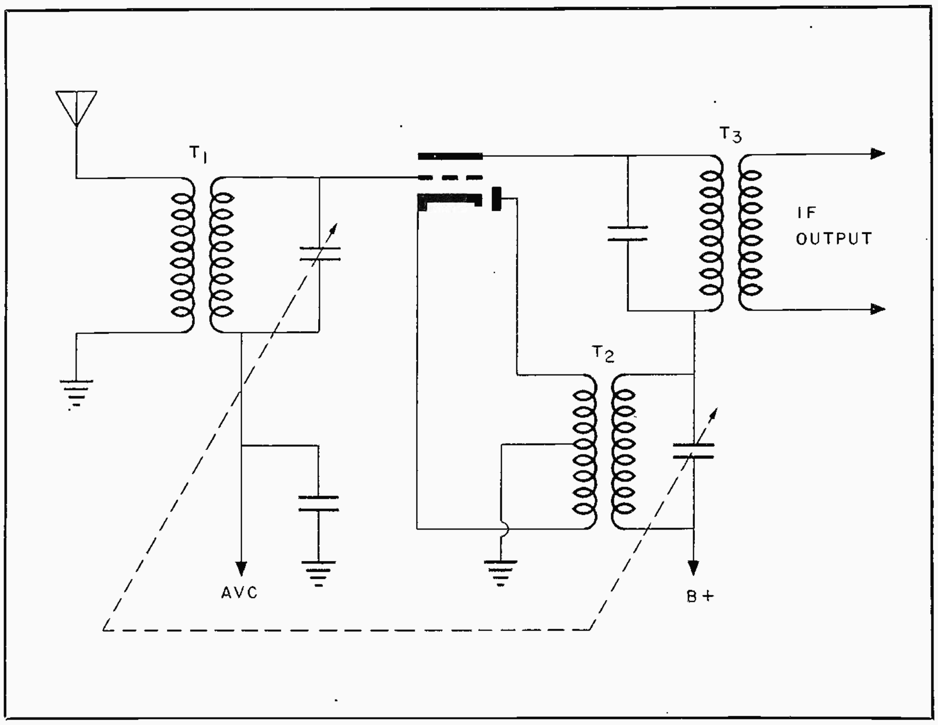


Figure 4. Autodyne Converter with Diode to make possible use of AVC.

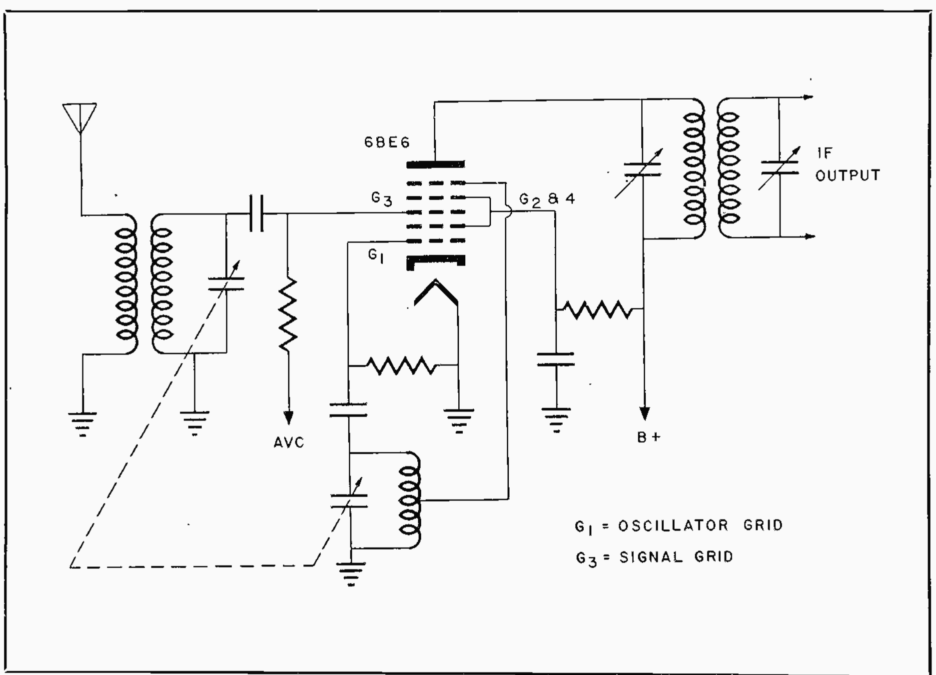


Figure 5. Typical Pentagrid Converter Circuit.

the amount of signal fed back to the cathode.

ADVANTAGES OF THE AUTODYNE

The most outstanding advantage of the autodyne converter is its higher gain. This can be readily demonstrated by comparing the autodyne circuit in Figure 1 to a common pentagrid converter circuit as shown in Figure 5. Note that in the pentagrid circuit the tube is required to have two control grids, grids No. 1 and 3, plus another grid, grid No. 2, working as an anode. To perform the function of an oscillator, the anode grid must intercept a considerable part of the cathode current. If the reader observes the ratio of plate to cathode current for the Type 6BE6, which appears in most Tube Manuals, he will see that only ¼ or approximately 25% of the cathode current reaches the plate. This means that the conversion gain of a Type 6BE6 when used in a pentagrid type circuit is only 25% of the conversion gain obtained with a Type 6AU6 in an autodyne circuit.

Now, returning to Figure 1, we see that almost all of the cathode current is plate current. Actually, some cathode current goes to the grid because of oscillator action. Oscillator feedback and the incoming signal are both inserted between the grid and cathode.

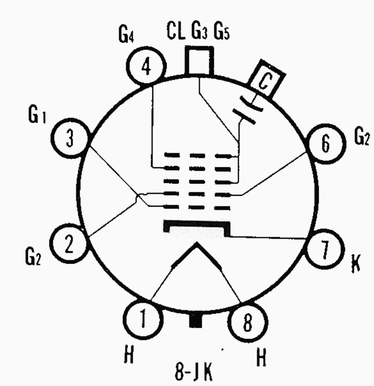
In comparing the circuits in Figure 1 and 5, the reader has perhaps noted the circuitry is somewhat reduced and that the tube requirements are less. Thus, circuit simplicity becomes a second advantage of the autodyne circuit.

A third advantage makes the first two all the nicer. That is, the higher gain and reduced circuitry are obtained without reduced image rejection or increased oscillator pull or noise.

ERRATUM

Picture Tube Characteristics Booklet

The basing diagram 8JK, for Types 17DAP4, 21EAP4, and 24AVP4 is incorrectly drawn in the recently issued Picture Tube Characteristics Booklet Revision No. 1, 1958. Instead of showing Pin No. 6 connected to Grid No. 1, the correct basing diagram for these types, as shown below, should have Pin No. 2 and be so labeled.



SYLVANIA RADIO CHASSIS 1-629-1, 2

Figure 6 is a partial circuit diagram of the Sylvania Model 629 radio chassis. After a brief study, we see that V1 (Type 12AU6) is being used in an autodyne converter not too different from the circuit in Figure 1. Although a pentode tube is used, it is triode connected as far as the oscillator frequency is concerned. At the IF frequency, the tube is working as a pentode with the effective plate resistance being increased by the feedback to the screen grid.

Since the 12AU6 is an oscillator as well as a mixer, it is necessary to make sure the signal input circuit is free of oscillator voltage. This prevents radiation of the signal at oscillator frequency through the receiver antenna. The capacitor C7 (4.7 $\mu\mu$f) is, therefore, connected between the control grid and the IF output transformer tap. This capacitor neutralizes any oscillator voltage that might be present at the grid as a result of the tubes interelectrode capacitive network.

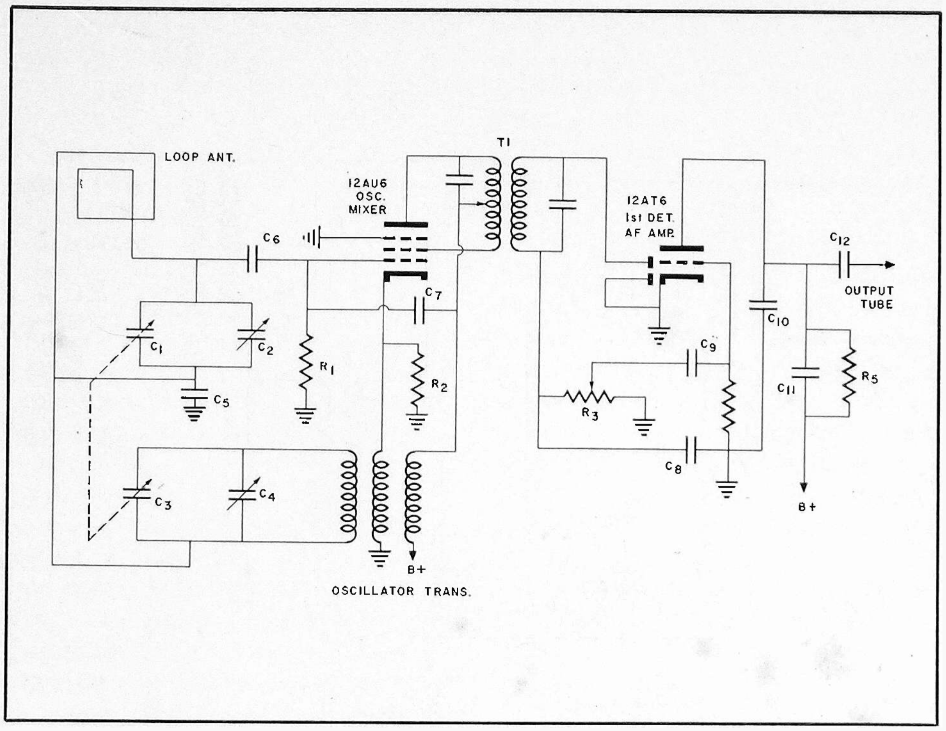


Figure 6. Partial Circuit Diagram of Sylvania Radio Chassis 1-629-1, 2.

CONCLUSION

In the foregoing discussion, we limited ourselves to AM receivers. However, it should be noted that the Autodyne may be used at any frequency at which a triode may be made to oscillate. Also, the method of modulation (television or FM) places no restriction on its use.

In the early days of UHF television, a single tube autodyne converter was used to receive signals from Sylvania's experimental station KG2XDU on Channel 22. The circuit for this one tube converter is shown in Figure 7. In this circuit, the input frequency and the oscillator frequency are so close to one another that one less tuned circuit is needed.

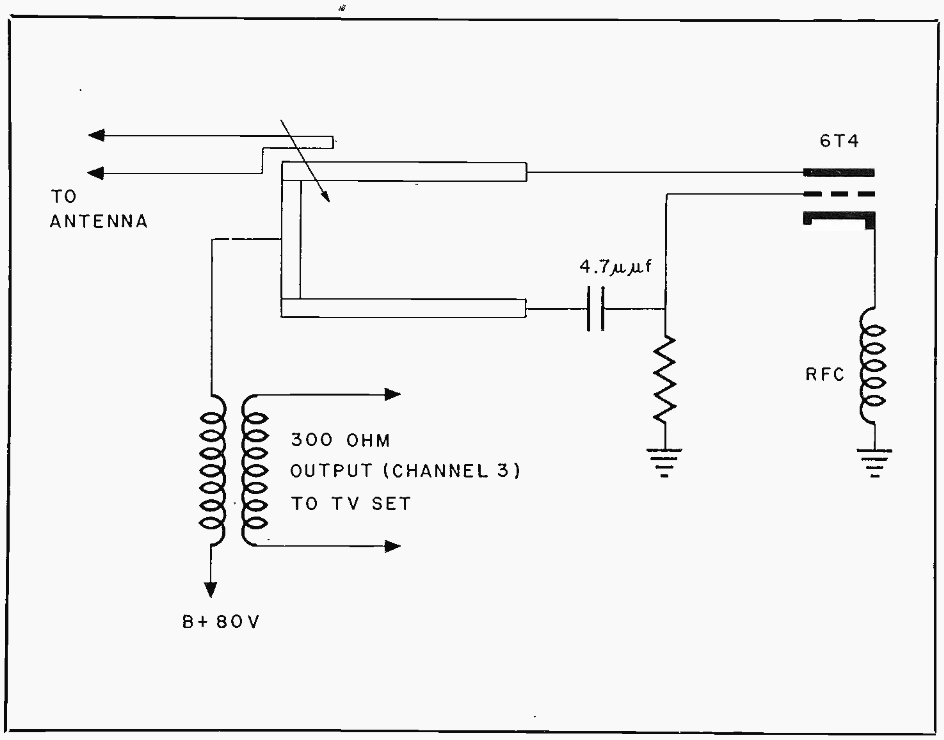


Figure 7. Autodyne UHF-TV Converter.

READER'S SERVICE HINT — DRILL SLEEVE

The sudden lurch inward, experienced when drilling holes in chassis, can cause extensive damage to component parts. This can be prevented by using a drill-sleeve approximately ½ inch shorter than the drill itself.

Copper and/or brass tubing of various sizes, generally used for this purpose, is available from hobby as well as electrical supply houses.

JOHN H. WILLIAMS
Pomano Beach, Florida

SYLVANIA NEWS
MARCH 1959 VOL. 26, NO. 3
R. A. Humphreys, Technical Editor
This information in Sylvania News is furnished without assuming any obligations.

technical SECTION

"PICTURE ON THE WALL" TELEVISION

(Part 1)

by R. M. Bowie, Vice President, Sylvania Research Laboratories, Bayside, New York

The "Sylvatron," which is a device combining the principles of the electroluminescent lamp and the variation in electrical conductivity of photoconductive materials, has frequently been suggested as the basis for "picture on the wall" television display. The purpose of this article is to describe several approaches to this objective, to point out some problems involved, and to describe progress toward realization.

An essential part of this form of television display is the phenomenon of electroluminescence, in which certain kinds of phosphor powders, when subjected to a varying electric field, extract energy from the field and transform it into light. In simplest form the lamp, shown schematically in Figure 1, is comprised of a glass plate which has a transparent, conductive inside surface. This surface is coated with a thin layer of insulating material which has embedded in it a small amount of electroluminescent phosphor. The insulating material or dielectric is backed by another conductor which may be a metal foil.

Electroluminescent lamps currently on the market look much like sheets of steel coated with porcelain enamel. Such lamps when operated at 110 volts, 60 cycles, generally exhibit a brightness which after 40,000 hours of operation is only 35 per cent less than the initial value.

When a lamp like the one just described, is operated at an alternating potential of several hundred volts, brightness curves can be obtained such as those in Figure 2. These curves indicate that the brightness increases with frequency within the range covered. Actually there is a limit set to the increase in brightness with frequency by the capacitance of the lamp and the resistance of the transparent conducting film. This limit is determined largely by construction and/or size and, with small lamp sizes, can reach several megacycles. Figure 2 also shows the way in which brightness increases with voltage; maximum voltage is limited, of course, by electrical breakdown. The practical brightness obtained with such a lamp is currently limited by dielectric breakdown to a value considerably below the instantaneous brightness now attainable by the scanning spot on a picture tube.

In the light-producing process, some of the power consumed is transformed into heat. For this reason the efficiency currently obtained is low, being normally about 2 lumens/watt, although an efficiency of 10 lumens/watt has been obtained. For comparison, a 100-watt incandescent lamp has an efficiency of 16 lumens/watt.

The present low efficiency and high capacitance introduce two other problems that must be surmounted in the eventual design for commercial television display. The efficiency influences the driving power required and thus the resulting heating of the display panel, while capacitance tends to load the driving circuits.

ELECTROLUMINESCENT TELEVISION DISPLAY

Let us now turn our attention to television. To display the intended picture one must scan, synchronize and modulate. To these three fundamental problems must be added that of obtaining high brightness

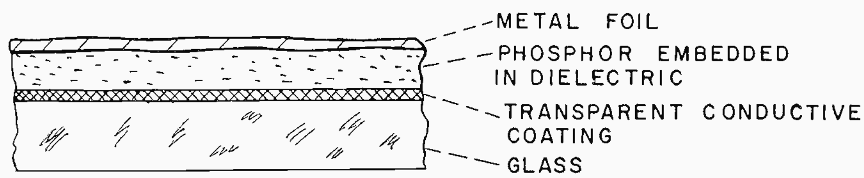


Figure 1—Cross section of the basic EL lamp.

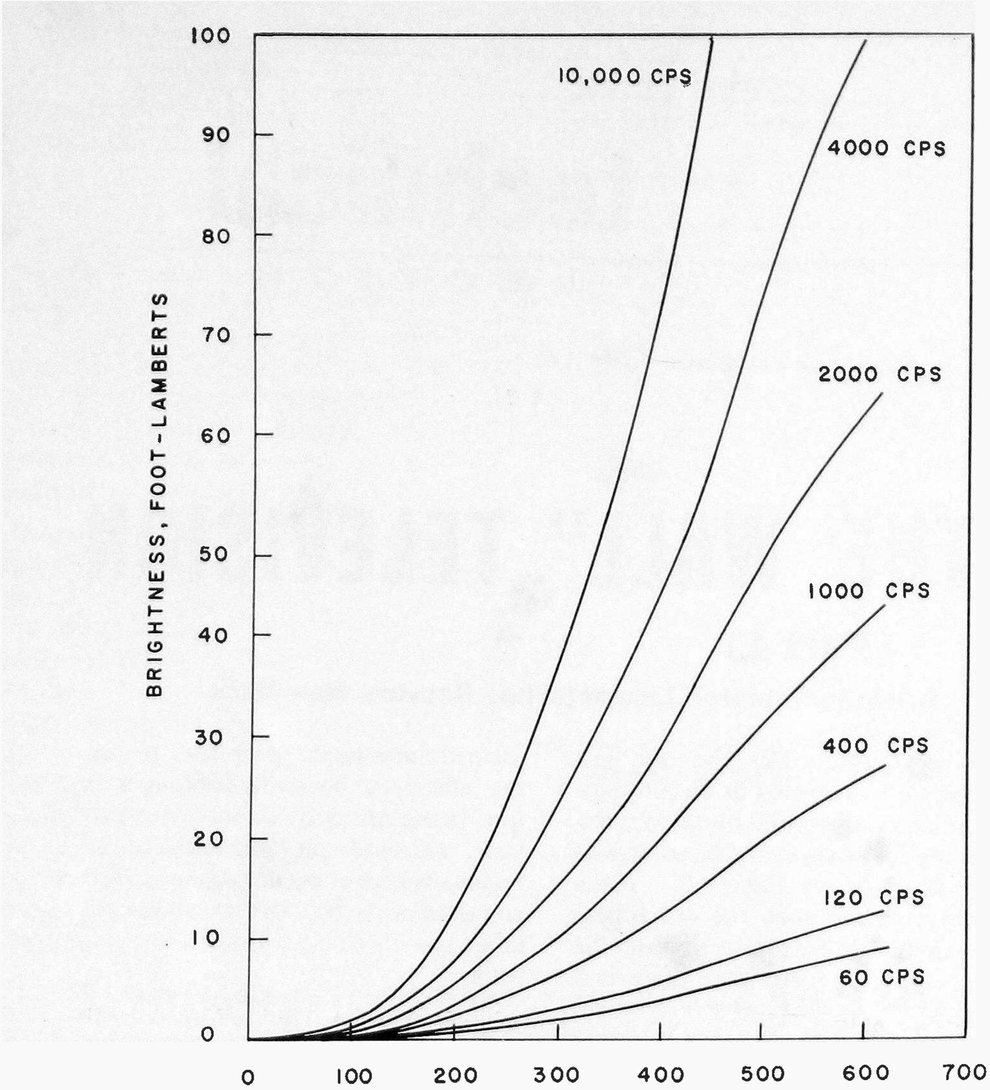


Figure 2—Brightness as a function of voltage.

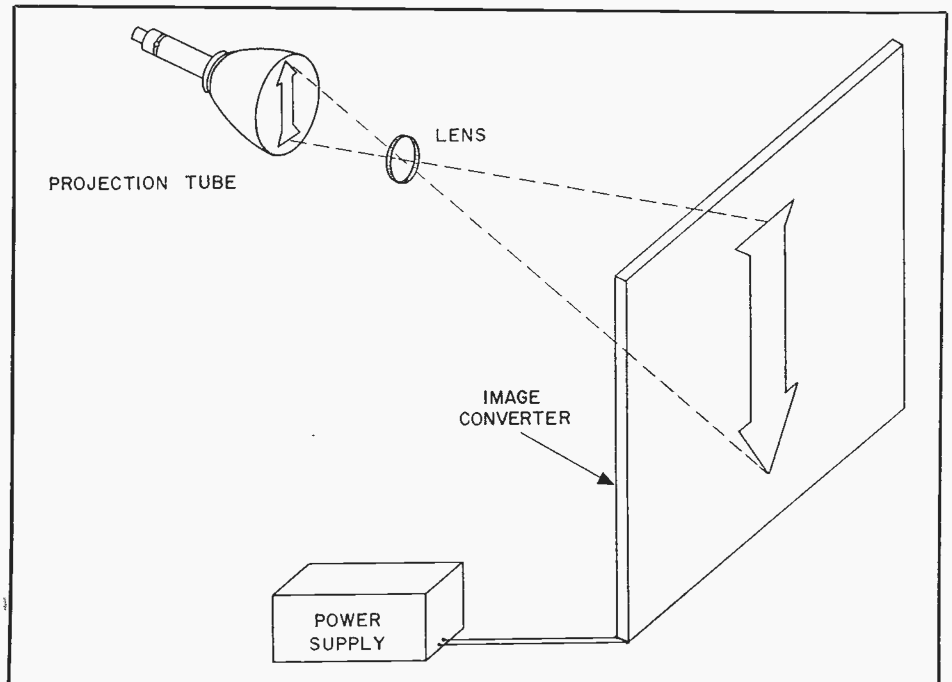


Figure 3—Television display system utilizing a small projection tube and an EL image converter

levels without excessive persistence of image.

One system of displaying the picture is to use an image converter or intensifier and a small projection tube, as depicted in Figure 3. The image converter is an electroluminescent lamp combined with a photoconductor, as shown in Figure 4. It comprises, first, a sheet of glass rendered conductive on the side next to the electroluminescent layer. An almost opaque, non-conducting layer between the electroluminescent layer and the photoconductor prevents optical feedback. Finally, a very fine wire mesh serves as the other electrode.

The image converter may be considered as broken up into elemental areas, though actually the surface is unbroken. Each such elemental area can be pictured as a small electroluminescent area in series with a photoconductive area. The equivalent electrical circuit shown in Figure 5 illustrates this point and shows how the resistive component (R_1) of the photoconductive areas controls the light output from the electroluminescent lamp section. Since the value of R_1 varies according to the intensity of the input illumination, the resistive component of each elemental photoconductive area can be thought of as a potentiometer. In darkness it may assume a value of several thousand ohms or more. When excited by a bright light its ohmic value will approach zero. A typical curve in terms of photoconductor current is shown in Figure 6.

Referring again to Figure 5, the effectiveness of R_1 in controlling light output from the electroluminescent lamp is limited by shunt capacitances C_1 and C_2. Even if the resistance of R_1 were to go to infinity in the dark, a portion of the ac supply voltage would be on the lamp due to the reactance of capacitance C_1. If the photoconductive layer and the electroluminescent layer were of about the same thickness and dielectric constant, then in the dark approximately half the voltage would be across each layer. Here the non-linear nature of the electroluminescent lamp response can be a distinct boon, as it may be used to

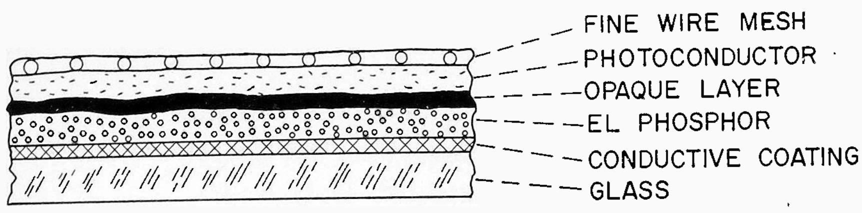
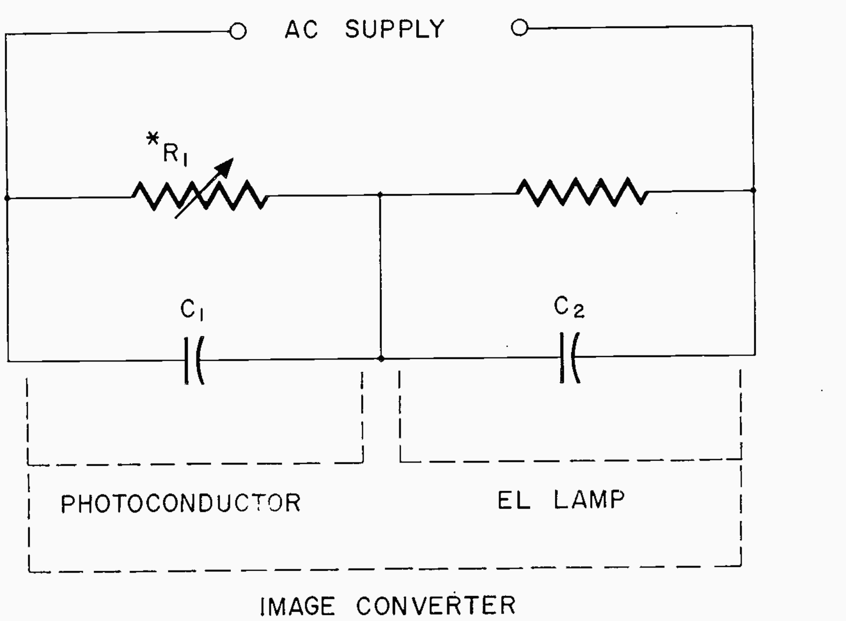


Figure 4—Cross section of the image converter.



* VALUE OF RESISTANCE R_1 VARIES ACCORDING TO INTENSITY OF LIGHT STRIKING PHOTOCONDUCTIVE LAYER

Figure 5—Schematic representation of the image converter.

reduce the brightness of the phosphor under conditions of no input illumination. At zero input illumination the voltage across the electroluminescent layer would drop to only about half of maximum, but the light would decrease by a factor of 5 or so. Under full input illumination, of course, the resistance of the photoconductor drops almost to zero and nearly full supply voltage appears across the electroluminescent layer. By proper compounding of the photoconductor and proper choice of input illumination level, the time constant can be reduced to below a tenth of a second, permitting the showing of motion pictures.

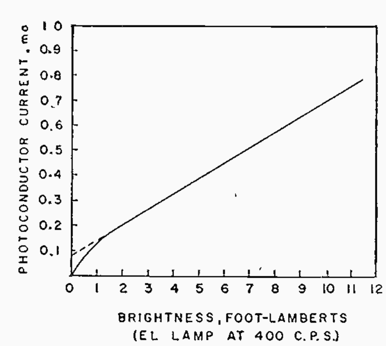


Figure 6—Photoconductor current versus brightness.

SERVICE HINTS

PHILCO MODEL 51-T1836

This set would exhibit severe sync pulling and picture bending on strong signals only. Reducing the contrast control would reduce the amount of picture distortion or removal of one side of the antenna would result in a stable picture. This problem was isolated to filter condenser C303A which filters the B+ to the 12AV7, first sync separator. Replacement of filter resulted in normal picture operation regardless of signal strength.

Leonard D. Chioma
Winter Park, Florida

KNOB SPRINGS

How many times have you lost a knob spring and went scurrying around to find one with little success?

Here is a solution. You will find the iron core laminations of discarded output transformers, when cut down to the correct size, will make excellant springs or wedges for any type of knob.

William C. Berman
Brooklyn, New York

TEMPORARY PLATE CAP REPAIR

On a recent house-call while removing the plate cap of the horizontal output tube, the wire broke loose from the cap as a result of heat and crystallization. A temporary field repair was accomplished by winding a paper clip around a nail, forming a spring. Upon slipping the spring over the tube cap, the lead going to the horizontal output transformer was placed between one of the coils of the spring. A wrapping of plastic tape completed the repair until a replacement cap was obtained from the shop.

Don Hopkins
Bury, Que., Canada

SUPPLEMENTARY TUBE TESTER SETTINGS

Listed below are important additions to the roll charts for Sylvania tube tester models 139 and 140. Make sure your charts are completely accurate and up-to-date by adding these important facts now.

FOR TUBE TESTER MODELS 139 AND 140

TYPE	A	B	C	D	E	F	G	TEST
1DN5	1.4	2	48	4	1	016	49	T
	1.4	2	48	4	7	—	55	T
4DE6	5.0	0	—	0	4	36	22	V
6DN7	6.3	0	678	1	7	5	50	Y
	6.3	0	278	1	3	3	80	W
6DR7	6.3	0	6	0	1	3	29	U
	6.3	0	3	0	1	6	29	U
	6.3	0	3	0	3	7	45	T
6DT5	6.3	0	4	0	4	026	25	Y
	6.3	0	6	0	4	024	25	Y
6DW5	6.3	0	4	0	4	026	20	Y
	6.3	0	6	0	4	024	20	Y
6EA8	6.3	0	—	0	3	36	38	V
	6.3	0	—	0	1	5	32	U
6EB8	6.3	0	—	0	1	—	49	T
	6.3	0	—	0	3	—	49	T
8BQ5/EL84	7.5	0	2	0	6	35	23	Y
9AU7	7.5	0	5	0	1	3	31	W
	7.5	0	5	0	3	7	31	W
12AL8	12.6	0	—	0	3	036	37	X
	12.6	0	—	0	1	9	76	T
	SEE NOTE							
12DU7	12.6	0	—	0	3	26	25	X
	12.6	0	—	0	4	—	19	V
	12.6	0	—	0	6	—	19	V
	SEE NOTE							
12DY8	12.6	0	—	0	3	26	45	U
	12.6	0	—	0	8	9	79	T
	SEE NOTE							
12EN6	12.6	0	—	0	1	034	18	W
12FK6	12.6	0	—	0	3	3	63	U
	12.6	0	—	0	4	—	70	U
	12.6	0	—	0	5	—	70	U
	SEE NOTE							
13DE7	12.6	0	3	0	3	7	32	W
	12.6	0	3	0	1	6	17	X
	12.6	0	6	0	1	3	17	X
13DR7	12.6	0	6	0	1	3	29	U
	12.6	0	3	0	1	6	29	U
	12.6	0	3	0	3	7	45	T
25EH5	25.0	0	5	0	3	26	24	X
	25.0	0	2	0	3	56	24	X
50EH5	50.0	0	5	0	3	26	21	X
	50.0	0	2	0	3	56	21	X
7137	6.3	0	36	0	3	5	35	U
	6.3	0	56	0	3	3	35	U
	6.3	0	35	0	3	6	35	U

NOTE: The tube types noted are of the auto hybrid types. To test them, the conversion outlined on page 8 of the October issue of SYLVANIA NEWS must be made.

SYLVANIA NEWS

technical
SECTION

APRIL 1959 VOL. 26, NO. 4
R. A. Humphreys, Technical Editor
This information in Sylvania News is furnished without assuming any obligations.

"PICTURE ON THE WALL" TELEVISION

(Part II)

by R. M. Bowie, Vice President, Sylvania Research Laboratories, Bayside, New York

Under Part I, we discussed how the projection television tube shown in Figure 1 and the image converter shown in Figure 2 fulfills the first three criteria for displaying a picture; namely scanning, synchronization and modulation. They do not, however, satisfy the commercial requirements for television with respect to brightness and cost.

Unlike the motion-picture projector, only one picture element is fully illuminated at a time. Since there are some 180,000 picture elements, each one must be very much brighter than the apparent picture brightness. Were there no phosphorescent decay of the projection tube screen and no lag in the photoconductor response, a picture element in the highlights would have to achieve 180,000 times the highlight brightness of the picture. Actually, the decay and the lag reduce this number appreciably, but probably not enough to come within the brightness range of electroluminescent materials commercially available.

One remedy appears to be the use of optical feedback from the electroluminescent layer to the photoconductor. Just as electrical feedback is used to sustain oscillation in vacuum tube circuits, sufficient optical feedback will keep the lamp lighted once it has been turned on. To prevent the feedback light from spreading to adjacent areas we break the lamp into discrete, small areas as shown in Figure 3. The photoconductive layer is deposited on the sides of very small glass pillars positioned on top of the electroluminescent layer. When light falling on a pillar lights the elemental lamp beneath it, the feedback light is restricted almost entirely to going up the same pillar. Hence, only that pillar remains bright and spreading is prevented. In this plaque, each element goes on fully when triggered by outside light and remains on until the whole plaque is turned off. Each element is therefore bi-stable. It will remain either off or on until transferred to the other state.

The system currently has in it all of the elements of a projection system and in addition an electroluminescent image intensifier with its power supply. Because space behind the screen must be made available for the projection equipment, there appears to be no saving possible in the size of the cabinet.

COMMUTATOR SYSTEM

A more attractive package would result if the projection tube were replaced by a flat device capable of being scanned, synchronized and

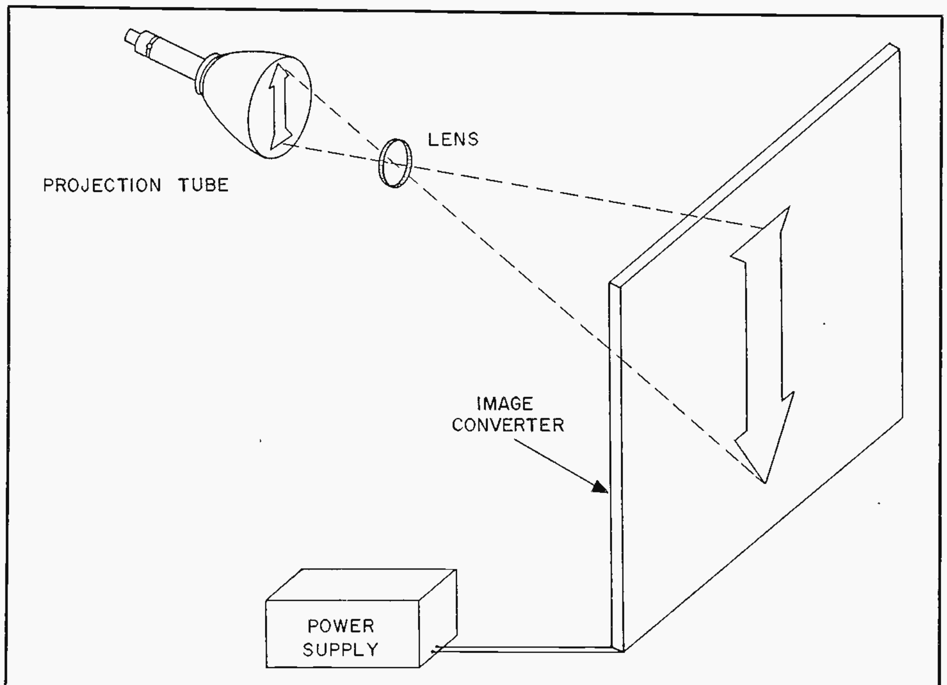


Figure 1—Television display system utilizing a small projection tube and an EL image converter.

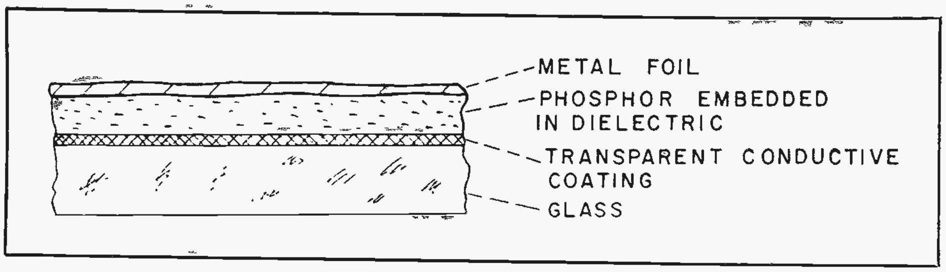


Figure 2—Cross section of the image converter.

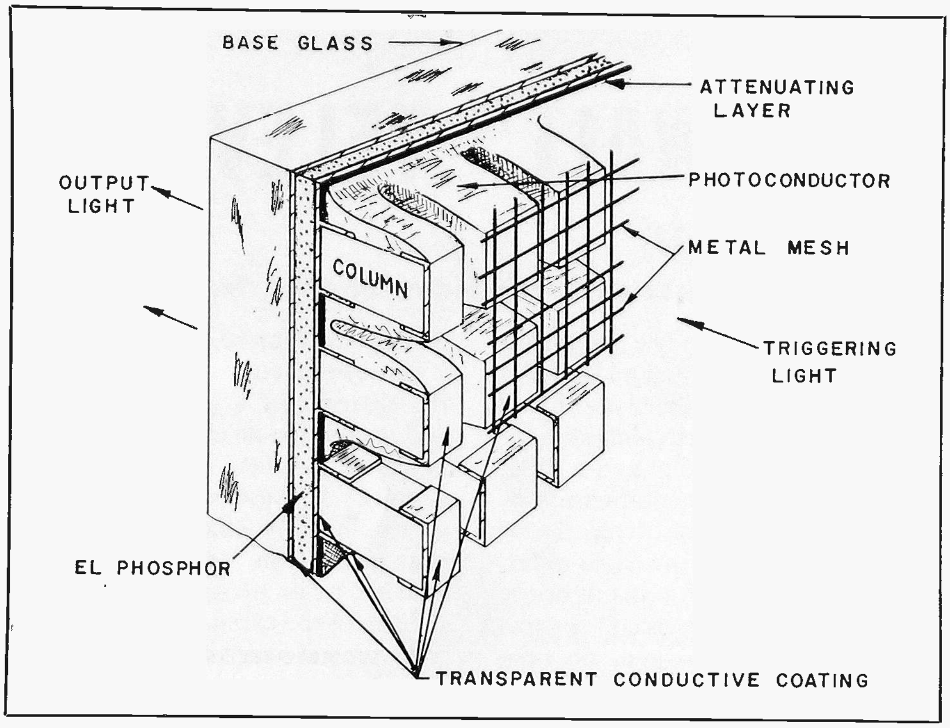


Figure 3—Cross section of the mosaic EL panel.

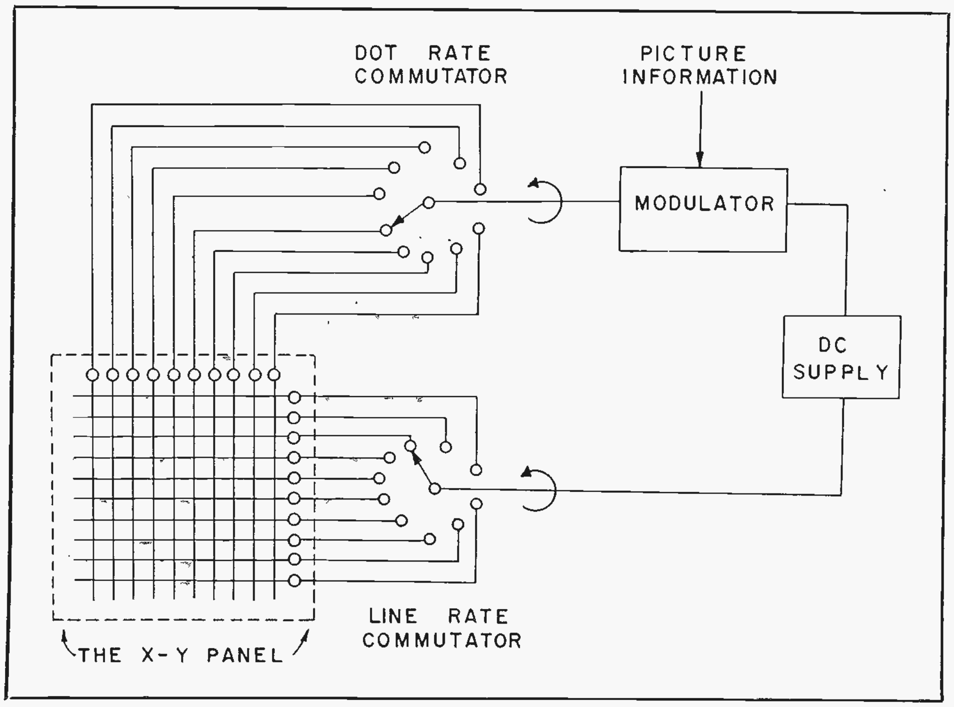


Figure 4—Commutator system for TV using EL display panel.

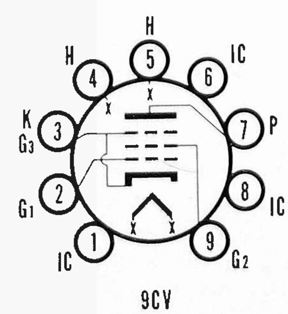
modulated to drive the image intensifier.

If one starts with an electroluminescent lamp and, in effect, slices the back conductor into strips running one way and the transparent conductor into strips running the other, he would have a cross-grid panel. In Figure 4, the panel is fed by two commutators which, for standard television, would probably be electronic. After the line-rate commutator has designated a line, the dot - rate commutator successively selects the dots along the line. As each is selected, a surge of voltage is applied and then removed, producing a bright spot at the intersection of the selected strips. Unfortunately, the unwanted portions of each strip are lighted sufficiently to form a noticeable "cross" when the panel is viewed in dim surroundings. This is because the selected horizontal strip is pulsed positively and the selected vertical strip is pulsed negatively; hence half voltage appears at all other points along the selected strips. This cross effect is, of course, less apparent under brighter viewing conditions. It can also be suppressed by external circuitry or by incorporating rectifiers into the panel.

We have thus achieved a scanning system and, presumably, synchronization. To achieve modulation one can modulate the voltage made available to the commutators taking into account, of course, the highly nonlinear brightness characteristic of the phosphor already mentioned.

ERRATUM

The Basing Diagram 9CV, for the Type 6BQ5, 8BQ5 is incorrectly shown in the recently issued Receiving Tube Characteristics Booklet, Revision No. 2, 1958. The correct Basing Diagram for the 6BQ5, 8BQ5 is shown below.



9CV

SYLVANIA NEWS

TECHNICAL SECTION

JUNE 1959

VOL. 26, NO. 6

R. A. HUMPHREYS, TECHNICAL EDITOR This information in Sylvania News is furnished without assuming any obligations.

TELEVISION TUNER APPLICATIONS OF LOW IMPEDANCE CRYSTAL DIODES

by William F. Palmer and Donald H. Rice, Semiconductor Engineering Laboratory, Sylvania Electric Products Inc.

The use of germanium very-low-impedance diodes as voltage sensitive capacitors is becoming popular in original equipment tuners of new television sets. In this article, you will find data concerning the variation of diode capacitance with bias voltage, discussion of circuit requirements for resonant circuits tuned with variable capacitance diodes, practical circuits for television fine tuning, FM automatic frequency control, and television automatic frequency control.

LIST OF SYMBOLS USED

a	Junction Area
V	Applied Voltage
ρ	Resistivity
μ	Mobility
Eo	Permittivity of Free Space
K	Relative Permittivity
Wj	Junction Width
Cj	Junction Capacitance
K	A Constant
Lw	Whisker Inductance
rb	Base Spreading Resistance
Rj	Reverse Biased Junction Resistance
Cp	Package Capacitance
F	Frequency
S	Frequency Sensitivity
Cd	Total Diode Capacitance
Cc	Coupling Capacitance
Ct	Total Circuit Capacitance
Xj	Junction Reactance
rs	Inductor Series Resistance
L	Inductance (Circuit)
Q	Quality Factor
W	Angular Frequency (Radians Per Second)
XL	Inductive Reactance
AFC	Automatic Frequency Control
Fif	Intermediate Frequency
Flo	Local Oscillator Frequency
Fsig	Signal Frequency
A	Sensitivity Without Feedback
A′	Sensitivity With Feedback
B	Sensitivity of Feedback Network
UHF	Ultra High Frequencies
VHF	Very High Frequencies
t	Time Constant
pf	Pica Farad

JUNCTION CAPACITANCE

A semiconductor diode, when biased in the reverse direction, acts as a capacitance shunted by a resistance. For a step junction, the shunt resistance is usually constant (saturated) and high over a considerable voltage range.

Junction capacitance varies inversely with the square root of the applied voltage. And, with a constant bias voltage, junction capacitance will be relatively insensitive to temperature changes because the effects of changes of resistivity and mobility with temperature tend to cancel. Voltage tunable LC and RC circuits may easily be constructed using a junction device in conjunction with external resistance or inductance. Sylvania VLI type "point contact" diodes, to a close approximation, act as step junctions.

Fig. 1 shows a typical curve of junction capacitance and diode terminal capacitance as a function of reverse bias voltage for a VLI diode. These data were taken on a Boonton type 250A RX meter at 1.0 Mcs.

CIRCUIT CONSIDERATIONS

Frequency Control Sensitivity of Diode-Tuned Circuits

When a reverse-biased diode is used in conjunction with an inductor (refer Fig. 2), a voltage tunable resonant circuit results. An expression for frequency sensitivity (frequency change per unit voltage change) may be derived and is shown below:

$$S = \frac{F}{V} = \frac{F}{4V}\left(\frac{1}{1 + C_d/C_c}\right) \quad (1)$$

where:

- S = frequency sensitivity
- F = frequency
- ΔF = change of frequency
- ΔV = change of voltage
- C_d = diode capacitance
- C_c = coupling capacitance
- V = bias voltage

From the above it can be seen that maximum sensitivity is obtained when (C_d/C_c) is small, F is high, and V is low. C_c is usually used for coupling only and therefore may be much larger than C_d. Large values of C_c may be undesirable in certain

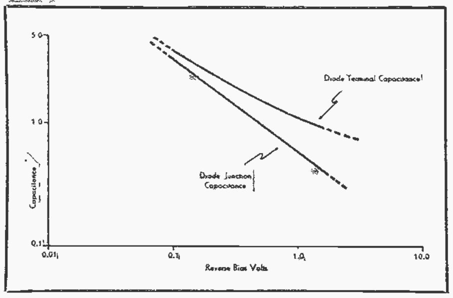


Fig. 1—Capacitance as a Function of Bias Voltage for a D1114 Diode.

circuits since they may lead to undesirably high self-bias voltages. (This is discussed in greater detail below.)

CIRCUIT Q

From the definition of Q for a resonant circuit, a variable capacitance diode Q may be defined as shown below. (A reverse biased diode is assumed.)

At high frequencies, the diode Q is determined mainly by the diode series losses. At low frequencies, Q is determined mainly by diode shunt losses.

If a lossy inductor is assumed to be in parallel with the diode, the expression Q_{HF} now becomes:

$$Q_{HF} = \frac{1}{2\pi f\,CR} \qquad (2)$$

Where:

R is the sum of diode series resistance and the inductor series resistance, C, is diode capacitance.

A graph of typical values of high frequency Q as a function of diode reverse bias voltage for D1114 and D1156 (VLI type) diodes in parallel with various inductances is given in Fig. 3. The peak a-c voltage across the diode was 0.22 volt so that at low bias voltages large signal and ultimately forward bias conditions exist. Resonant frequencies using the ideal inductances indicated are also shown at various bias voltages along the curves, thus indicating possible tuning ranges. Large signal Q values were calculated from measured values of capacitance and average values of shunt a-c resistance for the diodes.

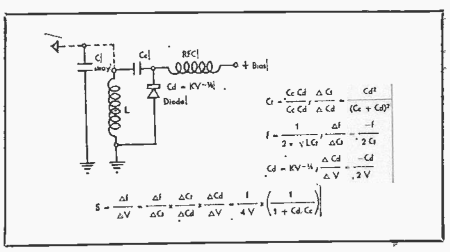


Fig. 2—Sensitivity of the Voltage Tunable Oscillator.

DIODE BIASING

During small signal conditions (peak a-c voltage across the diode much less than d-c bias voltage,) the diode d-c bias voltage effectively determines diode capacitance. If the diode is coupled to an inductance, the frequency characteristics of the resulting circuit are controlled by the diode bias. However, since the diode is a rectifier and may be coupled to a power source (see Fig. 2) by C_c there may be a rectified d-c (reverse) self-bias voltage across the diode. There are, therefore, two basic methods for obtaining diode bias voltage; self-bias and externally applied bias (combinations of these are also possible).

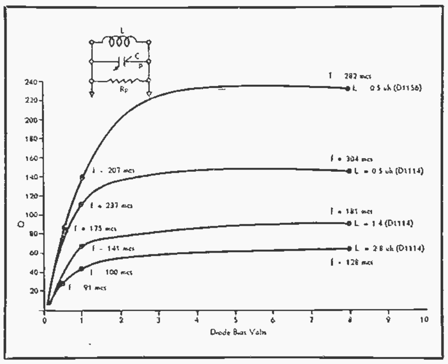


Fig. 3—Graph of Circuit Q for D1114 and D1156 Diode as a Function of Bias Volts.

SELF-BIAS OPERATION

If no external bias is applied, it can be seen that diode voltage will vary approximately between zero and somewhat less than the peak to peak value (see Fig. 4). Under these conditions, diode capacitance will become instantaneously very large as the voltage approaches zero. During the upper half of the cycle diode capacitance is smaller than at the midpoint of the cycle and of little consequence when compared to the values obtained during the lower half of the cycle. As a result, there is wave shape distortion and the effective capacitance is large; larger than would be predicted from the average (d-c) voltage reading on a meter. For example, line b in Fig. 4 is the d-c meter reading, but line f is actually the frequency (fundamental) determining voltage and is usually 10% to 20% less than the bias voltage (line b).

EXTERNAL BIAS OPERATION

When the diode bias voltage is supplied from an external source and small signal conditions prevail, the effective diode capacitance is de-

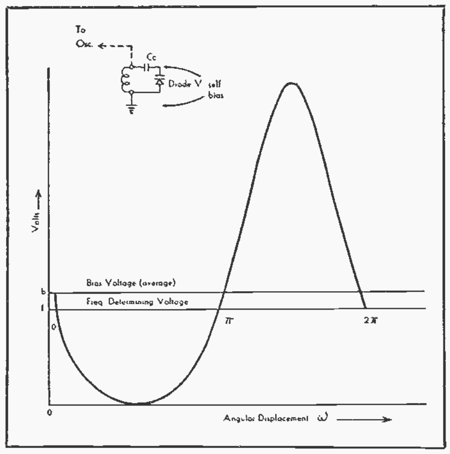


Fig. 4—Waveform of Diode Voltage for Self-Bias Operation.

termined by the d-c bias voltage as the sum of package and junction capacitances. Under these conditions (analogous to class A operation of vacuum tubes) there is little or no wave shape distortion.

The bias supply should be fairly well regulated and the voltage should not be greater than needed for the desired capacitance variations. Unnecessarily high reverse voltages may cause excessive leakage currents which would easily vary with temperature. This would cause capacitance variations by voltage divider action.

When large signal conditions prevail, however, the effective diode capacitance again becomes anomalously large as in the self-bias case. This leads to a third method of operation.

COMBINATION OF SELF AND EXTERNAL BIAS OPERATIONS

In the limit of this case, as diode voltage approaches zero during part of the cycle, the wave form approaches that of Fig. 4. In less extreme cases, however, substantial distortion may still exist depending upon the ratio of peak a-c swing to d-c bias voltage.

TELEVISION FINE TUNING

The frequency of a television local oscillator may be controlled using a

VLI variable capacitance diode. Fig. 5 shows the basic circuit used, and Fig. 6 shows the plots of local oscillator frequency as a function of diode bias voltage for channels 2 and 13. From these curves it can be seen that a 2% frequency deviation is easily obtained. At higher bias voltages the diode capacitance is approximately 0.5 pf, the value of package capacitance. The slopes of these curves at any operating (bias) point will give the control sensitivity in cycles per volt. From the curves of Fig. 6, it can be seen that sensitivity increases as bias voltage decreases and increases as frequency increases.

FM AUTOMATIC FREQUENCY CONTROL

When the diode bias control voltage is supplied from the output of a frequency discriminator, automatic frequency control (AFC) may easily be achieved. It should be remembered, however, for proper AFC action the diode bias control voltage should effect the circuit degeneratively. The necessary conditions for AFC in a typical FM tuner using a variable capacitance diode are that a degenerative closed loop be formed consisting of the local oscillator,

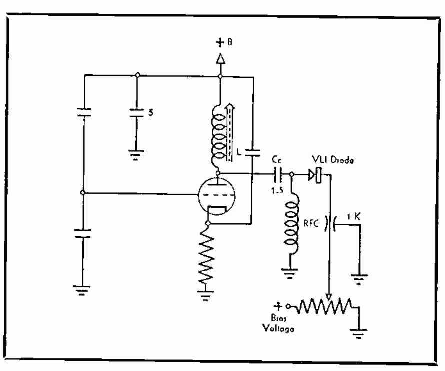


Fig. 5—Basic Circuit for TV Local Oscillator Fine Frequency Control.

mixer and i-f amplifier, frequency discriminator and detector, and variable capacitance diode. Such a circuit has been constructed and tested using a conventional FM tuner and a VLI variable capacitance diode. Fig. 7 shows the circuit diagram. DC output from the Foster-Seeley discriminator-detector is applied to the diode at b. Fig. 8A shows the discriminator-detector characteristics. Fig. 8B shows a plot of local oscillator frequency as a function of diode reverse bias voltage.

From Fig. 8A it can be seen that an increase in local oscillator frequency ($F_{if} = F_{lo} - F_{sig}$) causes the discriminator output to become more positive, and vice versa. Under these conditions, if the diode were connected directly to the discriminator output, a regenerative circuit would result and there would be no proper AFC action. It should also be pointed out that as the discrimi-

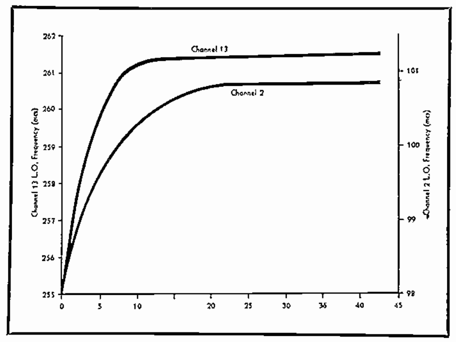


Fig. 6—Local Oscillator Frequency vs. Diode Bias for Channels 2 and 13.

nator voltage changed polarity the diode bias would change from reverse to forward, thus seriously lowering the oscillator Q. (If the output polarity is correct, however, the diode may in some cases be directly

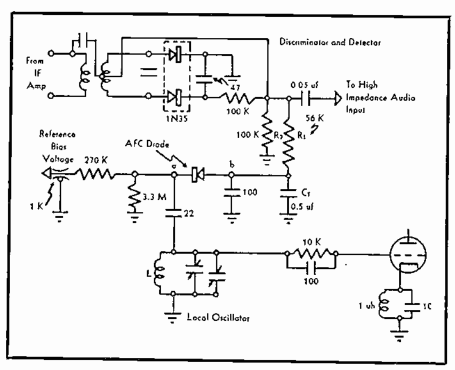


Fig. 7—AFC Circuit for FM Tuner.

connected to the discriminator.

Because of this, the circuit shown in Fig. 7 was developed. In this case there are other methods for securing degenerative AFC action such as reversing the discriminator output, or tuning the local oscillator below the signal frequency (sub-heterodyne) so that $F_{if} = F_{sig} - F_{lo}$.

A fixed positive diode voltage is applied between point a and ground. Therefore, the total voltage across the diode (V_{ab}) is the fixed bias voltage minus the discriminator output voltage.

The fixed bias voltage may be conveniently obtained from one of the tube cathode bias voltages, a voltage divider and reference diode regulator across the power supply, a small battery, or from diode self-bias voltage. V_a must be fairly well regulated since it determines the operating point and thus the sensitivity of the circuit. The degree of regulation, however, need not be high since any variations would be reduced by the degenerative feedback.

Overall circuit sensitivity depends upon the i-f amplifier-discriminator sensitivity (expressed in volts/kcs) and the oscillator-AFC diode sensitivity (expressed in kcs/volt). The amplifier-discriminator sensitivity is obtained from the slope of the curve in Fig. 8A. The oscillator-AFC diode sensitivity is obtained from the slope of the curve in Fig. 8B at the operating point (V_a.)

The sensitivity of a feedback system may be defined as the frequency change produced by a stress on the system when no feedback is present divided by the change produced by the same stress with feedback present.

Using the analogy of an amplifier with feedback this becomes:

$$A' = \frac{A}{1 + BA} \qquad (3)$$

(degenerative feedback) where:
A = sensitivity with no feedback
A′ = sensitivity with feedback
B = sensitivity of the feedback network

Then:

$$\frac{A}{A'} = 1 + BA = \frac{\Delta F}{dF} \qquad (4)$$

From Fig. 8A, A has a value of 0.06 volt per kc, and from 9b at 0.05 volt bias, B has a value of 1000 kcs per volt. Therefore, over all sensitivity (1 + BA) = 61. This means that a 61 kcs drift for an uncontrolled local oscilator would be reduced to 1 kc with feedback present. This value is greater than that often obtained with vacuum tube reaction circuits.

The circuit time constant (t) determines the time lag between the initial correcting voltage change and the actual frequency correction. Since the AFC loop is integral with the audio output, t should be long

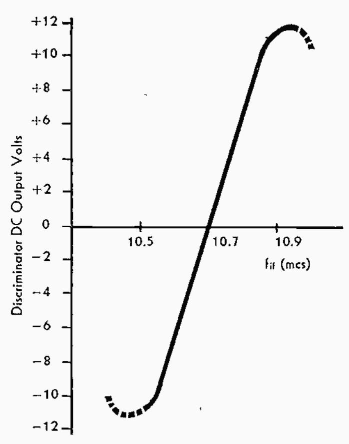


Fig. 8A—Discriminator Output Characteristics.

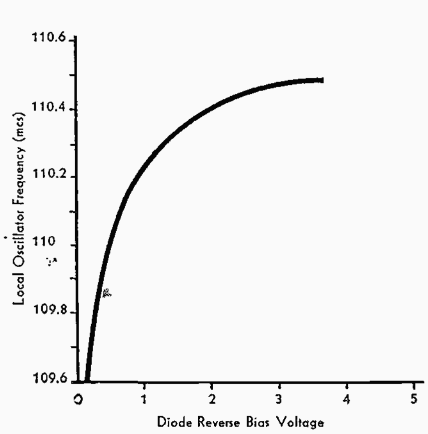


Fig. 8B—Local Oscillator Frequency as a Function of Diode Reverse Bias.

enough so that AFC correction does not follow the lowest audio frequency. In this circuit shown t = $(R_1 + R_2)\ C_1$, and is approximately 0.032 sec. This corresponds to a frequency of approximately 30 cps.

Using a well regulated supply for V_a, it was noted that a negligible local oscillator drift occurred over a period of 5½ hours of tuner operation. This included warm-up time and periodically moving the hand close to the exposed local oscillator tank while the tuner was tuned to a local FM station. Oscillator drift was determined by observing the d-c discriminator output voltage change. Fig. 9 shows a point by point plot of the d-c discriminator output voltage with and without AFC action as i-f frequency was varied.

Using similar techniques television AFC may be obtained. AFC voltage would be obtained from a discriminator at the video i-f output.

FACTORS AFFECTING THE CHOICE OF DIODE COUPLING CAPACITOR

In the two cases discussed above, where the diode is used to tune an oscillator, the amount of energy coupled to the diode is determined mainly by the size of C_c with respect to $(C_c + C_d)$. (Refer to Fig. 2).

It is therefore often desirable to use a small value of C_c so that diode self-bias is kept small. Low self-bias voltages mean greater sensitivities.

($\frac{\Delta F}{\Delta V}$ is large—see Fig. 6), losses are reduced (less forward conduction time per cycle,) and the range of diode bias control voltages changes needed is reduced. On the other hand, changes of C_d with bias have their greatest effect upon the circuit when C_c is very large. It is apparent, therefore, that an optimum value of C_c exists with respect to C_d. It should be pointed out that for low oscillator amplitudes, the self-bias voltage will be small regardless of the size of C_c so that a large value of C_c may be tolerated, giving maximum sensitivity. It is advisable, therefore, to judiciously choose the value of C_c with respect to $(C_c + C_d)$, oscillator amplitude, sensitivity required, and bias control voltage range available.

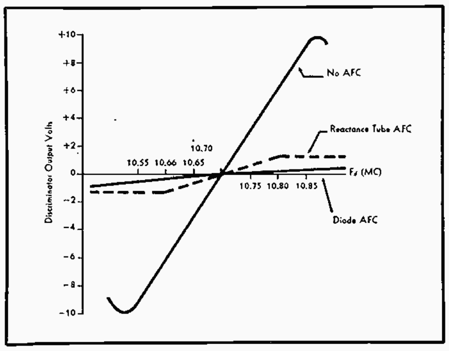


Fig. 9—Graph of Discriminator Output Characteristics With and Without AFC.

OTHER APPLICATIONS

Only two practical applications have been discussed in detail. It should be pointed out that other variable capacitance diode types may be used as tuning controls at other frequencies. In general, variable capacitance diodes may be used in almost all applications involving variable capacitors. Some specific examples are listed here:

1. Remote television fine tuning
2. Receiver tuning (ganged stages)
3. Dielectric amplifiers (adjustable filters)
4. Other feedback control systems
5. Wave shaping and compensating circuits (e.g., sawtooth linearity control)
6. Variable phase shifting and delay networks
7. Frequency modulators

Automatic frequency control may be obtained using circuits other than the common Foster-Seeley discriminator and difference detector. For example, the Round-Travis discriminator or the ratio detector may be used. It is also worth noting that a very simple frequency sensitive detector may be obtained by detecting on the "slope" of a tuned circuit. The fact that this circuit does not have a linear frequency response characteristic is not of prime importance as long as AFC only is required. Two examples of this circuit are shown in Fig. 10. In each case LC is tuned slightly above or below F_{if}. DC output is proportional to frequency.

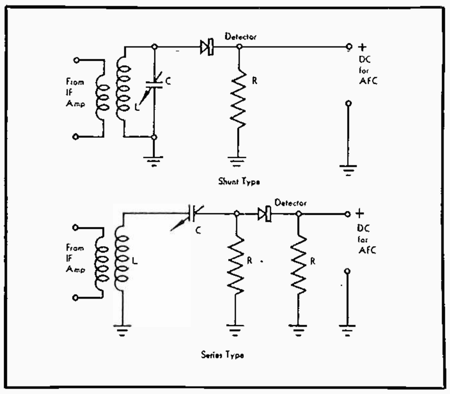


Fig. 10—Simple Frequency Detectors.

ADDITIONAL INFORMATION ON FILAMENT VOLTAGE TEST UNIT FOR HIGH VOLTAGE RECTIFIERS

The Weston Model 301 Meter used in the "Filament Voltage Test Unit for High Voltage Rectifiers," Sylvania News, March 1958, is not a catalogue item. This thermocouple type meter must be ordered directly from Weston specifying a heavy cobalt magnet and an eight (8) ohm coil movement. The end product would be a 450-500 μa Model 301 meter.

The Type 17 Vacuum Thermocouple, used in conjunction with the above unit, is available from the American Thermo-Electric Company located at 7269 Santa Monica Blvd., Los Angeles 46, California.

SYLVANIA NEWS

TECHNICAL SECTION

JULY
AUGUST 1959
VOL. 26, NO. 7

R. A. HUMPHREYS, TECHNICAL EDITOR This information in Sylvania News is furnished without assuming any obligations.

SIMPLE NOMOGRAPH ELIMINATES MATHEMATICAL MANIPULATIONS

Quite often, a serviceman may be required to parallel resistors in order to obtain a particular value of resistance. In most cases, unless the values happen to be even numbers, extensive pencil pushing is necessary to determine the proper pair of resistors to be paralleled or the resultant resistance.

Considerable time and effort can be saved through use of the simple Nomograph* of the form shown in Figure 1. Resistors in parallel; inductors in parallel; capacitors in series; in fact, any application which answers to the basic formula

$$\frac{1}{X_t} = \frac{1}{X_1} + \frac{1}{X_2}$$

can be solved quickly and easily with the aid of this Nomograph.

As an example of how simple and easy this Nomograph is to use, let's consider paralleling two 200 ohm resistors. Most of us know off-hand that the resultant value is 100 ohms because of the simple values chosen and a knowledge of the basic formula for figuring parallel resistance—

$$R_t = \frac{R_1 R_2}{R_1 + R_2}.$$

By placing a straight-edge on the value 200 on each scale and reading the value directly beneath the point of intersection with the 45° line, we find that the Nomograph answer is also 100 ohms.

Suppose now we parallel an 800 and a 500 ohm resistor. This requires pencil pushing unless we use the Nomograph. By simply placing the straight-edge across the respective values on the two scales (R_1 = 800 ohms, R_2 = 500 ohms), we read a value of approximately 300 ohms directly beneath the intersection of the straight-edge and the 45° line.

*Provided by E. H. Boden, Sylvania Electric Products Inc., Receiving Tube Operations.

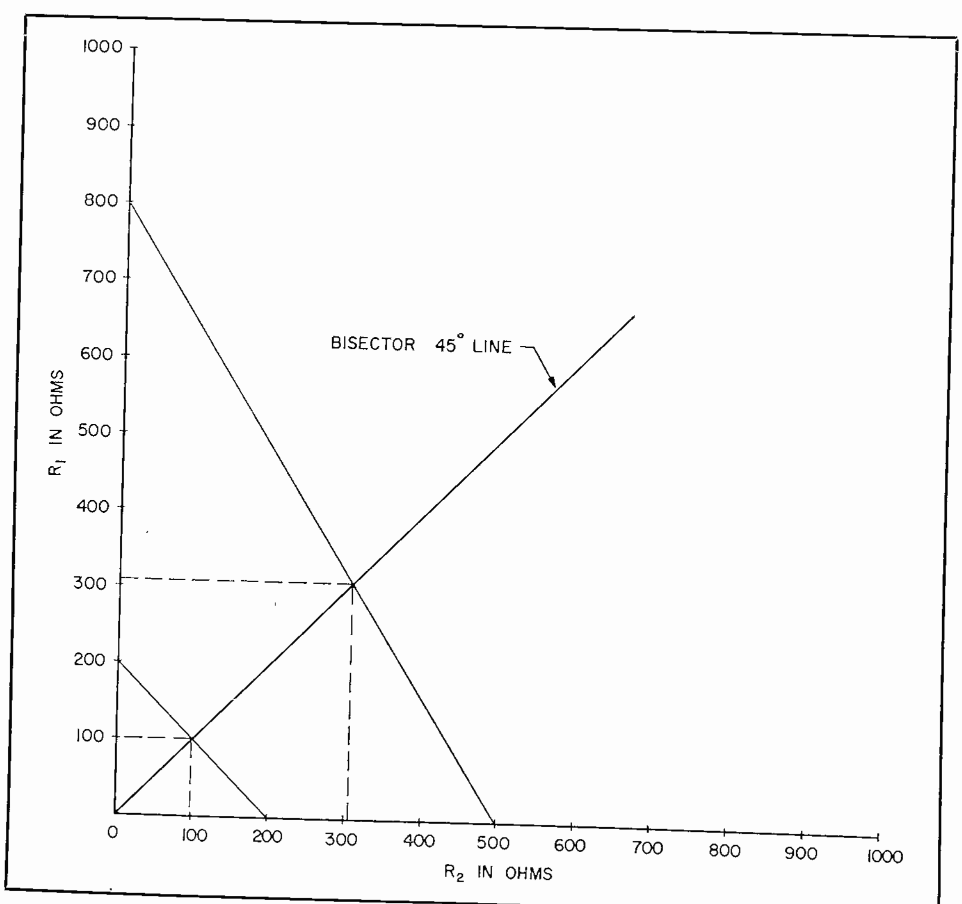


Figure 1—The two examples described in the text material are illustrated above. The dotted lines indicate that the value of parallel resistance can be read on either scale.

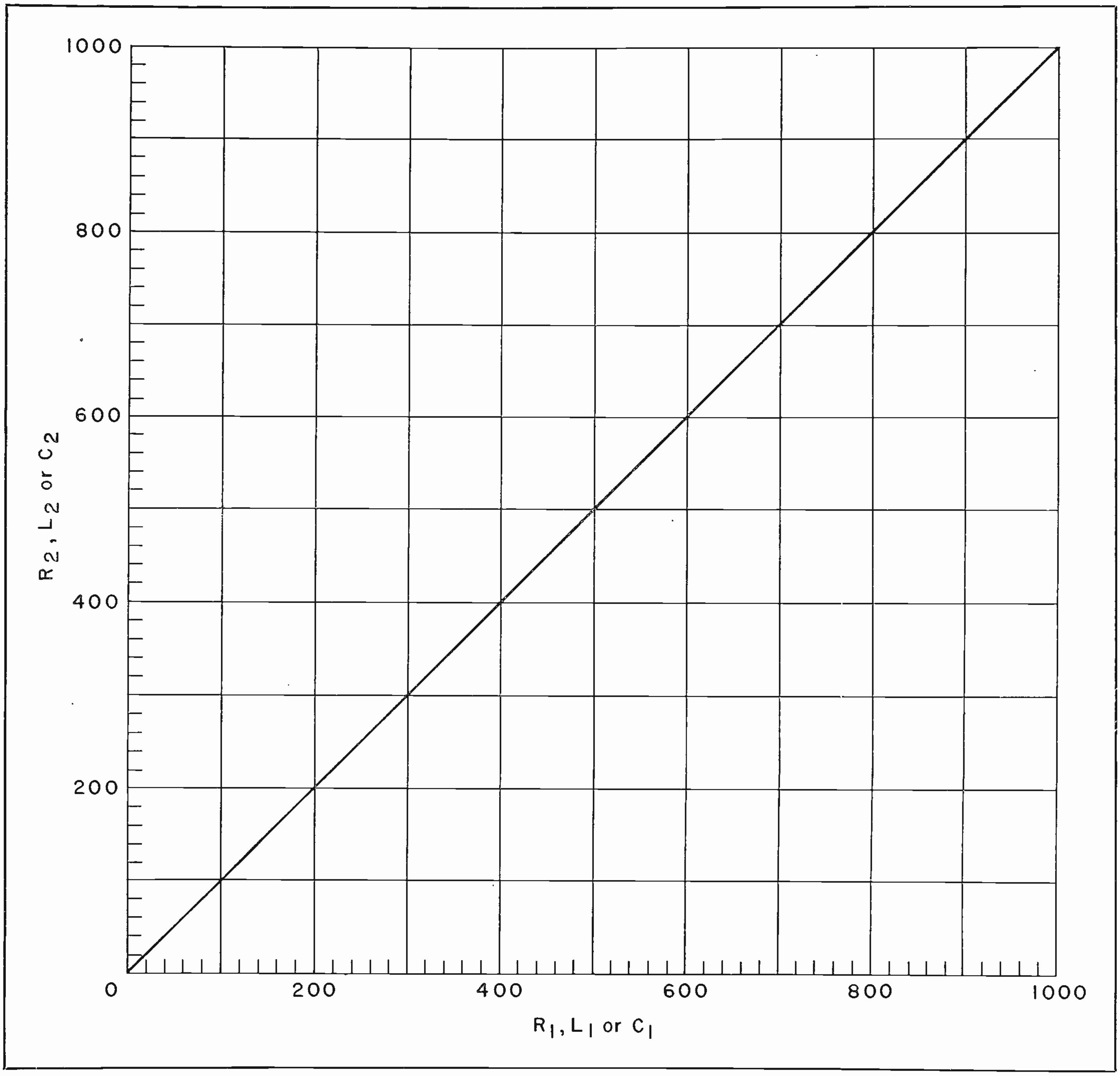


Figure 2—To better serve the serviceman or home-builder, the above Nomograph employs scales which may be increased or decreased by any factor of 10 provided both scales remain identical.

Actually, since both scales are identical, it doesn't matter which scale is used to read the value of parallel resistance.

Should a circumstance arise where three or more resistances are to be paralleled, a process of elimination should be used. First solve for two of the three values and then using the resultant and remaining value solve for the answer. Thus, the Nomograph can be used to solve for the resultant of any number of paralleled resistors.

The Nomograph would no doubt see more use in a case where a specific resistance must be used and the serviceman or experimenter just happens to be fresh out of that particular value. Now, by using as a fulcrum, the point on the 45° line directly above the resistance needed, any combination of resistors noted at each end of the straight-edge could be paralleled and used.

For the convenience of the serviceman or home-builder we have included a ready-to-use Nomograph in Figure 2. It is drawn to represent standard graph paper and the identical scales range from 1 to 1000. Depending on the particular values of resistance needed, the scales may be increased or decreased by any multiple of 10 provided both scales remain identical.

SCREEN DISSIPATION - Important Factor in Horizontal Deflection Tube Life

Sylvania's Engineering Department maintains a close and continuous surveillance of its tubes in service in the field. One interesting problem encountered, which required special attention, was that of early life failures peculiar to replacement horizontal amplifier tubes.

Conclusive investigations, conducted with the aid of Sylvania Service-Dealers throughout the nation, revealed that variations in circuit components during life were responsible for the majority of early life failures in replacement tubes. In these cases, electrical tests conducted on tubes exhibiting short life in customers sets, indicated low emission or low peak plate current. Once this was established, a mechanical analysis (breaking the tube open) would indicate an excessive screen dissipation type of failure.

Let's now consider the operating conditions that can cause excessive screen dissipation. The screen grid, of course, is required to dissipate electrical energy in the form of heat. It, as well as other tube elements, is designed to operate within a specified dissipation rating. However, operation of the screen grid above its maximum rating causes the grid laterals to reach a temperature much higher than intended which, in turn, causes minute particles to be driven off and deposited on other elements including the cathode. This in effect, "poisons" the cathode; causing its emission properties to gradually decay. When this deterioration occurs, the TV set in question starts to exhibit short scan, low brightness and poor focus.

The question that now comes to mind is what caused the tubes to operate at such excessively high screen dissipation levels in the first place. In many instances, the culprit has been found to be the series screen dropping resistor changing in value with life. For example, a decrease in the value of the screen grid dropping resistor of the horizontal deflection amplifier will tend to increase the screen grid voltage and dissipation. In sets which do not use a screen dropping resistor, improper adjustment of the Width Control may produce the same conditions.

Depending upon exact conditions, defective components, sometimes further aggravated by high line voltage and improper set adjustment tend to accelerate increased electrode dissipation, resulting in early life failures. These conditions may influence the life of tubes and components of other circuits. That is, an increase in screen voltage of the horizontal deflection amplifier due to a defective screen grid resistor may increase the boost voltage. This, in turn, increases the electrode voltage, current and dissipations of other circuits, such as the vertical deflection system, which also derives B supply from this source. Unfortunately, if a service-dealer is not fully aware of this particular situation he may simply replace the tube without getting to the source of the trouble.

In conclusion, if normal tube life and a minimum of call-backs is desired, the changes in the values of components with life and the disastrous results this can produce must be carefully considered by the service technician. A check of the value of the screen dropping resistor and the screen dissipation with the replacement tube in the socket, may insure against a call-back in a few weeks.

SERVICE HINTS

"BIFILAR IF COILS"

Recently, we had occasion to observe an unusual defect in a 1951 Raytheon TV receiver having the circuit common to Models C-1401 and M-1402-3-4.

The customer's complaint was that both sound and picture had gone dead. He had himself replaced a blown fuse in the low voltage supply. A fuse of the proper 0.25 amp. rating melted as soon as the set was turned on. He tried a 0.5 amp. fuse with the result that the 5U4G rectifier burnt out.

Examination in the shop with a VTVM revealed that, where the service data called for 35,000 ohms between the filament of the 5U4G and the chassis, only 180 ohms existed. A further check showed that, equipped with a new rectifier, the power supply, including all the high-capacity filters, was in working condition. Various by-pass capacitors that might be defective were tested, but none were found to have a serious leakage resistance. The rather baffling question, then, in an apparently simple problem was: What was causing a reading of 180 ohms everywhere in the main B+ circuit beyond the 0.25 amp. fuse?

The answer lay in a 25-mc. bifilar coil, coupling a 6AU6 fourth video IF amplifier to the video detector. As is known, primary and secondary windings on this type of coil are close-wound together to produce over-coupling and double-hump response. The insulation between primary and secondary in the defective component had broken down allowing the full output of the power supply to be fed through a 5600 ohm plate decoupling resistor to ground. With excessive voltage across it, the resistor decreased in value to 180 ohms; no doubt when the set owner inserted the 0.5 amp. fuse. Necessary replacements were made and the receiver restored to operation.

It was observed that with a 5600 ohm decoupler the voltage applied to the plate of the 6AU6 was considerably above the 300 volt maximum rating of the tube. This perhaps accounted for the eventual breakdown of the IF coil due to the electrical pressure between primary and secondary being greater than the resistance of the winding insulation. The plate decoupling resistor was replaced with a 15,000 ohm 1-watt unit, which brought the plate voltage within the recommended maximum.

An *open* RF or IF coil due to a winding that has melted or broken as a result of excessive operating voltages, thermal expansion and contraction, or electrolysis, is common. A *shorted* coil, producing the described effect, is apt to take us by surprise unless we remember the peculiar construction of bifilar components. The experience gained in the instant case can be used to advantage on nearly any make of TV receiver.

William Rittenour
Huntington, West Virginia

SUPPLEMENTARY TUBE TESTER SETTINGS

Listed below are important additions to the roll charts for Sylvania Tube Tester Models 137, 139, 140, 219, 220 and 620. Make sure your charts are completely accurate and up-to-date by adding these important facts now.

MODELS 137—139—140 TUBE TESTER SETTINGS

TYPE	A	B	C	D	E	F	G	TEST
6EM5	6.3	0	4	0	4	026	23	Y
	6.3	0	6	0	4	024	23	Y
6EW6	6.3	0	—	0	4	36	32	V
12AF3	12.6	0	3	0	4	—	17	Y
12DS7	12.6	0	—	0	3	67	37	X
	12.6	0	—	0	1	—	84	T
	12.6	0	—	0	4	—	84	T
12DT5	12.6	0	4	0	4	026	24	Y
	12.6	0	6	0	4	024	24	Y
12DV7	12.6	0	5	0	3	7	76	T
	12.6	0	5	0	2	—	63	X
	12.6	0	5	0	5	—	63	X

SPECIAL TEST

TYPE	A	B	C	D	E	F	G	TEST
12ED5	12.6	0	5	0	3	26	20	X
	12.6	0	2	0	3	56	20	X
17DE4	12.6	0	7	1	3	—	17	Y
18FW6	12.6	0	—	0	4	36	33	W
18FX6	12.6	0	—	0	5	3	59	X
	12.6	0	—	0	4	64	33	V
18FY6	12.6	0	—	0	3	3	47	T
	12.6	0	—	0	4	—	55	T
	12.6	0	—	0	5	—	55	T
32ET5	35	0	5	0	3	26	24	Y
	35	0	2	0	3	56	24	Y
36AM3	35	0	6	0	4	—	18	Y
	35	0	6	2	4	—	18	Y
7199	6.3	0	—	0	2	067	64	W
	6.3	0	—	0	1	5	20	W

MODELS 219 AND 220 TUBE TESTER SETTINGS

TYPE	A	B	C	D	E	F	G	K
6EM5	6.3	4	56	17	5	013Z	9	7
	6.3	4	35	17	5	016Z	9	7
6EW6	6.3	3	4	67	4	16SU	5	2
12AF3	12.6	4	25	12	4	Z	9	1

USE EXTERNAL ADAPTER

TYPE	A	B	C	D	E	F	G	K
12DS7	12.6	4	5	25	5	37SU	6	8
	12.6	4	5	39	5	T	1	8
	12.6	4	5	39	5	T	9	8

(Cont'd)

TYPE	A	B	C	D	E	F	G	K
12DT5	12.6	4	56	19	5	013Z	9	7
	12.6	4	35	19	5	016Z	9	7
12DV7	12.6	4	159	37	5	7T	6	8
	12.6	4	589	44	5	T	2*	1
	12.6	4	589	44	5	T	3*	1
12ED5	12.6	3	45	15	4	26V	7	1
	12.6	3	24	15	4	56V	7	1
17DE4	19.0	7	8	11	8	Z	5	3
18FW6	19.0	3	4	45	4	16Z	5	7
18FX6	19.0	3	4	40	4	067T	5	2
	19.0	3	4	30	4	1X	6	2
18FY6	19.0	3	4	35	4	1T	7	2
	19.0	3	4	40	4	T	6*	2
	19.0	3	4	40	4	T	5*	2
32ET5	35.0	3	24	18	4	56Z	7	1
	35.0	3	54	18	4	26Z	7	1
36AM3	35.0	3	46	12	4	Z	5*	7
	35.0	3	46	12	6	Z	5*	7
7199	6.3	4	58S	50	5	037Z	2	6
	6.3	4	56	15	5	9Y	1	8

MODEL 620 TUBE TESTER SETTINGS

TYPE	A	B	C	D	E	F	G	K
6EM5	6.3	4	56	17	5	013Y	9	7
	6.3	4	35	17	5	016Y	9	7
6EW6	6.3	3	4	67	4	16RT	5	2
12AF3	12.6	4	25	11	4	Y	9	0
12DS7	12.6	4	5	23	5	37RT	6	8
	12.6	4	5	40	5	S	1	8
	12.6	4	5	40	5	S	9	8
12DT5	12.6	4	56	19	5	013Y	9	7
	12.6	4	35	19	5	016Y	9	7
12DV7	12.6	4	159	39	5	7S	6	8
	12.6	4	589	47	5	S	2	1
	12.6	4	589	47	5	S	3	1
12ED5	12.6	3	45	14	4	26U	7	1
	12.6	3	24	14	4	56U	7	1
17DE4	25A	7	8	11	8	Y	5	3
18FW6	19.0	3	4	45	4	16Y	5	7
18FX6	19.0	3	4	44	4	067T	5	2
	19.0	3	4	28	4	1W	6	2
18FY6	19.0	3	4	37	4	1S	7	2
	19.0	3	4	42	4	S	6	2
	19.0	3	4	42	4	S	5	2
32ET5	35.0	3	24	18	4	56Y	7	1
	35.0	3	54	18	4	26Y	7	1
36AM3	35.0	3	46	11	4	Y	5	7
	35.0	3	46	11	6	Y	5	7
7199	6.3	4	58R	53	5	037Y	2	6
	6.3	4	56	15	5	9X	1	8

SYLVANIA NEWS

TECHNICAL SECTION

SEPTEMBER 1959

VOL. 26, NO. 8

R. A. HUMPHREYS, TECHNICAL EDITOR This information in Sylvania News is furnished without assuming any obligations.

A THIRD CHANNEL FOR STEREO

by

W. J. Sember, Receiving Tube Operations

The past eighteen months have seen a phenomenal growth in sales of stereophonic sound systems for use in the home. From the early systems, which were in most cases developed merely by adding a second channel to already existing Hi-Fi equipment, new and better methods of stereo reproduction have been developed These newer methods have taken stereophonic sound out of the novelty class, and placed it in the position of realistic and exciting home entertainment; and the maintenance of these home entertainment centers should enhance the business of any serviceman.

EARLY STEREO SYSTEMS

Much has been learned of the true nature of stereo reproduction in the relatively short time since equipment became widely available. It was first thought that to produce stereo sound, all that was needed was two separate sound channels. Thus, the equipment manufacturer provided the two channels; but in many cases this equipment was not balanced internally, either in stages of gain or in quality of the speakers in the two channels. It was later learned that along with providing two channels of stereo, it was desirable to provide these two channels with no phase difference so as not to cause a loss of the true stereo effect. A system with unequal stages in the two channels, where, for example, one channel has an even number of stages, and the other channel has an odd number of stages, may display an undesirable phase difference between the two channels. In a system such as this, if the speaker separation is too great or if speaker phasing has not been used to correct for the overall phase difference, a "hole in the middle" or loss of the stereo effect will occur in the area between the speakers.

THREE-DIMENSIONAL EFFECT

On many of the early stereo demonstrator records, a phase difference of this type was not critical, since most of these attempted to emphasize this "ping-pong" effect or sound from two sources. Demonstrator records of a bowling ball rolling down an alley and a railroad train going by were nice to listen to once, but the novelty of living in a bowling alley or next to a railroad track was bound to wear off. Even some early musical records in stereo showed only a little improvement over regular Hi-Fi. Critical manufacturers began to explore the possibilities of true, three-dimensional stereo, rather than stereo for directional effects only. That is, stereophonic reproduction which produces a "curtain of sound" in front of the listener; sound which has depth and realism, rather than just right and left.

In studying this true stereo effect, it soon became obvious that phasing of the program material was perhaps the most critical factor in producing this effect. It was also learned that the stereo records did not always end up with the same phase relationship in which they started, and that recordings from different manufacturers differed in phase relationships between the two channels; both of which may cause loss of the true stereo effect. It became obvious that a method had to be devised to reproduce stereo sound such that a change of phase in the two channels did not cause this loss.

THIRD CHANNEL PRODUCES A "CURTAIN OF SOUND"

While these improvements were being devised in stereo reproduction, a great stride was made in stereo recording methods. While earlier stereo recordings were cut with directional microphones as shown in Figure 1 to give directionality to the sound, it was soon learned that more of the true stereo effect could be captured if the method of recording shown in Figure 2 was used. Three or more non-directional microphones are used to provide the two channels of stereo. Each microphone "hears" all the sound from the orchestra, but with different levels from different directions. The third or "center" channel is blended into the two outside channels by the recording engineer to provide the two separate signals for the stereo cutter.

It is obvious that the quality of the

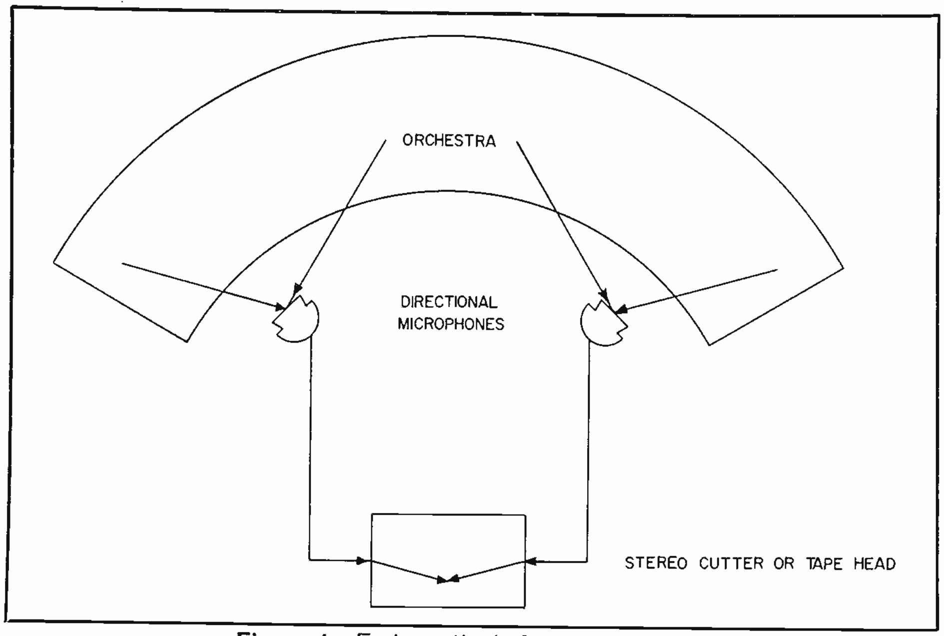


Figure 1—Early method of stereo recording.

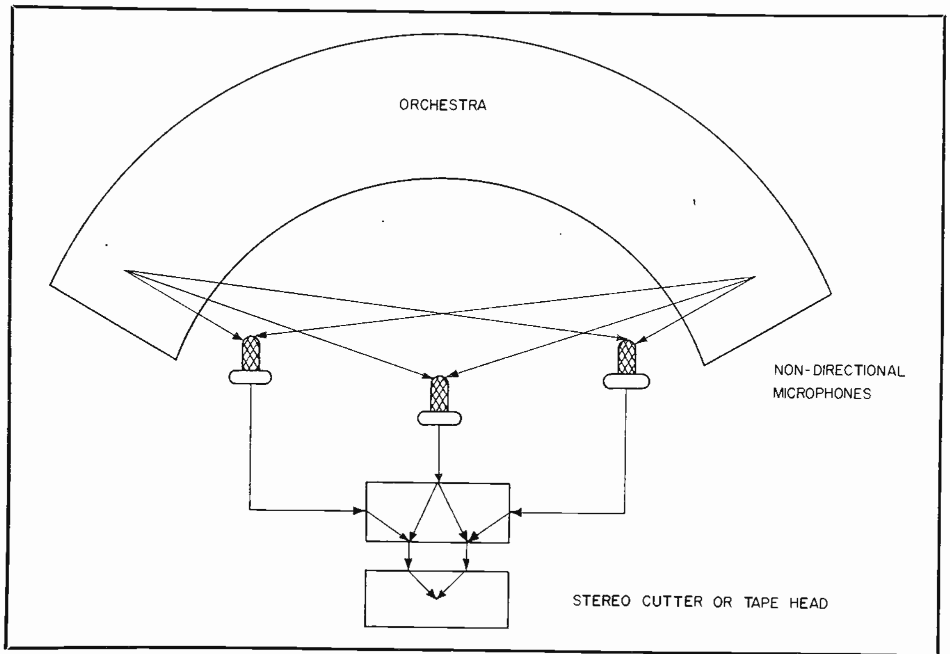


Figure 2—Later method of stereo recording.

stereo recording is influenced to a great extent by the skill of the recording engineer; but the immediate result of the use of this method of recording was that the overall quality of stereophonic recordings improved greatly. The music on these records seemed to have more "body"; and the stereo system produced the desired "curtain of sound" in front of the listener. The listener could still "place" individual instruments, but the sound was blended so he could hear them naturally, with both ears. Thus, the directional effect was still present, but it was obtained by having unequal levels coming from two speakers, rather than by having all the sound from one side of the orchestra coming from one speaker. This sound was interlaced in the area between the speakers to provide an overall region of sound rather than sound from the right and sound from the left. Speaker position becomes less important, since it matters little to the average listener whether the violins are on the left or the right, so long as the overall "curtain of sound" is present.

The quality of sound from the older equipment was greatly improved by these newer stereo records; but as the stereo material improved, there was also the drive to improve on stereo reproduction. It was determined that frequencies below 300 cycles contributed little to the overall stereo effect. At these low frequencies, the wavelengths of the sound waves are so long that the distance between the ears is not an appreciable part of a wavelength, so the head does not mask the sound between the ears. Since it is difficult to determine directivity at these low frequencies, they contribute very little to the overall stereo effect.

RECENT STEREO DEVELOPMENTS

This principle is utilized in the new equipment shown in Figures 3 and 4. Separate low, mid and high-frequency speakers are used in the amplifier to provide an effective third channel. The "woofers" from both channels are housed in the main console, while the mid and high range speakers from the two channels are housed in the "wings" or exten-

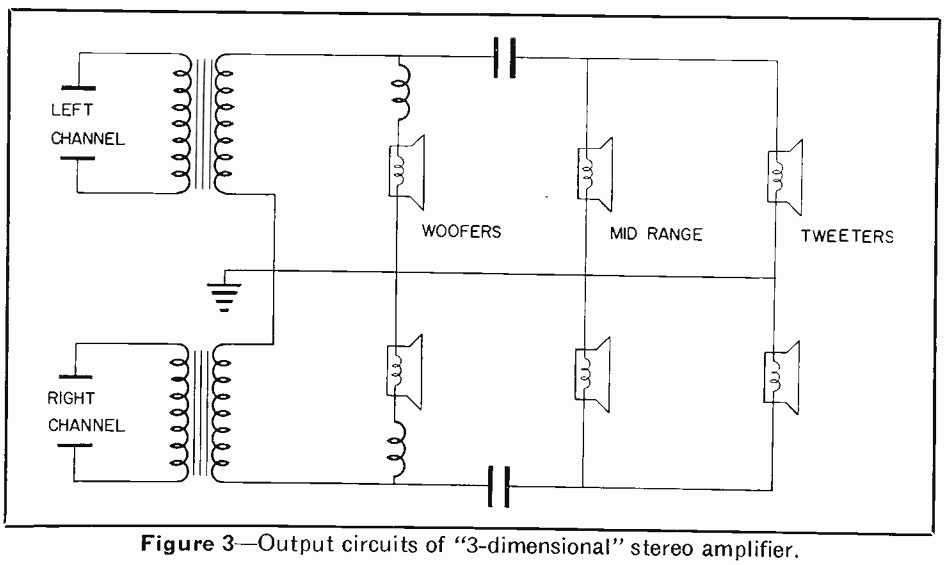


Figure 3—Output circuits of "3-dimensional" stereo amplifier.

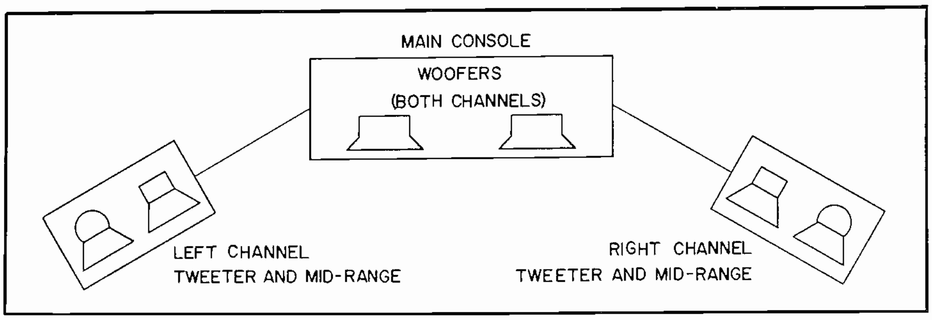


Figure 4—Physical speaker layout of "3-dimensional" stereo console.

sions of the console. The result is a greater area of sound source, which permits greater separation of the two extension speakers without loss of the true stereo effect. The phasing of the two channels becomes less important, since the "woofers" fill any "holes" which might appear in the center of the "curtain" due to phase differences. This amplifier also uses two identical channels of amplification.

The previously mentioned principle of the loss of directional effects at low frequencies has led to the development of the Dual Voice Coil Woofer, specially for stereo use. This speaker actually has two separate voice coils on the same cone, one for the low frequency notes from each channel. It thus combines these "lows" to provide the center channel.

Another method of providing the third or "phantom" channel is shown in Figure 5. A tapped potentiometer between the two channels is used to provide a signal to a third power amplifier which feeds a full-range speaker. Both outside channels also use full-range speakers. The potentiometer is appropriately called a "focus" or "stereo centering" control, because it appears to move the center of the orchestra.

STATUS OF PRESENT DAY STEREO

These latest improvements in the quality of stereophonic reproduction have placed it in the status of high-quality home entertainment. Present-day stereo has a depth of realism that has to be heard to be believed.

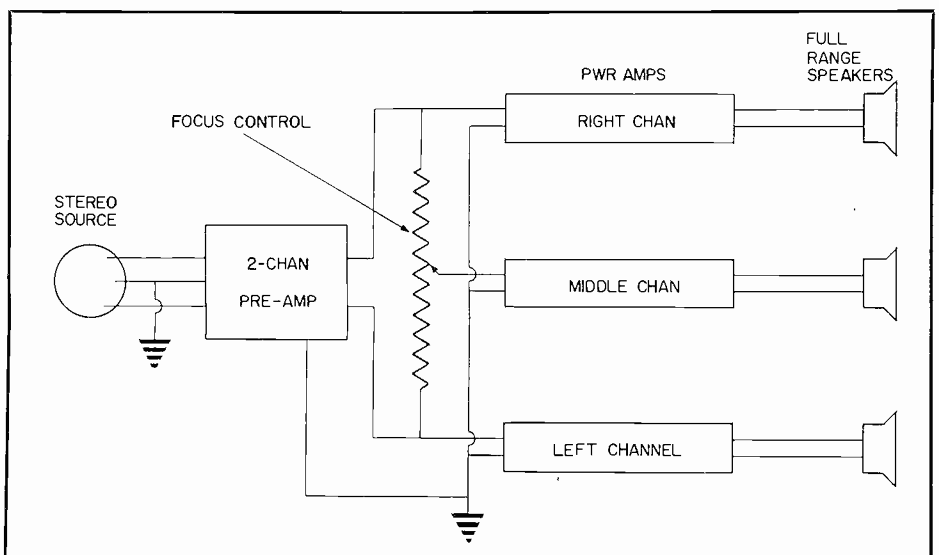


Figure 5—A method of obtaining a third or "Phantom" channel from two-channel stereo.

SERVICE HINTS

TIGHT GOVERNOR ASSEMBLY

The governor assembly of a signal seeker auto radio is no doubt too tight if the tuner does not respond to the touch bar. To alleviate, simply pry up on the cross-bar bearing until the governor runs free when the touch bar is depressed. Do not oil, as this assembly must operate smoothly over a wide temperature range (winter to summer driving).

Harry Miklasz
Chicago, Illinois

SOLDERING IRON ALWAYS TINNED

To keep the tip of your soldering iron bright and fully tinned, heat the tip area to be tinned with an alcohol torch and apply Silver Solder and powdered borax flux. Since the tip will never reach the temperature at which Silver Solder melts, the iron will always stay clean and ready to use.

Floyd A. Roberts
Kearney, Nebraska

BALLPOINT PROBE

Don't discard those empty 8 inch long ballpoint pens. They make dandy insulated test probes for those out-of-reach test points on radio circuits. Since the insulated hulls are not tapered, they can also be used for insulated sections behind alligator clips, etc.

Roy Inlow
San Francisco, California

INTERMITTENT MOTOR DETECTOR

The relays on the motor control of the "600" series Zenith Space Command T.V. Unit are very small. This makes it difficult to see if the contacts are closed. A simple check to see that the contacts are closing can be made by connecting a test light (preferably a 25-watt bulb) to the motor control socket. Intermittent motor operation will cause the bulb to light-up, making it very easy to spot while doing other bench work.

Lee LeBoeuf
Opelousas, Louisiana

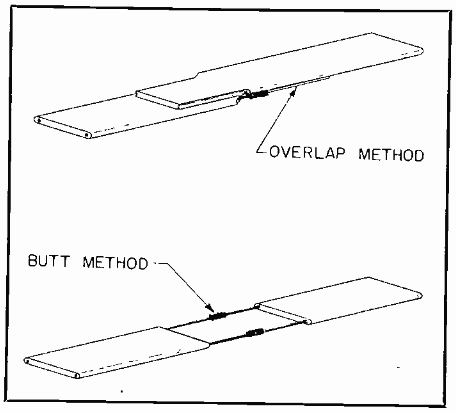
VARIABLE LINE VOLTAGE SOURCE

In order to check a 3-way portable receiver's ability to operate at reduced line voltage, a variable line voltage source was needed. Not having a Variac, I installed a 110 volt outlet on the panel of my tube tester and connected it to the filament selector switch. By means of the switch and line adjustment pot, the line voltage to the portable receiver can be varied to a point where the portable cuts-out. (Make certain that the set does not exceed the filament transformer rating of your tester.) I have found that if the portable can operate with a line voltage of 95V, it is unlikely to cut-out in the customer's home.

John E. Hopkins
Willimantic, Connecticut

ANTENNA SPLICE

When it is necessary to splice antenna lead-in, the 'overlap' method shown



will result in a much stronger splice as compared to the common "butt" method. After the splice is made, the overlap is secured with tape.

R. Bestoso
Middletown, R. I.

HEMOSTATS

Hemostats, such as are used by surgeons for clamping blood vessels, effectively hold leads in place while soldering since they lock when closed. Due to the fact that they have fine, matching teeth, they will hold the leads of condensers, resistors, transistors, etc. without slipping. They are also very thin, and fit nicely in narrow places.

Hemostats can be obtained in various sizes from surgical supply houses; your local surgeon may have used ones.

E. M. Prentke
Shaker Heights 20, Ohio

SPEAKER CONE ALIGNMENT

Off-center speaker cones can be easily repaired by removing the felt dust protector so that the magnet can be seen from the face side. With a screw-driver, pry gently on the side that is rubbing against the coil form. For more delicate speakers, we suggest bending the frame slightly. After centering, reconnect the dust collector with a good dope cement.

Roy Nakano
South Bend, Indiana

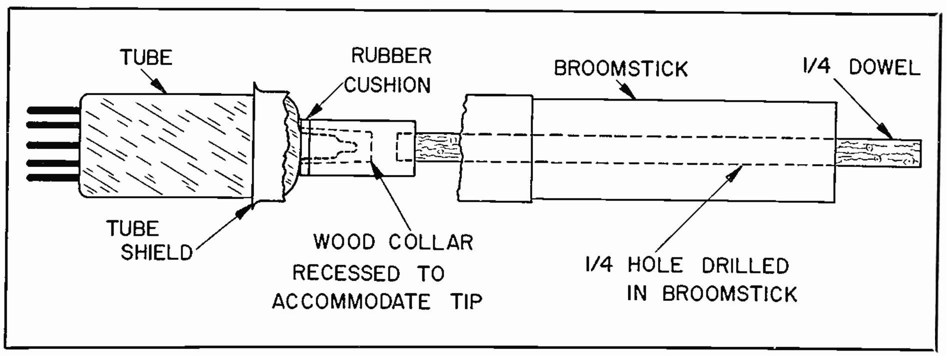
TUBE INSERTER

The gadget shown below can be quite a time saver when inserting miniature tubes in hard-to-get-at sockets. Materials needed include a 7 and/or 9 pin tube shield; a 6″ length of broomstick and an 8″ piece of ¼″ dowel.

To construct: Drill a ¼″ hole lengthwise in the broomstick; cut or grind off the closed end of the tube shield; drive broomstick into end of shield and shove the ¼″ dowel into the hole drilled in the broomstick. Depending on the type of shield used, the broomstick may need to be tapered slightly.

To use, place tube into shield end of inserter, press tube in socket and release it from inserter by pressing end of dowel with thumb. To prevent breaking the tube tips, avoid placing excessive pressure on the dowel.

W. L. Schloeder
Los Angeles 29, California



DEMAGNETIZE TAPE RECORDER HEADS

A solder gun is an excellent demagnetizer for tape recorder heads, watches, tools, etc. Just pass the object to be demagnetized between or near the two poles of the solder gun with the switch "on".

Roy Nakano
South Bend, Indiana

VIBRATORS

Upon inserting a new vibrator in an auto receiver, it may fail to operate especially if it has been laying around for quite sometime. This is due to tungsten oxide coating forming on the contacts.

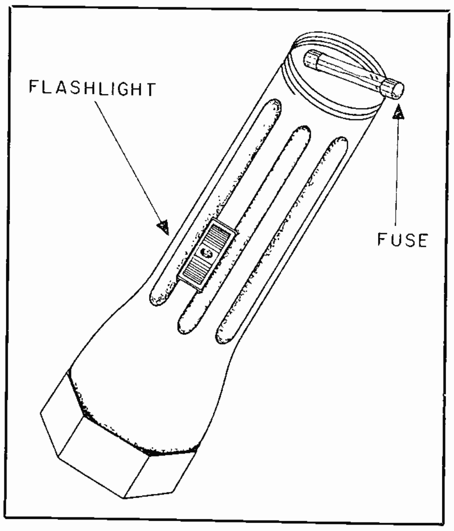
The contacts may be restored (cleaned) by applying 110 volts a. c. to the vibrating reed through a 40 watt lamp for at least half a minute. Actually, six or seven minutes will do no harm.

E. L. Deschambault
St. Romuald, Quebec, Canada

SIMPLE FUSE CHECK WHILE ON SERVICE CALLS

To check any small T.V. or radio fuse in the field, simply remove the back cover of your two-cell flashlight; turn the switch to the "on" position; and hold the fuse, as shown below, so that one end rests on the end of the battery and the other end on the rim of the flashlight. (Rating of fuse must be greater than current drawn by bulb.) If the fuse is good, the flashlight bulb will light. The brilliance will be in proportion to the size of the fuse.

Harry Haskins
Green Bay, Wisconsin



SYLVANIA NEWS

TECHNICAL SECTION

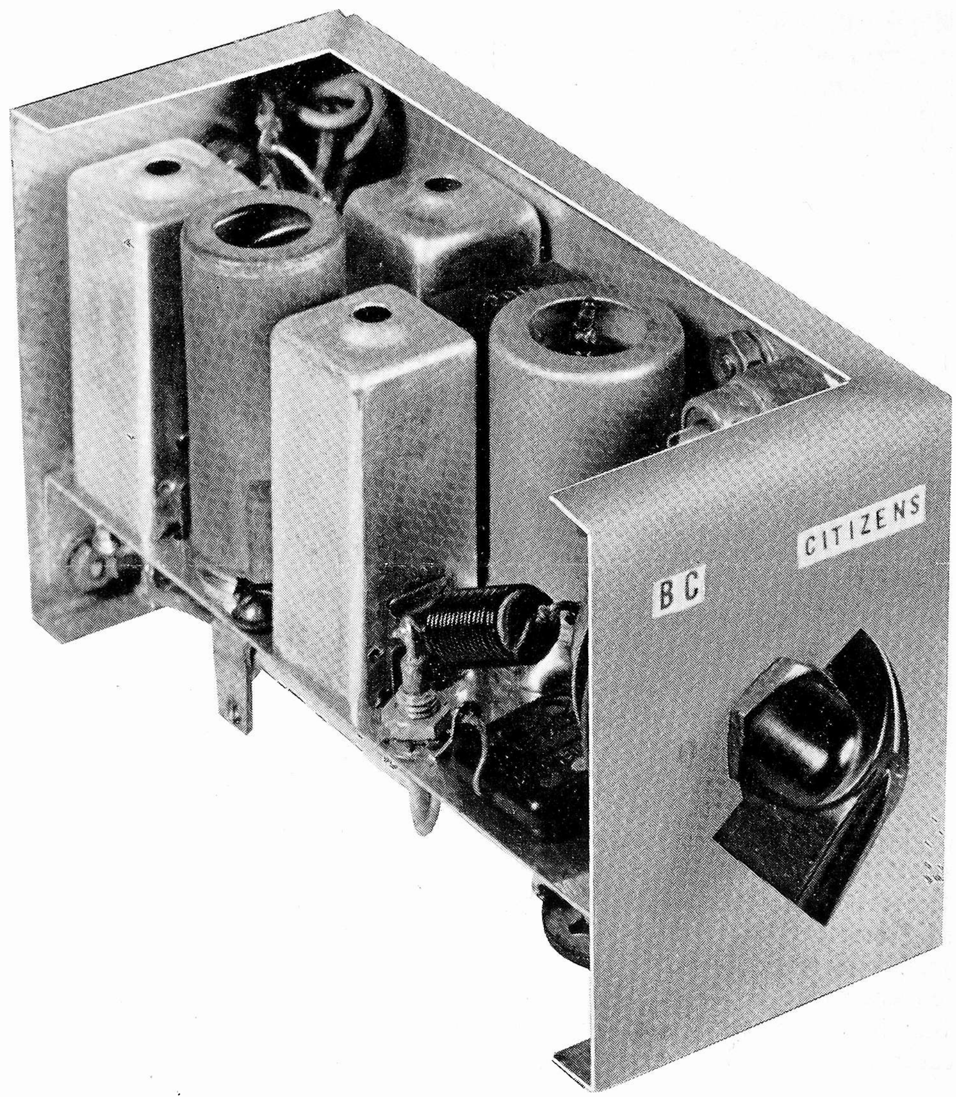
OCTOBER 1959

VOL. 26, NO. 9

R. A. HUMPHREYS, TECHNICAL EDITOR

DELUXE CITIZEN'S BAND (MOBILE OR FIXED) CONVERTER

by
W. K. Boots, Field Engineer
Receiving Tube Operations



The concept of using a converter ahead of a standard broadcast receiver for short-wave reception is not new; nor are the advantages to be gained, such as adaptation of existing equipment with little or no modification. With the opening of the "11-meter band" for Citizens Radio Communication, an 11-meter converter for automobile broadcast receivers would seem to be a most desirable and inexpensive approach to obtaining a mobile citizen's band receiver.

The converter described below was originally designed for mobile use on 10-meters, where it proved to be exceptionally stable and sensitive. Its modification for 11-meter service is a natural adaptation of the circuit. The only changes required are insertion of a different crystal and retuning the coils. There is no significant change in performance in making these slight modifications on the original model.

In operation, the converter circuit does not require adjustment and station selection is accomplished by tuning the broadcast receiver dial, thus permitting push-button channel selection with receivers so equipped. A 6500 Kc crystal, provides direct

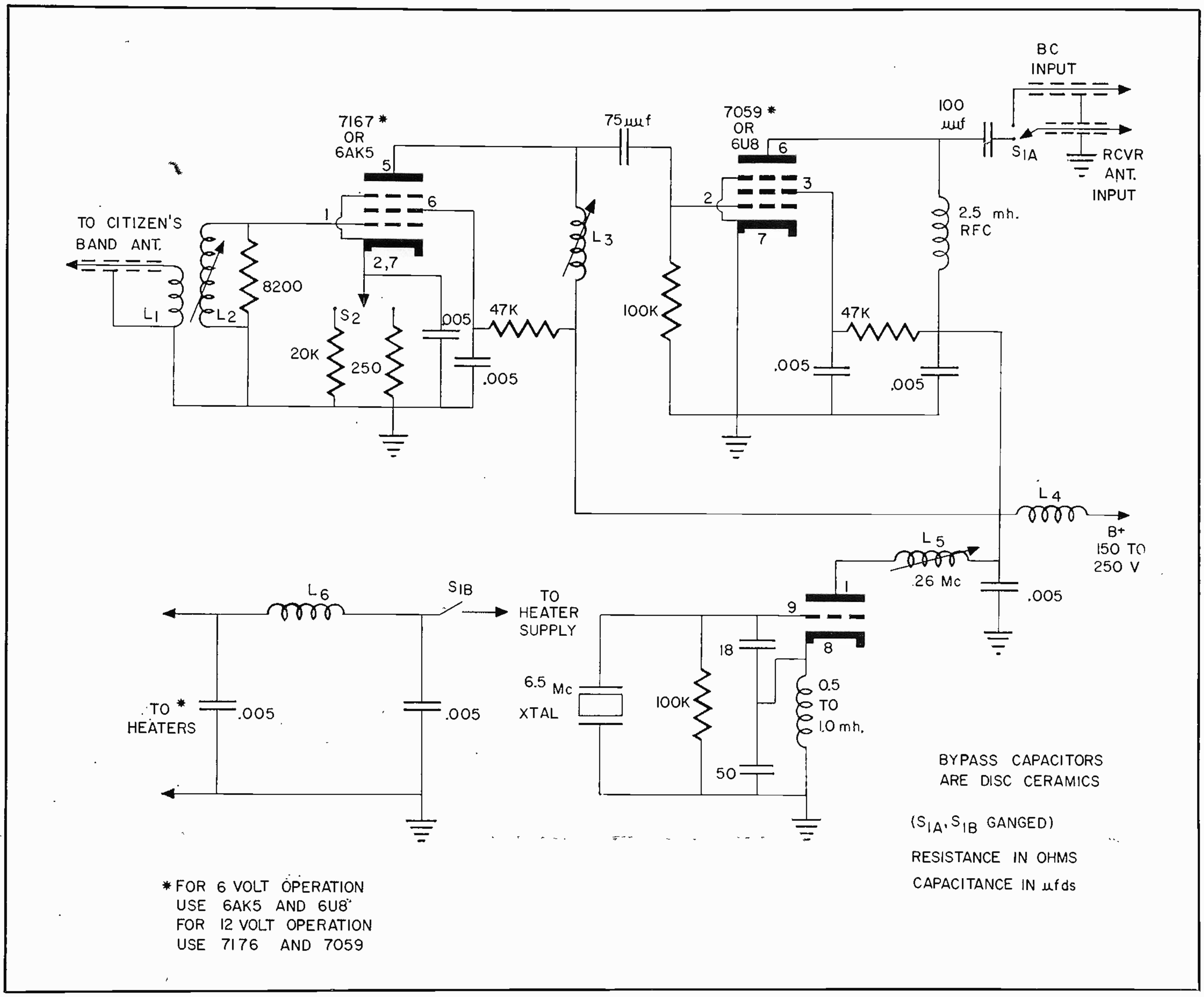


Figure 1—Circuit diagram of Citizen's Band (Eleven Meter) Crystal Controlled Converter.

logging on the broadcast band, i.e., 26.965 Mc tunes at 965 on the dial, etc. While this method differs slightly from conventional superheterodyne systems inasmuch as the intermediate frequency (broadcast band) is variable; it retains the image rejection features of double conversion.

CIRCUITRY

The circuit shown in Figure 1 is conventional in that it uses a 6AK5 for the broad-band RF amplifier, and a 6U8 for the oscillator-mixer. The oscillator employs a quartz crystal which is operated on the fundamental frequency to provide good frequency stability. The fourth harmonic of the crystal frequency is resonated in the 6U8 triode section plate circuit. Oscillator signal injection to the mixer grid is automatically provided by the built-in tube-lead and socket capacitances between the triode section plate and the adjacent 6U8 pentode section control grid. A satisfactory 6500 Kc crystal, mounted in an FT-243 or smaller holder, may be obtained from the various crystal suppliers or the surplus market.

If so desired, the Types 7167 and 7059, which have 12 volt heaters and are designed for dependable heater operation in mobile communication equipment, can be used in place of the 6AK5 and 6U8. Also, the plate and screen voltages may be obtained from the receiver power supply, providing it will accommodate the additional load, or an auxiliary pack capable of delivering 125 volts at 15 to 20 milliamperes.

The strong-signal handling capabilities of such a converter could be improved by adding AVC bias to the RF stage. Since this necessitates digging into the receiver wiring, this feature is generally not included for a "connect-on" converter. However, a manual "local-distance" switch, S_2 is incorporated in the converter.

CONSTRUCTION

Construction of the converter is not critical in that considerable leeway is permissible in the parts layout, as well as, in the choice of components. The unit is housed in a Bud Minibox, measuring 2 x 3 x 5 inches, which was modified to include a shelf. The component placement shown in Figures 2 and 3, proved to be desirable especially from the standpoint of wiring ease.

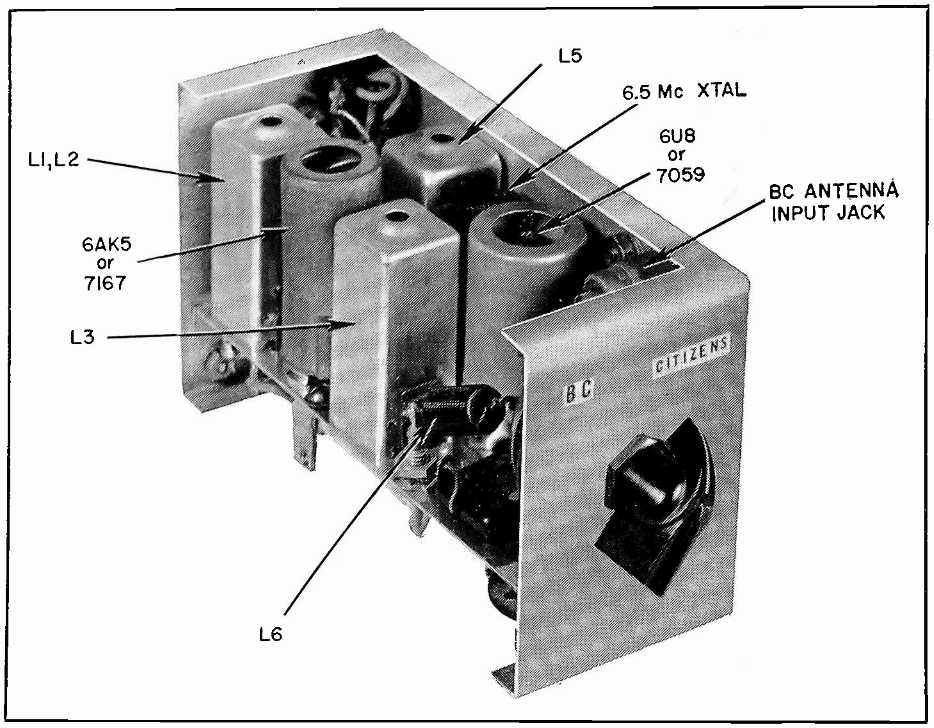


Figure 2—Citizen's Band Converter with cover removed. Note placement of component parts. Entire unit measures only 2 x 3 x 5 inches.

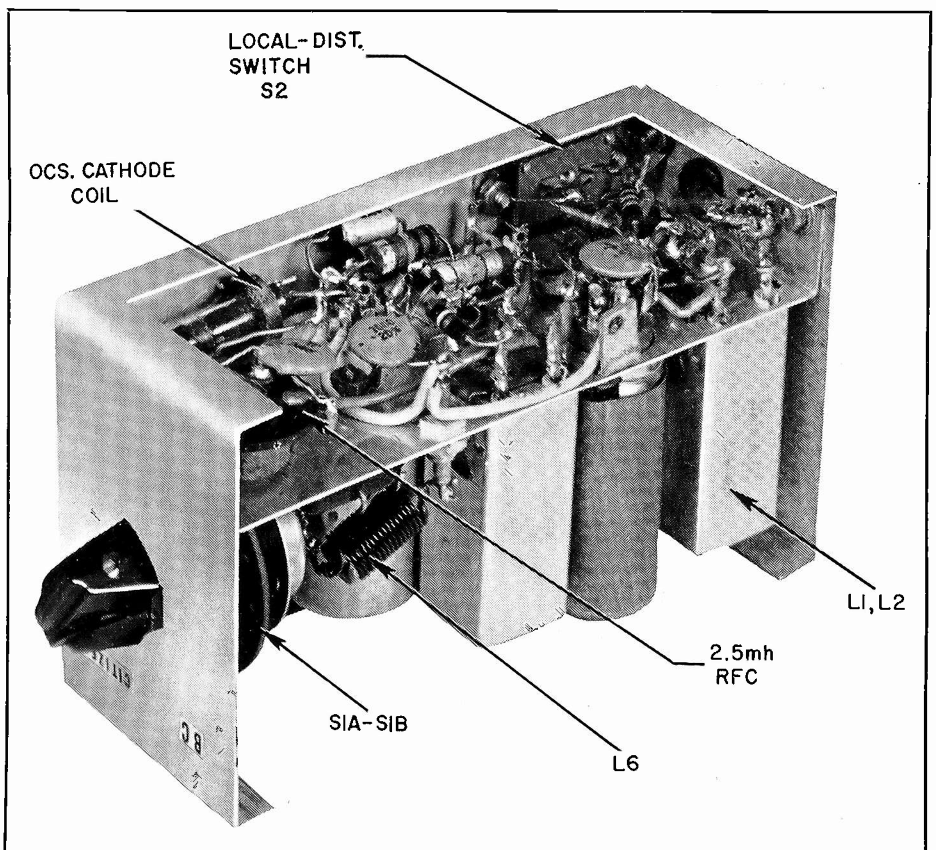


Figure 3—Under chassis view of Citizen's Band Converter. Note simplicity of wiring.

The RF, mixer and oscillator coil forms, L_2, L_3 and L_5, complete with shield cans were salvaged from an old 40 Mc television IF strip and easily modified for 27 Mc operation per the coil data presented in Table I.

TABLE I

Coil Data

L_1, L_2, L_3, L_5—5/16″ diam. slug-tuned shielded forms

L_1—3 turns #20 e close-spaced, wound over grounded end of L_2

L_2, L_3, L_5—20 turns #30 e close-spaced

L_4—20 turns #28 e close-spaced on 1/4″ diam.

L_6—10 turns #20 e close-spaced on 1/4″ diam.

The builder can minimize undesirable stray coupling and thereby insure foolproof operation by adhering to standard (good practice) wiring methods; i.e., use short leads and common grounds for each stage.

ALIGNMENT

Alignment of the converter is straight-forward. The oscillator plate circuit, L_5, is tuned for maximum signal injection (4th harmonic of the crystal) to the mixer grid. A VTVM is helpful for this adjustment; a reading of approximately two volts dc developed at the mixer grid is adequate for good performance. Other methods will also serve, such as adjusting the triode plate inductance, L_5, for maximum indication on the S-meter of a communications receiver, or absorption-type wavemeter tuned to the fourth harmonic of the crystal.

With the converter output coupled to the antenna input of a broadcast receiver, optimum tuning for the mixer grid circuit can most readily be accomplished with the aid of a signal generator. Simply connect the signal generator output to the converter antenna input and set the dial to about 27 megacycles. Keep in mind that the broadcast receiver must be tuned to about 1000 kilocycles in order to receive the 27 Mc signal with a 6500 Kc crystal in the converter. Adjust the mixer grid inductance, L_3, for maximum output from the broadcast receiver, using as weak a signal from the signal generator as practicable. This is necessary for proper alignment of the mixer free from "flattening" effects caused by AVC action in the receiver. The RF stage tuning is not critical since it is purposely broad-banded.

It is recommended that the antenna input transformer, L_2, be adjusted for maximum performance with the converter connected to the antenna system with which it will be used. "On-the-air" signals serve well for this adjustment; although, tuning for maximum noise can provide satisfactory performance.

CONCLUSION

While the converter described is intended primarily for use with automotive broadcast receivers, it will perform equally as well in fixed installations with "any" broadcast receiver. It should be noted, however, that full use of its preselection capabilities cannot be achieved unless adequate receiver input shielding is employed. While an auto radio meets this requirement, home radios may not. If the home radio with which the converter is to be used employs a loop antenna, a switch must be provided to disconnect the loop when the converter is in use. Otherwise, standard broadcast signals will continue to be received, thus interfering with the desired Citizen's Band signals. Additional shielding of the input circuit may be required, even in receivers that do not employ loop antennas. This will be determined by the amount of broadcast feed-through with the converter operating.

A refinement to enhance mobile performance would be the inclusion of a noise limiter in the auto receiver. The incorporation of the "TNS Noise Squelcher," as described in the May 1953 issue of C.Q., is a most worthwhile project. This addition also permits receiver silencing during stand-by.

SERVICE HINTS

PROTECTIVE SOLDERING

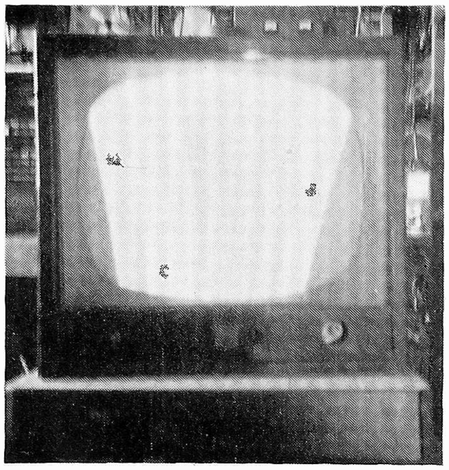
When using a soldering gun it is not uncommon to accidently burn other leads which may be rather close-by. This can be prevented by wrapping a piece of asbestos around the hot leads leading to the tip. Stapling the asbestos will keep it in place.

M. W. Thompson
Toronto, S. D.

EASY ACCESS TO TUNER TUBE

In order to replace a tuner tube in some of the older model TV sets, the serviceman has to remove the chassis from the cabinet. This task can be simplified (provided you have the set owner's permission) by cutting a 4 by 4 inch hole in the bottom of the cabinet directly beneath the tuner tube. Be sure to cover the hole with a screen for safety.

Hubert J. Dixon
Churseburco, Indiana



PICTURE KEYSTONED HORIZONTALLY

Although the effect seen in Figure 1 is known to most servicemen as "Keystoning," the cause was slightly different. Most sets exhibiting this defect are found to have defective horizontal deflection yokes; but this particular model had an open winding in the plate circuit of the horizontal output transformer.

Robert E. Redd
Union Furnace, Ohio

ADDITIONAL EYE

When inserting a Stylus or Crystal in a Phono arm, most of us have trouble losing screws and seeing what we are doing. A compact mirror, placed in the bottom of a small can, will not only give you a view of the under side of the Phono arm but will catch screws if they should drop.

F. L. Brenton
Mason City, Iowa

ELIMINATE SPEAKER RATTLE

You may be able to eliminate speaker rattle and/or cone distortion by simply inserting some ordinary absorbent cotton between the back of the speaker cone and its chassis. This is an emergency remedy which can be used on car radio speakers; the small cotton pads take up rattles nicely.

J. Perkinson
Miami, Florida

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SYLVANIA NEWS

TECHNICAL SECTION

NOVEMBER DECEMBER 1959
VOL. 26, NO. 10

R. A. HUMPHREYS, TECHNICAL EDITOR This information in Sylvania News is furnished without assuming any obligations.

WHAT THE SERVICEMEN TOLD TASO

By E. H. BODEN Advanced Application Engineer Receiving Tube Operations

Late in 1957, the Television Allocations Study Organization (TASO) sent approximately 9,000 questionnaires to television servicemen throughout the United States to probe the problems involved in installing and maintaining antennas, transmission lines, the receiver itself and allied accessories on both VHF and UHF. TASO sought to tap the vast knowledge and experience of the servicemen on all phases of television reception.

ESTABLISHMENT OF TASO

TASO was established by request of the Federal Communications Commission for collecting and examining those factors which should be applied to the allocations of television channels. Two hundred seventy one engineers from 139 companies (9 from Sylvania) worked for two years in the preparation of the report which has now been transmitted to the Honorable John C. Doerfer, Chairman of the Federal Communications Commission, Washington D. C.

The Engineering part of TASO worked under the direction of Executive Director Dr. George R. Town. There were six panels, each with a specific area of study.

PANEL 1—Transmitting equipment
PANEL 2—Receiving equipment
PANEL 3—Field tests
PANEL 4—Propagation data
PANEL 5—Analysis and theory
PANEL 6—Levels of picture quality

Each panel was made up of men who were leaders in the field with which the panel was concerned. The panels were, in turn, made up of committees, sub-committees and task forces. Here again the most qualified men of industry served to collect the massive amount of data which was assembled.

PREPARATION OF QUESTIONNAIRES

Panel 3, with Knox McIlwain of the Burroughs Corporation as Chairman, created committee 3.2 to prepare a questionnaire which would provide the required VHF-UHF television receiver installation, service and repair information. By late 1957, the questionnaire was completed and approximately 9,000 copies were sent out to the servicemen through Service Associations and Manufacturers' Service Organizations.

Space does not permit the printing of all the questions asked, however, for those who did not receive one of the questionnaires, a brief description will now be given.

The questions were in six sections:

A. *General Information*—Name and address of the organization making the report, the area served, number of service calls, number of antennas installed and a list of the stations received.

B. *Receiving Antennas* — Kinds of VHF and UHF, height and lead-in information.

C. *Receivers*—Service problems with various types of receivers on VHF and UHF.

TABLE I

Channel Group	Excellent	Good	Fair	Poor	Avg. Transmitting Station Power
2 - 6	22	37	67	76	88 KW
7 - 13	22	31	55	71	240 KW
14 - 40	15	18	16	27	350 KW
41 - 83	11	13	15	22	330 KW

D. *Multipath Problems*—VHF compared with UHF.
E. *Interference*—Kinds of and comparison of VHF with UHF.
F. *Color Reception*—Kinds of and comparison of VHF with UHF.

DATA HANDLING

In March of 1958, TASO Committee 3.4 was formed with Holmes W. Taylor as its Chairman. The responsibility of this committee was to reduce the data of the servicemen's questionnaires to a form suitable for summarizing and analyzing the results.

The committee received 730 copies of the completed questionnaires from 46 of the then 48 states (Delaware and Vermont not reporting). Of the 541 individually operating stations in the country, the survey covered 427 which represented 79 per cent of the stations.

Each questionnaire received was given a serial number by which it was identified from that time on. The information was coded and transferred to punch cards. A minimum of five cards were required for each questionnaire (those reporting on more than four television stations required an additional card.) Each card contained the serial number of the questionnaire from which the data was taken.

Electronic computers and sorters were then employed to make the desired summations and tabulations.

THE RESULTS

When finally assembled, the data varied in usefulness and importance. Some of the data was obviously of immediate importance, while other data will find use later.

Although the data collected was intended for the Commission's use, much information was of interest and importance to others; in particular those who had a part in its assembly. This was true for all of the panel and committee reports.

In the committee 3.4 report a most interesting and equally important table was computed. This table is included here as Table I.

For this table the distance to all stations reported as excellent were averaged for each of the channel groups shown. Likewise for good, fair and poor.

Table I then is a tabulation of the average distance of an excellent, good, fair and poor picture for each channel group.

On examination of the table, a curious oddity is evident in the channel group 14-40. The good and fair figures appear interchanged. However, because of the low number of UHF reports, the reversal is one of those statistical events which statisticians can show to be a chance event and has no significance. In short, a few more returns would possibly have altered the data somewhat.

The serviceman can get a rough idea from Table I of how well a new station coming on the air in a neighboring town will be received. The answer is found by knowing the channel number and the distance to the station and thus using Table I in reverse. For example, a station on channel 10 and a distance of 40 miles. Consulting the Table, one may safely conclude the signals will be from good to fair. It goes without saying that mountain ranges may cause weaker reception than that indicated by Table I because of shading effects.

Another bit of very informative information came in answer to the question—what type of outdoor antenna have you found most acceptable for reception in weak and strong VHF and UHF signal areas?

The computed percentages are tabulated in Table II.

TABLE II

Percent Antenna Types Most Acceptable

	Corner Ref.	Conicals	Dipoles	Yagis	Bow Ties
Weak VHF	—	25	10	60	—
Weak UHF	35	—	—	28	26
Strong VHF	—	40	30	24	—
Strong UHF	28	—	—	13	43

From Table II we learn that 60 per cent of the servicemen selected yagis in a weak VHF area while 35 per cent used corner reflectors in a weak UHF area.

It was also learned that for transmission line 82-94 per cent of the servicemen installed flat twin lead for VHF reception while 83-87 per cent used tubular twin lead for UHF. Sixty per cent of those in combined VHF and UHF areas installed separate lead-ins for reception of VHF and UHF while 40 per cent used the same lead-in for both. When installing VHF antennas, 53 per cent of the servicemen explored for maximum signal while 81 per cent explored for maximum signal when installing UHF antennas.

On the subject of ghosts, it was reported that 12 per cent of the VHF sets suffered from ghosts, while 19 per cent of the UHF sets had this trouble. Asked on which sets ghosts were more objectionable, 321 reporters said VHF by 69 per cent, UHF by 18 per cent and both VHF and UHF by 13 per cent.

GENERAL INFORMATION

A tabulation of the reported interference sources at VHF and UHF is found in Table III. Here one learns from the reported data the kinds of interference most troublesome and the relative effects on VHF, UHF or both. Since the ratio of VHF and UHF data was consistently 2:1, the last three columns should be corrected slightly for accuracy. However, such is not necessary in view of the large ratios found under the per cent of interference between VHF and UHF.

Under general information it was learned that servicemen made an average of 6,450 calls per year: 71.5% on VHF sets, 9.6% on sets with UHF converters and 18.9% on sets with combined VHF-UHF tuners. These figures again point out that the ratio of VHF to UHF data was consistently 2:1.

HOW GOOD WAS THE DATA

Data can only receive its proper mark of importance if it is accurate. In this connection the committee included the following statement in its final report.

"A close study of the servicemen's questionnaire indicated that those men who took the time to answer the questionnaire were quite thorough. We received very few questionnaires incompletely filled out. There were, of course, a number of unanswered questions for those areas that had neither UHF, nor color service, and this is the reason for the reduced response in those areas. In cross-checking the total results of various sections of the questionnaire, those which dealt basically with the same problem areas showed a very close correlation. Therefore, we believe this indicates that the serviceman did not just make haphazard guesses, but was particularly reliable in the way he went about answering the questions."

Although the sample size (the 730 returns) was a small percentage of the total number of servicemen in the United States and only those sets requiring servicing were reported on, the committee felt because the data was consistent, that the other servicemen and receivers were statistically represented.

REMARKS

In view of the comments made by the committee, the servicemen may be justly proud of their contributions to TASO and its great efforts. To what degree this or any other data will be used only time will tell. Committee 3.4 drew no conclusions as was true of the other committees and panels. All that can be said in conclusion is that facts have been found and have been reported.

To the Federal Communications Commission goes the task of drawing the conclusions and using them.

TABLE III

Tabulation of Interference Sources at VHF and UHF

	% reporting this kind of interference	% of these on VHF	% of these on UHF	% of these on both VHF-UHF
Ignition	86	92	1	7
Electric Household Devices	70	88	2	10
Amateur Radio Stations	63	92	2	6
Neon Signs	58	94	1	5
Diathermy	50	95	—	5
Power Services	45	89	1	10
TV Rec. Radiation	44	81	7	12
Police Radio	38	78	10	12
AM-FM Broadcast Stations	29	86	6	8
Shortwave Stations	29	91	3	6
Special Services	26	73	11	16
FM Rec. Radiation	21	87	7	6
Standard AM Rec. Radiation	9	85	7	8

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Technical Section Index

August 1958, Vol. 25, No. 7, through December 1959, Vol. 26, No. 10

It does not appear that the method of displaying television just described is likely to meet the criterion of cost, at least for home entertainment. It would appear, offhand, that 490 conductors leading to the vertical commutator and perhaps 550 to the horizontal would be quite expensive. Other approaches have been proposed. For example, the use of a loaded transmission line or a lumped-constant line for horizontal scanning with a lumped-constant line for vertical scanning has been reported.

CONCLUSIONS

Many of the ideas that have been discussed here have been demonstrated, but there remains a great deal to be done in extending these and other schemes to meet the requirements of commercial television. All in all, it appears that the advent of mural television on a commercial basis is not imminent. Before that day arrives, however, there will be ample use for the technique of the Sylvatron and similar devices for other forms of data display such as battlefield surveillance, missile tracking, stock-market listings and many others where high speed and low cost requirements of television will not bar their application.

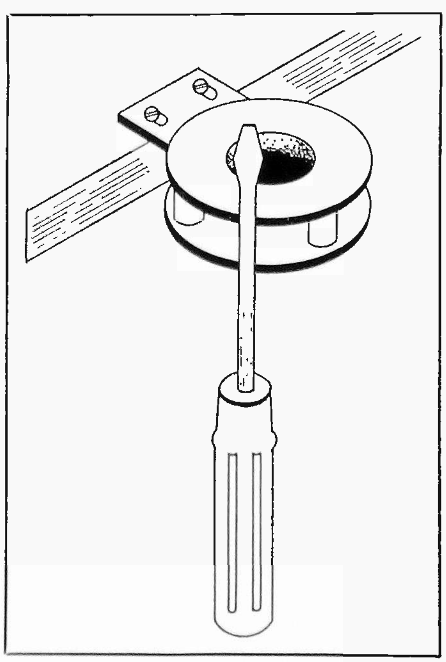
This concludes the series of two articles entitled "Picture on The Wall" Television, the first part of which appeared in the March 1959 issue of SYLVANIA NEWS.

SERVICE HINT

TOOL HOLDER

For those who do not mind magnetized tools, the Ring Magnet illustrated below makes a dandy tool holder. In this case, the ring magnet used was removed from a discarded Picture Tube P-M E-M Focalizer. If more strength for heavy tools is desired, two or more magnets can be stacked.

Austin N. Hubner
Cincinnati, Ohio

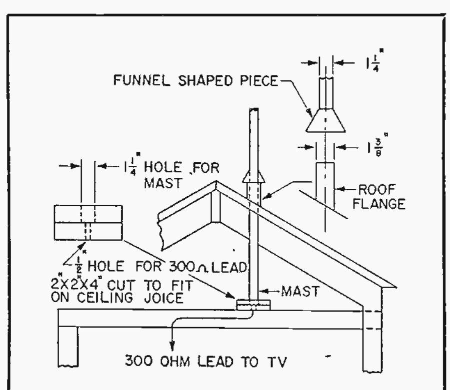


ANTENNA INSTALLATION

For those cases where a customer doesn't mind an antenna mounted through his roof the following method of installation will eliminate any possibility of the roof leaking. As illustrated in Figure 1, the greater the distance between the stud and the roof, the stronger the antenna. This inside distance also determines the length of the mast outside. The roof flange, which is designed to slip under the shingle above it, should be approximately six inches high and have an inside diameter of 1⅜ inches for the mast to slip through. The tight fitting funnel-shaped piece is taped to the mast to prevent water from leaking through the roof flange.

It is then an easy matter to fasten the 300 ohm lead-in to the antenna before dropping it down the mast and out through the ½ inch hole in the 2 x 4. A cork placed in the top of the mast then serves to keep most of the wiring out of the weather. If desired, a rotor can be mounted at the bottom of the mast.

R. Bestoso
Middletown, Rhode Island



FAULTY TAPE RECORDER?

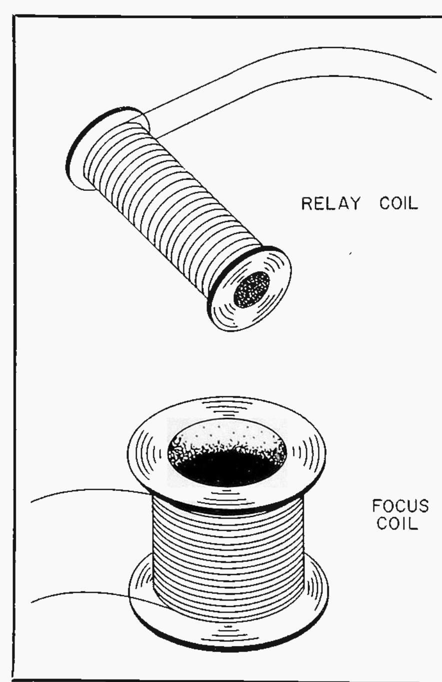
When servicing tape recorders the first step is to determine whether the recording-playback head or amplifier is at fault. The two "Junk-box" items shown in Figure 1, when properly connected, can save plenty of valuable servicing time in the above analysis.

The first is a solenoid which was removed from a relay. It should be between 200 and 400 Ohms D.C. or approximately 1,500 to 2,000 Ohms impedance. This solenoid is made ready for use by merely soldering to it a pair of wires approximately 12 inches long.

The second item is a coil removed from a discarded TV picture tube focal unit. With the cylinder or ring magnet removed, two short pieces of No. 16 wire can be imbedded in the plastic coil form to serve as the coil leads.

When servicing, disconnect the recorder head and substitute the relay coil in its place. This relay coil is then inserted in the focus coil. With earphones connected across the focus coil, you can hear whether or not the amplifier is operating, and/or whether the trouble is actually in the recording-playback head by simply talking into the earphones.

Austin N. Hubner
Cincinnati, Ohio



SUPPLEMENTARY TUBE TESTER SETTINGS

Listed below are important additions to the roll charts for Sylvania tube tester models 219, 220 and 620. Make sure your charts are completely accurate and up-to-date by adding these important facts now.

FOR TUBE TESTER MODELS 219 AND 220

TYPE	A	B	C	D	E	F	G	K
1DN5	1.25	1	7	39	7	036T	2	-
	1.25	1	7	45	7	T	4	-
4DE6	5.0	3	4	50	4	16SU	5	2
6DN7	6.3	7	68	25	8	1Z	2	3
	6.3	7	38	29	8	4Y	5	6
6DR7	6.3	4	358	20	5	2SY	1	9
	6.3	4	258	20	5	3SY	1	9
	6.3	4	2359	34	5	7T	6	8
6DT5	6.3	4	56	19	5	013Z	9	7
	6.3	4	35	19	5	016Z	9	7
6DW5	6.3	4	56	15	5	013Z	9	7
	6.3	4	35	15	5	016Z	9	7
6EA8	6.3	4	58	30	5	23U	6	7
	6.3	4	57	14	5	9V	1	8
6EB5	6.3	3	45	31	4	X	7	1
	6.3	3	14	31	4	X	2	5
8BQ5/EL84	7.5	4	1568	17	5	29Z	7	3
9AU7	7.5	4	589	26	5	2Y	1	3
	7.5	4	359	26	5	7Y	6	8
12AL8	12.6	4	59S	57	5	023V	6	7
	12.6	4	57	51	5	8X	1	9
12DU7	12.6	4	5	35	5	13SV	6	2
	12.6	4	5	43	5	T	7*	2
	12.6	4	5	43	5	T	9*	2
12DY8	12.6	4	57	70	5	13SX	6	2
	12.6	4	25	32	5	9T	8	7
12EN6	12.6	2	7	12	7	045Y	3	8
12FK6	12.6	3	4	36	4	1T	7	2
	12.6	3	4	40	4	T	5*	2
	12.6	3	4	40	4	T	6*	2
13DE7	12.6	4	359S	54	5	7Z	6	8
	12.6	4	358	11	5	2V	1	9
	12.6	4	258	11	5	3V	1	9
13DR7	12.6	4	358	20	5	2SY	1	9
	12.6	4	258	20	5	3SY	1	9
	12.6	4	2359	34	5	7T	6	8
25EH5	25.0	3	45	52	4	26SV	7	1
	25.0	3	24	52	4	56SV	7	1
50EH5	50.0	3	45S	30	4	26X	7	1
	50.0	3	24S	30	4	56X	7	1
7137	6.3	3	456	30	4	1X	7	2
	6.3	3	146	30	4	5X	7	2
	6.3	3	145	30	4	6X	7	2

FOR TUBE TESTER MODEL 620

TYPE	A	B	C	D	E	F	G	K
1DN5	1.25	1	7	42	7	036S	2	-
	1.25	1	7	65	7	S	4	-
4DE6	6.3A*	3	4	47	4	16RT	5	2
6DN7	6.3	7	68	25	8	1Y	2	3
	6.3	7	38	29	8	4X	5	6
6DR7	6.3	4	358	19	5	2RX	1	9
	6.3	4	258	19	5	3RX	1	9
	6.3	4	2359	38	5	7S	6	8
6DT5	6.3	4	56	19	5	013Y	9	7
	6.3	4	35	19	5	016Y	9	7
6DW5	6.3	4	56	14	5	013Y	9	7
	6.3	4	35	14	5	016Y	9	7
6EA8	6.3	4	58	29	5	23T	6	7
	6.3	4	57	14	5	9U	1	8
6EB5	6.3	3	45	30	4	W	7	1
	6.3	3	14	30	4	W	2	5
8BQ5/EL84	12.6A	4	1568	18	5	29Y	7	3
9AU7	7.5	4	589	28	5	2X	1	3
	7.5	4	359	28	5	7X	6	8
12AL8	12.6	4	59R	55	5	023U	6	7
	12.6	4	57	51	5	8W	1	9
12DU7	12.6	4	5	35	5	13RU	6	2
	12.6	4	5	45	5	S	7	2
	12.6	4	5	45	5	S	9	2
12DY8	12.6	4	57	70	5	13RW	6	2
	12.6	4	25	40	5	9S	8	7
12EN6	12.6	2	7	12	7	045X	3	8
12FK6	12.6	3	4	39	4	1S	7	2
	12.6	3	4	44	4	S	5	2
	12.6	3	4	44	4	S	6	2
13DE7	19.0B*	4	359R	57	5	7Y	6	8
	19.0B*	4	358	14	5	2U	1	9
	19.0B*	4	258	14	5	3U	1	9
13DR7	19.0B*	4	358	19	5	2RX	1	9
	19.0B*	4	258	19	5	3RX	1	9
	19.0B*	4	2359	38	5	7S	6	8
25EH5	25.0	3	45	54	4	26RU	7	1
	25.0	3	24	54	4	56RU	7	1
50EH5	50.0	3	45R	30	4	26W	7	1
	50.0	3	24R	30	4	56W	7	1
7137	6.3	3	456	30	4	1W	7	2
	6.3	3	146	30	4	5W	7	2
	6.3	3	145	30	4	6W	7	2

SYLVANIA NEWS

TECHNICAL SECTION

MAY 1959

VOL. 26, NO. 5

R. A. HUMPHREYS, TECHNICAL EDITOR This information in Sylvania News is furnished without assuming any obligations.

YOUR TELEVISION SCREEN

by J. B. Shinal, Picture Tube Operations

Service technicians are often questioned by owners of television sets about the appearance of undesirable images and/or blemishes on the screens of picture tubes which develop throughout life. Several types of blemishes, primarily due to improper operation, can appear on the screen as the tube ages. Before reviewing these undesirable images and/or blemishes, let's examine a few of the manufacturing steps designed to insure that the new screens of Sylvania Picture Tubes are of uniform, superior quality.

One important reason why Sylvania insists on new screens on every Sylvania picture tube is that any blemish caused by improper operation would still be present on screens which are re-used.

MANUFACTURING TECHNIQUES

One of the first steps involves the cleanliness of the bulb. Even though the bulb might appear clean, it is put through a series of mechanical and chemical washings in fluoride and caustic solutions followed by a number of rinses in extremely pure or demineralized water. This process actually removes a microscopic layer of glass exposing a very clean surface.

When the bulb leaves the washing operation, it is next placed on a long, slow moving "settling" conveyor. The screening solution and the phosphor particles in suspension are introduced at this point. Predetermined volumes of a weak acid or mineral salt and a silicate combine to form a gel-like solution, through which the phosphor particles settle onto the face of the bulb. This gelled solution creates a bond which holds the phosphor to the glass.

As the bulb reaches the end of the settling conveyor, it is slowly tilted, as shown in Figure 1, to allow the solution to pour off. An even layer of the settled phosphor is left behind covering the face of the bulb to form the screen. If the tube is to be aluminized, screened bulbs are placed on a lacquering conveyor. A cushion of demineralized water is dispensed into the bulb and a film of lacquer floated on top of the water. After the lacquer forms an elastic film, the water cushion is decanted out from

(Continued on page 6)

Figure 1—As the bulbs reach the end of the settling conveyor, they are slowly tilted to allow the bonding solution to pour off. The bulb face is thus covered with an even layer of phosphor which settled through the bonding solution.

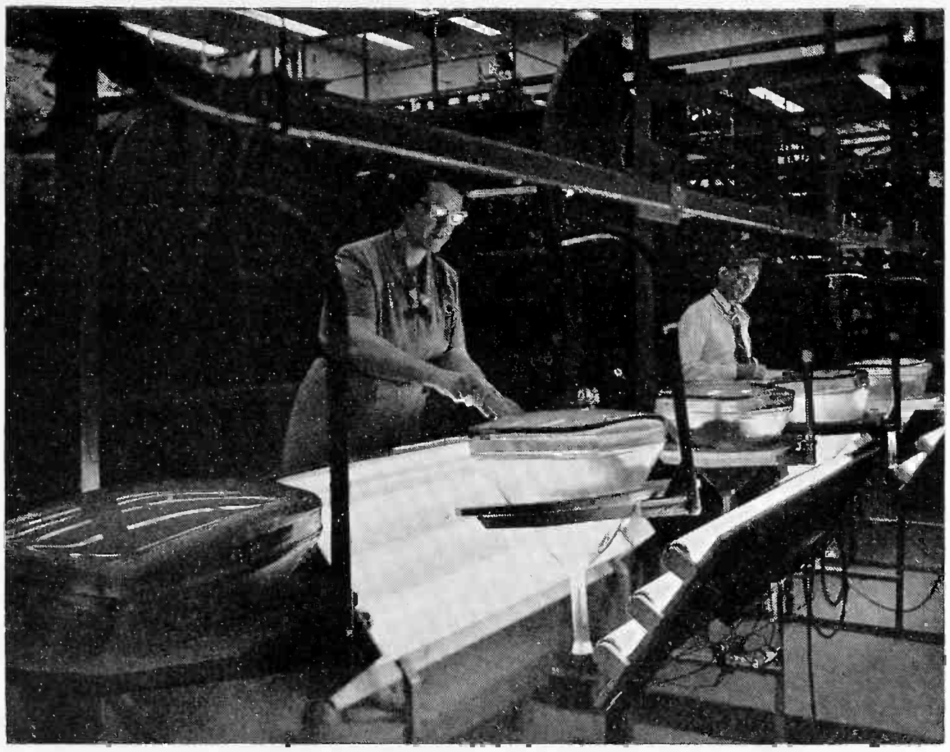


Figure 2—The lacquer-covered screen is carefully inspected before the tube is approved for the next step in aluminizing.

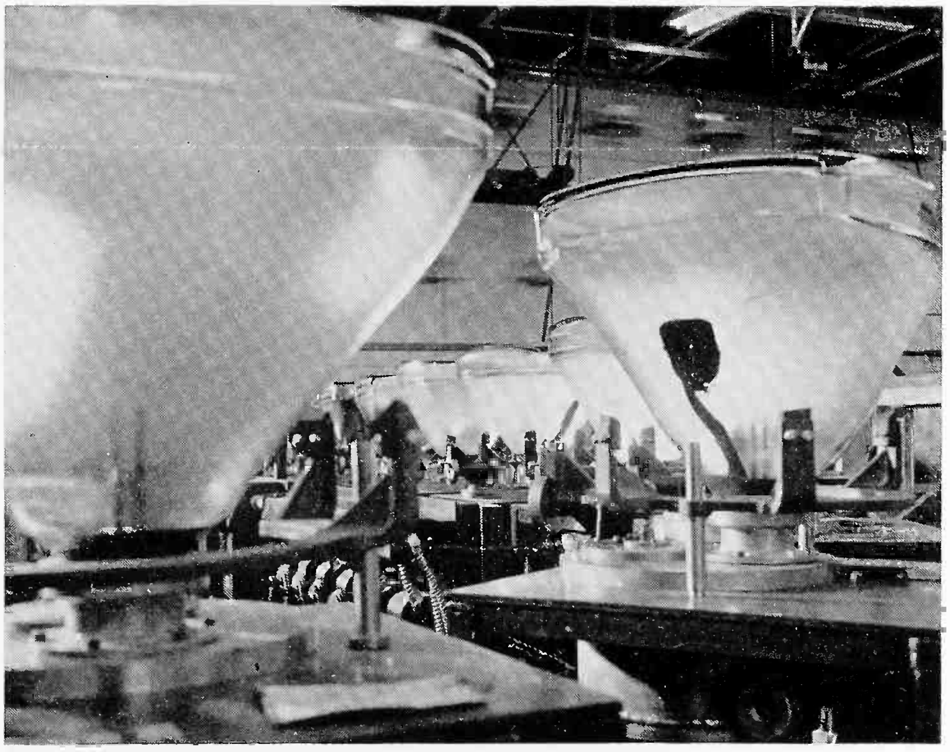


Figure 3—As the bulbs are evacuated, the aluminum vapor condenses on the inside walls of the tube, becoming the conductive and mirror-like aluminized screen backing.

under the film, leaving the lacquer deposited smoothly on the screen. The bulbs are then dried with warm air as they pass underneath the conveyor belt.

After inspection, see Figure 2, the bulb is placed over a tungsten coil which contains an aluminum pellet. The bulb is then evacuated as shown in Figure 3. The tungsten coil is electrically heated causing the aluminum to vaporize; thereby covering the back of the screen and inside of the bulb with a microscopically thin layer of aluminum. A test to determine the uniformity of the aluminum coating is then made.

For both aluminized and non-aluminized tubes, further processing of the screen includes baking for several hours at very high temperatures to remove any water vapor and other gases within the bulb. Baking also creates a stronger bond between the phosphor and glass faceplate. Inspections before and particularly after baking insure further processing of only the highest quality screens.

Color of the finished excited tube is a result of the initial blending and processing of the phosphors. Proper blending results in a satisfactory image on the tube screen. (The whites can range from bluish to yellowish, and the blacks from dark-bluish to brownish in color). Controls exercised during the phosphor manufacturing assure crystals of the proper size, color, brilliance or excitation and extreme purity.

BLEMISHES

The most common blemish of non-aluminized tubes is the rough brown ion spot appearing in the center of the tube face. This is usually due to an improperly adjusted ion trap which fails to remove the negative ions, (most of which originate at the cathode) from the electron beam. Improper adjustment may also deposit metal on the screen. Proper adjustment of the ion trap, (a relatively simple matter) will prevent this type of damage.

Another blemish, also common to non-aluminized tubes, but due to a somewhat different cause, is sometimes observed. Positive ions formed in the bulb space, or at areas subject to electron bombardment, may result in what is termed a "butterfly" or X burn on the screen.

Excessively high electron beam currents can carry sufficient energy to destroy the efficiency of the phosphor itself. Sometimes when a set is turned off the beam is present momentarily while the deflection is off. A bright spot near the center of the tube can be seen diminishing in intensity. In non-aluminized tubes, and if not controlled for in aluminized tubes, excessively high electron beam

(*Continued on page 8*)

LOW VOLTAGE AC STANDARD

D. J. Kelley, Technical Publications Section

While the electronic measuring equipment that is used in servicing is generally considered to be accurate; upon occasion, the user will have reason to doubt the validity of particular readings. This is particularly true with equipment that is infrequently used or is subject to rigorous field usage. While it may ultimately turn out that the meter or scope, as the case may be, is perfectly okay, it would be handy to be able to eliminate or confirm one's suspicions quickly and simply. To do this, a second instrument must be sought that can be used to check out the first. For many of us this does not, however, solve the problem, since the second instrument is usually one that has been shelved because it is not in good working order. What is really needed is a regulated supply that will serve as a reference voltage. A dc supply of this type is not difficult to come by. Such is not the case when ac is involved; especially if the standard must be capable of supplying a limited amount of power and have an output wave-shape that approximates a sine wave. We might think, and rightly so, that the latter presents a difficult design problem and could become expensive to construct. The circuit shown in Figure 2, while not the ultimate, will do the job that needs to be done about the service shop or home workbench and can be constructed from parts that are readily available.

This low voltage AC standard, the circuit diagram of which was brought to our attention by Mr. W. P. Mueller of our Advanced Application Lab, RTO, consists of three resistors, a potentiometer and a low voltage filament transformer. The device uses two standard panel lamps as regulators in a bridge circuit. These panel lamps do not use sockets in this application, but are soldered in place to insure solid contact. Care should also be taken to make sure the wiper arm on the potentiometer makes solid contact.

The solid curves in Figure 1 indicate the stability of the device at various predetermined levels of output voltage. Under no-load conditions, only a slight change in output voltage occurs for wide fluctuations in line voltage. The reader will note the existence of an optimum value of output voltage at approximately 1.5 volts rms.

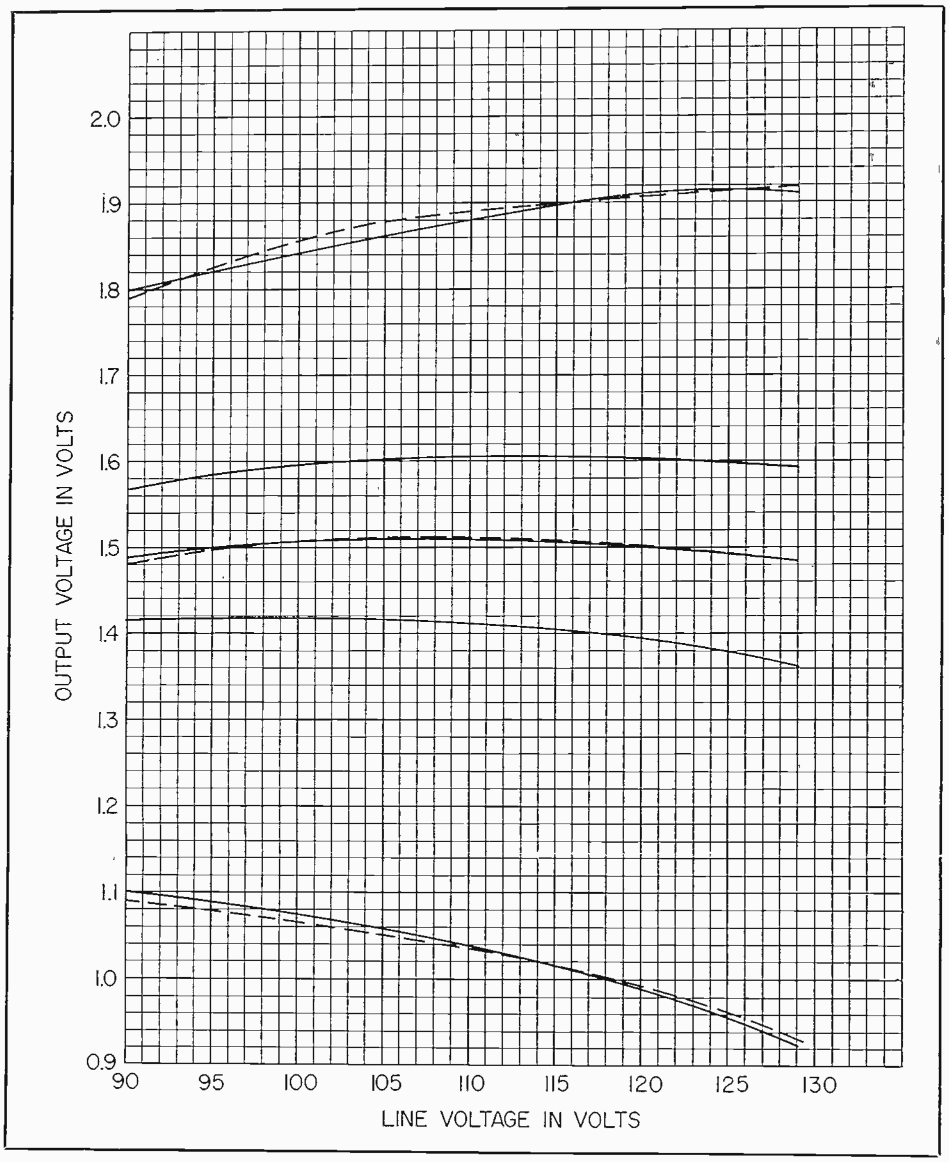


Figure 1—The solid curves indicate the stability of the device at predetermined levels of output voltage. In comparison, the dotted curves show the change in output voltage for wide fluctuations in line voltage under conditions of 1000 ohms load.

As shown in Figure 3, this optimum value of 1.5 volts rms was then used as the basis for determining the change in output voltage for a change in load resistance. This curve was obtained under average line conditions of 117 volts. Although the application may be somewhat limited, this curve indicates that the device is capable of supplying sufficient power to check meters having an input impedance as low as 1000 ohms per volt.

As indicated in Figure 3, the stability of the device started to drop off slightly at 1000 ohms and below. For comparison purposes, data was then taken to determine what change there would be in output voltage for wide fluctuations in line voltage under conditions of 1000 ohms load. The dotted curves in Figure 1 illus-

(*Continued on page 8*)

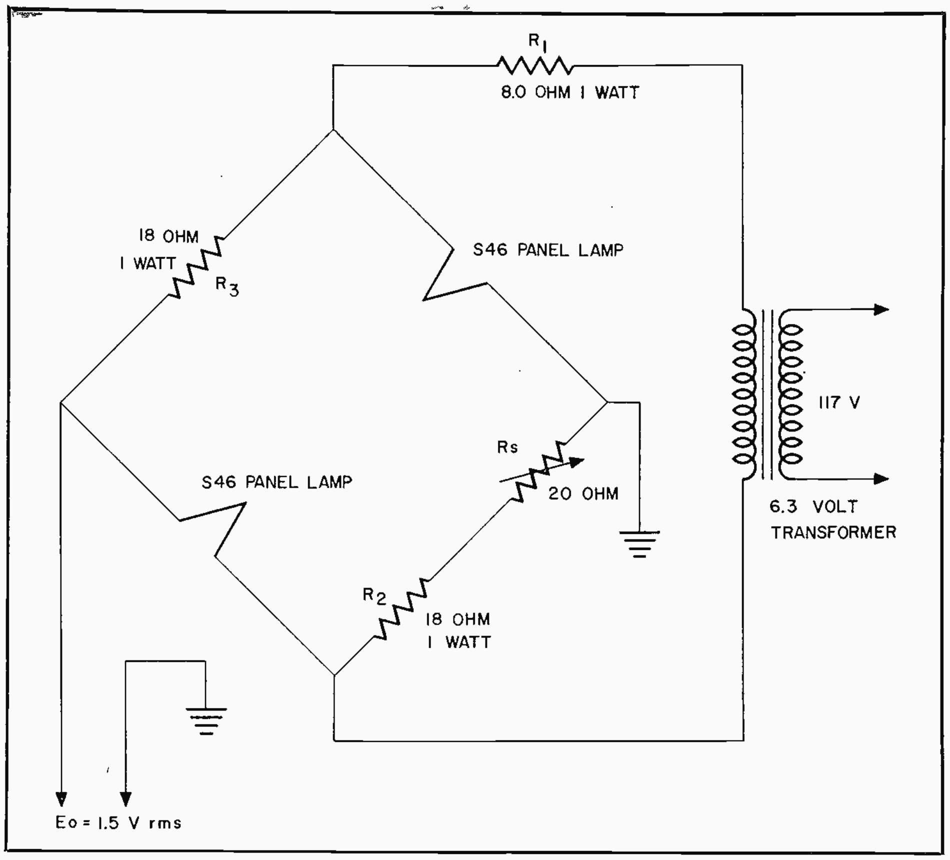


Figure 2—Circuit diagram of the Low Voltage AC Standard.

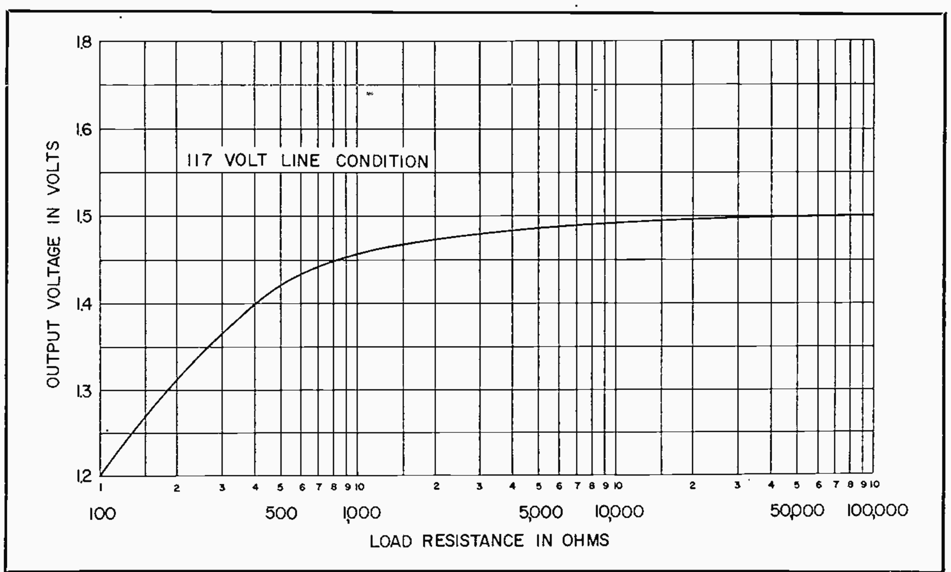


Figure 3—This curve, which was obtained under average line conditions, illustrates the minute change in output voltage over a wide range of load resistance.

trate this comparison. Again, note the degree of stability at the optimum value of 1.5 volts rms output.

This device, which can be assembled by the average home-builder in a matter of minutes, may be used not only to check the accuracy of low voltage ac meter ranges but that of external scope standards as well. Since it is remarkably stable for wide fluctuations in line voltage, the user can be sure of 1.5 volts rms output. The flexibility of the device is practically unlimited in that, the experimenter may, for a particular application, change the output by substituting different components. The use of a bridge circuit also offers the possibility of regulating in either direction.

YOUR TELEVISION SCREEN

(Continued from page 6)

currents can lead to destruction of the phosphor, causing a small brownish area on the unexcited screen. Further treatise on the subject is covered in the article "The Case of the Continuing Spot" which appears in the October 1957 issue of SYLVANIA NEWS Technical Section.

In aluminized tubes, screen blemishes due to ion activity within the tube are non-existent; the aluminum film protects the screen from ion charges. However, rough handling during shipment may cause loose particles of material inside the tube, resulting in a small hole or scratch on the screen.

Perhaps the most common blemish is due to the fact that a charged tube is an excellent dust collector. Complaints of decreased brightness can often be traced to a very dirty tube face and adjacent mask.

IMAGES

The raster outline can be seen on the unexcited screen of tubes which may have been improperly operated, or where the raster has been reduced in size and so operated for a long period of time.

Afterglow on the entire raster which is noticeable after the set is turned off in a darkened room usually indicates a phosphor of high persistence. That is, the phosphor still emits light after the exciting electron stream has been removed. Sometimes the image of the last scene present on the receiver can be seen for some time.

The total result of the entire television system, from studio camera, through transmitter and receiver circuits and finally the picture tube, is presented to the viewer on the all important picture tube screen. This is why Sylvania concentrates major engineering effort on perfect screens, and provides a new screen made by the very latest techniques in each and every non-aluminized and Silver Screen 85® aluminized picture tube.

In the Interest of the "Independent." . . .

NEW SYLVANIA ADVERTISING FEATURES

"Tubes Tested Free"—three words that can help lose or win, plenty of sales dollars for you! Make sure you're on the winning side. Take advantage of Sylvania's newest advertising and promotion program to help you build your business in the highly competitive radio-television consumer market.

Sylvania's new advertising program has been especially developed to help you, the independent service-dealer, effectively combat increasing competition from other sources of retail supply — consumer buying sources that have been attempting to increase business through the offer of "free tube testing."

The "do-it-yourself" trend reached over into electronics recently when special tube-testing machines were placed in stores selling directly to consumers. Many of these stores remain open on Sunday and attempt to attract TV parts consumers by telling them that the machines are available for their use at no charge.

Against competition from such outlets as drug stores, chain stores, general variety and hardware stores, the independent service-dealer must wage a positive and continuous sales promotion campaign to get a fair share of the expanding "do-it-yourself" tube replacing market. That's why Sylvania has designed this special advertising program around the "free tube testing" theme. Many service-dealers throughout the country are now facing damaging competition from other retail outlets which feature tube-testing to attract consumer traffic.

SURVEY SHOWS SALES THREAT

The service-dealer is currently the number one source of consumer tube supply. However, when Sylvania's market research department went out to get the facts about "do-it-yourself" tube replacing, it found certain principal cities where independent service-dealers were not gaining in replacement sales. For example, in the city of Indianapolis, approximately 14 per cent of consumer tube sales were not made by independent service-dealers. Here's a breakdown of the per cent of receiving tubes purchased by type of store according to the Indianapolis survey:

INDIANAPOLIS

SOURCE	PERCENTAGE
Radio-TV shop......	86.3
Drug...............	9.7
Appliance	.9
Other	.8
Don't remember....	2.3

Independent service-dealers, like yourself, must remain by far the number one source of consumer tube supply if your business is to expand. The best way for you to fight the "do-it-yourself" threat in your area is with Sylvania's advertising program.

THREE POINT DEALER PROGRAM

Sylvania's special, local consumer advertising program, built around the "tubes tested free" theme features three important sales promotion items that can help you combat the "do-it-yourself" trend and increase your sales volume. The company has invested thousands of dollars in preparing a colorful window streamer, a counter card and special newspaper ad mats. They are all available to you through your local Sylvania distributor.

NATIONAL ADVERTISING PROGRAM Continues in "Best Read" TV Guide

Sylvania's big, new national advertising campaign keeps the spotlight on the company's TV smog consumer theme and the "independent service-dealer" in the pages of *TV Guide*.

Featured as "America's best read magazine" *TV Guide* will spotlight twenty-six full page ads during 1957, giving millions of TV set owners the convincing sales message of "TV Smog."

The latest *TV Guide* ad, illustrated here, urges consumers to "make sure the next picture tube is a 'Silver Screen 85'."

The more than 5,000,000 readers of *TV Guide* find out, through every Sylvania ad, that they can get a TV smog rating from the man who displays the new independent Service-Dealer Emblem.

TV parts consumers, who *constantly* refer to the pages of *TV Guide* for program listings and feature articles are urged to treat themselves to brighter, clearer, "smog free"

pictures by replacing the old worn out picture tube with a "Silver Screen 85" picture tube.

The powerful full page ads appear in everyone of the *forty-four* local editions of the popular TV parts consumer magazine.

"TUBES TESTED FREE" CONSUMER THEME

WINDOW STREAMER AND COUNTER CARD

Sylvania's colorful new glascene window streamer will bring "do-it yourself" customers into your shop. Urging customers to "replace with dependable Sylvania tubes" the eye-catching streamer features the big, bold letters "tubes tested free." The counter card, which resembles an official certificate, will remind consumers who visit your shop that they need not go elsewhere to have their receiving tubes tested without charge. Both the window streamer and counter card are available free from your Sylvania distributor.

This eye-catching, colorful window streamer will help increase your tube sales.

LOCAL NEWSPAPER ADVERTISEMENTS

Sylvania has prepared special ads for use in your local newspapers featuring the "tubes tested free" theme and spotlighting the independent service-dealer emblem, tying you in with the company's powerful national consumer advertising campaign on "The Buccaneers" and in *TV GUIDE.*

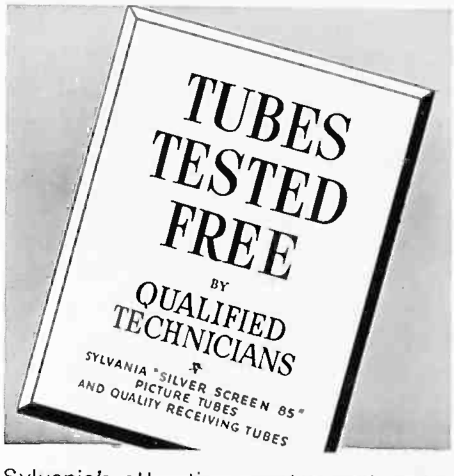
There's a special place on each ad where the name and telephone number of your shop can appear in bold letters. These ads are available, in mat form, free from your Sylvania distributor.

HELP YOURSELF TO MORE SALES

You'll be helping yourself attract more "do-it-yourself" fans and winning more radio-TV parts consumers as regular customers by taking advantage of Sylvania's new "tubes tested free" advertising campaign.

The colorful window streamer, the attractive newspaper ads are designed to attract more consumers to your shop. Once inside, even the most avid "do-it-yourself" consumer can probably be influenced to let you service his television set. As an experienced radio-television technician, you can show him that replacing parts in electronic equipment can not only be dangerous but costly. Take advantage of this chance to not only increase your tube sales, but build your service business, too. See your Sylvania distributor now for complete details on how you can receive the three special sales promotion items in Sylvania's big, new "Tubes Tested Free" independent service-dealer advertising campaign.

"Do-It-Yourself" fans will stop at your shop when they see these special ads in your local newspaper.



Sylvania's attractive counter card serves as a reminder to have YOU test their tube.

Help Yourself To More Sales . . .

PUT YOURSELF IN THE CUSTOMER'S PLACE

By JAMES W. RITTER, Sales Training Manager, Electronic Products Sales

Many millions of dollars are spent each year by manufacturing organizations such as Sylvania, your independent distributor and yourself to build a solid reputation for independent service-dealers as "headquarters for complete radio and television servicing."

When a TV parts consumer enters your shop, or when you enter a customer's home, it's your opportunity to win a steady customer by giving prompt, courteous service. Only by maintaining a large active list of "satisfied customers" will your business succeed!

How do you go about winning friends and influencing customers? There are hundreds of important points that should be considered when the subject of customer relations is approached. But, there is one simple formula that usually will help create a positive impression in anyone's mind. Merely do more of what they like and less of what they dislike.

Is your attitude toward every customer who enters your shop one of helpfulness? Do you try your best to make him feel at ease and as if you are really interested in giving him good service? Greeting your customer with a friendly smile and the pleasant words "may I help you, please" doesn't cost you a cent. It may help you increase your sales volume.

Good or bad, it's a well-known principle that people form opinions quickly. The old adage "a first impression is a lasting one" seems to be especially true when it comes to the "customer." This principle applies not only when you're behind the service counter in your shop but when you're visiting the home of a TV parts consumer, too.

When three or four customers descend upon your shop at once, do you politely acknowledge the presence of each and quickly service each in his turn? Is your merchandise attractively displayed for the customer's benefit so that he may take advantage of this waiting time to "browse a bit."

Many items which you carry in your shop can turn out to be plus sales for you if you put them within reach of the consumer.

One of the most important points to remember in applying some of the tried and true techniques of "salesmanship" is to avoid blunt, positive statements that do not allow for "give and take." If a customer indicates a preference for a specific product which you do not have in stock, your chances of losing the sale altogether are better if you imply by expression and tone of voice that it is an inferior product, anyway. Rather, if you courteously explain that you are temporarily out of stock on this item or that you don't carry it because, while it's a quality product, you feel the same product made by the XYZ people is better, you may still make the sale.

Never put yourself in the position with a customer where you may get a negative reaction from him. It's usually more advisable to recognize the reasons behind the customer's choice—then persuade him to buy the "better" product which you stock. In a positive manner, always sell up the products you stock—never sell down competition. It's not good salesmanship and isn't it the good salesman who makes money?

To many radio and TV parts consumers who haven't the slightest idea what a 2N229 transistor is and never heard of a 6BQ6GTA, electronics is that mysterious "something."

Certainly you should never talk down to your customers, but don't make the mistake of trying to impress them by using technical language which makes no sense to them.

And, if you take the time to explain your job to the customer, it often makes the bill for your services more acceptable.

Don't forget that you're just as much of a salesman when you're in a customer's home. Always look like what you are—a professional radio-television technician. Little things like leaving bits of wire and tube cartons in a living room can tear down a customer's opinion of you. Be sure you place your tools so that they will not scratch the TV set or other furniture.

Make your first rule on home service calls, "courtesy and neatness." You'll be helping yourself to more sales.

Everything you do in handling customers should build confidence in their minds. People are faced everyday with the problem of where to buy. They like to feel that their choice is the best. You can contribute to this feeling of confidence by being honest and sincere in your dealings with customers. An excellent way is to follow up on your service jobs. In most cases, a telephone call or one of those eye-catching Sylvania consumer postcards will fill the bill.

Customer good-will is often neglected in day-to-day activities and we should constantly be on the alert to do things that the customers like. A good yardstick to apply is to put yourself in the customer's place—if you like it, he probably will, too. And remember, customers are the only indispensable factor in our business.