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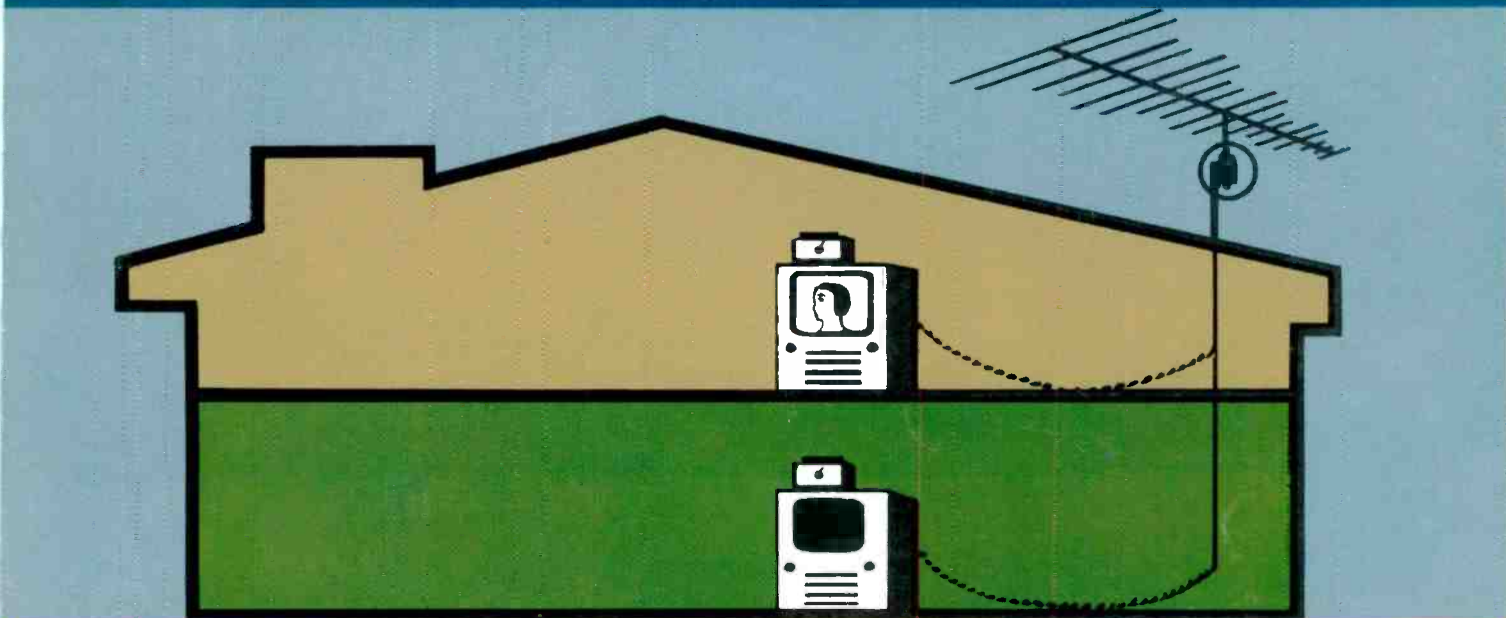
Electronic Servicing

ANTENNA SYSTEMS
MATV . . . first of a series, page 22
reception of distant TV signals, page 12



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Electronic Servicing

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news of the industry

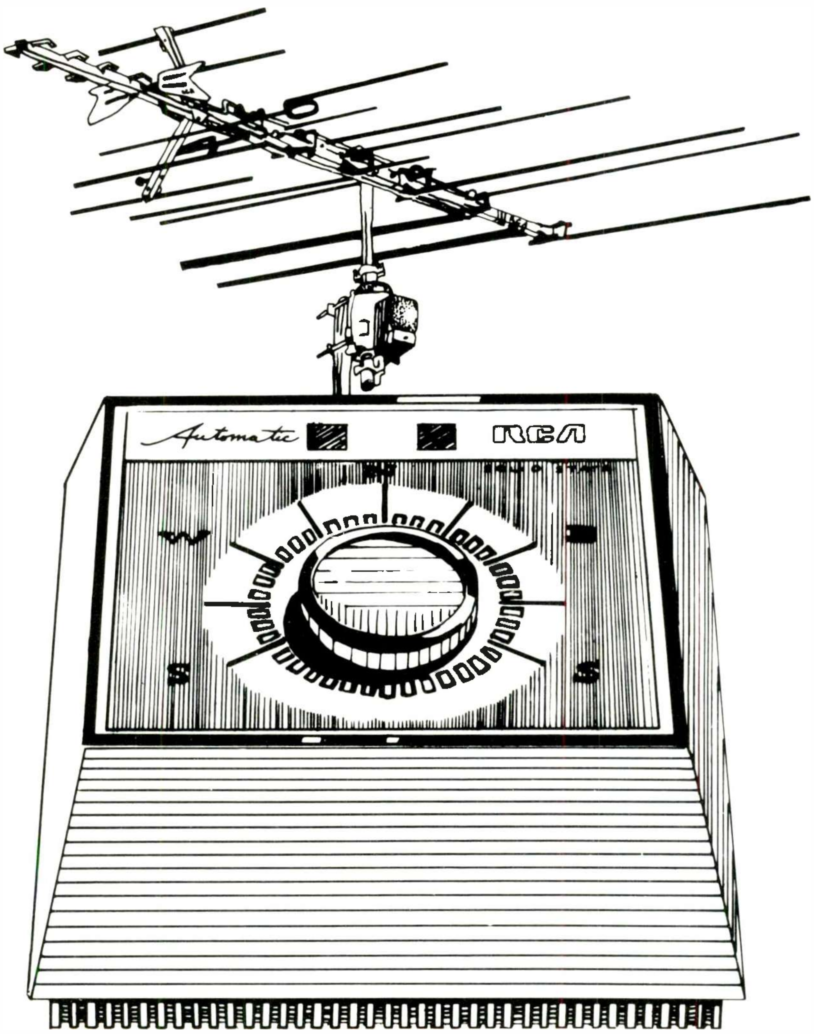
Sony Corporation recently announced the development of a 114-degree Trinitron color picture tube. The wider angle reportedly is the result of moving the electron gun closer to the phosphor screen, to produce better picture definition. Sony is using the new, wide-angle Trinitron picture tube in a new 18-inch Trinitron Color TV set which was introduced to the Japanese market in April. The company did not state when it planned to equip U.S. sets with the new tube. Sony color TV receivers previously have been equipped with 90-degree-deflection-angle picture tubes.

NARDA members reportedly favor servicing only brands they sell. According to a recent report in **Home Furnishings Daily,** appliance/TV merchants attending the annual convention of the National Appliance And Radio/TV Dealers Association (NARDA) in San Diego in April responded to a question about all-brands servicing with a show of hands indicating that most of them do not favor all-brands servicing. The amount of money tied up in the large parts inventory most felt is required to service all-brands seemingly was the major objection. Problems related to servicing topped the list of gripes aired by most of the dealers attending the convention.

Brother International Corporation recently announced their entrance into the home entertainment electronics field. The company, which manufactures and distributes sewing machines, typewriters, electric housewares and home and office electronic equipment, will introduce first a variety of component stereo systems.

Hitachi will market in the U.S. this fall a b-w television receiver which permits the "freezing" of an image. The new receiver, called Memory Vision, is the size of a conventional 17-inch table set but is equipped with two picture tubes—one 14 inches, for conventional viewing, and the other 9 inches, for displaying still, or frozen, pictures—and a magnetic disc memory system designed to "freeze" an image on the smaller picture tube while the program is displayed in the normal manner on the larger screen. The still image reportedly is retained on the "memory" picture tube for an indefinite period or until the viewer switches the memory system to "catch and freeze" another image or scene.

□



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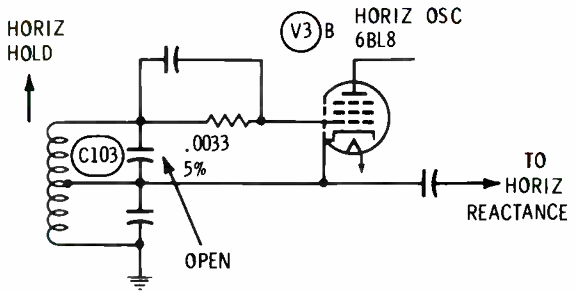
symcure

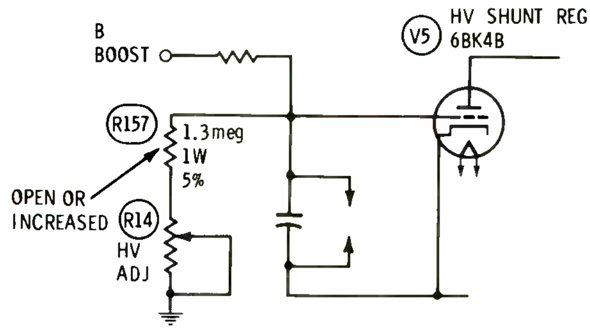
Symptoms and cures compiled from field reports of recurring troubles

Chassis—Sylvania D12
PHOTOFACT—1045-2



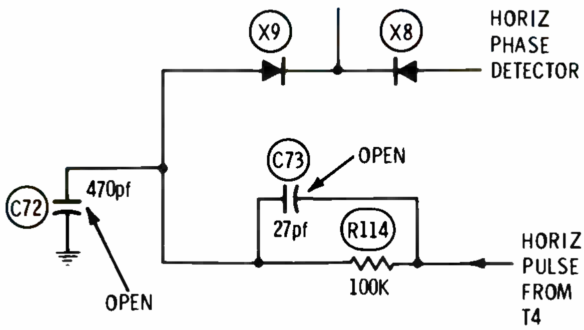
Symptom—No horizontal drive; output tube red hot
Cure—Check C103; replace, if open

Chassis—Sylvania D13
PHOTOFACT—1031-2



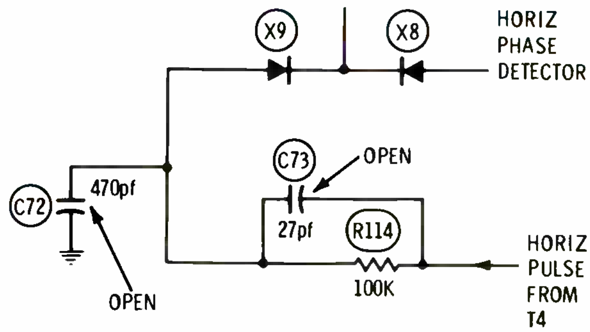
Symptom—Narrow width and insufficient high voltage
Cure—Check or replace R157 and reset HV ADJ control

Chassis—Sylvania D08
PHOTOFACT—977-2



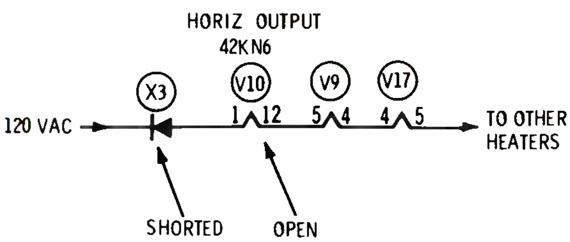
Symptom—Foldover on right edge of raster
Cure—Check C73; replace, if open

Chassis—Sylvania D08
PHOTOFACT—977-2



Symptom—Horizontal pulling with color change evident when pulling occurs
Cure—Check for open C72; replace, if defective

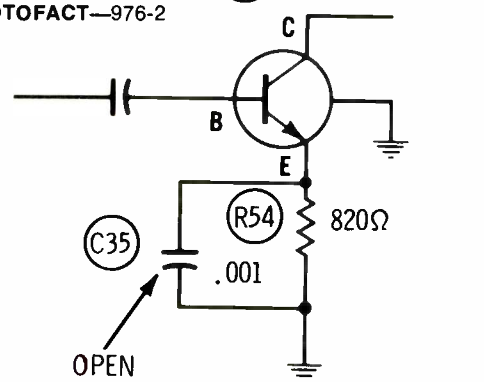
Chassis—Sylvania DO5
PHOTOFACT—905-3



Symptom—Excessive failure of horizontal-output tube (42KN6)
Cure—Check X3; replace, if shorted

Chassis—Sylvania D10
PHOTOFACT—976-2

Q3 3RD VIDEO IF



Symptom—Insufficient sensitivity; no snow off channel
Cure—Check C35; replace, if open

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	color bright 85® XR	color bright 85® RE	color screen 85
Sylvania rare earth red phosphors	yes	yes	yes
Other manufactured rare earth phosphors	no	no	yes
All sulfide phosphors	no	no	no
X-ray inhibiting glass	yes	no	no
New glass	yes	some	some
Reused glass	no	some	some
Regunned	no	no	some
Screen blemish specs	OEM	OEM	slightly wider than OEM
White field uniformity	OEM	slightly wider than OEM	slightly wider than "RE"
Cut off; purity currents; beam shield leakage	OEM	OEM	slightly wider than OEM

service bulletin

a digest of info from manufacturers

Changes of horizontal-output and high-voltage regulator tube types
RCA CTC39X color-TV chassis

New types of tubes are employed in the horizontal-output and high-voltage regulator stages in the "Q" line of RCA CTC39X color-TV chassis.

A 6EN4 replaces the 6BK4 high-voltage regulator, to reduce the possibility of X-radiation. Because the socket connections of the two types are not the same, always replace a defective tube with another tube of the same type.

RCA advises against changing the wiring in a chassis so that a 6BK4 will replace a 6EN4. However, after appropriate changes to the socket wiring, a 6EN4 can replace safely a 6BK4.

A 6EM6 type replaces the 6LQ6 horizontal-output tube. Because it has the same socket-pin connections and increased power capabilities, a 6EM6 can replace a 6LQ6. Do not use any other type to replace a 6EM6 in the CTC39X chassis.

Kit to eliminate interference on low bands
Magnavox T940 color-TV chassis

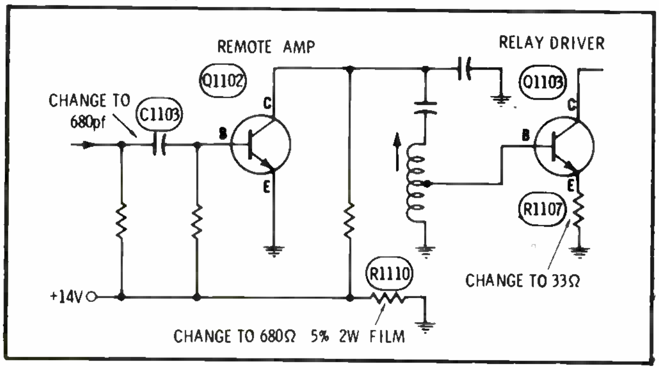
Interference from the internal 3.58M-Hz oscillator circuit which appears on Channels 2 through 6 in early-production T940 chassis can be eliminated by the installation of kit No. 171026-1, which is available from Magna-Par branches.

Magnavox urges that the instructions included with the kit be followed closely because lead dress is important.

Noise immunity of remote receiver
RCA CTC52 color-TV chassis

False triggering of the remote-channel-changing function of the RCA CTC52 color chassis might result from unusually loud high-frequency sounds, such as produced by door or telephone bells.

The sensitivity of the RF amplifier can be reduced, when needed, by the following two-step modification:

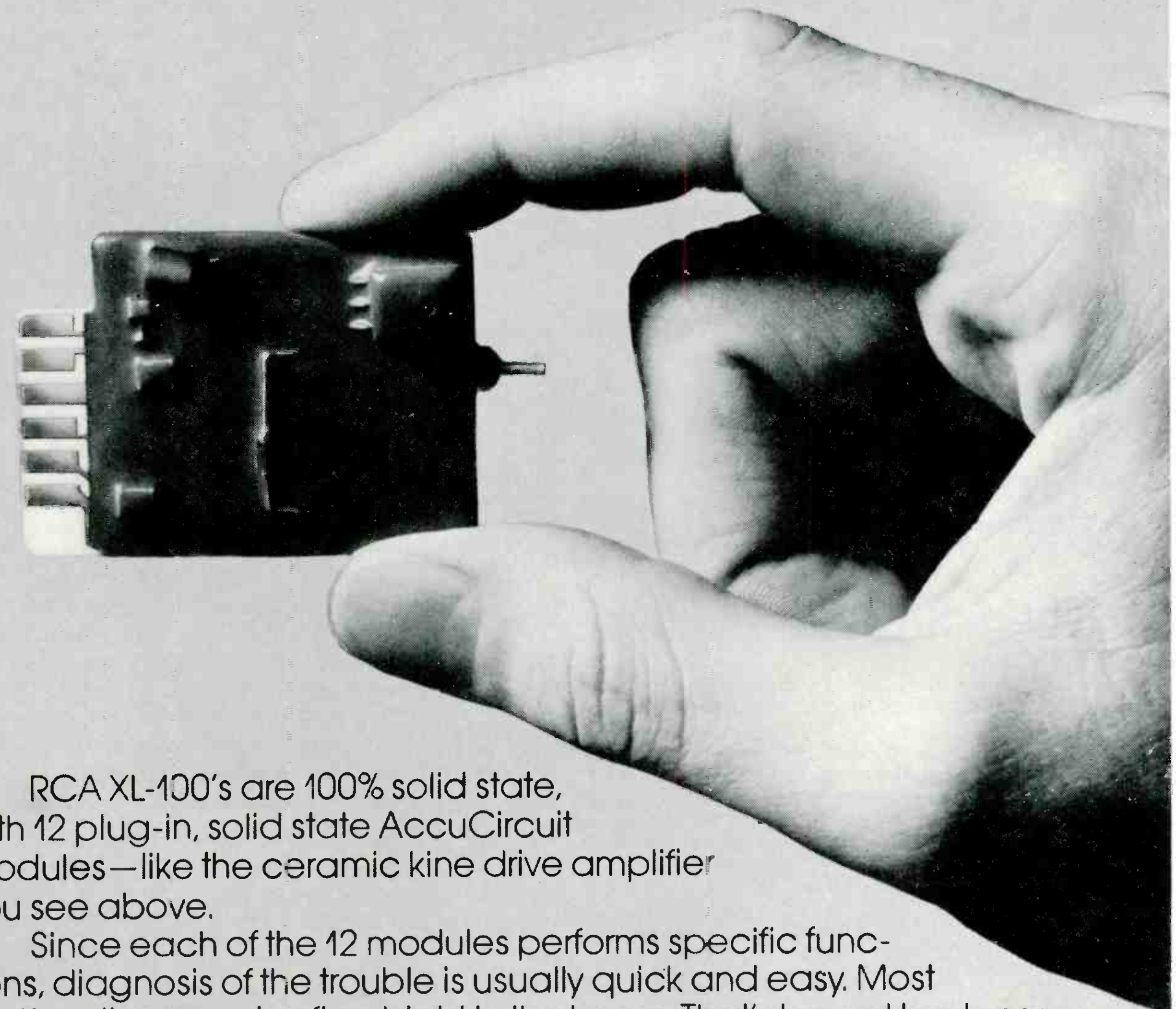


1) Check the values of R1107 (33 ohms) and R1110 (680 ohms, 5 per cent, 2-watt, film); replace these resistors, if the values are not as listed here.

2) If the sensitivity is not reduced enough by the preceding, replace capacitor C1103 (.01mfd) with a 680-pf, ceramic unit.

(Continued on page 10)

Why RCA XL-100's can be a quick fix:



RCA XL-100's are 100% solid state, with 12 plug-in, solid state AccuCircuit modules—like the ceramic kine drive amplifier you see above.

Since each of the 12 modules performs specific functions, diagnosis of the trouble is usually quick and easy. Most malfunctions can be fixed right in the home. That's bound to please your customer.

So when it comes to servicing RCA solid state color, XL-100's let you make more house calls—in a lot less time!

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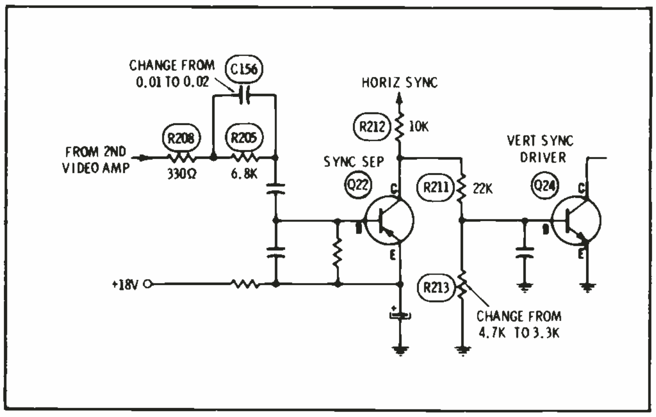
It could even add to yours.

RCA XL-100
100% Solid State AccuColor

Circle 13 on literature card

Correction of vertical jitter
Magnavox T952 color-TV chassis

Vertical jitter during reception of weak UHF channels can be eliminated by changing the value

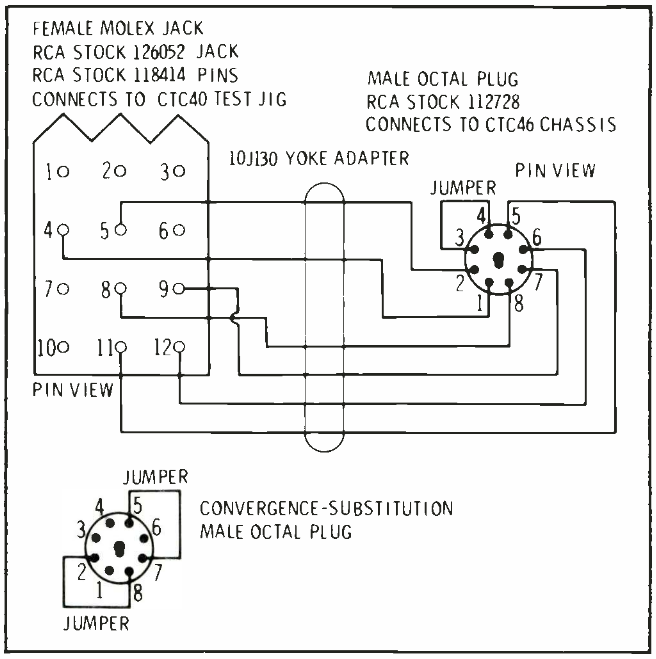


of C156 from .01 to .02mfd, and changing the value of R213 from 4.7K ohms to 3.3K ohms, as shown here.

Deflection-yoke test-jig adapter
RCA CTC46 color-TV chassis

A yoke-adapter cable makes it possible to operate the RCA CTC46 chassis on an RCA test jig designed for CTC40, CTC44 and CTC47 chassis.

Because of a difference in the inductance of the vertical yoke coils, operation of the CTC46 chassis on such a test jig will produce excessive vertical height. Decrease the adjustment of the vertical-height control, to reduce the resultant overscan.



Convergence components of the test jig should not be used with the CTC46 chassis. A male octal plug equipped with two jumper wires, as shown here, should be used as a substitute for the convergence assembly.

The yoke-adapter cable is available from RCA parts and accessories distributors under stock number 10J130. □

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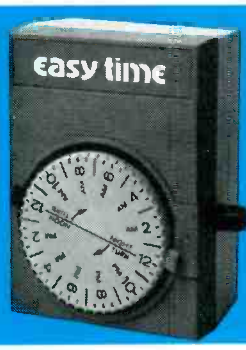

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Circle 11 on literature card

Antenna systems for reception of distant TV signals

Facts you should know about designing and installing.

by Helmut Hess, Systems Engineer, Jerrold Electronics Corp.

■ Frequently, you may be called upon to bring in TV channels from long distances. Bars, motels and homeowners, for example, often want to beat sports blackouts.

This article will discuss the latest methods of overcoming long-distance TV reception problems.

Reception Parameters

The performance of any receiving system is determined primarily by the quality of signals in the area, the type of antenna used, antenna location and antenna height.

Before examining the practical aspects of long-distance reception, let's take a close look at each of these reception parameters.

Antenna gain

The gain of any receiving antenna is dependent on its capture area. Because this area is determined by the physical size of the antenna, we can state that antenna gain is directly proportional to the physical size of the antenna. Single-channel, 5-element Yagi antennas usually have a gain of approximately 8 dB above that of a dipole. 10-element Yagis will only show an improvement of about 2.5 dB over a 5 element, for a total of 10.5 dB over that of a tuned dipole. As the number of elements is increased, so is the gain. At VHF, ten elements are a practical maximum because of the physical size.

Incident signal and antenna height

Little can be accomplished to increase the incident signal at the receiving location because it is determined by transmitter power, distance to the transmitter, and the intervening terrain. The choice of receiving location is normally fixed and cannot be moved to higher signal level areas.

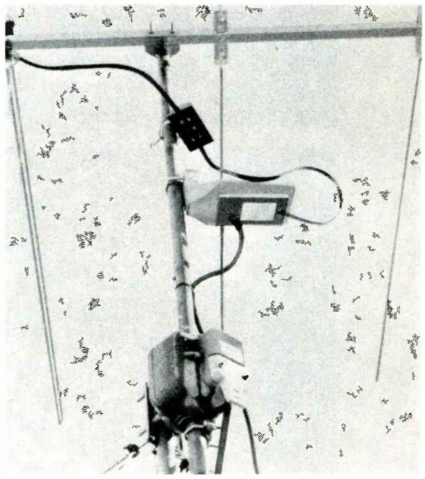
One thing that can be done is to increase the receiving antenna height. As a rule of thumb, you can expect an improvement of 6 dB in signal strength, if you double the antenna height at VHF. At UHF, even greater gains can be realized—up to 12 dB.

Because 6 dB is double the voltage output, and 12 dB is four times the output, it can be seen that increasing tower height can significantly improve reception. This rule of thumb will hold true for locations considered average terrain. However, if the antenna is already located at the top of a tall building, little improvement will be gained by increasing the mast length from 10 to 30 feet. To get 6 dB gain in this case, you'd need to double the height of the building.

Noise figure

The noise figure of the first stage of any receiver determines the signal-to-noise ratio at its output, especially at low signal levels. Noise is displayed by the TV set as the familiar "snow" (random black and white dots) when the signal into the receiver is too low. Preamplifiers help greatly to increase the signal-to-noise ratio, and therefore, decrease the snow.

Good preamplifiers are designed with a typical noise figure of 5 to 6 dB. Their gain must be



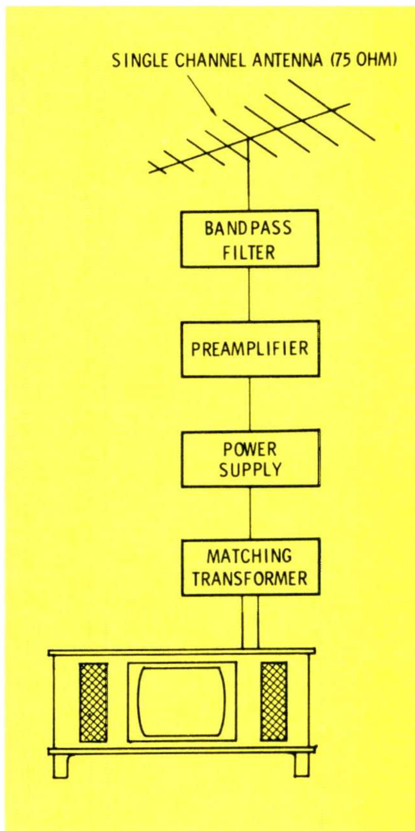


Fig. 1 A simple single-channel antenna system for reception of distant TV signals.

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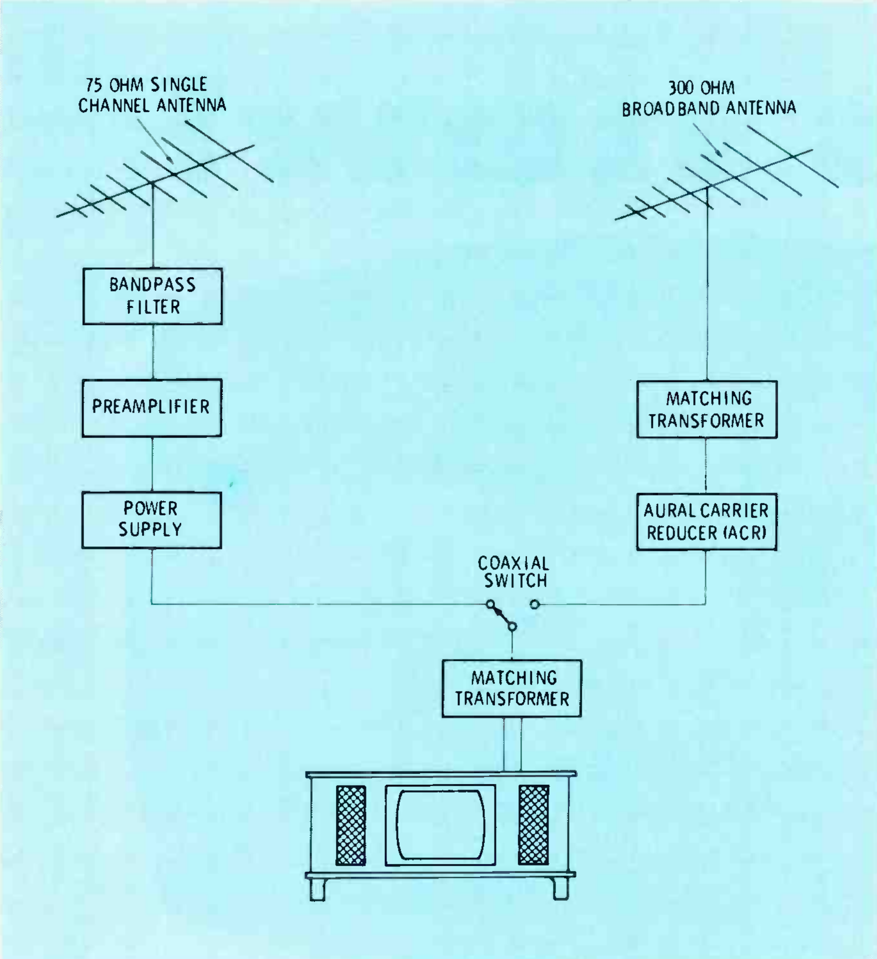

Fig. 2 Antenna system for both long-distance and local reception. Aural carrier reducer (ACR) is used only if the distant channel is adjacent to a local lower channel. Tune the ACR to attenuate the sound carrier of the local channel.

high enough to overcome the attenuation of the downlead. A gain of 12 to 15 dB is typical, and is adequate in most installations. The preamplifier should be installed at the antenna or as near to the antenna as possible, to keep signal losses at a minimum. Thus, the signal-to-noise ratio delivered to the TV set is almost as good as the signal-to-noise ratio received by the antenna.

Adjacent channel interference

The major problem encountered in distant TV reception is strong local channels. The levels of local channels might be higher than that of the distant station by 40 to 50 dB. Because the adjacent-channel-rejection characteristics of a typical TV set is relatively poor, it becomes obvious that serious interference can be created by the strong local channels. Therefore, your major effort must be to reduce the local channel pick-up, while providing the highest gain possible in the direction of the weak station.

Methods of reducing local signals

A number of methods are available to reduce pick-up of local channels. Highly-directional, single-channel Yagi antennas, bandpass filters, single-channel preamplifiers, and a variety of high-Q traps are available. Depending on the severity of the problem, some or all of these might have to be used to reduce the interference to a tolerable level.

Almost invariably, a cut-to-channel Yagi antenna will be required. The antenna, by itself, will provide some rejection of the local adjacent channel. The amount of rejection might be nearly insignificant if the local station and distant station are in a straight line relative to the receiving antenna. Significantly more rejection will be realized if the local-channel station is off the side of the main capture area of the antenna. If so, the Yagi might attenuate the local channel by up to 25 dB or better. Predicting the exact amount is impossible, because it depends on the model of the antenna used and the relative bearing of the station.

The preamplifier is the second major item in the system. It should be designed for single-channel operation. A less expensive broad-band unit frequently can be used, if it is preceded by a single-channel bandpass filter. Again, the adjacent-channel rejection, especially the lower adjacent sound carrier and the upper adjacent video carrier are rejected by some amount dependent on the filter slopes of the preamplifier. If insufficient rejection is achieved and beats are still visible on the TV screen, only external traps will clean up the picture.

One type of available trap is called an aural (sound) carrier reducer (ACR). This trap is essentially a high-Q-trap with the notch depth limited to approximately 10 to 12 dB. It is field tunable and used to reduce the lower adjacent sound carrier. TV stations usually transmit the sound carrier at 3 to 6 dB below the video carrier. Because the majority of TV sets will clearly reproduce sound with the sound carrier 20 dB below the video carrier, no harm will be done to the sound of the lower channel. However, if the local channel is not too much stronger than the distant channel, the ACR will remove any beats from the picture.

If an upper adjacent video carrier is causing interference, you'll have to use a high-Q-trap. This will attenuate the offending video carrier by 35 dB. Of course, this much attenuation probably will make the upper adjacent channel unusable.

The Simplest Distant-Signal System

The simplest systems are usually the most reliable ones. Fig. 1 shows a recommended method of receiving a distant station. A single-channel Yagi antenna feeds a preamplifier. If the

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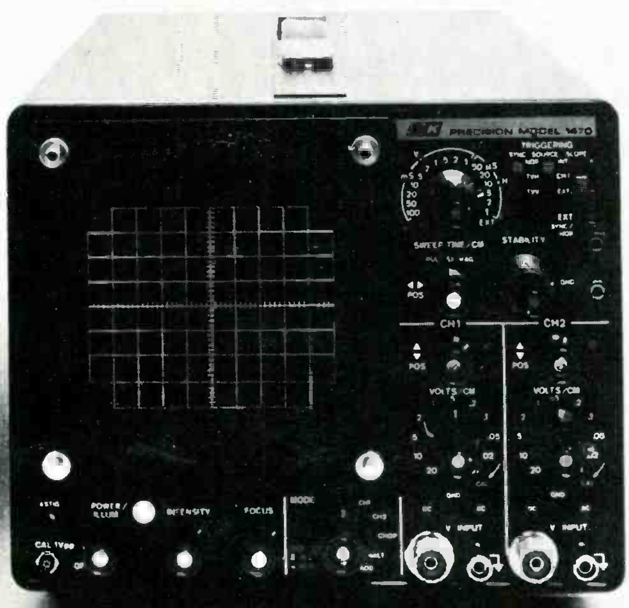

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Circle 12 on literature card

preamplifier is an inexpensive broad-band device the bandwidth of it can be limited by using a bandpass filter between it and the antenna. Coaxial cable is recommended as downlead, to eliminate pickup by the cable. The coax is connected to the TV set through a matching transformer. It is apparent that in Fig. 1 no attempt has been made to also receive local channels.

Local Plus Distant Reception

A very effective method of providing both local and distant TV reception is shown in Fig. 2. For long-distance reception, the basic single-channel Yagi system is installed. A second system, using a broad-band antenna, is installed with a separate downlead to the set. A switch to select either the broad-band or Yagi antenna is installed near the receiver. This installation is usually quite practical and eliminates an antenna rotator. It also provides the best isolation between local and distant stations.

There is another, better method for mixing a broad-band and Yagi antenna—a Yagi coupler. A Yagi coupler accepts two inputs —one from a single-channel Yagi and one from a broad-band antenna. The Yagi input will pass only the selected channel and attenuate all others. The broad-band input will pass all channels except the channel being picked up by the Yagi antenna. In a system like this, it is important that you balance signal levels so that the distant and local channels arrive at the TV set at approximately the same signal strength. You should use a field-strength meter to determine signal levels, and then use attenuator pads to reduce the local channels before they are mixed with the distant channel. Another reason for reducing the amplitude from local stations is to prevent overload of the preamplifier. In this system you also will have to use a sound-carrier reducer if a local lower adjacent channel exists.

Increasing Antenna Pickup

At times, a single-channel Yagi antenna will not provide enough signal to produce an uninterrupted picture. Distant stations often fade. Only one thing will reduce the effects of fading: more signal from the antenna.

As previously discussed, one usually reliable means of boosting signal is to increase antenna height. If this becomes uneconomical, you will have to increase the capture area of the antenna. There are two primary methods. One is to select a larger antenna. If this has been done without acceptable results two or more antennas can be "stacked" for even more gain.

Antenna Stacking

The basic rules listed in the accompanying table should be followed when combining antennas.

If all the rules are followed, the level of the received signal will be increased about 3.0 dB.

Vertical stack

This method of stacking is usually preferred when stacking antennas for improved gain. Mechanically, this installation is simpler because only one mast is required. The combining network and preamplifier can be mounted easily on the mast, and interconnecting leads are of minimum length. Also, orienting vertical-stacked antennas is a relatively simple matter, because in most cases the mast can be turned, simultaneously orienting both antennas. Two antennas provide 3 dB of gain over that of the individual antenna. Doubling the number of antennas used, doubles the gain. Up to four antennas are practical in the high VHF band, because the separation of 0.7 wavelength can be achieved without excessive tower heights. A "Quad" stack (4 antennas) can provide 5 to 6 dB

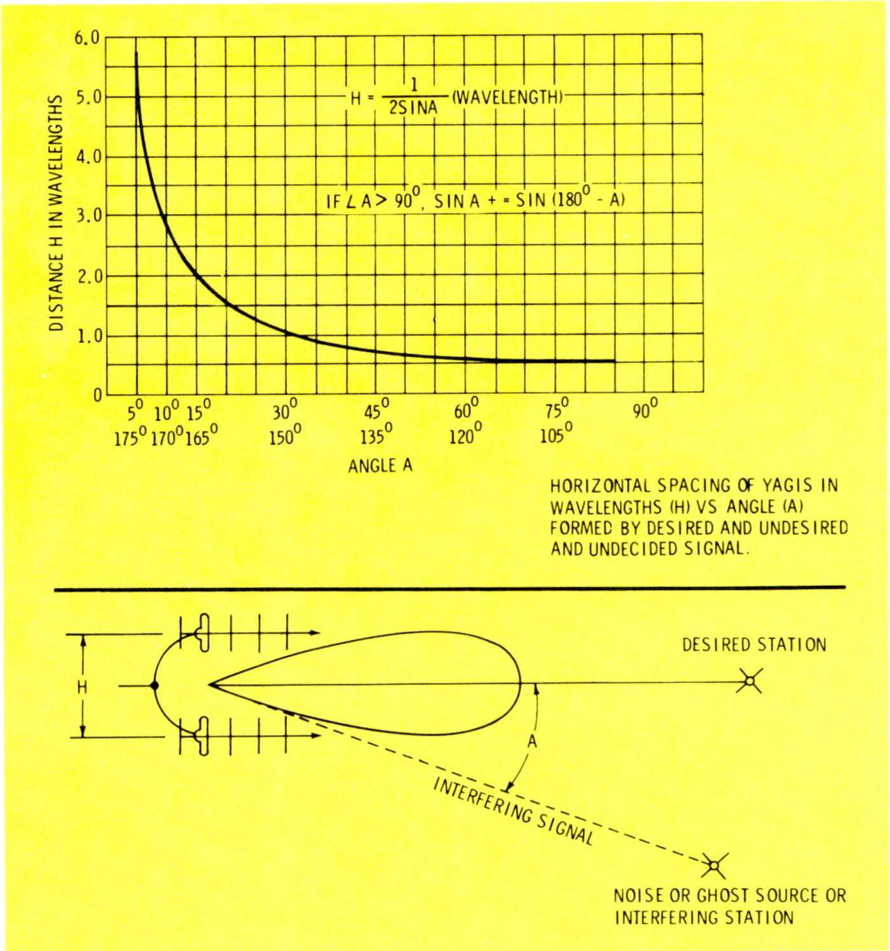
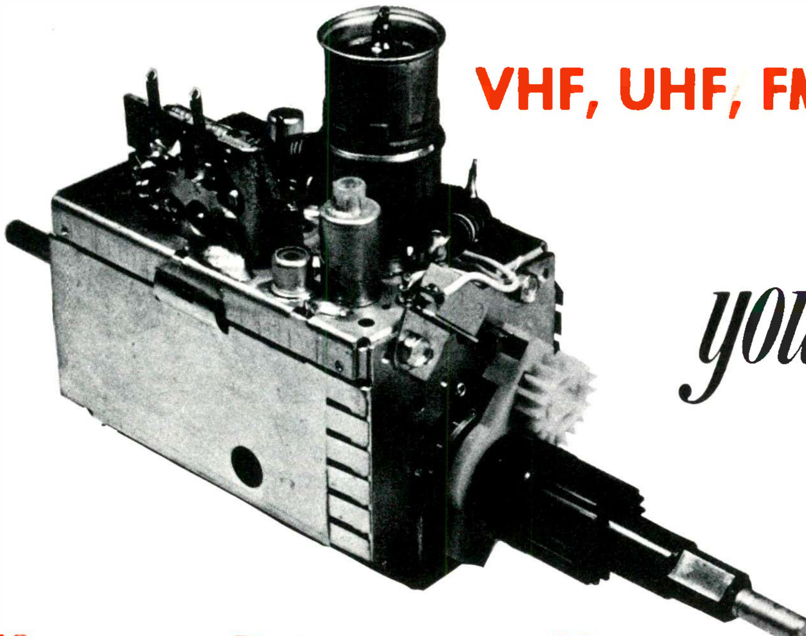


Fig. 3 Diagram and chart showing horizontal spacing of antennas for rejection of unwanted signals.

TV TUNER SERVICE



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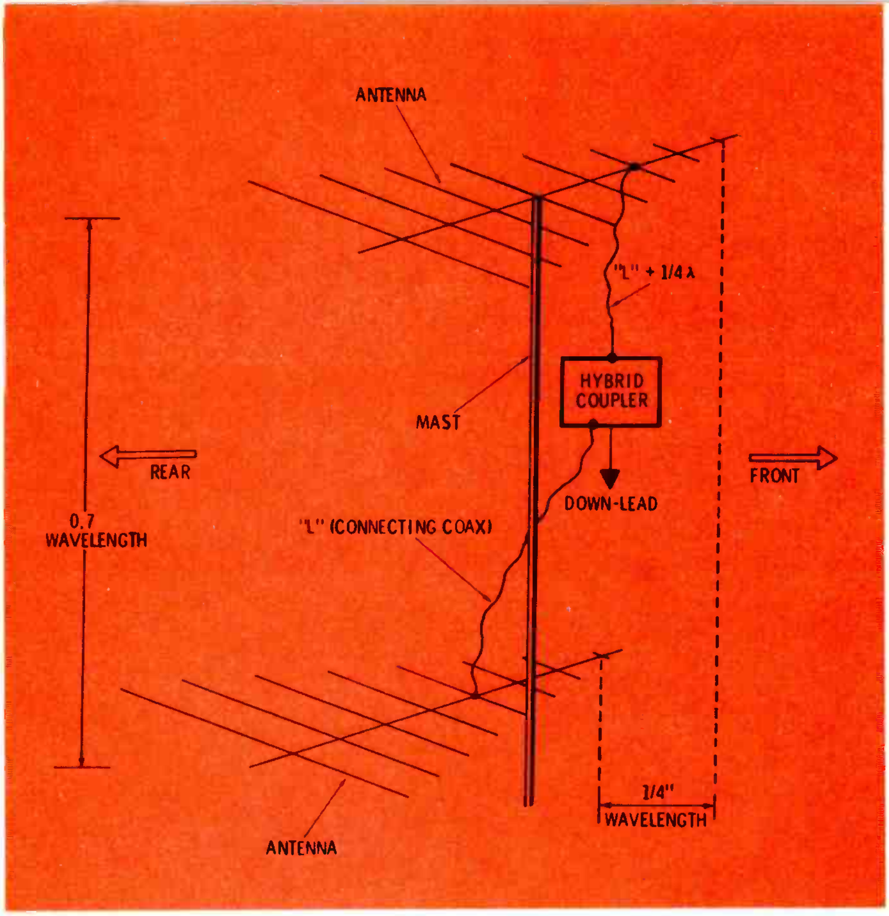
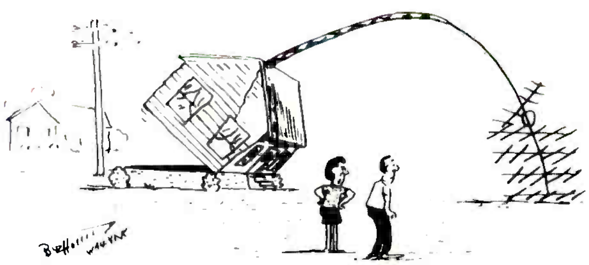


Fig. 4 Stagger stacking of antennas increases the front-to-back ratio of the system, to eliminate or reduce ghosting and other interfering signals.

Basic Rules For Stacking TV Antennas

- Identical antennas are required.
- Antennas must be mounted to produce signals in phase. This can be done easily by mounting both antennas with the connectors up, or both down, as long as both connectors point the same way.
- Antennas should be combined by a hybrid splitter, not a resistive device.
- Lead length from each antenna to the mixer must be the same. The actual length is relatively unimportant, as long as both leads are exactly the same length.
- The spacing between antennas is important. Vertically stacked antennas should be separated by a distance of 0.67 to 0.75 wavelength of the channel in question. For horizontally spaced antennas, the separation from boom to boom should be 1.0 wavelength of the desired channel.



"HOWCOME YOU HAFTA PUT ALL THAT STUFF ON TOP OF IT ANYHOW ?"

more signal than an individual antenna.

Horizontal stack

This method of combining antennas may be used to obtain additional signal, but its prime advantage is that it provides relatively predictable nulls in the pattern. These nulls can be used to reduce the effects of pickup from strong local stations. By properly spacing the antennas, the nulls are "positioned" to create maximum attenuation in the direction of the local station. The graph in Fig. 3 shows the required spacing versus null angle.

From this graph, you can see that four nulls are created. For a spacing of one wave length, there will be nulls at 30 and 150 degrees. There also will be mirror image between 180 and 360 degrees. These nulls will fall at 210 and 330 degrees.

Although the horizontal-spacing method of "stacking" antennas is mechanically more difficult because both antennas must be mounted in the same plane, it is relatively effective for rejecting unwanted signals, including adjacent channels, co-channels, and other sources of interference. In practice, it might not always be easy to calculate the spacing required for desired nulls. However, it is easy enough to find the nulls by experiment. Tune a field-strength meter to the unwanted frequency and vary the horizontal spacing until minimum signal is indicated by the meter.

For co-channel interference, a TV set can be used as an indicator of maximum rejection of the interfering station.

Stagger stacking

This method of combining antennas also can be useful in a small system, to increase the front-to-back ratio from an antenna system, and might be the only solution available to eliminate ghosting or other interfering signals. This method will improve the front-to-back ratio by 10 to 20 dB while still providing increased gain in the forward direction.

(Continued on page 20)

(Continued from page 18)

It can be seen in Fig. 4 that the forward signal is picked up by the top antenna ¼ wavelength ahead of the bottom antenna. This signal is delayed ¼ wavelength in the coax, because the coax is ¼ wavelength longer; consequently, both signals will be in phase at the mixing device, providing 3 dB more signal.

Signals from the back of the array are delayed by the top antenna by ¼ wavelength plus the ¼ wavelength delay of the coax. Consequently, signals from the two antennas arrive at the mixing device 180 degrees out of phase, and tend to cancel each other.

RF energy travels at a different rate in coax than in air. In solid-dielectric coax, one wavelength is .66 of that in air. In foam-dielectric coax (more commonly used), one wavelength is .82 of that in air. These factors must be included in the computations for determining coax length.

Summary

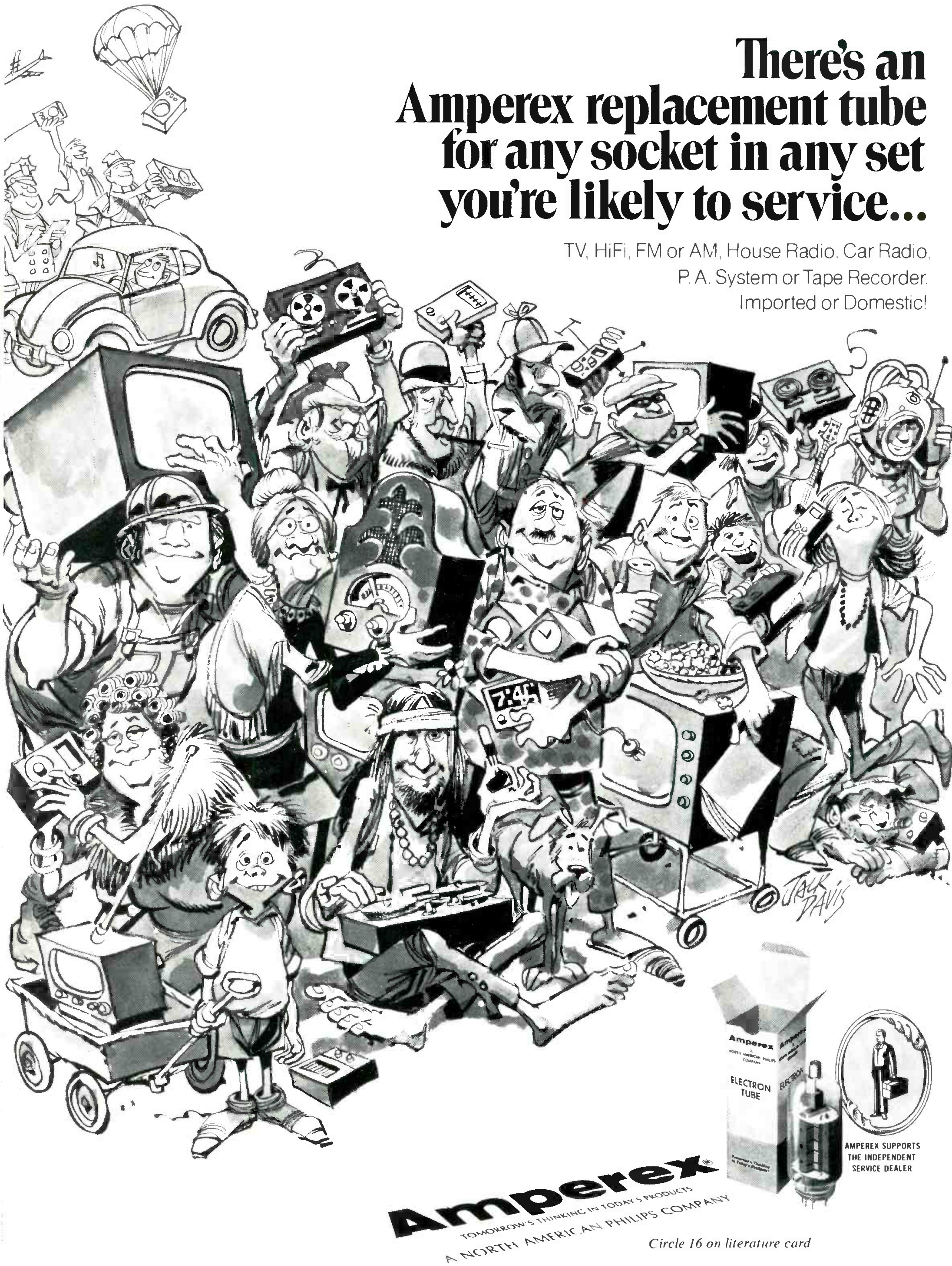
Filters are very useful for reducing intermodulation in preamplifiers and can be mounted on the antenna mast, if they are designed for outdoor use.

When traps become necessary, it is most desirable to temperature stabilize their environment by installing them indoors. Transmission lines should be as short as possible.

A field-strength meter is an essential instrument for designing and installing most types of antenna systems. It will help determine if problems exist and, if they do, point the way toward effective cures.

As explained previously, the major problem encountered when attempting to receive TV signals over long distances is the interference created by local stations. A number of solutions to reduce this interference are available. Any solution might be effective by itself or can be used in conjunction with other methods to obtain acceptable results.

Extensive experimentation might be required, but don't let this deter you. Once you solve the problems in a specific area, you can easily apply your solution to any number of installations in that area. □



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MATV Systems

■ A four-part series about master antenna television (MATV) systems.

→ 1) System Components
2) Decibels
3) Designing The Distribution System
4) Designing The Head End

by John Rogerson
Technical Director, MATV
Channel Master Div. of
AVNET, Inc.

A Master Antenna Television (MATV) system, by definition, is "a means wherein electromagnetic energy is induced from free space onto an antenna array, amplified to a useful energy level, and then distributed to the various television sets."

If there are 100 TV sets in a building, it would be very expensive to install and maintain 100 separate antennas. It would be unsightly and reception would suffer because that many antennas on one roof would probably inter-act with one another.

However, an antenna alone can't supply enough signal to provide good reception for a large number of sets. For good reception on each and every set in motels, hotels, hospitals, schools, apartment houses, and other buildings with many TV sets, the signal from one antenna must be increased manyfold, and then fed to the sets. The above considerations led to the development of MATV systems.

Any MATV system consists of two main sections: The *head end* and the *distribution system.*

The *head end* usually consists of the **antenna installation,** to receive the desired signals, and the **amplifiers,** to increase the signals to a useable level. In addition, mixing networks, traps, filters, and other equipment may also be required depending upon specific considerations such as the number of channels, signal strength, the direction of the transmitters, and the presence of interference.

A well-designed *distribution system* is necessary to guarantee that adequate signals will be delivered to all the sets in the system. Truck lines, feeder lines, and tapoffs must be carefully chosen so that each TV set, regardless of distance from the amplifier, receives an adequate signal for satisfactory operation. Considerations such as the proper choice of components, the proper choice of cable, and the layout for minimum cable loss, are among the prime considerations.

It is most important that the distribution system be designed first. Usually, the requirements of the distribution system will determine the type and the quantity of the equipment that will be required at the head end. The actual layout of the system will depend upon the structure. In this part of the series, the individual components which make up the head end and distribution system will be described.

The Head End

Antenna

The first component of any MATV system to receive the signal is the antenna. Because the quality of TV reception can be no better than the quality of the signal at the antenna, it is vital that antennas be selected and installed with extreme care.

Some MATV systems use broad-band antennas. But if the stations to be received are in different directions, or if the signal from one station is much stronger than that of another, single-channel antenna installations must be used. The number of channels to be received, the direction of the stations, and the signal levels available must be considered.

Baluns

Many antennas have an impedance of 300 ohms and most MATV equipment has an impedance of 75 ohms. Therefore, the signal coming from the antenna must be converted from 300-ohm twin lead to 75-ohm coaxial cable. This is accomplished by a 300-to-75-ohm matching transformer, called a balun. The balun is usually mounted as close to the antenna as possible.

Preamplifiers

In extremely weak signal areas, it is often necessary to preamplify the signal to get acceptable quality reception. In addition to increasing the signal, some preamplifiers also function as 300-to-75-ohm matching transformers. When this type of preamplifier is needed, it is important to install a unit with a low noise figure, because the preamplifier determines the noise figure (snow content of the picture) for the entire system.

UHF converters

In many large, commercial MATV installations, UHF signals are converted to VHF on an unoccupied channel before they reach the distribution amplifier. Because UHF converters convert to a single VHF channel, a separate converter is usually needed for each UHF station to be received.

UHF converters contain a mixing network which permits VHF signals from another converter or VHF antenna to be combined in a single cable before broadband amplification. In addition to converting UHF signals to VHF, converters usually amplify the signals they convert. This should be taken into account when equalizing signal levels.

UHF converters usually should be located indoors in an area where the year-round temperature is fairly constant.

Cable

Except for very small residential installations, MATV systems use 75-ohm coaxial cable to transport the signal throughout the system.

Coaxial cable is a concentric transmission line. It consists of a center conductor, a shield and a dielectric medium, such as polyethelene, which fixes the spacing between the center conductor and the outer shield.

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vantages over twin lead—it can be run through conduit, it stands up better outdoors, it produces less radiation interference, and it virtually eliminates the possibility of signal being picked up directly by the conductor.

RG11/U or similar cable is usually specified for the longer spans because of its lower loss. RG-59 type cable is smaller and has a higher loss; it is usually specified to connect the distribution lines to individual wall outlets. In smaller or medium-sized installations, RG-59 type cable is often used throughout the entire system.

Unlike 300-ohm twinlead, coaxial cable cannot be attached to the various pieces of equipment in the system by merely winding the conductor around a terminal. Fittings (connectors) must be employed in most instances. Most MATV equipment is equipped with standard "F" type fittings, for faster, easier installations.

Filters and traps

Filters and traps are used in the head end of many systems to eliminate undesired frequencies and provide interference-free reception.

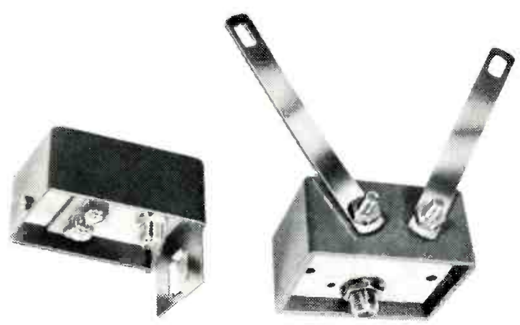
Traps are either fixed or variable. Fixed traps are designed to cover a specific frequency range, such as FM or individual television channels. Variable traps can be tuned to any given frequency within their range, as required.

Band pass filters permit the desired range of frequencies to pass through while greatly reducing (attenuating) all signals on either side of the desired range of frequencies.

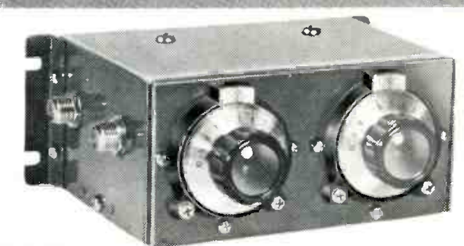
Traps are filters which are used to block an undesired frequency that is very close to the desired frequency. To be effective, a trap must have a very high "Q" (be very selective), so that it can eliminate the undesired frequency without appreciably attenuating the desired frequency.

Traps, filters and all head-end equipment except baluns and

Baluns

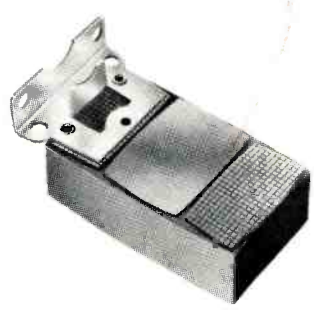


Bandpass Filter

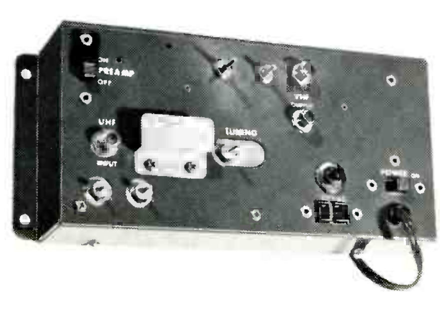


High-Q Trap

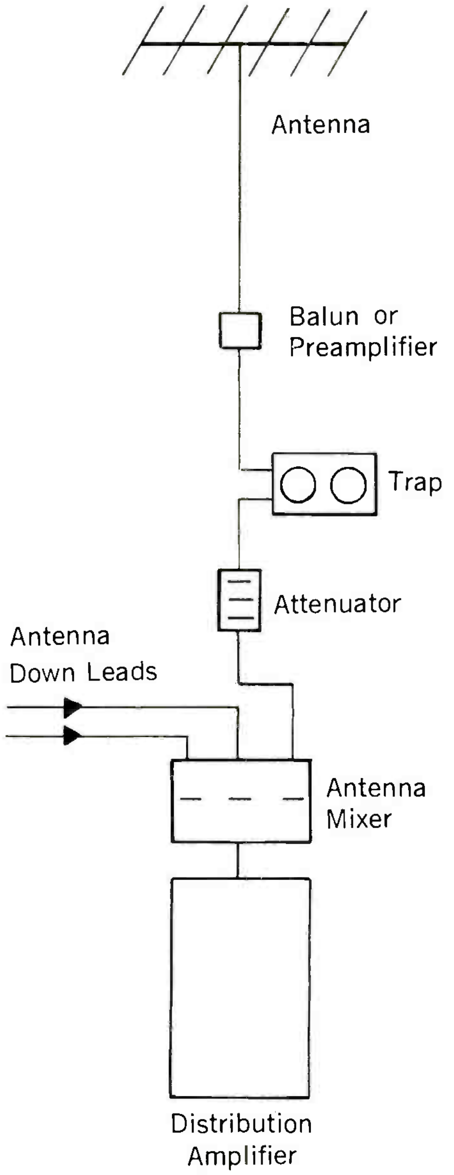
Preamplifier



UHF Converter

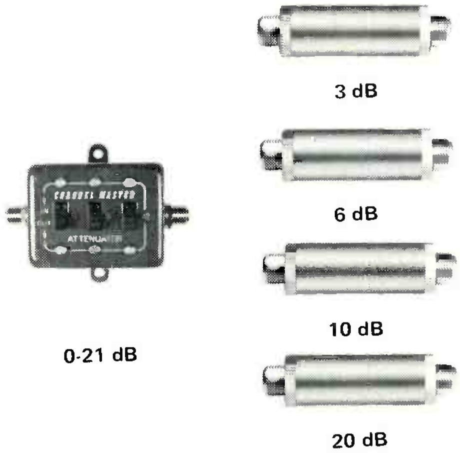


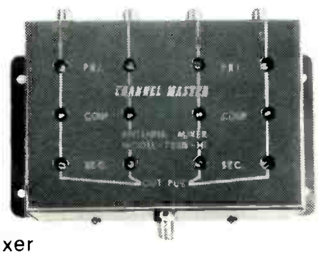
TYPICAL HEAD END



Amplifiers

Attenuators





Antenna Mixer

Coax

preamplifiers are usually mounted indoors. The equipment should be accessible for adjustment and servicing.

Attenuators

As signals are picked up by a single antenna or combination of attennas there may be a wide variation between the amplitude of the received signals. In this instance, the signal levels should be equalized to prevent the stronger signals from overriding the weaker signals. This is accomplished by the use of attenuators which reduce the incoming signal by a specific ratio (number of dB).

Attenuators are either fixed or variable, that is, designed to a particular attenuation level, or switchable, so that signals can be reduced to the exact level required.

Antenna mixers

If more than one antenna is used, the signals from the various antennas must be combined (mixed) before they reach the distribution amplifier (when broad-band amplifiers are employed). Antenna mixing units are usually a number of passband filters covering either the low band (channels 2-6) or the high band (channels 7-13).

In addition to combining the signals from various antennas, the antenna mixing unit also filters out interfering frequencies. However, if the interfering frequency is very close to the desired frequencies, a high "Q" trap may also have to be employed. For example: If channel 2 and channel 4 were being fed into a low-band antenna mixer, and channel 3 signal was also present, the mixer would filter out some of the channel 3 interference. But if the channel 3 signal was very strong, high "Q" traps would have to be used before the signal reached the mixer.

If both low-band and high-band channels are to be received, the signals from the low-band and high-band antenna mixers must be combined in a single line before broad-band amplification. This calls for a band separator/mixer. This unit joins any VHF low-band signal to any VHF high-band signal, to provide a single coaxial lead with a minimum of interaction. The unit can also be used to separate VHF low-band and VHF high-band signals contained in a single lead.

If a broad-band antenna is used, adjacent-channel operation (i.e. using both channel 5 and 6) is not recommended. Where adjacent channels are to be received, use single- or cut-channel antennas. However, if adjacent channel operation from a broad-band antenna is mandatory, traps should be used to attenuate sound carriers, to prevent adjacent-channel interference.

Antenna mixing units can also be reversed, and used to separate the signals from a broad-band antenna into separate lines.

Stronger signals can then be attenuated to the weaker signal level and then recombined before broad-band amplification.

Amplifiers

Amplifiers are used to increase the signals received from the antenna to a level greater than the losses of the distribution system, while providing an acceptable signal to all sets in the system. Though gain is important, output capability is just as important.

The amplifier specifications should be carefally checked to ascertain that the output level is sufficient to feed the system, and that signal input plus the gain of the amplifier does not exceed the amplifier's output capacity. Exceeding the output will cause overloading, (cross modulation) and overall signal deterioration.

A low noise figure is also important, because noise is seen as snow. The amplitude of the noise must be kept small in relation to the amplitude of the signal.

For the most economical installation, the amplifier should be centrally located in relation to the distribution lines. The longer the distribution lines, the more costly the system will be to install.

The Distribution System

Splitters

The coaxial cable which carries the signal from the distribution amplifier toward the sets is called the Main Trunkline. Occasionally MATV systems operate with a single trunkline. But it is usually more practical to separate (split) the signal into several lines for distribution to the sets. This is done with a 2-, 3-, or 4-way hybrid splitter. In strong-signal areas, it is important to use back-matched splitter/mixers. Back matching provides a good match for reverse current flow, minimizing the possibility of the signals re-entering the system and causing ghosts.

Tapoffs

The tapoff is a means of delivering signal from the distribution lines to the TV sets, while providing enough isolation to prevent sets from interfering with one another.

Each set in a MATV system should get approximately the same amount of signal. But there is more signal available in the distribution lines for sets close to the amplifier than for sets further down the line. Therefore, variable isolation wall tapoffs are used. These can be set to vary the per cent of signal to be removed from the distribution line to achieve a balanced signal.

There are four types of tapoffs in common use: The wall tap, the line-drop tap, the directional-coupler tap, and the pressure tap.

The wall tap is the most commonly used tap in MATV. It is employed in the same manner as an AC outlet. In new construction the distribution line is run inside the wall and the tap is mounted in a standard electrical outlet box within the wall (flush mounted). In existing buildings, it may not be possible to snake the wiring within the walls. In this case, the distribution line must be run along the baseboard or on the surface of the wall. The tapoff is then enclosed in a special surface-mounted housing, for protection, and to prevent unsightliness.

There are three types of wall taps available—the 300-ohm output, the 75-ohm output, and the dual output. The type to be used depends upon two factors—the number of outlets required per room, and the signal strength in the area. Generally, using a 75-ohm type with a matching transformer is recommended. In strong-signal areas, 300-ohm twin lead tends to pick up signals from the air (direct signal pickup) and can cause ghosting and interference. 75-ohm coaxial cable prevents this because it is shielded from direct signal pickup.

Some systems will require an outlet for both television and FM. It is in these instances that dual 300/75-ohm tapoffs are employed. The 75-ohm section is used for TV and the 300-ohm section for FM.

The line-drop tap is employed in attics and crawl spaces. Each line drop tap provides 1 to 4 drop lines, which carry the signal to a set. The drop lines can be run directly to the set and matching transformers, or they can be run to a 0-dB wall tap.

The line drop tap is most commonly used in schools, motels and hospitals, etc., where the main cable is run down the hallway and feeder lines drop down into each room.

The pressure tap is used outdoors when distribution lines are strung between poles, under the gables of apartments, or other external systems.

A directional coupler is a device which transfers power in one circuit (the feeder line) to another circuit (the drop line) for a signal traveling in the forward direction, but does not transfer power for a signal in the opposite direction.

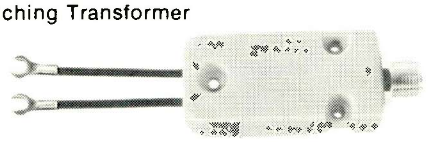
A coupler can be described by its insertion loss on the feedback line, its coupling loss from the feeder to the drop line, its directivity (the relative coupling to forward and backward traveling waves ... the efficiency of its directional property), and its return losses.

A directional coupler properly designed and installed has the following properties:

- Minimum insertion loss ... no other coupler design with this particular coupling value can have less loss.
- A good match at all ports (therefore, "back matches" because the output ports on both feeder and drop line are matched).
- A signal from the drop line will be directed toward the headend with the same losses and directive properties with which a signal from the headend is directed to the drop line.

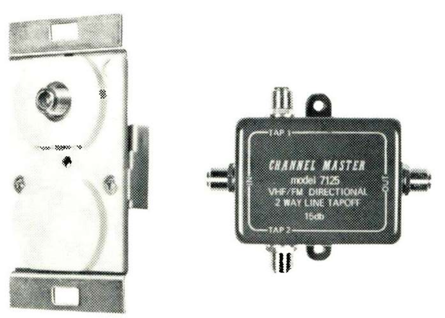
From the preceding it can be seen that a directional coupler helps assure excellent impedance matching at all terminals, high accuracy of coupling (±1

Matching Transformer

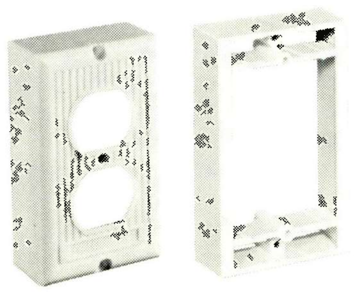


Terminators

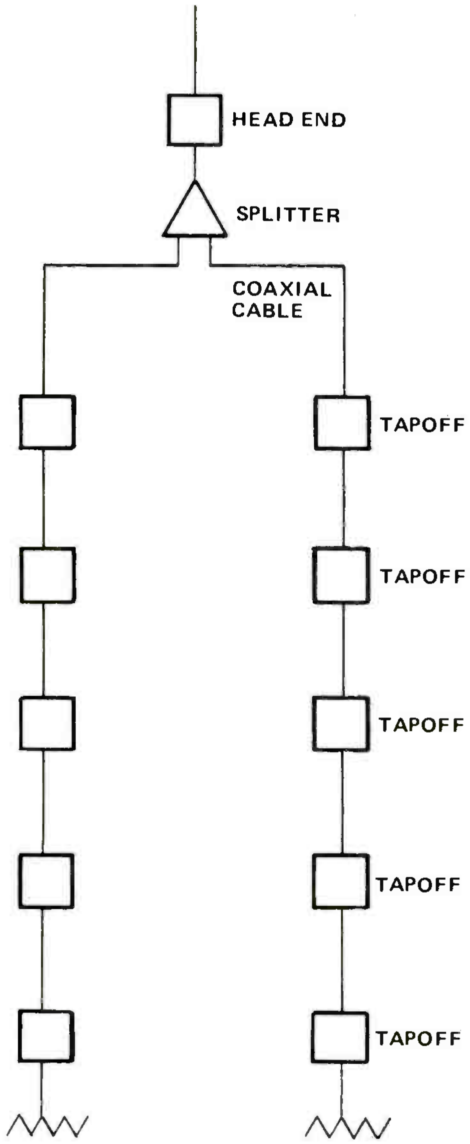
Directional Couplers

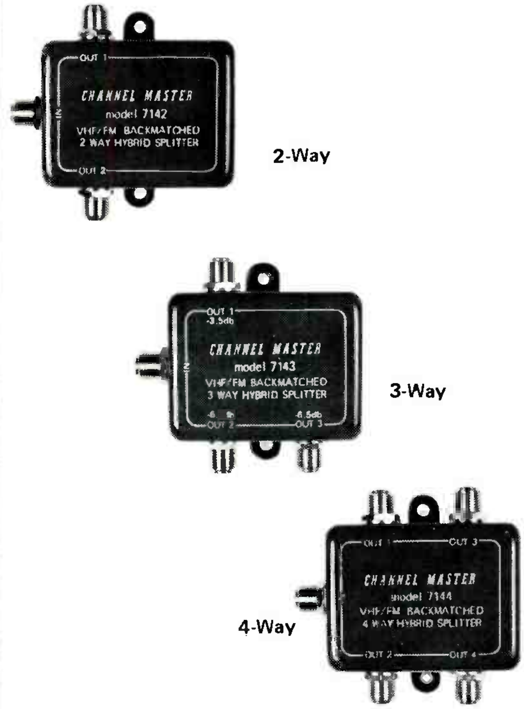


Surface-mounted Housings
For Wall Taps



TYPICAL DISTRIBUTION SYSTEM

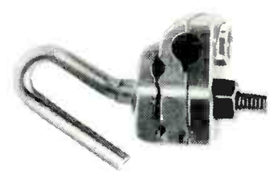




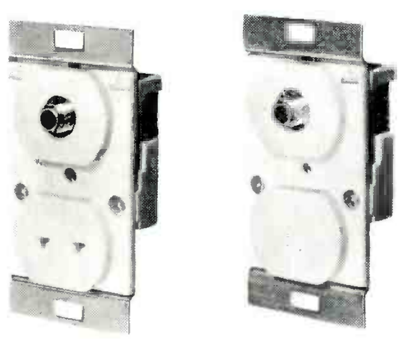
SPLITTERS

PRESSURE TAP

MOUNTING CLAMP



WALL TAPOFFS



LINE-DROP TAP

dB) and low insertion loss. Directional coupler tapoffs provide attenuation of 40-60 dB to signals leaving the line and returning because of receiver mismatch or disconnection. This virtually eliminates all problems such as ghosting and reflections which produce noise, phase distortion and overload.

This directional coupler circuitry is available in line tapoff configuration with one tap, two taps, or four taps for the drop lines and with various isolation values. Directional couplers are also available as a wall-type tapoff with a single 75-ohm output. The wall tapoff version is available with various isolation values.

75-to-300-ohm matching transformers

Since the characteristic impedance of the signal in MATV distribution lines is 75 ohms, and most TV sets require 300 ohms, the signal must be transformed from 75 to 300 ohms. Sometimes this is performed by a 300-ohm wall tapoff. But when drop taps, pressure taps, directional couplers and 75-ohm wall taps are employed, a 75-to-300-ohm matching transformer must be used at the TV set.

Band separators

Band separators are used in all-channel (UHF/VHF) MATV systems, to separate the UHF signal from the VHF signal before it is fed into the TV set. Unlike splitters which divide signal equally, band separators contain circuitry which separates one band from another. In addition to UHF/VHF band separators, you may also have occasion to use VHF/FM band separators in VHF/FM systems.

Terminators

The end of each 75-ohm distribution cable must be terminated with a 75-ohm resistor, to prevent signals from traveling back up the line and causing ghosts on the individual TV sets. These resistors are called *terminators*. ☐

Next—The Decibel

Typical recurring troubles in Color TV

Actual case histories which outline successful troubleshooting techniques and provide tips about difficult, but common, troubles.

by Robert L. Goodman

Red Vertical Stripes

Symptoms—About twenty, red, pencil-sized vertical stripes appeared intermittently across the screen of a Zenith color receiver equipped with a 14A9C51 chassis. These stripes occurred during both b-w and color broadcasts. However, the color disappeared when the stripes were seen.

Diagnosis—Signal tracing with a scope isolated the source of the stripes to the 2nd color amplifier stage, which is shown in Fig. 1. Moving transistor Q206, to test for the possibility of erratic connections in the socket pins, caused flashes in the color and occasionally seemed to trigger on the stripes. Cleaning and lubrication of the pins of the socket reduced, but did not eliminate, these symptoms.

Cure—Replacement of transistor Q206 eliminated all traces of the red stripes.

Although a defective transistor or a corroded socket pin in several cases have caused red stripes, in other instances the red stripes have been caused by a corroded contact between J204 and P204, which connect to the color control. In at least one other case, the red stripes were produced by an intermittently-open connection in the secondary winding of L216.

"Separating" Color

Symptoms—The "colors would separate," according to the customer, when a scene of the picture changed suddenly, or when the channel selector was adjusted. The color receiver was a Ze-

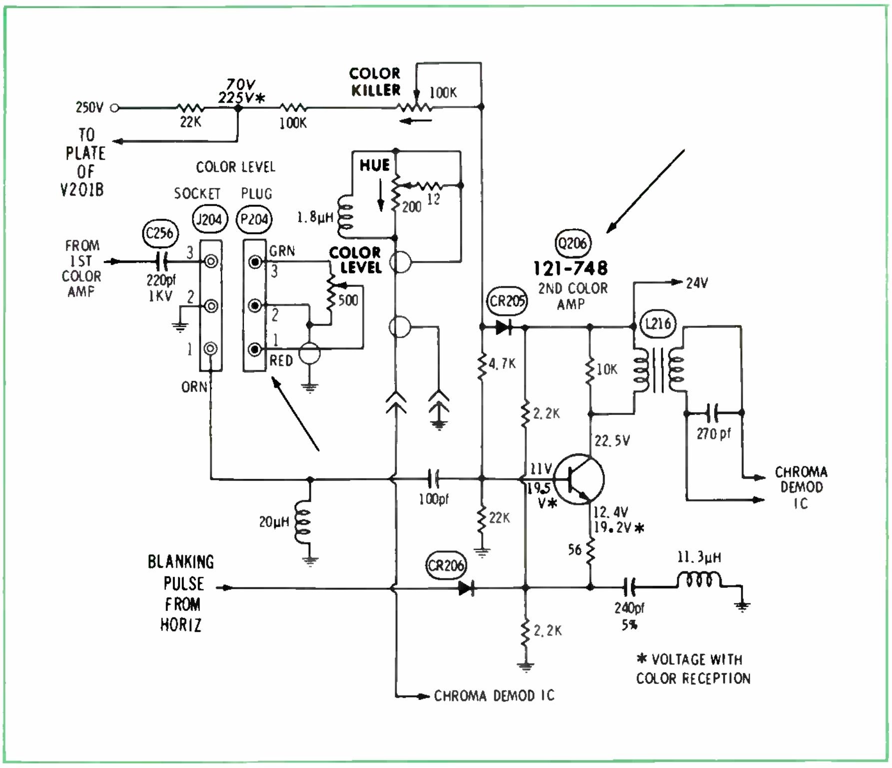


Fig. 1 Schematic of the 2nd color amplifier stage in Zenith 14A9C51 color chassis.

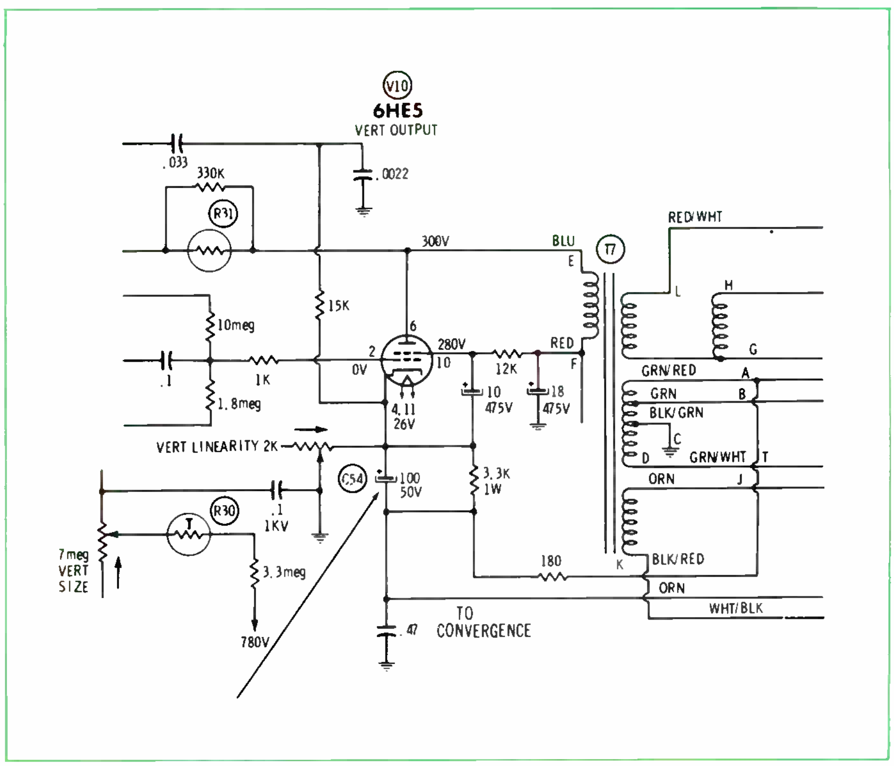


Fig. 2 Schematic of the vertical-output stage in Zenith 20X1C38 color chassis.

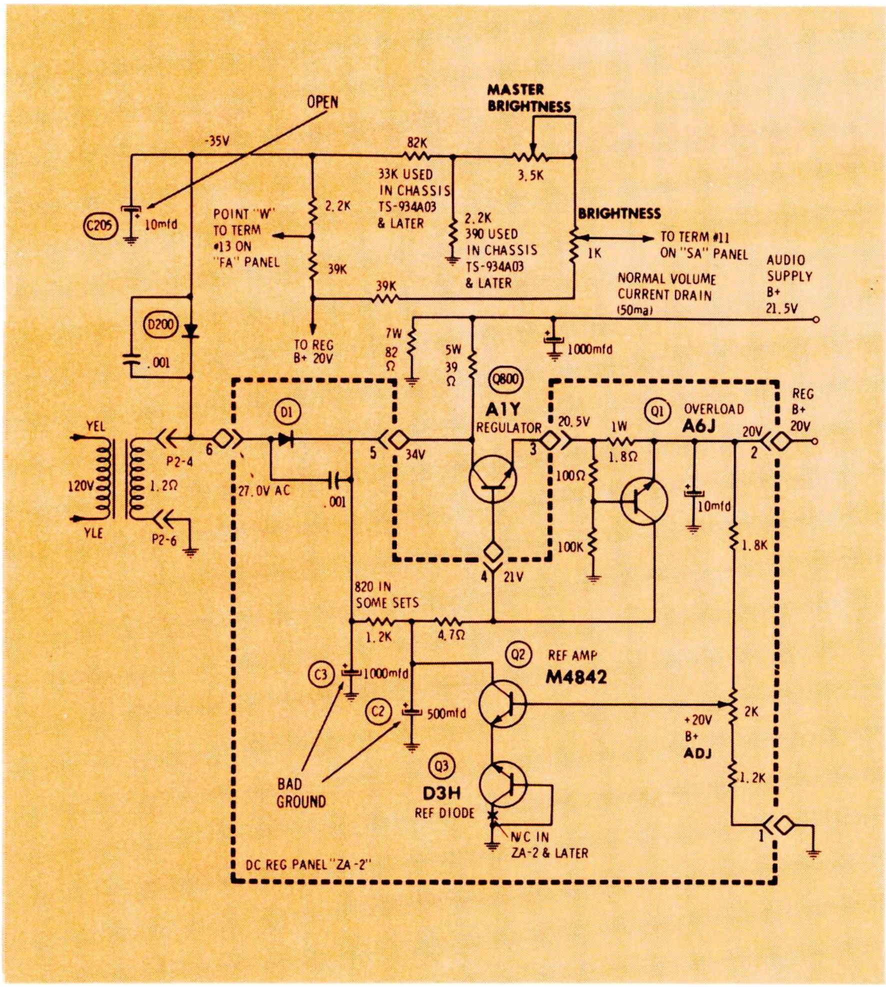


Fig. 3 This schematic of the power supply in the Motorola TS-934A chassis shows those filter capacitors which should be physically and electrically tested when hum bars are displayed on the screen.

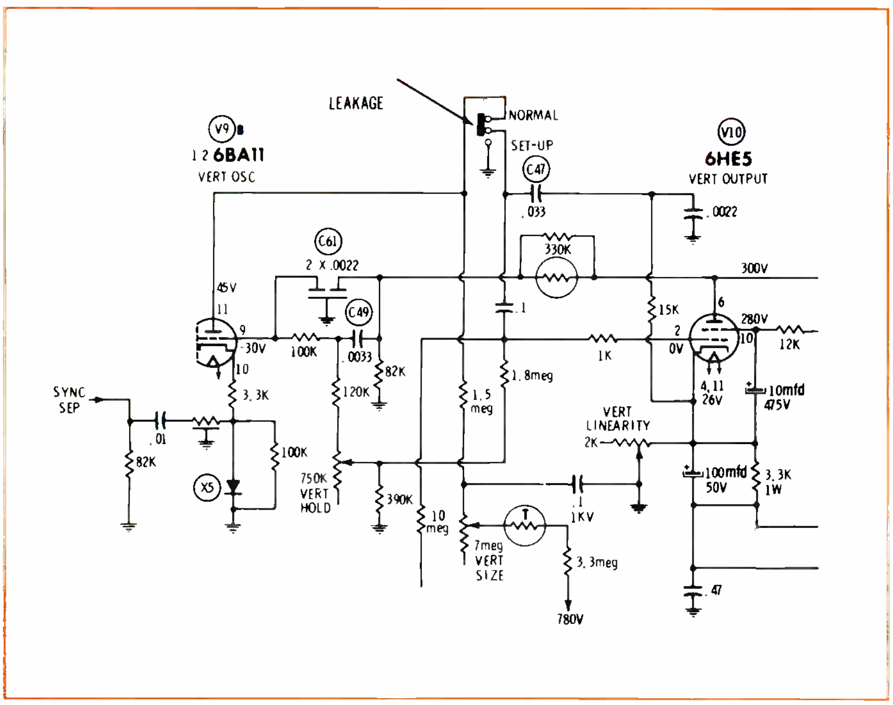


Fig. 4 Partial schematic of the vertical-sweep section of Zenith 20X1C38 chassis. The SETUP/NORMAL switch was the cause of erratic height.

nith which used a 20X1C38 chassis.

When a crosshatch pattern was displayed on the screen of the picture tube, a radical change in the dynamic convergence could be seen. The convergence would change rapidly, then over a period of 5 to 10 seconds, the crosshatch lines would drift slowly back to the normal position.

Diagnosis—Because of the gradual return to normal convergence, a malfunctioning electrolytic capacitor was suspected. Because bridges or meters for testing capacitance do not always reveal intermittents of this type, the electrolytic capacitors in the vertical sweep circuit and the convergence circuit were disconnected, one by one, and similar-sized capacitances from a substitution box were connected in place of them.

Cure—C54, the 100m-fd capacitor shown in Fig. 2, proved to be the cause of the intermittent dynamic convergence. In addition to functioning as a cathode bypass, C54 also assists in shaping the waveform which is supplied to the convergence circuit.

Horizontal Hum Bar

Symptoms—A dark, horizontal, hum bar could be seen moving slowly up the picture of the Motorola Quasar II color receiver, which uses a TS-934A chassis.

Diagnosis—Moderate tapping around the chassis eliminated the hum bar for short periods, but it soon returned. Further tapping, using a very light touch, pinpointed C3 (Fig. 3) as the component most sensitive to movement. An examination with a magnifying glass showed a cracked ground connection to C3.

Cure—Resoldering the connections to C3 eliminated the hum bar.

In another case, a similar hum bar was produced by a poor ground between the ZA panel and the frame. A cracked ground connection at C2 (500 mfd) also can produce a hum bar. In a few cases, an open C205 (10 mfd) caused a hum bar of similar appearance.

In all cases of hum in the pic-

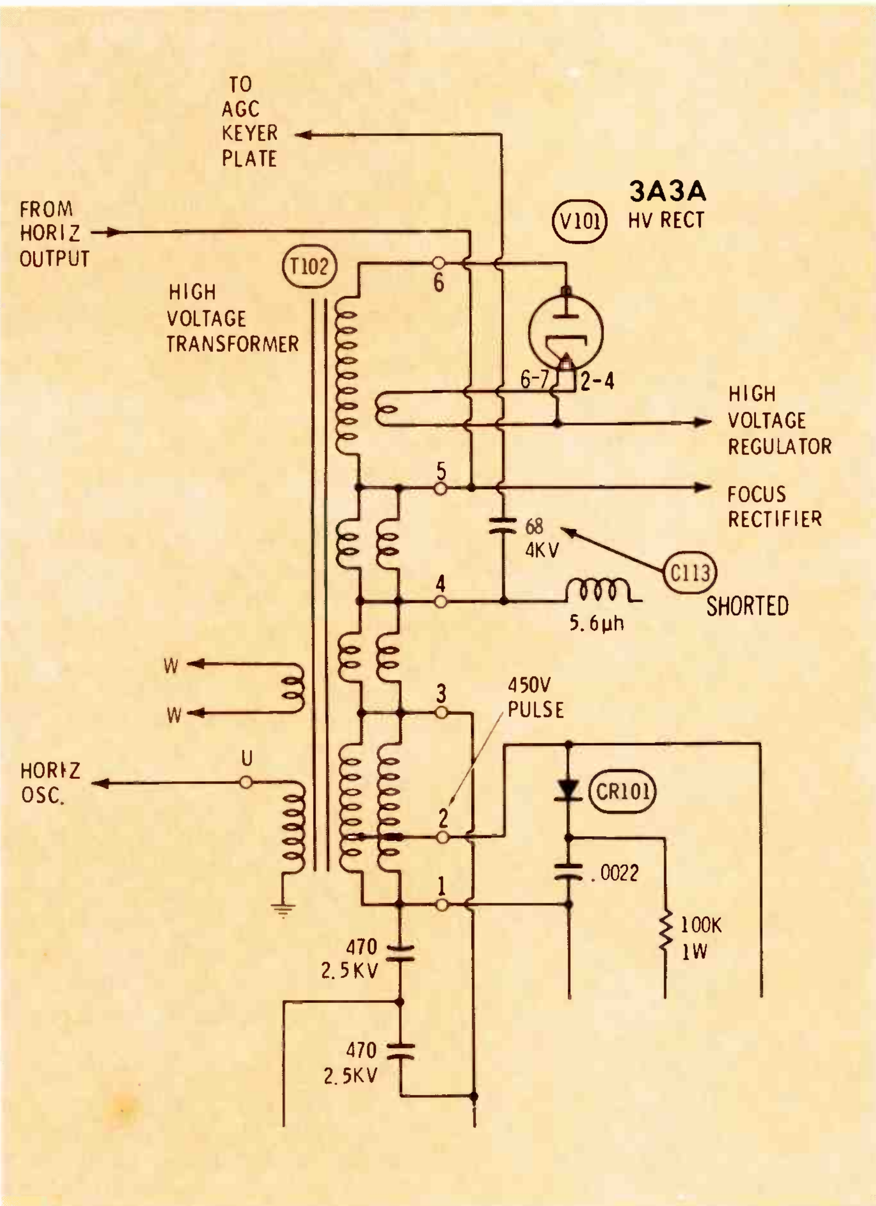


Fig. 5 Partial schematic of the horizontal-sweep circuit in RCA CTC25X color chassis. Capacitors eliminated the high voltage.

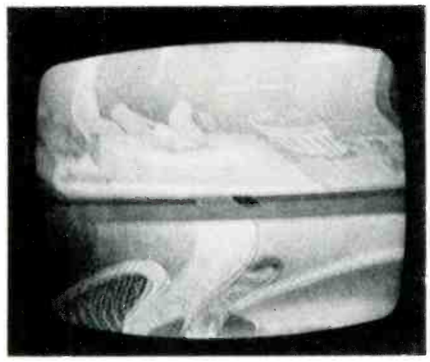


Fig. 6 The screen of the Zenith 20X1C38 color chassis displayed an "S" curve and instability of the AGC and vertical locking when C37D was open.

ture, closely examine the grounds of the electrolytic capacitors and panels.

Intermittent Vertical Sync; Occasional Loss Of Sweep

Symptoms—Erratic height, intermittent vertical roll and occasional loss of vertical sweep were observed within a few minutes on the screen of a Zenith equipped with a 20X1C38 chassis.

Diagnosis—Installation of a new vertical tube did not change the symptoms. An erratically varying voltage was measured at the plate (pin 11) of the vertical oscillator tube (Fig. 4). Because the plate voltage normally should vary if the grid voltage varies, a fast test to determine whether the grid or plate circuit is the source of the trouble is to ground the grid pin of the oscillator tube and see if the plate voltage continues to vary. In this case, although the plate voltage had decreased, it continued to vary erratically. This test cleared from suspicion the grid circuit voltages and the positive-feedback network.

The next suspects were the VERT SIZE control and the 3.3M-ohm resistor, which connects to it. Both of these parts were replaced temporarily by substituting an external 5M-ohm potentiometer. The height of the picture and the voltage at the plate of the oscillator tube still varied erratically.

Because setup/normal switches have caused such intermittent operation, this switch was tested by removing the two ungrounded wires from the switch and connecting them together. The vertical sweep became steady and could be adjusted to cover the entire screen area. The defect apparently was leakage across the insulation of the setup/normal switch.

Cure—A new setup/normal switch was installed.

No Raster; High-Voltage Transformer Hot

Symptoms—An RCA color receiver equipped with a CTC25X chassis produced no raster, the high-voltage transformer was running too warm, and the amplitude of the B-boost voltage was below normal.

Diagnosis—AC and DC drive voltages at the grid of the horizontal-output tube were within tolerance, and the DC voltage at the screen grid was higher than normal, which meant that no excessive current was being drawn by the screen circuit. All routine tube replacements and tests of the damper circuit, yoke, and the boost capacitor gave inconclusive results.

Because shorted turns in the windings of the side-pincushioning (PC) transformer can produce these symptoms, the leads of the PC transformer were disconnected from the high-voltage transformer, but the high voltage

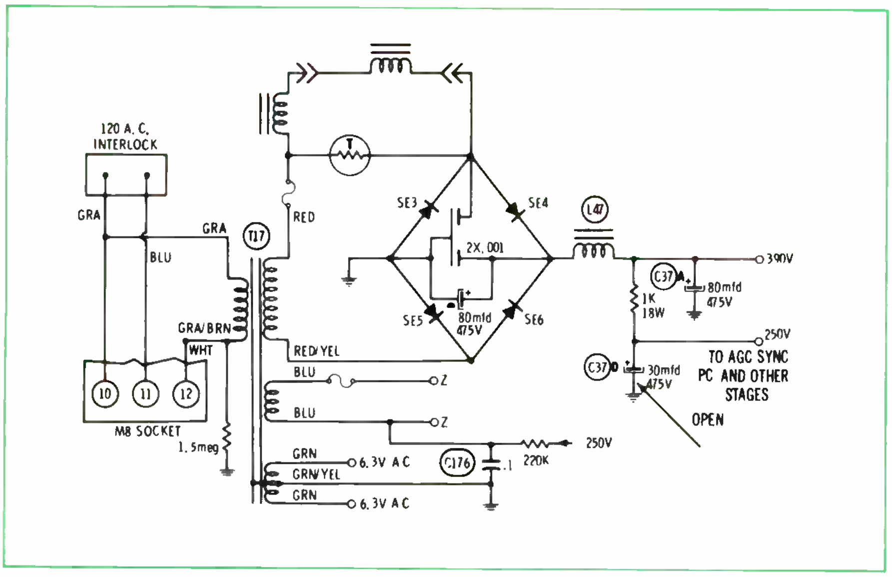


Fig. 7 Schematic of the power supply in Zenith 20X1C38 chassis.

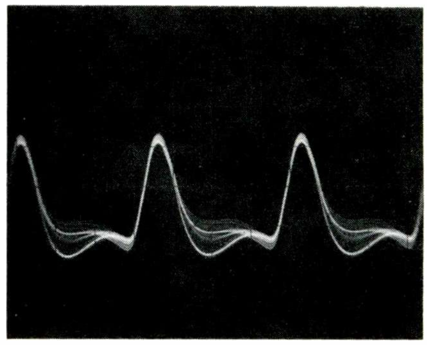


Fig. 8 This large 16-volt p-p waveform was produced at the 250-volt supply when C37D was open.

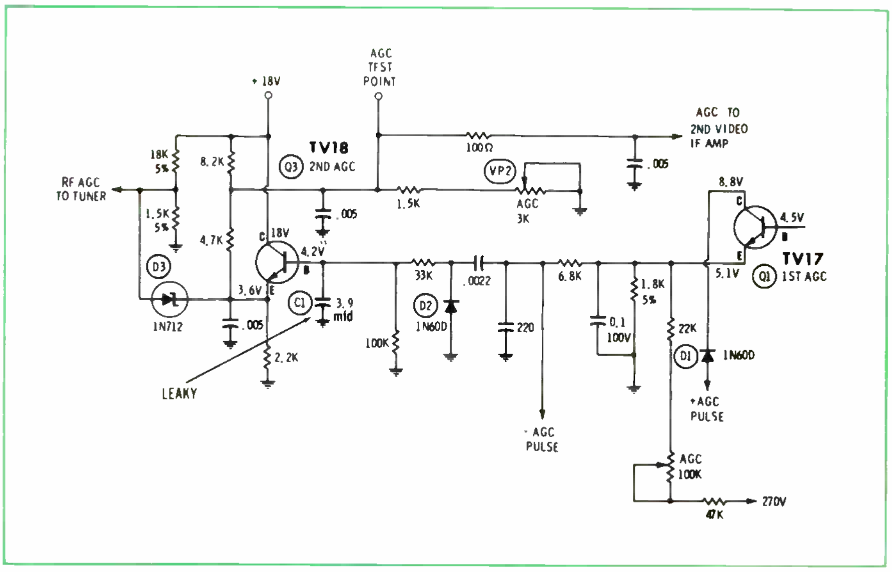


Fig. 9 Schematic of the transistorized AGC circuit in Philco 19QT87/B color chassis. Several components which can cause AGC overload are listed in the text.

was not restored. Ringing tests of the yoke/high-voltage transformer combined inductances did not indicate shorted turns in either component.

Finally, each circuit or component which received power from the high-voltage transformer was disconnected. When C113, shown on the partial schematic in Fig. 5, was disconnected, the high voltage was restored.

An ohmmeter check of C113 revealed that it was shorted. This capacitor furnishes horizontal pulses to the plate circuit of the AGC tube. When it shorted, the capacitor effectively placed the DC and AC loading of the plate circuit of the AGC tube in parallel with the high-voltage transformer. This excessive loading eliminated the high voltage and, in turn, the raster.

Cure—The shorted C113 was replaced by a new 68p-fd, 5K-volt ceramic capacitor, after which both the horizontal sweep and the AGC circuits functioned normally.

Bent Picture

Symptoms—The picture on a Zenith receiver equipped with a 20X1C38 chassis was distorted into an "S" shape, as shown in Fig. 6. The edges of the raster, however, were reasonably straight and vertical. Adjustment of the AGC control was extremely sensitive. An adjustment of the AGC control which would stabilize the picture on one channel would permit overload or bending of the picture on another channel.

Diagnosis—Hum in some circuit is indicated by the bending of the picture. However, the straight sides of the raster suggested that the hum was not in the horizontal-sweep circuit, and the absence of a horizontal hum bar on the screen indicated that there was no appreciable hum in the video circuit.

Because many symptoms involving hum originate in the filter components of the power supply, each filter capacitor in Fig. 7 was checked with a scope, for excessive ripple or any unusual waveforms. Nothing abnormal was located until a 16-volt p-p waveform (Fig. 8) was discovered at the terminal of filter capacitor, C37D. Usually the amplitude of the waveform at this point is less than 1 volt p-p. Capacitor C37D was open.

The undesired waveform exhibited when C37D was open was produced by the pincushion-correction circuit, and it consisted mostly of rounded horizontal pulses which were amplitude modulated by 60 Hz. When these extra frequencies from the 250-volt supply were injected into the AGC and sync-separator stages, symptoms of AGC overload and picture bending were produced.

When one section of a multiple-section filter capacitor opens, it is advisable to replace the entire can, because other sections might also be on the verge of failing.

Cure—Installation of a new multiple-unit filter capacitor, C37, eliminated the two symptoms of overload and picture bending.

No Raster When Station Received

Symptoms—The raster of a Philco color TV with a 19QT87/B chassis disappeared when the channel selector was turned to any local station. But when the selector was tuned to a channel which had no station, the raster returned, and the "snow" appeared to be normal.

Diagnosis—Confirmation of a preliminary diagnosis of "AGC overload" was obtained by the measurement of an abnormally-large negative voltage at the output of the video detector.

Transistors are used in the vieo IF stages of this model. The AGC voltage, which is applied directly to the 2nd IF transistor, and indirectly to the 1st IF transistor, is the "saturation" type. That is, the AGC voltage becomes more positive when the signal strength is increased.

Measurements of the AGC voltage showed little change whether or not a station was received. This test indicated a complete loss of AGC.

Several typical parts failures have occurred in the AGC circuit of this model, and similar ones which have the circuit shown in Fig. 9. An open in the winding of the high-voltage transformer which supplies pulses to the AGC stage can cause a complete loss of AGC. However, the winding in this particular receiver produced a normal pulse with an amplitude of 35 volts p-p.

A short or an open in D1, an open in Q1, or an open or short in D2 can cause a loss of all AGC action. However, in this case, these components tested normal.

An ohmmeter test of C1 (3.9M-fd) revealed that it had a leakage which produced less than 1000 ohms resistance. This leakage was eliminating the forward bias of Q3; therefore, no AGC voltage was developed in the emitter circuit of Q3.

Cure—Installation of a new C1 and adjustment of the AGC con-

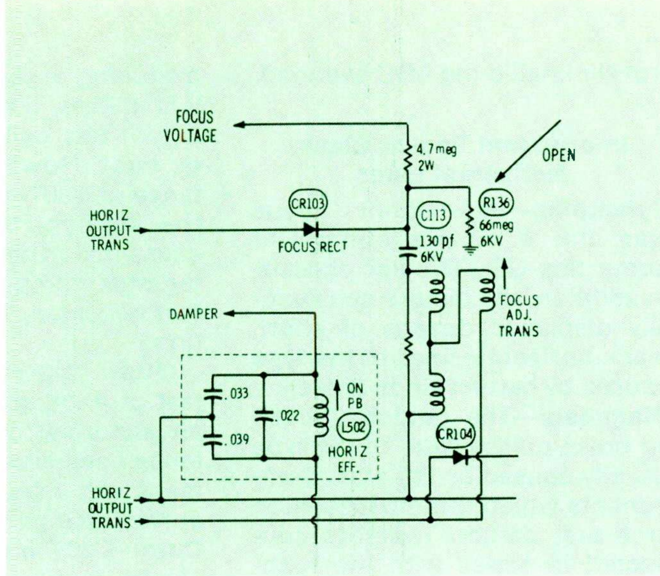


Fig. 10 Schematic of the focus circuit in General Electric KD color chassis. Several components which can cause poor focussing are pointed out.

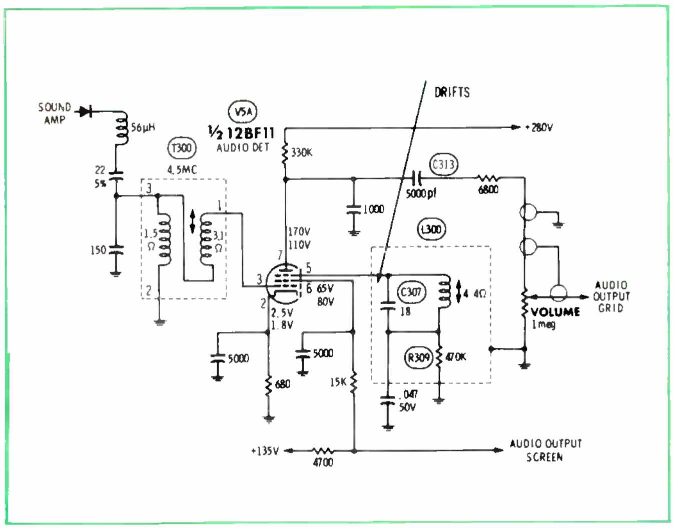


Fig. 11 Several components in the sound IF circuit of General Electric H-1 Porta-Color chassis might cause distortion which increases with increases in ambient temperature.

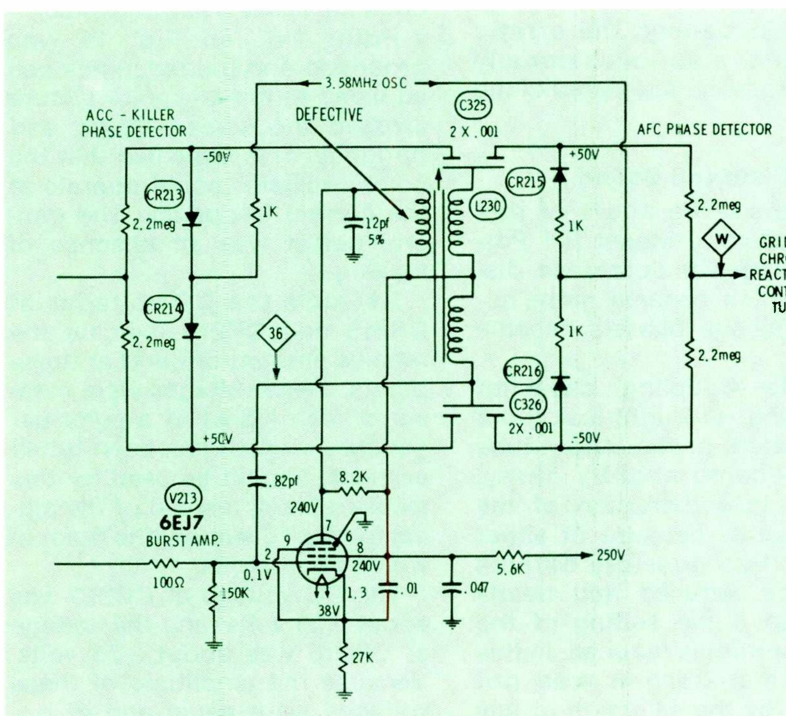


Fig. 12 Schematic of the burst separator stage in Zenith 14B9C50 color chassis shows many components which could cause loss of color locking and, in turn, loss of color because of killer action.

trol eliminated the AGC overload.

Intermittent Focus; Black, Horizontal Lines

Symptoms—Intermittent focus was the principle complaint about this GE KD color chassis. In addition, the picture occasionally displayed dozens of short, black horizontal lines of the type caused by certain kinds of arcs.

Diagnosis—The randomly-located noise pulses were of the type usually caused by DC arcs. Components which often cause such arcs are: carbon resistors connected in series with the high-voltage lead, and focus or high-voltage filter capacitors.

When this type of arc is accompanied by the symptom of erratic focus, suspicion should be directed to the components in the focus circuit (Fig. 10). The components most likely to cause both symptoms are: the focus rectifier, CR103; the 130p-fd focus filter capacitor, C113; and the 66M-ohm bleeder resistor, R136. Because it was easiest to test, R136 was measured on an ohmmeter.

Cure—R136 was replaced with the correct type of high-voltage resistor. Both the noise pulses and the erratic focus symptoms were eliminated. Evidently, an open R136 caused the erratic focus and also occasionally arced across the open area of the element.

Distorted Sound

Symptoms—The audio of this General Electric Model H-1 Porta-Color receiver developed distortion which became more noticeable as the chassis became warmer.

Diagnosis—Coupling capacitor C313 in Fig. 11 might leak more when heated, or the output tube might become slightly gassy. However, any distortion of the sound quality because of either of these two possible defects should be reduced and nearly eliminated if the setting of the volume control is reduced. In this case, the distortion was not changed by the selection of any amount of volume. This simple test ruled out those two possible causes of distortion.

Distortion can be caused by mistuning of the quad coil, L300. It is unlikely that the characteristics of this coil will be changed by heat. However, the capacitance of C307 might change with the ambient temperature and cause distortion. (C307 and L300 together comprise the tuned circuit necessary for "quad" detection.)

Often, the most satisfactory test of a capacitor suspected of an abnormal change in capacitance because of heat is replacement with a new capacitor of the correct ratings.

Cure—C307 was replaced by an 18p-fd, N470 (temperature characteristic), ceramic capacitor, GE catalog number ET18X399, and the quad coil was readjusted for minimum distortion.

No Color

Symptoms—This Zenith 14B9C50 color chassis produced no color. Replacement of all tubes in the chroma circuit did not change the symptom.

Diagnosis—To defeat the color killer, testpoints "K" and "KK" were connected together by a test lead. Color appeared on the screen. However, the color was in "barber pole" diagonal stripes, which indicated that the color oscillator was not locked.

Point "W" in Fig. 12 was grounded and the reactance coil adjusted so that the color picture crossed the screen slowly and uprightly. This indicated that the color oscillator could operate at the correct frequency. The general defect was an absence of locking.

Because the DC voltages at CR215 and CR216 indicate the relative amount of burst at those points, these voltages were measured. The signal of a color-bar generator which has been tuned correctly should be used for this measurement, instead of the signal from a TV station, the burst of which often varies.

The DC voltage at CR215 was about +25 volts, and the voltage at CR216 was about −25 volts. Because the amplitude of these voltages were equal and of opposite polarity, components C325, C326, CR215, CR216, the two 1K-ohm resistors, and the two matched 2.2M-ohm resistors

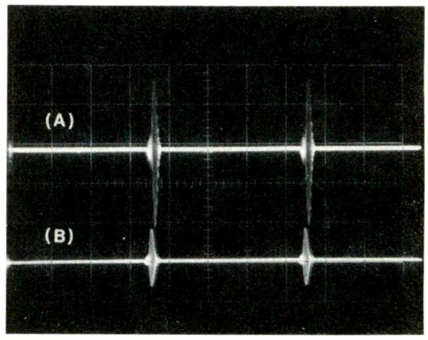


Fig. 13 A comparison of a normal burst waveform and the same waveform when a defect weakened the burst. **(A)** Normal burst at point "36" should be 75 volts p-p. **(B)** When the primary of L230 was open, the burst at point "36" was only about 30 volts.

were almost certainly okay.

However, the low voltages at both diodes indicated that the amplitude of the burst from L230 was weak.

The amplitudes of the horizontal keying pulses and the pulses of the color-bar signal at the grid of V213 were normal. A small sawtooth at the cathode of V213 indicated that the cathode bypass capacitor was not open. However, the burst amplitude was weak at point "36" and at the plate of the burst amplifier tube. The burst at point "36" should have an amplitude of about 75 volts p-p, as shown in the top waveform of Fig. 13. Actually, the burst there measured about 30 volts p-p, as shown by the bottom waveform of Fig. 13. The burst amplitude was being reduced by V213.

DC voltages at the socket pins of V213 were normal. However, there was one peculiarity: The DC voltage at the plate was about 14 volts lower than the voltage at the screen grid. Because both voltages are supplied by the same 5.6K-ohm decoupling resistor, they should measure the same. Ohmmeter tests in this area of the circuit revealed that the primary winding of L230 was open. Plate voltage for the tube was being supplied through the 8.2K-ohm resistor which parallels L230.

Cure—Replacement of L230, the burst transformer, and alignment of this transformer produced good color which was locked solidly. □

New in RCA's portable color-TV chassis

Although similar to the CTC55 chassis previously used in RCA "large-screen" portable color receiver, the CTC63 chassis does contain some new circuitry which will require a slight change in troubleshooting procedures.

■ Most of the circuitry in the new RCA CTC63 portable color-TV chassis is similar to that in the CTC55. However, some changes have been made to permit "protective" disabling of the video, if the high voltage becomes excessive.

Other changes have been made because the 19-inch diagonal color picture tube used in the CTC63 chassis requires high-voltage focus and more deflection power than that needed by the Einzel-lens, low-focus-voltage CRT which is used in the CTC55.

Blanking And Disabling Functions Combined

The vertical and horizontal blanking and high-voltage protection functions have been combined in the RCA CTC63 color-TV chassis, as shown in Fig. 1. Excessive picture-tube anode voltage indirectly causes a loss of video which appears either as a loss of raster or as a dim raster without video. This loss of video is intended to discourage operation of the receiver until the high-voltage regulator or related circuitry is repaired.

Horizontal blanking

Except during vertical retrace time, Q703 in Fig. 1 has no forward bias because the vertical oscillator is not conducting; consequently, its collector-emitter path is open and does not affect horizontal blanking or the video. (Operation of the horizontal blanking circuit is exactly the same as that in the CTC55.)

If CR701 were removed from the circuit and no pulse were present, the cathode terminal of CR701 would have about +3 volts and the anode terminal +25 or more volts, because of positive voltage through R732. With CR701 in the circuit, the video signal passes through with little attenuation because CR701 normally is forward biased.

When a negative-going pulse from the blanker tube enters the circuit through R733 and C724, CR701 is reverse biased and is an open circuit. Impedance of the common point between CR701 and C725 is now much higher, and the higher pulse that results passes through C725 to the grid of the video output tube. Negative voltage at the grid of the video output causes a more positive voltage at the plate, and consequently to the cathodes of the CRT which are coupled directly to the plate of the tube. The more positive voltage applied to the CRT cathodes reduces the brightness. This is horizontal blanking.

Vertical blanking

During the interval between vertical pulses when the vertical oscillator is not conducting, Q703 does not conduct because it has no forward bias. Consequently, it has no effect on the video signal or on horizontal blanking.

However, when the vertical oscillator conducts during the vertical retrace time, a positive pulse voltage is created at the base of Q703 by the voltage drop across R775 and the base-emitter junction of Q703, which are in parallel. This positive base voltage is sufficient to saturate Q703 into full conduction, so that the collector-emitter path is nearly a short circuit. Such a near-short removes the positive DC voltage and video sync pulses that otherwise would have appeared at the junction of DL701 and CR701.

The zero voltage at the cathode of CR701, which remains conductive except during horizontal retrace, is added through the brightness control to a small amount of negative voltage which is developed across the brightness-limit control and is applied to the grid of the video-output tube. Therefore, the grid voltage is less positive (or more negative) than during video time, and the raster is blanked out, as explained under horizontal blanking.

Over-voltage protection

R107 has been adjusted at the factory so that the neon bulb, DS101, is barely below the point of ionization and conduction. If a defect in the high-voltage regulator circuit causes the high voltage (and also the B-boost voltage) to increase excessively, the increased voltage, through R109 and R110, causes DS101 to ionize and pass part of the positive voltage to the base of Q703. The positive voltage is enough to saturate Q703 and eliminate the video. Once ignited, the neon bulb remains ionized. Also, the reduction of CRT current caused by the black or dim raster tends to increase the high voltage and the B-boost voltage, to prevent intermittent operation of the video.

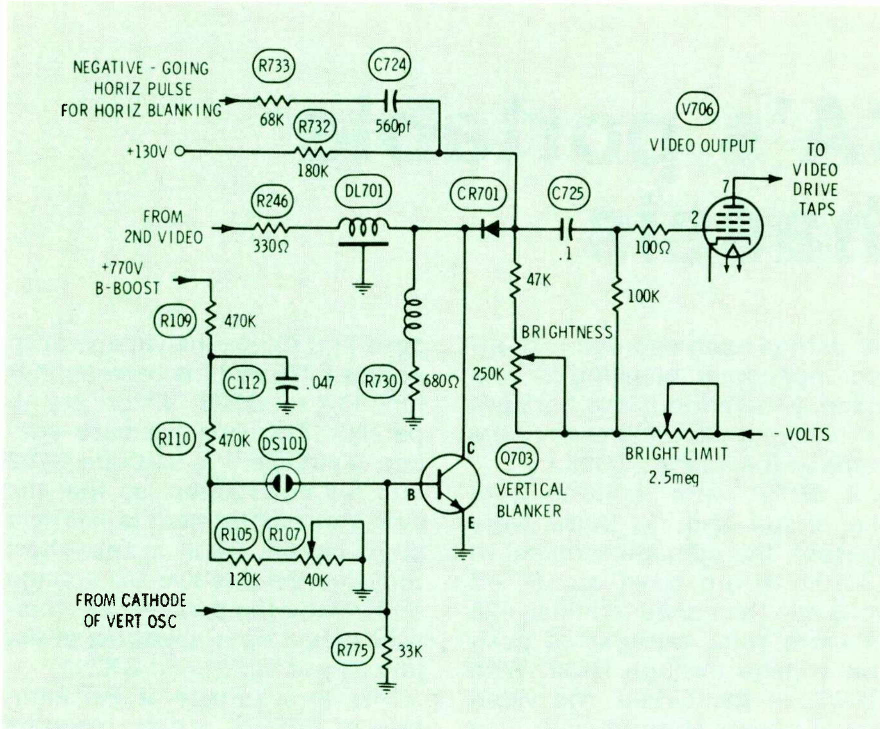


Fig. 1 Vertical blanking and blanking of the video when the high voltage becomes excessive are accomplished by Q703 and the components in the base circuit of Q703. Horizontal blanking is accomplished by CR701, R732, R733 and C724.

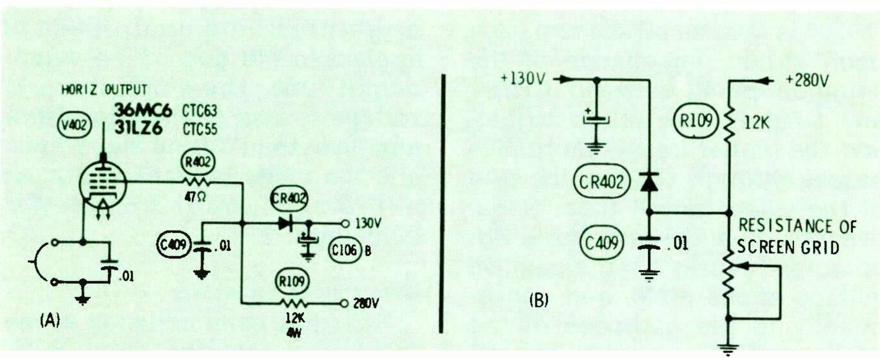


Fig. 2 Secondary regulation of high voltage and horizontal sweep is the function of the components in the screen-grid circuit of V402. Also, a thermal fuse is used in the cathode return. **(A)** The circuit supplying the screen grid prevents the screen-grid voltage from rising above +130 volts, although it permits the screen-grid voltage to decrease below +130 volts when the screen current is excessive. Also, de-generation, because the screen bypass capacitance is only .01 mfd, reduces the width and high voltage, when the screen voltage is not clamped. **(B)** This is the same screen grid circuit in **(A)**, but redrawn to make the action more clear.

The loss of video should encourage the viewer to turn off the receiver, and thus eliminate any danger from radiation, until the regulator defect is repaired.

Troubleshooting Loss Of Video

Loss of video can occur in the CTC63 chassis because the protective circuit correctly has operated after a regulator defect has increased the high voltage. Or a loss of video can occur because of a more conventional defect in the tuner, video IF's, AGC, or video amplifiers. Tests must be made to determine which is the source.

If the protective circuit has eliminated the video because of excessive B-boost voltage, the defect should be repaired. No changes should be made to the adjustment of R107 or to the values of other components to restore the video by defeating permanently the protective circuit. On the other hand, a defect in the **protective circuit** itself might be responsible for the loss of video.

In the CTC55 chassis, a loss of video caused by an open blanking diode or incorrect bias on the diode easily can be checked by shorting across the diode. If the video is restored by shorting across the diode, the trouble is the diode or the bias applied to it.

In the similar circuit in the CTC63 chassis an open CR701 diode causes a loss of video which is restored if a test lead is shorted across it.

False conduction of Q703 because of a defect in the protective circuit can be determined by grounding the base of Q703. Restoration of the video proves this base voltage to be wrong.

Of course, a collector-to-emitter short in Q703 permanently would short out the video. If the previous tests locate nothing definite, disconnect the collector lead of Q703. Video should return, if the transistor is shorted.

Another quick test involves temporarily deceiving the protective circuit into believing the high voltage is normal. Turn off the power, and connect a resistor of about 4.7K-ohms from one of the video-drive taps to ground. Turn on the receiver, and vary the brightness control up and down. When the raster is dim, there should be no video. Then when the brightness is increased, the video should flash in. Enough brightness to lower the B-boost voltage to normal should permit the video to operate. Such test results indicate a defect in the high-voltage regulator.

It is possible that loss of vertical oscillation could cause the vertical oscillator tube to draw a constant current, which would forward bias Q703 and, consequently, eliminate the video. Although visual symptoms indicate only a loss of vertical, a scope test would also reveal the loss of video. This could be confusing, if you are not familiar with the operation of the protective system.

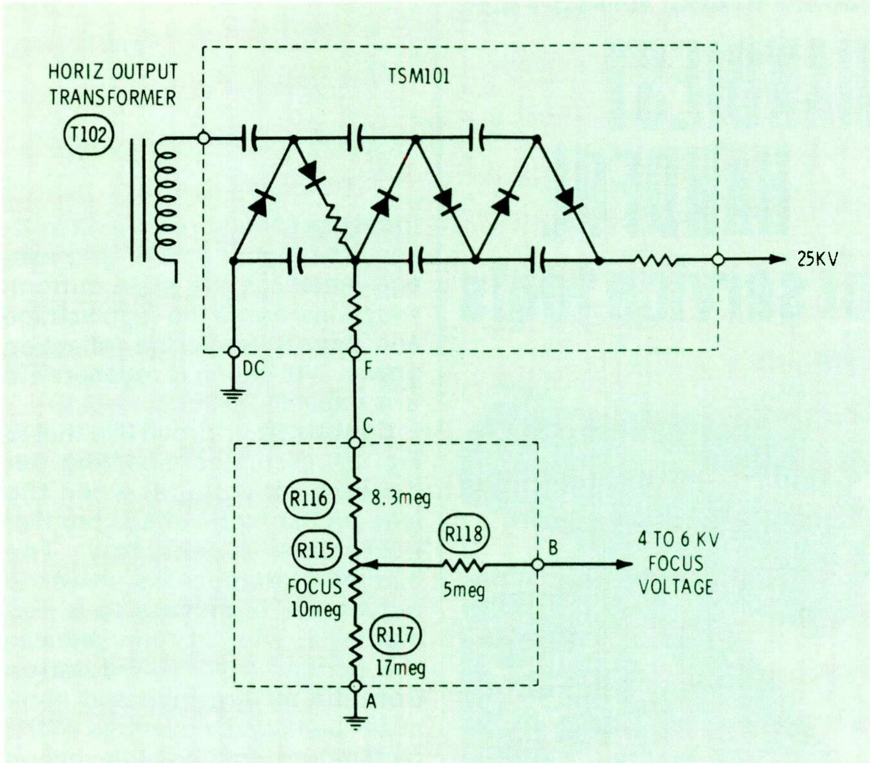


Fig. 3 Circuit of the TSM high-voltage tripler assembly and the focus control circuitry used in the CTC63.

High-Voltage And Sweep Regulation

The primary regulation of high voltage and horizontal sweep in the CTC63 chassis is by changing the negative grid voltage of the horizontal-output tube according to the load variations. Because this method of regulation has been explained in past issues, no additional explanation will be given here.

A second, and less obvious, method of regulation and protection in the CTC63 chassis involves the screen grid shown in Fig. 2A. Two separate actions take place in this circuit. One action permits the screen voltage to drop, but not to increase above +130 volts. The other action is degeneration, which occurs when the screen circuit is bypassed only by the .01m-fd capacitor, C409.

In the Shop Talk column in the April issue of ELECTRONIC SERVICING, I pointed out a method of testing horizontal-output stages by using visual symptoms and by measuring the voltage at the screen grid. In circuits where the screen grid is supplied through a large-value resistance from a voltage source higher than that actually needed, the screen voltage can be used as an indication of screen current. The higher the screen current, the lower the screen-to-cathode voltage.

Some defects in the horizontal-sweep stage cause higher screen-grid current; others cause lower screen-grid current. Measurement of the screen-grid voltage plus a knowledge of which defects raise and which lower this voltage often will point out the defect.

The screen-grid circuit in Fig. 2A is easier to understand when redrawn as shown in Fig. 2B. In reality, the variable resistor is the screen-grid-to-cathode resistance, which changes according to the loading on the output stage and the drive to the control grid. When the screen-grid current is low (high resistance), the voltage at the junction of a voltage divider consisting of R109 and the screen-grid resistance attempts to rise above the +130 volt supply. However, because this voltage point is also the anode of CR402, the diode becomes forward biased, conducts heavily and effectively clamps this point to the +130-volt supply. Therefore, the screen voltage cannot increase above +130 volts.

When CR402 clamps the screen-grid circuit to the +130 volt supply, the screen grid is bypassed by C409 (.01) and C106B (150 mfd). Because of this bypassing, very little AC degenerative voltage is developed there, and the gain of the output tube is maximum.

If for any reason the screen current increases (low resistance of the screen-grid circuit), the voltage divider (R109 and the screen grid resistance) changes value, and the anode of CR402 falls below +130 volts. Because CR402 is now reversed biased, the screen-grid voltage is no longer clamped to the +130-volt supply and decreases according to the amount of screen-grid current.

When CR402 is reverse biased, the screen grid is bypassed only by C409 (.01 mfd). Because this value of capacitance is too small to prevent degeneration the gain of the horizontal-output tube is decreased, which, in turn, decreases the high voltage.

In the more conventional circuit (CR402 not used and the value of C409 is .1 mfd), an increase of current to the CRT (increased brightness) increases the plate current of the horizontal-output tube. The increase of plate current decreases the screen current, which, in turn, increases the screen-grid voltage. The higher screen-grid voltage increases the plate current, which increases the high voltage and, consequently, the deflection power. The action is regenerative to a small degree.

Conversely, a circuit like that in Fig. 2A promotes blooming (reduced high voltage) when the load on the high-voltage rectifier increases excessively. The blooming prompts the viewer to reduce the brightness to a normal level. This, in turn, reduces the probability of X-radiation from the picture tube and minimizes damage by overload of the picture tube and the high-voltage circuit.

The automatic increase of sweep and high voltage, caused by other circuits which maintain a constant screen voltage even when the screen current increases excessively (permanent clamping) during certain kinds of defects, is prevented in this circuit because clamping ceases and the screen voltage is allowed to decrease to any amount determined by the screen-grid current.

Some defects which increase the screen-grid current (reduce the screen-grid voltage) are:

- leakage in the coupling capacitor to the grid of the output tube,
- a gassy output tube,
- loss of grid drive,
- an open deflection yoke,
- a weak damper tube.

Some of the defects which decrease screen-grid current are:

- defects in or mistuning of the efficiency circuit,
- excessive grid drive,
- excessive picture-tube current,
- weak horizontal-output tube.

The circuit shown in Fig. 2A prevents excessive power dissipation in the horizontal-sweep circuit by preventing the screen-grid voltage from rising above +130 volts, yet permitting the voltage to decrease when the screen-grid current becomes excessive.

Thermal Fuse In Cathode Of Horizontal-Output Tube

Fig. 2A shows a section of a circuit breaker in the cathode circuit of the horizontal-output tube in the CTC55 chassis. A new type of thermal fuse occupies this spot in the CTC63. Physically, the thermal fuse in the CTC63 is mounted in a clip-type bracket about ½ inch from the glass of the 36MC6 horizontal-output tube. Excessive heat from the output tube, regardless of the defect, causes failure of the fuse. Damage to the output tube is not prevented, but the probability of damage to other components, such as the high-voltage transformer, is eliminated or lessened.

Solid-State High-Voltage Tripler And Focus Assemblies

The 3A3C high-voltage rectifier used in the CTC55 has been replaced by a solid-state tripler assembly in the CTC63, as shown in Fig. 3. DC voltage from the output of the first section of the tripler is reduced by voltage divider resistors inside the focus assembly, and is used as a focus voltage which is adjustable from 4KV to 6KV.

No internal servicing of the tripler assemblies is possible.

Heating that is noticeable on the outside of the assembly or evidence of smoke after the anode cap of the picture tube has been removed for testing, are dependable signs of an internal defect which requires replacement of the assembly. □

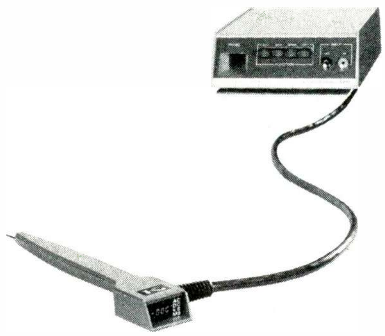
test equipment report

Features and/or specifications listed are obtained from manufacturers' reports. For more information about any product listed, circle the associated number on the reader service card in this issue.

Autoranging Digital Multimeter

Product: Model 167 digital multimeter
Manufacturer: Keithley Instruments, Inc.
Function and/or Application: Measures DC voltages, AC voltages, resistances, and has a digital LED readout display.
Features: The digital display is in the hand-held probe so readings can be made without requiring the operator to look away from the circuit under test. The probe can be stored and operated from a storage well inside the instrument. Polarity, decimal point, function, and the readout are indicated on the LED display, which is a 3½ digit type with automatic range selection. An optional Current Shunt kit is available to permit the measurement of AC and DC current down to 1 microampere per digit. Power is

supplied by an internal battery, but there are options for rechargeable batteries or for line voltage operation. The multimeter turns on by a push-to-read switch on the probe, and a stable reading is obtained in less than 2 seconds. Typical battery life for push-to-read operation is about 3 months. Overload protection is provided. For example, full line voltage can be applied, without damage to the multimeter, across the input on the ohmmeter function.

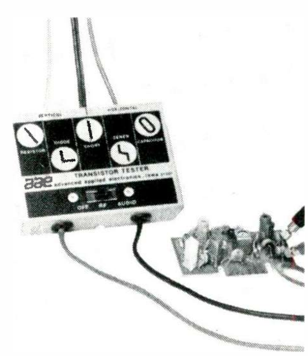


Specifications: Autoranging DC Voltmeter: Range—±1 millivolt per digit to ±1000 volts. Accuracy—±0.2 per cent of reading ±1 digit. Input impedance—55 megohms shunted by approximately 220 picofarads. **Autoranging AC Voltmeter:** Range—1 millivolt per digit to 500 volts rms. Accuracy—±1 per cent of reading ±2 digits up to 200 volts; less accuracy for high frequencies and higher voltages. Input impedance—50 megohms shunted by approximately 220 picofarads. **Autoranging Ohmmeter:** Range—1 ohm per digit to 20 megohms. Accuracy—±0.3 per cent of reading ±1 digit ±1 ohm; a maximum of 9 volts DC is applied into an open circuit. **Stability Of Instrument:** ±0.02 per cent of reading ±0.2 digit per degree centigrade.
Price: Model 167 sells for $325.00.

Circle 50 on literature card

Transistor and Component Tester

Product: A.A.E. transistor tester
Manufacturer: Advanced Applied Electronics
Function and/or Application: Checks transistors, capacitors (including electrolytics) and resistors.
Features: When used with a



scope, the unit tests diodes, and the junctions of bi-polar transistors. Resistors show as a slanted line, and capacitors produce a circle. Tests in-circuit diode and transistor junctions, resistors and capacitors. Typical patterns are printed on the panel of the instrument.
Specifications: Not available.
Price: The A.A.E. transistor tester sells for $29.95.

Circle 51 on literature card

Spectrum Analyst

Product: Model 260-A-8B Spectrum Analyst
Manufacturer: Sadelco, Inc.
Function: When used with a calibrated field-strength meter, this instrument measures the gain, loss and frequency response of MATV and CATV equipment.
Specifications: White-noise signal—emits all signals between 4.5M Hz and 300M Hz within ±1 dB, or better. Output impedance is 75 ohms, and the VSWR is 1.1 to 1.0. **Narrow-band signal**—the frequency is 73.5M Hz, and is crystal controlled. The output

impedance is 75 ohms with a VSWR of 1.1. **Return loss bridge**—impedance is 75 ohms, balance is 40 dB minimum, the unterminated output reference level is 1 millivolt, and the flatness of response is ±2 dB, or better. **Operating temperature**—+30 degrees Fahrenheit to +100 degrees Fahrenheit. **Battery**—continuous usage before recharging is 6 hours for wide-band operation or 36 hours on narrow-band

(Continued on page 42)

Circle 23 on literature card

Circle 24 on literature card

(Continued from page 41)

operation. **Charging time**—10 hours. The carrying case measures 11 inches X 4⅜ inches X 8½ inches. The analyst with case and batteries weighs 7 lbs.
Price: The Model 260-A-8B Spectrum Analyst sells for $495.00

Circle 52 on literature card

Pushbutton Multitester

Product: Model AS-10F
Manufacturer: Speco
Function and/or Application: Measures DC and AC voltages, DC currents, resistances and decibels.
Features: Iso-Stat pushbutton switches select the ranges, 100,000 ohms-per-volt sensitivity on DC voltage measurements, 5-inch mirrored scale for parallax correction, and the meter has double zener diode protection.
Specifications: The ranges are: **6 DC voltage ranges,** from 3 volt full scale to 1,200 volts full scale at 100,000 ohms-per-volt sensitivity and an accuracy of ±3 per cent; **6 AC voltage ranges,** from 6 volts full scale to 1,200 volts full scale at 10,000 ohms per volt and an accuracy of ±4 per cent; **4 DC current ranges,** from 12 microamperes full scale to 300 milliamperes full scale at an accuracy of ±3 per cent; **4 resistance ranges,** from 2K ohms full scale to 200M ohms full scale at an accuracy of ±3 of scale length; and **2 decibel ranges,** from −20 dB to +31 dB at ±4 per cent accuracy. Dimensions are 5⅛ inches × 8½ inches × 2¾ inches, and the weight is 2.36 lbs.

Price: Model AS-10F sells for $119.95.

Circle 53 on literature card

Solid-State AM Signal Generator

Product: Model 880 AM Signal Generator
Manufacturer: Edison Electronics Division of McGraw-Edison Company
Function: A generator of AM signals for testing electronic equipment in factories or service shops.

Features: Continuous frequency coverage up to 470M-Hz, electronic fine tuning, low RF leakage, automatically-controlled output voltage, and optional internal or external amplitude modulation.
Specifications: Not available
Price: The Model 880 signal generator sells for $830.00.

Circle 54 on literature card

Universal Power Supply

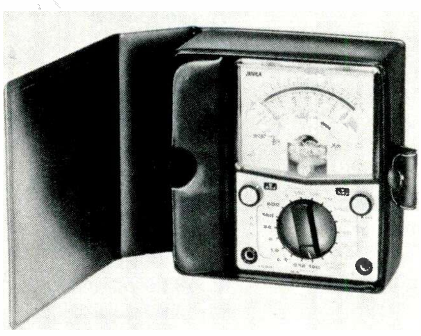
Product: Model UPS-164
Manufacturer: Sencore, Inc.
Function and/or Application: Supplies voltage-regulated and current-limited DC power for the operation of transistor radios, and other equipment. It functions also as a charger for 6-volt or 12-volt batteries.

Features: The power output is monitored continuously by voltage and current meters, the point of maximum-current protection can be adjusted, and three ratings of output can be selected.
Specifications: Ranges are: **2 DC voltage ranges,** 15 volts full scale, and 35 volts full scale; **4 DC current ranges,** 50 milliamperes, 200 milliamperes, 500 milliamperes and 2000 milliamperes full scale; **3 outputs from the Output Selector,** 12 volts at 10 amperes, 6 volts at 20 amperes for supply or charging use, and a variable 2 ampere up to 30 volts of highly-filtered and regulated output with .018 per cent ripple and a maximum current adjustment.
Price: Model UPS-164 sells for $240.00.

Circle 55 on literature card

FET Multitester

Product: Model FET-200 solid-state multitester
Manufacturer: Mura Corp.
Function and/or Application: Tester for field effect transistor circuits
Features: Controls and jacks are on the front of the unit with a single selector switch for all functions; range overlap, built-in battery check and easy-to-read face are included.

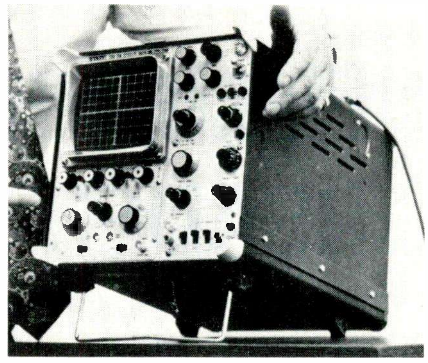


Specifications: Resistance readings up to 1 megohm and AC and DC volts up to 600 V, with an accuracy of ±3 per cent of full scale DC and ±4 per cent AC. Complete with battery and heavy-duty test leads with banana plugs.
Price: Model FET-200 sells for $52.95.

Circle 56 on literature card

Dual-Trace Oscilloscope

Product: Model CDU-150
Manufacturer: A. C. Cossor, Ltd., a Raytheon subsidiary
Function and/or Application: The display of two waveforms simultaneously on the screen of the scope
Features: Dual-trace, two vertical amplifiers, bandwidth of 35MHz, a rise time of 10 nanoseconds, delayed sweep, and 5 millivolt sensitivity.
Specifications: The scope measures 10 inches x 10 inches x 16 inches, and weighs 28 lbs.
Price: The CDU-150 scope sells for $1,495.00. □



Circle 57 on literature card

Electronic Servicing

READER SURVEY

We need your assistance in a special editorial project which will provide valuable information to you and to the editors of *Electronic Servicing*.

An in-depth, statistical profile of the entertainment electronic servicing business was published in the June, 1969, issue of *Electronic Servicing*. The data for this profile was obtained from a survey of the readers of *Electronic Servicing* in January of that year.

We now are repeating that survey, to update the profile and to obtain comparative data which will enable us to alert **you** to trends and conditions in **your** business. It also will tell us what topics **you** want to read about in Electronic Servicing.

All replies to this survey will be **strictly confidential.** The results will be published only in statistical form as totals and averages.

To help us provide you with a clearer picture of **your** industry and to indicate **your** preferences of the subject matter in *Electronic Servicing,* please take a few moments to complete this survey. The more replies we receive, the more accurate and useful will be the information we furnish **you.**

A tear-out, self-addressed, postage-free amswer card is provided on the opposite page. Instructions for completing the survey are included next to the answer card.

Thank you—the Editors

1. full-time service technician
A. yes **B.** no
2. part-time service technician
A. yes **B.** no
3. bench man
A. yes **B.** no
4. outside man
A. yes **B.** no
5. combination bench/outside man
A. yes **B.** no
6. owner of service shop, do servicing myself
A. yes **B.** no
7. owner of service shop, do no servicing myself
A. yes **B.** no
8. manager of service shop, do servicing myself
A. yes **B.** no
9. manager of service shop, do no servicing myself
A. yes **B.** no
10. student in resident electronic course
A. yes **B.** no
11. student in correspondence electronic course
A. yes **B.** no
12. years employed as service technician
A. Less than 2 years
B. 2 but less than 5 years
C. 5 but less than 10 years
D. 10 years or more
13. hourly rate of pay
A. $1.50 to $2.00
B. $2.01 to $3.00
C. $3.01 to $4.00
D. $4.01 to $5.00
14. Are bench men in your shop on incentive pay plan?
A. yes **B.** no
15. Are outside men in your shop on incentive pay plan?
A. yes **B.** no

Following coded responses apply to items 16-29.
A. now use
B. now own
C. plan to buy
D. plan to replace

16. VOM
17. VTVM
18. FET meter
19. color generator
20. sweep generator
21. oscilloscope
22. vectorscope
23. RF signal generator
24. audio generator
25. transistor tester
26. tube tester
27. CRT tester
28. frequency meter
29. stereo generator
30. full-time **bench** men employed in your shop
A. 2 or less
B. 3 but less than 6
C. 6 but less than 9
D. 9 or more
31. full-time **outside** men employed by your shop
A. 2 or less
B. 3 but less than 6
C. 6 but less than 9
D. 9 or more
32. if employee, years you have worked for present employer
A. under 2
B. 3 but less than 6
C. 6 but less than 10
D. 10 or over
33. if shop owner, years you have been in business
A. under 2
B. 3 but less than 6
C. 6 but less than 10
D. 10 or over

Items 34-44 are servicing categories. Use the following coded responses to indicate what percentage of your shop's total service labor income is derived from each category:
A. none
B. 20% or less
C. 21% to 50%
D. 51% to 75%
E. over 75%

34. b-w TV
35. color TV
36. stereo
37. home radio
38. auto radio
39. MATV systems
40. CATV systems
41. home antenna systems
42. communications equipment
43. industrial electronics
44. medical electronics

Top range of hourly pay for full-time technicians employed by your shop (items 45-47):
45. experienced bench men
A. $2 or less
B. $2.01 to $3.00
C. $3.01 to $4.00
D. over $4.00
46. experienced outside men
A. $2.00 or less
B. $2.01 to $3.00
C. $3.01 to $4.00
D. over $4.00
47. trainees
A. $2.00 or less
B. $2.01 to $3.00
C. $3.01 to $4.00
D. over $4.00
48. average hourly rate charged customer for bench labor in your shop
A. $9.00 or less
B. $9.01 to $12.00
C. $12.01 to $14
D. over $14

Home call rates charged by your shop for categories in items 49-52 (first 30 minutes):
49. b-w TV
A. $8.00 or less
B. $8.01 to $10
C. $10.01 to $12
D. over $12
50. color TV
A. $8.00 or less
B. $8.01 to $10
C. $10.01 to $12
D. over $12
51. color TV setup
A. $8.00 or less
B. $8.01 to $10
C. $10.01 to $12

D. over $12

52. stereo and other
- **A.** $8.00 or less
- **B.** $8.01 to $10
- **C.** $10.01 to $12
- **D.** over $12

53. Method of pricing replacement parts
- **A.** cost plus 50% or less
- **B.** cost plus 51% to 75%
- **C.** cost plus 76% to 100%
- **D.** cost plus over 100%

Does your shop retail:

54. TV
- **A.** yes **B.** no

55. radio and stereo
- **A.** yes **B.** no

56. communications equipment
- **A.** yes **B.** no

57. antennas
- **A.** yes **B.** no

Indicate percentage of total (100%) gross income your shop obtains from categories in items 58-60.

58. service labor
- **A.** 25% or less
- **B.** 26% to 50%
- **C.** 51% to 75%
- **D.** over 75%

59. replacement parts sales
- **A.** 25% or less
- **B.** 26% to 50%
- **C.** 51% to 75%
- **D.** over 75%

60. retail sales (TV, etc.)
- **A.** 25% or less
- **B.** 26% to 50%
- **C.** 51% to 75%
- **D.** over 75%

61. Does your shop perform warranty service?
- **A.** none
- **B.** exclusively one brand
- **C.** more than one brand

62. Does your shop offer free service estimates?
- **A.** yes **B.** no

Does your shop offer service contracts on categories listed in items 63-65:

63. TV
- **A.** yes **B.** no

64. radio and stereo
- **A.** yes **B.** no

65. communications equipment
- **A.** yes **B.** no

66. Do you favor any regulation of service technicians?
- **A.** governmental licensing
- **B.** association certification
- **C.** do not favor any type of regulation
- **D.** only local (city or state) regulation

67. Does your shop presently employ apprentice technicians?
- **A.** yes **B.** no

68. Do you belong to any electronic service associations
- **A.** yes **B.** no

69. How many service trucks does your shop employ?
- **A.** 1
- **B.** 2 but less than 5
- **C.** 5 but less than 10
- **D.** more than 10

70. Do technicians in your shop attend manufacturers' training sessions?
- **A.** yes **B.** no

71. Major sources of service information (schematics, etc.)
- **A.** manufacturers
- **B.** PHOTOFACTS
- **C.** other

72. Where did you obtain your initial electronic training?
- **A.** practical experience on the job, no formal schooling
- **B.** civilian technical school
- **C.** military technical school

Use the following coded responses to indicate your preference for each of the Electronic Servicing subject categories listed in items 73-80.
- **A.** no interest
- **B.** present coverage adequate
- **C.** some coverage desired
- **D.** coverage in each issue

73. analysis of circuit operation

74. business management

75. test equipment

76. troubleshooting procedures

77. industrial electronics

78. medical electronics

79. solid-state servicing

80. servicing communications equipment □

by Robert G. Amick/ES Business Consultant

FLAT RATE: Realistic Service-Labor Pricing For Shops, Technicians And Consumers

Part 2–Changing Over To Flat-Rate Pricing

■ In part 1 of this three-part series the fundamentals of profitable pricing were discussed, and the two basic methods of pricing—hourly and flat rate—were compared to acquaint you with the basic elements and advantages of flat-rate pricing. More specific information about why and how you should change over to flat-rate pricing are presented in this part of the series.

Flat-Rate Pricing Has Been Adopted And Used Profitably By Other Trades And Professions

Where I live, a haircut costs $3 regardless of how much hair winds up on the floor, or how long the barber spends on it. My dentist charges a flat rate for cleaning teeth.

An office call to your doctor is another good example of flat-rate pricing. You have a sore heel, he examines it, tells you what he believes it is, suggests heat and resting your foot, and suggests you come back in a week. Total time: five minutes. Another patient with the same complaint needs additional time to be reassured that it's not something terminal. He gets 15 minutes, you get five, yet you each pay the same rate for an office call. The doctor wasn't selling you time. He sold you both his *service*—the reassurance offered by his competency, the results of his efforts in your behalf, the facilities and resources at his command.

Flat-rate pricing is used not only by so called "professionals," but also by mechanics and technicians in automobile service departments, appliance repair shops, farm implement repair shops and cleaning shops. In fact, most service businesses use flat-rate pricing instead of the hourly-rate method.

What happens to you if you shift to flat-rate pricing? Well, aside from what happens if you don't, you'll find that the demand for productivity is inescapable. Just as the system rewards efficient, accurate job performance, it penalizes inefficiency and incompetence—yours, or your employees.

Why Most Service Businesses Use Flat-Rate Pricing Of Service Labor

Service businesses use the flat-rate method of service labor pricing because they realize that the product they sell is *service,* not merely time. They also realize that: 1) time is only one of many cost elements which make up the total cost of any service rendered, and 2) if they are to maintain or improve their profits while some operating costs increase, they must use a system of pricing which not only recovers all costs plus a profit but also one which makes it possible to profit from improved productivity.

The comparisons of the relative benefits of hourly and flat-rate pricing in Table 2 help explain why most service businesses prefer flat-rate instead of hourly pricing.

Explaining points covered in the chart, we come first to "average profit." The time allowance in flat-rate pricing manuals is based on the *average* time taken by an operation on a substantial number of sets, not all of them alike in complexity or difficulty. It's developed as a statistical average that includes a fair distribution of "service dogs" and "sweethearts". Based on the law of averages, the tabled times make profit possible in the vast majority of service jobs. Only a very few will be unprofitable or excessively profitable in terms of time spent. You lose a little on a few jobs, to gain on most of the increased number of jobs higher productivity allows. You gain enough on a few to make up for the loss.

That's what averaging produces for you. It also means that your "yield" per hour is a direct measure of productivity. When yield is down, you know productivity is down. When you sell only time, yield per hour will never rise above your hourly rate, and it will run low when dead-time is high. (Yield is the gross return on every hour of productive time.)

This is where your market share comes in. When you're after the business to increase your hourly yield, service income is only limited by the amount of work you and your people are able to do in the time available. Your market is all the customers you can get and satisfy with service. The more you handle, the more you make.

When you've sold out your time, you're sold out, if you're selling time. Yield is up to maximum. Order more time and it'll go down. Customers still waiting for service wait some more, which won't do much for your business, or they go elsewhere, which also is unprofitable. Worst of all, they may wind up going to a competitor whose shop is productivity oriented. He'll get their jobs out promptly, at a uniform price, make a profit, and with proficient, well-equipped people, do it satisfactorily. If his flat rate is equal to or less than your hourly one, he's got your customer. He's selling service, and satisfaction (in terms of quality and speed) is a part of service, too.

Is his flat-rate price equal to or less than your hourly one? Watch out for that one. Unless you've done the same job for a customer, there's little chance for the customer to compare. All the customer knows is he got service when he wanted it. Your competitor serviced his TV set and got it back to him before you could even pick it up. The charges didn't seem bad, and he got to see Sunday's ballgame.

What can you do? In the competitive battle your "guy down the street" has the initiative. Cutting your price won't help; neither will adding another technician. We're talking about **profits,** and those measures only can reduce yours.

You have one real choice—go flat rate yourself.

Planning For The Change-Over To Flat Rate

When you decide to adopt flat-rate pricing, your preparations have to include a number of plans:

- **A basic incentive pay plan, to encourage productivity in your shop**—It must be a plan you can sell your own people, complete with formulas for computing compensation, established settlement periods, effective guarantee level, callback penalties and other provisions appropriate to your shop.

- **A shop upgrade program for both personnel and facilities**—Step-by-step, you must develop proficiencies with adequate service literature, training opportunities for technicians, supervisors and managers, organization of shop methods and adequate equipment to get out the work. Your plan must include steps to be taken in each of these areas, their priorities, and how they're to be accomplished. Only you can make up your plan. You know, or should know, your technicians' weaknesses and strengths, loose spots in shop layout and work flow, gaps in your equipment inventory.

So far as upgrading is concerned, consider your personnel quality first. If you're satisfied that they're fully qualified and can get your productivity-boost program off to a satisfactory start with only incentives and improved shop facilities, begin with

Table 2
Comparison Of Benefits Under Hourly Rate And Flat-Rate Pricing

Benefit	Hourly Rate Pricing	Flat Rate Pricing
1) Profitability per job	Guaranteed profit on every job.	High average profit, although a very few jobs will produce no profit, or even a loss.
2) Potential profit	Limited to time you have to sell.	Limited only by the share of available market you can win and hold.
3) Encourages efficiency and shop upgrading	No—customer benefits, you and your help do not.	Yes—more work performed means higher returns at no increase in cost per hour.
4) Personnel supervision	Required to cut dead-time and keep work moving.	Minimized, because help has a stake in higher efficiency; supervision exercised to solve problems, improve shop methods rather than to "get the work done."
5) Personnel quality	Not encouraged—TIME is bought, not effort; good men leave for higher incentives.	Required and rewarded. Incentive pay plan attracts and holds good men, encourages improvement.
6) Customer satisfaction	Maybe—if you're efficient enough to keep total bill low.	Yes—Labor charge for the same operation is the same—estimating is simplified, billing lists work performed to demonstrate value to customer.
7) Investment recovery	Only on original investment without a change in hourly charge.	Yes; any investment that improves shop performance is returned.

those. Plan for proficiency improvements but give priority to getting productivity up quickly. As you start out under flat-rate pricing, you can expect low hourly yields until you pull in business enough to make use of your productive capacity.

Don't forget to include financial planning in this phase. Your upgrade program will cost money; you must plan to get it unless you have reserves enough to finance it yourself.

Table 3
What It Takes To Profit
From Flat-Rate Pricing

(It should be noted that Item No. 1—Accurate Cost Accounting—is necessary to **any** system of pricing. Items No. 2 through 4 are only appropriate to flat-rate pricing. Item 5 works with hourly-rate pricing only up to the point where all available hours for sale are sold (100 per cent labor recovery). After that, it's of no real value.)

1) Accurate Cost Accounting. You **must** know what your cost of producing service is, and the profit you should have, to fix your hourly rate. Educated guesses or rates set by "the guy down the street" can deprive you of reasonable profit, or even break you. If you're above the competition, efficiency's the answer. If you're below, **use your advantage.** (We'll discuss this in detail later.)

2) Incentive Pay for Technicians. If you set your sights on more jobs performed per unit of time, you must see that your benchmen are personally interested in helping you accomplish it. It's easier to reward them for high performance than to supervise them into it. (This, too, will be taken up later.)

3) Good Facilities. Tools enough, equipment enough, space enough to allow benchmen to get out the work quickly and accurately. Organization of facilities and procedures to assure this effort. Supervision aimed at helping them with problems and keeping efforts coordinated.

4) Upgrading Programs. Proficiency of your technicians and efficiency of your shop and equipment must be improved by a continuing program. Your management skills, and those of your supervisors, must be upgraded, too.

5) Aggressive Sales and Promotion Efforts. With efficient methods equipment, highly competent personnel, you have service to sell. If you fail at the selling job, you're jeopardizing your investment in them and their investment in you. Unless your facilities are in use, they're not producing profits. Unless your people are busy, they're not getting much out of the incentives to produce more.

- **A sales and promotion plan**—Where's the added business that means higher profit coming from? How much can you expect to get? How are you going to get it? What will your campaign to get it cost? Can you work up promotions that take advantage of seasonal interests, special neighborhood or community interests? When you sell your overall program to your people, you must be prepared, to show them that it really will work to their advantage. Your sales promotion plans must help prove that case.
- **A reliable Flat-Rate Pricing Manual,** backed up by accurate cost figures for *your* shop.
- **A study of your competition.**—Intelligence data on how your competitors price their labor, their hourly rate (if you can find out), how they promote, where they get their business, what they do well or badly. You need to know what you're up against and how you're going to deal with it. Do a comparable study of your own shop—just as though you were sizing up a competitor.
- **Analysis of your cost of doing business**—Get a firm grip on your cost-of-doing-business data. Figure it yourself (we'll discuss how later in this series) or have it done, but know what it is. Try to see what each factor contributes to it, and what changes in the various factors do to it. As a manager you should be as conversant with it as you are with electronic circuitry. You needn't be able to design either one, but you'd better understand them.
- **A program, coordinating all these separate plans into a single plan of action**—You need this to guide your decisions, and you need it to present to your people. When you've got all six steps worked out, and you're ready to move, get your people together and go over the program with them. Explain it to them and sell it to them, so they can help you make it work inside the shop and help you sell it outside the shop. (I doubt if you'll need to sell the program outside the shop, just the improved service.)

In all your planning, keep in mind two things: Your goal and the means of achieving it. Check each step of your action plan against these two. What does this move contribute to achieving the goal? How does it affect other moves?

Your incentive to upgrade your shop, your equipment, your people and yourself is higher profits. Profits based on *service* rendered. Professionalism is selling *service*, not time.

Next

Specifics about an incentive pay plan and an accurate method of determining your minimum hourly labor rate will be presented in the final part of this series about flat-rate pricing of service labor. □

Circle 29 on literature card

Desk-Top Digital Electronic Calculator Kit

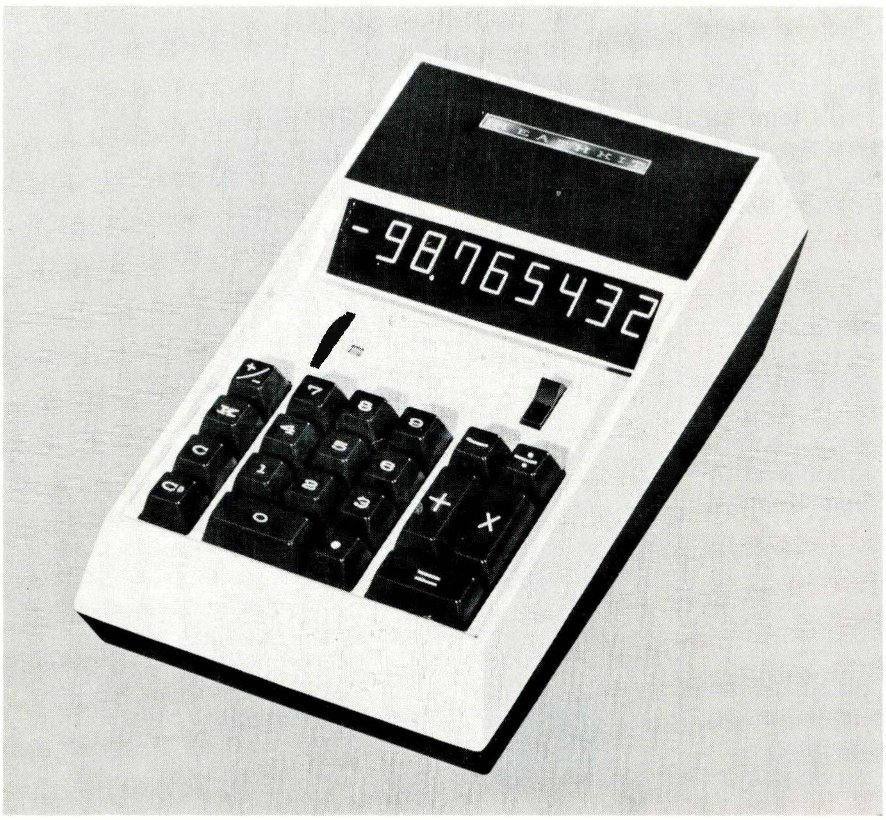
Heath has introduced, in kit form, an eight-digit, desk-top, digital electronic calculator, reportedly the first of this type of instrument to be available in kit form.

The new Heathkit IC-2008 Calculator performs addition, subtraction, multiplication and division electronically, and shows up to eight-figure totals on ½-inch, seven-segment display tubes. Punch-up the problem the same way it would be written (7 × 8 =) and you have the result. The screen displays each number with each key depressed, for checking your work as you go. The simplified keyboard provides 10 numerical keys (0-9), decimal, plus, minus, multiply, divide, and +/− for performing algebraic calculations with positive and negative numbers.

The unit can perform constant or chain operations. The K (constant) key allows multiplication or division of a series of figures by one preselected number, or multiplication of the constant by itself for squaring or taking it to a power. Releasing the constant key permits performing any function or series of functions (9 + 3 − 2 × 8) with the calculator memory holding all data until the total key is pushed.

The IC-2008 can automatically indicate a minus result—making it ideal for credit balancing. To balance ledger accounts, for example, you merely punch in your credits and debits, then "ask" for a total. It's one easy operation with no need to subtotal.

A thumbwheel places the decimal in one of eight positions. Or, there is a "floating" decimal mode for totals carried out to completion (3.5 × 3.5 = 12.25). Overflow for plus or minus totals is indicated on the ninth display tube, at the extreme left of the readout screen. This tube also displays a minus sign when a negative number is used or in the case of negative result as: (10 − 11 = −1). In the event of overflow, the most significant portion of the total (the largest portion of the number, or that portion to the left of the decimal) is retained on the display screen.



If an error is made in setting up a problem, the clear-display (Cd) key permits erasing the last entry (data or type of operation) from the circuit and proceeding ahead without losing the entire problem. At the completion of a problem or to correct an overflow, the "C" key clears the machine completely.

The Heathkit IC-2008 Calculator embodies the latest digital technology, and for that reason it's a relatively easy kit to build. All logic functions, keyboard encoder, three registers, decoder driver and matrixing circuitry are contained in one large-scale integrated circuit (LSI). Discrete circuitry mounts on two roomy circuit boards, to form the clock and readout drive circuitry. The high-voltage, cold-cathode display tubes come in three-tube clusters for easy installation on the circuit board. Heath says that total assembly time required is approximately 8 hours; it took us only 6.

The 6.5-watt power transformer can be wired for either 120- or 240-VAC line input.

The white and black high-impact plastic case measures 3-3/8 inches × 6-1/16 inches × 10-1/4 inches. The keyboard has black keys with white nomenclature.

Price of the Model IC-2008 Heathkit Calculator is $129.95. □

Circle 49 on literature card

photofact bulletin

PHOTOFACT BULLETIN lists new PHOTOFACT coverage issued during the last month for new TV chassis.

ADMIRAL
Chassis TR2-1A,
TR2-2A, TR3-1A 1245-1

BRADFORD
1005A32, 1005B32 1246-1

CURTIS MATHES
Chassis C37, CMC37 ... 1244-1

EMERSON
Chassis 32K1673-32,
32K1686-4, 32K1687-2 .. 1244-2

PENNCREST
4834B, 4835B, 4848B,
4854B, 4855B, 4896B,
6892A, 6893A 1247-1
AM-FM Radio 1247-1-A

RCA
Chassis CTC39XAJ/
XAK/XAR/XAT/XF 1246-2
Remote Control
Receiver CTP12G,
Transmitter CRK10C ... 1246-2-A

SEARS
562.50230100,
562.50270100,
562.50310100 1247-2

SEARS SILVERTONE
528.51030000 thru
528.51030021,
528.51030103,
528.51031200,
528.51130100 thru
528.51130118 1248-1

SINGER
HE-7030 1248-2

SONY
TV-740 1245-2

SYLVANIA
Chassis B10-6 1244-3
Chassis
D14-6/-7/-8/-10/-11 1245-3
Remote Control
Receiver, Transmitter ... 1245-3A

TRUETONE
MIC4218A-27
(2DC4218) 1246-3

WARDS AIRLINE
GEN-11442A,
GEN-11482A,
GEN-11492A 1247-3
GCI-12102A 1248-3

PRODUCTION CHANGE BULLETIN

SEARS
564.41220002 1247-4

SEARS SILVERTONE
528.51150016 thru
528.51150025 1244-4
528.50070006 thru
528.50070010,
528.50400004 thru
528.50400023 .... 1245-4 □

carr electronics

by Joseph J. Carr/ES Auto Electronics Consultant

Antenna And Related RF Amplifier Troubles

The car radio antenna, although a simple device, is a major source of trouble because it is exposed to the elements and is subject to many types of abuse.

Basic Designs

All AM-band car radio antennas are short, compensation types. (A full size, 1000K-Hz, middle-of-the-AM-broadcast-band, quarter-wavelength antenna would be 264 feet long.) Most AM car radio whip antennas are a little over three feet in length. The majority are of telescoping construction so that they can be set to a convenient length. They do, however, function best when fully extended.

A typical universal car radio antenna is shown in Fig. 1. This style is probably the most commonly used type of mobile antenna. It is nicknamed the "eight ball," because of the black, hemispherical base insulator. There actually are several basic designs which bear the name "eight ball." One very common design uses a molded metal fastener which holds the antenna by gripping the underside of the car fender. In the type shown in Fig. 1, however, the antenna is held to the fender by a toggle arrangement. It is secured from the top by a chrome-plated nut. The beauty of these types of antennas is that they can be installed from the top of the fender. Those designs that must be secured at one or more points beneath the fender can be both tough and time-consuming to install. The eight ball is universal to the extent that it can be mounted on a wide variety of sloping surfaces with cants up to either 30 or 45 degrees. On steeper fenders, and they do exist, you must use other types of antenna; either a custom original equipment manufacturer (O.E.M.) type or one of the universal swivel-base types.

A universal swivel-base antenna is shown in Fig. 2. The base of this antenna can be rotated through a full 360 degrees, merely by loosening one screw. The mast portion can be rotated in the opposite plane through an arc of approximately 270 degrees. These characteristics allow the swivel-base antenna to be mounted on almost any available surface. It can be set to an almost infinite variety of slopes and cants. It is not, however, totally without drawbacks. The swivel mount is, for example, a bit less sturdy than is the eight ball type.

Some automobiles, VW for example, require special antenna designs. Two "near-universal" types which are suitable for those installations are illustrated in Figs. 3 and 4. The antenna shown in Fig. 3 is a type used on a number of older, imported automobiles. It is called the "dual stanchion side cowl" (DSSC). The more recent type shown in Fig. 4 is the "single stanchion side cowl" (SSSC) design. Both

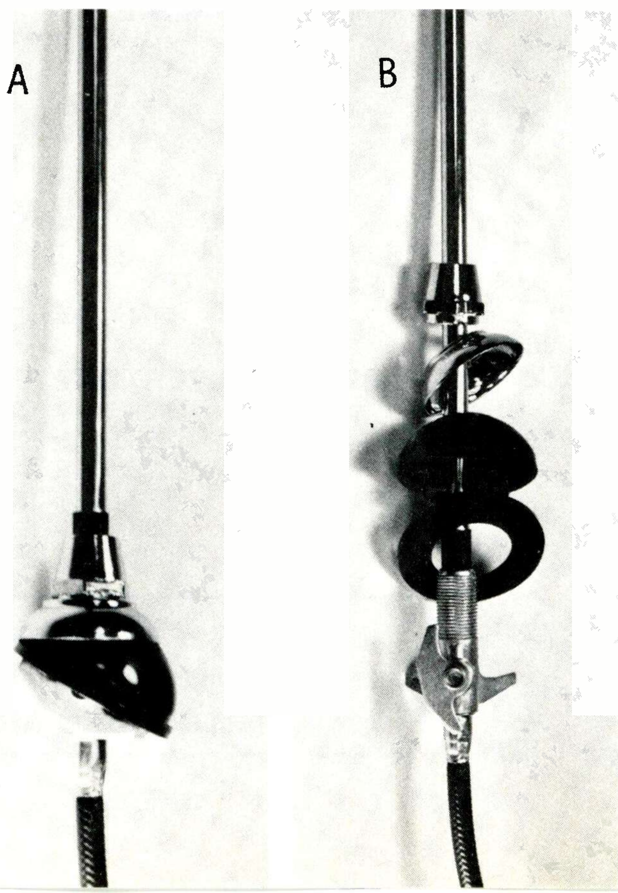


Fig. 1 (A) Typical universal "eight ball" car radio antenna. **(B)** This antenna is universal to the extent that it can be mounted entirely from the top of the fender at a wide variety of cants. Most designs allow mounting at a cant of up to either 30 or 45 degrees.

of these antennas require two holes in the fender. The difference is that the DSSC requires two large holes while the SSSC requires one large and one small hole. The DSSC stanchions can be adjusted for any spacing relative to the mast length and each other.

Installation

Hand tools

Antenna installation is not a difficult job, if you are equipped with the proper tools. Besides the usual complement of small hand tools common to all electronic service shops, you should have a full set of box-end/open-end wrenches between ¼ and 1 inch. A large crescent wrench should also be available; one that opens up to a full one and three quarters inch span is preferable.

Power tools

The hardest part about most new antenna installations is cutting the 1-inch hole in the car fender. You might believe that the metal of most of Detroit's products are paper thin and "buttery" soft—until you wear out several drill bits and hole saws. There are several approaches to the hole-cutting job. If you are a real glutton for punishment, try drilling a small hole with a garden variety drill and its usual complement of bits ranging up to ⅜ inch. You then get the pleasure of enlarging the hole to the needed one inch with a rat tail file. (At this stage of the operation you will begin to appreciate the auto maker's metallurgy department.)

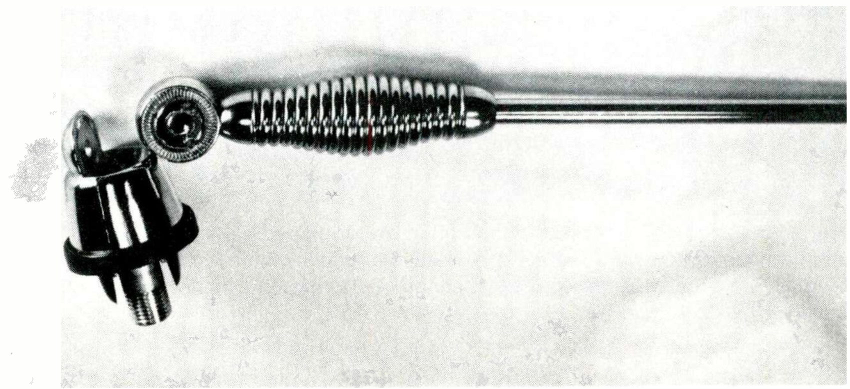


Fig. 2 This is a typical "swivel base" universal antenna. The base rotates through 360 degrees while the mast can be rotated through about 270 degrees in the opposite plane. These characteristics permit mounting the antenna on virtually any angle that might be encountered on an automobile fender.

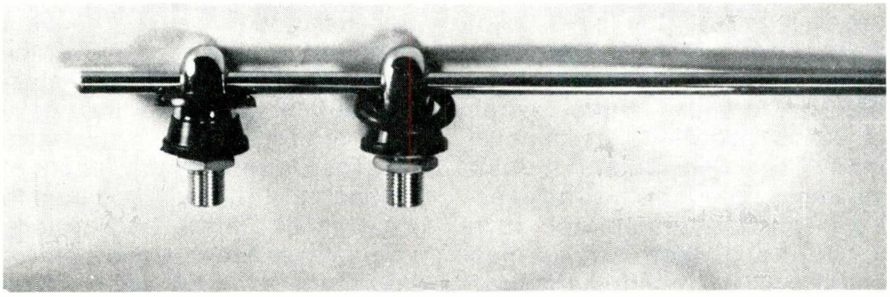


Fig. 3 The dual-stanchion, side-cowl antenna is designed for mounting to vertical body members such as those found on VW and other imports. The individual stanchion mounts can be positioned at a variety of points relative to each other and the mast.

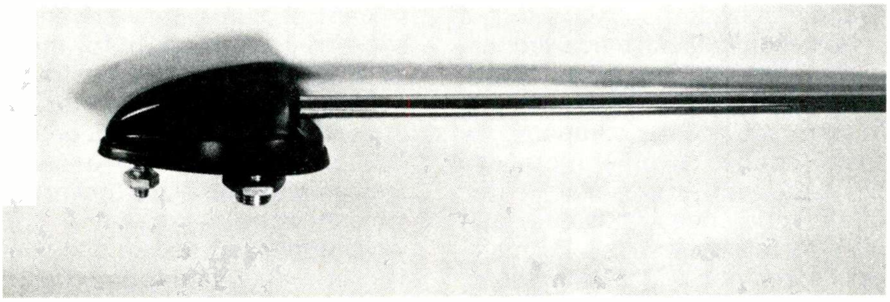


Fig. 4 The single-stanchion, side-cowl antenna is used on newer imports. It offers a better appearance at the expense of some mounting flexibility.

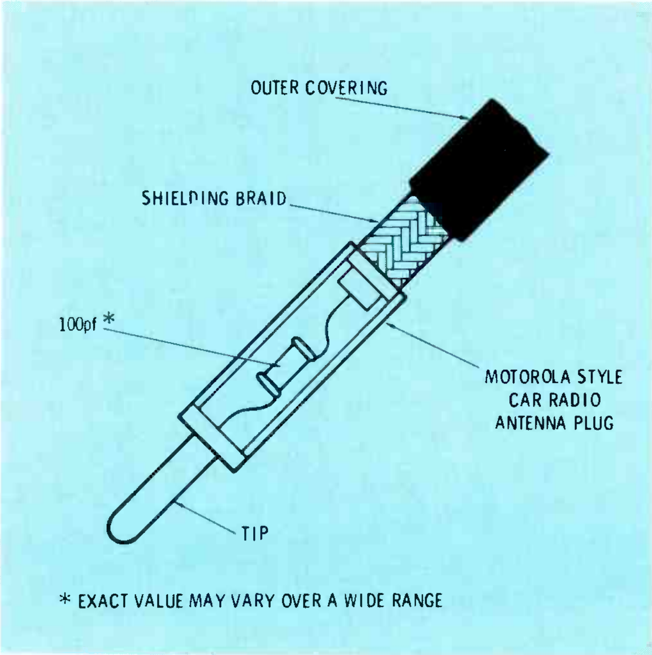


Fig. 5 Cables for rear-deck antennas often are equipped with a small-value capacitor, to reduce the reactive effects of the extra length. The precise value of the capacitor might vary, but it is usually close to 100 pf.

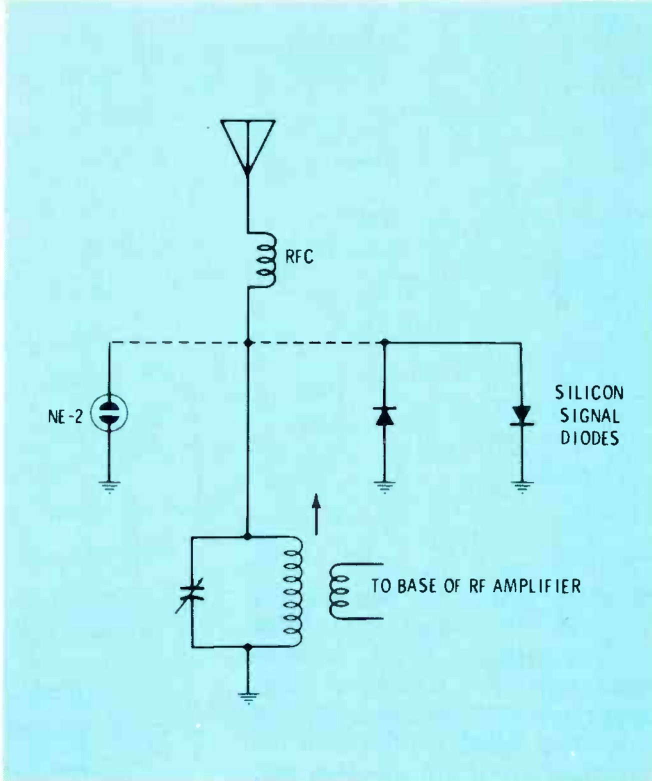


Fig. 6 Static discharges through the antenna circuit can destroy the RF transistor. Diodes or neon discharge lamps are often used to drain the charge before it "hits" the transistor.

On the other hand, if you are a reckless soul and appreciate a taste of the dangerous, buy a medium-to-high-speed drill equipped with the usual half-inch chuck and a 1-inch reduced-shank bit. Drill the small pilot hole (about 3/8 inch), then enlarge it with a big bit. Meanwhile, pray that the bit doesn't snap or grab anything; especially an immovable "I" beam or girder. If it does, you can expect some rapid action—and a twisted and torn fender, a broken arm (which breaks as it smashes through that expensive curved and tinted glass windshield immediately to your left), and no small amount of humiliation. Fortunately, there are ways to make the job simpler—and much safer.

Some auto electronics technicians prefer the use of a manual hole punch because of the "clean" job it does compared to that produced by other methods. On cars with little metal in the fender and those with easy access to the underside, the manual hole punch might be suitable. I prefer the use of a metal-cutting hole saw. These tools can be used on "garden variety," quarter-inch-chuck drills and they do a creditable job. It is, however, mandatory that you buy a quality saw. Saws made of what appears to be sheet metal are less expensive only on initial purchase. Because you can expect to wear them out on one or two jobs, the total per-job cost escalates rapidly. The best hole saws that I have used are those by Black & Decker. (There probably are others of comparable quality, if you care to experiment.) In the B&D system, you can purchase a mandrel for less than 10 dollars and replacement blades for a little over a dollar each. The mandrel includes the mounting assembly for the blades and the quarter-inch pilot bit. You will need a 1-inch blade for car radio antenna work and a three-quarter-inch bit for most CB antennas. It is also desirable to have a one-and-a-quarter bit for certain unusual O.E.M. antennas. Most shops keep a spare blade in stock for sizes that are in constant demand.

The hole saw assembly consists of a mandrel-mounted pilot bit that is coaxial to the saw blade. If used in a high-speed drill, you must saw the metal in short bursts so that the blade does not overheat. Do not use oil to cool the blade in car radio work, because the oil on the hot surface might discolor the paint. Also, the rotary action of the saw blade will splatter oil on your clothes. Water works fine; use it instead of oil, if a coolant is needed.

Always inspect machine tools before use. If the saw blade is cracked or if it is improperly assembled, it can come apart on (literally ON) you at high speed. The pilot hole should be drilled slowly. If the bit breaks through the fender suddenly, the saw blade will hit the metal surface too hard. If this happens, and the blade breaks, it might throw metal fragments at you—an unforgettable experience. If this advice is followed, every antenna installation will be both safe and successful.

The drill used must be chosen for safety and convenience features. It should, for example, be a multi-speed model. As for safety, remember that you might occasionally use the drill outside. Pick an unsafe tool and you might wind up being a 1500-watt fuse that blows all too easily. (Just watch your local newspaper; Harry Homeowners regularly electrocute themselves with their 5-dollar drills.) The author recommends a model with double insulation and a 3-wire plug. In these models, the metal case is grounded through the third wire. A short that could electrocute the user is shunted to ground and should blow the main fuse. If the 3-wire feature is defeated by the use of a 3-to-2-wire adapter, the drill again becomes potentially lethal. If you do not have 3-wire outlets, either have them installed or permanently mount an adapter in a 2-wire outlet, with the ground wire attached to the grounded outlet cover plate.

Antenna placement

There are too many different automobiles to offer any but the most general types of advice about antenna placement. The best thing to do is inspect the car for a suitable location, get the owner's approval, then drill away.

Look under the fender where possible for any obstructions that could interfere with the installation. Depending upon which antenna is selected, you will need between 1 and 1 ½ inches of vertical clearance beneath the fender.

You must also decide in advance where the antenna lead cable will run. A lot of cars have a rubber grommet through the firewall especially for the antenna cable. In others, it takes some imagination to determine a suitable route for the antenna cable.

Some states require that the antenna be on the passenger side, out of the driver's field of vision as much as possible. Do not knuckle under to a customer's demand for an illegal driver's side installation if your state has such a requirement. When he gets his illegal equipment ticket, he won't recall his own insistent demands for the left-side mounting. All that he will remember is that YOU did the job and caused HIM to get a ticket. (I learned about this the hard way—my own antenna was on the driver's side.)

Common Defects And How To Track Them Down

Common antenna system defects are open feedlines, shorted feedlines, and leaky feedlines. By leaky, I mean about a half cup of rain or car-wash water. Some automotive coaxial cable is hollow. If the sleeve insulator separating the mast and base is cracked, water will find its way inside the cable. If the water gets past the Motorola plug on the radio end of the cable, it might also cause corrosion damage inside the radio.

There are two main interrelated but different symptoms which point to either antenna or RF amplifier troubles. One of these is an inability to receive more than a few of the very strongest stations. The other symptom is a strong RF background hiss which is audible when the volume control is set to a high position. This hiss is the thermal noise of the transistors and "mixer" noise. It is of a slightly differ-

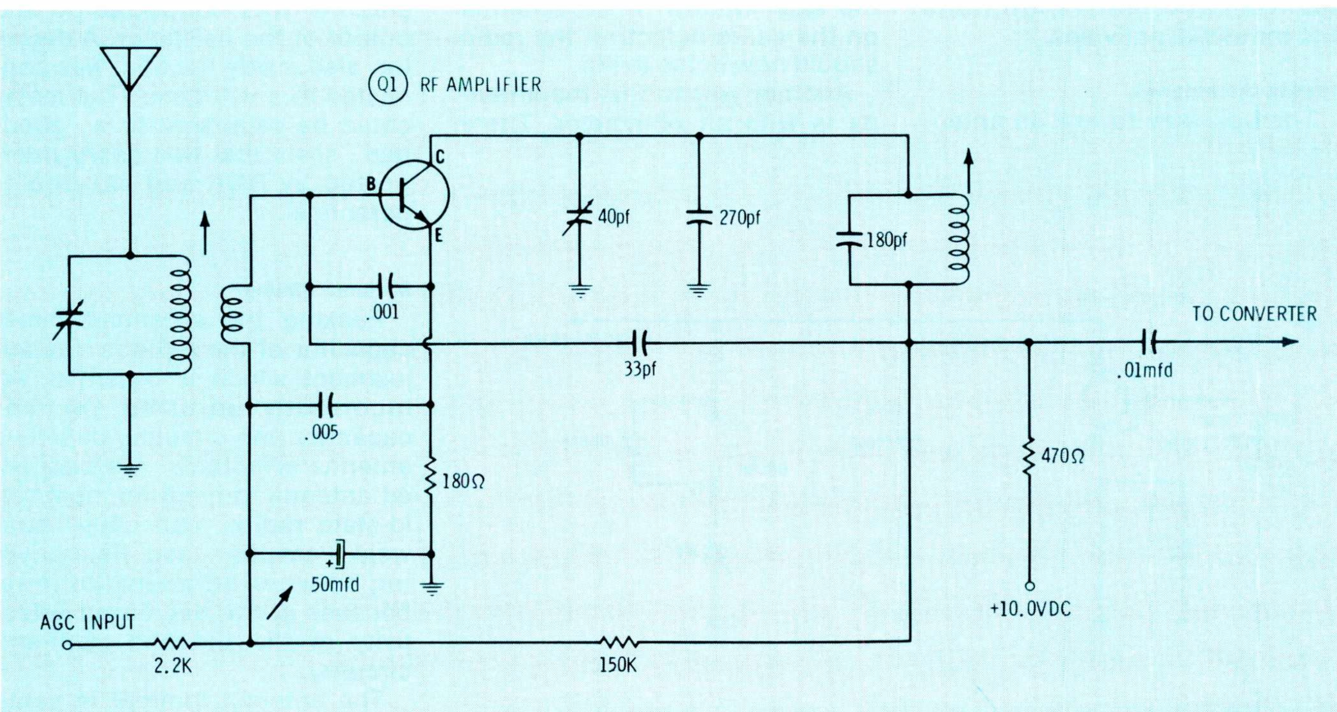


Fig. 7 A typical RF amplifier circuit which uses an NPN silicon transistor. This type circuit is typical of that in most recent designs.

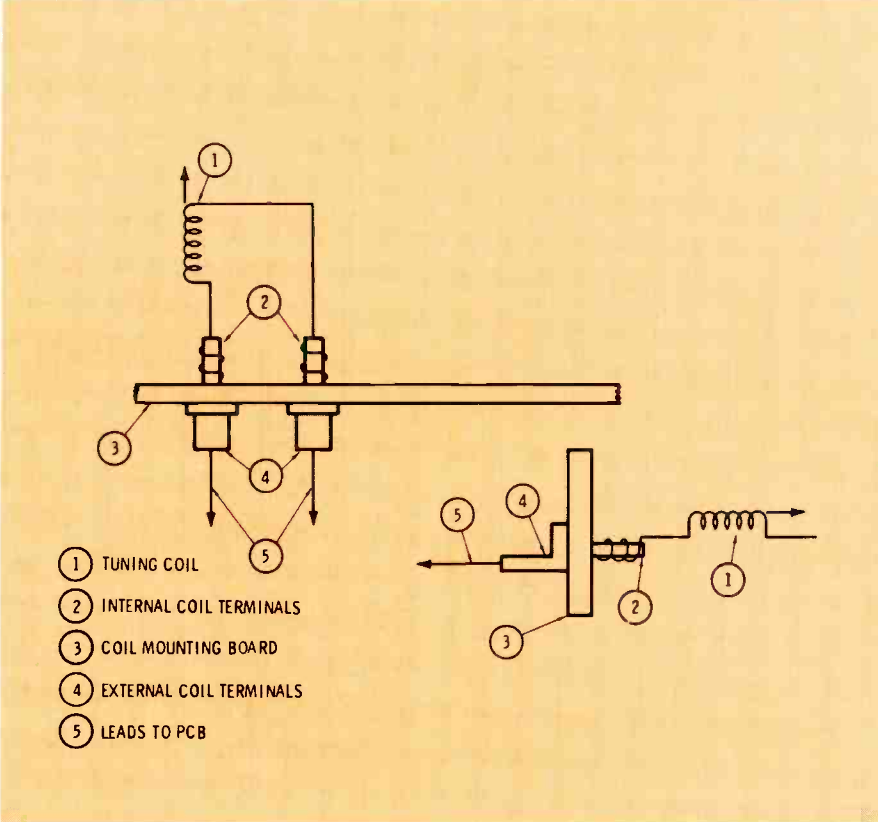


Fig. 8 A problem that has been showing up frequently is poor solder joints at the points where the RF and oscillator coils are attached to the mounting board. Resoldering usually is the cure.

ent character than the normal background noise of a normally functioning system, which includes atmospheric noise, man-made static from neon and fluorescent lights, and noise impulses from automotive ignitions and industrial activities.

Testing the antenna

The best way to test an antenna is by temporary replacement. Most car radio shops keep an inexpensive eight ball handy for use as a test antenna. Plug the lead of the test antenna into the radio and hold the antenna out the side window. If the antenna on the car is defective, the radio should now come to life.

Another way to test the antenna is with an ohmmeter. There should be a "dead" short indicated between the mast and the center tip of the Motorola plug, and also between the outer conductor of the plug and the car chassis. An open circuit should exist between the center pin of the plug and the outer conductor.

There might normally be an open circuit between the mast and the center pin of a rear-deck antenna. This is because some antennas of this type are equipped with a small-value capacitor which is connected in series with the center conductor (see Fig. 5). This capacitor, usually a 100-pf tubular ceramic, is used to cancel the effects of the reactance of the longer transmission line. (This reactance is the reason that antennas designed for front mounting do not perform as well when they are mounted on the rear via a 12-foot extension cable.)

A third way to test an antenna was used by Delco several years ago. They made available a piece of test equipment, often called the "goodie box," for antenna tests. This box was equipped with a modulated oscillator. The antenna was connected to the output of the oscillator. A detector, also inside the box, was connected to a voltmeter. The meter could be calibrated to a "good-bad" scale that was easily interpreted by RNR and car-dealer personnel.

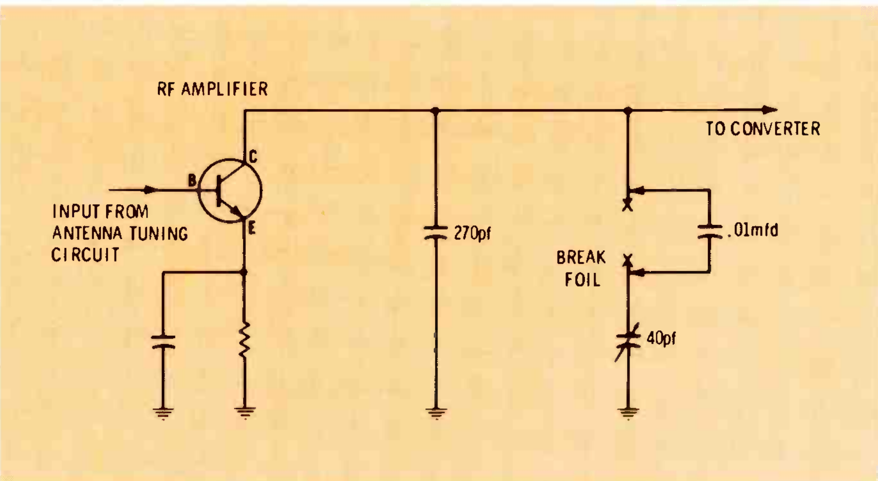


Fig. 9 In humid areas there is a high incidence of trimmer capacitor faults. To troubleshoot, break the foil to the trimmer and series connect a .01M-fd capacitor. If the noise stops, replace the trimmer.

Antenna trimmer

Peaking the antenna-trimmer capacitor of the radio is one adjustment which is essential. An incorrectly adjusted trimmer capacitor can simulate defective antenna symptoms. A misadjusted antenna trimmer, in most solid-state radios, can cause both weak reception and heterodyning between adjacent stations, because of the decreased selectivity of the detuned front-end circuitry.

The antenna trimmer in some radios is located right next to the antenna jack on the radio's chassis. In others, especially General

Motors units, look for it behind the manual tuning knob. On some models the trimmer is exposed by depressing either the extreme right or left pushbutton! In certain models made for imported cars (VW and others), Bendix placed a piece of gray, fiber, adhesive tape over the trimmer access hole.

Once located, the trimmer is peaked for maximum signal on a weak station *above* 1400K Hz. If no weak station is available in that frequency range, use the interstation noise in preference to either a strong signal or a weak signal lower in the band.

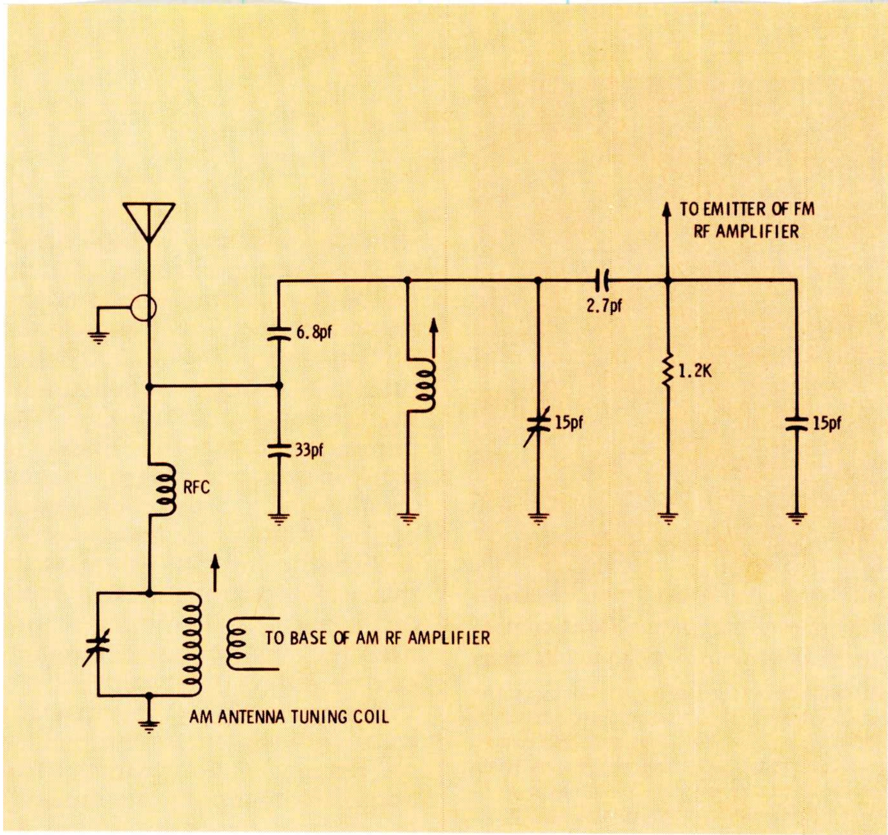


Fig. 10 The antenna of FM auto radios usually is electrically connected across a capacitive voltage divider, so that the antenna is matched to a higher "Q" and more selective tank circuit. Some models, a minority, use a one- or two-turn link around the "cold" end of the RF input coil, to match the antenna through transformer action.

FM operative, AM dead

One antenna-caused problem which the customer probably will not believe, until you hit him with irrefutable proof, is the case in which the AM band is dead (with RF rush) yet the FM seems alright. (The FM band actually will be slightly weaker than normal but a strong local station easily can hide the defect.) The cause of this particular symptom can be a broken center conductor in the antenna feedline. There is enough capacitance existing across the break to pass the VHF FM signal with only a slight amount of attenuation. The capacitive reactance, however, is extremely high at the medium wave frequencies occupied by the AM band, and, consequently, the AM signal is effectively blocked.

Common Front-End Defects

Static discharges through the antenna system, often caused by touching the mast, can destroy the RF amplifier transistor. Two methods commonly are used to eliminate this problem. In some radios, a pair of back-to-back silicon signal diodes are shunted across the antenna circuit, as shown in Fig. 6. In others, notably those from Europe, an NE-2 neon discharge lamp is connected across the circuit.

Problems in the RF amplifier usually are caused by a defective RF amplifier transistor. In certain cases, however, other components in the RF circuit are defective.

One of the most common defects involves loss of transistor forward bias because of a short circuit between the base and the emitter circuits. One prime suspect in these cases is the low-voltage, electrolytic, AGC bypass capacitor, which is pointed out in the common AM RF amplifier circuit in Fig. 7. Defects which cause an increase or decrease of the voltage on the AGC line also can produce similar symptoms.

One problem which has been showing up with regularity in auto radios is open tuner coils. Fig. 8 shows how most manufacturers fasten the coil wires to the terminals on the coil-mounting board. The coils are wound of enameled wire. If the solder pot isn't hot enough when the radio coils are made, the result is a poor connection. Unfortunately this defect cannot always be detected by visual inspection. It might be necessary to use either your ohmmeter or a DC voltmeter, to find the open circuit. The cure is usually quite simple: heat the connections and resolder them.

There is a high incidence of trimmer capacitor failures in humid areas. This causes a static noise similar to the "IF crackle" which was common back in the days when capacitors in the bases of IF transformers were not adequately sealed against moisture, and when relative high-voltage tubes were the rule. To test for this problem, disconnect one lead to the trimmer (see Fig. 9), connect in series with it a .01M-fd capacitor, and reconnect the lead to the trimmer. If the trimmer is defective, the noise will cease and the radio will play, as long as the "test" capacitor is connected. This is not a cure, it is only a test. If the trimmer is defective, the only proper cure is replacement of the trimmer.

A typical AM/FM RF input circuit is diagramed in Fig. 10. The RF choke is used to "separate" the AM and FM signals. These chokes are a common source of trouble. The symptom of an open choke will, of course, be no or poor AM. For FM operation, the antenna is connected across one leg of a capacitive voltage divider. This arrangement is used to match the low impedance of the antenna to the higher impedance of the resonant circuit. (Better selectivity is obtained by increasing the reactance—$Q = X/R$.) The capacitance of the cable is shunted across the 33 pf, capacitor in the radio. The precise value of the cable capacitance varies with cable length. Because of this, it is necessary to use a cable of the same approximate length even if it means adding an etension or cutting off any excess.

Antenna theory for quarter wave verticals enters the picture on FM car radio systems. The approximate length recommended in most cases is around 32 inches. Some manufacturers also tune the feedline to an electrical length of approximately one-half wavelength. This allows the base impedance of the antenna to be reflected into the radio at the end of the cable, because impedance conditions repeat themselves every half wavelength on a feedline. The length of most auto FM radio cables is around 56 inches. (If you noticed that 2 × 32 inches—the quarter-wavelength figure mentioned earlier—is not equal to 56 inches, please consider the velocity factor. The equations taught in class rooms are for perfect, zero-loss cables and antennas in free space. In the real world, feedlines are "lossy," and antennas are affected by nearby conductive objects, which detracts from performance. Even the geometry of the car affects the antenna. The best location for the antenna would be in the exact center of a metal counterpoise ground (ground plane) of perfectly regular geometry.)

Tuning the antenna and feedline by varying the length can make a significant difference in performance, particularly if the customer regularly listens to weak stations far from his normal driving area. The effect of tuning the antenna is like increasing the selectivity of the system by adding another resonant circuit. □

Standard Troubleshooting Techniques:

Tube/Transistor/Component Substitution/ and Static Testing

by Bruce Anderson
ES Contributing Author

There are basically four distinct techniques which can be used to troubleshoot a television receiver: tube and/or component substitution, static testing, dynamic testing, and performance testing.

The first two of these—substitution and static testing—usually lead directly to the trouble, because little or no interpretation is required of the technician.

The other two—dynamic and performance testing—require some degree of analysis, after which it usually is necessary to fall back on substitution or static testing, to find the specific component which is the cause of the problem.

Substitution and static testing usually lead to a specific component; the other techniques normally point to a general circuit area. To attempt a diagnosis using only the first two techniques is not realistic unless the substitution is unusually easy or the trouble symptoms point to a specific component. Deciding when to abandon the simple techniques and begin a logical routine of dynamic or performance tests is one of the most difficult decisions required of a technician. The articles in this series will discuss the four techniques and suggest which technique(s) should be used in specific troubleshooting situations.

Tube And/Or Component Substitution

It has been demonstrated many times that simply changing all the tubes with known good ones will fix a lot of TV sets. Once the symptoms have been cleared, original tubes can be reinstalled until the trouble reappears. With a few weeks experience, a reasonably alert person can correlate certain tubes with certain symptoms, and the substitution technique is no longer a guessing game. The efficiency of the "tube jockey" has increased because he is now observing the performance of the receiver before attempting a repair. In a rudimentary way, observing that the picture is snowy, for instance, is a form of performance testing.

Substitution of parts has some very real advantages. It is definite, and when restricted to plug-in components, it is quick. For the most part, it can be done in the home, and several of the manufacturers are encouraging this technique, either with plug-in transistors or plug-in circuit modules.

It seems unlikely that anything as simple as changing a few tubes could cause trouble, and this is true—most of the time. One exception is the defective replacement. For an example, let's say that the problem is a filament-cathode short in a video amplifier. The hum bar produced by this defect makes it a simple trouble to analyze, and simple to repair—unless the new tube also has a filament-cathode short. If so, it is very likely that the uninitiated will take the chassis to the shop—just to change a tube.

Tubes which are carried about daily exhibit an abnormally high

Fig. 1 Typical plots of tube gain versus time in service.

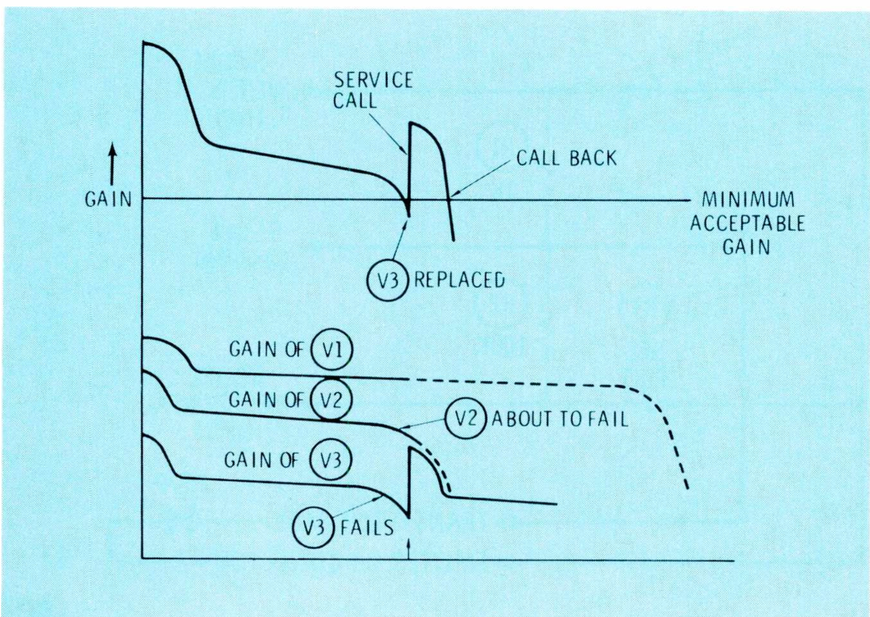
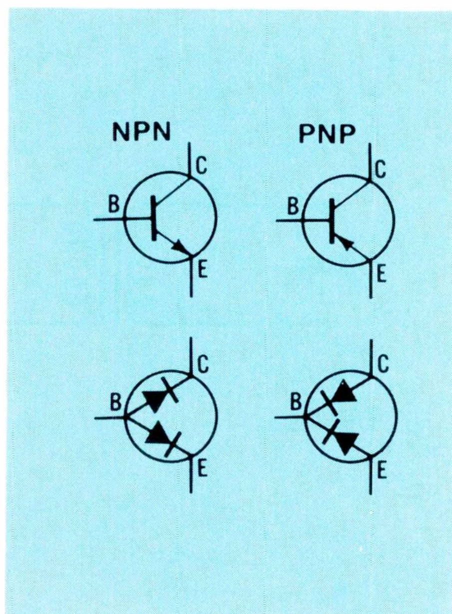


Fig. 2 Equivalent circuits for testing transistors.



rate of interelectrode shorts. For this reason, be on the lookout for variations of the above example. Sometimes this problem can be avoided simply by making it a habit to watch a new tube when the set is first turned on. Often an internal short will produce arcing during warm-up. This is particularly true of dampers, rectifiers and horizontal-output tubes.

Another little trick is to rotate the slower moving tubes out of the caddy and into the bench stock at least once a month. A shorted tube in the bench stock is an inconvenience, but it doesn't cause a needless chassis pull. It is also worth noting that customers don't like to see a bunch of dog-eared tube cartons when you open your caddy. If you rotate the stock, they won't. This is a minor point, perhaps, but appearances are important.

Another pitfall of tube substitution is that multiple faults are often missed. For example, the symptom of poor contrast often is cured by changing the video-output tube. On some occasions, a pair of weak IF amplifiers (or all three, if there are that many) will be the problem. Possibly both, or all three, video amplifiers are weak; or it can be some combination of IF and video amplifiers. Unfortunately, the unwary technician might see such an improvement when the first tube is replaced that he fails to notice that performance is still below what it should be.

In the previous example, the technician simply overlooked substandard performance. In some instances, the second half of the problem is a little harder to uncover. Suppose there are three stages of amplification. It is good engineering practice to design these stages so that there is a reserve of gain to compensate for the gradual decrease in gain of the tubes. This concept is illustrated in Fig. 1.

At the time of the service call, V3 had definitely failed and was replaced, restoring the overall gain to an acceptable level. The high gain which is normal when a tube is brand new was sufficient to compensate for the abnormally low gain of V2, which actually was in the process of failing. After a few days or weeks, V2 will get weaker still, and at the same time, the gain of the new V3 will level off at its long-time gain figure. Unfortunately, the overall gain at that time will again be below standards, and a callback results.

To compound the problem, the unwary technician might simply return and replace V3 a second time, perhaps restoring normal operation, but leaving the basic problem unsolved. Even if the second weak tube is discovered, the customer is apt to be somewhat less than overjoyed by the fact that it "took two calls to find a couple of bad tubes."

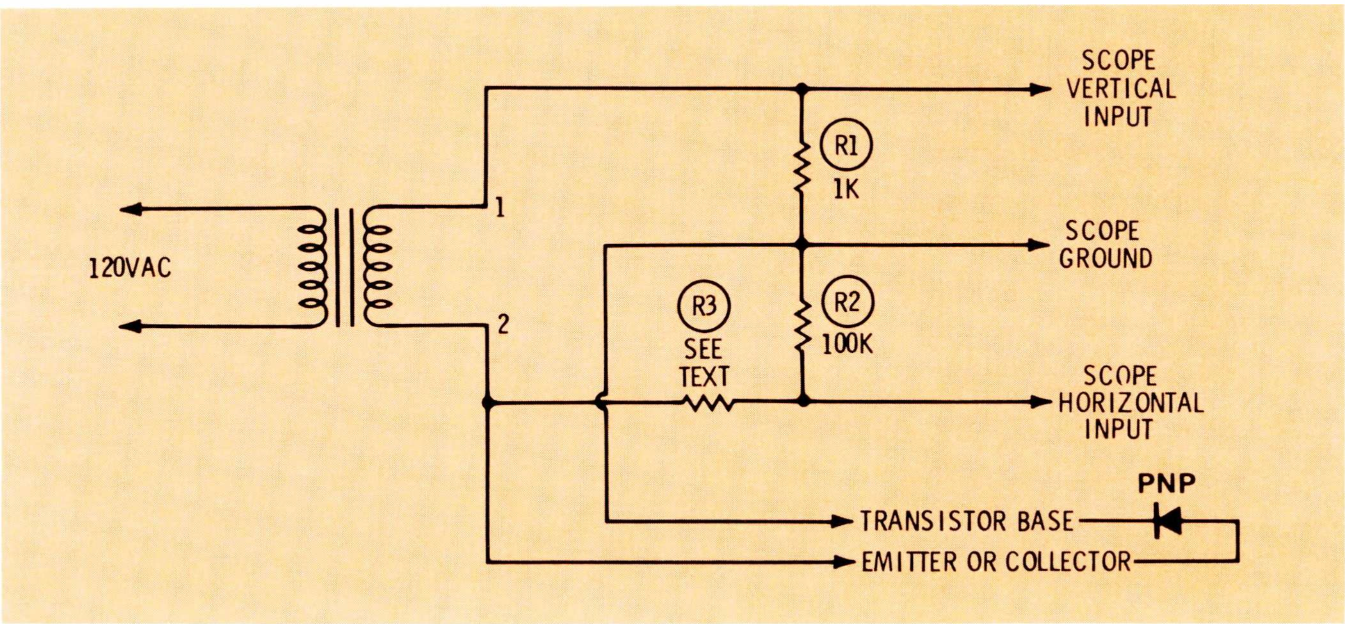
This type of problem can be avoided rather easily by being a little more careful and thorough on the initial call. After the immediate trouble has been located, spend a little more time and determine if there are any other "bugs." This usually is not a waste of time; there is more profit in selling another tube or two than there is in making a callback.

One way to avoid this sort of trouble is to replace immediately all tubes in the suspected circuitry or section. Then reinstall the old ones until some degrading of the performance is noted. Whenever performance does fall off, reinstall the new tube. By starting with all new tubes, you can tell what the optimum performance really is, and it is much easier to tell if a weak tube is pulling down the performance.

Another way to accomplish about the same thing is to use a tube tester; but that will be discussed later.

Substituting transistors is not so involved, because the gain of transistors remains just about constant throughout the lifespan of the device. Failures normally are caused by shorts, opens or, occasionally, leakage.

Fig. 3 Circuit diagram of a simple transistor tester. See text for explanation of theory of operation.



Therefore, there is little chance that you will encounter a situation in which a second transistor is weak, although the effects of leakage can duplicate a weak stage. On the other hand, whole strings of transistors can fail at the same time, because they are electrically fragile and often are directly coupled. This makes it possible for the failure of one transistor to damage the transistors coupled to it. For this reason, check the adjacent transistors before installing a new one.

It is common practice to check filter capacitors by "bridging" them. This works well if the suspected one is open, but can be very misleading if it is leaking. Because the latter type of failure is just about as common as the former, the technician who assumes that a filter is good, just because connecting a good one across it does not improve performance, is headed for a lot of pointless troubleshooting. It takes a couple of minutes to disconnect a capacitor and temporarily sub a new one; it might take an hour to isolate a leaky capacitor after it has been passed over once or twice before.

Static Testing

For the purposes of this article, static tests are defined as any tests made under nonoperating conditions. These include resistance measurements of components, tube tests, transistor tests, capacitance measurement, capacitor leakage tests, etc. The test may be made either in-circuit or out-of-circuit, depending on the availability of test equipment, convenience, and personal preference. Bear in mind, however, that a static test is most valid when it most closely duplicates actual operating conditions.

Tube testing

In emphasizing the shortcomings of the tube tester, many teachers and writers have left the impression that this instrument is next to worthless. Although it is true that a tube tester can give misleading information—mainly because the test conditions it establishes are a poor simulation of actual operating conditions—it is a valuable tool, if the necessary precautions are observed.

A good way to start arguments is to claim that one type of tube tester is better than the other. The emission tester measures the ability of the cathode to emit electrons; the transconductance tester measures the plate signal produced by a given amount of grid drive, but usually at relatively low levels of cathode current. Both basic types check diodes for emission, check for internal shorts, and usually check for grid emission, which is an indication of gas.

Although some bad tubes might "sneak by" a tube tester, it seldom rejects good tubes. Because of this, it can help you avoid installing defective tubes, and it can help you find borderline troubles which involve several weak tubes.

An area which often is ignored is preventive maintenance. A few minutes spent critically observing TV performance after the repairs are completed often will reveal that some other function of the receiver is below par. If so, checking the tubes in the suspected circuits and replacing any which are substandard, in the long run, actually will save the customer money, because it will reduce the number of calls he must purchase in a certain period. For the technician, the sales per service call will be increased. Also, the callback rate can be reduced and customer satisfaction improved.

CRT checkers

The experienced technician usually can "eyeball" a picture tube and determine if it is defective. Still, it is a bit difficult to tell the difference between an open drive control and a dead gun in the picture tube. The question here is not, "Can I find the trouble every time without a CRT tester" but, "Will the tester save enough time to pay for itself"? If labor cost is $10.00 per hour, it doesn't take much "saved" time to pay for a tester.

My own experience with rejuvenation of picture tubes has been good; however, this seemingly is not the experience of the majority of technicians. Perhaps they forget that rejuvenation does not fix a CRT; it only might prolong its useful life.

Transistor testing

Transistor testing cannot follow the same "rules" as tube testing, for several reasons. Because most transistors are soldered in, they usually cannot be removed easily for testing or substitution. In-circuit testing often can be helpful, but usually there are many "ifs."

Transistors usually are either good or bad; there is seldom a "weak" transistor. Except for an occasional noisy transistor, or one with excessive leakage current, failure is caused by a shorted junction or an open junction, and these are easy to find with an ohmmeter. Noisy transistors can seldom be spotted by testing. Leaky transistors usually overheat, because power transistors are the type most prone to leakage.

(Articles in the February and March 1971, issues of ES thoroughly cover transistor testing, and will help you decide what transistor testing equipment you need, and, of course, how to use it most effectively.)

The shortcomings of relying on an ohmmeter for transistor testing usually are outweighed by the speed and convenience of this method, particularly if signal tracing and performance testing are your primary troubleshooting techniques. If the test equipment is not available for these types of tests, more reliance must be placed on static tests, and a more sophisticated method of testing transistors has to be used.

Diode checking of transistors is based on the fact that a transistor can be considered, for test purposes, as two diodes connected in series. As shown in Fig. 2, an NPN transistor appears as two diodes with a common anode; a PNP has a common cathode. If the positive ohmmeter lead is connected to the anode terminals, low resistance will be measured to either cathode. Reversing the meter polarity should always produce a high-resistance reading. In a few diffused-junction transistors, used mainly as RF or IF amplifiers, the

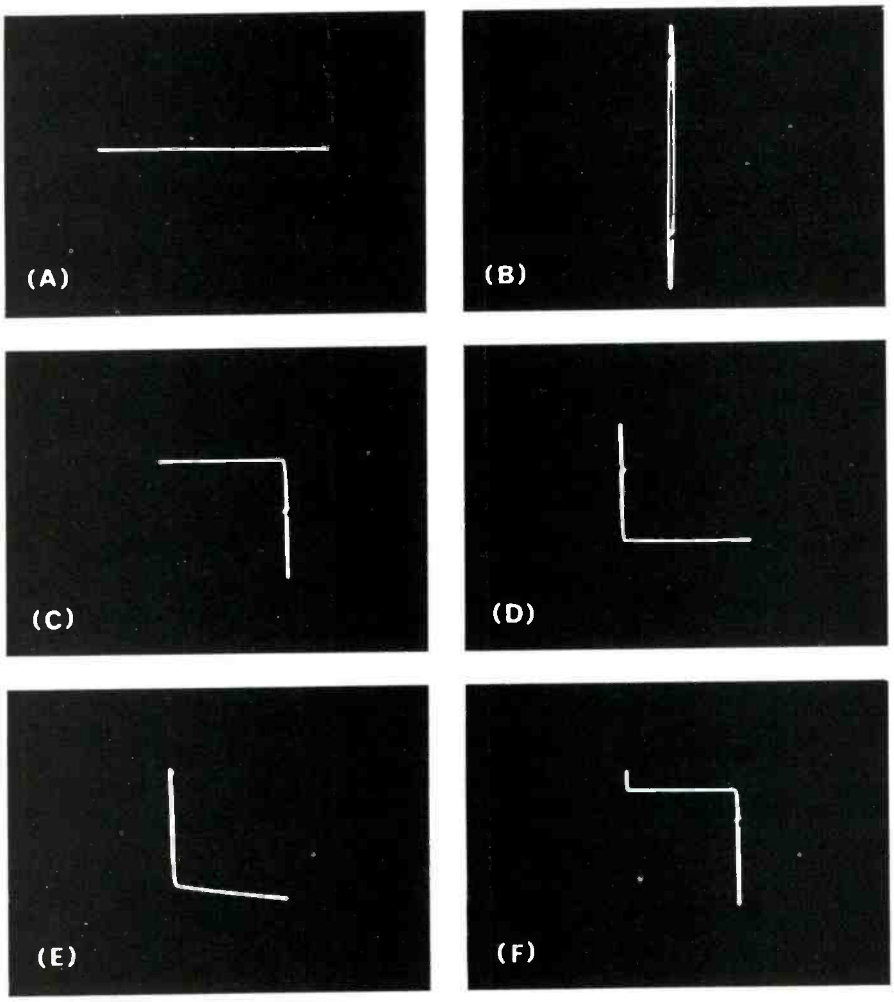


Fig. 4 Typical waveforms obtained using the transistor tester in Fig. 3. **(A)** Open junction **(B)** Shorted junction **(C)** Normal junction, ground lead to base, PNP transistor. **(D)** Normal junction, ground lead to base, NPN transistor. **(E)** Leakage is indicated out-of-circuit; in-circuit it could be caused by loading; NPN transistor. **(F)** Normal waveform for PNP transistor with low emitter-to-base avalanche voltage. Vertical segment at right indicates normal diode conduction; segment at left caused by avalanche mode of conduction.

reverse-voltage breakdown point (avalanche voltage) is less than the output of an ohmmeter, and an emitter-base short will be indicated.

A circuit diagram of a transistor testing device which recently has received a lot of attention is shown in Fig. 3. The operation is quite simple: For the moment, consider that R2 is open and R3 is a short (they serve only to attenuate the input to the scope).

During the half cycle when terminal 1 of the transformer is positive with respect to terminal 2, the cathode of the transistor junction is positive with respect to the anode, so no current flows. With no current flow, the voltage across R1 is zero and there is no vertical deflection of the scope. At the same time, all of the output voltage of the transformer is applied to the horizontal input of the scope, and a horizontal line is produced.

During the next half cycle, the transistor junction is forward biased, and the output of the transformer is developed across R1. (The voltage drop across the junction is small enough that it can be ignored.) The horizontal input to the scope is shunted by the junction, so a vertical line is produced on the scope. Since horizontal deflection is produced during one half-cycle and vertical deflection is produced during the next half-cycle, a right-angle waveform is produced.

If a junction is shorted, conduction will occur throughout the power cycle and only a vertical line will be produced on the scope. An open junction produces only a horizontal line. If there is leakage current through the junction, the horizontal part of the waveform will be inclined towards the vertical. A few sample waveforms are shown in Fig. 4.

A filament transformer or a doorbell transformer can be used for the transformer. If the output voltage is more than about six volts, a resistor (5 to 10K) should be connected in series with the primary of the transformer, to limit current through the transistor. The value of R3 depends on the transformer voltage and the horizontal sensitivity of the scope. It should be selected to allow full deflection without overdriving the horizontal amplifier; the value probably will be somewhere between 470K and about 2 megohms.

In practice, this instrument can be considered as an ohmmeter the battery polarity of which is switched sixty times per second. It may be used either in-circuit or out-of-circuit; however, it cannot discern between junction leakage and the currents which flow in the circuit surrounding the transistor. For example, a rectifier diode will appear shorted in-circuit because the impedance of the power-supply filter is practically a dead short to 60 Hz.

Next

In this article, the techniques of tube and component substitution and the testing of tubes and transistors have been discussed. While both of these techniques are relatively simple, there are procedures which will minimize mistakes and also allow quicker troubleshooting. More sophisticated servicing techniques will be discussed in subsequent articles in this series. □

productreport

Features and/or specifications listed are obtained from manufacturers' reports. For more information about any product listed, circle the associated number on the reader service card in this issue.

Speaker Grille Replacements

Product: Change-A-Grille kit
Manufacturer: Mellotone, Inc.
Function and/or Application: Acoustic grille replacements for TV and speakers
Features: Acoustic fabric grilles, premounted on perforated baffle board, can be cut to size with household shears and affixed with self-stick tape, which is included. The grilles are designed in bright acoustic fabric in decorative weaves to assure unobstructed, distortion-free passage of sound.

Specifications: N/A
Price: The Change-A-Grille sells for $4.95.

Circle 70 on literature card

Entertainment Semiconductors

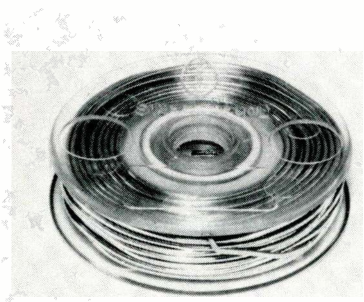
Product: Fifty-six of the most used entertainment semiconductors
Manufacturer: General Electric Tube Products Dept.
Function and/or Application: Self evident.
Features: The new packaging display provides space for product specifications and application information on the front of each display card. These semiconductors are available in skin-packages on perforated strips of five or ten.

Specifications: The skin-pack cards measure 3½ inches x 4¼ inches.
Price: Not available.

Circle 71 on literature card

Solder Spools

Product: Type SN60 resin core solder
Manufacturer: Edsyn, Inc.
Function and/or Application: Soldering of connections.
Features: Each spool contains approximately 35 feet of 1/32 inch diameter solder and comes packaged in clear plastic bags. The spools have been designed to snap into Edsyn's Idle-Rest soldering instrument holder or they may be placed over any peg for ease in unreeling the solder.

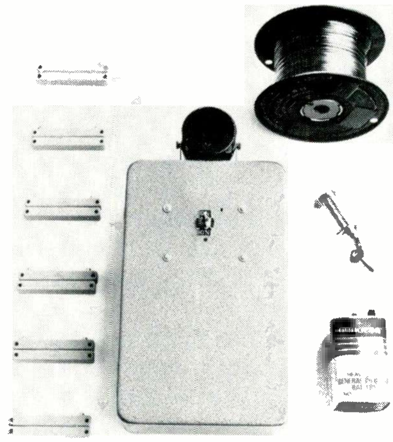


Specifications: Not available.
Price: Type SN60 sells for $1.00.

Circle 72 on literature card

Home Burglar Alarm

Product: MW-880 intrusion alarm kit
Manufacturer: Mountain West Alarm
Function and/or Application: Burglar alarm to protect against entry of intruders.
Features: All solid-state alarm control, a loud siren, magnetic contacts for protecting 6 doors and windows, a shunt lock to permit the owner to enter the premises, wire, a battery, and instructions are included in the alarm kit. Any cutting of the closed-circuit wire or entry of the protected openings will sound the alarm until turned off by the owner.
Specifications: The control circuit and battery are housed in a crinkle-finish box measuring 12 inches x 7½ inches x 3½ inches. Each MW-880 alarm kit includes complete application, installation and test instructions with a full set of professional alarm parts.



Price: The MW-880 intrusion alarm kit sells for less than $60.00.

Circle 73 on literature card

Tool for Multilayer Board Repair

Product: Model 4024 Grab'r hand tool.
Manufacturer: ETM Corp.
Function and/or Application: A tool to aid removal of defective transistor circuits from multilayer PC boards.
Features: Adjustable joint to maintain alignment and design features for access to densely packed boards. The Grab'r holds onto defective components until they are removed.
Specifications: O.D., .375; I.D., .323; cavity depth of .200. It can handle all standard transistor cans.
Price: The 4024 Grab'r sells for $33.50. □

Circle 74 on literature card

shoptalk

The sync separator

Theory of operation, component functions, common defects and proven troubleshooting techniques.

■The sync pulses required for synchronization of the vertical- and horizontal-sweep circuits in TV receivers are obtained from the video signal by sync separator circuits.

Because the sync pulses have a much higher amplitude than the video waveforms or the blanking pulses, all sync separators, regardless of brand or model of receiver, are designed to amplify only the parts of a video signal which have the highest amplitude, which normally are the sync pulses.

A sync separator also must function correctly even when the amplitude of the video signal is varying either excessively high or low. This requirement eliminates the possible use of a tube or diode which has a fixed, cutoff bias.

A Simple Sync Separator

A shunt-type, peak-reading rectifier circuit, such as the one in Fig. 1, fulfills the requirement of conducting only during the highest-amplitude portion of the video waveform, and it does so regardless of the exact amplitude of the video signal.

The waveform in Fig. 2 shows that the signal at the grid of the sync separator tube is clamped to the tips of the sync pulses by conduction of the diode. Therefore, the remainder of the waveform is negative-going. Because of the large amplitude of the negative signal, the grid of the tube is biased beyond cutoff, except during the times the sync tips force the grid to become slightly positive. Therefore, except when the sync tips are present, the sync separator tube is cut off.

The positive sync tips at the grid of the sync tube produce maximum plate current, which produces large negative-going pulses. During the intervals between pulses, the plate current is zero, and the plate voltage increases to the level of the supply voltage. The zero-voltage and average-plate-voltage lines in Fig. 3 should help clarify the voltages at the plate.

The Actions Of A Typical Sync Separator

The diode is not used in the sync separator circuitry of production designs of TV receivers. Both the functions of diode conduction and control of the plate current of the sync tube are performed by the grid-cathode circuit of the sync stage.

The schematic of a typical, tube-type, sync-separator circuit is shown in Fig. 4. Also included are average DC voltages and typical waveforms.

The function of each component in the sync separator circuit and common defects and related trouble symptoms are described in the following paragraphs.

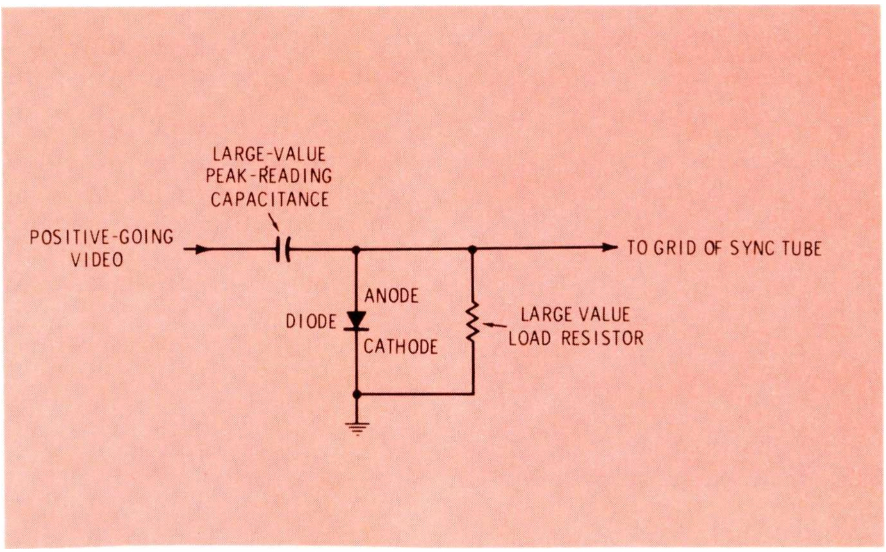


Fig. 1 The schematic of a shunt-type, peak-reading rectifier circuit, if followed by a direct-coupled sync amplifier tube, could function as a sync separator.

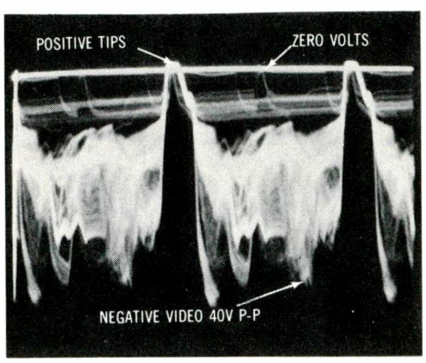


Fig. 2 The zero-voltage, or DC reference, line has been added to show the AC and DC voltages present at the grid of the sync tube. Only the tips of the sync pulses are positive; the remainder of the waveform is negative, and it biases the tube to cutoff.

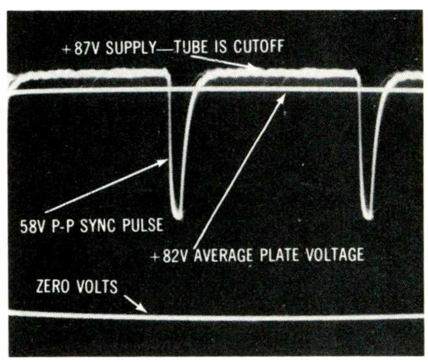


Fig. 3 Addition of the zero-voltage and average-plate-voltage lines show the relationships of those voltages to the supply voltage and to the amplitude of the pulses.

- **R76 (22K-ohm resistor) and R75 (39K-ohm resistor)**—These resistors perform several functions. They function as a voltage divider which 1) reduces the amount of video applied to the grid of the sync separator (notice the decreased amplitude of the video in W2 of Fig. 4 relative to that of W1) and 2) reduces the amplitude of the noise-cancellation signal (if any is developed) which is added to the video and subsequently applied to the grid of the sync tube. The resistors also function as decouplers which prevent excessive mixing of the video and the noise-cancellation signals.

Moderate deviations from the values specified for these resistors do not significantly affect the locking. An open R76 eliminates all noise-cancellation action, but the vertical and horizontal sync signals are increased. Values of R75 above about 100K produce weak vertical and horizontal locking.

- **C55 (.0033M-fd ceramic capacitor)**—This capacitor functions as a coupling capacitor, to channel the video signal to the grid circuit of the sync separator tube. Because the grid draws current when the tips of the sync pulses are present, the capacitor also functions as a peak-reading capacitance.

If the value of C55 is decreased to about .0001M fd, the vertical sync is decreased about 50 per cent, as shown in Fig. 5. Values between .001M fd and .1M fd produce virtually no change in either waveforms or locking when the signal level to the receiver is constant. If the level of the signal changes rapidly, as it does when an aircraft overflies the reception area, for example, values larger than .01M fd cause the picture to move sideways about ¼ inch with each increase or decrease of signal strength.

Leakage across C55 is a critical factor. A small leakage of 11M ohms across the capacitor produces severe horizontal bending

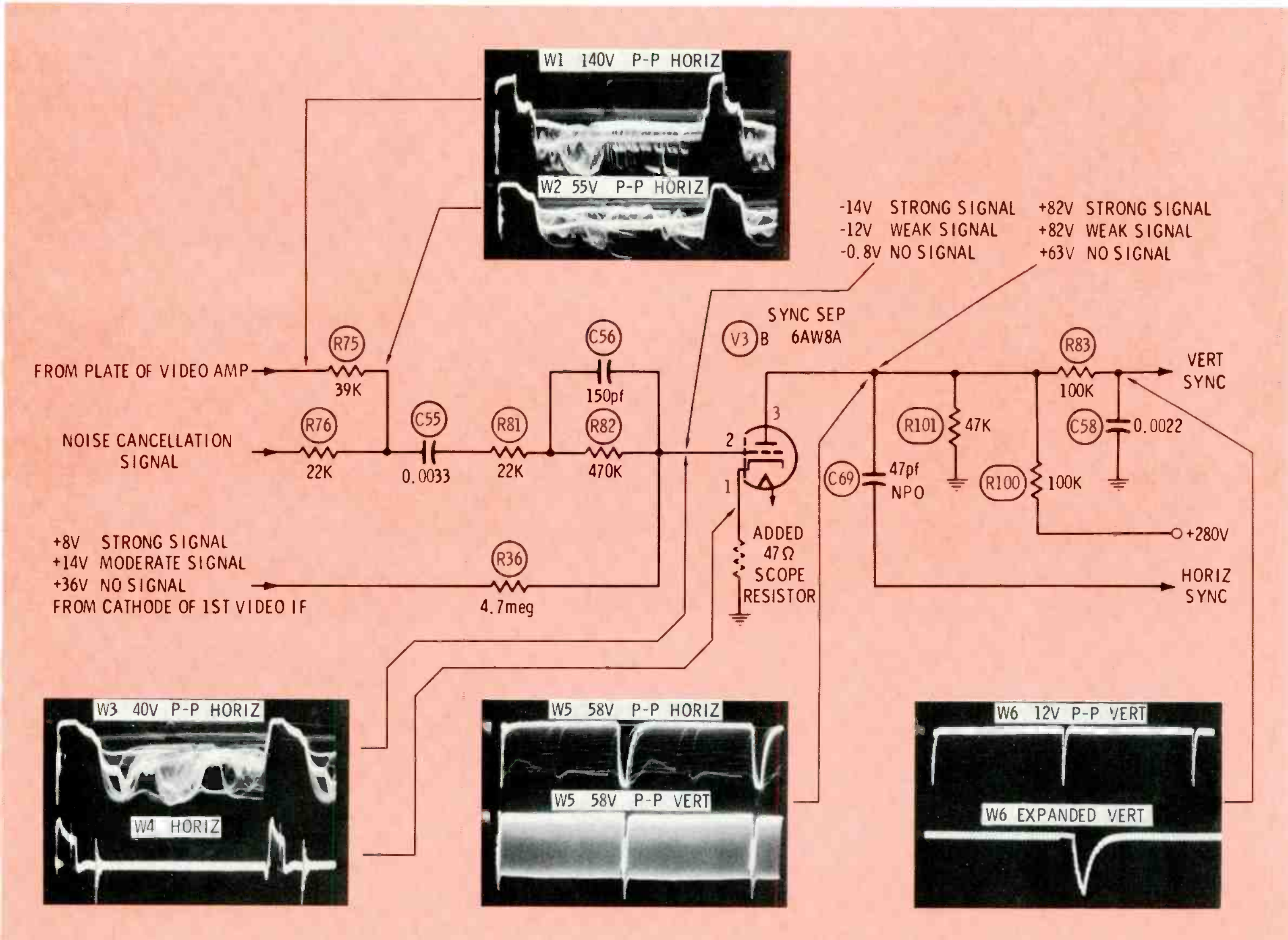


Fig. 4 The schematic of the sync separator circuit used in the Admiral 25D6 chassis (PHOTOFACT 540-1). This is the same chassis that was used in the RCA CTC10 and other models. Voltages and waveforms shown were taken from one chassis; however, they can be considered typical for similar circuits.

of the picture, and the vertical locks only with the blanking bar near the center of the picture. The symptoms produced by leakage of C55 are shown in Fig. 6. Note: 1) the excessive clipping of the sync tips at the grid of the sync separator tube; 2) the wide, distorted pulses at the plate, with video contamination between the pulses; and 3) the bending of the crosshatch pattern.

With the leakage of 11M ohms across C55, the DC voltage at the grid end of C55 was +8 volts, the voltage at the grid of the tube was −7 volts, and the plate voltage was +72 volts. Normally, the DC voltage at the grid is only about 1 volt more negative than the voltage at C55. This excessive change in the voltage drop across R82, added to the clipping of the sync tips at the grid, indicates leakage in C55, or a gassy tube.

- **R81 (22K-ohm resistor)**—This resistor also has several functions. It is a decoupling resistor, to prevent the stray capacitance of the sync separator stage from decreasing the high-frequency response of the video amplifier. If the resistances of R75 and R81 are reduced to zero, the picture on the screen of the CRT will be noticeably blurred.

R81 also increases the amplitude of the vertical sync at the plate of the sync tube. The waveforms in Fig. 7 show the change in vertical sync when R81 is normal and when it is shorted. (To prevent the larger vertical-sweep pulse from obscuring the sync pulse, the vertical tube was removed from the socket while the waveform in Fig. 7 was photographed.)

The tolerance of R81 is not critical. A short across it moves the picture about ¼ inch to the right and decreases the vertical sync about 25 per cent. A value of 220K ohms produced distorted separator plate pulses with ringing (Fig. 8). Values above 220K ohms eliminated all vertical and horizontal locking.

- **C56 (150 pf) and R82 (470K ohms)**—These two components comprise a series, high-pass filter which 1) corrects for the tilt of the vertical sync, 2) balances the amplitude of the equalizing pulses (see Fig. 9) and 3) also balances the amount of vertical sync relative to the amount of horizontal sync at the output of the separator.

The tolerance of these components is not very critical. However, a short across them does increase slightly the amplitude of the vertical sync, as shown in Fig. 7.

- **R36 (4.7M-ohm resistor)**—R36 functions as the load of the peak-reading rectifier circuit at the grid of the sync separator tube. The time constant of R36 and C55 determines how much of the tips of the sync pulses will cause tube conduction. In other words, a short time constant (low value of R36) produces excessive conduction of the separator tube, which also might clip some of the video, causing horizontal bending of the picture. A long time constant (increased value of R36) produces conduction during only the extreme tip of the sync pulse. Such "shallow" conduction might cause a loss of sync during rapid changes in the level of the video. Fig. 10 shows the various amounts of conduction produced by three different time constants.

R36 returns, not to ground, but to a source of voltage which becomes more positive during reception of weak stations. This gives the effect of a shorter time constant and produces increased conduction of the sync separator tube, which, in turn, produces better sync clipping of weak signals.

Increasing the value of R36 to about 10M ohms produces more negative voltage at the grid. However, the amplitude and waveshape of the sync pulses at the plate do not change significantly. An open R36 eliminates all sync. Values of resistance below about 560K cause horizontal bending of the picture on the screen of the CRT and video contamination of the sync pulses at the plate of the sync tube, as shown in Fig. 11.

- **6AW8A (triode section)**—

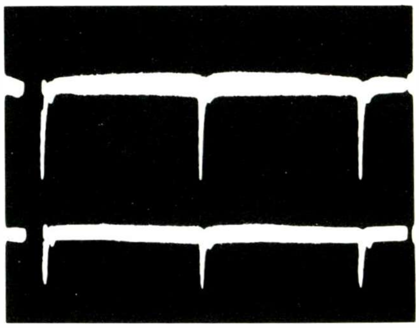
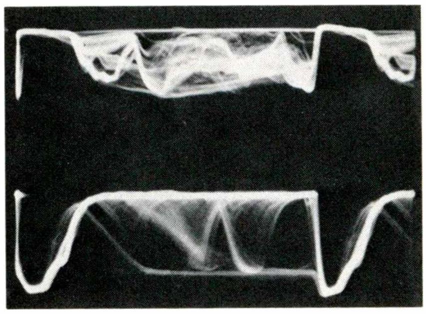


Fig. 5 When C55 was changed to a value of .0001M fd, the amplitude of the vertical sync decreased about 50 per cent. This waveform was obtained at C58, with the grid of the vertical-output tube grounded and the scope sweep operated at about 30 Hz.



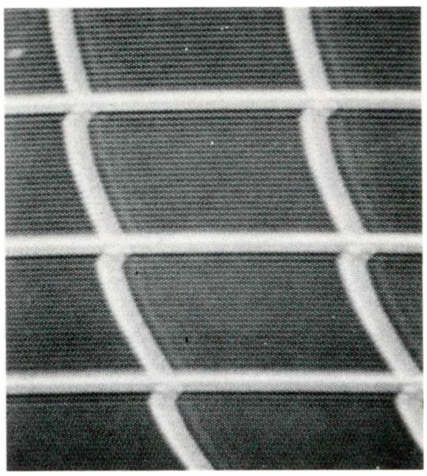


Fig. 6 These symptoms were produced when C55 had a leakage of 11M ohms. **(A)** The waveform at the top shows the sync pulse at the grid of the sync tube is clipped. The waveform at the bottom shows the distorted pulses and the video at the plate of the sync tube. **(B)** Erratic horizontal bending and marginal locking were the symptoms on the screen of the picture tube.

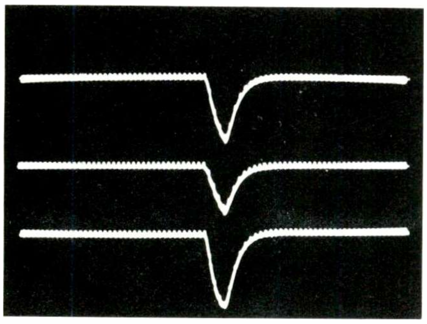


Fig. 7 The vertical sync waveform at the top is normal, for comparison. When R81 was shorted, the sync amplitude was reduced, as shown in the center waveform. When C56 was shorted, the sync amplitude, as shown in the bottom waveform, increased above normal.

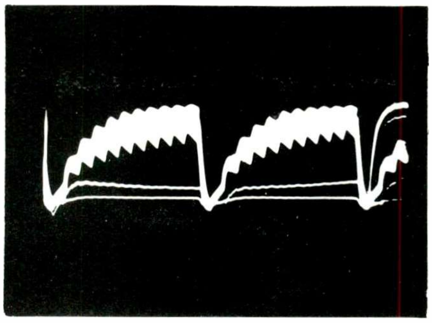


Fig. 8 This distorted waveform was obtained at the plate of the sync tube when R81 was 220K ohms.

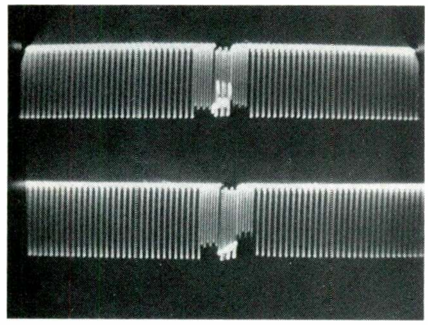


Fig. 9 To obtain these waveforms, the scope was operated at about 60 Hz, the sweep was widened 5X, and the scope was connected to the plate of the sync separator tube. The waveform at the top was produced by normal values of C56 and R82. As shown in the bottom waveform, a shorted C56 tilted the sync pulses and caused a decrease of the amplitude of the equalizing pulses, which follow the sync pulses.

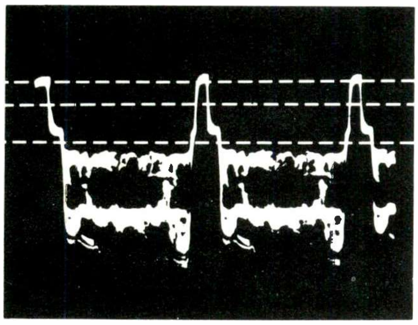


Fig. 10 The top dotted line shows the amount of tube conduction of the tips of the sync pulses when the time constant of C55 and R36 is too long. A slight change in the amplitude of the video signal might cause a temporary loss of sync. Normal conduction is shown by the center dotted line, and conduction produced by a time constant which is too short is shown by the bottom dotted line. Video or the corners of the blanking pulses might cause conduction and picture bending.

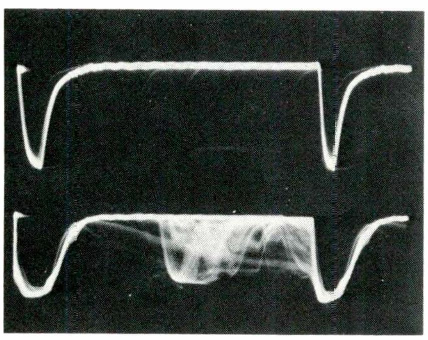


Fig. 11 The top waveform is a normal one for the plate of the sync separator tube. The bottom waveform shows the distorted sync pulses and the video present at the plate of the sync separator tube when the value of R36 was 100K. Bending of the picture was caused by the video mixed with the sync pulses.

Emission of the sync separator tube can gradually decrease; the result is weak sync and soft locking of both the vertical and horizontal sweep circuits. The separator tube also can become gassy and cause horizontal bending (same symptoms as caused by leakage in C55), or a heater-to-cathode short in the tube can cause a loss of vertical sync (and a temporary vertical roll) about once every 17 seconds.

- **C69 (47p-fd, zero-temperature-coefficient, ceramic capacitor)**—This capacitor differentiates the sync pulses and couples them to the phase detector of the horizontal oscillator.
- **R100 (100K ohm resistor) and R101 (47K-ohm resistor)**—These two resistors determine the amount of plate voltage of the sync separator tube, and, in turn, the plate voltage determines the amplitude of the sync pulses at the plate of the sync separator tube.

The voltage at the plate of any pulse amplifier which is operated with saturated plate current increases to the supply voltage between pulses. In this case, R100 and R101, acting as a voltage divider, determine the "supply" voltage by clamping the maximum plate voltage between pulses to about +87 volts. Even if the tip of the pulse dipped to zero volts (which it does not), the maximum pulse voltage at the plate would be 87 volts p-p.

If the supply voltage is increased, both the average plate voltage and the amplitude of the pulses increase. For example, if R101 is open, the maximum plate voltage between pulses is 280 volts, and the pulse increases to 180 volts from the normal 60 volts p-p. No deterioration of the performance is noted. However, the dissipation of the tube probably would be excessive if no station is received. The value of R101 can be increased up to 100K ohms to provide extra sync for a receiver which is operating with marginal vertical and horizontal locking.

If the supply voltage is decreased, both the average plate voltage and the amplitude of the pulses decrease. For example, if R100 increases to 330K ohms, the pulse decreases to only 35 volts p-p and the locking becomes marginal.

In a sync separator stage which is operating normally a change in the amplitude of the video signal—because of AGC adjustments, aircraft flutter, or station scene changes—does not change the amplitude of the sync pulses at the plate of the sync separator tube. There are two reasons for this: 1) The diode action of the grid of the tube follows the amplitude of the video, and 2) the plate current is operated beyond saturation. Consequently, the amplitude of the sync pulses produced by a normally-operating sync separator stage is relatively constant.

- **R83 (100K-ohm resistor) and C58 (.0022M-fd capacitor)**—

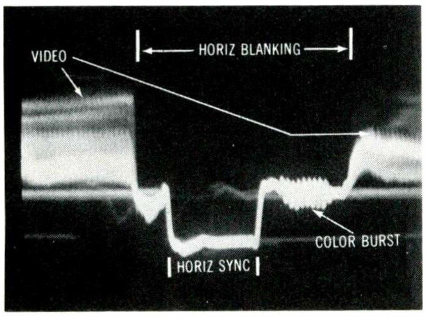
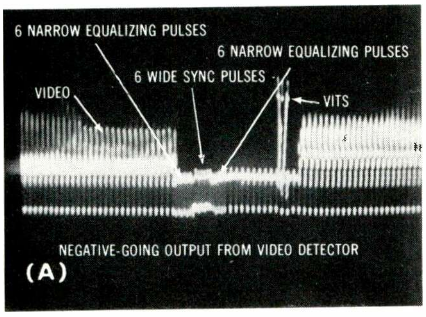


Fig. 12 This composite video waveform, obtained from the video detector, has been locked at 60 Hz and widened for clarity.



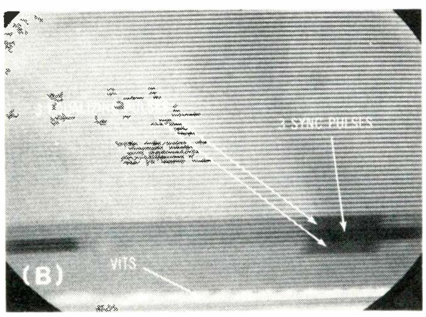


Fig. 13 Vertical equalizing pulses and sync pulses can be seen in a scope waveform or on the screen of the picture tube. **(A)** This waveform is the same as that in Fig. 12, except the scope is locked at 60 Hz. **(B)** The same vertical equalizing and sync pulses can be seen on the screen of a picture tube, when the picture is rolled downward. A method of visually analyzing the "hammer" is given in the text. An apparent difference is shown by these two pictures. The equalizing and sync pulses are in groups of three in the hammer, but the scope waveform shows them in groups of six. There are really two hammers, one for each interlaced vertical field; however, one cannot be seen on this CRT because it occurs during horizontal retrace. The scope waveform shows the pulses of both fields. Because of the phase difference between the two interlaced vertical fields, there appears to be twice as many pulses in them as there are ordinary pulses during an equal amount of time. This distinction is important in understanding the symptoms produced by certain defects.

These two components are the first section of the vertical integrator circuit. To produce a vertical sync pulse with maximum amplitude, a certain time constant is necessary. A shorter time constant does not filter enough, and a longer time constant excessively reduces the amplitude.

Increased resistance of R83 (or R84, the second integrator resistor not shown in this schematic) produces decreased vertical sync and "softer" vertical locking. Horizontal locking is not affected. If "firmer" vertical locking is desired, R83 can be changed to 47K ohms. If a lower value is required, check the associated circuitry for a defect, which is reducing the vertical sync.

Vertical Sync Is A Variation Of The Width Of The Horizontal Sync Pulses

The various elements which together are the composite video waveform are shown in Fig. 12 as they appear on the screen of a scope which is locked to the horizontal scanning frequency. For increased clarity, the waveform has been widened by the 5X-sweep feature of a triggered-sweep scope.

The appearances and characteristics of the vertical blanking and sync pulses, shown in Fig. 13, are less familiar. The scope waveform (Fig. 13A) and the picture of the "hammer" from the screen of the CRT (Fig. 13B) help explain how vertical sync is broadcast.

The narrow equalizing pulses and the wide sync pulses can be seen at the plate of the sync tube, as shown in Fig. 14A. Integration of these narrow and wide pulses by R83 and C58, the first integrating filter, produces the waveform shown in Fig. 14B.

Because the equalizing pulses are so narrow relative to the rate of repetition, C58 charges during the pulse time, then discharges to zero before the arrival of the next narrow pulse. Therefore, there is no charge on C58 when the sync pulses begin.

The first of the wider horizontal sync pulses, which are used for vertical sync, produces a voltage charge on C58, and the period of time before the arrival of the next pulse is so short that C58 discharges very little. Therefore, each wide pulse increases, in a series of small steps, the charge in C58 until it becomes a vertical-frequency pulse of sufficient amplitude to trigger the vertical oscillator.

The equalizing pulses, which follow the wide sync pulses, are so narrow that the charge in C58 discharges to less than the charge from the previous pulse before the next narrow pulse arrives. Therefore, the charge in C58 decreases in a series of small steps, until the voltage is zero, when the first "normal" horizontal sync pulses arrive.

The narrow equalizing pulses, which are used also to keep the horizontal oscillator on frequency during the time of vertical blanking, help to narrow the vertical sync pulse and sharpen the leading and trailing edges.

Analysis Of Vertical Sync In The Picture

In many cases, it is difficult for a technician to immediately determine if a defect which is causing poor locking is degrading the video signal supplied to the sync separator or whether the defect is in the sync separator circuit. A fast and relatively accurate evaluation of both the vertical and horizontal sync pulses in the video signal is to examine visually the "hammer" which is produced on the screen of the picture tube by the equalizing and vertical sync pulses.

To observe this hammer, slowly roll the picture downward by use of the vertical hold control, then decrease the contrast and increase the brightness level until the hammer is distinct.

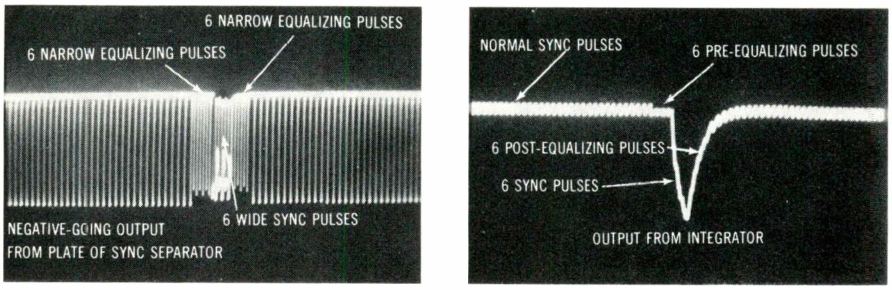
Although the appearance of the hammer changes from one station signal to another, after some experience in evaluating hammers a technician can determine quickly whether or not both the horizontal and the vertical sync pulses are present in the video signal.

Although the hammers shown in Fig. 13B and Fig. 15 are slightly different, both are normal. The hammers should be more black than the vertical blanking area or any other portion of the picture. If the hammer is about the same shade of gray as the remainder of the picture, compression of the "black" polarity of the video signal is indicated.

Symptoms of an open AGC bypass capacitor

The hammer in Fig. 16A reveals that the amplitude of the sync pulses is decreased. Accompanying symptoms were picture bending, and the right side of the picture was lighter than the left side. Although the picture exhibited bending, the horizontal locking was relatively solid. However, locking of the vertical was marginal.

All of these symptoms were produced by an open AGC by-



(A) (B)

Fig. 14 The wide horizontal pulses from the plate circuit of the sync separator tube can be integrated by the time constant of R83 and C58. **(A)** This waveform of the sync pulses at the plate of the sync separator tube shows the narrow equalizing pulses and wide sync pulses for both interlaced vertical fields. **(B)** After integration by R83 and C58, the sync pulses build up the voltage (downward on the scope), and the equalizing pulses restore the voltage to zero again. Thus, a vertical pulse is produced by integrating horizontal pulses of different widths.

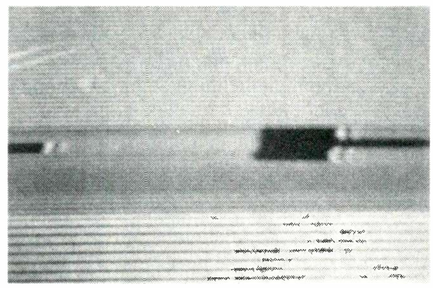


Fig. 15 This vertical sync hammer is normal. The equalizing and sync pulses are blacker than the blanking bar or picture. (The ringing is caused by a rabbit-ear antenna.)

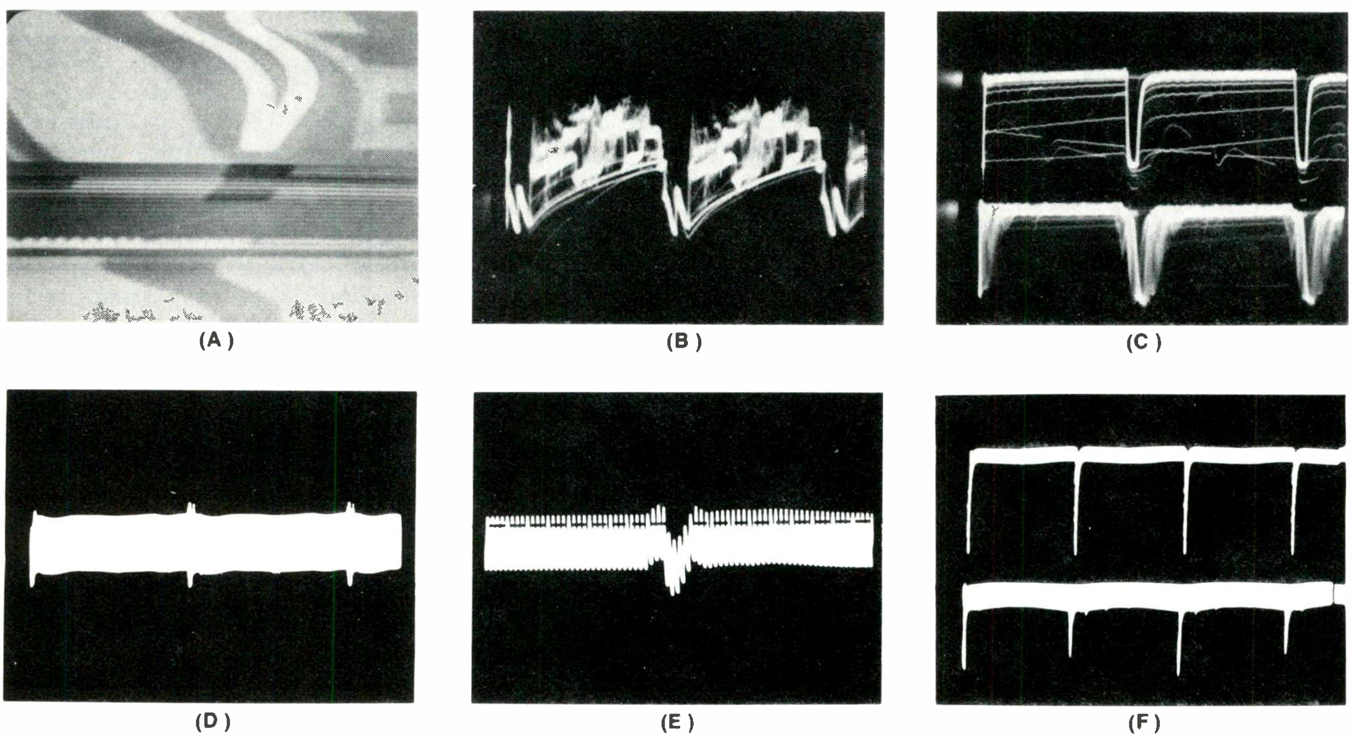
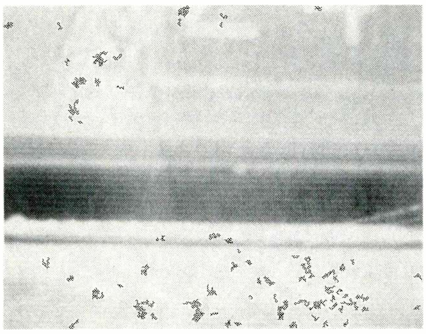
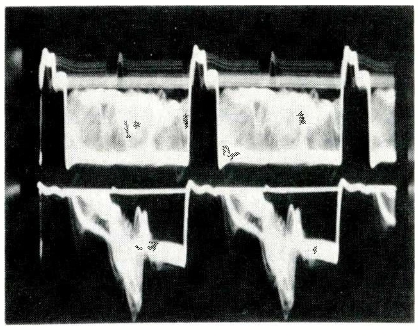


Fig. 16 Symptoms and waveforms produced by an open AGC capacitor. **(A)** Picture bending, and a hammer with decreased amplitude of the sync lines are shown in this closeup from the screen of the picture tube. **(B)** The waveform at the video detector, locked at 7867 Hz. **(C)** A comparison of the normal pulses at the plate of the sync separator relative to the strong, but contaminated, sync pulses shown below. The scope was locked to 7867 Hz. **(D)** This waveform appeared at the AGC voltage supply for the IF tube when the scope was locked to 30 Hz. **(E)** This waveform is the same as **D**, except the sweep has been widened and the zero-voltage line added. **(F)** Sync pulses for the first vertical interlaced scanning field are decreased more than the ones for the second field, as shown in bottom trace. Scope is locked to 15 Hz.





(A) (B)

Fig. 17 "Black" compression can eliminate the sync pulses. **(A)** This hammer is no blacker than the vertical blanking area; an indication of black compression. **(B)** A normal video waveform (upper trace), compared to a video waveform (bottom trace) which has the sync pulses clipped.

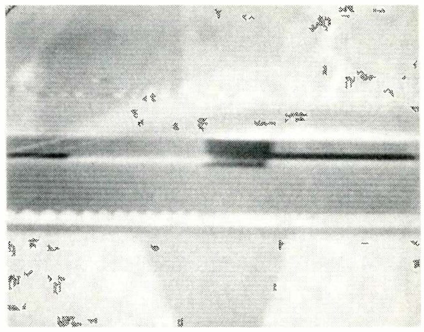


Fig. 18 This white line in a hammer does not necessarily indicate a defect in the TV receiver. See the text for an explanation.

pass capacitor (C13 in an RCA CTC10). To prove that such a defect exists, bridge a .1M-fd capacitor across the terminals of the AGC bypass capacitor.

The waveforms in Fig. 16B, obtained from the video detector, revealed pronounced "sloping" of the video portion of the signal. This caused the right edge of the picture to be lighter and have less contrast than the left. Fig. 16B also revealed a notch in the center of the sync pulse. The output from the sync separator, viewed at a horizontal sweep rate, and shown in Fig. 16C along with a normal waveform, revealed strong pulses with a significant amount of video contamination. The contamination caused the horizontal bending.

The waveforms in Figs. 16A, B and C only verified the symptoms already observed from the screen of the picture tube. Next, the scope was connected to the AGC supply for the IF tube and locked to just below 30 Hz, to produce two complete vertical fields. The 4-volt p-p waveform shown in Fig. 16D was found at that point, where virtually no AC should be. Most of the waveform obviously was part of the horizontal signal from the plate of the AGC tube, which was not filtered out because of the open capacitor. However, there was no obvious explanation for the small pulses which seemed to occur for every frame of the vertical frequency.

To make these pulses more visible, the waveform was locked at 60 Hz, to provide just one frame, and the scope sweep was widened by 5X. The resultant waveform, shown in Fig. 16E, was composed of the expected horizontal-frequency sawteeth (integrated pulses) but with unexpected, periodic up-and-down undulations.

Because the scope was operated in the DC mode, the probe was removed from contact with the circuit, to locate on the screen of the scope the zero-voltage, or DC reference line, shown dotted in Fig. 16E. The periodic undulations began to be understandable at this point. Because the horizontal sawteeth were DC oriented, they were in effect an AC AGC voltage. The gain of the IF tube was being varied by each individual horizontal sawtooth. This explained the notch missing from the sync pulse in Fig. 16B—the sawtooth AGC was reducing the IF gain at that point.

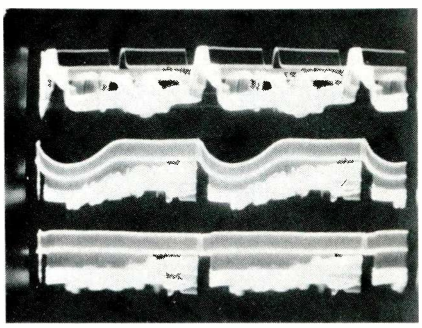


Fig. 19 Scope waveforms of video and sync signals are usually most informative when viewed with the sweep of the scope locked to 7867 Hz, to produce two horizontal fields. If the horizontal lines in the waveform are too thick, as shown in the upper trace, hum might be present. The scope should be locked to 30 Hz to check for hum, such as shown in the center trace. A normal video waveform locked at 30 Hz is shown in the bottom trace.

These facts partially explain why two of the three vertical sync lines shown in Fig. 16A are weakened, but it does not explain why the third was not. One other factor was yet to be discovered and explained.

When the scope was connected to the integrating capacitor, C58 in Fig. 4, and locked at just below 15 Hz, to produce four waveforms, the sync pulses were only about one-third of the normal amplitude, as shown in Fig. 16F. Even less amplitude was exhibited for alternate sync pulses. (Reduction of the amplitude of alternate sync pulses sometimes causes vertical shimmy, because the vertical locks on the stronger pulse and attempts to roll during the weak one.)

The reason for the decrease of the amplitude of alternate vertical sync pulses can be found in the nature of the interlaced vertical fields. The equalizing and sync pulses for the second interlaced field occur just one-half horizontal scanning line later (center of the picture) than those of the first field. Because no horizontal pulses occur at that time, the vertical sync for that field is not reduced so much as the other. In this case, because the AGC was composed of horizontal sawteeth instead of a well filtered DC, there was a larger gain reduction during the first interlaced field than during the second.

Open filter capacitors

Occasionally, an open filter capacitor will permit horizontal pulses to enter the video or AGC circuits. Many of the symptoms will be similar to those produced by an open AGC bypass capacitor. Check each terminal of the filter capacitors, especially the multiple-section cans, for waveforms with excessive amplitudes. The terminal of the open section usually produces horizontal pulses with amplitudes higher than those of pulses at other terminals.

"Black" compression

Overload or clipping in a video amplifier stage can remove most of the horizontal sync pulse but not affect the video signal. The picture might appear to be normal, but have little or no vertical or horizontal locking. If so, the hammer on the screen of the picture tube will be no blacker than the blanking bar or other portions of the picture. An example is shown in Fig. 17A.

The waveform of the video signal will reveal the clipped sync pulses, as shown in Fig. 17B. By observing the input and the output signal of each video stage, the one in which the defect exists should not be difficult to find. If the video signal is clipped, substituting components in the sync separator will not restore the locking.

If the video signal is normal, but the waveform at the grid of the sync separator is compressed, the defect is in the sync separator circuit.

White lines in otherwise normal hammers

The white line which is located where the last sync line should be in the hammer in Fig. 18 does not indicate a defect in the video signal. Such lines are common with some models or receivers; don't allow them to deceive you. Apparently, it is a narrow foldover which can occur when the vertical is not locked. Compare the appearance of this line with the greyed-out sync lines shown in Fig. 16A. The white line usually can not be seen when the hammer is near the top of the screen, but it becomes more noticeable the closer it gets to the bottom.

Sync Defects Which Originate Outside The Separator

Because the paths of the horizontal and vertical sync signals divide at the plate of the sync separator, defects which occur after that point usually affect only the vertical or the horizontal locking, not both. If the locking of one sweep circuit is entirely normal, but the locking of the other is abnormal, check the related circuits which follow the plate of the sync separator tube.

There are a few exceptions to the preceding general rule. In many models of TV receivers, an open AGC capacitor eliminates or weakens the vertical locking, but does not greatly weaken the horizontal locking. Auxiliary tests are recommended in these cases.

In other cases, poor horizontal locking can produce a large signal on the AGC line, and, in turn, can weaken vertical locking.

Hum

The troubleshooting methods recommended in this article involve waveform analysis. In most cases, the scope should be locked to 7867 Hz, which shows two complete horizontal fields on the screen.

If the tips of the sync pulses are too thick, as shown in Fig. 19, switch over to 30-Hz locking of the scope, to check for the possibility of hum. A normal 30-Hz waveform is shown in the lower trace for comparison.

Hum in the video signal, or in the sync separator circuit, can cause a loss of vertical locking every 17 seconds. □

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101. *Blonder-Tongue, Inc.*—announces a booklet presenting the basic facts necessary to understand MATV systems. A Glossary of Terms is included for further understanding.

102. *Gavin Electronics, Inc.*—has introduced new full-color literature for its Colorfinder outdoor color TV antenna line. The 6-page brochure describes all seven Gavin Colorfinder models. Featured are antennas with a reception range from metro to deep fringe.

103. *Jerrold Electronics Corp.*—Catalog S, titled "Systems and Products for TV Distribution," lists specifications of this manufacturer's complete line of antenna distribution products, including antennas and accessories, head-end equipment, distribution equipment and components, and installation aids.

104. *Union Metal Manufacturing Co.*—announces a new 8-page catalog that illustrates self-supporting antenna poles up to 250 feet in height, design information for 25 foot through 200 foot poles, pole accessories, foundation specifications and erection information.

AUDIO

105. *Arista Enterprises, Inc.*—announces their 58-page needle and cartridge catalog. The needle cross reference reportedly has up-to-date cross references of all major needle marketers, in addition to cross reference sections of phonograph manufacturers' needle and cartridge numbers.

106. *GC Electronics*—an updated line of exact replacement rubber drives and belts is detailed in the new Walsco cross-reference catalog. Included are a variety of phono and recorder drive wheels and pulleys, pinch rollers, round rubber belts, square cross-section rubber belts, spring belts and fabric drive belts, felt pressure pads, phono mounting "E" and "C" clips in an assortment kit, motor mounting grommets, changer switches, and a kit of assorted phono drives and belts.

107. *G-V Controls*—Bulletin No. 4007 announces specifications, applications, line drawings, photographs and ordering information for the self dialing "hot-line" telephone unit.

108. *Jensen Manufacturing Div.*—has issued an 8-page catalog, No. 1090-E, which describes applications of 167 individual speaker models. Special automotive, communications, intercom and weathermaster speakers, plus a complete line of electronic musical instrument loudspeakers are featured.

109. *Mellotone, Inc.*—introduces a new catalog featuring CHANGE-A-GRILLE self-stick acoustic fabric for speaker grilles. Swatches of six basic patterns are attached to the catalog showing fabric styles and colors.

110. *Nortronics*—a new publication, "Recording Equipment Maintenance Manual" describes factors that make regular maintenance important. Also, product-by-product catalog section on QM-SERIES accessories.

AUTO ELECTRONICS

111. *Littelfuse, Inc.*—has released a new 32-page, 1971 automotive replacement fuse guide for passenger autos, sports cars, trucks, and taxi cabs. Fuse descriptions and circuits they protect are included.

112. *Nortronics Co., Inc.*—announces a revised brochure describing the Model 5800 replacement head for a reported 90 per cent of all 8-track auto and home stereo players. A listing of players is offered by more than 70 different manufacturers in terms of model number or head part number.

CAPACITORS

113. *Cornell-Dubilier Electronics*—has issued an 80-page cross-reference, 1972 catalog for location of single, dual, triple, and quadruple section replacement electrolytics.

114. *Loral Distributor Products*—has made available a 24-page electrolytic capacitor replacement guide. The catalog features replacement products by the original manufacturers part number.

115. *Sprague Products Co.*—has announced a 40-page manual which lists original part numbers for each manufacturer, followed by ratings, recommended Sprague capacitor replacements, and list prices. More than 2,500 electrolytic capacitors are included.

COMPONENTS

116. *Essex International, Inc.*—the new 64-page Color and Monochrome Television Parts Replacement Guide lists over 500 Stancor transformer and deflection components for 200 television manufacturers. A reported 14,000 replacements for original parts are available.

117. *P. R. Mallory & Co., Inc.*—introduces a 64-page general catalog containing approximately 10,000 items. Included in the catalog are batteries, capacitors, controls, resistors, semiconductors, switchers, and timers plus security systems, cassette recorders and cassette recording tapes.

118. *Precision Tuner Service*—announces a new tuner

parts catalog, including a cross reference list of antenna coils and shafts for all makes of tuners.

119. *Workman Electronic Products, Inc.*—has released a 68-page 1972 catalog of replacement components for radio and television. Included are resistors, fusing devices, circuit breakers, sockets, convergence controls, electronic chemicals, audio cables, adapters for hi-fi and cassette type recorders battery holders and prototype kit components.

KITS

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PICTURE TUBES

121. *General Electric*—introduces a new 24-page guide to GE ULTRACOLOR(TM) (ETRO 5373-A) and monochrome television picture tubes. Information pertaining to light transmittance figures and spot cutoff listings for G1 and G2 voltages are also included.

SECURITY ELECTRONICS

122. *Mountain West Alarm Supply Co.*—a 64-page catalog describes and offers over 350 intrusion and fire alarm products. Six-pages of Application Notes for alarm equipment also is included.

SEMICONDUCTORS

123. *Electronic Devices, Inc.*—announces a 4-page catalog on solid-state replacement and renewal parts for color TV receivers including solid-tubes, cartridges and multipliers. Solid-state solid-tube high-voltage rectifiers, focus rectifiers and damper diodes, silicon and selenium focus cartridges, diagrams showing dimensional drawings and socket connections for solid-tube solid-state replacements of vacuum tubes with maximum ratings for pulse rectifier service is also included.

124. *GTE Sylvania, Inc.*—introduces a 73-page illustrated catalog which provides information for more than 41,000 semiconductor devices, and outline drawings of the 124 components in the ECG semiconductor line. A complete alphanumeric cross-reference by type number is contained in the guide.

125. *RCA Distributor Products*—introduces a 96-page "SK Series Top-Of-The-Line Replacement Guide" (SPG-202M) which cross-references over 46,000 semiconductor device numbers. In addition a Solid-State Quick Selection Replacement Chart (1L1367A) listing entertainment SK-Series devices is included.

126. *Sylvania Electric Products, Inc.*—a 73-page guide which provides replacement considerations, specifications and drawings of Sylvania semiconductor devices plus a listing of over 35,000 JEDEC types and manufacturers' part numbers.

SERVICE AIDS

127. *Chemtronics*—announces a new 12-page, 1971-1972 catalog of products, including: tuner sprays, circuit coolers, insulating sprays, contact and control sprays, lubricants, tape head cleaners and conditioners, electronic glues and cements, solder, and spray paints.

SOLID-STATE

128. *Electronic Devices, Inc.*—offers a replacement guide on tubes and parts replaced by the EDI solid-state replacement components for color TV.

129. *International Rectifier*—64-page volume, JD-451, has been revised and lists information on diodes, zeners, capacitors, rectifiers and SCR's. There are a reported 4000 new transistor listings. Specifications, characteristics, tables and wall charts are also included.

TECHNICAL PUBLICATIONS

130. *Howard W. Sams & Co., Inc.*—announces publication of a new 96-page 1972 Technical and Scientific Book Catalog. Described are over 800 hardbound and softbound books which cover "do-it-yourself" titles from the Audel Division, amateur radio publications, audio visual materials, instructor's guides and student workbooks. Titles range from "ABC's of Air Conditioning" to Writer's and Editor's Technical Stylebook".

131. *Sencore, Inc.*—Speed Aligner Workshop Manual, Form No. 576P, provides 20 pages of detailed, step-by-step procedures for operation and application for Sencore Model SM 158 Speed Aligner sweep-marker generator.

132. *Sylvania Electric Products, Inc., Sylvania Electronic Components Div.*—has published the 14th edition of their technical manual, which includes mechanical and electrical ratings for receiving tubes, television picture tubes and solid-state devices.

133. *Tab Books*—has released their Spring 1972 catalog describing over 170 current and forthcoming books. The 20-page catalog covers: schematic/servicing manuals, broadcasting; basic technology; CATV; electric motors; electronic engineering; computer technology; reference; television, radio and electronics servicing; audio and hi-fi stereo; hobby and experiment; amateur radio; test instruments; appliance repair, and transistor technology.

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134. *Dynascan Corp.*–announces a new 24-page 2-color catalog of B&K Precision Test Equipment. A total of 21 instruments are reportedly presented; from a Mutual Conductance Tube Tester to a new DC to 10 MHz Triggered Sweep Oscilloscope.

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The cost? A bargain either way. Photofact-of-the-Month Club members pay just $13.50 a month—a $56.00 a year saving for the entire service package. And if you need a Photofact on Rip Van Winkle, above, the price is only $3.

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135. *Eico*—has released a 32-page, 1972 catalog which features 12 new products in their test equipment line, plus a 7-page listing of authorized Eico dealers.

136. *Hickok*—has published a 4-page brochure, "Hickok Oscilloscopes," which contains descriptions, specifications and prices for Models 5000A and 5002A oscilloscopes.

137. *Information Terminals*—has introduced a new brochure featuring the M-100 Tension Monitor, the M-200 Torque Tester and the M-300 Head and Guide Gage.

138. *Leader Instruments Corp.*—announces the 1972 Catalog of Leader Test Equipment. Test equipment included is the LBO-301 portable triggered-eweep oscilloscope, LSW-300 new solid-state post injection sweep/marker generator, and the LCG-384 miniportable, solid-state battery operated color-bar generator.

139. *Lectrotech, Inc.*—announces the 1972 catalog. "Precision Test Instruments for the Professional Technician". It contains specifications and prices on sweep marker generator, oscilloscopes, vectorscopes, color bar generators and other test equipment.

140. *Mercury Electronics Corp.*—14-page catalog provides technical specifications and prices of this manufacturers' line of Mercury and Jackson test equipment, self-service tube testers, testers, test equipment kits and indoor TV antennas.

141. *Pomona Electronics*—announces their new 60-page 1972 general catalog of electronic test accessories. The catalog provides illustrations and complete engineering information on all products, including dimension drawings, schematics, specifications, features, and operating ranges.

142. *Tektronix, Inc.*—introduces a 76-page "New Products" catalog. Products listed are: automated test systems, computer display terminals, machine control products, and TV test instruments and monitors.

143. *Testline Instruments*—has issued a brochure for their new Model 101 Curve Tracer for checking transistors in- and out-of-circuit. All features, specifications, applications and warranty information are included.

144. *Triplett Corp.*—a 4-page, illustrated, 2-color brochure featuring a new battery-operated, portable Model 603 FET VOM has been introduced. Application data and specifications are included.

145. *Triplett Corp.*—announces a 2-page, 2-color data sheet for Model 6028, a 2¾ digit VOM. Data sheet gives DC volts, AC volts, ohms AC and DC current ranges plus construction information, price and accessories.

146. *Speco Components Specialists, Inc.*—announces their 43-page, 1972 catalog of VOM multitesters and meters for TV technicians. Individual features and specifications for each instrument are included.

TOOLS

147. *Jensen Tools and Alloys*—has announced a new catalog No. 470, "Tools for Electronic Assembly and Precision Mechanics." The 72-page handbook-size catalog contains over 1,700 individually available items.

148. *Plato Products, Inc.*—introduces a 28-page, 2-color soldering tip catalog, No. 0372. Illustrated with dimensioned drawings to facilitate accurate selection, the new catalog features tips to fit leading brands and models of soldering irons.

149. *Upson Tools, Inc.*—Catalog No. 72 contains many new service kits. and metric tools. The complete line of 4-in-1 tools offers 16 combinations of double-ended screwdrivers and a variety of nutdrivers.

150. *Vaco Products Co.*—has issued a 12-page price schedule for all Vaco tools. Stock number, description, and list price on each item is given.

151. *Xcelite, Inc.*—Bulletin N770 describes this company's three new socket wrench and ratchet screwdriver sets.

TRANSFORMERS/COILS

152. *Essex Controls Division*—new Stancor Transformer Catalog No. 207 lists over 1,900 standard transformers for design engineers. Full technical data, mounting dimensions, photographs and other specifications on the line of audio transformers, power transformers, chokes and inductors are included. A complete listing of all Stancor sales offices and stocking warehouses is included.

TUNER REPAIR

153. *PTS Electronics, Inc.*—62-page catalog with over 600 exact-replacement tuners listed under their original manufacturer number for ease of exchange. A replacement guide for antenna coils and shafts is also provided.

TV ACCESSORIES

154. *Telematic*—introduces a 14-page catalog featuring CRT brighteners and reference charts, a complete line of test jig accessories and a cross reference of color set manufacturers to Telematic Adapters and convergence loads.

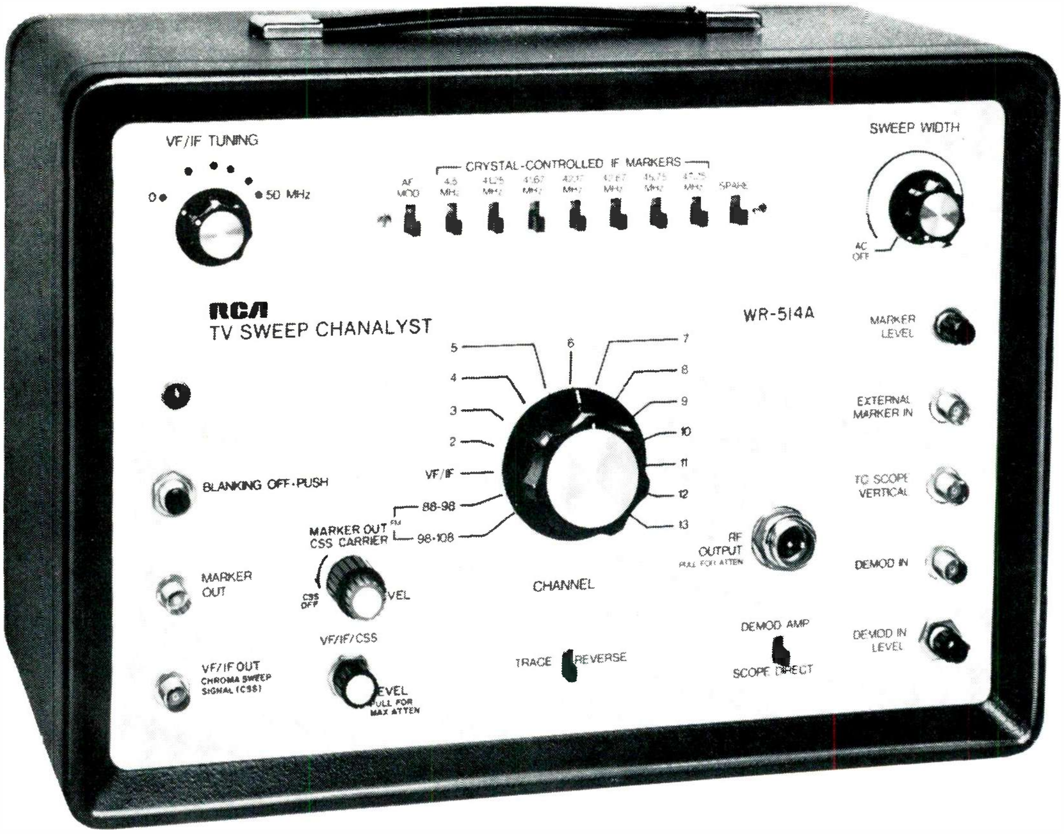
TV PICTURE TUBES

155. *GTE Sylvania*—50-page brochure which describes characteristics of over 900 television picture tubes, plus data on interchangeability information and tips on installation and handling of TV picture tubes.

156. *GTE Sylvania, Inc.*—has published an interchangeability guide listing 191 commonly used color TV picture tubes which can be replaced with 19 GTE Sylvania Color Bright 85® types. □

RCA's TV Sweep Chanalyst checks every VHF channel.

And this complete system has other features you need to restore new-set performance.



- Concerned about CATV, CCTV, MATV? WR-514A checks all VHF channels for tuner malfunction
- Precision attenuator permits peak fringe area reception adjustment
- Versatile snap-on probe allows fast, accurate alignment technique
- One-year warranty on parts and labor . . . local replacement parts availability

Unit combines the functions of a sweep/marker generator, marker adder. RF, IF, video and special Chrom-Align sweep signals permit checking of VHF tuners and alignment of IF, video and color bandpass amplifiers. That's why we call the RCA WR-514A a complete system.

Yours for only $380* including RF output cable, three direct cables, connector adapter, VF/IF 75-ohm input head, and two direct termination units. Ask your distributor if he offers easy payment terms.

Together with the bonus accessories offered below, you will have just what you need for TV alignment procedures.

To get the special bonus offer, simply mail the WR-514A warranty card to RCA Test Equipment Headquarters, Harrison, N.J. 07029. Offer subject to withdrawal without notice. See your RCA Distributor for a demonstration of the RCA TV Sweep Chanalyst. Application Notes and other technical data are also available — on request.

*Optional Distributor Resale Price

Special bonus offer–3 accessories worth $42.25* free with purchase of an RCA WR-514A

WG-433A

$11.25*

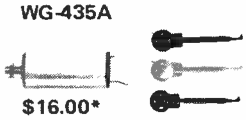
MIXER-INPUT ADAPTER

WG-434A

$15.00*

VIDEO/CHROMA BANDPASS DETECTOR

WG-435A



$16.00*

LINK/IF DETECTOR

RCA Electronic Components

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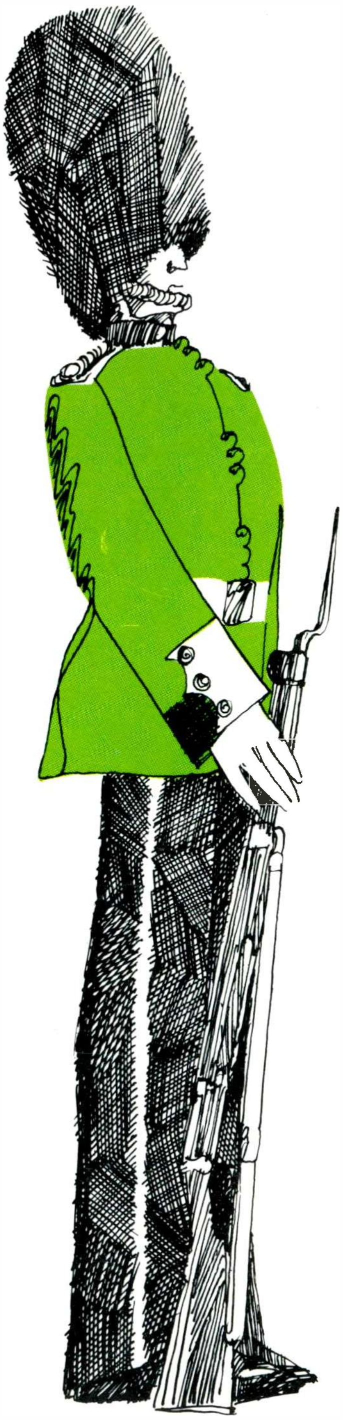

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