May, 1974 ☐ 75 cents

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A HOWARD W. SAMS PUBLICATION

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That's a tough question, because when it comes to service, it's hard to compare apples to apples. Some companies offer you many services—others very few. So before you make up your mind, we'd like to tell you about some of the services Panasonic has developed. Services that can make both our jobs a lot easier.

Like offering complete technical back-up information and assistance. We make available detailed service manuals on every product we've ever sold—over 11,000 since 1959. And if you need more information, call the regional office in your area. And if you still want assistance, we'll send out one of our traveling field service specialists as your personal problem solver. And there's more. We hold annual training seminars to acquaint you with our products, inside and out. And at industry conventions, you'll find a Panasonic representative to explain our latest service advances.

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So before you consider who to name as the top electronics service company, run through the facts. The more you know about Panasonic, the better it is for everybody.

May, 1974 ☐ Volume 24, No. 5

Electronic Servicing

in this issue...

ABOUT THE COVER

Diana Erter of the Zenith Distributing Corporation of Kansas demonstrates the all-solid-state Zenith remote control.

DEPARTMENTS

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For More Details Circle (3) on Reply Card

electronic scanner

news of the industry

Motorola's television receiver business has been sold to Matsushita Electrical Industrial Company of Japan, according to several articles in **Home Furnishings Daily.** New name of the TV's will be Quasar; the name "Motorola" was not part of the purchase. Industry figures show Motorola, Sears and Magnavox were tied for third place in TV sales. Although many persons in the field approve the change of ownership, others point out that Matsushita is the source of Panasonic receivers, and this would eliminate one manufacturer from the industry.

Bill Loris is shown riding "shotgun" for a day of TV service calls in the Cincinnati, Ohio area. Mr. Loris is a design engineer with the Motorola Consumer Products Division, and he is accompanying service technician Jim Lyon on his rounds to observe on-the-spot service problems and solutions. All Motorola color TV engineers are involved in a program of nation-wide service call visits. This is an extension of the previous program of visiting and calling Quasar color TV owners to insure their satisfaction after the sale. We approve of design engineers obtaining experience in the field, and we hope Matsushita will continue the program after they take over Motorola.

RCA is going exclusively to the production of solid-state color television sets, beginning in June. According to industry reports, only five screen sizes, 15-, 17-, 19-, 21- and 25-inch, will be manufactured in the XL-100 line, and the instant-on feature will be discontinued.

The Philco-Ford Corporation and White Consolidated Industries Inc. announced that they have mutually agreed to end negotiations to sell a part of Philco to White. Under the original agreement, White would have purchased the sales and marketing organization of Philco plants, reports **Radio and Television Weekly.**

Magnavox plans to manufacture all of their television sets in the United States. The company has decided to close its manufacturing facility in Nogales, Mexico, which was engaged in the production of black-and-white television sets and electronic components. Manufacture of black-and-white sets will be transferred to the Jefferson City, Tennessee plant. The move to Tennessee makes Magnavox the only one of the five leading television manufacturers to produce all of its color and black-and-white television sets in the United States.

(Continued on page 6)

Zenith Radio Corporation has introduced in the 19-inch diagonal screen size four new black-and-white all-solid-state receivers with the Power Sentry system of magnetic voltage regulation. The Power Sentry system automatically stabilizes voltages in the television set.

Sylvania Service Company, which provides service for GTE Sylvania products, has opened a branch operation in West Hartford, Connecticut.

A new cadmium-sulfide phosphor has been developed at the Westinghouse Research Laboratories. The PX-78 phosphor is capable of much brighter displays than the standard phosphor now in use. It is suggested for CRT applications where ambient light levels are high, such as airplane cockpits, shipboard radar, and sonar displays.

A newly-developed safety device for heavy machinery, **VoxGuard** by Vox Industries, **is activated by the operator's voice,** and is immune to engine sounds and other mechanical noises. The six-ounce, cigarette-pack-sized VoxGuard transmitter is carried in a pocket or worn on the operator's clothing. When activated by a shout or scream, it transmits a radio signal to the machine-mounted receiver unit. The receiver unit instantly shuts off the machine's electrical power or fuel supply.

Despite overly optimistic projections by some firms, a successful consumer video-tape system will not be developed for some time. That conclusion was drawn at the International Tape Association Fourth Annual Seminar, reports **Home Furnishings Daily;** the seminar was confined almost exclusively to industrial and educational applications of tapes.

A new "Colorama A" line of totally remanufactured color television picture tubes with used radiation-attenuation glass, latest all-new rare-earth phosphors, and a new electron gun assembly has been announced by RCA Electronic Components. The seven tube types, including three matrix types, are said to cover 92% of the industry color picture tube replacement needs. It is stated that these replacement picture tubes will enable the older color TV sets to produce a brighter picture, and also improve the X-radiation attenuation in the set.

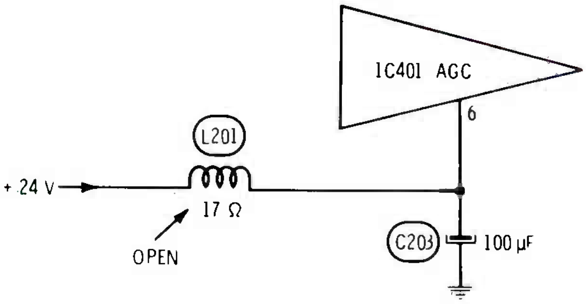
The Canadian electronics industry is expecting to sell slightly more than one million color television sets this year, reports **Radio and Television Weekly.**

Arthur Friedman, an appliance dealer in Oakland, California, **became an instant celebrity** after he explained on a local radio program that for five years his employees had been determining their own salaries, raises, vacation schedules and working hours. According to **Home Furnishings Daily** he said, "Many people think I'm a bit weird," admitted Friedman, "but just give people what they want, and everyone will be happy."

symcure

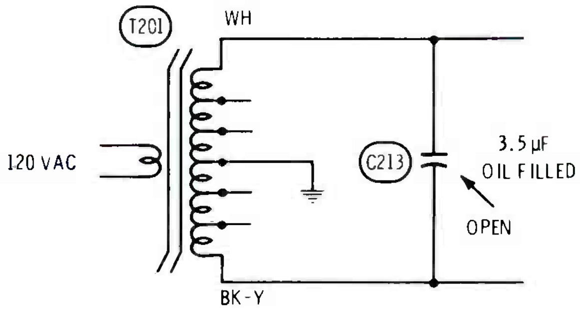
Symptoms and cures compiled from field reports of recurring troubles

Chassis—Zenith 17EC45 and 19EC45
PHOTOFACT—1377-3



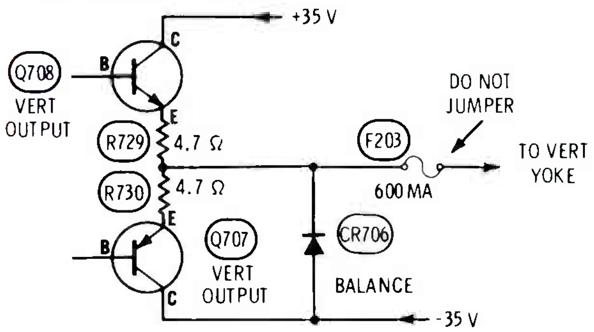
Symptom—No AGC action and dark picture
Cure—Check L201, and repair or replace it if open

Chassis—Zenith 17EC45 and 19EC45
PHOTOFACT—1377-3



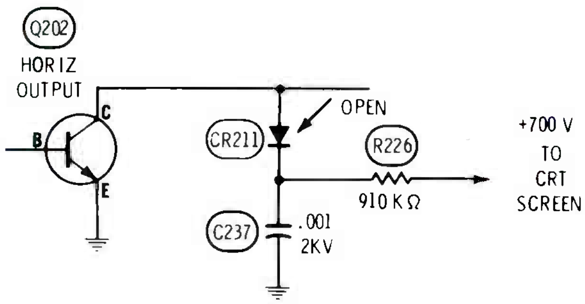
Symptom—Small picture, both vertically and horizontally
Cure—Check C213, and replace it if open

Chassis—Zenith 17EC45 and 19EC45
PHOTOFACT—1377-3



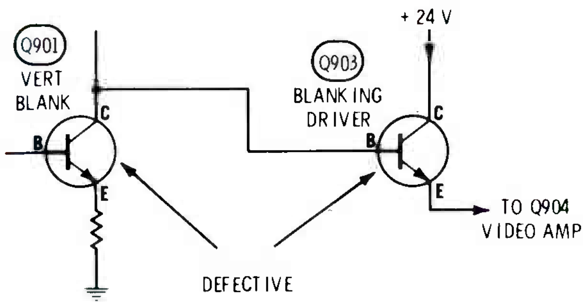
Symptom—No vertical deflection
Cure—If fuse F203 is open, **don't** jumper it. Check vertical module for shorts, then install new fuse

Chassis—Zenith 17EC45 and 19EC45
PHOTOFACT—1377-3



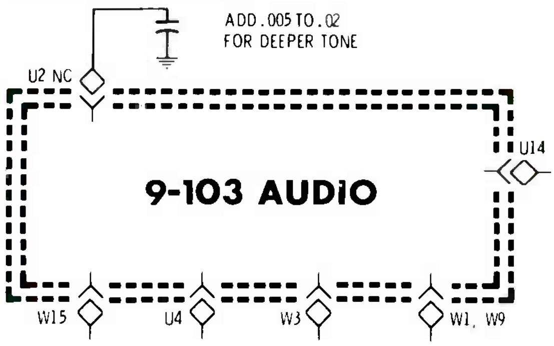
Symptom—No raster, or a dark picture and no set-up line
Cure—Check CR211, and replace it if open

Chassis—Zenith 17EC45 and 19EC45
PHOTOFACT—1377-3



Symptom—No raster; HV okay
Cure—Check Q901 and Q903 transistors, and replace them if defective. Also, try a new vertical module

Chassis—Zenith 17EC45 and 19EC45
PHOTOFACT—1377-3



Symptom—Sound too high-pitched
Cure—Add a capacitor of between .005 and .02 from U2 of the sound module to ground □

reader's exchange

Needed: *Instruction manual and schematic for Hickok 610A FM-TV signal generator. Will pay or copy and return.*

Harry W. Barnes
9322 N. Rancho Verde Drive
Tucson, Arizona 85704

Needed: *Vertical-output transformer number TO-0066 for a Muntz AS 5003-1. Will pay all costs.*

J. Kinkopf
9303 South Highland Street
Garfield Heights, Ohio 44125

Needed: *Volume control and switch assembly for a Clairtone model 4011 25-inch color TV, made in Canada. The part number is 650-105.01.*

George's TV
5430 N. Meade Avenue
Chicago, Illinois 60630

Needed: *Schematic and manual for a Heathkit condenser checker model C-3.*

Terry T. Walton
1709 Morrison
Big Spring, Texas 79720

Needed: *Complete schematic and operators manual for a Jackson oscilloscope model CRO-2. I will pay $5.00 for this material or $2.50 for legible copies.*

Vincent P. Marion, Jr.
26 Church Street
Groton, Connecticut 06340

Needed: *Address of Century Electronics Co. or tube chart set-up and manual for a model MC-1 Century Mini-Check tube tester.*

C. E. Breidenbach
828 Robinson Avenue
Kenton, Ohio 43326

Needed: *Schematic and operating instructions for a Precision oscilloscope Series ES-500A.*

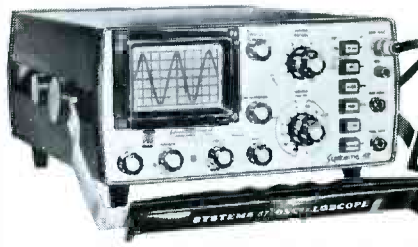
T. E. Anderson
972 Garden Grove Avenue
Norco, Calif. 91760

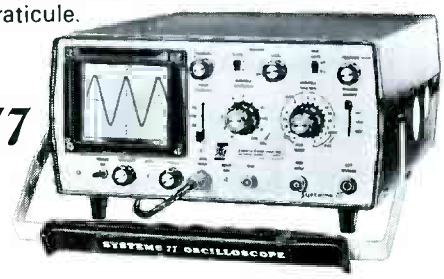
Needed: *Schematic and power transformer for PT-1000 Plush model super 450 W/slave multiplex amplifier.*

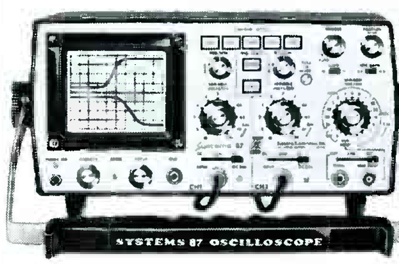
Nick Pirko
211 Willowick Avenue
Temple Terrace, Florida 33617

Wanted: *Power transformer for a World Wide 9 all-wave receiver manufactured by McMurdo Silver.*

Paul Capito
637 West 21st Street
Erie, Pennsylvania 16502







troubleshooting tips

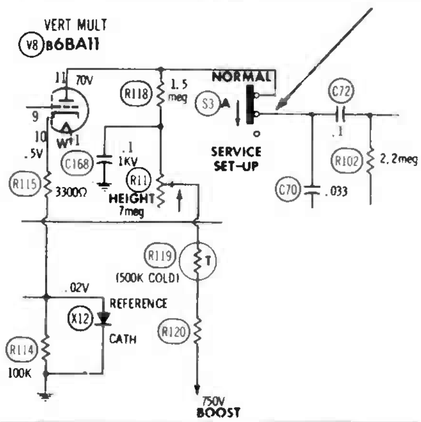
Send in your helpful tips—we pay!

Erratic height
Zenith 20Y1C50 color chassis
(Photofact 981-2)

Each time the receiver was turned on, the picture was short by three or four inches at the bottom of the screen. Also, the height jittered erratically as though something was breaking down. After a few minutes of operation, the height gradually would expand and become normal until the set was turned off again.

All voltages in the vertical circuit measured about 15% low. I replaced the vertical output tube and yoke, but the results were the same. Neither did spraying coolant indicate any sensitive components.

Peak-to-peak waveform measurements with the scope showed all were about 20% low. This is often the case with a multivibrator, because it is a closed-loop circuit. A defect anywhere often affects DC voltages and waveforms everywhere.

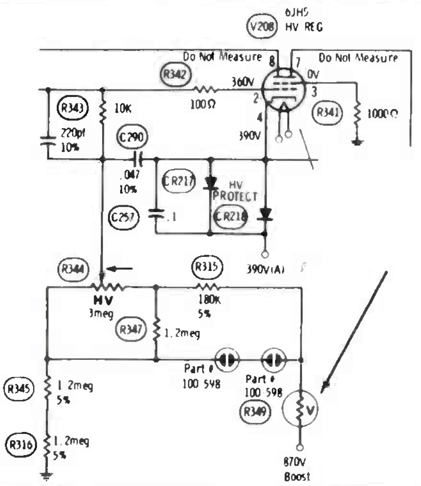


To localize the trouble, I disconnected the .01 capacitor in the positive-feedback circuit and applied 14-volts AC through it into the oscillator stage. AC signal at the plate of the oscillator now didn't change much, but it did at the grid of the output tube. Only a .1 coupling capacitor and the service/normal switch were between those two points.

The villain was the service/normal switch that had become oxidized and intermittent. It's best to replace such switches without attempting to clean them.

Haruo Kawamoto
Pepeekeo, Hawaii

Rapid width changes
Zenith 25CC50 color chassis
(Photofact 1267-3)



Recently, I worked on several Zeniths having the same rapid pulsations of width, somewhat similar to the movement of accordion bellows. Otherwise the picture appeared to be normal. The raster, without a picture, seemed to be okay.

I wasted a lot of time with the first chassis by checking voltages and resistances in the horizontal-sweep circuit. High voltage was a steady 26KV (which surprised me), and nothing seemed wrong until I began measuring the DC voltages around the HV control. Boost voltage of 840 volts, but at the tube side of the varistor (VDR) the voltage was only 360 volts. This seemed to indicate that the varistor had increased in resistance. A new varistor cured the width pulsations.

Of course, the next chassis with the same trouble was fixed in a hurry!

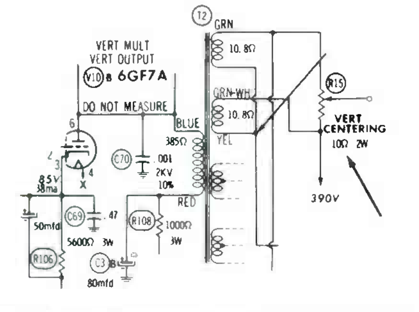
James D. McKenzie
Magnolia, Mississippi

Editor's Note: We have reported this same trouble several times, but we're repeating it once more because varistors are difficult to test.

(Continued on page 12)

(Continued from previous page)

Intermittent height
RCA CTC16 color chassis
(Photofact 818-2)



Intermittently, the height would jump up about 2 inches at the bottom of the picture. There was no regularity or predictability about this, so I concluded it was not thermally caused.

When the height was full, I measured and wrote down the DC voltages and waveform amplitudes in both the oscillator and output stages. Then after the height jumped up, I rechecked. There were no significant differences between the two sets of figures.

From this I concluded the source might be in the output transformer or yoke. While I was measuring DC voltages in those circuits, I touched the meter probe to the vertical centering pot. The vertical jumped in height. To make sure the loading of the meter probe was not responsible, I used an insulated tool to contact the centering control. No results from moving or touching the center terminal, but movement of the end terminal would trigger the intermittent.

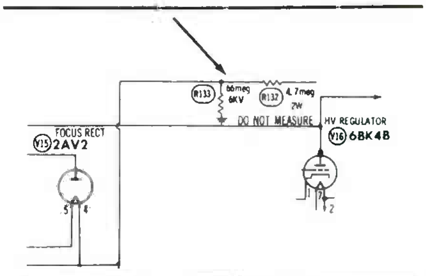
Replacement of the centering control cured the height problem.

Kenneth Wiederman
Columbus, Ohio

Intermittent focus and brightness
Curtis Mathes CMC24 color chassis
(Photofact 1002-2)

This TV had two troubles, apparently not related. Focus of the scanning lines would blur occasionally. At other times, the picture became very dim, although the high voltage checked all right.

None of the components in the focus circuit tested as being bad. Finally in desperation, I replaced R133, the focus-bleeder resistor, and found the intermittent focus was cured. The resistor checked okay out of circuit, but evidently became defective when the focus voltage was applied to it.



By measuring the DC voltages during times the picture was dark, I found the boosted-boost dropped away low. Resistance measurements proved there was an open circuit at terminal FC of the flyback transformer. A good re-soldering of the joint eliminated the second problem.

Stanley F. Gutt
Bayonne, New Jersey

letters to the editor

Dear Editor:

In the October issue of **Electronic Servicing** you asked for comments about problems related to module servicing of the newer solid-state TV's. Perhaps my experiences might be of help.

I am working for Lazarus, the largest department store in Columbus, Ohio, as an in-home and shop technician. Lazarus sells Magnavox, Zenith, RCA, Sony, Panasonic, and a few others in smaller volume.

Recently, we completed inventory of our service vehicles and found in just one truck the following quantities of modules and related parts for only three popular brands:

Magnavox 33 modules, and 47 semiconductors

Zenith 29 modules, 60 components in kits, triplers, and Belfuses

RCA 18 modules, 31 components in kits, plus triplers, etc.

These quantities are minimums for proper servicing. With them, I have been able to complete about 90% of the calls in the home.

Our shop has 10 outside service vehicles. I don't need to say what our inventory cost was for modules alone this year!

Each outside technician is responsible for the parts inventory in his own vehicle. So in a sense, I am a one-man shop on wheels, and I must "cut corners" to use a minimum number of parts, while finishing the work quickly.

One of the methods I use to avoid needless replacement of modules is first to replace any plug-in devices (transistors, IC's, etc.), after I have determined that a certain module is defective. With Zenith or Magnavox sets, an individual part can be replaced without scrapping the whole module.

Sometimes a local parts distributor runs out of certain modules, resulting in a 3 or 4 week delay and irate customers. So, if you can keep from using your last module, do so. Even large organizations such as ours have back-order problems and resort to robbing modules from stock receivers to serve our customers.

Another tip is to stock extra modules of the types you find are used most often. Many of these are the less-expensive kinds, such as the RCA 133563 power-supply module, or the Magnavox 612046-202 sound-output module. These modules cannot easily be repaired in the home.

One easy way to check modules is by comparing the resistance readings of a good module with the defective one. Of course, extender cables and a chassis of the correct type would enable you to work on them under power.

I believe we will see in the near future a new industry developing around the rebuilding of defective modules, much as is done now with tuners. Of course, this depends on whether or not a manufacturer leaves the modules open so the parts can be removed. One of my pet peeves is a module with a pound of epoxy around it, so even Superman couldn't get to the components.

Kenneth Barton, CET
Columbus, Ohio □

Understanding and servicing the new Zenith remotes

By Robert L. Goodman, CET

SCR's, triacs, IC's and transistors control station selection and volume without relays in some of the "E"-line Zenith color receivers.

A first glance at a schematic of the remote-control receivers used with varactor-controlled tuners in some "E" line Zenith color sets shows no relays and only one small motor. But there are more equally interesting and unique differences in these sets compared to previous models. In fact, the 500X and 600Z Space Command remote receivers have little resemblance to the former ones.

Improved 3-rod and 4-rod "bonger" type mechanical transmitters supply the ultrasonic signal for operation. Details are given later.

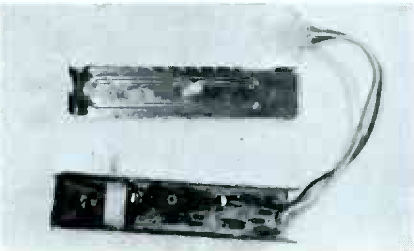


Fig. 1 Microphone and amplifier for all frequencies are contained in a subassembly mounted at the front of the receiver.

Microphone And Amplifier

A three-stage transistorized amplifier is mounted with the microphone on a separate subchassis, positioned so the microphone hears sounds from the front of the receiver (photo in Figure 1). The circuit (Figure 2) has one tuned transformer and a gain control. Both remote receivers employ the same mike amplifier (Figure 3).

General Theory Of Operation

SCR's connected in parallel, but in opposite polarity, control the motor power in either channel-higher or channel-lower direction. SCR's require a very small positive voltage at the gates to cause conduction. Therefore, it's very practical to rectify signal voltages from tuned circuits, filter the DC, and apply the DC voltages direct to the gates, without additional amplification. When the motor is running, DC control voltages blank the video and mute the sound.

Logic-type circuits change the sound volume in steps. Other circuit features lock the memory, so the same channel and volume are obtained after the receiver is turned off and then back on.

SCR characteristics

Two conditions are necessary to make an SCR conduct: the anode must be positive relative to the cathode; and the gate must be about .8 volts or more positive relative to the cathode. After an SCR is triggered on and is conducting, it will continue to conduct (even if the gate is made negative) so long as the anode is positive and a minimum "latching" current flows.

Therefore, to turn off an SCR, the gate must be negative, or insufficiently positive, and the latching current must drop below the minimum amount. Of course, when the SCR is operated on AC, the current stops and the anode is negative for one-half of each cycle. An SCR is a half-wave rectifier

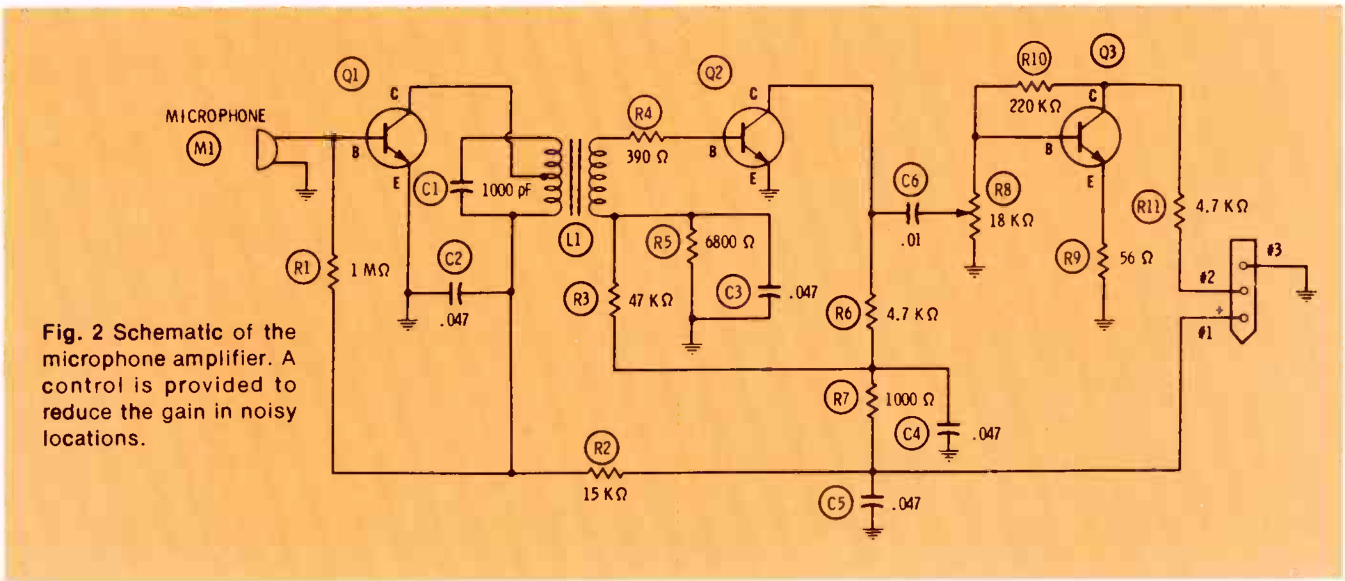


Fig. 2 Schematic of the microphone amplifier. A control is provided to reduce the gain in noisy locations.

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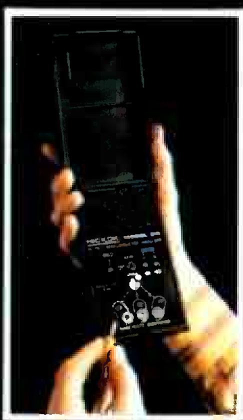

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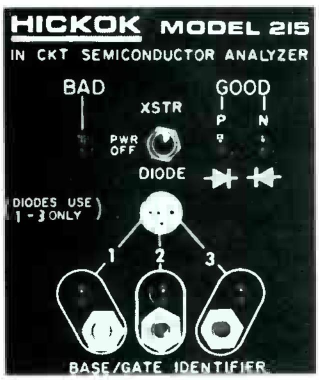
You'll find this semiconductor tester the easiest and fastest of all to use. No searching through data books and service manuals to find basing diagrams. No switches to operate, no buttons to push. Easy no-hands operation allows you to use both hands for probing or making lead connections. Just connect the 215 to the device leads in any order, in/or out of circuit. Instantly and automatically, the 215 determines the lead configuration, and tells you in bright LED displays if the semiconductor is GOOD or BAD. If GOOD, it further identifies which lead is the base (gate for FET's) and whether NPN or PNP.

The solid state design of the Model 215 is based on low power CMOS circuitry that greatly extends battery life. This instrument will not damage transistors, diodes or circuits under test.



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- RF adjustable, Channels 2-4.
- Crystal controlled chroma and timing oscillators.
- Powered by two standard 9V batteries.
- Rugged polypropylene case.

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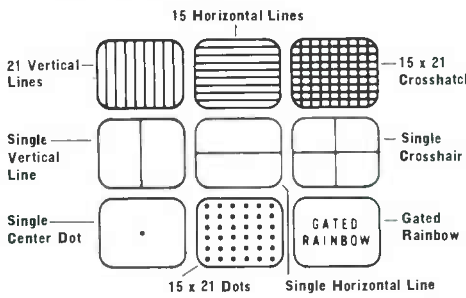

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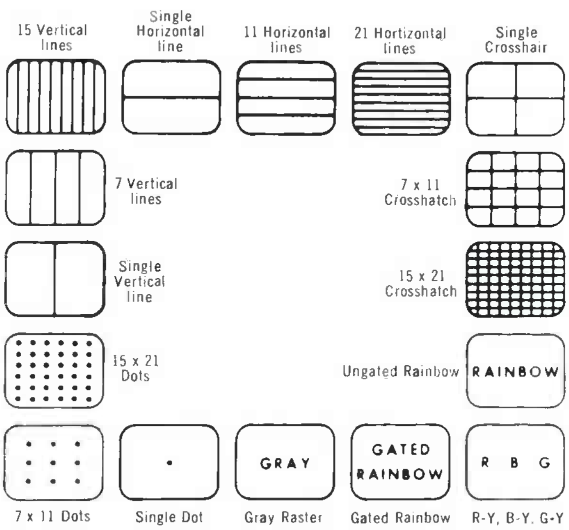

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Compare these features:

- Exclusive Hickok-developed MOS LSI IC provides digitally controlled stable patterns from -50° to +150°F. The lower component count with this IC also increases overall reliability and permits a smaller package size.
- A full 16 patterns gives maximum versatility and minimum distraction when making critical checks and adjustments.
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- RF adjustable, Channels 2-4.
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which can be prevented from conducting by an appropriate gate/cathode voltage. Thus it is a Controlled Rectifier made of Silicon.

Efficient running of AC motors requires current to flow during both halves of the AC sine waves. A single SCR can't do that, so two SCR's are used.

Channel Changing

The essential components for channel-up operation of the motor are shown in Figure 4. Another similar circuit permits channel-down selection. Both circuits share the audio muting, video blanking, and AFC defeat functions associated with the carryover switch on the motor.

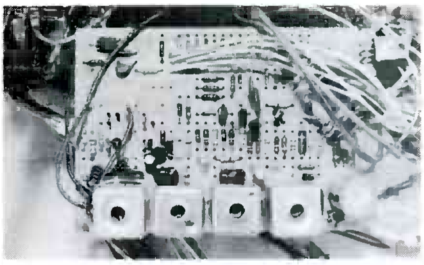


Fig. 3 The four shielded coils show this main remote chassis is part of the 600Z system.

Output signals from the microphone amplifier go to the tuned circuits by way of the series-connected coil primaries. L201 is the adjustable coil for the higher-channel frequency (41.25 kHz). CR202 rectifies the supersonic signal, and C205 makes the action peak-reading (filters and increases the positive DC voltage).

From R205, the positive DC signal voltage is channeled to two different paths. We'll trace the motor wiring circuit first.

AC voltage to operate the motor is obtained from an isolated winding of the power transformer. This permits one side of the winding to be grounded without presenting a shock hazard. The hot side goes to the motor.

Before the motor can run, two conditions must be satisfied. First, either the gray or yellow motor wire must be grounded so one winding has 120 volts across it. Also, the other winding must be supplied with phase-shifted power. This is done by R227 and C211, which are connected in series between the gray and yellow wires. Both windings are identical, although one functions as a "start" and one as a "run" winding. Direction of rotation of the motor shaft depends on **which** motor wire is grounded. Up-channel operation grounds the gray wire; down-channel commands ground the yellow wire.

SCR conduction

Instead of rotating a tuner shaft, the remote motor drives three rotary switches which apply voltages to the varactor-type tuners, and light the channel numbers. The motor is turned on by conduction through the two paralleled SCR's.

Positive DC voltage from R205 is applied to the gate of SCR CR206. Therefore, the SCR conducts during the positive half-cycles of the sine waves, and becomes open for the duration of the negative portion. Diode CR210 is one of the components used in triggering SCR CR207, and it conducts only when CR206 does.

Conduction through SCR CR207 will pass current for the negative halves of the voltage, **if** its gate can be made positive with respect to the cathode.

Here is the explanation from Zenith: An SCR with negative voltage at the anode, but with positive voltage applied to the gate (relative to the cathode), acts as a "remote

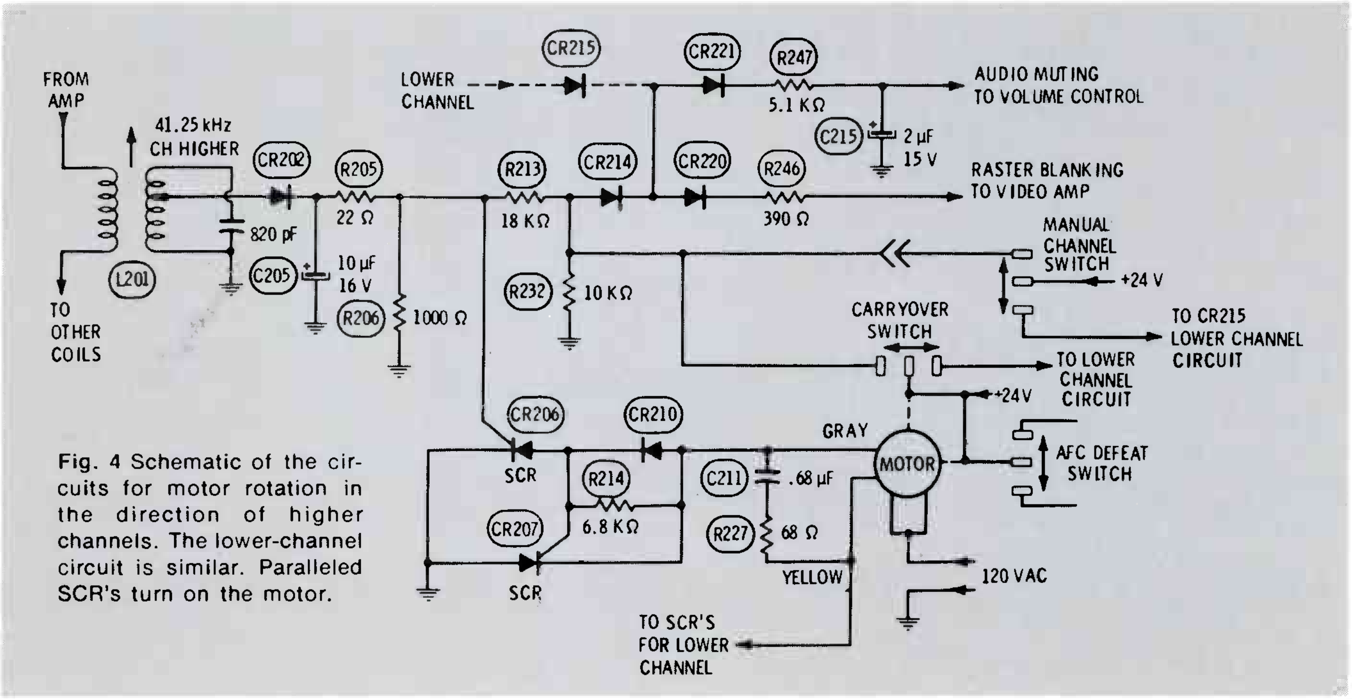


Fig. 4 Schematic of the circuits for motor rotation in the direction of higher channels. The lower-channel circuit is similar. Paralleled SCR's turn on the motor.

base" PNP transistor. The anode acts as the collector, the cathode as the base, and the gate as the emitter. (Refer to Figure 5 for the equivalent circuit.) Positive voltage applied to the "emitter" is forward

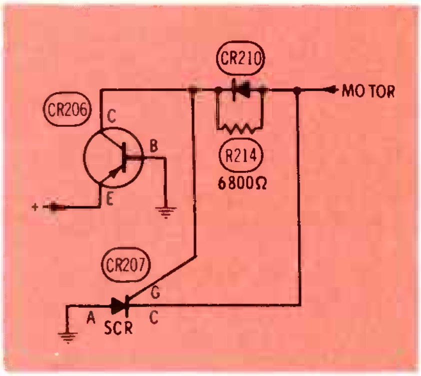


Fig. 5 During the negative-going peak of the 60 Hz sine waves, SCR CR206 acts as a PNP transistor, as shown here, to provide a positive gate voltage for SCR CR207.

bias, the "collector/emitter" junction is saturated, which connects the positive triggering voltage from CR202 to the gate of SCR CR207. (Most of the negative part of the sine wave from the motor is blocked by CR210.) Therefore, CR207 conducts during the negative half-cycle of each sine wave.

The sum of the currents through CR206 and CR207 represent virtually the entire sine wave of motor current, so the motor runs exactly as though turned on by a conventional switch.

Although we have mentioned the anode going positive or the cathode of the SCR's going negative from the sine wave from the motor, one more condition should be made clear. The motor is in series with the SCR's; therefore, when an SCR conducts, the voltage from anode to cathode is less than a volt.

When both SCR's are non-conducting, a meter should measure 120 volts AC across them. If the motor refuses to run, a fast test is to ground either the gray or yellow wire. Continued failure to run indicates a bad motor, a lack of voltage, or an open in the phase-shifting components (C211 and R227). But if the motor runs, the problem is in the SCR's or the positive triggering voltage.

Incidentally, the action of SCR's is more like a snap-action switch than it is like a variable resistor. Triggering is similar to a regenerative action. As the gate voltage is increased gradually, nothing happens until a certain very-critical voltage is reached; then the SCR conducts completely.

Another factor affecting the triggering voltages is that the gates draw current, somewhat as the bases of transistors do. This gives a kind of voltage regulation to the DC gate voltage of CR206. Therefore, an open gate circuit allows the

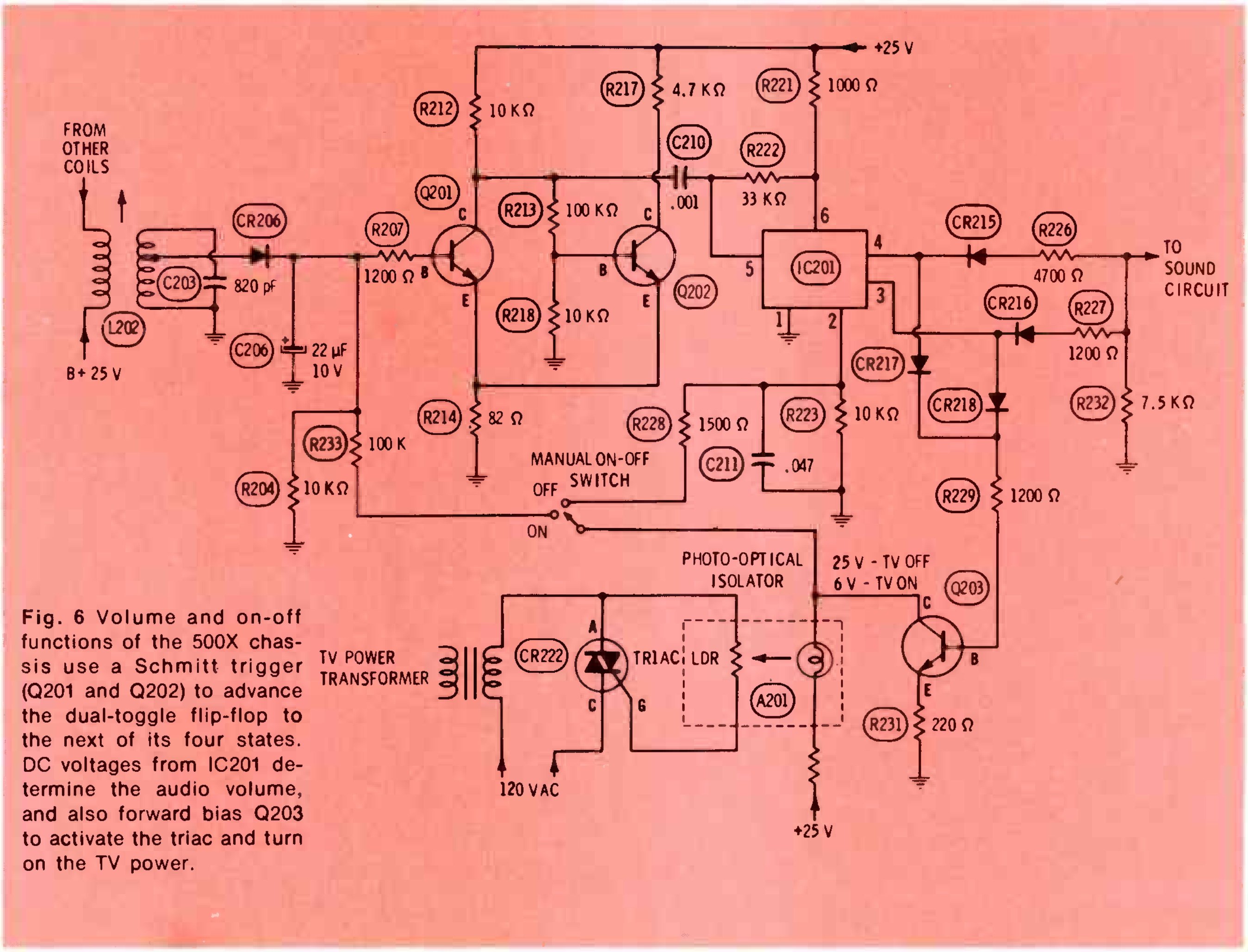


Fig. 6 Volume and on-off functions of the 500X chassis use a Schmitt trigger (Q201 and Q202) to advance the dual-toggle flip-flop to the next of its four states. DC voltages from IC201 determine the audio volume, and also forward bias Q203 to activate the triac and turn on the TV power.

triggering voltage to rise considerably.

It's a good idea to measure the triggering voltages in several remotes to determine the average. If the average is .8 volt, .6 is **not** enough to trigger the SCR.

Manual Channel-Change Switch

The manual channel-change switch located on the front of the set applies a positive voltage to the junction of R213, R232 and CR214. (CR214 is used as isolation from the lower-channel circuit.) A voltage divider consisting of R213 and R232 feeds part of the positive voltage to the gate of SCR CR206, causing the motor to run toward a higher channel.

Positive voltage from the channel-change switch goes through isolation diode CR214 to CR221 and CR220. Voltage through CR221 eventually reaches the volume control, muting the sound. Similarly, voltage through CR220 is applied to the video circuit, blanking it out.

Carryover Switch

If the rod in the remote transmitter hand unit did not vibrate long enough, the trigger voltage might drop down and shut off the motor between channels. To avoid this possibility, a carryover switch closes when the selector switches are between channels, and feeds a positive voltage to trigger the SCR's, mute the sound and blank the video in the same way as does the voltage from the manual channel-change switch. When the next channel is reached, the switch opens.

A second section of the carryover switch shorts out the AFC control voltage when the selector switches are between channels.

The previous circuits are used in both the 500X and the 600Z Space Command receivers. Circuits from here on are in one or the other receivers as specified.

500X Volume Circuitry

Functions of three-steps of volume and on/off of the TV power are combined in the 500X remote chassis (Figure 6).

Tuning (L202 and C203) and peak-reading detection (CR206 and C206) are accomplished in the same way as for the channel changing. However, the positive voltage developed is used to activate a Schmitt Trigger.

Schmitt Triggers

Q201 and Q202 are wired in a Schmitt Trigger circuit which changes "states" rapidly when the input signal exceeds a certain critical voltage.

Without an input signal, Q201 is cutoff, making the collector voltage high. The high collector voltage is fed to the base of Q202 by voltage divider R213/R218. Therefore, the base of Q202 has a high forward bias causing a saturated collector/emitter current. This reduces the collector voltage to a very low value. In other words, Q201 is cutoff and Q202 is saturated. In fact, Q201 has reversed bias, because the emitter current of Q202 creates a voltage drop across R214, the 82-ohm resistor that is common to both emitters. The base of Q201 is near zero, and the emitter is positive; therefore, it has reversed bias.

Now notice the regenerative action when Q201 has sufficient bias. The remote transmitter button is depressed, positive voltage is produced by CR206, and is fed to the base of Q201, forward biasing it and reducing the collector voltage. Both the collector of Q201 and the base of Q202 which is coupled to it become nearly zero volts. Q202 at first has insufficient bias, and then as the action proceeds, it has reversed bias. That's because the increased Q201 emitter current makes both emitters positive while the base of Q202 is nearly zero. This two-stage "snap" action makes the voltages change much more rapidly than would be possible with only one stage used as a DC amplifier.

Both transistors hold the new state until the input voltage is removed, then they revert to the original conditions with Q201 cutoff and Q202 saturated.

The purpose of the Schmitt Trigger is to supply a steep-sided negative-going pulse from the collector of Q201 to pin 5 of IC201, a dual-toggle multivibrator.

Four-State Multivibrator

IC201 is a dual-toggle multivibrator which changes to the next of its four states each time a pulse is received from Q201. This is a type of digital logic.

These are the voltage conditions of IC201 for the four steps:

STEP	PIN 4	PIN 3
TV off	low	low
volume high	high	low
volume medium	low	high
volume low	high	high

Suppose the TV is off (both pins 3 and 4 are low voltage), and the remote button is operated to advance the multivibrator to the high volume position. Pin 4 is high, reverse biasing CR215. Pin 3 is low, so CR216 conducts. This places R227 (1200 ohms) in parallel with R232 (7.5K ohms). This greatly reduces the positive voltage at the volume control, and increases the volume to maximum. Also, the high state of pin 4 forward biases CR-217, passing the positive voltage to the base of Q203 to turn on the TV power. More about that later.

Next advance by the remote button makes pin 3 high and pin 4 low. CR216 is reverse biased and non-conducting, removing R227 from the circuit. The low state at pin 4 forward biases CR215 into conduction, which grounds R226 (4700 ohms), making it in parallel with R232. This increases the positive voltage at the volume control, decreasing the volume. The high state of pin 3 forward biases CR218, feeding the positive voltage to the base of Q203 and keeping on the TV power.

Fourth toggle of the multivibrator produces high states at both pins 3 and 4. CR215 and CR216 are reversed biased, thus removing both R226 and R227 from the circuit. Only R232 now reduces the voltage at the volume control, giving low volume. Highs at pins 3 and 4 cause CR217 and CR218 to conduct positive voltage to the base of Q203, keeping on the TV power.

Next operation of the remote button makes both pins 3 and 4 low. CR215 and CR216 both conduct, paralleling R232 with R226 and R227. This would make the volume extremely high, except the TV is turned off. There are no voltages at pins 3 and 4 to go to the

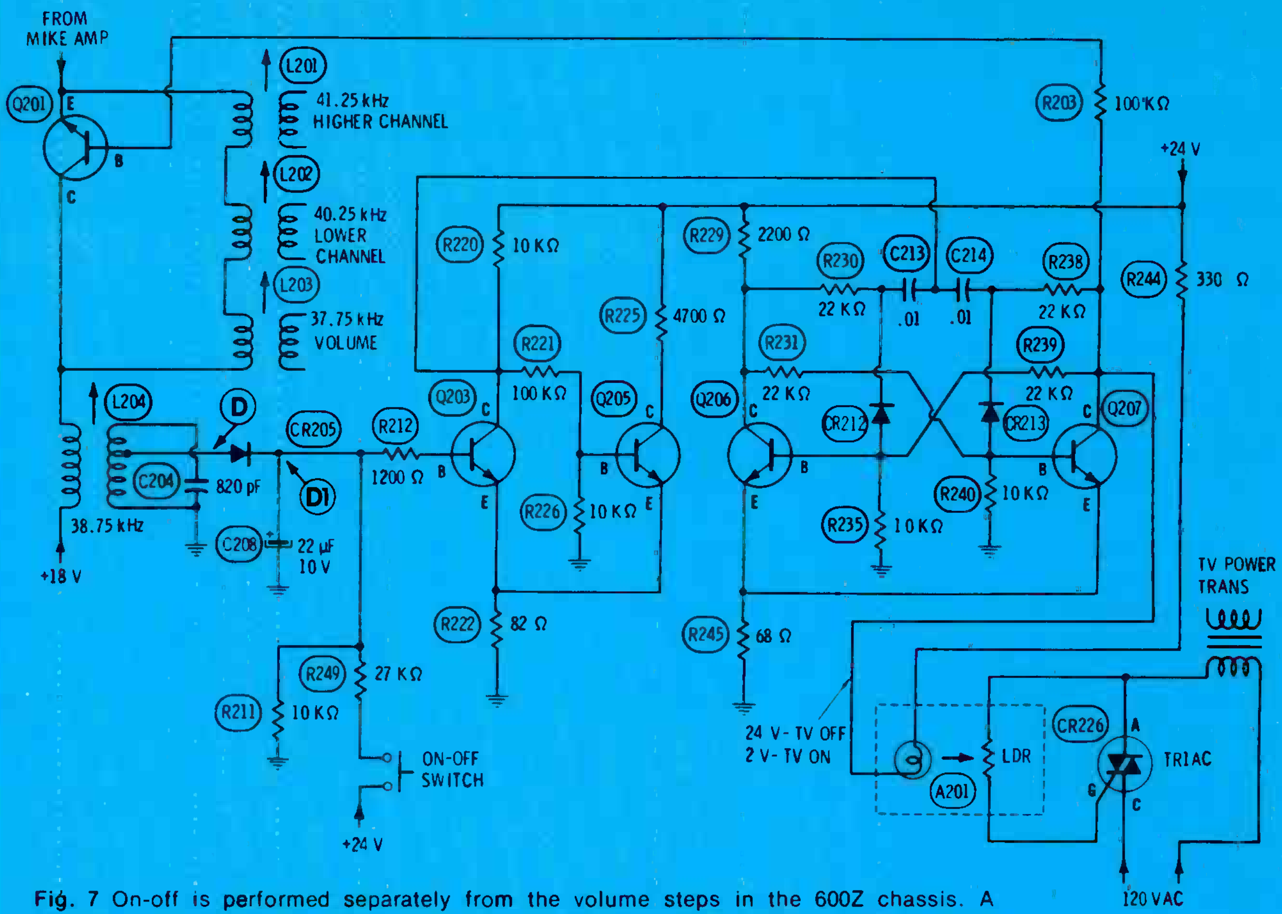


Fig. 7 On-off is performed separately from the volume steps in the 600Z chassis. A Schmitt trigger (Q203 and Q205) drives a 2-state flip-flop circuit (Q206 and Q207) which turns on the TV power when Q207 draws current. One snap of the remote button turns the power on, the next turns it off, etc.

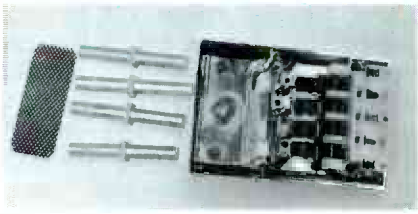


Fig. 8 The new remote hand-held transmitters have been redesigned to make them more rugged, and to have greater output.

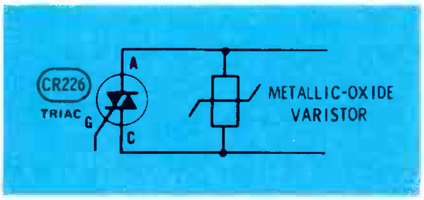


Fig. 9 A Zenith kit with a special varistor is available for locations having spikes or other transients on the AC line. The MOV reduces resistance from higher voltages, thus protecting the triac from damage.

base of Q203; therefore, it doesn't conduct and the TV power is off.

On-off function

One problem of controlling the TV power without using a relay is in isolating the 120 volts AC from the solid-state components of the remote receiver. In several brands of TV's, this is solved neatly with a "photo-optical" isolator. The interface is by means of light waves, which can't conduct electricity.

When either or both CR217 and CR218 conduct bringing positive voltage to the base of Q203, the transistor saturates. The resulting current flow lights the incandescent lamp inside A201 isolator. The light causes the Light-Dependent Resistor (LDR) to greatly reduce resistance, and this increases the AC voltage applied to the gate of CR222, a triac, causing it to conduct, and supply power to the TV chassis.

The LDR inside the photo-optical isolator must not see any light other than that from the bulb. Any light entering from outside might turn on the TV.

Triacs are very similar to SCR's except each triac is the equivalent of two SCR's wired in parallel, but with reversed polarity. Therefore, triacs conduct both positive and negative peaks of the waveform, acting as a switch.

Manual control of TV "off" is accomplished by feeding some of the voltage from the collector of Q203 to pin 2 of IC201. For TV "on", the voltage is applied to the base of Q201, giving the same action as if the remote button is operated.

600Z Remote Circuitry

In the 600Z four-function Space Command chassis, the on-off function is separate from the volume control steps.

This permits four steps of volume loudness instead of three. The first state of the dual-toggle multivibrator grounds both R227 and R226, reducing to a minimum the DC voltage at the volume control, and providing very-loud volume.

On-off function

A two-state multivibrator made with discrete components controls the on-off function (Figure 7).

The 38.75 kHz remote signal is rectified, filtered, and the positive DC used to bias-on Q203, which is part of a Schmitt trigger. This action is very similar to that previously described.

However, the negative-going pulses from the Schmitt trigger (Q203 and Q205) are applied to the bases of Q206 and Q207 through C213, C214, CR212 and CR213. The two diodes function as "steering" diodes to conduct the negative-going pulses to whichever base is the most positive at the time. The nature of multivibrators is for one transistor to be cutoff and the other to be saturated. Therefore, each click of the on-off remote-transmitter button reverses the state of the multivibrator.

Current of Q207 lights the lamp in the photo-optical isolator, A201, the light reduces the resistance of the LDR, which biases on the SCR and applies power to the TV chassis. When Q206 is saturated, the TV is off.

Memory

Ordinary multivibrators have no memory. For example, when the power to a conventional symmetrical multivibrator is interrupted and then restored, the multivibrator might assume either state, strictly according to chance. If not prevented, a receiver might come on in the middle of the night (very undesirable!), following a power outage.

In this circuit, the multivibrator always returns to a power-off state after a power loss, because Q206 has a higher beta than Q207, and Q207 has a lower collector resistance. Therefore, Q206 always is saturated when power first is applied.

Noise protection

One of the problems with any remote system using supersonic frequencies is that spurious sounds might trigger one or more functions. Telephone bells, jingling keys or squeaks from dry motor bearings are some of the possible sources.

Protection of the channel-changing and volume-stepping functions is afforded by Q201, which shorts across the tuned coils for those three stages (Figure 7), when the TV power is off.

When Q207 is cut off (TV is without power), the collector voltage is high. This voltage is fed through R203 to the base of Q201, producing saturation which shorts across the coils. When Q207 is conducting, the lower collector voltage dropped through R203 is not sufficient to forward bias Q201, so Q201 becomes an open circuit that does not interfere with the signals in L201, L202 and L203.

Therefore, when the TV is off, only the command to turn on can be received. This prevents the memory of channel selection and volume levels from being changed by noise while the TV power is off.

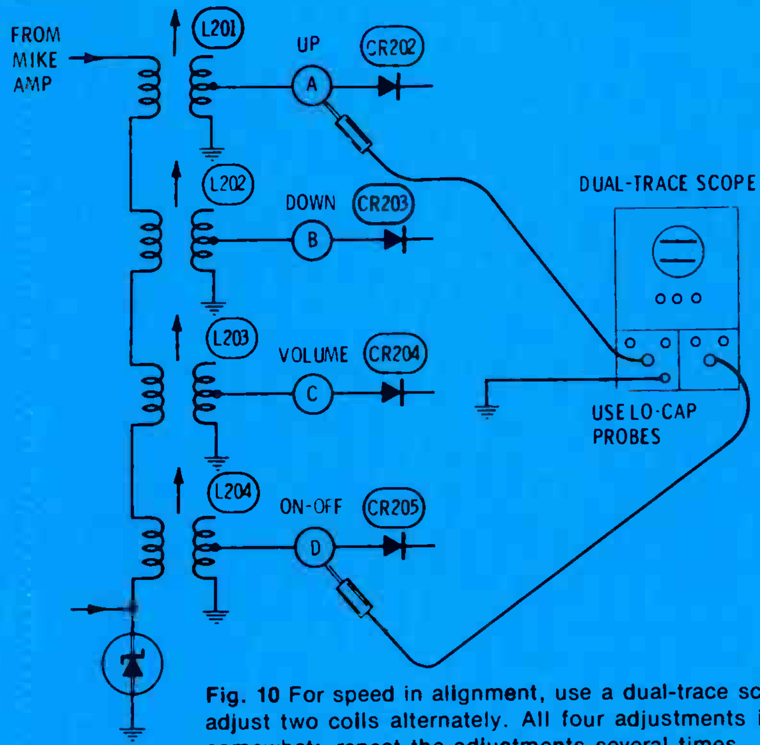


Fig. 10 For speed in alignment, use a dual-trace scope and adjust two coils alternately. All four adjustments interlock somewhat; repeat the adjustments several times.

Remote Transmitters

An improved three-button remote transmitter is supplied with receivers having the 500X remote-receiver chassis. This transmitter also can be used with 3-function TV remotes of previous years.

Four-button transmitters (Figure 8) cannot be used to replace older ones, because the frequencies are not the same.

Each sonic rod is mounted within a molded plastic block, which is fitted into a crevice in the plastic case. No other hardware is used to mount the rods. This is to equalize and increase the sound output of the rods, and minimize failures from falls.

Magnets near each trigger provide longer throws of the hammers and permit firing while the unit is tilted.

Troubleshooting Procedures

For isolating troubles in remote systems, the first step is to place the auto-manual switch in the manual position, and then check operation of all the control buttons located on the front panel. Any functions that don't work normally suggest the defect is in the motor, SCR's, the triac, Schmitt trigger, IC multivibrator or transistor multivibrator. Normal operation indicates some of those components are not defective.

Next, change to auto operation and check channel-up and channel-down functions. Any that worked okay on manual, but not on auto, indicates that the trouble is in the tuned circuits, diode detectors, or other components in the detector circuits of the defective channel.

If none of the remote functions work, probably the defect is in the transmitter, microphone, microphone-amplifier stages, the supply voltage, or the connecting cables.

Failure of remote on-off

Suppose the on-off function of the 600Z chassis would not operate, although it did manually (see Figure 7). Test for the DC voltage at the cathode of CR205 (testpoint D1). Using a sensitive meter, such as a DMM, FET meter or VTVM you should measure about +1.5 volts (minimum of +.8 volt) with the corresponding button of the remote transmitter pressed.

If the voltage there is missing or insufficient, connect the low-cap probe of your scope to the anode of CR205 (testpoint D). There should be about 5 volts p-p when you snap the button of the hand unit. If the peak-to-peak reading is okay, but there was no DC at the cathode, chances are the diode is open. However, if it is shorted, the p-p signal will be nearly wiped out. Unsolder the diode and check the amplitude of signal without it.

In one case, the signal showed only 1.5 volts p-p, and this low amplitude was caused by misadjustment of L204.

One test for the Schmitt trigger is to measure the DC voltage at the collector of Q203 while you operate the manual or remote switch. The voltage should show a definite dip each time. Most scopes won't show this, so the DC meter is a better choice of instruments.

Another test of a faulty Schmitt trigger is to ground the collector of Q203. Make sure there's voltage here, so the short will create a negative-going surge which should trigger the on-off multivibrator to the next state. If not, then the multivibrator might be defective.

Check the multivibrator by grounding the base of Q206. This should make Q207 conduct, lighting the bulb and turning on the TV. If that doesn't work, ground the collector of Q207, thus bypassing both the Schmitt trigger and the multivibrator. Now, if that doesn't turn on the TV power, the isolation unit or the triac must be bad. Short across the triac from anode to cathode for a final test.

If the TV should turn on and off rapidly, it's likely the triac is faulty (nervous). A shorted triac prevents the TV from being shut off; at least by any means except unplugging the power cable.

Transient protection

Transients coming in on the AC line can damage (short out) triacs. Zenith has available a kit, part number 800-618, that includes a Metallic-Oxide Varistor (MOV) and other essential parts. Install a kit if the receiver has had a triac failure, or where noise spikes on the line are suspected. (See Figure 9.)

Testing Channel Changing

Similar test procedures should be used in the channel-selector circuits, although there are no Schmitt triggers there.

Ground either the gray or yellow motor wire. If the motor runs, both it and the phase-shifting components (C211 and R227) are okay.

If you can measure 5 volts p-p at the anode of CR202 and +.8 to +1.5 volts DC at the cathode, when the remote button is pressed, that indicates the circuit up to the detector is normal. In between CR202 and the motor are the SCR's, and it's likely they are bad.

Shorted SCR's are easy to find using an ohmmeter. However, open ones or those without proper gate action are more difficult to find. In addition, some machines have both SCR's in one package. Keep that in mind.

Miscellaneous Tips

Check the operation of the microphone and amplifier by measuring the signal at the yellow lead between the amplifier and the main board. Normal voltages with a remote button depressed is about 4 volts p-p of sine waves and +16 volts DC. If room noises trip the remote functions, adjust R8 on the amplifier chassis to reduce the gain.

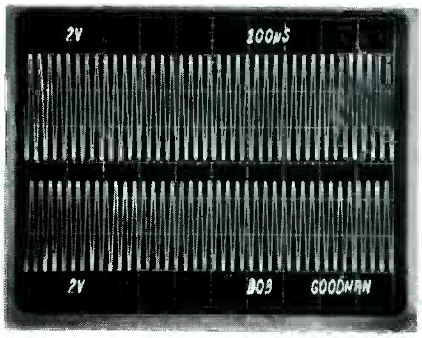


Fig. 11 Dual-trace waveforms show a normal strong channel and one with insufficient amplitude.

Noise in the sound might be caused by a faulty IC201.

If none of the control functions operate, neither automatic nor manual, look for a blown fuse, or a faulty rectifier diode (CR225) in the 24-volt supply. A shorted C216 filter capacitor might cause those two parts to fail.

In the 600Z chassis only, a shorted Q201 would allow only the on-off function to operate. Disconnect it for a test.

Erratic operation during channel changes might be caused by intermittent SCR's or by corroded contacts on the carry-over switch. Cross-switch the SCR's between channel-up and channel-down circuits. If the symptoms also move to the opposite channel, this shows you which SCR's are bad.

Channel changes when no buttons are pushed might be produced by defective SCR's. Let it run for a time, then touch a finger to the SCR's. The warm one is conducting because it is faulty.

Remember, if you unplug an operating TV for service, the next time you plug it in it's supposed to change to the off position. Don't wonder why it won't light up; operate one of the on buttons.

Normal manual operation, but no response to the remote unit, might indicate a mechanical defect in the transmitter. Check to see if the hammer strikes the rod, if the rod is touching anything which would dampen the vibrations, or if the nylon mounting block might be cracked.

A complaint of skipped channels (two or three at a time) might result from a broken damper, which allows the rod to vibrate too long.

I remember one rough case where the channel-up button changed volume, and the off-on button would select lower channels. Luckily, before I wasted too much time on it, I found the owner had tried to repair the transmitter and had mixed up all the rods! It pays not to overlook the simple things.

Alignment

Alignment of L201, L202, L203 and L204 can be done by using a known-good transmitter as a source of signal.

Because the four coils (in 600Z chassis) are in series, there is some interaction when they are tuned. Therefore, the adjustments must be made alternately.

One efficient way is to do them two at a time, using the two channels of a double-trace scope (see Figure 10). Connect both low-cap probes, as shown, then alternately depress the corresponding transmitter button and tune the proper coil for both frequencies. Next, change the probes to points "B" and "C" and repeat. Do this sequence several times, or until all four are peaked at maximum. Figure 11 shows the waveforms of one normal and one weak channel.

Summary

You must understand the purpose and the practical theory of every stage of these all-solid-state remotes before you can troubleshoot with speed and accuracy.

Contrary to video servicing, a scope is not the primary test instrument. Instead a DMM, FET meter or VTVM should be used most often.

Another different situation is the wide changes of DC voltages between signal and no-signal conditions. None of the voltages in the microphone amplifier stages change with signal. But from there on, either the DC voltages are different with a signal, or they change in steps according to the "state" of a DC-coupled multivibrator.

Added to that are the video-blanking and audio-muting functions that operate while the motor is running. Separation of the functions and channeling them to the proper circuit is done with diodes.

A bright side of the troubleshooting picture is that comparison between the various channels helps to isolate troubles. For example, the channel-up and channel-down circuits are virtually identical, thus permitting a direct comparison of resistances and voltages. Signal voltages in the three or four tuned circuits also help analysis, because all should have approximately the same amplitude.

All in all, the information presented here should enable you to troubleshoot these remotes with a minimum of difficulty. □

"BY GOLLY YOU'RE RIGHT! IT DOES HAVE A HOLY GHOST ON IT!"

Reports from the test lab

By Carl Babcoke

These monthly reports about electronic test equipment are based on actual examination and operation in the ELECTRONIC SERVICING laboratory. Observations about the performance, and details of new and useful features are spotlighted, along with tips about how to use the instruments for best results.

This is the first edition of our new feature about test equipment, and it deserves an explanation. Good test equipment, efficiently operated, is indispensible for servicing of modern electronic equipment.

Perhaps you could use some facts about test equipment before you buy, or you might appreciate advice from another technician about how best to operate the equipment. We will attempt to help in those two ways. There will be no parroting of long lists of equipment specifications; those you can get from the manufacturer's ads, or from our Test Equipment column, which will be continued.

Send us your suggestions for types of equipment you would like to see reviewed. We will attempt to cover all items receiving enough interest.

B&K Sine And Square Wave Generator

The B&K Dynascan Precision Model E-310B solid-state sine and square wave generator is the one used to produce many of the sine, square, and ringing waveforms published in **Electronic Servicing** the past few months. Not all writers have the special cameras necessary to take their own pictures of scope waveforms. In some cases, we have duplicated the test conditions, and added the waveform photos to the articles. Also, we use the lab and the various items of equipment loaned by the manufacturers to develop the information needed for articles I write.

Sine Wave Tests

Sine-wave output of the E-310B is rated by the manufacturer as 20 Hz to 2 MHz in 5 decaded ranges with a maximum variation of ± 1 dB over the frequency range. Our measurements using an ancient high-sensitivity AC VTVM showed less than 1 dB difference between the 5 ranges, and only ± 1.1 dB over the range with the most variation. Many of the ranges were flat within $\pm .5$ dB. In other words, you could use the generator without considering the flatness of response with frequency, for all but the most precise measurements.

Output amplitude with no external load measured 23 volts p-p maximum; the specification was 8 volts RMS (22.84 V p-p).

Distortion was extremely low. It

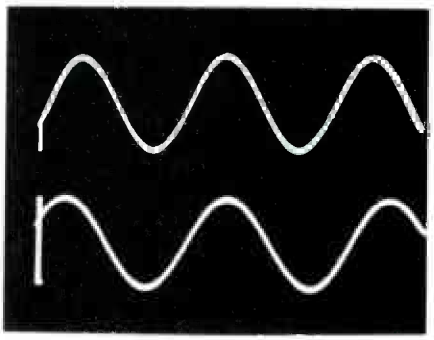


Fig. 1 Sine waveforms from the B&K E-310B are stable and have low distortion. Upper trace shows 20 Hz sine waves, and the lower trace the same waveform at 2 MHz.

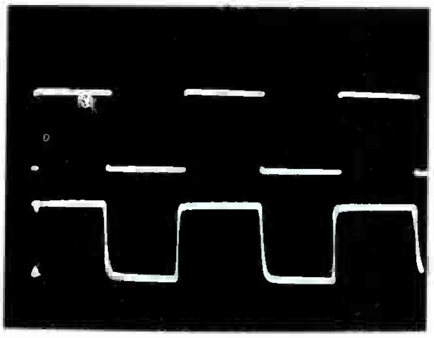


Fig. 2 Upper trace shows 20 Hz square waves. The rise time is so rapid the sides are invisible, and the response below 20 Hz is good, as proved by the lack of tilt to the top and bottom plateaus. Waveshape at 200 KHz (lower trace) is good for that frequency, showing only a slight rounding of the corners and a slower rise time.

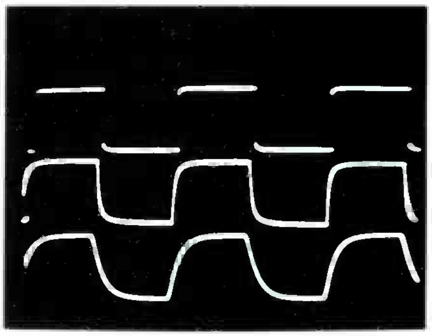


Fig. 3 These waveforms show the visual effects of high-frequency amplifier response on square waves. Top trace is the output of the E-301B generator at about 400 Hz. Trace at the center has rounded corners and tilted vertical lines after the square waves have traveled through a single-section low-pass RC filter. Lower trace shows the effects of two sections of low-pass filters.

Before you sell any color TV, listen to these experts.

The people who service them. For the second consecutive year, a leading research organization asked TV service technicians from coast to coast which color TV needs fewest repairs – which is highest in quality – and which they would buy today. Again, Zenith was named most often.

Question
"In general, of the brands you are familiar with, which one would you say requires the fewest repairs?"

Answers	
Zenith	**35%**
Brand A	14%
Brand B	11%
Brand C	5%
Brand D	3%
Brand E	3%
Brand F	2%
Brand G	2%
Brand H	2%
Brand I	1%
Other Brands	3%
About Equal	13%
Don't Know	11%

Question
"In general, of the brands you are familiar with, which is the highest quality color TV?"

Answers	
Zenith	**45%**
Brand A	24%
Brand B	10%
Brand D	6%
Brand F	3%
Brand E	4%
Brand C	2%
Brand H	2%
Other Brands	4%
About Equal	8%
Don't Know	4%

Question
"If you were buying a new color TV set for yourself today, which brand would you buy?"

Answers	
Zenith	**35%**
Brand A	23%
Brand B	12%
Brand D	6%
Brand C	4%
Brand E	4%
Brand F	3%
Brand G	3%
Brand H	2%
Brand I	2%
Other Brands	5%
Don't Know	8%

NOTE: Answers add to more than 100% because of multiple responses.

The people who own them. When a person lives with a TV set, year in and year out, he knows more about its reliability and picture quality than anybody. In a recent nationwide survey of color TV owners, more than 8 out of 10 Zenith owners said they would buy another Zenith if they were buying a new color TV set today. No other brand showed this much owner loyalty. Can you think of a better measure of owner satisfaction?

We invite you to send for details of these surveys. Write: Zenith Radio Corporation, 1900 N. Austin Ave., Chicago, IL 60639.

For More Details Circle (13) on Reply Card

measured about .1% Total Harmonic Distortion (THD), although that's about the limit of resolution of our distortion meter; the actual distortion might have been less.

Waveforms taken at 20 Hz and 2 MHz are shown in Figure 1. This is a stringent test, and the identical waveforms speak well for the lack of distortion.

Uses for sine waves

Variable-frequency sine waves can be used to measure the bandwidth of audio or video amplifiers. This is a very useful test, often performed for P.A. amplifiers and the audio portion of stereo machines.

Sine waves are a must for determining the overload or clipping point of amplifiers. **How can you see clipping of a square wave?**

To measure the frequency response of a power audio amplifier, disconnect the speaker and substitute a non-inductive load resistor of the same resistance as the rating of the speaker. Connect the sine-wave generator to the input and adjust the amplifier gain control and the level control of the generator for less than maximum output from the amplifier. Measure the AC voltage (preferably in decibels) across the temporary load resistor as you vary the frequency of the generator over the range you want. If your meter is not calibrated in decibels, remember that **each 11%** gain or loss is about 1 dB.

Surprisingly, not all AC functions of VTVM's, digital meters, or VOM's have flat response. Use the generator output to test your meter. If you need accurate results, make a calibration chart of the readings obtained from the generator alone. Then use those figures to correct the readings measured at the output of the amplifier.

Overload or distortion measurements are made with the same hookup, except a scope or distortion meter is substituted for the AC meter. Overload is determined by running up the gain until one or both peaks of the sine waves show a slight flattening. Distortion measurements are made by substituting a distortion meter for the scope, and operating the amplifier at whatever frequency and power output you want.

Square-Wave Tests

Analysis of square waves can provide a fast, but not too accurate, evaluation of frequency response both above and below the repetition frequency. The B&K E-310B generator produces good square waves over the entire range. Incidentally, only sine waves are provided between 200 KHz and 2 MHz.

Figure 2 shows the waveforms at 20 Hz and 200 KHz, the most difficult to produce without distortion. Although the 200 KHz waveforms have slower rise and fall times (brighter vertical lines), they still are usable. Perfect reproduction of such a waveform would require the response of both generator and scope to be flat to about 20 MHz!

High-frequency loss

Reduced amplitude of harmonics

(Continued on page 61)

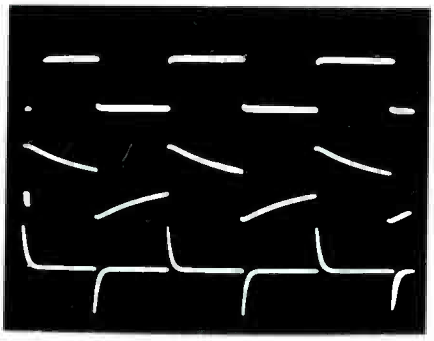


Fig. 4 Top trace is the generator output of 400 Hz square waves, for reference. Center trace is the effect of a moderate amount of attenuation below the repetition rate, produced by a high-pass RC filter. Bottom trace shows only positive-going and negative-going pulses caused by a strong high-pass filter that attenuated even the fundamental of the square waves.

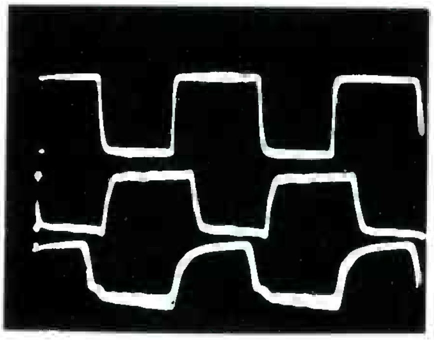


Fig. 6 The 200 KHz square waves help to analyze the bandwidth of video amplifiers. Top trace is the generator output, center trace is the output of the delay line in a color receiver, and the trace at the bottom is that found at the picture tube. Most color video amplifiers cut off at about 2.5 MHz; therefore, some distortion of the square waves is inevitable. The amount of corner rounding tells whether the response is normal or not.

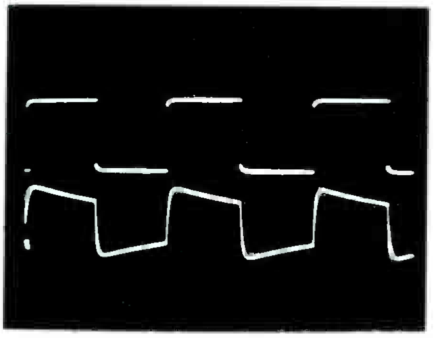


Fig. 5 Many actual amplifiers exhibit both high-cut and low-cut response. Top trace is the square waves from the generator at 400 Hz. Bottom trace shows moderate amounts of tilt and rounding caused by a low-pass and a high-pass filter in series. If inductances are in the circuit, ringing often occurs.

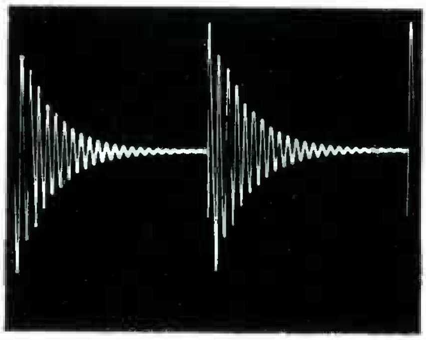
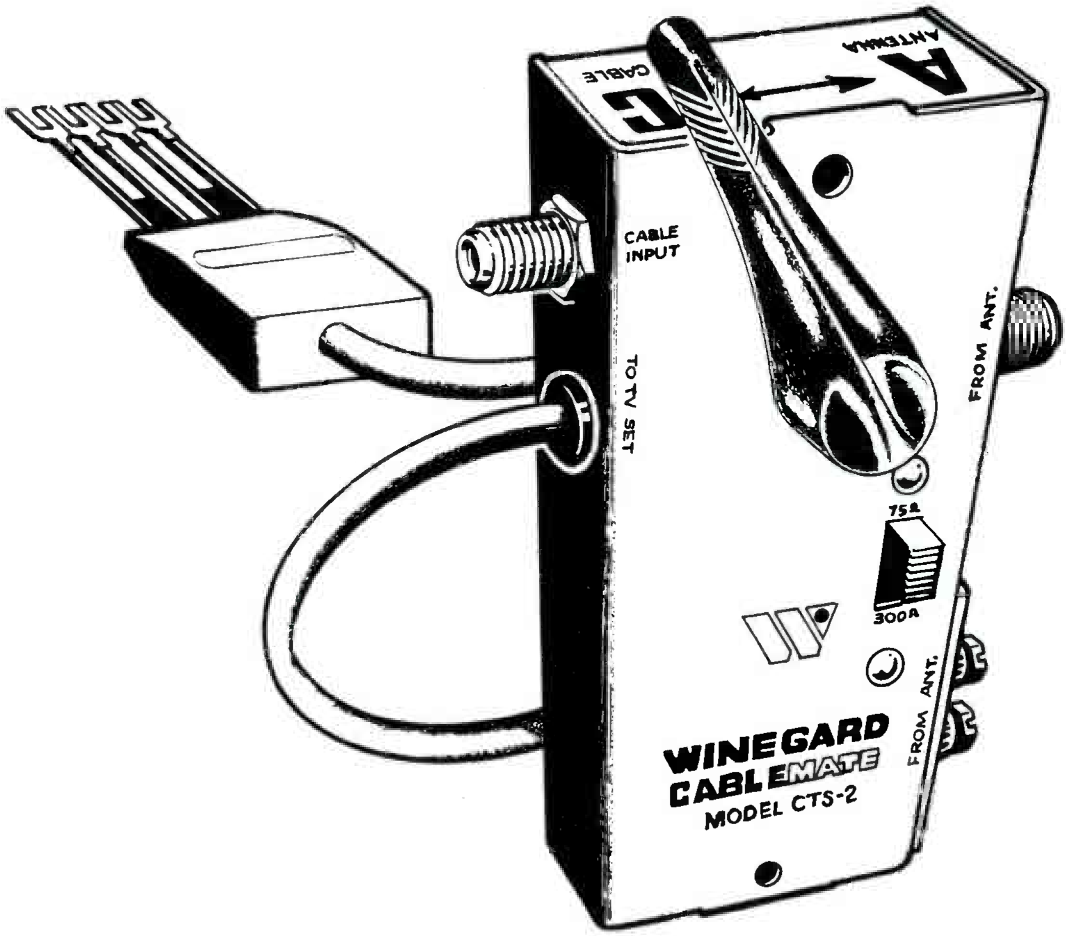


Fig. 7 Square-wave generators are fine sources of the pulses needed for tests of inductances by the ringing technique. A generator gives the freedom from drift, and the ability to be reset accurately to the desired frequency, that's essential for accuracy of results.

How to sell a TV antenna to a cable TV subscriber.



The new exclusive Winegard Cablemate TV Signal Selector lets your customers enjoy the advantages of both cable and TV antenna reception.

If there's cable TV in your area, a lot of your customers already have, or someday will have, a cable hookup. Most of them sign up to get long distance stations or local programming not possible with an outdoor antenna. At the same time, cable people claim that every subscriber will get better reception all the way around.

But the cable subscriber usually gets shortchanged. He soon finds out that the channels he regularly watched with an outdoor antenna **don't** come in as clear on cable. And these are almost always the network stations, the ones people watch 90% of the time.

Technicians Frequently Get Blame

The problem of poor quality cable reception on one or more channels is a common one in city after city. Too often the TV technician is called for TV set repair when the cable is really at fault. Cable outages, too, are a frequent customer complaint.

That's where you come in. With a Winegard Cablemate TV Signal Selector and a Winegard outdoor antenna.

Cablemate lets you connect cable signal **and** the antenna signal to the TV receiver. The viewer simply flips a switch to select antenna or cable.

Not "Just Another Switch"

Cablemate, of course, is not an ordinary switch. It has specially designed circuitry with 58db isolation to prevent interference between cable and antenna signals. And it gives you a choice of coax or twinlead antenna input.

Customers Are Waiting For You

If your cable TV customer already has a good antenna on the roof, then all he needs is Cablemate. But if he has an inadequate antenna or none ar all, then he's a hot prospect for **both** an antenna and Cablemate. That's profitable business . . . and the easiest way yet to sell a TV antenna to a cable subscriber.

As you can tell, you stand to gain a lot from one switch! But then remember it comes from Winegard, the folks who consistently originate new and better products for the TV service industry.

MODEL CTS-2 (illustrated):
$16.95 suggested list.
MODEL CTS-1 (same, but has 75 ohm and 300 ohm output to set and does not include coax or band separator): **$14.95** suggested list.

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For More Details Circle (14) on Reply Card

It was only a tube!

By Wayne Lemons

It isn't always as easy to find bad tubes as you might imagine. These examples prove the point.

You've probably heard the old saw which goes something like this: "Lady, it's only a bad tube...a 25VAMP22!" But picture tubes are not the ones I have in mind here. As a kind of part-time consultant, I often get called in to help with a real "dog" that some poor tech has been working on for a couple of days. I always feel sorry for the guy, and a bit embarrassed for him when the trouble turns out to be a small tube. Of course, I tell him of all the times this bad luck has happened to me. But all too often it seems he can't forgive himself for calling in someone else just to find a bad tube—nor me for knowing that he has.

Of course, it shouldn't be that way. Anyone who has ever worked on radios or TV's has had his share of goofs. You should feel some sympathy as I tell you about my two latest cases of "all it was, was a tube."

No Vertical

The Zenith color set, reported the technician, had come into the shop with no high voltage. He had checked all the tubes, replaced the weak and doubtful ones, and installed a new fuse in the horizontal-output circuit.

Now the set had high voltage okay, but only about an inch of erratic height. The shop technician told me over the phone that he had twice replaced the vertical output tube and the oscillator transistor. In addition, he had checked all capacitors for leakage, the resistors for correct values, and bridged all filter capacitors. The voltages, he said, were high at the collector of the oscillator, and the screen grid of the output tube. It seemed he had tried just about everything, so I promised to come over and help.

After I arrived, I asked for the schematic (Figure 1) and began analyzing the circuit. It seemed to be a straightforward multivibrator. The only unusual feature was the transistor in the oscillator stage.

Now it's my custom whenever possible to have the technician who has been working on the set make all the measurements as I ask for them. He usually knows already where the components and test points are, and I can free my mind for an objective diagnosis. You might try this system sometime, if you are stuck on a tough one.

I asked for the collector voltage of the vertical-oscillator transistor. It was about 150 volts, but the schematic said it should be 40. Either the transistor was defective, or there was insufficient bias. He checked the base voltage. It was +.4 volt measured to ground.

The schematic indicated -8.3 volts, although the transistor was an NPN. Of course, NPN's used as amplifiers have a positive base/emitter bias. But here, rectification of the positive-feedback pulses should give an **average** voltage that is highly reversed bias. Naturally, the base should go positive on the tips of the pulses so the transistor can conduct.

Without any oscillation in the circuit, the base should have been more than .4 volt positive. This reading is nearly cutoff bias. I followed the resistive path from the base through the hold control and some resistors and found the voltage source to be the cathode of the vertical output tube, a 6JA5. I asked the technician to measure the cathode voltage, saying he could find it at **either** pin 4 or pin 11. "There is about one volt at pin 4," he told me, "and nothing at pin 11." Notice that **both** pins should have measured about +15 volts. "Is there anything tied to pin 11?" I

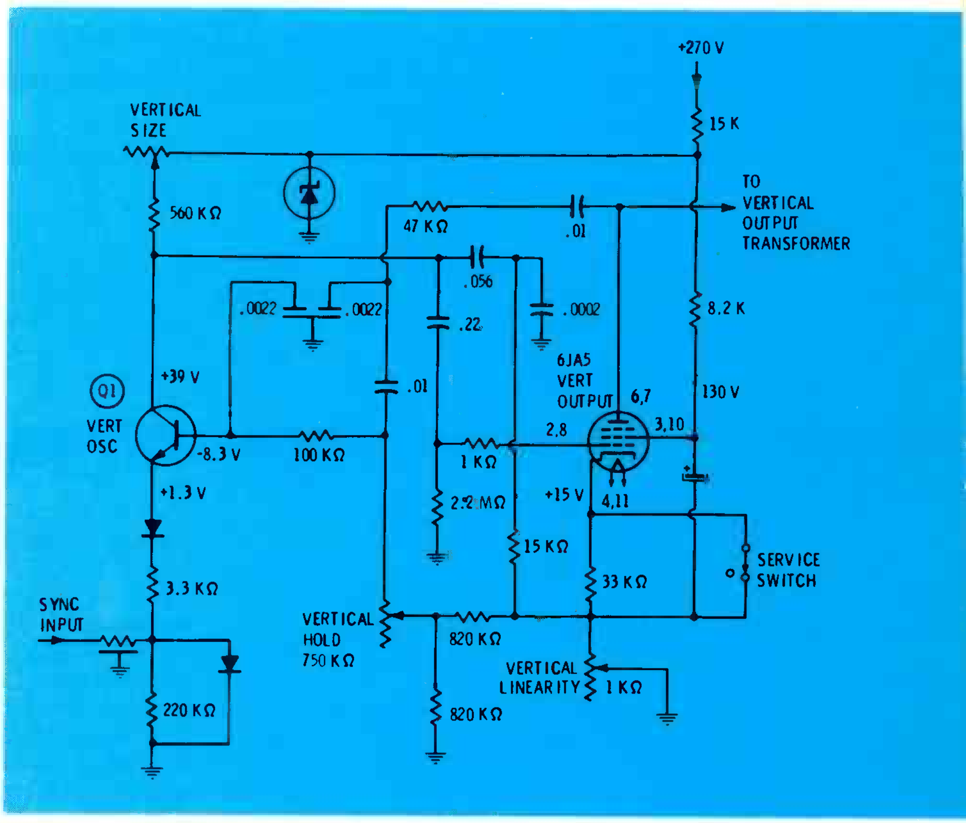

Fig. 1 Vertical-sweep schematic of a Zenith color chassis that had no height.

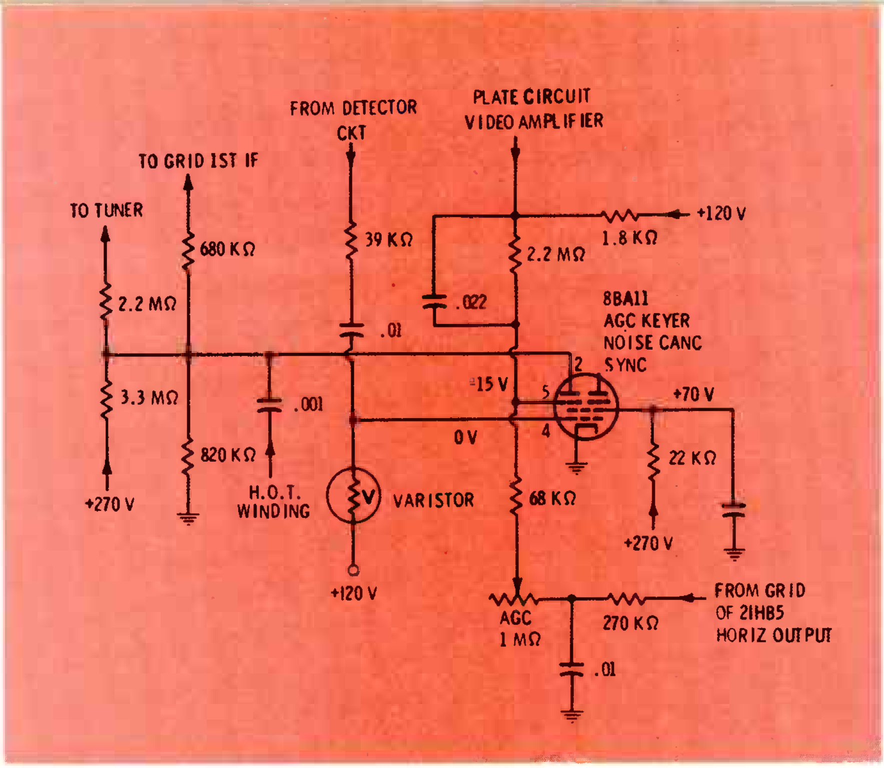

Fig. 2 Schematic of the AGC circuit of a Zenith b-w set having drifting contrast.

asked. "No," he replied. **That was the tipoff!** Did you catch the error? Well, I must admit I didn't for a few minutes. The 6JA5 plate voltage was normal, control grid about -1, and the screen-grid voltage about 20% high. And remember, two new vertical output tubes had been tried, yet the diagnosis was that the output tube had insufficient plate current.

In cases like this having impossible symptoms, we should suspect technician errors. And so it was here. The technician had mistaken the 6JA5 for a 6JH5. The squared "A" to him appeared to be an "H". 6JA5's have an internal jumper between pins 4 and 11, so the same voltage reading should have appeared at both pins.

These tough jobs are easy **after** you know the answer!

Creeping Overload

By a coincidence, the second set was a b-w Zenith TV (Figure 2). When first turned on, the set had AGC overload. After a few minutes the overload would clear and a normal picture appear. But after about twenty minutes or so the contrast gradually decreased, and this symptom remained as long as the set was left on. Next time the sequence was repeated, even after an off time of only five minutes.

The technician had adjusted the AGC control to prevent the overload when first turned on, but the contrast faded sooner and finally the picture would disappear. On the other hand, if he brought the picture back using the AGC control after the set was hot, then the overload was worse when the chassis was cold.

He had replaced the 8BA11 AGC-keyer tube (which is also a noise canceller and sync tube) and the video-output tube. All the capacitors had been checked for leakage, and the resistors for correct values. The technician suspected the VDR which is in the grid circuit, but didn't have one to substitute. He had even tacked in another AGC control as a test. Nothing had made the slightest difference.

I studied the circuit and asked the technician to ground pin 4, the noise-control grid. I pointed out that the grid runs near zero DC volts and was used only to eliminate noise pulses, so a grounded grid should not cause any wrong performance of the circuit. There was no change of symptoms, which proved the components in the control-grid circuit were not to blame.

Next, I asked him to monitor pin 5 of the 8BA11. At first the voltage was -16 volts, but within a few minutes time it was down to -10 and still dropping. At the same time, the plate voltage (pin 2) was drifting more negative. It seemed clear a change of grid voltage was changing the AGC.

Back to Figure 2, I noticed the positive voltage fed to pin 4 was cancelled by a negative voltage through the AGC control and a filtering resistor from the grid of the 21HB5 horizontal output tube. That's good design which permits the cathode of the keyer to be grounded.

"Only about two things it can be," I said. "Either the positive voltage from the video stage is becoming more positive with warm-up (which doesn't seem likely—more AGC should make the voltage go down) or the negative voltage from the grid of the horizontal-output tube is decreasing." The grid voltage should be fixed, and the video voltage is expected to change, so we decided to check the output tube grid voltage first.

A VTVM was connected to the grid of the 21HB5 output tube, and the power turned on. At first the reading was -42 volts, but it immediately started down, and after about three minutes it was only -39. "Replace the 21HB5," I said. "And let's go get a cup of coffee; tube troubles dry me out."

It's not likely any service-type tube tester would have found any defects in the 21HB5. No doubt a tube engineer could give a more sophisticated answer for the tube defect, but I call it a "gas cloud", for want of a better name. This cloud forces the grid to become less negative as the tube heats up. High line voltage causes more severe symptoms, as does excessive screen-grid voltage. The same problems occurred with audio output tubes in past years when distortion would become worse as the chassis temperature increased.

Yes, both the loss of height and the drifting AGC were caused by unusual tube troubles. But be charitable with the techs who were caught in these traps; after all, tomorrow it could happen to you! □

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For More Details Circle (16) on Reply Card

The nitty gritty of installing

By Bert Wolf,
General Manager
Jerrold Electronics DSD Division

Are you reluctant to do outside antenna installations? Perhaps you don't know the "tricks of the trade", and are fearful some jobs might take so much time you would lose money. Here are practical suggestions to help you quickly do technically-correct installations.

The first suggestion for speeding antenna installations is to have all the necessary tools and materials with you at the site. An extra trip back to the shop or the distributors for things you have forgotten can rob all the profit from the job.

Probably you already have most of the tools you need. If not, get them. They are not expensive, and will pay for themselves in time saved.

Use the best tool for each individual task. For example, don't use open-end wrenches instead of the nut drivers mentioned elsewhere in the list of recommended tools.

Keep the tools you use most often near you at all times. One of the best ways is to use a leather tool pouch or holster which fastens to the installer's belt (Figure 1).

Plan the work to avoid extra trips up and down the ladder, and do the various steps in order, to prevent wasted time.

Take care not to drop tools or hardware while you are on the roof. Usually they end up in the gutter, causing much aggravation.

Many installers favor shoes with crepe-rubber soles which help to eliminate sliding on steep roofs.

Make sure your ladder is sturdy and has feet to prevent slippage. Walk with care on ladders and roofs. Remember, **safety first!**

Assembling The Antenna

Always assemble the antenna and attach it to the mast while you are **on the ground.** Usually, it's faster and easier to assemble the antenna upside down (Figure 2).

Fig. 1 A leather tool pouch saves time and aggravation during antenna installations.

Fig. 2 Assemble the antenna, mast, matching transformer (if used), and downlead on the ground, with the antenna upside down.

antennas

Avoid bending the antenna elements. Bent elements not only look bad, they can degrade reception.

If it's a coaxial installation, connect the cable to the terminals of the antenna through a good-quality, weatherproof matching transformer (Figure 3).

The correct way of attaching a connector to coaxial cable is shown in Figure 4. After wiring both ends of the matching transformer, spray the antenna terminals with clear acrylic, and coat the coax connector with silicone grease. Then, slide a weatherboot (Figure 5) over the connector.

If twinlead is used, make sure it is attached securely to the antenna. This is important, for in most installations the twinlead is the first part to give trouble. Broken lead wires at the terminals are all too common.

Pass the twinlead **twice** through the plastic strain relief, as shown in Figure 6.

It's not advisable to strip insulation from the twinlead, and then wrap the wire around the terminal before tightening the screw. If the manufacturer provides crown washers (washers with teeth), don't strip the wire at all. Just split the twinlead, place one insulated wire under each toothed washer, and tighten the screw. The teeth will bite through the insulation to make good electrical contact with the wires inside, and the insulation makes the connection much stronger than would bare wire alone.

But if the manufacturer doesn't provide crown washers, use terminal lugs. Strip back a little insulation, and crimp the lugs onto the ends of the wires. Make sure the lug grips both the wire and the insulation to provide added strength.

Connections made with toothed washers are self-protected against weather, but those made with terminal lugs should be sprayed with clear acrylic.

After you connect the downlead to the antenna, fasten it to the mast. Use 5-inch mast standoffs for twinlead. Tape coax directly to the mast.

Carry the completed assembly up to the roof (Figure 7). If the antenna and mast are very large, it's better to have an assistant hand you the assembly after you reach the roof.

Antenna Mounts

There are so many kinds of antenna mounts available that we can't possibly discuss them all. However, these four types are commonly used: chimney mounts; wall or eave mounts; tri-mounts; and roof mounts.

Chimney Mounts

Chimney mounts (Figure 8) are popular with installers because chimneys generally are high, offer strong support, and require no drilling or guy wires. If the home has a strong, well-placed chimney, use it.

But if the chimney is in a deteriorated condition, or is not conveniently located, stay away from it.

Tools Required

Don't skimp on tools; they pay for themselves over and over again. These are the tools you should have: a complete set of hand tools, including screwdrivers, pliers and cutters, 1/4" and 3/8" nut drivers, a set of ratchet wrenches, coax-connector crimping tool, a heavy hammer, pocket compass, field-strength meter (not needed in some localities), a small level, 3/8" electric drill with wood and masonry bits, 100' extension cable, an extension ladder, electricians fish tape or wire, and black vinyl electricians tape. Most of the tools will fit into a leather tool pouch fastened to the installer's belt.

In addition to tools, you also should have the following items:

- roofing tar, to seal around nails, screws, and bolts that make holes in the roof;
- caulking compound to seal the hole through which coaxial cable enters the wall of the house;
- silicone grease, for waterproofing coax connectors; and
- clear acrylic insulating spray, for protecting twin-lead connections at the antenna terminals.

Fig. 3 When coax cable is used with a 300-ohm antenna, install a good-quality weatherproof matching transformer at the antenna.

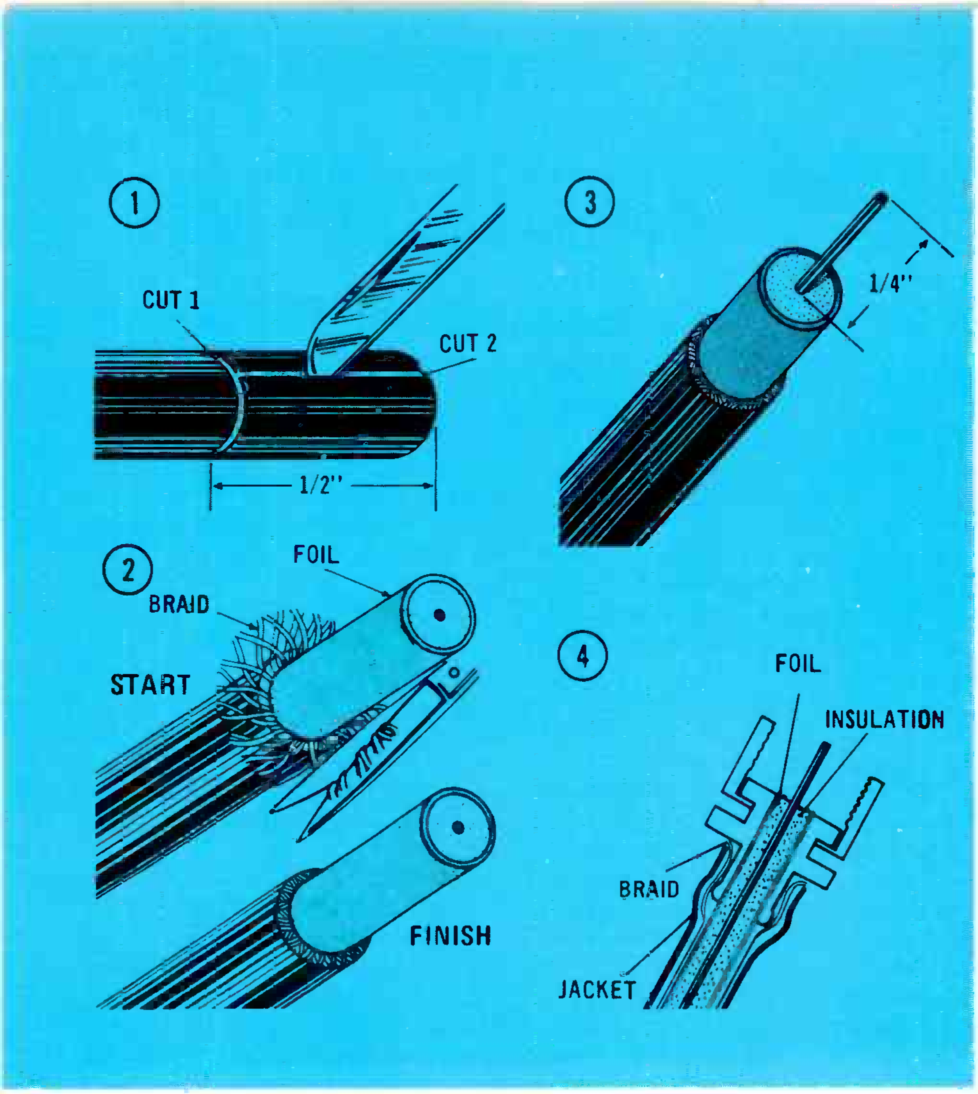

Fig. 4 Use this method of installing F-56 and F-11 connectors on CAC-6 and CAC-11 coax cable: ***Slide** a weatherboot and a ferrule (if used) over the end of the cable. ***Cut around** the outer jacket 1/2 inch from the end of the cable, using a sharp knife. Make a cut to the end, and remove the piece of jacket. Don't cut deeply enough to damage the braid. ***Fold back** the exposed shielding braid and cut off the excess using scissors or cutting pliers. ***Cut foil** and dielectric foam 1/4 inch from the end of the cable and remove the pieces. Be careful not to nick or score the center conductor. ***Dress the foil** against the foam dielectric by twisting the cable between thumb and forefinger. ***Lightly scrape** the center conductor to remove any remnants of foam. ***Push** the connector onto the end of the cable. The bushing should seat between the foil and the braid for good contact. ***Crimp the ferrule,** and inspect the inside connector for any foreign material, such as metal chips or fragments of wire.

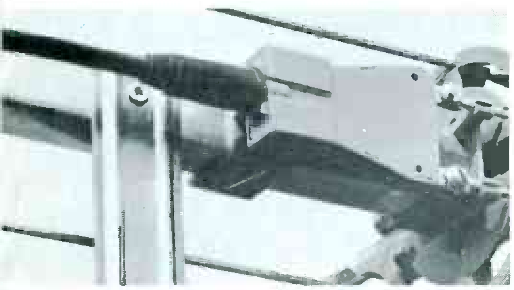

Fig. 5 Slide the weatherboot over the coax connector at the matching transformer on the antenna. Spray the antenna terminals with acrylic spray, and apply silicone grease to the coax connector.

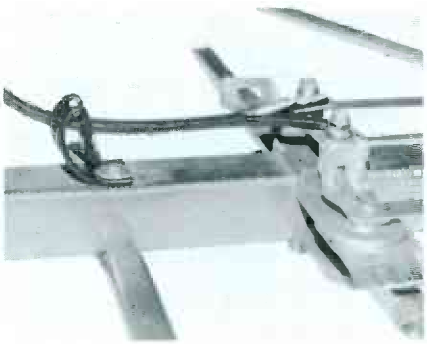

Fig. 6 Insert twin-lead through both holes of the strain relief. This minimizes breakage of wire at the terminals.

Some modern chimneys are not made of brick, so they are too weak. Old ones might have mortar that crumbles to the touch. You could be held responsible for repairs or a new chimney, even if the old one was about to collapse on its own. Choose a different kind of a mount, if you have doubts.

A typical chimney mount consists of two brackets, two stainless-steel straps with eye bolts, and miscellaneous hardware.

There are two important factors in installing a chimney mount. First, separate the two straps as widely as possible, to obtain greater leverage. Straps for a 5-foot mast should be at least 2 feet apart, and for a 10-foot mast, the straps should be separated by at least 3 feet.

Second, make sure the straps are straight and tight. Line up each strap with a row of bricks. Check the far side of the chimney to eliminate any kinks or droops of the straps. Take the strap through an eye bolt, and pull it tight. Line it up straight and pull it, bending it at each corner of the chimney. When most of the slack has been taken up, recheck to make certain the strap is straight, and then clamp it firmly in place.

But don't tighten the chimney straps all the way before the mast is clamped in place. At this point, many installers make a mistake. They try to line up the mast vertically by eye. This is almost impossible on a pitched roof. The slightest deviation from true vertical allows the weight of the antenna to apply torque to the mast, weakening the installation. Besides, even a small amount of tilt looks bad from the ground. **Always use a level** to make sure the mast is absolutely vertical.

Orienting The Antenna

Once the mast is vertical, it is time to orient the antenna. This vital step too often is approached casually by installers. Some simply point the antenna in the same direction as the neighbors' antennas, or they aim in what **they** think is the right direction.

To orient the antenna correctly,

you need two inexpensive tools: a compass and an air map. Any $2 or $3 compass will do, and you can get a "sectional" air map for about 50 cents at any airport for private planes. This type of map shows compass directions, and the locations of all TV transmitter towers.

Locate the transmitter tower on the map and mark it clearly. Then, use the compass to aim the antenna directly at the tower.

Some installers use walkie-talkie's during antenna orientation. One man watches the set for the best picture, and the other moves the direction of the antenna. Good results can be obtained by this two-man technique, but it is quite time consuming. Only if you run into severe ghosts caused by signal reflections from hills or tall buildings (or if the TV stations are located in different directions) is orientation by trial-and-error indicated.

After the mast is vertical and the antenna aimed properly, it's time to button up the installation. Make certain all the clamps and nuts are tight, so the antenna can't twist or move in high winds.

One last word of caution about chimney mounts. Don't let the bottom end of the mast rest on the roof. The entire weight should be supported by the chimney mount to prevent the mast from digging a hole into the roof.

Wall and Eave Mounts

Wall and eave mounts (Figure 9) are quite similar, but the eave mount extends out farther so the mast can clear an overhanging eave. Installation is easy; just make sure that your mounting screws hit solid wood.

Use your level to make the mast vertical, and the compass and map to orient the antenna. Caulk all screw holes.

It isn't easy to use guy wires with wall or eave mounts, so don't try to use a high mast. About 10 feet is the limit.

Tri-mounts

Two types of tri-mounts are shown in Figure 10. They can be

Fig. 7 Carry the completed antenna/mast assembly up to the roof. Don't attempt to assemble it on the roof.

Fig. 8 Chimney mounts are favored by many installers. Place the straps as far apart as possible.

used on any slope or at the peak of a roof. However, you're usually better off to choose the peak because that's where it's most likely you can hit solid wood with the mounting screws.

If the tri-mount is not set at a peak, locate rafters by tapping the roof. A screw that doesn't hit solid wood is worse than useless.

Sometimes you might be forced to locate a tripod where one of the legs is not over a rafter. In that case, use a six-inch square of 3/4- or 1-inch plywood **inside** the roof, and sink the lag bolt into it so it pulls the plywood tightly against the roof. This kind of installation is very durable, but should be avoided as much as possible because it takes so long.

Use roofing tar around all mounting screws and lag bolts.

Tri-mounts can hold a 5-foot mast easily, but if you go up 10-feet or more, you should use guy wires.

Roof Mounts

Roof mounts, like tri-mounts, can be used in a variety of ways, although the best place is at the peak of a roof, because it's easier to find solid wood there.

If you can't use the peak, it's a good idea to attach the roof mount to a 2X4. Position the 2X4 so it passes over two rafters; this makes a secure installation.

Guy wires are **always** required with roof mounts. After the mount is firmly anchored, swivel it down and insert the mast. (You should have the guy ring, guy wires, antenna and downlead already assembled to the mast.)

Don't shove the mast so far into the mount that it can rip a hole in the roof. All of the weight should be supported by the set screws on the mount. Tighten the set screws so they dig deeply into the mast.

Next, "walk the mast" to an upright position. Masts 10 feet and shorter can be handled by one man. Higher masts require two men.

Figure 11 shows how two men easily can "walk-up" a tall mast.

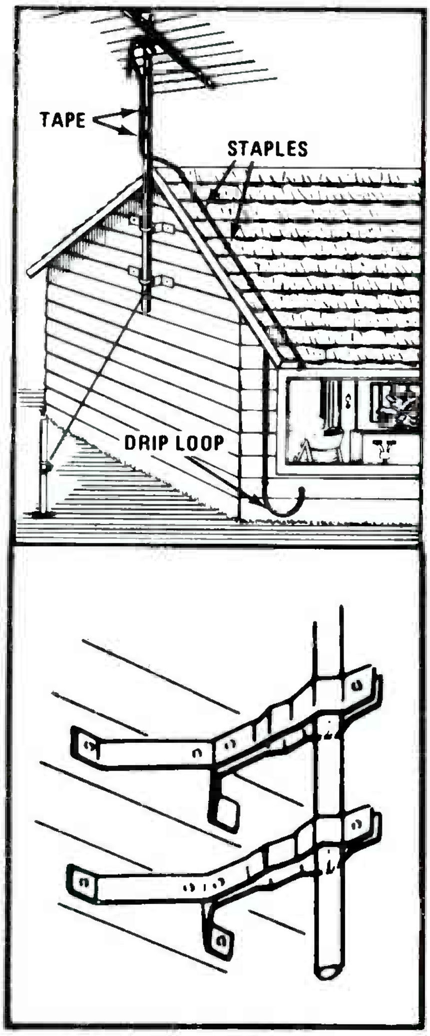

Fig. 9 Wall mounts are good for use with short masts. Eave mounts are similar, but they are longer so the mast can clear projecting eaves.

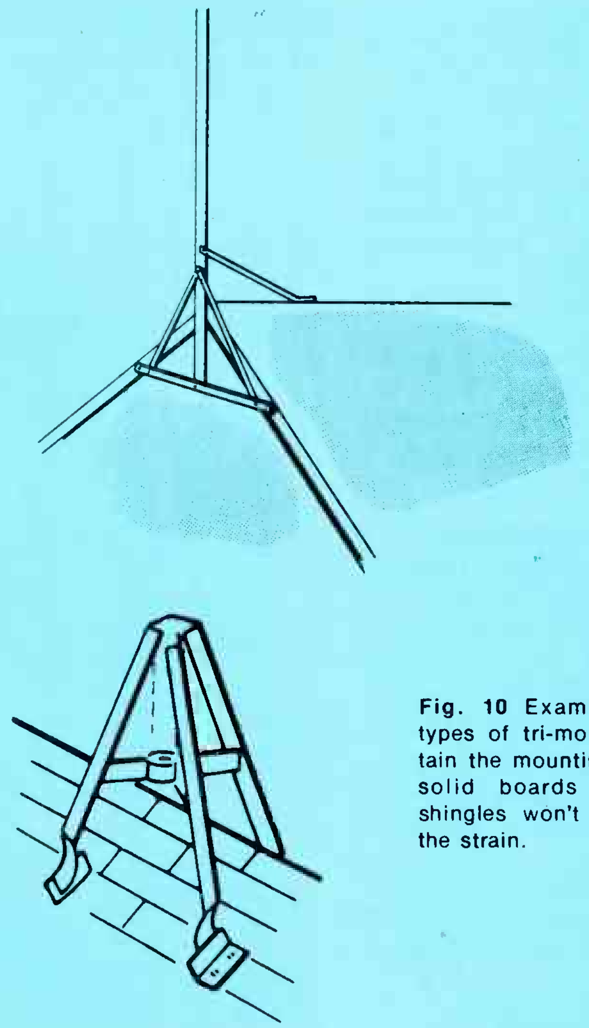

Fig. 10 Examples of two types of tri-mounts. Be certain the mounting screws hit solid boards or rafters; shingles won't hold against the strain.

One guy-wire eye bolt is installed directly opposite the antenna, and a guy wire passed through it. One man pulls on the guy wire while the other man pushes the mast upright.

Before the mast is upright, aim the antenna, using the compass. Then, when the mast is approximately vertical, use the level to be sure it is absolutely straight. As the guy wires are tightened, the level should be used to keep the mast perpendicular.

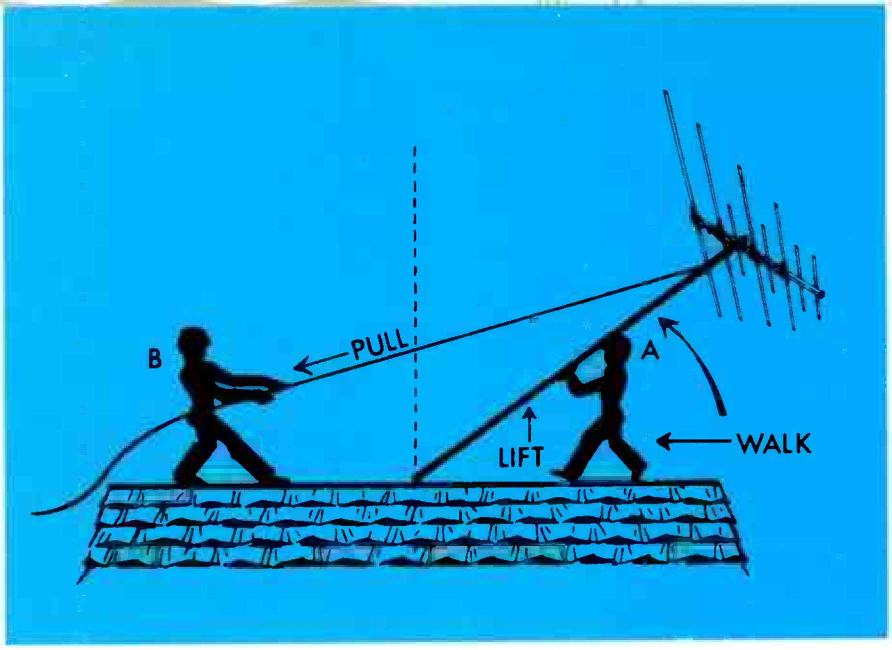

Fig. 11 Tall masts require two men to "walk-up" the antenna assembly. Use one guy wire for the pull.

Guy Wires

Guy wires are essential for all masts over 10-feet. Tall masts should be guyed every ten feet, as shown in Figure 12. Vinyl-clad steel guy wire costs a little more than other kinds, but it is strong, attractive, rust-proof, and easy on the hands during installation.

Guy wire can be attached either by twisting it tightly, or by using a clamp. Twisting is quick and secure, but removal is difficult. Many good installers prefer to use clamps.

Some installers use four guy wires, spaced 90° apart. However, most professionals feel that three wires spaced at 120° do just as good a job, plus requiring less time and materials.

At the mast, use a guy ring for each set of guy wires. Solidly clamp the guy ring to the mast.

Turnbuckles are a "must" for adjusting the tension of guy wires. You can get away with two turnbuckles on a 3-wire installation; but it's better to use a turnbuckle for each wire.

When you adjust guy-wire tension, be careful not to cause any bows in the mast. This especially can be a problem with masts over 10-feet high.

Guy hooks or eyebolts, of course, must be screwed into solid wood. To prevent leaks, use roofing tar around each eyebolt.

Grounding

Grounding of the antenna and mast is required by the National Electrical Code. The ground wire must go directly from the installation to a good ground, with no intervening splices or connections. Grounding wires must be of large gauge and be made of some corrosion-resistant material, such as copper, aluminum or copper-clad steel.

According to the code, only two types of ground electrodes are acceptable. They are:

- a 3/8-inch (or larger) ground rod, driven at least four feet into the ground; or
- a metal cold-water pipe. (Hot-water pipes won't do.)

MATV installers often use cold-water pipes, but installers of home antennas usually find it easier to drive in ground rods, and connect them to the mast with aluminum ground wire.

If a chimney mount was used, fasten the ground wire between the mast and one of the chimney mounts. Then, take two or three turns around the mast to take the strain from the connection. A similar technique can be used with other types of mounts, also.

Route the ground wire in as nearly a straight line as possible directly to the ground rod. If you have to cross a gutter or an eave, insulate the ground wire. A short length of ordinary garden hose slit down the middle and fitted around the wire at the point of obstruction does an excellent job. A few 6-inch lengths of hose, pre-cut and slit should be carried for the purpose.

Use a heavy hammer to drive the ground rod into the earth at least 4 feet. All ground rods come equipped with a clamp that makes connection easy. Carefully choose the spot for the ground rod. Don't place it where someone is liable to trip over the rod or the wire.

One way you can save both time and materials is to choose an antenna that is electrically grounded to the mast. This way only one grounding wire (from mast to the ground rod) is required.

Non-grounded antennas require that the lead-in also must be grounded, using a lightning arrestor which is grounded. A stronger mechanical hookup is to run the wire from mast to ground rod, and then to the lightning arrestor (Figure 13).

Coax cable is even more difficult to ground than twinlead. A grounding block is required (Figure 14).

Another advantage of electrically-grounded antennas is that checking downlead is much easier. If the antenna is not grounded, you must climb the roof, short across the antenna terminals, and then go back down to the set before taking the continuity reading.

To check the downlead of a grounded antenna, all you have to do is take a continuity reading right at the set; the antenna completes the circuit. This is a great time saver, especially on callbacks or during repairs.

Why ground?

Many installers question the wis-

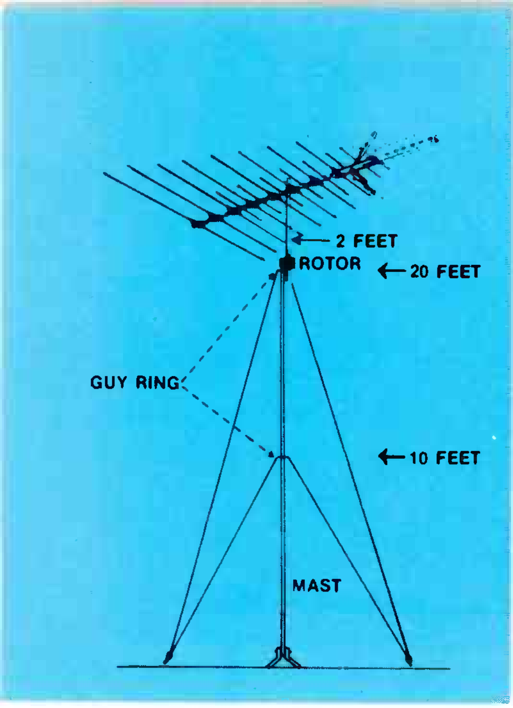

Fig. 12 Install guy rings and wires for each 10 feet of the mast. Either three of four guy wires can be used.

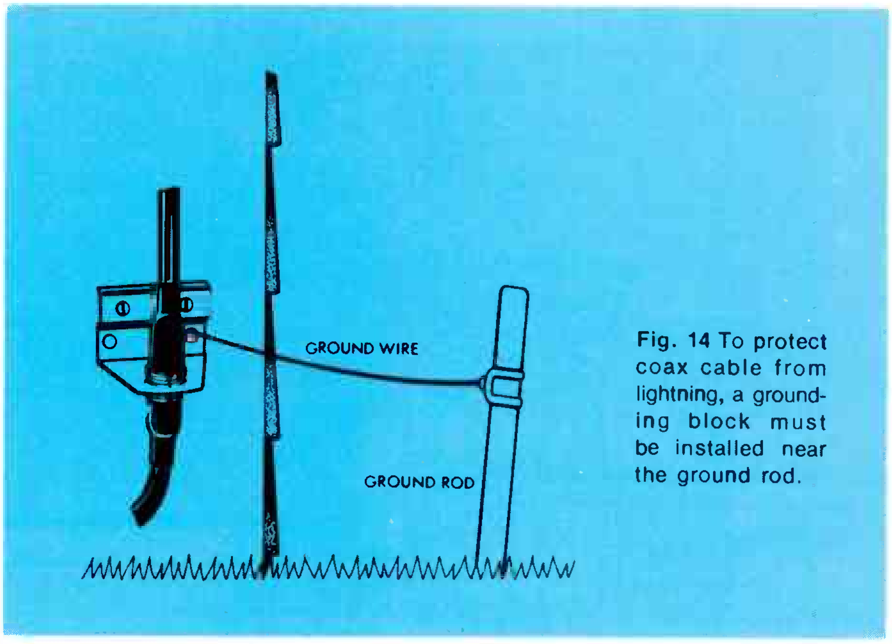

Fig. 14 To protect coax cable from lightning, a grounding block must be installed near the ground rod.

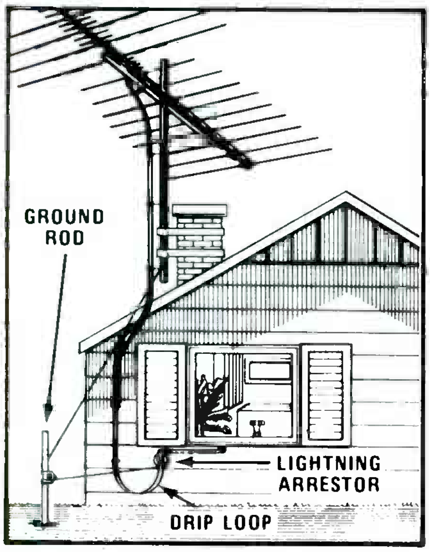

Fig. 13 A typical twinlead installation showing the grounds. For clarity, the ground rod is shown too far from the house.

dom or necessity of grounding antennas. They say lightning is capricious and not much better understood than when Franklin made his experiment with kite and key.

It's true that an installation meeting all requirements of the National Electric Code has no guarantee that lightning can't burn down the house or damage the TV.

But there's one strong, overriding reason for grounding: **without it you leave yourself open to a lawsuit in case of trouble.**

What about grounding rotor wires? Theoretically, this should be done. Actually, nobody does it because there is no practical way. Lightning arrestors for rotator wires are available, but they are of questionable value. There are two good rationales for omitting rotor-wire grounding: The antenna is higher than the rotator, so lightning is more likely to strike it; and if lightning does travel down the rotator wire, it is not apt to burn out anything but the rotor control box. Of course, this is preferable to burning out the TV receiver.

Lead-In Wires

Lead-in wire is the vital link between the antenna and the TV set. Two basic types are used: twinlead and coax.

Since the early days of TV, twinlead has been most commonly used. It is convenient, easy to work with, and inexpensive. However, more and more professional installers are turning to coaxial-cable downleads.

Because the characteristic impedance of coax is 75 ohms, it must be connected to 300-ohm antennas and TV sets through matching transformers. This is the major disadvantage of coax. (But some manufacturers now are providing 75-ohm inputs at the receivers.)

The advantages of coax are numerous:

- Coax is shielded. Thus, it keeps interference out, and keeps signals in;
- Coax maintains its impedance match no matter how it is run. Twinlead must be run through standoffs, and kept away from metal. Because it is impossible to keep the download away from all objects, mismatches result which produce color smears and shifts, plus some loss of signal;
- Coax doesn't pick up auto-ignition interference; and
- Coax is much more durable than twinlead. The average lifetime of twinlead is 3 to 4 years. Coax can last 10 to 20 years.

Some installers shy away from coax for fringe installations because they have heard that the attenuation of twinlead is lower. This is more theoretical than practical. Theoretically, good twinlead causes about 5dB per 100 feet at Channel 83, while good coax produces about 7dB per 100 feet. This 2dB difference appears to be significant. However, in practice, standoffs and the proximity to wood and metal significantly increase twinload loss. What's more, **when twinlead gets wet, dirty or cracked, it might have from 10 to 50dB per 100 feet of loss.** Often this more than balances the scales.

The installer who uses coax doesn't have to worry about running it carefully. And he knows the good picture obtained initially will continue to be good for many years, even when it rains.

If you use twinlead, run it carefully. Use two mast standoffs for the first 5 feet of mast, plus an extra standoff for each additional 5

Fig. 15 Most TV receivers have 300-ohm input impedance, and so require a matching transformer between the terminals and the coax cable. For all-channel installations where the receiver has separate UHF and VHF terminals, the matching transformer should be a frequency-splitting type, as shown.

feet of mast. Use them closer together near bends, or where necessary to keep the twinlead away from metal.

Indoors, use a staple gun to fasten twinlead to the baseboard. Whether the staples run parallel or across twinlead, they upset the impedance match. But this is the only practical way; so use as few staples as possible.

If you choose coax, just tape it to the mast using vinyl tape. Don't worry about keeping it away from wood or metal. Hold it with round staples where necessary. At the set, use a matching transformer. With an all-channel antenna and a single downlead, connect a combination matching transformer and U/V splitter (Figure 15).

Another advantage of coax is that you can coil an extra length behind the set for use when cleaning or servicing the set. **Don't ever coil twinlead!**

Tips For Running Downlead

If possible, bring the lead-in into the house through the attic, basement, or a convenient window.

If you are forced to enter the house through the siding, break away a shingle, drill the hole, then fasten back the shingle to cover the hole.

Use a carbide-tipped bit and the electric drill to go through a brick or masonry wall.

After you get through the exterior wall, use a bit extension with a very small bit to go through the inside wall. Without an extension bit, you could use an ice pick to find the right spot on the inner wall. Then, drill the larger hole in the inside wall, going from inside to outside.

Don't crimp standoffs tight around twinlead, because this is a closed loop of metal which acts as a short at that point.

Don't crush coax, or bend it sharply. Any change of spacing between the center conductor and the shield results in a mismatch.

Unless you have plenty of time, and are getting a lot of money for the job, **don't** try snaking lead-in through the walls using an electrician's fish tape. Just run the wire neatly along crawl spaces, through closets, and along baseboards.

The way you run downlead is a direct indication of your skill as an antenna installer. You should be able to do the job quickly, neatly, and without causing problems to the signal.

Summary

If you use good tools and practice the techniques given here, you can do better antenna installations more quickly. That's the name of the game! ☐

Multiple scopes for classes

By Henry V. Golden, CET

Modify your "master" scope and you can operate several "slaves" for better visibility by your students.

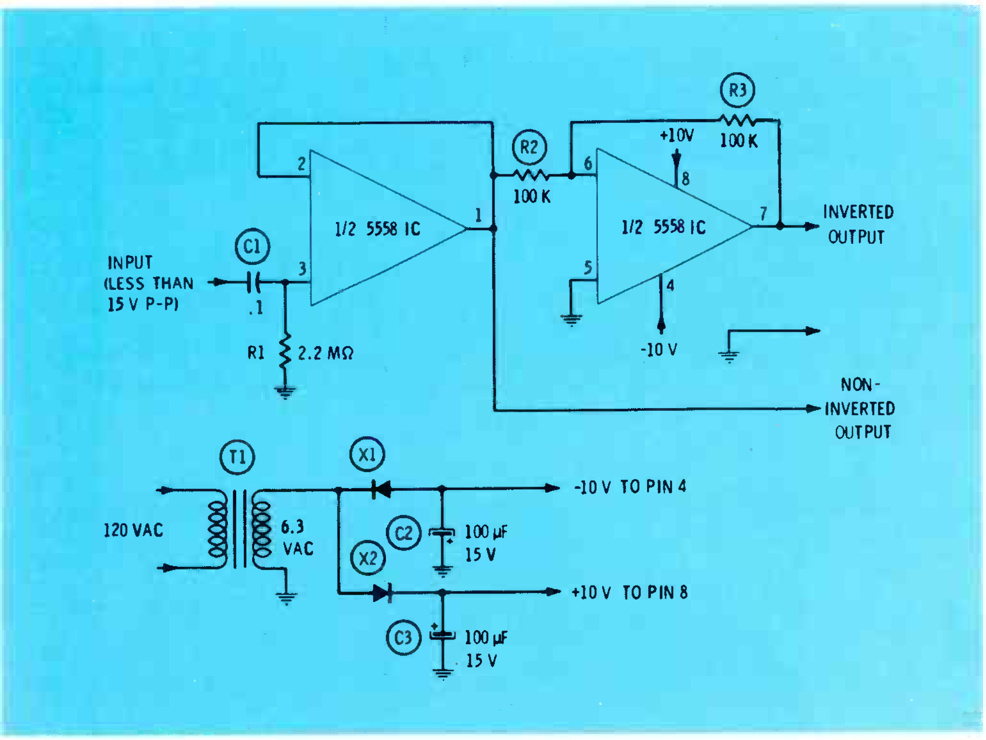

Fig. 1 Schematics of power supply and one channel of the isolation device using IC's. One channel is used to supply vertical deflection, and the other to supply horizontal deflection to the slave scopes. Both IC's have negative feedback to give improved frequency response and reduce the gain to unity. 1558 IC's also can be used.

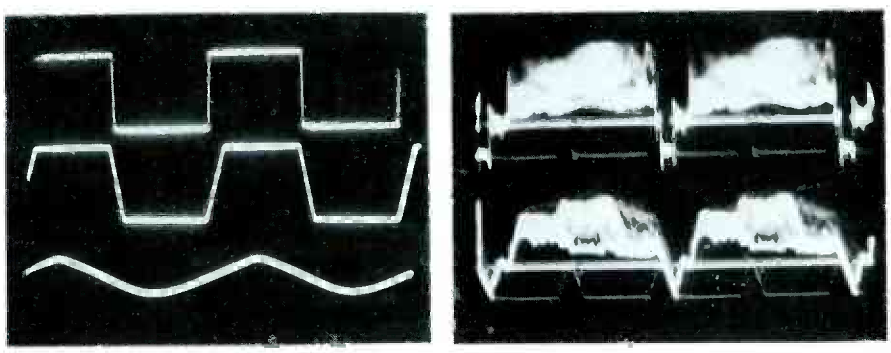

Fig. 2 Frequency response and "slew rate" are not satisfactory for waveform analysis at TV horizontal scanning rates. **Left** Top trace is the square-wave response at 1,575 Hz, center trace is the response at 15,750 Hz, and bottom trace is waveform at 157,500 Hz. **Right** Top trace is the input to the isolation amplifier, and bottom trace is the output, showing sloping sides and narrowed bandwidth.

Hands-on demonstrations of video troubleshooting or alignment using scopes are excellent educational presentations. However, in a class or service meeting, such demonstrations also can lead to frustration for the viewers straining to see one small 5-inch scope screen. One instructor and two students are about the limit for effective viewing and adequate elbow room. Imagine what it's like when 20 people try to see one screen!

How convenient it would be if you could adjust one scope and have 4, 5 or 6 slave scopes following every waveform without any adjustments. This could be done by bringing out signals from the vertical and horizontal amplifiers of the master scope and connecting them to the slaves. But a direct connection of this kind has many potential problems, such as:

- The impedance of several scope inputs in parallel seriously can load down the take-off point of the master scope, causing reduced gain and poor high-frequency response;
- Without shielded connecting wires, hum picked up through the air by the cables can distort the waveforms; and
- With shielded cables, the capacitance is greatly increased, causing loss of high frequencies.

What is needed

Some kind of isolation circuit is needed which will not load down or cause distortion of the waveform in the master scope, will give at least a gain of one, and can supply several

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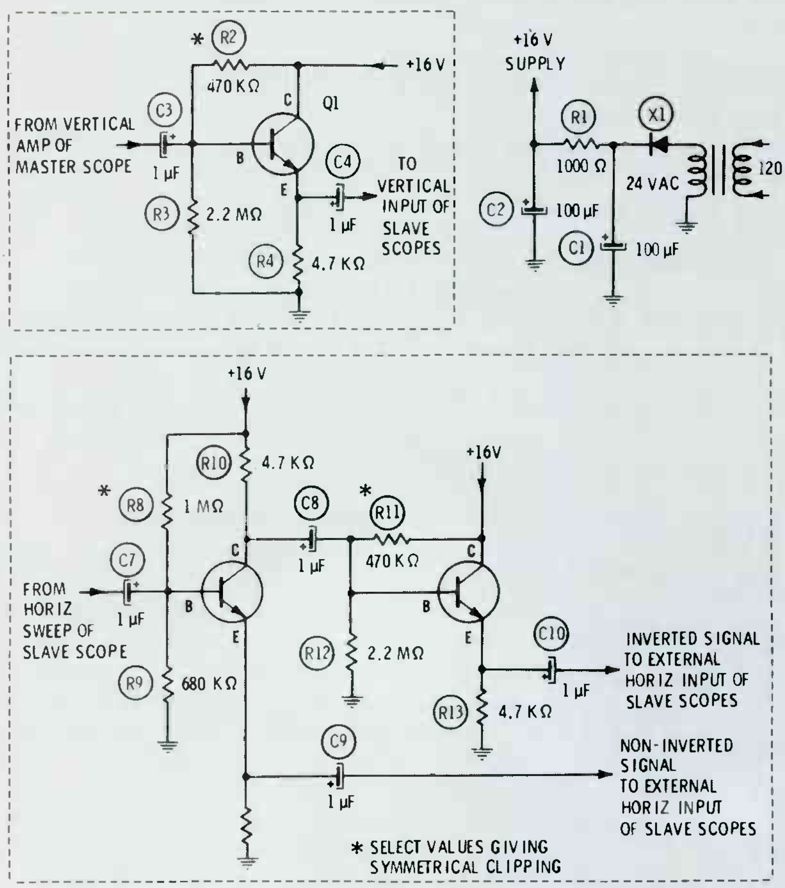


Fig. 3 Schematics of power supply, and the vertical and horizontal amplifier stages which use transistors. Input impedance of the phase inverters is about 150K ohms, and of the emitter followers is about 220K. Resistors marked with an * should be selected to give symmetrical clipping at top and bottom, when the unit is overloaded. Change the polarity of the input coupling capacitors according to the voltages in the master scope. Transistors are Motorola HEP735 or equivalent.

volts of output signal not sensitive to capacitive effects. These specs translate to a circuit with high input impedance and low capacitance, unity gain, and low output impedance. At this point, you might be thinking of emitter followers, or op-amps. If so, you're on the right trail. But there are several details to be considered and some problems to be solved.

For example, the custom is for scopes to give an upward deflection from a positive-going signal at the input of the vertical amplifier, and a deflection to the right from a positive-going signal applied to the external-horizontal input. Unfortunately, not all scopes conform to this. Therefore, our isolation circuit should include a phase inverter to provide either polarity of signal, so the waveform on each slave scope will be identical to that on the master.

Op-Amps, A Narrow-Band Solution

Except for their limited high-frequency response, operational amplifiers (op-amps) built with IC's offer an easy solution to the problems previously mentioned. Because only bandwidth enough to pass a 60 Hertz square wave is required for TV alignment or troubleshooting at 30 Hertz sweep, the op-amp to be described is very adequate for those two jobs.

Theoretically, an op-amp should have an infinite input impedance, infinite gain, infinite bandwidth, and zero output impedance. In the real world, these specifications might be an input impedance of several million ohms, a voltage gain between 20,000 and 500,000, and an output impedance of about 100 ohms.

Isolation circuit

The circuit of one channel of the isolation device is shown in Figure 1. Two channels are required; one for the vertical amplifier and one for the horizontal sweep. Only one capacitor, three resistors, and one IC are needed for each channel. The power supply only has five active parts.

Building the circuit

Mechanically, the circuit can be laid out in just about any way you like. It should be small so it will fit **inside** your master scope. To prevent any possible interaction between the signals, separate the two channels, or install a metal shield between them. Also, keep the input leads and output connectors separated as far as practical. Don't shield the wires from the original scope wiring to the isolation circuit. In fact, they should not be dressed near any other parts of the circuit or against any metal.

Position the unit as far to the back of the scope as possible to prevent the magnetic field of the power transformer from adding hum to the scope trace. Wire the transformer primary wires in parallel with those of the scope transformer, so the extra circuit comes on when the scope does.

Phono plugs on the rear of the master scope permit you to disconnect the extra wiring when not needed. Four plugs allow you to easily connect either polarity of the two channels, as needed for the particular scopes in use.

Undistorted output is about 16

volts peak-to-peak. It's just slightly less than the sum of both polarities of power supply.

Because the gain is one (or unity), 16 volts p-p is the maximum which should be applied to the input. Use the following procedure to find the best spot to connect the inputs to the wiring of the master scope:

- Remove your master scope from its cabinet to expose the internal wiring;
- Connect the master scope to a TV chassis and adjust it for a video composite waveform at the horizontal rate (two horizontal lines of video on the screen). Increase the gain so the waveform is as tall as the graticule markings at top and bottom;
- Use a second scope to trace through the vertical circuit of the master scope. Locate a point following the gain switch and control that has several volts p-p, but not exceeding 12 to 15 volts;
- Watch the color burst on the master scope as you touch the input lead of the isolation circuit to the point. Amplitude of the burst should **NOT** decrease. If it does, try another point, perhaps on the other side of a peaking coil or resistor;
- Solder the lead, being careful of the lead dress, as previously explained. There should be no change of waveform on the screen of the master scope.
- Trace the horizontal sweep and find a point beyond the horizontal gain control, but one with no more than 12 volts p-p at full width;
- Temporarily connect the other input lead of the isolation circuit. There should be no change of width or length of retrace on the screen. Solder that input wire. That's all; just replace the chassis in its cabinet.

Performance of the op-amp

The waveforms of Figure 2 show the limitations when using ordinary 5558 IC's in the isolation circuit at the horizontal scanning rate of TV's. Chief cause of the change of waveform is not bandwidth, as you might imagine, but a characteristic called "slew rate". This is the speed with which the op-amp can switch from off to saturated, and is shown by the slanting sides of the square waves and horizontal sync pulses.

This response is more than adequate for TV alignment or for viewing video waveforms at a 30 Hertz rate. And, by making mental allowances for the sloping sides, we could even accept the pointed wave-

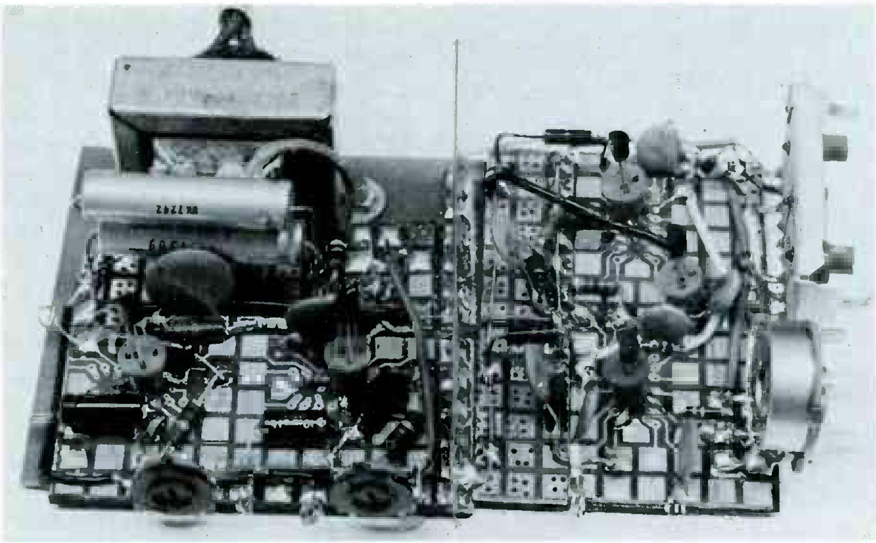


Fig. 4 An experimental breadboard of the circuit in Figure 3, showing the shield between vertical and horizontal, and the pots used to determine the values of the bias resistors.

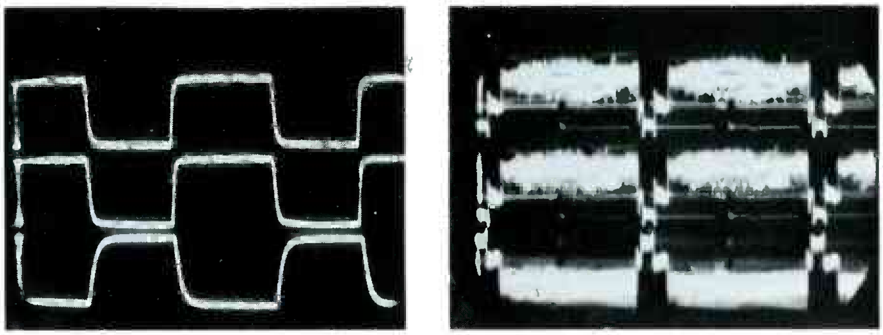


Fig. 5 Waveforms show that the bandwidth using transistors is adequate for video analysis at the horizontal rate. **Left** Top trace is the generator output at 200 kHz, center is the almost identical output from the emitter of the phase inverter, and the bottom trace is the collector output, showing some loss of high frequencies. **Right** Top trace is the output from a video detector, center is the output from the emitter of the phase inverter, and the bottom trace is the output from the collector.

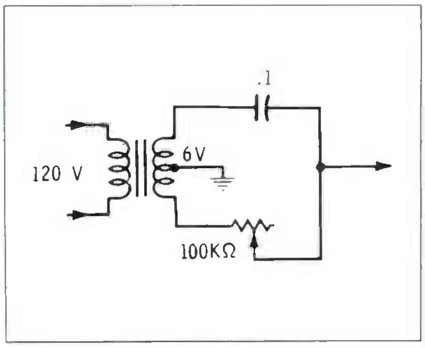


Fig. 6 Schematic of a unit you can build that produces nearly 180° variation of 60 Hz voltage. This is needed for TV alignment, if the signal is not supplied by your alignment generator or scope.

shapes seen at the scope rate of 7867 Hz.

A better solution is to substitute the newer 5558S version of IC's; according to the spec sheets, the square waves should be nearly perfect. Unfortunately, we were unable to obtain them in time for a test.

Wider Bandwidth With Emitter Followers

Another circuit (Figure 3) using a few more parts has several emitter followers (for high input impedance and low output impedance) plus a phase inverter. The frequency response and slew rate are much better than when using op-amps, but the stages overload at a lower input signal. Overload is at about 9 volts p-p.

Most of the precautions about location of the unit and dressing of the connecting wires applies to this circuit, also.

To prevent any loss of bandwidth or distortion of the waveform because of cross-coupling, separate the vertical and horizontal circuits, or add a small partition shield between them (Figure 4).

Polarity of the input electrolytics should be selected according to the voltages at the connecting point in the master scope.

If you are sure there will be no need for the phase inverter, it can be omitted. Both circuits, then, will be like the vertical stage of Figure 3.

"WOULD YOU BELIEVE A TYPOGRAPHICAL ERROR IN THE PRINTED CIRCUIT?"

Waveforms showing the bandwidth are in Figure 5. Color burst was attenuated only about two dB's by the emitter followers.

Variable-Phase 60 Hz

TV sweep alignment requires a source of variable-phase 60 Hz voltage for horizontal deflection of the scope. Some sweep generators supply this voltage; some scopes have the circuit and the control for it.

If your scope and generator do not have this necessary voltage, you can construct the circuit of Figure 6. It requires a center-tapped winding, and some scopes might have this already. In that case, you would not need the heater transformer, and the circuit could be installed inside the master scope.

Or the entire circuit could be built in a small metal box so it could be used with any scope or generator.

Connecting The Scopes

Low-capacitance shielded microphone cable is recommended for wiring between master and slave scopes. If you are going to vary the setup at other times, use phono plugs and jacks for connections. For TV alignment work not requiring wide bandwidth, these precautions are sufficient.

But if you also want to show undistorted horizontal-frequency video waveforms from the emitter-follower isolation circuit, take two more steps. Don't use any more cable than absolutely necessary. Even emitter followers are not completely immune from capacitance loading. Also, operate the slave scopes with their low-capacitance probes to reduce stray capacitance even more.

Summary

Although I have tried to work out most of the "bugs" from the circuits, I am aware, as you are, that many variations are possible. That's why the reasons for doing certain things were given. The concept of master and slave scopes has worked well in the classes I have taught, and I sincerely hope it will for you. □

I'd rather "switch" than fight

By Carl Babcoke, CET

There is a way of obtaining the best reception from BOTH outside antennas and cable. Special switches select either source of signals.

Cable TV finally arrived in my neighborhood in a suburb of Kansas City. This particular system included a converter and separate remote control box with two rows of buttons, a fine-tuning control, and a switch to select one of two cables.

Signals on the cable had been converted to another band, as proved by the lack of signal when the cable signal was fed through a matching transformer direct to the receiver without benefit of the converter. To operate with cable, the set was tuned to Channel 2, and all stations then were selected by push-buttons on the remote control.

Each of the twelve channels had a viewable signal. Four channels carried signals from two cities about 50 miles away (impossible for us to receive before), and three channels featured cable news, weather, and stock market. It was great fun playing tunes on the buttons, and the pictures all looked fine. At least, they did at first.

Then the local news came on with the newsmen in bright red coats. The color was very bright, but had streaks and a grainy kind of snow in it. In all fairness, I must say most people would have found the reception very satisfactory. But there had been **no** visible snow before on the five local channels received on our outside antenna. About that time, my wife said she wanted the cable taken out; reception was better before.

What to do? I liked the weather instruments and forecasts, and the possibility of receiving programs at different times from the slots decreed by the local stations. Yet, I didn't want to sacrifice better color registration and lack of snow for those other advantages.

Then I remembered an ad that

Separate UHF and VHF antennas at your editor's home were used to compare signal quality with a new cable installation.

No, that's not your editor installing the Cablemate! Picture is by the courtesy of Winegard.

was in the paste-up stage of next month's magazine. It was for a special switch to select either cable or your own antenna. I called Hal Sorenson at the Winegard Company, and he promised to send me a Cablemate switch.

The Model CTS-2 Cablemate switch eliminated all our objections to cable. Probably 95% of our viewing is on the three local VHF and one local UHF channels, and the switch is left in the "antenna" position. The switch is mounted on the rear of the TV, with only the tip of the bar knob showing. Then, a flip of the switch and a turn of the tuner to Channel 2, and the signal is coming from the cable.

Cable Not At Fault

I don't intend to knock the quality of reception from the cable. It's much better than that from rabbit-ear antennas. The out-of-town stations come in virtually snow free. And the cable weather and news channels are helpful. The quality is much better than others I saw several years ago. I like the benefits of cable.

However, after the cable signal has been converted twice and amplified many times, it **must** receive added noise, and lose some sharpness. Even so, the quality is good, except when compared to the signals from a good outside antenna.

Signal strengths

Was the snow on cable caused by weak signal levels? To find out, I employed a signal-strength meter and compared levels of cable versus antenna. At the 300-ohm terminals of the receiver, the cable signal ran from 3,000 microvolts on Channel 4 to 800 microvolts on Channel 13. I have a loss pad of about 10 dB at the end of the downlead of my antenna, because this gives a sharper picture and better color, in areas where the signal is strong. Probably that's because it improves the matching between antenna and tuner. Anyway, with the pad still connected, the local channels measured about 800 microvolts.

In other words, the cable signal was stronger, but the snow and smear were slightly worse.

Adjacent-Channel Reception

Most cable systems convert UHF channels and add their own channels until all 12 VHF channels have a signal. With some receivers this can cause degraded reception that is not the fault of the cable.

If the IF alignment curve is too wide, or the sound trap is ineffective or misaligned, the cable signal will be much worse than a signal from an antenna where none of the channels are adjacent.

Luckily, I was spared those problems. My receiver is an excellent solid-state model and showed no adjacent-channel problems when used with the automatic fine tuning (AFT). By turning off the AFT and mistuning either the converter or receiver fine tunings, I could get some herringbone, and other disturbances.

From this experience, and other similar ones, I have concluded the only positive test of whether a certain trouble is caused by cable or receiver is to use a good color receiver as a test instrument. The receiver should be checked out on other antennas and other cable drops to make certain it is in perfect shape. Then you can believe the results it gives you.

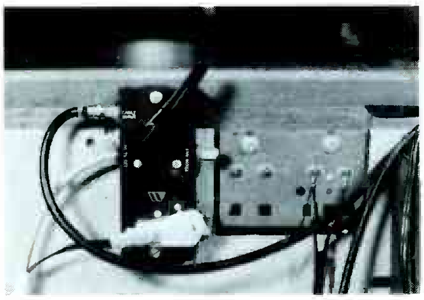
Wrong AFT Action

Several years ago I wrote an article about how we technicians could estimate the performance of an antenna system by the AFT action. If the AFT gives a good picture (as good or better than manual tuning) on some channels, but on others you can obtain a much better picture by turning off the AFT and tuning manually, it's a cinch something is wrong with the antenna or lead in. By its very nature, AFT adjusts the picture carrier to one specific frequency, and that frequency is in the IF's where it is the same for each and every channel. Therefore, if the AFT is correct for one, it's correct for all. However, an antenna system with standing waves (poor VSWR) can give the **effect** of incorrect IF alignment on the affected channels.

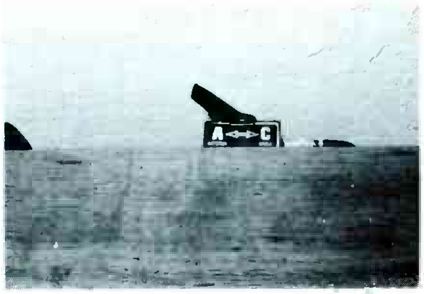
Use a color portable of screen size between 15" and 19" which has AFT as your test receiver for both cable and other signal sources.

Do You Sell Antennas?

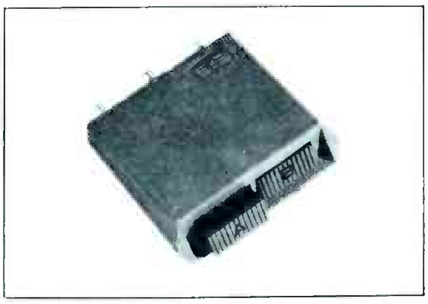
Perhaps you are not interested in my personal experiences with cable



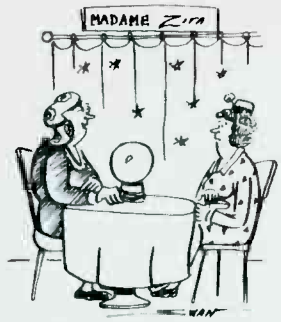
My installation includes a home-made loss pad on the outside-antenna lead. UHF tubular downlead not used at that time. On the right is the corner of the cable converter.



From the front of the receiver, only the tip of the knob shows.



Cable-to-cable switch from the EIE division of RCA. Courtesy of RCA.



"THE PICTURE'S MUCH BETTER SINCE I WENT ON THE CABLE."

versus antennas. But there is a lesson there for you, if you have stopped trying to sell outside antennas just because there is a cable system in your area.

Every cable subscriber is a potential customer for an outside antenna, if he is shown a reasonable way of obtaining the best of both worlds. It's up to you to inform your customers, then get the business.

Not Any Old Switch

A word of caution. Don't try switching cable and antenna signals by wiring up a DPDT toggle switch. Any switch used for this purpose **must** have a high degree of isolation between the two signals. Any mixing of the two through capacitance action will produce serious interference.

At this writing, Winegard offers two Cablemate switches (differing only in minor details) whose isolation is 58 dB. Another slightly-similar switch is available from the Electronic Industrial Engineering (EIE) Division of RCA. It is intended for cable-to-cable operation in systems with two cables, has large "A" and "B" channel push-buttons and 85 dB isolation.

Summary

Cable systems have moved from the mountains and the prairies into the metropolitan areas. Like them or not, they are a fact of life with which we must deal. And so long as they don't repair TV's and we don't bother their wiring, there should be no conflicts.

There are two facts to be stressed. Technicians **must** sharpen their skills so they can be sure whether a trouble is in the set or in the cable.

Secondly, we need to know how to give the customer **better** local pictures than he gets from cable. **Customers need us; don't let them forget that!** □

Cable Or TV?

Condensed from a letter by Mr. I. Switzer, Engineering Consultant of Ontario, Canada.

Mr. Cunningham's article "Is It The Cable...Or The TV?" in the October, 1973 ELECTRONIC SERVICING is very informative and treats the subject with great fairness. However, a few things need clarification in the light of recent technical advancements.

The heading "Co-Channel Interference" covered mostly what cable people call "direct pick-up". If the local channel is being carried on cable without a frequency shift, the receiver may "see" two signals; the cable signal and the direct signal picked up on the line cord, or unshielded tuner wiring, or from an inadequately-shielded cable drop. The effect usually is the leading ghost that Mr. Cunningham describes. Most often the cause is poor shielding of the receiver; many show a fair picture without any antenna connected.

A cable channel that has been converted from another channel and now is on the same channel as a local station can cause a "beat". This beat might show as horizontal, diagonal or shifting bars, depending on the frequency difference and the stability. Beat patterns are far more objectionable than leading ghosts, and are visible at interference levels about 12 to 15 dB lower than for leading ghosts. And the beat pattern usually reaches an intolerable level before any second image can be seen, or before the blanking bars from the second picture can be noticed. Many CATV systems use phase-lock techniques to lock their converted channel to the frequency of the local broadcast channel. That way there can be no beats. At worst, the interference would appear as a faint second picture.

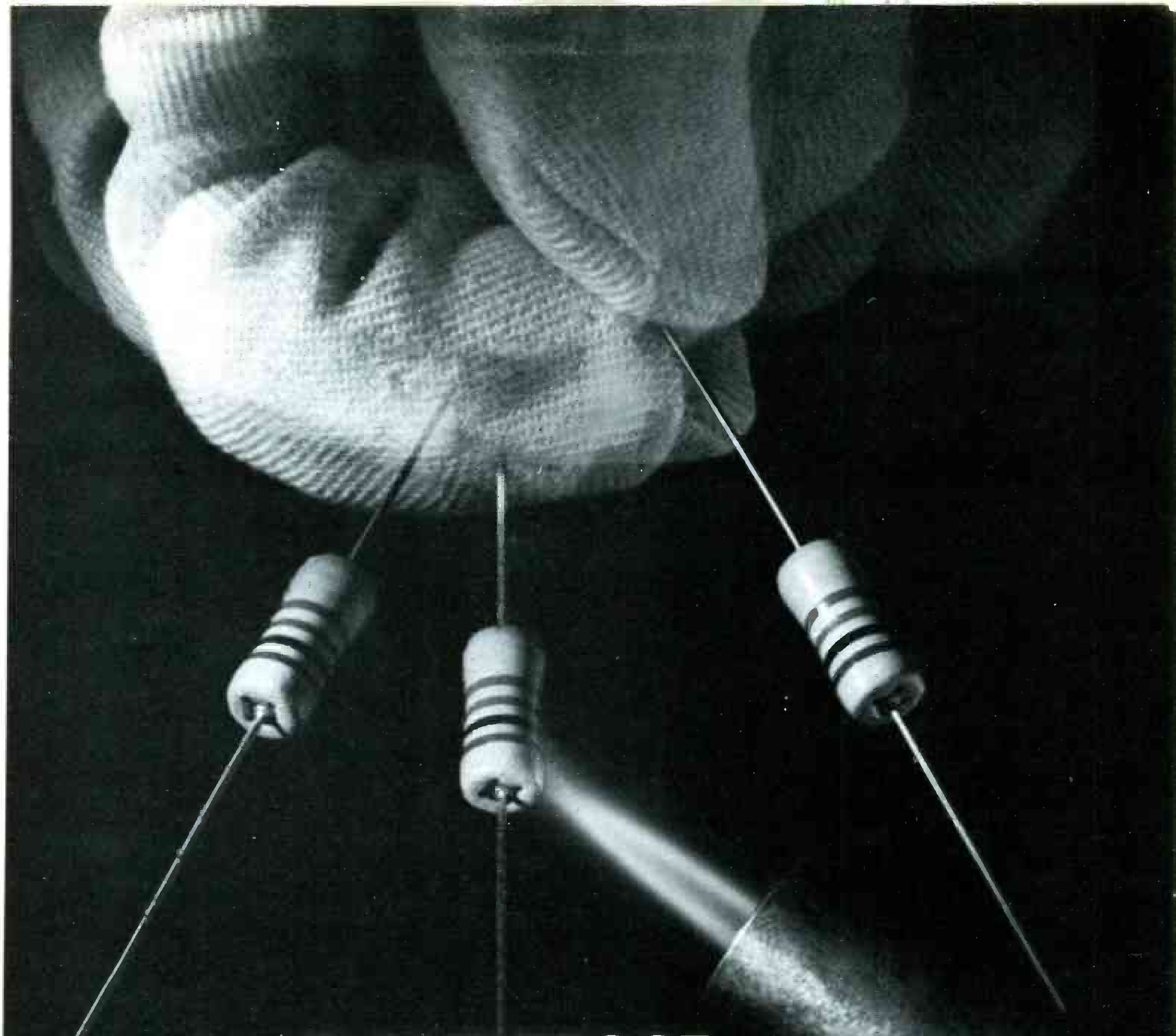
Modern broadcast sync generators are so stable that the second picture (even without phase locking) would show very little "windshield wiper" The effect is of a second picture moving slowly sideways.

Of course, if the cable system is picking up co-channel interference with its antennas, the effect is the same as for home antennas: horizontal bars, often called "venetian blinds". In this case the bars wipe out the desired picture **before** the ghost or wiper can be seen.

Excessive signal level from the cable is often the cause of receiver overload. Although a technician can install a loss pad to alleviate the condition, it is preferable for the cable company to do it. If the technician installs a pad, and then the cable company reduces the level to normal, the signal at the set is insufficient and produces snow.

I agree that b-w receivers are inadequate as test receivers for cable quality. We use b-w for quick checks, but then use color portables for more critical checks and subscriber demonstrations.

The biggest problem most cable systems have with the service industry is the misadjustment of receiver AFT discriminators. Often these are set when there is no adjacent channel present. When back on cable, the AFT does not bring the adjacent sound channel into the trap. As a result, the picture has a 1.25-MHz adjacent-sound beat. AFT's should be adjusted so the IF picture carrier is exactly 45.75 MHz. Adjacent-channel traps should be adjusted in accordance with the manufacturer's recommendations. Also, they should be checked for thermal stability. We have found many traps that drift badly with set warmup. □



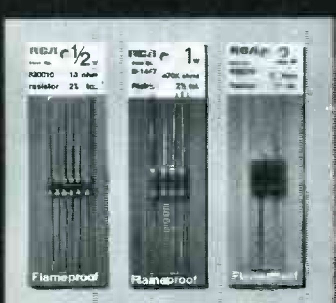
FLAME PROOF.

Put safety first with flameproof film resistors . . . new from RCA Parts and Accessories

If you have a genuine concern about safety in consumer instruments, you should be using RCA flameproof film resistors. They won't flame or short under the most severe overloads. Although designed for use as "exact replacements" in RCA instruments, they can be used as general purpose replacements in consumer instruments of any make.

We even mark them as "safety" parts in RCA service data, designated by a star, to insure their use by service technicians. RCA's flameproof film resistors have a *2% tolerance* and are available in ½ watt, 1 watt, and 2 watt ratings in attractive blister packs. There are 61 standard resistance values, ranging from 10 ohms through one megohm, in each wattage rating. That adds up to 183 flameproof film resistors to choose from.

Right now three dealer "starter" packages, one for each wattage rating, are available from your authorized RCA Parts and Accessories distributor. Call him today and place your order.



RCA

For More Details Circle (19) on Reply Card

test equipment report

These features supplied by the manufacturers are listed at no-charge to them as a service to our readers. If you want factory bulletins, circle the corresponding number on the Reply Card and mail it to us.

Test Probe

An improved version of the self-contained CRT high-voltage test probe with built-in meter is offered by **Pomona Electronics.**

Model 4000 is designed to test all existing black and white and color television sets, including new and future models with voltages up to 36 KV. The probe can be used to make high-voltage adjustments in the home without the need for extra equipment; the instrument is small enough to be carried in a tube caddy.

All a technician has to do is ground the instrument, contact the HV anode with the probe tip, and read the voltage; the probe requires no warm-up time or batteries.

Model 4000 CRT high-voltage test probe sells for $24.95.

For More Details Circle (40) on Reply Card

4-Digit Battery/Line DMM

A 4-digit digital multimeter that will operate from either line or battery power is the Model 45 by **Data Technology Corp.**

Model 45 has five AC and five DC voltage ranges with 10-microvolt resolution, six resistance ranges, and five

AC- and five DC-current ranges.

The multimeter features a display of .33-inch 7-segment Sperry's; it measures 2-1/2 X 6-1/4 X 9 inches and weighs 2-1/3 pounds. Model 45 sells for $399.00.

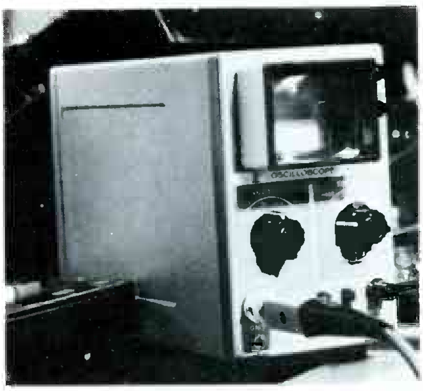
For More Details Circle (41) on Reply Card

Miniature Scope

A portable, simple-to-use oscilloscope, designed for on-site check-out and servicing of TV, CATV, and radio broadcast equipment is the Model 9601A, just announced by **Telonic Industries, Inc.**

Weighing 4 pounds, the new scope can be hand-held or hung from a neck strap, permitting the technician to test electronic equipment without removing it from service.

The scope measures 3-1/2 X 5 X 7-3/4 inches and contains a 1-1/2 inch CRT screen that is enlarged to 2-1/4 inches by a snap-on magnifier. It is powered either from an AC line or a battery pack that permits up to 5 hours of continuous service before requiring a recharge.



The scope is also available in a dual-trace version, Model 9602A. Prices start at $595.00; accessories include carrying case, AC adapter, and test leads.

For More Details Circle (42) on Reply Card

FET Multimeter

Sencore has introduced the FE27 Big Henry multimeter, featuring 1.5% DC accuracy with 15-meghohm input impedance and designed to reduce circuit loading and eliminate measurement errors in high-impedance circuits. A special AC RMS circuit is incorporated into the unit to read true RMS voltage within 3% for either sine waves or square waves produced by regulated power-supply transformers. A separate function is provided for AC peak-to-peak measurements.

The FE27 Big Henry FET multimeter sells for $150.00. ☐

For More Details Circle (43) on Reply Card

product report

These features supplied by the manufacturers are listed at no-charge to them as a service to our readers. If you want factory bulletins, circle the corresponding number on the Reply Card and mail it to us.

Tool Set

PTS Electronics offers the Dura-Seven, a seven-piece glass-filled polymer plastic alignment tool set for all electronic-alignment problems and available in all the popular sizes. This tool set is said to last longer than regular plastic tool sets, and sells for $2.95 net.

For More Details Circle (44) on Reply Card

TV Tables

A new line of TV tables, featuring an enclosed bottom cabinet for secure lock and key storage, is offered by **H. Wilson Corp.**

Available in three heights, the tables come with a flat top shelf or with a 5-degree slant to reduce reflective glare. The tables are made of heavy-gauge steel and are completely mobile. The top shelf measures 24 X 28 inches; a large lip on all four sides keeps the TV receiver in place and reduces vibration.

For More Details Circle (45) on Reply Card

FET Circuit Book

A basic introduction to the technical workings and properties of the field effect transistor, as well as schematic diagrams for 9 different circuits, are offered in the FET Circuit Book published by **GC Electronics, Calectro Division.**

The FET Circuit Book, Cat. No. FR-172, also includes a brief history of the field effect transistor and complete instructions on how to build circuits such as a FET timer, touch switch, 8-range DC volt meter and telephone remote ringer.

The FET Circuit Book costs 25 cents.

For More Details Circle (46) on Reply Card

Open-End Wrench

Helix Wrench, an adjustable open-end wrench from **Taylor Reynolds Company,** features a new slide adjustment located on the side of the wrench body. The result is a thinner tool head that permits work in places that other wrenches won't fit.

The wrench is machined from stainless steel. The thumb-operated slide adjustment drives the jaw through a high-ratio worm-to-bevel-to-worm gear train for easy adjustment in small increments.

Nominal body size is rated at eight inches and the jaw adjusts continuously from 0 to 15/16 inch. The unit is backed by a life-time factory replacement guarantee should it fail in normal use. It sells for $10.95.

For More Details Circle (47) on Reply Card

Recharging Stand

Wahl Clipper Corp. offers a recharging stand with their 7500 Iso-Tip cordless soldering iron. The stand automatically makes the electrical recharging connection when the iron is placed into it; there are no plugs to connect and no positioning of the iron is necessary. A dead Iso-Tip can be completely recharged overnight.

Featuring a broader base and lower silhouette, the recharger is less prone to accidental tipping. For convenience, the stand also has a compartment on top designed to hold a spare soldering tip.

For More Details Circle (48) on Reply Card

Alarm Systems Guidebook

"Fire and Theft Security Systems" by Byron Wels discusses the selection, installation, and maintenance of home and business security systems. The book explains how an individual can protect his family and property, what equipment is needed, what type systems are available, how alarms work, and how to maintain such a system.

Available from **Mountain West Alarm Supply Company,** "Fire and Theft Security Systems" sells for $4.95 in paperback. □

For More Details Circle (49) on Reply Card

catalogs literature

Circle appropriate number on Reader Service Card.

100. Amphenol Sales Division—has published a full-color pocket-sized catalog which describes connector and socket devices designed specifically for use in hobbyist equipment. The catalog provides details on Amphenol's microphone, hexagonal, and RF connector families, and on its chassis socket, dual-in-line and T.O. can socket lines.

101. The Antenna Specialists Co.—offers an 8-page brochure entitled "Why CB Antennas?". Illustrated with diagrams, patterns, and sketches, the brochure explains the technical side of CB antennas and a gain-to-effective power chart.

102. Bell Industries, J. W. Miller Division—offers a comprehensive 100-page radio and TV coil-replacement guide with a cross-reference directory. The guide lists 30,000 replacement coils for 375 manufacturers' names.

103. Cornell Dubilier—has released an eight-page SCR-Capacitor brochure describing their paper, paper/film, and film-dielectric capacitors. These units have been designed for applications such as SCR commutating, motor-speed controls, frequency changers, induction heating, electric vehicles, static power supplies, snubbers, resonant filters, choppers, and static switches.

104. General Electric—has announced availability of a 28-page catalog of service, advertising, and sales-promotion materials for use by independent electronic technicians.

105. Heath/Schlumberger Instruments—has published a catalog which provides descriptions, photos, and specifications for instruments such as frequency recorders, oscilloscopes, power supplies, digital multimeters, recorder systems, an analog-digital teaching system, and the Heath/Malmstedt-Enke Lab Stations. Featured in the catalog are the new line of autoranging frequency counters and a low-cost strip-chart recorder.

bookreview

Sound Systems Installers Handbook
Author: Leo G. Sands
Publisher: Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, Indiana 46268
Size: 5-1/2 X 8-1/2 inches, 192 pages
Price: $5.50 softbound

The purpose of this handbook is to assist electronic technicians in the design, application, and installation of sound systems. Written in plain English, the book progressively takes the reader into the more technical areas. The first chapter describes the various types of sound systems. The second chapter is about amplifier requirements and explains how to correctly select amplifiers for specific applications. Speakers, microphones, record players, and tape decks as well as other input and output devices are covered in subsequent chapters. One chapter is devoted to signal control and circuit interfacing; another explains how to design sound systems, and how to install sound system components and cables in a professional manner. Additional topics include sound system accessories and a detailed description of sound system maintenance and measurements. ☐

photofact bulletin

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

ADMIRAL
Chassis T3K3-1A/-2A, T9K3-1A/-2A, T15K3-1B/-2B, T16K3-2A, T24K3-1A-2A, T26K3-2A, T28K3-1A, T29K3-1B 1396-1

ADMIRAL
Chassis T15K10-1A/-1B/-2A/-2B, T16K10-1A/-2A ... 1392-1
Remote Control 750A1462-2 .... 1392-1-A
Remote Control 750A1462-9 .... 1392-1-B
Chassis 6Z5, 10K3 .... 1392-1-C

GENERAL ELECTRIC
Chassis EB, 25EB 1394-2

PANASONIC
Chassis N-95A 1394-3

PHILCO-FORD
Chassis 3BS32 1395-2

RCA
Chassis CTC64A 1386-3
Remote Control Receiver CTP21B, Transmitter CRK20A 1386-3-A

ZENITH
Chassis 16EB12, 16EB12X, 19EB12, 19EB12X 1385-3

Test Lab

(Continued from page 30)

above the repetition frequency of the square waves is shown in Figure 3 by the rounded corners and sloping sides. With a little practice, you can estimate the response well enough for many purposes.

Low-frequency loss

Tilted tops and bottoms result from a small amount of attenuation of frequencies **below** the repetition rate of the square waves (Figure 4). An extreme loss of those frequencies permits only positive- and negative-going pulses located at the edges of the square waves.

Loss of both highs and lows

In actual audio amplifiers, attenuation of both highs and lows often occur at the same time (Figure 5). These waveforms are more difficult to analyze visually, but the same rounded corners and tilted tops and bottoms are there.

Refer to the May, 1971 issue of **Electronic Servicing** for a more detailed explanation of square-wave analysis.

Video-signal injection

As shown in Figure 6, 200 KHz square waves can be used to check the approximate frequency response of video amplifiers. And, if you have a dual-trace scope, you can determine the actual phase delay of the delay line in a color receiver.

Checking Transformers By Ringing

As I have mentioned many times in other articles, a square-wave generator is a perfect source of the pulses needed to check inductances by ringing. The method is simple. Just connect the generator to the coil or transformer to be tested by a small-capacitance coupling capacitor. The value depends on the inductance to be tested. Usually a value between 50 pF and 500 pF works well. Then connect your scope with low-capacitance probe across the inductance. That's all.

If you wonder how square waves are supposed to do the job of pulses, consider the bottom trace of Figure 4. Those pulses were made by feeding square waves through a high-pass filter using one series capacitor and a resistor in parallel with the scope input. Consider that it's even easier to make pulses from square waves using a series capacitor and an inductance.

There are two slight peculiarities. Because one pulse is positive-going and the next is negative-going (Figure 4, lower trace), one damped wavetrain starts in an up direction, and the next one in a downward direction. For this reason, you see a more clear trace if you adjust the scope for **two** wavetrains (see Figure 7).

And because there are two pulses for each repetition cycle of the square waves, the optimum frequency of the generator should be exactly one-half that of a pulse generator, or of the pulses taken from a scope.

Frequency of the square waves is quite critical for the most precise results with ringing tests. That's the reason an audio generator is a better source of pulses than is a scope. There is virtually no drift of frequency; and with a large calibrated dial, the generator can be reset accurately to the desired frequency time after time. And that's impossible by taking the pulses from the horizontal-sweep circuit of a scope.

Miscellaneous Tips

There are two tips that apply to this one model of generator. In addition to the continuously-variable Output Level control, six sliding switches are provided to give fixed amounts of attenuation (56 dB total). When I first measured the attenuation they gave, I thought them very inaccurate. The 1 dB button gave nearly 2 dB, etc. Then I read the instruction manual and found the generator must be connected to an external 600-ohm load for the attenuators to be accurately calibrated. I connected a 680-ohm resistor across the output terminals, for a test, and found the output voltage reduced, but the attenators now performing accurately.

Incidentally, some ringing tests work much better with attenuation for isolation between the generator and the ringing circuit. Fixed attenuators are a good feature, helpful for more than just audio measurements.

Finally, on the square-wave function, the output terminals measured about +5.5 volts DC. Evidently this is necessary for the correct waveform of square waves of low repetition frequencies. If this voltage should not be applied to your circuit, merely apply the signal through a coupling capacitor. The size depends on the frequency, and on the impedance of the circuit to which the signal is fed; lower frequencies or lower impedances demand a larger capacitance.

Sine-wave ranges have no output DC voltage.

Summary

Many of the uses and features of the B&K Model E-310B generator, described here, also apply to other brands and models.

A good-quality sine- and square-wave generator can be put to many good uses in your service shop. We have tried to show you some of the better-known uses; but, after you obtain your own generator, you'll find many additional jobs for it. ☐

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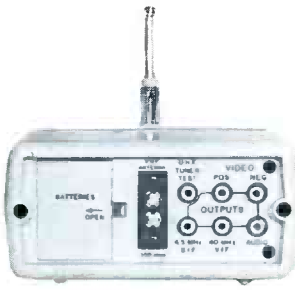

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