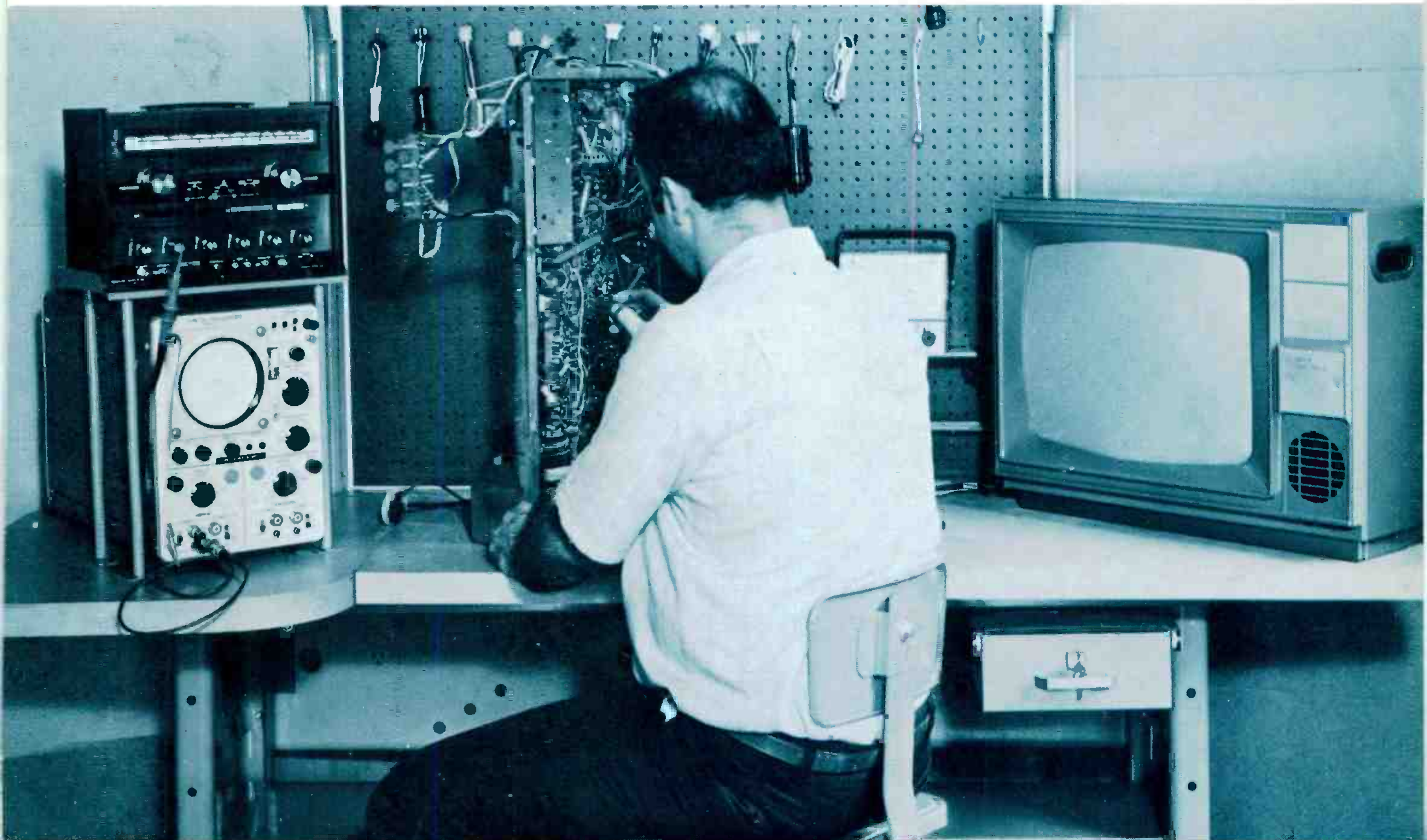
December, 1973 □ 75 cents

Electronic Servicing

A HOWARD W. SAMS PUBLICATION



HORIZONTAL SWEEP REVISITED

Are Antenna Specs Accurate?
Troubleshooting With Dual Trace
Understanding VHF Scanners

December 1973 □ Volume 23, No. 12

Electronic Servicing®

in this issue...

DEPARTMENTS

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ABP

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Robert E. Hertel, Publisher

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electronic scanner

news of the industry

"Home" type of mobile phone service is now possible in autos equipped with the new Pulsar system just introduced by the Motorola Communications Division. The phone user picks up a conventional handset, hears a conventional dial tone, and then dials the same as he would with a residence-type telephone. The non-mobile phone terminal can be fully automatic, enabling the car phone to direct-dial any landline phone, anywhere in the country. Also, any landline phone can direct-dial the car phone, which has a regular seven-digit number. Or the phone terminal can be semi-automatic, permitting mobile-to-land dialing, but requiring an operator at the terminal to complete land-to-mobile calls. Each terminal can be operated by a telephone company, or by one of the more-than-800 radio common carriers (RCCs) that now provide mobile telephone service throughout the United States. Up to 16 channels can be accommodated by the Pulsar telephone.

Sales of color receivers to dealers during the first 9 months of 1973 were 13.7% higher than the same period of 1972, according to the EIA, while sales of monochrome receivers declined 14.3% during the same period. Also, home-radio sales were down 9.5%, but auto-sound sales increased 26.8% during the first 9 months of 1973 compared to 1972.

One probe (expose?) of electronic-repair charges started by a district attorney has backfired. Francis Vogt, a district attorney located in Kingston, New York, initiated an investigation of TV-repair charges. After the probed started, it evidently became clear that the opposite was true: pricing was too low for most repair shops to even stay in business. According to Dick Jones, owner of Jones Radio & TV Service in Kingston, the probe (plus inspiration from the speech of Miles Sterling at the NEA convention last August) caused several of the regional shop owners to examine their costs and their methods of pricing. The other shop owners (all members of Certified Electronics Technician Association, a local affiliate of NESDA) included Dan Ellsworth (TV Enterprises of Kingston) and Ron Palluth (Fixit Shop of Poughkeepsie, New York). Before costs were calculated accurately, these shops averaged about $15 per service call. Since then Jones has increased his service call charge by nearly 60%, and Palluth has doubled some of his charges. Both report that business volume has not dropped. And, surprisingly, that fewer complaints are received from customers. They intend to increase charges again when their figures show that costs have risen enough to justify it. These three shop owners have refused to do warranty work unless the manufacturer pays the regular shop prices. Jones says he has kept careful records, and only about 2% of the warranty customers call him after the warranty has expired. He believes that warrantly work should not be done at discounted prices in the vain hope of retaining customers. The initial probe seems to have fizzled into a cooperative effort to have a licensing law passed.

(Continued on page 6)

3-D color-TV programs and movies might result from an experimental system shown recently in Tokyo, Japan by Hitachi. By means of high-storage-density holograms, this system can store and reproduce full-color 3-D images. Components include a laser beam, memory elements, hologram illuminator, and a screen. 35-MM film provides the high-density storage, and the images can be moved or switched by the manipulation of the film. At present the system can be used for 3-D color display of advertisements or educational materials. When the components have been redesigned to be more compact, 3-D movies and 3-D color-TV programs should be possible.

The first color-TV sets built in the Republic of Korea are expected to be sold in the United States by the end of the year, according to **Home Furnishings Daily.** These sets will carry Panasonic and JVC labels. Later imports are expected to have the names of Sony, Toshiba, Sanyo, and Mitsubishi (MGA). Oddly enough, color broadcasting in Korea will not be in color until about 1975. Production costs are lower in Korea, perhaps 20% less than in Japan.

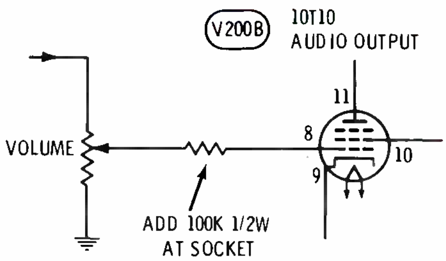
A new mobile radio laboratory, equipped with the latest in electronic monitoring equipment, is helping Delco Electronics engineers solve problems of auto-radio reception in crowded cities, and in weak-signal areas. In use, the van is driven to the area where reception problems are encountered, the reception conditions are recorded, then the van is returned to Kokomo, Indiana for analysis of the data obtained. For example, recently the van was brought to New York City near the Empire State Building, from which 15 FM signals are broadcast. The strength of each station was measured by a spectrum analyzer inside the van, and then how much the amplitude changed as the van was moved away from the building. At the same time, a tape recorder was capturing the sound levels of the stations, and recording the analyzer display readings. The data obtained from these trips should enable the engineers to design radios of improved characteristics.

Sprague Products Company has acquired the Jud Williams Company, which manufactures the Jud Williams Model A Solid-State Curve Tracer. The joint announcement was made by Jud Williams and R. W. Woodbury, president of Sprague. Mr. Williams will head up the new Jud Williams Department of the Sprague Company, and will expand his nation-wide series of seminars on servicing TV, radio and stereo equipment using his "Signature Pattern" techniques for checking semi-conductors. Present facilities at Winter Haven, Florida will be expanded for increased production of curve tracers and other items of test equipment.

symcure

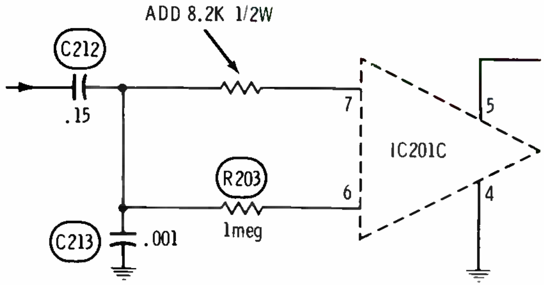
Symptoms and cures compiled from field reports of recurring troubles

Chassis—Admiral K19
PHOTOFACT—1284 POM



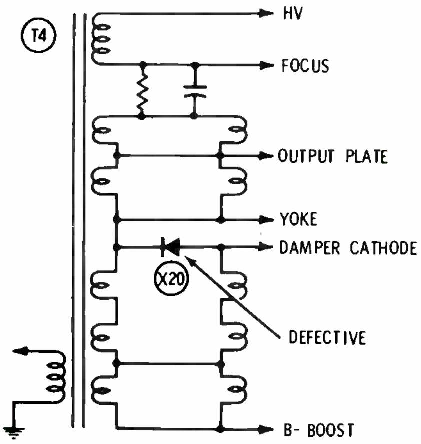
Symptom—Burned volume control because of tube arcs
Cure—After replacing the volume control and tube, install a 100K resistor in series with grid wiring at the socket

Chassis—Admiral K20
PHOTOFACT—1281-1



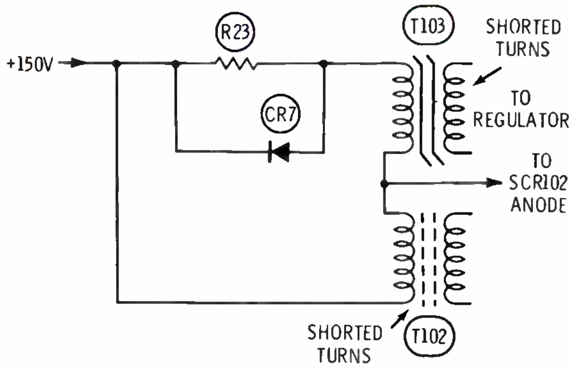
Symptom—Failure of audio IC because of arcs
Cure—Make sure C134 is grounded to shield braid, replace IC and add a 8.2K resistor in series with pin 7, as shown

Chassis—Philco-Ford (most hybrids)
PHOTOFACT—1040-1



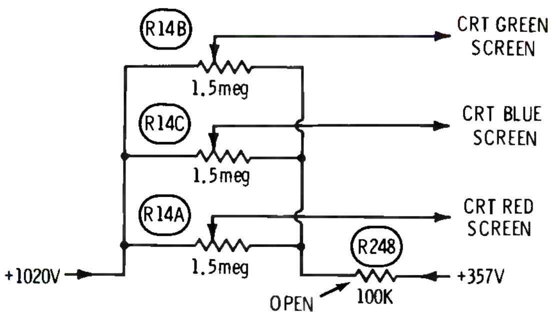
Symptom—Picture 3 inches to the right
Cure—Replace defective X20 centering diode

Chassis—RCA CTC44
PHOTOFACT—1191-1



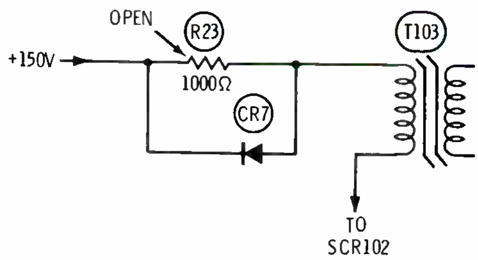
Symptom—Breaker opens following SCR replacements
Cure—Check for shorted turns in T102 and T103

Chassis—RCA CTC38X
PHOTOFACT—1000-3



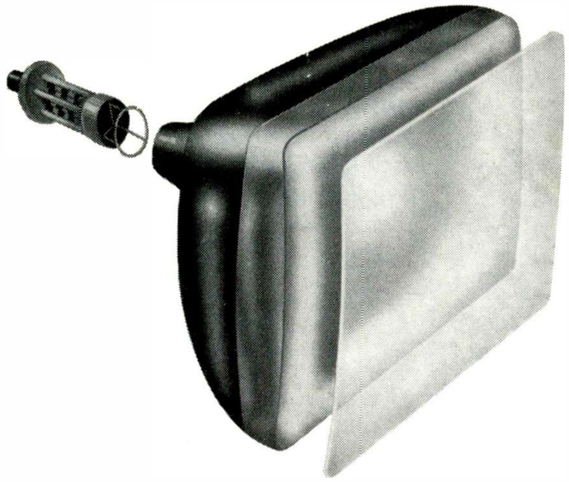
Symptom—Excessive brightness with retrace lines
Cure—Check R248, and replace if it is open

Chassis—RCA CTC44
PHOTOFACT—1191-1



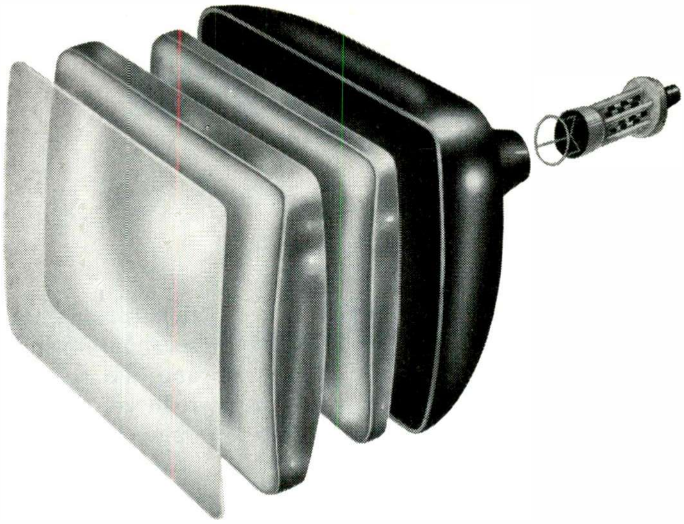
Symptom—"Pie-crusting" that varies with brightness
Cure—Check R23, and replace if open, or resolder if connection is bad

□



How some tubes are rebuilt.

1. Inspect screen and replace electron gun.
2. Reinstall safety glass.
3. Test tube.



How our color bright 85® RE is rebuilt.

1. Completely clean old glass so it gleams like new.
2. Apply new internal and external coating to the bulb.
3. Replace phosphors with Sylvania high-brightness types.
4. As required, install new aperture mask with Sylvania thermal compensation system.
5. Replace electron gun with Sylvania electron gun assembly.
6. Install new implosion protection system.
7. Final test.

Every tube is remanufactured and tested on the same assembly line used for our new color tubes. And that line includes the latest computer-designed improvements in screen exposure optics. In short, when you install a Sylvania *color bright 85RE* picture tube, you are installing a tube that is practically brand new except for the glass. In fact, if we rebuilt it any further, it would be a new tube.

Available at your local Sylvania distributor.
Sylvania Electronic Components,
100 First Avenue, Waltham, Mass. 02154

GTE SYLVANIA

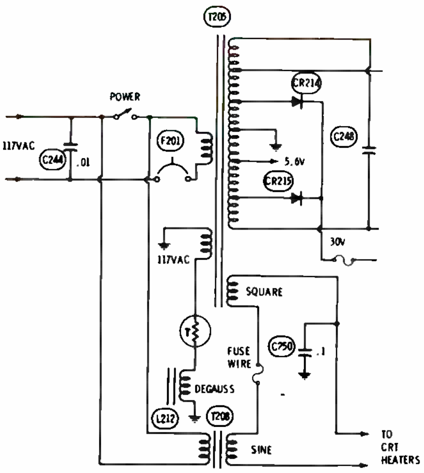
troubleshooting tips

Send in your helpful tips—we pay!

Picture tube appears weak
Zenith 25DC56 color TV chassis

(Photofact 1312-3)

The picture on the screen of this Zenith showed all the typical symptoms of a weak color picture tube. However, during the troubleshooting tests, we noticed the heaters of the picture tube were not lit brightly enough. The power transformer, T205, is a special one that has



voltage regulation and a near-square waveform. Also, notice from the schematic that the heater should have below-normal sine-wave power applied during the "off" time, and sufficient square waves during the "on" time. Because of the waveforms, we must consider the ability of different meters to give true or false readings. In this case, we measured the p-p amplitude of the heater voltage and found it to be too low.

An ohmmeter test proved the primary of T208 was open. Which brings up a question: during normal operation, the primary winding of T208 is shorted out by the on/off switch so is out of the circuit. The secondary winding remained in series with the CRT voltage; therefore, why was the heater voltage low? The answer is that the shorting of the primary in normal operation reduces the impedance of the secondary winding to nearly zero, and the voltage from T205 is not reduced. But when the primary is open, the secondary impedance increases to oppose the voltage from T205 and decrease the voltage at the picture tube.

Installation of a new T208 brought back a sharp, bright picture.

George E. Hague, CET
Jacksonville,
North Carolina

Picture bending, or loss of sync
Magnavox T933 color TV chassis (Photofact 1005-1)

A typical problem in these models seems to be the socket of V7, the 6GH8A sync/AGC tube. Intermittently, the tube will show a loss of heater glow followed by an unstable picture.

Although using tuner spray on the heater contacts of the socket often temporarily restores operation, replacement of the socket is the best and most permanent cure.

Frederick P. Hall, Jr.
Ironton, Ohio

Horizontal wobble
Zenith 25MC36 chassis

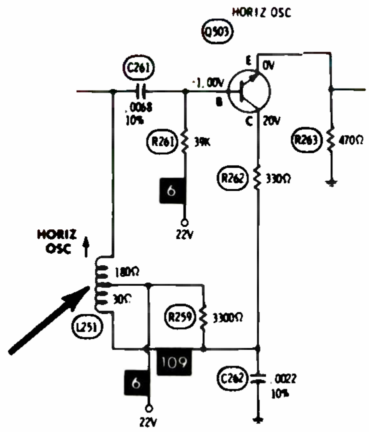
(Photofact 773-4)

Picture, color and sound were all excellent. The only problem was a sideways bounce or wobble of the picture.

Video and sync separator waveforms were perfectly good. Bias and drive voltages at the horizontal output tube were normal.

Sometimes it's a good test to adjust the set the way a customer would. When I got to the volume control, I found the horizontal bounce would stop when the sound was turned down.

After considerable time testing the audio circuit (which was a big mistake), a test probe accidentally pressed against the horizontal-oscillator coil. This stopped the problem, even at loud volume.



The defect was a loose core in the horizontal-oscillator coil. Apparently, it would vibrate from any mechanical movement and cause a shift of frequency.

Because a new coil was not available, I made a temporary repair by removing the core, running a thin rubber band through the form, and then replacing and adjusting the core. The extra thickness of the rubber band tightened the core and stopped the problem.

Larry Nichols
St. Louis, Missouri

Troubleshooting tip
All brands and models

In my opinion, nothing beats a hand-held hot-air hair styler for drying cement, or for warming up a chassis during the troubleshooting of an intermittent.

Such dryers consume a moderate amount of current, and are easier to use than are heat lamps.

If you get the kind with a "no heat" setting, it can be used to blow the dust out of the corners of chassis, or for drying anything that might be moist.

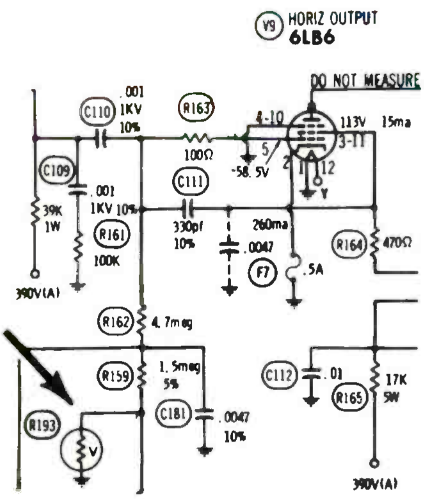
One caution, do not use a dryer too near plastics; some plastics soften when moderately hot.

Stan Telson
Tucson, Arizona

Horizontal pulsations Zenith 20CC50 chassis

(Photofact 1238-3)

The symptoms were rapid horizontal width pulsations, and the brightness control changed the width at the lower right edge of the screen.



Measurement of parts in the high-voltage regulator circuit showed the varistor (R193) to be open. Probably it was arcing internally in the circuit.

Willis Coddington
Eudora, Arkansas

No vertical sweep Zenith 17EC45 color TV chassis

Vertical sweep was only about one-half-inch tall on the screen of this 1974 model receiver. Replacement of the 9-92 Duramodule (which includes output transistors, heat sink, size and centering controls) failed to change the symptom. Next the deflection yoke was removed for testing. This assembly includes a board with the pincushion components, and with it removed I could see a wire hanging loose on one end of L1301, the pincushion-phase coil, which is in series with the vertical yoke winding.

After the wire was resoldered the picture had normal height.

George E. Hague, CET
Jacksonville, North Carolina

readers exchange

Need a not-available schematic? Need an obsolete part? Have an unusual service problem and want help? Send information and full mailing address to ELECTRONIC SERVICING. Other ES readers should send replies with their offer of help direct to the writer. We reserve the right to edit and print all letters sent to this column. **Let us help one another.**

Needed: *Schematic and operating instructions for a Precision sweep generator model E400.*
Stanley Ensminger
415 West Street
Ada, Ohio 45810

Needed: *Schematic for a Feiler Stethoscope, model T.S.7. This is a five-inch oscilloscope manufactured by the Feiler Engineering Company.*
Frank Schomber
32 Elm Hill Drive
Wallingford, Connecticut 06492

Needed: *Schematic for hand-held "walkie-talkie" manufactured by Osborne Electronics Corporation. The following information appears on the instrument: DUO Com 120; 1 Watt Class "D" Transceiver; Serial 24548; MFRD EH; 27-0006 Model 120; Rev GG.*
Bennett G. Miller
3004 Adams Street, N.E.
Washington, D.C. 20018

Needed: *Schematics for Electro-Harmonix Big Muff II distortion device and for UMI Electronics buzz-tone and volume expander. Will copy and return, or buy.*
William Hinkley
Main Street
Jonesport, Maine 04649

Needed: *Operating manual and schematic for a Jackson dynamic tube tester, Model 636C. Will copy and return.*
Jesse A. Peck
952 30th Street
Altoona, Pennsylvania 16601.

Needed: *Schematic for German-made stereo with AM-FM radio, Imperial Model 609A.*
Paul Ruiz
8360 Oakdale Avenue
Canoga Park, California 91306

Needed: *Schematic for Sears TV, Chassis #562.10096.*
Mack Kunzman
1051 Bale Lane
Calistoga, California 94515

Needed: *A 6ME5 for a Lafayette tape player.*
Murray Goldstein
Murray's Repair Service
Grange Hill Road
Sauquoit, New York 13456

Wanted: *Video detector coil assembly for Motorola TV Model Y21K588M chassis WTS538YB-03. Will pay for part plus postage.*
Steve J. Andrejka
3409 North 36th Street
Milwaukee, Wisconsin 53216

Needed: *Schematics for a Zenith transoceanic multiband tube receiver Model H500, a Hallicrafter multiband tube receiver Model S-38-C, and an AFCO transistor home stereo.*
Hollis A. Baker
P.O. Box 514
Perth, New Brunswick, Canada

Needed: *Schematic and parts list for Howard Industries motor speed control model number SM300. Will pay for schematic, or copy and return.*
John Boitson
225-44 112 Avenue
Queens Village, New York 11429

Needed: *Horizontal hold control (L15) for Model 16G23 Zenith, part number S-45678, Thordarson HS-7, or Workman TV T104.*
Henry B. Metzelaar
483 West Main
Milan, Michigan 48160

Needed: *Schematic for Knight (Allied Radio) wideband oscilloscope. No model number available, only notation on chassis, "refer to this number 83Y144-301002".*
Steve Topley
145 Quarry Street
Mt. Pleasant, Pennsylvania 15666

Needed: *Power transformer for CRA-2 Pyramid capacitor tester.*
Haruo Kawamoto
RFD 1, Andrade Camp
Pepeekeo, Hawaii

Needed: *Service information for Ambassador b-w TV S19-MET, run no. T-63AP12, serial no. 17315.*
Dale H. Smith
P.O. Box 205
Lake Stevens, Washington 98258

Needed: *2 tubes; XXD and 35A5 for an old Philco radio. Also have a number of tubes from older radio. Will sell individually or in bulk. Write for list.*
Paul Cournoyer
Leisureville, Bldg 26, Apt. 3
Watervliet, New York 12189 □

part 1

Horizontal sweep revisited

By Bruce Anderson

Horizontal sweep defects are among the most difficult to find of all TV problems. Here is a new method of testing, publicized by RCA this year, by changing the horizontal-output stage into a simple amplifier so the sweep can be tested in two halves.

A good day at the service bench brings electronic troubles that are in amplifier circuits where signal tracing techniques easily isolate the defect. Then, there are rough days when all the sets are dogs. Finally, comes a black day when all the dogs have horizontal-sweep problems.

After such a particularly trying session, I fervently wished for a better way of isolating problems in the horizontal/high-voltage sections of TV receivers. Of course, a knowledge of the current flow during each quarter-cycle of operation is a great help in understanding normal operation. But what we really need is more information about what's happening when the circuit doesn't work!

Fortunately, there is a testing technique that helps tremendously. But there are some tests to be made before we use this new method.

Preliminary Tests

Before getting too deep into troubleshooting the horizontal-sweep circuit, make these fast tests:

- Carefully test the tubes, or exchange them with known-good ones;
- Make sure there is B+ at the plates of the damper and the oscillator;
- Pull the damper tube and test the resistance from plate to cathode to make sure the capacitor there is not shorted or leaky;
- Remove the plate cap from the output tube and check the resistance to ground. The reading should be high, probably above 100K. If lower than that, the B-boost capacitor might be leaking or shorted; and
- Measure the resistance of the screen-grid dropping resistor, or resistors.

If these preliminary tests fail to find anything abnormal, go on to the new method described next.

Divide The Sweep Circuit

Because the flyback/yoke circuit is a complex one with interdependencies to complicate the theory, it is logical to leave it until last, by checking the rest of the system first.

To eliminate the flyback and yoke, disconnect the plate cap from the output tube and disconnect the lead from the cathode of the damper. **Then connect a resistor between**

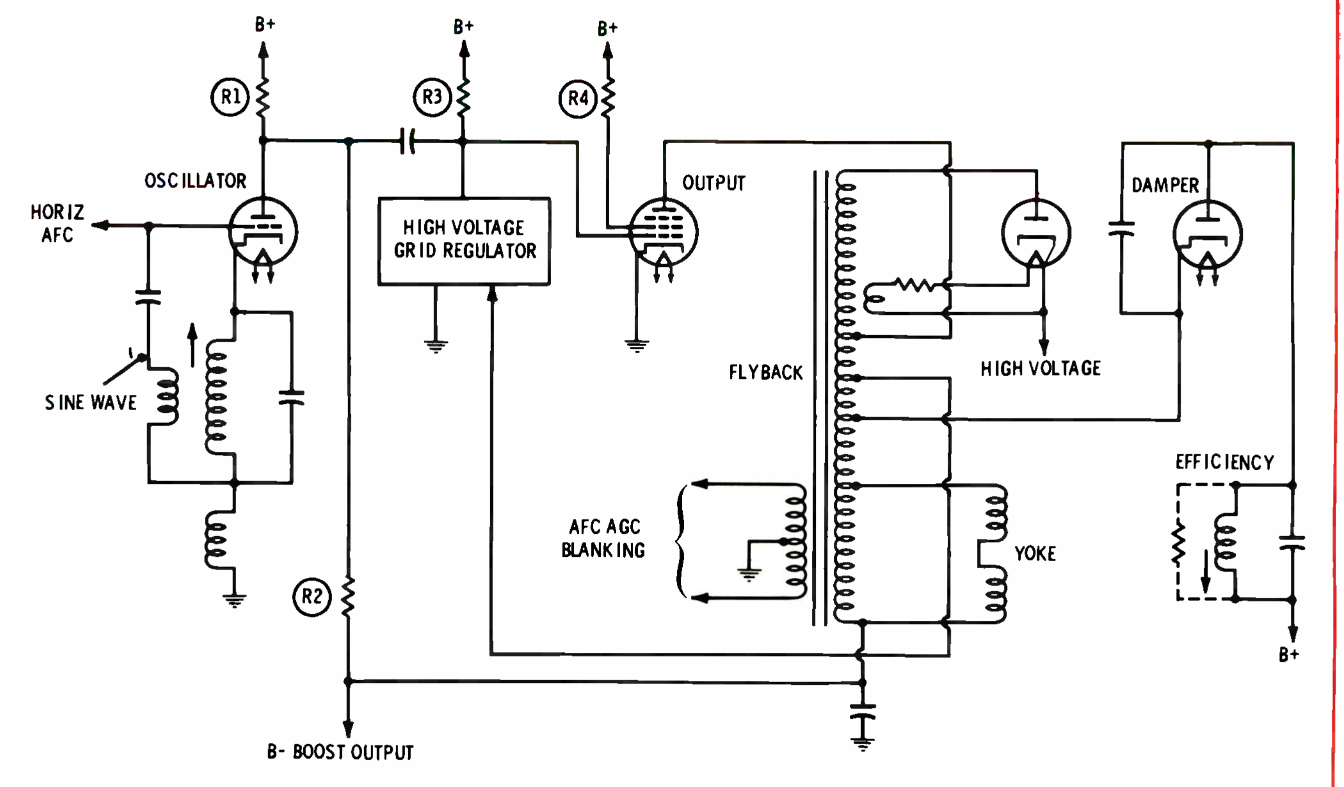


Fig. 1 A typical horizontal-deflection system.

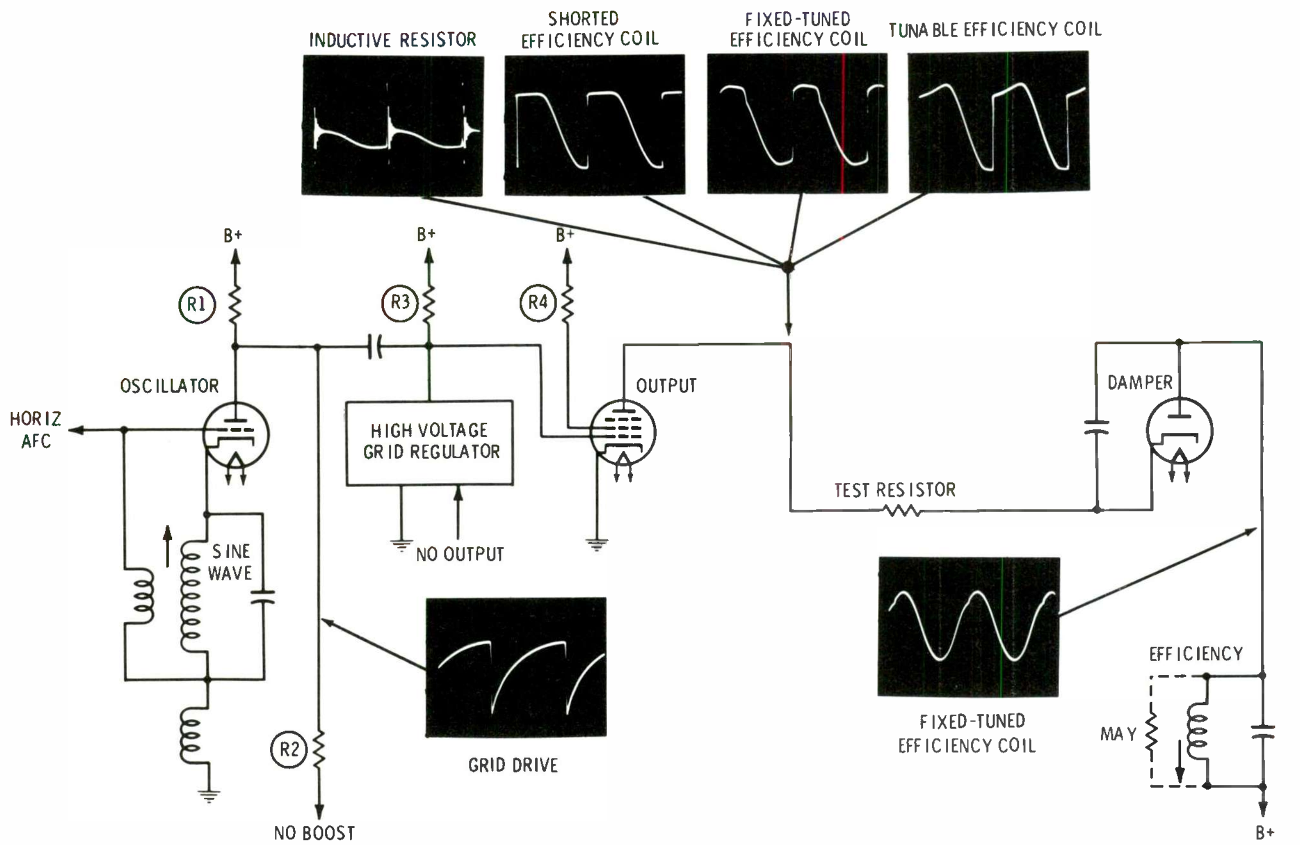


Fig. 2 Substitute a high-wattage resistor for the flyback/yoke circuit and test the parts remaining as a resistance-coupled amplifier. Don't use an inductive-type resistor, it will ring.

the damper cathode and the output plate. This changes the circuit of Figure 1 into the simple circuit of Figure 2. Presto, the horizontal-output stage has been transformed from a very complex stage to a fairly simple resistance-loaded amplifier. If it performs properly, the fault must be in the flyback-yoke circuitry. If it doesn't do its job, the tests described below will pinpoint the trouble.

Value of test resistor

The value of resistance to be used for the plate load depends on the amount of B+ that is supplied to the plate of the damper. As a rule of thumb, the resistance in ohms should be 2.5 to 3 times the B+ volts. For example, a set with 280 volts B+ requires a test resistor of about 700 to 850 ohms; 330 volts B+ dictates a resistance of about 825 to 1000 ohms. Get a 1000-ohm variable resistor, solder a plate cap to one end and a test lead to the other. Since this resistor is going to dissipate about as much power as is normally delivered to the flyback transformer, it should be a 50-watt type. If it is left connected for more than a few minutes, **it will be hot enough to burn fingers or damage plastic parts.** Don't use an inductive resistor, it will ring as shown in Figure 2 and give a false indication.

If there are no faults in the system, this value of test resistance will allow a cathode current in the output stage of about the normal operating current in sets which use only B+ for the horizontal oscillator. In RCA's and others where B-boost supplies the oscillator, expect a little less. For example, if the cathode current is rated at 240 milliamperes in a particular chassis, expect to read about 200 ma with this test setup. If the current exceeds the rated current, or if it is less than about 60% of rated current, something is wrong with the circuit.

In those sets whose oscillators are powered by B-boost (see Figure 2), the grid drive to the output stage will be about 70% of the normal drive. Likewise, the bias on the grid will be about 70% of normal. Typically, the normal drive and bias voltages are about 260 V p-p and -50 volts DC, respectively. Under test conditions, expect to find about 180 volts of drive and -35 to -40 volts of bias. If drive is normal but the bias is wrong check R3, the coupling capacitor, and the grid regulator circuit (if grid regulation is used). If the drive is low, go back to the oscillator. **The shape of the grid-drive signal should be about the same under test conditions as it is in normal operation.** This waveform is shown in Figure 2.

The waveform at the plate of the output tube should be approximately a square wave. Its amplitude should be somewhat **greater** than the B+ voltage. Reason: the efficiency coil rings at the horizontal rate, causing the voltage at the plate of the damper to rise above B+ while the output tube is cut off, and to drop below B+ when the output tube is conducting. (In the test setup, the damper and output tubes conduct at the same time; this is **not** the case in normal operation.)

Operation of the efficiency coil can be monitored by scoping the waveform at the damper plate. The amplitude of the sine wave varies considerably in various chassis, so it is difficult to state a typical value. As a general rule those efficiency coils which are adjustable will produce a greater amplitude of sine wave. Those which are fixed-tuned are usually swamped by a resistor, and so their output is less. In practice, if there is a fault in the efficiency coil or its associated capacitor, it probably will not ring at all.

Coil adjustment

Adjustment of the efficiency coil should be done as a matter of routine any time the horizontal system is serviced. Some manufacturers recommend slightly different procedures and these should be followed whenever the information is available. In general, the procedure is to monitor both the cathode current of the horizontal output stage and the B-boost. First tune the efficiency coil for minimum cathode current. Then tune "out of the dip" in the direction which increases B-boost voltage, until specified cathode current is obtained. If service notes are not available, consult a tube manual for typical cathode current. If no information is available, tune out of the dip just far enough to get a half inch or so of overscan and sufficient high voltage.

A misadjusted or malfunctioning efficiency circuit usually will produce excessive cathode current in the output tube, possibly with reduced scan and high voltage. The test procedure given here will expose the defective efficiency circuit, but it will not necessarily indicate an off-frequency condition. If the circuit is tunable, failure to "get a dip" indicates a fault (usually an off-tolerance capacitor). If the circuit is fixed-tuned and it is suspected of being off frequency, substitute the capacitor and observe the cathode current.

Summary

The horizontal-deflection/high-voltage system is one of the more difficult systems of a TV receiver to service, first because of the complexity of the loads on the output tube, and second, because a malfunction anywhere in the system is likely to cause nearly all of the voltages and waveforms to become abnormal. This makes it difficult to tell the cause of trouble from the symptoms that result.

In any troubleshooting situation, start by eliminating possible faults which are easy to discover, such as loss of B+, open screen-grid resistors or capacitors, bad tubes, etc. If this is not productive, proceed to more sophisticated tests, in the order of increasing difficulty. Since the flyback/yoke circuit is very complex, reserve it until last.

Substituting a high-wattage resistor for the flyback transformer allows operation of the oscillator, horizontal-output tube, and the damper circuit to be checked under conditions which **approach** actual operating conditions. The test setup can be made quickly, and the test data which can be obtained are reliable indicators of the quality of the circuits. The first time that data for a particular chassis are obtained by this method, they should be jotted on the schematic for future reference.

Frequently, the circuits tested in the procedures described here will be found to be without fault. This, of course, isolates the trouble to the load circuits, which consist of the flyback transformer, high voltage, focus, yoke, and pincushion circuits, plus their associated components. Here again, dynamic testing under controlled conditions will avoid much of the guesswork and random replacement of parts which often attend troubleshooting the system. These techniques will be described in the concluding half of this series. □

Using a dual-trace scope for troubleshooting

By Robert L. Goodman, CET

When the relative phase of two signals must be known, or when the condition of two waveforms must be known simultaneously, only a dual-trace scope will do the job. Here are some examples showing the advantages of dual-trace scopes.

The era during which dual-trace scopes were considered a luxury has now passed. More and more technicians are finding practical and essential uses for them. If you don't have a dual-trace scope, borrow one and use it for a time. Chances are, you'll grow to like it as much as we do.

One of the more obvious advantages of dual-trace operation is in analyzing circuits like chroma and video which have keying or blanking from horizontal pulses.

Lock To The Sweep Pulses

Often, these keying circuits need special scope locking. For example, a complex waveform made up of sine waves, or other individual shapes, should be locked to the repetition rate of the waveform, and not the individual parts of it. In other words, a burst signal or chroma signal can be locked tightly only by applying horizontal-sweep pulses from the TV receiver to the external-sync terminal of the scope and using the external-sync function.

Sufficient amplitude of pulses for good locking usually can be obtained merely by connecting an unshielded test lead to the external-sync terminal and positioning the other end near the yoke wires or the horizontal-output section of the TV set. An added bonus is that locking is not disturbed when the amplitude of the waveform is changed drastically.

Correct Phasing Of Burst Keyers

A schematic of the burst keyer stage in a 16Z7C50 Zenith color receiver is shown in Figure 1. If there were no horizontal pulses reaching the grid through R249, the tube would be biased to cut-off by the huge 27K cathode resistor. Therefore, the tube amplifies only when the tips of the positive-going horizontal pulses are at the grid to key it into conduction.

Phase of the grid-keying pulses is normally delayed by the low-pass filter action of C168 and R249 (see Figure 2). As we shall see, parts defects that change this delayed phase can weaken or eliminate the burst, and with it the color locking.

Figure 3 shows typical waveforms of the keyer stage when the phasing of the color burst waveforms is the same as the tips of the keying pulses. Notice that the entire chroma signal (including burst and chrominance sidebands) is applied to the grid, but only the amplified burst appears at the plate. Bear in mind that **any** signal present at the grid when a pulse is there will be amplified by the tube, but only those frequencies near 3.58 MHz (because the plate is tuned) appear at the plate.

Correct operation demands that the burst arrive simultaneously with the pulses. Otherwise, harmonics of video, or chroma sidebands, also can be amplified if the phasing of

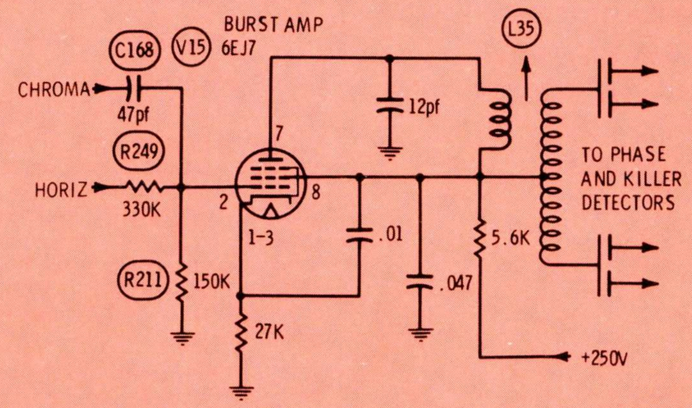


Fig. 1 Schematic of the burst keyer stage in a 16Z7C50 Zenith chassis.

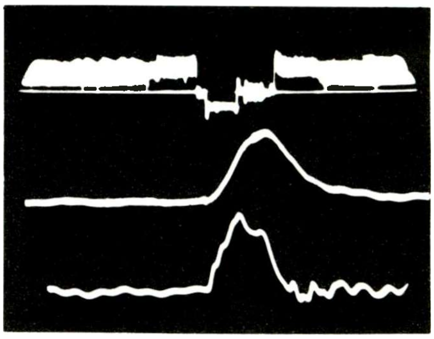


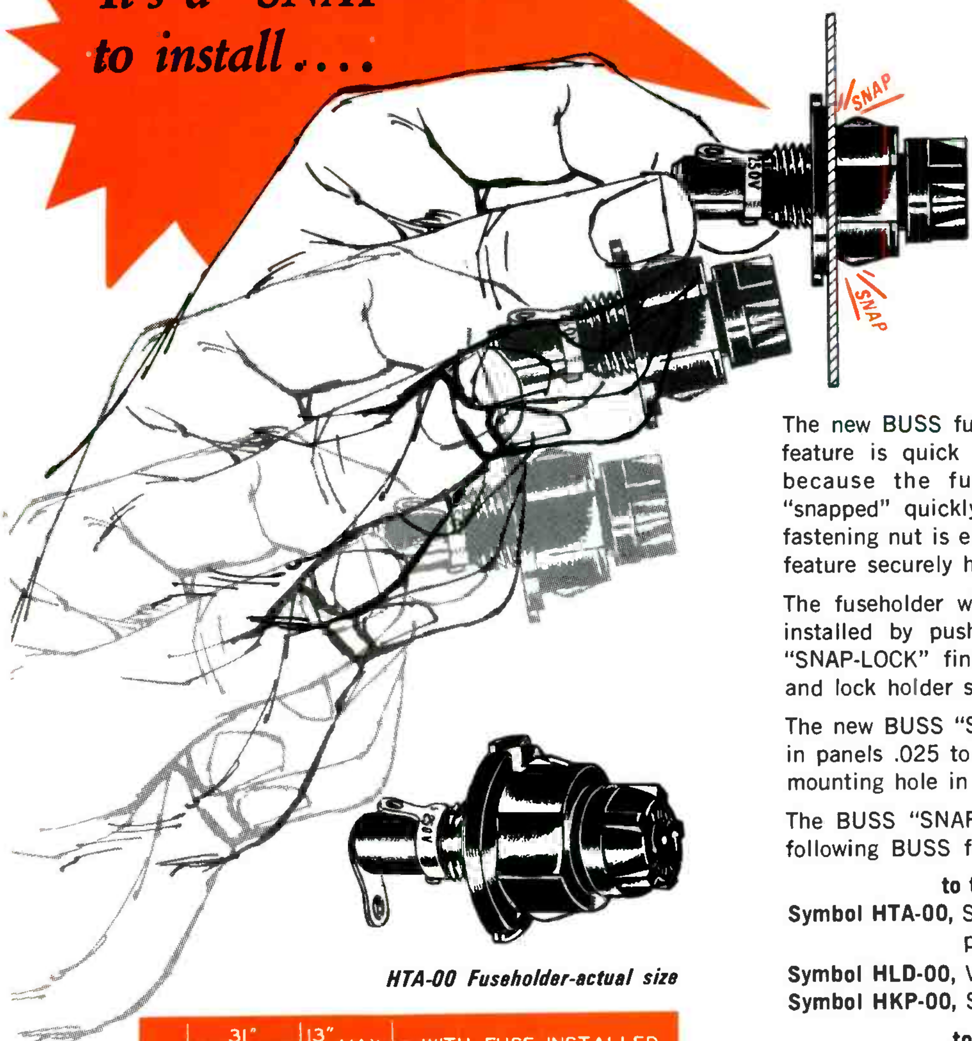
Fig. 2 Phase relationships of burst and keying pulses. Top waveform is the station video at the detector showing the burst to the right of the sync pulse. Bottom waveform is the raw horizontal pulse, whose tip arrives before the burst, making it unsuitable for keying. Center waveform has been delayed by R249 and C168 acting as a low-pass filter. The tip arrives at the same time as the burst.

the New BUSS® SNAP-LOCK

Rear Panel Mounted FUSEHOLDERS

It's a "SNAP" to install....

Easy...
Quick...
Time Saving...



HTA-00 Fuseholder-actual size

The new BUSS fuseholder with special "SNAP-LOCK" feature is quick and easy to install. It saves time because the fuseholder can be **pre-wired** and "snapped" quickly into place from rear of panel. A fastening nut is eliminated because the "SNAP-LOCK" feature securely holds the fuseholder in place.

The fuseholder with "SNAP-LOCK" feature is simply installed by pushing it into panel from rear side. "SNAP-LOCK" fingers engage edge of hole in panel and lock holder securely in place.

The new BUSS "SNAP-LOCK" fuseholder can be used in panels .025 to .085 inch thick. (See recommended mounting hole in dimensions below).

The BUSS "SNAP-LOCK" feature is available on the following BUSS fuseholders:

to take ¼x1¼ inch fuses:

Symbol HTA-00, Space Saver, extends just 1 in. behind panel.

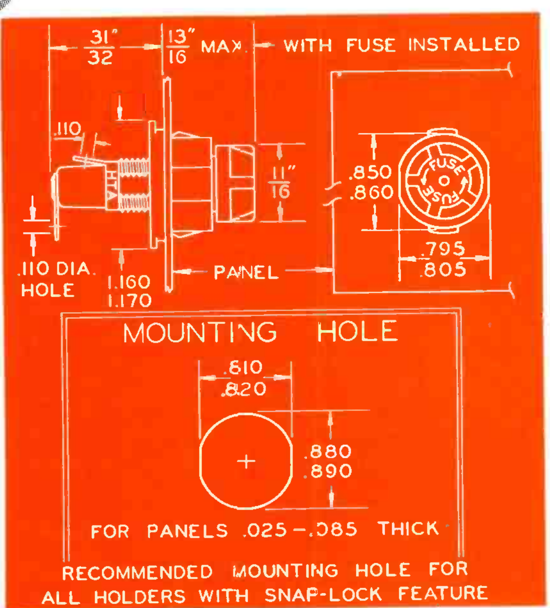
Symbol HLD-00, Visual Indicating Fuseholder.

Symbol HKP-00, Standard Fuseholder.

to take ¼x1 inch fuses:

Symbol HJM-00, Standard Fuseholder.

All are available with quick connect terminals, if so desired.



Dimensions of HTA-00 holder.
When tooling up for mounting get latest blueprint.

Also fits ½ in. knock-out in electrical boxes

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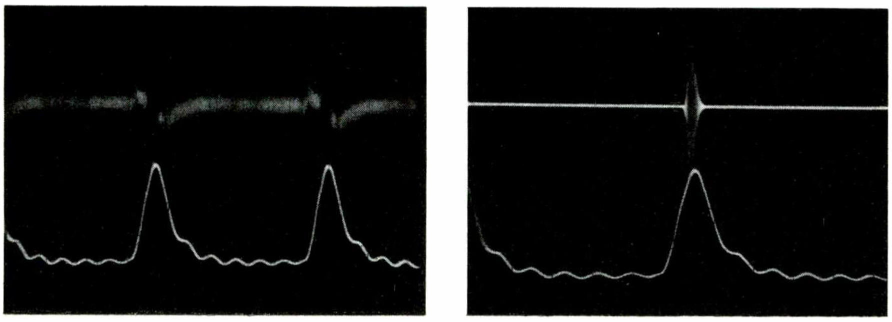


Fig. 3 Normal waveforms in one keyer stage. **(Left)** Top waveform is colorcast chroma at the input to the keyer, and bottom waveform is the keying pulse. Burst is in phase with the tip of the pulses. **(Right)** Top waveform is the separated burst at the plate of the keyer, while the bottom waveform is the grid pulse.

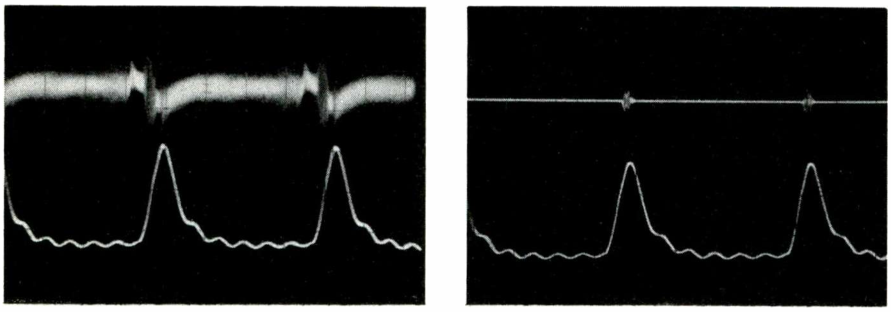


Fig. 4 Examples of wrong phase of the keying pulses. **(Left)** Top waveform is the colorcast chroma at the input to the keyer. Bottom waveform is the keying pulse, incorrectly delayed too much. **(Right)** Top waveform shows the weak burst at the plate caused by the wrong phase of keying pulse.

the pulses is wrong.

A false burst, or "spook", is produced at the plate in Figure 4 by an abnormal delay of the keying pulses, perhaps because of a larger value of C168 or R249. There is no change in the phasing of the spook and the grid pulses, because the pulses determine the conduction time.

False burst is created also by operating the receiver on snow off channel (the false burst has almost normal amplitude and waveshape), or on a b-w program (as shown in Figure 5, it has weak amplitude).

Keyer bias

Another important measurement easily made by dual-trace technique is measuring the grid bias of the keyer tube at the tip of the keying pulse. This is something not possible with a DC voltmeter.

Select DC function and preset the vertical sensitivity of both vertical channels so a p-p voltage of around 100 volts will fill most of the screen. Then, without input signal, adjust the vertical centering controls so both horizontal lines are on the top line of the graticule markings. Attach the common ground wire of the scope to the **cathode** of the keying tube, one low-capacity probe to the grid of the keyer tube, and the other probe not connected. Turn on the TV receiver.

This should produce a horizontal zero line on the scope screen, and below it the pulses at the grid, as shown in Figure 6.

The space between the tip of the pulse and the zero line versus the calibration of the scope gives the instantaneous bias voltage in DC volts. A bias voltage of more than -3 to -4 volts indicates a defect which should be corrected. Perhaps there is insufficient pulse amplitude, or a wrong value of cathode resistance. Excessive bias decreases the amplitude of burst at the plate, and a strong burst signal is necessary for normal, solid color locking.

Demodulator Phasing

In most color receivers, phasing of the demodulators is accomplished by supplying each one with a different phase of 3.58-MHz carrier.

Measurement of these phases can be done if the scope horizontal sweep can operate at speeds up to 1 MHz in order to lock and show individual cycles of the 3.58-MHz carriers. If so, the phasing is determined visually the same as for audio sine waves (Figure 7), in which a separation of 1/4 cycle is a 90° phase difference.

Phasing between R-Y and B-Y is never less than 90°, and might measure as much as 140° at maximum operation of some automatic-tint controls. Without ATC, most modern receivers will measure a phase of about 105°. Any phase less than 90° indicates defective phase-shifting components, and the need for repairs.

Pre-CRT Matrixing

For many years, the three -Y chroma signals were fed to the three grids of the picture tube, and the video (Y) signal was applied to all three cathodes. Matrixing (mixing in desired percentages) occurred in the electron stream of the CRT; there was no direct connection between b-w and chroma signals.

Many solid-state models now matrix the chroma and video signals together first, then apply them to either the three grids or the three cathodes. This is called pre-CRT matrixing. One example is shown in Figure 8 in which the chroma is applied to the base of Q209, the video is fed to the emitter, and both together appear amplified at the collector.

Differences in these waveforms are much easier to see with dual-trace operation because any two can be viewed at a time. For example, Figure 9 shows the matrixed video-and-chroma and the chroma alone during a color broadcast. Both waveforms are quite different.

On the other hand, color-bar waveforms (Figure 10) are nearly the same, because bar patterns

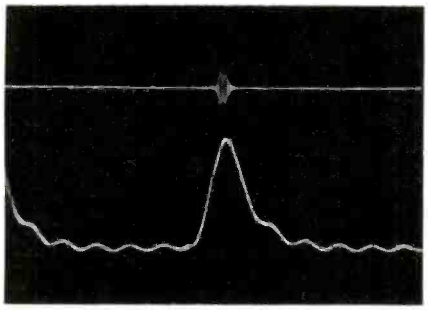


Fig. 5 False burst (spook) is produced at the plate by operation during a b-w program.

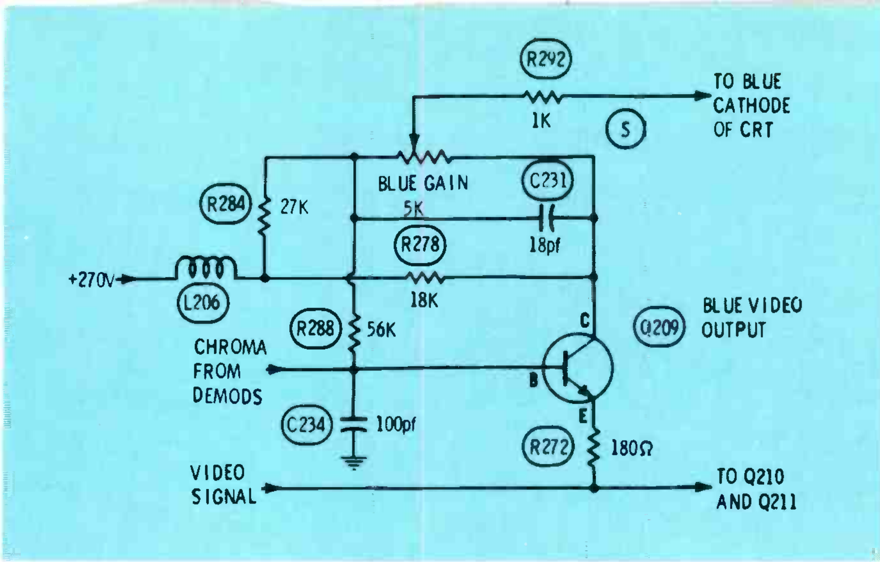


Fig. 8 Schematic of the b-w and color matrixing in a blue video amplifier stage.

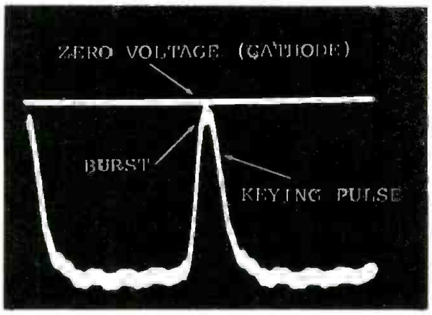


Fig. 6 Use the DC function with dual trace to measure the true bias voltage of the burst keyer tube at the tip of the keying pulse.

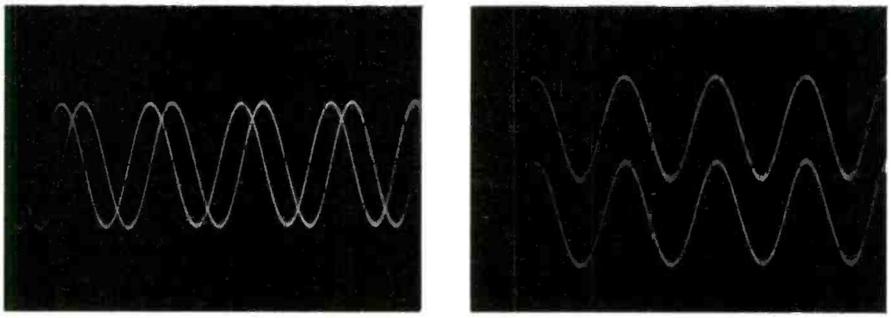


Fig. 7 Examples of 3.58-MHz carriers with various phases. **(Left)** The two sine waves are spaced 1/4 cycle apart, so the relative phase is 90°. This is correct phasing for the demodulators in many color receivers. **(Right)** Both sine waves have the same phase because of a defective phase-shifting coil.

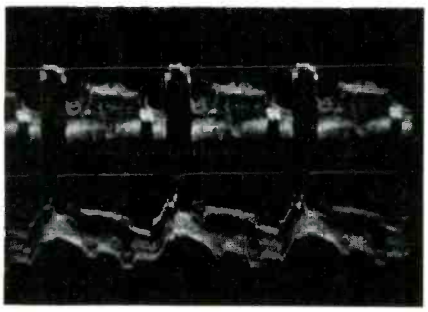


Fig. 9 Matrixed waveforms of a colorcast. Top waveform is of the combined video and chroma, and the bottom waveform is the incoming chroma alone.

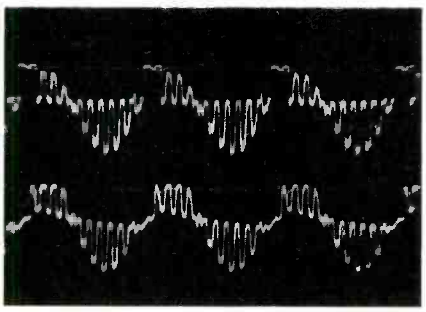


Fig. 10 Color-bar patterns don't show as much change as those of colorcasts. Top waveform is the matrixed video and chroma, and the bottom waveform is the chroma alone.

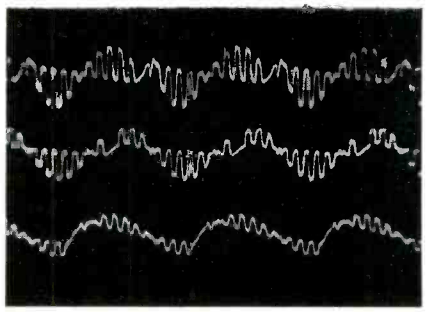


Fig. 11 Correct color-bar waveforms (without video) at the cathodes of the CRT are inverted from that of older sets. Top is red, center is blue, and bottom waveform is green.

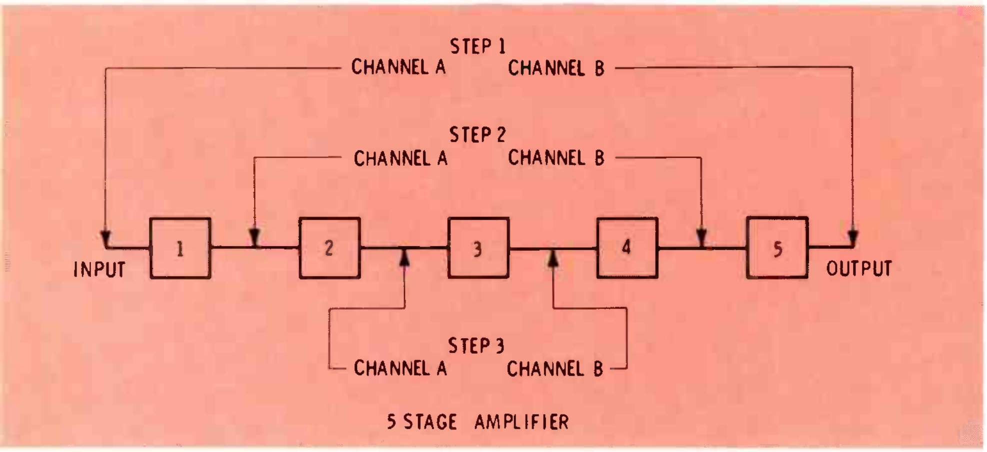


Fig. 12 Steps to zeroing-in on the origin of an intermittent.

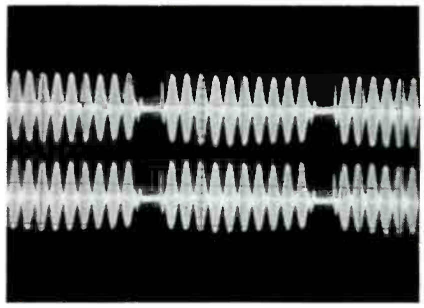


Fig. 14 Waveforms obtained during the tests. **(A)** Normal waveforms at the input (top) and output (bottom) were nearly identical.

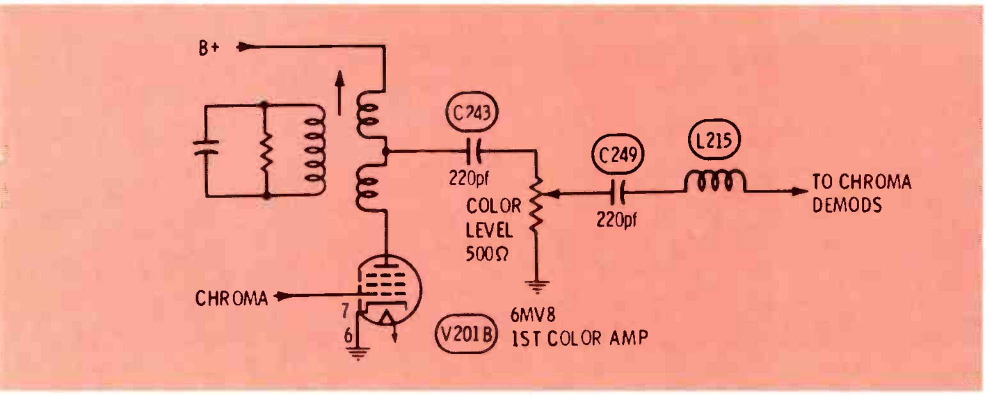
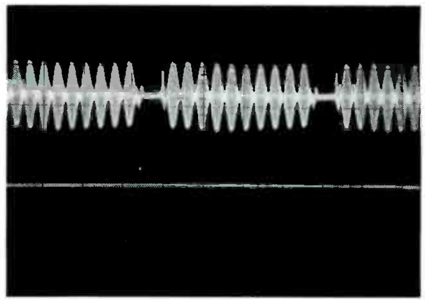


Fig. 13 Schematic of a chroma stage in which an intermittent was located.



(B) During the intermittent, the output waveform (bottom) disappeared.

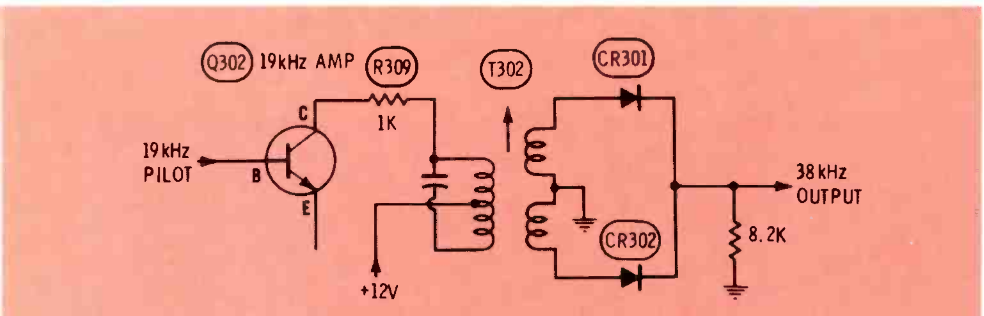
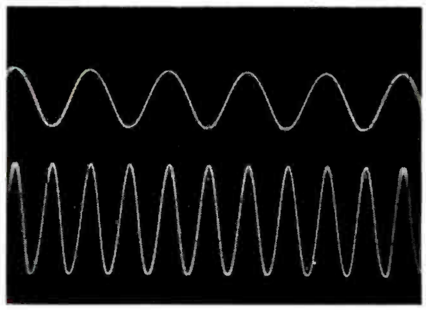


Fig. 15 Schematic and waveforms from a FM-stereo receiver. **(A)** Partial schematic of the pilot amplifier stage.



(B) 19-KHz and 38-KHz sine waves show perfect 1:2 ratio of frequency, identical phase, and low distortion.

have very little amplitude of the video component.

When the pre-CRT matrixed waveforms are applied to the cathodes of the picture tube, they are inverted from the way shown for the older receivers where the chroma -Y signals went to the grids. Correct bar waveforms are shown in Figure 11. Pulses above the zero line make dark color bars, and those below the line make brighter color bars.

Locating Intermittents

The use of dual-trace techniques often can cut in half the time otherwise required to locate the stage in which an intermittent originates. The method (see Figure 12) is to connect one probe at the input of the series of components or stages, and the other probe to the output. If the input waveform did not change during an intermittent, but the output disappeared, the trouble is between those two points.

Next, move the input probe back one stage, and the output probe up one stage or component, and wait for the intermittent. If both waveforms disappear at the same time, the defect is ahead of the input probe. If the input waveform remains, but the output one disappears, the defect is between the two points. If neither waveform is affected, the trouble is behind the output probe.

Go on, if necessary, to any other stages in between, and repeat this kind of test until only one part or stage is between the probes. The trouble must be there.

An intermittent in the chroma

When analyzing an intermittent in the circuit of Figure 13, I connected the probes to the plate of the tube, and the output of L215. Each time the intermittent occurred, I moved the scope probes one component at each end of the circuit until C249 was found to be the cause of the intermittent loss of chroma. During the tests, the waveforms of Figure 14 were obtained.

Frequency Doubling

Dual-trace scope waveforms are very handy for observing two harmonically related waveforms.

One good example is found in FM-stereo receivers where the 19-KHz pilot carrier is tuned, doubled to 38-KHz, tuned to get rid of the harmonics, and then applied to the stereo demodulator circuit (Figure 15A).

It takes only a glance at the Figure 15B waveforms to see that one is twice the frequency of the other, and that they are in phase. Another advantage is that any distortion of the sine waves would be easy to spot.

Of course, there are other methods of finding whether or not the pilot carrier has been doubled. A frequency counter (good but expensive), or the use of Lissajous figures also give the proof of frequency relationship. To obtain Lissajous patterns, one frequency is fed to the scope's vertical amplifier, and the other signal is applied to the horizontal amplifier. However, it's more trouble to obtain the information using these two methods, and the big drawback is that the waveforms cannot be known without separate measurements.

Another bonus with dual trace, while the low-capacitance probes are still connected, you can use the scope patterns as indicators of the maximum amplitude as you tune the coils for resonance.

Dual-Trace As An Educational Tool

Dual-trace waveforms can help us learn more about the operation of electronic circuits. Perhaps you have noticed the many multiple-waveform pictures in past issues of ELECTRONIC SERVICING.

As innovators in this field, we will use even more multiple waveforms. Watch for them. □

part 2

Record changer workshop

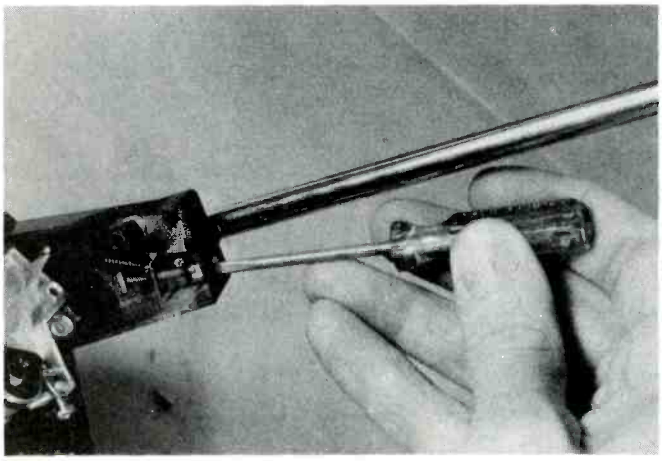
By Forest H. Belt

In our first Workshop session you found out the best way to approach record changers and automatic turntables for servicing. A thorough cleaning starts the procedure. Then comes inspection and testing, both of which lead toward diagnosis.

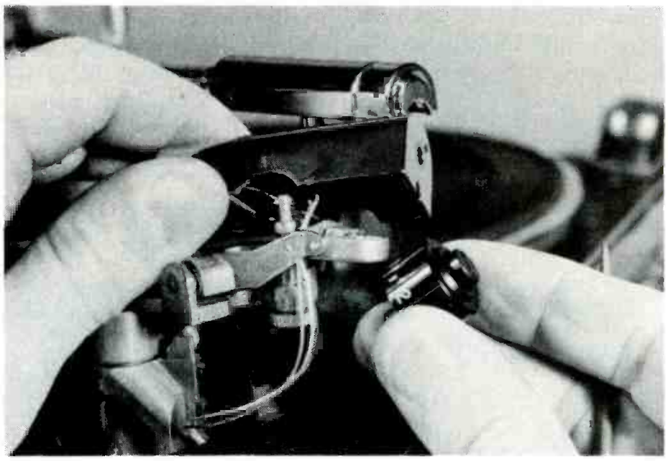
But they aren't the only steps. Another, and an important one, is **adjustment**. That's what this session covers.

One fact becomes apparent as you study through the photos in this session. Inexpensive record changers differ from automatic turntables more than just in price. Once you discover the main differences, something else becomes obvious: costly machines actually are easier to repair. You find more adjustments, but that saves you "bending" parts to make them perform within acceptable limits.

Certainly, not every make or model appears in this session. But enough adjustments are pictured, and sufficient information supplied, to help you adapt your knowledge easily to other versions. Make adjustment an early part of your diagnosis and repair procedure. And give then a final check before you hand the unit back to your customer.

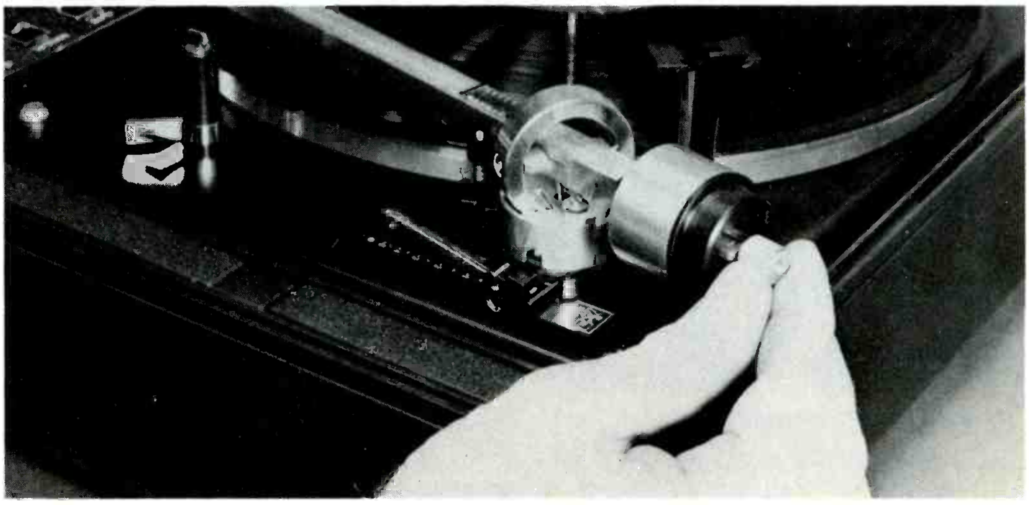


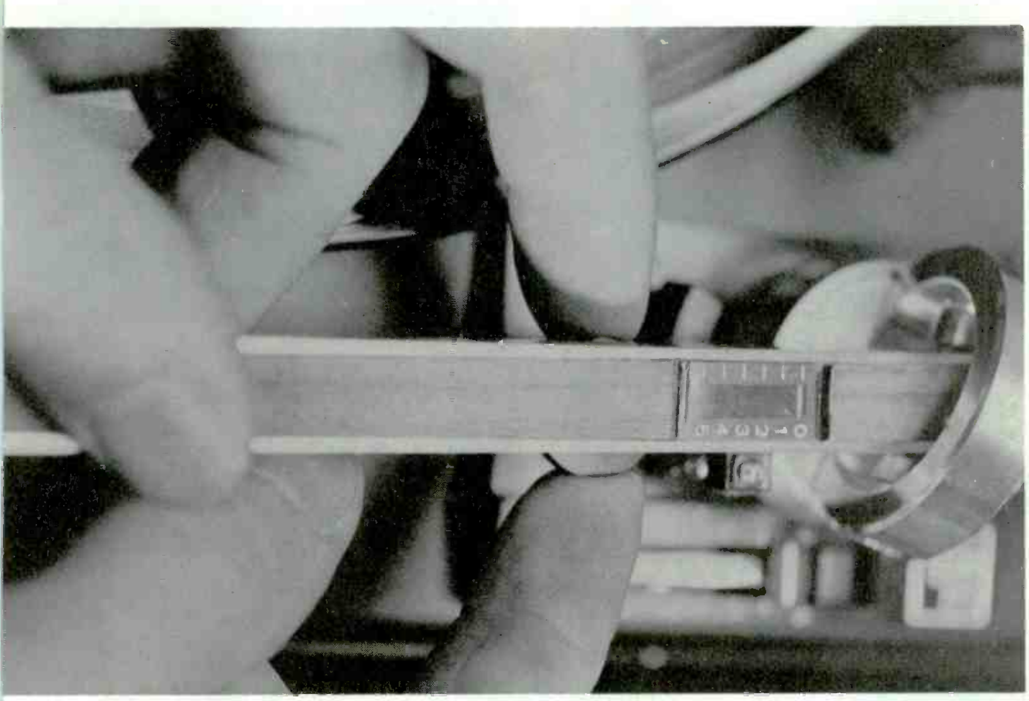
Step 1 To adjust pressure that tone arm of record changer puts on stylus, you alter spring tension at vertical pivot. Inexpensive models have only rough adjustment—you shift the spring anchor point.



Step 2 Many costly changers, and most hi-fi turntables, have knob for setting exact stylus pressure. This one, not the most expensive, uses spring tension to counterbalance weight of arm and cartridge.

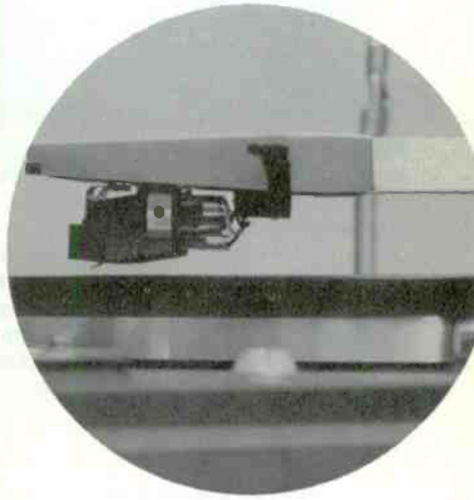
Step 3 Better automatic and manual turntables use a counterweight method of controlling stylus pressure. A weight at the back end of the tone arm balances out the weight of the arm and cartridge.

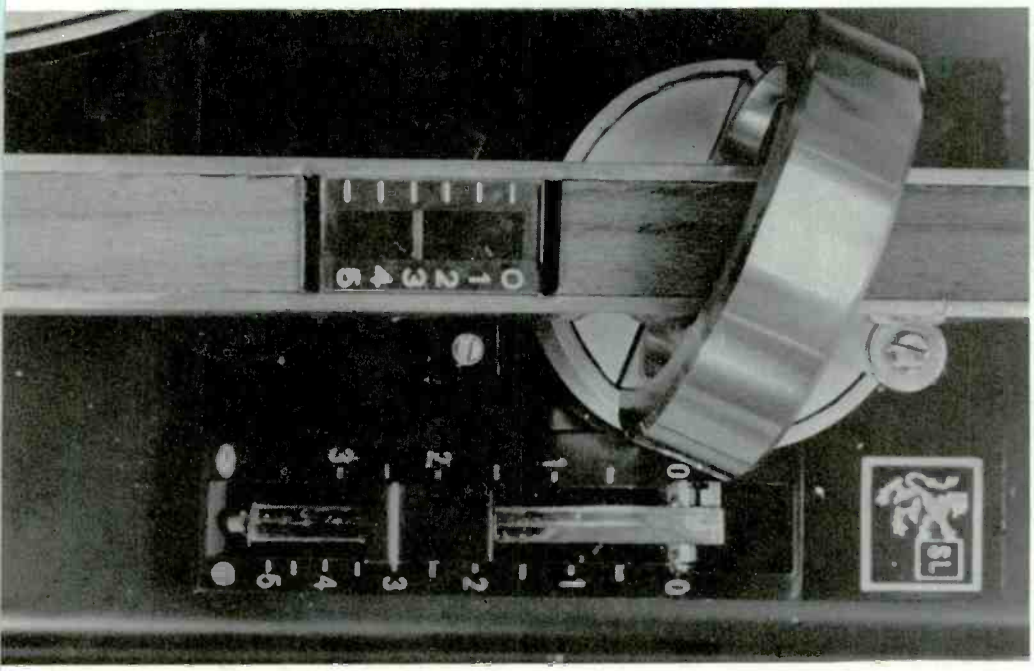




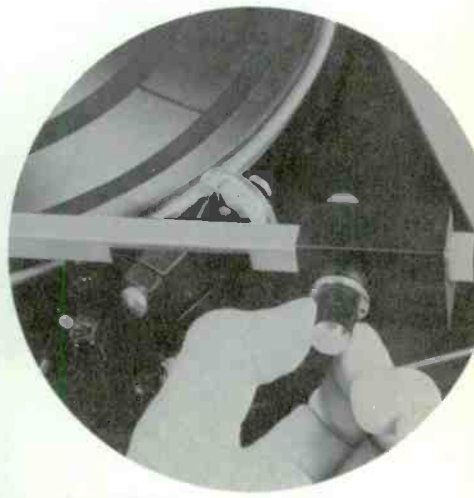
Step 4 To begin adjustment, you first set the grams-scale knob to zero. This calibrates the knob to deliver exactly the indicated grams of weight at the stylus tip, but only after the arm is balanced.

Step 5 The trick is to balance the tone arm precisely, with the grams scale set at zero. You adjust the counterweight knob to let the stylus hover just above one record on the turntable. Don't let the stylus touch, or you won't know the arm is balanced.

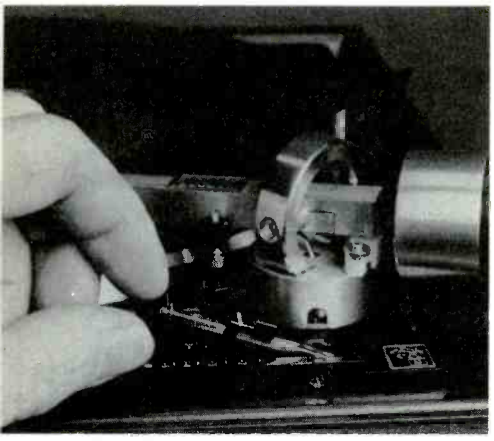




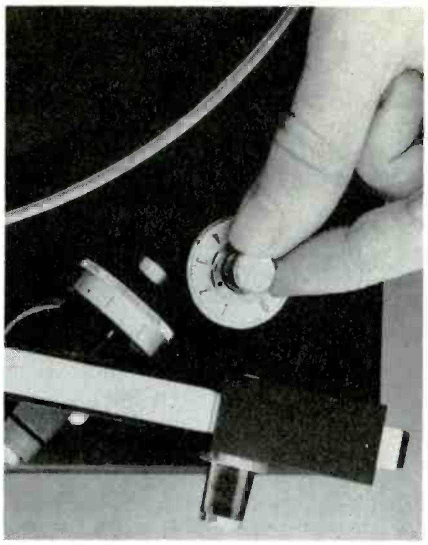
Step 6 After the tone arm is balanced, the grams scale is accurate. You dial in the stylus pressure recommended for the cartridge being used. If the cartridge is changed, the tone arm must be rebalanced at zero, and the new stylus pressure then set on the dial.



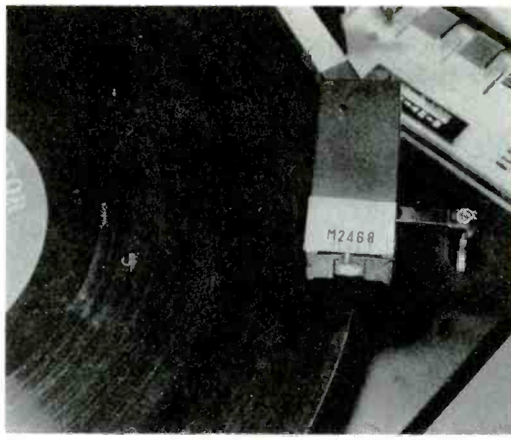
Step 7 The tone arm shown here has a sliding counterweight moved by a friction knob. The grams knob, the white one on the other side of the mounting post, is typical of medium-price automatics.



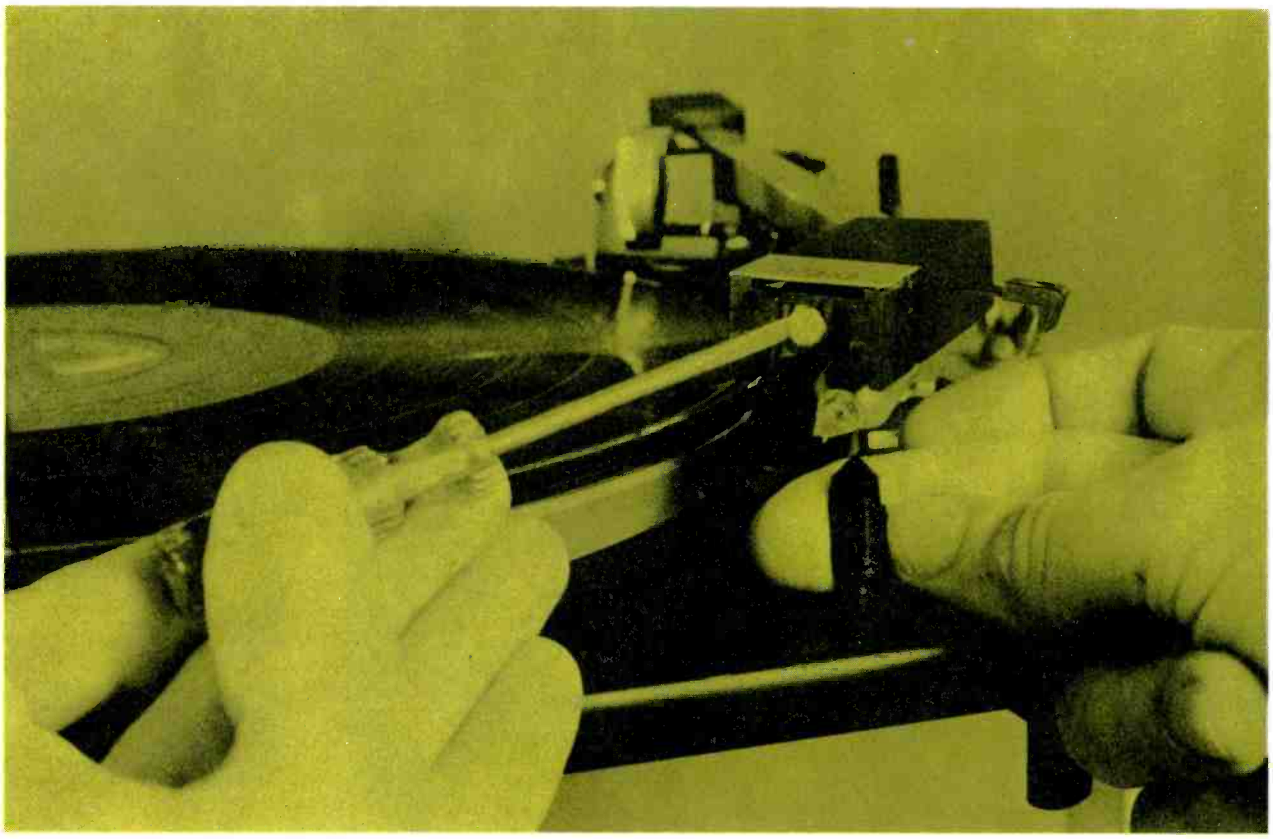
Step 8 Sideways movement of tone arm across record grooves towards the center is called skating. To minimize this unwanted effect, designers include some means of countering it. The feature goes by the name **anti-skate**. This one, consisting of a bar connected by a cord to the tone arm, has a sliding weight that determines how much anti-skate pressure is applied.



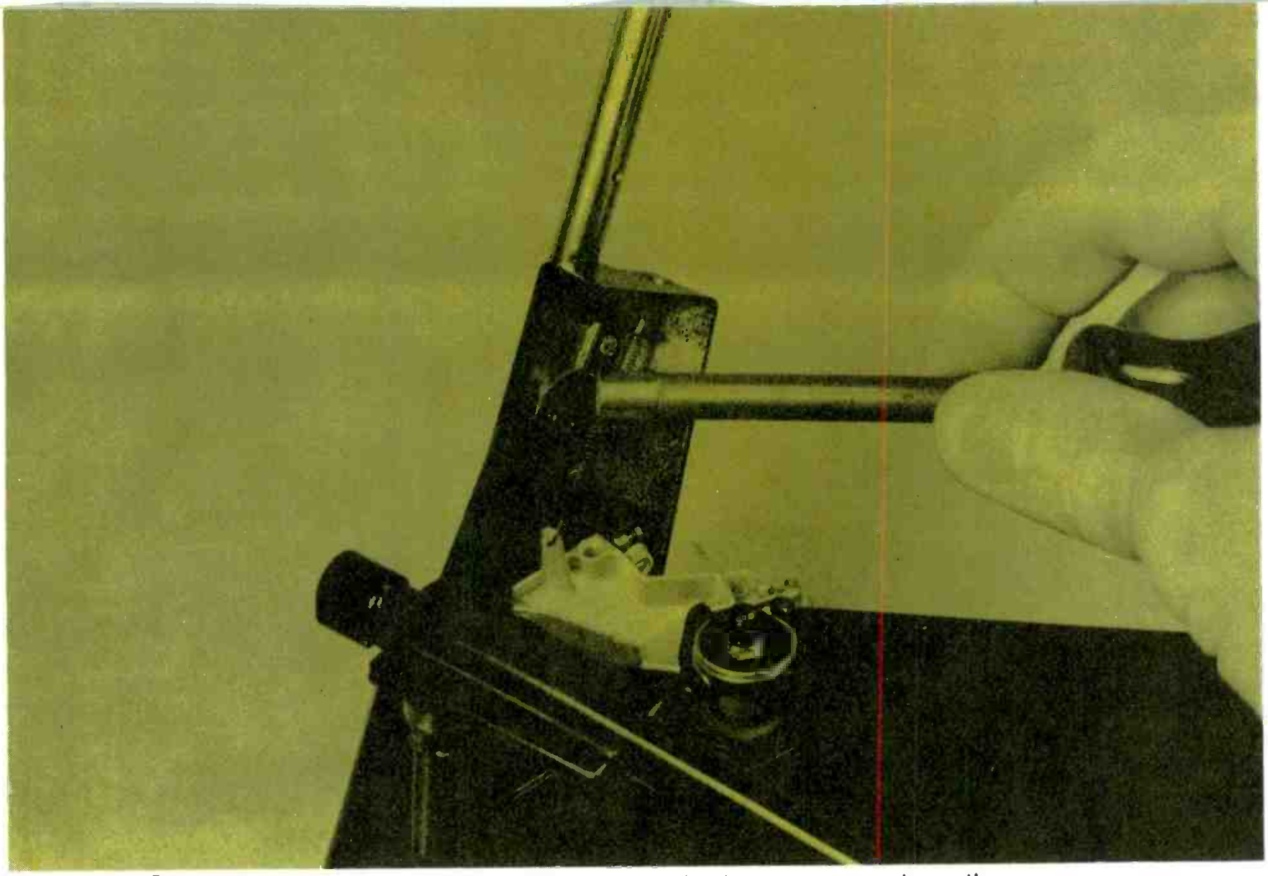
Step 9 This alternate anti-skate system incorporates springs underneath the baseboard. They apply sideways pressure to the tone arm to counter any skating tendency. Ordinary adjustment calls for anti-skate pressure equal to stylus pressure. When done right, the anti-skate adjustment "balances" the tone arm in the lateral plane.



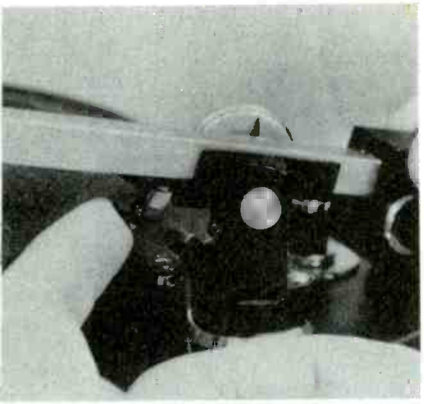
Step 10 This is the vertical tracking adjustment on a high-quality turntable. You saw a cartridge in Session 1 that needed this adjustment corrected. It looked sideways in its mounting, viewed from the front. The stylus can't seat properly in the groove unless this is right.



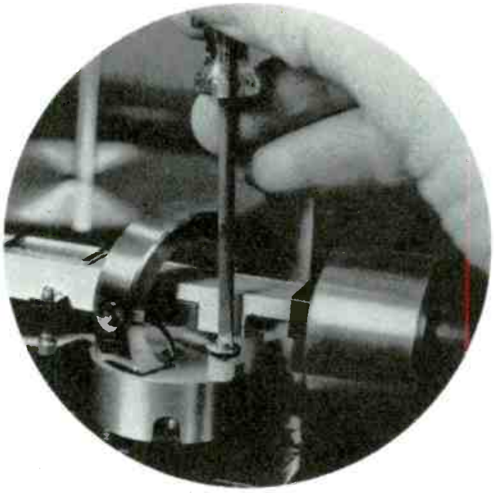
Step 11 The lateral tracking adjustment puts the tone arm at the stylus on precisely the right tangent to the circle formed by the record grooves. This introduces the least possible tracking distortion. On the machine illustrated here, a guide post lets you determine where the exact tangent is; you align the stylus tip with the apex of the post.

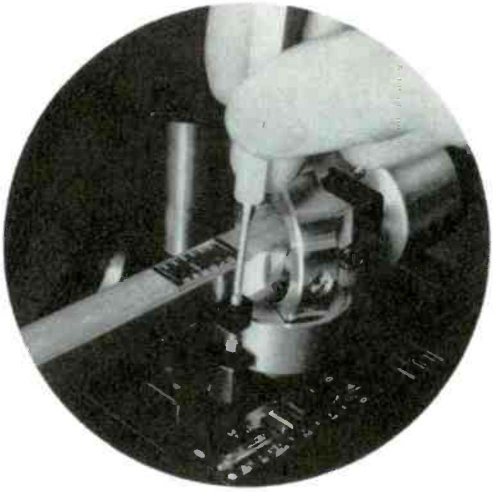


Step 12 How high the tone arm lifts is determined by a screw underneath the tone arm, on this record changer. Might take a nutdriver, a Phillips, or regular screwdriver.

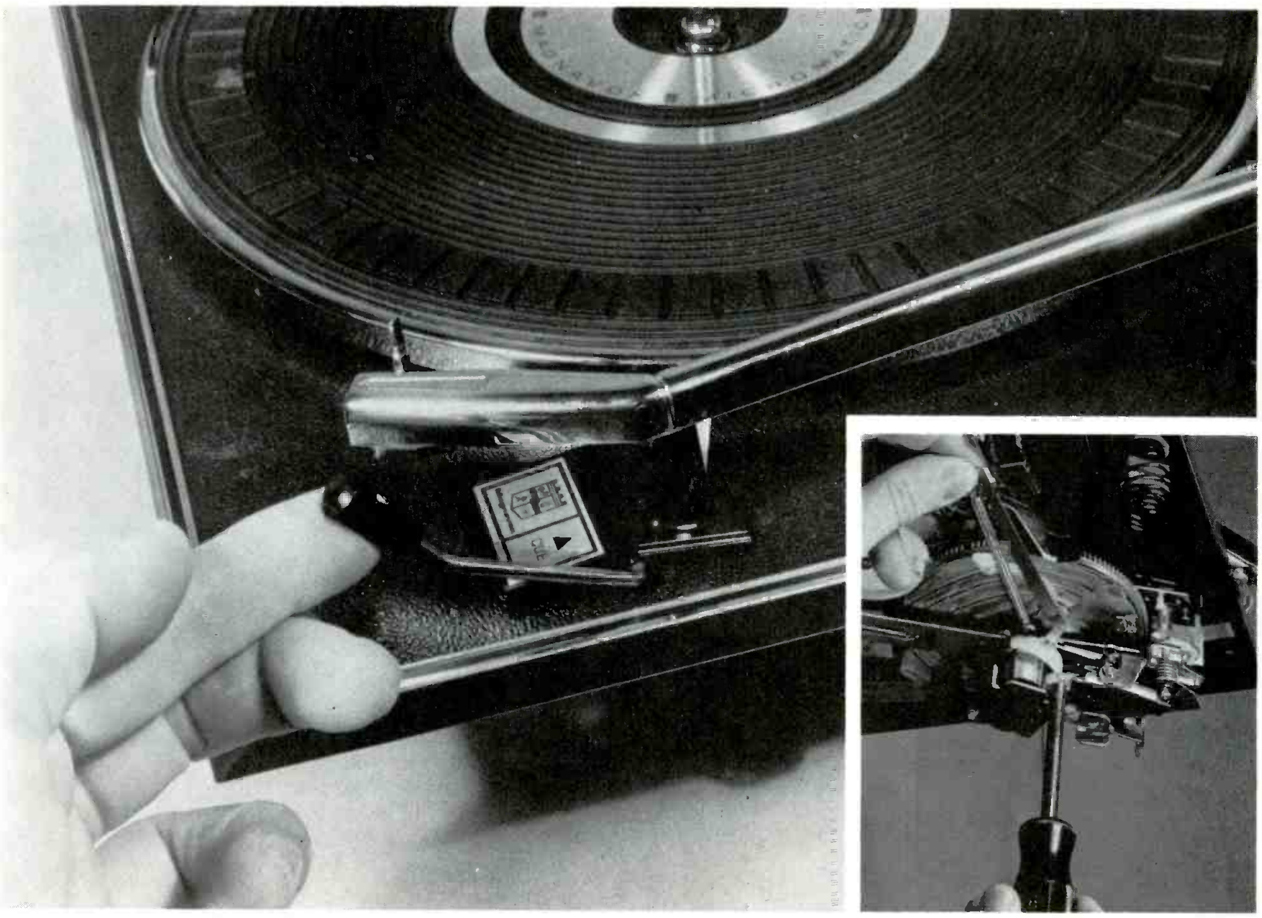


Step 13 Thumbwheel rides on lift bar of this automatic turntable. Fingertip adjustment is easy. The arm shouldn't be raised any higher than necessary to clear records on platter.

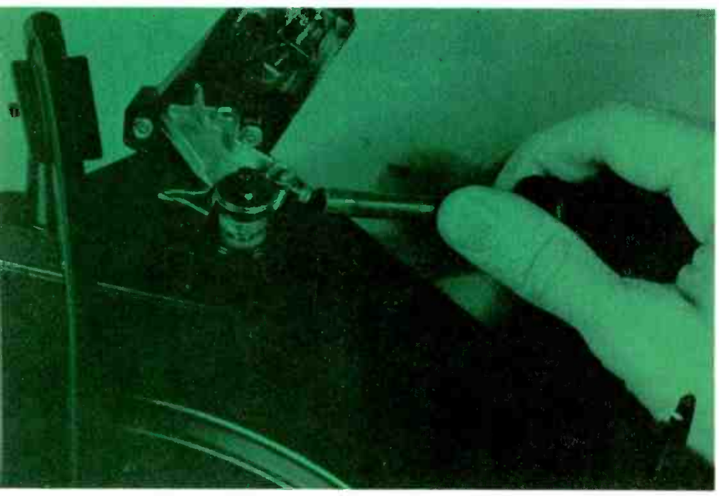


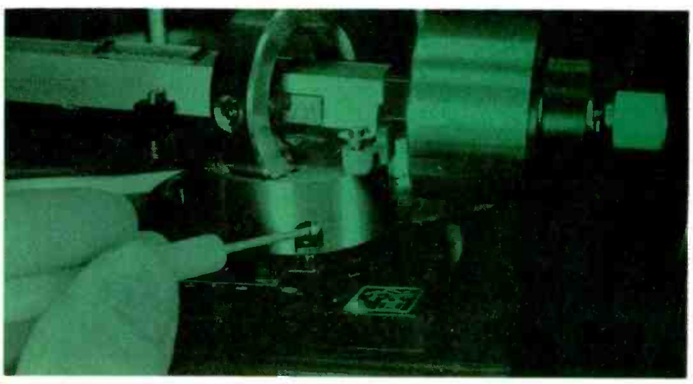


Step 14 The tone arm, when it lifts during the change cycle, must raise high enough to clear records on the platter but not high enough to bump those stacked on the spindle. Above and to the left, respectively, are adjustments that control these limits.

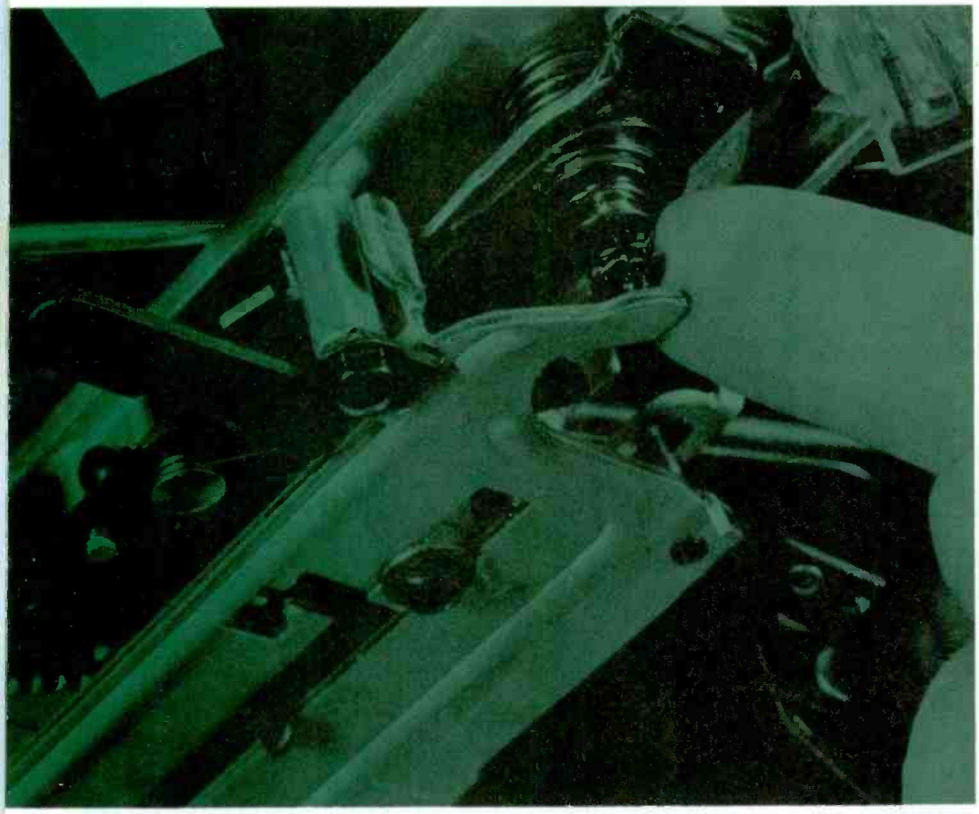


Step 15 Where cueing is a part of an automatic turntable, damping often is provided to keep the tone arm from dropping abruptly and damaging the stylus tip or the record. Below, the cue handle. At right, adjusting limit of cue lift, so arm doesn't go too high.

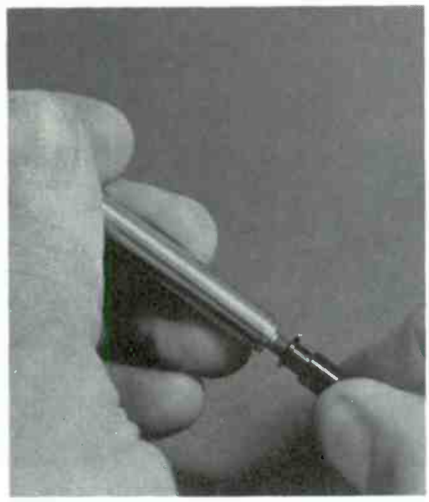




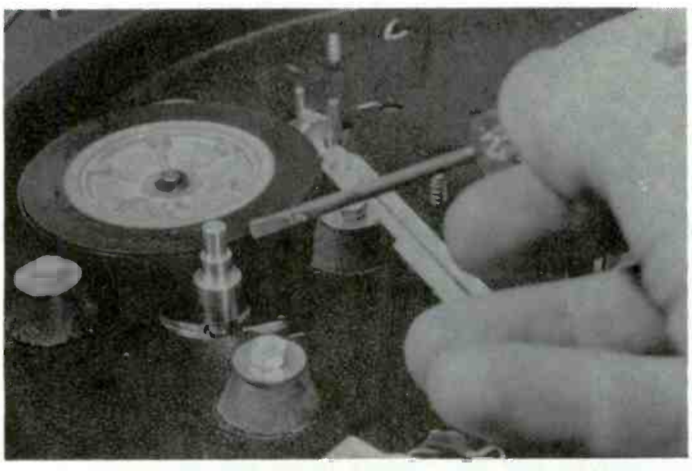
Step 16 Indexing picks the size of record the tone arm sets down on, but a finer adjustment puts the stylus right in the lead-in groove. The above photo shows the setdown screw on a popular record changer; use a nutdriver. Above right, the setdown adjustment is almost hidden at the base of the tone arm mounting. Likewise in the photo at right; screw is nearly out of sight in lower gimbal ring.

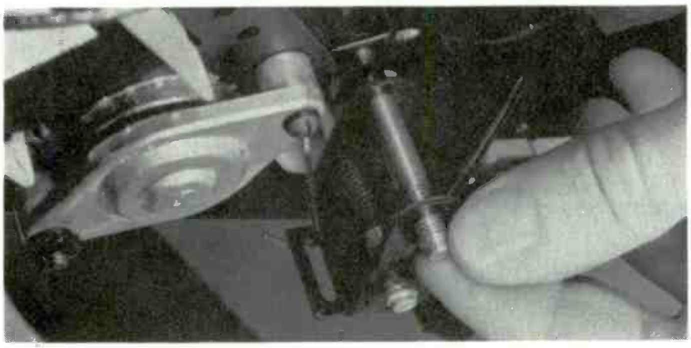


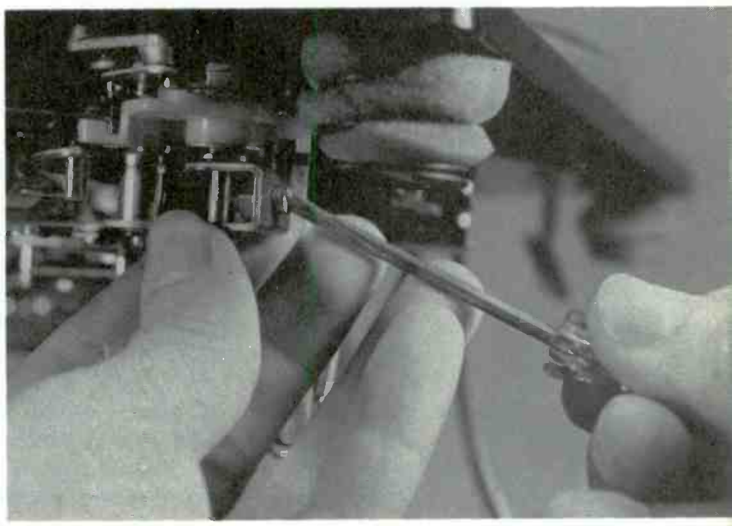
Step 17 Dropping the record is a function of the spindle. But down underneath, something does the pushing. Here, it's a projection on the cycling slide. Usually, there's some adjustment to make sure the lift rod shoves the pushoff tab out far enough, but not too far.



Step 18 In one automatic turntable, the pushoff adjustment is part of the spindle. A fork is part of the cycling mechanism. At the right time, the fork pulls downward on the bottom of this spindle, pulling rods inside it and dropping the record. The same pulling action causes the spindle to sense whether to shut off after the record plays.

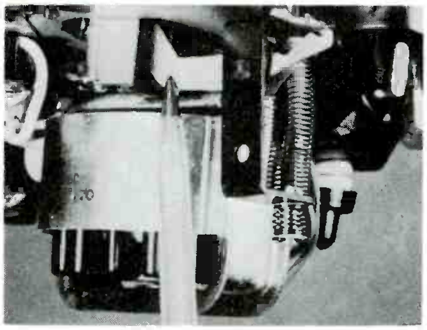


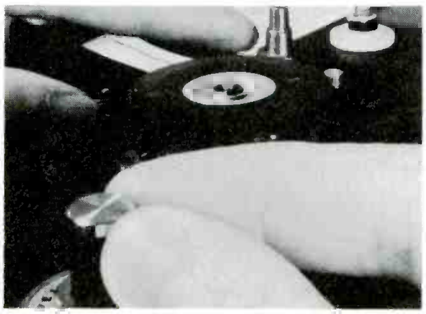


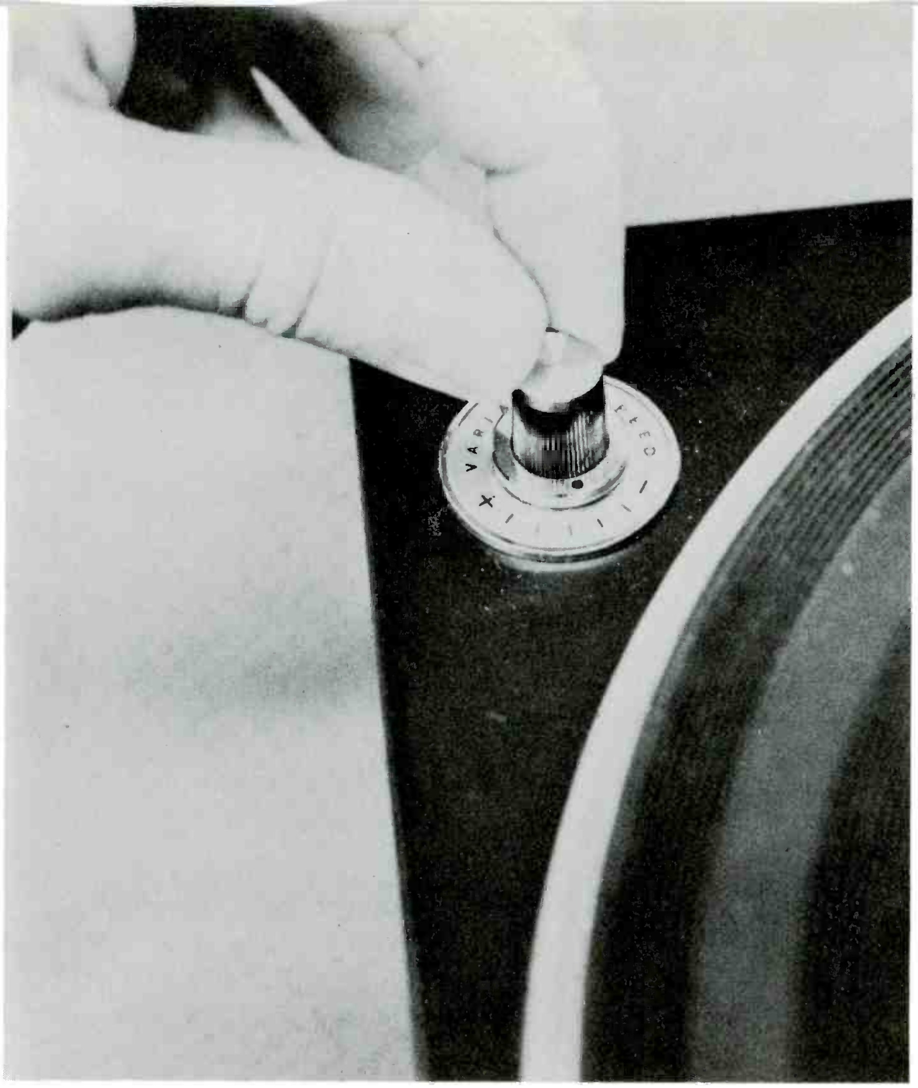


Step 19 In the ordinary record changer and in most hi-fi turntables, there is no provision for fine speed variation. There are two, three, or four speeds, set by the diameter of a pulley on the motor shaft. The drive idler rides on one of the diameters. If it rides too high or too low, it can cause wow and/or abnormal wear. The adjustments at right are typical of those provided for keeping the idlers at an even height. You may have to compromise a bit, or replace the mounting the idler fits on.

Step 20 Here's one that does have variable speeds, brought about by a tapered pulley on the motor shaft (below, right) against which the idler rolls. Speed changes (78, 45, 33) are as usual. The Variable knob at left moves a lever (below, left) that slips the idler up and down on whichever step the speed selector has placed it.







Summary

Every adjustment of any record changer or turntable you have in for service should be checked before you begin diagnosis. And, once the repair job is done, another quick run-through can head off unsatisfactory operation.

Actually, you'll find that a careful analysis of the results of each adjustment gives you a pretty good idea where any mechanical difficulty might be. From there, diagnosis of a specific faulty operation is but a short step.

For that, you do need a rather complete understanding of how the machine works. You might be able to figure out the mechanism by watching its attempts to operate correctly. To aid you in that analysis, our next session shows you the key operations inside a typical record player. □

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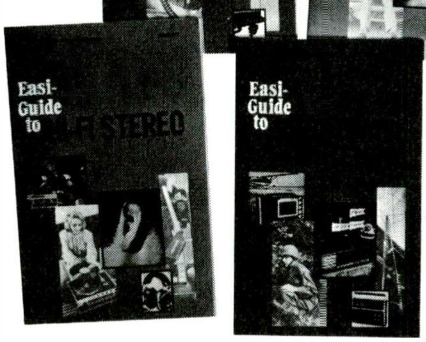

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Is the transistor oscillating?

More help for the man who wants to change from tubes to transistors.

By Wayne Lemons

Away back in the dark ages, it was easy to tell if a tube oscillator stage was actually oscillating. You measured the grid-to-cathode voltage. If the grid was several volts negative, it was a cinch the stage was oscillating. The grid was doing double duty, acting as a control grid should, and at the same time self-rectifying the signal there as though the grid were a diode. In one sense, the circuit was a shunt-fed rectifier circuit with the DC output taken from the anode (grid), so the DC polarity was negative. The larger the amplitude of signal, the higher the negative voltage. It was easy to tell if the stage was oscillating strongly enough. You compared the negative voltage actually measured with the normal level. So it was with tubes, how about transistors?

Transistor rectification

Transistor oscillators self-rectify using base and emitter elements in much the same way tubes use grid and cathode. However, there are differences which make it more difficult to measure the transistor circuit with the same degree of accuracy. For example, there are both PNP and NPN polarities of transistors with the resulting reversal of voltages.

To a tube, negative grid voltage is bias in the direction of cut-off. Therefore, a tube oscillator measures as though the grid was completely cut off. Transistors do the same thing, but you must stop to consider which polarity of voltage represents a cut-off bias. NPN action resembles that of a tube since a negative base voltage represents a total cut-off bias. And a PNP, of course, is just the opposite.

Oscillating, or just wrong bias?

Let's say we are checking a radio whose schematic calls for a DC base voltage of -1.5 for a NPN-type transistor, and our VTVM with an external decoupling resistor (to reduce capacitance effects) reads just about that. Does this prove the stage is oscillating? After all this does represent cut-off bias.

No, at this point we have proved nothing. Perhaps a defect in the biasing circuit has placed a steady cut-off bias on it.

We must have a rule to guide us, and here it is: **A transistor which is oscillating will appear to have insufficient forward bias** (or even a reversed bias) **and yet will be drawing normal collector current. A transistor with a reversed bias and which is not oscillating will have zero collector current.** (Assuming in all cases that the transistor is not defective.)

Measuring collector current

Measuring collector/emitter current directly is too much trouble. It involves unsoldering or disconnecting part of the circuit, then clipping in a current meter of the proper range.

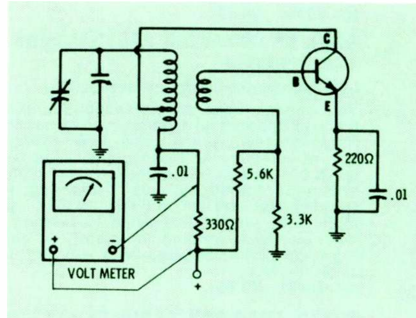


Fig. 1 In this oscillator circuit the collector current can be checked by measuring the voltage drop across the 330-ohm resistor, and then calculating the current by using Ohms Law. In the same way, check the emitter current by the voltage drop across the 220-ohm emitter resistor. Base voltage can be measured without adverse capacitive effects at the junction of the 5.6K and 3.3K bias resistors.

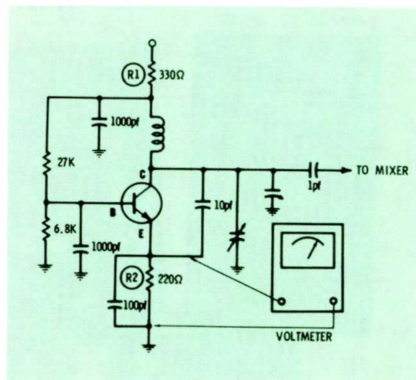


Fig. 2 Minimize any capacitive loading in this emitter circuit. It's better to measure the voltage drop across R1, in the collector circuit.

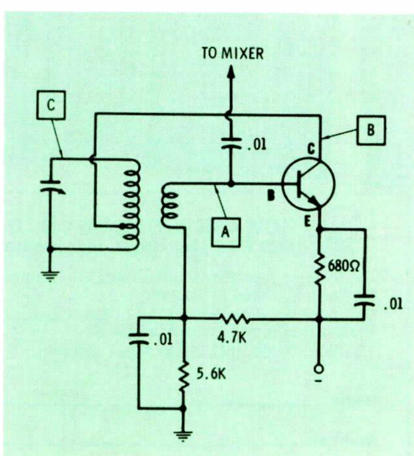


Fig. 3 How much the added resistive and capacitive loading of your test equipment effects the amplitude and frequency of any oscillator depends on the impedance at the point of measurement. **(A)** Is the point of lowest impedance in this circuit. **(B)** Has a medium impedance. **(C)** The coil has a step-up ratio, so this point is very high impedance and very susceptible to loading. By the same reasoning, it's a good point if you **want** to load the circuit.

A better way is to measure the voltage drop across a resistor; this can be done without disconnecting anything (a valuable shortcut in miniature equipment having circuit boards), and most circuits have such a resistor.

Figure 1 shows two resistors whose voltage drops indicate either collector or emitter current. (Usually collector and emitter currents are almost the same, so the choice should be made for other reasons.)

The voltage drop across the 330-ohm collector-supply resistor gives (by Ohms Law) the collector current. Also, the 220-ohm emitter resistor can indicate by its voltage drop what the current is there. Both resistors are bypassed, and present no problems of upsetting the oscillator performance by the added capacitance of the meter leads. True bias can be measured between the junction of the 5.6K and 3.3K resistors and the emitter lead, without detuning the circuit.

But collector or emitter current might be possible because of leakage either of the circuit or internal leakage of the transistor. We must prove that the current is due to oscillation.

Disturbance tests

Shorting the base to the emitter should stop all collector/emitter current. That proves the transistor can be controlled, but it doesn't prove much about the oscillation.

The next step is to temporarily change the strength of oscillation, as proved by a change of collector current. One radical way is to short across one of the windings of the oscillator coil. The base/emitter bias should become very nearly correct for a class "A" amplifier.

Another fast test is to take hold of the metal shaft of a small screwdriver and then touch the tip to the "hot" side of the oscillator tuning capacitor. Both the bias and the collector current should change noticeably.

In the circuit of Figure 2, it's best to connect the meter across R1 (in the collector circuit) to avoid capacity changes that are nearly certain to invalidate the test if the emitter voltage drop is monitored. While reading the collector current, just touch a finger to the collector terminal. Again, both the collector current and the bias should change enough to be significant.

Capacitance loading

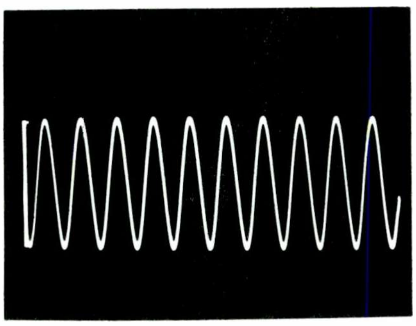
It helps if you know where the low-impedance and high-impedance points are in each circuit so you can either find or avoid them at will. The higher the impedance, the more effect on frequency and amplitude will result from adding probes and connecting wires.

In Figure 3, point "A" has the lowest AC impedance of this circuit. Point "B" has a medium-impedance, point "C" has the highest impedance of all. Point "E" is bypassed so it has no signal; it is low-impedance to AC.

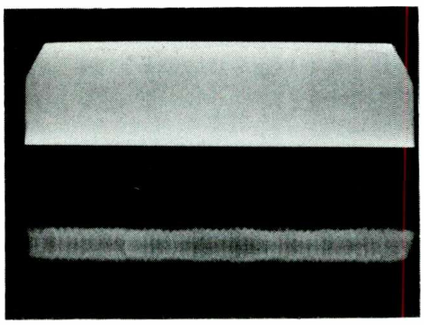
Check A Radio With A Radio

An AM radio with an oscillator suspected of being dead can be rapidly checked by use of another known-good AM receiver. Turn on both radios and place them close to each other. Tune the good radio to a high frequency on the dial, perhaps 1260 kHz. Because the intermediate frequency is 455 kHz, the oscillator of the suspected radio should be received when its dial is set to about 805 kHz. Therefore, vary the dial of the bad radio from 600 kHz up to about 1000 kHz to see if a carrier can be heard on the good radio. A carrier (rushing

Fig. 4 Many AM radio oscillators can be checked by use of a good, wide-band scope.



(A) A triggered-sweep scope locks easily to this AM oscillator of about 1.06 MHz. Amplitude can be measured by the scope calibrations.



(B) Locking the scope to audio frequencies can be all that's necessary. Top trace is the oscillator signal (unmodulated) which is so far out of lock that it appears like a rectangle without detail. Even so, the height indicates the amplitude. Lower trace is a modulated carrier found at the loop antenna. It's there only when a station is tuned in, while the oscillator signal is there always.

(C) Another way to be sure the oscillator is oscillating is to connect the scope to the oscillator circuit (using a low-impedance point if possible), then noticing how much the amplitude of the scope trace decreases when you touch certain parts of the circuit. The top trace is the normal-amplitude one, while the bottom waveform shows the decrease of amplitude when a finger touched the hot terminal of the oscillator-tuning capacitor.

sound) heard when the dial is near 805 kHz indicates the oscillator is operating.

A variation of this method is to tune in a weak station at the high-end of the dial of the good radio, then adjust the dial of the suspected one for a beat frequency (whistle).

FM oscillators can be checked the same way, keeping in mind that the intermediate frequency is 10.7 MHz.

One precaution, radios that have a well-shielded oscillator section (such as some car radios) must be coupled together more tightly. For example, add a piece of insulated wire from the antenna terminal of the test radio and position it near the oscillator section of the suspected radio.

Testing TV Oscillators

If the TV tuner has a mixer-grid test point, use the DC voltage found there to indicate the relative strength of oscillation. A typical tube tuner might measure -4 volts on channel 2, -1 volt on UHF (oscillator not working) and -2.7 on channel 13. Make a habit of measuring these voltages on each set you service, and you soon will be able to spot those bad oscillators regardless of brand or condition.

With transistor oscillators it is better to locate the resistor which decouples the collector current and measure the voltage drop across it when the channel selector is switched through channels 12, UHF and 2. The differences of reading will indicate whether the oscillator is operating, and approximately how strongly.

Undesired Oscillation

A stage which is oscillating, but is not supposed to be, is often a "nervous Nelly" that is extremely sensitive to capacity changes such as holding a finger or screwdriver near a part of the circuit or cupping a finger around an unshielded coil. For example, a radio IF amplifier that is oscillating often will undergo a radical change of bias if you touch a finger to the collector.

Tracing With A Scope

Before you've tried it, checking radio oscillators by using a scope might seem impractical. And it is true the average service-type scope won't show any pattern on an FM oscillator. But it works fine with AM oscillators.

It doesn't surprise us that we can signal trace a complete chroma circuit using a good wide-band scope. Yet, many of the signals used in radio work are lower in frequency than those in a chroma channel.

For example, Figure 4A is the waveform of an AM oscillator. The radio is tuned to 610 kHz, so the oscillator frequency is about 1.06 MHz; well within the range of any good service scope. Of course, not all scopes would lock to and display individual cycles of the carrier as did this triggered-sweep model. But for most work it isn't necessary to see each cycle.

The bottom trace of Figure 4B shows the audio-modulated carrier at the loop antenna of an AM receiver. The scope was set to lock approximately at the low audio frequencies. Just above this trace is the motionless, unmodulated RF carrier from the oscillator. The scope locking remains at audio frequencies, so the RF pattern is just a white blank. But that's enough to judge relative amplitude.

If you want to make certain the signal is from the oscillator, watch the amplitude on the scope while you touch a high-impedance point of the oscillator circuit. Figure 4C shows the reduction of amplitude when I touched a finger to the oscillator tuning capacitor.

Conclusion

Because there are so many different tests for oscillation, ranging all the way from disturbance tests to scope waveforms, it is always possible to find out for certain about the oscillators in radios.

We hope a few of these tests, at least, will give you food for thought and narrow the tube-transistor gap. □

The growing problems of customer security

By Robert G. Amick

Today, more people lock their doors than ever before. And fewer open them—day or night—to anyone who isn't expected. This trend is most apparent in the larger cities, but it's spreading to the smaller communities and farms, as people's fear of criminals grows.

In the past few years, for example, this anti-stranger attitude has forced a change in the working habits of one American business group: the door-to-door salesman. Faced with doors that didn't open (although a corner of a window curtain moved just enough to permit someone inside to inspect the caller), the brush, vacuum-cleaner, and pots-and-pans salesmen had no alternative but to change their operation. Many of them switched to group selling. That is, making their presentation to a number of neighborhood women, instead of trying to sell to one prospect alone in a house. Women feel safer in a group, and the appointment is set in advance so the caller is expected.

Customer Security And You

What does this new flood of fear for lives and possessions have to do with you, an honest electronic technician? Perhaps not very much right now. Perhaps a lot more in the future. It's better to consider the problem before it becomes more acute.

Appearance of outside men

Take a searching look at your outside men, thinking about what you see in the way a frightened person might. Of course, all men who make home calls should be reasonably clean and well groomed, but that's not enough. Even a mass-murderer could do that. What about clear identification? Something should plainly mark your man as the technician the customer is waiting for.

Within the next five or ten years, it's possible a recognizable working uniform might become a necessity.

Another contribution to make the outside men appear more trustworthy is to equip each one with an engraved plastic name badge. This gives identity, as well as a hint of professionalism, legitimacy and permanence. A fringe benefit might be that each man would be more careful of his behavior in the customer's home, if his name was displayed so obviously.

Instead of just a first name, or nickname, list both names. And to be really big-league, list both names plus "Customer Service".

Appearance of your truck

Your truck is another vital link in the identification process, too. Have it lettered clearly and legibly by a professional sign painter with your business name and address, and then keep it washed and clean. This gives an impression of permanence, respectibility and legitimacy.

An untidy do-it-yourself sign on the side of a panel truck projects none of these reassurances. Even worse is an unmarked truck.

I am emphasizing the service truck because of a recent story in my local newspaper. A woman, who had been beaten and robbed in her home by a man posing as a deliveryman, later said, "As I opened the door, I felt a little doubt about him, because the street in front of my home was empty. His truck was nowhere in sight."

Make a habit of having your truck parked where the customer easily can see it from the home. This is strong backup identification for the technician's jacket patch and tool kit. Incidentally, a tool kit alone is not worth much as identification; anyone can carry one. The marauder in the case cited carried a package, just as a deliveryman might have.

Reassuring the extra-cautious

The preceding suggestions probably are sufficient for all areas except the tight-security townhouses and certain areas of the big cities. But what about the super-cautious or seriously-frightened who won't believe name tags, working uniforms, or truck signs?

There is a simple procedure that heads off trouble before it starts. When the customer phones for home service, whoever takes the call should give the job order right from the ticket. Then your outside man can use the number as a password, if it's needed. He can show the ticket or read the number through the door to any customer who has serious doubts.

It's Not A Problem—Yet!

Perhaps security problems of this nature have not reached your business area. Maybe they won't. But the experience of salesmen and others can't be ignored.

Start using these suggestions now, and you will solve most of the personal security problems before they arise. □

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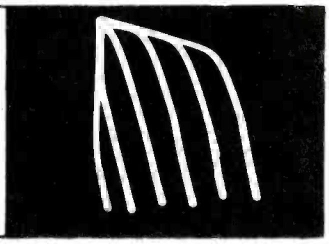
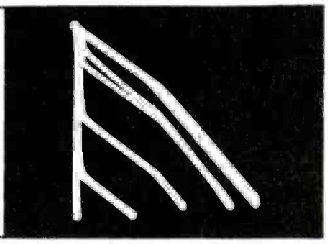
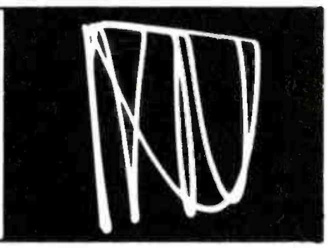
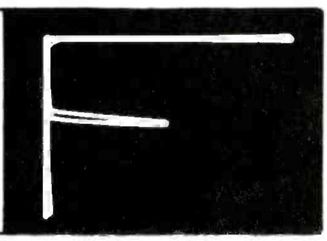
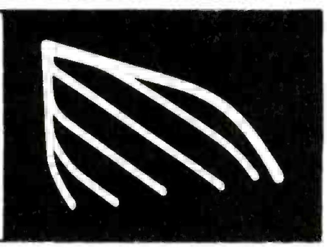
Q303 3rd PIX IF **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 100uA	
Q304 NOISE INVERTER **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 50uA	
Q305 AGC INVERTER **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 20uA	
Q306 AGC AMP **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 100uA	
Q307 VIDEO AMP **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 50uA	

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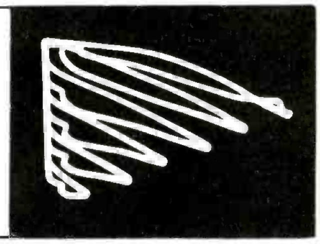
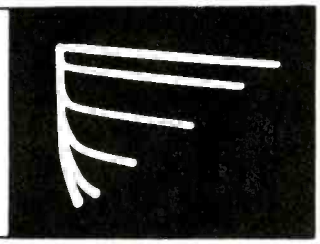
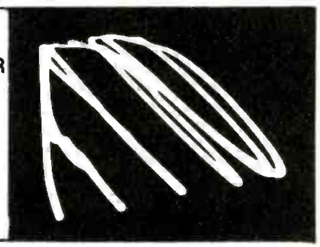
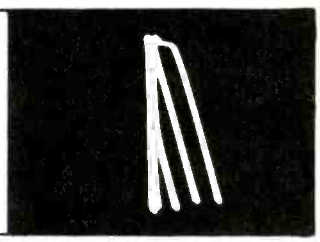
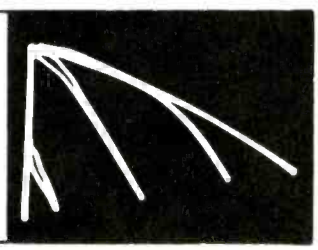
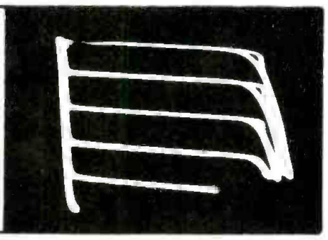
Q308 AUDIO DRIVER **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 20uA	
Q501 SYNC SEP **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 20uA	
Q502 EMITTER FOLLOWER **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 50uA	
Q701 IIV REGULATOR **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 50uA	
Q702 BLANKER **POLARITY** NPN **SWEEP VOLTAGE** 30V **BASE CURRENT** 50uA	

Q703 B-Y

POLARITY NPN

SWEEP VOLTAGE 30V

BASE CURRENT 10uA

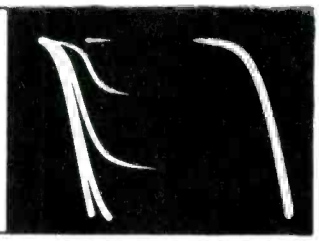


Q706 REG PROTECTOR

POLARITY NPN

SWEEP VOLTAGE 30V

BASE CURRENT 20uA

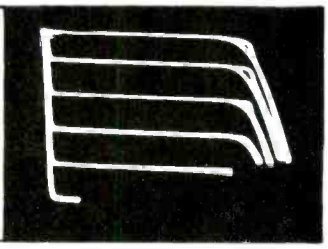


Q704 R-Y

POLARITY NPN

SWEEP VOLTAGE 30V

BASE CURRENT 20uA

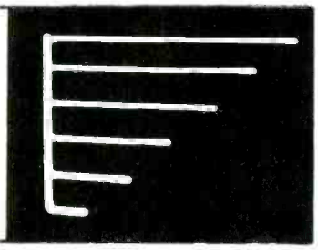


Q707 30V REG

POLARITY NPN

SWEEP VOLTAGE 30V

BASE CURRENT 20uA

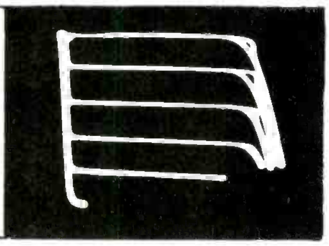


Q705 G-Y

POLARITY NPN

SWEEP VOLTAGE 30V

BASE CURRENT 10uA

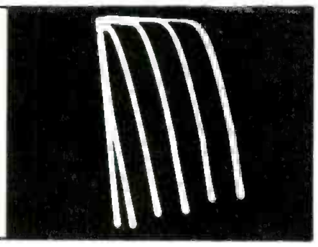


Q1401 AFT AMP

POLARITY NPN

SWEEP VOLTAGE 30V

BASE CURRENT 200uA



For More Details Circle (14) on Reply Card

For More Details Circle (15) on Reply Card

VHF SCANNERS... a new challenge

By Joseph J. Carr, CET

VHF-FM scanner receivers are a new breed of equipment requiring both digital and VHF experience for successful troubleshooting. Learn about them, either so you can repair them or just for the satisfaction of knowing how they operate.

Over the years, VHF-FM monitor receivers have enjoyed a modest but steady popularity with police officers, firemen, newsmen, or just plain news buffs. These early receivers suffered from frequency drift and were very difficult to tune because of the wide general-coverage dials and the narrow carriers.

The introduction of crystal-controlled receivers solved both of those problems, but at the expense of being channel bound. Modern scanner receivers have nearly the tuning capability of the continuous-tuning models with the advantages of crystal control. The scanner sequentially searches eight or ten channels and stops when a signal is received.

A Simple Scanner

Dual-receive CB receivers are not VHF-FM machines, but a knowledge of their operation helps us understand the operation of the more-complex scanners.

CB scanners were developed so a single transceiver could monitor both one channel of the operator's choice plus the national emergency channel (Channel 9). The receiver tunes back and forth between the channel selected by the synthesizer and Channel 9. An increased AGC voltage, indicating that a signal is being received, causes the scanning to stop and the squelch to open. Basic operation is shown in Figure 1. A J-K flip-flop selects which local oscillator controls the receiver. An inhibit line causes the flip-flop to latch when an AGC signal is present.

VHF Scanner Circuits

A typical VHF scanner receiver probably has double conversion (Figure 2). A local oscillator, operating from crystals selected by the scanner, beats against the incoming signal to produce an IF in the range of 10 to 13 MHz, with 10.7 often selected by the designer. A second mixer heterodynes the IF signal and a 11.155-MHz crystal oscillator producing a second IF of 455 KHz, which is handled in the usual manner.

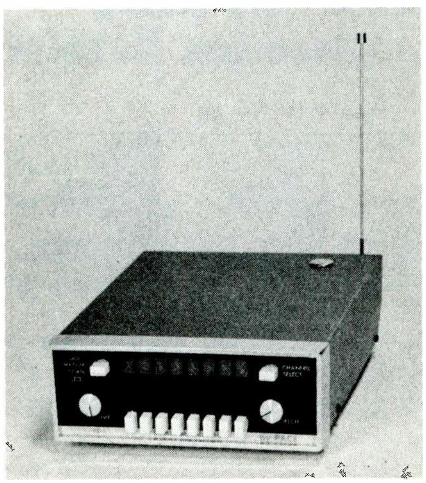
The squelch circuit of a scanner does more than mute the audio between transmissions; it also provides the necessary scan-control signal. Any "open squelch" signal locks the receiver to that channel.

Scanner Logic Circuitry

Figure 3 shows a partial schematic of a scanner circuit. Unijunction transistor (UJT) Q1 operates as a pulse generator and clock. It supplies sharp pulses to a shaping circuit and the control section. The control circuit interrupts the pulse train on command from the squelch. Uninhibited pulses are counted by the SN7490P TTL decade counter (counts by tens).

Binary Coded Decimal (BCD) output from the counter is fed to a decoder circuit which converts it to another number system, or to a form that will drive a suitable display tube or LED readout. In this case, the decoder is a BCD-to-octal type, with eight output lines. Other types have either seven or ten outputs for that many channels of operation.

Another type of scanner logic (Figure 4A) has two J-K flip-flops and four two-input NAND gates that sequentially select one of a



A typical eight-channel base/mobile scanner receiver.
Courtesy of Pace

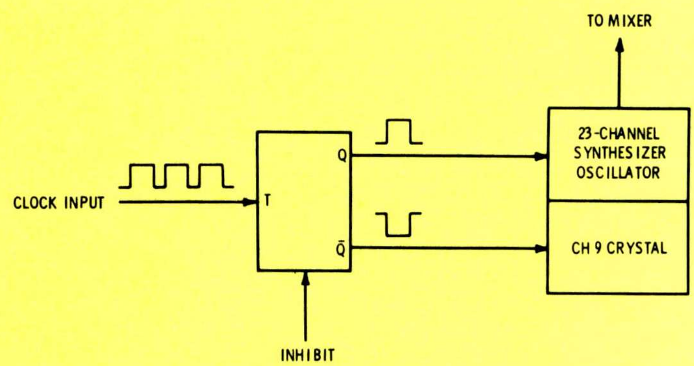


Fig. 1 Block diagram of a two-channel CB scanner circuit. A digital J-K flip-flop alternately grounds the synthesizer then the channel-9 crystal to permit monitoring of two channels.

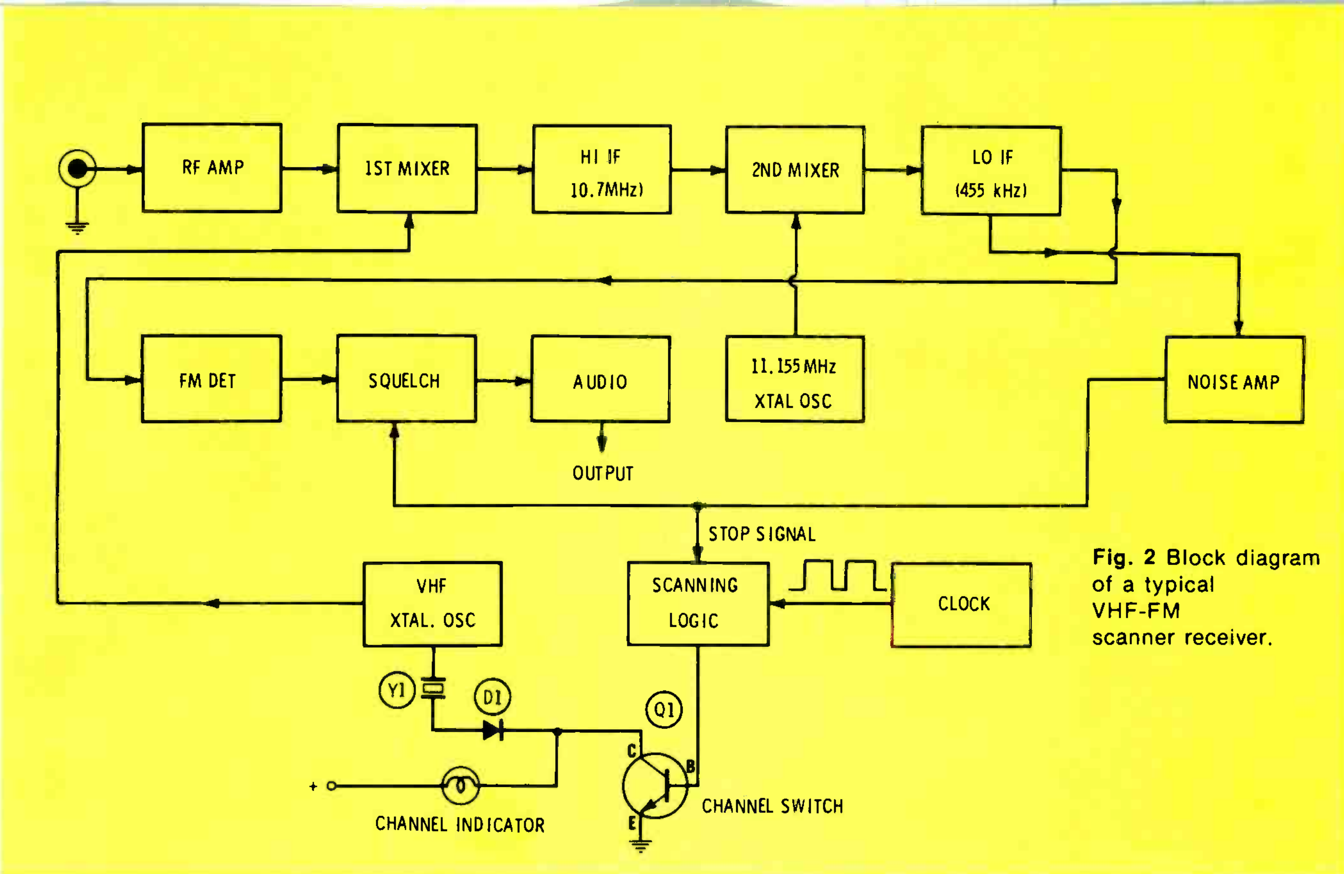


Fig. 2 Block diagram of a typical VHF-FM scanner receiver.

bank of four crystals.

Waveforms explaining the action are shown in Figure 4B. The NAND gates are wired to the flip-flops so they produce a zero (that is, grounded output) only when **both** inputs are high. Notice the waveforms from FF1 and FF2 beneath clock pulse number one. At this point in time, only the Not-Q of FF1 and the Not-Q of FF2 are high, so they are used to drive G1. In turn, when clock pulse two is present, the Q of FF1 and the Not-Q of FF2 are high (all others are low), so they drive G2. The sequence continues until condition four, then repeats.

Scanning More Than Four Channels

Most scanner receivers offer more than four channels. Because binary is based on a radix of two, you might imagine it only necessary to multiply the circuit by two to obtain eight channels. In reality, straight gating with eight channels becomes hopelessly complex.

To overcome this problem, a few receivers simultaneously scan two banks of crystals designated "odd" and "even". One additional flip-flop sequentially selects from these two alternate buses of crystals (Figure 5).

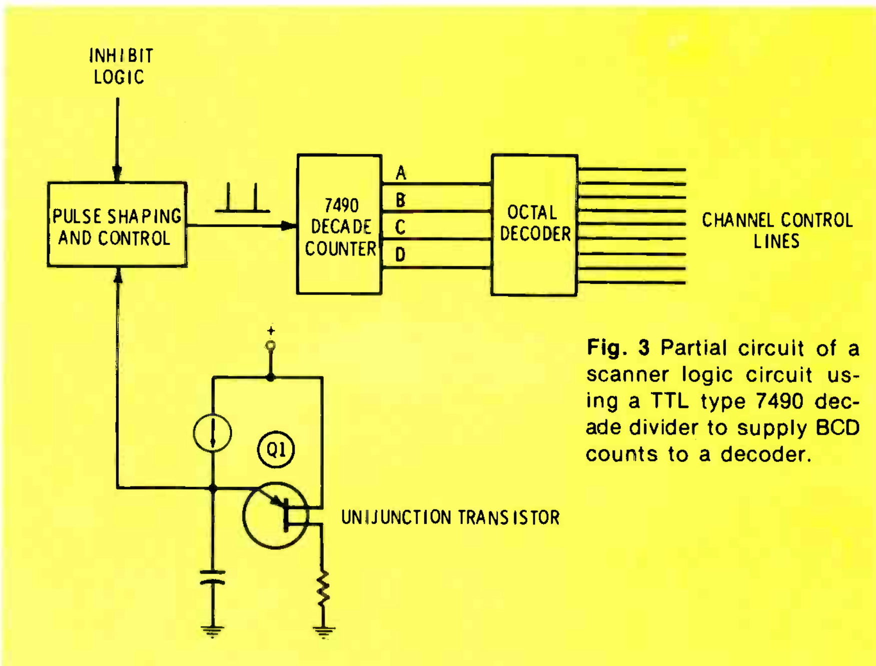
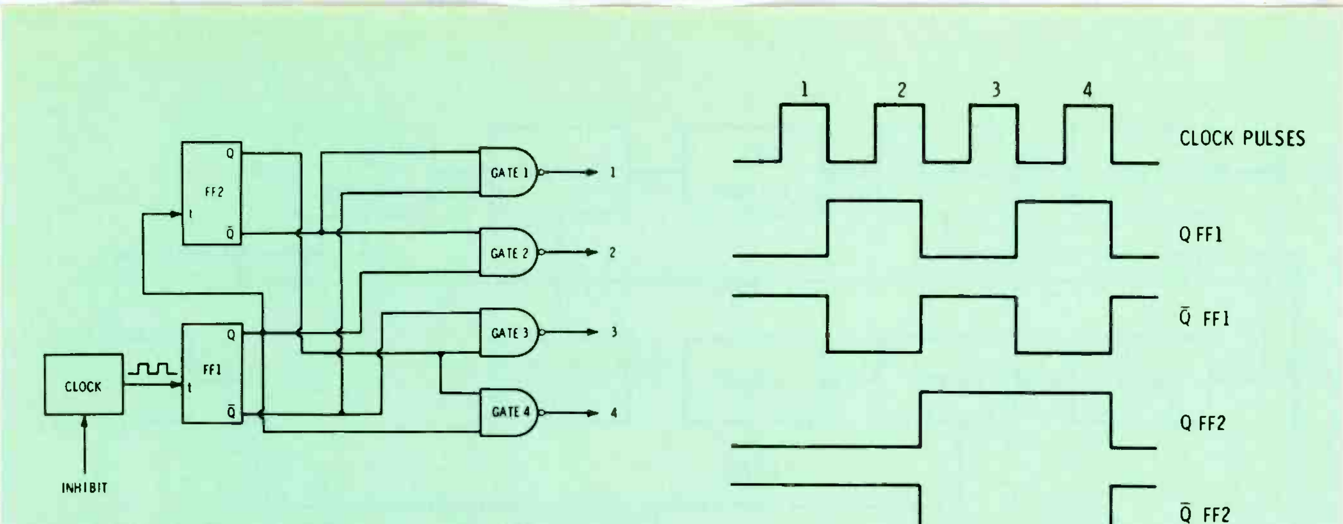


Fig. 3 Partial circuit of a scanner logic circuit using a TTL type 7490 decade divider to supply BCD counts to a decoder.

Crystal switching

Transistor Q1 in Figure 6 is the regular VHF crystal oscillator which feeds the mixer. Although only one complete switching circuit is shown here, each crystal has a similar circuit and will be grounded by its switching transistor Q2 at the command of the logic circuit.

When the logic circuit selects a channel, a positive voltage will be applied to the Q2 of that channel. The collector/emitter resistance approaches zero ohms which grounds the crystal and lights the LED to show which channel is selected. Sometimes lock-in or lock-out switches are provided. These either ground the crystal or prevent it from being grounded by the transistor. In most receivers, each crystal has a small variable capacitor in



(A) Block diagram showing the digital IC's.

(B) Waveforms in the scanner.

Fig. 4 Circuit and waveforms of a four-channel scanner.

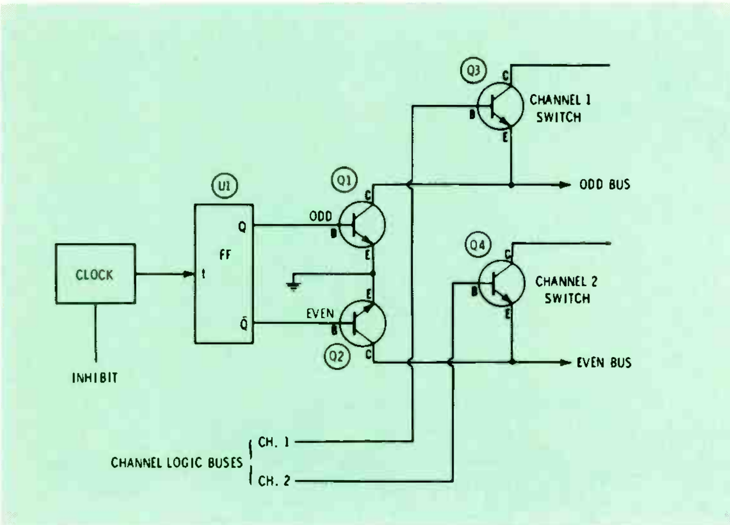


Fig. 5 Odd/even selection logic allows two four-crystal circuits to scan eight channels.

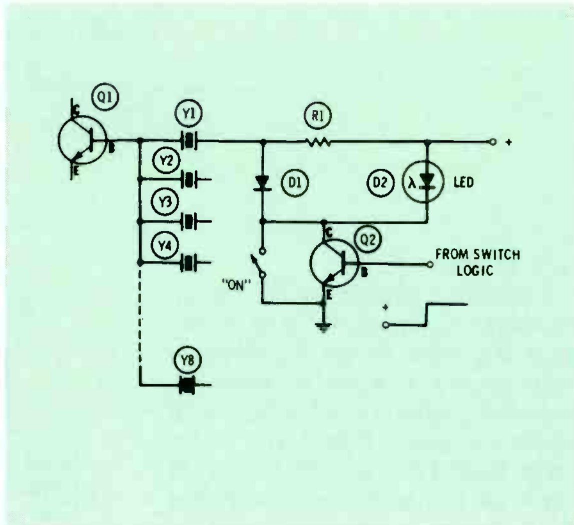


Fig. 6 Voltage switching of a diode for each crystal allows simple circuits to scan eight channels.

parallel to permit zeroing in on the exact frequency.

Crystal Selection

Contrary to popular belief, crystals are neither absolutely calibrated (despite case markings), nor do they always remain at their nominal frequency. The exact frequency depends on the circuit and on the temperature.

Therefore when you order crystals for the VHF and UHF bands, you should supply the vendor with enough information about the equipment and circuit so he can make a close fit. Of course, you could try to obtain crystals from the manufacturer of the receiver. These might or might not be available to non-franchised servicers. Another possibility is to order from a custom crystal manufacturer.

Before you order from any of these sources, you will need certain factual information, such as the operating frequency desired. To find this you need to know the IF and the channel frequency. Also, you must determine whether the crystal is operating on the fundamental or one of the overtone modes.

VHF receivers typically (but not always) operate in the fundamental mode on low band (30 to 50 MHz), the third overtone mode on high band (144 to 175 MHz), and the ninth overtone on UHF (450 to 470 MHz).

Assuming this is true for the receiver you have, use one of the following formulas:

- Low band: crystal frequency = channel frequency + IF.
- High band: crystal frequency = channel frequency + IF, and that sum divided by 3.
- UHF band: crystal frequency = channel frequency + IF, and that sum divided by 9.

Prepare a chart for the crystal maker which includes:

1. Make of receiver and model number.
2. Crystal frequency desired.
3. Style of holder (consult crystal catalog).
4. Mode of operation (fundamental, 3rd overtone, etc.).
5. Operating capacitance.
6. Drive level in milliwatts.

7. Maximum allowable series resistance.

How can we obtain these important bits of information? The hard way is to invest in the kind of expensive equipment needed to measure those parameters. It's much easier to consult the service manual for the receiver. And there is now a new book available from Howard W. Sams called "Scanner-Monitor Service Data" (Vol-1/SD-1) which covers most of the receivers produced to date.

Stocking crystals

A large part of the profit in scanner repairs is in the sales of additional crystals, and the replacement of defective ones (usually off frequency). If there are only a few brands of scanner receivers in your area, it might be wise to stock crystals covering the local police, fire, and other frequencies of interest.

Legal Precautions

Two legal aspects are important regarding scanner receivers, or any kind of VHF-FM monitor receivers. First some authorities prohibit the installation in private vehicles of receivers tuning police frequencies, unless a permit (usually difficult to obtain) has been issued for the installation.

Secondly, Section 610 of the Communications Act of 1934 prohibits unauthorized use or disclosure of communications. This applies equally to the tow-truck operator responding to police accident calls, and the unscrupulous taxi driver responding to the pickup call of a competitor.

Other Scanner Circuitry

For the most part, the remaining circuits of scanner receivers closely parallel similar circuitry in VHF or FM receivers. However, a couple of differences merit our attention.

Mixer/IF

The second mixer of a popular model of scanner is shown in Figure 7. Input to the mixer is through a 10.7-MHz ceramic crystal filter, and the mixer output is tuned by a similar 455-KHz filter.

Two-way VHF-FM transmissions are narrow band, and the bandwidths of conventionally-tuned IF transformers are too wide, causing excessive noise level.

Receivers for the usual ±5 KHz deviation should have a bandwidth 6 dB down at 6 to 8 KHz each side of the carrier. Therefore, many of the lower-priced receivers use the Murata filters already familiar to servicers of FM home and car radios.

IF amplification almost always is supplied by an IC. Many receivers also use FM-detector IC's, such as the RCA internal-diode type (CA-3043, etc.), and the quadrature type (Motorola MC1357P).

Squelch circuit

You might not be familiar with the squelch circuit of Figure 8. Because the audio signals travel through both diodes when the squelch is open, it is surprising that no noticeable distortion is generated. The reason is that diodes will pass small AC signals without distortion if they are heavily forward biased. Transistor Q1 shorts out the forward bias voltage when the audio is squelched, and is an open circuit permitting B+ to be applied to make the diodes conductive when the receiver is unsquelched.

In fact, a similar circuit is used to mute inter-station hiss in one brand of expensive FM-Stereo tuner.

The Future Of Scanners

A gradual growth is predicted for the sales and servicing of VHF-FM scanning receivers. Many of the national mail-order chains push them.

You can obtain your share of this market if you are prepared to handle it. □

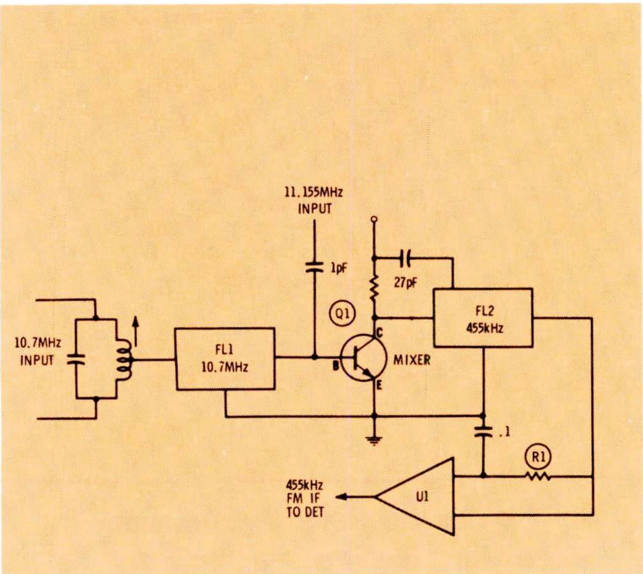


Fig. 7 Details of the dual 10.7-MHz/455-KHz IF circuit using ceramic crystal filters to give sharp selectivity.

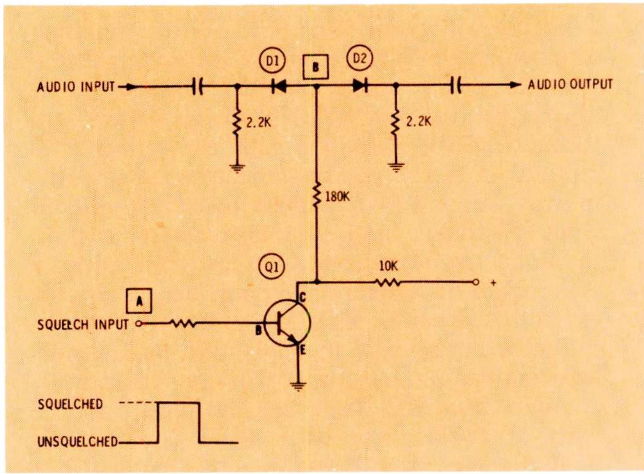


Fig. 8 Circuit of one type of audio squelch. When Q1 is cutoff, B+ flows through the 10K and 180K resistors to forward bias D1 and D2, and they pass the audio with very little distortion. When Q1 conducts there is no bias voltage on the diodes, and they become open circuits to squelch the audio.

book review

Understanding & Using The Oscilloscope (No. 664)
Author: Clayton Hallmark
Publisher: Tab Books
Size: 5-1/2 X 8-1/2 inches, 256 pages.
Price: $4.95 softbound.

This is a handbook designed for technicians who would like to become more familiar with the oscilloscope, and contains information on scopes of every type and price range. The first few chapters cover the basics: how the scope works, how displays are created, and how the cathode-ray tube presents the information. One chapter is devoted to the how and why of scopes, with an introduction to internal and external sync, the relationship between sweep and input-signal frequencies, triggered sweep, blanking and unblanking. The book tells how to set up the scope, calibrate it, and use it for low-signal and large-signal voltage, frequency, phase, time, response, gain, and modulation percentage. Also covered are scope construction, sweep circuits, time-base circuitry, sync circuits, blanking and unblanking, probes and their applications, scope setup and calibration, the how and why of linearity, how to check for distortion in the scope itself, intensity modulation, how to read and use Lissajous figures, direct and indirect phase measurement, plus electronic switching for dual-trace displays.

Transistor-Transistor Logic (20967)
Author: George Flynn
Publisher: Howard W. Sams & Co., Inc.
Size: 5-1/2 X 8-1/2 inches, 176 pages.
Price: $5.50 softbound

Transistor-transistor logic (TTL)— the dominant form of semiconductor logic—is thoroughly examined in this book. Chapter 1 discusses the digital families of which TTL is a part, and covers the basic units: the gate, the various basic circuits, and the voltage and current requirements. The next five chapters cover the different types of circuits used in a logic system such as flip-flops, decoders, multiplexers, shift registers and counters. Chapter 7 contains an explanation of the math used in TTL, while chapters 8 and 9 study the devices and methods used to determine information priority and storage. Chapter 10 discusses how TTL logic can be joined to other types of circuits and other logic families. The final chapters are concerned with how fast TTL logic will operate, how many individual units can be combined in a single IC package, and how basic counting and data transmission systems work. Numerous illustrations and appendices (including a glossary) supplement the text. □

"I think the trouble is in the knobs. They don't fix the picture at all."

"I only wanted to adjust the vertical hold."

CAN YOU BELIEVE THE MANUFACTURERS' ANTENNA SPECS?

By Julius Green
Chief Antenna Engineer
Channel Master Division of Avnet, Inc.

Electronic Servicing *asked the manufacturers to submit articles about subjects in which they have expert knowledge. This informative article is one received in response to our request.*

Channel Master receives many letters commenting on the performance of its products. In recent years, as sophistication of the technician's knowledge has grown, an increasing number of letters read like this:

"Gentlemen: I recently purchased your new model XYZ antenna, and made some field tests comparing it to the model PDQ which I have been installing in this area for many years. On Channel A, it was 5 dB better (or worse), on Channel B it was 3 dB better (or worse), and on Channel C it was 6 dB better (or worse)."

Sometimes these comparisons are between competing brands, or they might be between two models of the same brand. The writer of the letter then concludes by stating, "I think this antenna is really a heck of a lot better than you said it is." Or, "This antenna is nowhere as good as you say it is. I'll never believe your claims again."

These reports are often contradictory. Different technicians testing the same antenna come up with conflicting results.

We strongly suspect that all antenna manufacturers receive similar reports.

Why should the installer's own on-site tests deviate so widely from the laboratory results? Which figures can he believe?

Some of these reported differences were so improbable that in the beginning we were tempted to dismiss the findings as being the result of careless field-testing, or defective equipment. However, we have always taken such reports seriously and tried to come up with some answers.

Over the years, TV-antenna installers have developed a healthy skepticism about performance claims. In part, this is due to some outlandish claims made in earlier years by over-zealous manufacturers (remember the antenna with "22 dB gain in all directions"?)

But there is much more to these obvious discrepancies than just disbelief. The truth lies in the many factors drastically affecting results in the field.

It should soon be apparent that, although a technician makes a comparison of antennas A and B at a particular location and finds that unit A gives more signal, it is quite possible that B has more gain. This seems to be a contradiction.

Only by taking extreme care, or by making a great number of tests at many locations with many TV receivers, can the effect of the unavoidable error-sources be eliminated. Our purpose is to make technicians aware of these factors so they can make more-accurate comparison tests. After a discussion of each error-source, we shall point out how it has been eliminated or minimized in the Channel Master tests.

The most significant causes of erroneous results are:

- poor free-space conditions;
- impedance of the measuring device; and
- variation of the signal at different times.

We are assuming that anyone who makes an antenna comparison will be able to read a field-strength meter properly, dress a twin-lead correctly, keep it away from metal, and generally avoid the obvious antenna-installation mistakes.

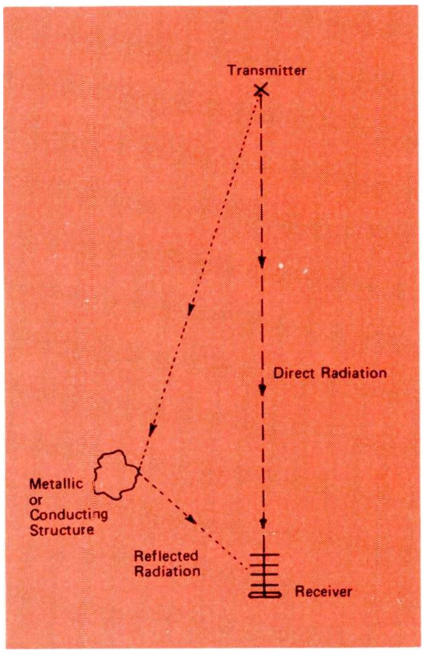


Fig. 1 Amplitude and phase of reflected signals can change a signal-strength reading 3 dB's or more.

Free-Space Conditions

Ideal antenna measurements assume the signal is to come from a distant source, and that the antenna is in a completely free space. In a practical case, we must settle for conditions where there are no metallic or signal-reflecting objects which might bounce an additional signal into the antenna being tested. This requires that the supporting structure be non-reflecting, and that there are no "reflectors" receiving signal from the transmitting source.

As an example of the sort of errors that occur when these basic conditions are not met, refer to Figure 1. The reflector could be a large steel-framed building miles away, a nearby aluminum-sided dwelling, electric-power or telephone lines, mast guy wires, etc.

Notice that the reflected signal travels a different, longer distance. Therefore, the signal strenth will be less and the phase will be different.

Assume that the reflected signal is down 15 dB from the direct one and the two arrive in phase. This produces a voltage ratio of 1 + .18, or 1.18. If the signals are out of phase, the signal will be 1 - .18, or .82. The voltage ratio 1.18/.82 is 3.2 dB.

Therefore, if we were comparing two antennas of **identical** forward gain, a gain difference of over 3 dB might be measured if:

- the two antennas were not measured in precisely the same spot, so that the two signals added in one case and subtracted in the other or
- one antenna had appreciable more (or less) gain than the other in the direction of the reflected signal. In other words, one might have a different side-lobe pattern.

Notice that mounting the antennas on the same mast does not necessarily satisfy the first condition. This is because each antenna has a "phase center". And because the antenna mounting point is selected purely to provide a weight balance, two antennas of different design might have phase centers differing by several feet, relative to the mast.

What can be done to eliminate this source of error? The best cure is a statistical one: make the comparison at several different locations—the more the better—and average the results. The differences between individual readings will give us a good idea of the magnitude of this error.

At the Channel Master Antenna Laboratory, a very large transmitting antenna—a corner reflector with a 12 feet by 20 feet aperture—is used to eliminate side lobes and narrow the beam, which is directed upwards towards the antenna under test. The region in which the antenna is to be tested has been probed carefully with a small test antenna to make certain the electromagnetic field is uniform. That is, only the direct radiation, without reflections, is there.

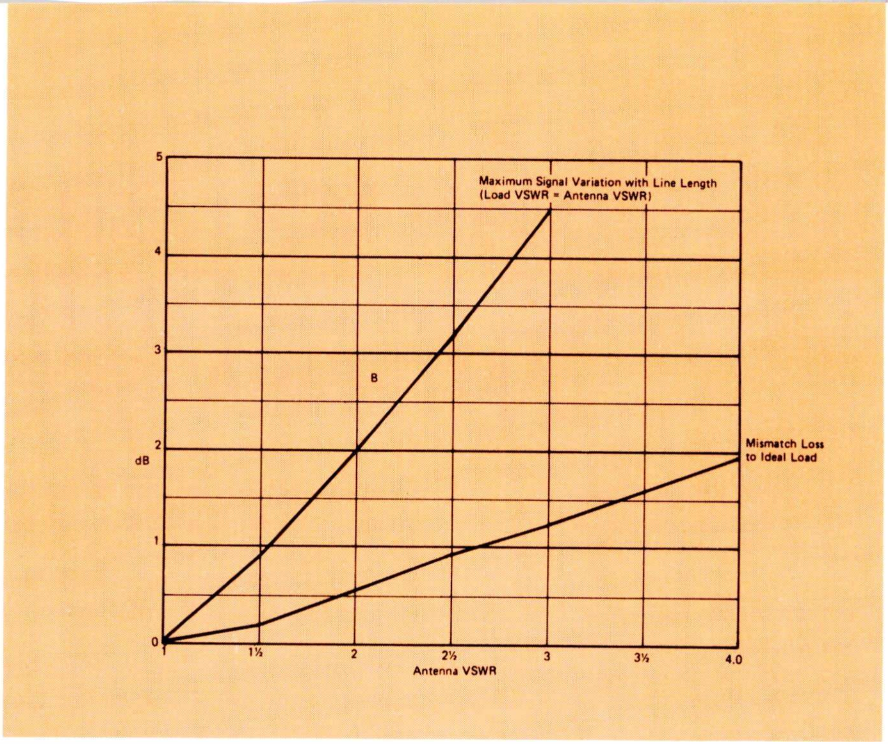


Fig. 2 The effects of VSWR and transmission line length on signal strength.

Impedance Of Measuring Device

Most competent antenna-installation technicians are aware of the signal loss due to mismatches (non-identical impedances for the antenna, transmission line, and the TV receiver, or field-strength meter). The amount of mismatch usually is expressed in terms of the Voltage Standing Wave Ratios (VSWR) with respect to the standard values of down-lead (300 ohms for balanced, and 75 ohms for coax).

Curve A (Figure 1) shows the loss for a signal source—such as an antenna—connected to an ideal load. This seldom happens. Usually there is more loss.

In practice, a length of transmission line is required between the antenna and the load, and neither is perfectly matched to the line. As an example, suppose both antenna and load have a VSWR of 2½ with respect to 300 ohms (the antenna and load each look like 750 ohms at their terminals). Now, if the transmission line is an **even** number of quarter wavelengths long, the impedance seen looking toward the antenna at the load terminals is still 750 ohms, and there is a perfect match with no signal loss to the 750-ohm load.

If, however, the transmission line is an **odd** number of quarter wavelengths long, the impedance seen at the load terminals is 120 ohms—still a VSWR of 2.5 with respect to 300 ohms—but the mismatch to the load is now 6.2 to 1, or a signal loss of 3.2 dB.

Therefore, the signal can be either .9 dB higher or 2.3 dB lower than the ideal 300-ohm load case (in which the signal is independent of length). This is an error range of 3.2 dB.

If we perform the same calculation for other VSWR's, we can construct curve B of Figure 2, which shows the maximum signal variation which occurs if the line length is varied. For simplicity, it is assumed that both the antenna and the receiver have the same VSWR.

Test the VSWR error

To determine if this VSWR error is changing the signal strength, take a series of measurements each with small changes in the length of the transmission line, and see if the indication varies appreciably.

To eliminate this error in a field measurement, construct a balanced attenuating pad of the right characteristic impedance (300 ohms) and place it between the antenna terminals and the transmission line or balun.

We have not discussed the effects of unbalance of the load into which the antenna feeds, because such load unbalance affects antenna performance in very complicated ways which are dependent on the particular antenna design. These effects can lead to appreciable errors of measurement, and we know of no simple field method to determine if they exist.

In the Channel Master Laboratory, the baluns used as antenna loads are of instrument quality. Added to this are input attenuator pads made of matched precision resistors measured to .1%. The VSWR of the completed units is less than 1.1 over the frequency range of interest, and the ratio of balanced to unbalanced modes is greater than 30 dB.

Time Variation Of Signal

One characteristic of fringe-area reception is considerable variation of the signal strength. Anyone with experience in a fringe area can expound at length about how his picture improves, or gets worse, with weather conditions, time of day, or time of year.

The results when we monitored the channel 4 signal from over 90 miles away over a mountain range are shown in Figure 3. And this was a dry, sunny winter day. Greater variations should be expected in changeable weather. Even so, it's easy to see that some signal variation could occur during the time required for a person to take down one antenna and replace it with another for comparison.

To eliminate this error, you should repeat the comparison several times and average the results.

At the Channel Master Laboratory, readings are taken using a reference antenna before and after each data run. Also, the supply voltages for the measurement equipment are regulated.

Summary

Adding the results of the three major conditions, we have:

Signal Variation	Cause
3.2 dB	reflected signal
3.2 dB	VSWR
1.0 dB	time variation
7.4 dB total	

These are conservative estimates. Stronger reflections and higher VSWR's are not uncommon. This shows that differences of signal strength of nearly 10 dB are possible when all conditions are at their worst. In practice, a difference of 3 to 4 dB's is more likely.

Conclusion

Because of all these valid reasons for differences in signal-strength measurements of TV antennas, a technician is faced with two choices:

- make the listed measurements over and over to obtain an average; or
- take the word of the manufacturer that his measurements were correctly made.

Editor's Note: although this article was written by a representative of the Channel Master Corporation and, therefore, reflects only their views, it's likely many of the other antenna manufacturers employ essentially the same techniques, and also publish accurate information. □

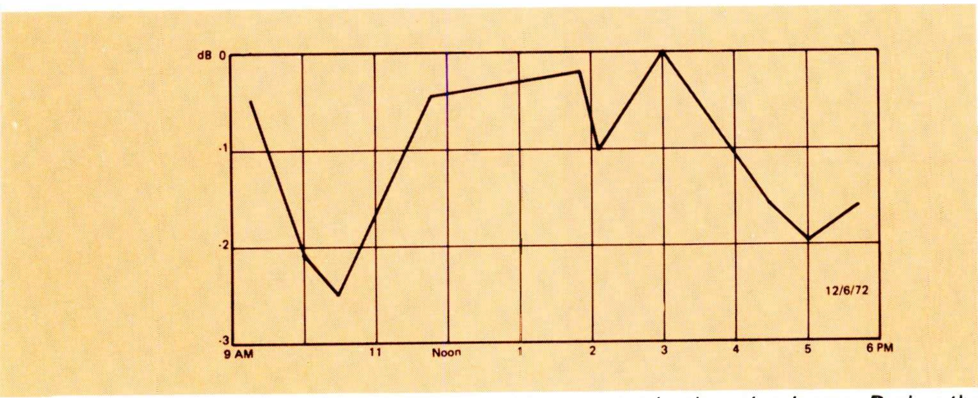
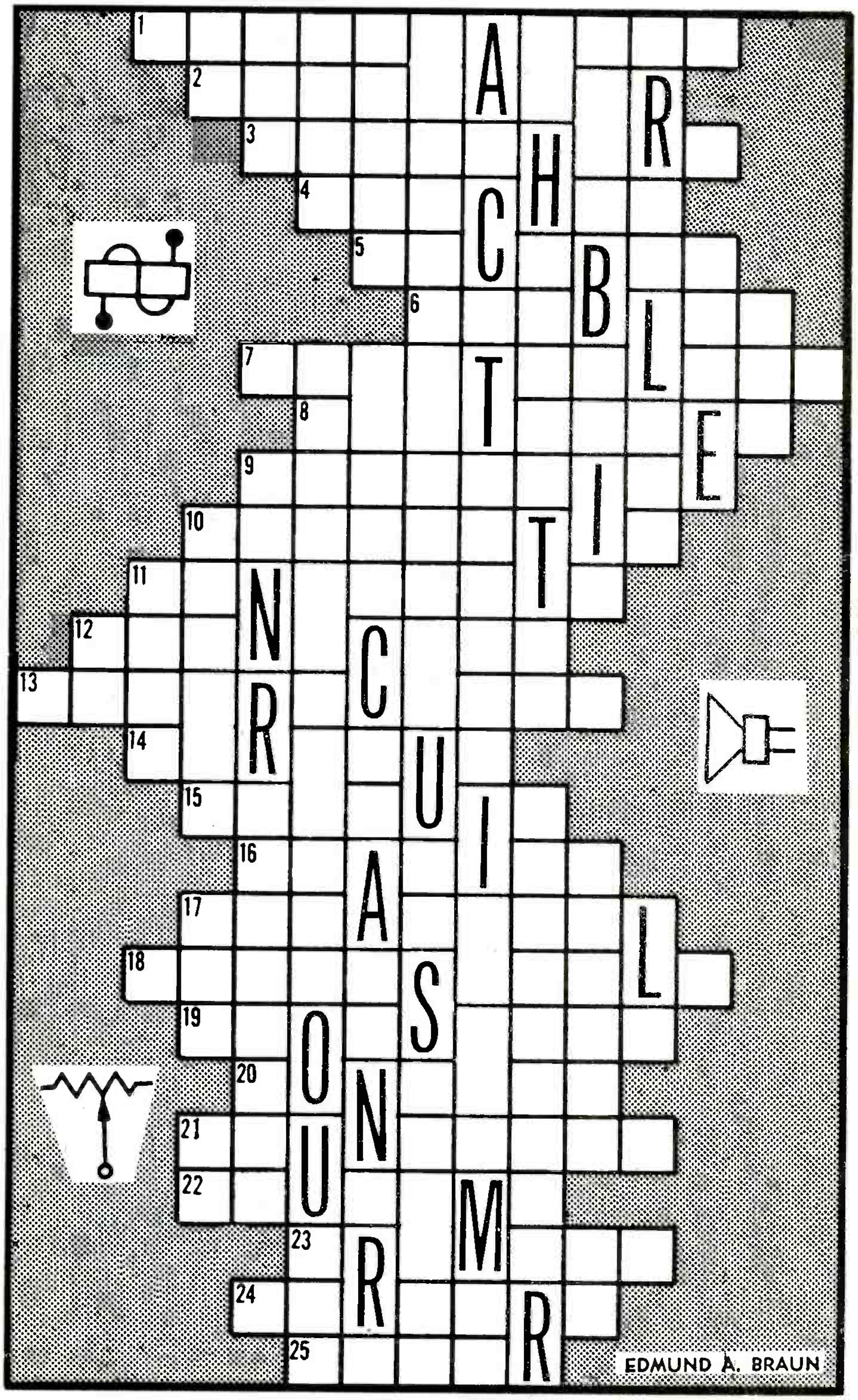


Fig. 3 Fringe signal-strength measured in one test lasting nine hours. During the time necessary to change antennas, the signal strength might change significantly.

Hi, voltage!

by Edmund A. Braun

Now that you have a few minutes to spare, try solving this Just-across-word Puzzle based on Electronics. Each word is connected to the word above and below by one or more letters but only one letter is shown as a clue. Each correct answer is worth 4 points; a perfect score is 100. It should prove fairly easy to get a high rating except perhaps for someone who thinks "woofer" is a dog, or that "transformer" comes with various size cups like A, B, C, etc! Comfortable? Then GO!



1. Comparison of two instruments to determine accuracy.
2. Rotating machine which converts mechanical energy into electrical energy.
3. Luminescent material applied to inner face of a CRT.
4. This uses a pawl to prevent reversal of motion.
5. Unit used to express loudness or volume of sound.
6. Device for cutting holes of various sizes and shapes in sheet metal.
7. Non-magnetic metal frequently used in an electronic chassis.
8. Converts bidurectional current flow into unidirectional flow.
9. Layer of ionosphere that reflects radio waves back to earth.
10. Done without conscious thought or volition.
11. Straight line response to an input signal.
12. Device for electrically joining one or more electronic circuits.
13. Effects parts or components have on one another while each is functioning.
14. Pertaining to iron.
15. The complete path of an electric current.
16. Type of transmission line not susceptible to external fields.
17. Antenna having maximum response in two diametrically opposite directions.
18. Parts and components combined into a unit for convenience.
19. Science concerning production, transmission, and effect of sound.
20. Device used in checking signals.
21. Transferring of energy from a coaxial cable or shielded paired cable into a wave guide.
22. Quantity of electricity transferred by one ampere in one second.
23. Insulating washer inserted through a hole in a panel or chassis.
24. Silver-white metal used in some switches.
25. Device to combine two or more signals.

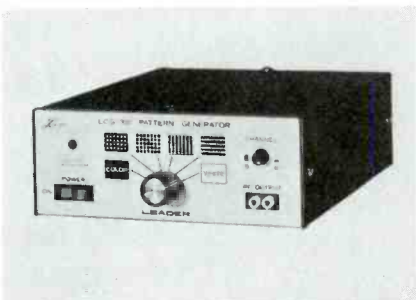
Solution on Page 56.

test equipment report

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

Color Bar Generator

Product: Model LCG-391 color bar generator from Leader Instruments Corporation.



Features: Model LCG-391 is solid-state and portable, designed for testing in field, shop and laboratory. Compact and light-weight, the unit has a binary clock and digital integrated circuitry to assure accuracy. The LCG-391 also offers return-trace blanking for vertical and horizontal signals; flickerless horizontal lines; square cross-hatch pattern for linearity checking; two switch-selectable channel frequencies; front-panel RF-output connectors; and silver-plated, integrated circuit PC board construction.
Size: Dimensions are 2-1/2 X 6 X 8 inches. Weight is 3 pounds, complete with carrying case and one RF output cable.
Price: Leader Model LCG-391 is priced at $129.95.

For More Details Circle (33) on Reply Card

Outlet Tester

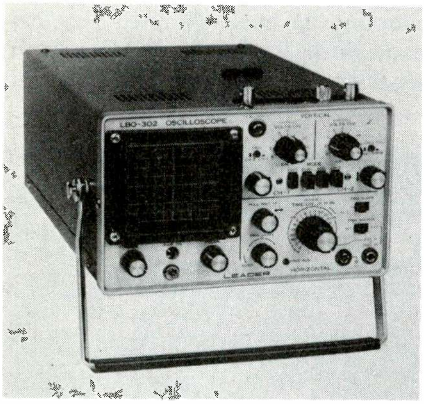
Product: VERI/TEST electrical-ground outlet test instrument by Omega Scientific.
Features: VERI/TEST offers a simple, accurate, low-cost method of checking and measuring the ground resistance to make certain that power wiring is grounded properly. Readings are given for both the neutral and the ground wire of a 3-wire line. Each wire is checked simply by throwing a switch on the panel. VERI/TEST operates by applying 10 amperes of current through the ground line and measuring the voltage drop that results, detecting resistances as low as 0.1 ohm.

For More Details Circle (34) on Reply Card

Dual-Channel, Dual-Trace Scope

Product: Model LBO-302 3-inch dual-channel, dual-trace solid-state oscilloscope from Leader Instruments Corp.

Features: The LBO-302 features pushbutton controls for triggered or automatic sweep with AC or DC coupling on each channel. Vertical bandwidth is DC to 10MHz with separate or simultaneous display of the sweep mode in channels 1 and 2. The sweep range is from lus/div to 0.2s/div in 17 calibrated steps. Vertical sensitivity is at 10mV P-P/div to 5V P-P/div in 9 calibrated steps. Magnification is 5 times. Polarity of channel 2 can be inverted. Input impedance is 1 megohm shunted by 40 pf.



Size: Dimensions are 4-3/4 X 8 X 12 inches. Weight is 10 pounds.
Price: Model LBO-302 sells for $699.95, complete with 2 direct low-capacity probes, 2 terminal adapters and 1 set of test leads.

For More Details Circle (35) on Reply Card

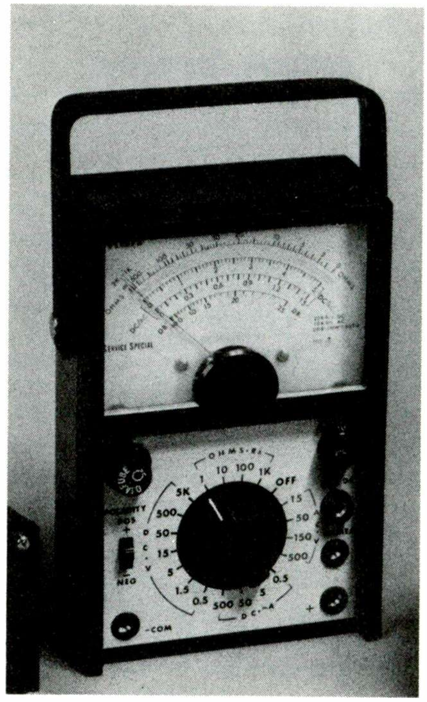
Three-digit Multimeter

Product: Ballantine Model 3/24 digital multimeter from Ballantine Laboratories.
Features: Model 3/24 has a five-function measurement capability with 24 ranges; 4 ranges of AC and DC voltage; 5 ranges of AC and DC current and 6 ranges of resistance. Accuracies on DC voltage ranges are 0.2%+ 1 digit; on DC current 0.5% + 1 digit; and on resistance 1% + 1 digit. Typical applications include field servicing, auto repair, computer repair and servicing, communications maintenance. In addition to usual safety features, operational advantages include auto polarity and an over-range. The multimeter, including the current and ohmmeter ranges, is protected against overloads.
Size: The dimensions are 5 X 2-1/2 X 7 inches. The weight, including the internal battery, is two pounds.
Price: Ballantine Model 3/24 is priced at $195.

For More Details Circle (36) on Reply Card

VOM

Product: Model WV-529A Service Special volt-ohm-milliameter from RCA Electronic Components.



Features: The WV-529A is designed to meet both the electrical measurement needs of modern servicing, and the abuse to which a portable instrument is subjected in the field. It offers durability by use of a taut-band meter movement, recessed panel controls, a high-impact plastic case, and diode protection against burnout of the meter movement. The instrument incorporates a 5000-volt DC range for servicing TV receivers, a front-panel polarity-reversal switch for testing semiconductor devices, a panel-mounted overload fuse, and full-scale AC and DC ranges based on 0.5 and 1.5 scale factors. Measurement functions include "positive" and "negative" DC volts, AC volts, resistance, direct current, and decibels.
Price: RCA WV-529A is priced at $53.50. □

For More Details Circle (37) on Reply Card

productreport

for further information on any of the following items, circle the associated number on the reader service card.

Desoldering Iron

Product: Endeco Model 510 by Enterprise Development Corporation.

Features: This pencil desoldering iron offers safety power-indicating light, 3-way on-idle-off switch, and a bracket to insure alignment. It operates at 40 watts or idles at 20 watts to give longer tip life. The light indicates which heat is selected. Other features include six tip sizes, cool, unbreakable polycarbonate handle and flexible, burn-resistant neoprene cord.

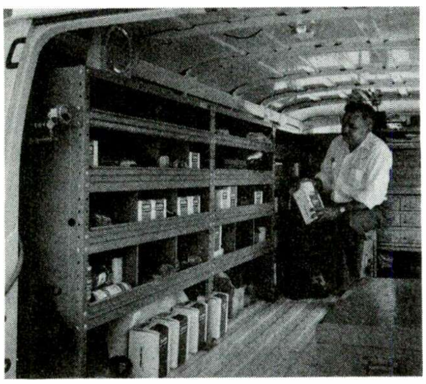
Size: The length is 8½ inches, the weight 3½ ounces.

Price: The desoldering iron sells for $16.95.

For More Details Circle (40) on Reply Card

Truck Storage Units

Product: Truck bin storage units from Equipto.



Features: The storage units are designed to provide technicians with better-organized parts storage in their trucks. They are available in 30 models to fit any truck, are made with rigid steel construction, and won't shake loose. Bins and drawer units store small parts. For added storage safety, bins and drawer units are tilted backward. Shelves and dividers are adjustable to fit the sizes of parts and supplies.

For More Details Circle (41) on Reply Card

Repair Manual

Product: Symptom Repair Manual by General Electric.
Features: The manual is step one of the three-part STC Program that assists service technicians to quickly identify most causes of GE television breakdowns. It lists a variety of symptoms for individual GE TV chassis, and outlines what to check and in what order. The symptoms and repairs were developed from computerized data supplied from actual service invoices. The manual presents the accumulated experience of hundreds of service technicians. In the STC program, "S" refers to the Symptom Repair Manual, "T" stands for Troubleshooting Flow Charts, and "C" refers to Circuit Analysis, the third and most elaborate diagnostic procedure.
Size: Dimensions are 5-1/2 by 8-1/2 inches, 47 pages.
Price: The Symptom Repair Manual is priced to sell for $1.00, or five copies for $3.00.

For More Details Circle (42) on Reply Card

Connector

Product: 3-way Vaconnector which acts as a tap connector, pigtail connector, or an inline connector, by Vaco Products Company.
Features: Vaconnector is easy to use by simply pushing wire to be tapped into slot at side of connector. The wire is inserted into hole at end of connector (inspection window allows user to make sure tapping wire inserts past metal clip). Metal clip is then squeezed with pliers until flush with top of connector body. Hinged cover snaps closed to complete the insulated connection with no cutting or stripping of wires.
Size: Vaconnectors come in three sizes and are color-coded.

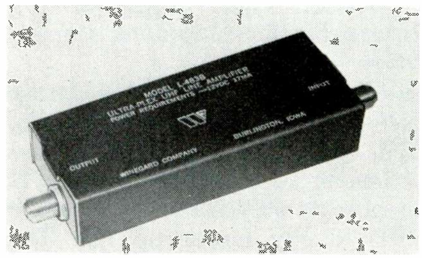
For More Details Circle (43) on Reply Card □

antenna systems report

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

Line Amplifiers

Product: Models L-213B and L-483B line amplifiers by the Winegard Company.

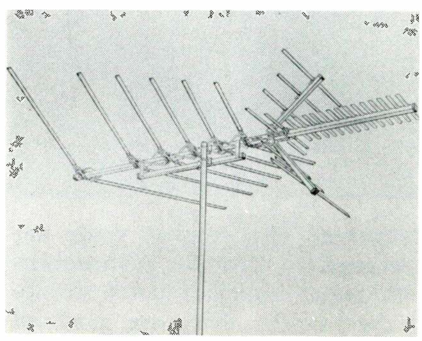


Features: The L-213B is a VHF amplifier with an output per channel of +51dBmV and an input of 40dBmV. It also features a built-in tilt control which eliminates need for a switch. The L-483B is an UHF amplifier which features an input per channel of 33dB and an output of 49dB. It also has a built-in tilt control. Both line amplifiers are powered through the trunkline by voltage supplied from the distribution amplifier or auxiliary power supply. Each unit is housed in a steel cabinet having baked finish.
Size: The dimensions of each unit are 7-3/4 X 2 X 1 inches.

For More Details Circle (44) on Reply Card

Color Zoom Antennas

Product: Super Color Zoom antennas from Jerrold Electronics Corp.



Features: Mechanical features of the antenna line include 360° reinforced sleeve crimping on all elements, aluminum construction, over-under feed lines, square booms and snap-lock insulators. There are seven models of Super Color Zoom antennas, three for VHF-FM only and four for all-channel areas. Complete kits are also available; these include antennas, masts, lead-in wire, standoff insulations and chimney or tri-mounts. The antennas feature high gain and flat response for color reception. Front-to-back and front-to-side ratios are also high, to minimize interference. The line is available in floor displays which help the customer choose the correct antenna for his reception area.

For More Details Circle (45) on Reply Card

Remote Cablevision Control

Product: Jewel Case V-31 Converter, remote cablevision control from Oak Industries, Inc.

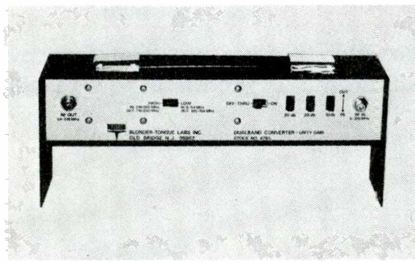
Features: Jewel Case V-31 Converter, a varactor unit, eliminates fine tuning by incorporating automatic frequency control (AFC) into the converter itself. Elimination of fine tuning reduces possibility of home owner incorrectly tuning his TV, a prime cause for maintenance calls by the cable system operator. This system offers 31 possible viewing channels spread over the 54-88 MHz and 120-376 MHz ranges.

Specifications: The remote converter has 75-ohm nominal input and output impedance, 2:1 maximum input VSWR, 5 dB ±3 dB gain, and better than 100 dB isolation against direct pickup.

For More Details Circle (46) on Reply Card

Dual-Band Converter

Product: Model 4755 dual-band converter from Blonder-Tongue Labs.



Features: Although intended for use primarily with Blonder-Tongue's model FSM-2 Field Strength Meter, the dual-band converter can be adapted for use with other types of meters. Sub-channels of the 5- to 54-MHz range can be converted to mid-band frequencies from 105 to 154 MHz. Also, superband signals of the 216- to 300-MHz range can be converted down to 116 to 200 MHz. Attenuation is 50 dB, switch selected, and the converter can be used without external attenuators because it can handle a wide range of input signals without overload. Only 6 milliamperes of current is drawn from the single internal 9-volt battery. The converter provides unity gain, so no correction factors or recalibration is required.

Price: Model 4755 sells for $219.00.

For More Details Circle (47) on Reply Card

Antenna Rotator

Product: Model 10W606 automatic antenna rotator by RCA.

Features: Model 10W606 offers decorator-styled cabinet, a motor-driven indicator light, which shows the direction antenna is aimed, and quiet operation. "Quick Connect" pressure terminals speed installation time and reduce the chances for short circuits. Additional features include a weatherproof drive unit containing a heavy duty, high-torque motor with worm drive gear, allowing fast turning through a full 360°. The light-weight aluminum drive unit comes with pre-mounted hardware and takes four-wire rotator cables. RCA offers a 3-year factory warranty policy with model 10W606. □

For More Details Circle (48) on Reply Card

photofact bulletin

Photofact Bulletin lists new **Photofact** coverage issued during the last month for new TV chassis.

ADMIRAL
Chassis K1904-1, K1984-4, 2K1974-8 1358-1

BRADFORD
1071A24 (WTG-79251),
1071B34 (WTG-79269),
1071C34 (WTG-79277) 1361-1

BRADFORD
1105A24/B24/C24 1355-1

BRADFORD
1171C34 (WTG-79335) 1354-1

DUMONT
25DC72S (Ch. 30M2002-3) 1357-1

GENERAL ELECTRIC
9SF, 12SF, 15SF 1354-2

MIDLAND
15-226 1363-1

PANASONIC
CT-398, CT-701 (Ch. ETA-1) 1358-2

PANASONIC
CT-994 1354-3

PENNCREST
1711 1362-1

RCA
Chassis CTC51K/XAC/XAD,
CTC52F/XAH/XAK/XAL 1361-2
Remote Control Receiver,
Transmitter CRK19A 1361-2-A

RCA
Chassis CTC63XH/XJ/XL/XM 1362-2
Remote Control Receiver,
Transmitter CRK19A 1362-2-A

RCA
Chassis KCS188B/C 1355-2

SANYO
Chassis WS-35000, WS-51R00 1355-3

SEARS SILVERTONE
528.41240200/201/202,
528.41250200/201/202/203/204 1356-1

SHARP
C-1226 1356-2

WARDS AIRLINE
GAI-12423A/B/C/D,
GIA-12423C 1361-3

WARDS AIRLINE
GAI-16523A/B/C/D,
GAI-16553A/B/C/D,
GAI-17423A/23B/43A/43B/53A/53B,
GAI-17623A/23B/53A/53B 1362-3

WARDS AIRLINE
GAI-16622A/42A/52A,
GCI-17322A/22C/42A/42C/52A/52C 1357-2

ZENITH
Chassis 14DC15 (Late Prod.) 1363-2

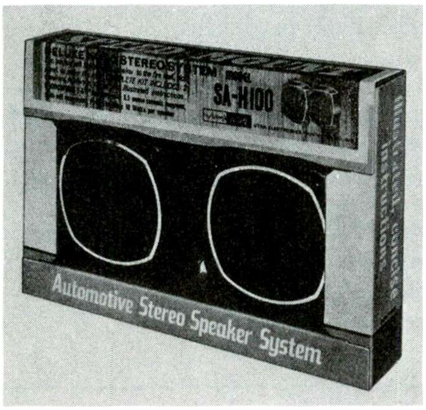
ZENITH
Chassis 22DB36 1357-3

audio systems report

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

Car-Stereo Speakers

Product: Model SA-H100 car-stereo speakers from Utah Electronics.

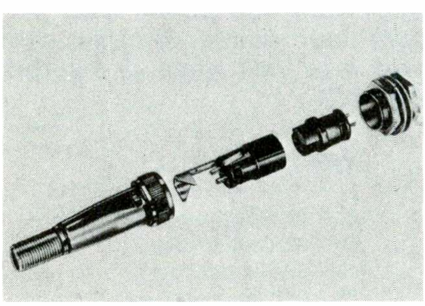


Features: 1-3/4-pound ceramic-magnet structures power the 5-1/4-inch high-fidelity speakers which have high-compliance cloth-roll suspension and separate treble cones for full-range music reproduction. Rated at 12 watts, the SA-H100 system includes black, silver-trimmed cases, color-coded wiring, hardware, and illustrated instructions.

For More Details Circle (49) on Reply Card

Audio Connectors

Product: "Slim-Line II" audio connectors from Switchcraft, Inc.



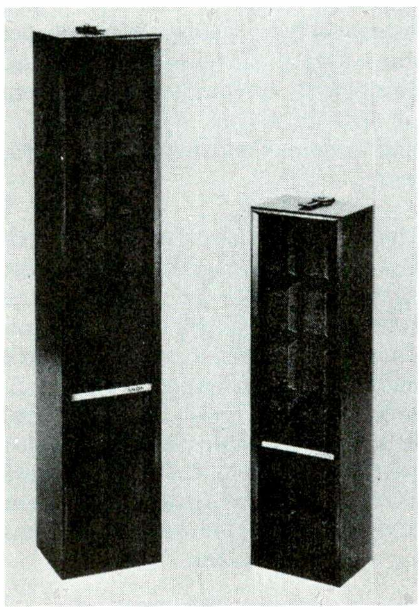
Features: A series of miniaturized connectors allows any plug or receptacle to be male or female. Interchangeable inserts provide the user maximum flexibility in applications such as for microphones, public address, industrial control, and broadcast. The connectors are designed so that housings shield internal connections and provide ground (common) connections without using a pin/contact.

Price: "Slim-Line II" series is priced from $.80 to $2.50.

For More Details Circle (50) on Reply Card

Sound Columns

Product: Models FSC-75 and FSC-50 sound columns by Fanon/Courier.



Features: Models FSC-75 (75 watts) and FSC-50 (50 watts) have been designed to provide improved performance in large area coverage. They are engineered for use in auditoriums, churches, theatres and gymnasiums. They also limit echoes and feedback while providing uniform audio levels throughout the area covered. Both models may be either wall- or floor-mounted, and are finished in walnut material with sculptured grill cloth. Wall-mount brackets are of steel, through-bolted and able to meet safety codes. Each Fanon column comes double-sealed front and rear, and the six flex-edge speakers are front-loaded for ease of replacement.

For More Details Circle (51) on Reply Card

Paging System

Product: Voice-In-Plant (VIP) radio pocket paging system from Fanon/Courier Corporation.

Features: Tone-only receivers or voice and tone receivers may be integrated into a single system, thus providing for two-level paging. Easy to install and operate, the system consists of a table-top selector console and microphone, five-watt transmitter on 27.255, 31.04 or 35.08-MHz frequencies, plus either voice and tone or tone-only receivers. The system is capable of paging up to four miles. Console model VEN-20 has a capacity of up to 20 receivers and model VEN-110 may be expanded to 110 stations.

For More Details Circle (52) on Reply Card ☐

catalogs literature

Circle appropriate number on Service Card.

102. AVA Electronic Corp.—has published a 1973 CATV, MATV connector price schedule featuring a comprehensive listing of "p" connectors. Each connector is illustrated with a picture. The schedule also illustrates a complete listing of UHF and BNC connectors.

103. Cornell-Dubilier Electronics—has issued a 1973 replacement guide for electrolytic twist-prong capacitors. The guide lists 276 CDE capacitors which can replace 97% of all twist-prong units now in service (estimated to be over 25,000). The 56-page brochure tabulates the capacitors in three ways; by catalog number, OEM number (manufacturer's name) and by ratings.

104. EV. GAME, INC.—has issued a combined replacement catalog of the most needed parts for phonograph and tape recorders. The new catalog contains 240 pages listing phonograph cartridges and needles, wheels and belts, phonograph-changer motors, center-posts, adaptors, plug-in heads, shells, cartridge mounts and accessories.

105. GC Electronics—offers the Audiotex Catalog FR-73-A which lists everything necessary for proper care and maintenance of sound equipment, a complete assortment of security alarms and accessories, and antennas and installation hardware.

106. Hitachi Sales Corp. of America—presents a compilation of audio basics written to be used by retail salesmen. It's a primer and introduction to the most commonly used audio terms. Complete with definitions, illustrations, and diagrams, it runs the gamut from "acoustic suspension speaker" to "woofer and wow". A special feature is a clear explanation of the various systems for 4-channel sound.

107. International Rectifier Corp.—offers the 1973 Semiconductor Cross-Reference and Transistor Data Book. The 72-page cross-reference uses straight alphanumeric listing and includes rectifiers, capacitors, zeners, transistors, SCRs and ICs (chips). The book shows IR transistor specifications and case diagrams, and also contains an "exact replacement" IC data sheet.

108. Jensen Tools and Alloys—has a tool catalog describing 1900 items. "Tools for Electronic Assembly and Precision Mechanics" is a handbook of particular interest to electronic technicians. A feature of the catalog is the inclusion of technical data on tool selection. Known as "Jensen's Tool Tips", these four pages include sections on screwdriver selection, machine screw data, tool materials, plier facts, metal conductivity, color coding, wire and insulation data, solderability of metals, temperature conversion, drill sizes, metal gauges, and safety.

109. Kay-Townes, Inc.—introduces a 16-page short-form MATV-CATV catalog and price lists. The new catalog contains complete specifications on the "New Reliables" line of equipment, listing over forty additional products.

110. Koss Corp.—describes listening sensations in a catalog designed to serve as a dealer handout. The 36-page full-color brochure uses descriptions about each of the firm's 16 dynamic (including high-velocity and four-channel) and electrostatic stereophones and accessories. □

(Continued from page 48)

Solution to:
Hi, voltage!

1. calibration
2. generator
3. phosphors
4. ratchet
5. decibel
6. nibbler
7. electralloy
8. rectifier
9. Heaviside
10. automatic
11. linearity
12. connector
13. interaction
14. ferrous
15. circuit
16. coaxial
17. bilateral
18. subassembly
19. acoustics
20. monitor
21. launching
22. coulomb
23. grommet
24. mercury
25. mixer

Start with 100 points and deduct four points for any part you may not have answered correctly.

Your rating:

60 - 64 Short circuit
68 - 72 Circuit clear.
76 - 80 Switch "on."
88 - 96 Operating well.
100 - **Perfect performance!**

Universal Warranty Form Designed To Reduce Paperwork

Huge reductions of the present paperwork burden would result from industrywide adoption of a standardized form serving as service ticket, customer's invoice and in-waranty claim form. This form has been developed by joint effort of many manufacturers at the urging of the Service Committee of National Appliance & Radio-TV Dealers Association (NARDA). At present, RCA, General Electric, MGA, Whirlpool, Magic Chef, Hotpoint, Maytag, and Hamilton have indicated they will accept warranty claims from servicers on the form. Other manufacturers are considering similar actions. Quantities of the form can be obtained at nominal cost from NARDA, 318 West Randolph Street, Chicago, Illinois 60606.

NAME | NO. 028N280
ADDRESS APT. | DATE RECEIVED / / ☐ A.M. ☐ P.M.
CITY PHONE | DATE PROMISED / / ☐ A.M. ☐ P.M.
STATE ZIP | BRAND/PRODUCT
CUSTOMER REQUEST | MODEL NO.
SERIAL NO.
DESCRIBE WORK DONE | DATE INSTALLED OR SOLD / /
DATE FAILED / /
SOLD BY | FAILURE CODE A B C D E F G H | WARRANTY LABOR CHARGE

QTY.	PART NO.	DESCRIPTION	PARTS DISPO.	UNIT PRICE	AMOUNT

TECHNICIAN NO.
TECHNICIAN SIGNATURE
I certify that I have performed services indicated and installed parts listed.
CUSTOMER SIGNATURE
X
I acknowledge that repairs have been performed in a manner satisfactory to me.
DATE / / | TIME BEGIN | TIME END
DATE / / | TIME BEGIN | TIME END

TOTAL MATERIAL
TRIP CHARGE
LABOR
SUB TOTAL
STATE TAX
LOCAL TAX
TOTAL

Not Home ☐ Lack Part ☐ Call Back ☐

Demand ☐ _ Warr. ☐ _ Other Warr. ☐ _ Cont. ☐ _ Sales ☐ _ Misc. ☐ _

DEALER'S NAME
Street Address
City, State, Zip
Telephone

Dealer's Signature ____________

STORE
DIST.
OTHER

So What's An Electronician?

NATESA, after a delay because of the possibility of merger, has activated its Certification Program with qualifications based on competence in symptom-analysis and basic electronic knowledge. According to Frank Moch, Executive Director of NATESA, the initial kickoff of the program probably will be at Long Island, New York under the direction of Ed Gorman, publisher of TV Tech-Aid. The examination is open only to working technicians, and it consists of two parts. First, color slides show the symptoms of a TV defect, and the candidate must list which circuits need testing. Then questions about basic electronic facts will be asked. A passing score requires 70% right answers. Successful candidates will receive wall-type certificates and ID cards. The word "Electronician" is registered by NATESA, and apparently was chosen because of the similarity to "electrician", which is well-accepted by the public.

Customer Relations Film Now Available

Sid Baker (left), an executive of the RCA Service Company, recently presented a 16-MM movie film to Dick Glass (right), Executive Vice President of NESDA. Indiana Radio-TV License Board Investigator James W. Baker (center) looked on approvingly. The film is about good customer relations and is entitled "The People Fixers". It is now available for loan to NESDA local associations. ☐

The MARKETPLACE

This classified section is available to electronic technicians and owners or managers of service shops who have for sale surplus supplies and equipment or who are seeking employment or recruiting employees.

Advertising Rates in the Classified Section are:

- 25 cents per word (minimum $3.00)
- "Blind" ads $2.00 additional
- All letters capitalized 35 cents per word

Each ad insertion must be accompanied by a check for the full cost of the ad.

Deadline for acceptance is 30 days prior to the date of the issue in which the ad is to be published.

This classified section is not open to the regular paid product advertising of manufacturers.

FOR SALE

TV & RADIO TUBES 36c EA!! Free color catalog. Cornell, 4221 University, San Diego, California 92105 4-73-tf

AMAZING, Automatic, diagnostic, dial-a-fix is guaranteed to save you on your T.V. repairs. $3. Paul Tayo 980. Greene Avenue, Brooklyn, N.Y. 11221. 11-73-3t

PHILCO AUTO RADIOS (1969-1974) audio network, 3L5-0002-01, $1.75 each or 6 or $10. BZ Enterprises, 6920 7th North St. Liverpool, N.Y. 13088. 11-73-3t

USE YOUR SCOPE (ANY MODEL, NO REWIRING) TO TEST TRANSISTOR IN/OUT CIRCUIT. SIMPLE ISTRUCTIONS $1.00. SCHEK TECHNICAL SERVICES, 8101 SCHRIDER ST., SILVER SPRING, MARYLAND 20910. 10-73-12

SAMS 1-791, Rider 1-4, 1-19; Steel cabinets and binders; assorted TV-Radio equipment; Imperial, 3325 Hone Avenue, Bronx, NY (212) OL-4-6125 12-73-1t

UNUSUAL SURPLUS AND PARTS Catalog. $1. ETCO Electronics Dept. E.S., Box 741, Montreal "A" H3C 2V2 12-73-12t

FOR SALE, TV repair business in Santa Fe, N.M., grossing approximately $20,000. Asking cost of stock plus 2 months gross. Write P.O. Box 4132, Santa Fe, 87501. 12-73-2t

FREE TV Tuner Eliminator Yours in one hours' time. Plans $1. William Morgan, Bruce, Mississippi 38915 12-73-1t

FOR SALE (Cont.)

"157 SAMS PHOTOFACTS for $99.00. From #500 up. Radio Appliance Service, 600 E. Park Ave., Fairmont, W.V. 26554" 12-73-1t

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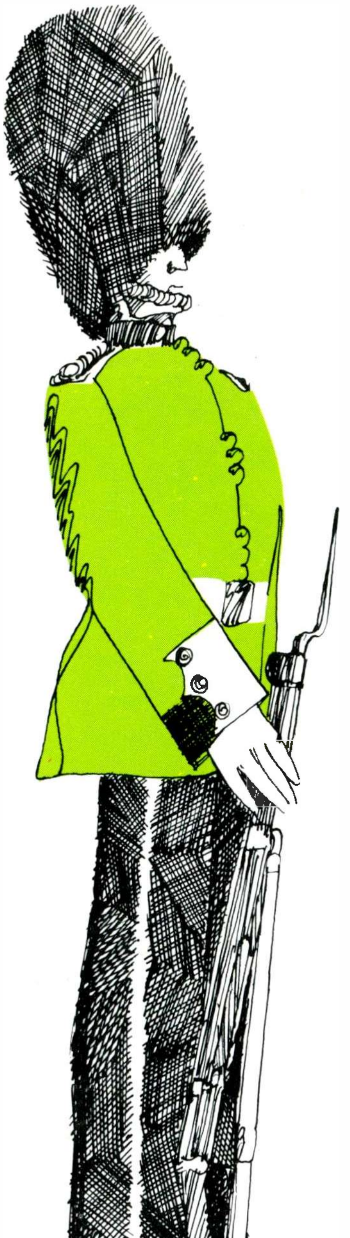

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