January, 1977 75 cents

Electronic Servicing

Installing CB Base Antennas
GE Chroma
8-Track Repairs
1976 Index

January, 1977 ☐ Volume 27, No. 1

Electronic Servicing®

in this issue...

ABOUT THE COVER

Paul Casper is intent on finding the trouble in an old tube-equipped color TV.

DEPARTMENTS

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Electronic Servicing

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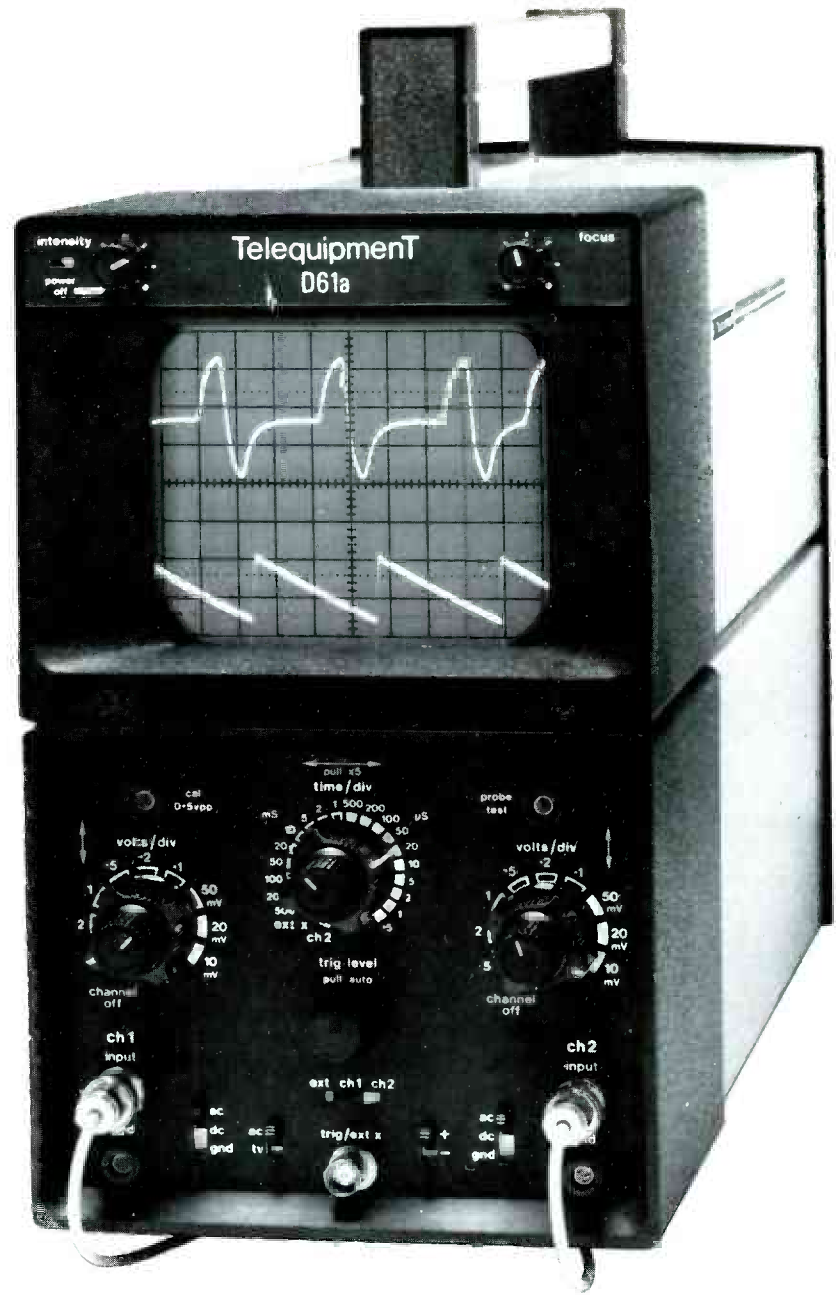

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electronicscanner

news of the industry

Dick Pavek, President of **Tech Spray** and spokesman for the electronic chemical manufacturers, **delivered a strong presentation recently in Washington D.C. at the Environmental Protection Agency** (EPA) hearings on the aerosol/ozone issue. Pavek's testimony pointed out the absolute necessity of an exemption for the chlorofluorocarbons used in the electronics industry. Some of these, such as chilling sprays and cleaning solvents, are not the propellant of a pressure spray, but instead are the active ingredients. Although materials other than Freon can be used for propellants, there are no acceptable substitutes for these active ingredients. It was estimated that the ban of such essential materials would increase the repair costs to the public by more than a billion dollars per year. When asked later if the battle was over, Pavek replied that the EPA has not yet made a national exemption, and that problems still exist in Oregon and New York where state bans soon will go into effect prohibiting the sale of chilling sprays.

The 1977 "National Electronic Servicing Convention" will be held August 16-20 at the Sheraton Twin Towers, Orlando, Florida. Nolan Boone, Convention Director for NESDA has announced that this year's convention will feature ISCET's "College of Service Knowledge"; a management school for service dealers; a gigantic "Magic Kingdom of Electronics" trade show; predictions about service in the future; and election of officers. For further details and registration information write: 1715 Expo Lane, Indianapolis, Indiana 46224.

The FCC has extended indefinitely the requirement of ±2-MHz in tuning accuracy (without fine tuning) for 70-position UHF tuners. A ±1-MHz tuning requirement was to have gone into effect July 1, 1977.

Paper voting ballots can produce election results faster and more accurately than voting machines. That is, they can if the paper ballots are "read" on both sides simultaneously by optical scanners using infrared light. Data from the scanners are relayed to a computer which keeps the total count. Recently in Nebraska, 43% of the votes had been counted by the time the polls closed at 8 p.m.; and all ballots, including write-ins, were tabulated by 2 a.m. the following morning. By contrast, hand counting would have continued until 9 a.m. or 10 a.m. of the following day. Ballots which were marked improperly or which could not be read by the scanners were removed for review by a county board. Other advantages of the system include the ability to trace an individual ballot back to the specific polling place, and the approximate time of voting. The optical scanners were developed by a subsidiary of Westinghouse.

GTE Sylvania's line of "Color Bright 85" replacement color-television picture tubes now will have a five-year limited warranty. It is said that such an extended warranty was not available before. The warranty covers the Sylvania line of 17 tube types from 18V-inches to 25V-inches. Labor costs for replacement are not included.

Continued on page 6

The Sylvania CK3000

Suddenly, you're the most versatile shop in town.

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GTE SYLVANIA

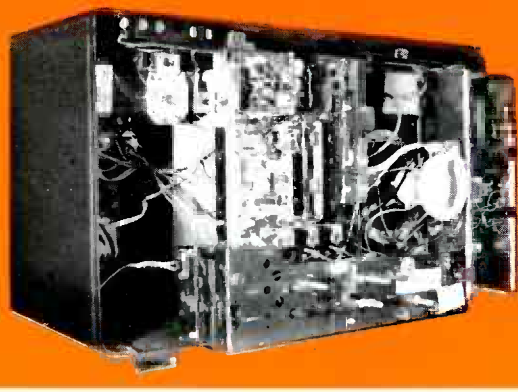
Continued from page 4

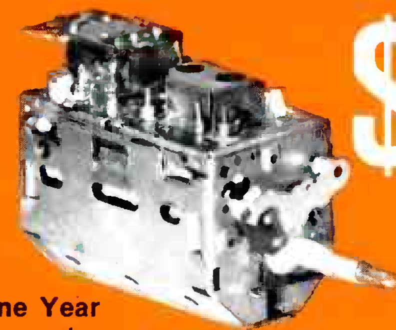
Ten years ago, ITT's Dr. Charles Kao and Dr. George Hockham developed the concept of using light to transmit information along hair-thin conductors of glass-like fiber. The first commercial factory in Europe for the designing and manufacturing of optical fibers was opened recently in Harlow, England. The plant has been established by Standard Telephones and Cables, ITT's largest British company.

1976 sales of CB radios might have reached 10 million, predicted John Sodolski, the Vice President of the Communications Division of EIA. That's double the record volume for 1975. Most authorities believe 1977 will show another sales increase because of these factors: the increased use of CB's by law-enforcement officials (enabling motorists and truckers to report traffic problems direct); more auto makers are offering CB's built-in as optional equipment; and less channel congestion made possible by the expansion to 40 channels.

A 50-year-old ER-171A radio tube manufactured by Raytheon was taken from an antique Atwater Kent radio by George Demirjian and presented to Harold Hart, the Vice President of Engineering at Raytheon. The semicentennial tube will be placed in the company's archives. Perhaps the old-timers in radio remember that 171A's were 4-prong power-output tubes with 5-volt filaments. Tiny transistors now produce more sound volume than those huge old tubes did.

Tuner Service Corporation





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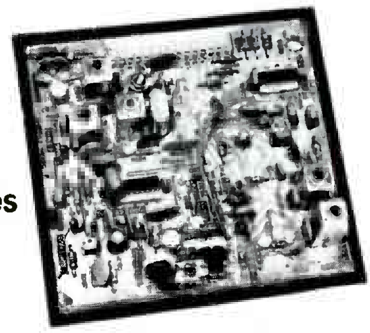

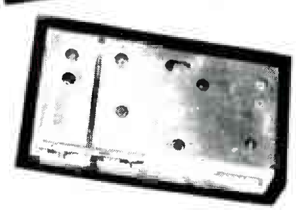

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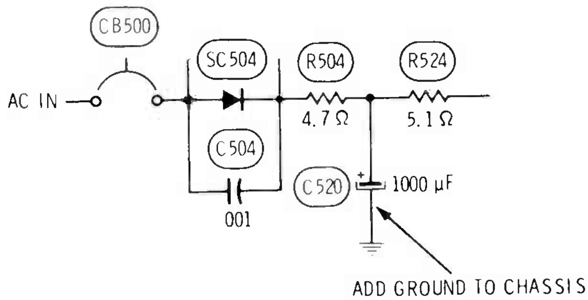
WATCH US GROW

symcure

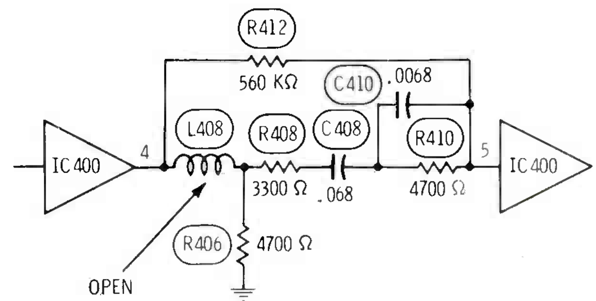
Symptoms and cures compiled from field reports of recurring troubles

Chassis—Philco E06/E21
PHOTOFACT—1609-1



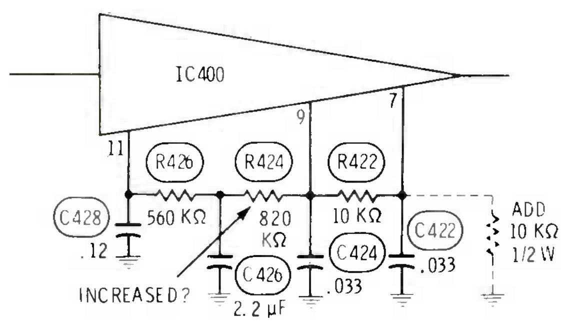
Symptom—Soft hum at low volume settings
Cure—Add a ground lead from C520 to chassis

Chassis—Philco E06/E21
PHOTOFACT—1609-1



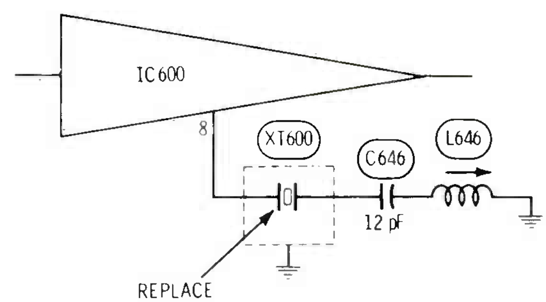
Symptom—Intermittent vertical or horizontal locking
Cure—Check L408, and replace it if open

Chassis—Philco E06/E21
PHOTOFACT—1609-1



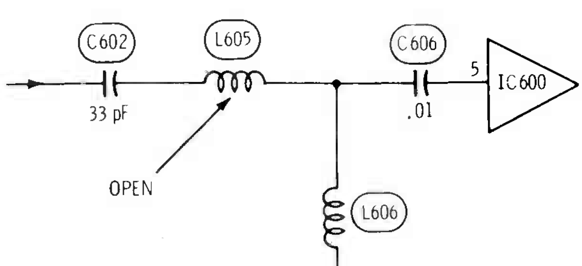
Symptom—Picture (not raster) shifted to the left
Cure—Check R424, and replace it if increased. Also, add a 10K resistor as shown

Chassis—Philco E06/E21
PHOTOFACT—1609-1



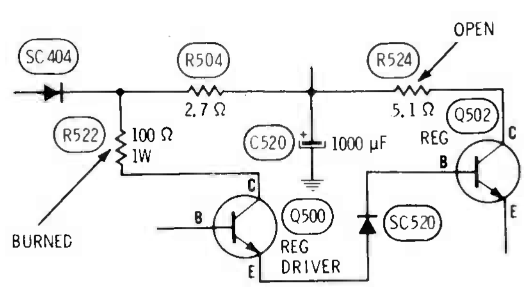
Symptom—As set warms, tint changes toward green
Cure—Replace the 3.58-MHz crystal, XT600

Chassis—Philco E20/D21
PHOTOFACT—1585-2



Symptom—No color or weak color
Cure—Check L605, and replace it if open

Chassis—Philco E06/E20/E21
PHOTOFACT—1609-1 or 1585-2



Symptom—R22 burned or operating hot and no raster
Cure—Check R524 and Q502, and replace if defective ☐

troubleshooting tips

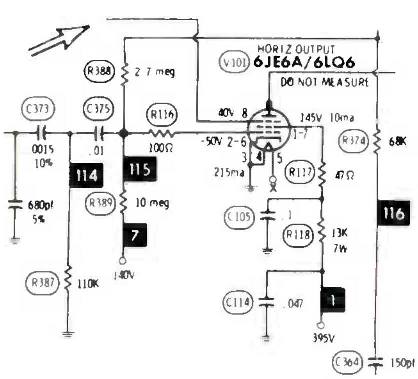
Send in your helpful tips—we pay!

Small picture Fleetwood CO1 (similar to Emerson in Photofact 1104-2)

The picture was small, showing black on all four sides of the raster. Of course, I thought first of the power supply and the possibility of an open filter capacitor reducing the DC voltages. But paralleling the filters one at a time did not improve the height and width.

Tests of the B+, using DC meter and scope showed normal voltage and no excessive ripple. Apparently the B+ was okay.

Horizontal troubles sometimes also decrease the height, so I decided to work on the width symptom first. Voltages at the socket of the 6JE6 were: control grid, -55; screen grid, high; and suppressor grid, -80. Now, the suppressor grid should be around +35 or +40, which is obtained from the cathode of the vertical output tube. Ohmmeter tests located an open in R144. Unfortunately, a new resistor gave full height, but did not help the width.



Drive and DC at the grid of the 6JE6 were normal, and the tube ran cool. But the B-boost and the HV both were low. I had just about decided to replace the flyback, when luck came to my rescue. By chance, I was watching the screen of the picture tube as I checked the output tube voltages for the umpteenth time. As I touched the control-grid pin, the width filled out. I looked at the 2.7 and 10 megohm resistors in the grid circuit and my 20K-ohms-per-volt VOM. I reached for my VTVM. The grid now measured -75 volts (much too high). Tracing back to the grid of the blanker tube (V306A), I found not -80 volts, but a whopping -160 volts, and pulses of excessive amplitude. The 68K resistor (R374) measured a low resistance, and a new one filled out the width.

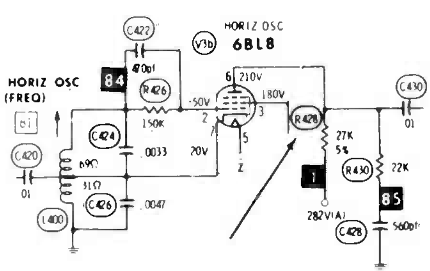
All that wasted time taught me to not use a VOM with high-impedance circuits.

P. M. Leyden
St. Catharines, Ontario

Excessive 6LR6 failures Sylvania D16 Chassis (Photofact 1178-3)

I had replaced a couple of tubes and the color receiver was working okay. Then the customer mentioned that the same 6LR6 tube was being changed about once a month; and didn't they make them to last?

Of course, this new bit of information meant I had to check further. The cathode current of the 6LR6 horizontal-output tube measured 400 milliamperes, which is excessive. I pulled the chassis for the shop.



Back at the bench, I found less than -30 volts at the control grid of the horizontal-output tube. After wasting some time checking the components of the biasing network, I finally used the scope to find the grid drive was only about a third of the usual 300 VPP.

That pointed to the oscillator, although it had plenty of plate voltage. Going back to the ohmmeter, I found R428 checked less than 4,000 ohms. Of course, a new resistor increased the negative voltage at the 6LR6 grid, and decreased the cathode current.

I should have suspected such a resistor, because I have found several in Sylvanias lately.

Daniel Tavares
New Bedford,
Massachusetts

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There is no charge for listing in *Reader's Exchange*, but we reserve the right to edit all copy. If you can help with a request, write direct to the reader, *not to Electronic Servicing*.

Needed: *Service manual for U.S. Army Signal Corps frequency meter TS175C/U. Will buy, or copy and return.*

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Needed: *Schematic for a Hickok Model 660 color-bar/dot generator. Will buy, or copy and return.*

A. Orze
757 Alameda
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Wanted: *Old Rider and Supreme manuals for my collection.*

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CB Electronics
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Glassboro, New Jersey 08028

Needed: *Up-to-date tube manual for Accurate Instrument Model 257 tube tester, or the name and address of the manufacturer of a similar tester.*

Bob Mauer
158 Thornhill Rd.
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For Sale: *Tubes for antique radios: 22W, 2A5, 39/44, 71A, 31, 1Q5, 1LA6, 2A7, 37, 36, 26, 6A3, 1LC5, 1B5, 1Q5, 6H6, 6SF5, 75, 12A7, 82, 85, 89, 1F5, 6F7, and 6C5 new box tubes.*

John Mednansky
Box 259
Stevensville, Montana 59870

Needed: *One power transformer, part # AM-TS-321 for a Crowncorder Model SHC-47F, CSP-65.*

Gilberto Hernandez
Electronic Technician
Calle 10, Block 18, No. 18
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Needed: *Schematic and operator's manual for Sony TC-770 tape recorder.*

Edward A. Hunt
Box 6691, R.R. 2, S.R. 133
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For Sale: *One Heathkit Model 10-101 vectorscope and color-bar generator, $129.95; used about 6 or 8 times. One Heathkit IG 57-A post-marker generator; never used.*

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Eastlake, Ohio 44094

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Paul Copito
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George A. Koch
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Kenneth Miller
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Will Trade: *B&K 1076 for B&K 747.*

Kenneth Miller
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Cornie's TV & Appliance
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Needed: *Source of supply for Broadmoor flyback transformer, part #8FT-014-1. Also, name of company in Japan that exported under the brand name Broadmoor (currently owned by Olympic).*

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For Sale: *Eico #944 flyback, transformer and yoke tester, brand new.*

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Brooklyn, New York 11238

Needed: *Up-to-date tube chart and schematic for Triplett Model 3413 tube tester.*

Gene E. Wernersbach
3609 175th Place
Hammond, Indiana 46323

Needed: *A 15GP22 picture tube for a 1953 color receiver; must be in good operating condition. State price.*

Ed Edwards, Jr.
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Warsaw, Missouri 65355

Needed: *Heathkit Model IB-102 frequency scaler. Will buy or trade for a frequency scaler unit in excellent operating condition and appearance.*

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For Sale: *Very-clean Sencore wide-band PS-127 scope in factory box; Magnavox #701264-1 color test jig in factory carton; Eico yoke and flyback tester. Best offers will be accepted.*

Don Martin TV
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Needed: *Schematic, tube diagram, and other service information for Magnatone custom 200 hi-fi stereo vibrato made by Magna Electronics, Inglewood, California; will pay.*

Gus A. Green
12692 Green Street
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Needed: *Schematic and service information for a B&K Model 1075 TV analyst; will buy, or copy and return.*

Gerwig's TV & Electronics
Rt. 1 Box 194
Round Hill, Virginia 22141

continued on page 12

Needed: *Complete instruction book on the construction of RCA Institute's 3-inch oscilloscope used in a former electronics course.*
Commack High School South
Vanderbilt Parkway
Commack, N.Y. 11725
Attn: Adolph Krauz

Needed: *One Hickok Model 186 Tracemeter with manual. Also need one 1B85 Geiger counter tube.*
APO Electronics
735 Mills Street
Kalamazoo, Michigan 49001

For Sale or Trade: *Allen ignition tester for both conventional and transistor ignition; $75, or trade for television test equipment.*
Kenneth Miller
10027 Calvin Street
Pittsburgh, Pennsylvania 15235

Needed: *Service manual or schematic for Monarch Electronics CB "walkie-talkie" Model TC-66.*
Al's Radio & TV
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Hyannis, Massachusetts 02601

For Sale: *Gonset Comm II, 2-meter transceiver (120VAC/12VDC power); $75.*
Al's Radio & TV
9 Leonard Road
Hyannis, Massachusetts 02601

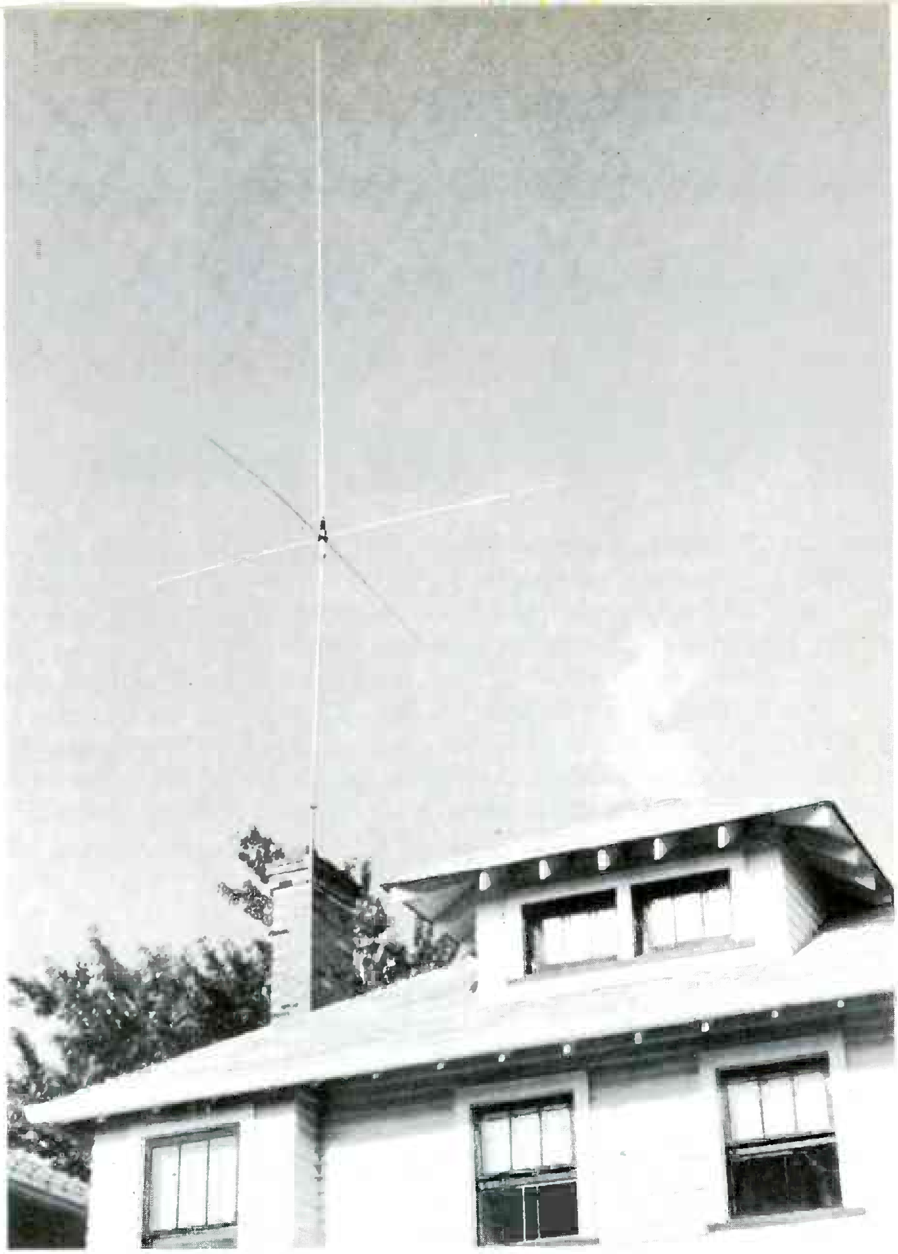
Needed: *B&K 1460 or 1465 scope, B&K 415 sweep generator, B&K Model 970 transistor analyst. State age, condition and asking price.*
A&D Electronics
3042 37 Avenue
Rock Island, Illinois 61201

For Sale: *B&K Model 1801 frequency counter; brand new, $200; fine for CB repairs.*
George E. Gammel
R. D. #1 Box 113
Oley, Pennsylvania 19547

For Sale: *B&K 1077B TV analyzer; brand new, still in box. Paid $454; make an offer.*
Dan Forrester
318 Brinker Street
Bellevue, Ohio 44811

Needed: *Complete set of knobs for Delmonico TV Model 8PV-47U.*
Lee Johnson
8617 Piney Branch Road #303
Silver Spring, Maryland 20901

Needed: *Deflection yoke, part number 708455, for a Model 11P04A Emerson TV, chassis 120771.*
D. Manigault
P.O. Box 333
Bronx, New York 10451



A chimney mount is the easiest way of installing a CB base-station antenna. But, be sure the chimney is strong enough to withstand the strains.

Those CB base antennas...hang them high!

By George Paul

Give your CB customers the long-distance reception they want—take advantage of the extra height provided by the house roof.

Probably you know already that raising an antenna increases the signal from it. For fringe reception of TV stations, extreme height of the antenna is necessary.

And now, you'll find it even more important for Citizen's Band radio base stations. Because the limit is only 4 watts of RF power from the transmitter, the weak signal must be conserved or increased. And that means a good antenna mounted **high.**

Roof Mounts

Frequency and design fix the antenna's own size (height, in the case of CB antennas, which are vertical). So it's the support you choose that determines how high any

Fig. 1 Locate a spot at the ridge where two rafters meet, so all the screws can bite into solid wood. This is a saddle mount.

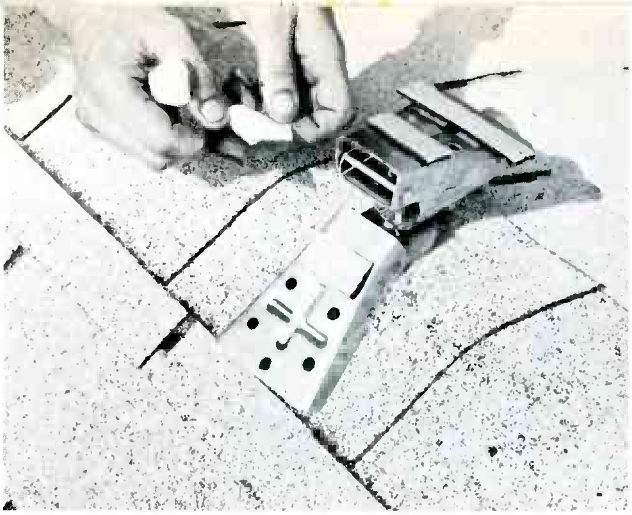


Fig. 2 On the bottom of the saddle mount, cover the screw holes with self-sticking tape, which prevents water from entering.

Fig. 3 Use a center punch to dent the roofing where the screws will go. Soft wood needs only a small starter hole; but for oak or other hard woods, make a complete hole (just slightly smaller than the screw for a tight fit without splitting the wood).

Fig. 4 After the mount is fastened in place, apply caulking to the edges of the mount and to the screw heads. This prevents leaks.

antenna sits. That in turn sets its maximum range. What's handier for height than the house itself? The FCC allows 20 feet above the highest point for a CB **beam** antenna, more for an **omnidirectional.** So, in most instances, the roof makes a good mounting "platform."

Anyone can install a roof bracket. But there are ways of doing it right, and doing it wrong. Often, you're called in when your customer or some other technician has already botched the installation. For example, what do you think of an installer who guys an antenna with clothesline hooks and nylon rope? If you've never seen it before (I have), it's probably because the mount and antenna tipped over before you got there. (Nylon rope stretches—a lot!) Just be sure no other installer needs to be called to fix **your** errors.

You already have two vital requirements for installing roof-mounts: electronic knowledge and common sense. Add to that some construction basics you'll read and see here, and you should be prepared for any type of roof.

Let's say your customer phones for an installation. He (or she) already bought the antenna, and probably some kind of bracket. You set a date (weather permitting) for the job. Don't go empty-handed, with only your tool kit. Second trips waste time.

Bring supplies

Remember, your customer probably bought only the obvious necessities—and maybe not all of those. Take along lag screws, mast bolts and nuts, wood-screw eyes (not hooks), eye bolts (3- or 4-inch), silicone or tar caulking, plenty of stranded guy wire, a few turnbuckles, cable clamps or preformed guy grips, a variety of brackets and mountings, and extra pipe masts. Also, toss in some 4-inch flash plates.

Locating The Antenna

At the site, you evaluate the building size, shape, and material. Study the surroundings; you mustn't put the antenna near electric wires or tree limbs. Find out the transceiver location. From all that, you decide where it's best to mount the antenna, and what kind of bracket you need.

Match antenna and mount

What kind of antenna goes in this mount? Beam antennas (especially those with rotators) are **OUT** for roof brackets. The stress and strain from wind velocity and weather often rips top-heavy beam antennas right out of their mounts. Frequently, this calamity takes part of the roof with it. If your customer insists on a beam antenna, do him a favor. Suggest a tower. Or, at the very least, suggest a pipe-and-gable mast assembly. Also, recommend that the tower or pipe be based solidly in 2-foot-deep concrete. **Mount only omnidirectional antennas in roof brackets.**

Avoid long cables

Situate the antenna as near the transceiver as you find practical. For one thing, you want to keep the lead-in cable short. Coaxial cable, especially the small ¼-inch RG-58/U which handles easiest, presents quite a bit of signal loss. Larger cable, the more efficient ½-inch RG-8/U, also costs more. Either way, short cable runs are preferable.

Keep antenna clear

Evaluate the surroundings. Arrange to stay clear of electric wires (even as you assemble the antenna and supports). Imagine a circle, with a radius at least 10 feet more than the entire installation height (from roof to antenna tip). Your mounting goes in the center of this circle. No electric or phone wires should be inside the radius. Then, should the antenna blow down, it can't touch electric wires and carry lethal voltages indoors.

Place the CB antenna 35 to 40 feet away from other antennas—on your customer's or neighboring roofs. Antennas that are too close interact. Radiation effectiveness of a CB antenna can drop sharply from another antenna nearby. Proximity to a TV antenna also contributes to TVI, and your customer's neighbors don't need that.

Keep your distance from trees and other tall structures. Give a CB antenna the best possible signal clearance.

Roof strong enough?

Along with all these observations, look at the roof construction. Is the roof flat or sloped? How steep? Do you have enough ladders and ropes to guarantee your safety while working on the roof? Sometimes you'll find a roof which looks unsound. Experience can guide you—plus an attic inspection. If you think the rafters are too weak to support the proposed antenna, or if they look unsafe to work on, insist that your customer call in a housing contractor. If the roof caves in while you're on it, or later from the stress of the antenna mounting, guess who will get the blame (and maybe even a lawsuit for damages)?

What roofing materials are used —asphalt or wood shingles, slate, or tile? Expect difficulty and trouble with slate, tile, and rock- or gravel-topped roofs. They are slick and dangerous to work on. Besides, they damage easily. Weight on the tiles and slate shingles can break them. Even if you get by that successfully, an antenna mounting eventually works the tiles loose, bringing leaks. You might have to remove some of the roofing material to mount the bracket; this breaks the seal. It boils down to this: Avoid these roofs, or have your customer call in an experienced roofer. You and your customers both will come out ahead if you convince them to install a tower, or a pipe-and-gable mount. A chimney-mount might suffice—as long as you don't have to walk on the roof to install it.

There's one more step to take before you begin. Climb up into the attic and measure the distance between rafters. In older houses, rafters are usually on 16-inch centers. To save materials, newer houses may have wider spacing. Your mounting job will be stronger if any through-the-roof lag screws or guy eyes bite into rafters or roof beams.

Saddle Mounts

Okay, let's begin with the easiest of the mounting brackets: the saddle (or hip) mount. It straddles the ridge or roof beam (Figure 1). The base flanges adjust to fit the roof slant. Place the saddle mount

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One simplified tester in a single case saves time on every test on any CB that comes in your door, including Single Sideband sets; you won't even need a scope.

$AVE ON BENCH SPACE:

The CB42 takes less than one-third the bench space of other equipment. You can even take it to the field with you, for on-the-spot mobile checks, since it is also 12 Volt battery powered.

$AVE ON ANNOYING HOWL:

Why get a screwdriver in the back from the guy next to you, when you can substitute for that annoying speaker howl? Just plug the built-in speaker sub cable into the transceiver and quietly monitor the audio output on the meter.

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One direct-reading digital readout saves interpretation time and reading errors. You'll know the CB's frequency, generator frequency, Percent Off-Channel, positive/negative modulation and distortion, RF output, and audio output with a simple flick of a switch. Only the CB42 is this simple and complete.

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Simply rotate the CB42 and CB selectors through all 40 channels and read "percent off center frequency" on the direct-reading digital meter (.005% FCC maximum deviation) in less than two minutes for all 40 channels.

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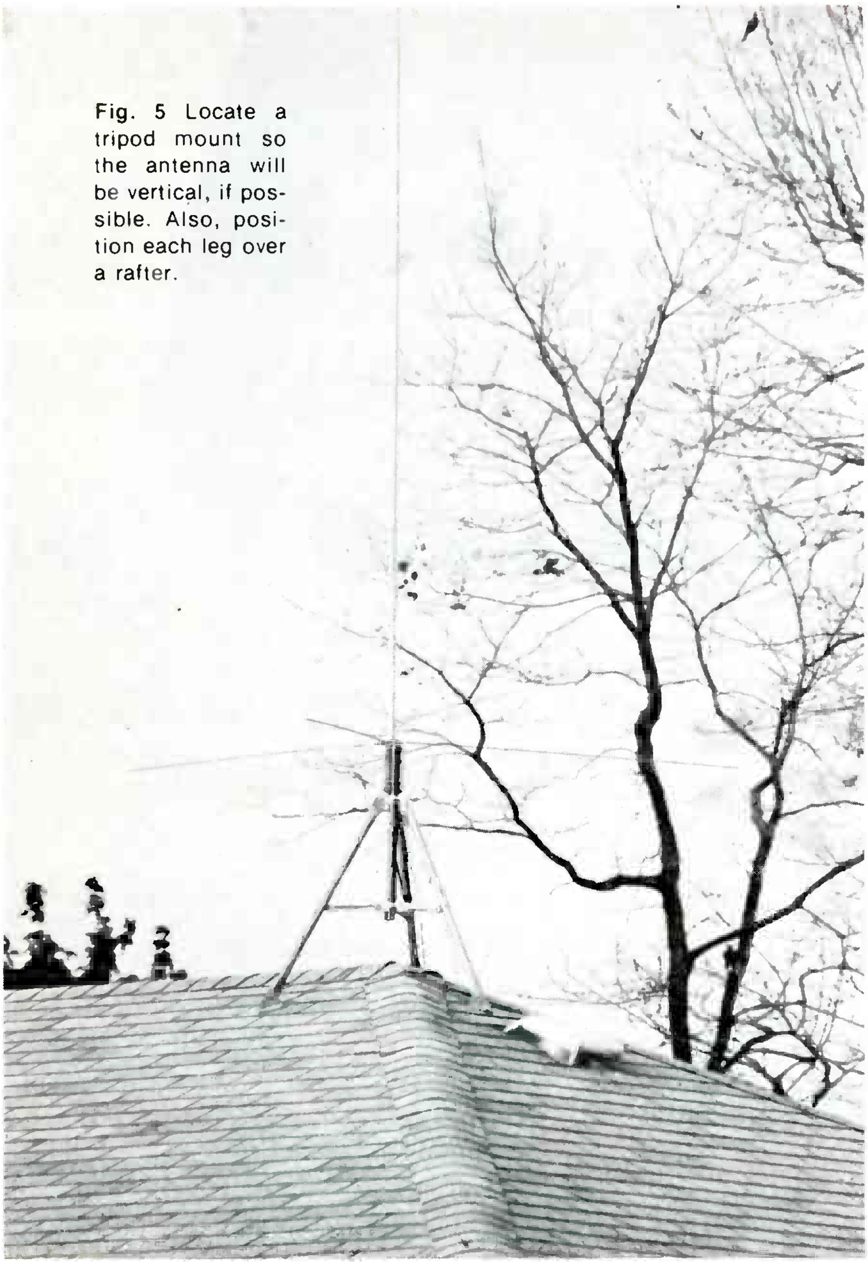


Fig. 5 Locate a tripod mount so the antenna will be vertical, if possible. Also, position each leg over a rafter.

so all the lag screws bite into solid wood. This is most likely at a spot where a pair of rafters join the ridge. You can "probe" for solid wood by hammering a slim screwdriver bit or a nail-set punch into the roof till you find solid rafter. (Be sure it's not just the plywood roof sheathing.) Holes made this way and not used are easily sealed.

You'll need to seal under the bracket, too. You might use a self-sticking tape (Figure 2). It clings tightly to the roof as you tighten the lag screws that hold the bracket base.

With the sealing tape in place under the bracket, punch the roof (and tape) where the lag screws must go, as shown in Figure 3. Lift off the bracket. If the rafters or beams are oak or other hard, seasoned wood, you might have to drill holes (smaller than the lags, of course). Use only a drill with a grounded, three-prong plug and three-wire extension cord; don't risk shock or electrocution. Drill through the tape and into the rafters or beam. Softer wood needs only a starter hole, made with screwdriver or nail-set punch. Then just screw the lags solidly into the beams. You want the lag screws to make a solid bite. (NOTE: That sealing tape is really sticky stuff. It leaves a tar-like residue on your nail punch or drill bit. Clean off the gunk with **Renuzit** or gasoline.)

If you didn't use sealing tape, spread silicone or tar caulking under the bracket before you set the bracket in position. The caulking won't look pretty, but it keeps the roof from leaking. Set the bracket over the holes, and start all six lag screws.

Don't tighten the screws with a relentless twist. Instead, tighten a few turns, then back the lag screw out one turn. Tighten a few more turns, then backward again. This tightening and loosening relieves excess stress on the wood. If you tighten the screws too fast without relieving this strain, you might split the beam or rafters. That would weaken the roof and ruin your mounting job.

After you have tightened all the lag screws, apply caulking around the tops of the screws and around all the bracket edges (Figure 4). With the mounting bracket secure, you're ready to set the mast in it and arrange the guying (details on that presently).

Mounting Tripods

You go through much the same preliminaries with a tripod bracket as you do with a hip mount. With the tripod, of course, the feet are much farther apart. You know it's preferable to sink the mounting lag screws into solid wood. But with a tripod that isn't always possible for all three feet. Never screw an antenna mount directly to an unsupported portion of the roof. This is where you put those 4-inch flash plates to work. They go underneath the roof sheathing, inside the attic, for reinforcement.

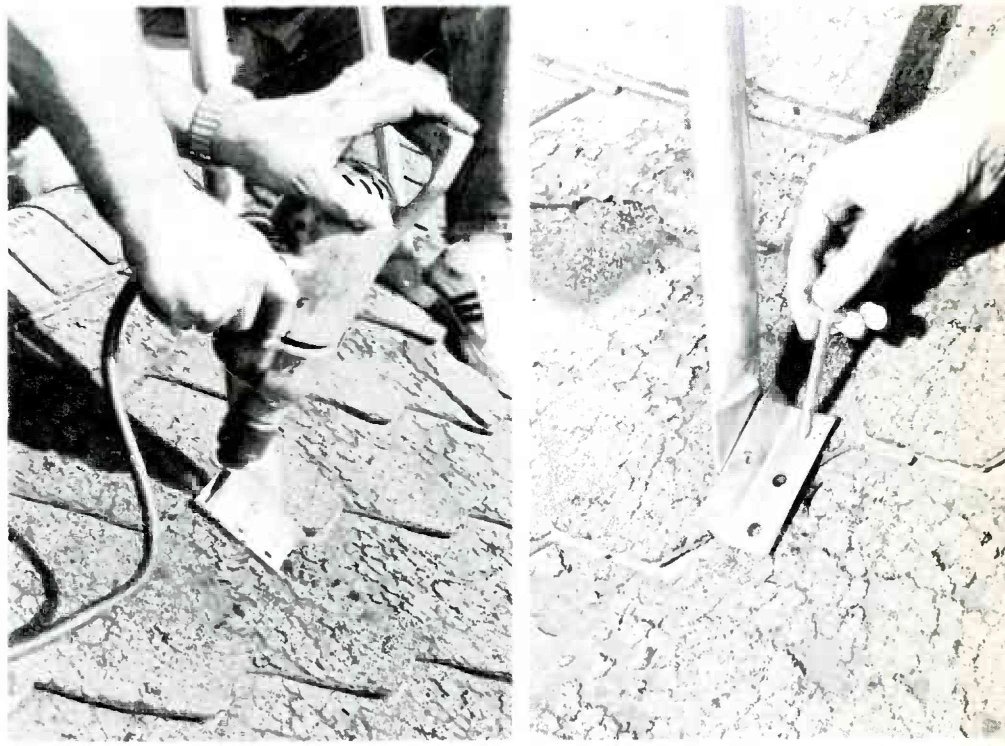
Stretch the tripod legs out fully (Figure 5). Situate as many of the feet as you can right over rafters, using the same attachment procedure as for a saddle mount. At least one foot can always be fastened this way. Fasten this one leg, to establish the tripod position.

With the feet that won't match up with rafters, you'll use flash plates. Holes have to be drilled all the way through the shingles and sheathing (Figure 6A). If the flash plate lacks holes (as it usually does), slide it under the tripod foot and centerpunch for each hole. Drill the first hole. Drop a bolt in, to hold the tripod foot and the flash plate steady while you drill the other holes, as shown in Figure 6B.

Go through the same procedure for the third foot, if it doesn't match a rafter. Once roof and plates are drilled, remove the temporary bolts. Slip the flash plates out from under the tripod feet.

Lift the tripod and smear caulking under it. Put washers on the machine bolts and push all the bolts into the holes in the feet and through the roof, so they protrude into the attic space. You'll need a helper for the rest of this mounting job (your customer might be cooperative). Someone has to climb into the attic and slip each flash plate over its bolts. Then the helper puts flat washers, lockwashers, and nuts on the bolts. He tightens the nuts while the person on the roof holds the bolts so they can't turn.

The helper should squirt caulking between the plate and the roof sheathing. If the attic has insulation batting between the rafters, take loose the staples that hold it near the mounting location. Reach beneath the insulation to spread the caulking, install the plate, washers, and nuts, and tighten the assembly. Be sure to restaple the insulation. On the outside, spread caulking over all three tripod feet.



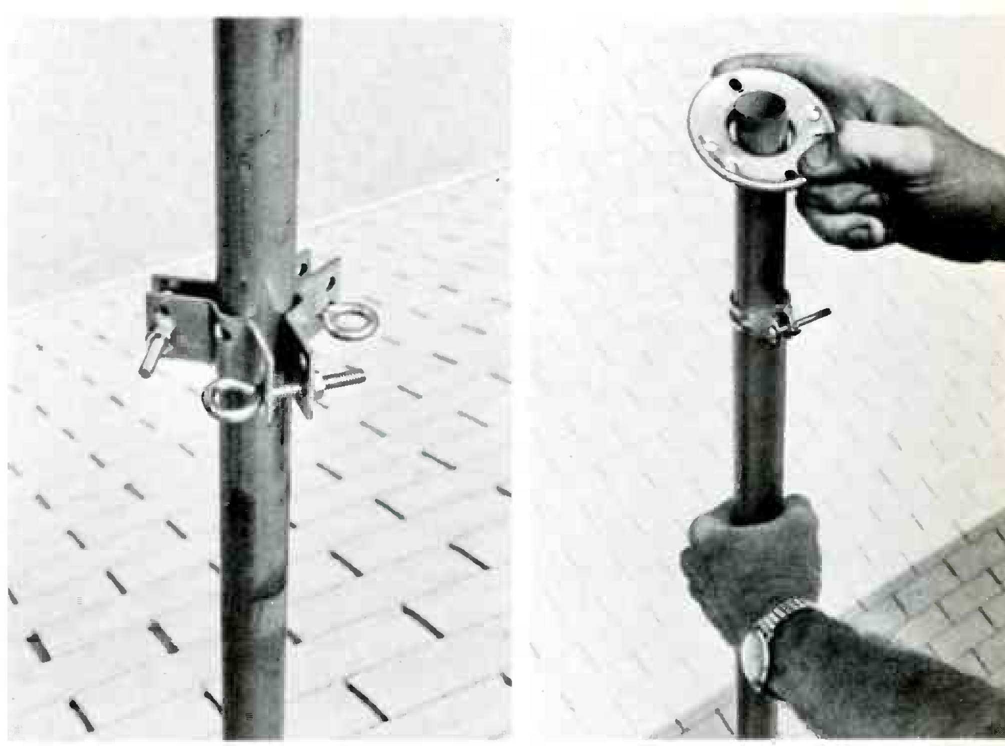
(A) (B)

Fig. 6 Drill one hole for the tripod mount (A), then slip a bolt (without a nut) through the hole (B) to keep the mount in place while you drill the other holes.

Guying

Setting guy wires is not tricky. Yet, it's often done wrong. Certain principles apply—for example, using the right materials.

Seven-strand aluminum or steel guy wire works best. Once it's widely available, you might come to prefer the new non-conductive plastic guy material. (We have not tried it, so can't tell you much about it.) Use eye bolts or screws (not hooks) for anchoring guy wires to the roof. Fasten the wire ends with cable clamps—three on each end—or with pre-formed guy grips. Twisting the wire around itself shows a lack of professionalism. Turnbuckles help too. A turnbuckle in one guy wire helps take up the sag later;



(A) (B)

Fig. 7 Two kinds of collars or hubs commonly are used to anchor the guy wires to the mast. One (A) clamps to the mast with eye bolts, with the wires fastened through the eyes; and the other (B) is a collar with holes (thimbles should be used to minimize wear of the wires) for the guy wires. A pipe clamp is fastened underneath the collar to hold it into place.

one in **each** wire lets you (or your customer) keep the mast exactly vertical. Thimbles, to guide the wire inside the eyes, make a neater and safer job. They're not absolutely essential; but they strengthen the installation by alleviating some wire wear caused by the eye bolt.

You should guy a pipe mast every 10 feet. Hence, a mast 20 feet tall needs two levels of guy wires. At each level you fasten a hub or collar to the mast. Two types are common. One clamps to the mast with eye bolts (Figure 7A); the guy wires fasten in the eyes. The other is a collar that rests on a simple pipe clamp (Figure 7B). Three holes in the collar accommodate the guy wires. You should use thimbles with this type, to relieve wear on the wires where they wrap through the collar holes.

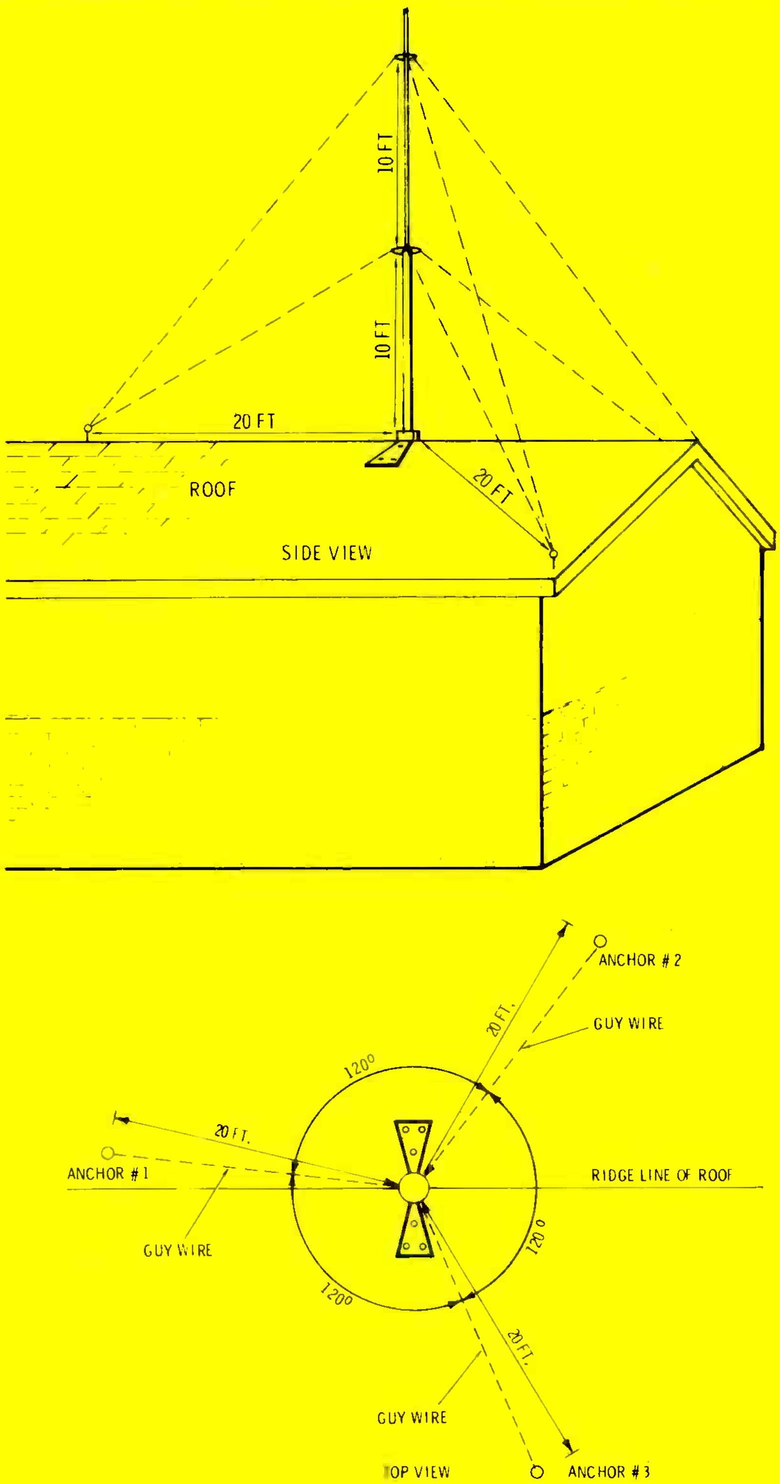


Fig. 8 These sketches show how the guy wires are to be arranged.

Lay out a guying plan as the sketch in Figure 8 shows. Each level of guying takes three wires. And each level has two criteria. (1) **The wires must be spread 120 degrees apart.** A narrower angle creates too much stress when winds blow from "between" the guy angles. (2) **A guy anchor should not be closer to the mast base than the height of its guy level.** That is, guy wires for the 10- and 20-foot mast levels should anchor at least 10 and 20 feet from the mast. If the shape or size of the roof does not permit the guy anchors to be spread according to these criteria, settle for a shorter mast or find places somewhere off the roof to anchor.

Once you've laid out the guy-wire plan, screw eye-type guy anchors into the solid wood of rafters or beams. Seal around the eyes with caulking. If you can't screw every eye into solid wood, use eye **bolts** with washers, nuts, and small flashing plates as you did when anchoring the tripod base mount. This method distributes the stress, so the roof can hold the guy anchors.

Assemble the mast, with guy collar or hub at each guy level. Clamp one end of the mast onto the saddle base (or the tripod). If you're anchoring both levels of guy wires at 20-foot anchors, you'll need 31 feet of wire for each top guy, and 25 feet for each bottom guy.

Connect all six guy wires to the two mast hubs. Drape each wire **toward** the anchor to which it will fasten. If you have them, use a thimble for protection of each wire at the hub. Take the wire (and thimble) through the hole in the collar or through the eye at the hub; pull about a foot through. Put one clamp next to the thimble (or hub), clamping the free end of the wire to the running portion. Use two more clamps with 4 or 5 inches separating them. Tighten all the clamps well, but not enough to smash and weaken the wire strands.

Lay the mast down along the roof ridge between the two anchors (anchors 2 and 3 in the sketch) that are **not** on the ridge line. Thread 18 inches of the top guy and 12 inches of the bottom guy into anchor 2.

Wrap each wire loosely around itself for a half-dozen turns. Then go to anchor 3 and fasten both of those guy wires temporarily, also.

Raise the mast. One person can hold it erect by pushing lightly toward anchor 1. Guys fastened temporarily at anchors 2 and 3 keep the mast from falling. Now, temporarily fasten both guys at anchor 1. That holds the mast up.

Adjust all six guy wires so they set the mast exactly vertical. Using thimbles and clamps, fasten the bottom guy wires permanently to anchors 2 and 3. Then, being sure the mast remains perfectly vertical, permanently clamp the top guys to anchors 2 and 3.

Add The Antenna

Lower the mast by releasing the guys at anchor 1. Install the antenna, push up the whole array, and clamp the two guys for the last time to anchor 1. Turnbuckles in these two guy wires allow adjustment, if it's ever necessary. Tighten the lock nuts at the base, as shown in Figure 9.

Fig. 9 Screws in the saddle mount hold the mast firmly, after the guys are all in place. Two wrenches are necessary because of the lock nut.

Grounding

That leaves only grounding. Every CB antenna needs lightning protection to prevent damage to the transceiver.

Look for the shortest route to earth. Drive a 6-foot copper stake into the soil at a point near the antenna mast (Figure 10A), or near a guy anchor (if the guys are steel or aluminum). (You can buy ground stakes at electric supply stores, if your electronic distributor has none.) Avoid metal gutters when you run the ground wire to the copper stake (Figure 10B).

Chimney Mounts

Chimney mounts are much easier to deal with. You have no drilling. Nor any sealing, if you're careful. Do not, however, attach a chimney bracket to a weak chimney. Look for crumbling mortar and loose bricks. If it is needed, insist that the customer have the chimney repaired. You can return later and hang the chimney mount after the new mortar has cured.

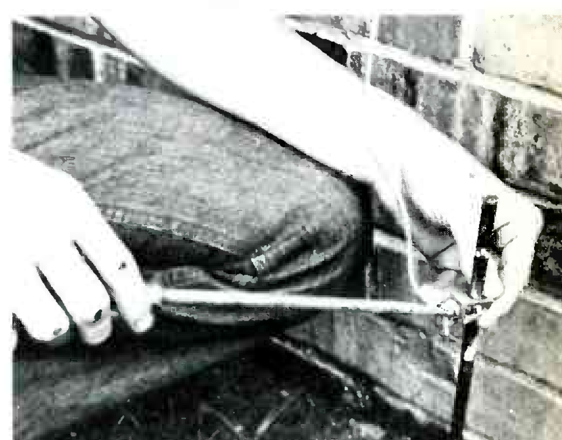
You can buy several grades of chimney mount. **For CB, stay away from the cheap ones.** In fact, don't put up one of that kind, even if your customer bought it and insists. **You'll** catch the blame when cheap straps break or bolts rust. The better types have ratchet fasteners and strong, thick straps.

Mounting the outfit goes simply. You just wrap each strap around the chimney, thread it into the fastener, and tighten. Some suggestions: (1) Put the bottom strap on the chimney first. (2) Separate the top strap from the bottom one as far as chimney height will permit. That provides the greatest strength, and the least strain on the chimney. (3) Keep each strap straight and level as you tighten it. (4) **Never put a mast longer than 10-foot in a chimney mount;** the chimney won't stand it, unless you can arrange for guy wires.

Summary

You can run into a variety of other situations in CB antenna installation on roofs. Experience is your best teacher. And you must be able to improvise. Few installations are average or normal. Each seems to have something different to contend with. Knowing the basics given here, and carrying along the extra materials we suggest, can smooth out a lot of the kinks. Knowledge and preparation make it possible for you to hang those antennas high and inexpensively, and make money while doing it! □

(A)



(B)

Fig. 10 A good ground, having high-current capacity, is necessary for protection of the CB equipment. Drive a 6-foot copper stake into the ground at a point near the antenna mast. (photo A). Firmly bond the ground wire to the mast and run it (as straight as possible) to the stake (B), avoiding metal gutters wherever possible.

Servicing GE Modular Color TV

Part 6/By Gill Grieshaber, CET

Only two IC's and one transistor are required in the chroma circuit of the General Electric 19YC-2 chassis. What's more, there are **no** *adjustments for take-off or bandpass alignment.*

Chroma Features

There is an old cliche about "A calm following the storm", and it applies to this circuit analysis. Last month, we found that the video circuits of the General Electric 19YC-2 chassis were far more extensive and complicated than the average. By contrast, the chroma circuit we're examining this month is quite simple.

Two 14-pin IC's and one transistor are the only active chroma devices. In addition, the chroma take-off and bandpass tuning stages cannot be adjusted; only the "tint-phase" coil is adjustable.

The simplicity of the chroma system is obscured in the chassis because it shares the EP93X108 module (Figure 1) with the multiple video stages. From that module, the three chroma -Y signals and the video Y signal goes to the module surrounding the CRT socket, where they are matrixed together in the color-amplifier transistors before going to the three picture-tube cathodes. It is important that we know where to find these signals and what waveforms and amplitudes to expect before we attempt to troubleshoot any chroma problems.

Many major test points are provided. They are metal rods, sticking up from the module, as shown in Figure 2. These are very handy, and we should practice using them to save our testing time and prevent accidental shorts.

Basic Chroma Requirements

Regardless of whether tubes, transistors, or IC's provide the amplification, several basic AC signals are necessary.

Chroma sidebands

Two kinds of chroma signals (burst and chrominance sidebands) are included with the composite video that's broadcast. These signals are removed from the video (before the delay line or any 3.58-MHz traps) by a resonant circuit, called a take-off coil, which is tuned to about 4 MHz. Purpose of the tuning is twofold: it removes the low-frequency video components while passing the chroma frequencies; and the peak compensates for the roll-off of the IF alignment curve.

Therefore, only the burst and chroma signals (the so-called "comb" pattern of color bars) pass through to the chroma IF's. Next, bandpass circuits provide amplification and a flat response between 3 MHz and 4 MHz. A color-level variable control is included in these stages. In some chroma bandpass circuits, the burst is keyed-out, so the bar pattern at the output has only 10 bars.

Burst

Burst is extracted from the combined burst/chroma signal by a keying process using enabling pulses. These pulses are merely samples of horizontal sweep, which have been delayed in phase (time), and sometimes clipped or cleaned up a bit.

The burst is amplified before it's used to synchronize a 3.58-MHz oscillator. From the oscillator comes a continuous carrier of a certain phase. (Of course, a few models, including some of the older General Electric's, make the burst ring so that it becomes a continuous carrier; but that's not the case with the YC-2 chassis.)

Demodulators

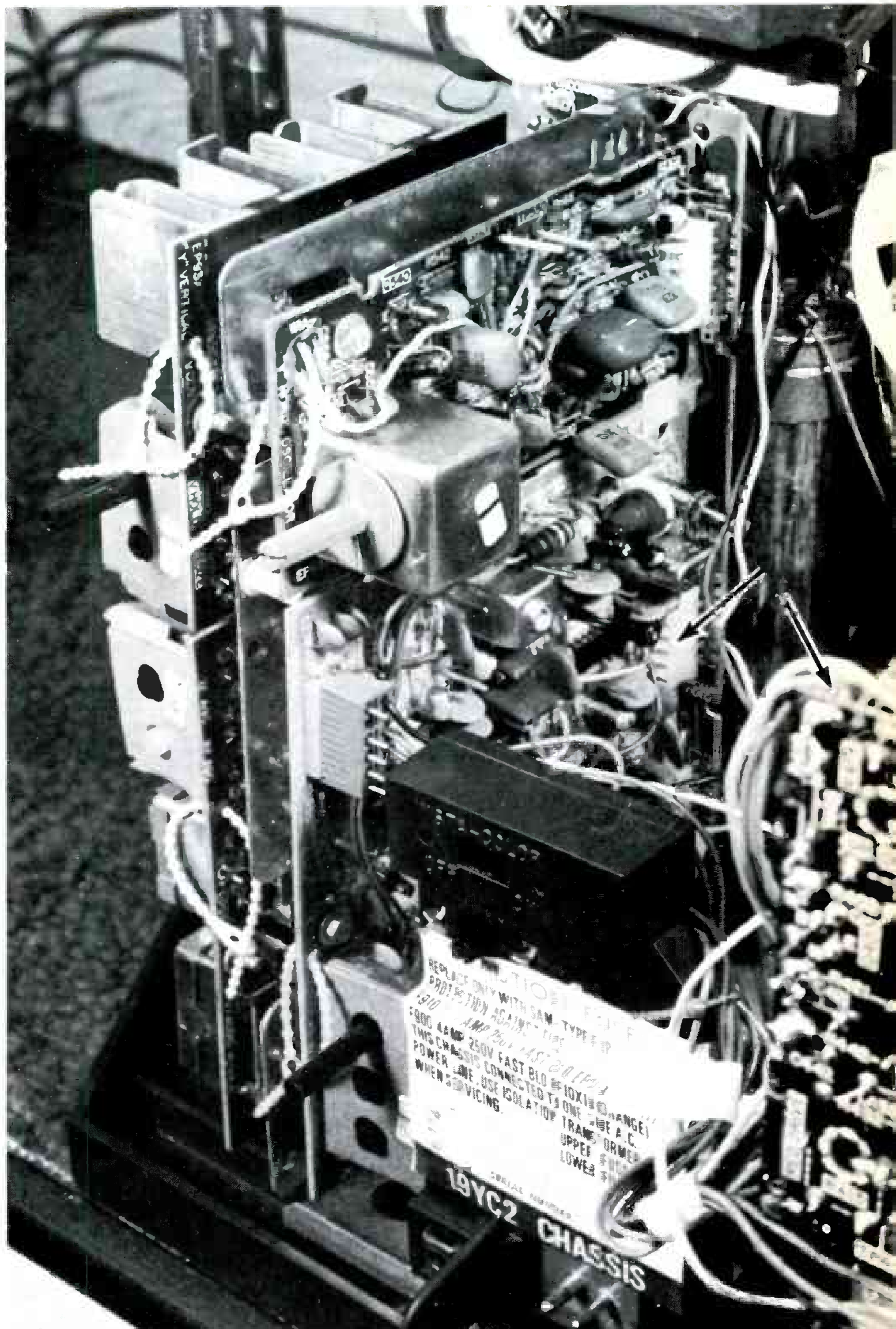
Each demodulator must have those two input signals: the amplified chroma sidebands; and a 3.58-MHz continuous carrier. The phase between these signals determines the tint of the color from each demodulator.

Therefore, since there are three primary colors, it follows that three demodulators are required. Many models demodulate R-Y and B-Y, however, then matrix them to form G-Y, thus requiring only two demodulators. And the phase between the carrier and the sidebands must be different for each demodulator. That means, the phase of either the sidebands or the 3.58-MHz carrier must be changed before each demodulator. In this model, the carrier is phase shifted by LCR filters.

The output of a demodulator is one complete color, except for the missing black-and-white component. So, R-Y actually means "red color minus the video."

Matrixing

Each color circuit must combine the -Y color signals and the video signal. Older sets fed the color signals to the CRT control grids and the video to the common cathodes; matrixing was accomplished inside the picture tube. The GE YC-2 matrixes the color and video signals by applying the color to a base, and video to an emitter of each of the color amplifier transistors. Those three power transistors and the video-driver transistor are on the CRT-base module, as described last month.



Both the video and chroma circuits are on the EP93X108 module, except for the final color power amplifiers on the CRT-socket module.

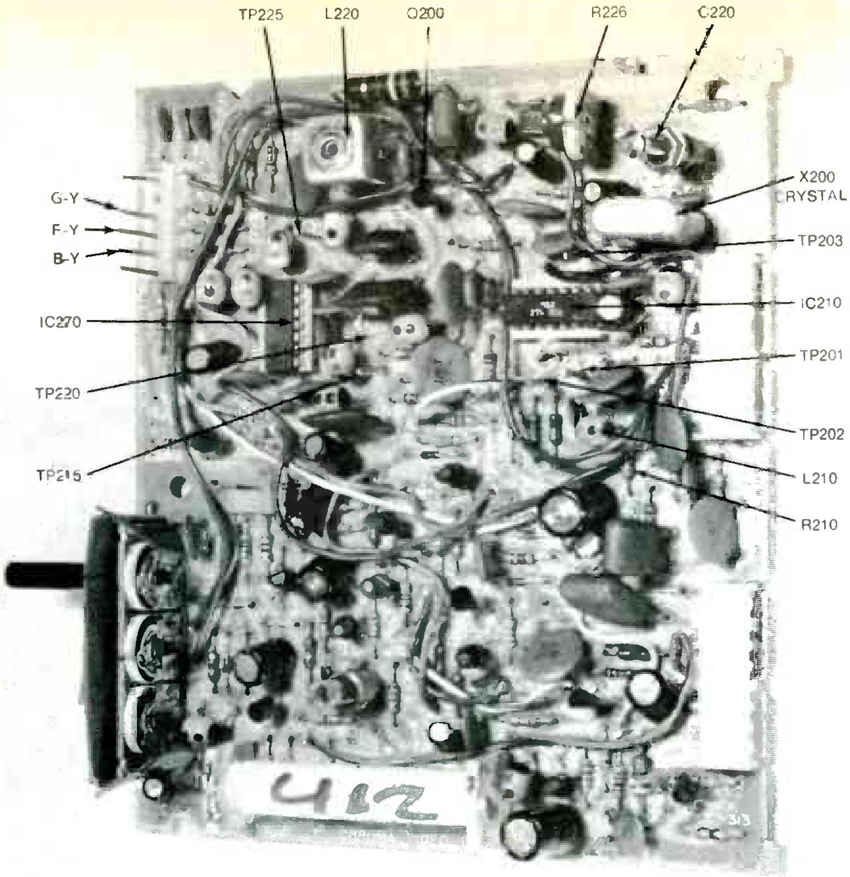


Fig. 1 Chroma circuits of the General Electric YC-2 chassis occupy less than half of the EP93X108 module.

Back to the "black box"

I have gone through these color basics to show you that the requirements are the same, and the waveforms are identical, whether tubes or IC's are used. The biggest difference is the way many stages are included inside of one IC, thus preventing any testing of **individual** stages.

So, we are limited to the "black-box" method, including these steps:

- Check all of the DC voltages of the IC; and
- Look at all of the waveforms around the IC.
- **If both the DC voltages and the waveforms are wrong, it's likely the IC is defective;**
- **But if the DC voltages are within tolerance and the waveforms of the signals are wrong, probably the defect is outside of the IC.**

Of course, I have over-simplified a bit. But it should illustrate the general method of testing. And it helps that **all** of the chroma waveforms and amplitudes are easily within the ability of a good scope to handle.

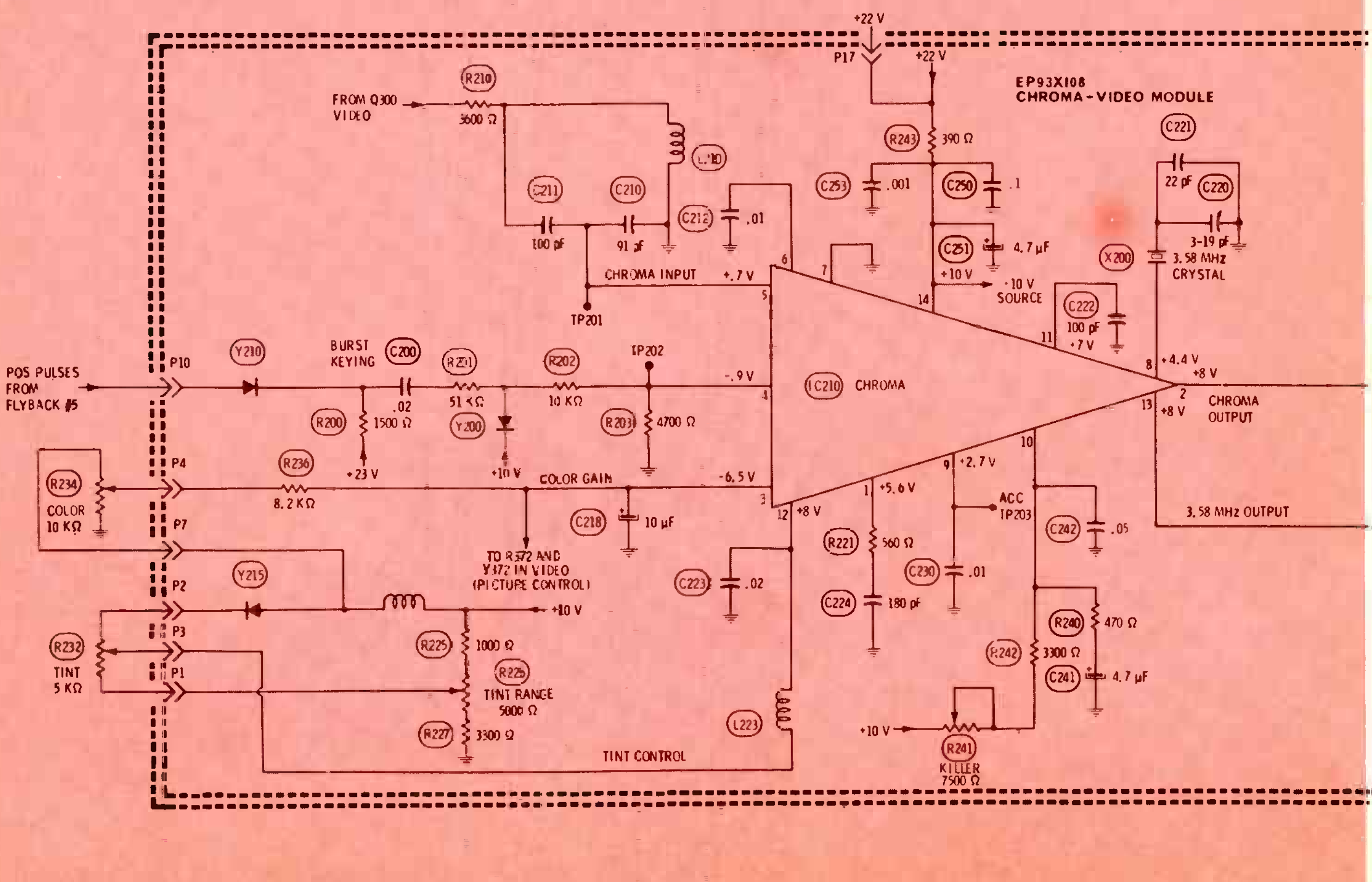


Fig. 2 Two typical test-point pins are shown just below IC210. These test-points can save your testing time and help prevent accidental shorts.

GE 19YC-2 Chroma Circuit

The essential first step of trouble-shooting **always** is a clear understanding of the circuit being tested. So, we will first explain how the YC-2 chroma system operates, in addition to giving some typical DC voltages and AC waveforms to guide you in future servicing.

Figure 3 gives the entire schematic of the YC-2 chroma circuit, minus only a few details of the color/video matrixing which were covered last month.

Chroma input

Composite video comes in through R210, which also serves as isolation. L210 and C210/C211 (capacitances in series) tune to about 4 MHz.

The effect of a tapped coil is obtained from the two tuning capacitors, C210 and C211, so approximately half of the total signal voltage finally reaches the input of the IC210 at pin 5 (Figure 4).

Chroma IF's and color control

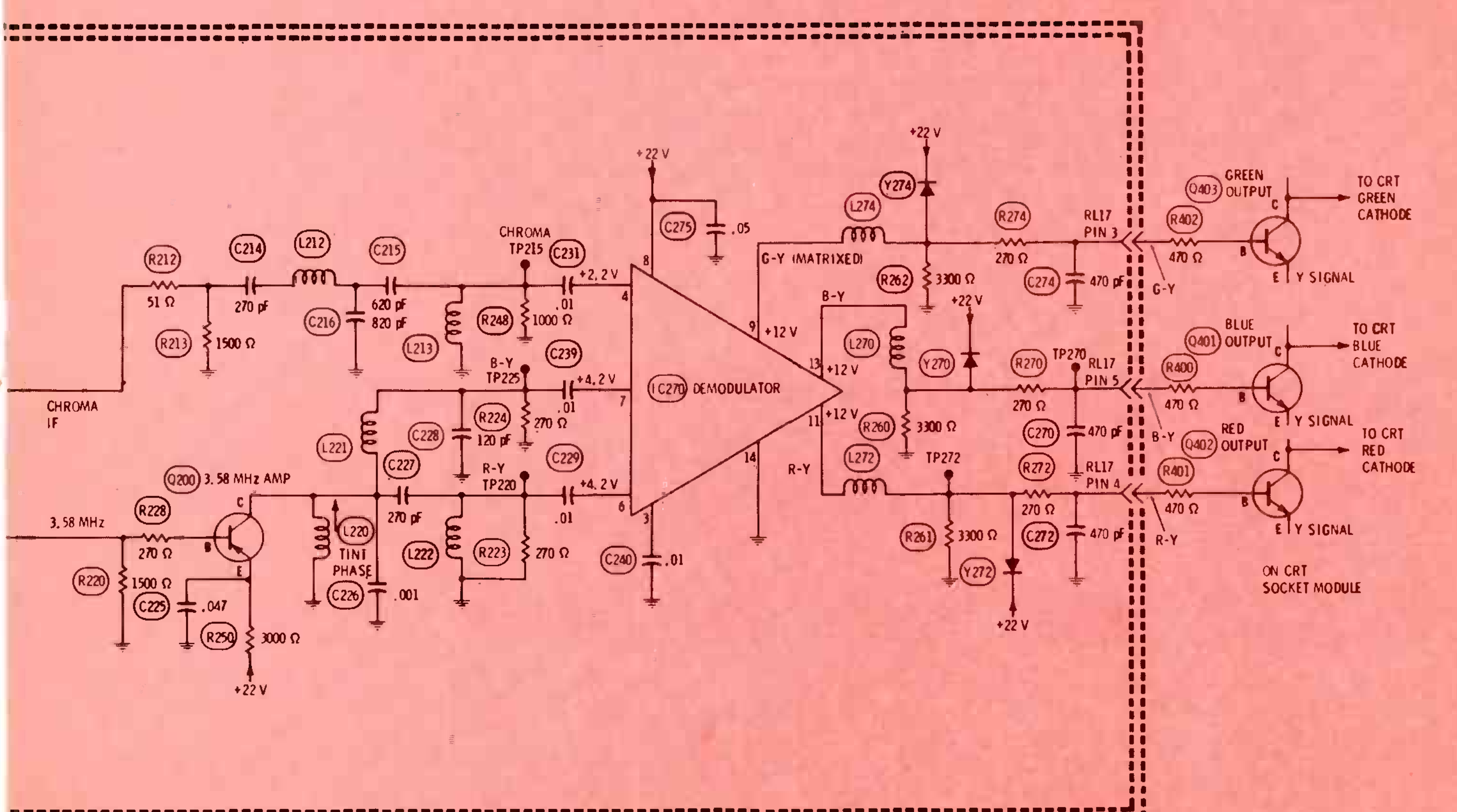
Older tube models used a potentiometer to control the AC color signal. Manual control of the color level in the YC-2 is accomplished by a variable DC voltage (from external control R234 and from the "picture" control in the video) which determines the gain of the IF transistors inside IC210. When the control was turned CCW for no color, the DC voltage at pin 3 of IC210 was +5 volts; with normal color, it was +7.1 volts; and at maximum rotation, the DC was about +9 volts, in this individual chassis.

Chroma output comes from IC210 at pin 2. From there it goes across the page to a low-pass filter section consisting of C214, C216, and L212, then on to a high-pass filter (C215, L213, and R248). Together, these two fixed filters provide reasonably-flat response between 3 MHz and 4 MHz. From the filters, the chroma sidebands go through C231 (notice test point TP215) to pin 4 of the demodulator IC, IC270. Figure 5 shows the waveforms.

Killer and ACC

Both of the killer and ACC functions are adjusted by the value of the DC voltage at pin 10 of IC210. Control R241 is used to vary

Fig. 3 This is the complete schematic of the GE YC-2 chroma circuit, with a few off-module components shown. Especially notice the cascaded high-pass filter (C214, L212, and C216) and the low-pass filter (C215, L213, and R248) which together give the same flat-topped bandpass response that usually requires an overcoupled double-tuned transformer. These filters can be non-adjustable, whereas that would not be accurate if no adjustments were provided for an overcoupled transformer.



the voltage between about +7 VDC with the control CCW, to about +9 VDC when the control is at maximum CW. Correct adjustment of this sample gave +7.6 volts.

Almost all technicians first will check the killer control when there is no color. Right? Well, where do you look if the complaints are weak color and green faces? In the GE YC-2 you had better check the killer/ACC control setting. This could be a real dog problem, so I'll explain it rather thoroughly.

With a color program tuned in on a new YC-2 chassis, the color becomes weak and the hues all green when you turn the killer control (R241) fully counter-clockwise. Then, as you turn it slowly clockwise, the hue slowly becomes normal and the color saturation increases. Finally a point of maximum color is reached, and any CW rotation beyond that eliminates the color entirely. Apparently, this is the ACC operation at work. But that's not all.

If the tuner is set for an unused channel, the antenna leads are removed, and the killer control then is varied from end to end, you will find only **one** adjustment which brings in color snow.

Now, given these separate ACC and killer actions, where should you set the control? As you can imagine, a wrong adjustment can cause all kinds of apparent defects.

The Photofact for the previous YC chassis recognizes these opposite requirements. Here is a rewritten version of the Photofact sequence of killer adjustments:

- With a color program or a color-bar pattern tuned in normally, turn the killer control clockwise until the color suddenly disappears. This is a critical point, so turn slowly and stop immediately when the color leaves. Notice (perhaps by the slot in the shaft) where the control is turned;
- Tune to an unused channel, and remove the antenna leads. Turn the killer control CCW **slowly** for the one critical point giving colored snow. Notice the shaft position;
- Finally, turn the control about midway between the previous test points. Try the performance both with a color program, and without any signal for proper killer action.

Of course, it's difficult to know how to locate those points accurately. You might attempt a shortcut by using a blank channel—rotate the killer control for the one critical point giving colored snow—then, rotate it slightly clockwise. Test the killer action with both color and B&W programs. But don't be surprised if you have to do this several times before all conditions are right.

Burst

Burst separation and the use of burst to synchronize the 3.58-MHz oscillator are all inside IC210, except for the horizontal pulses that allow gain only during the horizontal-retrace time.

Most burst keyers delay the arrival of the horizontal keying pulses so they coincide with the burst time. Another approach is used in the YC-2 chassis.

The waveforms of Figure 6 and the schematic in Figure 3 help us understand the burst pulses. At module pin 10, we find 120 volt PP pulses from a winding of the flyback. Tips of the pulses are pointed, and are not suited for burst keying. But Y210 acts as a rectifier which passes only the most positive portions of the positive-going pulses (that's why the base line between pulses—lower waveform of Figure 6A—has a sawtooth slope). Then R201 and diode Y200 clip the tips of the remaining pulse height which exceed 10-volts peak.

Therefore, by the time the pulses reach pin 4 of IC210, both the tips and baseline are flattened (Figure 6A). However, this dual-trace waveform reveals little phase change. Normally, the tips of sweep pulses occur **before** the burst. How, then, can these non-delayed pulses provide correct burst keying?

The answer is in the wide, flat tops of the **clipped** pulses. Figure 6B shows a dual-trace waveform of the burst area of the video versus one pulse tip. The clipped tip makes the top of the pulse much wider than usual, and it is perfectly flat for more than twice as much time than is necessary for any variation of burst location.

If diode Y200 should open, it's likely that the resulting sharp tip of the pulses would give poor burst and critical color locking. Of course, the higher amplitude of the pulses might ruin the IC, also.

Tint control

External variable control of the color tint also is by a DC voltage applied to IC210 at pin 12. Skin color is all green at about +7 volts; therefore, the "tint-range" control (R226) is included on the module to prevent the DC voltage, from the front-panel tint control (R232), from dropping below +7 volts.

Range of the tint voltage at pin 12 of IC210 was about +7.2 VDC CCW for green faces, about +8.4 for normal skin hue, and about +9 VDC CW for blue faces. Tint is another function that's under VIR control in other variations of this chassis.

3.58-MHz oscillator

Almost all of the oscillator circuit is hidden inside of IC210. The crystal and two capacitors for setting the precise frequency are connected to the IC at pin 8.

The 3.58-MHz continuous carrier emerges from IC210 at pin 13, and goes to the base of Q200. Now,

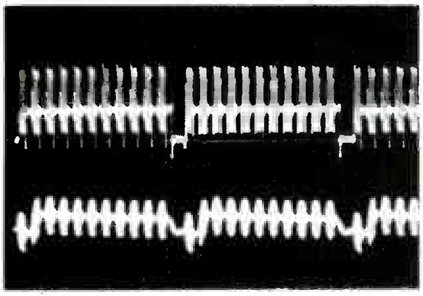


Fig. 4 Waveform at the top is the 1-VPP color-bar pattern at the input to R210, before the take-off coil. Below is the 0.1-VPP color-bar "comb" pattern at the input of IC210 at pin 5.

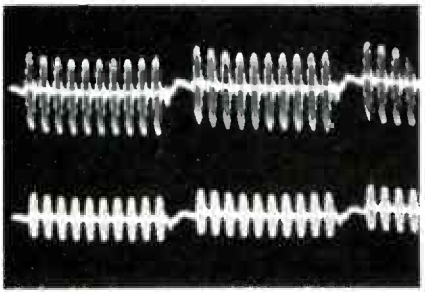


Fig. 5 At the top is the 0.2-VPP color-bar waveform at pin 2, the output of IC210, and the bottom trace is the 0.1-VPP waveform at pin 4, the input of IC270, following the high-pass and low-pass filters.

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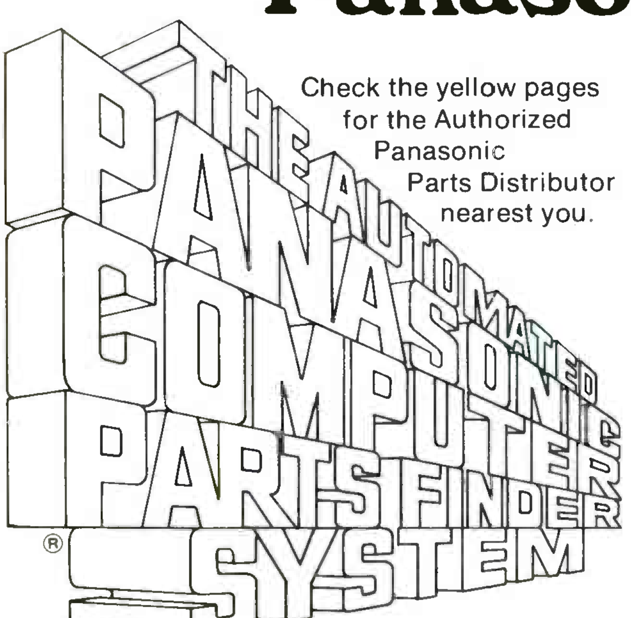

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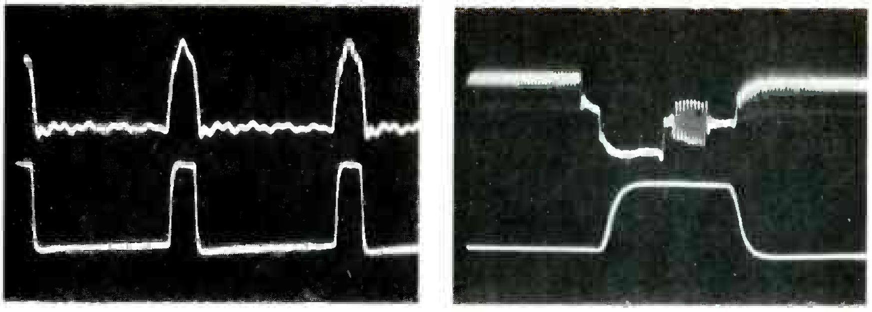


(A) (B)

Fig. 6 The burst-keying horizontal pulses are clipped rather than being delayed in phase. The top waveform of (A) is the 120-VPP input to the module at pin 10, and below it are the 7-VPP pulses after clipping of top and bottom. There is no discernable phase change. In (B) photo, it's clear that the wide, flat pulse tips should key the burst with accuracy, even without any phase delay.

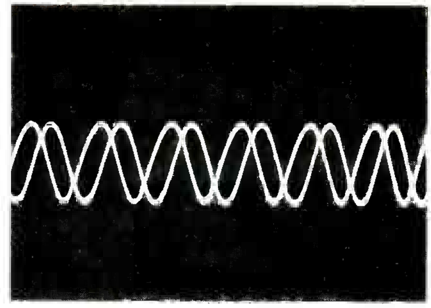


Fig. 7 This dual-trace waveform taken at the outputs of the phase-changing filters (TP220 and TP225) shows more than 90° phase difference between the 3.58-MHz carriers for R-Y and B-Y demodulation.

Q200 is labeled "3.58-MHz amplifier", but it has little gain. Instead, its purpose seems to be to furnish isolation for the "tint-phase" tuned circuit (L220 and C226) at the collector. L220 has an adjustable core, which is used to bring the correct skin hues to the center of the tint-control rotation.

From L220, the carrier divides and is sent through two LCR filters that shift the phase for the demodulators, which are inside IC270. C227, L222, and R223 provide a **leading** phase for R-Y, while L221, C228, and R224 give a **lagging** phase of the carrier for the B-Y demodulator. According to Figure 7, the total phase difference is slightly more than 100 degrees.

Demodulators

The chroma signal is at pin 4 of IC270, the carrier for the B-Y demodulator is at pin 7, and the carrier for R-Y is now at pin 6. All of the necessary signals are present.

Inside IC270 are located several amplifiers, two demodulators, and one matrix stage which combines samples of R-Y and B-Y to produce G-Y. These three -Y signals appear at the output of IC270.

In the blue channel, L270 and R260 provide peaking and the correct load. Diode Y270 is there only to clip arcs or other transients; it has no signal function. R270 and C270 remove unwanted demodulation ripple. Similar components of the other two channels do the same functions.

These three -Y signals drive the bases of the three color amplifiers, which are located on the CRT-base module (Figure 8). Video is applied to the emitters of the color power amplifiers, thus completing the matrixing, and the amplified complete color signals are applied to the three picture-tube cathodes. The output waveforms are shown in Figure 9.

Comments

By now you should be convinced that tracing the cause of a chroma trouble is no more difficult in this solid-state color-TV receiver than it would be in the older tube-equipped receivers. But there are several "if's".

Troubleshooting is no more difficult:

- if you know the path of signal flow and the location of the test points;

continued on page 58

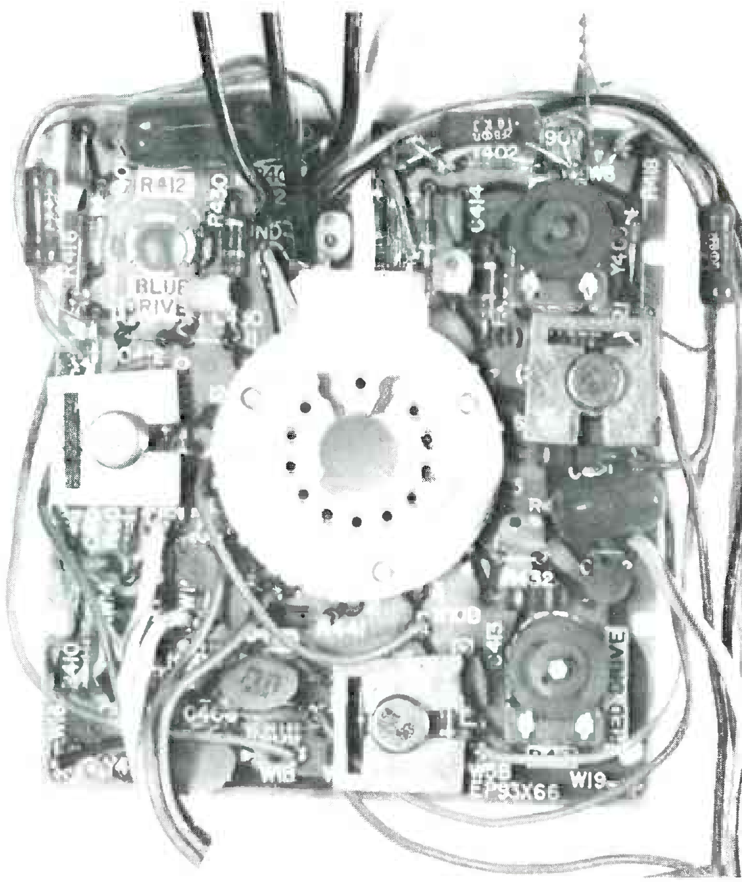


Fig. 8 Front side photo of the EP93X66 combination CRT-socket and matrixing module shows the three power transistors with their heat sinks.

Profitable Repairs of CB Mikes

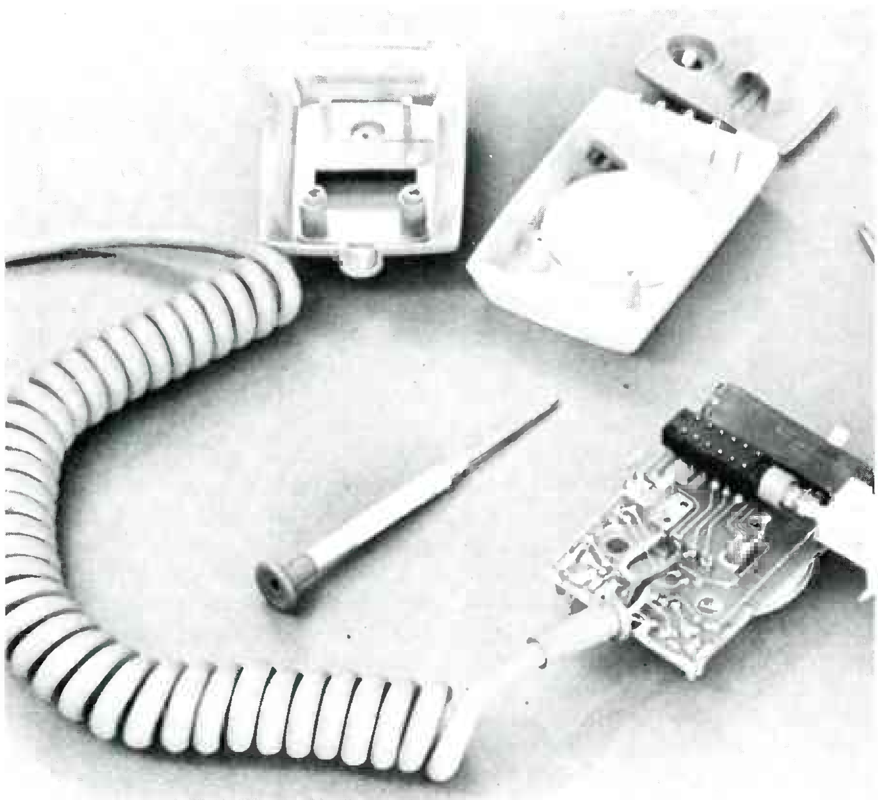
Part 1/By Marti McPherson and Forest Belt

The lack of a uniform color code for cables is one of the problems that discourages some CB technicians from making mike or cable repairs. Here is the solution: learn how to analyze mike wiring so you can repair any type rapidly and profitably.

It's half past four and your shop closes at five. A customer walks in and asks for a replacement mike to fit his CB radio. From memory, you know his transmitter is electronically keyed. The only mike of that model you have in stock happens to be a relay-switching version. **If you don't want to lose the sale, you'd better know how to rewire the mike to suit electronic switching.**

That's just one possible problem you encounter with microphones for two-way radio. But, mike repairs are simple, sometimes. In fact, probably 80% of the time, a so-called mike trouble can be cured by replacement of cable or connector. If you can make the fix quickly, it pays your customer to have the mike repaired instead of replacing it.

You might view the problem as an opportunity to step-up the customer to a better mike, perhaps a noise-cancelling or an amplified type.



Here is a typical CB microphone after it has been opened for testing.

Wiring Not Standardized

But either way, you'll have to know how to deal with the wiring of CB-radio mikes. As you might know, the manufacturers follow no standardization of wire coding for microphones. If you're lucky and have the transceiver schematic, sometimes you can use it and the old mike to guide you. That way, the replacement goes without a hitch.

All too often, however, you have modifications to make, either because you don't have exactly the right type of mike, or because the replacement needs some change to match the transceiver.

In these two articles, we'll put you through a "mini" repair course for CB microphones. Afterwards, you'll earn your mike-repair fees more quickly.

Analyzing Mike Cord Troubles

Let's deal with some of the easy ones first. Certain mike repairs are primarily mechanical. That is, you needn't always go through a detailed diagnosis. You analyze the complaints of your customer, perhaps try the mike yourself, stretch and wiggle the connector and cable, and the results show you what is needed.

Nothing's easier to spot—usually—than a defective mike cord. How can you tell? Often you can see it, as when the outer covering frays next to the mike or the connector. You might feel the defect as a bulge in the cable, or spot a wire broken inside the insulation by the limp, too-flexible appearance of the cord at that point. You could take a clue from your customer's recital of symptoms: complaints from other CBers that transmissions sound irregular and choppy, even when nearby; rhythmic cutoff in conversations, such as when the mike cord swings or bounces; carrier but no modulation; the transmitter won't key at all, or keys intermittently; or, the transceiver stays on when the mike is plugged in.

You'll hear other symptoms described. Any complaint referring to modulation at least suggests a mike difficulty. Trouble with transmitter keying **almost certainly** indicates a mike fault. And the coil-cord or cable stands out as one likely trouble spot. In fact, a bad cord is the most common microphone breakdown (bad mike connectors run a close second).

To avoid wasting time and involving yourself in guesswork, tell your customer to bring both microphone *and* transceiver. You'll need the transceiver diagram too, if you don't have it in your files.

Put a dummy load on your watt/modulation meter, and connect the instrument to the transmitter. Hook up the set, turn it on, and verify that the receiver works. Now, quickly, make the following tests.

Plug in the mike, if it's not a wired-in type. Squeeze the microphone button. Watch the modulation monitor as you scratch the front of the mike with a fingernail. Stretch the coil cord to its limit, still scratching and watching modulation. Twist the cord severely next to the microphone, especially right where it enters the strain-relief clamp. Do the same at the other end, where the cable enters the mike connector or the transceiver. Most cord defects come to light under this exaggerated mistreatment. Even impending breaks often show up.

If all seems normal to this point, investigate one more common "hidden" trouble spot. Loosen the strain-relief clamp. Again twist and stretch the cord. Often wires will sever just inside the microphone itself, without damaging the insulation (Figure 1). Such defects tax your deductive and troubleshooting powers.

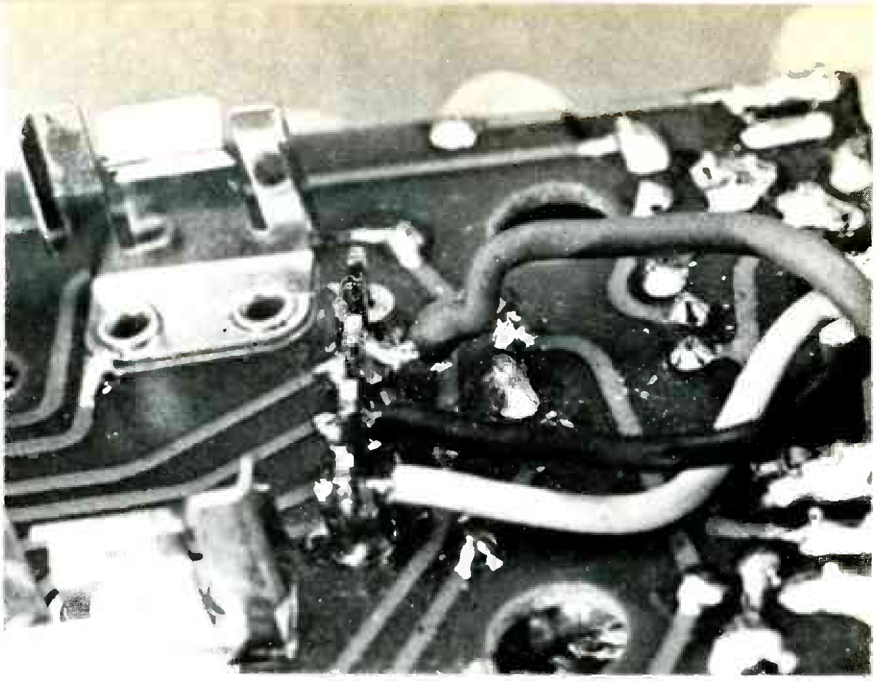
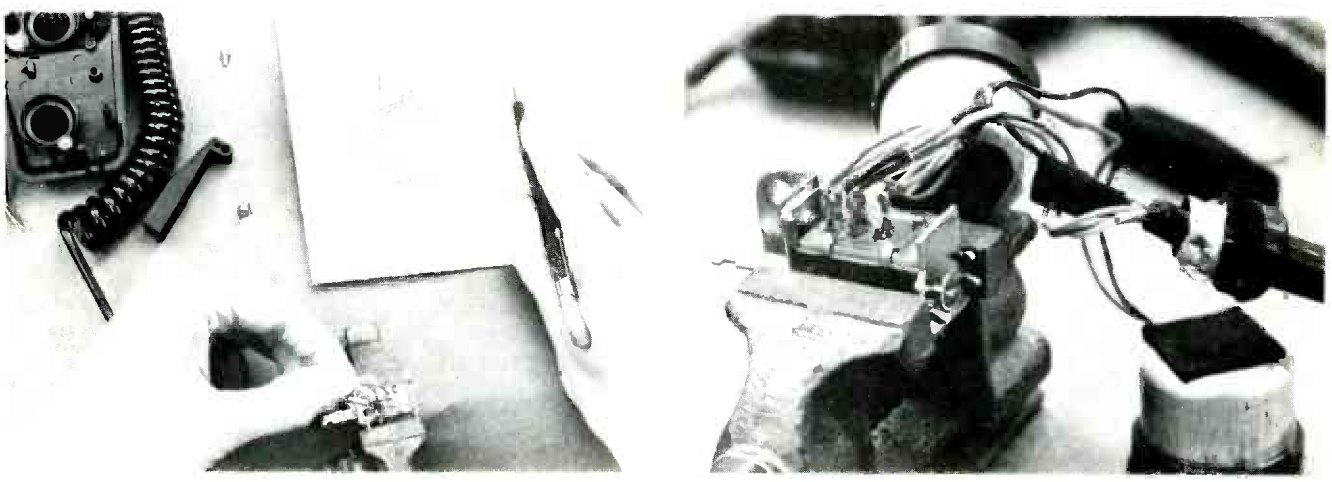


Fig. 1 A hidden break of a wire at the terminal block inside a microphone does not require a new cable. Merely unsolder the open wire, clip it just behind the break, re-strip, and re-solder to the terminal.

Cases of "no keying," in which you squeeze the microphone button but the transmitter doesn't come on, can be checked out a bit further. Open the microphone case, exposing the wires. Hold the mike button down. With a jumper clip, short together the two wires that connect to the keying contacts on the mike switch. You might have to examine the transceiver wiring diagram to know which wires they are. Simple relay-keying systems typically use the red and black wires for keying. With electronically keyed transceivers, it could be red and black or red and blue. (Keying never involves the white wire. We'll show you much more about keying in the second of this two-part article series.)

Suppose jumpering at the mike doesn't key the transmitter. Unplug the mike. Again referring to the



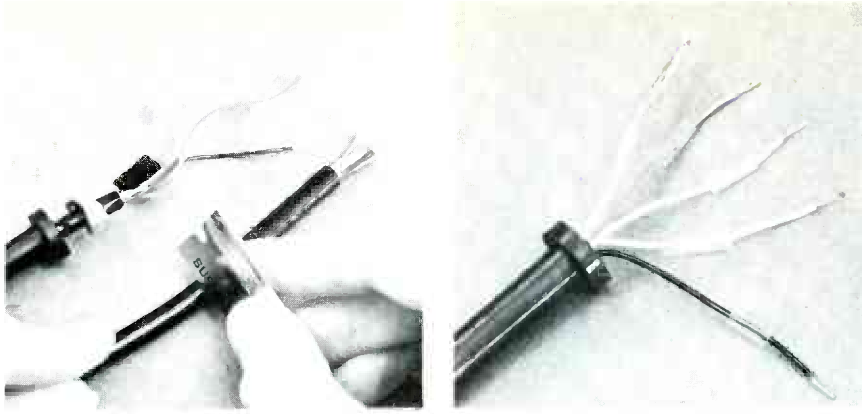
(A) (B)

Fig. 2 Always make a diagram of colors and connections before you disconnect the old cable (A). Also, you might find it saves time to remove some components (B) from the mike shell.

transceiver diagram, jumper together the transmitter keying pins at the mike jack, or the keying wires inside the set. That should key the transmitter if the fault lies in the cable or connector. If it doesn't, then service the transmitter.

A similar technique works with "no modulation" cases. (Subbing a known good mike would be quick; but you may not have one of the right type handy and with the right connector.) Inject about 1-volt RMS of 1000-Hz audio signal on the white wire inside the mike; the shield is ground for this. Squeeze the push-to-talk button. No modulation? Make some provision for keying with the mike unplugged; the jumper just described will do. Inject the same audio signal at the mike input jack (or inside the transceiver where the white mike wire connects). Still no modulation? Diagnosis: the transmitter has a defect.

That should give you the idea. Just remember one factor, however. You'll find a dozen different connector configurations used with CB microphones. Mike cords may have three, four, five, or even six conductors, some or all of them in use. Whatever you do, when the fault doesn't yield readily and quickly to the tests just described, **get the transceiver and microphone schematics.** You can't do an intelligent troubleshooting job without them.



(A) (B)

Fig. 3 Prepare the new mike cable by stripping away about 3 inches of outer insulation (photo A). Slice ¼-inch of insulation from the wire ends (B), tin the ends, and transfer the insulating sleeves from the old to new wires.

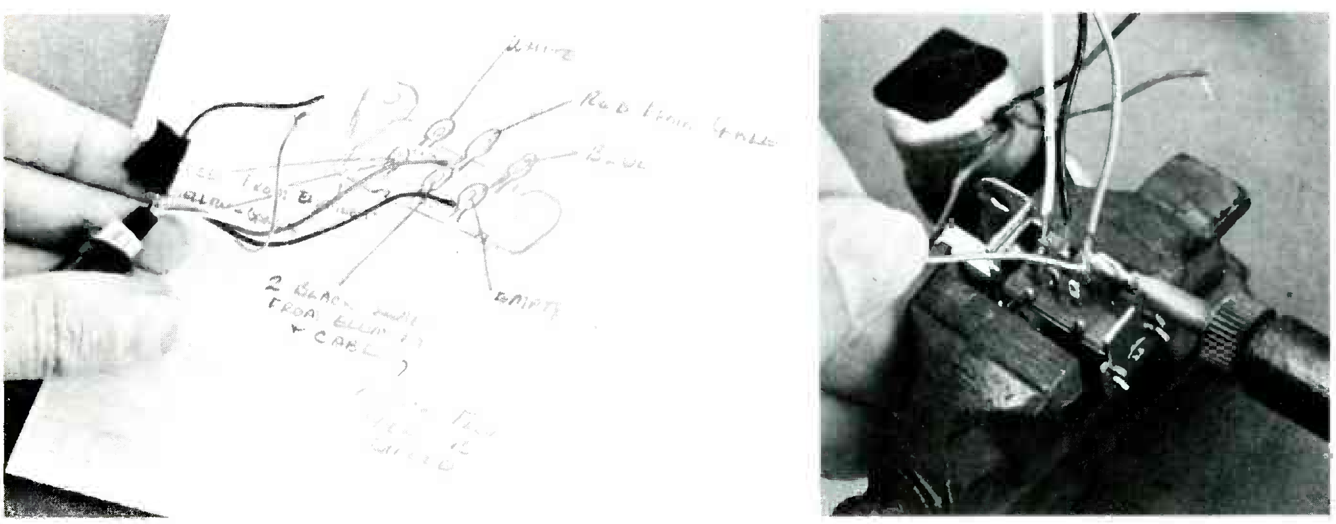
Making Short Work of Cable Repair

Rule one: Pick a replacement cable with the right number of conductors. Of course, you can work with one that has more wires than required. But it might confuse your wiring; and the diameter might not fit the connector as it should. Moreover, check to make sure the right wires are shielded. Color of the shielded wire won't be critical, because you can figure out the new color scheme. Usually, though, white has the shield.

Rule two: Select a replacement cable as long or longer than the old one. Be especially conscious of length in coil-cords, the so-called "retractile" cables. Some appear as long as the original, but won't stretch as far. Mike cables must withstand a lot of stretching; it's best if they don't have to be drawn out to their limits.

Rule three: Install a new connector at the transceiver end of the replacement cable. A worn cable suggests unseen wear and tear in the connector too. A new connector makes excellent insurance against callbacks.

Gather the replacement cable and connector, a soldering iron, solder, a wire cutter/stripper, a small clamp-type vise, plus pencil and paper. Lay the old mike and the replacement cable side-by-side



(A) (B)

Fig. 4 Before making new connections, match up the color codes with the diagram. Then, if the colors don't match, mark down the colors you assigned to the new cable. Keep as many as possible of the original colors (A). Check against the diagram as you solder the wires (B).

on your workbench. Carefully disassemble the mike so you can see how the old wires connect. With pencil and paper, record the pin numbering—if there is any. List which color conductor goes to each terminal.

As likely as not, you'll find a difference in color coding between the old cable and the new. **The most common mike cable contains three insulated conductors and one shield.** (The shield might, in a few cables, be replaced by a bare wire.) The conductors usually carry red, black, and white insulation. Yet, you'll find mikes with yellow, violet, green, and blue in the cables too—even in four-wire cords. There simply is no standard color coding.

However, for replacement mikes that we've used most (Turner and Telex), this coding seems to be the norm: White is for the main audio or mike-output wire; ground is a shield or a bare wire; a red conductor usually makes the relay connection which activates the tranmitter; and black is the return path.

But, sometimes the red connects to ground in the transceiver, along with the shield. In that case, the black conductor keys the transmitter relay. Or, black might key the transmitter electronically by completing its ground circuits when the mike button is pressed; the red wire is the receiver ground when you release the mike button. And from here the situation becomes hopelessly confusing. Variations abound, especially with electronic switching for the transmitter. Fifth and sixth wires perform special transmit/receive functions. We'll go into all of that in Part 2. You can see, though, why it's a great help if your customer thought to bring his transceiver schematic along. Or, perhaps you can find a similar one in the Sams PhotoFact CB Series.

You can manage for now with mike and new cable together on your bench. Remove the screws that hold the microphone halves together. For a handset, unscrew the mouthpiece to expose the wires. Make a diagram and notes of which wires go where (Figure 2). Sketch the mike, and list wire colors. Put the mike half with the terminal block or the switch in the small clamp vise. Or, remove the block or switch itself from the mike and clamp it in the vise.

The old mike wires might be encased in clear plastic insulating sleeves at the terminals. Slide those out of your way. They keep each connection insulated from the rest. You'll use these sleeves in a similar manner on the new cable.

Heat up the soldering iron thoroughly before you touch it to each terminal. Free the old wires quickly, and get that iron away from the mike as fast as you can. Overheating here could damage the mike element. Disconnect all of the wires.

Pick up one end of the new cable. Figure 3 illustrates how to prepare the cable end. Strip the outer covering back about 3 inches from the end. Transfer any insulating sleeves, grommets, and the like from the old cable onto the new cable.

Let the old wires be your guide while stripping insulation from the ends of the conductors. Some terminal connections require more (or less) bare wire end than others. If you leave too much, you introduce the possibility of arcing and shorts. If the strands of the wires aren't already tinned, do it now. Slide the clear plastic sleeves onto the wires after the solder cools. Push them back out of your way; you don't want to melt them when you resolder.

Solder the wires to the terminal block or switch. Start from one side and work toward the other. Match the wires according to your diagram and notes (Figure 4). Don't use too much solder. It can cause shorts, in such tight surroundings.

When all connections are firm, **verify that you've wired correctly.** Slip the insulating sleeves down over the terminals. Screw the terminal block back into the mike (if you took it out). Arrange the conductors and sleeves so they fit snugly in the mike shell with no pinching. Make sure the cable outer covering protects the cord where it clamps. Screw the mike housing back together.

At The Connector End

You can cure most mike problems in 15 minutes or less. And to make a profit, **you have to.** Take

(A) (B) (C)

Fig. 5 Mike connectors are manufactured in many different variations. (A) This one comes with the screw-adjustable strain relief assembled ready to be slipped over the cable before the wires are soldered. Another kind (B) must be assembled as you go. (C) After the parts are installed on the cable, the wires are soldered to the connectors. Soldering is quicker and less-susceptible to wiring errors if you hold the connector block in a vise or vise-grip pliers.

connectors as an example. Whether you're putting a connector on the end of a new cable, replacing a defective one, or adding the right connector to a new mike, the basics are the same.

You wired the mike end of the cable exactly as the old cord was wired. Right? Do the same at the other end—with a new connector, preferably. If you kept track of color coding, marking any changes between the old cable and the new, then transferring those alterations to the new connector should present no difficulty.

Remove the collar of the old connector, and expose the wires. Orient the notch of the old and new plugs to the same position, and clamp them both in the vise. Wire the new plug the same as the old, taking into account whatever color-code differences there were.

Strip the wire ends 1/8 inch, and tin the ends. Disassemble the new connector (Figure 5). Slide the shell and coupling ring onto the cable. Clip the ring into the shell with the snap-ring. (If the cable was pre-trimmed, the conductors might be too long, and difficult to thread through the shell. Twist the conductors together before you poke them through the connector shell.)

Heat up your soldering iron. Measure the tinned tips of the conductors. Snip off all but 1/8 inch of each. Clamp the pin insulator in the vise.

With your wiring data at hand, slip the conductor tips into the holes in the proper connector terminals. Solder each wire to its terminal, but go easy on the amount of solder. When you leave a wire not connected (NC), cut off the bare tip so the wire remains fully insulated. If two wires go to the same pin, tin the bare ends together, and solder them as one wire to the pin.

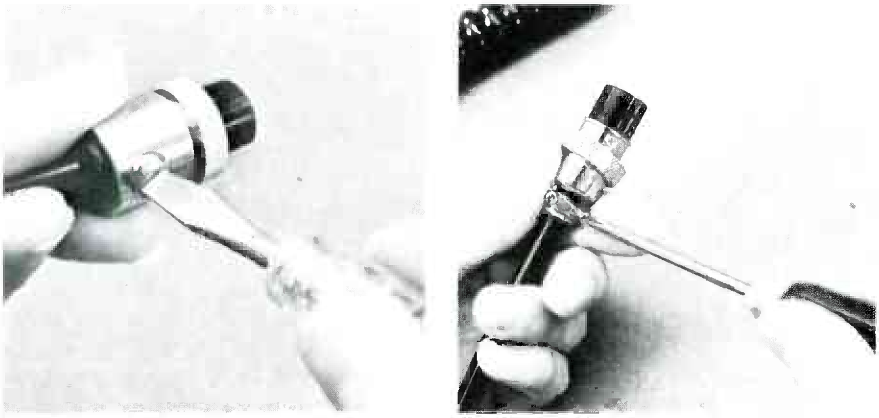
Tug on the joints, after they've cooled, to see that the connections are solid. Slide the body of the connector down onto the pin insulator. Screw them together (Figure 6). Tighten the strain-clamp screws.

Next Month

What do you do when a mike comes to you in pieces? You can't compare old with new. Color coding may be different. We tell you in Part 2 how to "trace" what goes to what.

Then comes that full explanation we promised you on the three ways modern CB transceivers are switched from receive to transmit, and back again. You need to know that so you'll recognize what kind of microphone a transceiver takes. Also, you'll see how to interchange mike types and styles.

Finally, we take you through some quick symptoms and cures which are all intended to help you make money when repairing microphones. It can be fast and easy! ☐



(A) (B)

Fig. 6 After the connectors are soldered and assembled, take these precautions to prevent shorts or an early failure. (A) Tighten the connector screws snugly, but don't use so much force that the threads are stripped or the insulator body is broken. (B) Don't squeeze the strain-relief so tight that it bites through or smashes the insulation.

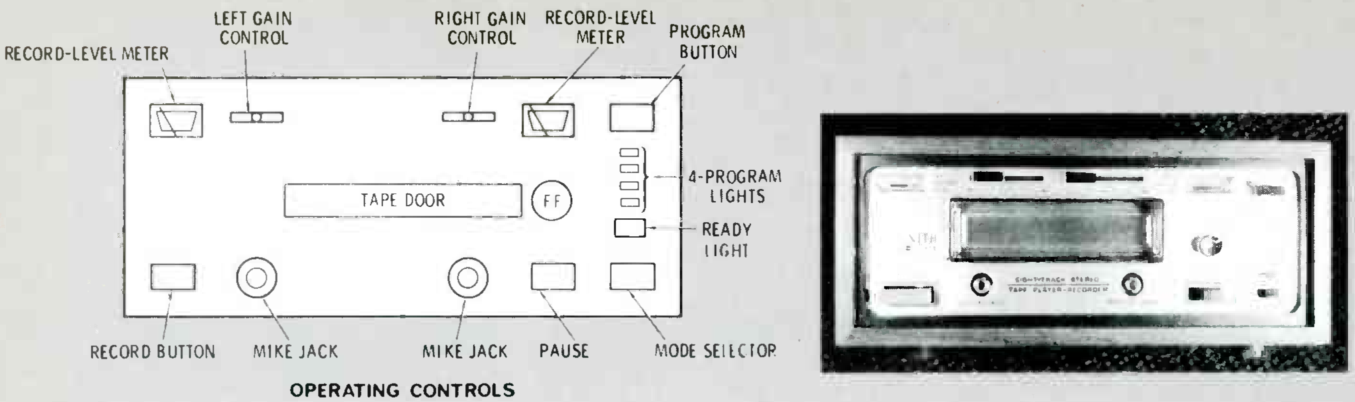


Fig. 1 The Zenith Model F638 is a deluxe tape deck (no power amplifiers) that both plays and records in stereo using 8-track cartridges. Meters show the recording level, lights indicate which of the four stereo programs is operating, and a "fast-forward" button switches in another motor winding that gives a faster tape speed. AC bias reduces the noise level and distortion during recording.

Theory And Repairs Of Stereo-8 Tape Machines

By Robert L. Goodman, CET

The "old Pro" gives good advice about 8-track tape machines in general, and specific servicing tips about the Zenith Model F638 tape deck.

Troubleshooting and servicing tape machines demand both mechanical and electronic skills. Of course, these opposite requirements can be learned separately, but there are distinct advantages in knowing the entire machine. Therefore, we are going to give some of the basics plus a description of one specific tape player/recorder, the Zenith Model F638, as an example of practical servicing.

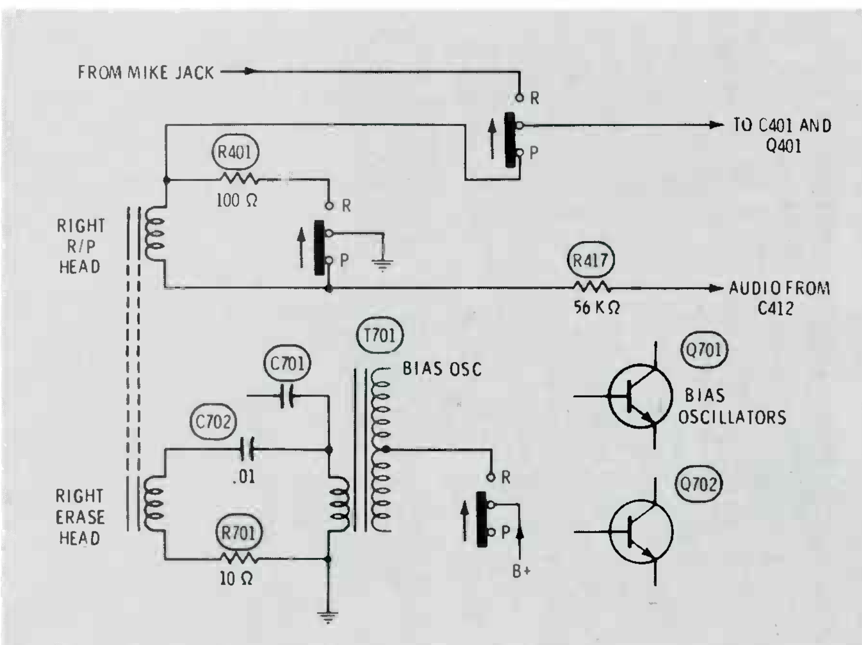


Fig. 2 The bias-oscillator transformer is wired permanently to both of the erase windings in the combination record/play/erase head. During playback, the supply voltage is removed from the bias-oscillator transistors. Internal magnetic coupling between the erase and R/P parts of the head feeds sufficient bias signal to the head during recording. One end of the R/P head goes to the input for play function, and the other end is fed audio through R417 for recording; the switching grounds the unwanted end of the head. In addition, another section of the switch feeds either the microphone or head output to the pre-amplifier.

Electronic Background

Most of the unique electronic circuits in tape recorders are necessary because of the **magnetic** recording and playback heads. The strength of any magnetic field depends on the core material and the number of turns of wire versus the current. That's why the heads in tape machines primarily are driven by **current** during recording. A magnetic field that is uniform for all audio frequencies of the same amplitude requires identical current. This is commonly called "constant-current" recording.

Constant-current recording

Although it sounds complicated, obtaining a constant AC current for all frequencies is easily done. The recording head (which has an impedance that rises evenly with increasing frequency) is driven by a voltage source through a fixed resistor of perhaps ten times the impedance of the highest frequency that's to be recorded. Therefore, the total impedance of resistor plus head only varies about 10% over the required audio band. When driven by a flat-response voltage, the head receives the same AC current for all frequencies.

No circuit gives something for nothing, and here much of the voltage is lost in the resistor. But the head requires very little voltage, and total voltage can be obtained without difficulty.

Cure for distortion

From the preceding condensed explanation, it would seem that to have a tape system would require an amplifier to drive the head and a mechanism to move the tape. Then, just reverse the process for playback, with the output from the head feeding an ordinary audio amplifier. It's simple; nothing to it!

Unfortunately, **such a primitive system would emit very high playback distortion, along with low volume and insufficient bass response!** We'll discuss each of these in turn.

Engineers finally discovered that "hysteresis" of the magnetic material was causing the distortion. Briefly stated, the magnetic field does not trace the same curve when increasing in intensity as it does when decreasing. In other words, it is magnetic non-linearity.

Over many years, various methods of solving the problem were developed. Today, there are two practical ways. Both operate by keeping the magnetic field from ever reaching zero.

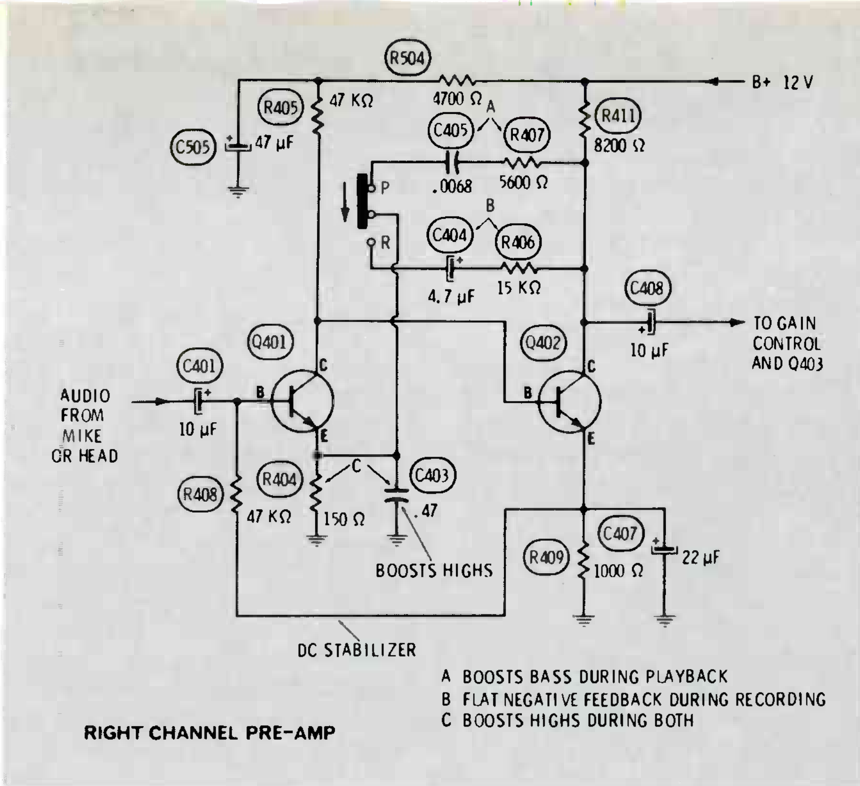


Fig. 3 Amplification and frequency compensation are functions of the 2-transistor pre-amplifier section. C403 bypasses the emitter of Q401, boosting the treble by reducing the emitter degeneration at high frequencies. In addition, the bass is boosted during playback by the values of C405 and R407 (A). DC stabilization of the direct-coupled stages operates by taking the base DC voltage for Q401 from the emitter of Q402. Each channel has a pre-amplifier.

DC bias

The cheap, dirty way is to run a DC current through the head along with the AC signal current. Well, the distortion is minimized alright, but at the expense of a huge amount of "tape" noise. Often the

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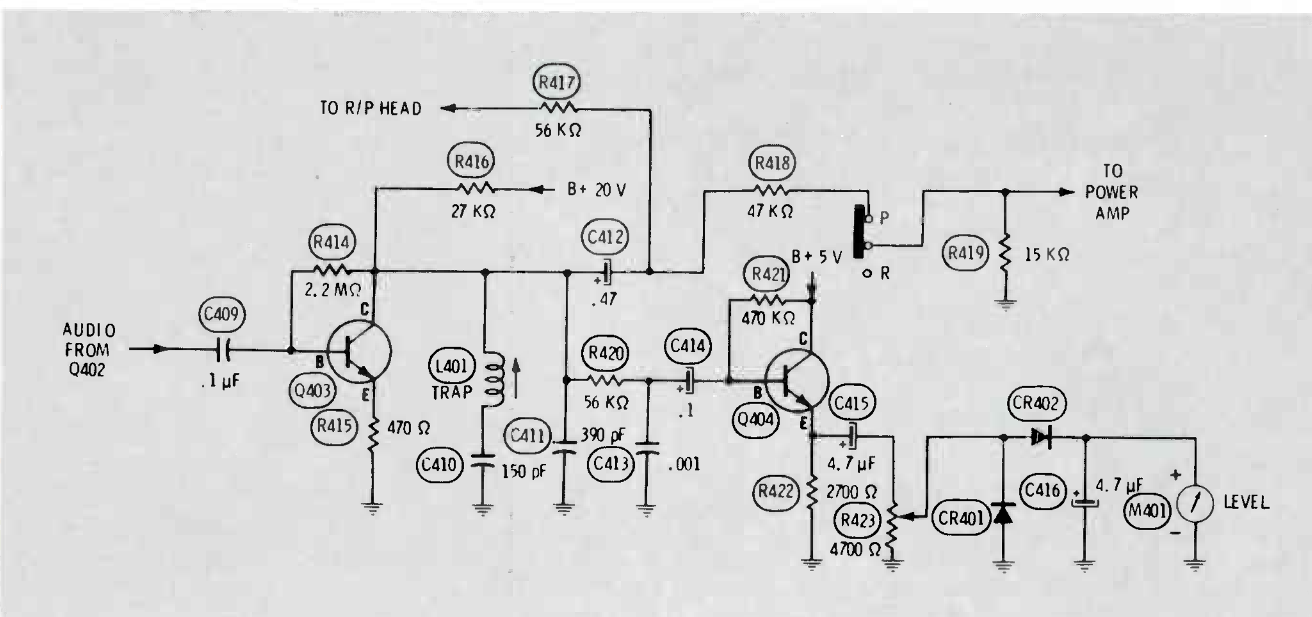

Fig. 4 Q403 is a simple amplifier with a tuned trap (L401 and C410) at the collector to remove any bias frequencies coming back from the head through R417. Output of Q403 goes to the head for recording (through R417), to the external power amplifiers (through R418), and to the emitter follower, Q404, which drives the meter rectifier and the recording meter. A similar circuit is provided for the other stereo channel.

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noise is similar to and larger than that from a worn phonograph record! Even so, today some "low-priced" machines are built with DC bias, as it is called.

AC bias

A better solution is to add high-frequency pure sine waves (that's redundant; a sine wave is pure by definition) directly to the recording head. The experts are not certain how this reduces the magnetic non-linearity, but the results cannot be argued. A well-designed AC bias circuit can reduce the distortion to a very low figure.

Notice one important fact: the audio signal and the AC-bias signal are **NOT** mixed together in a fashion similar to the oscillator/mixer function of a superheterodyne radio, which gives sum-and-difference frequencies. Non-linearity can not be tolerated. That's probably why the AC bias **never** is added to the AC recording signal in a previous tube or transistor amplifier stage.

Also, the AC bias permits recording with more current (louder sounds), and this increases the maximum volume of tape systems.

No bass

For an explanation of the lack of bass in our primitive system, we need go only to the characteristics of inductances. The playback head inductance rises with increasing frequency. So, the playback head is efficient only at the higher frequencies.

We are ignoring other minor sources of poor frequency response (such as the width of the gap in the head, and the effect of the tape speed). In an actual record/playback system that has no frequency compensation, the extreme high frequencies roll-off, also.

That previous sentence tells us what must be done to obtain a tape system of acceptably-flat frequency response.

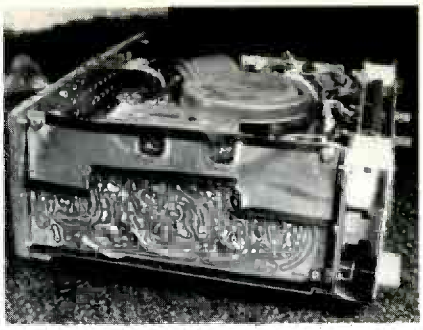


Fig. 5 One large circuit board holds all of the transistor stages. A second board contains the power-supply components and the relay.

Compensation

The frequency response of a

The Eight-Track Cartridge

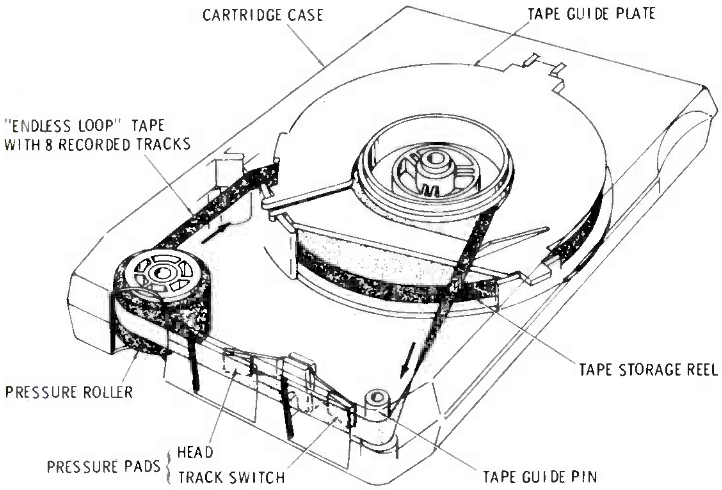
Eight-track tape cartridges (sometimes called Stereo-8) all conform to the specifications of the original Lear-Jet cartridge. The endless tape is wound on a single internal reel, and the tape does not leave the cartridge. Three cutouts at the rear of each cartridge allow the track-change contacts, playback head, and capstan drive to protrude into the cartridge, making contact with the tape.

Four sets of stereo tracks are recorded on each tape, making necessary some kind of mechanism to select the desired track. A strip of metal foil is attached to the tape at the point just preceding the start of the music, and it shorts between two contacts to act as a switch that starts the track change. Each time the foil closes the circuit continuity, the mechanism moves the playback head to the *next* set of stereo tracks. Most machines also provide a manual-change switch.

All the tape is wound on a single internal reel, with the tape leaving at the hub (inside of the tape pack) and arriving at the outside. No power is applied to the reel. When the cartridge is inserted into the player, the capstan of the player mechanism contacts the pressure roller that's a part of the cartridge, pinching the tape in between. This is the only power that is applied to the cartridge. Also, the internal spring-mounted pressure pads keep the tape tight against the head and the track-change contacts.

Rotation of the capstan and roller pulls the tape from the center of the pack on the reel (by way of the head, track-change contacts, and the corner guide pin). That rotates the reel, which in turn winds the tape from the capstan around the outside of the pack on the reel. The tape is a special kind, designed for minimum friction; each layer of tape slides against the next layer.

Because there are eight narrow magnetic tracks on tape that is only 1/4-inch in width, extreme accuracy of cartridge and head positions must be maintained to prevent crosstalk (music of one track being heard faintly on another).



Courtesy of Howard W. Sams,
from **1-2-3-4 Servicing Automobile Stereo** by Forest H. Belt.

Fig. 6

simple record/playback machine is deficient in both high and low frequencies. The solution is to incorporate frequency-boosting circuits to strengthen both highs and lows.

Generally speaking, the extensive professional machines record with boosted high frequencies, and play back with boosted bass. Cassette and cartridge machines that operate at slow tape speeds often require some high-frequency boost during playback, as well.

If our machine never was required to record again over a section of tape, then it would not require any more circuits or functions. The statement applies to playback-only machines. All others need some device to remove any previously-recorded tracks. That's the function of the "erase" circuit.

DC or AC erase

A magnetic field (either DC or AC of higher intensity than the one used to record) can erase previous recordings. It is applied by a separate magnetic field from that used during the recording.

Some simple cassette machines merely move a permanent magnet into contact with the right part of the tape. Others have an erase head, but it has only a DC current through it. Best of all are the machines which have a separate erase head supplied with a high-amplitude sample of the same signal that is used for AC recording bias.

A workable tape system

Although the actual circuits are more complicated than we have indicated, the previous basic building blocks, plus the switching, are all that are necessary for satisfactory record/playback operation.

Next, we'll describe the amplifiers and heads of the Zenith F638, pointing out the basic circuits already described.

Zenith Electronic Circuits

The Zenith Model F638 is a deluxe-type 8-track (sometimes called Stereo-8) recorder/player for home use. It is complete except for the power amplifiers, which usually are part of a component system (Figure 1).

Head wiring

Machines designed for playing tapes only do not need an erase head. And the 8-track cartridges don't have room enough for extra heads. So, the Zenith combines the record/play head and the erase head in the same housing. The schematic of the windings for one stereo track are shown in Figure 2, along with the record/play head switching and part of the erase circuit.

Notice that the erase head has some magnetic coupling to the record head. Enough signal for proper recording passes through without any visible path. During playback, the supply voltage is removed from the bias-oscillator transistors. Other machines feed a little supersonic bias signal through a small capacitor (often adjustable) to the record head.

The same head winding is used for both recording and playback, by having the R/P switch ground one side or the other. The 56K resistor (R417) feeds audio AC voltage to the head during recording. (Remember the "constant-current" requirement?)

Pre-amplifier stages

Two transistors are used in each channel (left or right) for pre-amplification and frequency compensation (Figure 3). Notice that the components that provide compensation are marked.

C403 bypasses R404, the emitter resistor of Q401, at high frequencies, but it is ineffective at low frequencies. Therefore, the values chosen allow Q401 to have more gain at high frequencies, and this boost is provided both for recording and playback.

Two alternate pairs of series R/C circuits between the collector of

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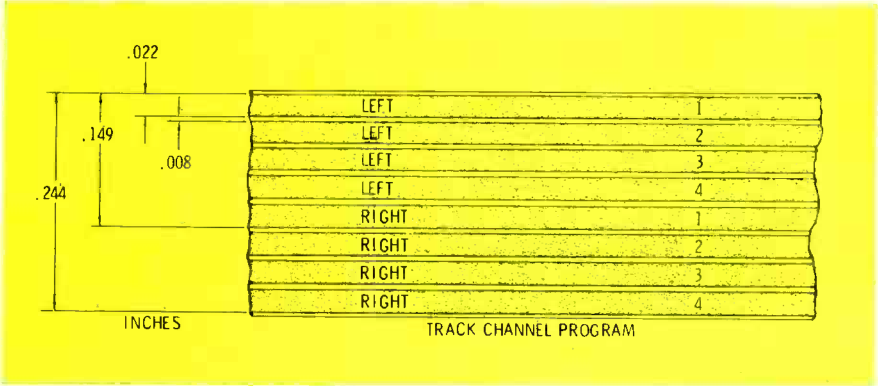
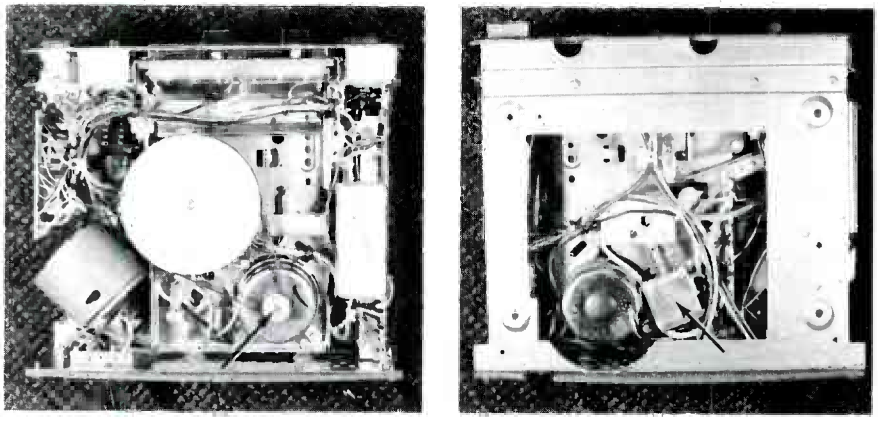
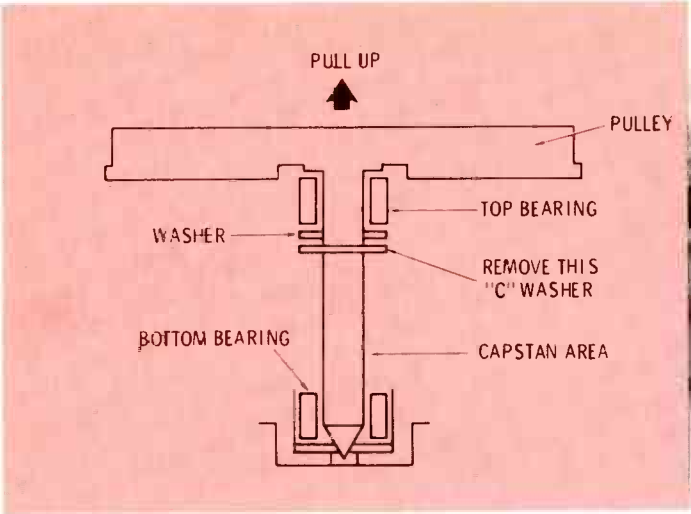


Fig. 7 Eight tracks, which are used as four stereo pairs, are recorded on the ¼" tape. Track 1 and 5 are the left and right stereo tracks of Program 1, tracks 2 and 6 are for Program 2, etc.



(A) (B)

Fig. 8 On these pictures of the Zenith F638 tape deck, the front panel is at the top. The audio board is on the right (A), and the rectangle next to it is the bias module. The motor (arrow), belt, and flywheel should be recognizable near the bottom-center. The object at the left-bottom corner is the magnetic shield that surrounds the power transformer. In picture (B), an arrow points to the solenoid which activates the track-change mechanism.



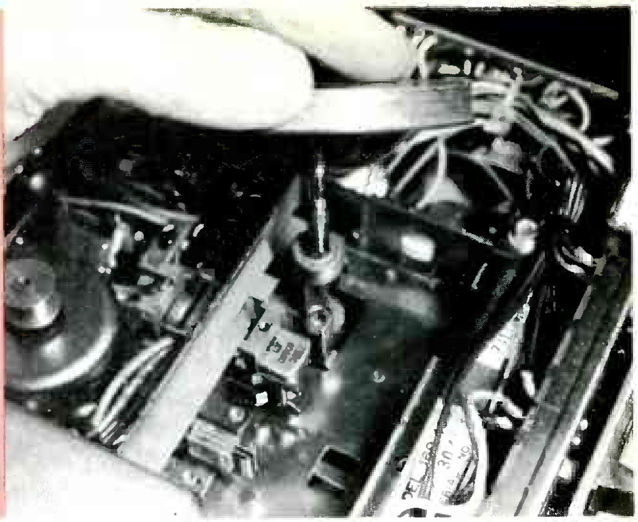


Fig. 9 The flywheel/pulley assembly must be removed to reach the head. First, remove the "C" washer (drawing) and the belt, then lift up on the assembly, as shown in photo.

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Q402 and the emitter of Q401 determine the bass response. The record/play switch selects either R406 and C404 during recording (these values give negative feedback having flat response), or R407 and C405 for playback. The C405 capacitor is small so the capacitive reactance increases at bass frequencies, thus decreasing the negative feedback there and increasing the gain. In other words, these values give playback bass boost.

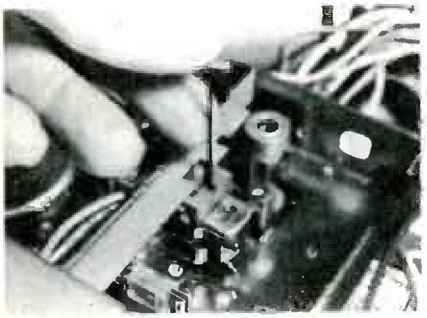

Fig. 10 An Allen setscrew secures the head in position.

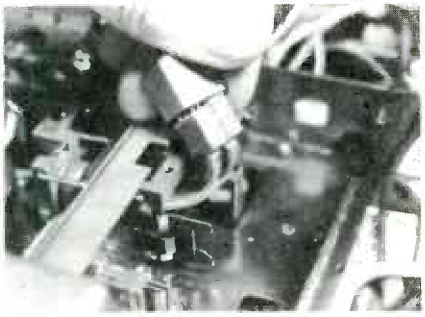

Fig. 11 Wiring of the head is through two connectors (no soldering).

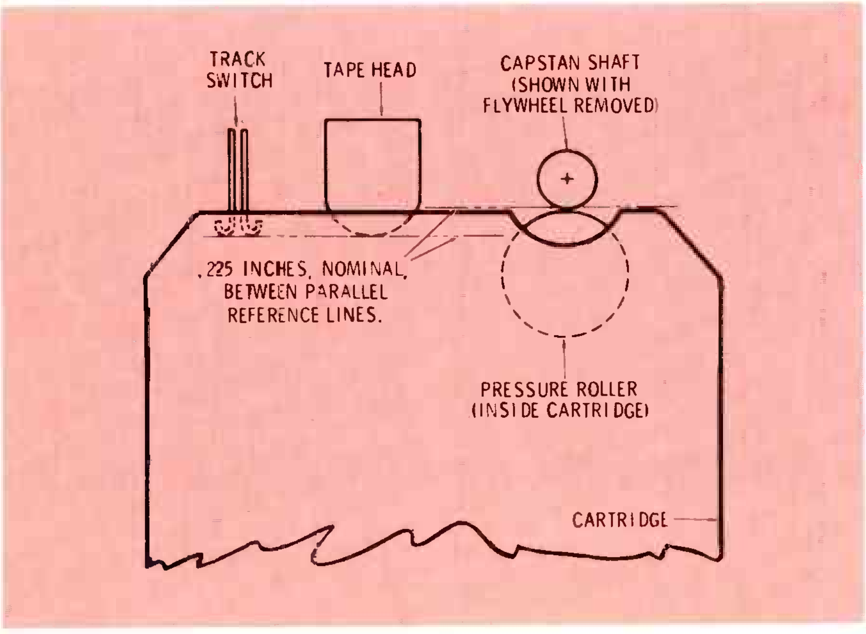

Fig. 12 The head should extend into the cartridge by approximately 0.225 inch. Notice that the track switch and the head are in line.

Direct coupling is employed between the collector of Q401 and the base of Q402. Therefore, good DC stabilization is needed. It is provided by obtaining the base voltage for Q401 from the emitter of Q402. Suppose Q401 begins to draw more current, perhaps because of an increase of heat. The collector voltage of Q401 (and the base voltage of Q402) decreases. Of course, the emitter voltage of Q402 "follows" the base and decreases. This is the source of the Q401 base voltage, so the bias of Q401 is reduced. The lower base bias decreases the collector current of Q401, nearly restoring the original collector voltage.

Amplifier and meter

Figure 4 gives the amplifier circuitry beyond the volume control. Q402 is a simple amplifier, with the base bias obtained from the collector to provide single-stage stabilization.

L401 and C410 are a series-tuned trap which removes any bias high-frequency signal coming through R417 from the head. In addition, R420 and C413 filter out the remaining bias signal so it does not read on the recording-level meter.

Audio from the collector of Q403 goes to three destinations. R417 feeds the signal to the head during recording (that end of the head is grounded during playback). Part of the signal goes through R418 to the external power amplifier for that channel, and the audio also feeds the base of Q404 through R420.

Q404 is operated as an emitter-follower, with the emitter feeding a full-wave peak-reading rectifier circuit (C415/CR401 and CR402/C416), which in turn drives the recording-level meter, M401. A control is provided to vary the sensitivity of the meter circuit.

One of the two circuit boards is shown in the side view of Figure 5.

Tape And Mechanism

Stereo-8 tape cartridges are a special kind of endless-loop device, as explained in Figure 6. Each cartridge has a pressure roller, spring-loaded pressure pads, and a single reel with the tape (which leaves at the hub and is wound on the roll at the outside). Of course, the capstan drive and magnetic head are a part of the mechanism.

Across the width of the ¼" tape are eight tracks (see Figure 7) arranged in four groups of stereo tracks. One of the complications of this kind of machine is that the head must be moved vertically so the two gaps trace down the exact center (as accurately as possible) as the tape is pulled past the head.

When the endless tape approaches the beginning of the music of each track, a piece of metal foil on the tape bridges the contacts of the track switch. This energizes a solenoid which rotates a collar having four steps; each step positions the head vertically for one program of music. Thus, the machine should play the music programs consecutively and continuously until turned off. A manual track-change switch usually is provided also.

I'm sure you appreciate the need for precision adjustments and workmanship here. With four pairs of stereo tracks across only ¼", a very slight looseness of the head mounting or of the lifting mechanism can produce some sour music.

The Model F638 Zenith now will be described. continued on page 42

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Preliminary Tests

The first step for adjusting or repairing any 8-track machine is to attempt to operate it in normal fashion. One of the typical "defects" is a malfunctioning cartridge that has jammed and stopped the movement of the tape. Sometimes this can be seen, after you remove the cartridge. Or, the tape might have become wound around the capstan shaft so it is difficult to remove the cartridge. A third possibility is a cartridge that's jammed internally.

For these reasons, you should keep handy a tape which is known to operate okay. It should not be a test tape, but a conventional one with music. Caution: don't use a tape that you value; suppose the mechanism is breaking the tape, or ruining it in some way?

If the tape seems to move properly try the track-change switch to see if it brings in the next musical selection. Listen to all four programs, noticing any wow, flutter, distortion, noise, weak channel, or crosstalk.

Change to another tape and try to record on both channels (if the machine has that capability, as the Zenith does).

One or more of these operational tests should fail to perform properly, thus giving you a clue about where to begin.

For most repairs and adjustments, you must remove the tape machine from its cabinet (Figure 8 shows top and bottom views of the Zenith).

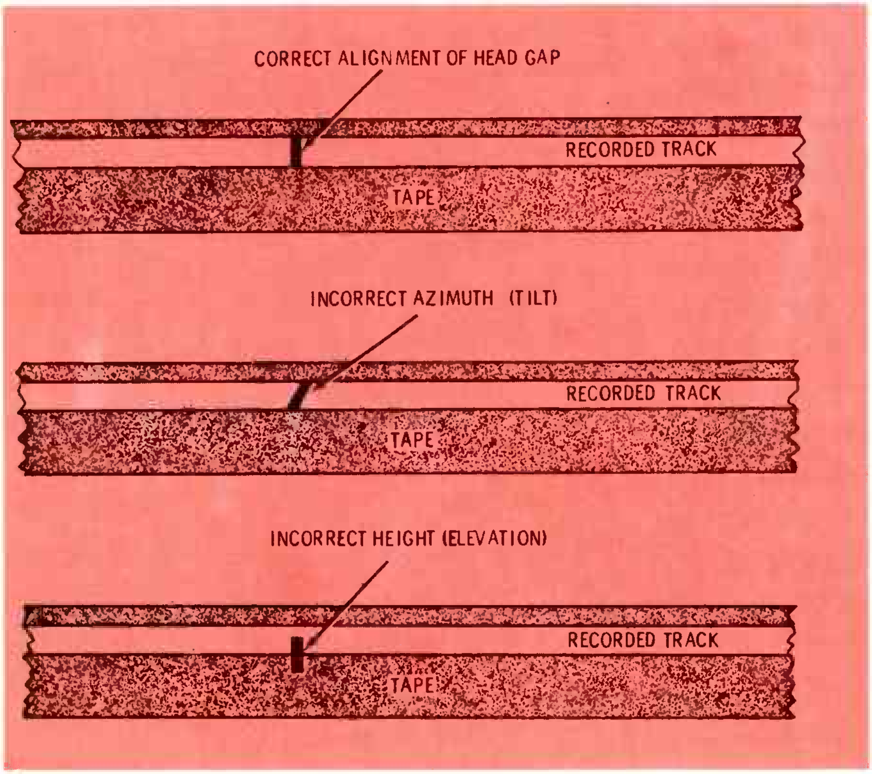

Fig. 13 An incorrect azimuth adjustment reduces the high-frequency response. A wrong elevation does not affect the frequency response or the distortion, but it reduces the volume, and an extreme error might move the head gap enough to cover part of an adjacent track. This music from the wrong track is called "crosstalk".

Fig. 14 Cartridge test tapes help you make head adjustments faster and with better accuracy; we highly recommend them.

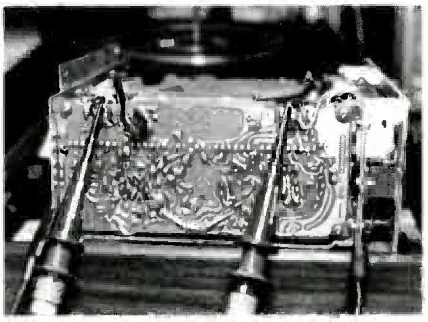

Fig. 15 Attach the scope probes here for the output signal to the external amplifiers. Dual-trace operation gives a more accurate comparison of the two signals.

Mechanical Adjustments

Eight-track mechanisms are unique because of several functions they do not have. For example, the tape is endless, and so it is never rewound. That eliminates many components and adjustments.

It's not necessary to provide any mechanism for moving the heads away from the tape (as is done with cassettes), for the entire cartridge is inserted and removed by the person operating the machine. Even the traditional on/off switch has been eliminated. Instead, a snap-action switch turns on the 120 VAC power when the cartridge is completely seated. Incidentally, this prevents any flat spots on the pressure roller.

On the other hand, the head must move vertically to match the four sets of stereo tracks, and this requirement probably is more critical than any adjustment on a reel or cassette machine.

Head replacement

Head adjustments must be made: as tests; whenever a mechanical part has been changed; or after a new head has been installed. So, rather than repeat the sequence of head adjustments for each type of problem, we will give a worst-case example: head replacement and a description of **all** adjustments.

In this Zenith machine, the flywheel/pulley and capstan shaft assembly hides the head from the top. Therefore, it's necessary to remove the pulley first, as shown in Figure 9.

Next, remove the Allen screw that holds the head in the block (Figure 10), and slide the head out towards the front.

This head is fitted with plug-in cables, so they should by removed from the head. Install the plugs on

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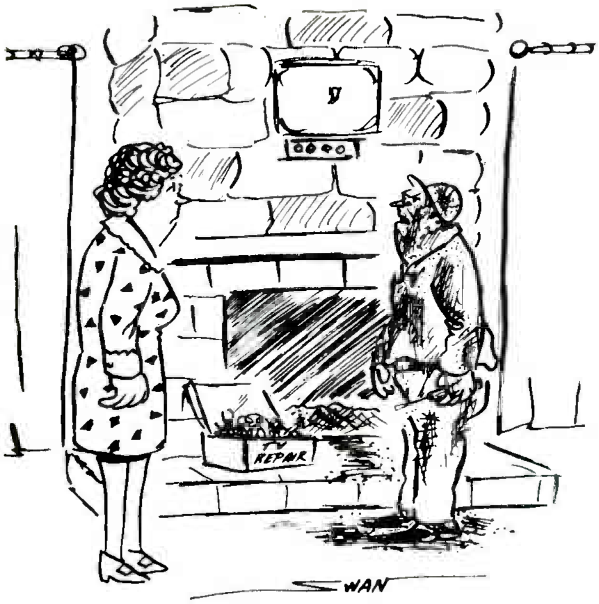
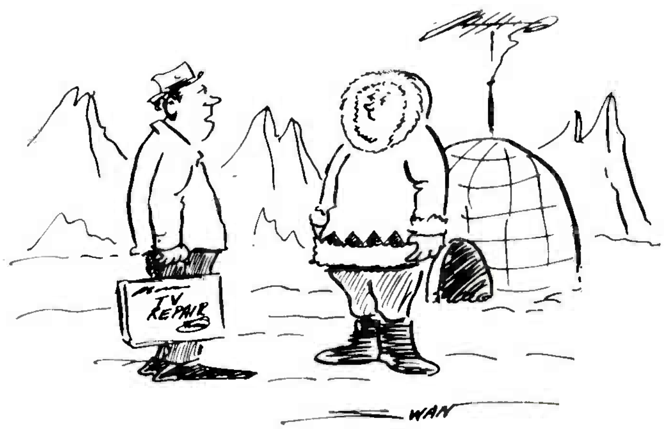
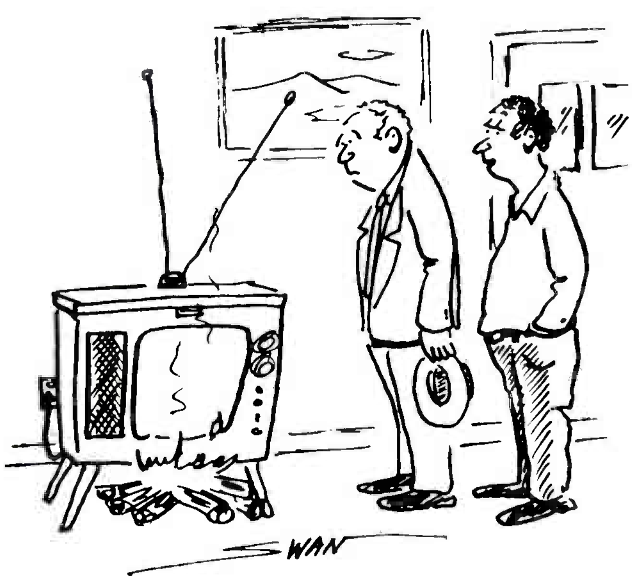
CARTOON CORNER



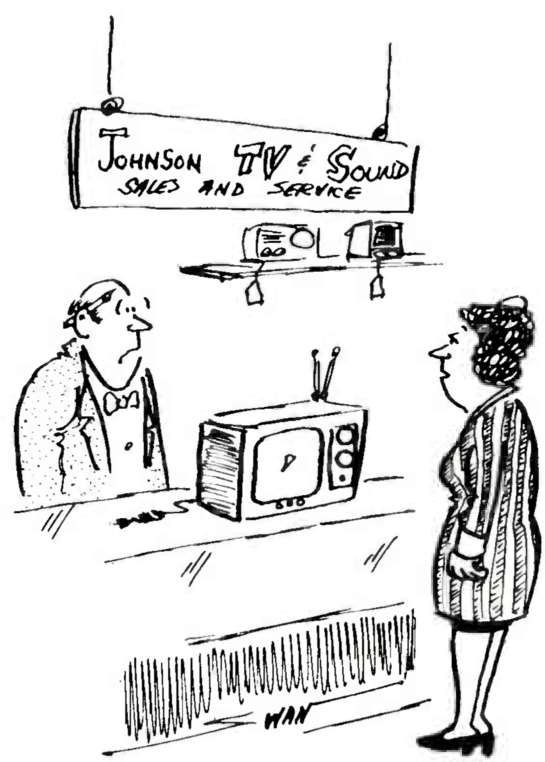
"Whose idea was it to have the set built into the fireplace?"



"You called about getting a snowy picture?"



"That model takes awhile to warm up."



"My husband says the trouble is in the rabbit ears because the picture hops up and down.

Reports from the test lab

By Joe A. Baldaczar

Each report about an item of electronic test equipment is based on examination and operation of the device in the ELECTRONIC SERVICING laboratory. Personal observations about the performance, and details of new and useful features are spotlighted, along with tips about using the equipment for best results.

Fig. 1 Three of these CB instruments by Hickok are reviewed this month. The function (audio) generator and the semi-conductor tester have been reported on before.

Hickok CB Test Equipment

Hickok, already well-known for quality TV/radio test equipment, has assembled an impressive array of instruments for CB-radio servicing. Seven items of test equipment (including the regulated power supply) are shown in Figure 1 assembled into a standard relay rack. Probably that's the reason for the identical width of each.

But the smaller units each have a combination handle and stand, so one can be used alone on a bench. Or, you might stack them (Figure 2) according to your needs. Although these units apparently have been designed to form a complete set when used together, the individual instruments can be used in combination with ones you have already. In other words, they are "mix-or-match".

For our evaluation, each will be considered as an individual.

Model 244 DC Power Supply

The ideal power supply for bench testing a CB transceiver should:

- be operated from 120 VAC without batteries (that require maintenance and present problems from corrosion);
- have low ripple to eliminate hum in the radio;
- operate over a range of perhaps +10 volts to +14 volts with the precise voltage determined by a variable control;
- maintain the selected voltage regardless of load changes;
- have a meter for reading both the voltage and the current; and
- preferably be moderately small physically.

The Hickok Model 244 power supply exceeds all of these requirements. I am a bit of a fanatic about power supplies, because I have seen so many cases where technicians suffered severe extra problems because of inadequacies of the supply voltage. For example, a tech might use an old-fashioned battery eliminator which has inadequate filtering and poor regulation, and then wonder why his voltage readings are all wrong, the RF output is low, and the radio has excessive hum level. In addition, some voltage supplies can ruin solid-state devices because of a strong transient that occurs during the radio switching from receive to transmit, or vice versa.

Specs

According to the instruction manual, the DC voltage is continuously variable from +10.5 to +14.5, with the regulation between +10.5 and +13.8, equal to or better than 0.1% with line-voltage changes of ±10%. Also, the regulation between those voltages should be equal to or better than 0.5% from zero current to 3 amperes DC.

What do those figures mean to you? Well, in actual servicing they mean you can set the voltage for +13.8 volts (the correct voltage for RF power-output measurements) and the voltmeter will hardly flicker enough to see it move when the radio is keyed to transmit, or when the TV man at the next bench turns on one of the old color sets. That excellent regulation can prevent some wrong measurements or extra knob twiddling!

The same observation applies to the hum and noise from the supply. Specs say it should be 10 millivolts (or less) at 3 amperes of load. That's only 0.01 volts, which is too small to be of any consequence.

Overload protection

Although the Model 244 has a 1½-ampere slow-blow fuse in the primary circuit of the power transformer, it has a more modern protection against excessive load current. The regulating circuit has a feature called "foldback".

Suppose the supply has a dead short across it (Figure 3). The output voltage drops to almost zero, the current is about 1.4 amperes, and the overload light on the panel is illuminated. As shown, a piece of solder was connected across the output and left there for 15 minutes. Nothing ran hot (perhaps partially because of the large heat sink for the series-pass transistor on the back, as shown in Figure 4). When the short was removed, the voltage recovered immediately. It's performance like this that justifies the price tag!

Metering

A two-position switch changes the single meter from DC volts to DC current. The current scale is conventional, with the area above 3 amperes shown with a red block.

But the entire arc of the DC voltage scale occupies only from +10.5 to +15.5 volts (Figure 5). In other words, the scale is **expanded** to give accuracy and ease of reading.

Also, the recommended voltage for measuring power output is marked with a red line and 13.8 in red; another convenience.

Three 5-way binding posts are provided for the output. Two are for the positive and negative. The third is marked "GND" and it is connected to the metal case of the power supply and to the third (ground) plug of the AC input plug. The supply can be operated either with the negative and ground connected together, or the ground can be left floating.

Model 388 In-Line Digital Tester

Three-function CB testers are not rare. The Hickok Model 388 tester has **four** functions, plus other features that make it unique. It tests CB output frequencies, power output in two ranges, Voltage Standing-Wave Radio (VSWR), and modulation percentage. Also, no manual adjustments, such as calibration or balancing, are needed. Equally important is the convenience of having all four functions read-out on the 0.3-inch LED display.

Frequency counting

With the Model 388, frequencies can be counted in two different ways. In Figure 6, it is pictured measuring the Channel 8 frequency of a Model 256 generator, using a short cable between them. Or, a direct/X10 probe could have been used for measuring internal frequencies of a transceiver. A minimum of 100 millivolts is required for the front-panel counter input (selected by the "INPUT" pushbutton), and this function is for general frequency measurements between 10 Hz and 55 MHz.

However, a more convenient and faster way is provided for reading frequencies of the transmitter RF output signal. While the cables remain connected to the tester by the through-line loop on the back of the tester (Figure 7), only a few seconds are required for the digital-readout frequency check. About 1 watt of **unmodulated** carrier is needed for an accurate reading by this method.

In addition to the speed of reading, another advantage of the loop-through pickoff is that the circuit is compensated for best results in the 27-MHz range. Although frequencies between 10

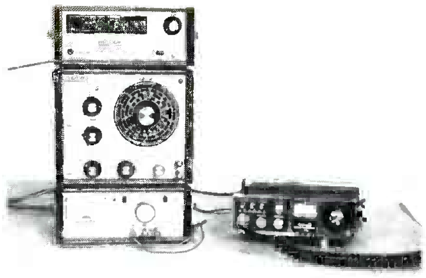


Fig. 2 The units can be stacked one above the other, if desired.

Fig. 3 A piece of solder connected as a short across the output terminals of the Hickok Model 244 power supply caused no damage, and the current drain was about 1.4 amperes. This short-circuit protection is part of the voltage regulator.

Fig. 4 A large heat sink on the rear of the 244 easily dissipates the heat from the 2.5 amperes that CB radios require during transmissions.

Fig. 5 The DC amperes (lower) scale is conventional, but the voltage scale (above) is expanded to show readings only between 10.5 and 14.5 The +13.8-volts point is marked in red.

Fig. 6 There are two inputs on the Model 388 In-Line Tester (top instrument) for measuring frequency. The one on the front panel is high-impedance for checking low-level stages in receivers, or for checking the frequency of variable signal generators, as shown.

Fig. 7 On the back of the Model 388 are the connectors for placing the tester in series between the transmitter and the load or antenna. Also, a BNC connector and switch permit a more-stable Model 388X to be connected here, giving higher accuracy of readings.

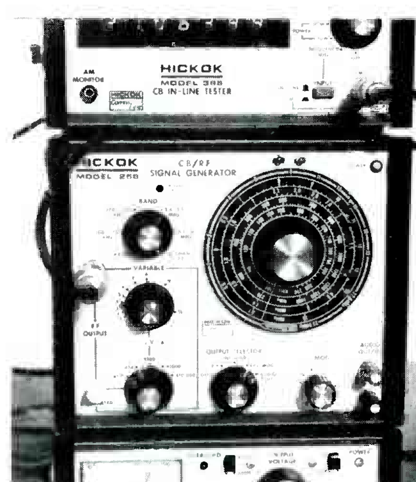


Fig. 8 One output plug of the Model 256 CB Signal Generator has a carrier signal whose amplitude is not affected by the setting of the attenuators. This way the generator has the advantage of variable tuning, and yet the accuracy can be as good as the frequency counter attached to the special output.

MHz and 55 MHz can be measured with only slightly more error.

Model 388 has a crystal oscillator rated at an accuracy of 10 PPM, and with a 5 PPM aging rate, giving a total reading accuracy of ±1 count plus the previous time base uncertainty. If you need better accuracy and long-term stability, Model 388X has a temperature-compensated oscillator, and one 388X can drive up to four Model 388's.

Cables

All four functions can be measured by connecting a cable from the transceiver to the input of the tester, and a cable from the tester output to the antenna or a dummy load. An antenna or load should **always** be used; without them the readings are wrong, and there's danger of damage to the transmitter.

VSWR and modulation %

The VSWR and modulation-percentage functions of the Model 388 operate by a "dynamic ratio" principle, which is said to be exclusive to Hickok products. This circuit permits accurate, continuous VSWR, or modulation readings without a calibration step or control.

Modulation readings can be read on the digital display from 1% to 110%, and VSWR readings are from 1:1 to 10:1.

Power measurements

Carrier power is measured by the formula: Power equals Voltage-squared divided by load Resistance. The squaring is performed by internal digital circuits.

Single-sideband power must be measured by the usual method, then the digital reading is multiplied by 2.5 (2.46 is the precise figure).

Demodulated output

A jack on the front panel has demodulated audio, from whatever carrier is in the through-line loop, which can be displayed on a scope, even a narrow-bandwidth model.

Model 256 CB RF Generator

A good signal generator for CB-radio servicing should have stable output of known high-accuracy. There are two ways of doing that. One is to build-in a crystal circuit of the required accuracy. However, the trade-off is that these frequencies are not continuously-variable; instead, they usually are for each CB channel.

Hickok has chosen the other alternative in the Model 256: a continuously-variable source of all frequencies (from IF's up to the top of Channel 40) with provision for connection to a frequency counter to give high accuracy (Figure 8).

Of course, a counter can be used with other kinds of variable-tuning generators, but usually there's a large problem. The output is turned up to maximum so the counter can have a large signal. But when the level is turned down for use with the radio, and the counter disconnected, the frequency jumps an excessive amount.

This problem is solved in the 256 by providing a separate output which has high-level signal, regardless of the attenuator settings. Caution: after you have set the frequency accurately using the counter, leave the cable connected. Otherwise, the frequency shifts about 10 KHz in the 27 MHz band.

Frequency coverage

Four overlapping bands cover from 100 KHz to 16 MHz for IF alignment or broadcast AM work. Also, the 40 CB channels have been spread out to cover the entire rotation of the outer band. The channels are marked, but not the frequency.

A five-position switch and a variable control attenuate these signals to a low level. The only shortcoming of the instrument noted during our tests was excessive signal leakage, even with the output cable disconnected. However, the amount was moderate, considering the price of the unit.

An internal 1 KHz oscillator can modulate the carrier between 0% and 100%, or an external audio signal can be used for modulation. Also, the 1 KHz sine wave is brought out to two banana plugs for use as a tone source for other kinds of audio servicing.

Comments

These three items of Hickok equipment should help you make measurements and repairs in minimum time, with high accuracy. □

INDEX OF 1976 ARTICLES

TITLES OF ARTICLES

ANTENNA, MATV, CATV

AUDIO

8 Track Repairs

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SYMCURE

TROUBLESHOOTING TIPS

test equipment report

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

Stylus-Pressure Gauge

Robins Industries has developed the Gramee stylus-pressure gauge which measures phono-stylus pressure to within 1/10 gram. The gauge has two ranges: 0.5 grams to 1.5 grams, calibrated in 0.1-gram divisions; and 1.0 grams to 3.0 grams, calibrated in 0.2-gram divisions. An angled inspection mirror makes it easy to observe when the gauge is perfectly balanced. Suggested resale price is $2.49.

For More Details Circle (41) on Reply Card

CB Dummy Load

AVA Electronics offers a new CB dummy load with a modulation light. Model DL 776 protects transceivers from no-load operation and prevents illegal transmission. List price is $3.95.

For More Details Circle (42) on Reply Card

Stylus Evaluation Kit

A stylus-evaluation kit from **Shure Brothers** is designed for close inspection of styli. The SEK-2 kit features a microscope; a stylus-locating device for centering the stylus under the microscope; and a manual containing photos of good and worn styli for comparisons. User net price is $150.

For More Details Circle (43) on Reply Card

Analog Meter

Ballantine is offering the analog meter "Option 20" for the **Ballantine** 3028A DMM. Option 20 fits into the front panel and is useful for applications where a trend indication is required rather than a digital readout. The meter is calibrated in ten linear divisions—0 to 2 full scale for use with AC and DC voltage and current modes—and has 5% accuracy at full scale. The panel meter also has a dB scale with 0 dB referenced to 1 mW into 1000 ohms. The meter scale extends from -20 dB to +6 dB. Thus, the instrument provides a dB range from -40 dBV to +66 dBV. Option 20 sells for $65.

For More Details Circle (44) on Reply Card

Pulse Generator

The WR549A pulse generator from **VIZ** operates over a 5 Hz to 5 MHz range. A pulse width of 100 nanoseconds to 0.1 second can be maintained over an unlimited duty cycle with a rise and fall time of less than 20 nanoseconds on all ranges.

Output is adjustable for both TTL and CMOS covering a range of 0 to 15 volts peak-to-peak. Impedance can be switched for 50 ohms or 600 ohms.

Model WR549A operates on 120 VAC, 60 Hz, with 5 watts of power. The dealer price is $119.

For More Details Circle (45) on Reply Card

Antenna Impedance Matcher

The CBT-15 antenna impedance matcher with a built-in SWR meter is available from **Mura.** It has an

impedance matching range of 25 ohms to 140 ohms for adjustment of all 23 CB channels under most conditions. The unit has an SWR scale of 1:1 VSWR to 1:3 VSWR. The scale meter is backlit for night-time use. A 2-foot connecting cable is pre-wired to the unit.

For More Details Circle (46) on Reply Card

FM-Deviation Meter

The **Bi-Tronics** FM-deviation meter is designed for use in repair and maintenance of VHF/FM marine and VHF/UHF land-mobile transceivers, but also can be used as a signal generator.

The instantaneous peak deviation is measured on a graticule scale in front of a 3-inch cathode ray tube. This permits the waveform to be observed for identification of distortion or hum. The measured deviation is independent of the waveform, and true values can be observed with voice modulation.

The instrument also functions as a monitor receiver with .0005-percent accuracy. The price is less than $1100.

For More Details Circle (47) on Reply Card

bookreview

Handbook of Basic Electronic Troubleshooting
Author: John D. Lenk
Publisher: Prentice-Hall Inc., Englewood Cliffs, New Jersey 07632
Size: 239 pages
Price: $15.95

The explanations are complete enough that beginners can understand, while experienced technicians can benefit from the complete and logical methods. Troubleshooting examples are presented in step-by-step form, with numerous diagrams to supplement the explanations. The use of test equipment is described in detail, including how to connect it and interpret the results. Alignment and adjustment procedures also are covered thoroughly.

Contents: Overall Troubleshooting Procedure; Relationship Among Troubleshooting Steps; Modification of the Troubleshooting Procedure; Determining Trouble Symptoms; Localizing Trouble to a Functional Unit; Isolating Trouble to a Circuit; Locating a Specific Trouble; Safety Precautions in Troubleshooting; Analog Meters; Digital Meters; Bridge-type Test Equipment; Signal Generators; Oscilloscopes; Probes; Troubleshooting Notes; Amplifier Troubleshooting; Receiver Troubleshooting; Transmitter Troubleshooting; Index.

photofact™ bulletin

HITACHI
Chassis NP4SX-H2/-L2 1619-1

JCPenney
2001AA (855-0055) 1630-1

MGA
BB-097, BB-128 1628-1

QUASAR
Chassis 12TS-480 1621-1

RCA
Chassis CTC78WC/WD/WE/WJ 1628-2

SEARS
562.50165600, 562.50180600,
562.50731600 1630-2

SONY
TV-131 1629-2

SYLVANIA
Chassis E40-1, E40-3 1620-1

productreport

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

Handicabinets

Additional storage space of 10-to-12 cubic feet is provided by the **Bay Handicabinet**. Shelf and drawer models are available for 5-foot or 6-foot work benches. Shelf models have four shelf openings with at least two adjustable shelves. Handicabinet

storage area measures 12 inches deep and 24 inches high. The overall height is 39 inches. The 5-foot and 6-foot models have 21 and 25 drawers respectively. The all-steel unit is phosphatized against rust. Additional accessories are available.

For More Details Circle (64) on Reply Card

CB Connect/Disconnect Kit

It is easy to disconnect and reconnect a CB in a car with Model QCD 1-SP kit from **AVA Electronics**. A power-plug adapter is supplied to connect the CB transceiver to the car's cigarette lighter. A second adapter goes to the antenna. No soldering or tools are necessary. Suggested list price is $2.95.

For More Details Circle (65) on Reply Card

Replacement Transistors For CB's

A full line of direct-replacement transistors for CB radios manufactured in Japan now is available from **Main Street Enterprises.**

The transistors are physically and electrically identical with the original-equipment transistors used in major brands of Japanese radios. They are being offered in starter kits to give dealers the variety of transistors needed to perform most service functions. The economy starter kit features 24 transistor types with a 24-drawer storage cabinet for a suggested dealer price of $315.38. The deluxe starter kit includes 30 transistor types and a 50-drawer storage cabinet for a suggested dealer price of $397.45.

For More Details Circle (66) on Reply Card

CB-Interference Filters

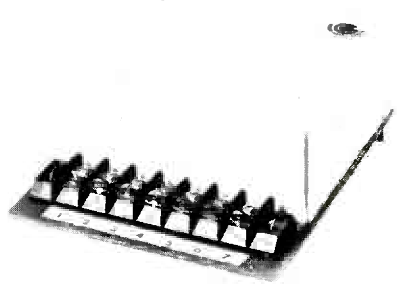
Avanti Research & Development manufactures three types of filters for reducing CB-radio interference to TV programs.

Model AV-800 low-pass filter installs in series with the coaxial cable of the transceiver to minimize harmonics which fall on a TV channel. Tuner overload at the TV receiver can be reduced by the Model AV-811 filter connected in the TV leadin wire. Model AV-820 is suitable to filter radiation from the AC line at the radio or at the TV receiver.

For More Details Circle (67) on Reply Card

Multi-Purpose Security Timer

Mountain West Alarm Supply Company has introduced the Model G7 multi-purpose timer, which has been designed to work dependably after long standby periods. The time can be adjusted from 3 seconds to 45 minutes, and reduces false alarms by delaying the signal sent to the police.



Also, it can be used as an entry or exit delay, and as an alarm recycle timer. Or the timer can cut off bell or siren after the delay period.

Model G7 costs $32.

For More Details Circle (68) on Reply Card

TV Remote Control

Jerrold Electronics is marketing a remote control which can select **all** UHF and VHF TV channels. The solid-state TRC-82 consists of an all-channel converter and a control unit, inter-connected by a small-diameter 25-foot plug-in control cord. The only wiring required is to connect the downlead from the TV antenna to the converter, and to connect the converter output to the antenna terminals of the TV receiver. Tuning is by varactor diodes. TV power on-off and fine tuning can be done from the remote box. The TRC-82

switches directly to the desired channel without clicking through intermediate channels. The unit converts all incoming VHF and UHF channels to either channel 3 or channel 4, depending on which is not broadcast locally.

Signal amplification is an additional advantage of the TRC-82 in producing stronger pictures. Direct-pickup interference is eliminated because the TV set is tuned to an unused channel. Suggested list price is $124.50. An extension control cord is available at $8.95.

For More Details Circle (69) on Reply Card

Radar Detector

A sensitive radar detector is available from **Radatron**. The "Senturion" mobile microwave detector is a constant reminder of proper driving habits and is effective in all situations, including the detection of "speed guns" and moving radar. The Senturion detects radar at roughly twice the distance from which the tracking unit will detect the driver,

thus providing a 10-to-15 second margin. The unit alerts the driver

Product Report
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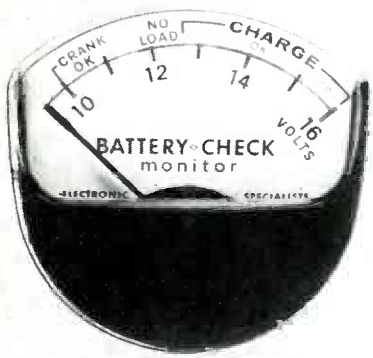
with a steady light and a persistant audible tone which can be stopped with an on-off speaker switch. The Senturion can be mounted on the dashboard or sun visor, and it can be hooked up to the ignition or cigarette lighter for 12-volt operation. Suggested retail price is $89.95.

For More Details Circle (70) on Reply Card

Battery*Check

The "Battery*Check" meter by **Electronic Specialists** can help your customers maintain their car and truck batteries in good shape for dependable CB operation. Generator



or regulator problems are indicated by the battery voltage, thus allowing repairs before further damage or a discharged battery can occur.

A guide explaining how to evaluate the vehicle battery system is included for the customer. Deluxe and economy models are available.

For More Details Circle (71) on Reply Card

Spray-Thru Caps

A new convenience for TV technicians is available in the "spray-thru" caps on **Chemtronics** aerosols. It has been said this is the first time non-removable caps of this type have been used in the electronics industry. Misplaced caps and accidental sprays are eliminated with spray-thru caps. Also, the extension tube can be left permanently in place, reducing any risk of loss.

For More Details Circle (72) on Reply Card

Tape Machine Repair *continued from page 42*

the new head (Figure 11), making sure the printed face of the head is on top. Slide the head back inside the bracket, install and tighten the Allen set-screw.

The head must have the correct penetration inside the cartridge, as shown in Figure 12. Usually the track switch and the head are in line, because the two ends of the pressure-pad spring inside the cartridge must press against them about equally. If the head extends too far inside the cartridge, the tape might be prevented from dragging the metal foil across the track-switch contacts, and that would stop the automatic program change.

Tilt and elevation

Because the exact location of the gaps in the face of the heads can vary from head to head, these next adjustments must by done while monitoring the performance electronically or audibly. It's not sufficient to merely install the new head in the same precise spot.

As explained in Figure 13, wrong tilt of the gap of the record/play head can cause a huge loss of high frequencies, when a pre-recorded tape is played. (Of course, if the same wrong tilt is used for both **recording** and playback, there is no problem. But 8-track tapes usually are pre-recorded.) Sometimes **tilt** adjustment is called **azimuth**; remember both names.

Wrong elevation (head height relative to the recorded track) has no effect on response or tone quality, but it does determine the volume. Narrower tracks produce weaker sound levels.

Of course, with four sets of narrow tracks on the tape, it's possible for an incorrect head elevation to cover part of the track of another program. You might hear weak music of the next program in the background of the right one. That's called **crosstalk**.

Another possible complication with 8-track (which does not happen with reel or cassette systems) is the four different head-height positions, one for each of the four pairs of stereo tracks. Because of tape and mechanism tolerances, you

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Tape Machine Repair continued from page 55

should check all programs for balance and crosstalk. Sometimes it is impossible to find just one adjustment that's perfect for all tracks. In such cases, it is necessary to compromise so no one of the tracks is obviously inferior.

Test tapes

I highly recommend the use of test tapes for all head adjustments. Two types are the Audiotex Catalog 30-213 (shown in Figure 14) and the RCA 1-321. The RCA cartridge has a 1-KHz tone recorded in the guard bands on each side of track two; therefore, the head elevation is adjusted for **minimum** amplitude of the tone.

The head height (crosstalk) adjustment on the Zenith is located on the bottom of the tape deck. Connect the left-channel output cable (coded yellow) to the scope. Insert the test record and select Program 2. Adjust the head height screw for either a null or for **minimum** amplitude of the sine-wave signal. Tighten the locking nut and recheck for minimum output level.

For azimuth adjustments, the RCA tape has an 8-KHz tone recorded on track six, which is the other stereo signal for track 2. So, it is not necessary to change to another program. Instead, connect the scope to the right-channel output cable (coded green). Adjust the hex-head azimuth screw for **maximum** amplitude of the 8-KHz signal.

Repeat both the head-height and azimuth adjustments, then use glyptal (a kind of glue) to seal the adjustments.

Checking the head

Magnetic recording heads can get covered with iron oxide from the tapes, or become worn enough that the performance is noticeably degraded. Strangely enough, one way to spot a worn head is to look at the signal from all 8 tracks.

On another recorder, known to be in good condition, record about 30 seconds of a 1-KHz sine wave with the same level on each channel. Do this consecutively for each of the four programs. This is your test tape for troubleshooting and checking head performance.

Now, plug the tape into the machine under test, connect a dual-trace scope to the two output cables, as shown in Figure 15, and look at the playback waveforms of each program in turn.

A normal machine and head should produce sharp sine waves of equal amplitude (Figure 16). However, a worn head can show various amplitudes or distortions (Figure 17).

Most head defects are not visible to the eye, even with the help of magnification. One possible exception is the rare case where the head laminations are worn completely away at the gap. Those will appear to have a very large gap.

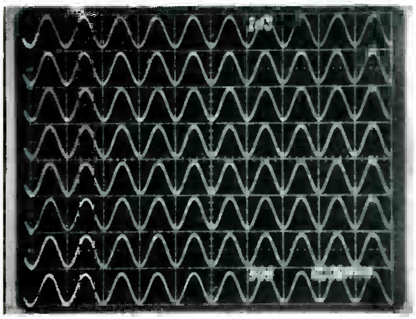

Fig. 16 A normal machine plays back the four pairs of stereo signals with the same waveform and amplitude. Sine waves are used for accuracy.

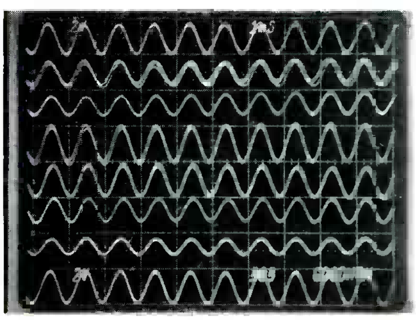

Fig. 17 One kind of head defect produces different waveforms and amplitudes of the various tracks.

Fig. 18 Of all the head defects, only gap wear, and a scratched or dirty face shows in a visual inspection.

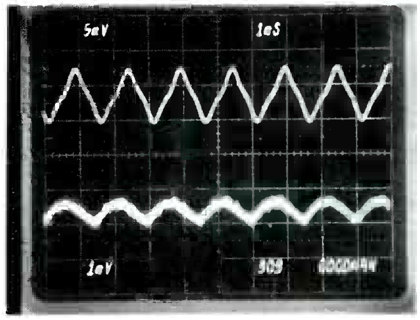

Fig. 19 One defective head gave this normal output (above) and the noisy, distorted one (below) from the other channel. It's good technique to check one channel against the other.

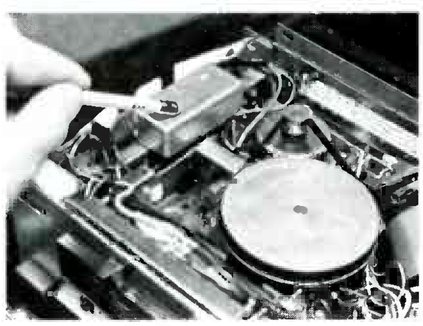

Fig. 20 The bias module has no adjustments and it is sealed. Replace it, if you suspect it has a defect.

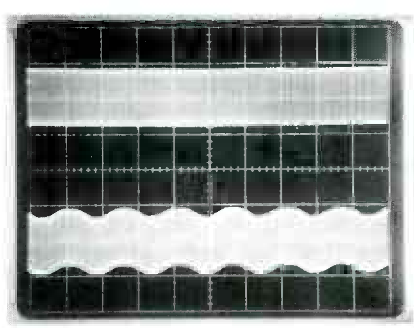

Fig. 21 Waveforms at the head during recording can give you much information. The correct waveform is below, with low-frequency sine waves and larger amplitude bias frequencies. Audio alone, without bias, would indicate a defect in the bias module. Bias without any audio (top trace) indicates a defect in the audio stages.

The face of a good head should be very smooth. Avoid scratching the face (see Figure 18) not only because such scratches might distort the shape of the gap, but also because the sharp edges of the scratches can scrape away the coating of tapes, ruining them. Figure 19 shows the waveforms of a head with one bad winding.

Recording tests

Unfortunately, the ability of a head to play back **correctly** a signal recorded on another machine (or this machine before it became defective) is **not** proof that the head is good.

For example, shorted turns in the winding sometimes allow near-perfect playback, but weak and distorted recording quality.

Another, more-likely, defect is a thick coating of iron oxide from the tape that collects on the face of the head over the gap. This coating moves the tape and the head apart, and the bias signal can't perform its work on the tape. **Consequently, the recording is weak, distorted, and noisy.**

That's why I recommend you **try the performance of both recording and playback, and then clean the head thoroughly before you test for any other defects**. Otherwise you might waste many hours looking for some other cause of the poor recording.

Checking tape speed

When the tape runs past the head either slightly fast or slightly slow, the effect is not very noticeable to the ear. But, even a slight **variation** of tape speed can be heard as a "wow". Many customers describe such music as being "flat" or "running slow".

Tape speed is difficult to test with a stroboscopic pattern (as is done easily with open reel machines) because the tape is hidden. One method is to record a 1-KHz sine wave, using a known-good recorder, while measuring the frequency with an electronic frequency counter. Then play it back on the machine you're testing and read the frequency. The difference of frequency should not be more than about 10 Hz. (Note: a varying speed can't be read accurately on many counters. In addition, some counters intended for use with radio transmitters read audio frequencies erratically. Check your counter on an audio oscillator to be sure it is stable at those frequencies.)

The motor of the Zenith operates from the +20-volt supply for the transistors. There is no adjustment for the speed. If the voltage is within tolerance, and the capstan/flywheel spins easily with the belt removed, but the speed is slow or varying, **the motor should be changed.**

Bias problems

Generally speaking, excessive amplitude of bias signal during recording reduces the high-frequency response somewhat. Too-little bias amplitude permits excessive distortion to be recorded. The bias circuit of the Zenith is inside a shield (Figure 20).

A dual-trace scope makes an ideal test instrument for checking the presence of the audio and the bias signals at the head during recording. Figure 21 shows no audio at one winding of the head and correct levels of audio and bias at the other head winding. Notice that the phase of the sine wave along the top of the bias is exactly the same as the sine wave along the bottom. **That's proof the signals are not mixed.** In other words, the audio is not modulating (changing the amplitude of) the bias. For a comparison, look at the waveform of amplitude-modulated RF from a radio transmitter (the sine waves at top and bottom appear to be opposite in phase).

If you scope a head while it is recording, and find ample bias amplitude and a waveform similar to the one in Figure 21, the recording should be normal. If it isn't, **the head is caked with oxide, or the head is defective**. Then if cleaning the face of the head does not repair it, replace the head.

On the other hand, bias present without audio indicates a defect in the amplifier. Audio at the head without bias at either winding proves a failure of the bias/erase oscillator circuit.

Yes, scoping the head during recording can tell you many facts about the condition of the tape machine, and even where the problem might be. □

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GE Modules

continued from page 30

- if you know what DC voltages, waveforms, and amplitudes to expect; and
- if you make allowances for some peculiarities of solid-state equipment.

Overload

Generally speaking, transistors (and IC's using internal bi-polar transistors) are much more susceptible to overload from strong TV-channel signals. For example, the YC-2 required careful adjusting of the IF AGC and RF AGC controls to eliminate overload and instability with strong signals without using extra gain reduction of the RF amplifier so that too much snow was seen.

Careful of shorts

An important hazard of making tests and measurements in high-density solid-state circuits is the distinct possibility of accidental shorts because of clumsy and too-large, old-fashioned test probes. You see, it's possible for a split-second short between lugs or connections to blow one or more solid-state components. It's dismaying to start out with one uncomplicated problem and add several tough ones by accident. Not only are the components expensive, but often they are very difficult to locate and obtain.

Two effective (but inexpensive) devices to minimize such hazards are shown in Figure 10. First, there's a special test clip which snaps over an IC, with spring wires to make solid contact. These wires protrude from the top, where connecting with some kind of "insulated-hook" probe is easy and safe. I strongly recommend the use of these two test aids!

Alignment grass

Other minor complications of modern solid-state circuits were brought to my attention accidentally. While studying the way the chroma bandpass curve is obtained by separate high-pass and low-pass filters, which are not adjustable, I decided it would be instructive to look at the alignment curve.

Immediately, I ran into problems. First, the overall IF curve was distorted in ways that I recognized came from the lack of a fixed AGC bias for the IF's. But where should it be applied, and with how much voltage? Last year's Photofact gave the answer to those questions.

But one problem remained: the excessive "grass" on the curves coming from pulses of horizontal sweep. Now, with tube-powered sets, we merely unplug the horizontal-output tube, clamp any voltages that are upset by the lack of sweep, and proceed with alignment without hindrance.

Not so with many of the new color receivers, because the horizontal sweep is used to power several of the basic power supplies. If I killed the horizontal sweep, the receiver could not operate. Of course, I could have rigged up some substitutes for the power supplies. But they are high-current ratings, and that's a lot of trouble just to **look** at alignment curves.

Anyway, that explains the fuzzy, poor-quality curves shown in Figure 11. The IF response was typical of a good-quality "haystack", and the overall chroma VSM curve was symmetrical and fairly flat. The skirts of the overall chroma curve seem to be slightly less steep than others which have an overcoupled transformer.

I hasten to add that these remarks are given only to help you in similar situations, and are not intended to downgrade the performance of this GE receiver.

In fact, the B&W and color (both on colorcasts and with a color-bar pattern) were excellent. The color bars were sharp and without ringing lines or shaded areas.

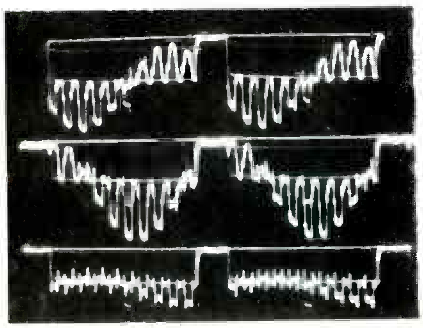


Fig. 9 Top trace is the color-bar pattern (with pedestal) at the red cathode of the picture tube; center is the waveform at the blue cathode; and at the bottom is the smaller waveform at the green cathode of the picture tube.

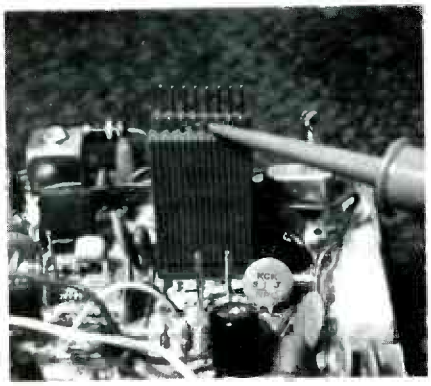
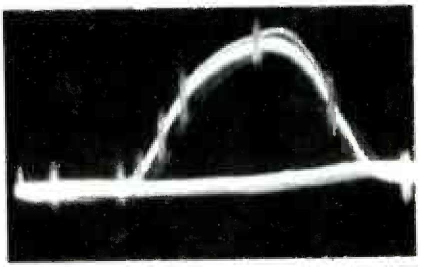


Fig. 10 You can check DC voltages or waveforms at IC's with safety and solid connections by using a test clip and an insulated-hook type of test probe.



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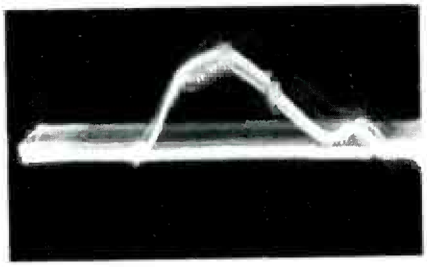

B

Fig. 11 Horizontal-sweep pulses are the "grass" that widens these alignment curves. The lower amplitude of the solid-state curves makes the pulses appear stronger. It was not convenient to kill the horizontal sweep because it also is the AC source for several DC power supplies. Curve (A) is the overall picture-IF response from tuner to the video; a type of "haystack". At (B), the curve shows the overall response from the tuner to pin 4 of IC270, using video-sweep modulation.

Next Month

We hope to have the first part of the **detailed** analysis of the exclusive GE "VIR" module by next month. VIR stands for Vertical-Interval Reference signal, and the GE module allows automatic correction of color and tint errors, regardless of where they occur. □

catalogs literature

Circle appropriate number on Reader Service Card.

80. Belden Corporation—has an 8-page illustrated booklet that features antenna, microphone, and speaker cables for CB radio systems. It offers more than 60 products for use with fixed and mobile CB, amateur, and marine radio systems and for industrial/commercial land/mobile applications.

81. Arista Enterprises—offers a 16-page catalog of two-way communication accessories. Some items featured are: microphones; CB speakers; CB transistors and semiconductors; CB antenna mounts and accessories; coaxial connectors; connector cables; noise elimination filters; CB meters; and power supplies.

82. Telematic—this 16-page #76-1 catalog features TV test rigs, yoke and convergence adaptors, color brighteners, replacement parts, and color service accessories. Also included are two cross-reference charts; one for test rigs, and one for brighteners.

83. Antenna Specialists—has recently published an informative booklet for everyone interested in CB radio. Written by Forest H. Belt, "CB Facts and Fables" analyzes the nature of CB antennas; how they work, which types work better than others, and why.

84. Bird Electronic Corporation—4-page form catalog SF-76 lists "Thruline" wattmeters, coaxial loads, RF termination wattmeters, and attenuators covering from 500 KHz to 2300 MHz and from milliwatts to 250 kilowatts. Also included is a new multirange digital wattmeter for 2-way radio service, as well as portable and panel instruments with RF output ports for frequency analysis.

85. Sperry Instruments—has issued a new product bulletin, SP-73, that features the complete Sperry line of multi-testers. The bulletin offers detailed specifications, product descriptions, a list of features, packaging information, and prices for each of the nine multi-testers. Additionally, there is a price list of accessories.

86. Techni-Tool—offers a wide selection of tool kits in their 20-page catalog. Some kits featured are: security installation kits; office machine kits; hospital/laboratory kits; electronic assemblers kits; engineers tool kits; and many others. They also feature a design-a-kit section in which tools and accessories are listed separately; the customer can order from this form and build his own personalized kit.

87. Saxton Products—the 52-page catalog features coaxial and twin-lead cables for CB, amateur radio and television use, plus antenna-mounting hardware, tools, hook-up wire, intercoms, audio connectors, and decorator telephones.

88. Mountain West Alarm Supply—has a free 64-page alarm and security equipment catalog, A-77, that describes more than 900 intrusion and fire-alarm products. An informative alarm-equipment application guide (which includes general alarm-system discussion, basic installation procedures, and connection diagrams) is a featured section. This selection of alarm equipment is complete from simple kits to the latest ultrasonic, radar, and infrared detectors.

89. TV Tech Aid—offers a 36-page catalog of B&K test equipment; popular flybacks; CB radios, antennas and accessories; tools; tubes; car radios and tape players; and other fast-moving merchandise at discounted prices.

Ideas for articles? Send them to ES, now!

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Classified columns are not open to advertising of any products regularly produced by manufacturers unless used and no longer owned by the manufacturer or a distributor.

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TV TECH, self-employed 7 years (part time), with new FCC 2nd phones, seeks full time employment, preferably in two-way radio shop. Bob James, 1101 2nd, Great Bend, Kan. 67530. 1-77-1t

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FOR SALE—Radio & T.V. Repair Shop, located in the beautiful town of Aptos, Calif. For further information, write: Mr. J. C. Fox, P.O. Box 1061, Aptos, CA 95003. 1-77-1t

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EDUCATION-INSTRUCTION

REPAIR TV TUNERS—High Earnings; Complete Course Details, 12 Repair Tricks, Many Plans, Two Lessons, all for $2. Refundable. Frank Bocek, Box 3236 Enterprise, Redding, Calif. 96001. 8-76-tf

FOR SALE

TV & RADIO TUBES 36c EA!! Free color catalog. Cornell, 4221 University, San Diego, California 92105. 8-76-tf

INCREASE SERVICE PROFITS & Collect In Advance. Service Contract Manual. Practical Home Electronics Service Business Manual. Each Manual $12.50, both $22.00. NATESA, 5906 S. Troy St., Chicago, Il. 60629. 11-76-3t

UNUSUAL SURPLUS AND PARTS Catalog $1. ETCO Electronics, Dept. E.S., Box 741, Montreal "A" H3C 2V2. 7-76-10t

SELL OR TRADE: Riders radio and television manuals, antique tubes-00A-01A-7 VOLTS-12 VOLTS-6S7-6W&G-G2S-874-12FR8-25B8-70L7-70A7-FM1000-and 117L7. Goodwin Radio Shop, Rankin, Ill. 60960. 12-76-2t

REPLACEMENT COLOR YOKES-DEALERS ONLY Zenith 95-2501-2532-2638-2667-S-89633 etc. 14.95, Magnavox 361380-1 18.95, Sylvania, GE etc. 14.95 to 19.95. Request for price list on your Letterhead. David Sims Enterprises, Inc. 665 Jericho Turnpike, Huntington Station, N.Y. 11746 12-76-tf

POTTER BRUMFIELD RELAYS: fc 11d-24, SL-7005-28. 8 on Board. Unused—$20.00. CKT. Board, Loaded, $1.00, 6/$5.00. Alpha Electronics, Drawer E, Escatawpa, Miss. 39552. 1-77-1t

FOR SALE: Complete TV Shop, test equipment - SAMS, parts, tubes benches, lighting, and shelving. All or part, over $15,000 worth, but CASH counts. Phone 503 842-7848 or write: J. W. Smith, 518 Elm Ave., Tillamook, Oregon, 97141. 1-77-1t

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LEFT AND RIGHT CHANNEL Record/Reproduce Preamps for Concertone Series 90 Professional Tape Recorder/Reproducer. Aaron Dickey, 99 North 800 West, Orem, Utah 84057 - (801) 225-0678. 1-77-1t

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SAMS PHOTOFACTS WANTED—Send list of set numbers and price, include phone number. Rich Roman, 1180 Los Altos Ave., Los Altos, Calif. 94022. 415/948-1793. 1-77-1t

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