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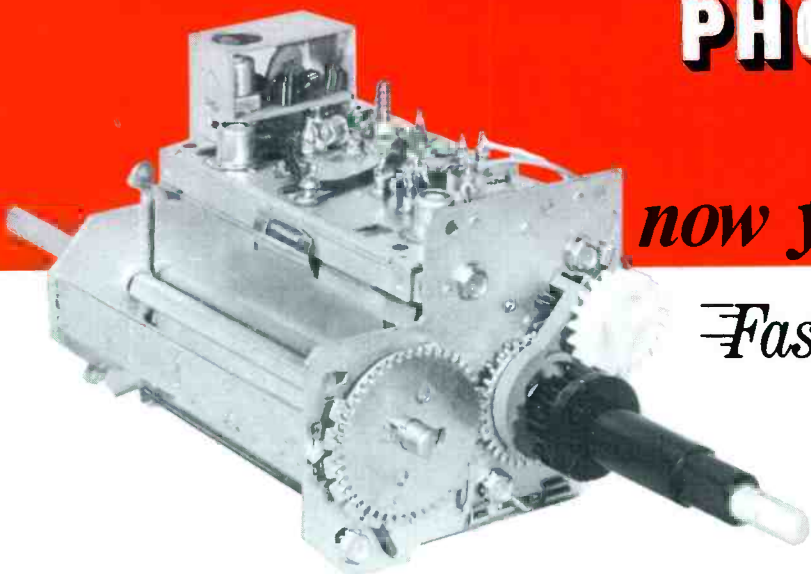

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electronicscanner

news of the industry

Addressing dealers at NARDA's National School of Service Management, Dean Ridgely, a dealer from Green Bay, Wisconsin, charged that inadequate rates paid for appliance/TV in-warranty service often prompts some dealers to "cheat" on their warranty service invoices to producers. Ridgely claims that manufacturers make money on in-warranty service, reports **Home Furnishings Daily.**

Both the number of dealerships and the total number of electronics technicians servicing home electronics equipment decreased in 1974, according to a survey conducted by the National Electronic Service Dealers Association (NESDA). From January 1974 to January 1975, the number of firms engaged in consumer electronics service decreased from 77,230 to 72,165; service technicians decreased from 204,000 to 183,566; apprentices decreased from 12,250 to 6,500; but the number of students increased from 18,000 to 20,000. Dick Glass, executive vice-president of NESDA says previous state totals have reflected inaccuracies, and the 1975 figures are more accurate.

Television manufacturers estimate that Underwriters Laboratories' requirements on plastic-cabinet fire retardancy, effective in July, will add to the retail price of sets to be introduced in the spring. According to a report in **Home Furnishings Daily,** one manufacturer said the requirements are the most expensive cost factors involving product safety to be incurred by the industry. Manufacturers using polystyrene with fire-retardant additives have run into problems such as brittleness and light color fading of cabinets.

A new set of regulations issued by the Department of Consumer Affairs in New York city covering repairs of TV's, radios, and audio equipment became effective February 24, 1975. Technicians must guarantee their work for 30 days, reports **Radio & Television Weekly,** and replacement parts must be guaranteed for 90 days. The regulations forbid customers from signing statements absolving the technicians from liability connected with the service work. Before the actual repair work begins, a written estimate covering all repairs must be in the mail. Technicians say that increased administrative work and mailing costs will have to be borne by the customers.

Licenses issued by the Federal Communications Commission for Citizen's Band radios have reached 1 million for the first time, reports Home Furnishings Daily. Applications in 1974 were up 95% from 1973, according to figures from the Electronic Industries Association, and the market is expected to grow another 30% this year.

Instant Rebates from $30 to $50 in fair-trade states will be offered on five color TV sets from Panasonic. According to **Home Furnishings Daily,** the amount of savings will differ in other states. The program affects two 13-inch color sets, one 17-inch set, and two 19-inch models.

(Continued on page 6)

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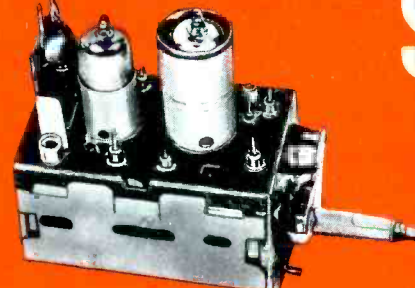

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news of the industry

(Continued from page 4)

According to a Home Furnishings Daily survey, only 10 high fidelity manufacturers account for almost half the industry's volume in this country. The manufacturers include U.S. Pioneer, Marantz, Fisher Radio, Teac Corporation of America, Kenwood, Sansui Electronics, JBL, United Audio, Shure Brothers, and JVC America.

RCA will introduce two commercial TV cameras featuring a new kind of electronic image sensor called the charge-coupled device. Although the silicon sensor is only the size of a postage stamp, it contains 163,840 electronic elements that can form an image pattern when exposed to light. Pictures similar to those produced by larger conventional vidicon tubes are created by scanning the sensor. **The Wall Street Journal** reports that RCA is making two "grades" of the sensor, varying in price from $1,500 to $2,300. Depending on which sensor is used, the cameras are priced at $3,000 and $3,800 each. For general use, one camera has a built-in lens with an automatic light-control system; the other takes interchangeable lenses and is intended for specialized industrial use.

Some dealers report that service work has increased up to 20% because consumers don't want to buy new products. To offset the declining sales profits, many dealers have raised the prices of service work. According to a report in **Home Furnishings Daily**, other profit-boosting methods in use include advertizing service departments, setting a minimum rate for repair jobs, and refusing unprofitable work.

Using a 43-year-old alloy developed by a Japanese university, the Victor Company of Japan has introduced a new tape-recorder head that reportedly matches the abrasion strength of ferrite heads and surpasses the frequency response of permalloy heads. Named Senalloy, the recording-playback head will be used in all JVC medium- and high-end cassette and open-reel tape recorders and decks introduced in April. **Home Furnishings Daily** reports Senalloy material consists of sendust chip and a permalloy core.

With the introduction of its 1976 color TV line in May, GTE Sylvania will shift to a 90-day labor warranty, **Home Furnishings Daily** reports. Changing from a one-year coverage, the new warranty will involve all Sylvania and Philco color sets. The one-year parts and two-year picture-tube warranty will be maintained.

The Climatic Corporation, Quasar distributor in South Carolina, recently offered rebates of $40 on portables and $100 on console color receivers, and **Home Furnishings Daily** reports that sales were boosted over previous slow weeks.

Zenith Radio Corporation will introduce a new warranty for its 1976 solid-state color-TV sets, beginning with the introduction of "G" line receivers in May. The plan will provide in-warranty service labor for the first 90 days of ownership, one-year coverage on replacement parts, and two years coverage on the color picture tube. □

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The labels tell you what's inside, in simple, everyday language.

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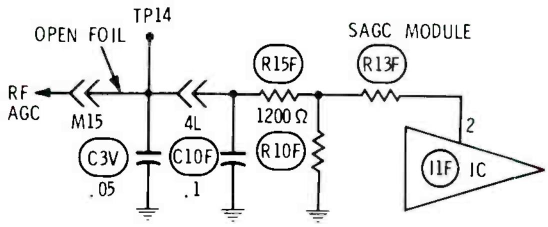
GTE SYLVANIA

For More Details Circle (7) on Reply Card

symcure

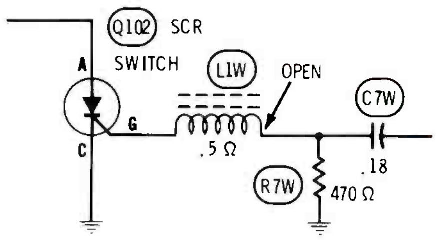
Symptoms and cures compiled from field reports of recurring troubles

Chassis—Philco-Ford 3CY90
PHOTOFACT—1344-1



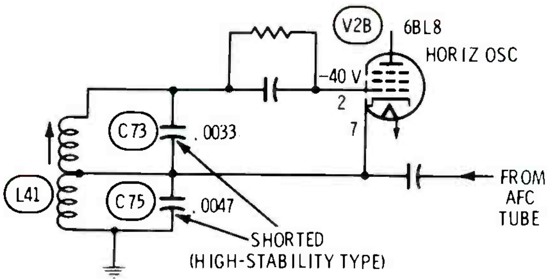
Symptom—Snow or blank raster, often intermittent
Cure—Check for an open foil between TP14 and M15 RF AGC terminal at the front of the chassis

Chassis—Philco-Ford 3CY90
PHOTOFACT—1344-1



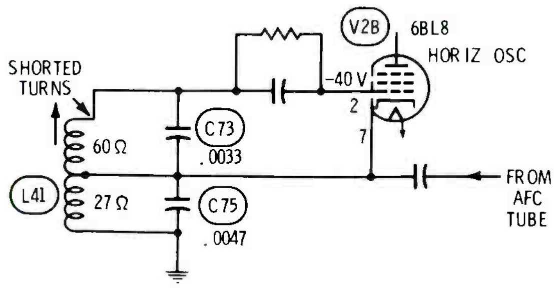
Symptom—Low high voltage, no raster
Cure—Check for an open RF choke L1W, and replace it if open

Chassis—Philco-Ford 2CY80
PHOTOFACT—1430-2



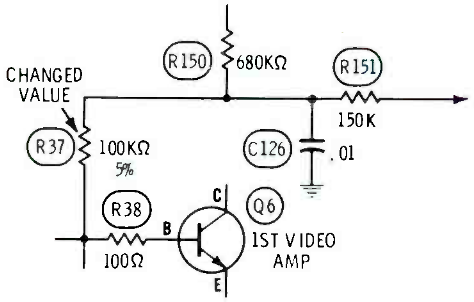
Symptom—No high voltage, plate of output tube is red
Cure—Check for a shorted C73 or C75, and replace it if open

Chassis—Philco-Ford 2CY80
PHOTOFACT—1430-2



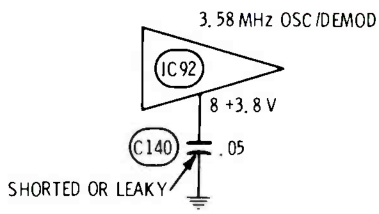
Symptom—Picture bends as brightness is varied
Cure—Check for shorted turns in L41 (60 ohms might be 35), and replace the coil if shorted

Chassis—Philco-Ford 2CY80
PHOTOFACT—1430-2



Symptom—Excessive or insufficient brightness
Cure—Check the resistance of R37, and replace it if out of tolerance

Chassis—Philco-Ford 2CY80
PHOTOFACT—1430-2



Symptom—Weak green is the only color
Cure—Check C140, and replace it if shorted or intermittently leaky

 For More Details Circle (9) on Reply Card

troubleshooting tips

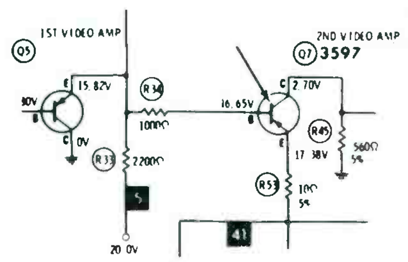
Send in your helpful tips—we pay!

No picture, no sound
RCA CTC51 color chassis
(Photofact 1332-2)

The RCA with a CTC51 chassis had a raster only, but no picture or sound. I started taking voltage measurements around the first IF and the mixer in the tuner, and noticed clicks in the sound. I assumed this meant the circuits were okay from there to the picture tube, and I didn't bother to look for the noise flashes on the screen. That's where I made my mistake.

I assumed that the oscillator transistor in the tuner was bad, and then replaced it. Unfortunately, the trouble remained. Neither would a tuner substitute bring in any stations.

Next, I tried injecting the video signal of my color-bar generator to the various video stages. No results were obtained until the video was connected to the collector of Q7. I tested transistors Q5 and Q7, finding Q7 was defective. In talking with other technicians, I have learned a failure of Q7 is quite common.



After the picture was restored, I had the mean job of squeezing the oscillator coils in the tuner to make the stations all tune in with the new (not needed) oscillator transistor. All this extra trouble could have been avoided, if I had stuck with my usual procedures.

Max Goodstein
Flushing, New York

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reader's exchange

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Sunnyvale, California 94086

Needed: *Information about a method of removing the protective enscapulation on military circuit boards without destruction from chipping or heat.*
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Houston, Texas 77023

Wanted: *Used Wintronix color rainbow generator Model 150 or 750, in working condition and with manual; reasonably priced.*
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TROUBLESHOOTING COLOR PROBLEMS IN PHILCO HYBRIDS

Part 1/By John Simrell

Although this information is about the Philco-Ford hybrid color receivers, some of the general servicing principles can be applied to other sets that have diode-AFC and reactance-control circuits.

Many problems far removed from the chroma channel can simulate chroma defects. A poor antenna or leadin sometimes weakens the color on one channel, giving critical fine tuning and degraded color quality. Poor purity of the raster can give the visual effect of no color, although test equipment will show it reached the picture tube. Even such a simple thing as a misadjusted fine-tuning knob appears to be a serious color problem.

This article, for the most part, covers defects in the chroma circuits.

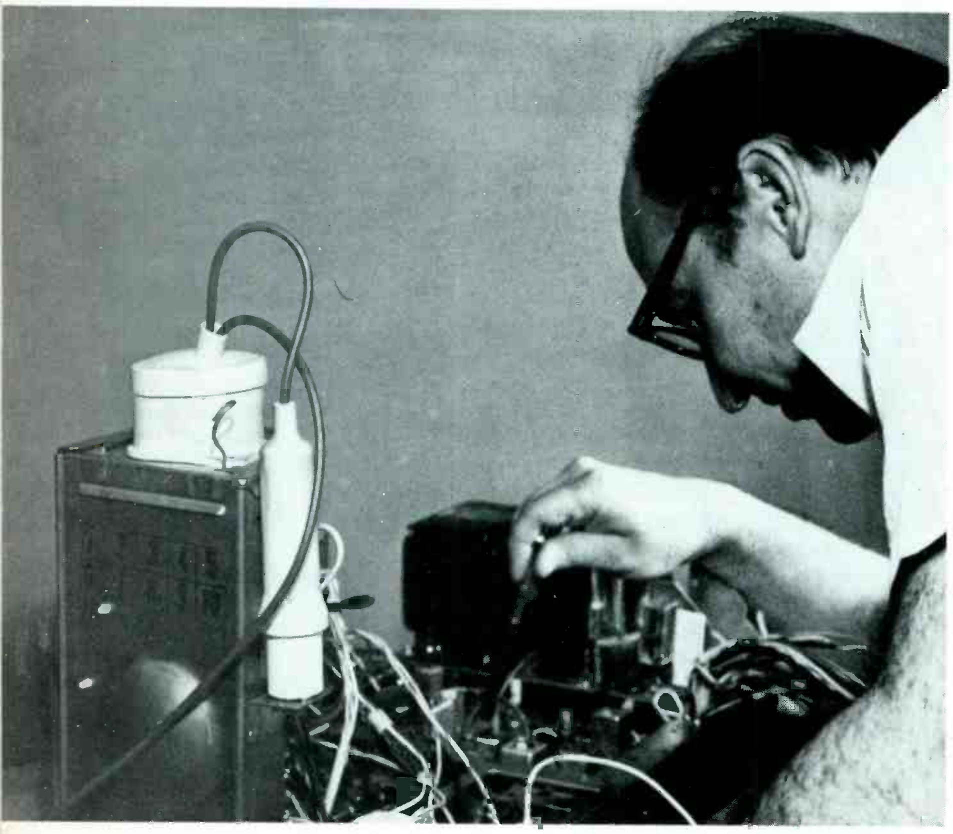
Actual chroma troubles can be grouped into these general categories:

- too much, or too little color;
- loose color locking;
- smeared color;
- wrong tints, and
- interference in the color.

It's not unusual to find various combinations of troubles happening at the same time. For example, weak color and intermittent color locking might be the twin symptoms.

Quite often, multiple symptoms make diagnosis easier, rather than more difficult.

The system of troubleshooting to be described requires only a meter, such as a VTVM, sensitive VOM, digital, or FET meter. Therefore, the tests can be performed during home service calls, as well as on the work bench.



John Simrell pointed out to the photographer the locations of the major test points.

No Color Or Weak Color

When the color is weak or missing entirely, but the b-w part of the picture appears to be normal, it seems logical to suspect the chroma circuits. But that's not necessarily correct. Defects in the tuner, IF amplifiers, and video amplifiers also can weaken the color.

Wrong alignment of the video IF's usually causes a larger change of chroma amplitude and quality than is possible by the same degree of chroma misalignment.

Luckily, there is a simple quick-and-dirty test for overall bandwidth that can be performed without equipment, but it's one providing reasonable accuracy.

Check the no-signal snow

Tune to a blank channel (if

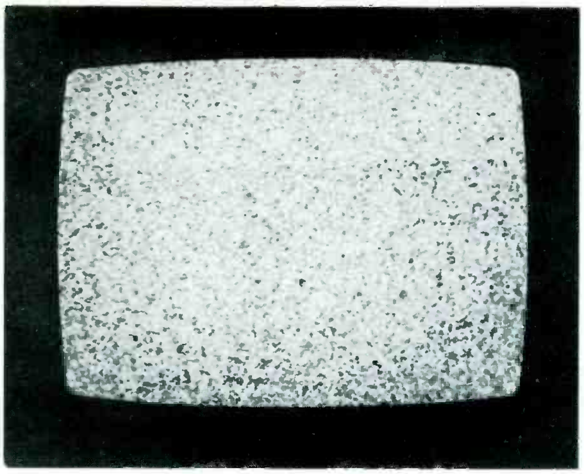


Fig. 1 Off-channel snow that appears hard, sharp, and grainy usually indicates the receiver is capable of passing the color signal through tuner, IF's, and video stages. Snow also can be used to simulate burst to test for approximate gain.

necessary, remove the antenna leads to eliminate any interference from another channel), and analyze the amount and quality of the snow visible on the screen. Make a practice of doing this on normal sets (Figure 1), and you will learn very quickly how much snow to expect.

In addition to having normal amplitude, the snow should appear sharp and grainy, not blurred or in streaks. Snow is "white noise", theoretically consisting of all frequencies. Any TV with sharp, grainy snow usually is capable of passing the color through tuner, IF's, and video stages.

If the snow does not have enough amplitude or sharpness, make whatever repairs are necessary to restore the normal quality of the snow. **Quite often, this also corrects the problem of the color.**

Defeat the color killer

The normal function of a color killer is to eliminate the color part of the picture when the program is in black-and-white. This prevents blotches of false color. However, a defective killer circuit might weaken or stop the color when the

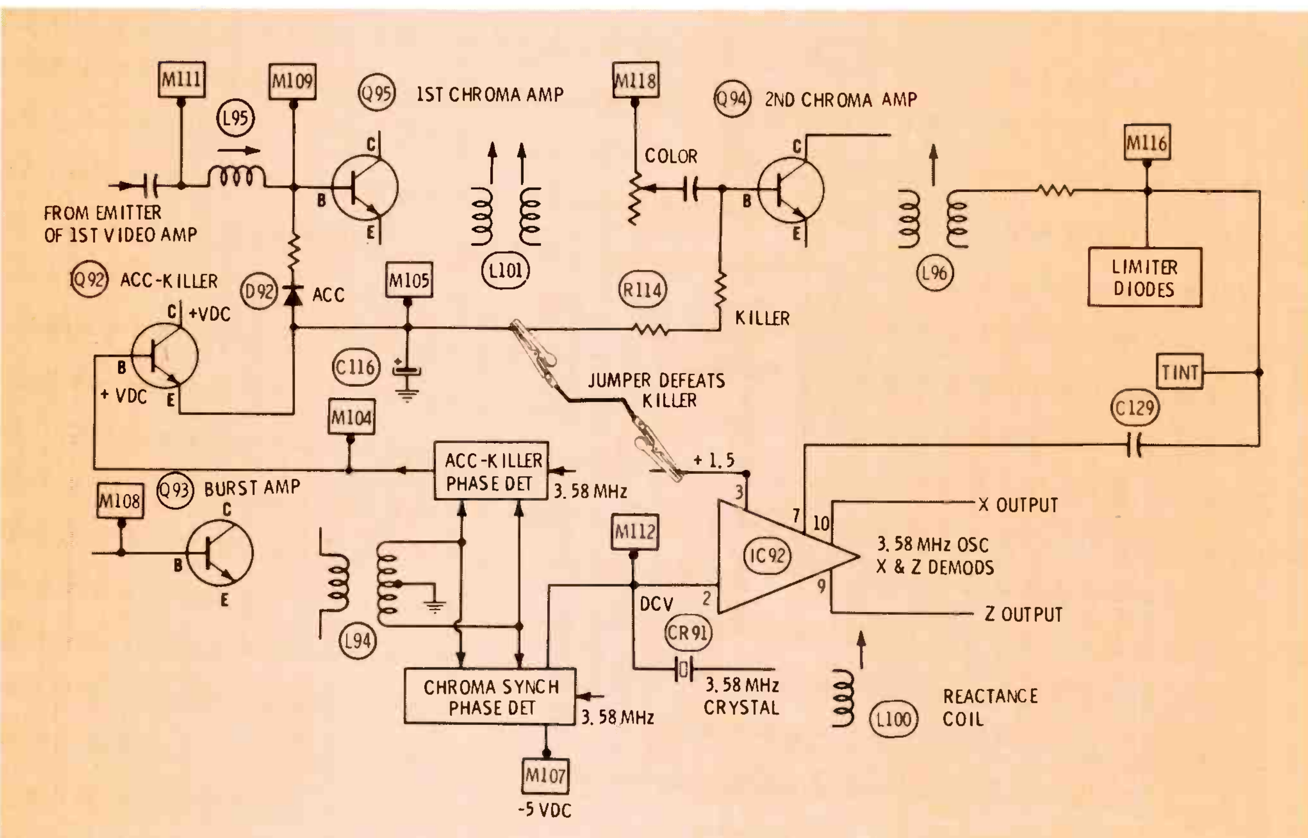


Fig. 2 This simplified schematic of the Philco 4CY80 chassis shows the major components and test points. Other similar chassis include 2CY80 and 3CP30.

picture is broadcast in color.

Often the killer action can be overridden by adjustment of the killer control (some Philco models don't have a variable control). Of course, that won't help if the defect involves the killer control. Most killer circuits have two points that can be shorted together, or a test point where a certain voltage should be applied, to defeat the action and give color gain at all times.

In these Philco receivers, both the ACC and killer voltages come from a common source, the emitter of Q92 (see Figure 2). Q95, the first chroma bandpass amplifier, has sufficient bias for normal operation without any DC voltage from Q92 (Figure 3). In fact, D92 blocks any additional voltage from reaching the base of Q95 until it exceeds the base voltage. When D92 conducts, the higher base voltage of Q95 reduces the gain. That's the ACC action.

On the other hand, the forward bias of Q94 (second chroma amplifier) is too low to allow gain until more voltage is furnished by Q92. Burst is compared in phase with the sample of 3.58-MHz signal and the resultant is rectified by D91 and D93 to generate a small positive voltage. This positive voltage forward biases the base of Q93 causing the transistor to conduct a positive voltage from the collector to the emitter and then on to the base of Q94, making the forward bias high enough that Q94 amplifies with normal gain. This is the killer action.

To defeat the killer action and make certain Q94 has sufficient forward bias for normal gain, apply +1.5 volts to the positive end of C116.

Bias from the IC

One easy way of obtaining the +1.5 volts (to make certain the killer is not interfering with the chroma gain) is to take the voltage from pin 3 of integrated circuit IC92. But there are two precautions to be observed first.

Check the voltage at C116 to make sure it is not already higher than +1.5 volts. If R116 is open or Q92 has a C/E short, the voltage there could be high enough to ruin IC92.

Also, be certain where pin 3 of the IC is, and check the voltage there. Don't use this point for a source of clamped killer voltage if the voltage is much above or below the usual +1.5 volts.

If these two voltages are not abnormal, connect pin 3 of IC92 to the positive (ungrounded) end of C116 (Figure 4).

How is the color?

After the killer has been defeated, check the color. One of these conditions should be found:

- the color is normal in saturation, tint, locking, and sharpness (diagnosis: the defect is in the killer circuit);
- the color is in stripes (diagnosis: the color oscillator is operating too far out of frequency, or there is no locking to pull it in);
- color saturation remains weak (diagnosis: gain or alignment of either video IF's or chroma bandpass amplifier stages is abnormal);
- the color jumps out of lock making stripes when the tint control is adjusted or the programs change (diagnosis: there's trouble in the burst amplifier or phase detector circuits);
- there is no color; or
- tint is wrong, the color is smeared, or there are stripes of interference in the color.

As you can see, an overactive killer might obscure many symptoms. We will discuss many of these general defects as we proceed. But before we leave the subject of the killer, there is one more helpful diagnostic tool.

Color-tuning light

Examine the front panel of the receiver for a color light (Figure 5). Actually, the light does not necessarily prove the color is okay when the bulb is on; it means only that Q94 (second bandpass color amplifier transistor) is drawing sufficient collector current. In a normal chassis this happens when the killer is **not** eliminating the color gain.

If the killer is operating normally (not defeated) and the bulb lights when the fine tuning is near the sound bars, then goes out when the fine tuning is turned to a smeared picture, that's fairly good proof the color signal is reaching the top of the color control. (The color burst is taken from that point; the burst operates the phase detectors; one phase detector plus Q92 takes care of the killer action; and the killer action changes the collector current

Chroma and sound circuits are on the circuit board to the left, deflection and IF boards are at the right.

of Q94, which controls the lighting of the lamp.)

At the other extreme, if the color-tuning lamp does not light at any time, even when the killer is jumpered, either Q94 is not drawing enough collector current, or the color-light circuit is defective.

Check DC voltages

When the color light doesn't operate, start testing by measuring the DC voltages at Q94. The collector should be around +18 volts, and the base should be about +.6 volt higher than the emitter.

Similarly, DC voltages at the light-control transistor (Q97) should be measured to prove or disprove any defect there. Because it is a PNP type, the base should be about .6 volt less positive than the emitter. And the collector should have enough voltage to light the bulb (4 volts or more for a 6-volt bulb, or 9 volts or more for a 12-volt bulb). Keep in mind that the forward bias for Q97 is developed by the collector current of Q94 flowing through R129. Both must be within tolerance for Q97 to have the proper bias. More Q94 current develops more forward bias for Q97, which in turn increases the Q97 collector current, lighting the bulb brighter.

No Color

In tube-powered color sets, chroma demodulation always was done in two separate stages; therefore, demodulator defects seldom would prevent all color. The use of IC's with a 3.58-MHz oscillator and both demodulators in one black box has taken that test from us. Now it's not too unusual for both demodulators to fail simultaneously.

If DC voltage tests of the IC are okay, or replacement of it doesn't bring back the color, it's necessary to find the stage where the color is lost.

Use snow as burst

One method is to use snow as a source of signal and measure the DC voltages that result.

Turn to a blank UHF channel. High frequencies of the video (snow) are amplified by Q95, the first chroma bandpass, and the output signal goes both to the second chroma stage, and through C137 to the base of the burst amplifier (Q93 in Figure 6). When the positive-going horizontal pulses reach the base, Q93 amplifies the color burst, which is applied to the phase-detector diodes, D94 and D95, producing DC voltages by rectification. Those DC voltages will be in proportion to how much the snow has been amplified.

An average reading is -5 volts at the anode of D95 (point M107 in Figure 7). When the snow is heavy and sharp, but the voltage is less than -5, it's likely the lack of gain is in the Q95 first chroma stage.

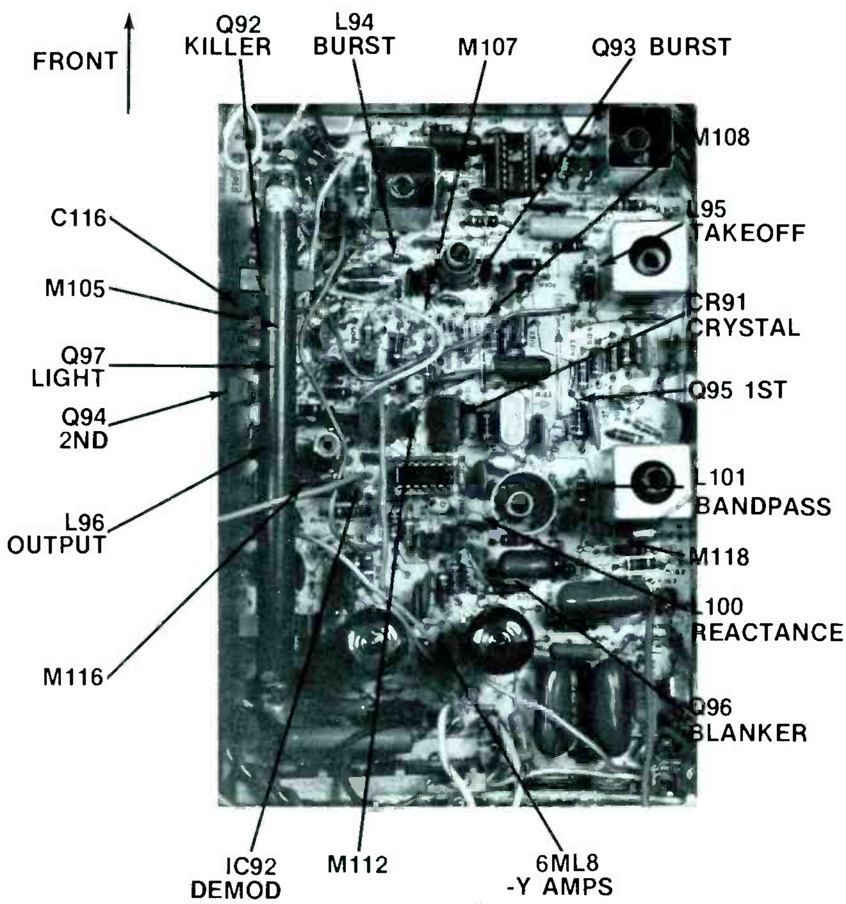
If this reading is obtained, but there is no color, the defect might be in IC92 or the second chroma stage (Q94).

Diode limiters

The two diodes, D96 and D97 of Figure 5, can be used to determine how much chroma-IF signal is being fed to pin 7 of the IC. They are provided to make certain excessive voltage does not reach that pin of the IC. This requirement probably includes excessive chroma signal, as well as minor arcs.

It would seem the diodes should eliminate all AC voltages, because they have opposite polarity; positive-going voltages would conduct through D97 and the negative-going ones through D96. However, silicon diodes below about .5 volt are open circuits, and they do not reach full conduction until the forward bias is about .8 volt. In power supplies, this bend of the curve is such a small percentage of the total voltage that it can be ignored. In this circuit, the chroma voltage is not clipped until it exceeds about 1.5 volts p-p.

Now, it's necessary only to disconnect **one** of the diodes, and the other becomes a half-wave rectifier. I ususally lift the ground lead of D97. If both chroma-bandpass amplifier stages have normal gain,



Arrows point to the major chroma components and test points.

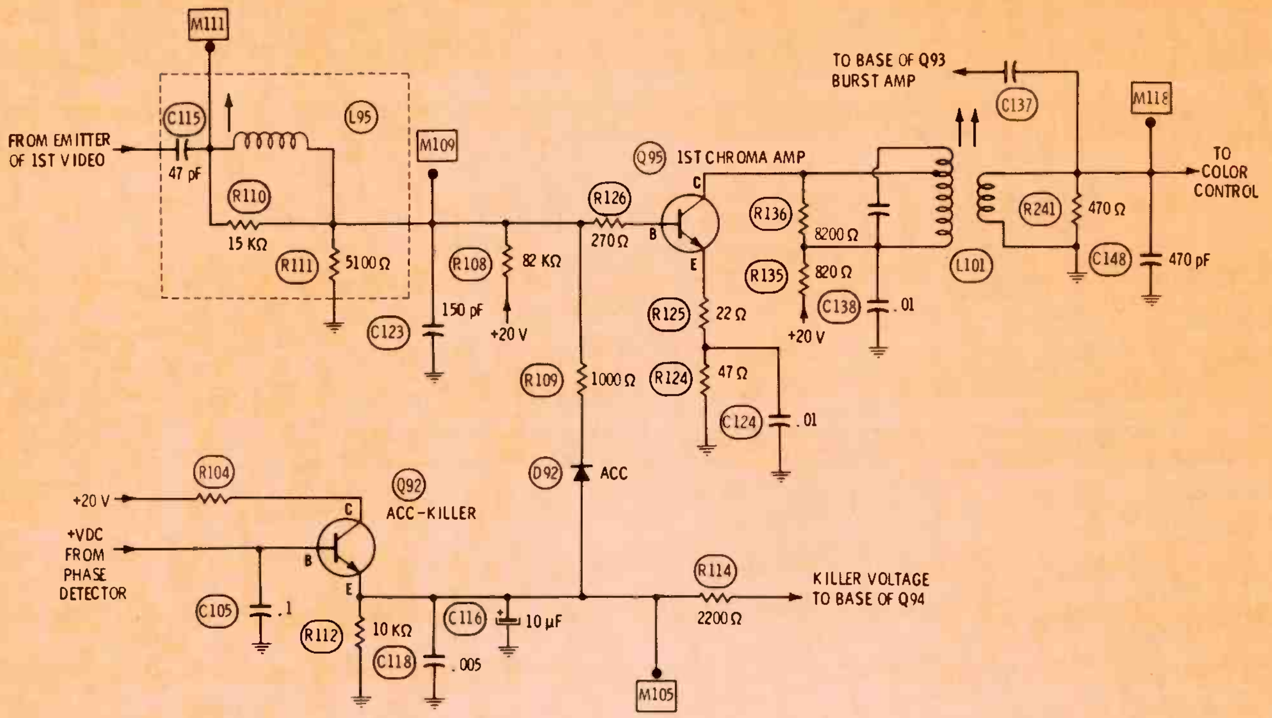


Fig. 3 R108 and R111 apply enough forward bias to Q95 to give normal gain. Excessive amplitude of burst at the ACC/killer phase detector causes Q92 to conduct and supply a positive voltage to D92, and D92 feeds the voltage to the base of Q95, reducing the gain. This is the ACC action. Burst is taken from the output of Q95.

a DC reading of about +.5 volts should appear at test point M116 (see Figure 8). Zero voltage means no signal is coming through L96. Of course, re-connect the diode after the test is completed.

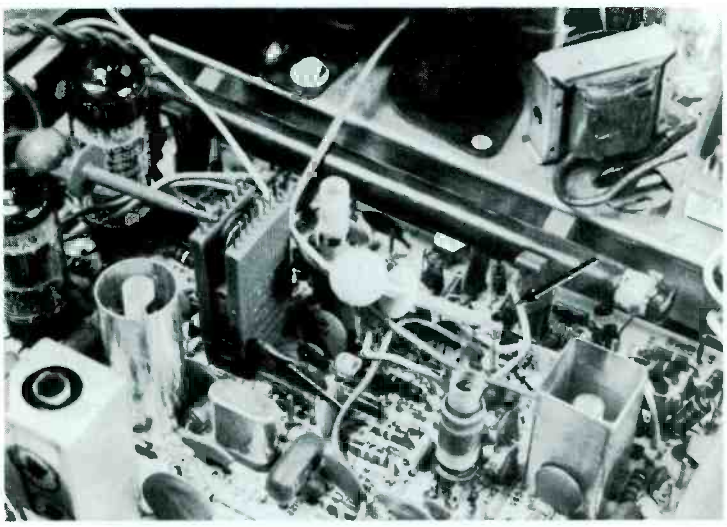


Fig. 4 If the voltages at the two points are not excessive, the killer and ACC can be clamped by connecting a test cable between C116 (just behind the front delay-line bracket) and pin 3 of IC92. The picture shows a Pomona DIP-CLIP used to extend the IC leads up high for easy connection. (Unfortunately, the photographer didn't count the pins correctly; pin 3 is the third one away from the 3.58-MHz crystal on the front side of the IC).

Some Case Histories

No color

Another technician brought to my shop a 2CY80 chassis that had no color. The snow on a vacant UHF channel was normal, indicating color should be available up to the chroma channel. Killer action was overridden by adjustment of the killer control; the color-indicator light came on proving Q94 was drawing collector current. With the color control at maximum, there was no color snow!

A voltmeter test at M107 showed -4.6, which is near enough to indicate the first chroma bandpass stage was amplifying. IC92 was replaced, with no change of symptoms.

These tests narrowed the field to the Q94 stage. DC voltages of the transistor were normal. D97 was unsoldered at the ground end, but there was no positive voltage at the cathode of D96 (M116).

Of course, D96 might be shorted, thus grounding the signal at M116. But an ohmmeter test proved the diode was good. The signal apparently was reaching Q94, which had correct voltages including forward bias; however, there was no signal at the output of Q94.

I was beginning to appreciate why the tech had brought me this tough one!

One of my helpful ideas is to imagine every amplifier as having two currents flowing; one is a DC current, and the other is the AC (signal) current. In this case, what could kill the AC but leave the DC? Bypass capacitors and tuned circuits are two possibilities.

I paralleled C128 and C117 with new .01 capacitors, but that did not produce any signal at M116.

Only one tuned circuit remained in the Q94 stage: L96. Resistance of the scondary seemed okay, but the primary checked zero ohms. I removed L96 and looked at it carefully under a magnifying glass. The lead going to the top of the primary coil was shorted to the bottom end of the coil. Only a few minutes were required to relocate the wire, reinstall the coil, and find **the color now was normal.**

Weak color

The color was so weak it barely could be seen on the picture from the 3CP30 chassis belonging to a retail customer. This model has no color killer, so I applied +1.5 volts to C116. It also has no color light, eliminating an easy test to determine conduction of Q94.

Off-channel snow was normal, but without any color flecks. At M107, a voltage test found -1.8 volts, which is much too low and indicated lack of gain in the first chroma stage.

DC voltages at Q95 showed base +1.2 volts and emitter zero. This is double the usual forward bias, but the zero emitter voltage proved a lack of conduction. Conclusion: base/emitter junction of Q95 was open. **Replacement of the transistor brought back the color.**

Low brightness

A Philco 2CY80 chassis came into the shop because of low brightness. Since that is a typical trouble (see Symcure this month), I easily found that R37 in the grid circuit of the video-output tube had decreased in value.

That solved the brightness problem, but the color would fall out of lock when the fine tuning was adjusted to remove the 920-KHz beat pattern. Also, I noticed the color saturation was barely enough with the color control at maximum.

Now, the receiver had a combination of symptoms. As stated before, sometimes this makes diagnosis easier. Because the burst signal is taken from the output of Q95, it seemed logical to assume that the defect was inside the first chroma stage.

Could D92, the ACC diode for this stage, be shorted? That would apply too much forward bias to the

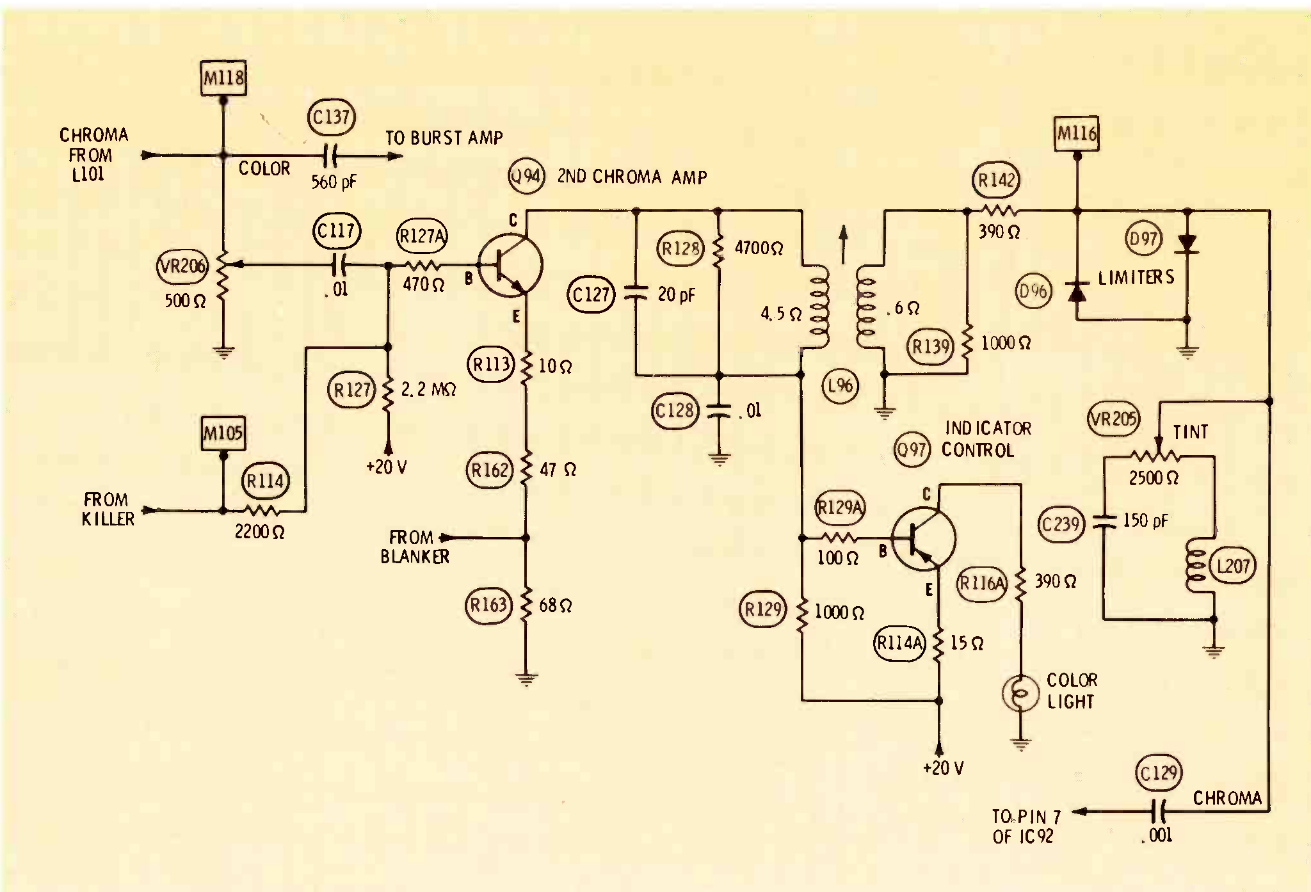


Fig. 5 Q94 does not have enough forward bias to give any gain until the killer transistor conducts. Forward bias to turn on Q97, the color light switch, is developed by the collector current of Q94 flowing through R129. One different feature is the limiter circuit (D96 and D97) used to prevent overload of IC92.

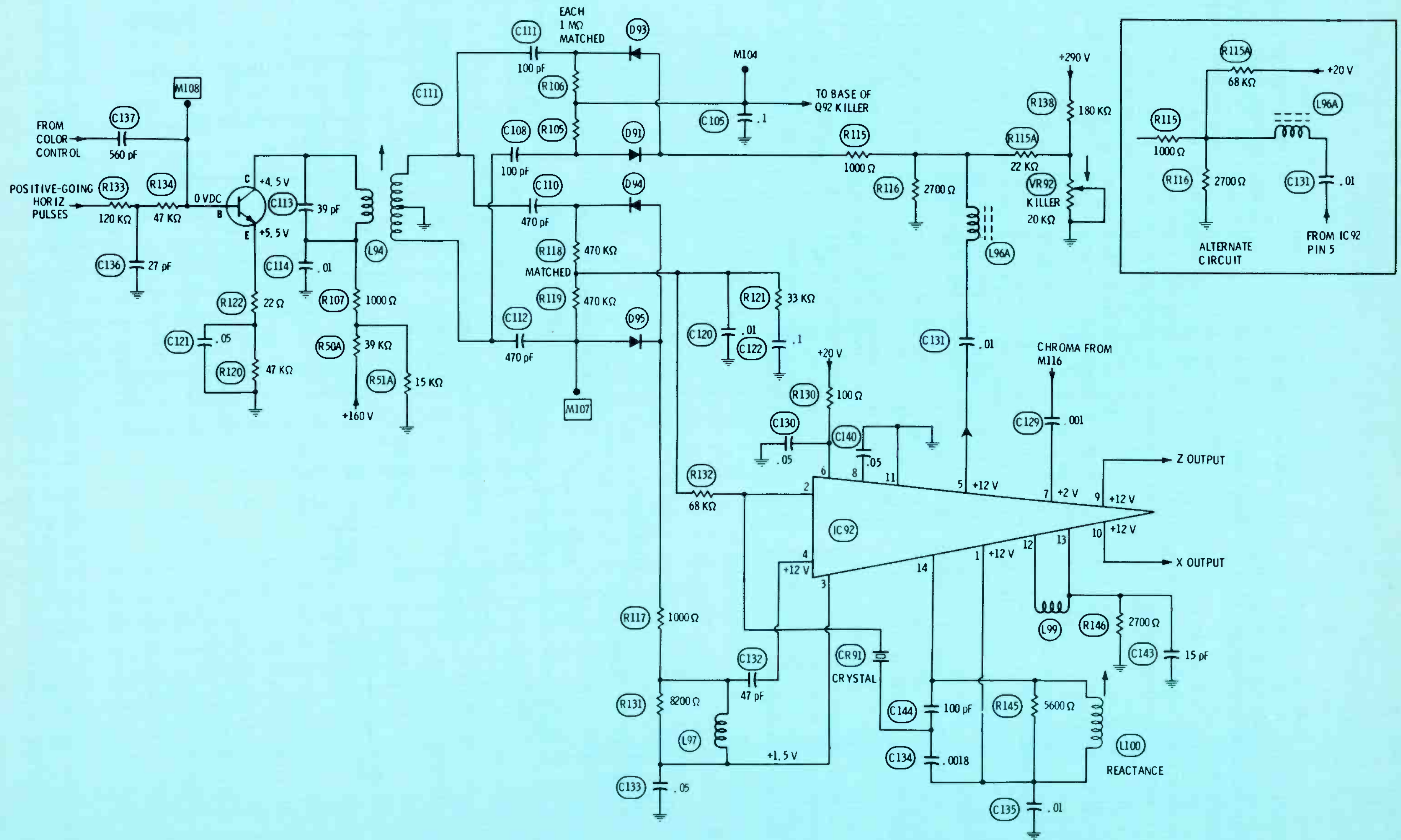

FROM COLOR CONTROL
POSITIVE-GOING HORIZ PULSES
C137 560 pF
M108
R133 120 KΩ
R134 47 KΩ
C136 27 pF
0 VDC
C +4.5 V
B
E +5.5 V
C113 39 pF
C114 .01
L94
R122 22 Ω
C121 .05
R120 47 KΩ
R107 1000 Ω
R50A 39 KΩ
R51A 15 KΩ
+160 V
C111
C111 100 pF
EACH 1 MΩ MATCHED
R106
R105
C108 100 pF
D93
D91
D94
D95
C110 470 pF
R118 470 KΩ
MATCHED
R119 470 KΩ
C112 470 pF
M107
M104
C105 .1
TO BASE OF Q92 KILLER
R115 1000 Ω
R116 2700 Ω
R115A 22 KΩ
+290 V
R138 180 KΩ
VR92 KILLER 20 KΩ
L96A
C131 .01
R121 33 KΩ
C120 .01
C122 .1
+20 V
R130 100 Ω
C130 .05
C140 .05
R132 68 KΩ
IC92
CHROMA FROM M116
C129 .001
+12 V
+2 V
+12 V
+12 V
+12 V
+12 V
Z OUTPUT
X OUTPUT
R117 1000 Ω
R131 8200 Ω
C132 47 pF
L97
+1.5 V
C133 .05
CR91 CRYSTAL
C144 100 pF
C134 .0018
R145 5600 Ω
C135 .01
L100 REACTANCE
L99
R146 2700 Ω
C143 15 pF
R115A 68 KΩ
+20 V
R115 1000 Ω
R116 2700 Ω
L96A
C131 .01
FROM IC 92 PIN 5
ALTERNATE CIRCUIT

Fig. 6 This schematic shows the burst amplifier, both phase detectors, the IC (which combines reactance, 3.58-MHz oscillator, and both color demodulators), and alternate wiring for those chassis not having a variable killer control.

base of Q95, thus reducing its gain by the saturation effect. But D92 was not shorted, and the DC voltages at Q95 were normal.

With the set tuned to a blank UHF channel, the voltage at point M107 was only -3.5 volts, instead of the expected -5 volts. It was certain the problem was in the first chroma bandpass stage.

If this was not a DC problem, then perhaps it was an AC defect. C124 was paralleled with a test capacitor, but there was no change. When C138 was shunted, the color suddenly came in with strong saturation and good locking. Then I noticed a cold-solder joint at the ground end of C138, and **a quick resoldering job completed the repairs.**

With C138 open, R135 became a part of the AC collector load, so some of the signal appeared across R135, leaving less for L101.

Troubleshooting Color Locking

Tube-equipped color oscillator circuits with a reactance stage controlled by a diode-type phase detector were adjusted easily to frequency by merely grounding the output of the phase detector (simulating a correct zero control voltage) and then adjusting the reactance coil until the single color picture floated by upright. This was called "zero-beating" the oscillator, and it was a good method.

Although the Philco circuit is the solid-state equivalent of those tube circuits, there is one important difference: solid-state devices need forward bias. Pin 2 of IC92 has about +1.25 volts coming from inside the IC. Therefore, it is not recommended that you ground the output of the phase detector (M112) before adjusting the reactance coil.

Instead, ground the base of the burst amplifier (M108) to remove the burst from the phase detector. Then adjust L100 for zero beat of the color.

You also can use these steps to determine whether the loss of locking is caused by weak burst or by wrong oscillator frequency. When M108 is grounded, notice the number of stripes of color in the picture. If there's less than two or three, the poor locking probably is due to a burst defect. However, many stripes of color indicate the oscillator is far out of frequency, either because of an oscillator trouble or because of a defect in the phase detector circuit (D94 and D95).

Comments

Of course, a scope can be used to locate many of the problems described here. I use one often. But, you don't always have a scope handy, and the voltmeter tests can help you to find most chroma troubles. In addition, voltage analysis of the circuits broadens our understanding about how they operate.

My next article deals with problems of interferences in color. □

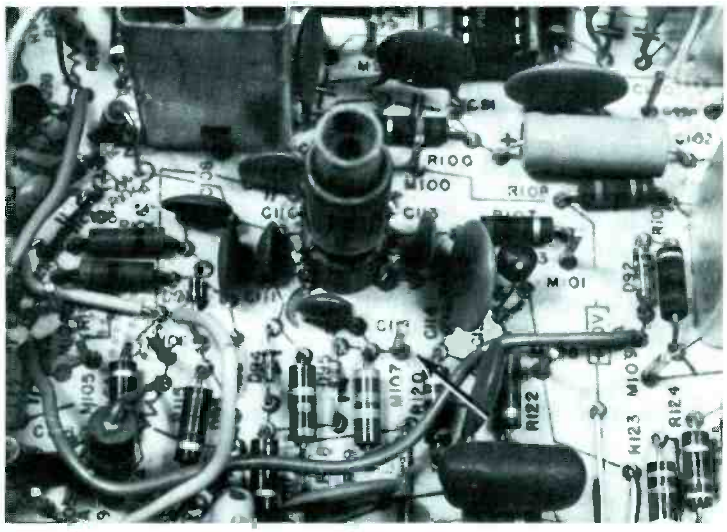


Fig. 7 Testpoint M107 is located slightly to the center and rear of the chassis from L94, the burst transformer. D95 and D4 are just to the left of M107.

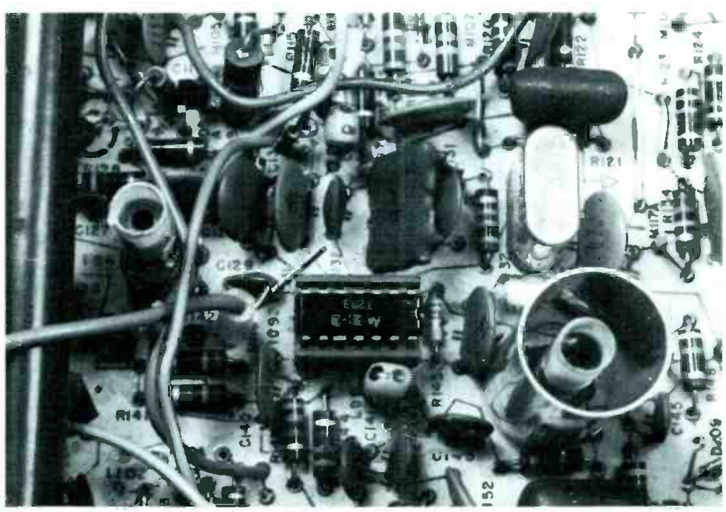


Fig. 8 Testpoint M116 is just to the left of IC92. A wire from there goes to the tint control on the front panel.

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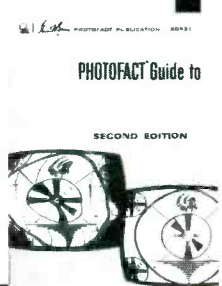

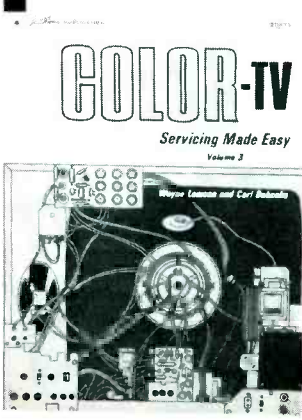

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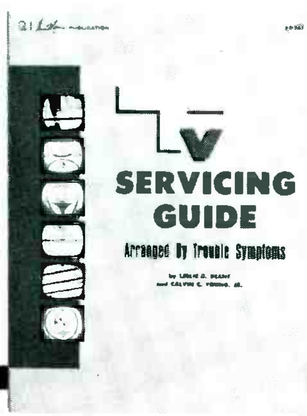

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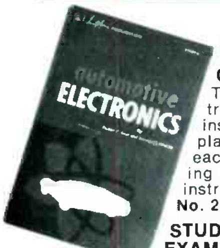

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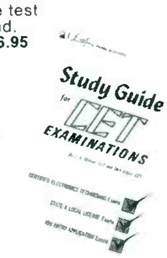

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Pricing Versus Consumerism

By Carl Babcoke

Wild variations of labor pricing arouse suspicions of fraud. Before too many shops are legislated out of business by the consumerists, the service industry should adopt a pricing system based on actual times of repairs, rather than by a flat job rate.

Recently, both state and federal government bureaus have held "investigations" of the pricing methods and honesty of electronic technicians in several cities. It is not my purpose to comment on them in this article (although some of their mistakes leave them vulnerable to criticism), but to use those events as illustrations of the need to "put our own house in order."

One crucial area is the pricing of repairs. No, not uniform pricing by dollars, for that is illegal "price fixing," but more accurate pricing based on the repairs actually done.

Methods Of The Past

Many service shops use a simple method of pricing all repair labor jobs the same. There is a fixed price for service calls, and an additional fixed price for those sets pulled for the bench.

Granted, you can **average** out the time and costs of a hundred such jobs and arrive at a price allowing you to make a modest profit. If this is your method, undoubtedly you are satisfied with it. Bookkeeping is minimized, estimates are easier, and you rationalize that the customers feel secure knowing there is a ceiling on the charges. Sounds ideal, doesn't it?

But, it takes little logic or mathematics to show that some people are paying too much to balance the ones who pay too little. How much longer will the rabid consumerists allow you to operate this way? Suppose an investigator places a service call with you, and after the preliminary examination, you pull the set for shop repairs. Perhaps you charge $59 shop labor to replace one sync capacitor. How much sympathy do you expect when you explain that $59 is your "flat rate" regardless of the time or difficulty?

John Sperry of Lincoln, Nebraska originated the Tech's Guide To Pricing.

Even worse, you are really caught red-handed if you charge $20 for a 50-cent capacitor and make the shop labor only $39! Yes, I know this type of billing sleight-of-hand has many precedents, originating perhaps in depression days of the 1930's when customers were even more unwilling to pay for labor than for parts. It will do you little good to protest that the **total** repair was priced reasonably.

Some of our critics might say that such over-simplified methods of repair pricing make no more sense than would a grocery store with **all** items priced at $1.00.

Another factor forcing pricing changes is the fewer number of jobs where you can compensate for an insufficient labor charge by the unusual markup on tubes. Transistors don't have those inflated list prices, and the normal profit on parts is little more than enough to pay the parts expenses.

The Dilemma

There are several alternatives to the one-price method, although they have some drawbacks. Perhaps the best solution is to charge for **all** labor time (at a per-hour price based on actual costs), and to bill all parts at the normal percentage of markup.

Undoubtedly, this will bring resistance from those customers who receive higher billings. What's more, some of the consumer's bargains will be gone. After many of you, who have been working 10 to 14 hours per day for about 8-hours pay, figure your cost of doing business (and recover from the shock of finding how high it is), you'll raise your prices to compensate.

Almost everything the authorities are demanding (in order to control the few "rotten apples" in the electronics barrel) is going to cost the consumer more. Certainly, the service shops can't absorb the extra costs of legally-binding written estimates which are sent through the mail, compulsory insurance, and the bills for additional printing and red tape. And the public in general must pay for the governmental agencies which will be required to police, investigate, and prosecute any suspected lawbreakers, should such legislation be passed.

However, as you can see, there is little choice; changes are being forced on the industry.

Now, suppose you decide you must change to pricing by the actual time used. How do you go about it? The thought of clocking every step of every repair is bad enough. Even worse is the problem of making estimates. Perhaps we can get ideas from other fields which also have had similar problems.

One Solution

One practical plan comes from the automotive industry, and the flat-rate **time** charts used for decades. Every servicing operation is broken down into minutes or tenths of hours. When the job is completed, the foreman totals the time and multiplies by the hourly labor rate.

A similar plan for repairing home-electronic equipment has been on the market since last year, and has been advertized in **Electronic Servicing.** It's called **Tech's Guide To Pricing** by John Sperry, and is (so far as we know) the only complete system of this kind on the market today.

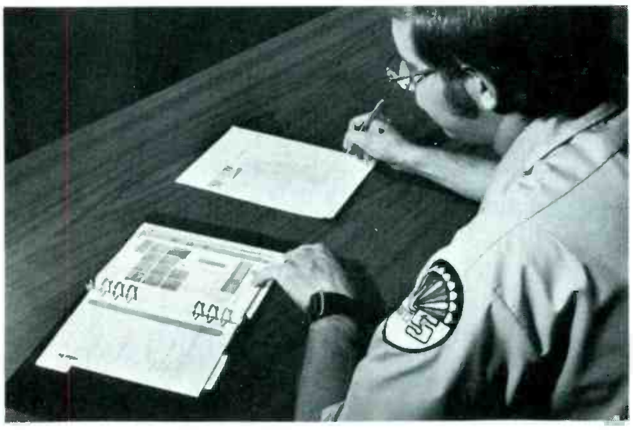
How It Began

Years ago, John Sperry (Sperry TV of Lincoln, Nebraska) wanted to start pricing repairs by the amount of time required. There was no industry list of repair times, and none of the TV manufacturers could offer guidance. So, John started timing typical repairs. His technicians recall the many times they looked up from their work and noticed the boss with his stop watch.

Since then, John has used the

system in his own business to check out the times for accuracy.

At one stage of the planning, I consulted briefly with John, and I can testify to the agonizing decisions that are necessary to reduce the hundreds or thousands of possible repair times to a manageable few (without reaching the other extreme of the one-price-for-all system). Therefore, if you try to develop your own system, lots of luck!



Michael Lukens, Sperry TV technician, is shown using the Tech's Guide To Pricing to bill the repair of a color TV.

Does The System Work?

Of course, no shop manager wants to change to another pricing system that would reduce the income, require an excessive amount of paperwork, or be complicated to use. So, you need to know how the Sperry system works in practice. Although I have examined the book, and have priced a few imaginary jobs, I haven't had enough experience to answer the question. But John Sperry can give you the names of dozens of men who have used the system, and their comments about it.

The following description of the book should give you some ideas of the Sperry Pricing system.

Background and examples

The first 25 pages list much information about how to use Tech's Guide, how to estimate your hourly rate, and examples of typical pricing using this system.

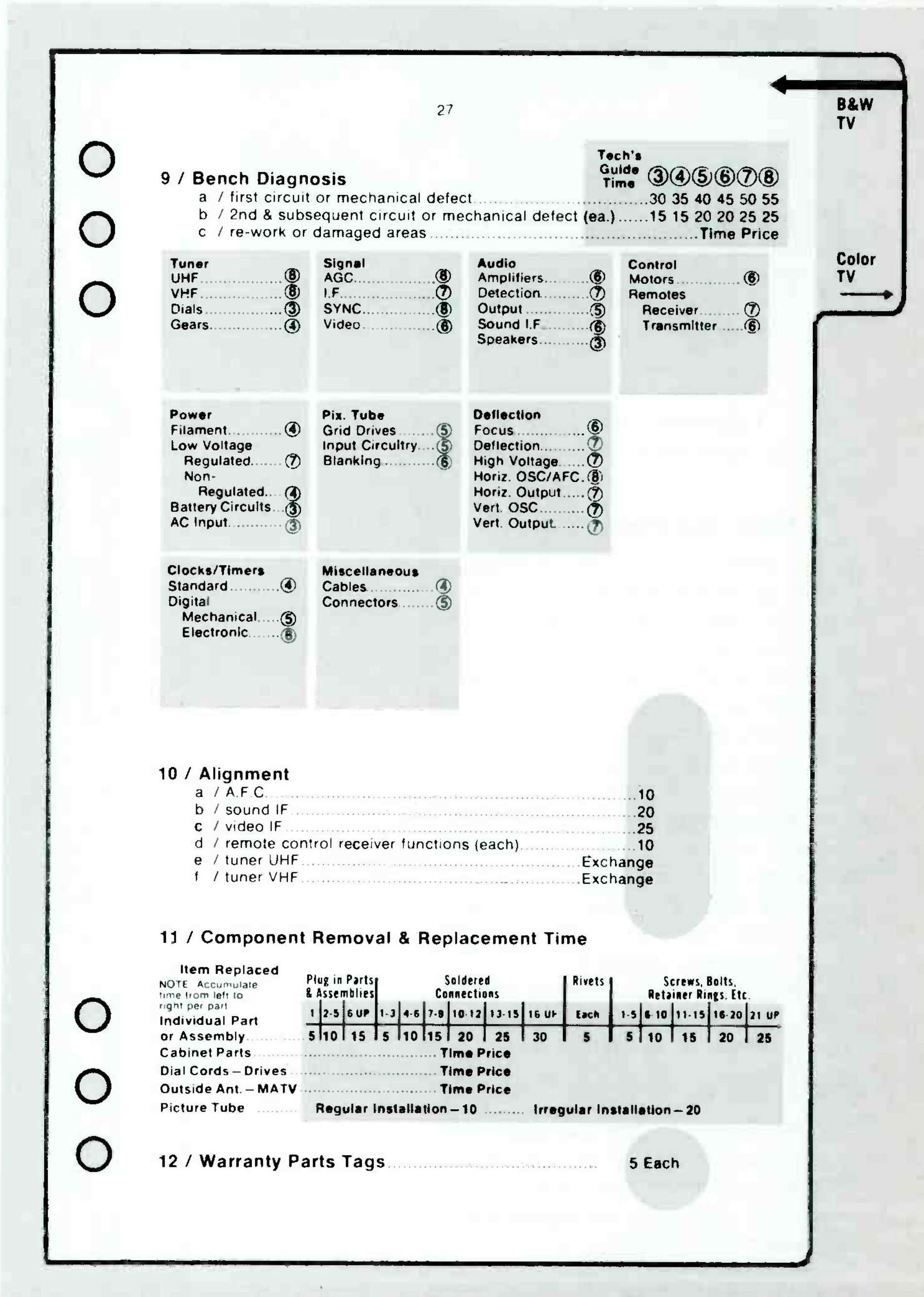
Repair steps and times

Next are the listings of 19 different classes of products, such as B&W TV, Color TV, Intercom Systems, etc, with the first page of each classification marked with a large index tab for fast location.

Each of the 19 product classifications occupy facing pages (to eliminate page turning while pricing) and is divided into 12 numbered sections (Preliminary Diagnosis, Adjustments, Alignment, etc.), which are the same for each product. Every section has sub-listings with either a time in minutes or a reference to a time chart on the same page (see Figure 1). In cases of multiple defects, allowances are made giving reduced times for the second and subsequent repairs.

Calculator charts

At the back of the book are 30 pages of Time Calculator charts listing the time in minutes versus the price in dollars for times in 5-minute steps from 5 minutes to 340 minutes for one-man hourly rates from \$8.40 to \$36.00 in 60-cent steps. Each page also has 8 different rates per time listing for a two-man crew.



27

B&W TV

Color TV

9 / Bench Diagnosis

	Tech's Guide Time ③	④	⑤	⑥	⑦	⑧
a / first circuit or mechanical defect	30	35	40	45	50	55
b / 2nd & subsequent circuit or mechanical defect (ea.)	15	15	20	20	25	25
c / re-work or damaged areas	Time Price					

Tuner
UHF ⑧
VHF ⑧
Dials ③
Gears ④

Signal
AGC ⑧
I.F. ⑦
SYNC ⑧
Video ⑥

Audio
Amplifiers ⑥
Detection ⑦
Output ⑤
Sound I.F. ⑥
Speakers ③

Control
Motors ⑥
Remotes
Receiver ⑦
Transmitter ⑥

Power
Filament ④
Low Voltage
Regulated ⑦
Non-Regulated ④
Battery Circuits ③
AC Input ③

Pix. Tube
Grid Drives ⑤
Input Circuitry ⑤
Blanking ⑥

Deflection
Focus ⑥
Deflection ⑦
High Voltage ⑦
Horiz. OSC/AFC ⑧
Horiz. Output ⑦
Vert. OSC ⑦
Vert. Output ⑦

Clocks/Timers
Standard ④
Digital
Mechanical ⑤
Electronic ⑧

Miscellaneous
Cables ④
Connectors ⑤

10 / Alignment

a / A.F.C. 10
b / sound IF 20
c / video IF 25
d / remote control receiver functions (each) 10
e / tuner UHF .... Exchange
f / tuner VHF .... Exchange

11 / Component Removal & Replacement Time

Item Replaced (NOTE Accumulate time from left to right per part)	Plug in Parts & Assemblies			Soldered Connections						Rivets	Screws, Bolts, Retainer Rings, Etc.				
	1	2-5	6 UP	1-3	4-6	7-9	10-12	13-15	16 UP	Each	1-5	6-10	11-15	16-20	21 UP
Individual Part or Assembly	5	10	15	5	10	15	20	25	30	5	5	10	15	20	25
Cabinet Parts	Time Price														
Dial Cords – Drives	Time Price														
Outside Ant. – MATV	Time Price														
Picture Tube	Regular Installation – 10						Irregular Installation – 20								

12 / Warranty Parts Tags .... 5 Each

Fig. 1 An example of the pricing coverage is the second page of the B&W TV listing. (Courtesy of Sperry Tech, Inc.)

Here's how to use the Calculator Charts:

- total the times listed for the individual repairs;
- turn to the page having **your** hourly rate:
- skim down the time column for your total time; and
- the labor price in dollars is just to the right. That's all.

Other Features

The pricing guide book is made in a 6-hole notebook format, with heavy plastic covers and thick plastic-coated pages for durability. I would guess that most smudges could be wiped from the pages.

Any or all of the pages can be removed and replaced at any time. However, I don't recommend that many unused ones be removed, they might be useful for review or to show a customer. And the system of locating tabs makes the task of finding the right section so easy that the extra pages are no bother.

One possible exception to this advice is to remove all of the Price Calculator pages except the one with your current per-hour rates. Store the extra pages in a safe place in case you change the rates at a later date.

Conclusion

Some surveys have shown repair prices for the same service in the same general area might differ by as much as 300%. There's not that much difference in technician's pay or the profit of the various shops. So, it is evident that much of the variation is due either to guessing the prices or to unrealistic billing of all repairs the same.

When these conditions are given wide publicity in the news media, the general image of electronic shops again will plummet.

All service customers want to do business with companies they can respect and trust. A customer surely will be impressed favorably by watching you price his job with the same manual you used to price the neighbor's repairs.

One important value of a pricing system in book form is the strong psychological impact both on customers and on government bureaus. Partially, **this is the power of "outside authority"**, and it gives the feeling that great effort has been expended in creating a system that's fair to both sides.

Industry-wide adoption of the Sperry Tech's Guide, or a similar system, would be a giant step toward improving the image of the electronic-repair industry. □

How to select ladders for value and safety

By **Norman Ackerman**, Vice-President of Marketing, Perma Power Corporation

A ladder can save its cost over a period of time, if it has convenience features and the best specifications for the job, requires minimum maintenance, and has a long useful lifespan. A ladder expert offers valuable tips.

Fig. 1 Typically, an extension ladder is used for installations of outside antennas.

Although the subject of ladders is not likely to arouse any strong emotions, or even much interest, it **is** important to anyone who ever will be required to climb one. After all, it's **your** time you might waste in using an inferior ladder, and it's **your** injuries you might suffer because of an unsafe one.

What's more, it might surprise you to find out how much there is to know about ladders. Even if you are not using ladders just now, file this information for future use.

Selecting The Right Ladder

When selecting a ladder, you must choose the right type, size, strength, material, and features. Other important considerations include storage and maintenance requirements.

Types Of Ladders

There are three general types of ladders commonly used for repairing or installing antennas and MATV systems.

Most common is the self-standing stepladder, usually available in lengths from 5 feet to 10 feet. The next type is known by several names, such as: straight, single or wall type, and comes in various lengths from 12 feet to 24 feet.

The third type, a variation of the straight ladder, is the extension ladder (Figure 1). They are made with two specialized kinds of straight sections nested together so the top section can be extended to various heights. Generally, extension ladders are available in four-foot multiples from 16 to 40 feet.

Each type has advantages and limitations. Stepladders are most useful where there are no walls near enough to support the other kinds. Also, stepladders can be placed at right angles to a wall, allowing you to work from ground level to the maximum height.

Extension ladders can do the same jobs as those required of simple straight ladders; in addition, they are adjustable in length, and usually have greater maximum lengths. However, they are heavier and more costly. You must decide on the type, based on your requirements.

What Size Is Needed?

When using a stepladder, you should not stand higher than on the third step from the top. This gives a place to brace the legs, or a steadying handhold. Maximum working height is the highest you can reach comfortably with arms extended, while standing on the third from the top step.

The base of a straight ladder should be moved out from the wall or eave (called the bearing point) to prevent any possibility of the ladder and user tipping over backwards. Also, the ladder should **not** be spaced too far from the bearing point, to keep the base of the ladder from sliding away.

A handy rule-of-thumb is to set the base of the ladder about one-fourth of the distance from the ground to the bearing point. So, if the top of a 16-foot ladder is resting against a wall, the bottom should be about 4 feet away from the base of the wall. Similarly, if a 20-foot extension ladder is resting against an eave 16 feet off the ground, the bottom should be 4 feet farther out than the eave (Figure 2).

That basic necessity affects the selection of the proper length in two different ways. First, there's the theorem of the hypotenuse of a right triangle. Calculation for a 4/1 ratio of triangle gives a hypotenuse

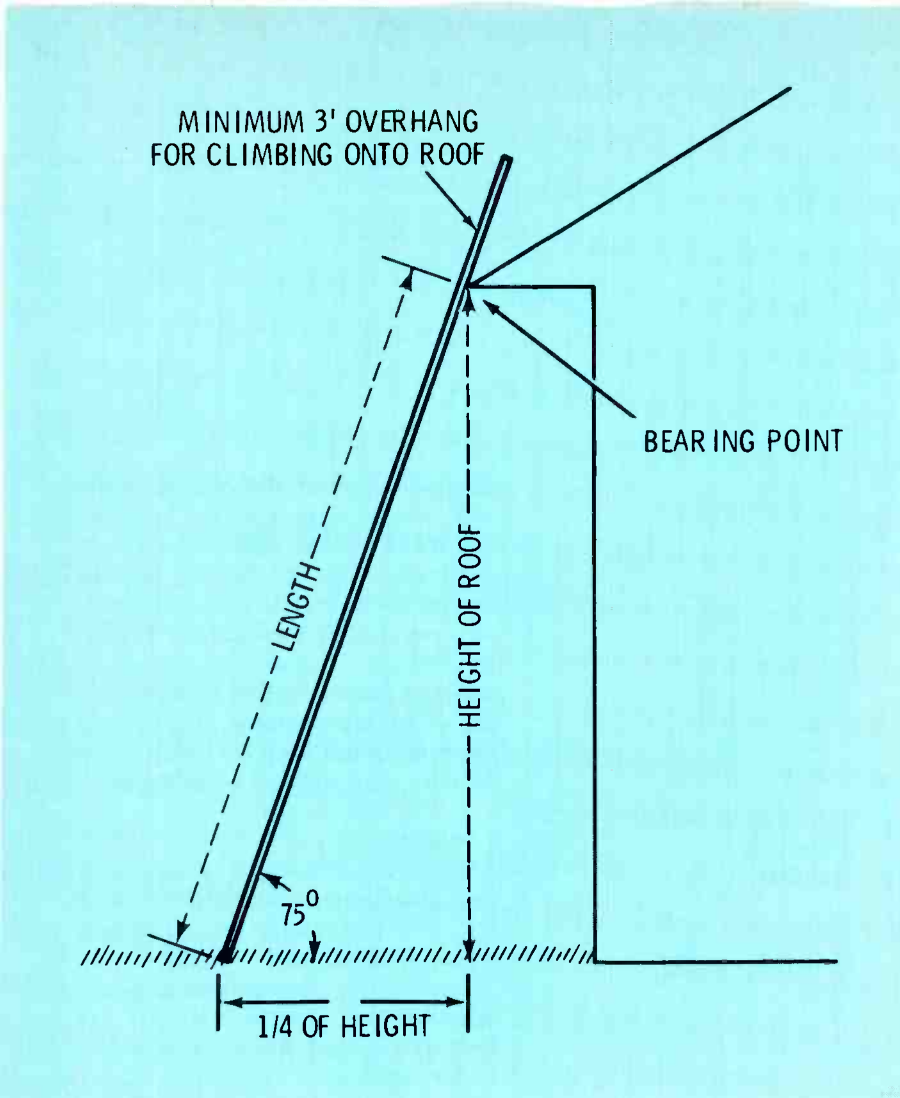


Fig. 2 When a ladder is leaning against an eave, the eave becomes the bearing point, and the ground directly below is the place from which to measure the horizontal distance to the foot of the ladder. Three feet, or more, of ladder must extend above the eaves, if you intend to climb onto the roof.

(ladder) length of almost 104% of the height. So, a 16-foot ladder would not reach an eave that's 16 feet from the ground. The next longer size must be selected.

Next is the question of the working height that is needed. Since a straight ladder is inclined toward the wall, a man on the ladder can't work against the wall until he reaches a certain height. Thus, the approximate minimum working height for a 16-foot straight ladder, with the top bearing against a wall, is 12.5 feet above the ground, and the maximum safe working height is reached by a man standing on the third rung from the top (Figure 3).

When a straight ladder is used by a man climbing onto a roof, the bearing point is where the ladder touches the eaves or gutters. The top of the ladder should extend 36 inches (or more) above that bearing point. This is an OSHA requirement, providing the climber with a safe handhold on the top of the ladder as he swings around onto the roof.

The data of Table 1 should help you determine the size ladder to purchase for the various heights.

Extension-Ladder Sizes

The size of an extension ladder is the total length of the two sections. That is, a 20-foot extension ladder consists of two 10-foot sections. Of course, for strength, the two sections must be overlapped a minimum of three feet. That puts the maximum **useable** length of a 20-foot extension ladder at 17 feet.

Much useful information about extension ladders is given in Table 2. The minimum working height range applies to the lowest point on a completely-closed extension ladder from which a man can reach the wall. For climbing onto the roof, the table allows for the minimum 36-inch overhang, plus the slight reduction of height brought about by the angle of the ladder against the wall. The maximum working height is for a man standing on the third rung from the top of the ladder when it is leaning against the wall. Thus, to climb onto a roof 17 feet from the ground, you need a 24-foot ladder.

As an aid in determining what ladder sizes to select, most manufacturers provide figures for typical houses. Although sizes can vary widely, the typical single-story dwelling has eaves that are approximately 11 feet from the ground, and the top of the roof about 17 feet from the ground; for this use a 24-foot ladder. A two-story dwelling has eaves approximately 19 feet from the ground, and the top of the roof is about 25 feet high; so use a 28-foot ladder.

Select the Right Duty Rating

After you've chosen the ladder size you need, look for a ladder of the right strength. The American National Standards Institute (ANSI) has established three duty ratings that are based on supporting the weight of a 200-pound man carrying various loads.

The Type I (Heavy-Duty) rating is based on a 250-pound load, or the equivalent of a man with a 50 pound load. Testing requirements, however, provide a four-times safety factor, so that a Type I duty rating is applied only when the ladder is tested to 1000 pounds.

In the near future, OSHA regulations are likely to be based on these ANSI standards. It then will become mandatory for electronic service industry personnel to use ladders with a Type I (heavy-duty) rating. A ladder for professional use also should have an Underwriters' Laboratories label.

Type II ladders are only appropriate for light-duty commercial requirements, as in infrequent

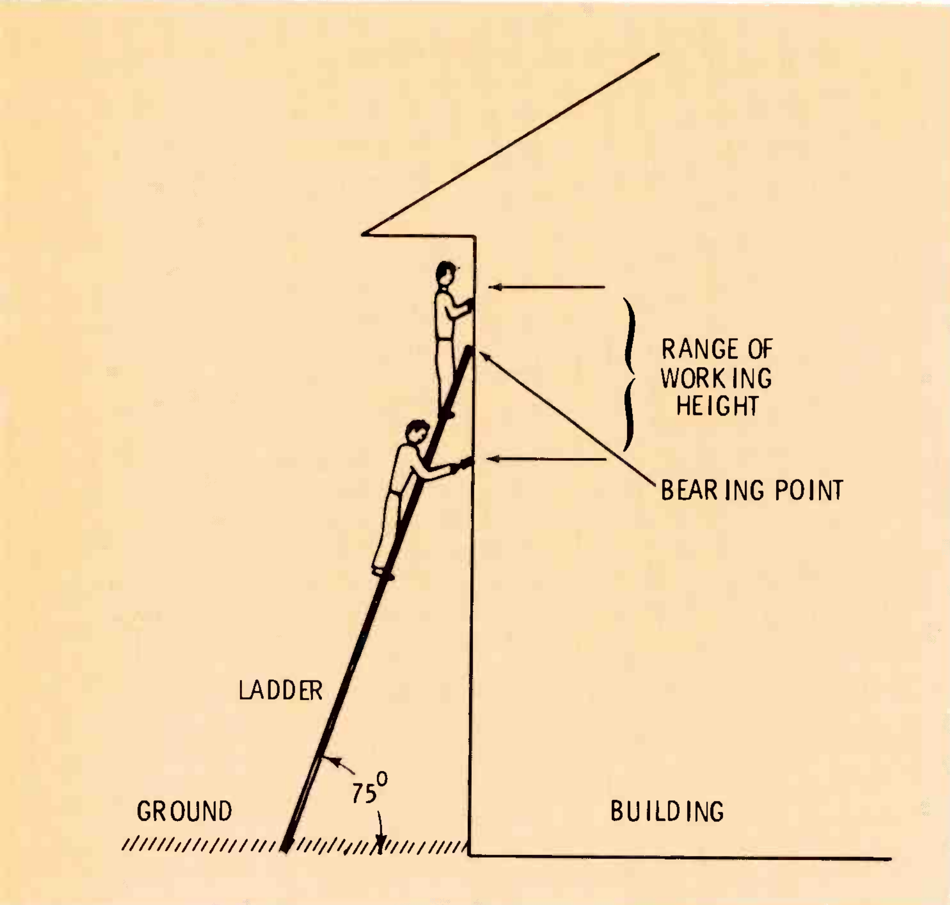


Fig. 3 Minimum working height is the lowest point on the ladder where you can reach the wall. Maximum working height is how high you can reach when standing on the third rung from the top; it's not safe to go higher.

maintenance use and in offices. Type III (Light-Duty) ladders are only appropriate for household use. Generally, hardware stores sell household and commercial ladders, Types II and III. Heavy-Duty Type I ladders can be found at industrial, maintenance, and some electrical supply outlets, as well as at some electronic distributors. For TV servicemen, the electronic distributor is an ideal source from the standpoint of convenience. Moreover, his stock will reflect those ladders particularly well-suited for your needs.

Ladder Materials

Portable, one-man ladders with a Type I rating are available in three materials: wood, fiberglass, and aluminum. Each material has its own advantages and shortcomings.

Wood

The greatest advantage of wood as a ladder material is its low cost. It is considered easy to care for and maintain. The main disadvantage of wood is that it becomes unreliable, especially as the ladder ages; also, it weakens under testing. In addition, wood's heaviness makes the ladder more difficult to move and erect. Exposure to moisture can make a wood ladder electrically conductive, so it should not be trusted for electrical work. Moisture also can double the ladder's weight, as well as cause the wood to splinter, rot, and warp, in ways that are often undetectable. That's why there are more accidents with wood ladders than with all other types.

Fiberglass

Fiberglass-reinforced plastic is a desirable ladder material because of its excellent insulating qualities, light weight, and resistance to corrosion. Its primary disadvantages are that fiberglass ladders are expensive, and they deteriorate under prolonged exposure (about one year) to environmental elements, especially direct sunlight. There also exists the danger of skin and eye injuries from splinters, flakes, and fraying fibers.

Aluminum

Aluminum has the best combination of qualities of any ladder material. Besides being moderate in cost, aluminum also can be designed to specific load requirements. Aluminum's light weight permits the ladder to be moved and erected easily. Since it resists moisture and does not corrode, it stands up well to rugged use and environmental exposure. Most manufacturers, therefore, provide guarantees extending up to twelve years. Obviously, it's worth paying a little more for a ladder that's guaranteed to last, rather than buying one you'll have to replace in a year or so. The only limitation is that it should not be used for electrical work unless it is mounted in an insulated stand.

Features

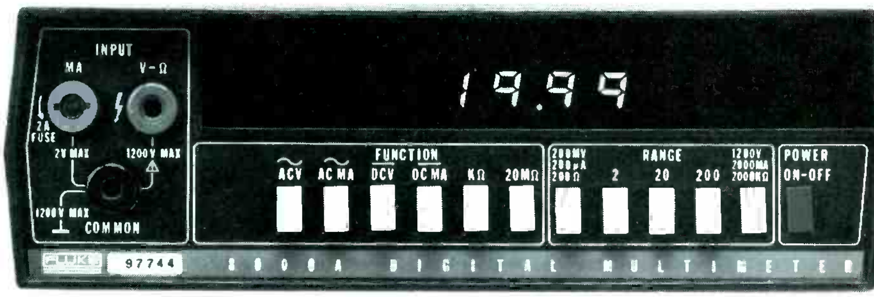
Before any ladder purchase there

Your VTVM is obsolete!

This may sound like a harsh claim, but it's true. Thousands of TV technicians are using instruments designed in the 1950's to troubleshoot circuits designed in the 1970's.

And now, most color TV's have solid state circuits. So use of out-of-date test equipment just compounds the problem.

The generation gap has grown too big.



Resolution is 100 microvolts, 100 nanoamps and 100 milliohms

The Fluke 8000A 3½ digit multimeter

Solid state calls for new performance standards.

Your "old fashioned" test equipment simply doesn't measure up to today's requirements. For example, the typical VTVM gives you 5% accuracy and 2% resolution. In the old days, that was good enough. Not so today.

Now you need an instrument to look at the voltages at each pin of an IC with sufficient accuracy and resolution to determine proper IC operation.

For example, a reading of "around 2.8 volts" is no longer sufficient. You must be able to distinguish between 2.80 and 2.82 volts.

You need a test instrument that gives you 0.1 ohm resolution so you can reliably measure resistance of switch contacts, circuit breakers, and low value resistors.

To do all this and more, you need the superior capabilities of the Fluke 8000A 3½ digit multimeter.

An instrument designed specifically for testing solid state equipment.

The 8000A gives you up to 50 times the accuracy and 20 times the resolution of a VTVM, so you can measure the various voltage levels in a solid state chassis with absolute confidence.

You get the sensitivity you need for low level dc measurements. The 200 millivolt range with 100 microvolt resolution tells you *exactly* what your values are.

The 8000A has an AC frequency response from 45 Hz to 20 KHz and, with accessory probes, to 500 megahertz. Resistance measuring capability ranges from 100 milliohms to 20 megohms. It offers a 15°C to 35°C accuracy temperature span. And a 1-year accuracy time span, meaning it seldom needs calibration.

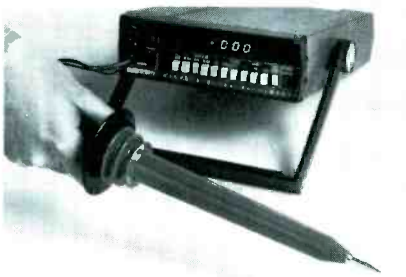
Unlike other DMM's the 8000A has fast response time—3 readings a second. And the bright, digital readout means that no interpolation is necessary.

The 8000A measures high voltages, too.

Our 8000A is designed to answer *all* the needs of an electronic service technician.

One very important (and talked about!) safety requirement is that the picture tube anode voltage must not exceed the maximum specified by the manufacturer. Our 8000A has an optional high voltage probe that gives you guaranteed accuracy of 1% at 25,000 volts. The probe also extends the capability of the 8000A to 40,000 volts to measure the high voltage in the new 32,000 volt chassis.

No other DMM's offer this feature.



High voltage probe accessory gives you 1% accuracy at 25,000 volts

Get the most up-to-date instrument available.

Don't be caught in the typical trap. Many electronic service shops don't really update their equipment when they decide to update. Switching to a TVM or a FET voltmeter doesn't really give you the accuracy and resolution you need today, or for that matter, tomorrow.

But with the 8000A on hand, you know you have a *true* solid state testing device . . . an instrument that can do the job the way it should be done.

Carry it anywhere. Use it on line or rechargeable battery power.
Note the conveniently mounted specs on the bottom decal. They're always with you.

The 8000A comes from Fluke, one of the largest instrument companies in the U.S.

It costs just $299 ($40 more with HV probe).* And it is far and away the largest selling, most rugged and reliable 3½ digit multimeter in the world.

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Table 1 Ratings for straight ladders

Ladder length	Max. height of bearing point	Horiz. distance at base	Range of working height
12'	11.6'	3'	8.5'—14.5'
16'	15.5'	4'	12.5'—18.5'
20'	19.4'	5'	16.5'—22.5'

are a number of things that should be checked. This will help to ensure a safe ladder that will provide years of dependable service.

Siderails

Look for metal ribbing—with an "I" or "Z" shape—to provide high strength with minimal weight (especially important with larger ladders).

Rungs

Make sure rungs will not twist in the siderails. They should be flat, preferably at least 3-1/2 inches across the flat and have non-skid treads that will provide positive footing at all levels. Rungs should be horizontal when the ladder is in working position.

Foot Assembly

The foot assembly should be wide and slip-resistant so it will not sink easily into soft ground. It should have provision for the use of ground spikes. High-quality ladders usually incorporate serrated ice cleats that are flipped into position.

Pull Rope and Pulley

The pulley assembly on an extension ladder should be of good quality, with the pull rope ample for the size of the ladder. Newer ladders use a polypropylene rope that will not deteriorate through environmental exposure.

Locking Assembly

One of the most important points to examine is the locking assembly that holds the extended section, to be sure it provides positive foolproof engagement.

Maintaining Ladders

Good ladder maintenance begins with proper storage. Ladders should be stored away from harsh weather, excessive heat, and strong chemicals. They should be hung on three or more supports equally along the length of the ladder so as to avoid any undue stress on any portion of the ladder.

Moving parts—extension locks, pulley, foot assemblies—should be lubricated occasionally. Avoid getting oil on the rungs. Regularly examine the siderails, rungs (for secureness and wear), and pull ropes. Metal ladders should not be twisted or distorted, and should be free from sharp edges and corrosion (especially the interiors of open and hollow rungs). Wood and fiberglass ladders should be examined for splinters and other evidence of deterioration.

Wooden ladders should not be painted, since this conceals possible defects. New wooden ladders can be coated with a clear preservative, such as varnish or lacquer, or brushed with linseed oil as recommended by some manufacturers.

Before each use, all nuts and bolts should be checked for tightness. The rungs should be clear of oil, grease, mud, or other contaminates.

Setting Up The Ladder

Before using a ladder, check that the ground surface is firm and level. On soft earth, use a wide, flat board to level the legs and prevent sinking. On ice or packed snow, use ice cleats or ground spikes and sand bags.

Other hazards also should be checked before setting up any ladder. **If doors can open toward the ladder, lock them or block them.** Secondly, check overhead for any electrical wires that present a potential hazard, (especially important when a metal ladder is being used). These precautions, incidentally, are specifically required by OSHA.

Whenever possible, have a second person help you erect an extension ladder. Brace the bottom of the ladder against some stationary object, or have someone hold it down so that it does not slide. Lift the top part of the ladder, then walk under it and slowly raise the ladder, rung by rung, until it is vertical. Next, lean the ladder against the building. At this point, the feet of the ladder should be placed (as far as possible) in the position where the extended ladder will rest. When the top section is raised it will become increasingly difficult to move the entire ladder. As noted above, the feet of the ladder should be one-fourth of the length from the ground to the bearing point. The ladder should meet the ground at a 75° angle, and the rungs should be horizontal in this position.

Make sure the locking hooks for the top section are free, then raise the extension with the pull rope until the desired height is reached. Secure the extended section firmly by engaging the locking hooks. Use care, since from the ground a hook that is merely balanced on a rung can appear to be engaged.

There should be two feet (or more) of width at each bearing point, so minor shifts of position will not force the ladder to rest only on a single point.

Whenever possible, the top of the ladder should be tied to a stationary object, especially on windy days. When the ladder is used against the eaves of a house, a rope attached to the top of the ladder should be thrown over the roof and fastened securely to a stationary object on the other side.

Most ladder accidents result from the ladder slipping and falling, so the importance of properly erecting a ladder cannot be overemphasized.

Safe Ladder Usage

Before climbing a ladder, make

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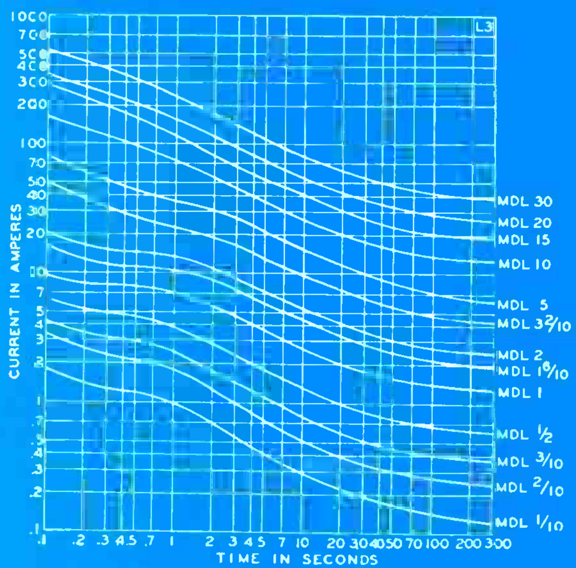
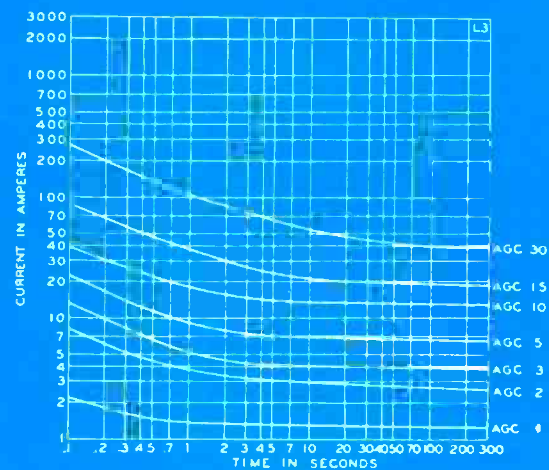
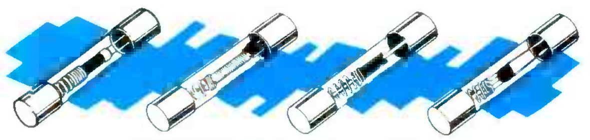
Time-current characteristics of FUSETRON® dual-element time-delay fuses



Time-current characteristics of BUSS® fast-acting fuses

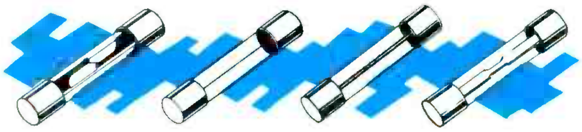




FUSETRON® dual-element fuses

Time-delay characteristics avoid nuisance openings from starting currents or surges—yet, give full protection from short-circuits or dangerous overloads.

Voltage	Symbol	Amperes
250 or less	**MDL**	1/100, 1/32, 1/16, 1/10, 1/8, 15/100, 175/1000, 3/16, 2/10, 1/4, 3/10, 3/8, 4/10, 1/2, 6/10, 7/10, 3/4, 8/10 or 1
250 or less	**MDX**	1-1/4, 1-1/2, 1-6/10, 1-8/10 or 2
125 or less	**MDL**	1-2/10, 1-1/4, 1-1/2, 1-6/10, 2, 2-1/2, or 2-8/10
125 or less	**MDX**	3, 3-2/10, 4, 5, 6-1/4 or 7
32 or less	**MDL**	3, 3-2/10, 4, 5, 6-1/4, 8, 10, 15, 20, 25 or 30



BUSS® fast-acting fuses

Fast-acting characteristics provide the instantaneous high speed opening necessary to protect sensitive instruments or delicate apparatus.

Voltage	Symbol	Amperes
250 or less	**AGC**	1/500, 1/200, 1/100, 1/32, 1/16, 1/10, 1/8, 15/100, 175/1000, 3/16, 2/10, 1/4, 3/10, 3/8, 45/100, 1/2, 6/10, 3/4, 1, 1-1/4, 1-1/2, 1-6/10, 2
250 or less	**MGB**	1/16 or 1/8
		MBW & MBB fuses now called AGC.
250 or less	**AGC**	2-1/2, 3
250 or less	**MTH**	4, 5 or 6
		For 250 volt fuses above 6 amperes—See ABC fuses.
125 or less	**GLH**	7, 8 or 10
32 or less	**AGC**	4, 5, 6, 7, 7-1/2, 8, 10, 15, 20, 25 or 30

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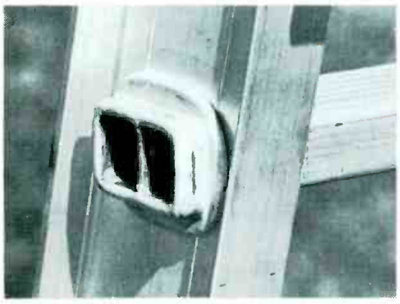
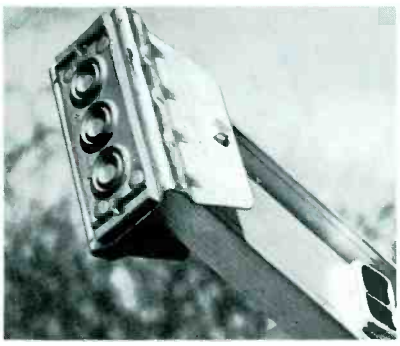
Table 2 Ratings for extension ladders

Ladder length	Max. useable length	Max. height for climbing onto roof	Minimum working height	Maximum working height*
16'	13'	9.5'	5'	15'
20'	17'	13.5'	7'	19'
24'	21'	17.5'	9'	23'
28'	25'	21.5'	11'	27'
32'	29'	25'	13'	31'
36'	32'	29'	15'	35'
40'	36'	32'	17'	40'

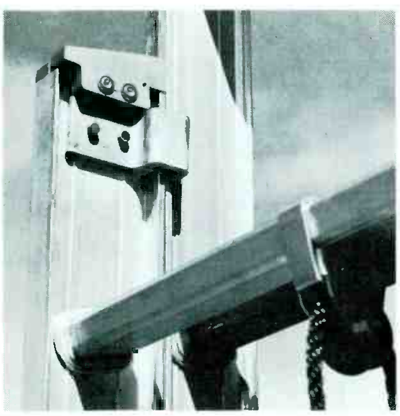
*based on the climber standing on the third rung from the top of the fully-extended ladder



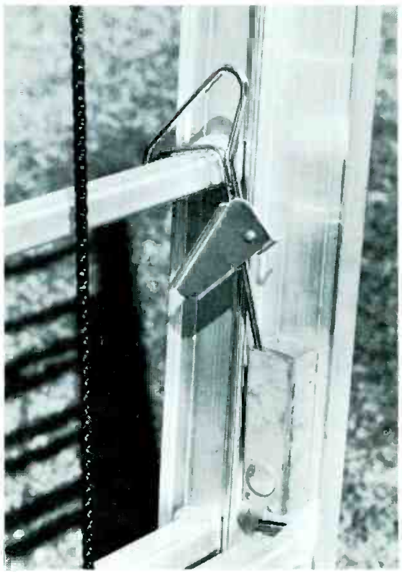
"I" beam construction of side rails gives strength with minimum weight. The flat rungs have center bracing, and are swedged to the side rails.



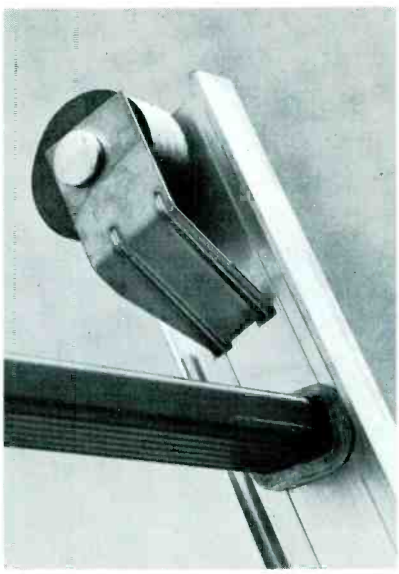
Safety shoes should be the large free-swinging type, with ice cleats and holes for spikes.



For long life, the pulley should be plastic, with a non-rotting pull rope. Strong brackets are required to prevent separation of the ladder sections.



A dependable automatic-locking device is essential to prevent the top section from sliding down.



Large vinyl rollers allow the top section to be extended while against tne wall, without damaging the house.

(Photos courtesy of Perma Power)

sure the soles of your shoes are free of mud, grease, or snow. **If you intend to work upon a roof, you should have shoes with non-slip soles.** When ascending and descending, always face the ladder and use both hands, preferably holding the side rails, not the rungs. Whenever possible, loads and tools should be hoisted by rope rather than carried. It's preferable for tools to be in a bucket rather than in a tool belt.

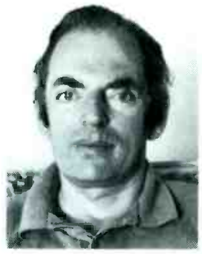
Never climb above the third rung from the top of a straight or extension ladder (the second top tread on a stepladder). **You always should have one hand on the ladder to maintain your balance.**

When working from a ladder, don't over-reach. The ladder should be positioned so you can comfortably reach your work at arm's length. It is recommended that you keep your belt buckle between the siderails. Otherwise your center of balance is away from the ladder. This results in an unstable weight distribution on the ladder that could cause it to slip and fall. If you can wrap one foot around a rung, you should do so.

Finally, **safe usage requires that you never leave an erected ladder unattended.** One danger is that a gust of wind can cause a ladder that is resting on a smooth bearing point to fall with considerable force. The resulting property damage can be expensive. Secondly, erected ladders are an attractive hazard to children, whose injury could well result in a lawsuit.

Like tools, ladders can be dangerous to yourself and others when precautions are not taken for their proper use. When properly selected, maintained, and used, however, they can provide many years of safe, dependable service. □

MY TUNER TIPS



By Max Goodstein

Tuner repairs come in all degrees of complexity. However, intermittent switch contacts account for most problems. An "Old Timer" shares his tips and opinions.

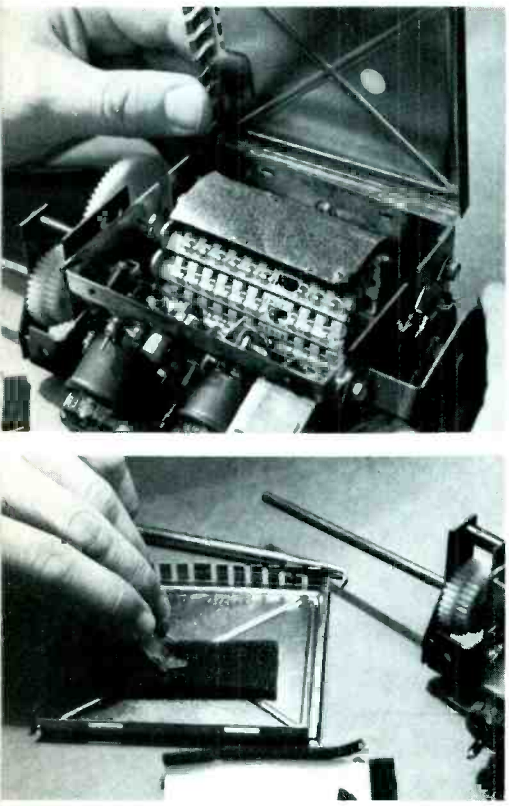


Fig. 1 To install a contact-cleaning pad in a Zenith Golden tuner, take off the shield, remove the protective backing from the pad, and lay the pad at the proper place on top of the turret (top photo), then install the shield so it adheres to the pad. Remove the shield and pad, and spread the lubricant on the pad (lower picture). Replace the shield.

Excluding tube replacements, about 90% of tuner repairs involve switch-contact problems. Most of the other 10% have neutralization troubles, or defective capacitors and resistors. Therefore, you shouldn't have much difficulty with tuner repairs, if you develop good methods of cleaning contacts, and then learn at what point to stop work and send the tuner to a repair station.

One of my theories is that the set users bring much of the contact troubles upon themselves by spinning the channel-selector knob too fast.

Also, I believe technicians should clean all contacts **before** attempting other repairs in tuners.

Symptoms Of Bad Contacts

It's usually possible to diagnose a case of poor switch contacts by operating the channel selector from the front of the receiver. Sometimes you must wiggle the knob to even receive a station. The slightest movement of fine tuning or channel knobs might kill the color, or bring in snow. Of course, the symptoms vary according to the particular contacts that are erratic.

These intermittents originate from two different conditions. Perhaps the circuit continuity is erratic because a contact spring has acquired a "set" from frequent pressure and doesn't hold the rotor contact tightly enough. Or the switch-contact surfaces have become covered with corrosion. Weak springs must be replaced or reshaped, and corroded contacts should be cleaned.

Cleaning Contacts

Although no method of cleaning produces permanent results, most experts agree that longer-lasting benefits are obtained if you remove corrosion from switch-type tuners by use of a good degreaser (perhaps chlorethene or alcohol) on a soft-bristled brush. Then apply a good lubricant direct to the switch contacts.

Turret (drum) tuners should have the coil-strip studs cleaned with a soft cloth moistened by degreaser (or by scrubbing with a short-bristled brush) before lubricant is applied to the stator contacts.

Cleaning pads

As a belt-and-suspenders precaution, I strongly recommend installation in turret tuners of a pad that cleans and lubricates the strip contacts with every revolution of the channel selector.

Here's the way to install a pad in a Zenith "Golden" tuner:

- Remove the shield cover;
- Strip off the protective backing from the pad, exposing the adhesive;
- Lay the pad on the drum (Figure 1) with the adhesive out (Caution: make sure none of the pad extends to the front far enough to interfere with the fine-tuning gears. If necessary, cut off some of the pad, so it is no longer than a channel strip);
- Re-install the cover, taking care not to move the pad. The pad now should adhere to the cover;
- Remove the cover, and squeeze the lubricant (usually furnished) along the length of the pad; and
- Re-install the cover. That's all.

Speaking of covers, **always** replace all covers and shields. Not only do the shields help keep out dust, but they often prevent large shifts of alignment caused by their removal. Perhaps the most noticeable result is when the fine tuning will not bring in the color until the cover is replaced. But remember that other circuits are misaligned just as much; the effect is not so noticeable.

Tightening Contacts

Spring-stator contacts that remain compressed when the pressure

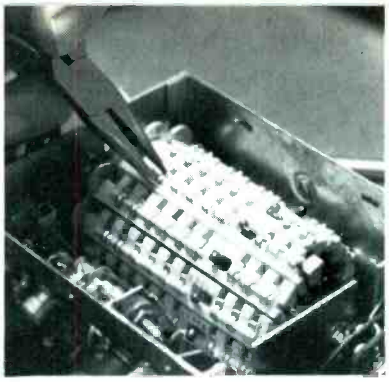


Fig. 2 Squeezing the contact studs of the Zenith turret makes them extend farther out from the turret. This is recommended rather than bending the stator springs to tighten intermittent contacts.

of the rotor is removed need more than cleaning.

Switch-type tuners have stationary contacts resembling a flattened "C" with the ends nearly touching. Then the flat blade of the rotor contact slides in between, spreading the "C" apart to apply pressure.

Turret tuners have flat stator springs shaped in an arch. When the rounded studs on the coil strips touch the arched springs, the springs are forced backwards by the pressure.

With either type of tuner, the "C" contacts or the arched springs should move when the rotor touches them. If not, the circuit might be open, or insufficient pressure might cause intermittents.

The correction you should do depends on the precise kind of tuner.

Zenith "Golden" Tuner

The arched, flat stator springs of the Zenith "Golden" tuner have given some problems. However, it's not so much the fault of the tuners, but from mutilated springs resulting from technicians using the wrong method of re-shaping the springs. Some have been found cracked near the rivets, and others have had excessive trouble with erratic contacts.

And the situation hasn't been helped by the drawing in the Zenith manual showing a hand with a modified paper clip used to re-arch a contact spring. Now, I'll grant you it's possible to do it that way. But it's also very easy to bend the spring too sharply, and that about ruins the spring.

Because of the difficulties of correctly shaping the stator springs, I recommend that you use small long-nose pliers (Figure 2) to **gently** squeeze the contacts on the coil strips. This raises the level of the contacts, and increases the pressure against the springs, but without distorting the springs.

Magnavox And Sylvania Tuners

Before being concerned about repairs to Magnavox and Sylvania tuners, first try degreasing and lubrication, then install a lubricating pad on the tuner cover.

For loose contacts, some sources have suggested lifting each coil strip contact, using a small screwdriver. I urge caution, however, because lifting the contacts too far can cause the tuner to jam, or to break the strip contacts.

Before tightening and re-shaping any springs, check the elasticity of each stator spring by taking out 2 or 3 channel strips, and pressing each spring using a soldering-aid pick. If any spring is sluggish, then re-shaping that one will help very little. In that case, the only good solution is to snap off the defective spring close to the rivet, and install a new one by soldering it to the rivet before re-shaping it. I've had good success using Zenith springs #80-1503. In some tuners, it's necessary to narrow the springs with diagonal pliers to obtain the right width.

With the strips still removed, slowly spin the drum and notice if the stator springs have enough movement when the strip contacts touch them. Any springs without enough movement should be re-arched by placing a small screwdriver at the end of the spring (in line with the spring) and applying pressure towards the rivet. This should give a smooth arch, but don't overdo it.

RCA Tuners

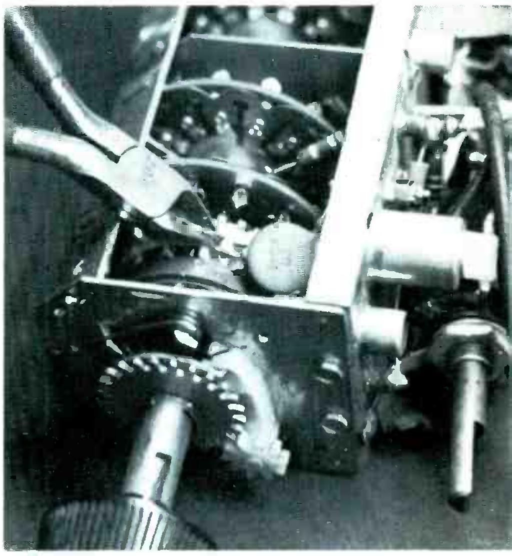
The proper way of cleaning or repairing an RCA tuner is to dismantle it. In addition to the outer shield, there is an inner shield which must be removed before degreasing and lubrication.

However, if cleaning and lubrication doesn't help, and you suspect more serious contact troubles, you probably should send the tuner to a specialized tuner clinic. Often there is no open space where the "C" springs can be re-arched.

If it's the kind with a small turret for the front (oscillator) section, you can tighten those contacts by cutting off the two rotor switch plates for the UHF position. This gives room to use the pick end of a soldering aid for bending the two ends of the "C" nearer together. Sanyo television tuners are built with these UHF contacts missing.

Zenith And Motorola Tuners

Zenith and Motorola tuners also have the antenna and RF sections built around rotary switches, while the oscillator section has a miniature drum or turret at the front. The photos of Figure 3 show how the UHF oscillator contacts can be cut off, thus giving room for shap-



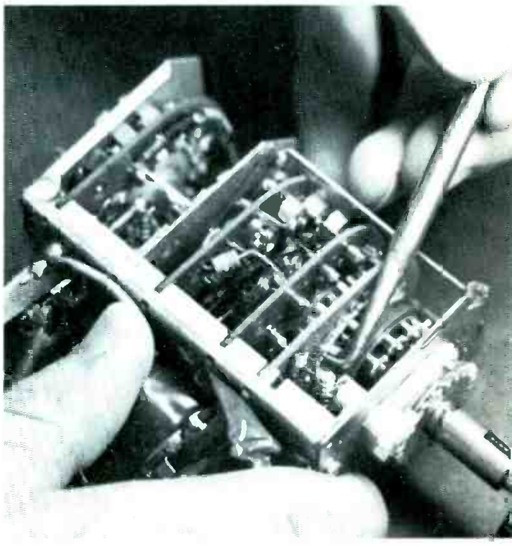


Fig. 3 With Motorola, Sylvania and some RCA tuners, to make room for re-shaping the "C"-shaped stator contacts, cut off the flat UHF contacts (upper photo), then tune to UHF position, and gently rebend the stator contacts (photo at bottom).

ing of the "C" section of the stator contact.

One recurrent problem with Zenith tuner numbers 175-701 through 175-749 is that the wafers of the RF and antenna switches strip so the shaft no longer can turn them. Either the defective wafer must be replaced, or it can be cemented to the shaft.

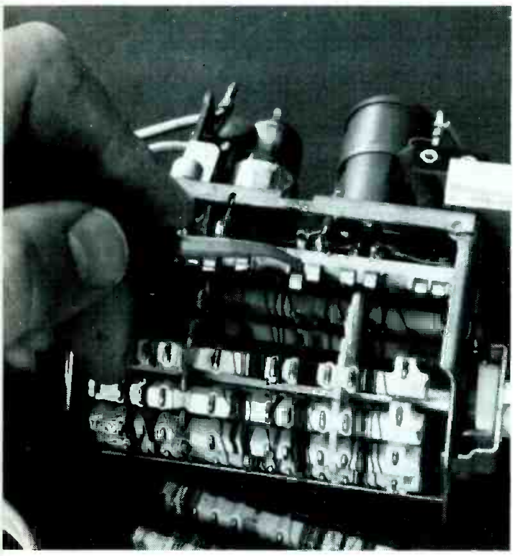


Fig. 4 Sarkes-Tarzian tuners can have the contacts tightened by removal of two coil strips, and then bending each spring, as shown.

Fig. 5 Correct fine-tuning action for color can be obtained with Sarkes-Tarzian tuners if the turns of the oscillator coil are moved (usually farther apart).

Admiral And General Electric Tuners

The Sarkes-Tarzian turret tuners used in Admiral and General Electric also occasionally exhibit problems with loose stator contact springs. These springs should rock back and forth as the channels are changed.

To tighten the contact of the stator springs, remove two channel strips and use a soldering-aid pick to bend out the springs, as shown in Figure 4. Degrease and lubricate the springs while the strips are removed.

Retuning Oscillators

Many turret tuners, after they age, cannot move the oscillator frequency enough by adjustments of fine tuning and the core of the oscillator coil to tune correctly into the color.

If the condition is not intermittent, remove the coil strip of that channel and change the inductance. With Sarkes-Tarzian types, use a pick (Figure 5) to spread the turns of the oscillator coil, the one nearest the front of the tuner.

Golden tuners by Zenith have the coil cemented in place. Therefore, it's necessary to break loose the cement, move the coil nearer the core gear and cement it again.

If you have available several brands of oscillator tubes, it's often possible to find one individual tube that will produce correct fine tuning on all channels without any manipulation of the coil.

Miscellaneous Tips

One of the headaches of tuner repairs is the inaccessibility of parts and some contacts. Use care if you move wires or components in an effort to reach some certain area, because the physical position of many parts is part of the alignment. That peculiar-shaped piece of wire just might be a trimming inductance. Move or bend it and you have misalignment.

In a Magnavox service seminar, we were told to hand clean the MOSFET tuner (instead of spraying) to prevent possible damage to the MOSFET. Also, meter probes should not be connected to any MOSFET gate, to protect the device.

Use care not to confuse an intermittent connection with dirty contacts or loose stator springs. Probe gently with a plastic alignment tool to locate any bad joints.

Some RCA tuners (that have the turret oscillator section) develop poor connections at the rivets holding the "C" stator springs. The solution is to solder the rivets to the springs; but be **very careful** the solder doesn't run onto the spring.

Good tuner repairs demand small tools (including a tiny soldering iron), a bright source of light, a magnifying glass, and lots of patience. It's much better to go easy and take more time, than to break a part or bend a switch contact too far. □

When you send in a tuner for repair

In many circumstances, it is wise to send a tuner to one of the specialized tuner repair stations. The following tips are suggested to help these repair stations do a better job for **you.**

- Include all identification about the receiver from which the tuner was taken—chassis, model and run numbers.
- Include the correct type of **good** tubes. Many similar tuners are made with parallel and series heaters, and other important differences. No tuner repair shop can possibly know all of this without information from you.
- Describe the trouble symptoms (or the defect) as clearly as possible. Nothing frustrates a conscientious technician so much as a "defective" tuner which appears to operate normally.
- If the tuner is from a color receiver, state this clearly so the tuner-repair technician will not adjust the mixer-plate IF coil. If this coil is misadjusted, you will need to align the IF circuit.
- Install all shields before you ship the tuner. Correct alignment or adjustment of the oscillator frequency is not possible without the shields.

SERVICING MODULAR COLOR

Part 3/By Charles D. Simmons

Lose vertical sweep and there's only one bright horizontal line on the picture tube. Right? Not if the color TV is a 19EC45 Zenith portable. With that series of chassis, a unique tie-in between vertical and video blanks out the raster if yoke current stops. That's just one different feature of the 19EC45 vertical sweep.

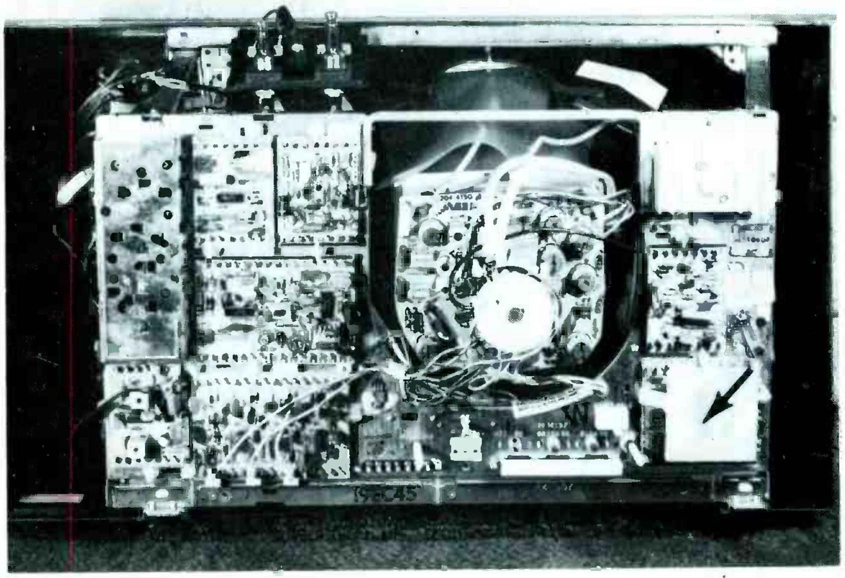


Fig. 1 All vertical-sweep components (except hold control, yoke and pincushion parts) of the Zenith 19EC45 chassis are mounted on the 9-92 vertical module, located at the lower right corner of the chassis.

All vertical-sweep components of the Zenith 19EC45 color chassis (except yoke and pincushion) are located on the 9-92 module (Figure 1). The three power transistors (driver and two outputs) are mounted on a heat sink that forms an "L"-shaped cover over the module (Figure 2).

Although the heat sink covers the module, preventing many live tests, it can be removed. Turn the plastic latches parallel to the edges of the module and gently pull top and bottom (alternately) of the module until the heat sink and module are freed from the terminals. Remove two mounting screws and carefully pull the transistor side of the heat sink away from the module. The transistor leads fit in socket pins, and can be removed and reinstalled without damage.

After the heat sink is removed, replace the module. Some tests with power on now are possible. The final three stages are direct coupled, and it's not practical to test much of their circuitry when the three power transistors are missing. However, the multivibrator oscillator and sawtooth-shaping stages can be tested thoroughly.

General Features

Many of the circuit features of the vertical sweep can be seen in Figure 3, the block diagram format eliminating some of the distracting details. **Notice that no sweep transformers are used.**

Two direct-coupled chains make up the total circuit. Two transistors, one PNP and one NPN, are used in a multivibrator 60-Hz oscillator, with direct coupling between Q701 and Q702. The output signal of Q701 also is direct coupled to transistor Q703, whose output is filtered to make sawteeth, before the signal is capacitance coupled to the amplifier stages.

DC voltage at the collector of Q703 determines the amplitude of the sawteeth there, and the voltage is adjustable by the VERT SIZE control to vary the height of the picture. No vertical linearity control is provided, and none is needed. Because of feedback from the yoke current, **good linearity is maintained at full height, or with only partial sweep** (Figure 4).

Each of the complementary-symmetry output transistors is supplied by its own voltage source. Output signal is from the two emitters, which are at zero DC voltage. At least they are so long as both output transistors are good, and not open or shorted. There is no coupling capacitor to the yoke, so a dead short in either output transistor would apply nearly the full power supply voltage to the vertical yoke windings. Such a severe overload might burn up the yoke.

There has been some speculation that the hot yoke plus the heat of the off-the-screen horizontal line might melt the glass of the picture tube. In any event, excessive power supply current flowing through the yoke certainly should be avoided.

That's the reason for the 600-milliampere fuse between the output transistors and the service switch. It is vitally important that **the fuse (F203) should never be jumpered or defeated** during tests, and that the replacement fuse should have the correct rating. There are good ways of testing while the original fuse is open; don't take chances.

Oscillator and Waveshaping Stages

The sweep circuit divides naturally into two halves, because of the way the stages are direct coupled. Understanding of the theory and troubleshooting techniques both are helped by keeping them separate.

A unique oscillator

Multivibrator oscillators are not unusual. Certainly, it's different, however, for one of the transistors to be a PNP type, and the other a NPN type. Both transistors draw current during the **same** part of the cycle, and not during opposite peaks as most multivibrators do. In addition, one feedback path is DC coupled, and the other is AC coupled.

Figure 5 shows the complete schematic of the oscillator and sawtooth-shaper stages. The large amount of parts, and the way some previous schematics were arranged, have made the circuit hard to understand. So, I have asked that the schematic be drawn to clarify the way each transistor's output feeds the other's input.

How it oscillates

Don't be too concerned because

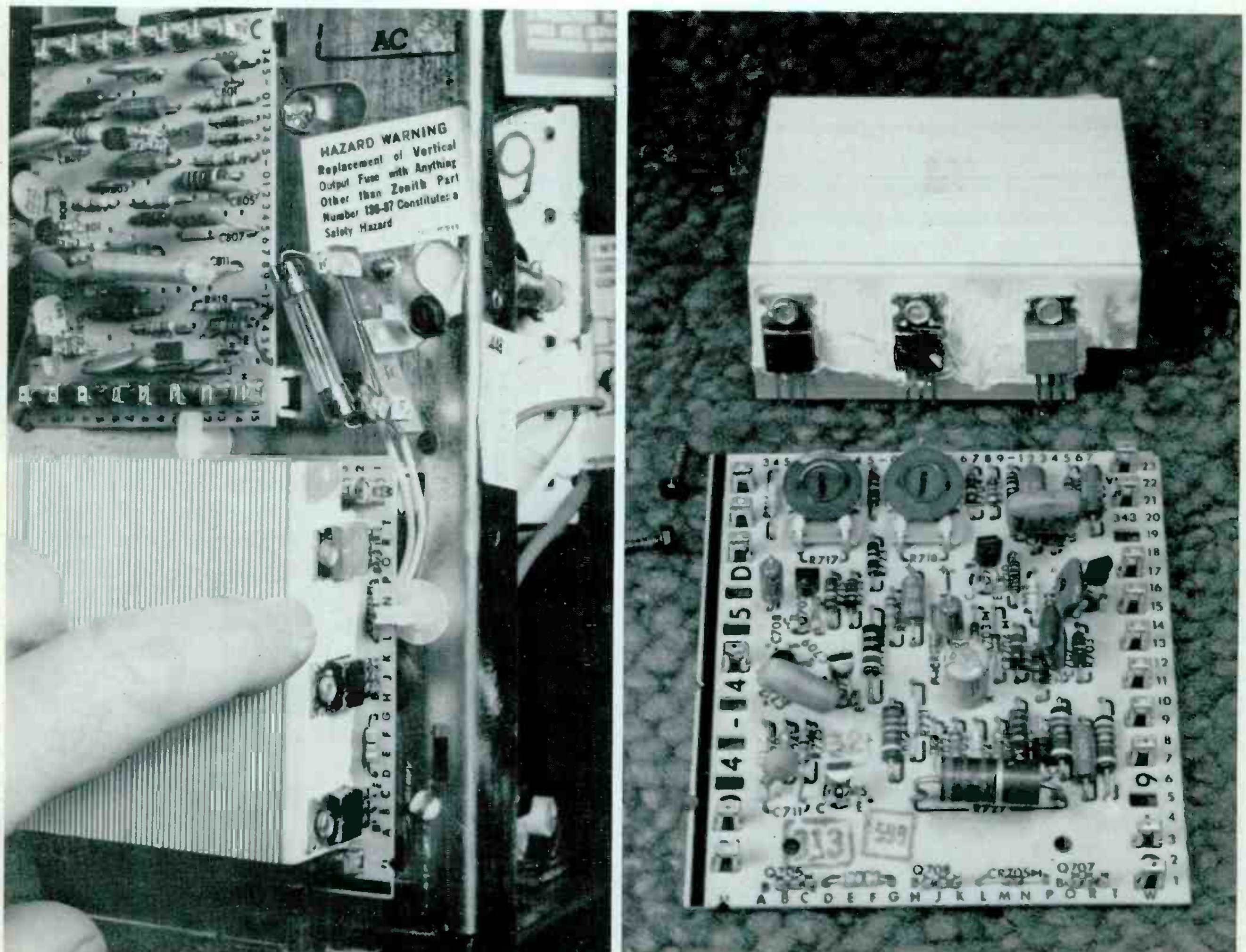


Fig. 2 Three power transistors (driver and 2 outputs) are mounted on a heat sink that covers the module. But the transistor leads fit into socket holes, and any transistor can be removed from the heat sink, or the heat sink with transistors can be dismounted from the module. The fuse shown is F203, which is in series with the yoke circuit.

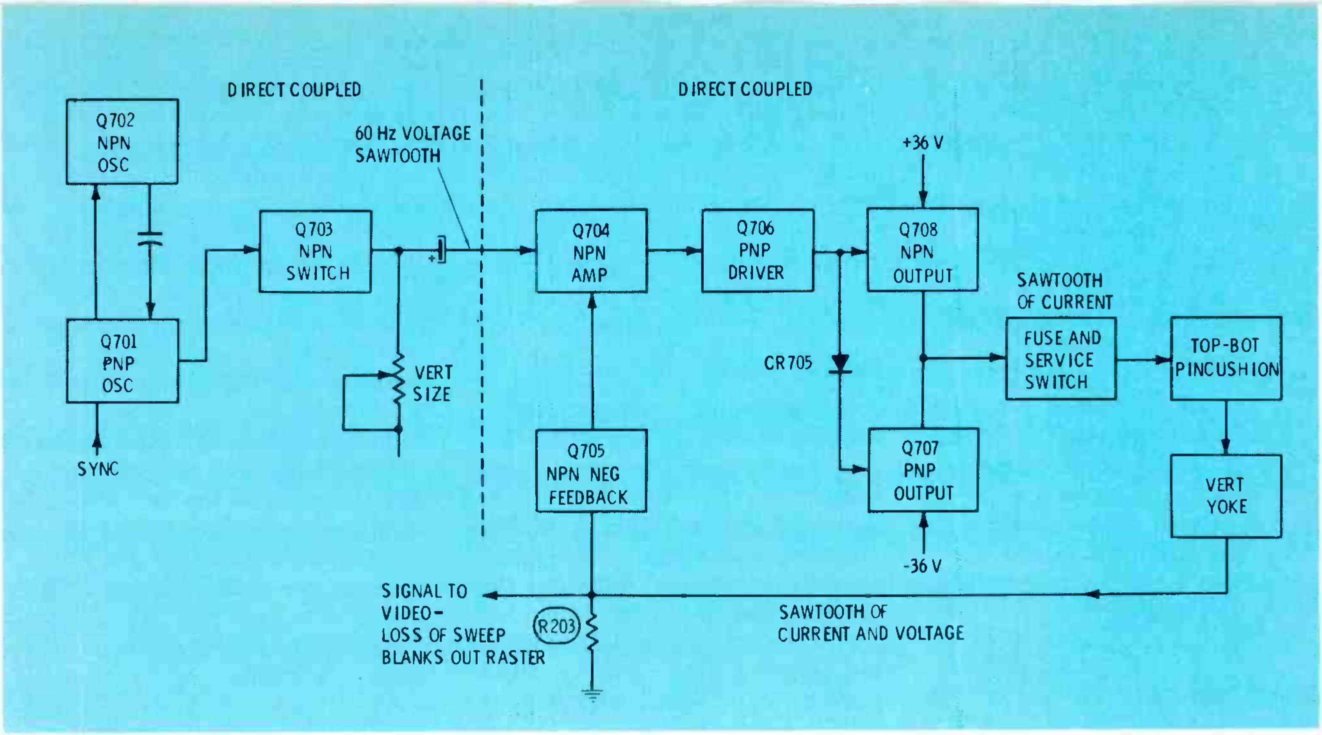


Fig. 3 This block diagram shows the complete vertical sweep system.

one oscillator transistor is a PNP, and the other a NPN. Naturally, this reverses the polarity of the forward bias necessary for maximum conduction. However, another fundamental remains unchanged: **an AC signal applied to a base emerges from the collector inverted in polarity, regardless of PNP or NPN.** Call the signals positive-going or negative-going and the circuit is far less confusing.

Let's assume the oscillator has been operating long enough to settle into its stable states. A pulse coming in through C704 to the base of Q701 causes base/emitter current (rectification) and charges C704 so the base of Q701 is more positive than its emitter. After the pulse is over, the base is biased to cutoff, so both base and emitter/collector currents cease.

There's no path for C704 to discharge through (CR702 and CR703 are reverse biased, thus are open) except through R704 and R256 (the hold control) to ground. Therefore, the time required for the base voltage to drop below the emitter voltage is determined mainly by the time constant of C704 and R704 plus R256.

Eventually, the base voltage of Q701 drops below its own emitter voltage (this is forward bias to the PNP) and collector current starts with a rush. Notice that Q701 is supplied with B+ to the emitter through R701, R709 and CR704, and the collector is grounded through load resistors R713, R714, R711 and R712.

Previous to the conduction, the collector voltage was nearly zero (the path through the transistor was open). During conduction, the current caused the collector to go positive. This positive-going pulse goes to the base of Q703, and also through R711 and R712 to the base of Q702 (Figure 6), where it is forward bias for the NPN transistor. Q702 now draws collector current through R710, R731, R709, and R701. Some of this negative-going pulse (Figure 7) is applied to C704, where it causes base/emitter current in Q701, and charges C704 with a DC voltage that reverse biases Q701 after the pulse has passed. The signal has gone full circle back to the beginning. All phases and amplitudes are correct, and oscillation takes place.

Vertical locking

Positive-going sync comes in through terminal W21 and is integrated by R706/R706 and R707/C707 networks (see Figure 8), then it is applied to the emitter of Q701. The positive-going sync pulse applied to the emitter acts the same as a negative-going one to the base: it is forward bias, which triggers Q701 slightly before the natural time.

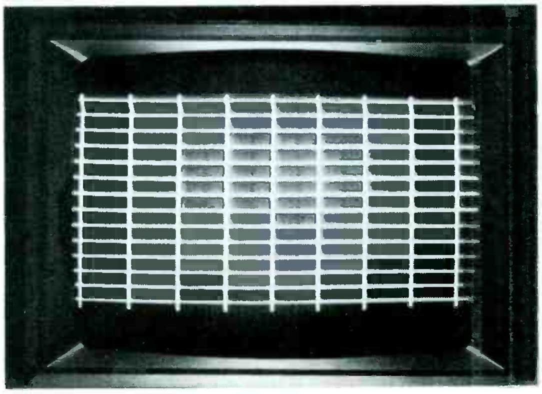


Fig. 4 There is no vertical-linearity control, but the linearity is very good, even when the height is reduced.

At first thought it seems CR701 would shunt the sync to the collector of Q702. After all, there are positive pulses at the anode of CR701, and negative pulses at the cathode. The explanation is that the two kinds of pulses are not there at precisely the same time. There is no pulse at the collector of Q702 (cathode of CR701) until the sync pulse has triggered Q701, and Q702 has been triggered in turn. By that time some of the Q702 pulses feed back through to the emitter of Q701. But that's too late to change the triggering. In fact, the extra pulses tend to turn off Q701 even more rapidly than would be possible without them.

Vertical blanking

Negative-going pulses (similar to those of Figure 7) come from the collector of Q702 through R703 to terminal W13 of the vertical module, and then on to terminal W11 of the 9-88 video module.

In the video-amplifier circuit, the vertical pulses blank out the video during the vertical-retrace time, preventing the retrace lines that might appear as diagonal white lines during scenes having low contrast.

Forming sawteeth

Narrow positive-going pulses are formed at the collector of Q701 (Figure 6), and they are direct coupled to the base of Q703, the switch transistor. Q703 amplifies and inverts that signal; therefore, if the output of the transistor had only a collector resistor, the waveform would be negative-going pulses. But C708 is at the collector, and it, in conjunction with the collector resistor, forms a low-pass filter that makes linear sawteeth out of the pulses (Figure 9).

Amplitude of the sawteeth is determined by the total resistance in the collector circuit, including the VERTICAL SIZE control. More sawteeth amplitude is required to drive the following amplifiers to produce increased height. In order to have a high-value resistance (for linearity), and yet have sufficient collector voltage, the voltage is obtained from the +130-volt source. Additional filtering is furnished by R202 and C202.

This completes the explanation of the oscillator and shaper circuits. All voltages and waveforms can be tested with power on (heat sink and power transistors removed).

Major components are located in Figure 10, and the board layout should help you to find the test-points you need.

Direct-Coupled Amplifiers

Second half of the vertical-sweep system consists of three direct-coupled stages (Figure 11).

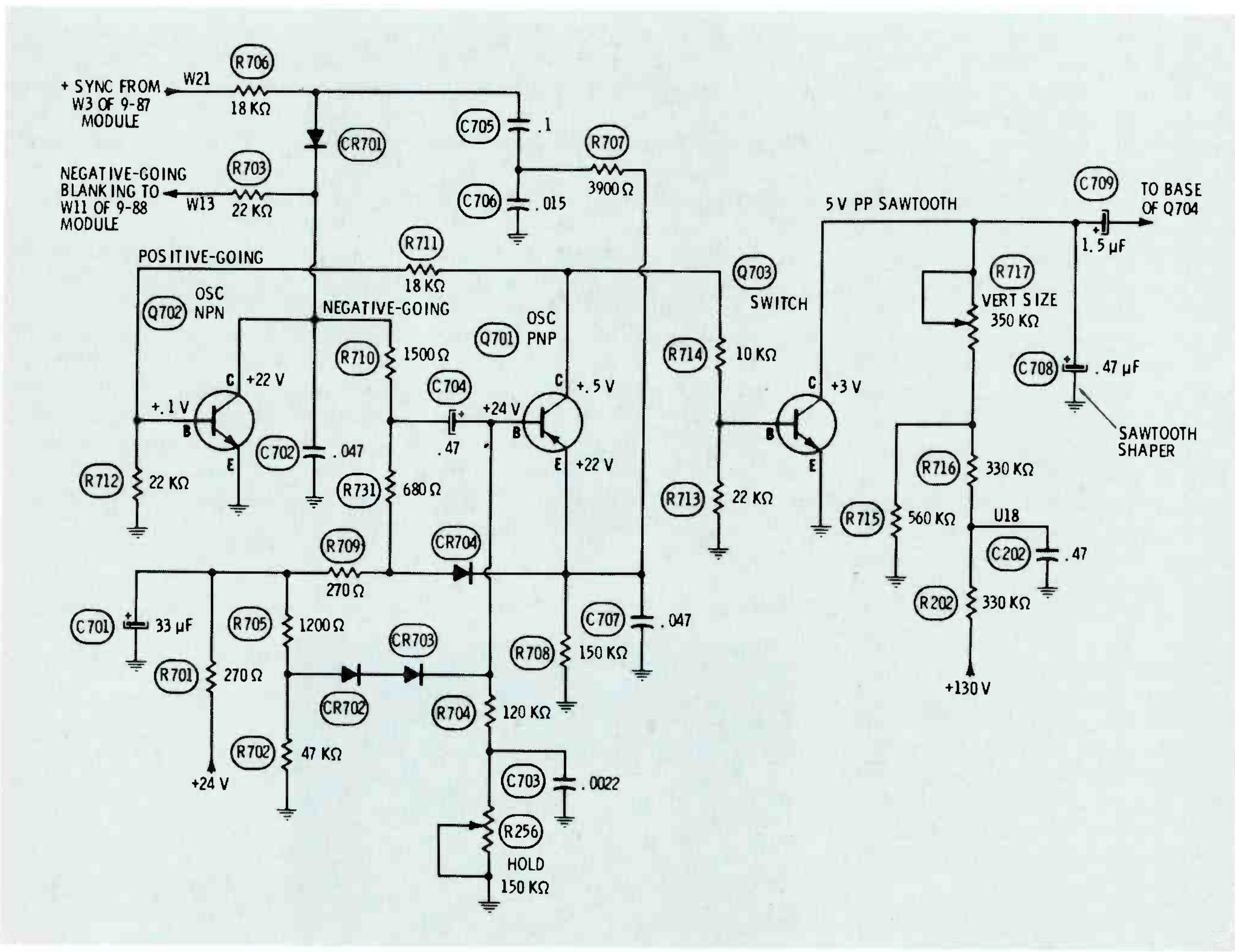


Fig. 5 Direct coupling is employed in two of the three signal paths of the vertical-oscillator and sawtooth shaper stages. One output signal is used for vertical blanking. The other (linear sawteeth) signal drives the 3 amplifier stages, and they power the yoke.

A unique first stage

Two things are unusual about the first stage. First, the bias is adjustable by the VERTICAL CENTERING control. This in turn changes the bias of the driver and the two outputs. Because one output is PNP, and the other NPN, the bias of one is increased and the other bias is decreased. Gain is not changed much, but the unbalanced transistor currents create a DC voltage at the output. Current from this voltage that's fed to the direct-coupled yoke moves the picture up or down (Figure 12).

The picture moves more than with any centering circuit I have ever seen before, but perhaps that is necessary to allow for accumulated component tolerances. There is a slight amount of linearity change and some misconvergence at the two extremes. However, it's unlikely so much correction ever would be required. The centering holds very well without drifting.

The other unique feature of the first stage is the use of two transistors in a differential circuit. Apparently, the reason is to provide a good path for negative current feedback. At the base of Q704 is the sawtooth signal from the oscillator/shaper stages, while the slower-retrace sawtooth from the yoke current is applied to the base of Q705 (Figure 13). Then the two emitters are tied together to mix the two signals. This mixing has the proper phases of signals to provide negative feedback that improves the linearity of the sawtooth of yoke current, and reduces the gain to minimize any drift.

In fact, the linearity correction is so good, that I could see no **expected** compression of sweep near the vertical center of the picture when I shorted out CR705 as a test!

Driver stage

The driver stage, with PNP Q706, appears to be a conventional one without complications. However, the waveforms there puzzled me for quite a time. I expected a sawtooth at the base and an inverted sawtooth at the collector. **Not so!** The actual waveforms are shown in Figure 14.

How can the waveforms at the base and the emitter of Q704 (Figure 13) ever produce the positive-going pulses (with just a hint of sawtooth between) at the collector? Well, remember base signals are inverted at the collector; emitter signals are not. Now, mentally add the waveforms with the top one inverted. The two sawteeth nearly cancel, leaving the **difference** between the two falling edges (negative-going pulses, see the top trace of Figure 14).

That accounts for the peculiar waveform, but it doesn't explain how pulses can produce sawteeth of deflection (without integration). Look at it this way: most of the pulse amplitude represents cutoff bias to Q706 (it's positive-going, and bias needs to be negative), so that part of the waveform does not affect the collector current. A fairly-linear sawtooth results, but there is a notch in the center where the conduction of one output transistor ceases and the other one begins.

Output stage

Two medium-power transistors of identical characteristics, but of opposite polarity, are driven by direct coupling from the collector of Q706, a PNP medium-power type. CR705 diode is included to offset the bias of one transistor to minimize crossover distortion at the center of the signal. As I have said already, the negative feedback is so effective, no perceptible distortion was noted on the screen of the

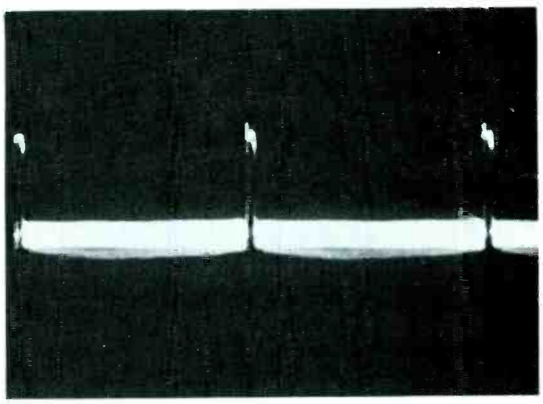


Fig. 6 Narrow positive-going pulses from the collector of Q701 go to the base of Q702 and the base of Q703.

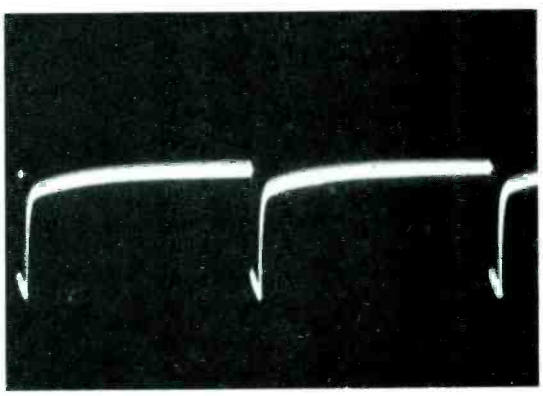


Fig. 7 Negative-going pulses from W13 (the collector of Q702 through R703) go to terminal W11 of the 9-88 luminance module to blank out the video during vertical-retrace time.

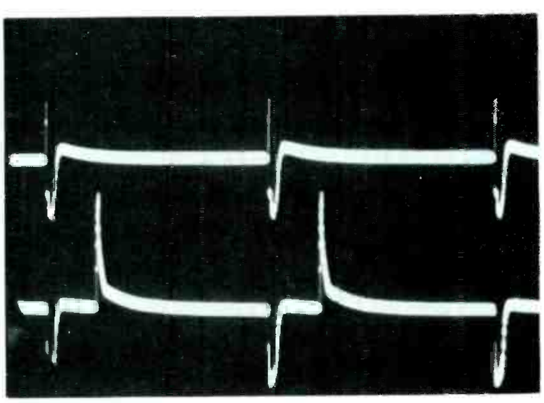


Fig. 8 Positive-going sync comes to the vertical module at W21. These waveforms show the sync and vertical-sweep pulses at the junction of CR701 and R706. The top trace is with the vertical locked, and the trace at bottom shows the two signals when the picture is drifting downward.

picture tube when I shorted across it as a test. Because of the opposite polarity of the transistors, the action is push-pull; one conducts more and the other less, and vice versa.

Q708 is a NPN type, with +36 volts applied to the collector. Q707 has -36 volts applied to the collector, because it is a PNP type. Both have 4.7-ohm emitter resistors that function as fuses if a transistor shorts, and the common point of the resistors is the output, going eventually to the yoke.

Because of the double power sources and the symmetrical design, the DC voltage at the output is almost zero. The exact voltage might be a volt or so of either polarity, depending on the setting of the CENTERING control. No output transformer or coupling capacitor is necessary.

First, the output signal goes to the protective fuse, F203, then to the setup switch (which opens the circuit to eliminate the sweep when the setup position is selected).

At the output of the setup switch, the signal goes three ways. A small amount goes to control the side-pincushioning correction, and some goes to the convergence circuit.

Most of the sweep power is used for the vertical yoke. The top-and-bottom pincushion correction is applied at the midpoint of the series connection of the two yoke coils, as shown in Figure 11.

Now, notice carefully that the low end of the yoke circuit does **NOT** go directly to ground, but through a 4.7-ohm resistor (R203) to ground.

If you want to obtain the voltage waveform of alternating current, just place a small value resistor in the current flow and connect a scope across the resistor. So, the 4.7-ohm resistor between yoke and ground has across it the waveform of yoke current; in this case, a sawtooth.

One use for this sawtooth waveform is to provide an improvement of the linearity. Obviously it works; because there is no linearity control. Also, loss of this signal blanks out the raster.

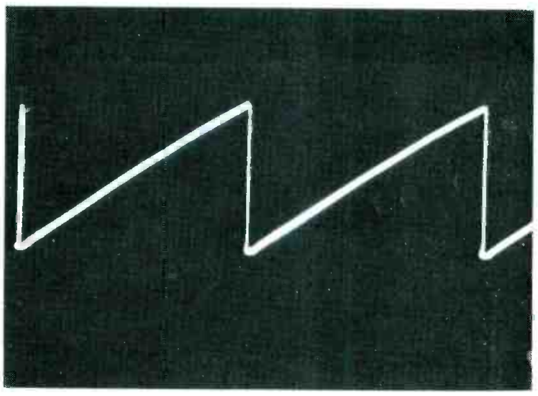


Fig. 9 Classic sawteeth, with very rapid fall times, are the correct waveform at shaping capacitor, C708. This is the signal used to drive the amplifier stages.

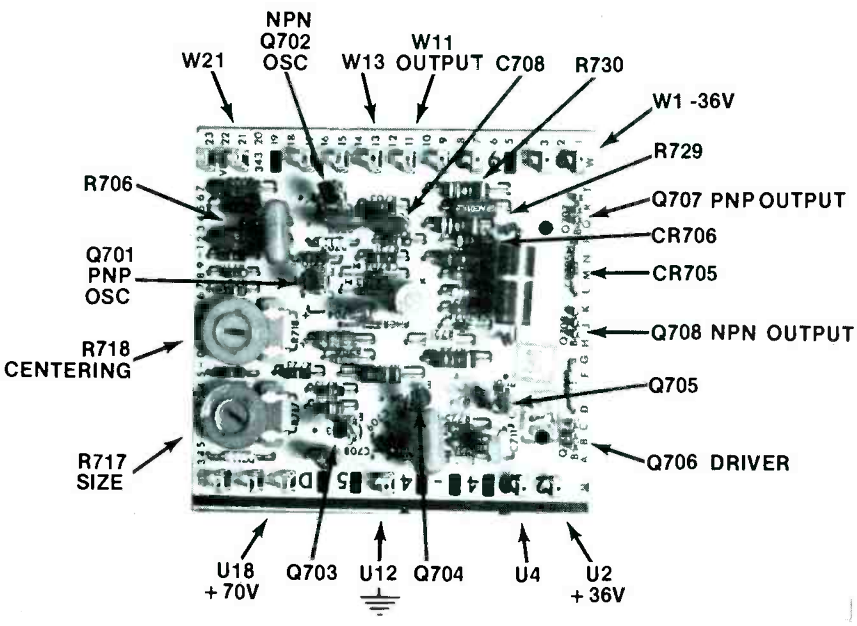


Fig. 10 Major components and test points are shown on the 9-92 module.

Blanking The Raster

Two fail-safe circuits are supplied to protect the components from damage if certain kinds of vertical-sweep defects occur. One is the 600-milliampere fuse, F203. The main job of the fuse is to protect the power supply, the yoke, and other components in the event one of the output transistors shorts. Such a short would place an emitter resistor and the yoke components (a total of perhaps 20 ohms) across one of the 36-volt supplies. Probably about 1 ampere would flow (guessing a large drop of supply voltage because of the short). This would be more than 20 watts of heat, which could do considerable damage. In addition, the huge DC current would deflect the single horizontal line above or below the screen where it could not be seen or used as a symptom. Some people have speculated that the heat of the yoke added to heat from the electron beam striking the neck of the picture tube might melt it. So far as I know, this has not happened, but **it reminds us not to defeat the fuse or use a wrong size.**

The second protection is one that blanks out the raster if the vertical sweep is lost. When the sawtooth signal from R203 is sent to the video, special circuitry sets the picture tube cathodes to a certain voltage, and during setup, the brightness is tracked properly. Then if the waveform from R203 is lost, the protective circuit increases the CRT cathode voltages by about 50 volts, thus cutting off the raster.

Of course, loss of sweep power from the module, or an open circuit in the fuse, setup switch, yoke or pincushion circuits (or even any decrease in the resistance of R203) would cause a loss of the single horizontal line that indicates the loss of vertical sweep.

Therefore, the best sequence of tests when there is no raster is to

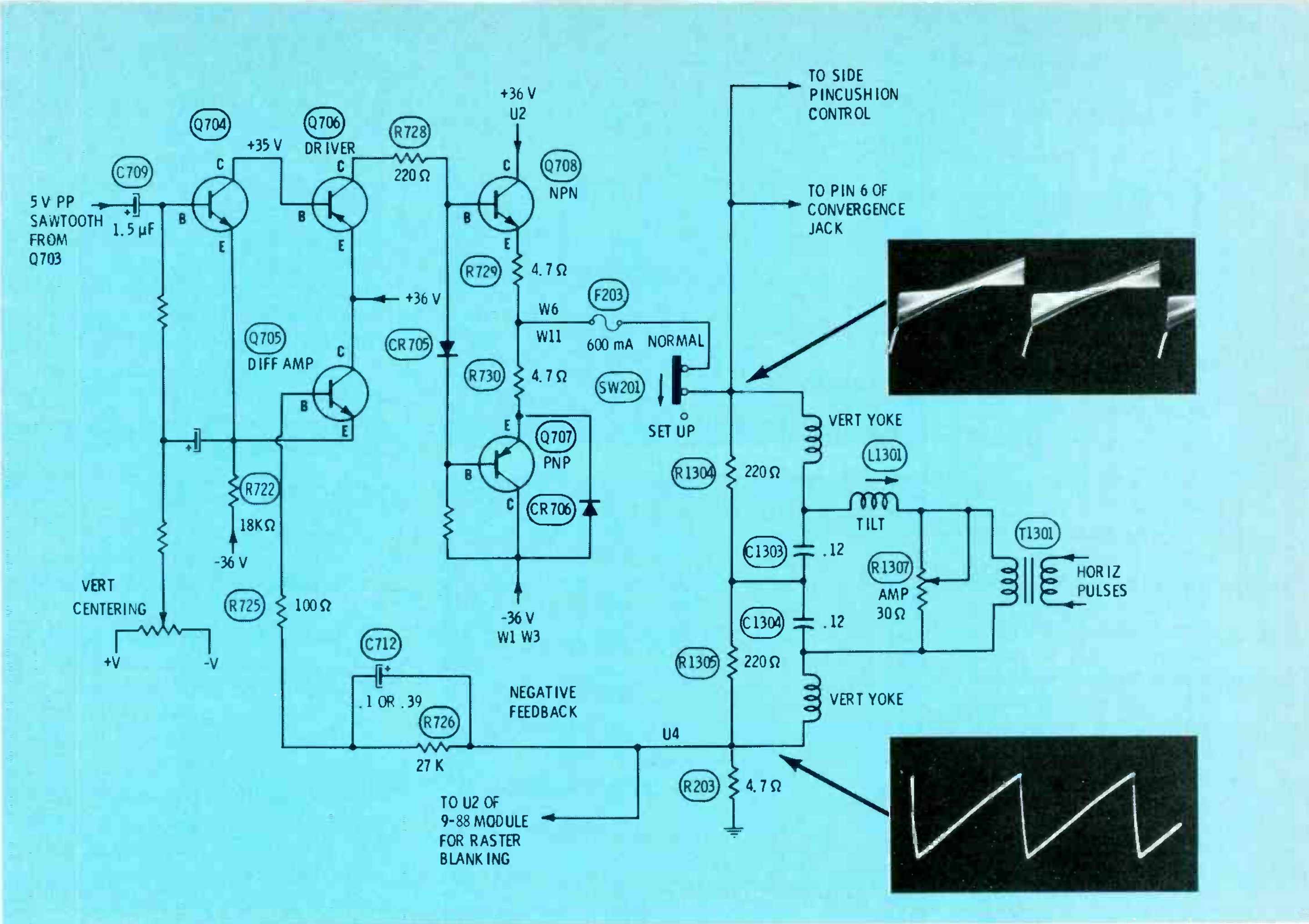


Fig. 11 Most of the components of the three amplifier stages, yoke, and pincushion-elimination circuits are shown in this schematic. Note especially that the low end of the yoke circuit goes through R203 before reaching ground. The waveform developed by the yoke current through R203 is used as feedback to improve the linearity, and as a signal whose loss blanks out the brightness of the raster.

test for high voltage and focus voltage; and if they are normal, to check the vertical sweep.

Waveforms And Troubleshooting

The output of the vertical-sweep circuit is connected to module terminals W6 and W11, also it's connected to the fuse, F203. This fuse makes a fine testpoint. Not only is it one of the components that need checking, but it is conveniently located out in the clear just above the vertical module.

The trace at the top of Figure 15 is the correct waveshape of the 50 to 60 volts p-p signal at the fuse during normal operation. Incidentally, the same waveshape is found at the bases of the output transistors, Q707 and Q708. That's because of the base/emitter conduction.

Before we analyze this somewhat-peculiar waveform, let's check out some of the facts behind it. As a test, I opened the fuse (to disconnect the yoke) and connected a 30-ohm noninductive 10-watt resis-

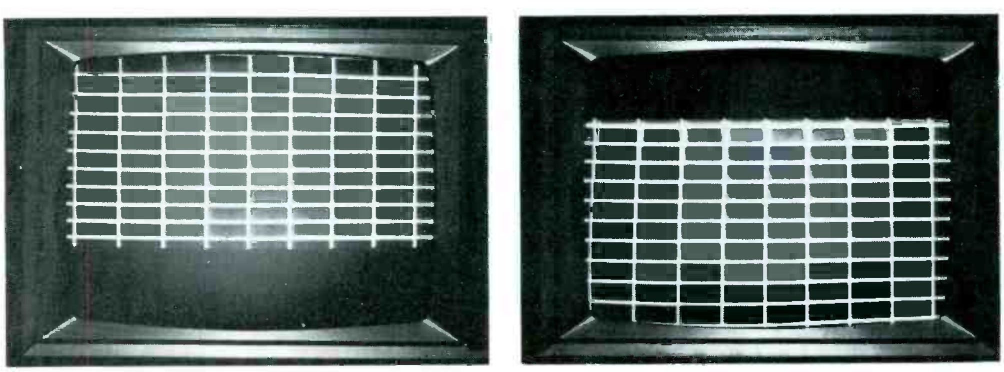


Fig. 12 The vertical-centering control moves the picture an unusual amount. Crosshatch patterns are shown at the extremes of the control adjustment.

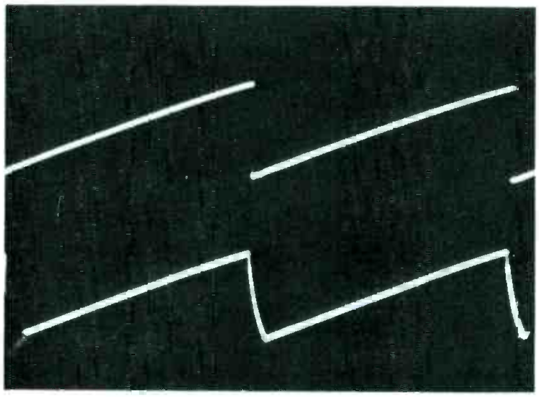


Fig. 13 At the base of Q704 are the sawteeth with fast fall times (top trace), while the emitter has sawteeth showing slower fall times (trace at bottom). Would you expect the output at the collector to be sawteeth? The text explains.

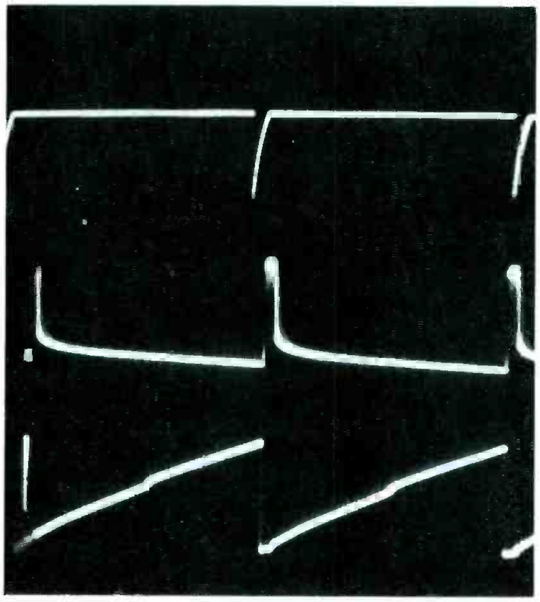


Fig. 14 The difference signal observed from base-to-emitter of Q704 is mainly negative-going spikes (top trace). At the collector of Q704 and the base of Q706 driver (relative to +36V) are positive-going pulses and weak sawteeth (trace at the center). Output of Q706 (as measured base-to-emitter of one output transistor, and shown by the bottom trace) has sawteeth, which have notches from the base conduction of the output transistors.

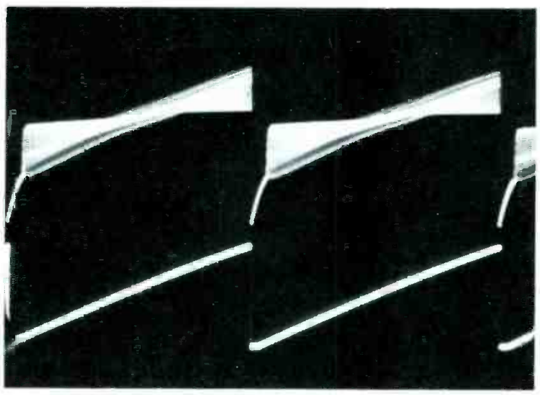


Fig. 15 Top scope trace shows the normal output waveform from the power transistors. When a resistor was substituted for the load of the yoke and pincushion circuits, the output signal consisted of plain sawteeth. (Pulses are added by the collapsing field of the yoke, and the "butterfly wings" are produced by the pincushion action.)

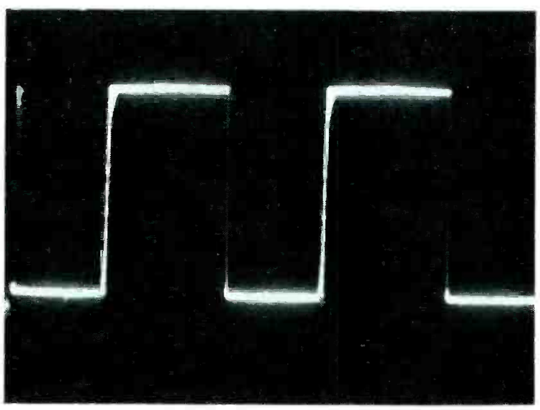


Fig. 16 An open in the yoke circuit, when the circuit is normal up to that point, causes the output waveform to be square waves.

tor between module terminals U4 and W6. This simulated the load of the yoke, but removed the inductive components. The sawteeth that resulted are shown at the bottom trace of Figure 15.

Now, add to that basic sawtooth a negative-going pulse at each falling edge (coming from the ringing of the yoke) plus the "butterfly wings" that are typical of pincushion-correction circuits, and the result is the waveform at the top of Figure 15.

Effects of an open load

That last test did not activate the protective circuit and blank out the horizontal line, because the load resistor returned to R203.

Other opens between F203 and R203 do cause loss of raster. In addition, there are other symptoms.

For example, assume a normally-operating vertical sweep, and that you opened the fuse circuit. At the module end of the fuse would appear large squarewaves (Figure 16). Why? Well, you would expect some increase of **sawtooth** amplitude (the pulses and butterfly wings would be eliminated, of course) because of the lighter load, but not so much change. The reason for the square waves is that the open circuit prevents any yoke current from flowing through R203. Without this waveform, there is no negative feedback to the differential amplifier. Loss of feedback allows the gain to increase, and the output transistors are overdriven until the output waveform is clipped and becomes square waves.

An open setup switch would give the same symptoms, except that the square waves would appear at both ends of the fuse.

Other opens in the yoke or pincushion-elimination circuit would produce different symptoms, depending on the location of the open.

For example, an open yoke coil will make the picture trapezoidal (taller on one side than the other). The anti-ring resistors, R1304 and R1305, would conduct enough current to give some deflection.

In the rare event of shorted turns in one of the vertical-yoke coils, the amplitude at the fuse would be reduced, and the current waveform at R203 would be greater than normal.

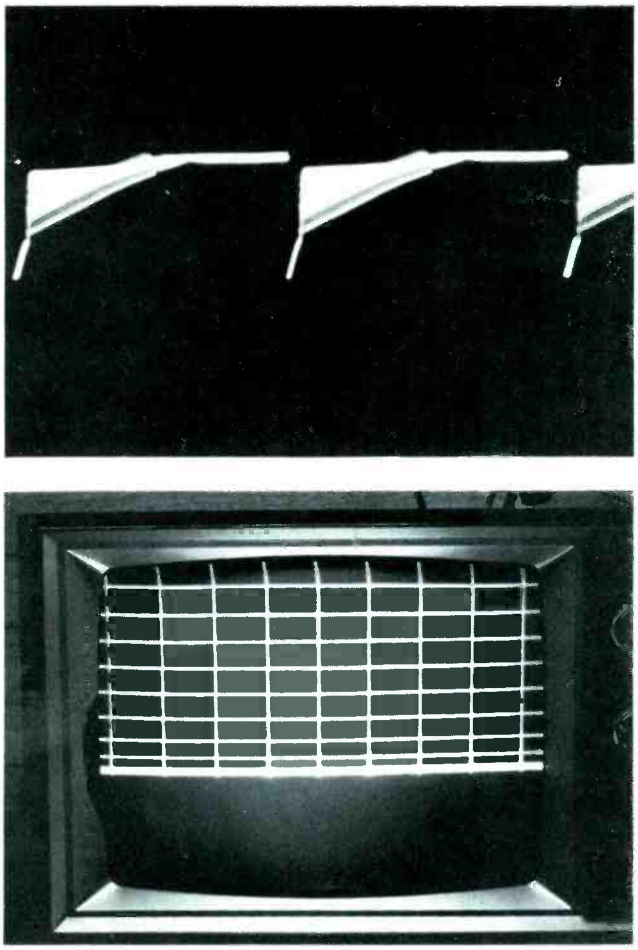


Fig. 17 When output transistor Q708 was open, the scope pattern of the output waveform and the crosshatch pattern on the raster both showed deflection only during the first half (top) of the sweep. In other words, Q707 supplies deflection for the top half of the picture. DC voltage at the fuse was -1.9 volts.

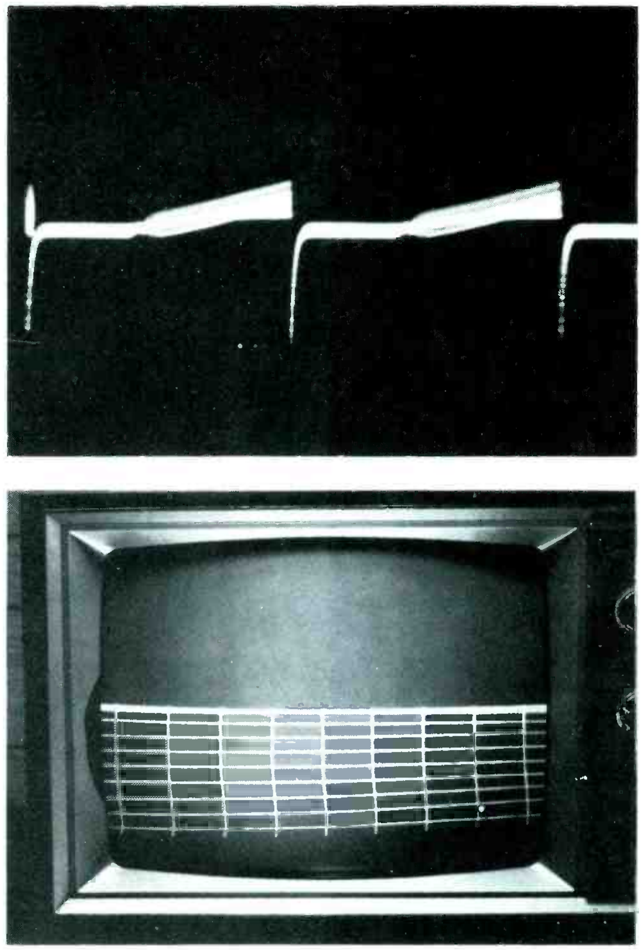


Fig. 18 An open Q707 permitted height only at the bottom, proving that Q708 gives deflection to the bottom half of the screen. Also, the clipped waveform at R203 confused the no-sweep protection circuit, and it blanked out the picture after a second or so. DC voltage at the fuse was +1.7 volts.

Open Output Transistors

Although far less likely to happen than shorted transistors, open output transistors (or open emitter resistors) can cause other strange symptoms.

Figure 17 shows both the scope waveform at the fuse and the resulting crosshatch pattern on the picture tube that result when Q708 is open. Both pictures prove that Q708 supplies the deflection for the **top** half of the picture.

The same things, in reverse, happen when Q707 is open (Figure 18). But there is one more symptom: the bottom half of the picture appears as usual when the AC power is applied. Then, it stays bright for a second or so before going black slowly enough that you can see it leave. The waveform fed back to the no-sweep protective circuit has fooled the circuit into believing the sweep is insufficient, so it blanks out the raster.

Comments

As stated at the beginning, most of the vertical-sweep components are on the 9-92 module. However, the driver and output transistors, heat sink, hold control, yoke and pincushion components do not come with a replacement module.

Therefore, a certain minimum of testing should be done, even if you intend eventually to replace the whole module.

It's recommended you replace both emitter resistors (R729 and R730) if the output transistors have proven to be shorted. Resistors that have been overheated are often not dependable.

All three power transistors should be removed and tested out-of-circuit. Of course, replacement of all three power transistors, the fuse, and the module is almost guaranteed to fix any trouble, if you can ignore the cost.

If a module is not available at the time, you can remove the heat sink, including the three power transistors, and check the oscillator and shaper circuits. These can be repaired quite easily.

Testing and repairing the final three direct-coupled stages is more difficult. Unless you're skilled in such diagnosis, it might be wiser to replace the module for problems in those three stages.

Next Month

The video stages of the Zenith 19EC45 chassis, with the no-sweep/raster-blanking and brightness-limiting circuits, will be the subject of discussion next month. □

test equipment report

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Field-Strength Meter

Mezzer Model FSM-U measures the video-carrier and adjacent-channel signal levels of all UHF channels. The product of **Castle TV Tuner Service** features electronic tuning and attenuation, protective meter-driver amplifiers for the linear voltmeter, a transistor-regulated power supply, and an inbuilt battery-test circuit.

Tuner and amplifier micro-circuit modules are completely shielded to minimize stray pickup of signals. Inputs for both 75 ohms and 300 ohms are provided. No zero or balancing adjustments are required; all compensation is automatic. Weight is only 2.5 pounds, including batteries and transformer, and the price is $99.95.

For More Details Circle (50) on Reply Card

Transistor Test Adapter

The **Eico** Model 688 Quick Tester connected to your oscilloscope dynamically tests the junctions of transistors and diodes. A switch selects the proper amount of current for in-circuit or out-of-circuit testing. Jacks and 5-way binding posts are mounted on the panel.

The adapter unit is available in kit form for $14.95, or wired for $22.95. A reference manual lists the test data.

For More Details Circle (51) on Reply Card

bookreview

Fix Your Small Appliances, Volume 1
Author: Jack Darr
Publisher: Howard W. Sams & Co., Inc. 4300 West 62nd Street, Indianapolis Indiana 46268
Size: 160 pages, book number 21051
Price: $3.95 paperback

Dedicated to the handyman, this book covers the servicing of small electrical appliances with heating elements. Some of the topics discussed are diagnosis of trouble, repair techniques, tools, chemical aids, parts procurement, and a special chapter on modular appliances. With the servicing techniques, practical tips and shortcuts Darr has picked up over the years in his own electrical fix-it shop, the average handyman should be able to repair every small appliance in the home.

Contents: Diagnosis of Trouble; Heating Elements; Portable Table Ovens; Electrical Cooking Appliances; Electric Cookers and Coffee Makers; Electric Irons; Electric Toasters; Modular Appliances; Portable Electric Heaters; Electric Blankets and Heating Pads; Lighting and Controls; Miscellaneous Repair Techniques; Appliance Servicing.

Fix Your Small Appliances, Volume 2
Author: Jack Darr
Publisher: Howard W. Sams & Co., Inc. 4300 West 62nd Street, Indianapolis, Indiana 46268
Size: 160 pages, book number 21052
Price: $3.95 paperback

Volume 2 covers the servicing of small electrical appliances with motors. Topics of discussion include diagnosis of trouble, testing techniques, small electric motors, and types of speed controls. Only time-tested, proven methods and tests are given.

Contents: Diagnosis of Trouble; Small Electric Motors; Electric Fans; Electric Carving Knives, Can Openers, Knife Sharpeners, Shoe Polishers, and Sewing Machines; Mixers, Blenders, and Grinders; Hair Dryers; Vacuum Cleaners; Electric Shavers; Electric Timers and Clocks; Electric Massage Machines and Scissors.

Your comments and ideas are welcome

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1014 Wyandotte Street Kansas City, Missouri
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productreport

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Two-Way Door Sign

An inexpensive, practical door sign from **General Electric** advises customers whether or not a store is open for business. A choice of two durable plastic signs is offered. The "clock" sign (ETRS 3826) informs the customer when the dealer will return; the "strip" sign (ETRS 7090) simply shows whether the store is open or closed.

For More Details Circle (52) on Reply Card

Heavy-Duty Ladders

Perma Power has announced a line of professional heavy-duty straight and extension aluminum ladders in sizes ranging from 12-feet to 40-feet. Designed for outdoor as well as indoor use, the ladders are rated at 250-pound load capacity, yet are light enough for easy one-man handling.

The ladders are unconditionally guaranteed for 12 years according to the manufacturer, and are moisture-resistant, non-sparking, and non-corrosive.

Safety features of the product include flat, extra-wide rungs with grip ridges that are center web-braced and swedged to the bar side rails to help prevent twisting; large free-swinging safety shoes with ice cleats and spike holes for greater stability; and an automatic locking device.

Prices range from $47.95 to $169.95.

For More Details Circle (53) on Reply Card

S.O.S. Light, Siren

A flashlight that functions also as a siren is now available from **Duola, Incorporated** for $9.95. The metal body of the light is semi-water proof and shock proof. A red lens hood slips over the illuminator, which can be focused easily for wide-angle illumination. A sliding switch turns on the screeching alarm, said to be audible for one-half mile. Battery-operated, the light/alarm includes a leather wrist band for easy carrying.

For More Details Circle (54) on Reply Card

Audio, Radio Design Handbook

A limited quantity of F. Langford-Smith's text on audio and radio design, **The Radiotron Designer's Handbook,** is available from **RCA Electronic Components**.

Written in an easy-to-understand style, the book contains 1,500 pages of comprehensive vacuum-tube theory and practical information. Subjects covered include: audio frequency voltage and power amplifiers; speaker networks; recording characteristics; fidelity and distortion; tone compensation and tone control; radio frequency amplifiers; rectification; regulation and filtering; and AM/FM receiver design.

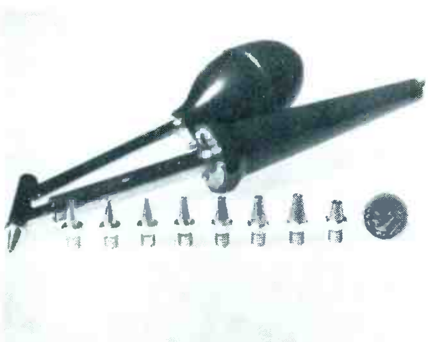
The $15.00 text includes circuits, design aids, curves and nomographs, 2,500 references, and a comprehensive 50-page index containing over 7,000 cross-referenced headings.

For More Details Circle (55) on Reply Card

Small-Size Desoldering Tips

Enterprise Development Corporation has added to its line two small desoldering tips for use with Model 510 pencil-type iron when small components are to be removed from a circuit board.

The new tips, sizes .025 and .031, are ironclad for longer life. The Endeco desoldering kits now include



tip sizes ranging from .025 to .090, with the .063 size as standard. A set of three in each size is blister packed.

For More Details Circle (56) on Reply Card

"Black Box" Adapters

Two "Black Box" adapters have been added to the variety of electronic test adapters offered by **Pomona Electronics**. The all-metal adapters are wired internally and provide the framework for in-line connectors.

Model 4057 adapter (two BNC jacks to BNC plug, wired in-line T) is designed for use where space limitations require cable to extend straight out instead of at right angles.

Model 4050 adapter (binding posts to double banana plugs with BNC jack in-line T) permits interconnection of equipment such as signal generators with either double banana jacks or BNC plugs.

For More Details Circle (57) on Reply Card

Bench-Top Ultrasonic Cleaners

Tooltronics announces a line of stainless steel bench-top ultrasonic cleaners that feature compact design and rapid, thorough cleaning.

Ultra-Clean is pushbutton operated, with all-solid-state circuitry. Priced between $98-$317, the cleaners are available in 1½ to 8 quart units.

For More Details Circle (58) on Reply Card

audio systems report

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"Music-on-Hold" System

Designed for new or existing key systems, Model TES-128 is a low-cost music-on-hold system that requires only a simple connection to the tip side of the line at the key telephone unit.

No modification of the telephone is necessary and no power is required for operation. Special features include: constant volume regardless of the number of lines on hold; a proprietary music-modulation circuit which helps to eliminate cross talk; and double-sided tape for easy installation without screws.

Music input can be obtained from any AM/FM radio, record player, or tape machine. The compact system from **Telephone Equipment Supply** is priced at $25.00.

For More Details Circle (59) on Reply Card

Four-Ohm Speakers

Quam-Nichols Company introduces two loudspeakers designed to be compatible with the latest model radios and tape decks. Both are air-suspension speakers with a voice coil impedance of 4 ohms.

Model 52C10FEXZ4 is a 5¼-inch speaker with a whizzer cone and orange foam edge and is priced at $12.50.

Model 69C10FEXZ4 is a 6-inch by 9-inch oval speaker with the same features, and costs $16.50.

For More Details Circle (60) on Reply Card

Telephone Amplifier and Monitor

Tele-Secretary, Model N70-150, is a battery-operated telephone device which can be used with any standard portable tape recorder. Connecting Tele-Secretary to the telephone and a tape recorder, permits automatic recording of all incoming and outgoing conversations.

Tele-Secretary is manufactured by **Workman Electronic Products.**

For More Details Circle (61) on Reply Card

Portable P.A. System

Edcor's SS-22 is reportedly the only wireless, portable, dual-channel public-address system on the market. The 16-pound model allows greater freedom of movement, and maintains a 300-500 person volume indoors or outdoors.

Two microphones are available. One is a lavalier clip-on type; the other is hand-held. The transmitting range is 100-300 feet, using a crystal-control system to decrease frequency drift.

The SS-22 can function as a complete sound system, a wireless tuner for already-existing public systems, and an amplifier/speaker for tape or record players.

For More Details Circle (62) on Reply Card

catalogs literature

Circle appropriate number on Reader Service Card.

101. Electronic Tool Company—a catalog for the technician that describes 18 fully-equipped tool kits. Also featured are 13 tool cases that can be ordered custom-filled with a choice of tools, meters, parts containers, etc.

102. Pomona Electronics—introduces the Pomona line of electronic test accessories, and provides illustrations and complete engineering information including dimension drawings, schematics, specifications, features, and operating ranges. The 68-page catalog covers 500 products.

103. Motorola Training Institute—offers an 8-page pamphlet describing MTI's newly-revised home-study course. The pamphlet outlines the contents of 40 lessons and 13 reference texts included with the course, which covers professional FM two-way radio from the technician's point-of-view.

104. GTE Sylvania—the catalog features 45 pages of information on Pathmaker wideband communications equipment. Included are sections on Series 2000 and 1000 trunk-amplifier stations, plug-in modules, power supplies, passives, and accessories. Product specifications and ordering information are given.

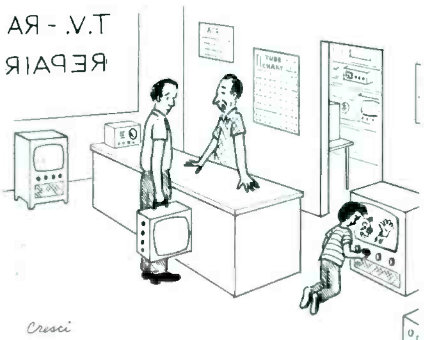
105. Marconi Instruments—the short-form catalog includes: FM/AM signal generators, FM deviation meters, HF spectrum analyzers, mobile-radio test gear, TV test equipment, intermodulation and baseband test gear, microwave instrumentation, bridges, Q-meters, and PCM/digital test equipment.

106. International Rectifier—the new edition of commercial products, lists four new product lines: Japanese "original equipment" transistors (for use in replacing Japanese TV and audio equipment parts); high-turnover electrolytic capacitors with working voltages from 12 to 50 volts; four matched-pair transistors to expand replacement capability; and lighted rocker switches in SPDT and DPDT versions. Also listed are various types of rectifiers, semi-conductors, and diodes, as well as color TV components. The brochure gives complete specifications, line drawings, photographs, and prices.

107. Chemtronics—features application information, photos, descriptions, and spcifications on chemicals used to speed electronic servicing and maintenance of electronic equipment. Included are tuner sprays, contact cleaners and lubricants, circuit coolers, insulating sprays, moisture removers, and heat sink compounds.

108. GC Electronics—offers a comprehensive assortment of CB and amateur radio replacement parts, and accessories such as power base and mobile unit microphones, dual power SWR meters, noise filters and suppressors, and a specially selected assortment of microphone and antenna plugs and connectors.

"We would have brought our set into the shop only the doctor forbid us to go outdoors until we get over this blasted flu."



"He's in charge of quality control. If the set still works after he fools with it we know we did a good repair job."

"Well, look who just arrived! Ol' 'work-with-the-power-on' Haggarty!"

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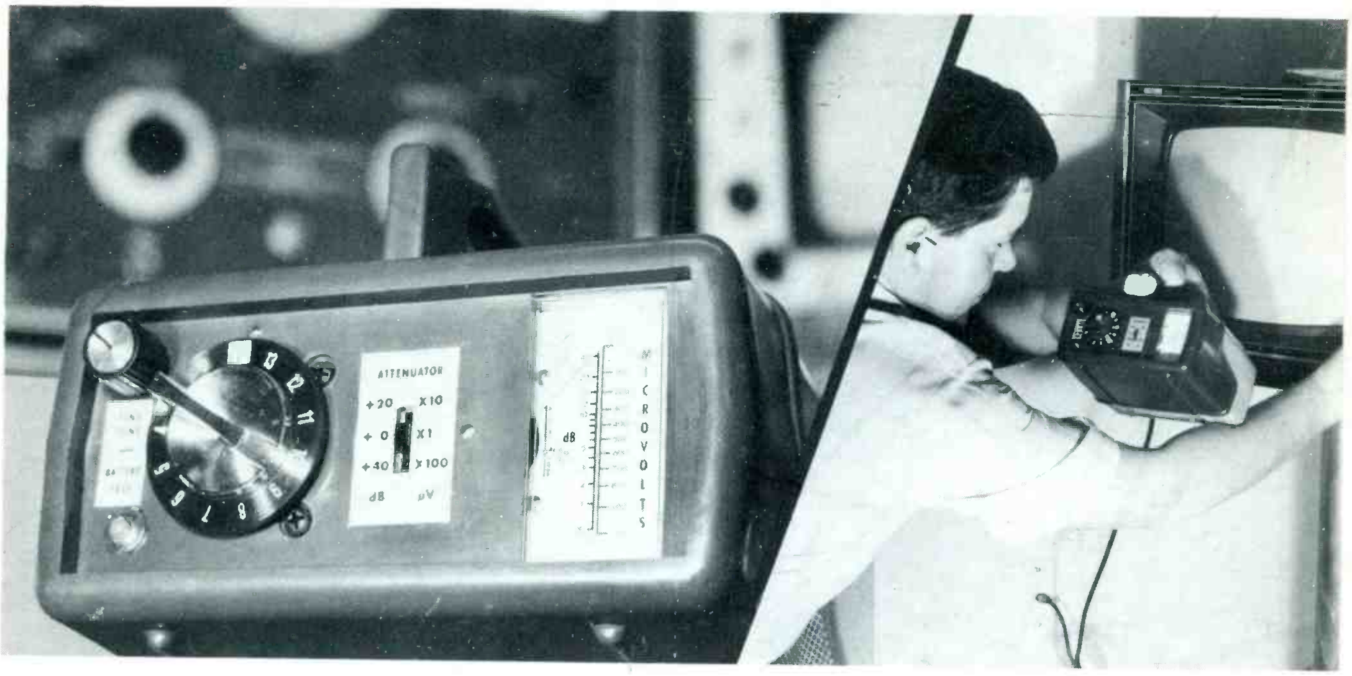

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