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JANUARY 1966/50¢

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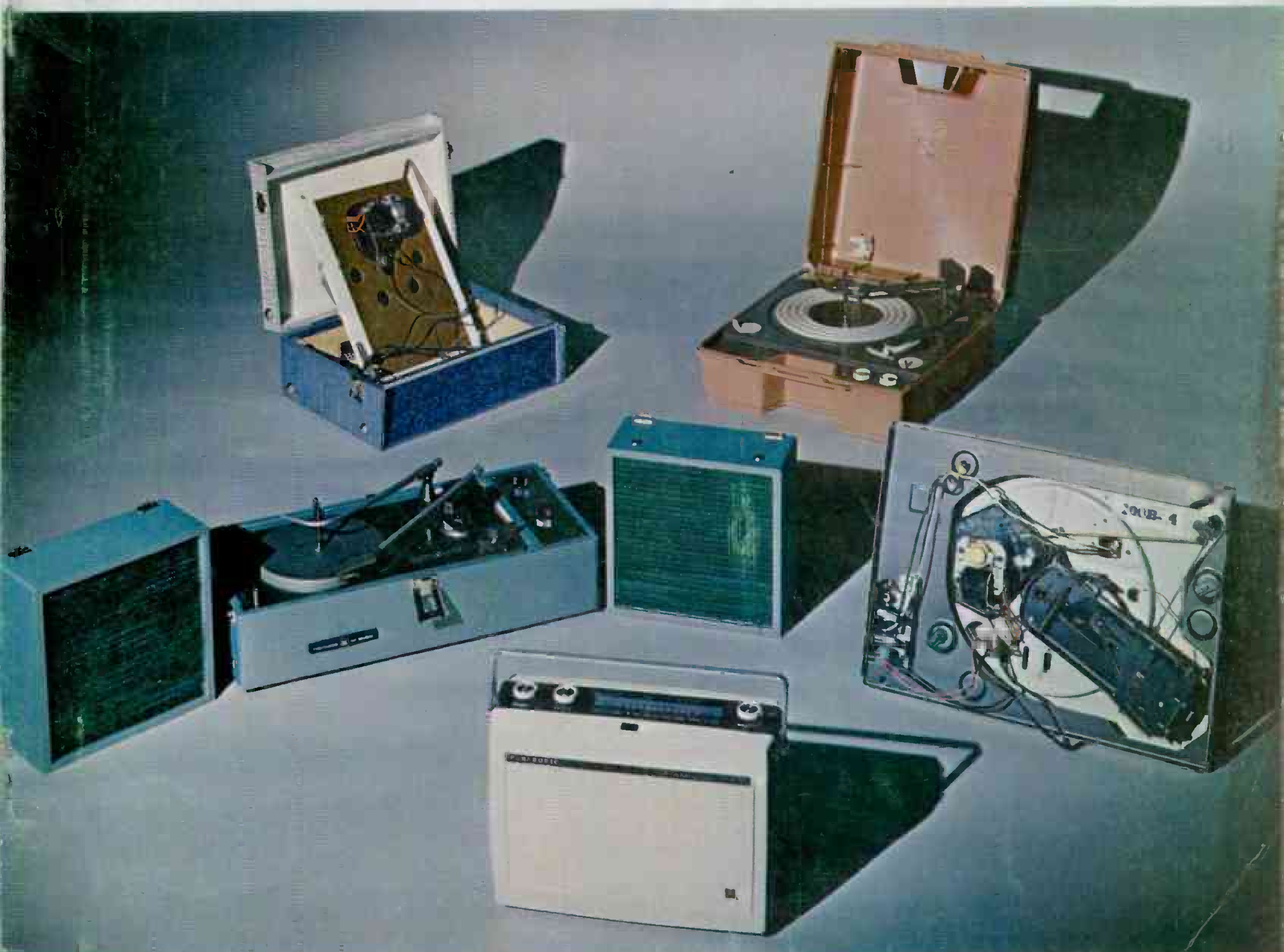
PF Reporter™

PHOTOFACT

the magazine of electronic servicing



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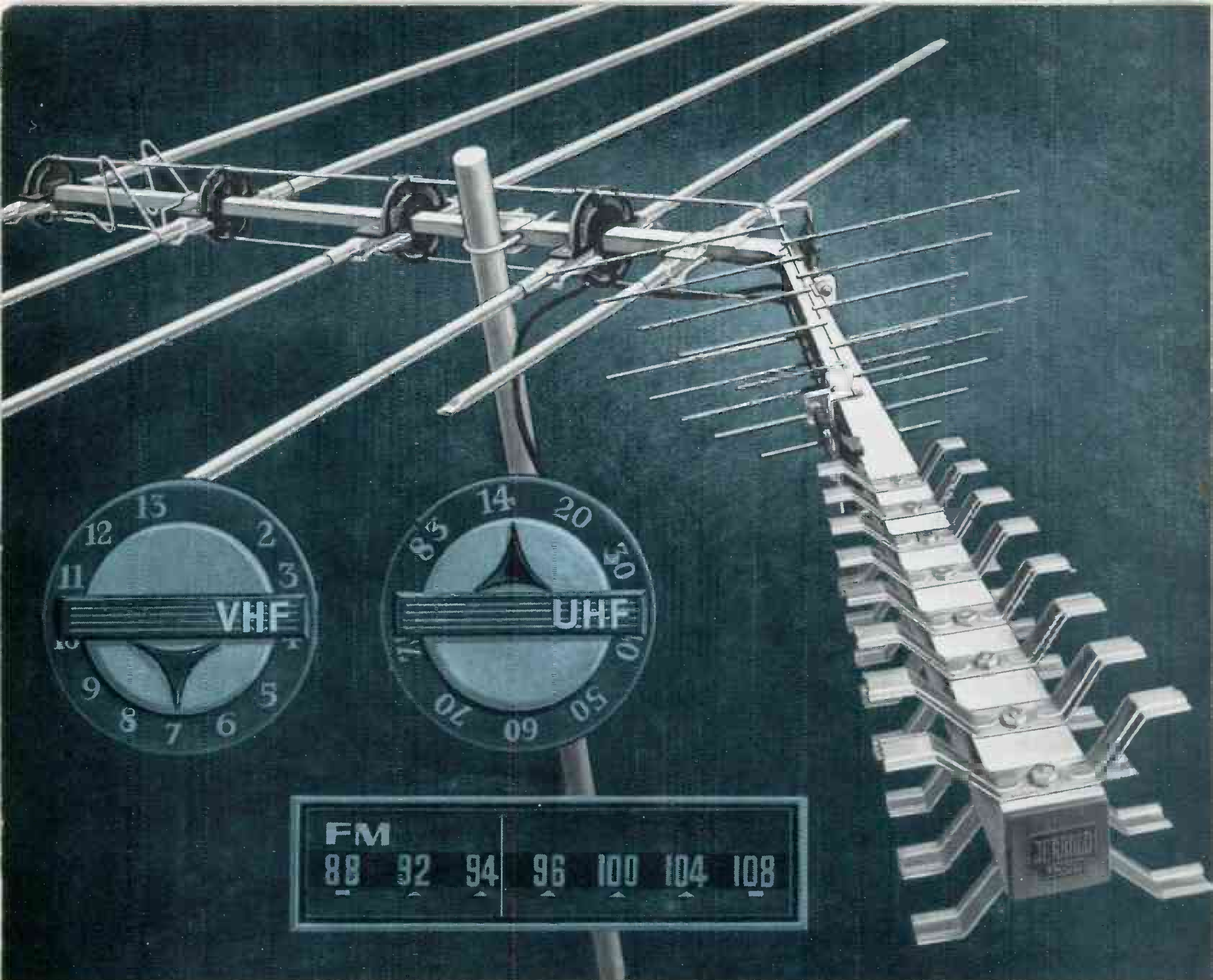
- Repairing the Small Record Player
- Square-Wave Tests of 3-T Networks
- Lasers You May Encounter
- One Component—Many Symptoms
- Plus other servicing features



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Circle 1 on literature card

5-YEAR Subject Reference INDEX 1961-1965

An index to article titles, categorized by subject, is included at the end of the main index.

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the magazine of electronic servicing

VOLUME 16, No. 1 JANUARY, 1966

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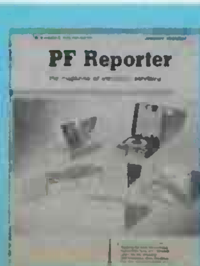
ABOUT THE COVER

Small, inexpensive record players such as those shown on our cover can mean a significant increase in the overall volume of your service work. The article starting on page 33 gives many hints for repairing these units more quickly and thus at a greater profit.



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the revolutionary new connectors that make QUICK work of parts replacement!

Nine times actual size

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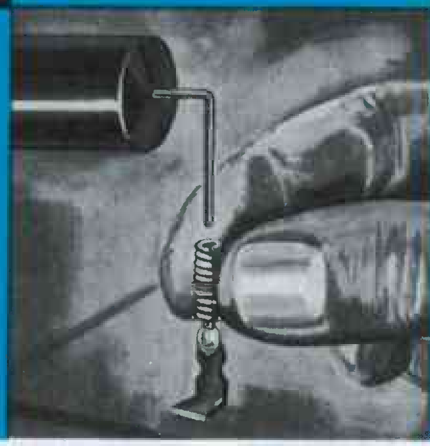
B SLIP ON KWIKETTE... it's quick!



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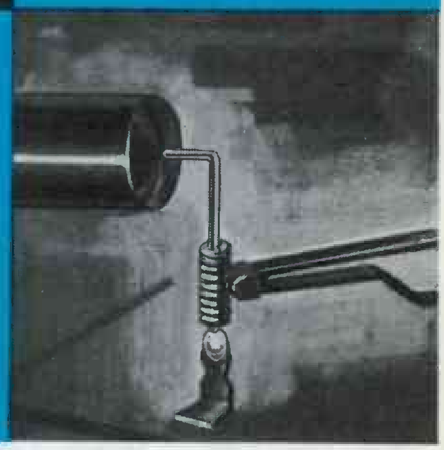

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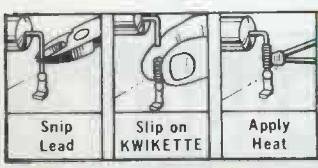

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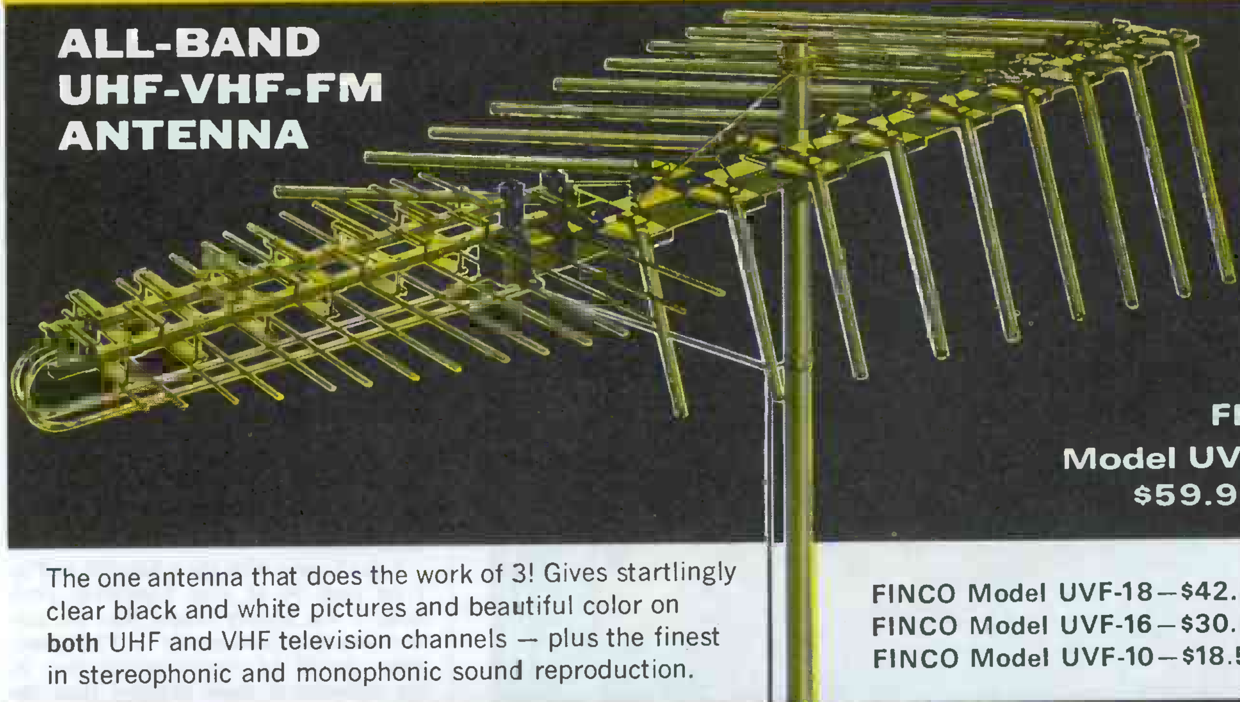
FOR UHF, VHF, FM RECEPTION

ALL-BAND UHF-VHF-FM ANTENNA



FINCO
Model UVF-24
$59.95 list

The one antenna that does the work of 3! Gives startlingly clear black and white pictures and beautiful color on **both** UHF and VHF television channels — plus the finest in stereophonic and monophonic sound reproduction.

FINCO Model UVF-18—$42.50 list
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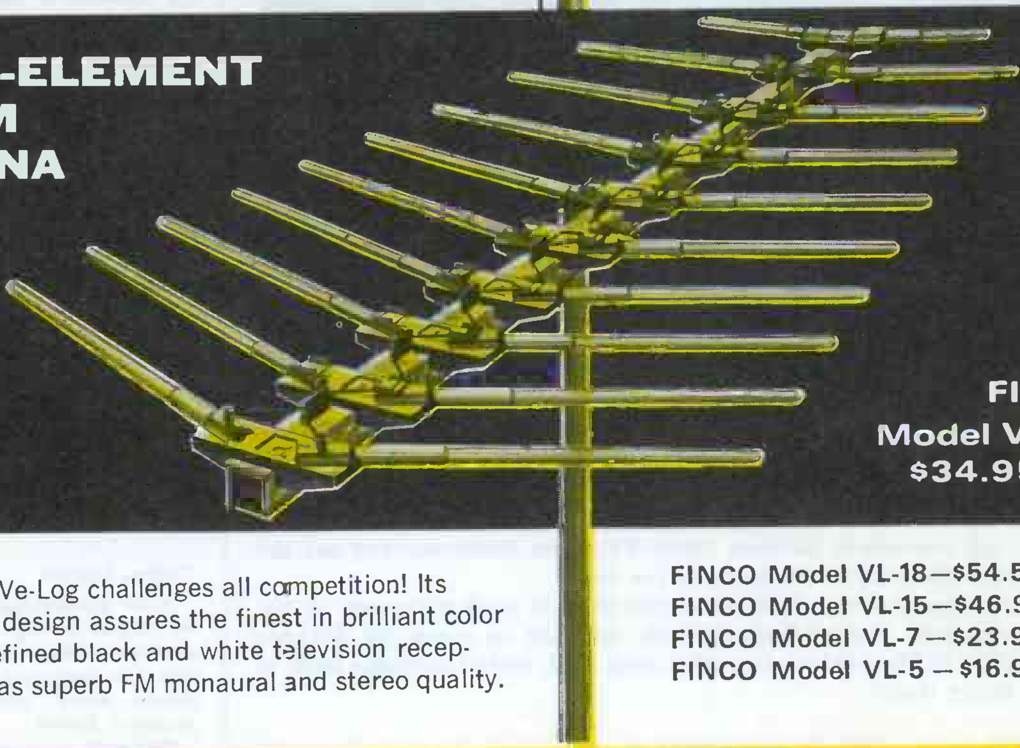
SWEPT-ELEMENT VHF-FM ANTENNA



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Model VL-10
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FINCO's Color-Ve-Log challenges all competition! Its swept-element design assures the finest in brilliant color and sharply defined black and white television reception — as well as superb FM monaural and stereo quality.

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Letters to the Editor

Dear Editor:

Can you please publish a complete list of radio and television manufacturers plus a list of test-equipment manufacturers for the last several years?

As you should well know, we technicians often need to write for information. I imagine you get plenty of letters like this. If you could publish these two lists, you might help yourselves as much as us, for then we could write directly to the manufacturer.

CHARLES MONTAG
Henderson, Texas

The addresses of radio and television manufacturers can be found in the PHOTOFACT *Annual Index available at your electronic parts distributor. In addition, we published "Source Guide to Imported Sets" in the June 1965 issue of* PF REPORTER. *The list of test-equipment manufacturers seems fine. We just might consider this for a future issue.—Ed.*

Dear Editor:

I don't agree with the schematic in Fig. 1 on page 36 of your September 1965 issue. I was always taught that the collector-emitter junction of a PNP transistor should be reverse-biased; that is, the collector is more negative than the emitter. You have shown a positive voltage to the collector in Fig. 1B. If positive voltage was to be used, it should have been connected to the emitter. Possibly this should be an NPN transistor.

In Fig. 1A, the transistor will be cut off without a signal. This is an NPN transistor and will need a positive-going signal to make it conduct at all. Any negative signal will only tend to cut it off further with no output on the negative half-cycle.

I may very well be wrong, but this is the way I understand transistors. If I have learned wrong, I want to get it straightened out as soon as possible. I enjoy reading, or I should say studying, your magazine each month. I am a technician in the U.S.A.F., and I do radio and TV servicing in my spare time. I have really found some helpful articles in PF REPORTER.

CARL COLLINS
Tampa, Florida

Your understanding of the action of the circuit in Fig. 1B is correct. I just can't understand how these errors creep into our magazine. Our artist has the emitter arrow pointing in the wrong direction. Sorry!

The time constant of the input resistor and capacitor in Fig. 1A can determine whether or not the transistor has an output during the negative input half-cycle. If the time constant is long enough, base current during the positive half-cycle can produce enough charge in the capacitor to bias the transistor into conduction during the negative half-cycle. The output may or may not be linear, but there can be an output during the negative half-cycle.—Ed. ▲

The Electronic Scanner

news of the servicing industry

Consumer-Electronics Sales Boom in 1965

Sizeable increases in distributor sales of color and black-and-white television sets and portable and table-model phonographs during the first three quarters of 1965 over comparable figures for 1964 were reported by the **Electronic Industries Association's** Marketing Services Department. Increases in distributor sales were also noted for home radios, including FM, and automobile radios during the first eight months of 1965 as compared to the same 1964 period.

Cumulative nine-month distributor sales of all television sets in 1965 totaled 7,412,808 units, an increase of 19.42% over the 6,207,147 sold from January-September 1964. Of total TV distributor sales, monochrome sales accounted for 5,628,856 units during the nine-month period, a 4.19% increase from 5,402,301 sets in the comparable 1964 period. Color TV set distributor sales totalled 1,783,952 in the 1965 nine-month period, a 121.65% increase over the 804,846 units sold in the same part of 1964.

Of total home-radio sales, FM-radio distributor sales for January-August 1965 totaled 1,557,562, up 69% from the 921,414 figure for the same period of 1964. Figures include table, clock, and portable radios.

Auto-radio sales by distributors in the eight-month period of 1965 totaled 6,511,333, up 24.3% from a figure of 5,236,598 units in the same eight-month period of 1964.

Distributor sales of phonographs in the first three quarters of 1965 totaled 3,446,604 units, an increase of 17.4% over the 2,936,690 total for the January-September period of 1964. Of the phonograph sales, portable, and table models accounted for 2,377,678 units, an increase of 30.1% over the 1,827,651 in the comparable nine-month period of 1964. Console distributor sales were down 2.83% over the nine-month period, from 1,109,034 in the 1964 period to 1,068,926 units in the three quarters of 1965.

TV Sales by Distributors

	Monochrome '65	Monochrome '64	Color '65	Color '64	Total TV '65	Total TV '64
December		811,446		226,478		1,037,924
November		711,243		163,754		874,997
October		759,970		171,223		931,193
September	935,475*	839,863	463,872*	157,603	1,399,347*	997,466
August	647,539	562,182	258,431	96,034	905,970	658,216
July	658,907	557,183	223,110	93,795	882,017	650,978
June	533,123	613,124	172,226	93,902	705,349	707,026
May	425,092	396,528	73,876	42,255	498,968	438,783
April	524,418	513,058	111,340	57,401	635,758	570,459
March	662,755	687,746	166,943	83,073	829,698	770,819
February	609,538	644,062	168,460	97,091	777,998	741,153
January	632,009	588,555	145,694	83,692	777,703	672,247

*Preliminary

Radio Sales by Distributors

	Home** '65	Home** '64	FM*** '65	FM*** '64	Auto '65	Auto '64
December		1,482,883		323,779		900,098
November		1,148,658		227,063		646,755
October		1,158,890		221,875		544,805
September	1,485,591*	1,297,571		240,378	867,719*	962,162
August	1,031,745	869,500	223,646	132,613	755,764	713,857
July	1,160,053	794,326	246,220	141,362	720,599	370,087
June	1,020,575	868,247	236,772	140,422	848,097	742,551
May	705,901	571,989	120,983	92,103	800,121	688,781
April	745,221	600,301	145,640	101,582	797,112	637,888
March	1,056,047	769,425	241,043	115,886	1,010,225	770,879
February	892,017	664,671	197,905	108,047	798,834	613,238
January	693,005	544,815	145,353	89,399	780,581	699,317

*Preliminary
**Includes table, clock and portable
***Included in home radios and excluding auto FM

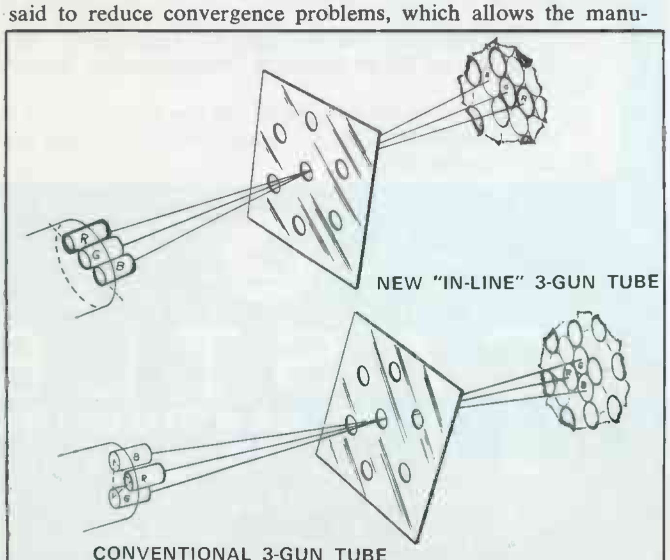
Phonograph Sales by Distributors

	Portable/Table '65	Portable/Table '64	Console '65	Console '64	Total '65	Total '64
December		684,234		251,339		935,573
November		420,383		190,555		610,938
October		485,346		187,742		673,088
September	510,781*	393,326	179,930*	214,947	690,711*	608,273
August	352,940	260,702	149,353	134,051	502,293	394,753
July	262,984	184,613	128,655	101,706	391,639	286,319
June	214,292	217,171	111,371	126,026	325,663	343,197
May	138,662	136,669	51,152	70,682	189,814	207,351
April	194,959	132,858	81,916	86,431	276,875	219,289
March	239,209	179,204	136,264	144,880	375,473	324,084
February	272,533	164,220	112,979	116,920	385,512	281,140
January	191,318	158,888	117,306	113,396	308,624	272,284

Picture-Tube News

A plant to manufacture glass television bulbs for the Mexican market will be built at Monterrey, Mexico, by **Productos Corning de Mexico,** a subsidiary of **Corning Glass Works.** Construction will begin immediately on a 66-acre site five miles northeast of Monterrey. The 53,000-square-foot plant is expected to be in operation by June 1966.

The 11" tube produced by **General Electric** for their new portable uses the same principles as the standard aperture-mask color tube, but it incorporates a different electron-gun arrangement. The three electron guns that produce the primary colors—red, green, and blue—are positioned in a straight line, instead of the delta or triangular arrangement used in the conventional tube. This switch to "in-line" arrangement is said to reduce convergence problems, which allows the manufacturer to dispense with the bulky convergence yoke and to incorporate the remaining convergence control in the deflection yoke. Also, high-voltage requirement for this 11″ tube is reduced to 15 kv.



Pilot production of a 21″ rectangular color-TV picture tube (see photo below) has started at **Motorola's** new tube factory at Franklin Park, Ill. Plans call for the start of volume production by March. Estimations are that the new plant will produce at least 100,000 21″ units in 1966.

A 90°, rectangular 22″ rare-earth color-TV picture tube will be introduced next spring by **Sylvania.** In order to facilitate design of TV chassis and cabinets, samples will be sent to the nation's leading color-TV manufacturers. At present, Sylvania's tube plant in Seneca Falls' N. Y. is operating on a round-the-clock schedule to help meet demands. In March, a new plant in Ottawa, Ohio will begin production of color tubes, augmenting production at Seneca Falls. In the fourth quarter of 1966, manufacturing capacity will approach two million color-TV picture tubes annually.

Seminars and Services

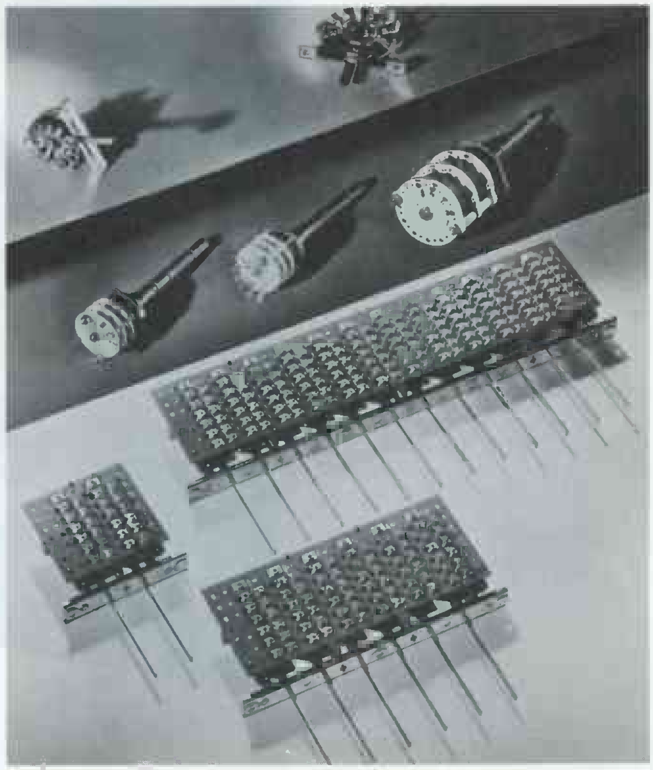
Overhauling and rebuilding for all makes and models of TV tuners is available from **Castle Television Services, Ltd.** in Toronto, Ontario. Color tuners are processed at no additional charge. The Canadian company is under the personal direction of Mr. A. Ernie Hanson.

More than 300 radio-TV service dealers recently attended a test-equipment seminar at Holiday House in Monroeville, Pa. Sponsors were **Lectrotech, Inc.** and Lectrotech distributors, M. Leff Radio Parts Co., Braddock, Pa., and Huston Electronics, Inc., Tarentum, Pa. Seminar subject was "The Problems of Servicing Color TV." Demonstrations on how to check color-TV picture tubes and use a vectorscope were given by William Grossman, Lectrotech president.

A factory-authorized tuner-repair center to serve the Eastern states has been opened by the **Tuner Service Division** of **Sarkes Tarzian, Inc.** The new center, **Tuner Service Corporation** is located at Jersey City, N.J. The new center will offer complete overhaul service on a 24-hour basis.

New Switch Line

A broadened line of switches for immediate delivery from electronic-parts distributors, "Operation Quick Switch" is being offered by **Oak Manufacturing Co.**, Crystal Lake, Ill. The firm provides a complete line of rotary, pushbutton, lever, and slide switches through local supply houses. The entire line was preselected to give distributors switch types preferred by OEM customers. Many designs now available were formerly produced on a custom-made basis. Increased usage of computers, peripheral electronic data-processing equipment, office equipment, audio equipment, meters, speakers, and similar equipment has increased demand for these switch types.



The most important connection you can make for FULL PROFITS from FULL-HOUSE TV!

The demand for multiple outlet, Master Antenna TV installations has entered a totally new phase ...one which goes far beyond the already big market for commercial applications and reaches to millions of newly created multiple set homes.

Color TV...as well as increasing FM multiplex popularity is the big reason why. Every homeowner who buys a color set instantly becomes a prospect for a residential MATV installation to operate two, three, or more receivers with maximum quality reception from one antenna.

New Channel Master mass production techniques on the same precision-quality, commercial-grade MATV components designed for big building applications have resulted in equipment price reductions that average 25% and more per installation. For MATV installing companies this means more volume and profit from highly competitive commercial jobs. For radio-TV service dealers it means an opportunity to get started in a totally new, high-income business meeting the booming demand for residential master antenna systems. The market is here now. And, it represents business that only you...a qualified service technician...can get.

IMPORTANT...Contact your Channel Master distributor now for details on a complete MATV system design and installation course.

CHANNEL MASTER M A T V

ELLENVILLE, N.Y.

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This is Al's new service van.

(Even for color it's all he needs with Amphenol's portable test equipment.)

Amphenol's new color television test equipment is so compact, there's room to spare, even in the smallest service truck. Try this for size—the Amphenol Color Commander (color bar generator) with nine useful patterns, yet no bigger than a small lunch box. Or our new CRT checker-rejuvenator with a built-in high impedance voltmeter in a 9" x 12" x 5" case.

There's even a versatile TV-FM field strength meter in a "pint" size package. And the cost of this equipment is as small as its size.

But don't let the compactness of Amphenol's test equipment fool you. Precision is as good as equipment many times the price. For example, the Signal Commander, either plug-in frequency module is under $190, and yet is the only field strength meter in its price class to provide absolute signal readings.

Look over the complete Amphenol Commander line at your Amphenol distributor. Or write us for descriptive literature.

AMPHENOL DISTRIBUTOR DIVISION
AMPHENOL CORPORATION
2875 South 25th Avenue, Broadview, Illinois 60155

ONE COMPONENT... MANY SYMPTOMS

Multiple troubles are sometimes caused by a single resistor or capacitor.

by Mickey Roberts

It was 6:30 on a hot summer Saturday afternoon. Business had been slow all week, so I decided to lock up for the weekend. Just as I was walking out the door, the phone rang. That's luck, no business all week, but try to close up and the phone rings! When I lifted the receiver, Mrs. Jones was on the other end of the line asking me if I would come over and look at her TV set. I was about to say, "I'm closed," but before I got the words out of my mouth, she interrupted. "It's only one of those little tubes in the back, and my husband will be so disappointed if he can't watch the ball game tonight."

The Joneses had been customers in the past and lived only a few blocks from the shop; so I decided —against my better judgement—I had better take the job.

I asked, "What seems to be the trouble, Mrs. Jones?"

She replied, "The sound is weak and has a buzz in it, and the picture is not black enough, you know, kind of all white."

"Okay," I said without much enthusiasm, "I'll be right over."

She was waiting at the door when I arrived. Smilingly she said, "We bought this set only a few months ago, so I'm sure it's only a tube and will not take much of your time."

I turned the set on and examined the picture while listening to the sound (or trying to above Mr. Jones's complaining something about they should have kept the old set; "this one is already causing trouble"). There was little contrast, the sound was weak with an annoying buzz, vertical retrace lines were visible, and the picture was bending at the top. I changed channels, and when I did, the set lost horizontal sync. With the hold control, I restored sync, but the picture was bending again; turning the contrast control did little for the picture. Thinking, "This is probably a tube in the video-IF or video-output section," I rotated the brightness control from habit more than anything else. I've found that many times rotating the controls will give valuable clues to the defective section. However, in this case it only served to confuse me. The brightness control had little effect and would not extinguish the raster.

As I was removing the back from the set, I was trying to decide what tube, if any, could be causing so many troubles. I discounted the video-IF tubes because it is unlikely that they would affect the brightness circuit. This meant the only tubes that could cause these symptoms were the video-output or picture tube. However, by this time I had about given up hope of tubes being the source of trouble. With the confidence of a baby taking its first step, I substituted the video amplifier and output tubes.

When I turned the set on again, the sound was okay until the sweep circuits warmed up; then the original trouble occured again.

Having learned long ago (after taking a few sets to the shop because of tubes) always to check any tubes that could be even remotely responsible for the trouble, I proceeded to check all the tubes including the CRT. Little to my surprise, the tube tester showed they were all good.

I explained that the set would have to be taken to the shop for repair. This statement always seems to get the same general line of questioning—this was no exception.

Mr. Jones stared disgustedly and grumbled, "What do you think is the trouble? How much will it cost? Can you fix it tonight?"

Rather than admit I hadn't the slightest idea of what was wrong, I answered with my Sunday technical talk and made the estimate plenty high without committing myself to a return date.

He frowned and said, "The thing is no good like that. You may as well go ahead and take it."

Loading up the set—cabinet and all—drew such remarks as, "You be very careful and don't scratch that cabinet; we paid quite a bit extra to get the nicer cabinet."

At the shop, pulling the chassis and connecting it to a test picture tube proved only that my tube tester had not lied about the picture tube being good. As I stared at the hundreds of dollars worth of test instruments before me, I wasn't sure which one to choose. In fact, I wasn't even convinced that the "big brass" in the test equipment industry had the unit I needed on the drawing boards. Knowing that a large percentage of troubles can be found with a VTVM, I reached for the leads.

Discounting the fact that the raster could not be extinguished, I thought it possible that the other troubles could all be caused by the video amplifier or output circuit,

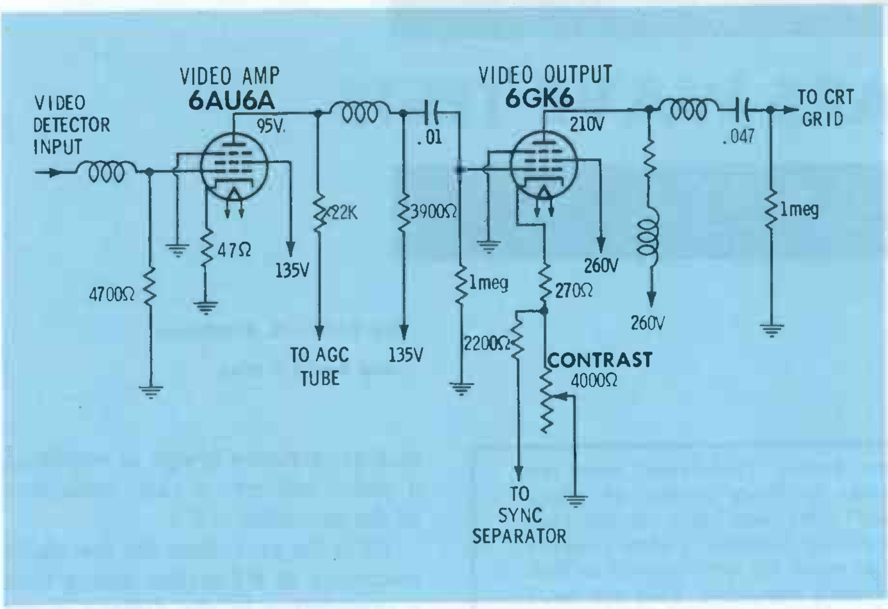

Fig. 1. Decreased voltage on video-amplifier tube caused a number of symptoms.

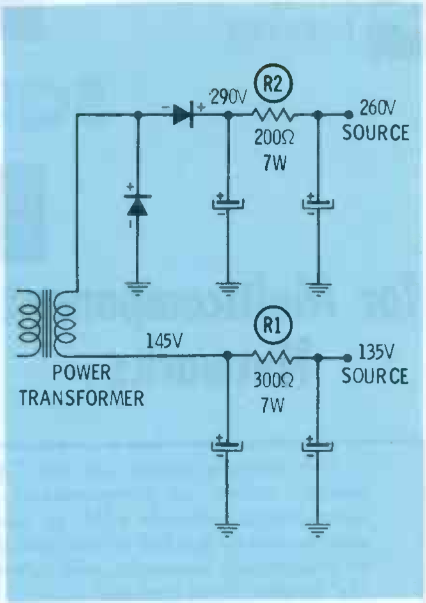

Fig. 2. R1 increase caused the trouble.

shown in Fig. 1. The voltages on all elements of the video-output tube were well within tolerance, so I proceeded to the video-amplifier stage. Suddenly I realized my luck must be changing, because the plate measured only 60 volts and the screen, which is connected directly to the 135 volt source, read 80 volts. Finding this caused me to smile for the first time since this chassis and I had become acquainted.

Directing my attention to the power supply (Fig. 2) proved to be the wisest step I had taken yet. The transformer side of dropping resistor R1 showed a normal 145 volts. This meant the resistor must have increased in value. A look at the schematic revealed the 135-volt line was also supplying, along with the video-output circuits, the video-IF tubes, the sound-IF and detector stages, and the cathode of the 6HS8 sync separator/AGC keyer/noise inverter tube. This explained the multiple trouble—or did it? I suddenly remembered the brightness-control problem. I turned the set on and waited to see what happened.

The set came on with a normal picture and good sound. I rotated the brightness control; much to my amazement, it operated as it should. When I looked closely at the circuit shown in Fig. 3, I realized why I had been unable to extinguish the raster with the brightness control. The reduced 135-volt source voltage had been insufficient to develop the cathode-to-grid bias required to cut off the CRT.

Replacing the chassis in the cabinet and returning it to the owner with a bill considerably less than the estimate made both the customer and me happy.

Some Customers Are Impossible

A few days later, a customer came into the shop carrying a television set with him. He walked over to the bench and set the receiver on it. Turning to me he said, "Do you think you can repair that set?"

I replied, "That's what I'm here for, and I haven't failed on one yet."

His next comments were, "I hope you aren't as unreasonable on price as the last guy was. He came out to the house, put in one tube, and was gone in ten minutes, but charged me $9.40. Can you imagine a $5.00 labor charge for only ten minutes work? That's $30.00 an hour! Well, this time when the set quit working I took all the tubes to a drug store and checked them. I found four bad ones and got them all four for less than that guy charged me. There must be something else burned out, though because it still has a faint picture and no sound at all. So what do you think is wrong, and can you fix it while I wait?"

I probably could have repaired the set while he waited, but I knew if I did and charged a reasonable price, he would spread the word that I, too, charged outrageous prices. I answered, "I can't be sure what the trouble is until I make some circuit checks, but I won't be able to get around to that until tomorrow." From experience, I knew that when a customer checks all the tubes, he is likely to put one back in the wrong socket. I checked this out thoroughly and convinced myself that at least he had the tubes where they belonged. I fired up the

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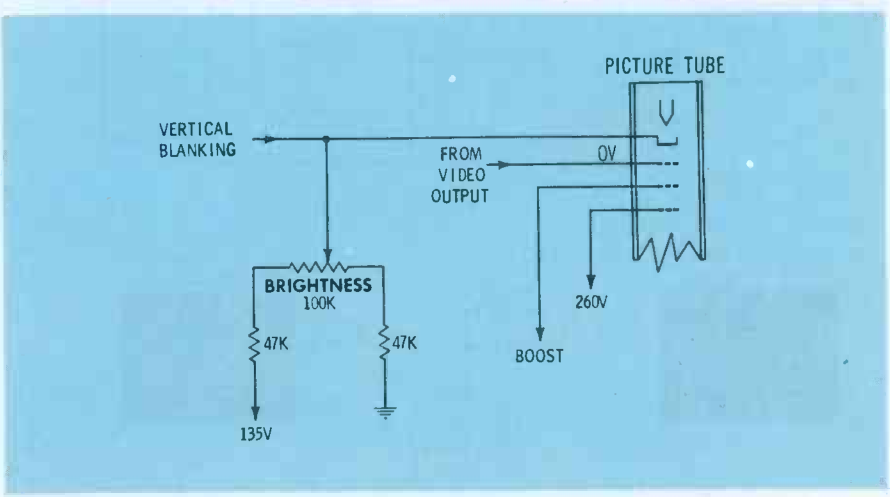
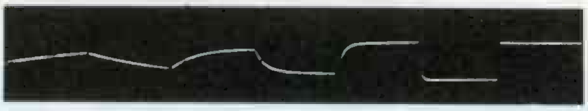


Fig. 3. Reduced supply voltage affected operation of the brightness control.



SQUARE-WAVE TESTS

for Multicomponent Networks

by Robert G. Middleton

and David I. King

This month's section of our "Advance Service Techniques" links last month's review on three-terminal networks to future articles on active (amplifying) networks such as audio and video amplifiers. Square-wave analysis can be applied to both active and passive networks to show presence of capacitance, resistance, and inductance in much the same manner as with the simpler three-terminal networks previously described. Tests for more complex circuits won't always be as simple as, for example, the $R_1 C_1 = R_2 C_2$ test; yet basic principles will remain the same.

Square-wave tests have been used for quite some time not only for design-laboratory experiments, but also for routine maintenance in industrial electronics and data processing; also, many production-line quality-control tests are based upon square-wave analysis. An excellent example is the importance manufacturers give to rise-time and overshoot characteristics when they describe many of their products.

As in the past, many production techniques previously used only in military and industrial electronics are now coming into use in home-entertainment devices—microcircuits are one example. To service home-entertainment devices effectively using these innovations, the service technician must be ready to adopt and adapt techniques used in military and industrial electronics.

A wideband triggered-sweep scope, such as those described in "Learning About Triggered-Sweep Scopes" has been used throughout this series. If you can arrange to use a scope such as this, try to do so; possibly a local TV station will let you become familiar with one of theirs. Even if you can't get to one of these scopes, follow with us. Information given in this series will be invaluable in the future.

—The Editor

A multicomponent coupling network such as the one in Fig. 1A may well appear formidable; fortunately most of its components can be tested with an ohmmeter or capacitance bridge. For example, an ohmmeter can be used to check R1 at terminals 1 and 2, and R3 at terminals 5 and 6; a capacitance bridge at terminals 4 and 6 will give a valid indication of the condition of C3.

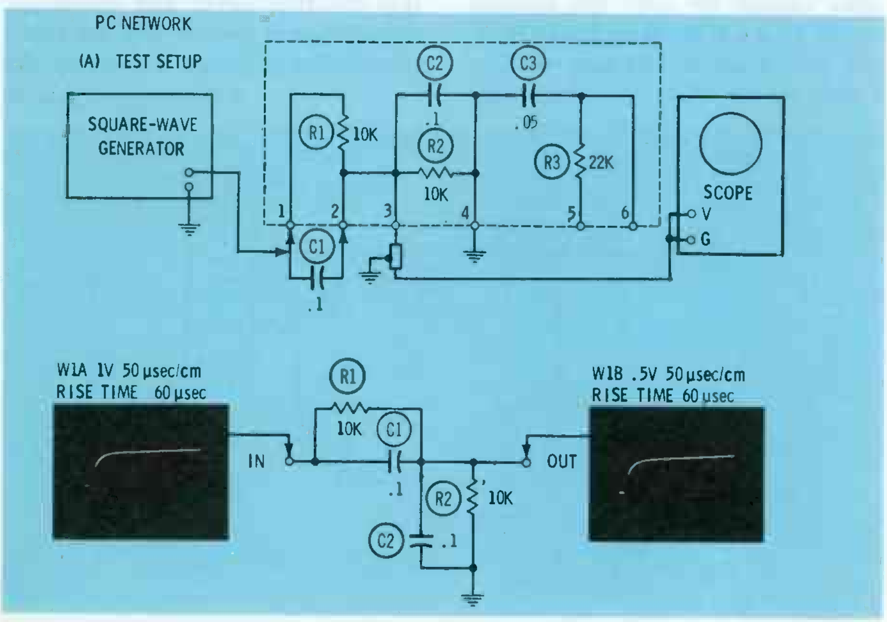


Fig. 1. Addition of C1 allows simple test; input and output waveshapes are identical.

C2 is the exception; the low shunt resistance of R2 makes testing with a capacitance bridge difficult if not impossible. You can however add a .1-mfd capacitor, C1, across terminals 1 and 2, as Fig. 1A shows. The resulting network is shown in Fig. 1B. If a square wave is applied at terminal 1 (W1A), a square wave (W-B) with identical waveshape, including equal rise time, should appear at terminal 2—p-p amplitude will be half that at terminal 1.

For best results, select a square-wave frequency that has a half-period interval close or equal to the $R_1 C_1$ or $R_2 C_2$ time constant. Here, time constant in sec is the product of R in megs and C in mfd: $.01 \times .1 = .001$ or 1 msec. The RC circuit is allowed to charge for each half of the square-wave period. Since period is the reciprocal of frequency, if the applied square wave frequency in Fig. 1 is 500 cps, then half-period interval $= \frac{1}{2} \times 1/500 = .001$ or 1 msec. For a proper comparison of waveshape and rise time between W1A and W1B, first select a scope sweep speed that shows a full square-wave period. Then compare leading edges and waveform tops; their shapes should be identical. Next, increase scope sweep speed or (if your scope has the provision) expand the trace until the time interval between 10% and 90% of maximum amplitude can be measured; rise times should be identical.

If the C2 value is decreased, rise time will remain equal to that at the input but the waveform top will begin to tilt downward immediately after the leading edge, indicating differentiation—the p-p amplitude will exceed half that at the input.

The $R_1 C_1 = R_2 C_2$ test for three-terminal networks, as shown in Fig. 1, was detailed in the previous article of this "Advanced Service Techniques" series; this test is useful for single-section integrating networks. Tests for multisection integrators, however, are not as simple.

Multisection Integrator Theory

A graphical description of multisection integrator action is given in Fig. 2. A wideband triggered-sweep scope was used to obtain all waveform photos. To show properly all phase relationships, the horizontal sweep was triggered with the leading edge of the positive-going square-wave-generator output. The time constant of each integrator section is .01 meg × .1 mfd = .001 sec, or 1 msec.

At W1, the applied square-wave frequency is 50 cps; the applied square-wave half-period interval is ½ × 1/50 = .010 sec, or 10 msec. This is ten times the time constant of each integrator section. W1A, W1B, and W1C give the appearance of resulting from successive integrations.

With the applied frequency increased to 500 cps (square-wave half-period interval equals integrator-section time constant), waveform photos show that the first, second, and third integrator sections produce different waveshapes. W2A is a typical sawtooth, but the shape of W2B seems midway between the sawtooth shape of W2A and the parabolic shape of W2C. Note the resemblance of waveshape W2C to a sine wave. In contrast to the output levels with a 50-cps square wave applied, a marked decrease in p-p output level from the two- and three-section integrators is observed with the application of a 500-cps square wave. An input-frequency increase to 5 kc produces: (1) a sawtooth waveshape with an amplitude 5% of input at the one-section integrator output. (2) a parabolic waveshape with an amplitude .2% of input at the two-section integrator output, and (3) a DC level at the three-section integrator output.

An explanation of the p-p amplitude isn't difficult: As input frequency increases, capacitive reactance decreases, and a greater part of the input signal is dropped across the resistors. Still, this does not explain the cause of the altered waveshapes at the two- and three-section integrator outputs.

Successive Integration

Note the leading edges of W2B, W2C, and W3B. The scope is synced on the leading edge of the applied square wave, yet the rising leading edges start almost midway in the first half-period interval. Successive integration shifts the relative phase of the output signal. Examination of the superimposed waveform photo in Fig. 3 shows the cause for both the phase shift and waveshape change.

After several input intervals, the integrator capacitor charges to the average DC level, which for a

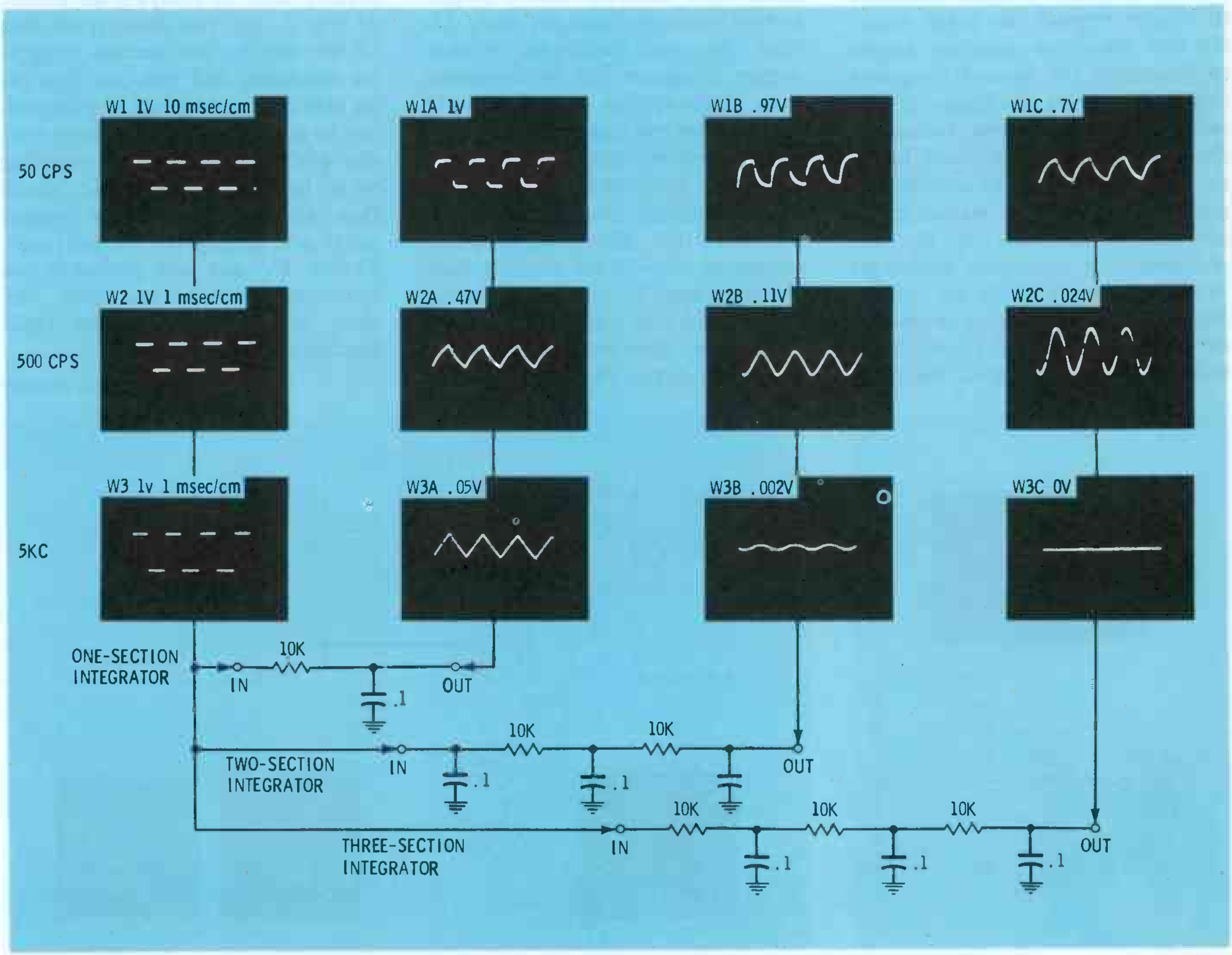


Fig. 2. Successive integration of squarewave input reduces output amplitude and makes waveshape more like a sine wave.

square wave is equal to ½ the p-p input amplitude. (Theoretically an integrator never completely settles, although for all practical purposes it does after several intervals.) The output waveform is referenced to the average DC voltage and shifts above and below this level. In Fig. 3, the larger waveform is taken at point A, while the superimposed smaller waveform is taken at point B. For clarity, the smaller (parabolic) waveform amplitude is increased in reference to the larger; therefore, the amplitude relationships are not to scale. The time bases for both waveforms are identical, and both waveforms are referenced to the same DC level.

The parabolic waveform from point B (Fig. 3) results from integration of the sawtooth waveform. In other words, the capacitor of the second integrator charges toward a sawtooth voltage, not a square wave; an approximately parabolic waveform results. The capacitor in the second integrator section continues to charge beyond the point where the first integrator capacitor begins to discharge; the second integrator finally begins to discharge at the point where the output voltage at the first integrator decreases below the output voltage at the second integrator. The discharge waveshape is also nearly parabolic, and the second-integrator capacitor discharges beyond the point where the first integrator capacitor begins to charge; the second integrator capacitor finally begins to charge at the point where the first-integrator output voltage increases above the second-integrator output voltage. Relative phases of the input, first-integrator, and second-integrator waveshapes are shifted in this manner.

An RC multisection integrator can be compared to an LC low-pass filter. As input frequency increases, output amplitude decreases. In addition, the amplitude of high-frequency elements of an applied square wave are attenuated more than the low-frequency elements, and the output waveform is similar to a sine wave at the fundamental frequency. Unlike an LC low-pass filter, an RC multisection integrator doesn't have a cutoff frequency. Also, the output-amplitude-vs-frequency curve of a multisection integrator is markedly different from that of an LC low-pass filter.

Testing Multisection Integrators

Since a multisection integrator is much more complex than a single-section integrator, tests are more difficult. In some instances, a two-section integrator can be converted to a single-section integrator, and the rise-time test can be applied. Fig. 4 shows one example.

The PC network in Fig. 4A must be disconnected from its circuit for test. Note that, with terminal 2 disconnected, C1-C2-R3 form a simple integrator; C1 and C2 in series form a .05-mfd capacitor. Use of Thevenin's theorem produces the equivalent circuit of Fig. 4B, where the value of R4 equals the parallel combination of R1 + R2 and R3. R1 is added to the circuit so that rise time can be measured; its value is made equal to R2 for convenience. Part of the output waveform is developed across R2; only the top (curved) portion of the output waveform is developed across C1-C2-R3. The straight-line portion of the output waveform isn't visible on the scope at the settings given; increase the input sensitivity and rotate the vertical-position control on your scope until the leading edge of the curved portion is clearly visible. Then measure the interval between 10% and 90% of peak amplitude on the *visible curved portion*. An RC circuit charges between 10% and 90% of peak input amplitude in 2.2 time constants. In this case rise time = 737 msec, and 1/2.2 × 737 = 335 msec.

This method is useful for two-section integrators; unfortunately, it isn't applicable to three-section integrators. Still, by studying the photos of Fig. 2, you can develop an idea of the way a three-section integrator functions, and you can then get an idea of its condition by comparison to normal operation. These tests are quite useful for PC coupling units because you needn't wreck them to determine if their components are greatly out of tolerance. Future TV sets will probably use integrated circuits, and tests like these will be necessary for rapid trouble-shooting.

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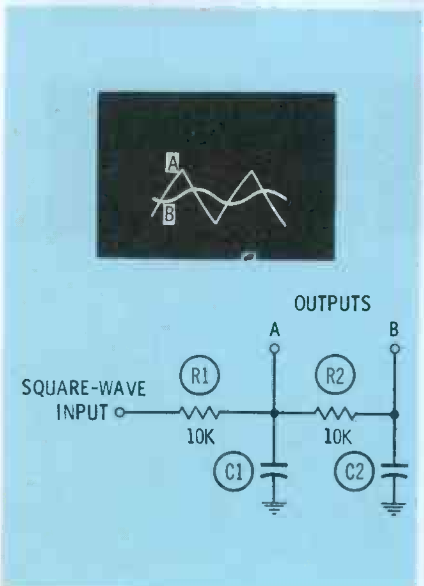


Fig. 3. C2 charges to voltage at C1.

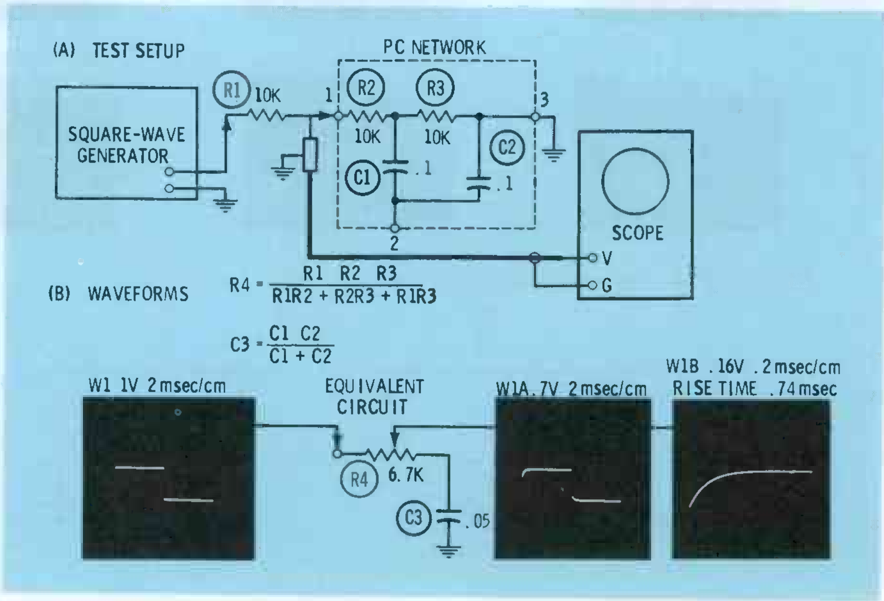
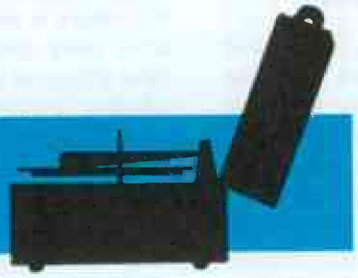


Fig. 4. Two-section integrator set up as one-section unit; rise-time test is used.

REPAIRING THE

Small Record Player



by Homer L. Davidson

It is profitable when you do it rapidly.

Generally, the small record player is used by the teenager or the young fry in the family and receives rough treatment. When a customer brings one of these units into the shop for repair, he will usually say, "This record player belongs to Johnny, and I don't want to spend too much on it. Can you give me an estimate? How much will it cost?" Some customers will have the record player repaired if the cost is less than ten dollars; others will spend only a couple of dollars. If the small record player has an automatic changer and a stereo cartridge, the customer will usually pay more to have it repaired. Also, sentimental values placed on a unit will have a bearing on the limit of repair charges. In any event, a true estimate should be made, not a low one just to get the job.

A serviceman may think that a repair under ten dollars isn't worth fooling with. But, he fails to realize that five of these jobs could gross fifty dollars; ten repairs will approach a hundred dollars. You can make a profit repairing small record players if the job is completed rapidly and efficiently. Since these small units lack hi-fi characteristics, sound quality is not a major repair factor; however, quick, dependable repair is a must.

Perhaps the primary reason to repair these units is that the customer may also possess a TV set, a car radio, household radios, and a stereo console; of course, all of

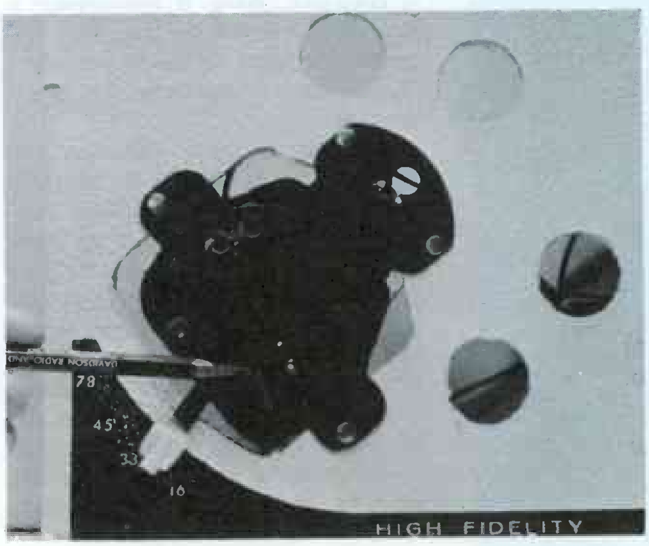


Fig. 1. You can cut off a few turns of the tension spring.

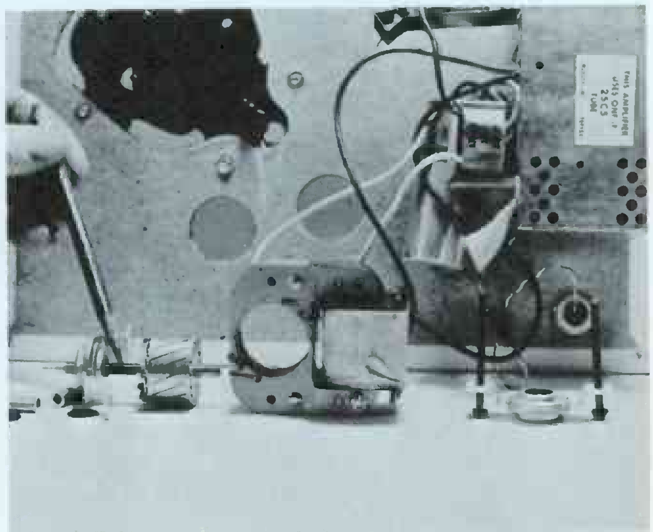


Fig. 2. Be sure to observe closely the field assembly.

checked and all of the old grease these represent future service jobs. And, you may sell him a new color receiver next year. All of these repairs and sales could add up to a large gross income.

Slow or No Speed

"The records won't turn" and "the speed is slow" are frequent complaints. A slow-moving turntable can be caused by dirt or grease on the idler wheel, a worn or dented idler wheel, dry bearings, an overheated motor, or turntable-rim slippage. When checking any phonograph, be sure to check all four speeds.

Make a visual inspection of the underside of the turntable. If oil or grease is on the rim, use cleaning fluid or alcohol to remove it. With metal turntables, slippage can be eliminated by applying a coat of liquid rosin, or some other product for this use, to the rim. If the turntable is made of plastic, liquid rosin will not do the job, and an appropriate product must be used. While the material applied to the turntable rim is drying, check and lubricate the motor assembly. Care should be taken when oiling the motor; excess oil will drip or be thrown on the turntable rim and idler wheel, and extra time must be spent in cleaning the parts again.

Check the idler wheel to see if the tire is worn or slick. If the tire has developed a flat side or dent,

The turntable bearing should be

replace it with a new one. A flat spot or dent is formed when the idler wheel is stuck; the motor shaft wears away a small portion of the tire. If the instrument is idle for a long period of time, the spring tension applied to the idler wheel causes a flat spot to form on the tire where it rests against the motor drive shaft. Some phono assemblies have a neutral position on the speed-selector control; but few people seem to know what it is for, and many of those who do know forget to use it. Also check the idler-wheel spring (Fig. 1). Should more tension be needed, cut off a turn or two of the spring and clip it back in to place.

The phono motor should be checked for dry or worn bearings; this is especially true of old record players. Take the motor apart, and clean the bearings and motor shaft; then, add oil to the felt oil cups. Before you disassemble the motor, be sure to mark the top and bottom ends of the field assembly (see Fig. 2). If the field is turned over mistakenly during reassembly, the motor will run in the wrong direction. Believe it or not, this can happen easily.

A few phono motors have oil holes for lubrication purposes, but the majority of them must be lubricated so that the oil will run down the motor shaft to the bearing. It is important not to over-oil the motor assembly; be sure to wipe off excess oil.

removed. A soft grease or petroleum jelly should then be applied to the bearing.

If the turntable rpm is still slow, there is one trick that can be tried. On machines that have a spring over the motor shaft, you can increase the speed of the drive pulley by using a larger-diameter spring. All the turntable speeds will be increased.

No Sound, No Speed

A common complaint is that both the amplifier and the turntable are inoperative. If the unit has a one-tube amplifier, chances are the tube filament is open. In these small phonographs, the heater of the vacuum tube is in series with the motor field coil. If the filament opens, the AC voltage path to the motor is broken (see Fig. 3). Replace the tube first; this will usually restore operation. In older record players and those having more than two tubes, the phono motor is usually connected directly across the power line.

Weak or Intermittent Sound

If the complaint is weak or no sound, replace the tube or tubes. If there is still no volume, check the crystal cartridge. Set the volume control to provide maximum amplifier output and flick a finger across the phono needle. If no audible noise is heard from the speaker, touch the hot lead of the cartridge with a screwdriver blade. If you then hear a loud hum, the cartridge is defective. Also, if the crystal is imperfect, a multitube amplifier will usually produce a loud hum when the volume control is set for maximum gain.

A defective crystal can also produce weak, distorted, or intermittent sound. Should the phono cartridge be suspected of causing weak sound, temporarily connecting a good cartridge will verify this suspicion. An intermittent crystal can be detected by moving the pickup arm up and down while the record is playing; the audio will come and go. Most cartridges found in small record players have relatively high output voltage, and replacements must deliver equal output.

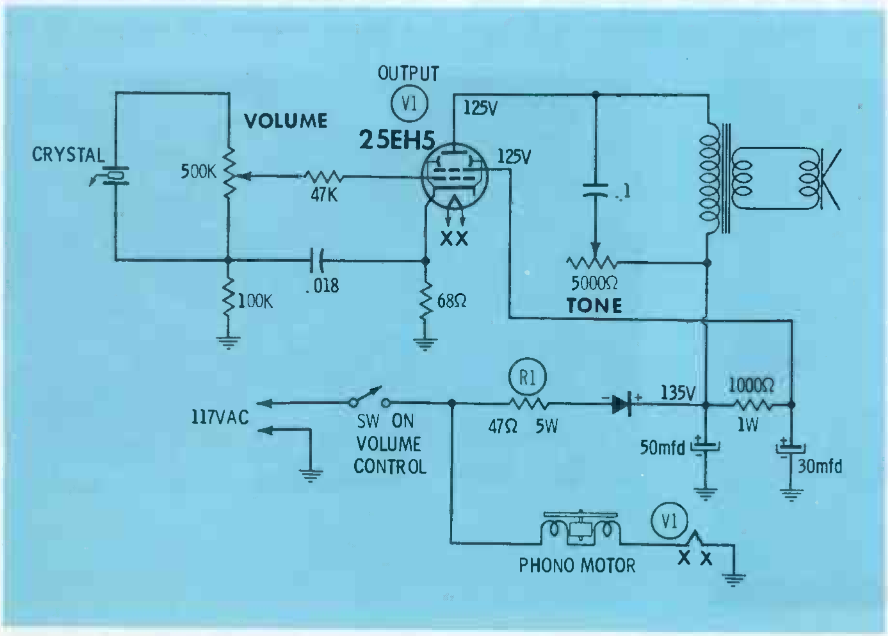


Fig. 3. This schematic diagram is typical of those found in small phono amplifier.

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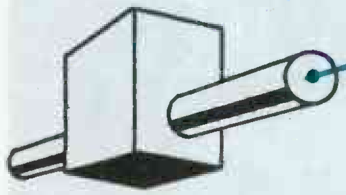
LASERS you may encounter



Industrial Electronics—An introduction to light amplifying devices

by William Nelson

Parallel rays of light that drill holes smaller than human hair.

Communications systems transmitting over beams of invisible "light" that spread out less than 6″ at a mile.

Pin-point welding of delicate foils with sun-hot light in less than one second of time.

The light that will do these and many more jobs is a new form of light, only five years old. It is generated by a **laser**—a device that harnesses the energy of the atom to produce a light more intense than that generated by nature.

Laser Operation

The primary action of a laser is to emit visible, infrared, or ultraviolet light when stimulated by optical, radio-frequency, electrical, or other kinds of energy. Most lasers work on the same basic principle. A light-producing material — such as ruby, glass, certain gases, or neodymium-doped calcium tungstate—is stimulated to a high level of internal energy by an outside energy source. This outside energy source can be a powerful photoflash tube as shown in Fig. 1, fired by some type of trigger circuit. Sometimes, a more elaborate trigger-circuit arrangement, such as the circuit of Fig. 2, is used in place of the simple ordinary switch.

Energy for the flash lamps used to excite the laser material is delivered by a pulse-forming network composed of capacitor banks as indicated in Fig. 1. This pulse is controlled using a trigger circuit. A power supply capable of delivering 3000 watts of average power replenishes the charge on the capacitors during the laser *interpulse* (between-the-pulse) period.

The physical nature of laser material causes it to produce an intense and narrow beam of in-phase light as the material settles back to rest from its stimulated state of high internal energy. This action is where its name is derived: **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation. A unit which emits visible light, using helium-neon gas as the laser material, can be seen in Fig. 3.

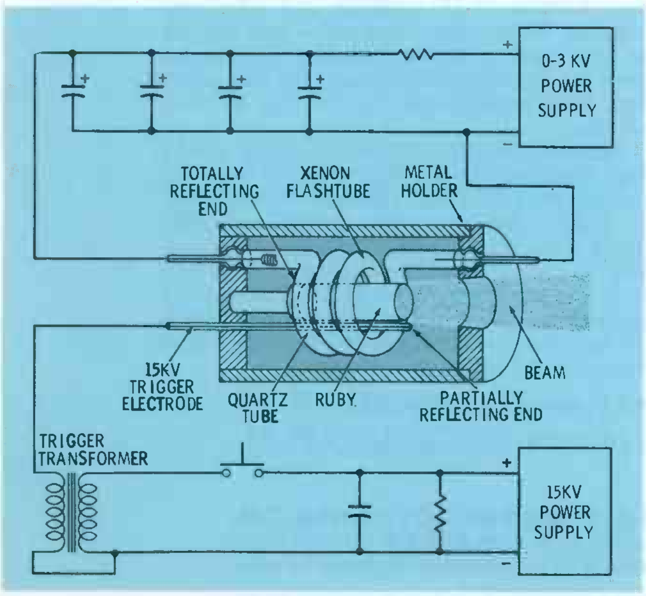


Fig. 1. Schematic of laser and associated circuits.

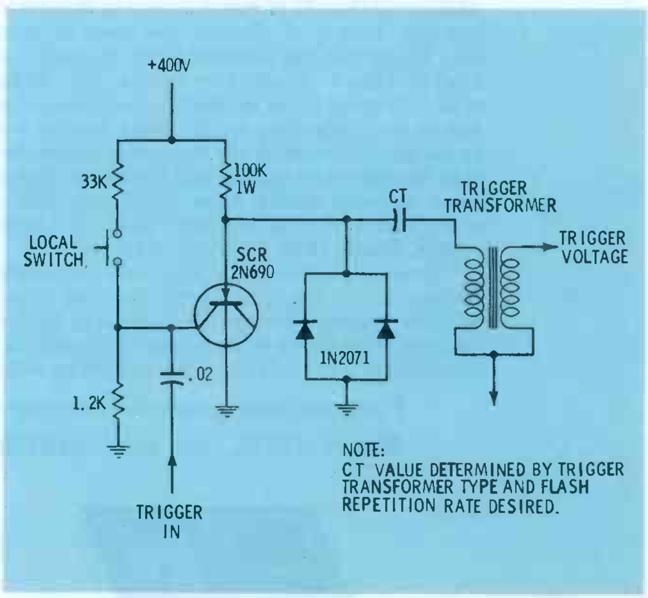


Fig. 2. Diagram of a trigger circuit using an SCR.

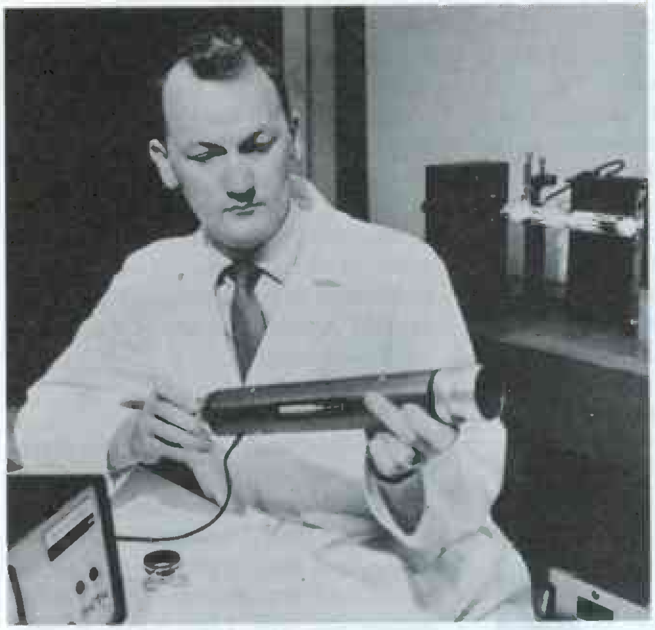


Fig. 3. This laser contains helium and neon gases.

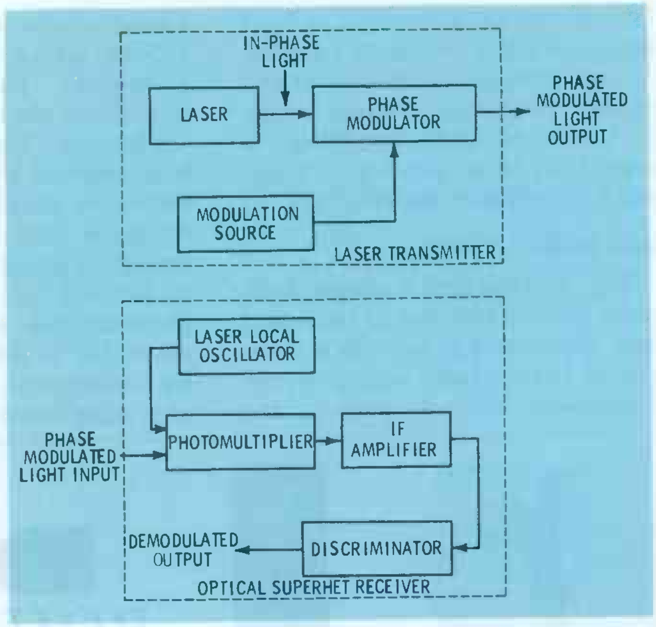


Fig. 4. A communications system that uses a laser.

Many Uses

More than 500 industrial firms, universities, and government agencies have moved into development work on lasers with a vast investment of over 750 million dollars. Communication men say that laser bandwidth is broad enough for a single beam to carry all the world's communication channels at the same time. Metallurgists are using the super-hot laser beam for drilling microtiny holes and for precision welding. The military looks to the laser to light the way to advances in radar guidance and searching, surveying, and battlefield range finding. Physicians use lasers to cauterize spots on the retina of the eye and to weld a detached retina, make openings in cell walls, and to clean cell interiors without damage to the cell walls.

TV Cameras

Combining a laser source with the flying-spot scanning system used in television, a laser camera produces images on an oscilloscope or television receiver screen. This system differs from the conventional television camera because it generates its own light for illuminating the scene being viewed. The laser light reflected by the scene is picked up by sensitive photomultipliers, synchronized, amplified, and applied to the control electrode of a cathode-ray tube. This technique is said to provide better resolution than is possible using conventional photographic techniques.

Communications

With the use of communication channels doubling every ten years, communications engineers have been working to find some method of transmission which will make possible more channels of information. Into this picture came the laser in 1960. For point-to-point communications systems at ultrahigh information rates or where extreme privacy (or noninterference) is demanded, lasers offer significant advantages over radio systems.

The laser is ideally suited as a communications carrier. Its beam is narrow enough for highly directional aiming and economic use of power.

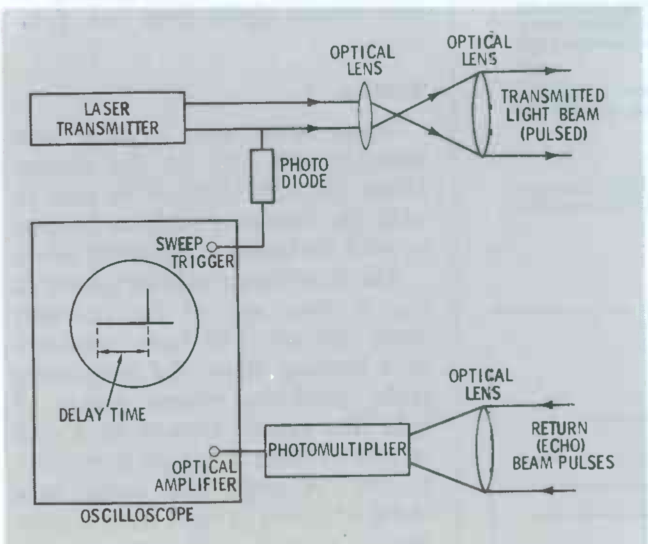


Fig. 5. "Radar" system uses a beam produced by a laser.

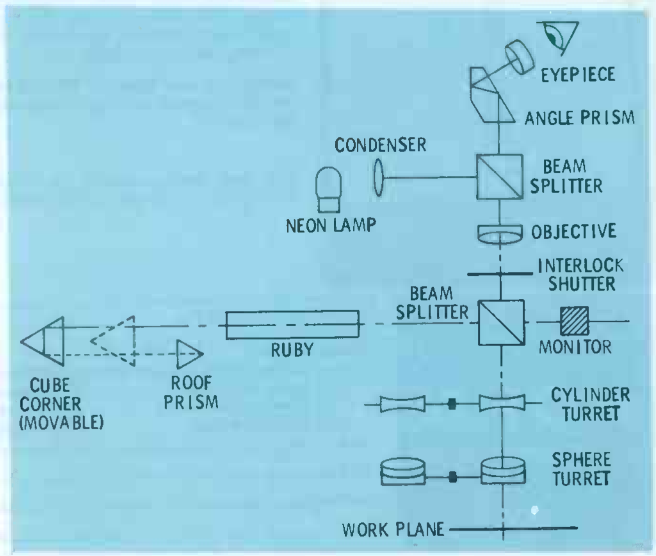


Fig. 6. Diagram of a welding system that uses a laser.

The amount of information a laser beam can carry is almost limitless. A laser communcations system can be seen in the block diagram of Fig. 4. Under the right conditions, a single laser beam can have a bandwidth of 100,000 mc (100 gc).

Laser Radar

Fig. 5 illustrates a simple laser radar system. The type of laser used here generates a pulse with a duration of 10 usec and a peak power of 1 megawatt. When the pulse occurs, a small portion of it is picked off by a beam splitter and directed to a photodiode. The output of this photodiode starts the sweep of an oscilloscope. The laser-beam pulse is transmitted with the light waves exactly in phase (collimated); the return, or echo, signal pulse passes through a second optical system. It is detected by a highly sensitive photomultiplier receiver whose output is fed to the main amplifier of the oscilloscope. By measuring the time delay between initiation of the sweep and reception of the return signal, the system computes the distance to the target electronically.

Such optical radar can work at very short ranges and have resolutions on the order of 1′ or better at 50,000′ away. At long range, this is equivalent to a resolution of 22 miles at the distance of the moon; resolution of conventional radar is several hundred miles at such extreme distances.

Laser Gyroscope

The laser may also take the place of the half-century-old mechanical gyroscope as an automatic guidance device for ships, aircraft, and missiles. This laser gyroscope is more stable and sensitive than the older mechanical type. Light waves traveling at a steady 186,000 miles a second give the laser gyroscope its "sense of motion." This light is immune to the forces of gravity which can cause instability and error in mechanical gyroscopes.

In operation, a laser gyroscope produces two light beams—both at the same frequency—which whirl continuously in opposite directions around a small square ring. At one corner, the light beams are picked off through a partially transparent mirror and fed into light-sensing photodiodes. Any change in the direction, altitude, or attitude of the vehicle to which the laser gyroscope is fixed causes a difference-signal output from the light mixer. This acts as an error signal which automatically operates controls to return the vehicle to its correct path, altitude, or attitude—resulting in zero output again from the gyroscope.

Welding

Since lasers can produce heat more intense than at the surface of the sun, this heat can be used to weld the hardest metals or focused to weld the tiniest of electrical wires.

The laser-beam welding system in Fig. 6 gives one of the strongest welds known. The laser, mounted in a housing above the positioning table, produces intense pulses of light that can be focused to a spot or line variable in length from .04″ to .06″. A single laser pulse, or a string of pulses at rates from 1 pulse per 12 seconds to 1 pulse per second, can be used.

• *Please turn to page 77*

uses for ELECTRICAL TAPE

There are hundreds — here are some for service shops.

by James Welch

Take a look around your shop and in your tube caddies. How many rolls of tape do you have? Are they all the same type? If so, chances are you've run into a situation where the tape you had was not suitable for a specific application. Either it wouldn't stick, or it loosened when exposed to extreme heat or cold. If you have been plagued with such problems, follow along with us as we take a look at some different kinds of electrical tape and point out specific uses for each type.

Using Tape

There are three common types of electrical tape: ordinary vinyl-plastic tape, high-temperature tape, and all-weather tape. Proper application of these tapes is generally a simple matter; however, situations do sometimes exist where a special method of application is helpful.

1. In many applications, you can spiral wrap vinyl-plastic tape over the area to be protected using an overlap equal to about 1/2 the width of the tape (Fig. 1). Apply the tape with the tension necessary to pull it from the roll.
2. When the working area is limited, or in places where high voltages are encountered, it is sometimes easier to cigarette wrap (Fig. 2) the area with a short length of tape and then overwrap using the spiral method. This insures more complete coverage of the area.
3. Where high temperatures are present, as around high-voltage transformers and some tubes, an electrical tape with a glass-cloth backing and a thermosetting adhesive usually performs most satisfactorily.
4. When the repair will be exposed to low temperatures, use an all-weather vinyl-plastic tape.

Having looked at the three basic types of tape and how to apply them best, let's examine some of their specific uses.

Splice Insulation

Whenever two wires are spliced by twisting, soldering, or a metallic connector, a plastic tape will provide the electrical insulation, mechanical protection, and moisture

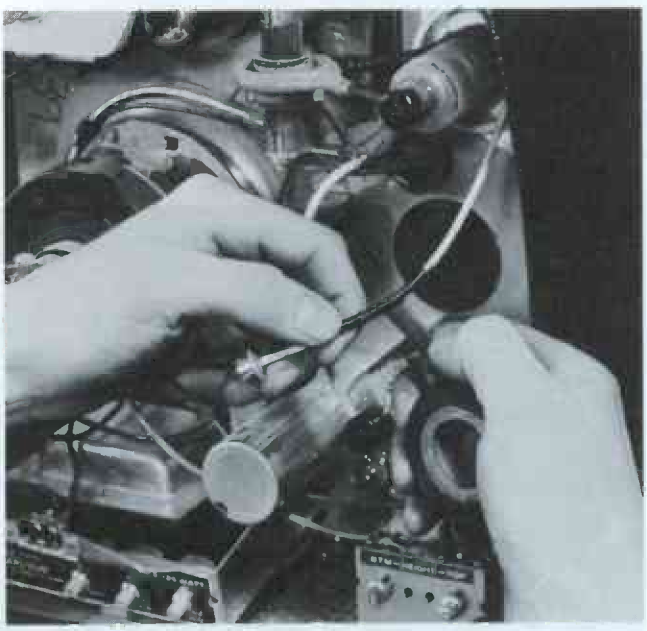


Fig. 1. Spiral wrap with plastic tape should be made to overlap each turn by approximately one-half tape width.

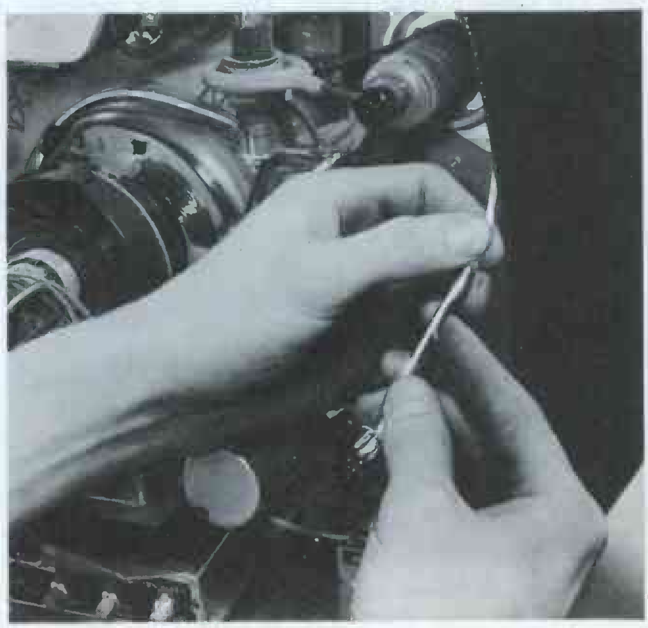


Fig. 2. A stronger and safe repair job can be performed by first wrapping the damaged area with a cigarette wrap.

Fig. 3. Typical tape wrap of a circuit splice for better insulation and added protection.

Fig. 6. Electrical tape can serve as an insulating sleeve on replacement of electrolytic capacitors.

and corrosion resistance necessary at this critical point. A spiral wrap will seal and insulate the connection (Fig. 3).

Wire Harnessing

When it is necessary for you to replace components or wires, or to modify a circuit, the factory harnessing of a group of wires is usually disturbed. Fig. 4 shows how simple it is to reharness this group of wires. Spot taping or an open spiral is sufficient to hold wires. In cases where the wires may be exposed to cleaning fluid, oil, etc., use a 1/2-lapped closed spiral for protection.

Component Isolation, Insulation

Often in the closely entwined circuitry of the modern radio or television set, terminals and leads are so closely spaced that normal vibration can cause a short circuit. This situation can well be intermittent, making the location of the trouble difficult. You can eliminate the problem by insulating with tape any leads that are likely to short; see the example in Fig. 5.

Insulating Filter Capacitors

Sometimes you'll find that a replacement electrolytic capacitor does not have the fiber insulating sleeve that is normally a part of new equipment. In some cases the sleeves can be salvaged from the original can, or sleeves that will fit can be purchased. In those instances where it is impossible to obtain a usable sleeve, the electrical characteristics of plastic tape provide the answer to the problem (Fig. 6) and reduce the necessity of carrying a large inventory of fiber sleeves.

High-Voltage Lead

In many television sets, especially portable models, the high-voltage anode lead passes through hole cut in a vertically mounted chassis. The general flexing of this lead caused by movement of the set or movement of the lead during repair contributes to the ultimate breakdown of the insulation. Once this deterioration begins, it is accelerated by the corona effect of the high voltage present on the wire. Eventually, replacement of the lead is necessary. However, arcing from this lead can be eliminated temporarily by cigarette wrapping (see Fig. 2) the problem area and spiral overwrapping with tape as shown in Fig. 7. Remember, though, this tape insulation is only a minimal barrier intended to reduce the arcing distance of the high voltage. Avoid making contact with the anode lead while the set is operating—you could receive a severe and embarrassing shock.

Cushioning Capacitor Straps

Cushioning of capacitor straps takes in a wide range of applications dealing primarily with building up the body of electrolytic ca-

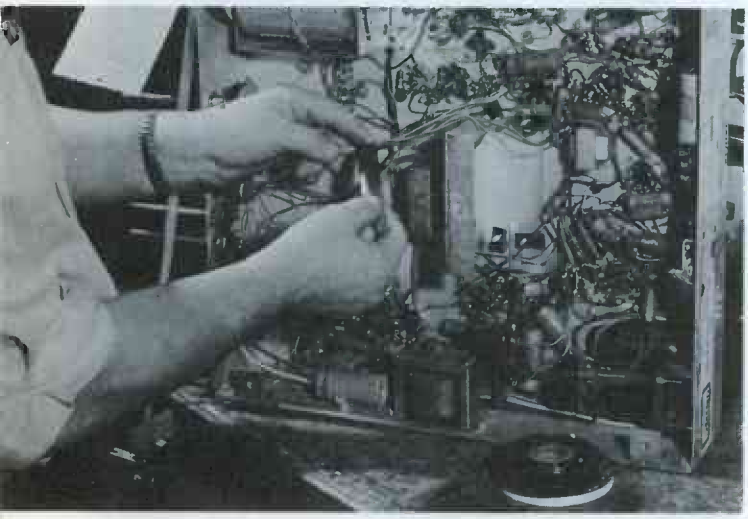


Fig. 4. Using electrical tape to harness a group of wires located on the under-chassis side of a typical television set.

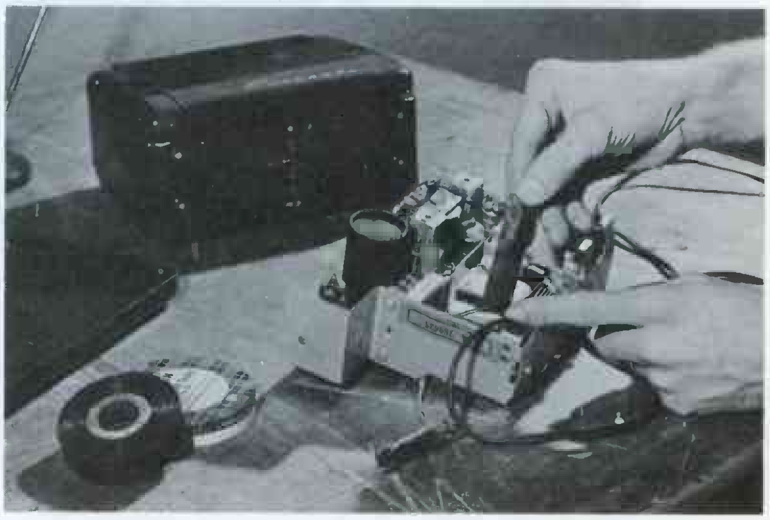


Fig. 5. Short length of electrical tape protects circuit against shorts caused by vibration of parts within chassis.

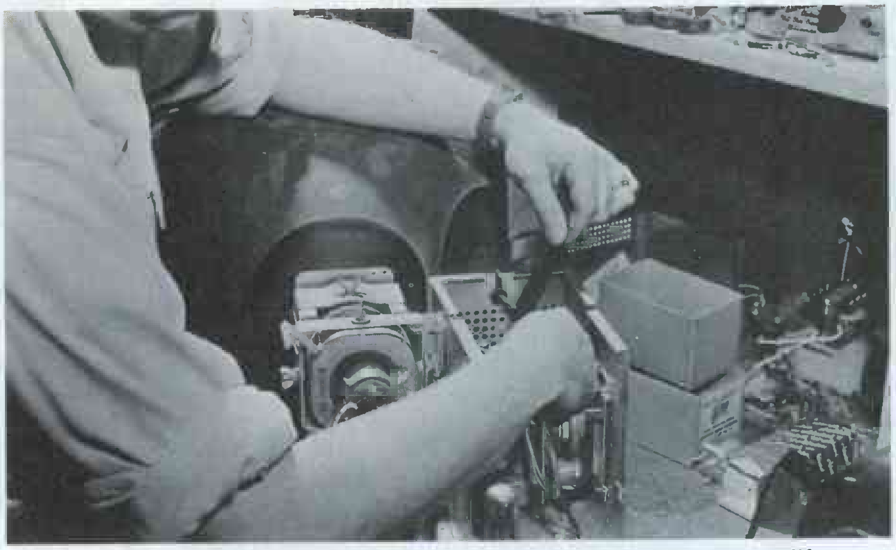


Fig. 7. Example of wrapping the high-voltage lead to prolong circuit life.

pacitors to insure their proper positioning and security on the chassis. The problem of looseness generally develops as a result of technological advances that decrease the size of replacement units. However, the problem can also arise when other than specified parts are used for some reason.

Often, the metal clip designed to hold the capacitor in place just will not lend itself to the bending necessary to do the job. A few turns of tape around the capacitor and then around the clip will fill the empty space and provide a snug fit. When a holding strap is not provided, wrap a short length of tape around the capacitor, and leave a small tab extending from the body of the unit. Punch a hole in the tab, and mount the capacitor with a screw and nut.

Picture-Tube Straps

The positioning of picture-tube holding straps and cushioning is often a critical factor in maintaining correct alignment of the tube. All new television receivers are provided with a cushioning material beneath the strap and around the tube. This allows for tension on the strap without tube breakage and prevents slippage of the tube or holding straps.

When this material, due to age or tube replacement, is no longer functional, install your own cushioning. A few layers of tape provide an excellent cushion and eliminate tube slippage.

Picture-Tube Base

Intermittent filament contact on old television picture tubes is often caused by a loose tube base. You can correct this by securing the base to the glass envelope with a piece of tape. In this application, use a tape that withstands high temperatures.

Buildup for Tuner Cams

Extended use of cam-operated tuning systems results in wear of the cam, piston, or both, creating looseness in the tuning system, intermittent contact, and inefficient operation. These worn parts can be beefed up to their original dimensions by wrapping them with tape.

Repair of Ion Trap

When the spring in the ion trap becomes distorted to a point that slippage is more the rule than the exception, try covering the area of its location on the neck of the tube with a layer of electrical tape. The tape acts as a filler to take up the slack in the spring and provides a more stable base for the ion trap, thus reducing the probability of slippage.

Lead-In Protection

The exposure of the television antenna, particularly the lead-in cable, to atmospheric conditions is an almost inevitable companion to the improvement in reception. However, electrolytic corrosion, moisture, and wind damage can cause rapid deterioration of the antenna-system efficiently.

Sealing the ends of the lead-in cable at the antenna and at the set, sealing the antenna-to-lead-in con-

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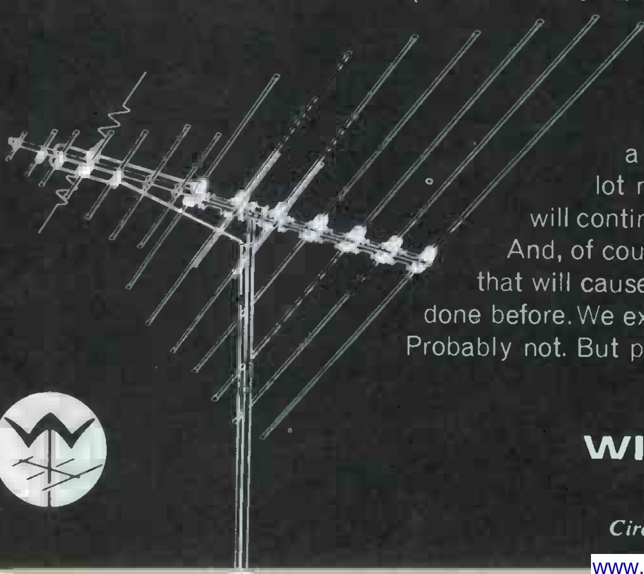
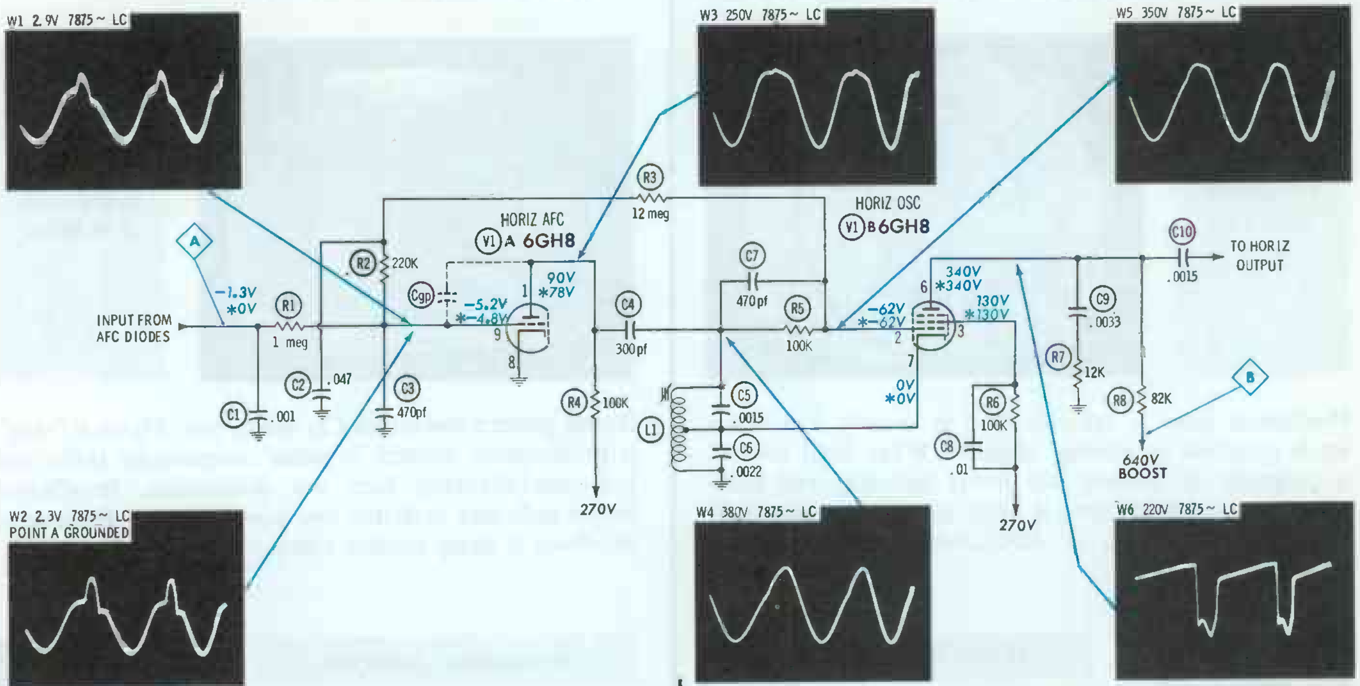


PF REPORTER Symfact®

Horizontal Oscillator

Sine-Wave Electron-Coupled



DC VOLTAGES taken with VTVM, on inactive channel; antenna terminals shorted. *Indicates voltages taken with signal present—see "Operating Variations."

WAVEFORMS taken with wideband scope; hold control set at midrange for 0 volts at AFC-diode input. Low-cap probe (LC) used to obtain all waveforms.

Normal Operation

Sine-wave oscillator V1B, like *Synchroguide* and multivibrator circuits, generates 15,750-cps drive signal for horizontal-output tube. To prevent load variations of class-C output stage from affecting L1-C5-C6 tank frequency, V1B screen grid shields tank from plate circuit. Oscillation is sustained by triode comprising screen grid, control grid, and cathode. Both inductive and capacitive halves of tank circuit are tapped to provide voltage step up at grid necessary for oscillation. As oscillator operates class-C, C7 and R5 are employed for grid-leak bias. Waveform at V1B plate results because tube is cut off for major portion of negative cycle at grid; charging of RC circuit C9-R7 causes sawtooth at waveform top. Tank frequency is controlled by hold-control slug and action of AFC-control tube V1A. C4 and V1A form shunt capacitive path between oscillator tank circuit and ground. V1A conduction controls current through C4 and therefore determines effective shunt capacitance value. DC voltage taken from V1B grid via R3 and R2 (C2 bypasses AC component) sets operating point for V1A grid; AFC-diode input voltage then causes V1A negative bias to shift above or below this point, controlling V1A conduction. Oscillator frequency is controlled as V1A conduction varies effect of shunt capacitance (C4) on oscillator tank; frequency is thus regulated by DC voltage from AFC diodes. Signal at V1A grid results from plate-signal coupling through plate-to-grid capacitance Cgp. Altered waveshape results from differentiation.

Operating Variations

PINS 1, 9 With receiver synced on station signal, DC voltage varies with position of hold control. Pin 1 range is 160 volts, control CW, to −4 volts, control CCW. Tube conduction clamps positive-going portion of tank signal at plate; negative-going portion is undisturbed. Consequently, average DC level goes negative as tube conduction increases. At pin 9, receiver synced, rotation of hold control causes shift from −9.8 volts CW to −1.5 volts CCW.

PINS 2, 3, 6 Voltages are independent of station-signal presence. As hold control is rotated from center position, pin 2 goes more negative at maximum CW or CCW position to −66 volts; pin 3 voltage remains constant. Pin 6 voltage depends upon boost supply; range is from 320 to 360 volts.

A, B At point A, with receiver synced, hold-control rotation causes shift from −6.2 volts CW to 4.6 volts CCW. At point B, oscillator not synced, voltage ranges from 580, hold control maximum CW, to 700, maximum CCW.

WAVEFORMS Receiver synced, W3 and thus W1 amplitudes vary with hold control position. P-P voltages are: hold control CW—W1, 2.4 and W3, 220; CCW—W1, 3.2 and W3, 340. W2 (point A grounded) doesn't vary during normal operation or during out-of-sync condition.

Symptom 1

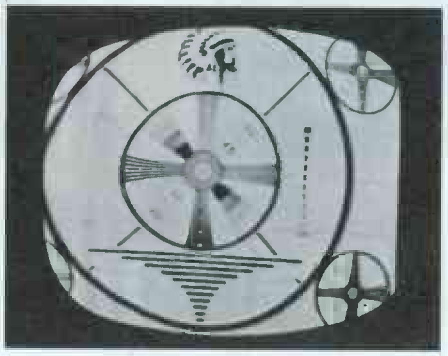
Horizontal Sync Critical

Pix Jitters

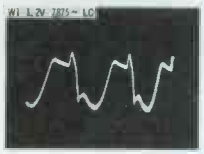
C3 Leaky

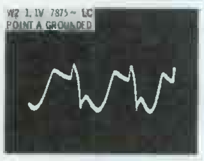
(V1A Grid-Circuit Capacitor—470 pf)

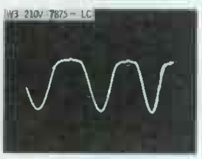
Symptom Analysis



Horizontal sync is critical; sync is usually lost when set is switched to another channel. When hold control is properly set, picture still jitters and may roll horizontally. As vertical sync is okay, symptom seems indicative of AFC-diode or AFC-control-tube trouble.



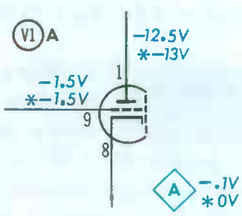




Waveform Analysis

Waveshape at control-tube grid (W1) is greatly altered, and amplitude is reduced to 1.2 volts p-p. Grounding AFC-diode input doesn't change (W2) waveshape; hence, trouble is localized to V1A circuit. W3 at V1A plate isn't changed, but rotation of hold control has no effect on amplitude. Normally, p-p amplitude varies from 220 volts (hold control CW) to 340 volts (hold control CCW). Trouble is likely in V1A grid circuit.

Voltage and Component Analysis



With-signal voltage at point A (ungrounded) is normal. Significant clue is voltage at pin 9, V1A grid. Normally, rotation of hold control causes change from −1.5 to −9.8 volts at pin 9; now, change is only .1 volt. Resistance check at V1A grid reveals 30K resistance to ground—path via R1 and AFC diodes to ground is at least 1 meg. Disconnecting C3 causes resistance-reading increase to 1.8 meg. Replacement of C3 restores normal operation. Negative plate voltage results from presence of 210-volt p-p tank signal.

Best Bet: Voltage, then resistance checks.

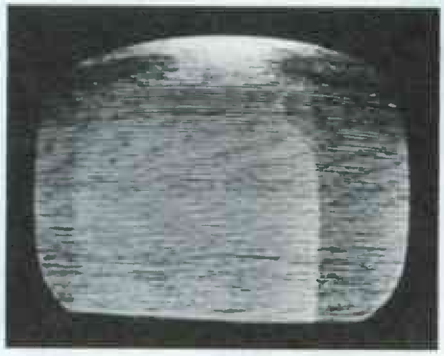
Symptom 2

"Christmas-Tree" Effect

Height Insufficient

R5 Increased in Value

(V1B Grid-Leak Resistor—100K)

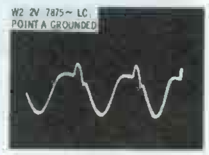


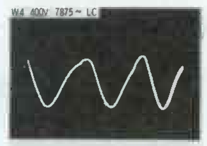
Symptom Analysis

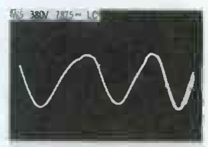
Raster pattern resembles Christmas tree. Flyback "sing" is pronounced. Pattern in raster occasionally shifts and horizontal-blanking bars are discernible. Insufficient height indicates probable low boost voltage. Horizontal oscillator is likely trouble source.

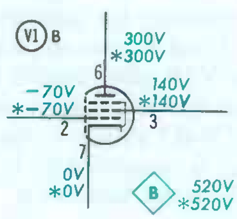
Waveform Analysis

Grounding point A has no effect on raster pattern; W2 amplitude and waveshape aren't normal, but this gives little help. Big clues are waveshapes across oscillator tank (W4) and at grid (W5). Fact that succeeding cycles have different shapes and amplitudes indicates that oscillator is operating simultaneously at two different frequencies or "squegging." Likely cause is excessive grid bias which blocks oscillator and causes erratic action.









Voltage and Component Analysis

Increased negative bias on V1B control grid accompanied by decreased plate voltage seems contradictory until plate supply (point B) is checked: it's decreased to 520 volts. Malfunctioning oscillator is upsetting flyback action and reducing boost voltage. Screen-grid voltage increase results from more negative control-grid voltage. Pin 2 voltage depends upon time-constant ratio between C7 charge path—via pins 2,7 to ground—and discharge path R5. Increase of R5 value to, in this case, 250K increased bias causing squegging.

Best Bet: Scope, VTVM find; ohmmeter confirms.

Symptom 3

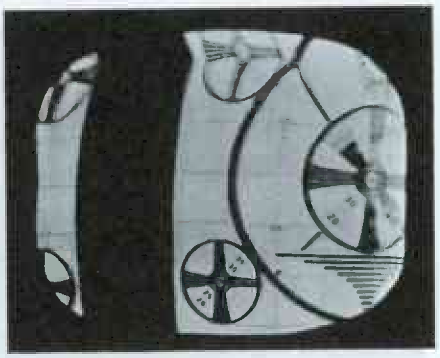
Horizontal Rolling

Hold Control Near CW Stop

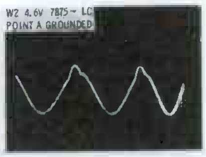
R4 Increased in Value

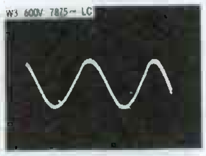
(V1A Plate Resistor—100K)

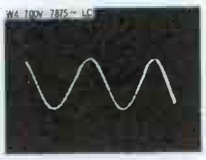
Symptom Analysis



Picture jitters constantly and occasionally rolls horizontally. Horizontal sync is completely lost during station breaks or if channel is changed; vertical sync remains stable. Hold control must be turned almost fully CW for horizontal sync.



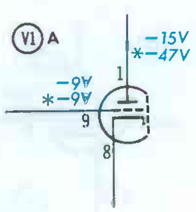




Waveform Analysis

Picture remains almost synced with point A grounded; trouble doesn't precede V1A circuits. W2 waveshape isn't normal; spike at top rides at front, not center, of waveform. Amplitude at W2 is increased to 4.6 volts p-p. At W3, amplitude and waveshape are also changed—amplitude increase is to 600 volts p-p. Rounded waveform top at W3 indicates that tube conduction is decreased. W4 indicates p-p tank signal is increased.

Voltage and Component Analysis



Point A grounded, plate voltage is −47. As point A voltage with signal is 0 Volts (ground potential), abnormal plate voltage gives important clue. Point A ungrounded, with-signal voltage at pin 9 swings from −2 to −11 as hold control is rotated slightly; grid-voltage change is accompanied by swing from −140 to +40 volts at plate. In addition, without-signal voltage at plate is decreased from normal +90 to −15 volts. More negative voltage at plate points to R4 defect; resistance checks verify value increase to 800K.

Best Bet: Scope aids; voltage, resistance checks detect.

Symptom 4

Horizontal Sync Lost

Drive Line Visible

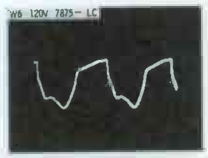
C7 Leaky

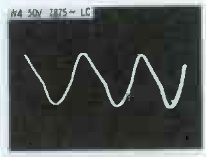
(V1B Grid-Leak Capacitor—470 pf)

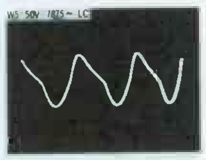
Symptom Analysis

Picture won't sync horizontally, although it approaches synced condition if hold control is turned full YCCW. Brightness is low; drive line in center of picture is visible. Definitely, horizontal oscillator is far off-frequency; drive line gives hint that output is low.

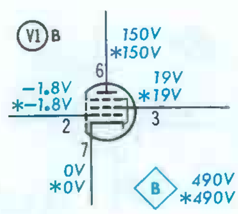
Waveform Analysis







Grounding point A doesn't affect picture — AFC-diode input is okay. Check at oscillator output (W6) reveals low amplitude and distorted waveshape which is cause for drive line. Valuable clue is found from W4 and W5; amplitudes are low and waveshapes are identical. Flattening of waveform lagging edges indicates grid current. Normally, W4 waveform top is rounded; similarity to W5 is strong indication of low-resistance path across C7-R5.



Voltage and Component Analysis

Reduced V1B plate voltage partially results from decreased boost voltage, point B. Plate voltage source is boost supply, which is dependent upon oscillator output. Decreased screen-grid voltage results from greatly reduced negative grid bias (−1.8 volts). Tank signal amplitude and C7-R5 time constant determine negative grid bias. In oscillator circuit, control grid and screen grid circuits interact preventing clearcut voltage analysis. Resistance check across R5-C7 reveals 500 ohms, not 100K. C7 is undoubtedly leaky.

Best Bet: Scope and resistance checks.

Horizontal Foldover

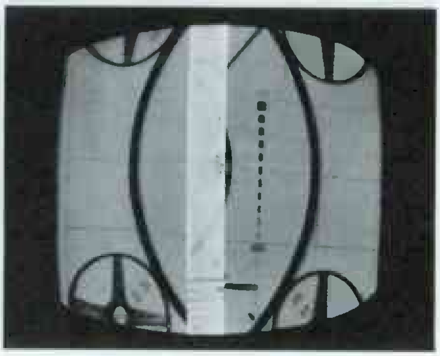
Width Insufficient

Symptom 5

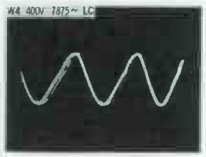
C9 Decreased in Value

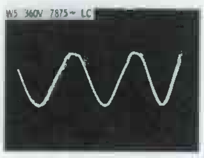
(Waveshaping Capacitor—.0033 mfd)

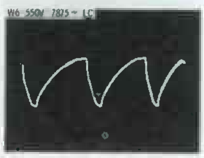
Symptom Analysis



Center of picture shows severe horizontal foldover; also, width is insufficient. Fact that other circuits operate normally clears power supply. Picture is in sync; hold-control action is normal—AFC circuits seem okay. Trouble is most likely in oscillator circuit.



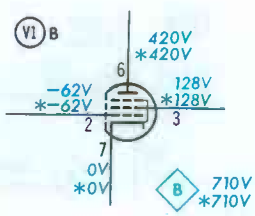




Waveform Analysis

W4 waveshape is normal; p-p amplitude is increased to 400 volts, which isn't definite sign of trouble. Despite 10-volt p-p increase, waveform at V1B grid (W5) gives clear indication that oscillator tank circuit is functioning properly. Trouble spot is found at pin 6 (plate); W6 shows drive to horizontal-output tube is severely integrated and p-p amplitude is increased to 550 volts. Component defect in V1B plate circuit is most likely trouble.

Voltage and Component Analysis



Voltage clues give little help; Plate-voltage increase results from increased boost-supply voltage (point B); all other voltages are within tolerance. Component checks reveal that C9 is decreased in value to 200 pf; replacing it restores normal sweep. Normally, major portion of drive signal is developed across R9; result is steep leading edge of drive-signal waveform. With C9 valve decrease, greatest part of drive signal is developed across high capacitive reactance—integrated waveform results.

Best Bet: Waveform and component analysis.

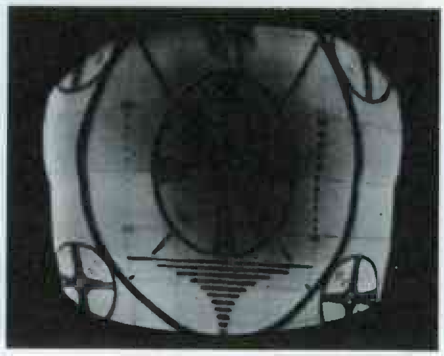
Width Insufficient

Horizontal and Vertical Linearity Poor

Symptom 6

R6 Increased in Value

(V1B Screen-Grid Resistor—100K)

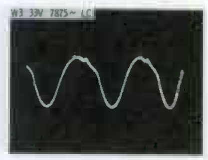


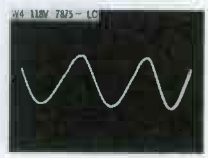
Symptom Analysis

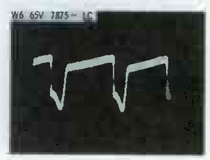
Both horizontal and vertical linearity are poor; picture is overscanned vertically. Attempt to increase width with control causes vertical compression. Picture blooms severely as brightness control is advanced. Sync is okay; horizontal-output or oscillator fault is likely.

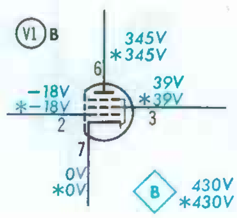
Waveform Analysis

Checks at V1A give little help: p-p amplitude at grid (not shown) with and without point A grounded is reduced; plate (W3) amplitude is reduced to 33 volts p-p. Signal across tank (W4) has normal waveshape, but amplitude is decreased to 118 volts p-p. Output signal at plate (W6) has normal waveshape also, but p-p amplitude is decreased to 65 volts. Normal waveshape at W6 clears plate-circuit components; reduced tank signal seems at fault.









Voltage and Component Analysis

V1B plate voltage seems normal until compared to boost voltage, point B. Reduced drop across R8 indicates decreased tube conduction despite reduced negative grid bias. Voltage reduction at pin 3, screen grid, is contradictory; drop across R6 indicates increased current from tube conduction or increase in resistance. Ohmmeter check verifies that R6 is increased in value to 1 meg. Screen-grid voltage decrease reduces feedback signal to tank circuit and p-p tank signal then decreases, reducing drive to horizontal output.

Best Bet: Scope, then voltage and resistance checks.

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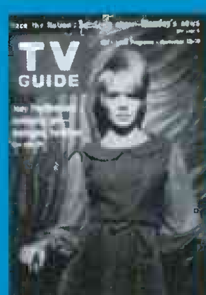
He'll put you in TV Guide



To give you a jump on color set repairs, your Sylvania distributor will put your name, your town, your phone number in *TV Guide*. Four ads will run this year exclusively for Independent Service Dealers carrying Sylvania's picture tubes and receiving tubes.

The plug for you will be run in localized, full-color double-page ads. Customers learn that you're the "right TV serviceman" for color set repairs. For all TV repairs.

And because you're Independent, they learn you give unbiased opinions on TV replacement parts. Sylvania knows that, more often than not, you recommend Sylvania tubes.

See your Independent Sylvania distributor. He'll tell you how Sylvania ads, featuring *you*, can make you your area's "right TV serviceman" for color sets. He'll tell you how to get into up to 4 *TV Guide* ads.

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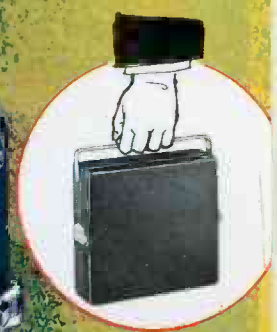


When it comes to tube checking, professional servicemen rely on the famous Sencore "Mighty Mite," America's most popular tube tester. Tests more than 3000 tubes — including Nuvistors, Compactrons, 10-pins, Novars, Magnovals and all foreign tubes — with a big, easy-reading, burn-out and stick-proof meter. Easy to read, speedy set-up booklet makes every test fast and sure. Uses 100-megohm grid leakage sensitivity to find the "tricky" tubes other testers miss; tests for all inter-element shorts; makes cathode emission tests under full operating levels. Fast, accurate, thorough — that's the Mighty Mite; it will never let you down!

TC131

TC136 Mighty Mite IV Tube Checker — The latest, most improved version of the famous Mighty Mite, the leader among tube checkers because it has the versatility and durability professional servicemen demand! Checks them all, including Compactrons, Novars, Nuvistors, Frame grid tubes, and now the latest 10 pin tubes by Amperex and Mullard such as the 6U9, 6Y9, 6W9, and others now being used in the newest color TV sets. Picks out the trouble makers other checkers miss. Tests Nuvistors and Frame grid tubes at lower potentials to prevent damage to the tube. Unique shorts test checks each and every element. Costly VTVM circuit and moving coil meter check for grid contamination and gas at sensitivities of over 100 megohms. New third hand set-up book holder cuts set-up time and speeds tube testing. All steel construction with new detachable hinged cover and taut band meter for extreme durability. The Mighty Mite is positively your "Best Buy" in tube checkers.
10"x9"x3½", 9 lbs. **$74.50**

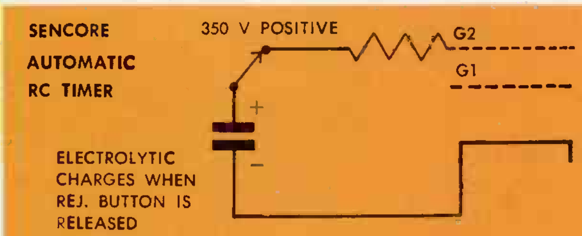
TC131 Semi-Automatic Tube Checker — The "Counter/Bench" version of the famous Mighty Mite Tester above, designed for two-way use — as a professional shop tester and customer self-service unit. Semi-automatic; simply turn function control to any test and watch lighted arrow on big, 6-inch meter stop on right scale — user can't go wrong, no neon lights or guesswork — everything is read on meter. Only 3 set-up controls. A money-making traffic-builder. Fits standard 24-inch counter.
21"x22"x4½", 20 pounds **$129.95**

SEE YOUR SENCORE DISTRIBUTOR
FOR $30.00 TRADE-IN DEAL ON TC131.

CRT CHECKERS & REJUVENATORS

CR133

Test Any Color or B&W TV Picture Tube with a Sencore CRT Checker — *Still the top income-producer for the serviceman. Sencore offers two models with all the latest features and sockets for fast, sure testing of conventional B & W, new low drive B & W, round Color and new rectangular Color tubes. Each Sencore instrument checks CRT emission, inter-element shorts, control grid cut-off capabilities, gas, and expected life.*



Applies exclusive automatically controlled (ACR) voltage as required by individual tube condition (precisely timed to prevent over-rejuvenation or tube damage). This is most useful for color tube current equalization to insure proper tracking.

CR133 CRT Checker & Rejuvenator — The compact, lightweight CR133 checks all present picture tubes and is ready for future tubes, too! Has exclusive variable G2 Voltage from 25 to 325 Volts to protect against obsolescence. Two replaceable plug-in cables, one for Color and one for B & W, have all sockets required — no messy adaptors. AC Line Voltage Adjustment guarantees most accurate CRT tests possible; recommended for Color CRT checks. Color guns are individually tested as recommended by manufacturers. Uses well-filtered DC for all checks to avoid damage and reading errors. Hand-wired and steel-encased for protection of meter and panel in truck or shop. The advanced-design CR133 is only, 10"x9"x3½", 10 pounds...... **$89.95**

CR128A

CR128A CRT Checker & Rejuvenator — The new improved version of the famous CR128. Now has a variable G2 control of 25 to 325 VDC to insure more accurate checks on the latest picture tubes. Similar to CR133 except does not have line adjust or plug in cables. 10"x9"x3½", 10 lbs. **$74.50**

39G14 Variable G2 conversion kit for CR125 and CR128 CRT checkers $9.95

RC121

RC121 Component Substitutor — Substitutes 81 individually isolated component values for test purposes. Substitution range: Carbon Resistors (12-1 watt 10 to 5600 ohms, 12 -½ W 10 K to 5.6 megohms); Capacitors (10-600 volt 100 MMFD to .5 MFD); Electrolytics (10 dual 2 MFD to 250 MFD at 450 V DC, used singly or paralleled to form up to 25 separate values) with exclusive surge protector circuit to prevent arc, spark or healing of condenser in set; Power Resistors (20 wire wound, 20 watts from 2.5 to 15,000 ohms), and Rectifiers (Universal Selenium .5 amps, 800 PIV; Universal Silicon, .5 amps, 800 PIV). 6"x10"x3½", with 4 test leads, 5 pounds **$39.95**

RC 121 K (Kit) $27.95

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H36 The "Handy 36" — Provides the 36 most often needed resistors and capacitors for experimenting, substituting and testing — 24 Resistors from 10 ohms to 5.6 megohms, 10 Capacitors from 100 MMFD to .5 MFD, 2 Electrolytics 10 MFD and 40 MFD at 450 Volts. 4"x5"x2", 2 lbs. **$12.75**

ES132

ES132 Electrosub — Substitutes electrolytics in a jiffy with full protection for you and the circuit. Provides 10 dual electrolytics from 2 MFD to 250 MFD at 450 VDC or up to 25 single values when paralleled. Surge protector prevents arcing, sparking or accidentally healing capacitors. 3½"x5½"x3", 2 lbs. **$15.95**

STANDARD RCA TYPE COLOR TV PATTERNS AT YOUR FINGERTIPS

NEW
All Transistorized

CG135

CG126

HERE ARE THE PATTERNS PRODUCED BY THESE EASY TO USE GENERATORS.

14 thin horizontal lines for vertical dynamic convergence. (Only 6 are generated on some generators).

Stabilized crosshatch pattern for simplifying convergence adjustments.

Ten standard keyed color bars (RCA type) as shown on all Color TV schematics.

10 thin white vertical lines for horizontal dynamic convergence adjustments.

Stable white dots with exclusive dot size adjustment.

*Here are three generators that will help you cash in on the booming color TV business. Sencore offers you a choice; a standard color generator, a deluxe solid state generator and analyzer or a complete TV analyzer for color or B & W. Choose now from one of these three industry leaders . . . they are recommended by every color TV manufacturer.**

CA122

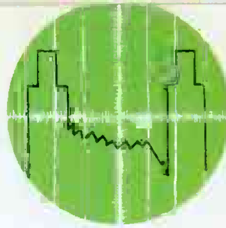
CG126 Standard Color Generator — Produces all the patterns that you need for installing color TV, converging or trouble shooting. Merely connect to antenna terminals and tune receiver to channel 4. CG126 can be retuned to channel 3 or 5 if desired. Then, dial any of the patterns shown above and watch them pop on the screen. Reserve output of up to 200 percent of normal available on color output control to force signal through defective circuits. Adjustable dot size on rear panel and counting circuits that can be retimed right on the TV set are exclusive Sencore features. Wt. 10 lbs. Measures only 9"x11"x6". A real buy at **$109.95**

All New! CG135 Deluxe Transistorized Color Generator and Analyzer — The ultimate in portability, stability and versatility. All solid state, insuring instant signals with no warm up time. Six jump out proof "Unijunction" counters guarantee solid patterns at all times . . . below zero and up to 140° F. Patterns and operation are same as CG126 (tube model). Unmodulated video (2 V PP plus or minus) for color circuit isolation and sync pulses (for the Zenith receivers) are a real analyzing plus. Quality mirror in removable cover for CRT Convergence. Color gun interruptors with switches on the front panel are guaranteed not to load the circuit. Uses 115 V AC — no messy batteries. 10"x9"x3½". Weighs 8 pounds. Only **$149.95**

CA122 Color Circuit Analyzer. For Color or B & W — Produces the patterns shown above plus shading bars for setting TV color temperature controls. Comprehensive analyzing features on the CA122 places it in a class by itself. Variable RF output ch 2-6, for greater flexibility, 20MC to 50MC variable IF output . . . for tuner substitution or injection directly into any IF stage, quickly locates IF stage with low gain. Unmodulated Video, Chroma, and horizontal and vertical sync pulses (all 30 V PP variable positive and negative) isolate trouble in color circuits, video amplifiers, sync circuits or in the color tube circuit in a jiffy. 4.5 mc crystal output insures accurate fine tuning and is used to trouble shoot Audio IF circuits . . . 900 cycle audio for injection at any stage up to the speaker. Color gun interruptors, with special adaptor for new 25" RCA and rectangular Motorola tubes is the greatest time saver of them all.
10"x14"x8", 15 lbs. Only **$187.50**

Adaptor for all rectangular color CRTs (part #39G12) $4.95

*525 line system only



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Exclusive Direct Reading Peak-to-Peak Voltage Measurements . . . No Confusing Band Switching!

Choose from two Sencore professional Wide-Band Oscilloscopes. Exclusive direct reading peak-to-peak volts and high sensitivity on wide band, places these scopes in a class by themselves. Portable, smartly-styled oscilloscopes equip you for every servicing job, and are ideal for field engineering and production line testing. Compare to other scopes costing much more for comparable features and performance.

PS127

PS120

39G3 DEMODULATOR PROBE:
for PS127 or PS120 .... **$5.75**

BE113 DUAL TV BIAS SUPPLY—Save time in AGC trouble shooting and TV alignment. A single or two separate 0 to 20 volts DC bias supplies — without interaction. Provides all recommended TV alignment biases. Well filtered; effectively pure DC with less than 1/10th of 1% ripple — calibration accuracy better than equivalent battery tolerance.
4"x2"x2", 1 pound **$12.75**

PS127 Deluxe 5-Inch-Wide Band Oscilloscope — Tops in performance, operational simplicity and appearance. Vertical amplifier frequency response flat within 1 DB from 10 CPS to 4.5 MC and only 3 DB down at 6.2 MC insures true waveform reproduction. Vertical amplifier sensitivity of .017 volts RMS for one-inch deflection on wide band (without band switching). High input impedance of 2.7 megohms shunted by 99 MMFD (or 27 megohms with 9 MMFD with built-in low capacity probe) insures minimum circuit loading. Now for the first time, view waveforms in TV horizontal and vertical output circuits with built-in low capacity probe up to 5000 volts peak-to-peak. Vertical amplifier attenuator controls calibrated in peak-to-peak volts. Merely set waveform to one inch height and read directly. Horizontal amplifier sweep range from 5 to 500 KC in five overlapping steps and horizontal frequency response from 10 CPS to 1 MC within 3 DB guarantee linear sweep and positive sync. External inputs for horizontal sweep and sync on front panel. Provisions for intensity modulation, and direct connection to deflection plates on rear. 12"x 9"x15½", 25 pounds **$169.50**

PS120 Professional 3-Inch Wide-Band Oscilloscope — New, simplified design — as portable and easy to use as a voltmeter. Vertical amplifier frequency response from 20 cycles to 4 MC flat; only 3 DB down at 7.5 MC and usable to 12 MC. Vertical amplifier sensitivity of .035 volts RMS for one inch deflection saves band switching and guessing. Horizontal sweep frequency range of 15 cycles to 150 KC and sync range from 15 cycles to 8 MC (usable to 12 MC) positively "locks" on all signals. Dual controls simplify tuning. Compartment conceals leads, secondary controls and jacks. With low capacity probe — lowest priced broad-band scope at **$124.50**
9"x7"x11", 15 pounds

PS120K (Kit) without low capacity probe **$74.50**

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MX 129 FM Stereo Multiplex Generator and Analyzer — A completely transistorized FM Stereo generator that provides all signals generated from the FM transmitter. Here is a lightweight portable unit for your shop or home service that stabilizes in less than a second and is all crystal controlled to maintain stability. It's an analyzer too; operating controls offer the user full control over the left and right signals, pilot signal and modulating signals. Stereo signals are formed from internal 1000 or 60 cycles or from external generator, mike or phono pickup. Exclusive built-in meter, calibrated in DB and PP volts, is used to balance the left and right signals to insure the utmost in signal balance; also used as an external meter to connect across the speakers for channel separation checks. Channel separation and adjustment (if necessary) can be made without pulling chassis by injecting FM signal at antenna terminals. RF is pre-set at 100 mc at factory but can be adjusted to any point on the FM band from front of unit. Unmodulated stereo available at composite output jack for injection at the stereo adaptor for trouble shooting or as a check on RF and IF alignment. 67 KC subscription signal provided on carrier or unmodulated for trap alignment. DB separation of left and right channels exceeds highest quality FM stereo receiver on the market.
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MX 129

SS137

SS137 Sweep Circuit Analyzer — Simplifies Sweep Circuit trouble shooting in Color or B & W. Uses positive, tried and proven signal injection and component substitution to find the tough sweep circuit problems. All tests dynamic, in circuit, with the TV set on. Checks all sweep circuits: Horizontal oscillator, output, flyback, deflection yoke, 2nd anode and focus voltages and sync circuits; Vertical oscillator, output and deflection yoke. External checks: DC volts, AC volts peak to peak (eliminates using a VTVM at the same time), and 2nd anode voltages of 10 and 30 KV with special built-in probe. With mirror in detachable hinged cover in all steel case. 10"x9"x3½", 10 lbs. **$79.50**

SM112A New Improved Service Master—Before the SM112, you had to cope with using both a VTVM and a VOM. Now, in one instrument, you get a conventional VTVM operating from 115 volts AC for bench or lab work, then, flip the switch to VOM and two batteries power the unit as a 5,000 ohms per volt meter. Make voltage, resistance and current measurements anywhere, anytime. VTVM scales automatically indicated by lighted arrows. Technical data conveniently shown in cover. Single permanent probe for all tests VTVM or VOM. High voltage probe attaches for measuring up to 30,000 volts DC. Input impedance: 11 megohms VTVM • 6 AC and DC voltage ranges 0 to 1000 volts VTVM or VOM • 6 resistance ranges 0 to 1000 megohms VTVM, 2 ranges VOM. 0-1000 MA on VOM. Two percent, six-inch meter covers all measurements. Zero center scale and peak to peak measurements 8"x8"x3½", 7 pounds **$79.95**
High Voltage probe, HP118 .... $7.95

HP118 SM112A

TRANSISTOR TESTING DEVICES

TR115 Transistor-Diode Checker — Tests transistors for leakage, gain, opens and shorts — good, bad or directly in beta; checks diodes for forward to reverse ratio. Tests them all, smallest hearing aid transistors to auto radio power types. Lists Japanese equivalents. Simply operated, proven checker can be used with or without set-up chart for service, experiment or lab work. 5"x4½"x 2½", 2 lbs. **$24.95**
Kit. $15.95

BE124 Battery Eliminator — Power supply replaces batteries during transistor radio repair. Tapped voltages at 1.5 volt DC intervals from 0 to 12 volts on front panel, connects simply for center tap and bias voltage as required. Function switch converts meter to trouble-shooting 0 to 50 Ma current reading device to monitor transistor radio current drain. Charges nickel-cadmium batteries. Guaranteed accurate. 5"x4½"x 2½", 3 lbs. **$24.95**

HG104 Harmonic Generator — Finds defective transistor radio stage in seconds — just touch output leads to inputs and outputs of transistors from speaker to antenna and a clear 1000 cycle note from speaker indiciates if stage is good. Two leads and calibrated output (not found on pencils) provided to prevent RF spray on front-end checks. Complete with batteries. 3½"x4½"x2" 1 pound **$9.95**

TR110(A) — New Improved Transi-Master! An out-of-circuit transistor tester just like TR115, a harmonic generator like HG104, that switches into an audio generator, plus a power oscillator type in-circuit transistor checker. This is the famous TR110 transistor radio analyzer that is as effective for locating trouble in new all-transistorized TV sets. Meter also used for voltage and current checks with special leads to prevent breaking circuit. 9"x8"x2¼", 2 lbs. . . **$59.50**

THE SENCORE ACCESSORIES

VB2 Vibra-dapter — Checks 3 and 4 prong Vibrators faster and easier. Plugs into any tube tester, like TC-130 or TC131 Mighty Mite Checkers. To check 6v vibrators set tube tester to test 6AX4 or 6SN7; for 12v vibrators set tester to 12AX4 or 12SN7. Two No. 51 lamps indicate need for vibrator replacement . . . **$2.75**

TM116 Modernizing Tube Tester Panel — Adapt your tube checker to test the new tubes — Compactrons, Novars, Nuvistors, 10-pins (except cardomatic types) — by plugging the TM116 into an octal socket of your tester. Works on any tube tester except card-o-matics. Tube set-up chart included with each modernizing panel **$24.95**

FC123 Filament Checker — Check continuity of all tube filaments including the new Compactrons, Novars, 10-pins and Nuvistors. Test leads for CRT filament checking. Also, doubles as neon voltage indicator. TV cheater cord is used to power unit as a check on the cord to insure 115 volts AC on TV. 4"x3"x1". 1 pound **$3.95**

HM119 "Handyman" — The "Handyman" is an all-in-one unit to save valuable service time — Cheater Cord with on-off switch, Dual Extension Cord, updated Filament Checker, Universal Fuse Checker, handy Trouble Light, Neon Voltage and Continuity Checker, Pin Straightener and Cord Wrapper — all in a single compact unit. Pays for itself in time saved on only a few service calls. 5"x3½"x1", 1 pound . . **$9.95**

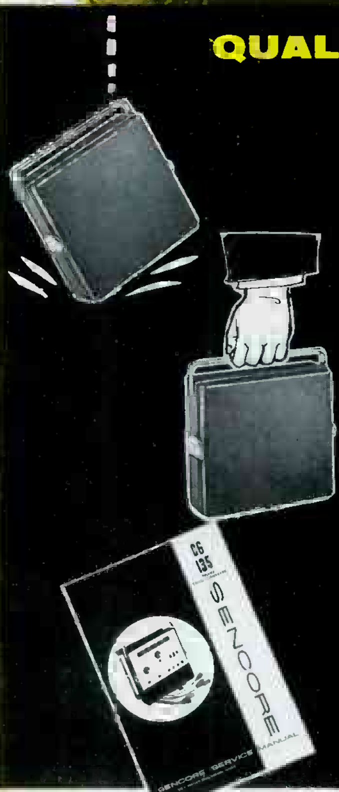
FIELD STRENGTH METER

Get in on the lucrative business in distribution systems, UHF, FM, and VHF antenna jobs with the all new FS134 completely solid state portable field strength meter. Calibrated in true microvolts on all bands: ±3DB on VHF-FM / ±6DB on UHF.

FS134 Field Strength Meter — The FS134 uses Jerrold coax connectors so you can correct problems on existing systems, as well as install, balance, and check new distribution systems. Built-in attenuators of 0, 20, and 40 db (X1, 10, and 100) enable you to measure signal strength from the amplifier to last tap-off in the system. The FS134 is portable so you can take it to the top of the tower to orient the VHF TV, UHF TV, and FM antennas for best signal with minimum interaction between them. Highly sensitive: 30 Microvolts ± 3DB on VHF-FM and 30 Microvolts ± 6DB UHF. Separate built-in UHF tuner for greater accuracy in critical antenna work and translator checking. 4" 2% meter calibrated in microvolts and db. Uses industrial standard for 0 db, often called 0 DBJ or DBM. Now check db loss in various cables and lines, compare different antennas and amplifiers for db gain, field intensity surveys, and show a critical customer why he needs a new antenna for his FM stereo or color TV set. The audio amplifier and speaker let you monitor the TV or FM sound signal and aid in tracking down noise. Besides the Jerrold connector for 75 ohm cable, the FS134 has a built-in balun to match 300 ohm twin-lead; no messy adaptors. The FS134 is powered by easy to get "C" cells or optional rechargeable battery supply (part #39G15), installed in minutes as cheater cord receptacle is already riveted to panel. 10"x9"x5", 9 lbs. . . . **$199.50**

39G15 Rechargeable battery supply (less battery). **$9.95**

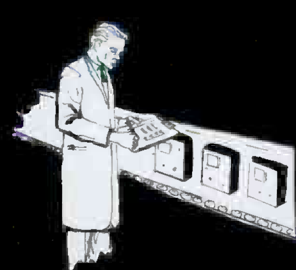
QUALITY FEATURES OF YOUR SENCORE EQUIPMENT



STRENGTH OF CASE — Sencore instruments are encased in steel of adequate gauge to insure rugged service and long life. In the shop, in the truck or in the field, Sencore instruments are built to give you reliable service longer!

CONVENIENT SIZE—Size, weight, and compactness are major considerations at Sencore in the design of every instrument. Along with famous Sencore quality, you are always assured of the maximum handling convenience attainable for each instrument by modern designing skill.

INSTRUCTION MANUALS—Clearly written, detailed operating instructions are included with every Sencore instrument, along with complete Circuit Schematics Trouble Shooting Charts and Parts List. Tube and transistor set-up charts are automatically mailed to you from the factory by merely signing the warranty card.



QUALITY ASSURANCE — Assured Quality has made American-produced Sencore instruments the first choice of professional servicemen. At Sencore, every unit is twice inspected for overall quality, then subjected to an extreme, continuous 24-hour performance reliability test, followed by rigorous tests for stability and proper function in extremes of cold and heat.

GUARANTEE — Sencore products are guaranteed to be free from defects due to workmanship when purchased. Except for misuse, abuse, or damage through mishandling, any unit found defective within 90 days and returned to the factory service department will be repaired without charge, provided the Warranty Card has been returned within 10 days of purchase.

A modest service charge is made for parts and/or labor in all other cases.

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SENCORE 426 South Westgate Drive, Addison, Illinois

The first completely new antenna concept in years...

Revolutionary CHANNEL ULTRADYNE SERIES

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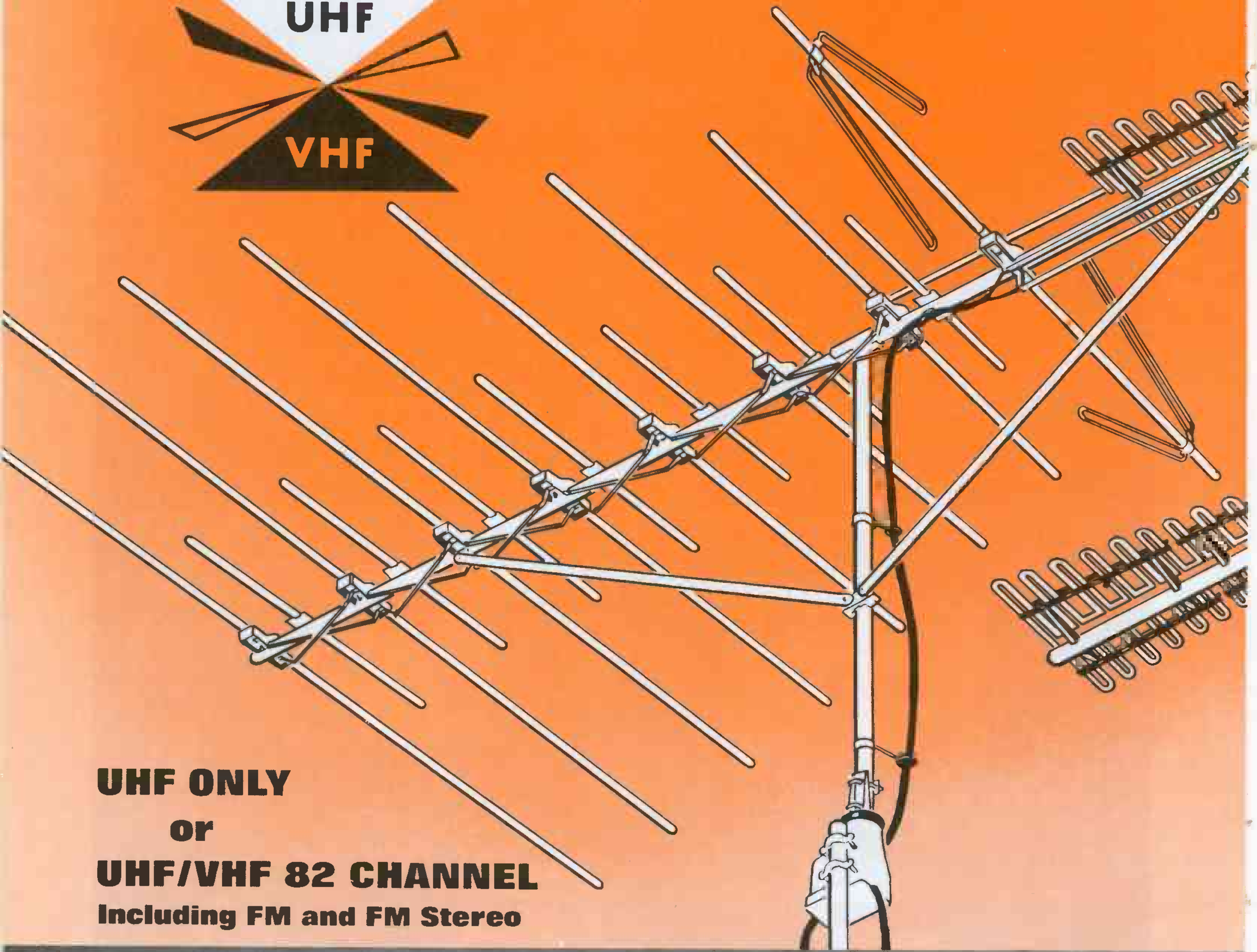
VHF



UHF ONLY

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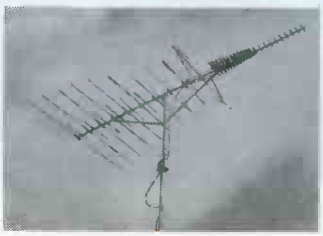
UHF/VHF 82 CHANNEL

Including FM and FM Stereo

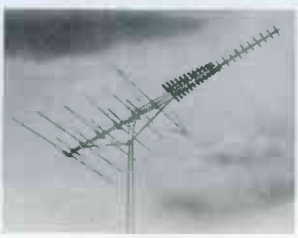
Model 0032 U-V Band Splitter included with all 82 channel antennas.

BREAKTHROUGH!

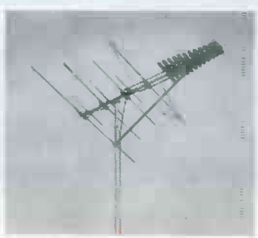
Five new ULTRADYNE CROSS-FIRE antenna models provide the first high gain FM and FM Stereo performance ever attained in an 82 channel TV antenna. Channel Master's exclusive, patented Tri-Band Directors make it possible. All ULTRADYNE series antennas feature the famous EPC golden coating.



Model 3632G
for deep fringe areas



Model 3634G
for near fringe areas



Model 3635G
for suburban areas

Model 3636G
for metropolitan areas

Notes on Test Equipment

analysis of test instruments . . . operation . . . applications

by Arnold E. Cly

Measures Strength of FM, VHF, UHF Signals

As the popularity of FM stereo listening increases, many customers will be asking whether they can expect good FM stereo reception if they purchase such an instrument. Others, who already are stereo listeners, will be asking if their reception could be better. The only way to answer these questions accurately is to measure the RF signal strength provided by an antenna system at a given location. The same holds true for VHF and UHF television reception. The SENCORE Model FS134 field-strength meter (Fig. 1), an all-solid-state instrument, permits these measurements to be made.

The first step in measuring an RF signal is to determine the impedance of the line that will couple the signal to the FS134 input; this could be 15 or 300 ohms. Signals coupled to the 300-ohm INPUT terminals are fed to a matching transformer, which then applies the signals to the ×1, ×10, or ×100 input jacks via a 75-ohm coaxial cable. The ×1 input couples a signal directly to the tuner; the ×10 input attenuates the signal to one-tenth of its original level (20 db loss), and the ×100 input affords an attenuation to one-hundredth of the original level (40 db loss).

Fig. 3. Solid-state circuits throughout.

The received signal is fed to either the VHF or UHF tuner, depending on the type of signal measured (FM, VHF, or UHF), through appropriate filters. The low-band VHF frequencies (channels 2 through 6 and the 88-108 mc FM band are coupled through a low-pass filter; channels 7 through 13 are fed through a high-pass filter. UHF signals are applied directly to the UHF tuner.

The output of both tuners is at 42.8 mc. A three-stage IF strip is used. When the selector knob is set to receive low-band VHF frquencies, a 42.8-mc trap is switched into the RF input circuit.

With the selector switch set to UHF, the 42.8-mc output of the UHF tuner passes through the VHF RF amplifier and mixer stages as well as the three IF stages; thus the UHF signal is fed through five stages of IF amplification.

The output of the IF strip is applied to a detector stage consisting of two 1N24 diodes. These form a doubler circuit that develops a positive DC voltage two times the average RF level. The demodulated signal is fed to an audio amplifier whose output is coupled through a volume control to another audio amplifier. (The demodulated signal also couples directly from the output of the diode detector circuit through a 47K resistor to a DET OUT jack mounted on the front panel. This jack permits the monitoring of a detected signal with an oscilloscope or external meter.) The output of the second amplifier receives additional gain as it passes through the driver and push-pull output circuits.

The voltage that appears at the emitter of the first audio amplifier has a DC level proportional to the RF carrier level. This voltage is coupled through a divider network to the base of an AGC amplifier transistor (NPN). As this voltage goes more positive, the forward bias of the transistor increases. This causes a collector-current increase and a resultant DC voltage decrease. The collector voltage is DC coupled to the base of

SENCORE Model FS134 Specifications

Frequency Coverage:
53 to 109 mc—Channels 2 to 6 and FM radio band.
173 to 218 mc—Channels 7 to 13.
465 to 895 mc—Channels 14 to 83.

Sensitivity:
53 to 109 mc, 30 uv ±3 db.
173 to 218 mc, 30 uv ±3 db.
465 to 895 mc, 30 uv ±3 db.

Selectivity:
500 kc @ 3-db points

Input Impedance:
75 ohms-300 ohms with built-in matching transformer.

Image Rejection:
53 to 109 mc, 40 db
173 to 218 mc, 40 db
465 to 895 mc, 30 db

IF Frequency:
42.8 mc

IF Rejection:
40 db

Audio Power Output:
150 mw

Meter:
2" x 4"
500-ua movement. Two scales: 30 to 30,000 uv, -30 to +20 db.

Power Required:
Self-contained supply consisting of nine 1½-volt size-"C" cells: 8 used as B+ source, 24 ma @ 12-volts on VHF (no signal) and 35 ma @ 12-volts on UHF (no signal); 1 used as bias source, 2 ma @ −1.5 volt. An accessory battery charger can be used with a rechargeable battery.

Size: (HWD)
9½" x 10" x 5"

Weight:
9 lb.

Price:
$199.50
Charger $9.95

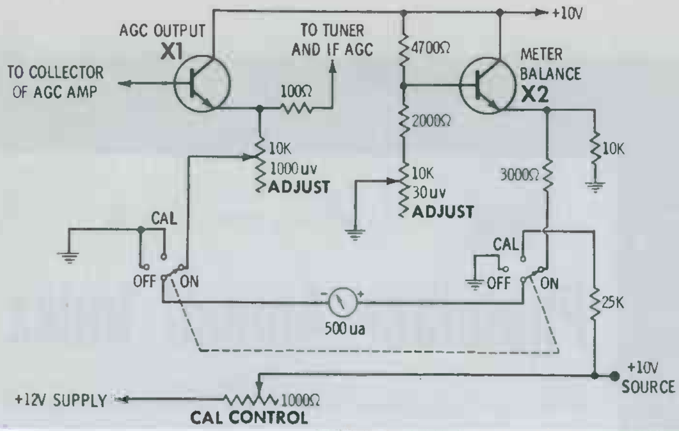


Fig. 2. Emitter circuit voltage on AGC-output transistor operates the meter.

the AGC output transistor (Fig. 2), and as it becomes less positive the AGC emitter voltage is reduced.

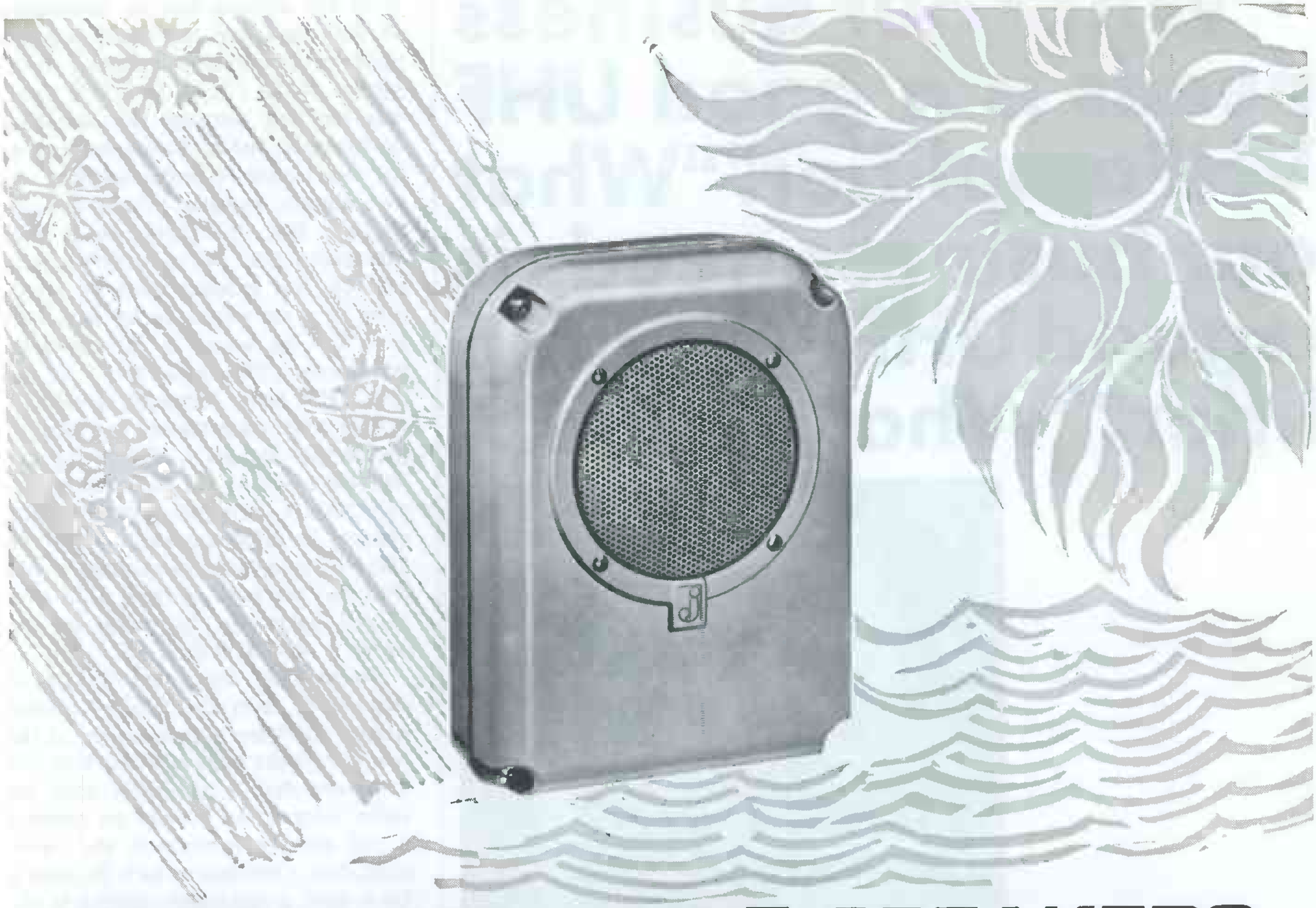
As the RF carrier level increases, the AGC voltage is less positive. The AGC voltage is applied to the VHF mixer and first and second IF stages; thus, a less positive AGC voltage reduces the overall gain of the unit. This same voltage is applied to the negative terminal of the meter. Since a voltage decrease occurs as the RF carrier level is increased, a greater potential is placed across the indicating meter, and the needle swings in a positive direction. The meter reading is the signal strength in micro volts.

The CAL control determines the DC source voltage to the tuner, IF, and AGC circuits. The indicating meter measures this voltage when the OFF-CAL-ON switch is moved to the CAL position. The control is adjusted until the meter needle points to the CAL mark on the meter face. Should the needle fail to reach this mark, the batteries are probably weak and should be replaced.

The 1000-uv and 30-uv controls, located in the emitter circuits of X1 and X2 respectively, are internal calibration adjustments for the meter. The service manual explains these adjustment procedures completely.

To measure the strength of an RF signal, the impedance of the antenna lead-in is determined, and the lead-in is then connected to the correct input terminals of the FS134. The selector switch is moved to the appropriate frequency band. Assume you are checking the RF signal strength on Channel 6. The bandswitch is set to the CHAN 2-6-FM position. Move the OFF-CAL-ON switch to CAL, and adjust the CAL control until the meter needle points to CAL on the meter face. Now, move the switch from CAL to ON, and adjust the volume control until noise can be heard from the speaker of the FS134. Rotate the tuning control until the number 6 on the frequency dial appears under the hairline indicator. As the letter P — located to the right of the number 6 on the frequency dial —is approached, a 60-cps buzz is heard from the speaker, and deflection of the meter can be seen. This is an indication of the video carrier frequency of channel 6. Continue to turn the tuning control toward the P until maximum indication on the meter is noted. When this point is reached,

Further assume that the connection



TOTAL EXPOSURE SPEAKERS WITH HI-FI RESPONSE

Install them! Forget them! Jensen's new "Total Exposure" loudspeakers fill the need for public address speaker systems with wide range response and high efficency. You can now have naturalness of speech and music at very high levels in speakers that ignore the elements. These units will indefinitely withstand the punishment of rain, sandstorms, tropical humidity and fungus, salt spray and industrial corrosive atmosphere; performance characteristics that exceed stringent military specifications.

The Jensen TX Series includes four units—two loudspeakers for installation in walls or existing baffle structures and two loudspeakers encased in "exposure proof" cases for wall or bracket mounting.

MODEL TX-800 8" loudspeaker with fabric-base plastic diaphragm incorporating multiple roll Jensen FLEXAIR® suspension system for low resonant frequency plus high amplitude.

MODEL TXR-800 Consists of the TX-800 loudspeaker unit in a molded fiber glass case. Hinged front cover simplifies installation. Outside dimensions are 14½" high, 13⅞" wide and 7⅜" deep.

MODEL TX-525 5¼" loudspeaker with durable plastic diaphragm, with exclusive Jensen FLEXAIR® suspension system to provide excellent amplitude capability and low resonant frequency.

MODEL TXR-525 Incorporates the TX-525 loudspeaker unit in a die cast aluminum case; front cover is readily removed for easy installation. Dimensions are 11" high, 8¼" wide and 4" deep.

JENSEN
LOUDSPEAKERS

JENSEN MANUFACTURING DIVISION / THE MUTER COMPANY / 6601 SOUTH LARAMIE AVENUE, CHICAGO, ILLINOIS 60638

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Circle 21 on literature card

from the antenna had an impedance of 300 ohms and the signal was applied to the 300-ohm matching transformer of the FS134. Since the signal was coupled through the matching transformer, the microvolt reading on the meter must be multiplied by 2. As an example, suppose microvolt reading was 200; multiplying by 2 gives 400 microvolts. For a more accurate reading, this product must be multiplied by a conversion factor which allows for the losses in the matching transformer. This factor is 1.1 for the low VHF band (channels 2-6-FM). (Other conversion factors are listed in the service manual.) Multiplying the 400 microvolts by 1.1 gives 440 microvolts; this is the signal strength of the channel 6 video carrier. (When the 300-ohm matching transformer is not used and the input is from a 75-ohm coaxial cable, the indication on the meter is read directly.)

To monitor the audio carrier of channel 6, turn the tuning control toward the letter s that appear at the low side of the channel-6 mark on the frequency dial. You should hear the audio information present on channel 6 and note an increase in the meter indication. Continue to turn the tuning knob until a maximum reading is observed on the microvolt meter. The correct microvolt reading is obtained in the same manner as was the video-carrier reading.

A maximum meter indication will be present with minimum audio output volume when determining the signal strength of an FM or TV-sound signal. This is normal, since slope detection is used in this instrument for frequency modulated signals. However, when the video carrier of a TV signal is tuned for maximum 60-cps buzz from the speaker, the meter will indicate maximum deflection since the video carrier is amplitude modulated.

The 500-ua meter has two scales for determining signal strength. The logarithmic microvolt scale extends from 30 to 30,000 microvolts, and the best meter accuracy is obtained between 30 and 1000 microvolts. If this portion of the scale is used, it may be necessary to use the attenuation provision of the $\times 10$ or $\times 100$ 75-ohm input jacks. Should either of these inputs be used, the microvolt reading must be multiplied by 10 when the $\times 10$ input is used and by 100 when the $\times 100$ input jack is used.

The microvolt scale begins at 30 microvolts. However, fringe-area video signals as low as 5 microvolts can be detected by listening for 60-cps buzz from the speaker. With proper antenna orientation or relocation, the signal may be built up to a level that will be visible on the meter (30 microvolts or more).

The decibel scale on the panel meter is used primarily for measuring the various losses encountered in pads, cables, couplers, etc., found in antenna distribution systems. The zero-db reference is 1000 mv across 75 ohms. Should the ×10 or ×100 attenutor jacks be used with the db scale, 20 db is added to the final db figure for the ×10 jack, and 40 db is added for the ×100 jack.

Field-intensity surveys are easily performed with the FS134 because of its compactness, portability, and self-contained power supply. A straight dipole antenna, cut to the frequency being plotted, and the field-strength meter are all that is needed. A "rabbit-ears" antenna could be mounted on the end of the pole and used as a straight dipole.

Occasionally, FM, VHF, and UHF antennas are mounted on the same mast. An interaction between them usually results; they must be arranged on the mast to minimize this interaction. The FS134 can be used to monitor the signals from the antennas, and the proper placement of each can be made to provide the best signal reception for each band.

This instrument is useful in setting up a TV distribution system. The signal levels can be checked across the band to determine if all signals are being distributed properly to each TV.

Signal generators can be calibrated by using the frequency dial of the FS134 and comparing its reading with that of the signal generator. The output impedance of the generator must match the input of the FS134. Also, it is important not to overload the field-strength meter with excess signal-generator output.

In our lab, we compared the frequency of several RF signal generators to the FS134. Some were found to be slightly off calibration; however, none of them were off enough to warrant recalibration. Nevertheless, these comparison checks demonstrated the ease and simplicity of checking the calibration of an RF generator using the FS134 as a standard.

We checked the signal strength of several FM and VHF stations in our area. The information from each audio carrier came through loud and clear from the speaker; also, the correct frequencies of these audio carriers were observed on the frequency dial. The video carriers of the VHF signals were easily located on the frequency dial, and at the same time the 60-cps buzz was heard from the speaker, a maximum indication was noted on the microvolt meter.

A UHF signal was checked with very little difficulty. The station was located approximately 30 miles from the measuring point. However, the monitoring of UHF signals for proper antenna orientation and installation is more critical than with VHF signals. Antenna height—especially above a metal roof, anchoring of the twin lead, antenna orientation due to foliage, etc., all must be considered when dealing with UHF reception.

Complete operation of the FS134 is fully explained in the comprehensive service manual supplied with each instrument. Thorough alignment and calibration instructions are given should these procedures be required. Also included is a troubleshooting chart pointing out some corrective measures to be employed if trouble is experienced with the instrument. ▲

Circle 25 on literature card

Small Record Player

(Continued from page 34)

Needles are subject to physical damage as well as normal wear. They should be checked and replaced if necessary. In a particular portable unit, the audio had a scratching noise. The noise would vary at different parts of the record. Even though the needle was rather new and had little playing time, it was suspected as the source of trouble. Observing the needle under a magnifier revealed the point was chipped. The needle was replaced, and the scratching noise in the audio was cured.

No Volume

Absence of both hum and signal indicates insufficient voltage from the rectifier section. Measure the voltage across one of the B+ filter capacitors. If no voltage is present there, test the rectifier. Check the fusible resistor (R1 in Fig. 3) with an ohmmeter; these resistors open if a short appears along the B+ line.

If you detect the odor of rotten eggs, you can be assured the selenium rectifier is shorted. The rectifier may have been defective and shorted itself, or a short could have developed on the B+ line. It is important to determine the location of the short before a new selenium rectifier is installed.

A selenium or silicon rectifier has a certain front-to-back resistance ratio; a silicon unit has a larger ratio than does a selenium unit. The condition of either rectifier can be determined by comparing the forward and reverse resistances with an ohmmeter. Should both resistance measurements be nearly the same, the rectifier is defective and must be replaced.

A loud 60-cps hum from the speaker of a phono indicates an open B+ filter capacitor. The volume control has no effect in quieting this hum. Also, a shorted amplifier tube can cause a certain amount of hum.

Conclusion

Don't dismiss the small record player as a nuisance. Servicing these units can put dollars in your pocket, and the customers who bring them in may bring you even more business in the future. ▲

(Continued from page 41)

Fig. 8. Electrical tape on antenna lead-in protects against corrosion.

nections (Fig. 8), and taping the lead-in cable to the antenna cross beams and mast will prevent this deterioration. Also, the more solid connections obtained will contribute to improving the signal-to-noise ratio. An all-weather electrical tape is best suited for such an outdoor application.

Circuit Isolation and Protection

Connection points on circuits are often left uninsulated on new equipment. Often these points are located relatively close to ground points such as the chassis or circuit cover

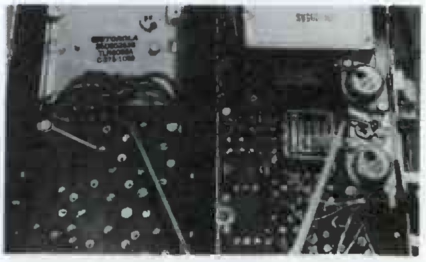


Fig. 9. Exposed portions of circuit are protected when wrapped with tape.

plates, and on occasion a direct short to ground develops. This situation can be remedied easily by placing a strip of tape either over the connection points or on the chassis at the contact area (Fig. 9).

Conclusion

This article has covered only a few of the literally hundreds of uses for electrical tape. Here, the concentration has been on uses helpful in the electronic repair shop, but yet often overlooked by the technician. Tape was never meant to be an identical substitute for the original material. In many cases, however, it does provide an adequate remedy for a servicing problem which may have no other solution.

A roll of tape isn't expensive. In fact, it can pay for itself many times over in the amount of time it will save you. ▲

 (Continued from page 32)

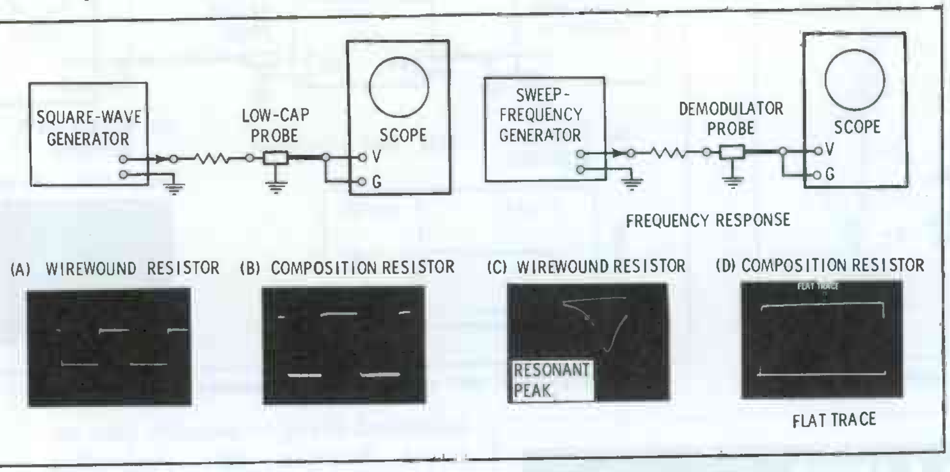


Fig. 5. Both tests supply proof that the wirewound resistor is resonant.

Square-Wave Response vs Frequency Response

A square wave consists of a fundamental frequency and its odd harmonics; the amplitude decreases for each successive harmonic. Rise time of the square-wave leading edge is determined by the highest frequencies present in the square wave. For example, a square wave with a .1-μsec rise time contains a series of discrete frequencies spaced 200 cps apart and extending from 100 cps to above 3.3mc. Thus, square-wave analysis can be compared to frequency-sweep analysis.

Practical Test

Suppose that you have a 5-ohm resistor and can't tell whether it is a wire-wound or a composition resistor. You don't have to destroy the resistor to get the answer. Either a square-wave test or a sweep-frequency test will tell you immediately. For example, Fig. 5 shows how to check the resistor with either a square-wave generator or a sweep generator. If the resistor is wirewound, the scope displays could look like those in Fig. 5A, and C. The *square-wave response* shows *overshoot and ringing*. On the other hand, the *frequency response* shows a *resonant-frequency curve*.

For a composition resistor, you'll obtain displays similar to those in Fig 5B and D. The square-wave response is free from overshoot and ringing. The frequency response is flat. In this example, it would make little difference from a practical standpoint whether a square-wave generator or a sweep generator is used. The test setups are much the same, and waveform analysis is simple in either case.

Analysis

Presence of overshoot and ringing on the square-wave output of the wirewound resistor indicates that this unit is resonant at a particular frequency; frequency-sweep tests verify that the wirewound resistor is resonant. Ringing occurs at the resonant frequency; thus, you can determine a network's resonant frequency by applying a square wave and measuring the ringing frequency. Since frequency is the reciprocal of the waveform period, use the scope

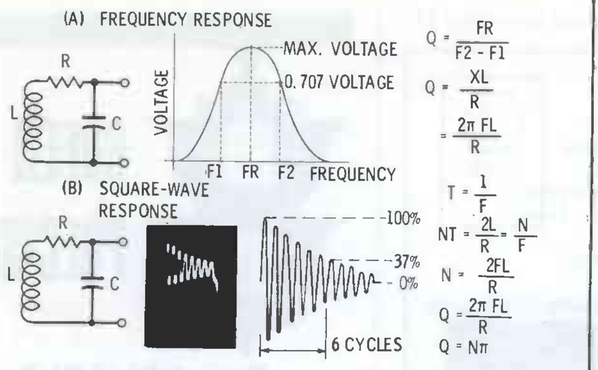


Fig. 6. Circuit Q can be measured with either method.

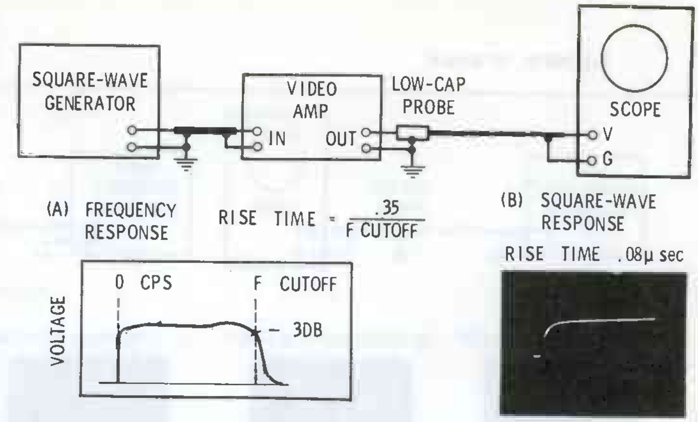


Fig. 7. Rise-time test predicts the frequency response.

calibrated sweep to measure time interval between two succeeding cycles: Frequency = 1/time interval.

Q Measurement

Bandwidth of a resonant circuit is determined by Q. Frequency-sweep tests can be used to determine Q, as the graph in Fig. 6A shows.

In addition, square-wave tests can be used to determine Q (Fig. 6B). The amplitude of the ringing waveform decreases in a manner identical to the decay of a simple RC or RL circuit. Now, however, $1/a$ is substituted for RC or L/R; a, the exponential damping function, is equal to R/2L. The ringing-waveform envelope will decrease from 100% to 37% of peak amplitude in $1/a$, or 2L/R, sec. If N is the number of cycles between the 100% and 37% points and T equals the time interval for each cycle, then NT = 2L/R. Since T is the reciprocal of the waveform frequency, then N/f = 2L/R, and N = 2 fL/R. Since Q = 2 π fL/R, multiplying N by π gives Q: π N = 2 π fL/R = Q. Q of a circuit at its *resonant* frequency can be determined by the number of cycles (N) between the points at 100% and 37% of peak amplitude and multiplying the number by π. In Fig. 6, for example, Q = 6 π or approximately 18.85. Note, however, that this method gives the Q value only at resonance.

Active Network Response

Thus far, only passive (nonamplifying) networks, such as RC and RLC circuits, have been considered. Active (amplifying) networks must also be discussed. Fig. 7A shows a typical frequency-response curve for a video amplifier. High-frequency cutoff is considered to be located at the point where response is 3 db down. This point could be measured

10 facts you should know about color-bar generators

If you are going to buy a color-bar generator *—or even if you already own one—*here are several facts you should know.

While other types of test instruments may lack one or more features, they may still be useful in skilled hands—*provided* the user is aware of their shortcomings and *provided* he has other means of determining what he must know.

This is not true of a color-bar generator.

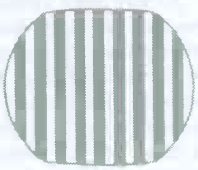
A color-bar generator should allow you to walk away from an adjusted receiver knowing that the owner can turn it on and receive color broadcasts in full-fidelity color and sound.

Not all color-bar generators can give you this assurance.

Let's talk facts.

FACT NO. 1: ***A gated-rainbow type generator is accepted as the standard of the service industry***

You do not need fully saturated NTSC colors to achieve perfect adjustment any more than you need an FCC-type broadcast signal for tuner and if-amplifier alignment. The gated-rainbow type signals are used by virtually all TV manufacturers in establishing service procedures for their sets.



Gated rainbow color-bar pattern

Urgent service needs for a trustworthy color-signal source were met years ago when RCA introduced the *gated-rainbow* system.

Today, this basic system is used in nearly all service-type color-bar generators. The waveforms and procedures in nearly all color-TV service notes are based on this system.

FACT NO. 2: ***All gated-rainbow type generators are not alike***

In spite of their basic circuit similarities, available models differ in their features, accuracy, and ultimate usefulness. Some of these differences are critical.

FACT NO. 3: ***The offset subcarrier oscillator must be controlled within a few cycles of its true frequency***

This oscillator controls the phase angles (hues) of the color-bar pattern. It is the *heart* of the color-bar generator.

The subcarrier oscillator should be within ±20 cps of its fundamental frequency of 3.563795 megacycles. *In the crystal-controlled RCA WR-64B Color-Bar/Dot/Crosshatch Generator, this deviation is kept well within the ±20 cps limit.*

FACT NO. 4: ***Provision must be included to prevent the subcarrier oscillator from drifting off frequency***

The subcarrier oscillator must not only be accurate when the instrument is *new*—it must *stay* accurate. Top-quality components minimize undesirable frequency changes.

Check, for instance, the trimmer capacitor used in the 3.56-Mc subcarrier oscillator. *You'll find a piston-type ceramic capacitor—not a flat mica type—in the RCA WR-64B.*

FACT NO. 5: ***The generator must have an rf-sound carrier to assure proper setting of the fine-tuning control***

Unless your color-bar generator has this essential feature, it may produce a perfect color-bar pattern on the receiver, *but at the wrong setting of the receiver fine-tuning control. In such cases, the receiver may not correctly reproduce a color program.*

The WR-64B has this necessary feature. With it, you can accurately set the fine-tuning control *before* making color adjustments. *In the WR-64B the rf-sound carrier is also crystal-controlled.*

FACT NO. 6: ***The rf picture carrier must be exactly on frequency to assure that the color subcarrier is correctly placed in the receiver bandpass***

Drift, faulty adjustment, or aging of components in the rf oscillator section can move the generator picture carrier off frequency. This shift, in turn, will also move the color subcarrier signal away from its correct position in the receiver bandpass. In some receivers, this shift will affect accuracy of color-circuit adjustments.

A separate crystal-controlled oscillator is used in the WR-64B to keep the picture exactly on frequency.

FACT NO. 7: ***The axes of the output color-bar pulses should lie on the zero axis—and not on elevated brightness pedestals***

Elevated pulses necessitate use of an oscilloscope for accurate setting of receiver phasing. A generator having zero-axis color-bar pulses, such as the WR-64B, does not require use of an oscilloscope for checking phasing in the customer's home.

FACT NO. 8: ***The generator should not require frequent adjustment of internal counter circuits***

All color-bar generators contain circuits which develop vertical and horizontal sync, and dot-and-bar-pattern signals, by dividing or counting down from a higher frequency: usually 189 Kc. If one of these circuits is unstable, the patterns can jitter, ripple, jump sync or contain the wrong number of dots or bars.

Conventional R-C circuits are used in the counters of most generators. *But the RCA WR-64B uses inherently stable iron-core inductors in its counters,* thereby assuring long-term counter-circuit stability.

FACT NO. 9: ***The proper way to check receiver color performance is to feed the generator signal into the antenna terminals***

Color performance depends on overall receiver condition—not on that of a single section alone. A color-test signal fed directly into the video amplifier—rather than through the antenna terminals—will not provide a proper check of the complete receiver. *The only method you should use in adjusting the receiver, therefore, is the rf-signal-input method*—the method provided by the RCA WR-64B.

FACT NO. 10: ***There is no "best" dot size or bar width for convergence adjustments***

Generator dot size or bar width has no significance for convergence adjustments.

Veteran technicians, however, have found that very small dots or thin bars are difficult to use under average lighting conditions. If receiver brightness is turned up to overcome this handicap, blooming will result. Proper convergence cannot be achieved under this abnormal condition.

The dot and bar size of the WR-64B is small enough to permit exact, speedy adjustment, and large enough to be useful under average lighting conditions.

These are ten specific facts you should know about color-bar generators. They add up to this

FACT: ***The new RCA WR-64B has all the features you need for complete color-circuit adjustment***

It's the *one* color-bar generator that meets all servicing requirements—from the company that pioneered and developed the color-TV system now in universal use: RCA!

Order it today from your local Authorized RCA Test Equipment Distributor.

$189.50* *Optional distributor resale price. May be slightly higher in Alaska, Hawaii and the West. Prices subject to change without notice.

RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, NEW JERSEY

The Most Trusted Name in Electronics

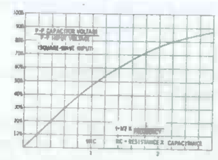
with a marker generator. However, it is somewhat quicker and easier to measure the high-frequency cutoff point with a square-wave generator. The test setup shown in Fig. 7 is used. The output waveform is expanded on the scope screen to measure its rise time, as depicted in Fig. 7B. The rise time is equal to .35/f, where f is the cutoff frequency. Suppose that f happens to be 4 mc. Then, 1/f is equal to .25 Nsec. In turn, the rise time of the output waveform will be approximately .088 μsec.

Conclusion

Basic relationships between square-wave and frequency response for multicomponent networks, have been introduced here. In articles to follow, you will be introduced to square-wave tests for active components such as audio and video amplifiers. Keep up with these techniques; they are important now and will be even more so in the future. ▲

Erratum

As has been reiterated in this "Advanced Service Techniques" series, test-equipment limitations must always be considered for any test. Unfortunately, this prblem produced errors in both the October and December articles of this series. After our lab square-wave generator was recalibrated, test results on integrators didn't agree with previous data; the error was approximately 20%. After considerable testing and mathematical analysis, it was found that the universal time constant chart will give only an approximate, not exact, re-

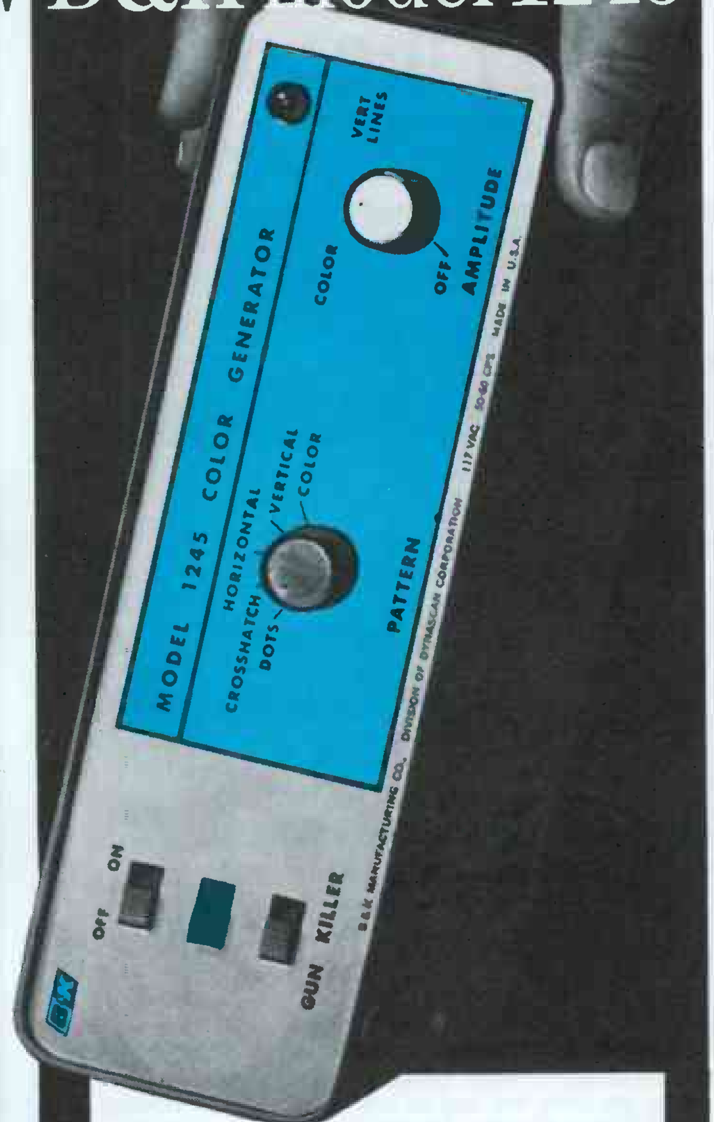


lationship between input and output. For example, if t=RC, integrator p-p output equals .47 input, and differentiator p-p output equals 1.47 input. The change from conditions given by the universal time constant chart results because the capacitor charges to ½ p-p input, and the DC axis shift reduces the charge voltage. The graph above gives relationships verified by empirical and mathematical analysis.

Inasmuch as the rise-time and $R_1 C_1 = R_2 C_2$ tests aren't dependent upon square-wave generator frequency, no error was induced in these tests; mathematical analysis and even stricter laboratory controls verify their validity.

Compare Color Generators

look at the rest . . .
and you'll buy the best, new B&K model 1245



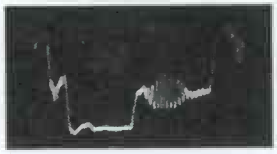
The all solid-state B&K Model 1245 Color Generator duplicates the waveforms transmitted by a color TV station.

Adherence to these waveforms makes it easy to converge the color tube, check sync and make other raster adjustments . . . and the color generator with station quality signal will be able to sync next year's sets. Generators with compromise waveforms do not give you this obsolescence protection.

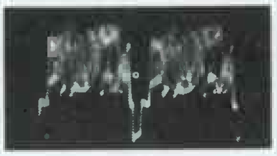
Here are oscilloscope photographs from the outputs of two typical competitive color generators, one transistorized and one tube type, and the B&K Model 1245. The detailed analysis with each photograph shows a few of the reasons why you'll save time and effort with B&K.

COLOR **CROSSHATCH**

STANDARD STATION SIGNAL

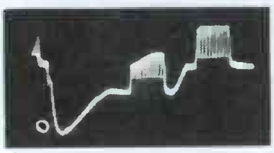


One horizontal sync pulse with its color burst.

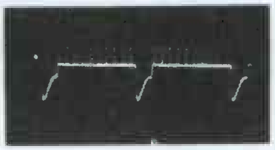


Two lines showing horizontal sync pulse with black and white tv signal,

TRANSISTORIZED B&K MODEL 1245

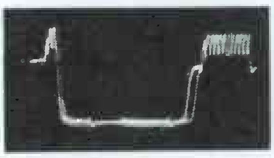


Good duplication of station signal including back porch. If the set won't sync, the set is defective.

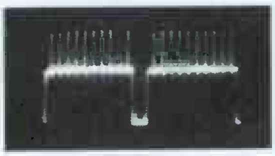


Well defined back porch on horizontal sync pulse permits accurately setting color killer and almost eliminates need to adjust brightness and contrast.

TRANSISTORIZED GENERATOR A



No back porch causes unstable color sync. Burst amplitude compression may permit sync on wrong color bar.



Square wave horizontal sync pulse with no back porch and poor dc coupling forces adjustments of brightness, contrast & fine tuning to obtain usable pattern.

GENERATOR B

No back porch; color information on top of sync-pulse makes sync difficult on some sets.

Complete absence of any back porch necessitates readjustment of brightness, contrast and fine tuning to obtain a usable pattern.

See your B&K Distributor for a demonstration or write for Catalog AP22.

For the first time, with the no-compromise waveforms from the B&K Model 1245, it is possible to accurately set the color killer threshold control with a color generator.

The miniature size and convenience of the Model 1245 match its performance. It provides crystal-controlled keyed rainbow color bar display, and dot, crosshatch, horizontal line and vertical line patterns as well as gun killer controls that will work with any picture tube. Size only 2⅞ x 8½ x 8⅞". Net 134^{95}.

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DIVISION OF **DYNASCAN** CORPORATION
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Circle 36 on literature card

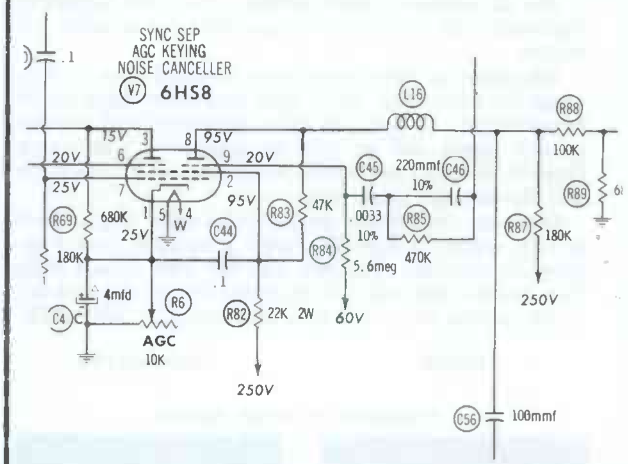
COLOR COUNTERMEASURES

Symptoms and service tips from actual shop experience

Chassis: Zenith 29JC20, 27KC20, 26KC20

Symptom: Loss of horizontal and vertical sync.

Tip: Check for open L16 (Sync Delay Choke Coil). Replace with Zenith part No. S50604 on the 29JC20 or 27KC20 chassis and part No. 20-2702 on the 26KC20, or use the replacement listed in the appropriate PHOTOFACT Folder.



Chassis: Most color TV receivers.

Symptom: Raster turns brown and slightly dim.

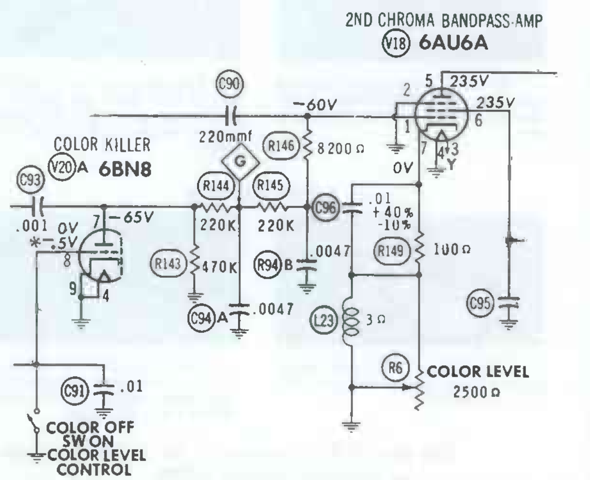
Tip: Replace the video output tube and reset the black-and-white tracking.

Diagnosis: As the video output tube weakens, the video and DC levels both alter at the three cathodes of the CRT. The blue gun usually feels the effects first; the red and green guns operate at a slightly reduced level. Red and green make yellow, and yellow with its brightness component reduced is orange; dimming the luminance signal even further makes brown. Replacing the video output tube restores the brightness component to normal, and resetting gray-scale tracking will return the colors to their proper balance.

Chassis: Zenith (all chassis)

Symptom: Color-off switch, located on the color-level control, fails to kill the color completely. This is more noticeable in a strong-signal area.

Tip: Misadjusted color-killer control or defective tube in in the killer circuit.



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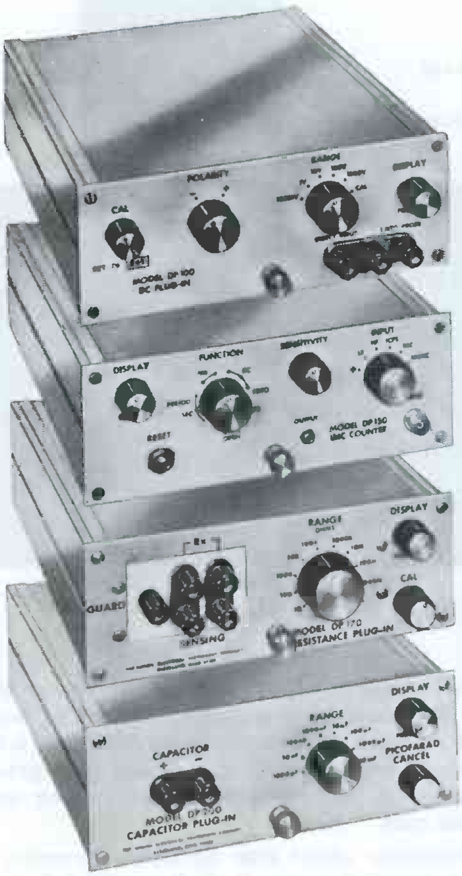
DMS-3200 Main Frame **$320**
(shown with DP-100)



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DC Voltmeter Plug-in
$175

DP-150
1 MC Counter Plug-in
$175

DP-170
Ohmmeter Plug-in
$240

DP-200
Capacity Meter Plug-in
$240

HIGHLIGHT FEATURES

3-digit Biquinary Tube Read-out
Plug-in Flexibility
All-electronic
Fully-transistorized
Modular Design
Fully Field-tested
Automatic Polarity Indication
Automatic Decimal Point Indication

AS A DIGITAL DC VOLTMETER (DP100 Plug-in)

Range 0.1 millivolts to 1000 volts
Accuracy ±0.1% FS, ±0.1% of reading
True integrating voltmeter design
10 megohms input impedance at all times

AS A DIGITAL 1 MC COUNTER (DP150 Plug-in)

±0.005% accuracy: Resolution 1 part in 10^7
(Overrange capability with sector read-out permits 3-digit display to be equivalent of a 7-digit instrument)
Frequency measurement range 0.1 cps to 1 mc
Period measurement range 0.1 ms to 999 seconds

AS A DIGITAL OHMMETER (DP170 Plug-in)

Range 0.01 ohm to 1,000 megohms
Accuracy ±0.1% FS, ±0.2% of reading

AS A DIGITAL CAPACITY METER (DP200 Plug-in)

Range 1.0 picofarad to 10,000 microfarads
Accuracy ±0.1% FS, ±0.2% of reading

The DMS-3200 is designed for rugged industrial and laboratory applications. By utilizing a design which has the optimum combination of accuracy capability and number of digit display, the DMS-3200 meets the general purpose measurement needs of industry for reliable, precision digital measurement equipment in the $400-$500 price range.

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Circle 38 on literature card

new
8290
Shielded Permohm*
Shown Actual Size

82 Channel TV lead-in

for the strongest, cleanest picture signal and best color... ever!

- Provides 82 channel color reception
- Less installation time and cost
- Eliminates transmission line pick-up of noise and ghost signals
- No expensive matching transformers required
- Can be installed anywhere

Photos courtesy of WGN-TV.

Unshielded twin-lead	Coaxial Cable	* Shielded Permohm
Severe picture disturbance due to ignition noise.	Ignition noise minimized—but not eliminated.	Eliminates automobile ignition noise.

New 8290 Shielded Permohm TV Lead-in combines the strong signal strength of twin-lead with the clean signal protection of shielded cable. Because it is a balanced line for 300 Ohm TV antennas and receivers, *costly matching transformers and connectors are eliminated.*

8290 is specifically designed for superior color reception on all 82 channels. The twin-lead is encapsulated in low-loss cellular polyethylene insulation, Beldfoil** shielded against all outside disturbances, and protected with a weatherproof jacket. A drain wire is provided for grounding the shield to the chassis. The need for stand-offs, twisting or routing of lead-in is eliminated. 8290 can be taped directly to a mast or tower, routed through metal pipe, buried underground, or even installed in rain filled gutters to reduce installation time and cost.

Ask your distributor about 8290 Shielded Permohm TV Lead-in cable, today! Or, write P. O. Box 5070-A for complete information.

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**Belden U.S. Patent 2,782,251 and patent pending

8-9-5

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Circle 39 on literature card

Lasers

(Continued from page 38)

A valuable application comes from the laser's ability to drill holes through hard metal (such as razor blades). The laser drill can make holes as small in diameter as one ten-thousandth of an inch (.1 mil) in tungsten wire —holes that are invisible to the naked eye. This unique application can lead to extremely compact and fast microsized memory units for computers. (Compactness and low electrical-energy requirements in computer memories depend on drilling holes very close to each other in magnetic wire. The smaller the holes, the closer together they can be drilled.)

Mechanical drills can punch holes as small as .01" in diameter, and electron-beam drills can make still smaller holes; but both methods are impractical because the metal overheats. The laser drill goes through in a microsecond—so fast the surrounding material never gets a chance to heat up.

Lasers can guide automatic machine tools to tolerances as close as 5 millionths-of-an-inch. Boring-tool spindles, for instance, can be aimed for perfect positioning by a laser fixed to the spindle above the work; a laser beam can be used to perform the actual boring operation.

The laser rangefinder promises to be a boon to surveyors. A microwave-modulated device employs the Doppler radar principle to compare the difference between two signals. The rangefinder samples a portion of its own transmitted signal and compares it with the return from a distant target. The phase of the echo signal changes with time as the light flicks out to the target and returns to the receiver. Detection and measurement of this phase shift gives ranging accuracies down to a fraction of an inch at 10 miles.

Light deflection at electronic speeds has been a major problem in harnessing light for data processing. Now, deflection of a laser beam by electronically switched crystals can project letters, numbers, or other symbols to exact positions on a screen at rates up to several million a second.

The laser beam is first passed through a stencil-like mask of the letter, number, or other symbol to be projected, and then passed through several pairs of crystals. Each crystal pair can give the beam one of two possible directions; each additional pair thus doubles the number of positions available. The laser beam next passes through a crystal which causes the beam to take two possible paths, either deflected or not deflected. This technique can be used in computer memories based on the binary number system, as well as in document reading or display.

The Future

Industry has barely begun to use lasers. More and more uses will be developed, and the present uses refined. It won't be too long till you may—on a service call to some factory or hospital—find yourself face-to-face with a laser device.

You'll need to understand optics as well as electronics, although mechanical and electronic portions will be the more likely points for failure. Some study, some careful analysis, and you may find you're suddenly a laser repairman. ▲

(Continued from page 29)

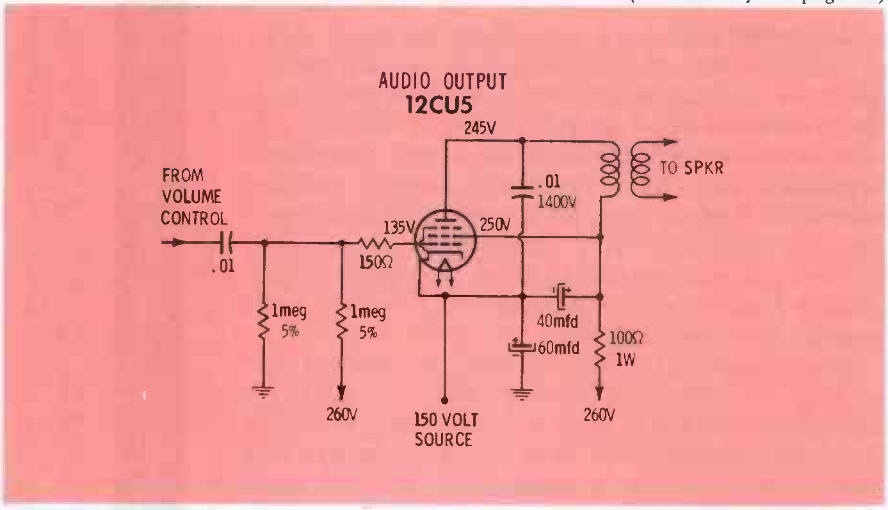

Fig. 4. The 135-volt low B+ is supplied from cathode of output tube.

receiver and found his description of the symptoms was correct; there was absolutely no sound, and the video was extremely weak.

The symptoms could have meant that both the video and audio circuits were defective. However, the fact that some video was present caused me to disregard the video circuits for the moment and concentrate on the audio. I replaced the audio-output, sound-IF, and detector tubes to no avail. Next I checked the voltages on the output tube (Fig. 4), and they indicated there was trouble somewhere in this circuit. The plate and screen are both fed from the 260-volt source through a load resistor. The source voltage was present at both elements. The fact that there was absolutely no voltage drop across the load resistor meant the output tube wasn't drawing any current. This tube was also being used as part of a voltage divider to supply the low B+ source voltage. The cathode voltage was reduced 85 volts; this accounted for the weak video, since the video-IF amplifiers and tuner tubes were being supplied from this B+ source.

I was convinced that once I found why the tube was not conducting I would have the problem solved. A voltage check at the grid gave a meter indication of 0 volts. The voltage divider network in the grid circuit should have given a reading of 130 volts. The ohmmeter measured 800K from grid to ground, and immediately I suspected that the 1-meg resistor to B+ had increased in value. Since the two 1-meg resistors were measured in parallel via the power-supply filters, this divider should have given a reading of around 500K. Disconnecting one end of the suspected resistor and checking its value verified my suspicion; the resistor measured 5 meg. I replaced the resistor and when I fired up the set there was sound. Once again one component had caused dual symptoms.

The next day, the customer came in to pick up his set, and the first

U.H.F.

HERE TO STAY

More and more UHF television stations and UHF translator stations are going on the air every day across the country. And the number is increasing rapidly. UHF is accepted . . . is here to stay.

Every new UHF station represents a whole new untapped profit area for electronics distributors and independent television repair men. Most of the existing television sets now in use were manufactured prior to 1965, and are not equipped with UHF reception. Every TV set owner in your trading area is practically a sure sale for a UHF television converter . . . *either a built-in* or "on-the-top" unit.

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words he uttered were, "How much is the bill?"

I handed him the bill, which included the price of the resistor and the nominal shop labor fee.

He paid me and stormed out saying, "I would rather be a TV repairman than have a license to steal; you guys really make a killing!"

Knowing that it is impossible to please everyone and being most thankful that these individuals are few and far between, I proceeded to the next repair job.

Puzzled by a Diode

The serviceman who had brought another set into the shop had the symptom listed on the shop card as a "terrible" picture. After one look at the screen, I agreed with him wholeheartedly. The picture appeared to be overloaded and the right side was white with almost a complete absence of video. The picture was bending at the top, and horizontal sync was lost completely upon changing channels. Vertical sync seemed to be stable enough, although I was quite sure this was only because the vertical section in this particular receiver required less amplitude and stability in the sync pulses. The sound seemed to be perfect, so I wasn't sure this was an AGC trouble even though it certainly resembled one. Since the sound was normal, I decided to check the video-output circuit before getting involved with the AGC.

With a meter I checked the voltages on the video-output tube and the picture tube. These voltages seemed to be perfectly normal under no-signal conditions; however, with a station tuned in and the controls set for normal operation, the grid voltage on the video-output tube was more negative than it should have been. This led me to believe that the trouble was probably in the video-IF stages even though the set did have good sound. Voltage checks throughout the IF stages proved to be absolutely no help. Resistance measurements in the video-IF stages weren't any help either; thus it was time to use a scope.

Scoping the output of the video detector showed there was an excessive amount of hum in the waveform. The scope, with probe connected to the input to the video detector, showed normal video. Next I used an ohmmeter to check the front-to-back ratio of the detector diode. A good diode should have a ratio of 100:1 or better; however, this one measured only 5:1. Installing a new diode took care of the troubles and relieved me of another multiple-symptoms receiver.

Conclusion

In most cases, troubles are indicative of the circuits at fault. Occasionally, however, many symptoms are caused by only one faulty component. A good way to avoid spending a lot of time in the wrong circuit is to examine closely the schematic for any unusual circuits. If one tube is performing more than one function, always survey the possibilities of what symptoms might occur if an incorrect voltage or signal is present on one of the elements. Time wasted is money lost. So take a couple of minutes to study the schematic before you begin troubleshooting the circuits. ▲

BOOK REVIEW

Fundamentals of Radio; Murray P. Rosenthal; John F. Rider, Inc., New York, New York, 1965; 318 pages, 6" x 9", hard cover; $8.95.

The basics of radio are covered in the 11 chapters and 2 appendixes of this book. In the first chapter, the author begins with the study of electricity. The structure of the atom and the role it plays in the field of radio are explained. Ohm's law and its relationship to electronics are covered.

Chapter 2 deals with magnetism and electromagnetism, and the third chapter studies various electrical circuits. DC and AC circuits are analyzed, and Kirchoff's laws are explained. Inductance and capacitance and the effects they present to different circuits are discussed.

Vacuum tubes and transistors are covered in Chapters 4 and 5, respectively. The elements that comprise a vacuum tube and the effects they have on the tube's operation are studied. PNP and NPN transistors are defined; reverse and forward bias, which are a necessary aspect of transistor operation, are explained.

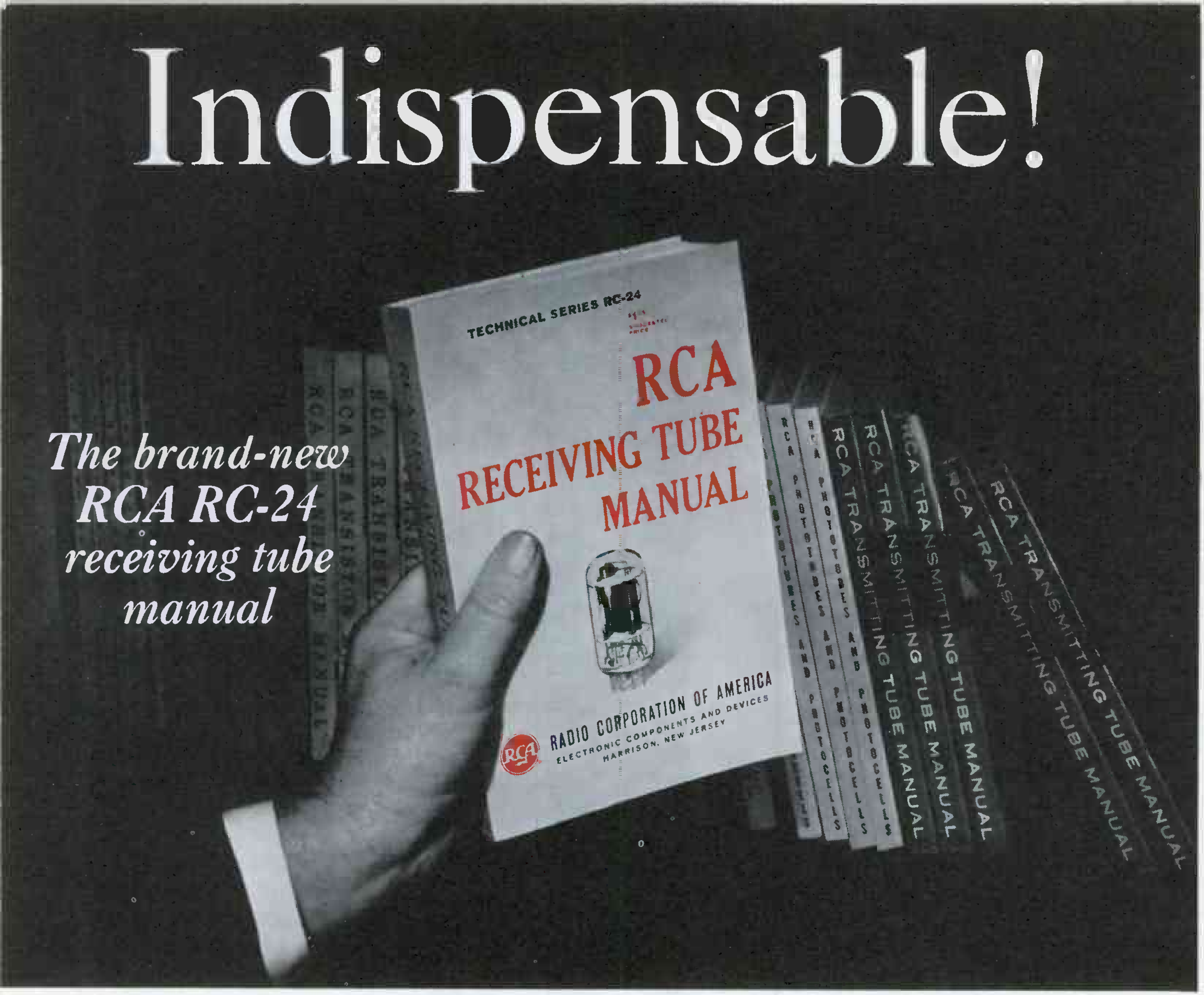
The heart of all radio equipment is the power supply. The sixth chapter delves into different types of these supplies; also, filter circuits are investigated.

Chapter 7 concerns itself with amplifiers, and Chapter 8 deals with oscillators. Each category is discussed for both vacuum tubes and transistors.

The ninth and tenth chapters are devoted to radio transmission and antennas. Each subject is thoroughly explained. Chapter eleven covers radio reception; AM and FM receivers are studied as well as stereo multiplex operation.

The mathematics used in the study of radio is reviewed in Appendix 1. Algebra, logarithms, trigonometric functions, and the use of vectors are discussed. How to use the slide rule is also explained in this section. The second appendix is focused on troubleshooting procedures for radio receivers. The use of the volt-ohm-milliammeter (VOM) and vacuum-tube voltmeter (VTVM) is explained.

The beginning student studying basic electronics, as well as the radio and TV service technician, will find a wealth of information in this book. ▲



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- Data section on active types only. (Discontinued and replacement types appear in a separate section.)
- Additional text material on TV in the tube applications section

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TV FUSE STOCK GUIDE

What is more exasperating—especially on a service call—than to find a fuse blown in a TV set and to have no replacement fuse? You can substitute a fuse of a different value than the original, but this is a poor practice and usually creates more problems. The only alternative is to run back to the shop or to a distributor and pick up the correct fuse. These extra trips cost money and reduce your profit.

To help eliminate this problem, you can use the accompanying *Fuse Guide* as a handy reference in determining an adequate fuse inventory for television receivers. This list covers the types of fuses used most often in TV sets up to and including the first six months of 1965.

For each type of fuse (regular, slow-blow, etc.), the numbers appearing opposite the *Amp*-column figures represent the recommended quantities of fuses to be carried in your tube caddy and as a backup shelf-stock inventory. (Each figure represents boxes of five fuses.) A dash signifies a fuse type very seldom used, and an assortment of these less common fuses could be combined and put in miscellaneous boxes.

Several TV manufacturers use different sizes of fine wire to fuse filament circuits. These sizes are No. 22, No. 24, No. 26, and No. 28, and a supply of this wire should be included in your fuse inventory.

Some television receivers use fusible resistors. A *Fusible Resistor Cross Reference Guide* appeared in the December 1965 issue of PF REPORTER; that list can be used to determine an inventory of these devices.

Since 1964, there has been a trend toward the use of circuit breakers as protective devices for TV receivers. The most commonly used circuit breakers operate and open, respectively, at the following currents: .6 amp-1 amp; 1 amp-1.8 amp; 1.46 amp-2.25 amp; 1.45 amp-2.75 amp; 2.1 amp-3.1 amp; 3 amp-4.5 amp. A minimum stock of the units is needed to make your inventory of protective devices complete. ▲

Regular

Amp	Caddy Stock	Shelf Stock
1/8	—	—
2/10	—	—
1/4	1	2
3/10	—	—
3/8	1	1
1/2	1	1
3/4	1	1
1	1	1
1 1/2	—	1
2	1	2
3	1	2
4	1	1
5	1	2
6	—	1

C-Type

Amp	Caddy Stock	Shelf Stock
3/10	—	1
3/8	—	—
1/2	—	—
3/4	1	1
1 1/4	—	—
2	—	—
2 1/2	—	—
3	—	—
3 2/10	—	1
3 1/2	1	1
4	—	—
7	—	—

Slo-Blow

Amp	Caddy Stock	Shelf Stock
15/100	1	1
175/1000	—	1
1/8	—	—
3/16	—	—
2/10	1	1
1/4	1	2
3/10	—	—
3/8	—	—
4/10	—	1
1/2	1	1
6/10	—	—
7/10	—	1
3/4	—	1
1	—	—
1 1/4	—	—
1 1/2	—	1
1 6/10	—	—
2	—	—
2 1/2	—	—
2 8/10	—	—
3	1	1
3 2/10	—	—
3 1/2	—	—
4	1	1
5	—	1

N-Type

Amp	Caddy Stock	Shelf Stock
1/10	—	—
15/100	—	—
2/10	—	—
1/4	1	1
3/10	1	1
3/8	—	—
4/10	1	1
45/100	—	—
1/2	1	1
6/10	—	1
7/10	1	1
3/4	—	1
1	—	1
1 1/4	—	1
1 6/10	—	1
1 3/4	—	—
2	—	1
2 2/10	—	—
2 1/2	—	1
2 8/10	—	—
3 2/10	—	—
3 1/2	—	—
4	—	1
5	—	1

Slo-Blow Pigtail

Amp	Caddy Stock	Shelf Stock
1/8	—	—
15/100	—	—
2/10	—	1
1/4	—	—
3/10	—	—
3/8	—	1
45/100	—	—
1/2	—	1
6/10	—	—
3/4	—	1
1	—	—
1 1/4	—	1
1 1/2	—	1
1 6/10	1	1
2	1	1
3	—	1
3 2/10	—	—
4	—	—
5	—	—

Pigtail

Amp	Caddy Stock	Shelf Stock
1/8	—	—
2/10	—	1
1/4	1	2
3/10	—	1
3/8	—	1
1/2	1	1
3/4	1	1
1	1	1
1 1/2	—	—
2	1	2
3	—	—
5	—	—

The Troubleshooter

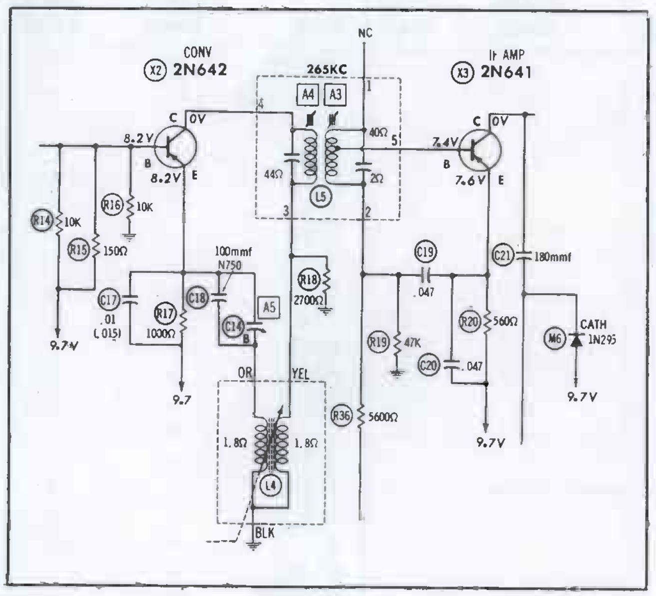
answers your servicing problems

Transistor Shorts

I am having trouble with a new Automatic tractor radio (all transistor) Model TR 0048 (covered in PHOTOFACT Auto Radio series AR-25). The radio failed to work when initially installed. I checked the unit and found 6 volts on the collector of the converter (X2). The lead from X2 to L5 was disconnected, and the 6 volts remained on the collector. The converter transistor was replaced, and the radio operated on the bench for two hours. It was installed on the tractor and three days later was back in the shop with the same trouble. I checked the unit and found the same condition that existed originally. Another converter transistor was installed, and again the radio played fine on the bench. However, after installing it on the tractor, I'm confronted with the same problem. The emitter and base voltages remain the same and agree with those listed on your schematic.

M. C. PATTERSON

LuVerne, Iowa



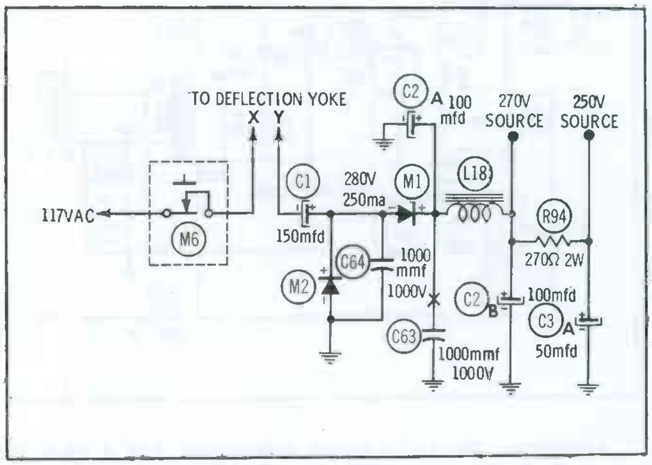
Your description of the symptoms indicates an intermittent connection or short in or around L4. Also, check R18, L5 and the surrounding circuitry. Apparently, after the radio is installed on the tractor, a short exists in a circuit associated with X2 and causes the transistor to break down. This could be caused by mechanical stress placed on the unit when it is mounted. Also, a tractor is usually subject to sudden jars and bounces, and this could lead to a short if some leads were close enough that additional movement would cause them to touch. Mechanical stress could be applied to the unit when you have it on the bench to see if the condition could be made to appear. A thorough check of all wiring should be made.

Vertical Bar Drifts Through Picture

I've been trying to cure a trouble symptom in an Admiral television chassis 15D1B (covered in PHOTOFACT Folder 471-1), and everything I've tried has been to no avail. A pale white bar, about 2" wide, moves up from the bottom of the screen to the top. The picture has a horizontal bend at this bar, and when the bar reaches the top, the picture rolls for a short time. After this sequence, everything is normal for a brief interval; then the bar starts its upward journey again. I've tested and substituted practically every component from the 3BU8 noise-limiter/sync-separator/AGC-keying tube to the 10DE7 vertical-multivibrator and output tube. Scoping through the video IF section, I find the video signal from the first IF distorted with what appears to be 60-cps hum. I would certainly appreciate some help.

C. O. JACKSON

East Providence, R.I.



It appears that you have 60-cps hum on the video line. You might try bridging the electrolytics in the power supply to see if the picture clears up.

Silicon rectifiers are used in this receiver, and often a bar such as you described is caused by radiation from the silicon rectifiers (they have a slight internal arcing), which is picked up by the tuner. You'll notice that C64 shunts rectifier M2, but M1 is not shunted. You might try replacing C64 and, in addition, shunting M1 with a similar .001-mfd capacitor.

Yokes Won't Last

I have a Zenith TV with a 16G27 chassis. (This particular chassis was covered in PHOTOFACT Folder 551-2.) I have checked everything I can think of, but this set continues to break down deflection yokes. I have tried three different makes of yokes, and each of them lasted only one to two hours. The yoke gets very hot, and the horizontal and vertical windings short. Boost voltage is normal. I substituted new damper and horizontal-output tubes with no success. All capacitors associated with the yoke were replaced. The picture looks good, even when the yoke is hot, and fills the screen completely.

E. HALEY

Olympia, Wash.

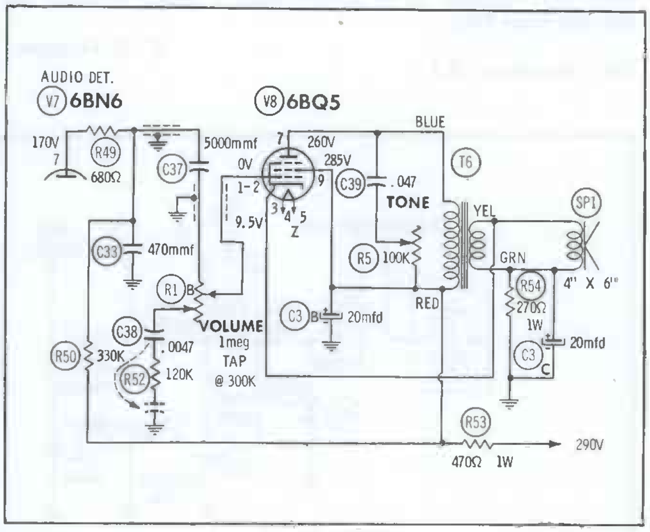
The recurring failure of deflection yokes in this receiver is probably caused by the width sleeve, located between the deflection yoke and the neck of the picture tube. This sleeve should have cardboard insulation to prevent arcing between the windings of the yoke and the metallic sleeve. I suggest you remove the width sleeve, turn the receiver on, and let it operate for a couple of hours. Check the yoke frequently to see if it is still overheating.

Weak Audio

An Airline TV Model 5093A (covered in PHOTOFACT Folder 480-2) is in my shop and has an audio problem. I turned the set on, and the plate of V8 glowed red. R54, connected from one end of the secondary of T6 to ground, started to overheat and burn. I changed V8, but the condition still existed. Several components in the circuit were checked, and none were found bad. The audio-output transformer was replaced, and everything returned to normal, except the volume is weak when I use a new 6BQ5. I've tried three new audio-output tubes, and all of them act the same. If I use the original 6BQ5 the volume is normal. What would cause this?

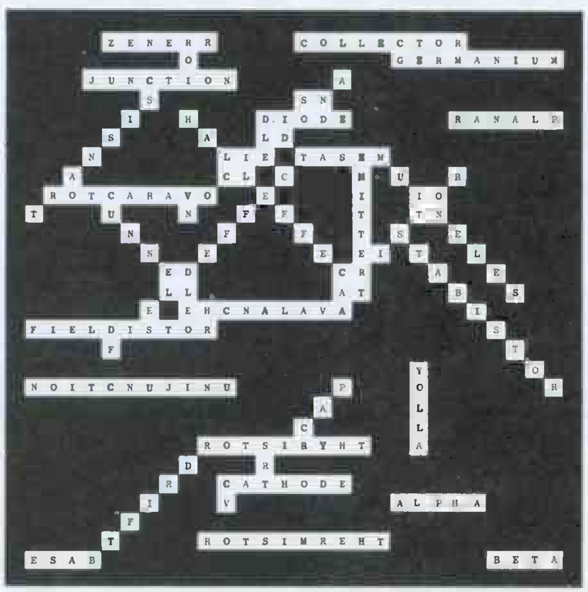
R. Fournier

Davenport, Iowa



Apparently, the audio output transformer had a short between the primary and secondary, which caused the overheated R54. However, this is not the actual cause of the trouble, since you have found that new 6BQ5's do not work in the circuit now. Check the bias voltage on pin 1 of V8. Also, replace R54, since its value has surely increased. It sounds as though heavy conduction of the audio-output tube caused T6 to break down, and during that time the characteristics of V8 were changed. The change in operating characteristics of the original V8 will now permit it to perform with associated defective circuitry, whereas, a new tube will not. If C37 is shorted, which would apply a positive potential to the control grid of the audio-output tube, this could account for the symptoms you observed. ▲

Answer to December PFR Puzzler



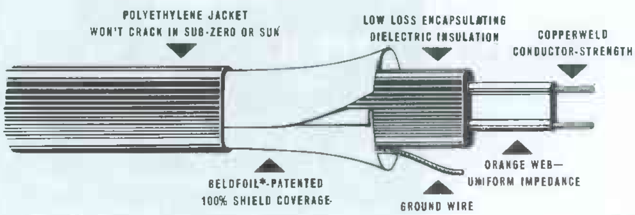
Product Report

For further information on any of the following items, circle the associated number on the Catalog & Literature Card.

CRT Checker-Rejuvenator

(140)

This CRT tester and rejuvenator checks the new black-and-white and color picture tubes. All the necessary sockets, including those for the latest rectangular color tubes, are mounted on two permanently attached cables. The SENCORE CR128A is an up-dated and improved version of the CR128. The new model has a variable G2 control replacing the old three-position G2 switch. The automatic controlled rejuvenation feature, which allows safe rejuvenation of picture tubes, was retained. The unit checks for emission, shorts, interelement leakage, gas, and expected tube life. It weighs 10 lbs and measures 10″ x 9″ x 3½″. The price is $74.95.



*PAT. NO. 3,032,604

Shielded Lead-In

(141)

"8290 Shielded Permohm" is a 300-ohm lead-in encapsulated in a cellular polyethylene insulation and enclosed in a foil shield that stops transmission-line pick-up of electrical noise (including automative ignition noise). An outside polyethylene jacket covers this **Belden** lead-in. It can be installed through metal pipes, secured to steel supports, placed underground, under water, or in salt areas without adverse effects. Standoffs at the antenna are not required; the 8290 can be taped to the mast. It is furnished in 50, 75, and 100′ lengths with factory-installed terminals, in addition to bulk lengths.

Recording Tape

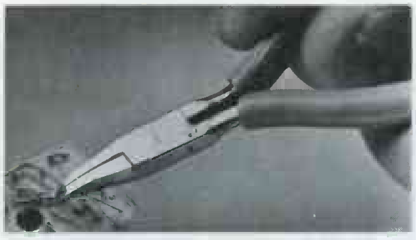
(144)

Three types of Dynarange Series tapes, manufactured by **The 3M Company,** are on 7" reels and meet most needs for sound recording and playback. The No. 201 (shown in photo) is designed for economy and stretch resistance, 202 for added strength, and 203 for extra playing time as well as tough use. List prices are $4.40, $5.10, and $7.35, respectively. The same tapes on 5" reels list for $2.80, $2.85, and $4.25, respectively.

Vertical Cutters

(145)

This tool has a vertical blade which permits cutting in hard-to-reach areas on welded modules. The **Tip-O-Dyke,** offered by **Hunter Tools,** provides maneuverability and visibility in cramped quarters



and cuts .007" x .015" nickel ribbon. Overall length is 4¼"; tip length is ⅛"; width across joint is 5/16". The price is $11.73.

FM Two-Way Radio

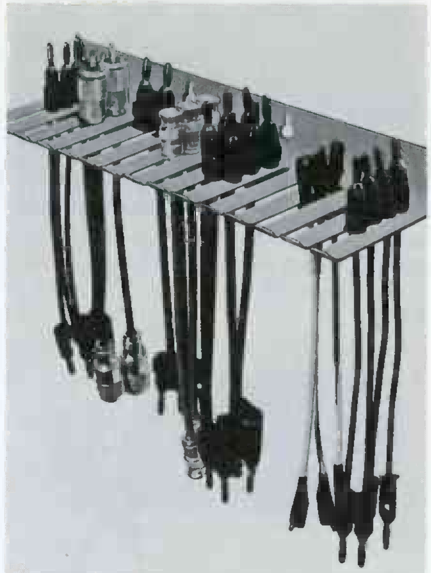
This transistor FM two-way communications unit is designed for mobile service in the 148- to 174-mc band. The **Hallicrafters** Commander "Thirty-Two" measures 3½"x10¼"x15¼", and has a rated output of 30 watts minimum. The transmitter/receiver chassis, control head, with built-in speaker are housed in a single cabinet. A key lock on the charcoal gray cabinet prevents unauthorized access. Additional channel and tone-coding options as well as separate chassis and control-head mounting are available.

Circle 55 on literature card

Circle 54 on literature card

Silicone Spray
(146)

This spray eliminates friction and drag when applied to plastic tubing or spaghetti prior to insertion on leads or hook-up wire; also, will solve problems requiring a release agent. It dries immediately with no buildup; and is nontoxic, colorless, heat stable, and nonflammable. **Sprayway** silicon spray is available with spray heads for pinpoint application.



Test Lead Holder
(147)

This handy test-lead rack is designed to store patch cords and cable assemblies used in electronic testing. The rack, manufactured by **Pomona Electronics Co., Inc.,** simplifies the job of locating a particular test lead by providing convenient, orderly storage that is readily accessible. The unit accepts cables up to ⅕" in diameter. Mounting holes are provided for installation on any vertical surface. The holder, with baked enamel finish, is priced at $1.95. ▲

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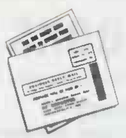

FREE Catalog and Literature Service

**Check "Index to Advertisers" for further information from these companies.*

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ANTENNAS & ACCESSORIES

75. *ALLIANCE* — Colorful 4-page brochure describing in detail all the features of *Tenna-Rotors*.
76. *ANTENNACRAFT*—Literature featuring 3 new 75-ohm, all-channel TV antennas available in factory-built or kit form.
77. *BLONDER-TONGUE* — Booklet titled "How to Plan a Home TV System" containing information on required components and cable with diagrams of actual systems. Written for both homeowner and technician.*
78. *CORNELL-DUBILIER*—New 3-color 8-page booklet describing line of antenna rotors and six colorful flyers each featuring a system.
79. *FINNEY* — Catalog 20-337 covering U-Vert series UHF converters and catalog 20-338 on Model 65-1 distribution amplifier.*
80. *HY-GAIN*—Brochures featuring antennas and accessories for SWL and Citizens-band use.
81. *JERROLD* — Colorful six-page brochure describing and explaining coax, matching transformers, and antenna amplifiers.*
82. *JFD*—Literature on complete line of log-periodic antennas for VHF, UHF, FM, and FM stereo. Brochure showing converters, amplifiers and accessories; also complete '64-'65 dealer catalog plus dealer wall chart of antenna selection by area.
83. *STANDARD KOLLSMAN* — Product literature detailing replacement tuner with preset fine tuning.*
84. *TRIO*—Brochure on installation and materials for improving UHF translator reception.
85. *WINEGARD* — 12-page brochure "Color Spectacular" featuring antenna products designed for color TV use.*
86. *ZENITH*—Information bulletin on antennas, rotors, batteries, tubes, power converters, record changers, picture tubes, wire, and cable.

AUDIO & HI-FI

87. *ADMIRAL* — Folders describing line of equipment; includes black-and-white TV, color TV, radio, and stereo hi-fi.
88. *ATLAS SOUND*—Catalog No. 565 illustrating public-address loudspeakers, microphone stands, and accessories for commercial sound applications.
89. *JENSEN*—Multicolored 24-page catalog No. 165-L featuring speakers and headphones. Also, 22-page catalog No. 6801 supplying phono-cartridge list and cross-reference.*
90. *NUTONE*—Two full-color booklets illustrating built-in stereo music systems and intercom-radio systems. Includes specifications, installing ideas, and prices.
91. *OAKTRON*—"The Blueprint to Better Sound," an 8-page catalog of loudspeakers and baffles giving detailed specifications and list prices.
92. *OXFORD TRANSDUCER*—4-page catalog describing three lines of automobile rear-seat speaker kits.
93. *PHONOLA*—Full-color 18½" x 12" brochure depicting full line of phonographs, tape recorders, and consoles.
94. *QUAM-NICHOLS* — Catalog 65 listing replacement speakers for public address systems, hi-fi, auto radio, and radio-TV applications.*
95. *ROBINS*—Condensed catalog No. 659C covering line of phono- and tape-recorder accessories, replacement parts, and maintenance kits.
96. *SAMPSON*—4-color catalog page illustrating entire line of Waltham transistor radios.
97. *SCOTT*—"1966 Guide to Custom Stereo," a colorful 20-page brochure providing photographs, descriptions, and specifications for stereo components, kits, and speakers.
98. *UNIVERSITY SOUND*—"The Lively Sound," a pamphlet giving specifications, photographs, and details of speaker systems.

COMMUNICATIONS

99. *MOSLEY ELECTRONICS*—Catalog covering complete 1966 line of Citizens-band equipment.*
100. *PEARCE-SIMPSON* — Specification brochure on IBC 301 business-band two-way radio, *Companion II, Director, Escort II, Guardian 23,* and *Sentry* Citizens-band transceivers. "The Modern Approach to Business Communications" concerning land mobile radio service for businessman.

COMPONENTS

101. *BUSSMANN*—Bulletin SHF-11 on new waterproof in-the-line fuseholder designed for use in circuits located in exposed areas, such as yard lights and marine equipment.*
102. *EBY*—Terminal-block, marker-strip, and connector specifications and cross-reference are covered in catalog No. 6X6.
103. *GC ELECTRONICS* — Cross-reference FR-605-G for TV-knob replacement. Catalog FR-66-TD listing TV antennas and accessories. Brochure FR-171-A and catalog FR-66-A covering audio accessories and solid-state modules. Wall chart FR-250-W providing cross-reference for tape and phono drives and belts. Wall chart FR-029-E listing test prods, plugs, and jacks.
104. *SPRAGUE* — Latest catalog C-616 with complete listing of all stock parts for TV and radio replacement use.*
106. *SWITCHCRAFT*—New-product bulletin No. 155 describing Series X "Glo-Button," a nonelectrically illuminated switch.

SERVICE AIDS

107. *CASTLE*—How to get fast overhaul service on all makes and models of television tuners is described in leaflets. Shipping instructions, labels, and tags are also included.*
108. *CHEMTRONICS*—Flyer sheet detailing tuner cleaner designed for use with color TV.*
109. *ELECTRONIC CHEMICAL* — Catalog sheet describing aerosol cleaners for electrical contacts, volume controls, and tape heads.
110. *PERMACEL*—Product data sheet listing uses and specifications of plastic tapes.
111. *PRECISION TUNER* — Literature supplying information on complete low-cost repair and alignment service for any TV tuner.*
112. *RAWN*—Bulletins covering methods and uses for *Plas-T-Pair* knob and plastic repair kits.
113. *WALLIN-KNIGHT*—Folder on Reflect-O-Scope, a tool for static convergence of color TV receivers.
114. *YEATS*—The new "back-saving" appliance dolly Model 7 is featured in a four-page booklet describing feather-weight aluminum construction.

SPECIAL EQUIPMENT

115. *ACTION SYSTEMS* — Form No. 762 specifications for signal-alarm controller.
116. *ATR* — Descriptive literature on selling new all-transistor *Karadio* Model 707, having retail price of $29.95. Other literature on complete line of DC-AC inverters for operating 117-volt PA systems and other electronic gear.
117. *GREYHOUND* — The complete story of the speed, convenience, and special service provided by the Greyhound. Package Express routes.
118. *PERMA-POWER* — Four-page catalog, GB281, illustrating solid-state garage-door operator using pulse tone modulation.

TECHNICAL PUBLICATIONS

119. *CLEVELAND INSTITUTE OF ELECTRONICS*—Free illustrated brochure describes electronics slide rule and four-lesson instruction course and grading service.*
120. GENERAL ELECTRIC—New semiconductor-application notes titled "Transistor Cascode in FM Tuners," No. 90.51, and "An Economical Three-Stage, Four-Transistor 10.7 MHz IF Strip," No. 90.52.
121. *HOWARD W. SAMS* — Literature describing popular and informative publications on radio and TV servicing, communications, audio, hi-fi, and industrial electronics, including special new 1966 catalog of technical books on every phase of electronics.*
122. *RCA INSTITUTES* — 64-page book, "Your Career in Electronics" detailing home study courses in telecommunications, solid-state electronics, and drafting. Preparation for FCC license, and courses in mobile communications and computer programming also available.*

TEST EQUIPMENT

123. *B & K*—New 1966 catalog featuring test equipment for color TV, auto radio, and transistor redio servicing, including tube testers designed for testing latest receiving tube types.*
124. *HICKOK* — New flyer detailing selected items of service test equipment.*
125. *JACKSON*—New 8½" x 11" catalog listing full line of test equipment.*
126. *LECTROTECH*—Specifications sheet supplying information on circuitry and applications for black-and-white picture-tube analyzer.*
127. *MERCURY*—Folder supplying information on complete line of test equipment.*
128. *SECO*—Catalog sheet No. 90065 describing Model 900 color-bar generator and Models 88, 98, and 107B tube testers.*
129. *SENCORE*—New 1966 4-color catalog showing latest equipment including models CR128A, SS137, and SM112A.*
130. *SIMPSON*—Flyer giving specificatoins of Model 604 Multicorder for measuring and recording volts, amps, milliamps, and microamps.
131. *SPECO*—Multicolor folder listing features and specifications of multitester line.
132. *TRIPLETT* — Complete information on burnout-proof VOM Model 630-PLK.*
133. *WORKMAN* — Catalog sheet No. 92C describing transistor/diode checker which uses a tone signal to indicate condition of unit under test.

TOOLS

134. *ENTERPRISE DEVELOPMENT*—Time-saving techniques in brochure from Endeco demonstrate improved desoldering and soldering techniques for speeding and simplifying operations on PC boards.

TUBES & TRANSISTORS

135. *IEC*—Flyer sheet listing line of tubes for use in home-entertainment equipment.
136. *SEMITRONICS*—New 1966 wall-chart replacement and interchangeability guide for transistors, rectifiers, and diodes.

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