A HOWARD W. SAMS PUBLICATION
MARCH 1967 75¢

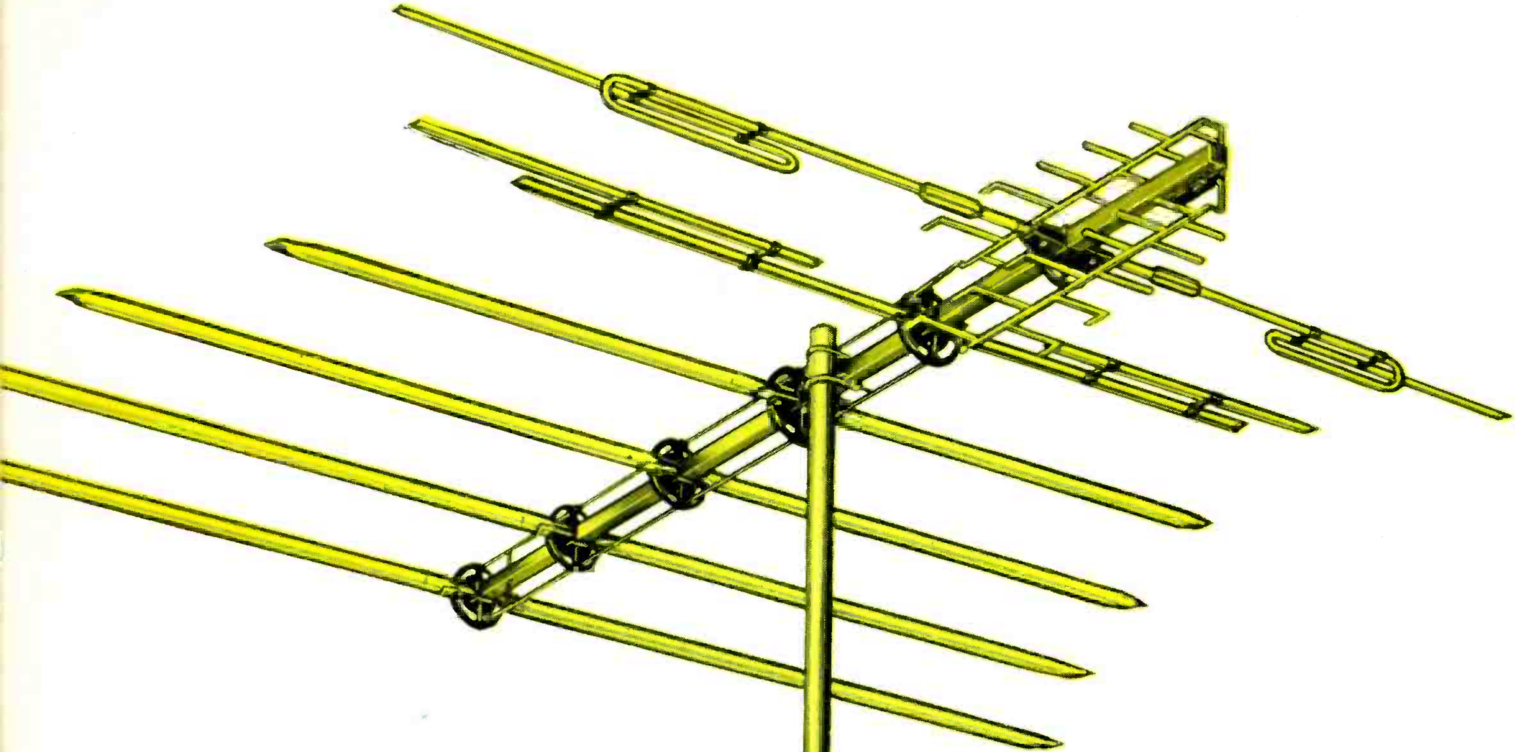
PF Reporter®

PHOTOFACT

the magazine of electronic servicing

- Notes on Test Equipment
- Transistor Testers
- Audio Equipment
- Scope Probes

NEW! beginning in the APRIL issue
TUBE SUBSTITUTION
Supplement
(SEE PAGE 1 FOR DETAILS ON THIS NEW FEATURE)



Fill the "profit gap" with the new Jerrold VU FINDER T.M. 82-channel antenna

Now—the economical new Jerrold VUfinder 82-channel antenna provides the best possible 300-ohm all-channel color TV and FM reception. The VUfinder joins Jerrold's Coloraxial Pathfinder and Paralog-Plus antennas to give you another chance to profit on Jerrold reception quality:

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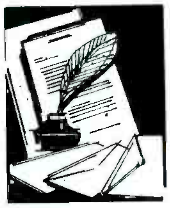


LETTERS TO the EDITOR

Dear Editor:

I've been a reader of your magazine since its inception. I think it's the best in the field. For electronic technicians it's a must.

I would like to see some articles on the European color systems, such as West Germany's PAL and France's SECAM. Also, what is Japan doing?

A. SKVARECK

Orange City, Fla.

We have outguessed you on this one. Negotiations are already under way to have an author in Great Britain write an article on European color systems.—Ed.

Dear Editor:

Just a line to let you know how much I enjoy your magazine. I generally read them from cover to cover. I have been most interested in your series of articles on square wave testing. However, it seems to me that there might be a simpler approach to the problem of integrated circuits that might be handled with less expensive and less complex equipment. Basically, there is nothing that the technician can do to these solid integrated circuits except replace them when they are found to be defective.

To me, it looks as if the introduction of integrated circuits will speed and simplify the servicing of electronic equipment provided that replacement parts are readily available. However, information about the input and output voltages and waveforms must be available to the technician. In any event, integrated circuits are going to be more and more frequently used, so anything that can be done to familiarize the technician with them will be most helpful.

W. WILSON

Pittsburgh, Pa.

Our intention in publishing the Advanced Servicing Techniques series was to instruct the technician in troubleshooting integrated circuits. If the function of the IC is known, the actual circuit configuration of the IC need not be known. Either the device works or it doesn't. If not, it must be replaced. You can be assured that PHOTOFACT *Folders will present the maximum amount of servicing information for integrated circuits.—Ed.*

Dear Editor:

I enjoy your PF REPORTER very much—keep up the good work. Follow up articles similar to the one you had on electronics in medichine would be appreciated. Any info you can send me on servicing such medical equipment would be very much appreciated.

J. ZALESKI

Titusville, Fla.

The results of a reader survey we conducted approximately two years ago indicated that very few of our readers actually service medical equipment. If enough readers are interested in articles on medical equipment, we will do our best to provide them.—Ed.

Dear Editor:

Recently we had trouble with a TV using the multivibrator vertical oscillator-vertical output circuit. After much trouble and time, we fixed the set.

Since there is so much inherent interdependence in this type of circuitry and pulsed voltages preclude live-voltage testing, may we propose a Symfact or a series of articles on this circuit. We truly believe this could be a time-saving article for those technicians who will, I am sure, encounter defects in this type of circuit at one time or another.

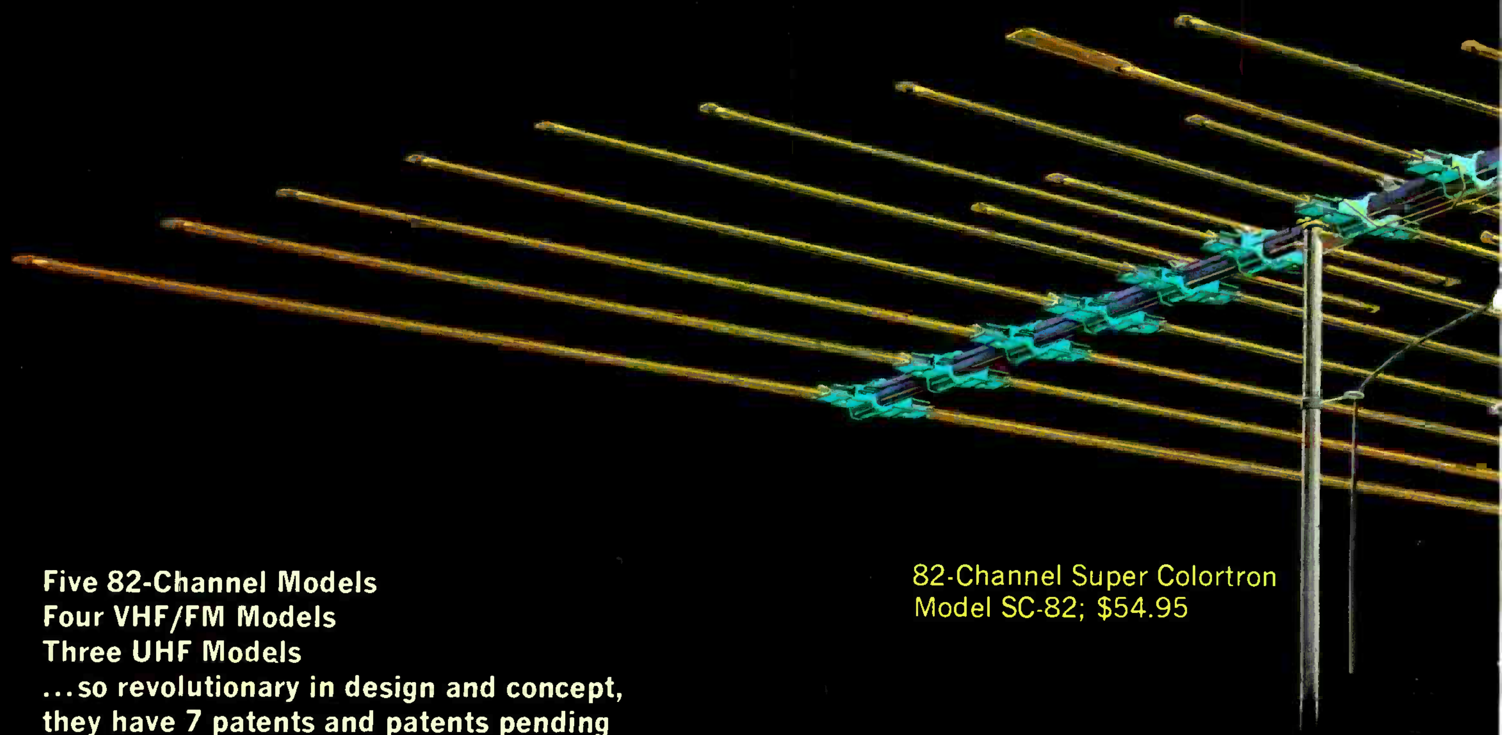
Many thanks for PF REPORTER, which we have found to be an excellent tool. Whenever we "run out of gas" on a dog, we return to the old copies for renewed inspiration and leads.

O. KINBACHER

Babylon, New York

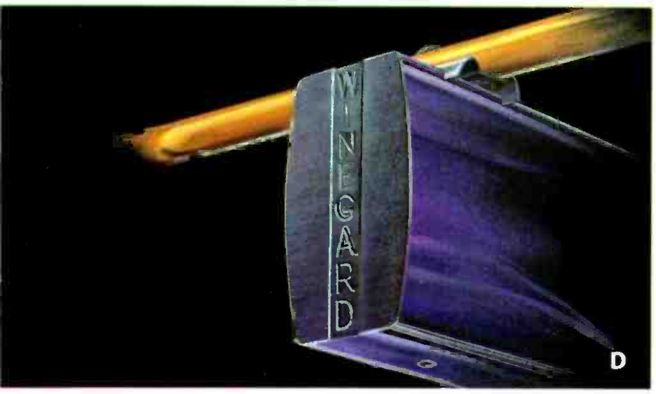
Suggestions from our readers are always welcome. How else can we know what our readers want and need. However, a very similar circuit was covered in the December, 1962 Symfact. We will continue to investigate the possibilities of another Symfact on this type of circuit.—Ed.

Winegard Introduces
Super Compact Total Design Electronic
SUPER COLORTRONS



Five 82-Channel Models
Four VHF/FM Models
Three UHF Models
...so revolutionary in design and concept, they have 7 patents and patents pending

82-Channel Super Colortron
Model SC-82; $54.95



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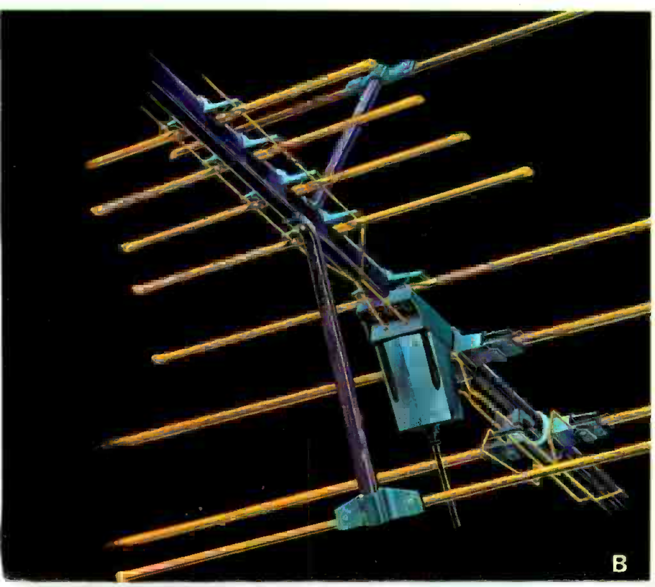

B

The World's First Total Design Antennas

New antennas come and go. But there's never been an antenna like the amazing Winegard Super Colortron. 12 models in all—totally designed with more exclusive electronic, construction and performance features than all other antennas combined. It's taken us a while to create and develop and perfect the Super Colortron. But it was worth the time. See for yourself. Read about the Super Colortron's exclusive features. Then call your Winegard distributor. Or write for full color, 8-page brochure.

(A) Total Design Cartridge Pre-Amps: Exclusive solid state, instant-loading cartridge pre-amps drop into totally enclosed, weatherproof cartridge housing at point of signal interception. Models for 82-channel (VHF-UHF) antennas, VHF only, UHF only—plus a color spectrum filter. Custom-match the Super Colortron to any reception requirements.

Total Design Impedance Correlators: Exclusive impedance correlators (2 patents pending) automatically increase 75 ohm driven elements to 300 ohms to provide 100% signal transfer from antenna to set. Enables antenna to be 20% more compact!

(B) Total Design Vertical Resonant Reflectors: Exclusive UHF vertical resonant reflectors achieve highest realizable gain on channels 14-83 because of exceptionally large vertical capture area. More UHF gain than any other 82-channel antenna design.

Total Design Electro-Lens Director System: Exclusive patented Electro-Lens system (U.S. Patent 2,700,105; Canada 511,984) absorbs entire signal and focuses it directly onto the driven elements to give Super Colortrons pinpoint directivity.

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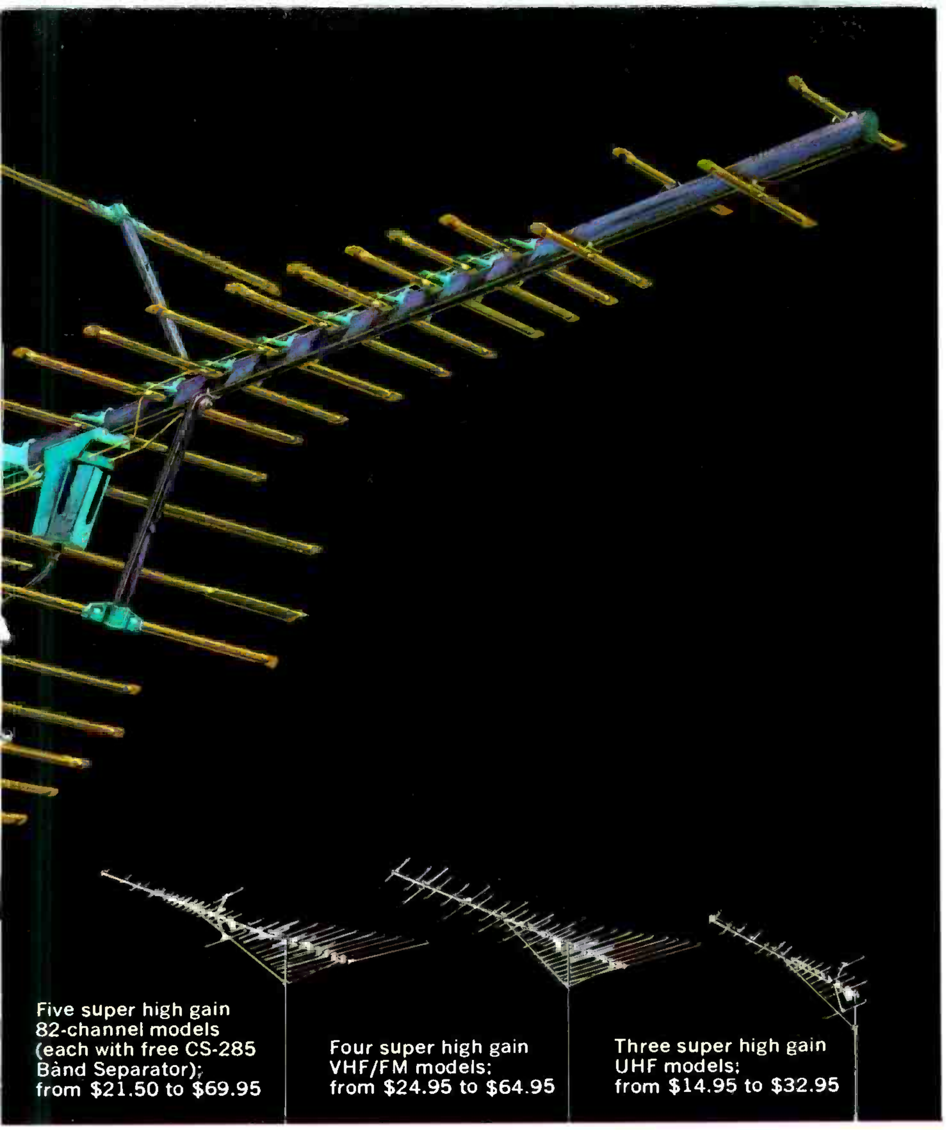
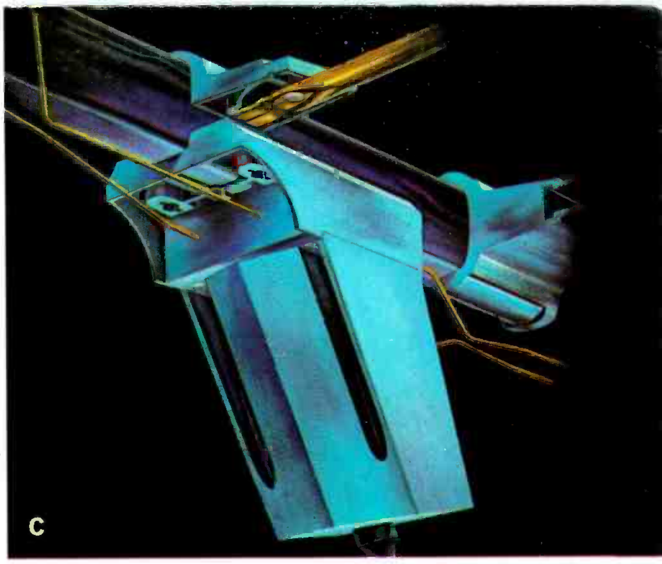
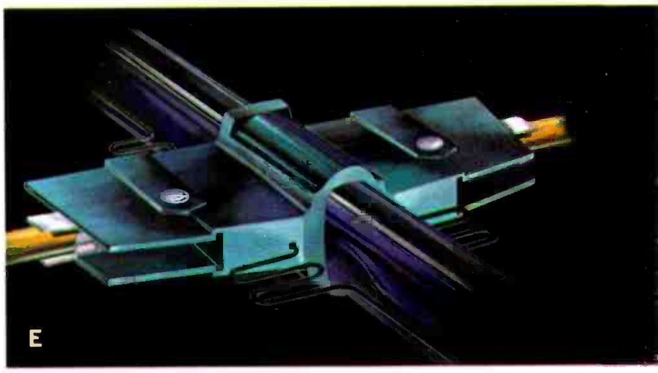


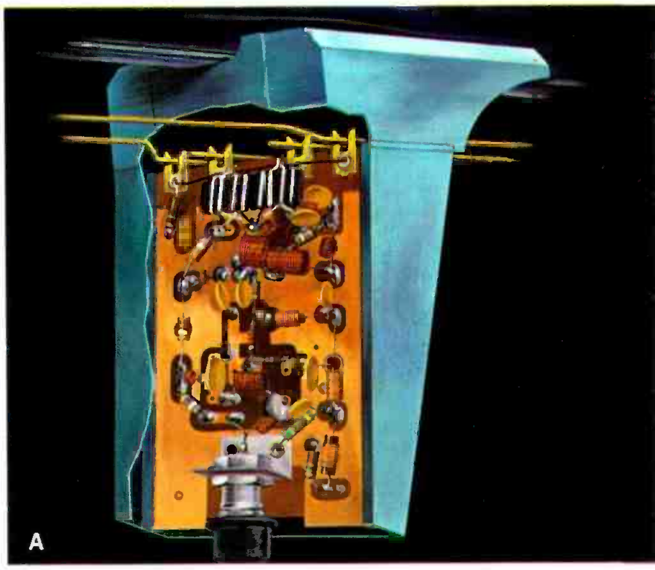
Five super high gain 82-channel models (each with free CS-285 Band Separator); from $21.50 to $69.95

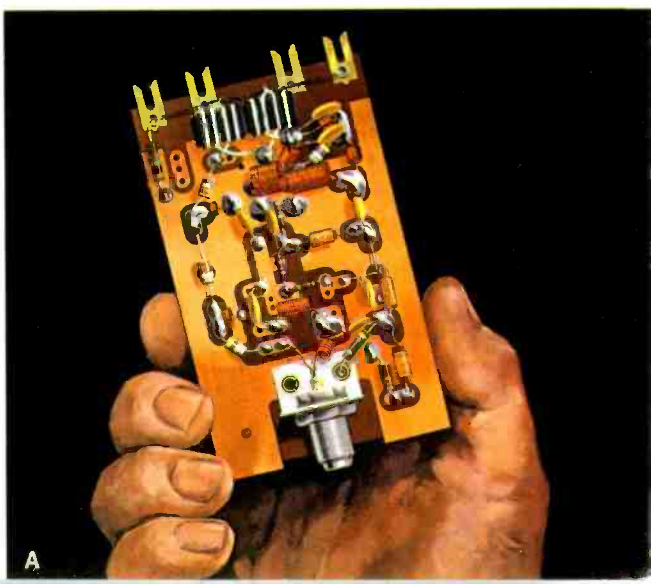
Four super high gain VHF/FM models; from $24.95 to $64.95

Three super high gain UHF models; from $14.95 to $32.95









Total Design FM Control Element: Exclusive FM element provides high gain on FM bands—and enables you to attenuate FM bands in areas where strong FM signals interfere with TV reception.

(C) Total Design Cartridge Housing: Exclusive housing is an integral part of Super Colortron—built-in and permanent. Completely weatherproofed to protect solid state cartridge pre-amps and connections.

(D) Total Design Ellipsoidal Boom: Exclusive boom is the first aluminum tubing shape engineered especially for antenna use. Proved far stronger than any other existing boom design.

(E) Total Design Wrap-Around Insulators: Exclusive low loss dielectric insulators completely encapsulate and weatherproof elements and correlators at point of electrical contact. Hi-impact polystyrene. Provide perfect alignment of elements and eliminate sagging and loosening.

Total Design High Tensile Aluminum Elements: Exclusive aluminum alloy has PSI rating of 38,000 as compared to 27,000 PSI for alloys used in other antennas. More than 49% stronger—and 29% more resistant to bend and wind distortion.

Total Design Wrap-Around Mast Clamp: Exclusive mast clamp has 4 pair of locking jaws (not just 2) to automatically align antenna on mast and for greater strength and durability. Requires only one U bolt.

Total Design Gold Anodizing: Exclusive Gold Anodizing is the only permanent gold finish used on any antenna—the only positive protection against corrosion and fading.

Total Design Assembly: Exclusive construction makes the Super Colortron truly easy-to-install—unfolds in seconds—completely factory pre-assembled.

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PHOTOFACT

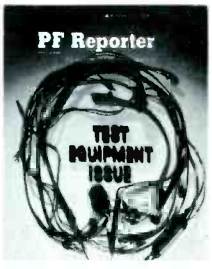
the magazine of electronic servicing

VOLUME 17, NO. 3 MARCH, 1967

CONTENTS

ABOUT THE COVER

Selecting the proper test equipment can spell the difference between success and near success in solving a particularly difficult servicing problem. Equally as important is the choice of probe. All too often the effectiveness of a test instrument is nullified by the choice of probe. Our cover this month symbolizes this interdependence of test instruments and probes. Further information on this subject is provided in an article beginning on page 28 of this annual test equipment issue.



KWIKETTE★ Soldering Aids available these NEW ways...

Packet of 10
for 29¢

Package of 100
for $2.79

With *all* Sprague pre-packaged wire-lead service-type capacitors *at no extra cost to you!*

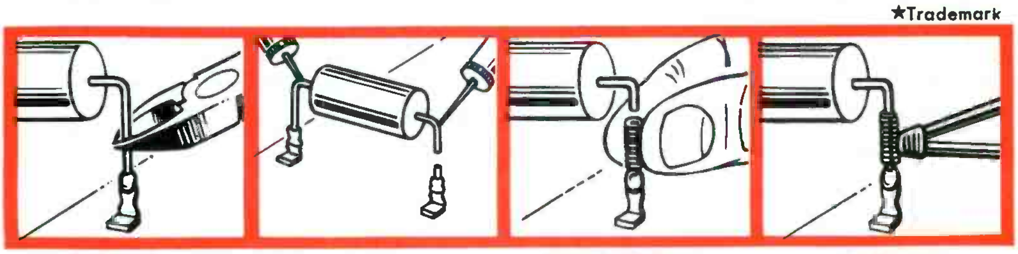
NOW...YOU CAN SAVE TIME, TROUBLE, AND $$$$ ON MORE SOLDERING JOBS

This is it: the revolutionary KWIKETTE that speeds component replacement . . . and practically lets you do "in-circuit" parts testing. This unique soldering aid is *not* just another wire spring connector. It features a Copperweld wire inner core, an intermediate layer of flux, and an outer jacket of solder . . . *all you need is heat!*

You can now buy KWIKETTES from your Sprague distributor in packages of 10 and 100. You'll also find them included with *all* Sprague pre-packaged wire-lead service-type capacitors . . . *at no extra cost to you.*

★Trademark

If you haven't tried KWIKETTES yet, do it now. They're the biggest boon to the service technician since the soldering gun!



SNIP LEAD... TEST... SLIP ON KWIKETTE... APPLY HEAT!

FREE TRIAL PACKAGE: A postcard request will bring you ten KWIKETTES for testing. Write to Sprague Products Co., 105 Marshall Street, North Adams, Massachusetts 01247. (Please include the name of your Sprague distributor.)

DON'T FORGET TO ASK YOUR CUSTOMERS "WHAT ELSE NEEDS FIXING?"

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THE MARK OF RELIABILITY

65-7103

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For window-size blow-ups of this message, send 10¢ to Sprague Products Co., 105 Marshall St., North Adams, Mass., to cover handling and mailing costs.

YOUR TV TECHNICIAN GUARANTEES YOU THE BEST SEAT IN THE HOUSE!

Did you ever stop to think how many millions of dollars in entertainment your TV set brings you? A national half-hour show once each week costs its sponsor about $7,000,000 a year. And you can watch it all for free . . . from the best seat in the house!

When something goes wrong, you can thank your local *independent technician* that it won't stay that way for long. Before you even got your set, he spent years of study in television techniques . . . repaired hundreds of sets . . . bought all kinds of necessary expensive test equipment to do the job right. That's why, when you call him you'll find he already knows your set and has the knowledge and equipment to fix it promptly. Call him at the first sign of trouble, and you won't have to spend a single night without TV.

As a responsible member of your community, your service technician stakes his reputation on your satisfaction. He'll charge a fair price for his work, based upon his time and the quality of replacement parts he uses. But you'll be able to go back to enjoying millions in entertainment—all for free!

THIS MESSAGE WAS PREPARED BY SPRAGUE PRODUCTS COMPANY,

DISTRIBUTORS' SUPPLY SUBSIDIARY OF SPRAGUE ELECTRIC COMPANY, NORTH ADAMS, MASSACHUSETTS FOR . . .

YOUR INDEPENDENT TV-RADIO SERVICE DEALER

6S-205 R1

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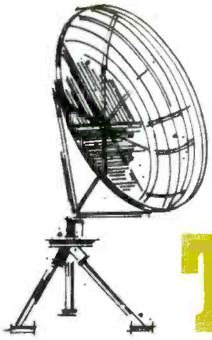

THE ELECTRONIC SCANNER

news of the servicing industry

Radio Most Popular

Radio is America's most popular entertainment, according to the **National Association of Music Merchants.** In fact, America has 25% more radios than people—242 million radios compared to a population of 195 million. The average U.S. family has four radios in its house.

Seven out of ten Americans listen to the radio every day and the most-listened-to programs on radio are music, according to the NAMM. Music is the most common interest of the entire family in terms of home entertainment and radio is the electronic device that delivers this to the home at the lowest cost.

Price has been a key element in making radios so common with total sales reaching 34 million annually. A typical U.S.-made transistor set costs just 25% of what it did seven years ago and imports, which account for half of all radios sold in the U.S., have dropped to an average wholesale price of $5.95 with sets from Hong Kong wholesaling at an average price of $2.57.

In the first nine months of 1966, Hong Kong alone sent 5,500,000 radios to the U.S., while Japanese exports of radios to the U.S. for the first nine months added up to 9,600,000.

Radio's penetration of the American home has been recognized by marketing experts and last year network radio had the biggest growth in advertising sales volume of all media, its 18% gain doubling even the percentage gain of television.

Americans are far ahead of the rest of the world in use of radios although half of our U.S. sets are foreign-made, mostly in the Far East. Compared to more than one set per person in the U.S., there's a set for every three persons in western Europe, one for every six people in Russia and one for every 40 in southeast Asia.

This *Remington* PREMIER PORTABLE TYPEWRITER

FREE

WHEN YOU BUY THIS RCA WR-64B COLOR BAR/DOT/CROSSHATCH GENERATOR...THE ESSENTIAL COLOR TV TEST INSTRUMENT

Here's a deal you can't afford to miss! A FREE Remington portable typewriter—yours when you purchase the most essential color-TV test instrument—the RCA WR-64B!

Just imagine how handy your new typewriter will be—in the shop or at home. You'll use it almost as much as you use the RCA WR-64B—standard of the color TV servicing industry.

Here's how to get your FREE Remington Typewriter. Mail in the warranty card plus the gold label from the shipping carton of your new RCA color bar generator to RCA Test Equipment Headquarters, Bldg. 17-2, Harrison, N.J. We will ship your new Remington portable typewriter to you direct, freight prepaid. But remember—this offer covers only equipment purchased between February 1, 1967 and May 15th, 1967. To allow for postal delay, we will honor cards postmarked up to May 31st.

Plan NOW to take advantage of this BIG offer—a FREE Remington portable typewriter with your purchase of an RCA WR-64B color bar/dot/crosshatch generator.

The standard of the Color-TV Servicing Industry. Generates all necessary test patterns—color bars, crosshatch, dots plus sound-carrier. *Only* **$189.50***

*Optional Distributor resale price. All prices subject to change without notice. Price may be slightly higher in Alaska, Hawaii, and the West.

Ask to see it at Your Authorized RCA Test Equipment Distributor

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RCA® **The Most Trusted Name in Electronics**

Circle 8 on literature card

All-Band MATV

In a recent press conference held in New York, **JFD Electronics** Company vice-president William Clancy stated: "We believe that the federal government, which is concerned about enhancing the growth of UHF, will soon require that multiple dwellings be equipped with master antenna systems that reproduce all television channels broadcast in the area."

Mr. Clancy further pointed out the paradox of requiring presently manufactured TV receivers to be of all-channel design, but not requiring that other receiving equipment (specifically MATV) follow this pattern.

To further bring home this point, and show what can be done, Mr. Clancy unveiled JFD's new "Smooth Line." This is a complete new line of MATV components designed for flat response and corrected tilt, so that no station—VHF or UHF—suffers distortion.

Potpourri

Mercury Electronics Corp. announced a new one year guarantee policy on all their test instruments. In making the announcement, president Harry M. Rich remarked: "We know of no better way to demonstrate the confidence we have in our products than to go beyond the conventional test equipment guarantee, and offer a full one year warranty on parts and workmanship under normal usage."

A new device for recording black-and-white television signals directly on motion picture film has been announced by the Revere-Mincom Division of **3M Company.**

Called the Electron Beam Recorder, the new device combines the speed and economy of film duplication with the image quality of magnetic video tape or live TV, 3M said.

"Under present systems, television images are photographed from the television screen itself," said Robert Herr, Revere-Mincom general manager. "The resultant product or kinescope contains much of the inherent noise disturbances and imperfections present on the tube's phosphor surface. Image quality of this film, when rebroadcast, is far below that of the original telecast."

A prime advantage of electron beam recording is that once the image has been photographed, duplication can be accomplished by conventional film duplicators, at a rate six times that of video tape duplications," Herr said.

Herr added that video tape plays an important role in the initial production stages. Tape originals are easier to produce and are less costly than film with the added flexibility of instant replay, re-use, and elimination of processing.

Electron beam recording, in operation, eliminates the conventional camera lens, cathode ray tube phosphor screen, and glass mask and mates a photographic film directly to a vacuum chamber. Electrons which normally produce an image on the phosphor screen, paint directly on the film. The result is a bright image of high resolution with reduced graininess and electrical noise.

Ray-O-Vac Division, The Electric Storage Battery Company is in the process of completing their move of technical personnel and equipment into a recently completed Ray-O-Vac Engineering and Development Center located in a 73,000 square foot building in Madison, Wisconsin.

The new building is designed to consolidate Ray-O-Vac Division's research, development and testing operations into a well-equipped single location.

Texas Instruments announced that it is starting construction of a new multi-million-dollar plant to provide approximately 185,000 sq ft of additional manufacturing and office space on the company's industrial site in Attleboro, Massachusetts. The multi-purpose building will house light manufacturing, research and development activities, and several administrative offices.

This new building will bring total manufacturing and office space owned by the company in Attleboro to approximately one million square feet, and presently there are more than 5,000 TI employees in the Attleboro area.

Vaco Products Company, manufacturers of tools and solderless terminals, moved its general offices to 510 North Dearborn Street, Chicago. The new quarters will double the amount of floor space, and provide for additional electronic order processing equipment, plus sales promotion facilities.

Expansions

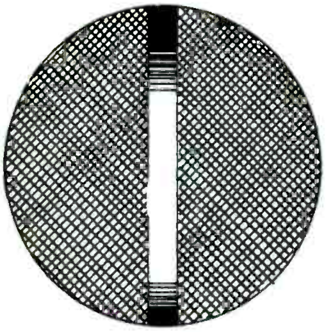
Amphenol Corporation's Cable Division has announced plans to build a cable-manufacturing plant on an 18-acre tract in the industrial park at Danville, Kentucky.

An Amphenol spokesman said the division will construct an expandable 30,000-square-foot, single-story facility as soon as contractural arrangements can be made. The plant is scheduled for completion in the early fall of 1967 and will employ about 50 persons. Amphenol Cable already has expanded twice in the last 18 months, first with the acquisition of Liberty Copper & Wire Company, Downers Grove, Ill., and then with the purchase of additional equipment for expanded plant facilities in Chicago.

A leading producer of public address loudspeakers, microphone stands, and accessories has announced the relocation from its Brooklyn factory to its new plant in Parsippany, N. J. According to Mr. Jerome W. Heller, Division Manager, **Atlas Sound** production capacity is 3 times greater as a result of the move.

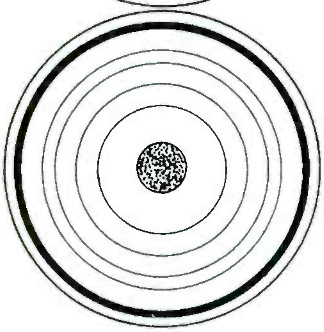
Bogen Communications Division of Lear Siegler, Inc., has announced the purchase of Cardion Communications Corporation's B-250-VA4 transmitter product line.

The move enables Bogen to manufacture and supply directly the powerful 250-watt transmitters that are used in Pagemaster city-wide radio paging systems made by the company.



Modern Hi-Fi sets require more than a VTVM for effective servicing. Here's a quick review of the instruments needed to keep these sets performing well.

AUDIO EQUIPMENT



by Monte J. Hasso

Although the growth of the Hi-Fi portion of the industry cannot compare with color TV, there is an ever-increasing number of Hi-Fi instruments in the field. Many shops are unprepared to service these instruments when they arrive in the shop. True, many repairs can be made with a VTVM, but the majority of jobs require more equipment. The customers are developing more critical ears and will not accept the distortions, background noise, and hum that would have "gotten by" a few years ago. Specialized test equipment is needed to track down these problems. Let's take a look at some of this equipment.

AC VTVM

The AC VTVM is only a distant cousin of the all-purpose VTVM. AC instruments employ feedback circuits and highly damped meters. The sensitivity of the lowest scales is typically .03 volts full scale, though many instruments have a .01 scale. The frequency response is flat over the entire audio spectrum and usually about ±1dB from 10Hz to 500kHz. Fig. 1 shows the face of one of the instruments. Note the lack of a zero control. The circuits are designed so that the instrument is insensitive to minor line voltage variations and tube aging, and the zero control is unnecessary. Fig. 2 shows a block diagram of an AC VTVM circuit.

The input attenuator is frequency compensated so that it is essentially flat from 10Hz to 600kHz. The cathode follower stage is a low-noise triode impedance matching stage. It matches the high impedance input to the low impedance voltage divider. The 6EJ7 pentode amplifiers were chosen for their stability and high gain. The feedback network insures that they operate at about the same amount of gain throughout their useful life.

Not shown is the power supply. In this particular instrument (Eico 250) the power supply has a regulator tube, and a small AC voltage is applied to a tapped bleeder resistor to buck out stray hum.

Audio Signal Generators

Audio generators come in more shapes and sizes than people. They are of two general types though, the sine-wave, and the square-wave generators. They each have their advantages, though the square-wave generator is probably more versatile in the hands of a technician who knows how to use it. However, neither can completely replace the other, and it is advantageous to have both instruments. For the shop which has a limited equipment budget, the sine-wave generator is probably the best choice; the square wave can be added later. There also are some combination instruments available with both sine- and square-wave outputs.

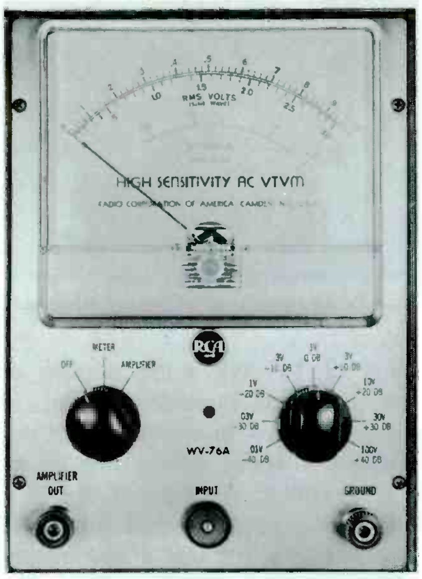


Fig. 1. Front panel of an AC VTVM.

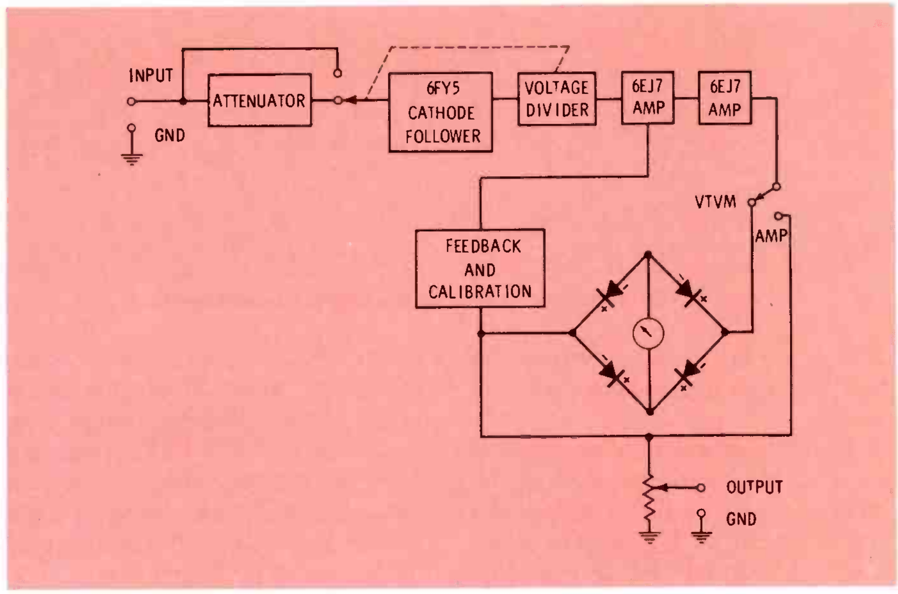


Fig. 2. Block diagram of an AC VTVM.

With either type of generator, the output should be flat over the entire audio spectrum, or else the instrument should have a built-in voltmeter. This is to insure that the test signal will not cause the amplifier to show an uneven frequency response.

The generator should have a low output impedance, since it can be fed into either a low or high impedance amplifier input. A high impedance output may show serious distortion when fed to a low impedance input stage.

The main use of an audio generator is to check frequency response of a stage or system. This is done by connecting the equipment as in Fig. 3. The input level is advanced until unacceptable distortion is evident on the monitor (scope or distortion meter), and the level is noted. Measurements are made at several points in the audio spectrum and the response can be graphically recorded. The measured response can then be checked against the manufacturer's specifications to see if the equipment is operating properly.

A general idea of frequency response can be obtained by connecting a square-wave generator to the input and a scope to the output of the system under test. Measurements need to be taken only at 200 Hz and 2000 Hz. If the wave is square at the output at both these frequencies, then the response is adequate from 20 Hz to 20 kHz. The reason is that the scope indicates any integration or differentiation of the input wave, which means poor low or high frequency response. Fig. 4 shows these waveforms. The square wave gives a good indication of the response about 1 octave either side of its actual frequency.

Distortion Analyzers

Again, there are two main types; Harmonic and Intermodulation distortion meters. Each has its advantage. The harmonic analyzer is usually the more inexpensive, and easier to operate. The intermodulation analyzer, on the other hand, gives a more accurate test of distortions which are most objectionable to the listener's ear. An in-depth article about the two instruments appeared in August 1966 PF REPORTER; this article in turn was taken from a portion of Howard Tremaine's fine book "Intermodulation and Harmonic Distortion" (Howard W. Sams catalog INT-1).

For harmonic-distortion analysis, a signal is fed to the instrument under test. The output is measured, and then a bandpass filter inserted in the analyzer so that the test signal is rejected. The second reading is the total harmonic level. The meter is usually calibrated directly in % total harmonics. Fig. 5 is a block diagram of this type of meter. The bandpass filter usually is tun-

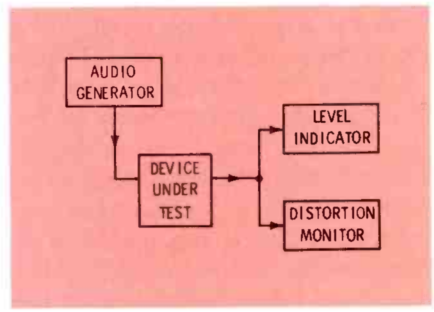
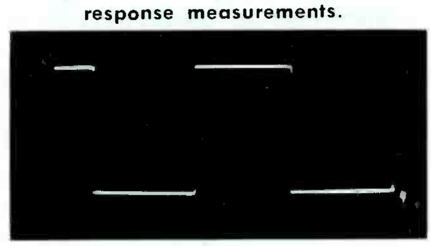
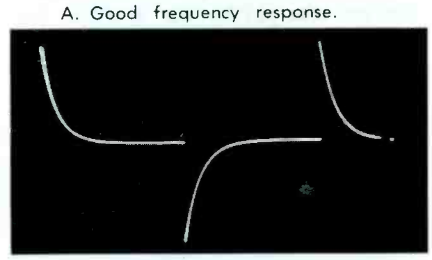


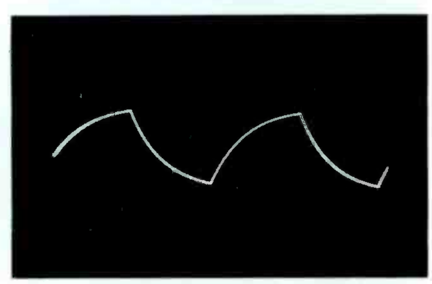
Fig. 3. Test setup for frequency response measurements.



A. Good frequency response.



B. Poor low frequency response.



C. Poor high-frequency response.

Fig. 4. Waveform of the square-wave test of a system.

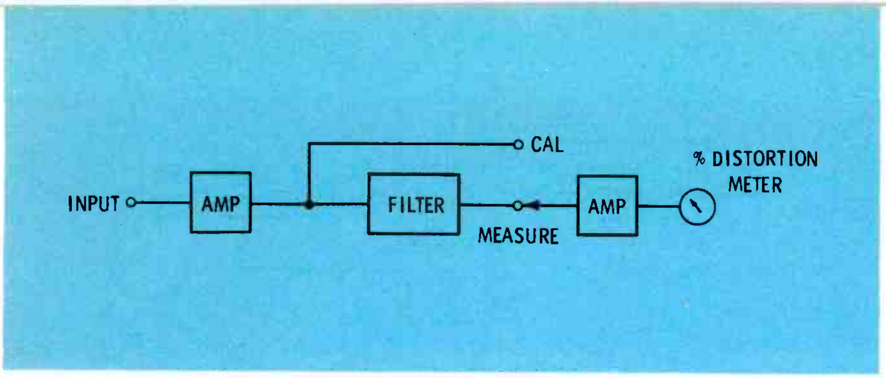


Fig. 5. Test setup for harmonic distortion measurements.

able over the audio spectrum so that test can be made at any frequency.

The intermodulation analyzer is quite a bit more complicated. A block diagram of the complete test setup appears in Fig. 6. The associated waveforms are shown. The distortion can be thought of as a beat-frequency, similar to that produced in a mixer stage of RF equipment. In audio instruments, IM distortion is usually quite objectionable, as compared to harmonic distortion. The reason is that the distortion products are unrelated to the fundamental signals. Harmonic distortion on the other hand is related to the desired signal, and as suggested by the name, sounds harmonious to the ear. However, neither type of distortion can be tolerated to any extent by Hi-Fi enthusiasts, so a distortion analyst is a must in any shop servicing Hi-Fi instruments. The two types of distortion often go hand-in-hand, that is, the causes are essentially the same, so shops with a limited budget can get by for a while with either instrument.

Miscellaneous Equipment

There are many other instruments which are peculiar to audio servicing. Several manufacturers make audio wattmeters, often as a feature of an AC VTVM. These are quite convenient, however, they are not absolutely necessary, as the power across a load resistor may be computed by Ohm's law.

When checking power output against manufacturer's specifications, make sure that you are both speaking the same language. There are several different power specifications popular in the Hi-Fi field. Among these are ESWP (equivalent sine wave power), EIA Music Power, and sine wave power. These may differ radically, and the serviceman is most likely to measure sine wave power; the output across a resistive load with a single frequency input. ESWP is equal to 1.47 times sine wave power.

Another handy device in audio work is the phase checker. This instrument is used to check the phase match of the loudspeakers in a multispeaker system, or between left and right speakers in a stereo system. It is an extremely simple device. A simplified schematic for the RCA phase checker appears in Fig. 7. The two receptors act as microphones in series with the primary of T1. When the outputs of the two speakers under test are in phase, the two microphones put out voltages in series aiding each other, and a voltage appears at the output of T1. If the speakers are out of phase, the voltages at the microphones are series opposing, and there will be no output at T1.

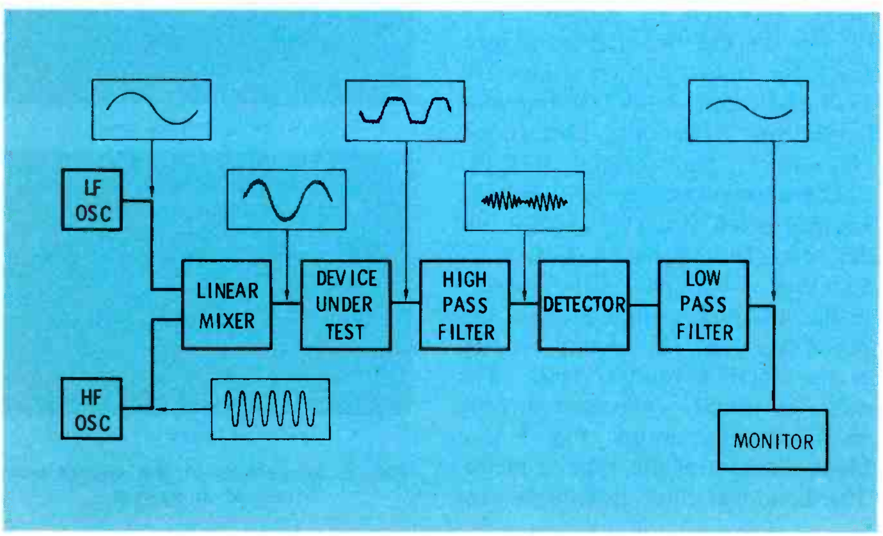


Fig. 6. Test setup for intermodulation distortion.

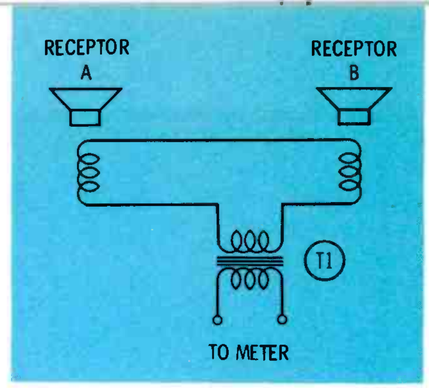


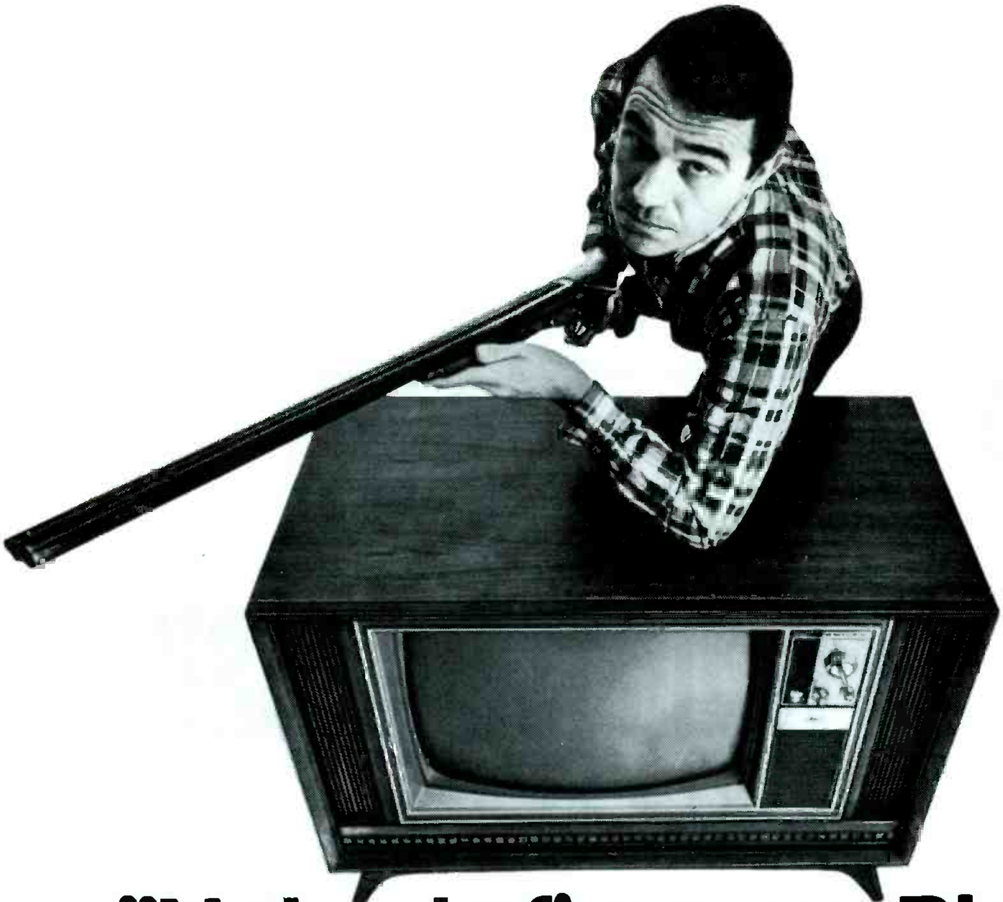
Fig. 7. Diagram of a phase checker.

Further Reading

The audio equipment field is a big area. No one magazine article can do more than just scratch the surface. Fortunately there are many good books on the subject. A very good book on practical applications of audio equipment is "101 Ways to Use Your Audio Test Equipment" by Robert Middleton. This book shows how to check the sets against manufacturer's specs and has many tips and tricks of the trade which should prove invaluable.

Another good book is Howard Tremaine's "Audio Cyclopedia." This 1280-page book is one of the best references available on audio work in general, from acoustics and design through studio techniques and maintenance. It answers such questions as "What is the best height above floor level for a loudspeaker?" and "At what output level should a frequency response measurement be made on an amplifier?"

Both of the above books are available from Howard W. Sams & Co. "101 Ways" is catalog number TEM-5 ($2.00), and "Audio Cyclopedia" is ACT-1 ($19.95). ▲



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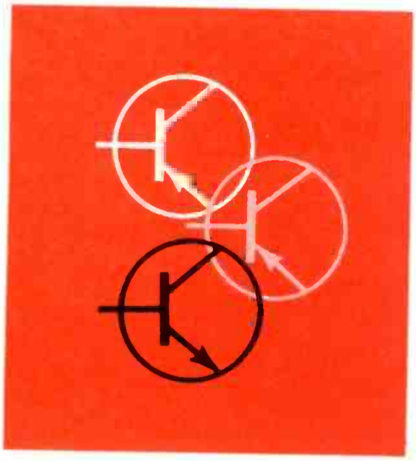


The key to efficient operation of a test instrument is knowing how it functions.

Here's the know-how on . . .

Transistor Testers

by Chris Edwards

The number of transistor testers available from test equipment manufacturers is increasing rapidly. It is time to take a close look at the models available, the tests they can accomplish, and the circuits they use.

In addition to the transistor test function, many instruments offer extra functions such as a power supply, signal generator, signal tracer, VTVM, voltmeter and ammeter, and tube tester. These extra measuring functions are usually switched and metered so that test leads do not have to be moved. Most instruments also offer in-circuit and out-of-circuit tests for transistors. Probably the most elaborate of the available instruments offers:

1. An in-circuit test.
2. An out-of-circuit test.
3. An RF signal generator.
4. An AF signal generator.
5. A metered supply to power the radio under test.
6. A VTVM.
7. An ohmmeter.

The actual transistor test is made in different ways, depending on instrument cost and manufacturer's preference. For instance, some make a check of actual DC or AC beta. Others make a relative reading which results in a GOOD/BAD meter indication.

The beta of a transistor is the ratio of collector current divided by base current when the transistor is connected in the common-emitter circuit. Since this circuit is the most commonly used, it is used in the majority of testers.

The primary function of the PN junction is to pass or to block current flow. The blocking action suggests a perfect junction; in practice this is not possible. Reverse leakage exists in any junction and is referred to as I_{CO} or I_{CBO}. As the subscript CBO implies, this is measured from collector to base with the emitter open.

Reverse leakage is a variable factor dependent on many conditions of the transistor. It is a good measure of transistor quality because, as leakage increases, transistor efficiency decreases. Leakage, as well as gain, can change with temperature. Tests should be made quickly, and sufficient time for junction cooling should be allowed. Never hold the transistor with a hand while it is being tested. The

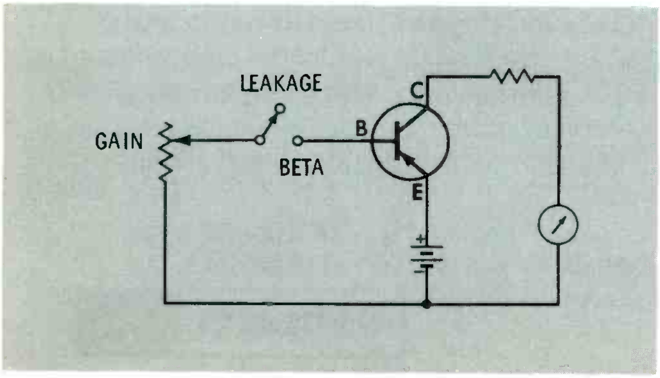


Fig. 1. Beta and leakage tests.

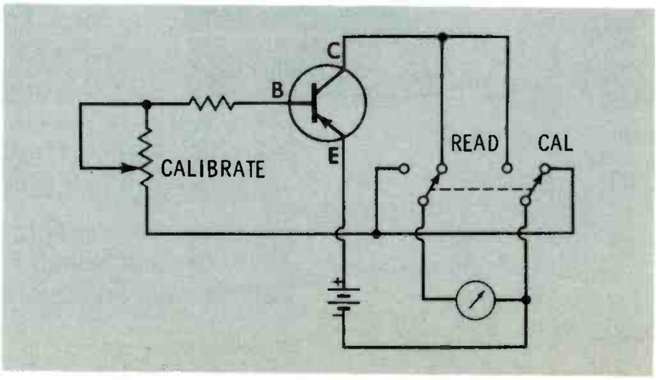


Fig. 2. A test for actual DC beta.

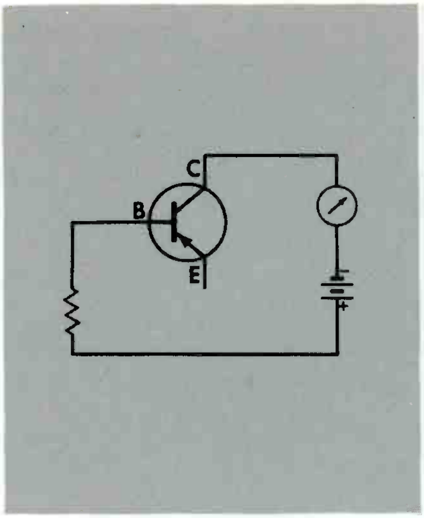


Fig. 3. I_{CBO} leakage test.

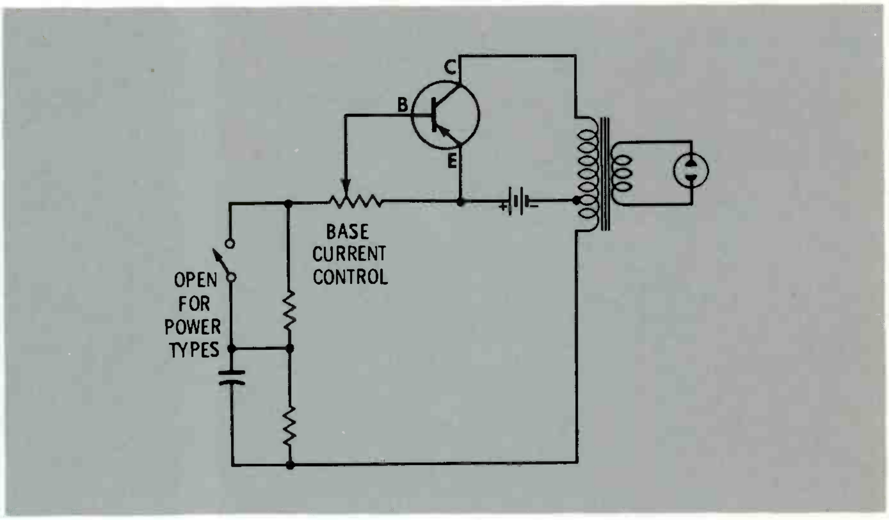


Fig. 4. Oscillator circuit for relative AC beta.

increase of temperature can cause a faulty reading.

Beta Tests

The simplest method of checking gain and leakage is shown in Fig. 1. For the leakage check, a voltage is applied between the emitter and collector, with the base open, and leakage current is read on the meter. When the switch is closed to read beta, a current is inserted into the base through the GAIN control. The control must be preset for the desired meter scale. The gain of the transistor is the meter reading in the beta switch position minus the leakage reading with the difference multiplied by the control setting.

A more elaborate test circuit is shown in Fig. 2. This circuit measures the actual value of DC beta. In the switch position shown, the meter is in the collector circuit and the CALIBRATE control must be set for exactly 1 ma of collector current. The switch is then set to the READ position, and the value of base current is read. The meter is calibrated for the ratio of base-to-collector currents. This is the beta of the transistor under test. This circuit is typical of most testers that read actual DC beta.

Leakage Tests

The majority of leakage tests measure I_{CEO}, the leakage between collector and emitter with the base open. The I_{CBO}, collector-to-base, leakage is not measured but does affect the I_{CEO} reading. Some instruments measure I_{CBO} with circuits similar to that in Fig. 3. The collector-to-base junction is reverse biased, and the emitter is open.

Relative AC beta can be checked with the circuit in Fig. 4. This is an oscillator circuit with the transistor being checked serving as the amplifying device. It can be used for both in-circuit and out-of-circuit checks. The in-circuit test is limited by the values of shunt impedance and capitance in the circuit under test. A low value of impedance or a high capacitance can "swamp" the oscillator and stop the oscillations. Usually impedances above 150 ohms and capacitors below 0.5 mfd will not affect the circuit.

A direct measurement of AC beta is possible with the circuit in Fig. 5. A close look will reveal that this is a bridge circuit with R1, R2, the transistor being tested, and the resistor network forming the four legs of the bridge. An audio oscillator injects a calibrated signal into the base circuit. For a typical small-signal transistor, the calibrated AC base current is 5 ua. This current is measured by an AC voltmeter which is switched to read the voltage drop across the 50Ω resistor in the base circuit.

To read AC beta, the AC voltmeter is switched to read the voltage drop across the 1Ω resistor in the collector circuit.

The purpose of the bridge circuit is to enable this instrument to measure and then cancel the effects of the circuit impedance during an in-circuit test. Fig. 6 shows the bridge circuit for this function. The I_C potentiometer is set to zero to cut off the transistor. This removes the transistor impedance and leaves only the circuit impedance in the upper right-hand leg of the bridge. The ZOHMS potentiometers are then set for a null reading on the voltmeter connected across the bridge. The value of the circuit impedance can be read directly across from the calibrated ZOHMS dials.

The input impedance of the tran-

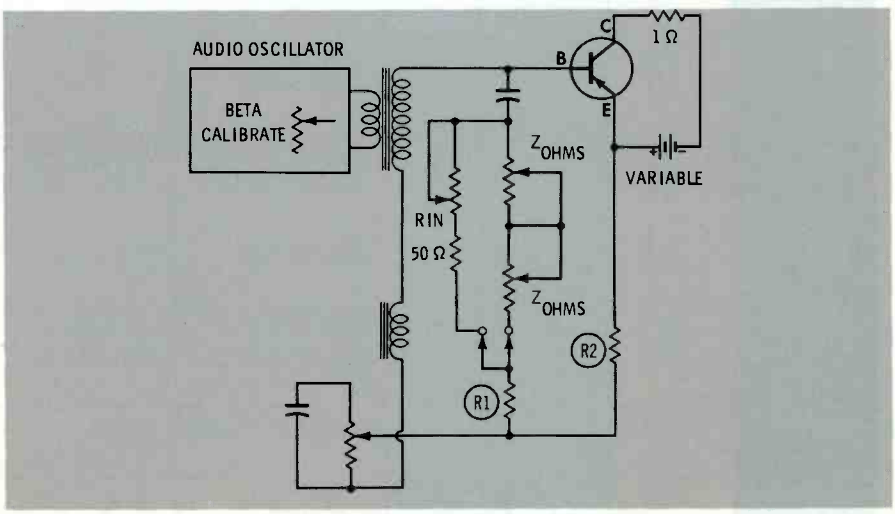


Fig. 5. Bridge circuit for AC beta.

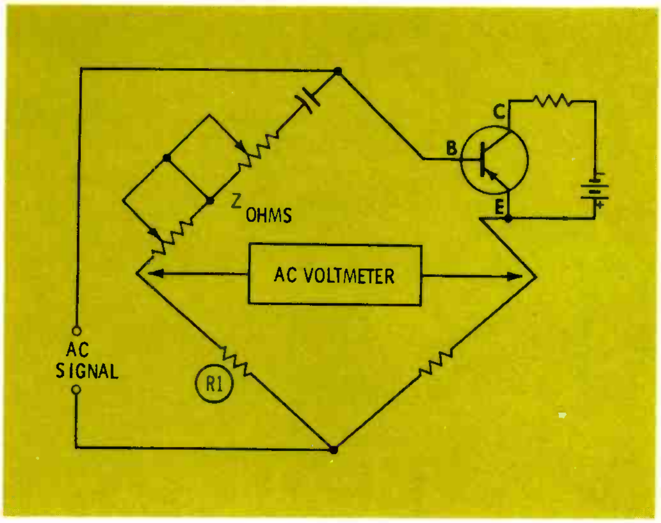


Fig. 6. Measurement of circuit impedance.

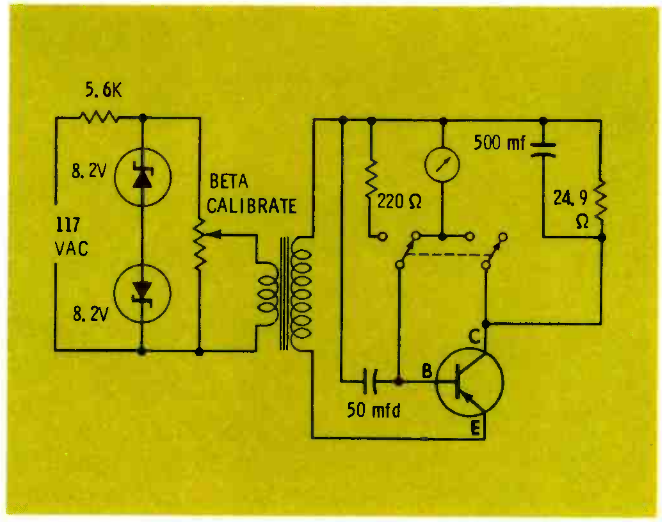


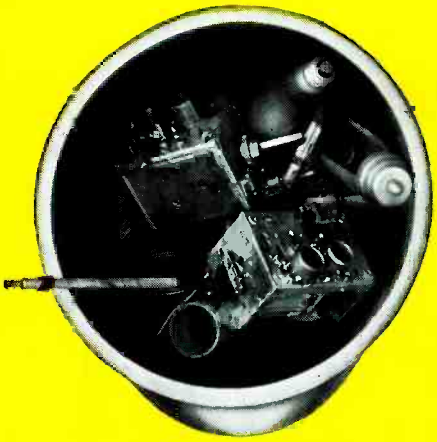
Fig. 7. Dynamic check of AC beta.

sistor itself is then measured by switching the R_{IN} potentiometer of Fig. 5 across the ZOHMS potentiometers and setting the I_C potentiometer to bias the transistor on. A second null is found by varying the R_{IN} potentiometer. Now the circuit and transistor impedances are balanced out and only the AC beta of the transistor is effective in the circuit. These are the conditions under which beta is measured in the circuit of Fig. 5.

A unique method of measuring AC beta is shown in Fig. 7. A signal from the AC line is coupled into the test circuit through the transformer. In the CAL position of the switch, the meter reads the voltage across the collector load resistor. The BETA CAL control is used to set the meter to full scale; this equals approximately 2 ma of collector current.

When the switch is changed to read beta, the meter is transferred to read the voltage acoss the base resistor. The meter scale is calibrated directly in beta. Note that there are no DC power supplies in the circuit; the test is made under dynamic conditions simulating actual operation. ▲

MFR.	MODEL	Iceo	Icbo	SHORTS	GAIN TEST	OTHER TESTS	PNP/NPN	MISC. NOTES
B & K	960	✔	✔	✔	actual DC beta	in-circuit tests	switch	pwr. sup., sig. gen., VTVM
	970	✔	✔	✔	actual DC beta	in-circuit tests	switch	pwr. sup., sig., gen., VOM
EICO	680	✔	✔		actual DC beta	indirect AC beta	switch	VOM
HEATH	IM-30	✔	✔	✔	actual DC beta	checks diodes & DC alpha	switch	
HICKOK	800A	✔			good-bad scale		2 sockets	tube tester
	870	✔	✔	✔	actual AC beta		switch	
	890		✔		actual AC beta	input and circuit Z	switch	
	6000A	✔			good-bad scale		2 sockets	tube tester
MERCURY	1200	✔			good-bad scale		switch	tube tester
	2000				actual DC beta		switch	tube tester
SECO	100			✔	oscillator go/no-go	in-circuit tests	switch	
	260	✔	✔	✔	oscillator go/no-go	in-circuit tests	switch	
SEMITRON	1000		✔	✔	actual DC beta	in-circuit osc. test	switch	E & I tests
SENCORE	TR115	✔	✔	✔	actual DC beta	checks diodes	switch	
	TR139		✔		actual AC beta	in-circuit tests	switch	checks diodes
SIMPSON	650				incremental DC beta	Ico test	switch	Adapter for Model 260
TRIPLETT	2590	✔	✔	✔	actual DC beta	checks Diodes	switch	
	3490A	✔	✔	✔	actual AC beta	Ico & Reach-thru tests	switch	actual DC beta



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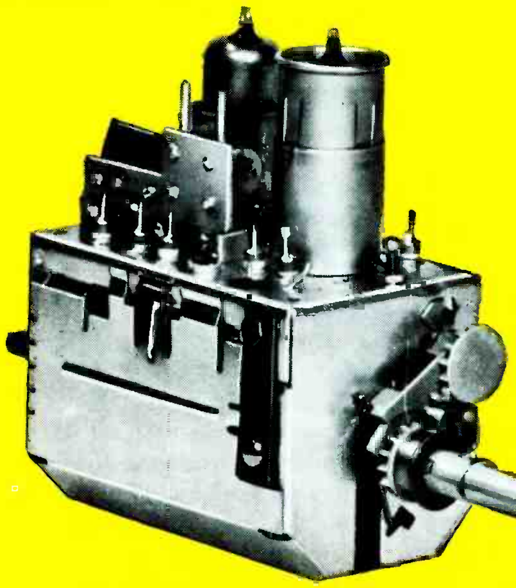

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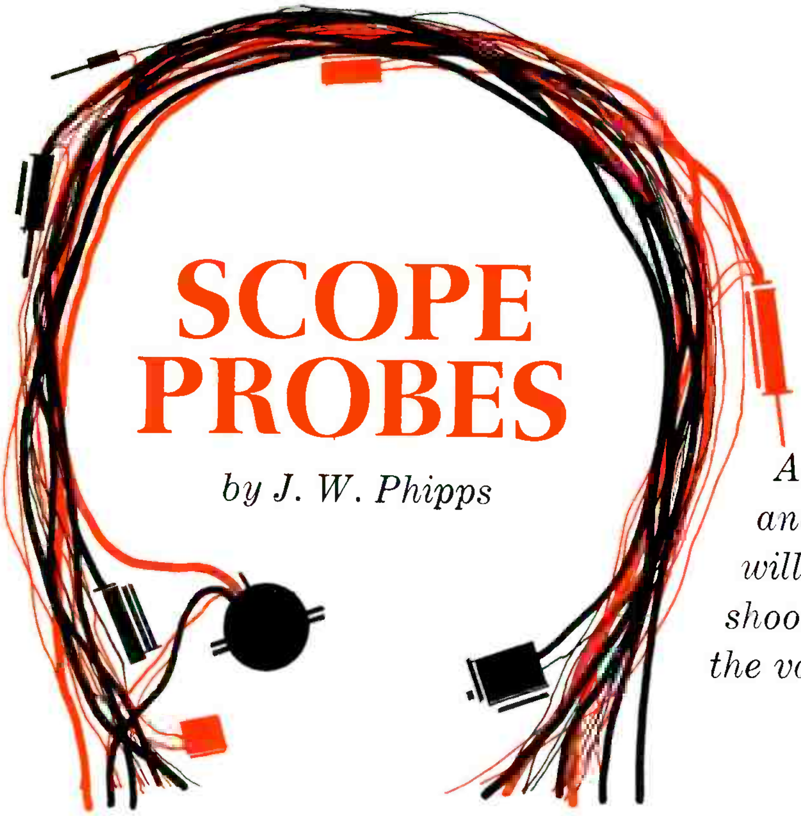

SCOPE PROBES

by J. W. Phipps

An understanding of the circuits and uses of typical scope probes will assure more accurate trouble-shooting information and increase the value of your scope.

The versatility and accuracy of an oscilloscope is dependent, in part, upon the ability to perform voltage and waveform measurements without unsetting the operating characteristics of the circuit being tested. To meet this prerequisite, the instrument must be adaptable to a variety of circuit characteristics, including impedance, signal level, and frequency. Consequently, these same factors—impedance, signal level, and frequency—are what determine the limitation of a scope. Such limitations can be overcome, for the most part, by selecting a probe designed to compensate for both the characteristics of the circuit being tested and the design characteristics of the scope. In effect, the probe tailors the scope to the test appjlication, or vice versa. The probes most commonly used with scopes are the shielded direct probe, low-capacitance probe (sometimes referred to as a high-impedance probe), and the demodulator probe. Other types include the capacitance voltage-divider probe, and the isolation probe. Although each probe has its own particular advantages, their use may overlap for some circuit applications.

Direct Probe

The input impedance of most scopes ranges from .5 megohms to about 5 megohms of resistance, shunted by a capacitance varying from 20 to 50 pf. This is the load felt by a circuit under test when an unshielded direct probe is used, as shown in Fig. 1. However, unshielded probes are seldom used with the scope because of their tendency to act as an antenna, thereby introducting spurious signals into the circuit being tested. Such spurious signals not only produce extraneous waveforms on the scope, but can also cause oscillations, upsetting the operation of the circuit under test. To prevent this lead reaction to stray fields, shielded cables are used.

Adding the shield to the test lead introduces an additional 25 to 50 pf of shunt capacitance to the overall input impedance of the scope and test probe. Fig. 2 illustrates the loading effect imposed upon the circuit by a scope and shielded direct probe. At lower frequencies, the total reactance of the shunt capacitance is high and does not appreciably increase the circuit loading; however, as the frequency of the signal increases, the reactance of the shunt capacitance decreases, and lowers the input impedance to the scope. This, in turn, increases the circuit loading and alters the characteristics of the signal. From this, it can be seen that frequency is one determining factor in the

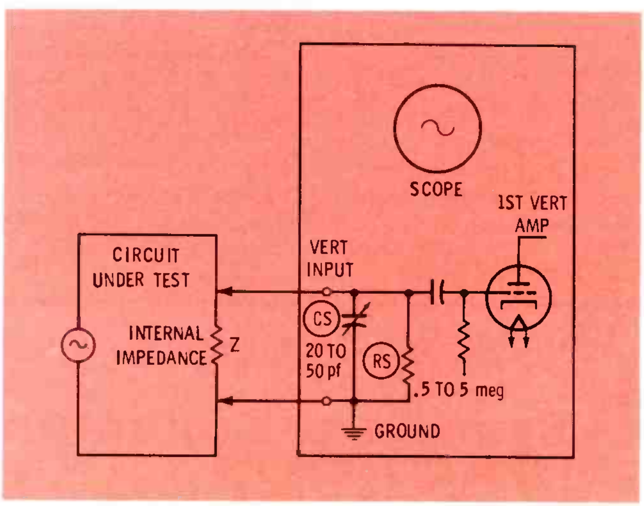

Fig. 1. Loading effect of unshielded probe.

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4

RCA Deluxe Multi-Set Couplers
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3

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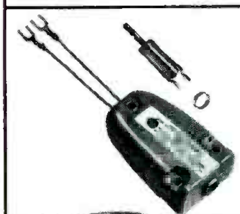

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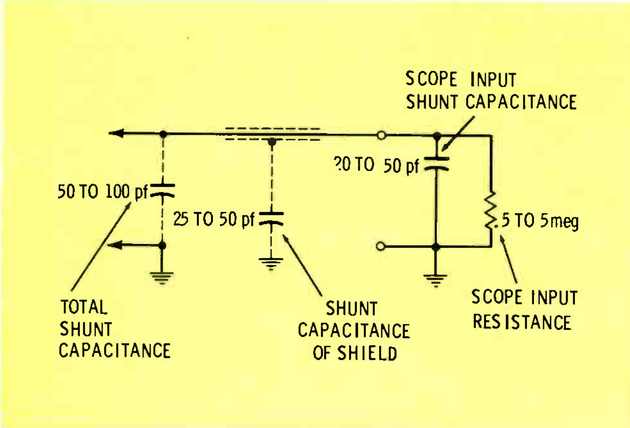


Fig. 2. Shield adds shunt capacitance to loading effect.

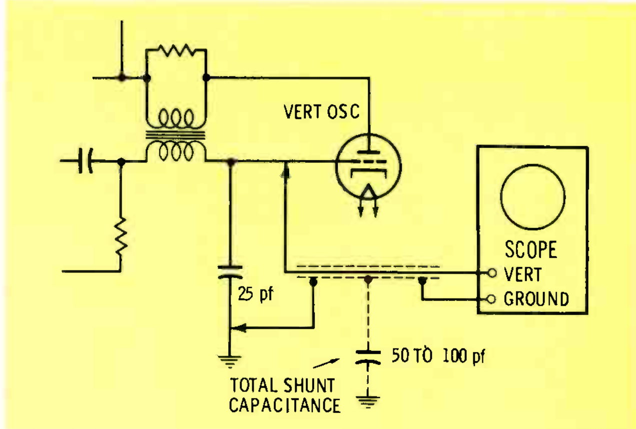


Fig. 4. High-Z circuit can be disabled by direct probe.

application of a direct probe.

The relative values of the scope input impedance and the impedance of the circuit under test must also be considered. To avoid excessive circuit loading, the scope input impedance should be at least 10 times the impedance of the circuit being tested. In Fig. 3, a scope and shielded direct probe are used to measure the ripple content of a low-voltage power supply. The reactance of the shunt capacitance to the 60-hertz ripple frequency is about 26 megohms. The reactance of the 250-mfd filter capacitor is about 10 ohms. Therefore, the ratio of the impedance of the reactive components more than meets the criteria required to avoid excessive loading. Fig. 4 shows a scope connected through a shielded direct lead to the grid of a vertical blocking oscillator. Again, the frequency envolved is 60 hertz; however, in this case, the impedance at the point where the probe is applied is much higher, and offers 106 megohms of reactance to the 60-hertz signal. Shunting this reactance with the 26.5 megohms of reactance produced by the shunt capacitance of the probe and scope will greatly load the circuit and upset its operating characteristics —even to the point of disabling it. From the foregoing comparisons, it can be seen why the impedance ratio between the circuit under test and the scope must also be considered.

Another factor limiting the test application of a shielded direct probe is the signal level. This factor is related directly to the fact that the blocking capacitor employed in the input circuit of most scopes is rated at about 600 volts. Obviously, if this level is exceeded, the capacitor will be destroyed and the input circuit to the scope could be seriously damaged. Aside from the loading effect of the scope input impedance, the direct probe does not attenuate the voltage being measured; what is applied across the probe tip is felt at the scope input. For this reason, the direct probe is not suitable for high-level measurements beyond the working volt rating of the scope input blocking capacitor.

The fact that the direct probe does not attenuate the signal being measured (beyond the loading effect of the scope input impedance) is the one single advantage of the shielded direct probe. This absence of appreciable attenuation allows use of the full sensitivity of the scope.

Combination Isolating and Direct Probe

The probe shown in Fig. 5 is designed to overcome some of the disadvantages inherent in the simple, shielded direct probe. When the switch is closed, the 47K-ohm resistor provides increased resistive isolation between the circuit under test and the scope. One major advantage of increased resistive isolation is that it reduces the effects of the shunting capacitance associated with the direct shielded cable. For example, if a 200-kHz signal is being measured with a shielded direct probe, the effective reactance of 100 pf of shunt capacitance will be 8000 ohms. The circuit under test is therefore being shunted by only 8000 ohms. Add-

• *please turn to page 42*

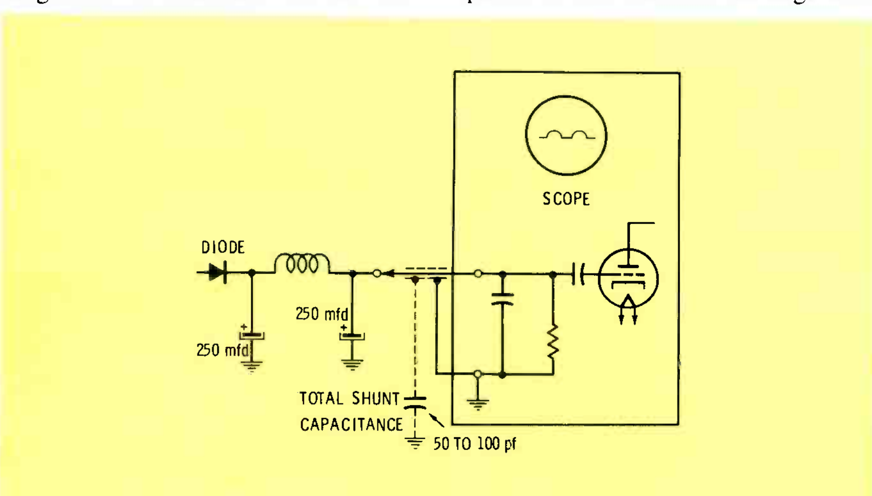


Fig. 3. Scope applied to low-impedance circuit.

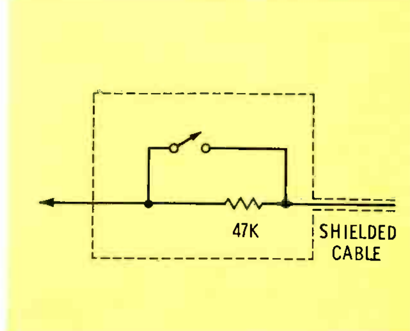
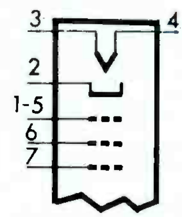


Fig. 5. Combination probe.

TUBE AND TRANSISTOR DATA

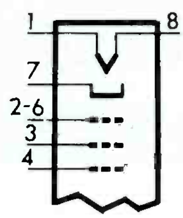
CATHODE-RAY TUBES

9WP4
Protection—tension band
Deflection—90°
Filament—12.0V @ 0.075A
Grid 2—100V
Neck Diam.—.788"



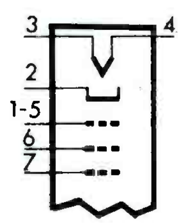
7GR

11KP4
Protection—tension band
Deflection—110°
Filament—6.3V @ 0.45A (11 sec)
Grid 2—50V



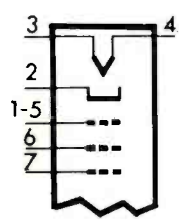
8HR

12BZP4
Protection—tension band
Deflection—104°
Filament—12.0V @ 0.157A (11 sec)
Grid 2—100V
Neck Diam.—0.788"



7GR

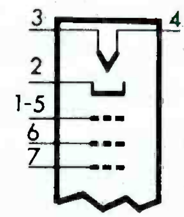
12CFP4
Pritection—tension band
Deflection—110°
Filament—4.2V @ 0.45A (11 sec)
Grid 2—200V
Neck Diam.—0.788"



7GR

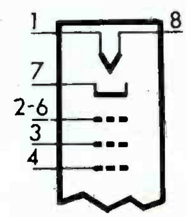
CATHODE-RAY TUBES

12CHP4
Protection—tension band
Deflection—110°
Filament—6.3V @ 0.45A (11 sec)
Grid 2—300V
Neck Diam.—0.788"



7GR

16CMP4A
Protection—tension band
Deflection—114°
Filament—6.3V @ 0.45A (11 sec)
Grid 2—300V



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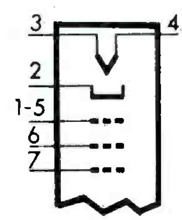
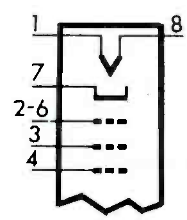
16CNP4
Protection—tension band
Deflection—104°
Filament—12.0V @ 0.157A (11 sec)
Grid 2—100V
Neck Diam.—0.788"



7GR

16CTP4
Protection—tension band
Deflection—114°
Filament—6.3V @ 0.45A (11 sec)
Grid 2—400V



8HR

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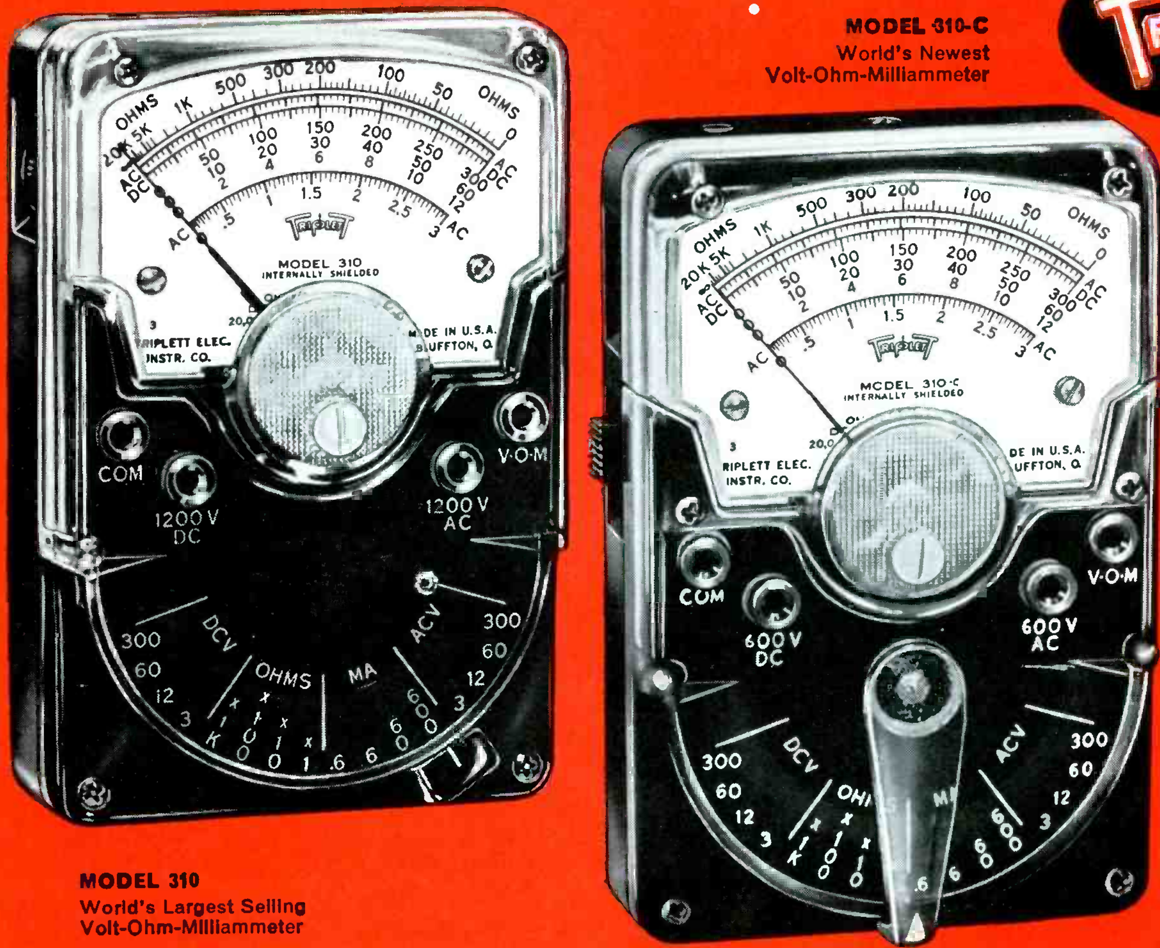
Volt-Ohm-Milliammeter



MODEL 310
World's Largest Selling
Volt-Ohm-Milliammeter

BOTH TESTERS SHOWN ACTUAL SIZE

1. **HAND SIZE AND LIGHTWEIGHT, but with the features of full-size V-O-M's.**
2. **20,000 OHMS PER VOLT DC; 5,000 AC (310)—15,000 AC (310-C).**
3. **EXCLUSIVE SINGLE SELECTOR SWITCH speeds circuit and range settings. The first miniature V-O-M's with this exclusive feature for quick, fool-proof selection of all ranges.**

SELF-SHIELDED Bar-Ring instrument; permits checking in strong magnetic fields. FITTING INTERCHANGEABLE test prod tip into top of tester makes it the common probe, thereby freeing one hand. UNBREAKABLE plastic meter window. BANANA-TYPE JACKS—positive connection and long life.

Model 310—$42.00 Model 310-C—$53.00 Model 369 Leather Case—$4.00

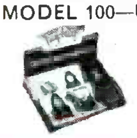
ALL PRICES ARE SUGGESTED U.S.A. USER NET, SUBJECT TO CHANGE

310-C PLUS FEATURES

1. Fully enclosed lever range switch
2. 15,000 Ohms per volt AC (20,000 O/V DC same as 310)
3. Reversing switch for DC measurements

MODELS 100 AND 100-C

Comprehensive test sets. Model 100 includes: Model 310 V-O-M, Model 10 Clamp-on Ammeter Adapter; Model 101 Line Separator; Model 379 Leather Case; Model 311 leads. ($78.00 Value Separate Unit Purchase Price.)
MODEL 100—U.S.A. User Net..$74.00



MODEL 100-C—Same as above, but with Model 310-C, Net...........$84.00

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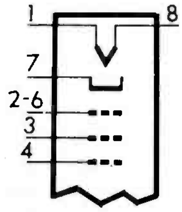
Circle 14 on literature card

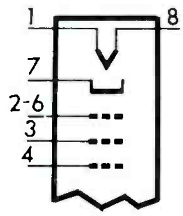
CATHODE-RAY TUBES

16CUP4
Protection—tension band
Deflection—114°
Filament—6.3 @ 0.45A (11 sec)
Grid 2—400V



8HR

19FCP4
Protection band
Deflection—114°
Filament—6.3V @ 0.45A (11 sec)
Grid 2—400



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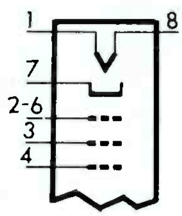
19FEP4B
Protection—tension band
Deflection—114°
Filament—6.3V @ 0.45A (11 sec)
Grid 2—30V



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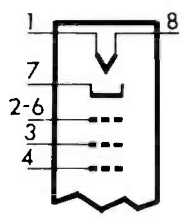
19FKP4
Protection—tension band
Deflection—110°
Filament—6.3V @ 0.3A
Grid 2—300V



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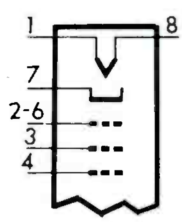
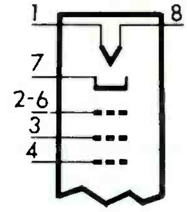
19FLP4
Protection—tension band
Deflection—114°
Filament—6.3V @ 0.45A (11 sec)
Grid 2—300V



8HR

CATHODE-RAY TUBES

19GMP4
Protection—bonded glass
Deflection—114°
Filament—6.3V @ 0.45A (11 sec)
Grid 2—50V



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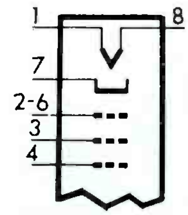
21FWP4
Protection—tension band
Deflection—114°
Filament—6.3V @ 0.45A (11 sec)
Grid 2—400V



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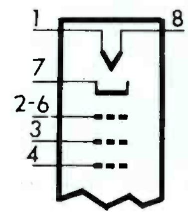
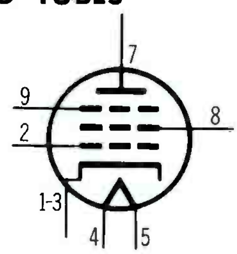
23ERP4
Protection—tension band
Deflection—114°
Filament—6.3V @ 0.6A (11 sec)
Grid 2—300V



8HR

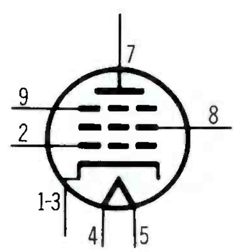
RECEIVING TUBES

3KT6
Video IF Amplifier
Fil.—3.5V @ 0.6A (11 sec)



9PM

4KT6
Video IF Amplifier
Fil.—4.5V @ 0.45A (11 sec)



9PM

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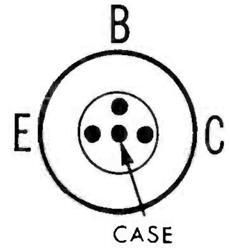
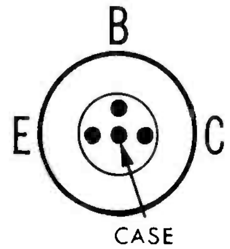
TRANSISTORS

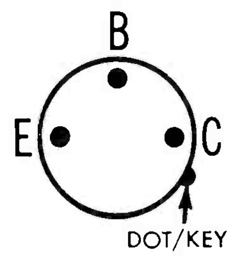
2SA360
FM IF Amplifier
PNP—Germanium



2SA368
FM IF Amplifier
PNP—Germanium

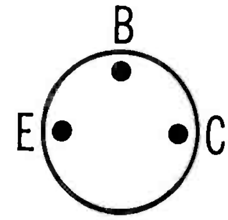


2SB155
FM IF Amplifier
PNP—Germanium

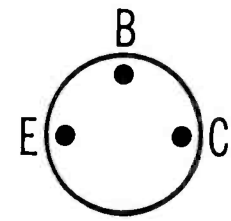


TRANSISTORS

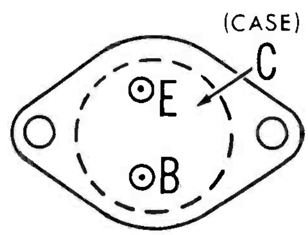
2SB181A
Horizontal Output
PNP—Germanium



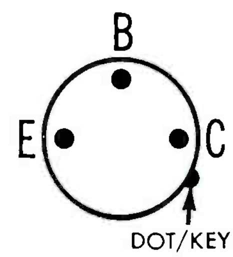
2SB405
Audio Output
PNP—Germanium



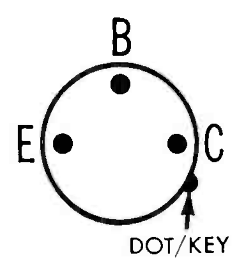
2SB407
Voltage Regulator
PNP—Germanium

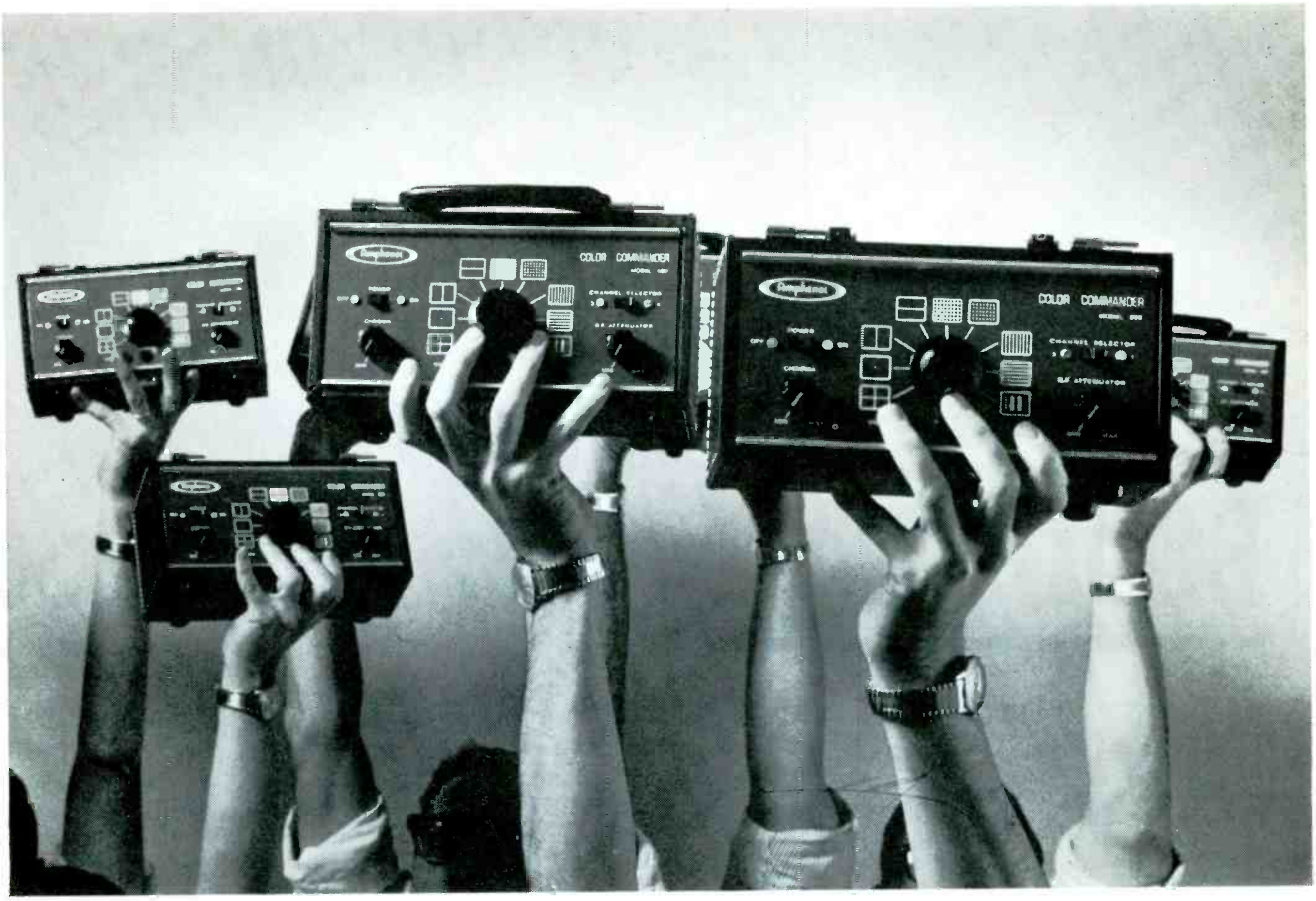


2SB457
Audio Output
PNP—Germanium



2SD178
Vertical Output
NPN—Germanium





Suddenly, everyone's a Watch Watcher

We hate to say we told you so. But never-the-less, we told you so.

Service dealers everywhere have been watching their watches. And they've found we were right when we said the Color Commander could save enough time for two or three extra calls a day.

The reasons are simple.

The *single cross bar* gives fast, accurate reference for both vertical and horizontal raster centering, constant monitor of yoke leveling, and center reference for center purity adjustment.

For static convergence, the *single dot* pattern alone can save about fifteen minutes on your next call. Because it's an excellent quieting pattern, there's no need to pull an IF tube for purity check.

Everything about the Color Commander is simplified.

For instance, there's a *single vertical line*, for dynamic convergence at top center and bottom center, and a *single horizontal line*, for dynamic convergence left center and right center.

This simplicity adds up to easier, faster operation.

We could go on and on about the three color bar that's so much faster to work with than the old 10 bar patterns, the three to four aspect ratio cross-hatch for making height, width, and linearity adjustments, and all the rest.

But you're probably watching the time.

So just ask your Amphenol distributor salesman for a demonstration of this *super* stable generator. He'll be watching for your call.

AMPHENOL
TM

Circle 17 on literature card

NOTES ON TEST EQUIPMENT

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

by T. T. Jones

Solid-State Generator Features Small Dots

Mercury's new Model 1900 has some of the most up-to-date features we've seen in color generators. This unit has all of the main patterns — horizontal and vertical lines, crosshatch, dots, and keyed rainbow. It has the usual gun killers, frequency adjustable RF output, and color level control. Just about all you'd want except 4.5-MHz audio carrier, which many servicemen don't use.

It has many little "extra" features which at first look are hidden. The horizontal and vertical lines are both adjustable in thickness with front panel controls. Fig. 2 shows a portion of the crosshatch pattern with these controls set for the narrowest practical lines. The horizontal line is 1 scan line thick. The horizontal line pulse width is set so that it just begins to overlap. It can be set so that it is six scan lines thick. The vertical pulse is very narrow in the picture, but it can be set to about 3/8″ width on a 21″ screen. It follows that the dot size can be set from a very tiny dot to a 3/8″ square.

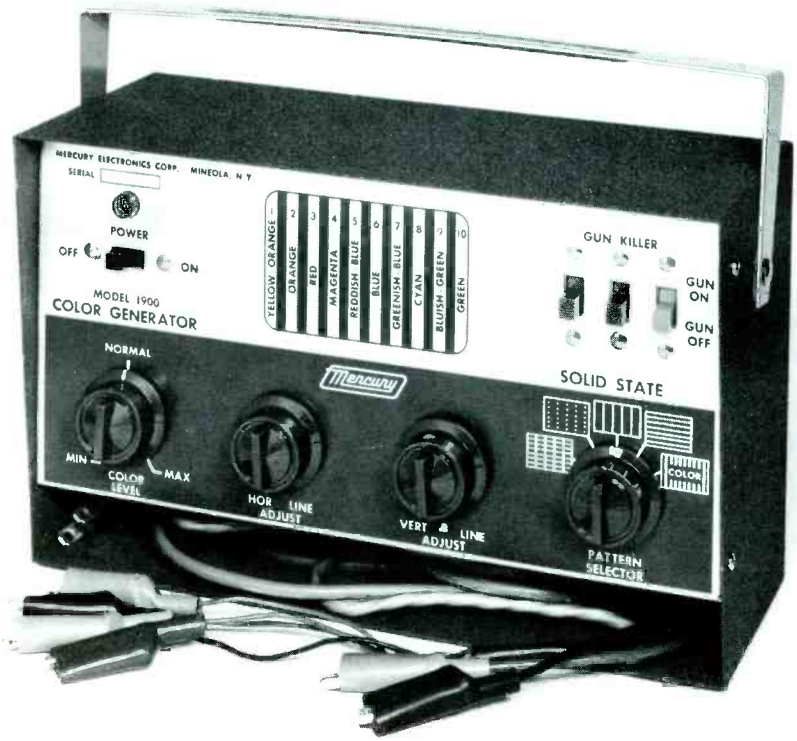


Fig. 1. New solid-state color generator.

Mercury Model 1900 Specifications

Outputs:
10 Vertical lines. adjustable width. 14 Horizontal lines, adjustable thickness.
140 Dots, adjustable size.
Crosshatch.
10 Keyed rainbow bars, adjustable color level.

RF output:
Adjustable channel 3-5.

Gun killers:
100-K ohms.

Power requirements:
117 VAC 3 watts.

Size (HWD):
6¼″ x 10″ x 4½″.

Weight:
4 pounds.

Price:
$89.50.

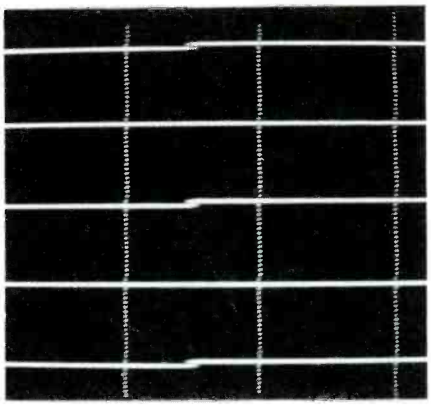


Fig. 2. Portion of crosshatch display.

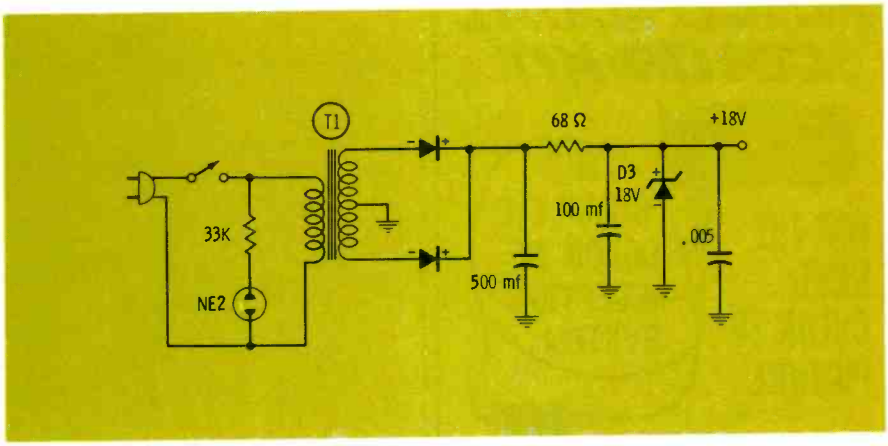


Fig. 3 Partial schematic of power supply.

Another operator convenience is that all internal adjustments can be reached through holes in the cabinet. The RF adjustment can be reached through the rear with a standard hex alignment tool. The Model 1000 is factory set to channel 3, and according to specs, may be adjusted to 4 or 5. The unit we tested however, had sufficient range to cover all channels on the lower band, 2 through 6.

All counter adjustments can be reached through the bottom of the Model 1000, with test jacks exposed at the rear. The unit should not need adjusting under normal use, as it has unijunction transistors in the counter stages, and shows very low drift. The color-crystal trimmer is also reachable through the rear panel.

The circuit is pretty much standard; it starts with a 189-kHz crystal oscillator and counts down to the vertical and horizontal sync rates. The horizontal lines are derived from a 900-Hz flip-flop oscillator. The pulse width of this oscillator is controlled by the front panel "HOR LINE ADJUST."

The power supply section (Fig. 3) is especially "beefy." Not only is it a full-wave configuration, but very large filters are used, and then the output is regulated by zener diode D3. The DC output is nearly as pure as a battery source. This insures that there will be no false sync pulses caused by power supply ripple.

The unit is housed in a grey crackle-finish steel case, and has a convenient storage compartment for leads. The power lead is a standard TV jumper, and stores in the same compartment.

For further information circle 59 on literature card

Transistor Multitester

Multitester is a name we think fits the Semitron Model 1000. The Semitronics Corp. calls it a Transistor Tester and Set Analyzer. No matter what you call it, it's a very versatile instrument.

It checks transistors for leakage and beta, both in-circuit and out-of-circuit. It also can be used as a diode tester, voltmeter, ammeter, and continuity checker. With a transistor in the test socket, it can be used as a signal generator; the output is a 5-kHz note with high harmonic content. The signal is useful at both audio and RF frequencies, so it can be injected anywhere in a receiver under test and traced through to the speaker. The Model 1000 can also be used as a code-practice oscillator, if you want to be a Ham.

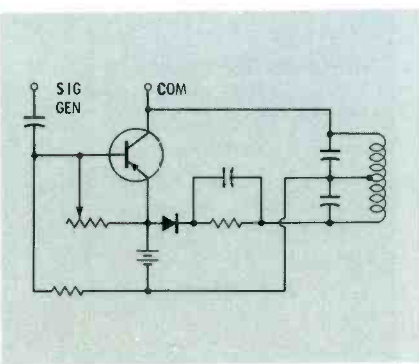


Fig. 5. Schematic of the generator.

Fig. 4. Model 1000 makes 8 tests.

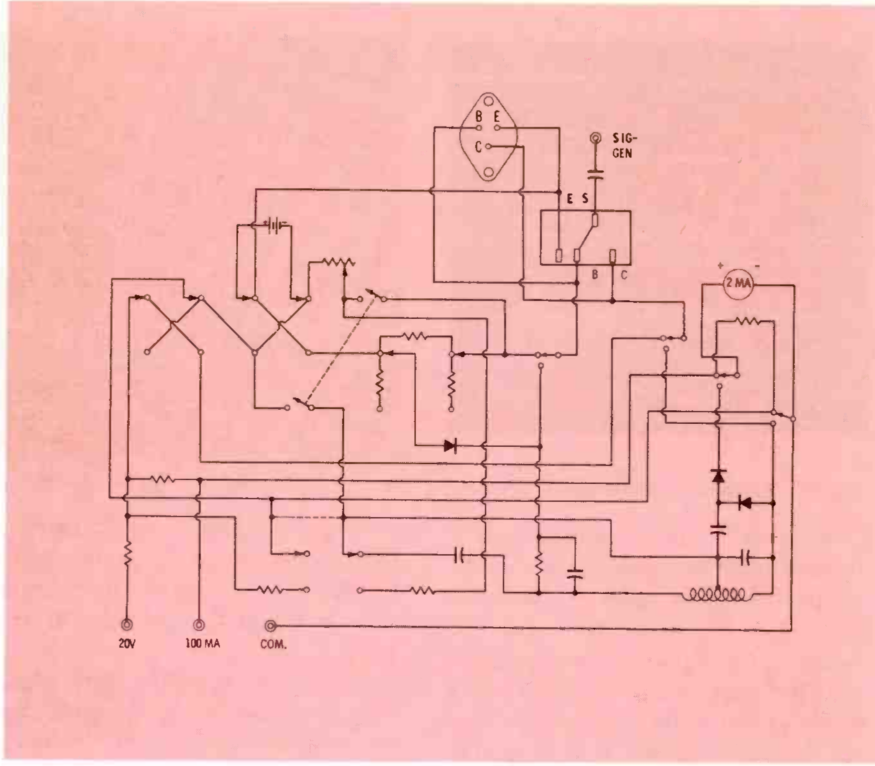


Fig. 6. Overall schematic.

The circuitry of the Model 1000 is extremely simple, yet quite complicated. This is because of the many functions, with several switches involved for each function. Any one individual test involves a simple circuit, such as the signal generator shown in Fig. 5. However, the many different switches make the overall schematic resemble a maze (Fig. 6).

The whole instrument is housed in a bakelite case with a fold-over handle so the instrument can sit at an angle on the bench. The price is quite low—$34.95 including all test leads.

Semitron Model 1000 Specifications

DC Beta (H_{FE}):
0-400 in 3 ranges, out-of-circuit.

AC Beta (H_{fe}):
In-circuit, uncalibrated

DC Beta (power transistors):
0-200

Diode:
Good-Weak-Poor scale

Volts DC:
0-20 V

Ma DC:
0-100

Continuity (Ohms):
0-∞. 1000 ohms center scale (must be calbrated).

Signal Generator output:
1½ V p-p on fundamental

Size (HWD):
5¼" x 7¼" x 3¼" o.a.

Weight:
1½ lbs.

Price:
$34.95

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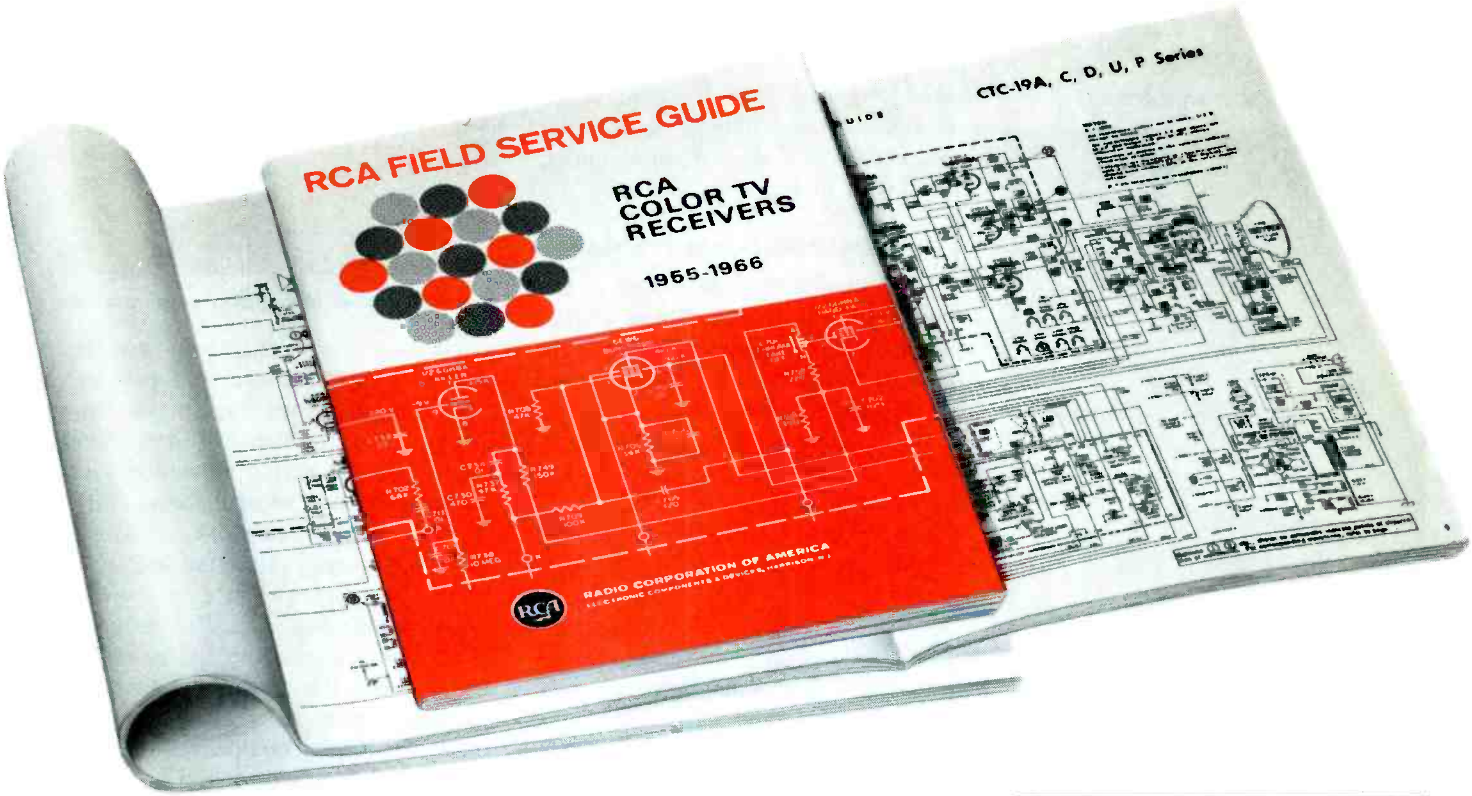

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SCOPE PROBES

(Continued from page 30)

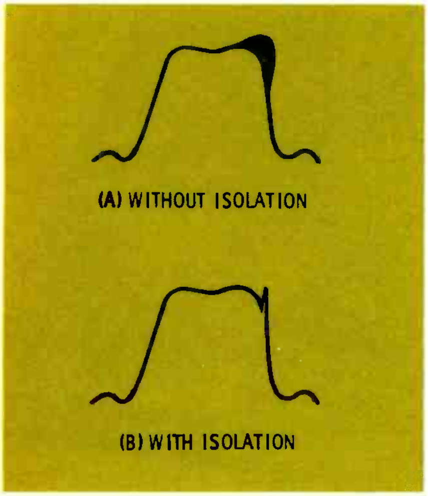

Fig. 6. Isolating resistor sharpens marker pip on response curve.

ing the isolation resistor assures a shunting impedance of at least 47K ohms — quite an increase over the relatively small impedance provided by the simple shielded direct probe. This added shunting impedance becomes even more significant at higher frequencies, where the shunting capacitance of the shielded direct probe can reduce the input impedance to only a few hundred ohms.

The addition of an isolation resistor in a probe is particularly useful when performing an IF sweep alignment. First, it helps filter out any IF signal which may have gotten through the detector, preventing such RF frequency components from reaching the scope and radiating back into the receiver. Aso, together with the shunt capacitance of the shielded cable and scope input, it forms an integrating network to bypass and attenuate any frequency above several kilohertz. This high frequency attenuation results in a sharper marker pip on the response curve, as shown in Fig. 6.

Low-Capacitance Probes

As mentioned previously, the combined shunt capacitance of the shielded direct probe and scope input circuit produces a shunt capacitance of approximately 50 to 100 pf. At low frequencies, the reactance of this shunt capacitance is sufficient to maintain a relatively high input impedance with respect to the low impedance normally found in low-frequency circuits. However, 50 to 100 pf of shunt capacitance can cause serious distortion in the high-frequency, high-impedance circuits found in the sync and video amplifier sections of a TV receiver. Also, the loading effect of the scope input impedance can detune the resonant high-frequency circuits of these sections.

Adding an isolation resistor to the probe increases the input impedance and overcomes some of the effects of the shunt capacitance; however, as pointed out, the isolating resistor introduces an integrating action. This high-frequency attenuation is suitable for viewing a response curve or other waveform where high-frequency response is not needed, or not present. However, when viewing complex waveforms containing high-frequency components, the isolating resistor tends to round off all sharp wavefronts.

A small capacitor placed in series with the probe and scope shunt

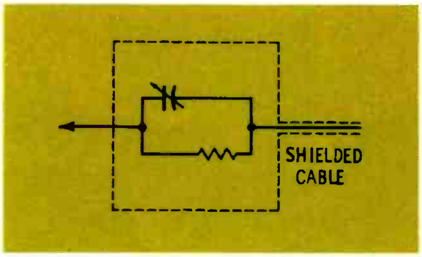

Fig. 7. Basic low-capacitance probe.

capacitance will effectively reduce the shunt capacitance and provide isolation. However, again we encounter the problem of frequency response—the series capacitor and input resistance of the scope form a differentiating network, resulting in low-frequency attenuation.

The low-capacitance (low-C) probe shown in Fig. 7 combines the advantages of both the isolating resistor and the series capacitor to provide decreased shunt capacitance, frequency compensation, and a known amount of signal attenuation. Obviously, knowing the exact amount of signal attenuation is an absolute must in determining the peak-to-peak amplitudes of a waveform.

Fig. 8 shows the low-C probe and its components in relation to the shunt capacitance of the shield and scope input, and the input resistance of the scope. The parallel combination of C1 and R1 are in series with the shielded cable and consequently in series with the scope input. Since C1 is in series with the combined shunt capacitance of the scope and shield, it decreases the total effective capacitance, thereby increasing the capacitive reactance. R1 acts as an isolating resistor, as described earlier, and also decreases the total input capacitance.

The two parallel circuits consisting of C1,R1 and C2,R2 are connected in series and act as a voltage divider, decreasing the amplitude of the measured signal. This attenuation is one minor disadvantage of the low-C probe, limiting its use to circuits having sufficient signal level to offset this inherent attenuation. Such circuit include the sync and video amplifiers stages in TV receivers.

To avoid waveform distortion, the voltage attenuation must be the same at all frequencies. Therefore, not only must C1,R1 be selected to

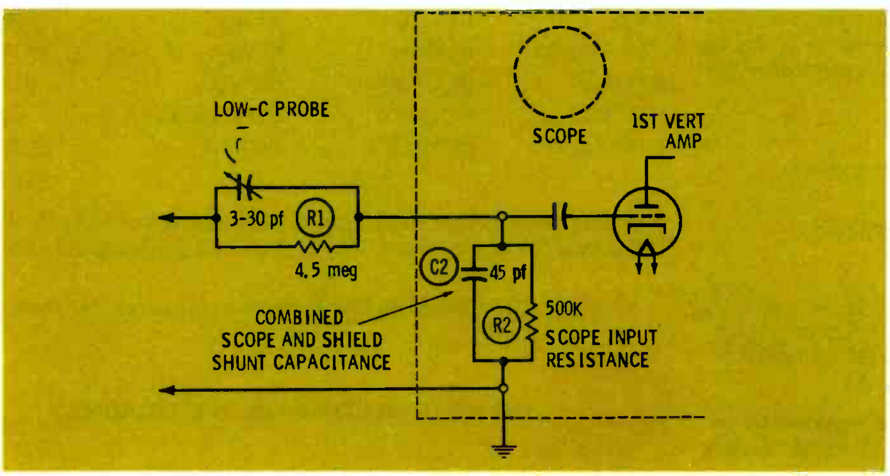

Fig. 8. Low-C probe in series with scope and cable input impedance.

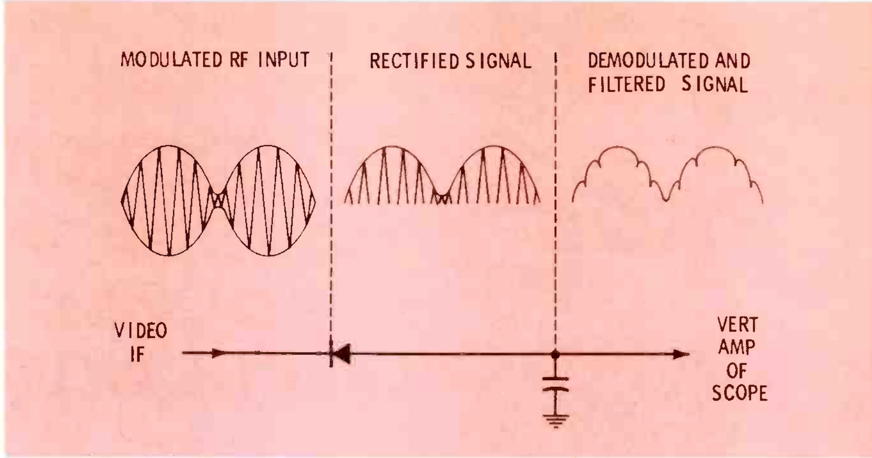

Fig. 9. Rectifying and filtering action of basic demodulator probe.

provide a voltage ratio of 100 to 1, 10 to 1, or some other fraction, but C1,R1 must be equal to C2,R2. With these two time constants equal, the voltage will be divided at all frequencies by the same ratio.

As an example, to construct a probe with a 10-to-1 ratio, C1 must be equal to 1/9 the capacitance of C2, paralleled by a resistor nine times the value of R2. With these ratios satisfied, the input impedance is effectively shunted by ten times its former resistance, while the combined shield and scope input capacitance (C2) is reduced to 1/10 its former value.

The probe components shown in Fig. 8 are for a 10-to-1 probe, with the component values selected for use with a scope having an input resistance of 500K ohms and a combined shield and input shunt capacitance of 45 pf. The formulas for determining the correct probe component values for the characteristics of a particular scope are:

$$R1 = R2\ (A\text{-}1)$$

$$\text{and } C1 = \frac{C2}{(A\text{-}1)}$$

The component designations refer to the components in Fig. 8. "A" is the desired ratio; if a 10-to-1 ratio is desired, 10 will be substituted for "A," etc. C1 is normally a small adjustable ceramic with a minimum capacitance lower than the calculated value for the specific application (5 pf for the scope characteristics in this application.

In actual practice, after the probe is constructed (or purchased), it should be connected to the scope, and the trimmer (C1) adjusted to provide uniform frequency compensation. This can be done by applying the output of a square wave generator to the probe, and adjusting C1 for the best square wave reproduction at 20 to 20,000 hertz. A sine-wave generator can also be used, with C1 adjusted for sine waves of equal amplitude at the frequency extremes.

Demodulator Probe

Servicing a television receiver often requires observation of the composite video signal in the tuner output or video IF circuits. Obviously, the RF frequencies of these circuits are beyond the frequency response of even a wide-band scope. Therefore, it is necessary to extract the video signal from the modulation envelope of the RF signal—a function normally accomplished by the video detector. However, since we are testing circuits prior to the video detector, we must, in effect, employ an auxiliary video detector in the scope input circuit. The demodulator probe is designed to serve this function.

The essential difference between a demodulator probe and a rectifier probe is that the demodulator probe must have a shorter time constant. The time constant of the filter circuit associated with the demodulator probe should be long enough to remove the high-frequency carrier, yet short enough to respond to the lower frequencies in the modulated envelope. The basic operation of the demodulator is shown in Fig. 9.

Two types of series demodulator probes are shown in Fig. 10.

• *please turn to page 52*

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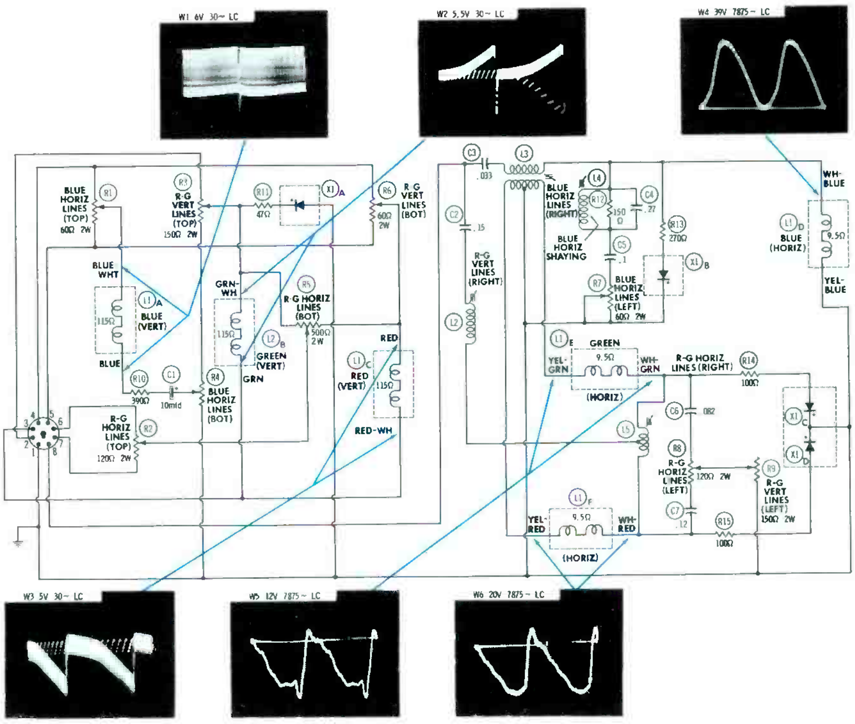
Convergence Assembly

Controls And Yoke



DC RESISTANCES taken with VTVM with interconnecting cable unplugged from main chassis. All controls set for proper convergence.

WAVEFORMS taken with wideband scope; low-capacitance probe (LC), connected across convergence yoke windings, used to obtain all waveforms shown.

Normal Operation

Convergence assembly alters path of three electron beams in picture tube so that they pass through same hole in aperture mask at any given instant. This is necessary since picture tube face plate is relative flat and beams sweep in an arc. Three beams will converge at center of screen, but without modifying path, beams will come together before reaching edges of face plate. Most popular method uses three section convergence yoke—one section for each beam. Each section consists of a permanent magnet for static or center convergence and an electromagnet with both vertical and horizontal windings for dynamic or edge convergence. Current through vertical and horizontal coils must have parabolic waveform for strong control of beams at edges, declining towards middle, and increasing to maximum again at edges. Waveforms from sweep circuits are shaped and mixed to supply proper control current across convergence yoke windings. Vertical waveforms are from separate windings on vertical-output transformer and output cathode. Horizontal pulse is from flyback winding. Circuitry shown here connects sweep waveforms to separate convergence board for shaping; resulting waveforms are connected to convergence yoke. While there is interaction between controls, convergence board circuitry is divided into two sections—vertical and horizontal. Vertical section controls converge red and green vertical lines at center and red-green-blue horizontal lines at top and bottom. Horizontal section controls converge red-blue-green horizontal center lines, and vertical lines at edges.

Operating Variations

W1 Blue horizontal lines (bot) control changes angle of tilt of horizontal portion of waveform. Blue horizontal lines (top) varies spike amplitude and polarity.

W2, W3 R-G vertical lines (bot) control changes spike amplitude and polarity. R-G vertical lines (top) varies tilt of horizontal portion of waveform. R-G horizontal lines (top) control changes amplitude and polarity of spike portion. R-G horizontal lines (bot) varies overall amplitude as well as tilt of sawtooth.

W4 Blue horizontal lines (left) control varies amplitude of waveform. Blue horizontal lines (right) coil moves harmonic "bump" up and down declining portion of waveform.

W5, W6 R-G horizontal lines (left) control moves hump up and down on declining portion of waveform. R-G vertical lines (left) control changes hump location on declining trace, overall amplitude, and angle of leading edge. R-G horizontal lines (right) and R-G vertical lines (right) coils vary overall amplitude.

Blue Horizontal Shaping Coil Adjustment Connect scope across blue horizontal winding (L1D) of convergence yoke and adjust coil so that harmonic "bump" is halfway up declining trace.

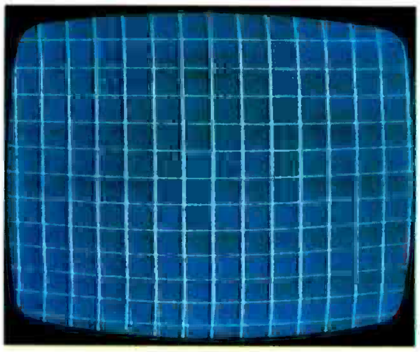
Symptom 1

Vertical Red Lines Displaced

Entire Screen Affected

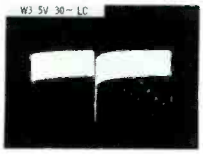
R6 Wiper Arm Open

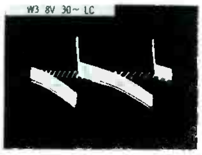
(R-G Vertical Lines (bot) Control—60 ohms, 2W)

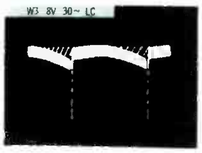


Symptom Analysis

B-W picture has excessive red vertical fringing on picture information. Cross-hatch pattern shows red vertical lines bowed right of other lines at top, left in middle, right again at bottom. Green bowed opposite. Blue straight. R3 and R6 inoperative.



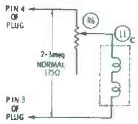




Waveform Analysis

Waveform W3 is slightly higher than normal 3 volts p-p, but normally, amplitude and polarity of spike can be changed to converge red and green vertical center lines with R6. Positive spike is connected to one end of R6, negative to other — center tap can be any amplitude of either polarity. Second and third pictures show W3 with R6 set at either end under normal conditions. Best clue from W3 is lack of tilt in horizontal portion.

Voltage and Component Analysis



DC voltages are small and insignificant when troubleshooting convergence board. Resistance readings are best. Waveform analysis points to L1C and associated circuitry—resistance measurements in this area turn up good clue. Resistance between pins 3 and 4 of plug (plug disconnected) should be about 175 ohms maximum, but now reads about 3 megohms. Trouble can be quickly isolated with one or two more continuity checks. W3 is result of several input waveforms—loss of any one can make proper convergence impossible.

Best Bet: Scope; VTVM for resistance measurements.

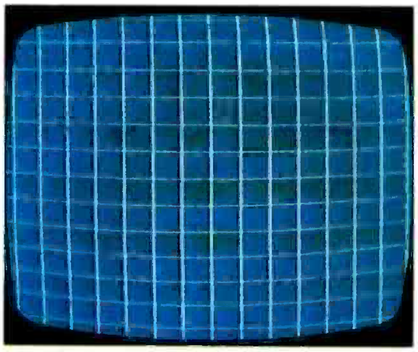
Symptom 2

Blue Horizontal Lines Bowed

Other Convergence Near Normal

C1 Open

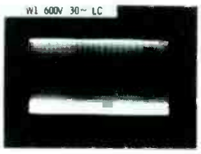
(Coupling Capacitor—10 mfd)

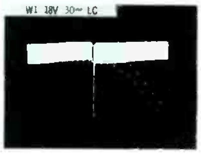


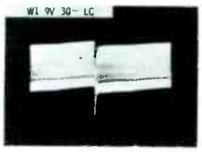
Symptom Analysis

Black-and-white program has blue and yellow fringing on horizontal edges of picture information. Cross-hatch pattern shows blue horizontal lines bowed over entire screen. All other lines are straight and converged. R1 and R4 are inoperative.

Waveform Analysis







Amplitude of W1 approximately one hundred times higher than normal 6 volts p-p. W1 contains no vertical information. Second waveform is normal except R4, blue horizontal lines (bot) control, is at one end. Waveform with R4 at other end (not shown) is similar, except spike is positive going. Third waveform is also normal except R1, blue horizontal lines (top) control, is at maximum clockwise point to show tilting effect.

Voltage and Component Analysis

In this instance, resistance measurements only verify continuity of components in suspected circuit. Waveform analysis and component substitution are necessary to solve problem. L1A positions blue horizontal lines at top and bottom of screen. Normally, some horizontal information is induced into vertical windings (from horizontal winding). With C1 open, L1A is "floating" —vertical waveforms have no effect and induced horizontal information becomes much stronger, bending horizontal blue lines into near sine wave.

Best Bet: Scope; resistance measurements; component substitution.

Symptom 3

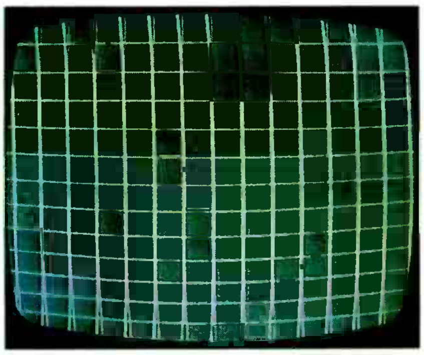
Vertical Red Lines Displaced

Controls Will Not Correct

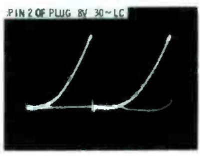
Broken PC Board

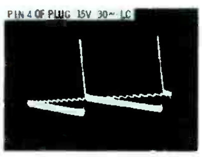
(Vertical-Output/Cathode Input)

Symptom Analysis



Black-and-white program has vertical red and green "edging" over entire screen. Cross-hatch signal, displayed with blue gun killed, shows green and red vertical lines are not converged. R3 and R6 move lines slightly but will not converge them.

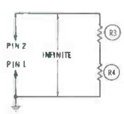




Waveform Analysis

Loss of first waveform shown here (from cathode of vertical output tube) causes symptoms. W3 (not shown) indicates trouble because there is no tilt in horizontal portion of waveform. Other vertical inputs are from tapped winding of vertical output transformer. Second waveform shown is positive going spike at pin 4 of plug. Waveform at pin 5 (not shown) is negative going spike. Third waveform is horizontal pulse input at pin 8.

Voltage and Component Analysis



Since sweep waveforms are used, sweep circuits must be operating properly for good convergence. Scope check of inputs would locate these problems quickly. Open PC on convergence board is located by systematic elimination of circuits by resistance measurements. Pin 2 of plug to common (pin 1), with plug disconnected, should measure about 210 ohms, but now shows infinity. This symptom could be caused by open PC or defective component on main chassis, open wiring harness, or cold solder joint in plug or socket.

Best Bet: Scope; VTVM for resistance.

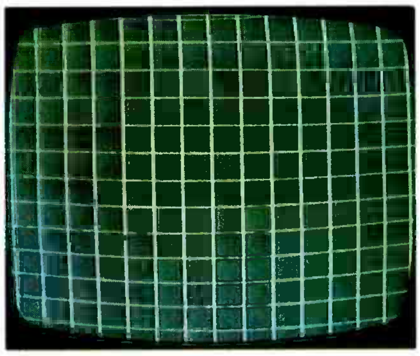
Symptom 4

Red and Green Vertical Lines Not Conperged

Left Side Only

X1C Open

(Wave Shaping Rectifier)

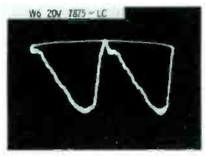


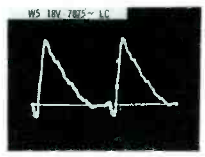
Symptom Analysis

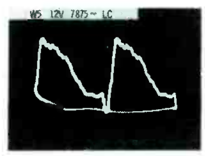
Cross-hatch pattern, with blue gun killed, shows red and green vertical lines are not converged on left side. R9, R-G vertical lines (left), corrects trouble, but then middle is off. Static adjustments converge middle again, but then range of R9 is insufficient.

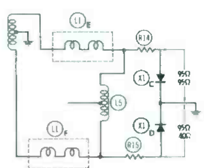
Waveform Analysis

While W6 may vary somewhat according to adjustments, it has necessary ingredients for good convergence — sufficient amplitude and hump on declining trace. W5 (second waveform shown here), across green horizontal winding, indicates trouble compared to normal W5 (third waveform) — amplitude is excessive and hump is missing in declining line. Result is sawtooth waveform that will not produce proper control of green beam.









Voltage and Component Analysis

Resistance measurements across X1C and X1D should be similar, since DC path for each section is similar. X1D readings show expected diode action when meter leads are reversed, but readings across X1C are same. X1C-R14 and X1D-R15 act as variable resistors to sinewave produced by L5 and associated circuitry and, in effect, form parabolic waveform necessary for proper convergence. Loss of shaping action by rectifier makes waveform across convergence yoke winding wrong, and proper convergence is impossible.

Best Bet: Scope; then resistance measurements.

Symptom 5

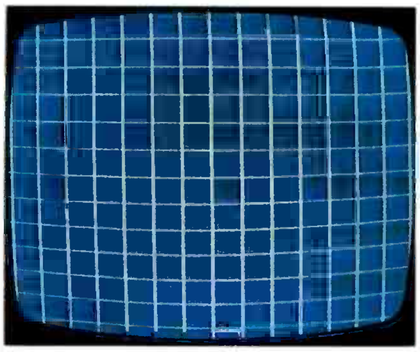
Horizontal Lines Not Converged

All Colors Affected

L3 Primary Open

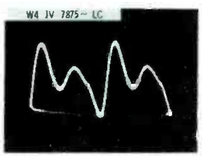
(Blue Horizontal Lines Coil—Right)

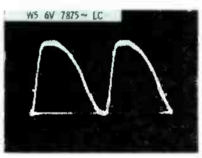
Symptom Analysis

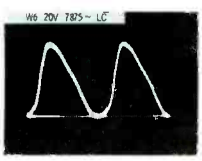


B-w picture has blue and yellow fringing on horizontal edges. Cross-hatch shows horizontal lines bowed—blue more than others. Lines low at left and right edges, high in middle. Static convergence only makes edges more separated. Controls have little effect.

Waveform Analysis

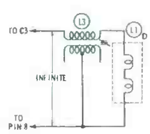






Waveforms across horizontal convergence yoke coils are incorrect. W4 is almost nonexistent (1 volt, normally about 39 volts p-p) and content is distorted. W5 half normal amplitude (6 volts p-p, normally 12 volts p-p) and sharp change of direction in waveform is missing. W6 near normal amplitude, but looks more like sine wave than normal waveform. Horizontal input pulse at pin 8 of plug (not shown) is normal.

Voltage and Component Analysis



Symptom and waveform analysis indicate blue horizontal lines are affected most. Resistance check from junction of C3 and L3 to common shows open—normally 20 ohms. One or two more checks will isolate. L3 primary shapes horizontal pulse to some extent and couples it to blue horizontal circuitry. Tapped secondary of L3 supplies opposing horizontal pulses to red and green horizontal convergence circuits. Horizontal lines do not converge—blue because coil receives no signal, red and green because signal reduced.

Best Bet: Scope and symptom analysis; then VTVM.

Symptom 6

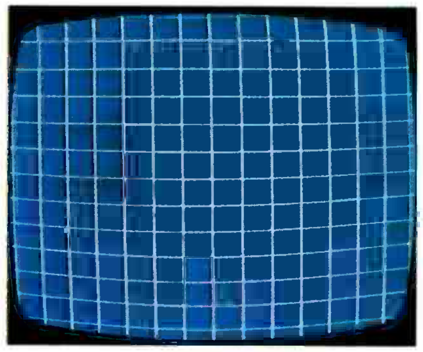
Red Displaced

Both Horizontal and Vertical

L2 Open

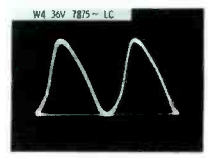
(R-G Vertical Lines Coil—Right)

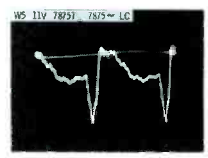
Symptom Analysis

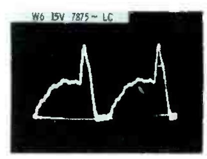


Green and blue converged over entire screen. Horizontal red lines low. Vertical red lines displaced to right of blue-green at either side, but to left in middle. Static convergence corrects horizontal and middle vertical lines, but makes red vertical at edges worse.

Waveform Analysis

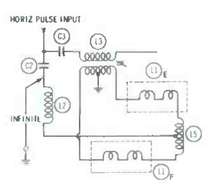






W4 across horizontal blue winding of convergence yoke normal, both in amplitude and content. W5 and W6 both appear to have something mising. About all that shows in these waveforms is horizontal pulse from secondary of L3 (negative going across green winding and positive going across red). The polarity of these waveforms may be reversed by scope connections, but important point is that pulses are present and opposite.

Voltage and Component Analysis



Horizontal input pulse is coupled through C2 to tuned circuit which is shock excited into oscillation by pulse. This produces sine wave at horizontal frequency that is connected to red and green circuitry and shaped by diodes X1C and X1D. Without this signal the only waveforms across red and green windings are opposing pulses from secondary of L3. Resistance checks in this circuitry give best clue—reading from junction of C2 and L2 to common (pin 1 of plug) is infinity—should be 15 to 20 ohms.

Best Bet: Scope; then resistance measurements.

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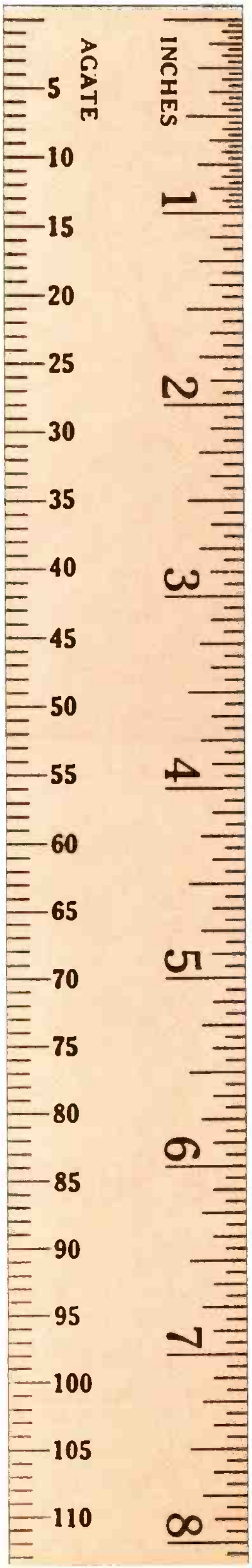

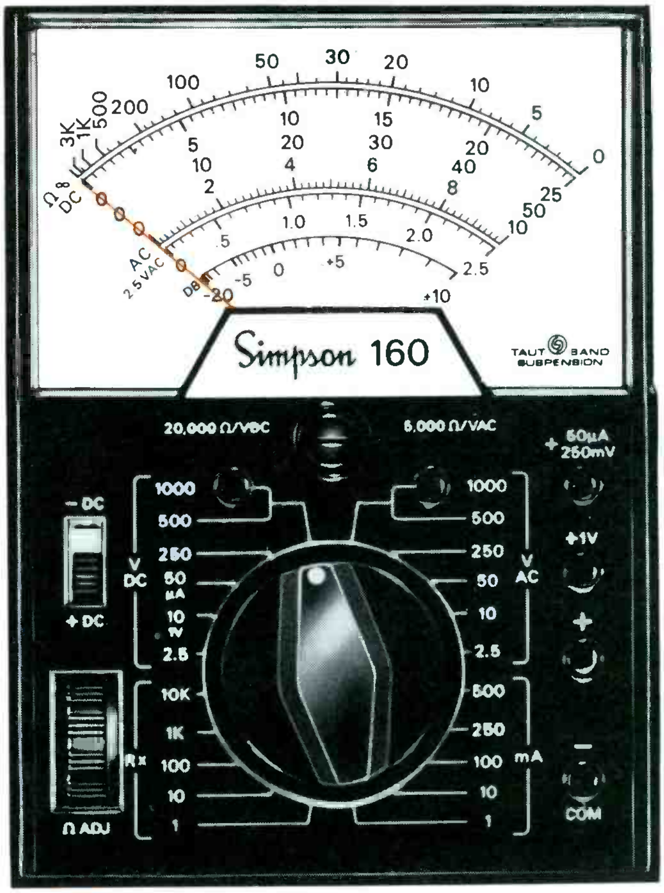

160 Volt-Ohm-Milliammeter
Complete with alligator clip leads and operator's manual. $50.00

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Simpson Handi-VOM gives you the ranges, the time-saving conveniences and the sensitivity of a full-sized volt-ohm-milliammeter—yet it's only 3-5/16″ wide, weighs a mere 12 ounces. Recessed range-selector switch never gets in the way . . . polarity-reversing switch saves fuss and fumble. Self-shielded taut band movement assures high repeatability and freedom from external magnetic fields. Diode overload protection prevents burn-out—permits safe operation by inexperienced employees and students. The demand is BIG, so get your order in to your electronic distributor, TODAY!

RANGES

ACCURACY: ±3% FS DC, ±4% FS AC

DC VOLTS: 0-0.25, 1.0, 2.5, 10, 50, 250, 500, 1000 @ 20,000 Ω/v

AC VOLTS: 0-2.5, 10, 50, 250, 500, 1000 @ 5000 Ω/v

DC MICROAMPERES: 0-50

DC MILLIAMPERES: 0-1, 10, 100, 500

DB: −20 to +10, −8 to +22, +6 to +36, +20 to +50

"0" REFERENCE: 1 MW into 600Ω

RESISTANCE: Rx1, Rx10, Rx100, Rx100, Rx10K
(30 Ω center)

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WORLD'S LARGEST MANUFACTURER OF ELECTRONIC TEST EQUIPMENT

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Color them green

Channel Master's Crossfire Antenna Series has

...More dealers prefer Channel Master to any other brand (2 to 1 by survey of leading trade magazine).

...More have been sold (and are still being sold) than any other antenna in the history of television. And dealer acceptance is still growing.

...More dealers bought Crossfire antennas in January and February than in any previous first two month period.

No wonder other antenna manufacturers try so hard to re-work their own designs along the famous Channel Master Crossfire lines.

But it just can't be done.

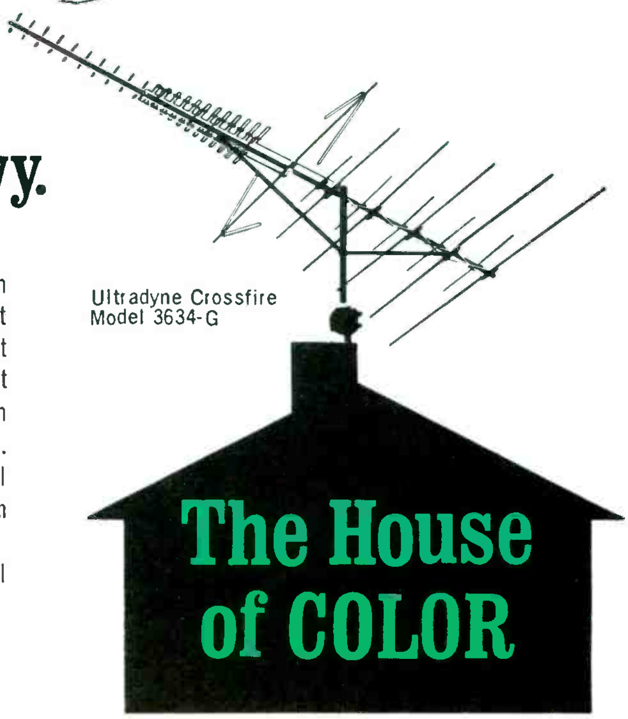
Legally, the Crossfire series is protected by five U.S. patents or patents pending.

And, in terms of mechanical and electronic design, the Crossfire series maintains a standard that has never been equalled.

Take mechanical design, for instance. Crossfire antennas have weathered six tough winters, verifying structural superiority originally proven in wind tunnel tests at the University of Miami hurricane test labs. Channel Master dealers ...who have just recorded the biggest first-two-months Crossfire sales in history...can tell you many of those antennas went up to replace less rugged makes that couldn't take the winter storms.

Most, of course, were teamed up with new set sales to meet the critical demands of color reception. Because, when it comes to electronics, Channel Master Crossfire Series antennas set the industry pace for clean, crisp color as well as outstanding black and white and FM Stereo.

In seven VHF models of Color Crossfires, electronic leadership takes the form of Proportional Energy Absorption



Ultradyne Crossfire
Model 3634-G
The House of COLOR

SCOPE PROBES

(Continued from page 44)

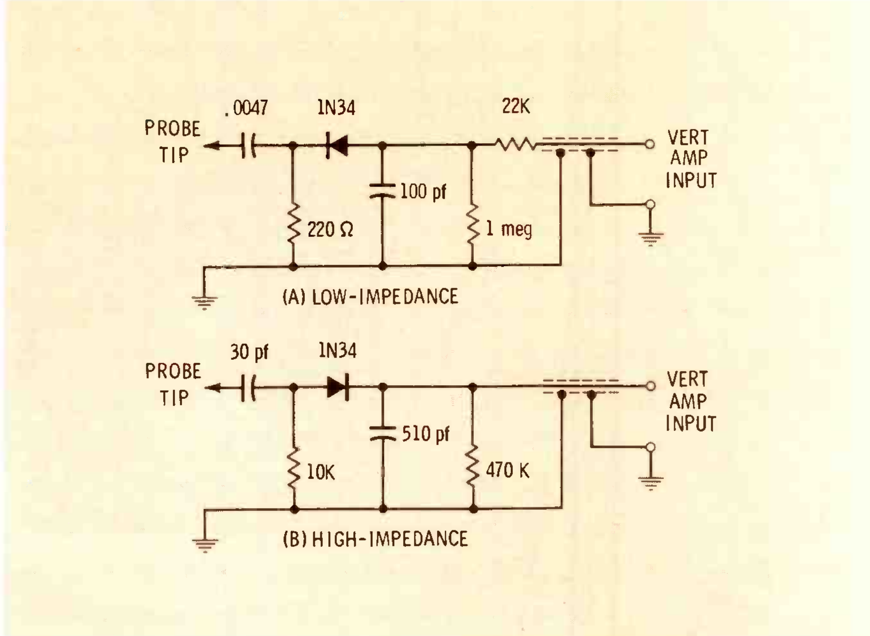


Fig. 10. Common series-type demodulator probes.

The low-impedance type is preferred over the high-impedance type because of its ability to swamp out the resonant response of the tuned circuit, thereby avoiding unwanted oscillation. Although the low-impedance probe has lower sensitivity than the high-impedance type, and consequently, lower output voltage, this can be compensated for by increasing the vertical gain control of the scope.

The shunt-type demodulator probe illustrated in Fig. 11 has less

Let's talk sense about color TV lead-in!

The common sense of the situation calls for *two* 82-channel lead-ins for color and UHF TV... one to give a stronger signal in uncongested fringe areas where interference usually is not a serious problem. The other to give a much cleaner signal in congested or close-in areas where serious interference problems are likely to exist. This is why Belden gives you a choice—the *Color Guard Twins.*

8285

*Color Guard Twin—Belden Permohm**

Use to get stronger signals in uncongested fringe areas, like this . . .

8290

*Color Guard Twin—Belden Shielded Permohm**

Use to get cleaner signals in congested or close-in areas, like this . . .

You get an excellent color image . . . because in a 100-foot run, Permohm delivers 38% to 200% more signal voltage than RG-59/U with matching transformers and 23% to 80% more signal voltage than "Low Loss Coax" with transformers.

Permohm obtains the highest efficiency of any available unshielded 300 ohm line when exposed to weathering and industrial atmospheres. Low loss cellular polyethylene insulation around the conductors provides the necessary protection.

You don't need expensive transformers and connectors.

Belden Shielded Permohm (8290) combines strong signal strength with the clean signal protection of shielded cable.

Shielded Permohm eliminates transmission line pickup of noise and ghost signals. You can install it easily anywhere . . . no need for standoffs, twisting, or inconvenient routing of lead-in. Tape it to a mast, route it through metal pipe, or bury it underground.

Beldfoil† shielding is used to shield against outside signal interference. The jacket is weatherproof polyethylene. The critical signal area is protected from rain, snow, salt, smog, fog and industrial contamination. No expensive transformers or connectors are needed.

Belden Trademarks Reg. U.S. Patent Office
**Patent No. 2,782,251 and Pat. Pending*
†Patent No. 3,032,604

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Circle 27 on literature card

sensitivity than either type of series demodulator, and therefore, less signal amplitude at the output. However, unlike the series type, it effectively attenuates any hum voltages in (or on) the tested signal. Because of its low sensitivity, the shunt-type probe is not as adaptable to video IF signal tracing as the series type. In some applications, even the series-type demodulator probe does not provide enough voltage for proper waveform reproduction. As the video IF waveform is traced from the video detector input to the tuner output, the measured signal becomes increasingly smaller. To offset this decrease in signal amplitude, it is sometimes necessary to resort to the voltage-doubler-type of demodulator probe for waveform observations at the tuner output. This demodulator probe type is shown in Fig. 12. Because the voltage-doubler probe provides twice the sensitivity available with the series or shunt type, it is particularly useful for relatively low-level signal observation. However, there are two disadvantages to be considered with this

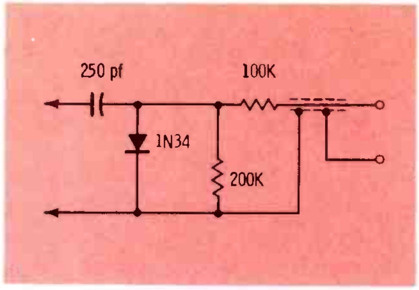


Fig. 11. Shunt-type demodulator probe has less sensitivity.

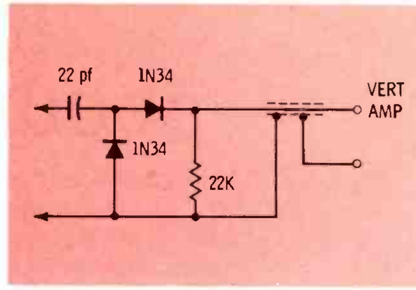


Fig. 12. Voltage doubler demodulator probe doubles sensitivity.

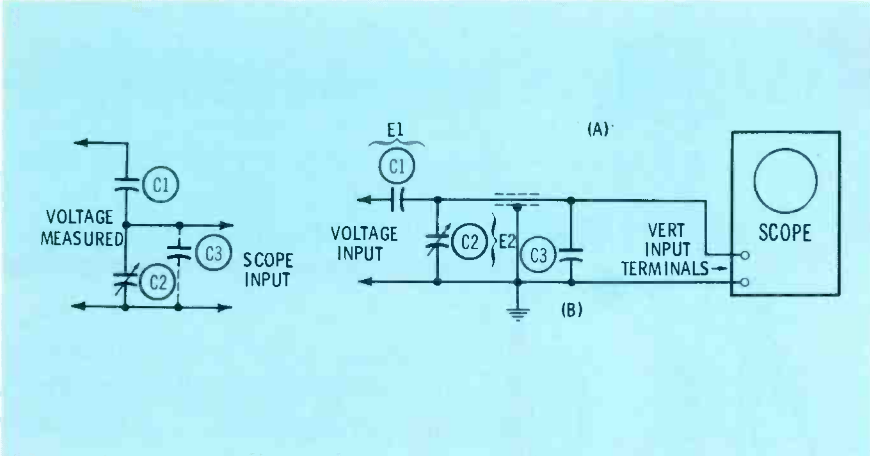


Fig. 13. Voltage dividing action of capacitance divider probe.

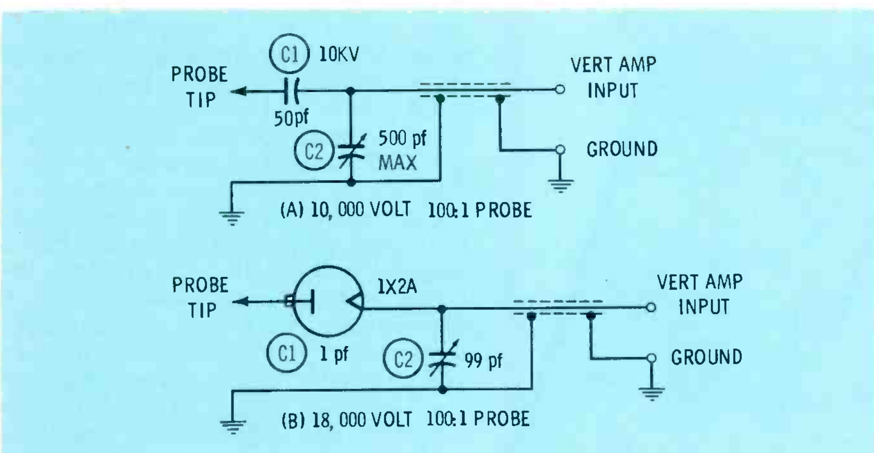
probe: (1) a lower input impedance than either the series or shunt demodulator probes, limiting its use to relatively low-impedance circuits, and (2) the frequency response is not as good as the series or shunt types.

It must be remembered that the demodulator probe is used only to determine the presence or absence of a signal at a particular stage. The loading effect of this probe makes accurate peak-to-peak voltage measurements impossible. Also, most types of demodulator probes have poor high-frequency response, and as a result, horizontal sync pulses are usually attenuated and slightly rounded.

Capacitance-Divider Probe

Although the vertical input terminals of most scopes are rated at about 600 volts maximum, it is occasionally necessary to measure much higher voltages, such as those found in horizontal sweep circuits. The capacitance-divider, high-voltage probe makes it possible to meas-

Fig. 14. Two common types of high-voltage capacitance dividers.



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ure horizontal sweep circuit voltages, and yet, not exceed the maximum input rating of the scope.

As shown in Fig. 13A, C1 and C2 are connected in series across the probe input. The input voltage divides across the two capacitors in inverse proportion to their capacitance. Since C1 is normally much smaller than C2, most of the input voltage will be dropped across this capacitor, leaving only a relatively small voltage across C2. The formula for expressing the relative component values of C1 and C2 for a particular voltage ratio is: $C_2 = C_1 (R-1)$, where R is the step-down ratio.

Referring to Fig. 13B, if C1 and C2 are chosen to produce a step-down ratio of 100 to 1, and a 10,000-volt signal is applied to the probe, E1 will equal 9,900 volts and E2 will equal only 100 volts—well within the maximum input limits of the scope. C3 is used to represent the combined shunt capacitance of the shielded cable and scope input circuit. Because this shunt capacitance is in parallel with trimmer C2, the probe will have to be recalibrated each time it is used with a different cable or scope. Calibration is accomplished as follows: (1) Connect the vertical terminals of the scope directly across a low-impedance, low-voltage source, and set the scope attenuator to the X100 position. (2) Vary the vernier attenuator for any convenient vertical amplitude and note the number of squares covered. (3) Connect the probe between the same voltage source and the vertical terminals of the scope. Advance the scope step attenuator to the "X1" position. The waveform should now occupy the exact same number of scale divisions as it did in step 2—if not, adjust the probe trimmer capacitor (C2) with a nonmetallic screwdriver until the waveform is the same. Once this is accomplished, the probe is calibrated to deliver to the scope 1/100 of any voltage applied to its tip.

Fig. 14 illustrates two commonly used types of 100-to-1 capacitance-divider probes. The probe in Fig. 14A is limited to 10KV by the breakdown rating of C1. This probe is suitable for measuring at the plate of the horizontal output tube or at the grid of the horizontal oscillator —actually, a 10-to-1 low-C probe can also be used here, but the 100-to-1 capacitance divider is preferred because its lower input capacitance detunes the circuit less. The probe shown in Fig. 14B is rated at 18,000 volts and can be used, along with a high-voltage filter capacitor, to measure the high voltage in some b-w receivers. However, in some large screen b-w sets, and in nearly all color receivers, the high voltage at the anode is beyond the maximum rating of this probe. The relative high voltage rating of this probe is possible because of the large breakdown voltage rating of the 1X2A used in the probe input in place of a conventional capacitor. The interelectrode capacitance of this tube is the equivalent of a 1-pf capacitor—with the added advantage of an 18,000 volt breakdown rating.

As implied previously, the 100-to-1 high-voltage, capacitance-divider probe can be used to measure the voltages at the horizontal oscillator grid and horizontal output plate. In addition, it can be used to measure the waveform across the horizontal deflection coils. The probe should *not* be used for measurements in the vertical sweep circuits. At such low frequencies, the shunt resistance and input capacitance of the scope react with the probe capacitance to cause differentiation. As a result, voltages at the vertical frequency would be greatly distorted.

Specific Probe Applications

The shielded direct probe is limited to low-impedance circuits having relatively low-level signals. In television servicing, such a probe is normally used only for checking the ripple frequency of the low-voltage power supply, or for checking the waveform at the damper cathode.

The 10-to-1 low-capacitance probe is more adaptable to television servicing and can be used for nearly all scope checks in the video amplifier, sync, vertical oscillator and sweep, and chroma circuits. In addition, it can be used to check the waveforms at the grids of the horizontal discharge and horizontal output stages, as well as the vertical retrace blanking signal at the picture tube grid or cathode. Although the 10-to-1 low-C probe can be used in the horizontal AFC circuit and at the horizontal oscillator grid, the 100-to-1 capacitance-divider probe is preferred because it causes less circuit loading.

Other uses for the high-voltage, capacitance-divider probe include waveform and peak-to-peak voltage measurements at the plates of the horizontal output and damper stages. This probe can also be used to check the high-voltage ripple at the picture tube 2nd anode, provided a 250- to 500-pf filter capacitor is employed in series with it. The demodulator probe is limited to use in the video IF section and tuner output circuit.

Conclusion

There are five primary factors to be weighed when selecting a scope probe for a particular test application: (1) the input impedance of the scope, (2) the impedance of the circuit under test, (3) the freqency response of the scope, (4) the frequency of the signal to be measured, and (5) the relative amplitude of the signal. Disregarding any one of these considerations can result in inaccurate voltage measurements, or distorted waveforms that prove meaningless. Selecting the correct probe not only assures more accurate troubleshooting information, but also compensates for many of the characteristics that can limit a scope's usefulness in television servicing. ▲

"That's part of the trouble."

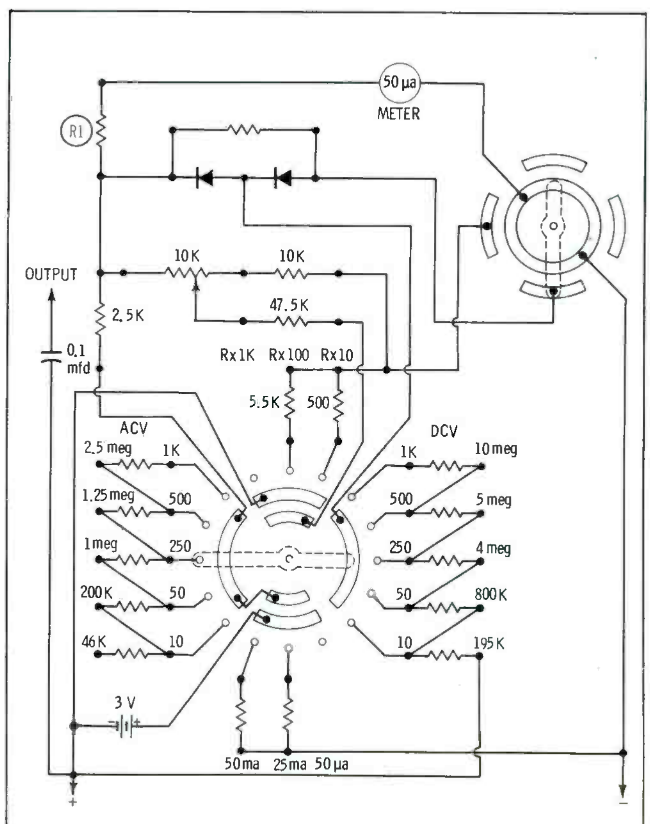
THE TROUBLE-SHOOTER

answers your servicing problems

Double Trouble

I have two unrelated problems that I would like your opinion on. The first concerns arcing from the "S" winding of a flyback to the iron core. I have applied both red and black (which jelled and set better) corona dope, but to no avail. Even after letting the corona dope dry a couple of days, the arcing returned about one minute after the set was turned on. Should I remove the old corona dope, and recoat the transformer again, or is there a better method to stop such arcing?

The second problem concerns an Olson TE-168 VOM that I use on house calls. It has suddenly become defective with no indication on ohms or AC functions. There



is a small indication on the DC ranges. This small deflection corresponds to .5 volts on the 10-volt DC range and is the same on all other ranges. I have replaced the batteries and checked the continuity of all the circuits. The only components I have not checked (and do not know how) are the meter movement and the two rectifiers. What is the proper troubleshooting procedure for test equipment and how can I check the meter movement?

C. B. KACZYNSKI

Cheektowaga, N.Y.

The arcing you are experiencing from the "S" winding of the flyback to the core is not easily corrected, and in many instances, the only positive solution is replacement of the flyback. However, in cases where the arcing has just begun and has not greatly deteriorated the winding insulation, it is possible to save the flyback by wrapping heavy plastic sheeting, or several layers of electrical tape, around the core at the point where the arcing has occurred. (This point is usually easily distinguished by a charred or blackened area on the core, or by a hole through the coil form.) After the core has been wrapped, apply anti-corona dope to both the wrapped portion of the core and the winding itself.

Troubleshooting VTVMs and VOMs need not be any more difficult than other electronic equipment—in most cases it is much easier. From your description of the trouble symptoms you are experiencing with the VOM, it can be seen that you are already aware of the proper troubleshooting procedure to be used with test equipment. Using the various functions of the VOM itself, you have, through the process of elimination, isolated the fault. The fact that all functions of the VOM were either inoperative, or gave an erratic indication, quickly pointed to a circuit or component that was common to all functions. In this particular VOM, as in most, this would point to either the meter movement, series resistor R1, or the test leads or sockets. Since a continuity check cleared the test leads, sockets, and associated wiring, only the meter movement and R1 remained as possible suspects. R1 can be checked easy enough; however, the meter movement is another matter. Never use another VOM to check the resistance of a meter movement—excessive current could possibly destroy the movement beyond repair. Instead, use the following procedure to determine the condition of the meter: Remove all connections to the terminals on the back of the movement case. Calculate the value of resistance needed for ⅔ full-scale deflection. In this case, since the full-scale current rating is 50ua with a 250mv drop across the movement, the value of series resistance required for full-scale deflection is 5K ohms ($R = .250/50 \times 10^{-6}$). Meter deflection can be reduced to ⅔ full-scale by increasing the size of the series resistor by about ⅓, resulting in a resistance of 6650 ohms. A standard resistance value of 6800 ohms will serve the purpose. Connect the 6.8K ohm resistor and 1½-volt dry cell in series across the meter. If the meter fails to deflect to approximately ⅔ full-scale, you can assume the meter movement to be defective. Never attempt to repair a defective meter movement; instead, return the meter movement to the manufacturer, according to instructions in the operation manual supplied with the VOM. (It is usually wise to write the manufacturer for shipping instructions before shipping the meter). ▲

Circle 37 on literature card

COLOR COUNTERMEASURES

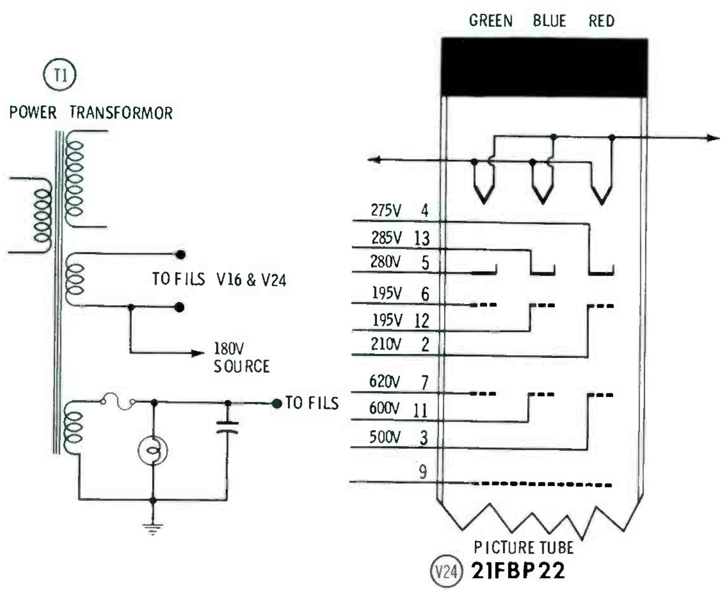
SYMPTOMS AND TIPS FROM ACTUAL SHOP EXPERIENCE

Chassis: RCA CTC11

Symptom: Complete loss of contrast. Raster and color signals remain on screen.

Tip: Check for heater-cathode short in V24 (CRT).

Analysis: Heater of CRT is connected to B+. A heater-cathode short will place this B+ source on the cathode. The power supply filter will then filter out the luminance information normally present on the cathodes of the CRT. In addition, the +180 volts applied to the cathode will clamp the normal bias and in effect make the grids of the CRT positive with respect to cathode, allowing raster to remain on screen.



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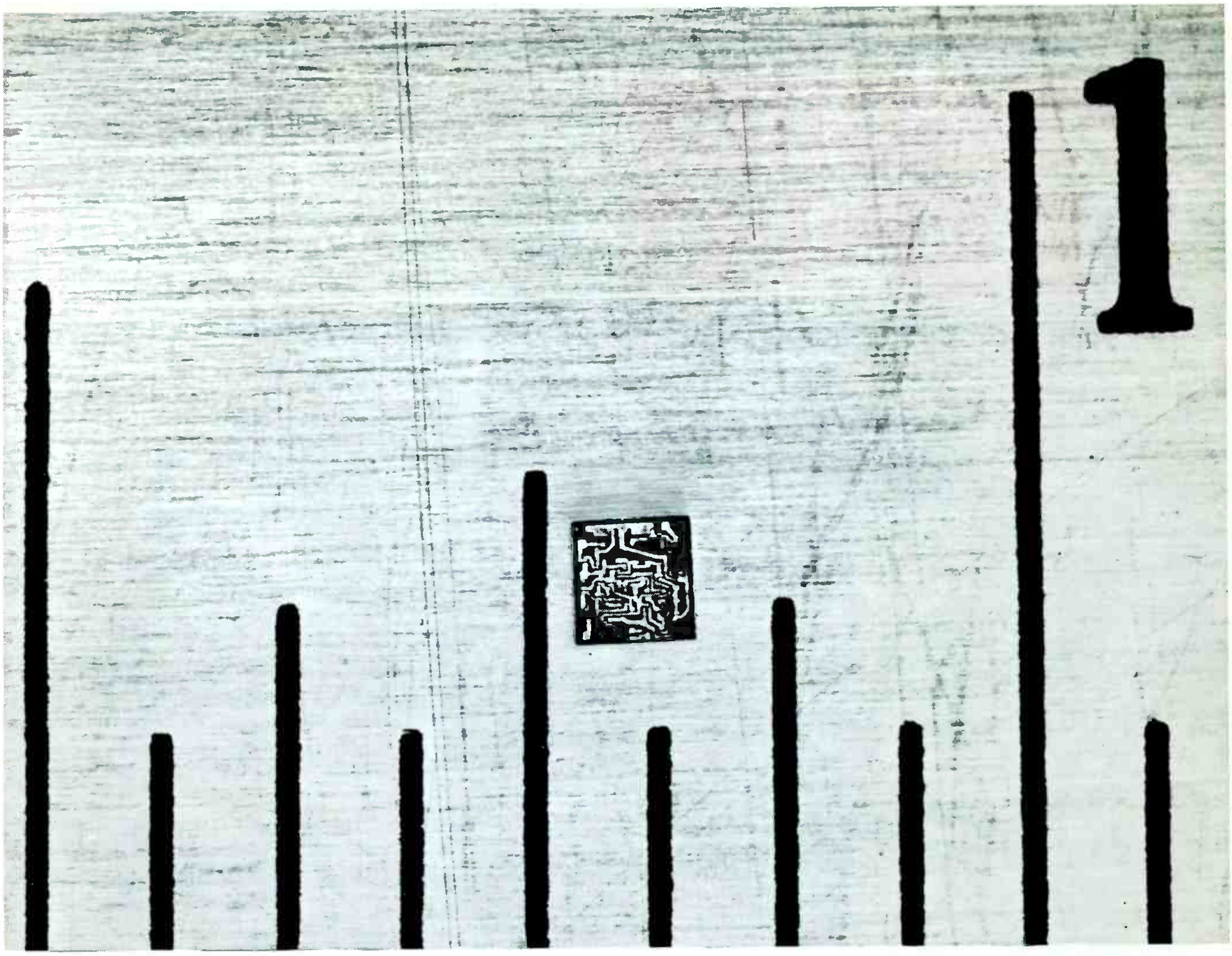
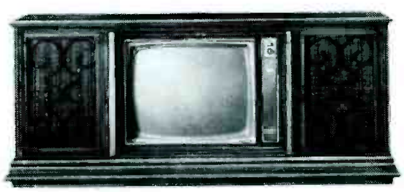


At $1/20^{th}$ of an inch square it's the biggest thing in electronics



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PRODUCT REPORT

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

Tube Tester
(65)

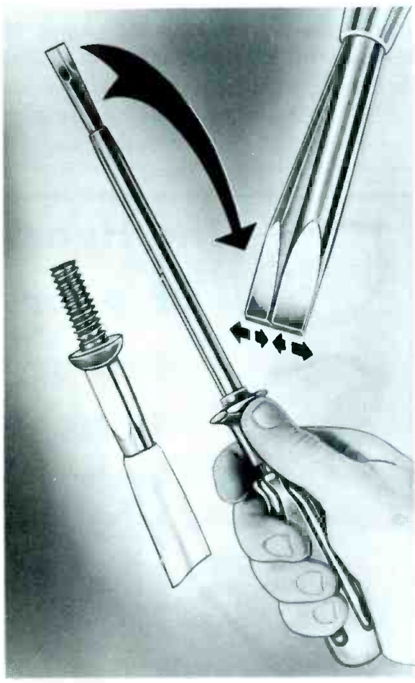
A new mutual conductance tube tester has been introduced by **Mercury Electronics Corporation.** Designated Model 2000, the new unit will test, under actual dynamic operating conditions, practically any tube type the technician may encounter in his every day work. It will also test transistors, diodes, and power rectifiers. A CRT adapter (offered at a small extra charge) enables the technician to check color and black-and-white picture tubes as easily as receiving tubes.

The unit will test all tube types for gas and grid emission, shorts, and leakage between any tube elements.

Among the tube types that the tester accommodates are the new Magnovals, 7-pin Nuvistors, 10-pin Decals, Novars, foreign and hi-fi tubes, voltage regulators, battery-type tubes, auto radio hybrid tubes, thyratrons, and industrial tube types. The circuitry has been designed with a unique leved switch principle to overcome obsolescence caused by new base pin arrangements or new internal jumpers in tubes.

The new tube tester features sockets of phosphor bronze construction and built-in custom pin-straighteners for all tube types. Additional features of the unit include automatic line voltage regulation and a 4½" D'Arsonval meter movement that is protected against accidental burn-out.

The tube tester is housed in a leatherette-covered carrying case and measures 18¼" x 10¾" x 4½". Price of the unit is $99.95. The optional Model MH-3 Multi-Head CRT Adapter is priced at $12.45.



Screw Launcher
(66)

This tool makes the launching of stubborn screws in awkward situations a one-hand job. It is suitable for use in professional assembly work, production work, repair and maintenance jobs, and for the home workshop. The new **Vaco** Screw Launcher is equipped with a double-blade bit which fits into the slotted head of a screw. A metal sleeve then slides forward on the bit, causing the V-shaped blades at the end to move together. This blade action forms a wedge that firmly grips the slot of the screw, holding it securely while the driving action is started. When the screw has been set, the driver is released from the slot by sliding the gripping sleeve back toward the handle. This relaxes the overlapping double blades, freeing the driver from the screw.

The tool is equipped with a "Comfordome" handle for comfort and driving power. The double-blade bit is made of durable spring steel and is available in ⅛", 3/16", and ¼" blade diameters, and three blade lengths. The handles are color-coded to indicate size. There are eight sizes in all. Prices range from $1.25 for the smallest size (over-all length of 5¾"), to $2.05 for the largest size which is 11⅝" long.

100,000 ohm/volt Multimeter
(67)

This 100,000 ohms/volts (DC) multimeter is the latest addition to **Eico's** Truvohm line of imported, battery-operated multimeters. Designed to fulfill the precision and versatility requirements of electronic engineers,

How "saving" 50¢ can ruin a $700 color TV system!

The coupler is probably the least expensive item in a home TV system . . . yet the wrong coupler can send the investment in a top-quality distribution system and TV set right down the drain.

At Blonder-Tongue, the same engineering skill and meticulous quality control goes into couplers that goes into our professional MATV products. The result: high isolation between sets, extremely low insertion loss and sharp pictures (they're backmatched).

Blonder-Tongue gives you variety, too . . . the widest variety of color-approved, all-channel coupler models in the industry:

A-102U/V—deluxe 300-ohm model connects 2 sets to one downlead.

A-104/UV—similar to A-102U/V except for 4 sets.

MDC-2VU—connects two coax (75-ohm) cables from TV sets to a single coax downlead.

TV-2—economy indoor model. Connects two sets to a single 300-ohm twin-lead. Not recommended for weak signal areas.

Quality combiners and splitters are also essential to a good all-channel color TV system. When you specify Blonder-Tongue, you get high quality, low loss and high isolation.

UVF-1—deluxe 300-ohm weatherproof model. Provides separate UHF, VHF and FM outlets from downlead carrying all three signals or feeds a single downlead from separate UHF, VHF and FM antennas.

UVF-C/S—a lower priced version of the UVF-1.

A-107—deluxe, weatherproof unit combines UHF and VHF antennas to one 300-ohm downlead or provides separate UHF and VHF output at set.

UV-C/S—indoor unit provides separate UHF and VHF outputs from a single 300-ohm cable carrying both signals, for connection to converter or TV set with separate UHF and VHF inputs.

Write for free catalog #74.

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Blonder-Tongue, the name to remember, for TV reception you'll never forget

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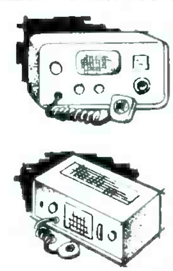
technicians, and hobbyists, the Model 100A4 combines minimum circuit loading with a wide-range of applications. In addition to a 100,000 ohms/volt DC sensitivity, the multimeter also features an AC input resistance of 12,500 ohms/volt. Other features include a double jewelled ±2% D'Arsonval meter movement; two-color, 4" mirror-back scale to



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Be a Bright Guy. Get your name into TV Guide up to 4 times this year.

Your Sylvania Distributor will put your name, your town and your phone number in TV Guide for your area as many as four times this year. And to make the most of it, we'll tie you into our big in-store display program. If you're a bright TV serviceman, you carry the most advanced replacement parts: Sylvania's famous *color bright 85*® color picture tube and receiving tubes.

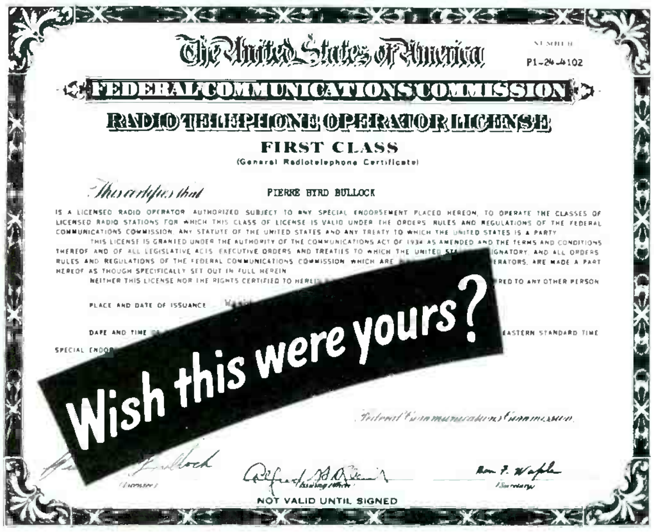
Because you're an Independent, we're telling TV Guide readers you're in the best position to make an honest, unbiased recommendation on color set repairs. We list your name right on the facing page.

That's what our double-page, full-color ads in TV Guide, and the display program, are all about. Business for you. If you like the bright idea, see your Sylvania distributor and ask him to include you in.

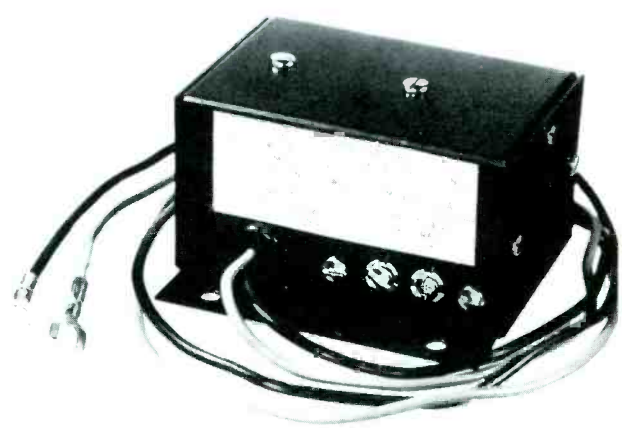
Sylvania Electronic Tube Divison, Electronic Components Group, Seneca Falls, New York 13148.

SYLVANIA
SUBSIDIARY OF
GENERAL TELEPHONE & ELECTRONICS GT&E

Circle 42 on literature card



eliminate parallax; a matched pair of silicon diodes to provide meter overload protection; and a high-impact case with integral handle for convenient positioning and portability. DC voltage ranges are 0-500 mv, 2.5, 10, 50, 250, 500, and 1000 volts. AC voltage ranges are 0-2.5, 10, 50 250, and 1000 volts. DC current ranges include 0-10μa, 250μa, 2.5ma, 250ma, and 10 amps. Resistance can be measured from 0 to 20 megohms in four steps. A decibel function is also included and extends from −20 dB to +62 dB in 5 ranges. The multimeter measures 7½" × 5¼" × 3¼". Price is $34.95, complete with batteries and test leads.



Inconverter And Voltage Regulator
(68)

The ability to operate low-powered communications and other electronic equipment from practically any DC power source ranging from 6 to 32 volts is now possible with two new accessories from the **E. F. Johnson Company.** Called the In-Converter and the Voltage Regulator, these units can be used to operate equipment drawing up to 14 watts of power and can correct improper input voltages or incorrect polarity.

The In-Converter is particularly adaptable for installing a two-way radio system, auto tape player, car radio, auto reverberation unit, or other electric appliance in a foreign car with a 6-volt electrical system or in a vehicle that uses a positive ground. The unit has an input

we looked into your future, then created the "little corporal," a most remarkable CRT tester.

B & K has done it again . . . put you a "jump ahead" by looking into your future . . . your problems, *your* needs. This is the "Little Corporal," the CRT Rejuvenator and Checker, designed to provide maximum obsolescence protection by providing continuously variable voltages for all CRT elements. You can make the most accurate possible tests, even on future CRT types, because the heater voltage is metered and is continuously variable from 0 to 13 volts with any tube heater current. And, using the required adaptors, you can test and correct all tube, transistor or integrated circuit black and white and color picture TV tube troubles (including GE 11" color and imported color tubes) in a few minutes . . . in the home or on the bench . . . without removing tubes from the TV set.

You can give new life to weak or inoperative picture tubes—prove to your customers their need for new tubes.

The "Little Corporal," another product of B & K electronic innovation, carries the B & K Professional Servicing Equipment emblem, your assurance . . . your customers' assurance . . . that you use the finest equipment made.

Model #465, Net: $89.95.

B&K A Division of Dynascan Corporation
1801 W. Belle Plaine
Chicago, Illinois 60613

B&K

A Division of Dynascan

Where Electronic Innovation Is A Way of Life

Circle 44 on literature card

of 6 or 12 volts DC and an output of 6 or 12 volts with either negative or positive polarity, or an output of 18 or 24 volts DC with the same polarity as the input.

The voltage regulator accepts any DC voltage from 24 to 32 volts and furnishes an output of 13 volts DC at 14 watts. Applications for the voltage regulator include material handling vehicles, aircraft, boats, and construction equipment. Prices of the voltage regulator are $14.95 with positive ground and $17.95 with negative ground. The In-Converter is priced at $22.95.

Transistor Tester and Set Analyzer

(69)

Completely selfpowered, this portable unit is actually 8 analyzers in 1 unit. Designed for bench or home-servicing, it can be used as a transistor tester, a diode tester, as a wattmeter. an ammeter, a signal generator, an in-circuit tester, and will also function as an AC and DC beta tester. The **Semitronics** Model 1000 Transistor Tester and Set Analyzer can check all transistors for gain, leakage. and oscillating ability, either in or out of the circuit. In addition, it can be used to determine whether a transistor is a P-N-P or N-P-N type. The unit can also be used as a signal tracer for detecting faults in transistor radios, hi-fi amplifiers. TV receivers, and similar electronic equipment. As a complete testing lab in one unit, the tester and analyzer can be used to check all sections of transistor receivers, including audio, IF, and RF circuits. The tester can be used to check battery voltage and current drain. It is designed to test both diodes and rectifiers. Sockets are conveniently mounted on the face of the instrument for testing both voltage- and power-type transistors.

Included with the unit(which comes completely wired, ready for bench or home use) is the *Semitronics Interchangeability Guide*, supplying replacement information on approximately 5,000 different semiconductors. Also included is a copy of the "*Transistor Tester and Set Analyzer*." This book not only supplies complete information on the operation and practical use of the unit, but also gives practical servicing hints. The complete package. consisting of the Model 1000 Transistor Tester and Set Analyzer

RCA Transistors Rectifiers Integrated Circuits

For EXPERIMENTERS HOBBYISTS HAMS and TECHNICIANS

LOOK FOR THIS DISPLAY AT YOUR RCA DISTRIBUTOR

Here displayed on the RCA Solid-State Center is the RCA SK-Series Transistors, Rectifiers, and Integrated Circuits; the new RCA 3N128 MOS Field-Effect Transistor; RCA's 40214 Silicon Stud Rectifier; and three RCA Experimenter's Kits. This new Solid-State Center, in addition to its host of devices, also includes technical literature to support the devices right on the rack. It's the "one-stop" answer to the solid-state needs of experimenter, hobbyist, ham, or the replacement requirements of the service technician.

All devices and kits are packaged in easily identifiable see-through packs for your convenience. Included with each device is broad performance data or specific ratings and characteristics where applicable.

RCA Solid-State Center Includes:

- RCA Experimenter's Kits. Three kits enable you to build a light dimmer or any one of 14 different circuits for dozens of applications around the house.
- RCA SK-Series "Top-of-the-Line" Devices: 17 Transistors, 2 Rectifiers, and 2 Integrated Circuits, for experimenter or replacement use.
- RCA Technical Manuals. Four manuals include: RCA Experimenter's Manual, RCA Transistor Manual, RCA Linear Integrated Circuits Fundamentals Manual, and RCA Tunnel Diode Manual.
- RCA Solid-State Replacement Guide. Lists all RCA SK-Series "Top-of-the-Line" Transistors, Rectifiers, and Integrated Circuits and the more than 7,300 types which they replace.

Keep RCA Experimenter's Kits and the RCA SK-Series in mind when you're shopping for solid-state devices. Look for the RCA Solid-State Center. Now at your RCA Distributor. Do it today!

RCA Electronic Components and Devices, Harrison, N.J

RCA®

The Most Trusted Name in Electronics

Circle 58 on literature card

the Interchangability Guide, the book entitled "Transistor Tester and Set Analyzer," a transistor, and a set of needle-point test leads, is priced at $34.95.

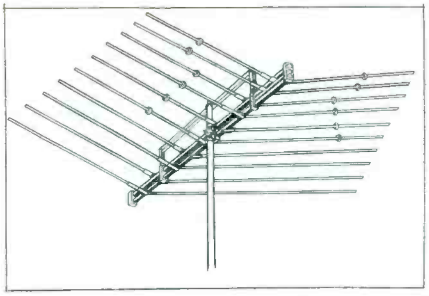
Battery Pack
(70)

A new, self-contained battery pack, especially designed to make all Courier solid-state CB rigs completely portable, has been introduced by **Courier Communications, Inc.** Model PAP-1 PORT-A-PAK, features a rechargeable nickel cadmium battery that provides continuous operation in the receive position for up to 8 hours and can be left on trickle-charge position continuously to insure ready-to-go operation, or can be recharged while in standby. The unit is reliable at all temperatures from −30°F to +140°F and cannot be damaged by overcharge when used with a CHARGE-A-PAK Battery Charger (Model CAP-1). When using PORT-A-PAK and CHARGE-A-PAK together, the Courier solid-state CB rig can be used as a base station.

The PORT-A-PAK is priced at $59.95, complete with collapsible antenna, Texion carrying case, rechargeable battery, battery meter, charging connector, mounting hardware, microphone bracket and shoulder strap. CHARGE-A-PAK is priced at $12.95.

TV-FM Antenna
(71)

The antenna shown here is one of 8 different models offered in the **JFD** LPV-TV/FM Color Log Periodic series. Designated Model LPV-TV-100, this 10 element log periodic is designed for color, VHF, (up to 125 miles) and FM stereo reception (up to 40 miles). Features of this antenna



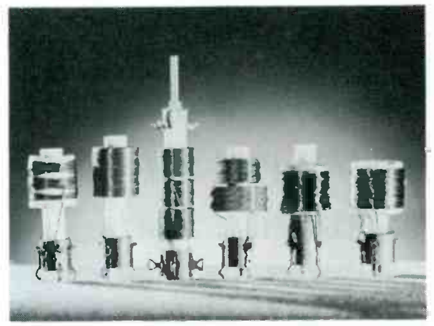
include capacitor-coupled dipoles which respond on the third harmonic mode, as well as the fundamental mode, resulting in more elements optimally tuned to work on both low- and high-band VHF channels. A low-impedance twin-boom feeder provides a better impedance match to the dipoles for increased signal transfer on all VHF channels. Also, an integrated transformer design achieves impedance match to the 300-ohm downlead. Dimensions of the antenna include a tip measurement of 92″ and a boom length of 112¾″. Weight is approximately 14½ lbs. The price of the Model LPV-TU100 is $41.95. Other antennas in the series range in price from $14.95 to $79.95.

Anti-Static Record Spray
(72)

A special lubricant designed to prolong record life by reducing groove wear is now manufactured by **Colman Electronic Products.** Klear Tone Anti-Static Record Spray, No. 1632-65, is safe to use on all records, including the old shellac type. It is non-flammabe and safe to use around all plastics used in photographs. In addition to cleaning and ldbricating records with a fine silicone film that prevents static build up, the record spray may be used to spray-clean dirty phono needles and cartridges. The price is $1.79.

Sweep Circuit Replacement Coils
(73)

Exact replacement sweep circuit coils for color TV sets produced by more than 25 manufacturers have been introduced by the **J. W. Miller Company.** The focus, convergence, and sweep circuit coils are directly interchangeable with original coils in color TV sets by manufacturers such



as RCA, Philco, Westinghouse, Motorola and Muntz. Single unit prices start at $1.20.

CB Transceiver
(74)

A new model has been added to **General Electric's** line of solid-state Citizen's Band transceivers. The Model Y7050 transmits and receives up to ten miles, depending on terrain and conditions. Either of two crystal-controlled frequencies—CB channel 11 or 16—may be used simply by flipping a channel selector switch.

A special feature of this walkie-talkie is power-source flexibility. It can be operated with standard "AA" penlight batteries, or with rechargeable nickel cadmium batteries (optional). Also, with optional accessories, AC house current, a car cigarette lighter socket, or a 12-volt storage battery can be used to power the unit. Input power is 1½ watts. In addition to the 51" telescoping antenna, a jack is provided for connection to an external antenna. This feature, along with adaptability to a variety of power sources, makes the unit useable as a base station.

Each unit features a squelch control, for reduction of background noise, and a battery checking meter. The unit is supplied with "AA" batteries, earphones, and carrying case. Also included is an application form for a Citizens Band license—required by the FCC because of the unit's power output level. Application is by mail. The only requirements are that the applicant be 18 years of age and a U.S. Citizen.

The set weighs 1.7 lbs. with batteries, and measures 7⅝" high by 3¼" wide by 1⅝" deep. Optional accessories include an auto power cord, Ni-Cad rechargeable batteries, and combination AC converter/Ni-Cad battery charger. Price is $125 per pair.

SERVICE PUZZLER

What circuit would you first suspect if you were confronted with the picture on the RCA portable (Chassis KCS 151) in Fig. 1? Read the following clues before making an educated guess.

The picture changes from the effect shown in Fig. 1 to a normal picture, indicating an intermittent component. The effect stays at the top of the screen, even when the vertical is rolled, and it is not changed by height or linearity adjustments. The same effect is seen on a blank channel.

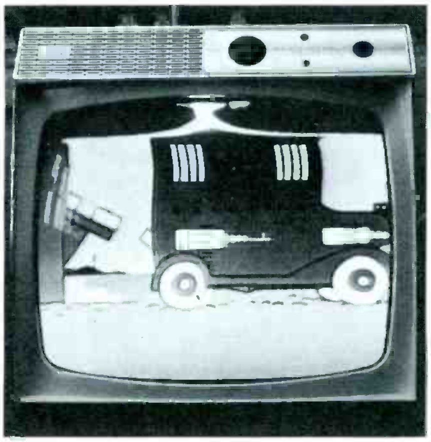


Fig. 1. Odd symptom displayed on screen of RCA portable.

Right or Wrong?

After careful analysis, you should have concluded that the vertical pulse was killing the horizontal sweep shortly after the vertical retrace time. But how are the two getting together? How about a yoke short? The picture was still the same with a new yoke. Open filter

capacitor? Sounds logical, but the scope showed no such disturbance on the B+ line, and test capacitors shunted across the filters did not help. CRT blanking? No connection at all.

Solution

Study of the PHOTOFACT schematic (730-3) showed one possibility of an accidental cross-feed, and then only if C62 opened (Fig. 2).

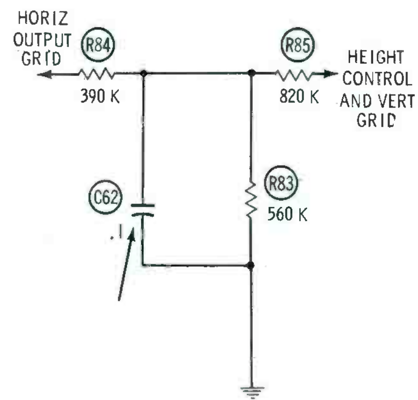


Fig. 2. Open capacitor causes symptom.

The scope showed both vertical and horizontal pulses on the capacitor when the trouble appeared on the screen. A new capacitor cured the trouble. Of course, a bad ground at C62 would also produce the same symptom.

Several schematics showed more models with the same circuit. These include RCA Chassis KCS 143, KCS 144, KCS 148, and KCS 149. All of these are 1965 models. ▲

Occasionally he hands out awards!

BOOK REVIEW

How to Build Speaker Enclosures: Alexis Badmaieff and Don Davis; Howard W. Sams & Co., Inc., Indianapolis, 1966; 144 pages, 5½" × 8½", soft cover; $3.25.

The volume begins with an evaluation of the five basic enclosure types: finite baffle, infinite baffle, bass reflex, horn projectors, and combination units. This is followed by an analysis of driver units, with statements regarding their limitations and effects of changing sizes and types.

Next, speaker and enclosure placement are considered, with particular emphasis on phasing, efficiency, and equalization, both electronically and mechanically. This involves discussion of phasing and crossover networks, and how they are best related to individual components.

In the work are photographs, graphs, curves, and construction plans (including material lists) for many examples of each type of enclosure, including complex folded horns and combination units. Information in the book is sufficient to permit an individual to design the changes required for adapting any specific unit to the particular room or driver unit with which it will be employed.

Concluding chapters deal with crossover networks and how their design is achieved. Graphs and charts indicate frequency and power demands of various orchestral groups, and for the "coil winders" there is sufficient information to permit construction of networks in the workshop or home. The chapter dealing with constructing and testing describes the materials, tools, and methods by which the most satisfactory results can be obtained. Testing techniques, from simple arrangements to elaborate professional setups, are then presented.

This book has been written for a wide range of readership and essentially requires little more knowledge than what a speaker is. Source material is from those who manufacture both enclosures and speakers of the professional type. The authors are engineers who have been engaged in the design of enclosures and speakers for commercial manufacture. ▲

Solution to **PFR PUZZLER**

February Electronic Crossword

E	L	E	C	T	R	O	N	I	C	S	■	N	E	T
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INDEX TO ADVERTISERS

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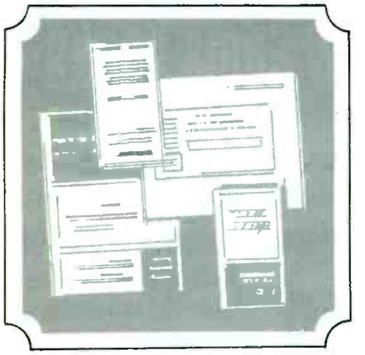


$FREE$ CATALOG AND LITERATURE SERVICES

*CHECK "INDEX TO ADVERTISERS" FOR FURTHER INFORMATION FROM THESE COMPANIES

ANTENNAS

75. *ALLIANCE* — Colorful 4-page brochure describing in detail all the features of Tenna-Rotors.
76. *ANTENNACRAFT*—12-page catalog listing complete Antennacraft line of UHF, VHF & FM antennas for all types of installations.
77. *BLONDER-TONGUE*—Compact brochure detailing a line of all-channel products expressly designed to improve reception in the home and small MATV systems. *
78. *CORNELL-DUBILIER*—16-page booklet: "How to improve TV/FM Reception."
79. *FINNEY*—Forms 20-338, 20-356, and 20-357 describing distribution amplifiers and antenna amplifiers for 300-Ohm and 75-Ohm TV and FM systems. *
80. *GC ELECTRONICS* — Form FR-28-C, 8-page brochure about Colormagic antennas and coupler-splitters. *
81. *JERROLD*—New 4-page full-color catalog describes the new Paralog Plus antennas. *
82. *JFD*—Color Laser and LPV antenna brochures. New 1967 dealer catalog covering complete line of log-periodic outdoor antennas, rotators, and accessories. *
83. *WINEGARD*—8-page color brochure on new Super-Colortron antennas: 5 VHF-UHF-FM, 4 VHF-FM, 3 UHF. Includes information on 6 new solid-state preamplifiers. *

AUDIO

84. *ANDREA* — History booklet about the company, also full-line folder in color.
85. *ATLAS SOUND*—Catalog 556-67 illustrates and describes many new models of public address loudspeakers, microphone stands, and accessories for commercial sound applications.
86. *EICO*—Brochure on the new "Cortina" solid-state stereo system.
87. *KOSS* — Brochures on Rek-O-Kut turntables and personal listening products.
88. *OAKTRON*—"The Blueprint to Better Sound," an 8-page catalog of loudspeakers and baffles giving detailed specifications and list prices. *
89. *OLYMPIC* — Complete-line folders and catalog pages on color and black-and-white television, Hi-Fi, stereo/monaural phonos, radios and tape players.
90. *OXFORD TRANSDUCER* — Catalog sheets featuring speaker systems for automobiles. *
91. *STANFORD INTERNATIONAL*—Brochure about a new battery-operated tape recorder. Also, brochures about headphones and microphones.
92. *TRIAD*—Data sheet on 8 new line-matching transformers.
93. *VIKING*—Brochure about Model Studio 96 tape transport.

COMMUNICATIONS

94. *ACTION*—Wall mounted intercommunicating interphone providing hotline paging and selective buzzer calling for stores and factories.
95. *AMPHENOL* — 2-color spec sheets on new Model 650 CB transceiver and Model C-75 hand-held transceiver. *
96. *MOSLEY ELECTRONICS* — New 1967 deluxe citizens band antenna catalog.
97. *MOTOROLA*—New brochure tells how to reach people on-the-move through use of personal two-way radio. *
98. *POLYTRONICS*—Flyers about Poly Pup—a very small 7-channel CB transceiver, and Duo-Com 123 3-watt Walkie-talkie.
99. *SHURE*—Data she 's on Ranger II noise-cancelling microphones.

COMPONENTS

100. *BUSSMAN*—Bulletin on BUSS Fustat Box Cover Units for protecting electrical tools against damage and burnout. Units fit standard outlet or switch box, have fuseholder plus a plug-in receptacle, pilot light, switch, etc. For detailed information ask for BUSS Bulletin SBCU. *
101. *CENTRALAB*—Catalogs offered on electrolytic capacitors, PEC's, and auto radio shafts and bushings.
102. *GC ELECTRONICS*—Catalogs FR15-G TV knob cross reference, FR-028-C antennas, and TR-7018-G transistor reference. *
103. *LITTELFUSE*—Pocket-sized TV circuit breaker cross-reference gives the following information at a glance: Manufacturer's part number, corresponding Littelfuse part number, price, color or b/w designation. A second glance gives trip ratings and acquaints you with a line of caddies. Ask for CBCRP. *
104. *QUAM-NICHOLS* — Quam-auto radio speaker replacement guide. Complete replacement information on front and rear-seat speakers for automobile radio models from 1955-1966. *
105. *SONOTONE*—New revised cartridge replacement manual—SAC-25 (Rev. 12/66).
106. *SPRAGUE*—#C-617, a complete catalog of the Sprague line. *
107. *SWITCHCRAFT* — Bulletin D-814 describes Switchcraft's new "traffic-tailored" dealer audio-accessory merchandiser and merchandiser program.

SERVICE AIDS

108. *CASTLE*—How to get fast overhaul service on all makes and models of television tuners is described in leaflet. Shipping instructions, labels, and tags are also included. *
109. *CHEMTRONICS* — Flyer about a new cleaner especially for Nuvistor and transistor tuners. *
110. *CLEVELAND INSTITUTE OF ELECTRONICS* — New pocket-sized, plastic "Electronics Data Guide" of formulas and tables, including frequency and wavelength, dB formulas and table, antenna lengths, and color code. *
111. *ELECTRONIC CHEMICAL* — Catalog sheet on aerosol sprays for servicemen.
112. *MIDSTATE TUNER* — 24-hour tuner service is described in a colorful brochure.
113. *PERMACEL*—Brochures on a wide variety of adhesive tapes for the electronics industry.
114. *PERMA-POWER* — Flyer showing the complete line of TV tube brighteners and service accessories. *
115. *QUALITY TUNR SERVICE* — Introductory letter describing costs and service on all makes of TV tuners. Repair tags and shipping labels included.
116. *RAWN*—Bulletins on repair ideas using Plas-T-Pair knob and plastic repair kits. Also, bulletins on tuner cleaners and circuit coolers. Includes price sheets.

SPECIAL EQUIPMENT

117. *ADMIRAL*—Flyers on 2 new educational-style TV receivers.
118. *SONIC INDUSTRIES*—Bulletins on 2 new Police-band to AM-band converters. Small, solid-state, and low-priced.
119. *SQUIRES-SANDERS* — Bulletins on 2- and 6-meter Ham transceivers and a new solid-state CCTV camera.
120. *STACO* — Flyer describing 4 popular bench model variable autotransformers.

TECHNICAL PUBLICATIONS

120. *PHILCO*—Information about Tech Data & Business Management service. Also, free parts catalog.
122. *RCA INSTITUTES*—New 1967 career book describes home study programs and courses in television (monochrome and color), communications, transistors, industrial, and automation electronics. *
123. *HOWARD W. SAMS* — Literature describing popular and informative publications on radio and TV servicing, communications, audio, Hi-Fi, and industrial electronics, including special new 1967 catalog of technical books on every phase of electronics. *

TEST EQUIPMENT

124. *B & K*—New 1967 catalog featuring test equipment for color TV, auto radio, and transistor radio servicing, including tube testers designed for testing latest receiving tube types. *
125. *EICO* — 1967 short-form catalog is 48 pages long. Describes a complete line of test instruments, CB and ham equipment, Hi-Fi components, and miscellaneous electronic equipment.
126. *HICKOK*—Specification information on new Models: CR-35 CRT rejuvenator tester, GC-660 solid-state color bar generator, 860 AM/FM signal tracer.
127. *JACKSON*—New line folder or "Service Engineered test equipment includes push-button-operated color dot/bar generator. *
128. *LECTROTECH*—Two-color catalog sheet on new Model V6-B color bar generator, the latest improved model of the V6. Gives all specs and is fully illustrated. *
129. *MERCURY*—1967 16-page booklet features the full line of test equipment for servicing color and black/white TV, radio, Hi-Fi, and communications equipment. Includes the new Model 1900 color generator and Model 2000 mutual conductance tube tester. *
130. *PRECISION APPARATUS*—Illustrated catalog describing signal generators, oscilloscopes, and meters.
131. *SECO*—New line folder featuring the new Model 107C Gm, Em, and grid circuit tube tester. *
132. *SEMITRONICS*—Brochure on the new Model 1000 transistor tester.
133. *SENCORE*—8-page full color catalog plus a new 4-page supplement catalog. *
134. *SIMPSON*—Flyer giving specifications of Model 604 multicorder for measuring and recording volts, amps, milliamps, and microamps.
135. *TRIPLETT*—Catalog D-66-I features the complete line of panel instruments. *

TOOLS

136. *ARROW*—Catalog sheet showing 3 staple gun tackers designed for fastening wires and cables up to ½" in diameter. *
137. *CHANNELLOCK*—General catalog #66 and price supplement on the complete tool line.
138. *ENTERPRISE DEVELOPMENT*—Time-saving techniques in brochure from Endeco demonstrate improved desoldering and resoldering methods for speeding and simplifying operations on PC boards.
139. *LUXO*—Flyers on counterbalanced and magnifying bench lamps.
140. *VACO*—Catalog #SD-120 completely describes new Vaco screw launcher which holds, starts, and drives all straight-slot screws.
141. *WEN*—4-page 3-color catalog describes 9 new electric power drills. ¼- to ½-inch capacity, light and heavy-duty use.

TUBES AND TRANSISTORS

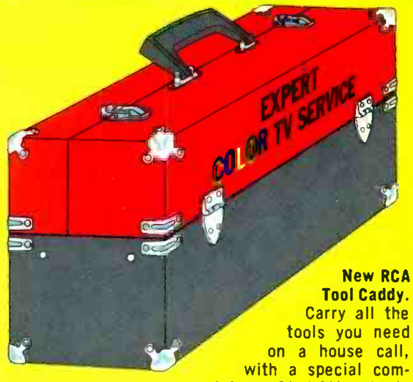
142. *IR*—Transistor cross reference guide — 22 pages of detailed specifications on universal silicon and germanium transistors and a complete listing of more than 5000 devices which they replace.
143. *MOTOROLA* — Catalog HMA-27-R describes ratings and characteristics of all devices in HEP line, includes info on heat sinks, mounting kits, device outlines, and home project ideas. *
144. *NATIONAL SEMICONDUCTOR* — 18-page catalog of silicon transistor and IC's.
145. *RADIO CORP. OF AMERICA*—PIX 300, a 12-page product guide on RCA picture tubes covering both color and black-and-white. Includes characteristics chart, terminal diagrams, industry replacement, and interchangeability. *
146. *SEMITRONICS*—Flyer on the new HO-300 replacement transistor for horizontal and vertical output stages.
147. *WORKMAN*—Two new cross-references in vest pocket size. Miracle Five transistors, and circuit breakers.

Your local participating RCA Tube Distributor invites you to

Step into the winner's circle

with 1967's greatest collection of technical, service and promotional aids to make your servicing jobs easier and help you promote more business.

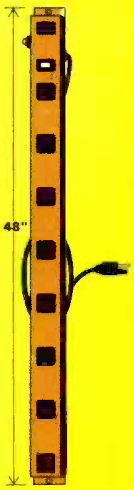
Get RCA's new Field Service Guide Free in the RCA Color Pack '67... This tremendously helpful book holds the schematics and field service adjustments of all color TV sets manufactured by RCA Victor from 1955 to 1966. With it you can do all adjustments possible with a color bar generator, including replacing a color TV tube... **in the home.** You get it FREE when you buy the RCA COLOR PACK '67 assortment of 21 popular RCA receiving tubes for color TV from your participating RCA Tube Distributor.

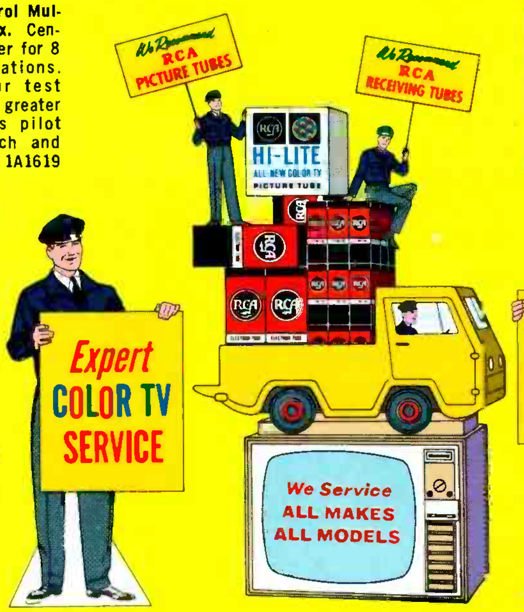


New RCA Tool Caddy. Carry all the tools you need on a house call, with a special compartment for your model WV-38 VOM. Sturdy metal trays for different size tools fold out easily, fall back readily. Covered in strong SUPERWELD fabric with metal guards protecting the corners, it will take a lot of abuse. Note color TV service message on the side. 1A1630

48" Power Control Multiple Outlet Box. Centralize your power for 8 different operations. Maneuver your test equipment with greater efficiency. Has pilot light and switch and circuit breaker. 1A1619

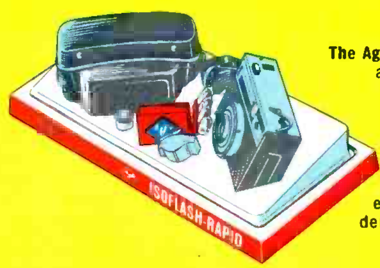
Mylar Decal for truck or window. Bright, bold colors on all-weather mylar send your color TV service message all over town on your truck. Put one in your store window, too. 1A1620





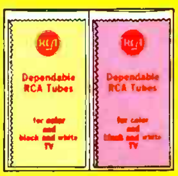
Set of RCA Monogram Decals. In three sizes... a perfect way to dress up any surface that calls for product identification. 1A1624

Motion Display on RCA Receiving Tubes and Picture Tubes for Window or Counter. Ingenious, striking! Service truck moves back and forth atop a simulated color set. Draw attention to your window or counter with this novel display which promotes all of your services—color TV, black and white TV, radio and hi-fi. Electrically powered, it combines your receiving tube and picture tube story in one visually compelling unit. Put one in your window and watch the reaction! Two auxiliary serviceman pieces carrying additional service messages, can be used in conjunction with the center display or as separate units. 1A1621

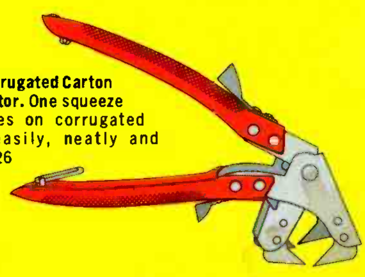


The Agfa Isoflash Camera Kit... Is also available with your purchase of RCA Receiving Tubes. You'll be a winner when you bring home this easy loading beauty complete with film, battery, bulb, flash cube adapter, carrying case and shoulder strap. 1A1629

TV Cleaning Cloth Set. A set of two to take with you on house calls ...one for the cabinet and one for the faceplate of the picture tube. 1A1627



Swingline Corrugated Carton Staple Extractor. One squeeze opens staples on corrugated cartons... easily, neatly and safely. 1A1626



Many other attractive and valuable items are available through THE WINNER'S CIRCLE program, including ad mats, RCA's Color TV Fastcheck series of helpful hints, the famous RCA Receiving Tube Manual, postcards and new business cards, and a bottle opener premium. Check with your local RCA tube distributor. He can supply you with the finest in receiving tubes for color and black-and-white TV, radio and hi-fi. And he can tell you how to STEP INTO THE WINNER'S CIRCLE.

RCA Electronic Components and Devices, Harrison, N.J.

RCA

The Most Trusted Name in Electronics

Introducing a Complete Line of Littelfuse Quality Circuit Breakers

Actual Size
$1\frac{3}{4}'' \times \frac{13}{16}'' \times \frac{1}{2}''$

Exact replacement from factory to you

Designed for the protection of television receiver circuits, the Littelfuse Manual Reset Circuit Breaker is also ideally suited as a current overload protector for model railroads and power operated toy transformers, hair dryers, small household appliances, home workshop power tools, office machines, small fractional horsepower motors and all types of electronic or electrical control wiring.

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Circle 57 on literature card