ELECTRONIC TECHNICIAN

WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION

LOW COST TEST EQUIPMENT

APRIL 1965

INTRODUCING

Jerrold COLORAXIAL™ Program

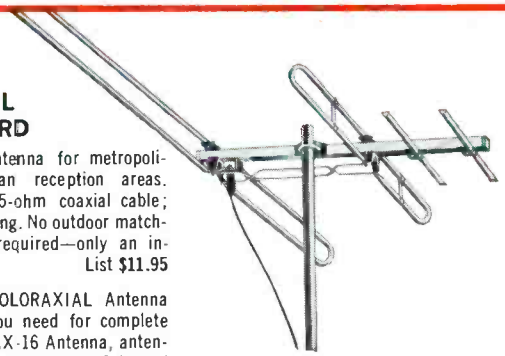
COAX IS A MUST FOR COLOR TV

THIS

NOT THIS

Commercial installations have proved that coaxial downlead is *essential* for predictable, consistently good color TV pictures. Coax loss doesn't increase in wet weather, while twinlead loss goes up as much as six times. Coaxial cable can be run anyplace, even next to metal, without mismatch. Coax doesn't deteriorate with age. It won't pick up ignition noises or other interferences. In a word, for satisfactory color reception, even in "ideal" reception areas, your customers need coax.

And now, new Jerrold COLORAXIAL antennas and kits give you a perfect home-installation package for every color-reception need. With COLORAXIAL, you can offer the whole system, from coaxial antenna to indoor matching transformer, or adapt an existing 300-ohm antenna for coax operation. Listed below are all the COLORAXIAL components packaged individually and in kits, for easy, low-cost conversion. Ask your Jerrold distributor for COLORAXIAL brochure, or write *Jerrold Electronics, Distributor Sales Division, Philadelphia, Pa. 19132.*

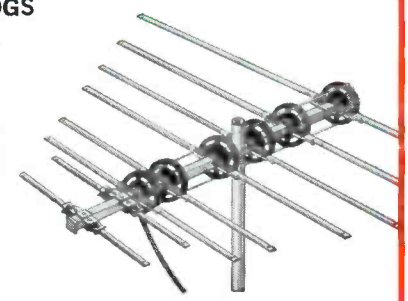


CAX-16 •
COLORAXIAL COLORGUARD

COLORAXIAL Antenna for metropolitan and suburban reception areas. Prematched to 75-ohm coaxial cable; complete with fitting. No outdoor matching transformer required—only an indoor Model T378. List $11.95

K-CAX-16 • COLORAXIAL Antenna Kit. Everything you need for complete installation—a CAX-16 Antenna, antenna tri-mount with 5-ft mast, 50 feet of coax cable with fittings, and T378 indoor matching transformer. List $29.95

COLORAXIAL PARALOGS

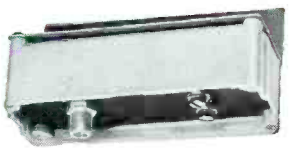


PAX-40 • COLORAXIAL Antenna for difficult suburban areas. Prematched to 75-ohm coaxial cable; complete with fitting. No outdoor matching transformer required — only an indoor Model T378 needed. List $22.95

PAX-60 • COLORAXIAL Antenna for suburban to semi-fringe areas. Prematched to 75-ohm coaxial cable; complete with fitting. No outdoor matching transformer required—only an indoor Model T378 needed. List $32.95

CAT-2 •
COLORAXIAL MATCHING TRANSFORMER KIT

One TO-374A mast-mounting matching transformer for any 300-ohm antenna, and one T378 set-mounting matching transformer, complete with bracket and mounting strap. List $8.20



COLORAXIAL matching transformers are also available individually: TO-374A, list $4.95; T378, list $3.25

COLORAXIAL CABLE

CAB-50 • 50 feet of sweep-tested RG-59/U 75-ohm coaxial cable complete with F-59A fittings attached, plus weatherboot. List $9.50

CAB-75 • 75 feet of sweep-tested RG-59/U 75-ohm coaxial cable complete with F-59A fittings attached, plus weatherboot. List $11.50

JERROLD ELECTRONICS

A subsidiary of The Jerrold Corporation

. . . for more details circle 35 on postcard

Stop banging your head against the "electronic iron curtain!"

There's an "electronic iron curtain" that stands between you and new customers. What is it? It's the manufacturer who sells to national mail order electronic catalogs.

Want proof? Just flip open any one of these books, turn to the antenna pages, and glance at the prices.

Makes you feel like banging your head against the wall in sheer helplessness, doesn't it?

These well-advertised catalog *consumer* prices (and those of the catalog houses' captive discount chain stores) are approximately the same as what you, the dealer, *pay*. And the advertised prices on rotators and boosters —picture and receiving tubes, and other TV products — are enough to make you turn blue with frustration, too.

Because when your customer compares these catalog prices with your prices, you're lucky if you even get a *chance* to make the sale; much less the honest profit to which you're entitled.

What does a guy like you do then, to break down this "electronic iron curtain" that separates you from customers?

One thing you *don't* do is throw in the sponge and say to yourself, "Go fight City Hall!"

No, indeed! You fight back. How?

Sell the products of those manufacturers who support you. Get behind Channel Master—a manufacturer who's behind you all the way. As a matter of policy, Channel Master does not sell to any outlet that by-passes the dealer and advertises to consumers at dealer prices.

This way we protect your business and let you reap a full profit. The highest in the industry, too. A good living is the very least we feel we owe the dealer who sells our products.

So stop banging your head against that wall. Are you with us? Do something!

CHANNEL MASTER
ELLENVILLE, N.Y.

. . . for more details circle 19 on postcard

if any set needs a transistor a signal diode, or a rectifier tung-sol supplies a replacement

Low power PNP
ET1
ET2
ET3
ET4
ET5
ET12

Medium power PNP
ET6

High power PNP
ET7

Low power NPN
ET8
ET9
ET10
ET11

Signal Diodes
IN34A
IN60
IN64
IN82A
IN198
IN295

Silicon Rectifiers
ET200
ET400
ET600

Order Tung-Sol "ET" transistors–diodes–rectifiers

RECEIVING TUBES—Every major manufacturer of radio, TV and hi-fi has used Tung-Sol tubes for original equipment. You can have complete confidence that the quality of Tung-Sol tubes will help you maintain the highest standard of service. Tell your supplier you'd rather have Tung-Sol.

Tung-Sol Electric Inc., Newark, N.J. 07104

CENTER LINE QUALITY®

TUNG-SOL

TUBES · TRANSISTORS · DIODES · RECTIFIERS

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APRIL 1965
VOL. 81 NO. 4

ELECTRONIC TECHNICIAN

WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION

AN OJIBWAY PUBLICATION

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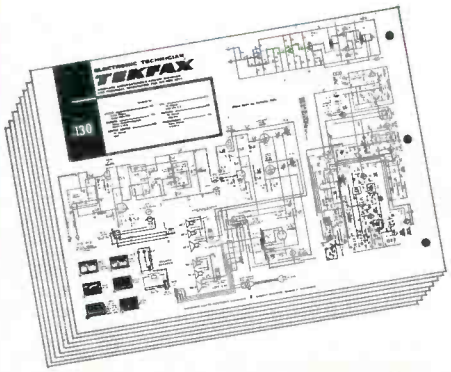
Cover

Our artist has given this month's cover, symbolizing our focus on lower-priced test equipment, his own 'brushed-up' interpretation of how a full instrument compliment in this range should appear.

FEATURES

DEPARTMENTS

TEKFAX ——16 PAGES OF THE LATEST SCHEMATICS



ADMIRAL: Color TV Chassis G11

FIRESTONE: TV Chassis 12-129-94U

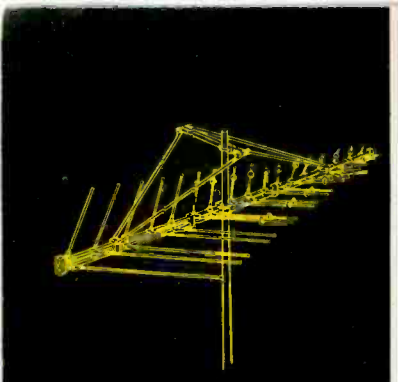
MOTOROLA: TV Chassis TS, TTS and VTS-587

PHILCO: TV Chassis 15N50

RCA VICTOR: TV Chassis KCS 151A

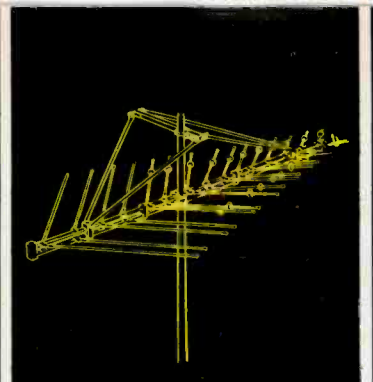
SYLVANIA: TV Chassis 585-1,-2,-4,-5

ZENITH: TV Chassis 13M15



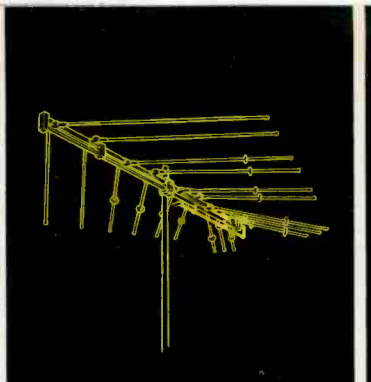
Model LPV-VU18
List $69.95

Description
18 Active Cells
VHF—up to 175 miles
UHF—up to 90 miles
FM —up to 75 miles



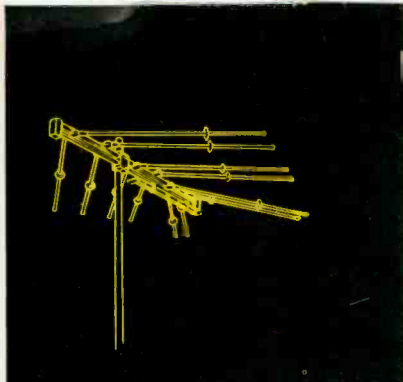
Model LPV-VU15
List $59.95

Description
15 Active Cells
VHF—up to 150 miles
UHF—up to 90 miles
FM —up to 60 miles



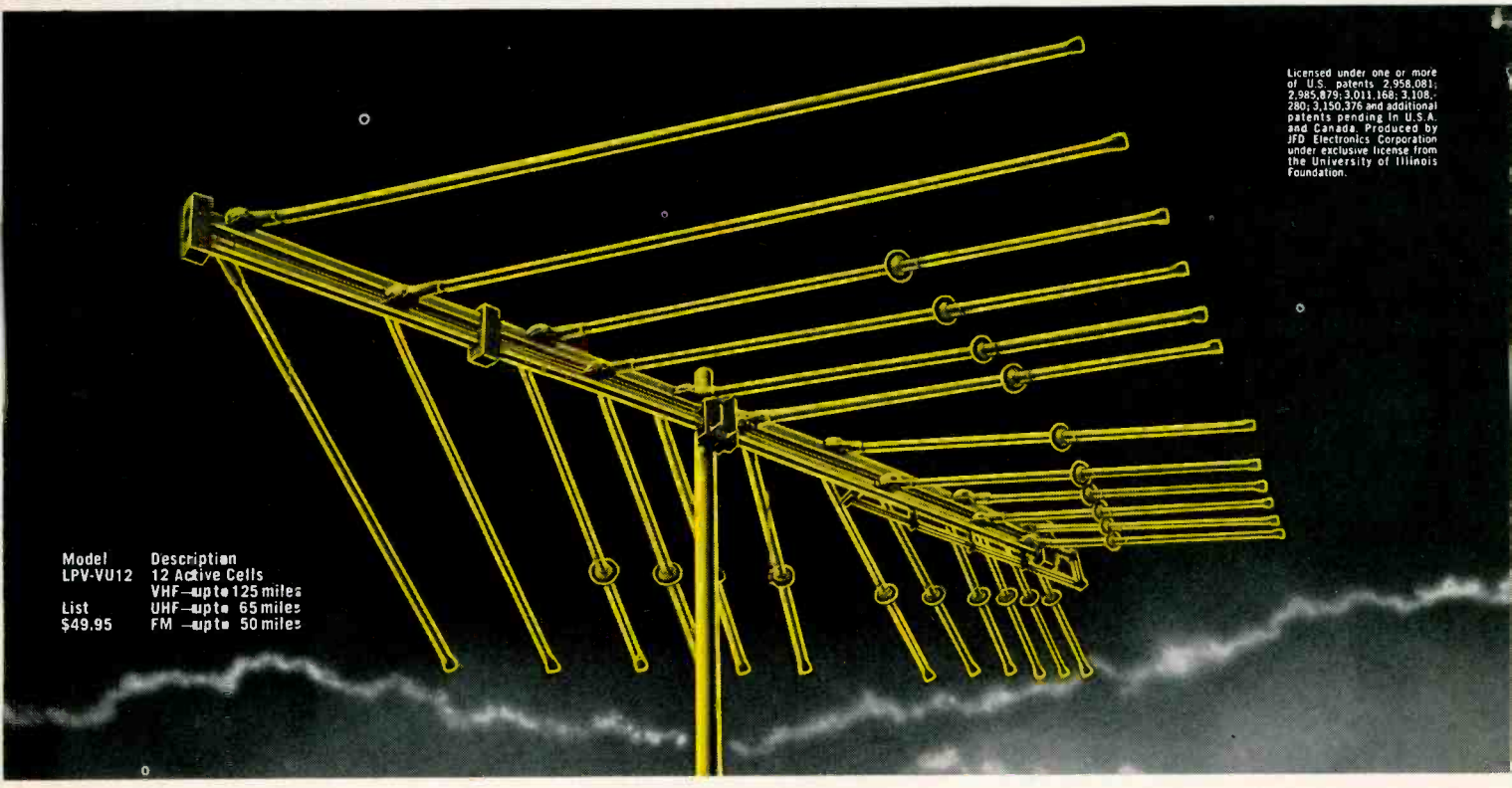
Model LPV-VU9
List $39.95

Description
9 Active Cells
VHF—up to 100 miles
UHF—up to 40 miles
FM —up to 40 miles



Model LPV-VU6
List $27.50

Description
6 Active Cells
VHF—up to 75 miles
UHF—up to 25 miles
FM —up to 30 miles



Licensed under one or more of U.S. patents 2,958,081; 2,985,879; 3,011,168; 3,108,280; 3,150,376 and additional patents pending in U.S.A. and Canada. Produced by JFD Electronics Corporation under exclusive license from the University of Illinois Foundation.

Model LPV-VU12
List $49.95

Description
12 Active Cells
VHF—up to 125 miles
UHF—up to 65 miles
FM —up to 50 miles

Who Says

You Can't Have Everything You Want in a TV Antenna?—

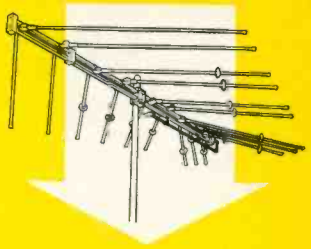
VHF? UHF? FM Stereo? Single Down-lead?

You most definitely can—when you install the remarkable new

JFD LPV-VU LOG-PERIODIC

FEATURING THE CAP-ELECTRONIC DIPOLE

The World's first all-channel VHF/UHF/FM/Stereo antenna (with single Down-lead) is here. (And only JFD has got it!)



You can't satisfy today's complex VHF/UHF/FM reception needs with yesterday's antennas. Today's "VU" TV sets call for a single all-*powerful* all-*band antenna that delivers the signals you need for picture-perfect reception on all channels 2 to 83—plus FM Stereo.*

That's why smart installers and dealers are switching to the new JFD LPV-VU. This newest antenna advance from the JFD Champaign, Illinois R&D Laboratories, teams (1) the acclaimed JFD Log-Periodic concept with (2) a totally new antenna design principle—the *capacitor-coupled electronic dipole.*

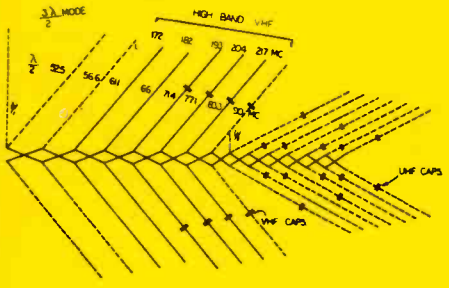
Result? More driven elements than ever before possible for the most efficient performance ever on VHF, UHF, FM/Stereo —from *one* antenna, **with one lead-in.**

And you can choose from five gold alodized LPV-VU Log-Periodics to satisfy every location, any budget: model LPV-VU-18, LPV-VU-15, LPV-VU-12, LPV-VU-9 and LPV-VU-6.

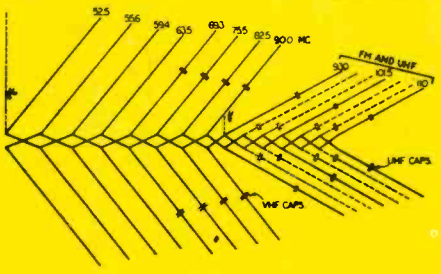
New from JFD—another outstanding advance in dipole design, the *capacitor-coupled electronic dipole!*

By introducing parallel plate capacitors into predetermined positions along the dipoles, and by precisely adjusting the value of each capacitance:

1. *More* dipoles are made to resonate on the high VHF band with a corresponding increase in gain.



2. *Higher mode* operation in UHF band achieves higher gain on channels 14 to 83—equal or better than that of parabolics. Improves FM stereo performance.
3. *More uniform* gain across each band, with narrower beamwidths. High front-to-back ratios greatly improve ghost rejection—insure excellent color fidelity.

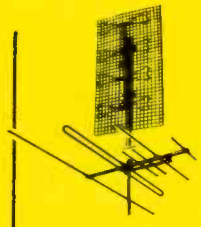


PLUS . . .

1. *Patented frequency independent Log-Periodic design* maintains same high performance efficiency regardless of station or band tuned in.
2. *Only one downlead needed.* A JFD AC80 splitter, included with each LPV-VU, permits you to tie directly into VHF, UHF and FM set inputs.
3. *New low-impedance twin crossarms* function as crossed feeder harness. Step up gain and improve signal transfer.

LPV-VU OFFERS NEW *MECHANICAL* ADVANCES, TOO!

■ Twin square aluminum crossarms. ■ Stainless steel terminals. ■ Oversized unbreakable Celanese "Fortiflex A" insulators. ■ Solid aluminum bus bar transformers. ■ Tubular crossarm supports on larger LPV-VU's. ■ Double U-bolts with 4 serrated-gripping profiles for 6-inch gripping span. ■ Electrically conductive gold alodizing.



INSTALLER BEWARE!

Don't spoil your VHF reception!

Addition of a separate UHF antenna to a present VHF installation may cut the VHF signal being delivered to your set. Incoming signals from a VHF transmitter may be scattered from the UHF antenna. Scattering produces less signal and multiple signals which cause ghosts.

SO WHY USE TWO WHEN *ONE LPV-VU* WILL DO?

Install the *all*-channel JFD LPV-VU and get the best VHF and UHF from *one* antenna with *one* down-lead!

A SPACE-AGE PRODUCT OF THE WORLD'S GREATEST TV/FM ANTENNA LABORATORIES

This newly completed laboratory, located on a ten acre site in Interstate Research Park, in Champaign, Illinois (home of the University of Illinois) marks a milestone in antenna history. It is dramatic proof of JFD leadership in antenna technology. Its fully staffed and equipped engineering staff, under the supervision of Dr. Paul E. Mayes, is blazing new trails in antenna design. This priceless know-how is built into each LPV-VU you sell.

The JFD LPV-VU is adapted from the geometrically derived Log-Periodic antenna formula developed by the Antenna Research Laboratories of the University of Illinois.

JFD

JFD ELECTRONICS CORPORATION
15th Avenue at 62nd Street, Brooklyn, N. Y. 11219
JFD Electronics-Southern Inc., Oxford, North Carolina
JFD International, 64-14 Woodside Ave., Woodside 77, N. Y.
JFD Canada, Ltd., 51 McCormack Street, Toronto, Ontario, Canada

SEE YOUR DISTRIBUTOR. WRITE FOR BULLETIN 806 FOR COMPLETE DETAILS.

. . . for more details circle 36 on postcard

LETTERS TO THE EDITOR

Old TEKFAX Went Fast

My letter in the February edition brought in a deluge of letters! Suffice it to say, have answered every one. The Circuit Digests (TEKFAX) went quickly . . . I still have back copies of RADIO & TELEVISION RETAILING. Anyone want these? With postage and stationery costs being what they are today, I just about broke even on the schematics deal! Some people just won't enclose return postage for a reply!

HORACE D. WESTBROOKS
Griffin, Georgia

A five-cent stamp isn't much. But when you get a hundred letters or so it goes up into a substantial sum of 'folding money.' Have a heart boys! —Ed.

Disenchanted

I have subscribed to ELECTRONIC TECHNICIAN for many a year — probably ten or more — and think honestly that it is the finest publication of its kind . . . But I have become disenchanted with the TV service industry after having been part of it from the very beginning . . . I don't feel strong nor heroic enough to buck the headaches — particularly those from customers . . . I have switched to industrial electronics . . . I want to thank you for the help you have given to the service industry and will always recommend your very fine publication.

H. G.
(Name withheld on request)
Baltimore, Md.

If we keep studying and keep up with things electronic we can always get a job in industrial electronics if we find that we can't take the public-service 'gaff.' — Ed.

Where are They Now.

We have a Shell "Testomatic" model S102 which needs a new tube chart. The old one is obsolete. We have sent two letters to Shell Electronics, 112 State St., Westbury, N.Y., but both have been returned. Could you help us with the proper address.

GONTY'S
Heppner, Oregon.

Anyone know if they are still in business? If so, where? — Ed.

Nothing — But Nothing

I've been digesting your magazine for nearly 2 years now, and while I agree it is a good magazine from the standpoint of paper and typing quality, the only trouble is, *there's nothing in it.* Not even essays on how to operate that equipment you are urging us to buy. This is one thing that could be enlarged upon. Only a brief sketch of its operation comes with the instrument.

The schematics are fine, but they don't *fit* anything . . . None of the schematics received, including those in the subscription inducement, have found a use. It's the *old* sets that come in for repairs. No thank you, until . . .

R. M. FRENCH
Boyce, La.

What would you like to see in ET besides all those technical articles and TV schematics? Upcoming are detailed articles on how to use VTVMs, scopes, transistor analyzers and many other test instruments. But you must be talking about some other magazine — ET never urges readers to buy anything. — Ed.

Have you tried new QUIG® connectors?

Not just another wire spring connector!

The 3-in-1 QUIG is brand new and different . . . Copperweld wire inner core, a layer of flux, and an outer jacket of solder . . . all you need is heat!

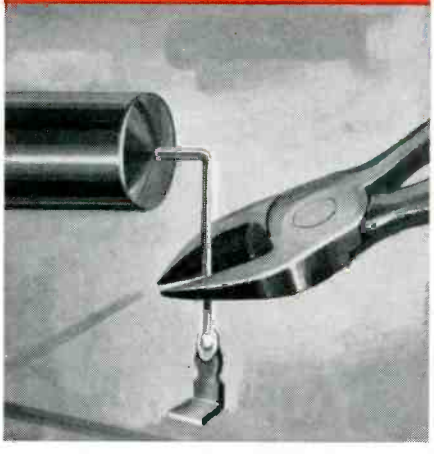
Makes one-handed soldering possible!

Ten times actual size

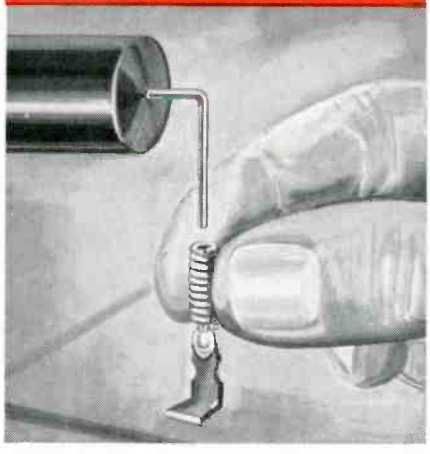
Once again, Sprague helps the TV-radio service industry by solving two increasingly serious problems . . . parts replacement in those "inaccessible" chassis nooks, such as crowded tube sockets, as well as soldering onto the delicate circuitry of printed wiring boards.

Mechanically sturdy and electrically reliable, the revolutionary QUIG provides fast, expertly-soldered connections as easy as A-B-C!

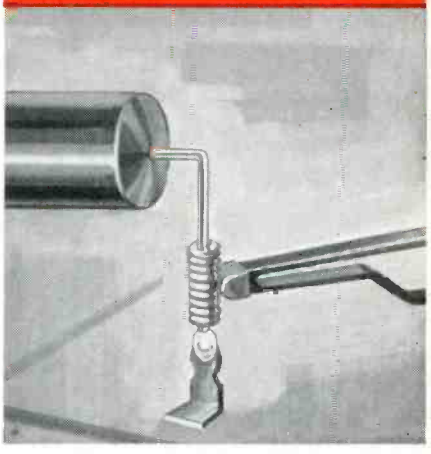
A Snip Lead



B Slip on QUIG



C Heat QUIG, Connection Made!



NOBODY ELSE HAS QUIG CONNECTORS... YOU GET 'EM ONLY FROM SPRAGUE PRODUCTS!

QUIGS are now being packed with Sprague Atom® Capacitors *at no extra cost to you!* Whenever you need tubular electrolytics, insist on pre-packaged Sprague Atoms from your parts distributor and you'll automatically get your QUIG component connectors . . . the biggest boon to the service technician since the soldering gun!

SPRAGUE®
THE MARK OF RELIABILITY

WORLD'S LARGEST MANUFACTURER OF CAPACITORS

6S-4104

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LETTERS TO THE EDITOR

. . . Who manufactures the portable, transistorized BUTOBA MT7 tape recorder? Can any ET reader help me? I need a schematic. . .

R. A. PELLETIER
Chicago, Ill.

Butter For the Ego

. . . I appreciate the service you and your magazine has provided for years: I rate ELECTRONIC TECHNICIAN the top magazine in its field, and I have and always will recommend it without reservation . . .

WOLBERT ROETTGERS
Pearl River, N.Y.

. . . Your ELECTRONIC TECHNICIAN is a wonderful help to anyone in TV-radio service. . . .

JAMES S. CANNON
Memphis, Tenn.

I have been a subscriber of your magazine for the past 11 years. It sure has shown improvement in the past several years. Especially in the schematic section. I have noticed recently that Tekfax has been giving TV more coverage. TV is my bread and butter and having new schematics available really makes things easier. As color TV service has become an important part of my business, I am happy to see the many color diagrams being printed.

S. A. ANDERSON
Los Angeles, Calif.

A Suggestion

I have been getting a number of service calls for garage door operators. I would like to see some coverage on this subject in your magazine. Some of the circuitry appears strange to me.

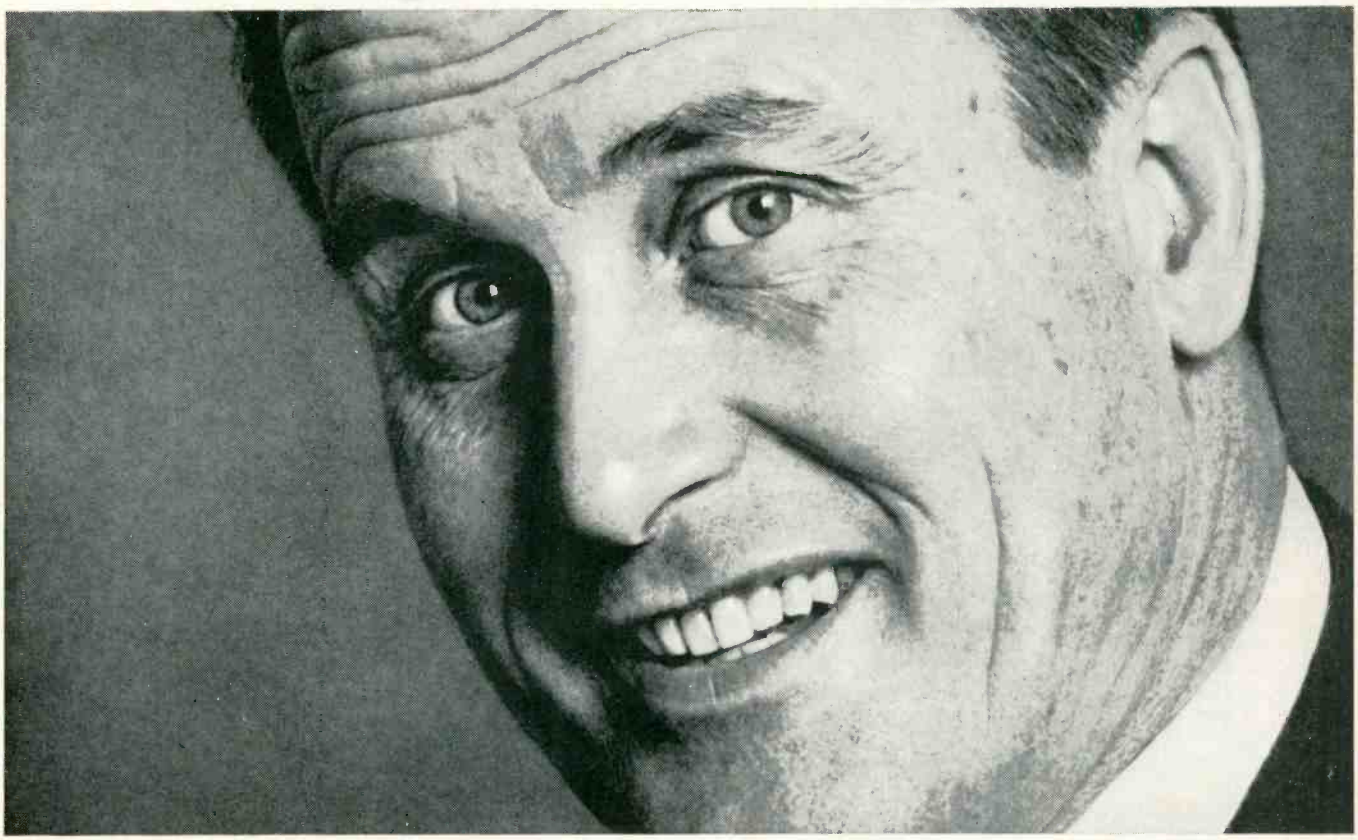
D. L. RAMER
Cleveland, Ohio

Technician Certification

I am very interested in your engineering technician certification program. Please send me full information on the subject.

R. K. OLSON
St. Louis, Missouri

"I can ship anytime day or night...



that's why I always specify Greyhound Package Express!"

Greyhound Package Express never stops for lunch, never quits at five, never sleeps at night. Not on weekdays. Not on weekends. Not even on holidays. Your shipments travel on regular Greyhound buses... via fast, frequent Greyhound schedules. Your shipments get moving *faster* so they can arrive *sooner*. Packages shipped hundreds of miles frequently arrive the very same day. And even on longer trips, overnight deliveries are routine. Save time! Save money! Save trouble, too! Ship C.O.D., Collect, Prepaid or open a Greyhound Package Express Charge Account.

For information on service, rates and routes, call Greyhound or write today: Greyhound Package Express, Dept.53-D, 140 S. Dearborn St., Chicago 3, Ill.

It's there in hours...and costs you less

For Example:	Buses Daily:	Running Time:	20 lbs.	30 lbs.	40 lbs.*
DALLAS—SAN ANTONIO	10	7 hrs. 15 min.	$1.90	$2.15	$2.45
CINCINNATI—LOUISVILLE	14	2 hrs. 20 min.	1.65	1.90	2.15
CLEVELAND—COLUMBUS	10	3 hrs. 5 min.	1.80	2.05	2.40
LOS ANGELES—SAN FRANCISCO	28	9 hrs. 20 min.	2.10	2.45	

*Other low rates up to 100 lbs.

GREYHOUND® PACKAGE EXPRESS

One of a series of messages depicting another growing service of The Greyhound Corporation.

. . . for more details circle 28 on postcard

EDITORS' MEMO

Shrink Or Swim?

Anthropologists tell us that the earliest-known primitive tools date back some 600,000 years. Discoveries about Peking and Neanderthal Man, Middle Paleolithic and Modern Man, indicate that man's brain began to increase in size as he adjusted to new ways of life. And after man started using tools — which some scientists believe gave larger-brain types more survival advantage — the size of man's brain just about doubled . . .

We doubt that you'll have to buy a larger hat right away if you begin using test instruments more intelligently to keep up with modern service techniques, meet service competition and the "profit-squeeze" head on. But we do have an idea that the principle involved hasn't changed much after all these years. Certainly, the technician who spends a few extra hours establishing systematic methods for using his signal tracer, transistor tester, VOM, VTVM or capacitor tester more effectively, isn't going to find his head or pocketbook shrinking.

Too many of us, however, expect our test instruments to solve trouble-shooting problems like a $3-million computer programed to the Monte Carlo system. Our instruments are just tools. They're not gifted with whatever it is that distinguishes man from the most advanced type electronic computers. These so-called "brains" solve certain problems in minutes that would take man a lifetime to solve.

And using the least efficient and accurate "tool" on a certain job is just another sure way to shrink faster.

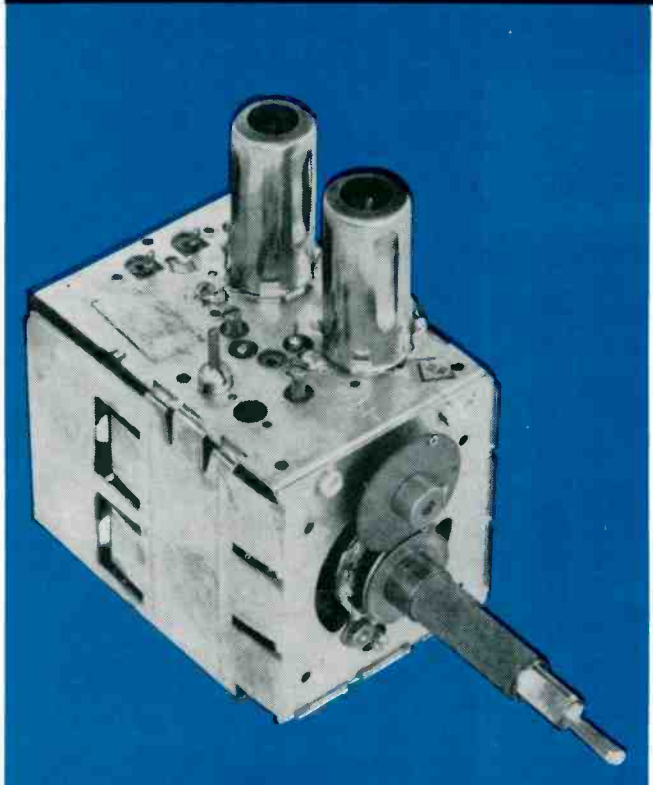
The saddest thing I have found in visiting shops around the country has been the lack of test equipment "know how" on the part of many technicians. In many cases you will find the scope and other equipment gathering dust in a corner just because the man doesn't know how to use it.

In forthcoming issues, ELECTRONIC TECHNICIAN will concentrate more on specialized test instruments for getting specific jobs done rapidly, efficiently and accurately.

We plan to do this in connection with an expansion program now being carried out in our laboratory. Not only do we intend to tell you how to use some of the most modern test equipment, but articles will be developed to show how you can use tried-and-true, standard test instruments more effectively.

Briefly, we intend to help you swim, not shrink.

TUNER REPAIRS



$9.50

FOR COMPLETE OVERHAUL

Includes ALL parts (except tubes)
ALL labor on ALL makes

24-HOUR SERVICE with FULL YEAR WARRANTY

Sarkes Tarzian, Inc., largest manufacturer of TV and FM tuners, maintains two completely-equipped Service Centers to serve YOU. Both centers are staffed by well-trained technicians in this specialized field and are assisted by engineering personnel to assure you of FAST, DEPENDABLE service.

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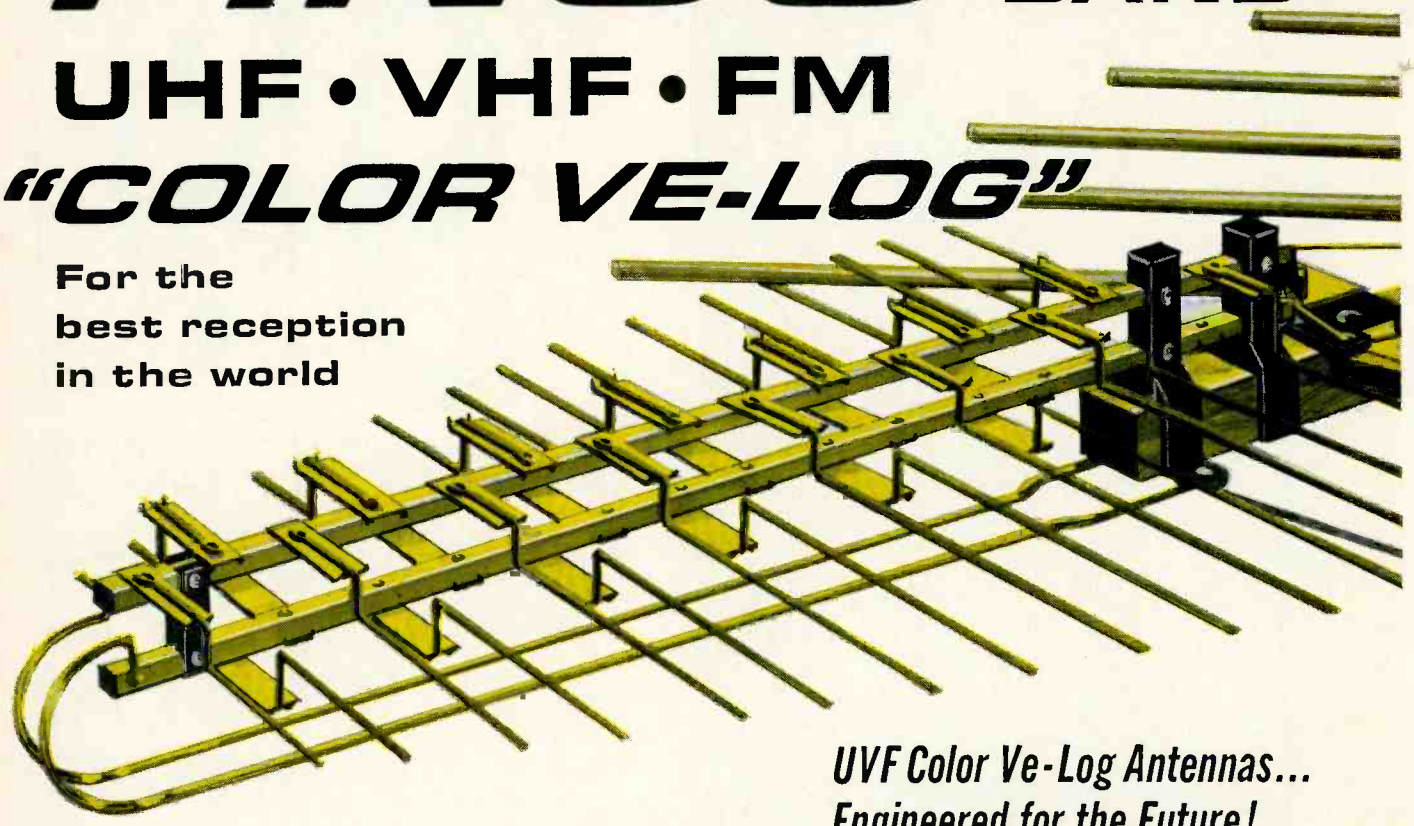

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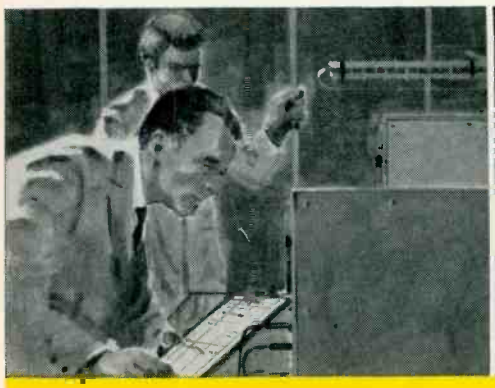

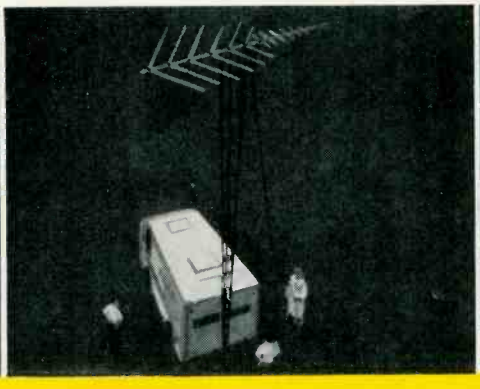

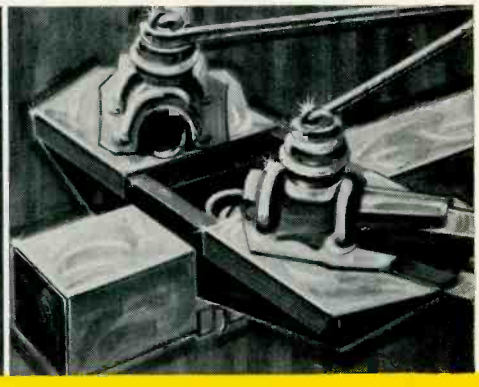

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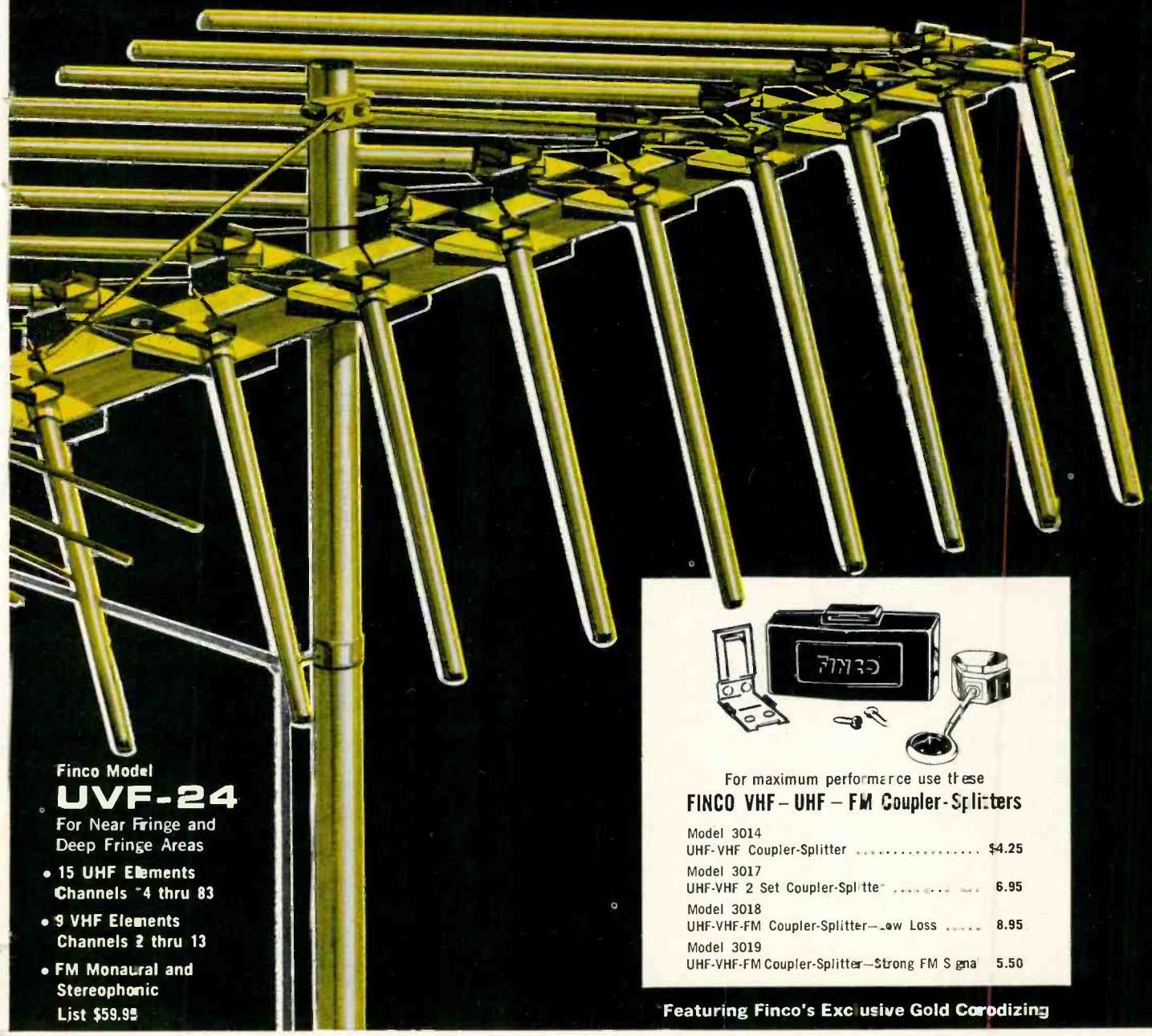

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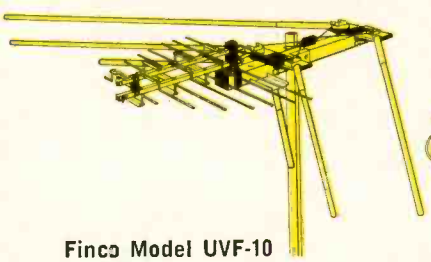

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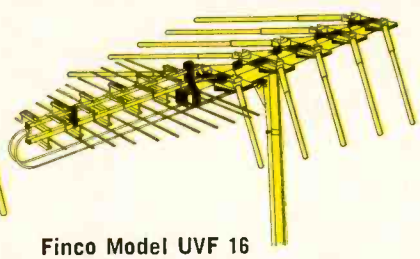

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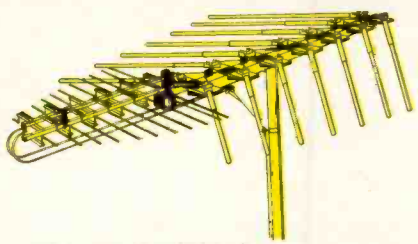

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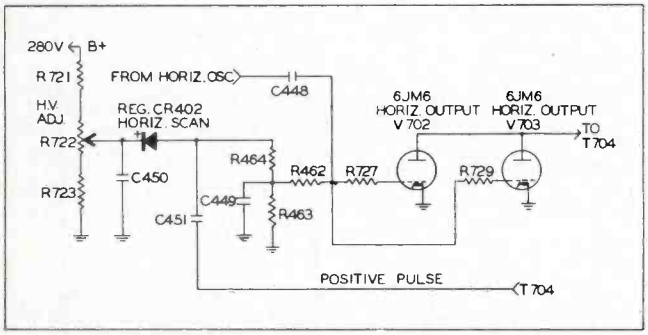
TECHNICAL DIGEST

ADMIRAL

Color TV Chassis G11 — Circuit Descriptions

HV Regulator

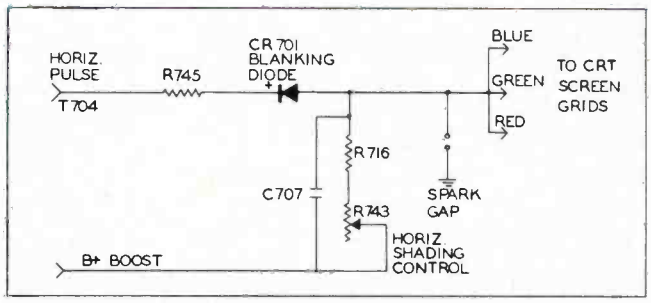
The purpose of the high voltage regulator (CR402) is to provide current regulation of the horizontal output circuit. CR402 and its associated components produce a negative voltage which biases the horizontal output tube grids proportionally to the load on the horizontal output transformer. This bias supplements the normal bias produced by the output stages. A positive pulse from the



horizontal output transformer (T704) determines the amount of regulating bias produced. The amplitude of the feed back pulse varies with the load on the transformer and in turn regulates the bias for V702 and V703. The high voltage adjustment (R722) varies the amount of reverse bias at CR402 and, therefore, the amount of conduction. The high voltage is proportional to the current through the horizontal output transformer.

Horizontal Blanking

Horizontal blanking is accomplished by applying a pulse from the horizontal output transformer (T704) to the Red, Green, and Blue screen grids of the picture tube. The diode, CR701, is reverse-biased during horizontal scan time and the screen grids have B+ boost applied through R743 and R716. During horizontal retrace time, a negative pulse is applied to the cathode of the diode which causes it to conduct. This negative pulse reduces



the screen voltage sufficiently to blank the picture tube off. A HORIZONTAL SHADING Control, R743, is provided to adjust the blanking time to eliminate shading at the left-hand side of the picture tube. This adjustment will not normally require adjustment.

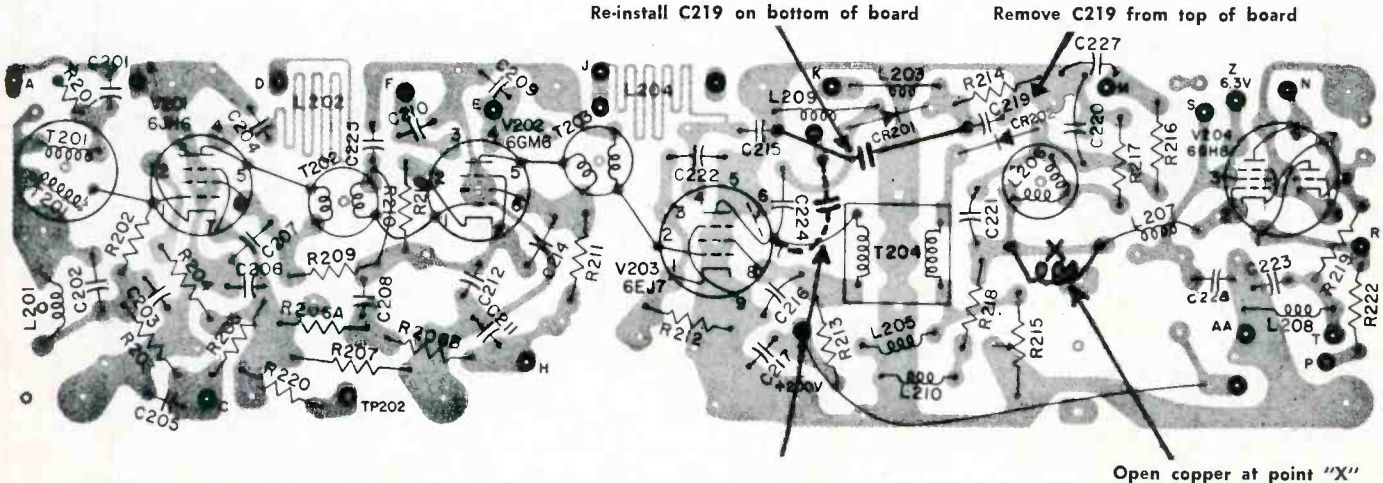
MAGNAVOX

Color TV Chassis 45 Series — Circuit Modification

In some channel 8 areas reports have been received of an unusual interference pattern on the screen of the 45 Series Color TV Chassis incorporating the AFC feature. This was found to be caused by the 4th harmonic of the picture IF signal (which falls within the channel 8 passband) being fed back to the front end and resulting in the development of a beat signal. Since the resulting signal is modulated, the pattern on the screen will vary and has at times been described "loosely" as a herringbone pattern and at other times as being similar to diathermy interference. This type of interference can be readily identified, however, if removing the 6BZ6 tube in the AFC circuit materially reduces the interference.

Changes have been incorporated in production to eliminate this interference.

Modification instructions for earlier chassis are as follows: 1. Remove the IF board top shield and remove C229 — 0.47 μf. capacitator from the IF board. This



View of video IF board, Magnavox 45 Series Color Chassis.

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TECHNICAL DIGEST

capacitor is not marked on the board, but can be located rather easily. It is positioned on the top side of the board between C224 and the 3rd IF shield. (See illustration). Note: C229 is not replaced by another capacitor since the space coupling is satisfactory for feeding the IF signal to the AFC board. Removal of this capacitor will tilt the IF curve. This will not be noticeable in the picture, but may cause a significant reduction in chroma under weak signal conditions. Adjustment of the 3rd IF will be necessary and *this adjustment is critical.* Working from the top side of the board, this is the second (or lower) core in the can. Using a hex tuning wand, insert it through the first core into the second. *Do not turn the top core.* Turn the lower slug ¾ of a turn *counter-clockwise.*

2. Change the 6BZ6, AFC amplifier tube to a 6BA6, readjust the secondary of the AFC discriminator. This can be done rather easily by tuning in the channel 8 signal, with the AFC in operation, and retune the secondary for the proper tuning point.

Now observe the picture on channel 8. This modification should normally reduce the interference to an acceptable level. In more persistent cases, however, it may be necessary to make the following additional changes.

1. Remove the chassis and then the shield under the IF board. Remove capacitator C219, 10 pf from the top of the board and reinstall on the bottom side. Solder one lead to the point to which it was originally connected. Add a 1 inch wire to the other capacitor lead and solder to the ground connection at the same point where C215 is connected. This simply places the ground connection of C219 at a new point. (See illustration.)
2. Open the circuit between L206 and L207 by cutting a ⅛ in. section of the copper land from the board and install choke #360852-3 across this open circuit.
3. Top and bottom IF shield should then be replaced, being certain to resolder the bottom shield at all six points.
4. Insert a 5600 Ω resistor at point C on the AFC board, in series with the AFC voltage line to the tuner.
5. Re-install the chassis in the cabinet and check reception, particularly on channel 8.

GENERAL ELECTRIC

TV Chassis TA — Low Voltage Power Supply — Circuit Operation

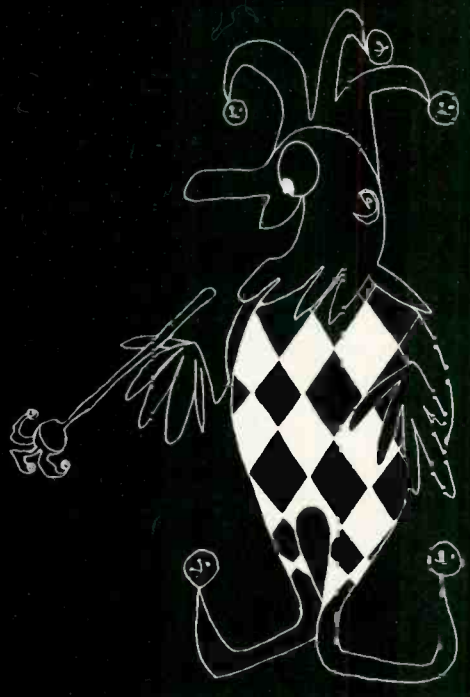
The low voltage power supply is a transistorized, adjustable, voltage regulated type which uses two transistors, two silicon diodes, and one zener diode. The silicon diodes Y401 and Y402 are connected to form a full wave rectifier circuit, with the output filtered by C401. The dc output voltage is connected to the emitter of Q21, a PNP germanium transistor, which serves as a series voltage regulator.

For simplicity, consider the transistor Q21 to function as a variable resistor. The internal resistance of the transistor can be varied by changing the amount of forward bias voltage that is applied to the emitter-base junction.

Q20 is an NPN silicon transistor which functions as an error amplifier. It will respond to voltage variations which appear at the collector of Q21 and adjusts the base bias on Q21 to keep the output voltage at a constant amplitude. The base voltage for Q20 is supplied from the

Continued on page 94

GOOF-PROOF VOM



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SYNC ON BUSINESS

The tape recorder industry is beginning to attract an entirely new type of customer — one that has the potential to break the market wide open — according to Wybo Semmelink, manager of the Norelco Hi Fi Products Dept. of North American Philips Co. The new customer, he said, can be characterized as "the great American middle-class consumer," the average person who has never owned a tape recorder before — one that wants a tape recorder that falls between the low-end, poor-quality recorder and the high priced stereo unit — the two extremes that have tended to dominate the field. If this is true, perhaps we can generate some business out of it.

• • •

An "Entertainment Semiconductors Replacement Guide" has been published by G-E. The guide is devoted to a full line of transistors, rectifiers, dual diodes, crystal diodes, and color TV rectifiers. It is available only at your G-E distributor.

• • •

Its first course in CATV system maintenance was conducted by Entron in Silver Spring, Md. some time ago. Students from New York, New Jersey, Illinois, Minnesota, Tennessee, Alabama, Mississippi, North Carolina, New Mexico and Pennsylvania are shown here participating in the course which included instruction in all phases of installation, operation and maintenance. Other courses are planned.

• • •

"How to Clean, Maintain and Protect Records" by Cecil E. Watts, internationally recognized authority for record maintenance, is a little booklet you may be able to use as a Hi Fi customer relations piece for your best Hi Fi customers. It is written in easy-to-understand language and covers the subject thoroughly. Price is 25¢ from Elpa Marketing Industries, Inc., New Hyde Park, N.Y. Probably be a good idea to order a sample copy first and take a first-hand "gander" at it yourself.

• • •

Speaking of customer relations, the "message" of the new president of Texas Electronics Association, Don Chambers, published in the December/January issue of TEA TIMES, contains some of the most modern but sage advice we have recently observed in technician association literature. We'll quote only one paragraph: "Talking to our fellow business men is not enough. We must let our customers and our competitors' customers know what we are doing. Let them know that we will attend our school of management; Let them know that we have the proper equipment, technical information, and qualified personnel to perform with efficiency."

• • •

The sound equipment line of LTV University is being supported by an enlarged advertising and promotional program, according to Irving Greene, industry veteran. The program will support its line of speakers for commercial, industrial, military and consumer use, including Hi Fi component speakers and systems, PA speakers and accessories, microphones and related electronic equipment.

• • •

"Tape Recording the Sounds of Your Life" is another book that Hi Fi service-dealers may find helpful. The retail price is $1.35, and its 128 pages are dedicated to all tape recordists, hobbyists and professionals. Perhaps a modest supply made available in your show room for purchase by customers and prospects, would be a good idea. They're copyrighted by Robins Industries Corp., Flushing, N.Y. 11356.

• • •

Sylvania parts depot changes have caused some confusion in the field. If you don't know where parts orders should be placed, the factory suggests this procedure (1). Check your phone book yellow pages for a distributor listing. If no distributor is listed, order your parts from one of the parts central locations. (2). If it is necessary to order from a parts central location, use these boundaries as a guide to ordering: The area including as a boundary Pennsylvania and Delaware to the northeast should order from New York City. The address is 97 New Hyde Park Road, Franklin Square, N.Y. Those ordering from the northeast boundary to the eastern limits of Montana, Colorado, Utah and Arizona should order from Illinois. The address is 2001 North Cornell Avenue, Melrose Park, Ill. All orders placed from the west coast to the central boundary should order from Los Angeles, Calif. The address is 6505 E. Gayhart St., Los Angeles, Calif.

• • •

The Electronic Industries Association's Semiconductor Division has set up a three-man task force to study reports of counterfeiting of semiconductor devices. The group, headed by Robert J. Maijer of Bendix Semiconductor Division, will determine the extent of the alleged counterfeiting and recommend possible action by EIA and semiconductor manufacturers if the need for action is identified. The task force will report to the division's executive committee at its meeting during the EIA annual convention in July at Chicago. During preliminary discussion, the consensus of the executive committee was that the counterfeiting problem appears serious, even though it is apparently not widespread or on a grand scale.

Space-To-Home TV Forecast

Perfect color television — no "ghosts," no "snow," no double or triple images, no weak signals — could be relayed from outer space directly to homes and schools in any inhabited area of the world, however remote, within two or three years.

Dr. Harold A. Rosen, assistant manager of Hughes Aircraft Company's Space Systems division, told European and U. S. newsman that the technology exists for launching a 1,550-pound stationary satellite into synchronous orbit to relay color or black and white programs to home receivers anywhere, including areas where no TV reception is possible today.

"Such a system — and it would be relatively inexpensive — would be of greatest immediate benefit to underdeveloped countries of Africa and South America and some smaller parts of Europe and North America not now reached by microwave communications or community cable systems," Dr. Rosen said.

A forerunner of the satellite is currently under development and test in Hughes laboratories, Dr. Rosen said. He also disclosed that current work in the field of synchronous satellites could result in a multi-million channel equatorial communications network carrying television, voice, photo facsimile and teletype every place in the world, except the sparsely inhabited polar regions, before the end of the century.

A home or school antenna could be stamped out of aluminum in much the same way as the top of an automombile is made, he said. The receiver could be designed by extending the concept of the UHF signal converter now in use. Conversion of microwave frequencies is fundamentally no more difficult, he said.

Dr. Rosen, who identified himself as a scientist rather than a businessman, said that he could visualize methods of financing such a venture.

"Individual governments might pay for the system because of the great benefits to be derived by schools and universities and because of the possibilities of wider dissemination of information," he continued. "A group of industries with common interests in many different countries might form a consortium to exchange visual information about product developments, sign contracts or conduct conferences in which charts, graphs or other presentations were pertinent to a discussion.

"It is even reasonable to assume that the manufacturers of TV receivers might underwrite such a system in anticipation of greatly increased sales. And, of course, subscription television is another possible financing method," he said.

Dr. Rosen refused to predict a time when such a system might be available but he did say that "as soon as someone with the necessary funds says 'Go!' we can have such a satellite in orbit within two years."

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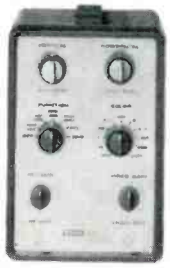

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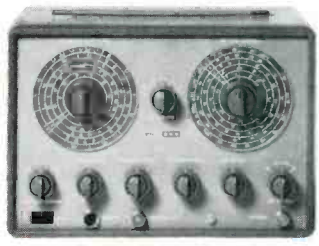

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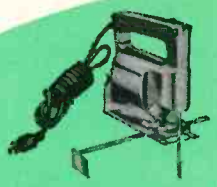

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GENERAL ELECTRIC

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MALLORY

Tips for Technicians

Mallory Distributor Products Company
a division of P. R. Mallory & Co. Inc.
P.O. Box 1558, Indianapolis, Ind. 46206

How to reduce ripple in solid state circuits

Many of the new solid state circuits you'll be working with are line operated. This means that the power supply has to produce just about as pure DC as possible, at anywhere from 3 to 25 volts. How do you get ripple down to the rock bottom minimum, so there's no trace of 60 cycle hum in the output?

First tip: start out with a full wave rectifier. This inherently gives you far less filtering to do than a half-wave rectifier. If you need up to 1.5 amperes DC, the simplest way to do the job is to use a Mallory Type FW full wave bridge circuit package. All four rectifiers are factory-connected in this compact, encapsulated unit. All you need to do is connect the four leadwires—AC input and DC output—in your circuit, and you're ready to go. You'll save yourself some money, because the package costs appreciably less than four separate rectifiers. Or you can use a full wave center tap . . . we have packaged circuits with either positive or negative center, also rated 1.5 amperes. And if you need higher currents, take a look at our stud-mount and press-fit types which go up to 25 amperes.

Next tip: use a lot of capacitance. Brute force filtering is the sure way to kill ripple. And when it comes to packaging maximum capacity into a filter, the Mallory line gives you a broad choice. The "mostest microfarads" comes in the CG computer grade series, where you can get up to 115,000 mfd. at 3 volts in standard, off-the-shelf parts . . . dollar for dollar, the most filter for your money. But you don't always need this much capacitance, or perhaps you have limitations on physical size. Then take a look at what you can get in Mallory TC capacitors (the horizontal mounting type): up to 1000 mfd., at 50 volts.

Or maybe you'd prefer a vertical twist-mount type. That's our famous FP series. Up to 10,000 mfd. at 6 volts, or 7,500 mfd. at 25 volts in single units, and slightly less in multiple-section types.

Your Mallory distributor carries a wide selection ready for immediate delivery. See him soon. He's your best source for everything that's best in electronic components.

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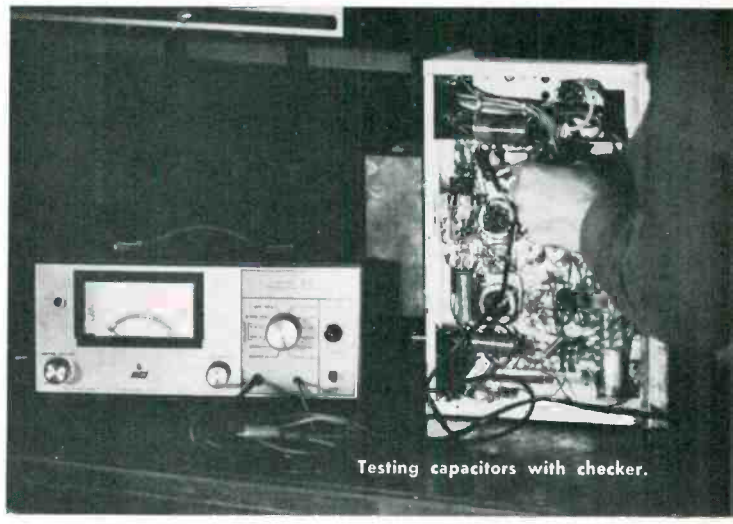
ELECTRONIC TECHNICIAN

APRIL 1965

The Intelligent Approach to Capacitor Checking

by Tony D'Angelo
Central Service Co.

Eliminate unprofitable troubleshooting procedures with specialized test instrument



Testing capacitors with checker.

■ Next to tubes, we have always found a relatively large number of defective capacitors in the electronic equipment we service. This has resulted in expending a lot of unprofitable service time locating open, leaking and shorting capacitors by hit-and-miss "meter methods." But we have recently put an end to a large portion of this waste by adding an in- and out-of-circuit capacitor tester to our test instrument collection. In a brief period we have located a rather large number of marginal capacitors with the in-circuit test alone.

Leaky capacitors will sometimes reveal a visual clue. A typical example is a leaky capacitor bypassing a B+ circuit. If the leakage is great enough the resistor will overheat, smoke or possibly burn up. More frequently, however, the leakage is not enough to give a visual indication but bad enough to cause a certain degree of circuit malfunction.

No one has yet developed an inexpensive test instrument for TV-radio, Hi Fi work that performs high-speed "go", "no-go" indications — equipment that practically "thinks" for you. Sophisticated, expensive test equipment of this type is used only to check elaborate electronic systems. For this reason, your capacitor checker is just like your scope, VTVM or other shop instrument — you have to learn how to use it. Additionally, you have to know the particular function of a capacitor in a given circuit before you can properly evaluate its condition.

Capacitor defects will fall roughly into three categories: opens, shorts and leakage. But these defects can be further divided into various "degrees of defectiveness." And some defects may not be severe enough to materially upset the circuit. Hence, to get efficient results from your capacitor checker, you must understand its operation thoroughly and how it should be applied to individual situations. Some capacitors tested in-circuit cannot be considered bad or good without taking the individual circuitry into consideration.

The best way to begin learning about your capacitor checker is with the instruction book furnished by the instrument manufacturer. In our case, each technician attended a briefing session on the capicitor checker prior to being allowed to go it alone. They became thoroughly familiar with its use at the beginning.

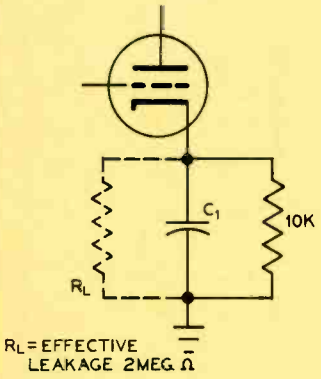


Fig. 1—A 2M leakage in C1 would not materially affect the total circuit resistance.

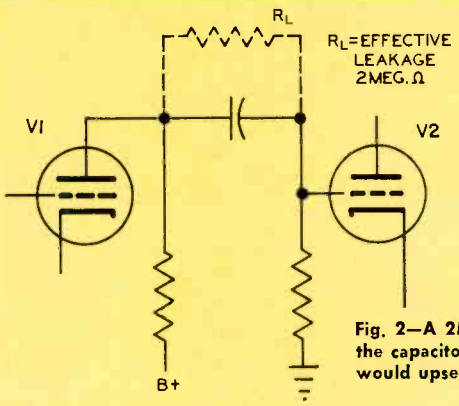


Fig. 2—A 2M leakage across the capacitor in this circuit would upset the bias on V2.

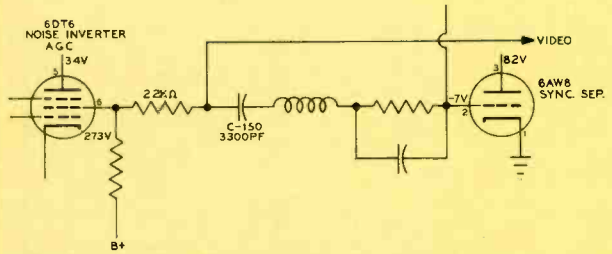


Fig. 3—A 30 M leakage in C150 caused 'touchy sync' in this color-set circuit.

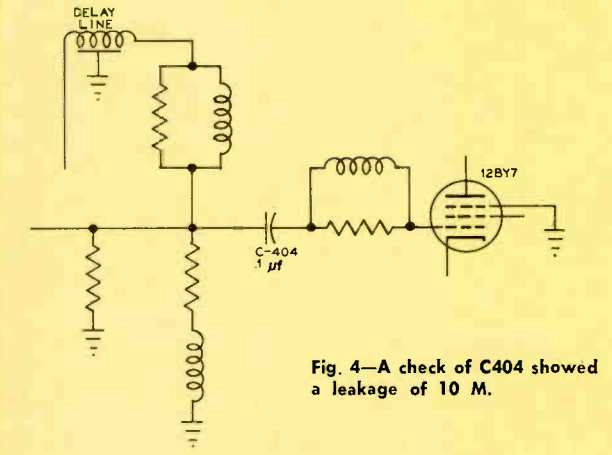


Fig. 4—A check of C404 showed a leakage of 10 M.

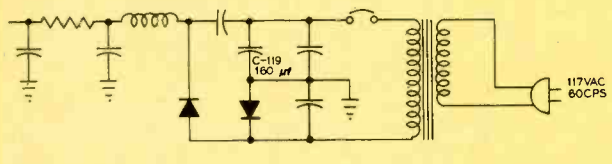


Fig. 5—Electrolytic C119 showed a decrease of approximately 50 uf in capacity.

Some Capacitor Considerations

Some of our technicians are primarily concerned with making house calls and doing limited bench work. Because of this, they are inclined to get somewhat out of contact with electronic theory. And this was true of electrolytic capacitor theory, too. Some technicians, for example, had forgotten how wide the tolerances are on electrolytic capacitors. Manufacturers' tolerances can be as high as 70 to 80 percent *over* rated values. And many circuits will work perfectly normal with electrolytic capacitors that are 100 percent higher than specified circuit values. On the other hand, a capacitor that checks 20 percent *below* its rated value would adversely affect the operation of most circuits and should be considered defective.

Ceramic capacitors should be understood also. Most good ceramics will show a rather high degree of leakage and should not be considered defective by this test alone.

Practical Examples

Referring to Fig. 1, the effect of 2 MΩ leakage through C1 would be negligible since paralleling 2 MΩ with 10 KΩ does not offer much reduction in circuit resistance. But the same capacitor with 2 MΩ leakage in a circuit like that shown in Fig. 2 would seriously affect the circuit operation since the leakage resistance would allow some B+ to flow to the grid of V2, causing a change in operating bias.

In these two examples it is necessary for technicians to analyze the circuits and determine if the leakage resistance of 2 MΩ would affect circuit operation.

We recently completed a job on an RCA CTC-11 color chassis. When the set came into the shop the tag said "touchy sync." Color and audio appeared normal and it was determined that the problem was somewhere in the sync separator circuit (See Fig. 3). Voltage checks in the sync separator showed the voltages to be rather close to specifications. Pin 2 of the 6AW8 separator, however, showed a -1 v reading instead of the normal -7 v. Pin 6 of the 6DT6 tube showed approximately 270 v.

When C150 was checked, the tester indicated 30 MΩ leakage and C150 was replaced. The set resumed

Sprague capacitor analyzer.

B&K capacitor analyst.

normal operation. Ordinarily, we would have considered this set repaired and would have taken it back to the customer, but we checked the other accessible capacitors. We found C404 (Fig. 4), a 0.1 μf capacitor, coupling to the second video amplifier, to be leaking 10 MΩ. Although this capacitor caused no apparent problem at the time, it was replaced to prevent a possible callback in the near future.

We also checked the filter capacitors of this set. C119 (Fig. 5), rated at 160 μf, showed an effective operating capacity of 110μf. According to recommendations of the tester manufacturer, the capacitor was replaced because it was well below rated capacity. This normally indicates considerable aging, a short life expectancy, and could result in a callback and unhappy customer.

We would not normally have found the two aforementioned marginal capacitors and would have returned the set to the customer without knowing they existed. We have no way of knowing now when or if these two capacitors would have failed, but we delivered the set to the customer with a great deal more confidence because we were able to locate and prevent a possible future service problem.

A typical capacitor trouble, not uncommon but difficult to determine, is a change in capacitor value. The normal capacitor will change value no more than 3 to 4 percent during its lifetime. But a large change in capacity can be caused by improper foil crimping at the time of manufacture which results in a poor contact to the connecting leads. This defect may not show up for a long time. It may only show itself when mechanical vibration or temperature changes take place.

A recent example was the vertical multivibrator circuit in an Olympic chassis "KU". The complaint said "vertical hold did not have enough range to lock the picture." In checking the vertical circuit, of course, we first substituted tubes. Finding no problem here, we started to check components in the vertical circuit. We found no resistor problems.

We began to check the capacitors in this circuit. A 0.002 μf checked OK, a 0.01 μf unit checked OK and a 0.007 μf checked out at 0.003 μf — almost half of its rated value. When the 0.007 μf unit was replaced, the set resumed normal operation.

While working on this set, we checked three other capacitors in this circuit. All came within normal tolerance. The 100 μf filter capacitor at the 12BH7 cathode measured only 80 μf. Since we considered this capacitor marginal, we changed the entire unit which included another section which checked OK. We again felt that we may have saved ourselves a future service problem by checking all the capacitors in this circuit.

General Approach

Some technicians are prone to replace all capacitors when a problem arises in a particular circuit. Although this corrects against capacitor failure and catches marginal capacitors, the profit from the sale of a half-dozen capacitors does not warrant the extra time involved in changing them.

A better method is to check all capacitors in a problem area and replace only the ones which show signs of failure. We have adopted a policy of checking all *accessible* capacitors in any piece of equipment on our bench even though no problem is indicated in those circuits. This normally takes less than 10 minutes and has resulted in locating an average of two additional marginal capacitors in each piece of equipment we have worked on.

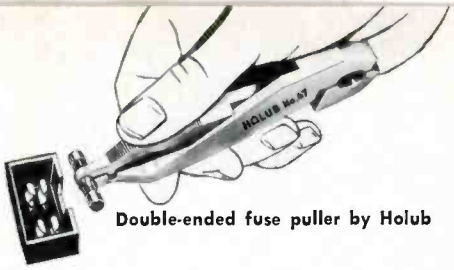
We do not dig into the tuner or into other places that are not easily accessible unless some problem exists in these areas. Although it is true that checking all capacitors in the set would probably result in finding more marginal units, the amount of time required to check all of them would not make it worthwhile from a profit viewpoint. Because of the small cost of the capacitor, it should be replaced automatically if any question arises regarding its quality. We have found that customers are not too fussy about the charge for small parts.

We feel that we have taken a progressive step forward in extending better and more reliable service to our customers by using the equipment and methods outlined here. We believe that the days of the "screwdriver mechanic" are numbered and only the progressive service shops who keep up to date with proper service equipment and techniques can survive in this business. We like to believe that we, together with a large group of other service-dealers, belong in the progressive category. ■

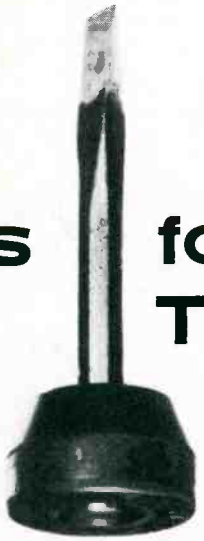
Tools for Busy Technicians

Tools are time savers. And the proper tool in the proper place gets the job done easier. It all ads up to time saved — and every hour saved can be converted into returns that add up to a certain number of dollars and cents.

We cannot list all the new tools that have been designed to speed TV-radio servicing. We have selected only a few examples to keep you informed about the latest developments in this area.



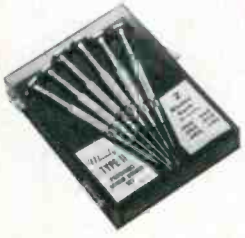
Double-ended fuse puller by Holub



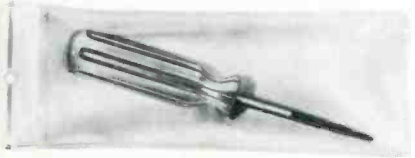
Safety cap for star drills by Pendergast.

Screw starters by Rinck-McIlwaine.

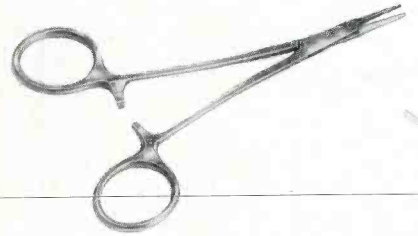
Variable speed control by Radatron.



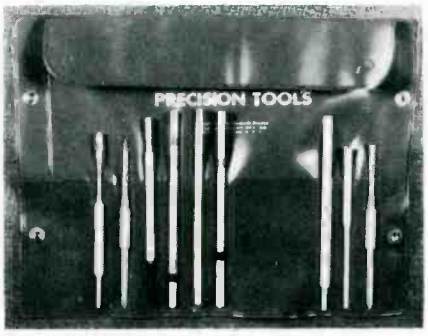
Moody tiny screwdriver set.



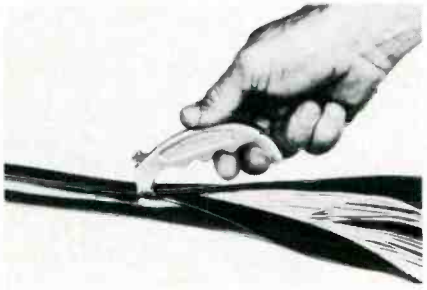
Vaco tapping tool.



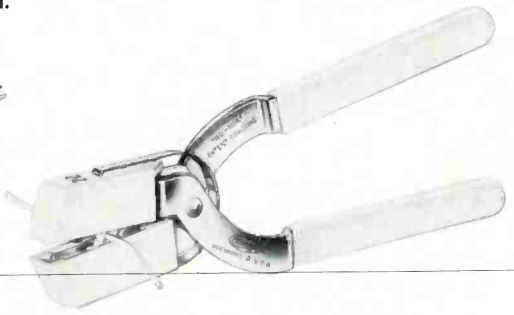
'Junior' seizers by Xcelite.



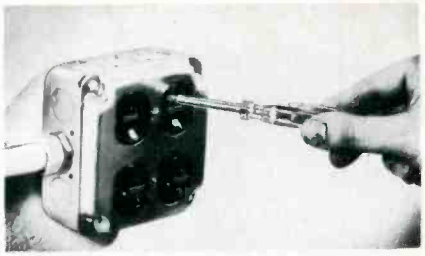
GC's citizens band alignment tool kit.



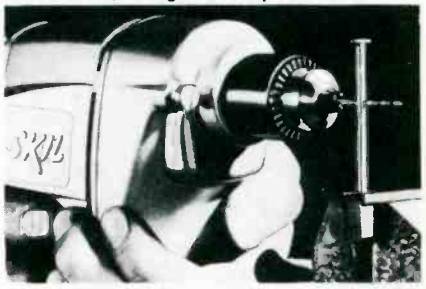
Zip-Eze hand tool for closing cables is by Zippertubing Co.



Insulation remover by Clauss Cutlery Co.



Screwdriver/voltage tester by Littelfuse.

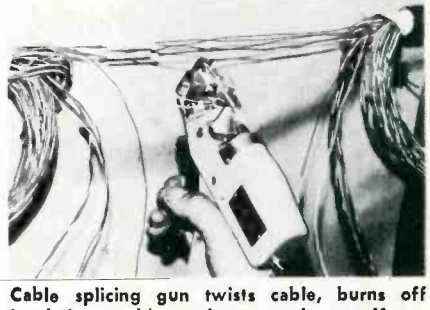


Skil's variable speed drill minimizes 'skittering.'

Manual cabling tool is by Panduit Corp.

Jensen Tool's stereoscopic magnifier.

Terminal crimping tool by Thomas & Betts.



Cable splicing gun twists cable, burns off insulation, welds conductors and cuts off surplus wire. Made by Jonard Industries Corp.

Increase the efficiency of your scope and VTVM with the proper application of available accessories.

Probes—An effective tool

by Don R. Borden

■ Alert, successful TV-radio, Hi Fi technicians have always found it necessary to use adequate test equipment to speed troubleshooting and repair. With today's fast-moving developments in color TV, however, this becomes even more urgent.

A scope and a VTVM are two important test instruments required by every TV-radio shop. But the effectiveness and full potential of these instruments is impossible without a complete set of accessory probes. And the technician who does not understand how to use the scope, the VTVM and probes efficiently, will find it difficult to survive the "profit-squeeze" in the color-TV service age.

Direct Probe

Some kind of test leads are required to connect a scope to any circuit. Two ordinary unshielded leads would not be suitable because they would pick up objectionable hum and permit the scope reading to be affected by stray fields. A coaxial cable, however, will prevent unwanted signals to reach the scope input but this cable would add a considerable amount of capacitance to the already highly capacitive scope input (Fig. 1).

The input capacitance of the vertical amplifier of a service scope may range from 20 to 40 pf. This, plus the capacitance of a direct probe, (50 to 200 pf) cannot be tolerated in a number of circuits. When a low impedance probe is connected to a high impedance circuit the stage is severely loaded and a faulty indication results. For this reason a direct probe cannot be used in many TV applications. A probe which offers a higher impedance is designed for this application.

Low Capacity Probe

The low capacity, high impedance probe effectively inserts an impedance in series with the input impedance of the scope. This raises the total impedance and lowers the capacitance and thus reduces the loading effect of the scope on the circuit under test.

Although it is necessary to present a low capacity load to high impedance circuits, this type of probe has the disadvantage of attenuating

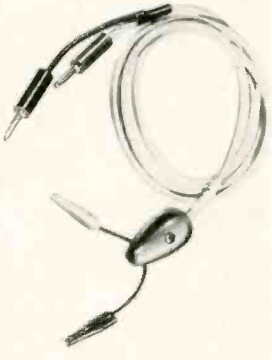
A Heathkit scope high voltage probe.

RCA capacitance-type voltage divider probe.

EICO's direct scope probe.

EICO scope demodulator probe.

An EICO low capacity probe.



RCA's VTVM crystal-diode RF probe.

the signal. This does not present too great a problem, however, as an adequate signal is available in most TV circuits and the scope's vertical amplifier gain is sufficient to make up the loss.

As a matter of convenience, the probe is usually designed to have an attenuation ratio of 10 to 1. This ties in directly with the decade attenuator system found in modern scopes. After the scope is calibrated with a direct probe, a 10 to 1 low capacity probe may be used without recalibrating. The decimal point of the result is shifted one place to the right.

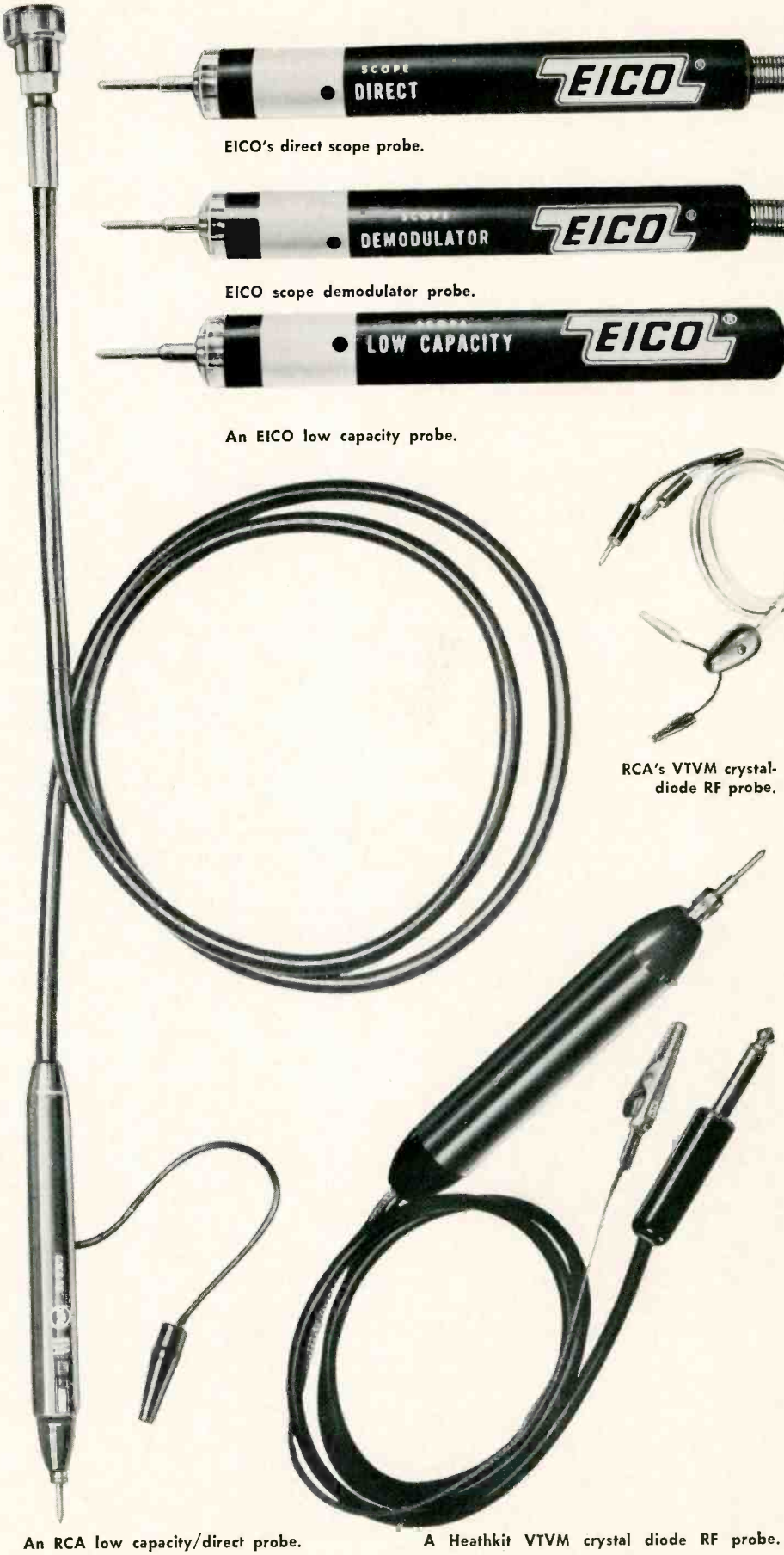
A typical low capacity probe is shown in Fig. 2. A value of 1 M Ω is common for a service scope's input resistance. For a scope with a 1 M Ω input resistance, a value of 9 M Ω for R1 will give an attenuation ratio of 10 to 1. A probe containing a resistor only would effectively attenuate the low frequencies to pass and distort the signal. A variable capacitor (C1) is added to compensate for this, C1 is adjusted to obtain a broad frequency response.

A square wave generator can be used to adjust the probe. A 15 kc square wave is applied to the scope with a direct probe and the shape of the wave is noted. The same square wave is fed through the low capacity probe and C1 is adjusted for the same waveshape.

A low capacity probe is used for observing and tracing waveforms in high impedance, high frequency and wide band circuits. It is used extensively to observe and trace TV sync signals and to test video, sync and sweep circuits. It is very valuable for making measurements in frequency-critical circuits.

Demodulator Probe

The top frequency limit of a wide band service scope is around 4.5



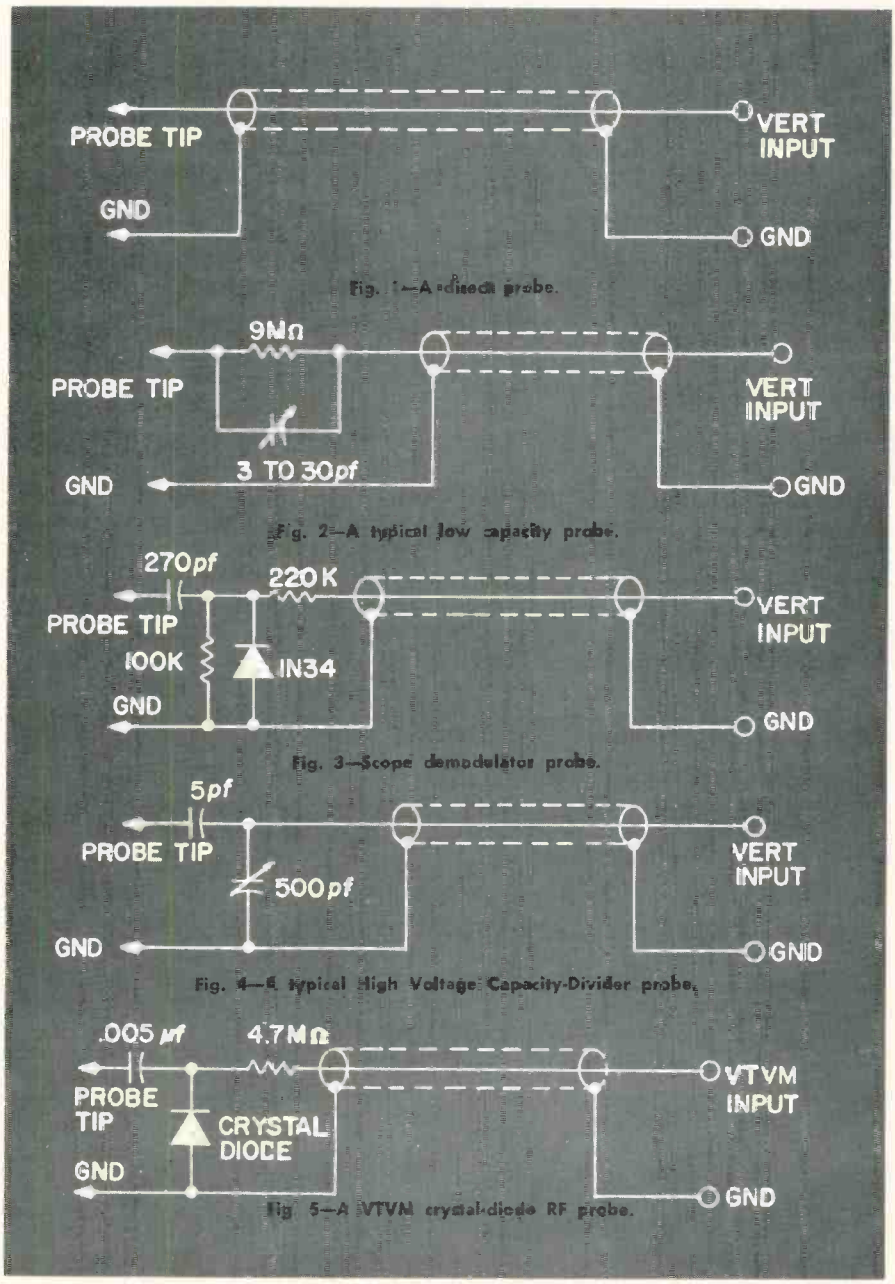
An RCA low capacity/direct probe.

A Heathkit VTVM crystal diode RF probe.

Mc. It is sometimes advantageous to observe waveforms in a high frequency circuit. For example, the 40 Mc TV IF signal could not be viewed on a service scope without altering the scope's input. A demodulator probe is used for this purpose. This type probe is shown in Fig. 3. It is also called a crystal diode or RF probe. It serves as a detector in recovering the signal's modulation envelope. The main disadvantage of a probe of this type is its distortion of high frequency signal components. For this reason it cannot be used as a measuring device or for waveform comparison. It is very useful, however, for indicating the presence or absence of adequate signal in TV IF or RF stages. The probe can also be used in conjunction with a sweep generator to observe IF or RF response curves.

A wide band probe *could* be designed to pass the high frequency components without distortion. But a probe of this type, utilizing a cathode follower tube circuit for impedance matching, would be too expensive for service work. Its use is generally limited to laboratory applications.

The demodulator probe should not be confused with a low capacity type. In general, when the signal frequency of the circuit under test comes within the range of the scope, a low capacity probe should be used. When the frequency exceeds the scope range, a demodulator probe is used.



High Voltage Capacitative-Divider Probe

A special type probe has been developed for measuring high ac voltages in TV sweep sections. This probe, shown in Fig. 4, consists of two capacitors. C1 is a low capacitance, high voltage type and C2 is a high capacity, low voltage type. These two capacitors in series act as a voltage divider with the largest voltage drop appearing across C1. The voltage waveform which appears across C2 can then be observed. Voltage from this point to ground will be well within the scope's rating.

C2 is usually made adjustable so the attenuation ratio can be properly set. A ratio of 100 to 1 is very common for a probe of this type. This again simplifies scope calibration.

The HV probe will distort the 60 cycle vertical frequency and its attenuation factor is too great for use in low signal level circuits. Its use is limited to waveform measurements in the horizontal output tube plate circuit. Since the pulse at the HV rectifier plate exceeds the probe's rating, it cannot be used at this point.

Isolating Probe

Another scope probe, for use in alignment work, consists basically of a resistor in series with the scope cable. The probe acts as a low pass filter and sharpens the marker pips on a TV response curve. No special probe is needed as an ordinary 50K resistor will suffice.

VTVM HV Probe

Troubleshooting and adjustment of modern color TV sets requires accurate knowledge of the amount of high voltage that exists at the CRT anode. The dc voltage range of most VTVMs can be increased up to 50,000 v. This is done by using a high voltage probe which contains

Continued on page 86

You and Your

Know your electron-tube voltmeter, develop systematic use-routines and it'll help speed your troubleshooting and repair work

■ Although your VOM is a handy and no doubt well-worn instrument — besides being the most widely used TV-radio, Hi Fi bench instrument for current measurement — it does have certain limitations. It's a d'Arsonval-movement type instrument and can't produce satisfactory readings in very low voltage, high resistance circuits. Only an electron tube- (or transistor-type) voltmeter can do this. Your VTVM (properly ETVM) has a high resistance input impedance and is designed to "amplify" weak voltages without "overloading" or disturbing the circuit. It's more sensitive than your VOM. It also has a much higher frequency response and can measure resistances up to 1 giga-ohm or higher. Moreover, it's internal movement will stand more abuse than the one in your VOM.

But some technicians make the mistake of leaning too heavily on their VTVMs. They expect it to "think" and troubleshoot for them. It won't. They disregard manufacturers' instructions and never develop routine, systemic operating methods that eliminate wasted motions and measurement errors. And they have never learned when, where and how to use a VTVM for maximum service efficiency; what it can do and what it can't do. And they seldom give it a chance to work effectively.

When expert benchmen reach for a VTVM's probes, for example, you can bet they've already got the trouble pretty well cornered. They've already used four of their five normal senses — sight, smell, hearing and touch — to isolate the trouble. And a lot of times they even use their "fifth sense" to wet a finger with before touching something. To them, a VTVM is an instrument for "confirming" what they either already know or strongly suspect. It's a "make-sure" instrument.

If you want to get the most from your VTVM — to speed TV-radio and Hi Fi repairs — then learn all about it, inside and out. Develop a routine approach to using it. This approach will eventually become almost "mechanically fast."

Know It — Systematize Its Use

The first important thing about you and your VTVM, is "know your instrument" — whether you are an apprentice or experienced technician. And you should begin your "knowing" with the instruction manual that came with your instrument when you got it.

Although three different basic VTVM types are in general use, we're concerned here only with a commercial service type ac/dc instrument found on most TV-radio and industrial electronics repair benches. The other two types — highly sensitive, straight dc or ac types — are specialized instruments. Special transistorized TVMs are also made. Let's sketch the "innards" of this instrument briefly.

A simplified block diagram of the general-purpose VTVM is shown in Fig. 1. And Fig. 2 shows a simplified schematic of the diode block (usually a dual-diode in practical VTVMs which serves as a voltage doubling rectifier and facilitates RMS and P-P indications), together with the dc amplifier block. The dc amplifier is frequently a dual-triode in a balanced bridge circuit as shown in Fig. 3. A modification of this circuit places the indicating meter and resistor adjusting network across the tube cathodes.

The ac input voltage divider, VD (Fig. 2) provides three or more voltage ranges selected by the switch. The rectified voltage driving the amplifier appears across R1. In this simplified arrangement, the rectified value equals the ac peak value at the diode rectifier input. The dc amplifier output goes to the meter movement which has scales (in the typical practical instrument), calibrated in Ω, ac, RMS, P-P and dc volts. R1 is a meter-sensitivity or "zero adjust" resistor. The VTVM may have a regular power supply derived from a 117 vac source, or it may be a battery-powered portable.

The second important thing is your approach to "methods-of-use." If you have not already developed a systematic approach — procedures based on information contained in most instrument instruction manuals — then begin now. A systematic approach can (a) eliminate wasted motions, (b) eliminate errors and (c) guarantee accurate, time-saving measurements.

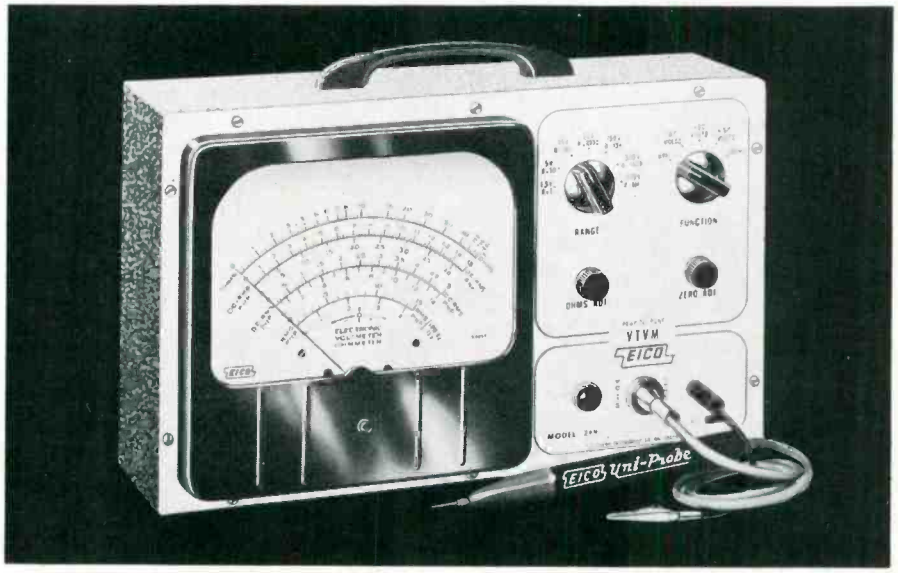
In general, the over-all system can be briefly outlined as follows: (1) Always place your VTVM near the center of the work bench, to the right or left of the equipment to be checked. It should not be placed near the edge of the bench where it can be easily toppled to the floor and damaged. Plug the power cord into an ac outlet. Turn the function selector switch from the "OFF-TRANSIT" position to the —dcv or +dcv position. Let the instrument warm up for 15 minutes before you

VTVM

by John Haskell

Simpson model 311 VTVM.

B&K model 375 VTVM.



EICO model 249 VTVM.

are ready to use it. (2) Set the voltage/resistance range switch to the desired position. Set the meter's indicating needle to the desired zero or infinity position by adjusting either the ZERO- or OHMS-ADJUST control. You are now ready to pick up the probes and go to work. But before you begin, always glance at the function selector switch, the voltage/resistance range switch to make sure both are on the proper position, pick up the probes, flip the probe's ac-ohms/dc push switch to the desired position and make the measurement.

Some technicians have refined this routine to cover individual ac, dc, ohms procedures — memorizing and practicing the simple routine until it has become mechanically precise, fast and accurate.

If you want to make highly accurate resistance readings, you will have to short your probes, make ZERO and INFINITY adjustments alternately two or three times to obtain perfect balance. If you are making a number of voltage readings recheck and readjust the ZERO control periodically if necessary — especially if you are making low voltage readings. When you switch to another voltage or ohms scale, recheck for proper ZERO, INFINITY or balance. All of these procedures are carried out mechanically by every skilled benchman.

Know What It Does Best

The third important thing is to know what your VTVM can do best. There's no point in attempting to detail a diversified number of the "one-thousand-and-one" uses to which you can put your VTVM. A number of books have already been written covering this subject thoroughly. We are concerned here only with the uses for which a VTVM was designed; jobs it can perform accurately and efficiently. A VTVM cannot replace your VOM in a few important applications, nor can it do some things that your scope or capacitor tester can do a lot better.

You would not think of using your VOM, for example, to check the AVC voltage in a radio or the AGC voltage in a TV set. In these high impedance, low voltage circuits, a VOM would come up with very misleading indications. Sure, on the 1000v scale, your 20,000 ohms/v VOM has an input impedance about twice as high as your VTVM — but you'll have a tough time reading transistor and tube-grid voltages, AVC and AGC voltages accurately on that scale.

A VTVM is necessary here. And we are not about to recommend that your VTVM be used to check capacitors — filter, coupling or bypass — although some "bench-wizards" use it in many cases very successfully for this purpose. Actually, for most technicians, a capacitor checker is faster, more thorough and accurate for over-all capacitor checking. That's what the checker was designed to do.

Conversely, you would not use your VTVM to determine the approximate amount of current being

RCA WV-98-C VTVM (top left). Triplett model 850 VTVM (top right). EMC model 107A VTVM (bottom left).

drawn by a TV horizontal output tube by measuring the voltage drop across its cathode resistor and using ohms law. It's a slow, inaccurate process. You'd use your VOM to measure the current, quickly, and accurately within one or two milliamperes.

Another place where your VTVM "shines" is in measuring low level signal voltages in audio and Hi Fi equipment — especially at the input of preamplifiers. This is frequently necessary while troubleshooting, signal tracing and aligning. And you can get careful peaking while making alignments or when "touching up" radios by placing your VTVM across the AVC line and ground, rather than across the speaker voice coil. If you run into difficulty here, place it across the 2nd detector load resistor (for AM receivers) or across the limiter load resistor for FM.

No other instrument functions so effectively in servicing low voltage circuits in transistor radios. And there' no faster way to determine if the oscillator stage of a tube radio is operating than measure the negative dc voltage developed on the oscillator grid. Or, if you're not sure the oscillator is operating in a transistor radio, connect your VTVM probes from emitter to ground, short the radio's tuning capacitor plates momentarily and observe if a change in voltage takes place. If a change occurs, the oscillator is working; if no change takes place, the oscillator is not operating.

If you suspect the AGC action of a transistor radio is not what it should be, place the VTVM probes from base to emitter (ground probe to the base and positive probe to the emitter on PNP transistors; reverse probes for NPNs). Normal bias here is about 0.2 v or somewhat less. Now rotate the tuning dial on-and-off a strong station. When the station is the strongest, a drop of approximately 0.1 v should be noted. If not, or the voltage increases, there's likely something wrong in the AGC circuit.

Of course, the ZERO-CENTERING facility of your VTVM makes it a natural for aligning or touching up FM discriminator transformers too.

In color TV work, if your VTVM is equipped with low-capacitance, demodulator (diode) and HV probes, you'll be prepared to measure almost anything requiring a VTVM.

Care and Maintenance

The fourth important point to consider is the personal care you give your VTVM. And if you develop a systematized, fail-safe system for using it, chances are it will give you years of service without needed repairs. But, if you have a breakdown and you're not experienced at overhauling meters, don't attempt to fix it — other than replacing tubes and the 1.5 v cell. Fill out a service order sheet (one usually comes with the meter), pack it well and ship it to the factory or manufacturer's service station.

You should check your meter periodically on the RX1 ohms position and rotate the OHMS-ADJUST control to determine if the 1.5 v cell is adequate. If not, it should be replaced with a fresh one.

If a tube burns out or otherwise fails in your VTVM, the new replacement tube should be "burned in" or "aged" for approximately 100 hours. The VTVM's calibration should then be checked according to the manufacturer's instructions. You will have no difficulty calibrating your instrument if you follow instructions outlined in the book which came with your meter.

If you remember these four important things about *You and Your VTVM* it will serve you faithfully and make money for you. ■

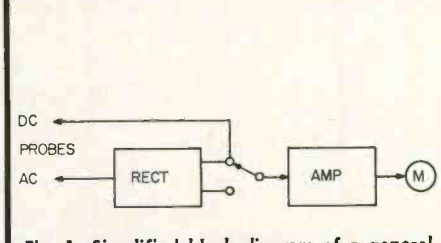


Fig. 1—Simplified block diagram of a general-purpose VTVM.

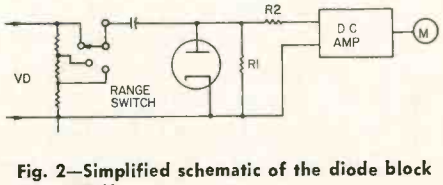


Fig. 2—Simplified schematic of the diode block in a VTVM.

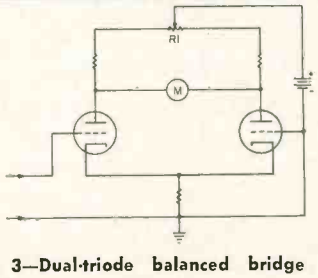
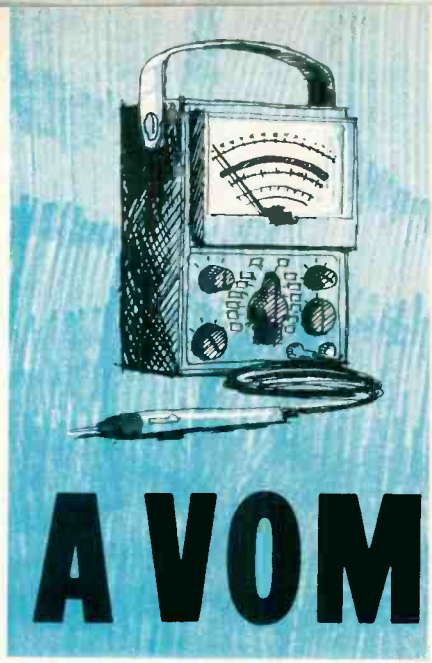


Fig. 3—Dual-triode balanced bridge VTVM circuit.



Selecting A VOM

Characteristics and specifications determine the type of meter for a given application

by John W. Martin
Simpson Electric Co.

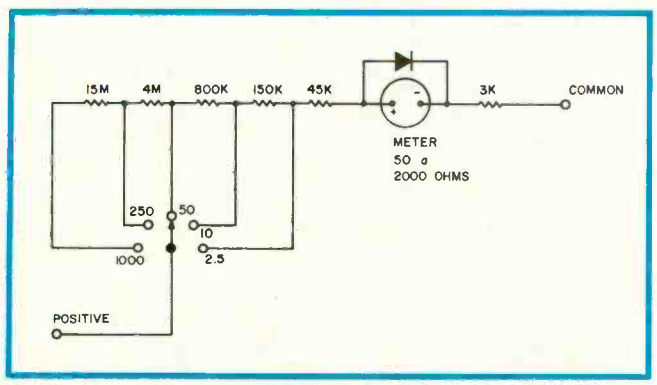


Fig. 1 — Simplified schematic of dc voltage circuitry for a typical VOM.

■ The VOM is probably the most versatile and widely used piece of test equipment in almost every electronics shop or plant. It is a reliable, low cost unit which can be used for a wide variety of measurements. Although a VTVM has a higher input impedance for low voltage, high impedance circuit measurements, the VOM is not dependent upon ac line power for operation and therefore, is completely portable.

The input impedance of a 20,000 Ω/v VOM on the 1000 vdc scale is 20MΩ. This is higher than the input impedance of most VTVMs and makes it possible to read voltages in very high impedance circuits. Since each division on the 1000 v scale corresponds to 20 v it is possible to read voltages as low as 10 v on this scale with virtually no circuit loading effect.

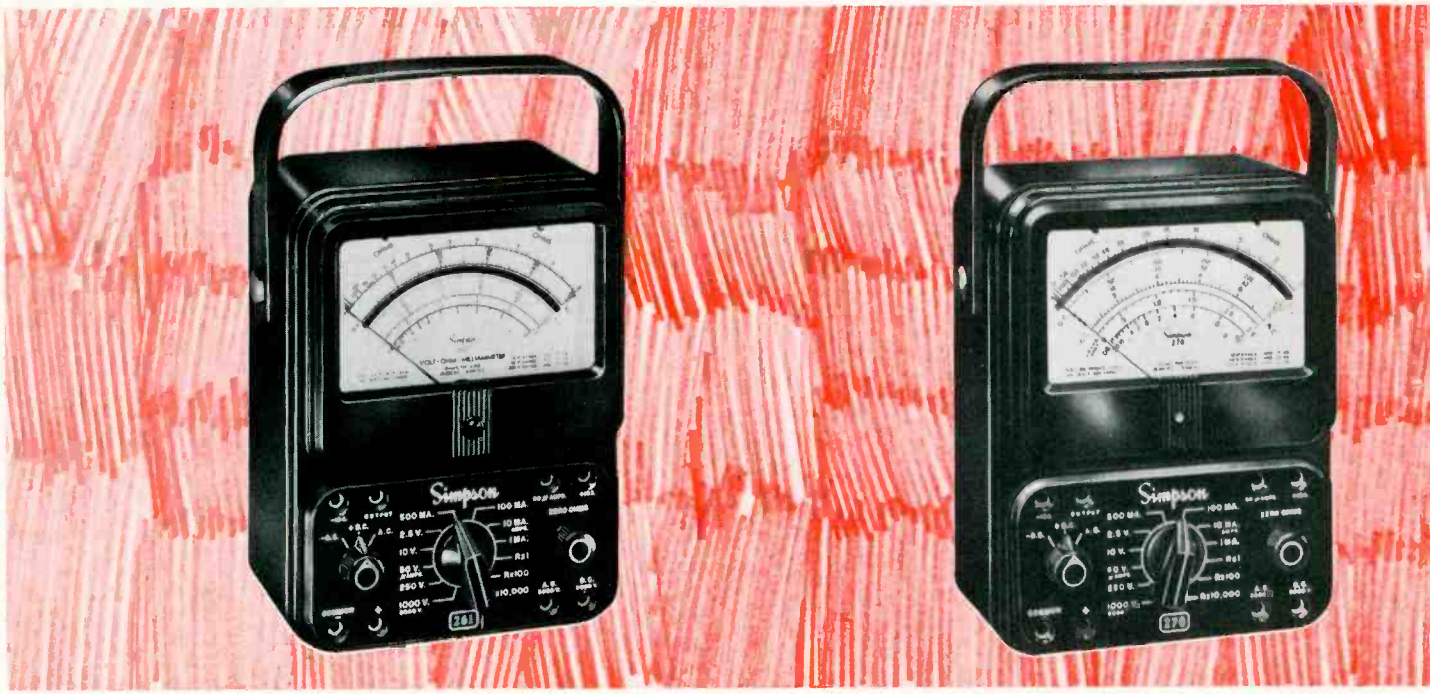
Utility

A great variety of VOMs are available today to suit almost any possible application. Because of the large selection available, it is often difficult to select the proper VOM for any specific use. No specific listing can possibly be made which would indicate the "correct" VOM for every application. In fact, most VOM users require a meter that performs many functions. In addition to immediate requirements it is also very important to consider future needs when purchasing a VOM. Many VOMs have some characteristics which are very similar (even identical in some cases), but the seemingly minor differences can be very important and must be considered when choosing the "best" VOM for any particular situation.

Accessories

Some of the things to be considered when choosing a VOM are meter size, input sensitivity, range coverage and case construction. The utility of a meter can be extended by using probes and other accessories. The availability of accessories is a very important factor in choosing a VOM.

Some of the accessories that can be procured are: (1) Various high voltage probes which greatly increase the voltage range of the instrument. (2) Leather or other case types which increase the portability of the unit. (3) A selection of adapters which utilize the basic features of the VOM to provide a wide variety of specialized test equipment at a fraction of normal cost. With the proper conversion plug in adapter a VOM can be converted into the following: (1) Transistor tester (2) A dc VTVM (3) Temperature tester (4) An ac am-



Model 261 VOM.

Model 270 VOM.

meter (5) Battery tester (6) Microvolt attenuator (7) Audio wattmeter (8) Milliohmmeter (9) A dc ammeter.

Characteristics

To illustrate the available characteristics of VOMs several types will be considered in detail. The similarities as well as the differences in these units will be pointed out in an attempt to clearly show the features which should be taken into account when selecting a VOM. The units discussed are typical of the type of VOM available today. All of these testers which we will call A, B, C, and D are housed in the same size case. They all utilize the same size meter (4 in.). Table I lists the ranges available; each meter is the same in this respect. The dc sensitivity of all the units is also the same, 20,000 ohms/vdc and 5000 ohms/vac. Characteristics of the four similar (and yet very different) units are tabulated in Table II.

It should be noted that the accuracies of all voltage and current ranges are expressed in percentages of full scale readings. In the case of the resistance ranges the accuracy is presented in degrees of arc rather than percentage of full scale.

This method of specifying the ohmmeter accuracy is necessary because of the non-linear ohmmeter scale and because the full scale value on the resistance ranges is infinite. Therefore, an accuracy stated as a percentage of full scale reading would be rather meaningless. Since the VOMs under consideration use meter movements with a 100 deg arc corresponding to full scale deflection, it is an easy matter to determine the possible tolerance by using the linear dc voltage scale, where each division is equivalent to 2 deg of arc.

The most basic VOM under consideration is Model A. This meter provides good accuracy along with extreme reliability and rugged construction.

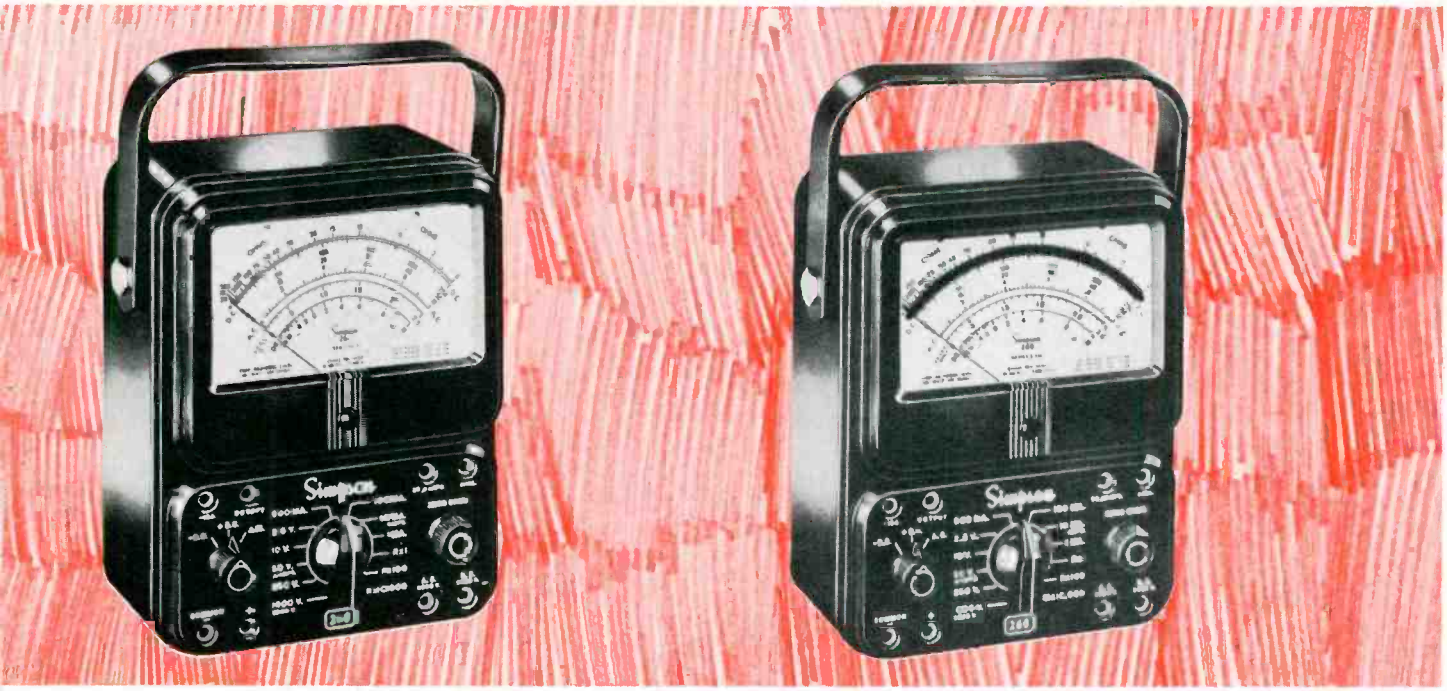
As indicated in Table II, Model B is identical with A except for the addition of a mirror scale and knife-edge pointer. This combination provides more accurate readings by eliminating the effect of parallax. It is essential that parallax errors be minimized by a mirror scale if high accuracy readings are to be obtained.

Meter C is similar to the B as it also includes a mirror scale to eliminate parallax reading errors. However, C provides greater accuracy than either A or B. Another significant feature of C is the self-contained overload protection. A schematic showing the dc voltage circuitry is shown in Fig. 1. The movement has the resistance of approximately 2000 Ω and a full scale sensitivity of 50 μamp. Therefore, at full scale deflection, the voltage drop across the movement will be approximately 0.1 v.

Movement overload protection is provided by the diode connected (in the forward direction) in parallel with the movement. As shown in Fig. 2 (note the logarithmic current scale) essentially no forward current will flow through the diode when rated current passes through the movement.

If an overload of 2000 times rated (100 ma) is applied to the metering circuit, most of the current will flow through the diode. With 100 ma of diode current, the voltage drop across the movement will be 1.02 v which indicates that the movement will have a current of 0.51 ma — 510 μa. Thus, with an applied overload of approximately 2000 times, the movement is subjected to an overload of only 10 times rated. This small overload will not cause damage to the movement even if applied continuously.

Model C is designed for applications where a high degree of accuracy is necessary. The improved accur-



Model 260 VOM.

Model 260-4 M VOM.

acy of this meter is a result of the finer movement used. In addition to greater accuracy, this movement is also constructed to withstand greater physical abuse. It also utilizes a mirror scale and diode overload protection.

Features of these few VOMs have been presented to show that the small differences in specifications may be the determining factors in selecting a VOM for specific applications. In considering the relevant factors it is important that possible future requirements be considered so that the VOM selected will continue to serve your needs for many years to come. ■

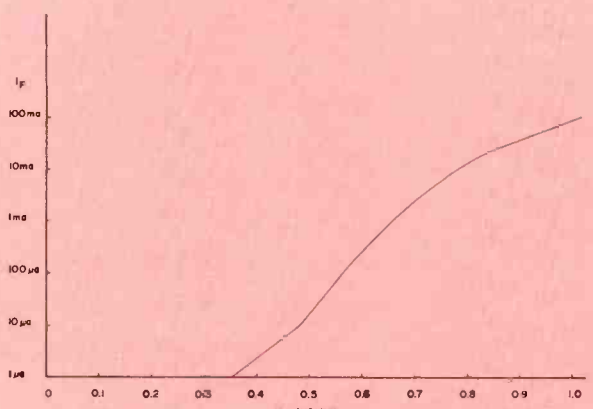


Fig. 2 — Typical diode forward characteristic.

Table I

Dc Voltage (20,000 ohms/v):
0-250 millivolt, 0-2.5, 0-10, 0-50, 0-250, 0-1000, 0-5000.

Ac Voltage (5,000 ohms/v):
0-2.5, 0-10, 0-50, 0-250, 0-1000, 0-5000v.

AF Voltage (Output) — with 0.1 μf, internal series capacitor;
0-2.5, 0-10, 0-50, 0-250v.

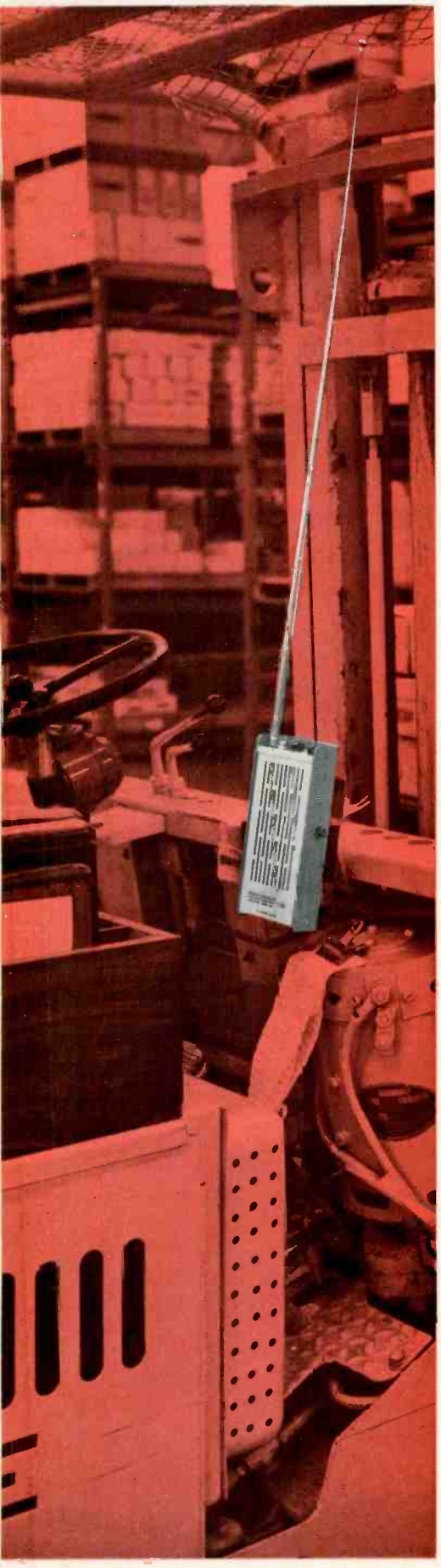
Decibels (zero db equal to 1 milliwatt across 600 ohms):
−20 to +10 db, −8 to +22 db, +6 to +36 db, +20 to +50 db.

Resistance:
0-2000 ohms (12 ohm center), 0-200,000 ohm (1200 ohm center), 0-20 megohms (120,000 ohm center).

Direct Current:
0-50 microamperes, 0-1 milliampere, 0-10 milliamperes, 0-100 milliamperes, 0-500 milliamperes, 0-10 amperes.

Table II

Accuracies:	A	B	C	D
0-2.5 to 0-1000 vdc	2%	2%	1.5%	1.25%
0-5000 vdc	3%	3%	2.5%	2.25%
0-50 Microamperes	1.5%	1.5%	1%	0.75%
0-1 ma to 0-10 Amp dc	2%	2%	1.5%	1.25%
Rx1 (0 to 2000Ω)	2.5°	2.5°	2°	1.5°
Rx100, Rx 10,000	2°	2°	1.5°	1°
0-2.5 to 0-1000 vac	3%	3%	3%	2%
0-5000 vac	4%	4%	4%	3%
Mirror Scale	No	Yes	Yes	Yes



Electronic Instrument

Assemble-it-yourself equipment offers

by C. A. Robertson

The Author
Charles A. Robertson is Technical Product Manager for Heath Company and holds a BS degree in electrical engineering. He also holds a 1st class FCC radiotelephone license and a general class amateur radio license (K8BLL).

■ With the common denominator of low-cost, versatility and easy maintenance, the application of kit-evolved instruments in industry runs the use-range from electronic design labs, electronic equipment maintenance, through in-plant communications, to wide spread usage in production and quality control. And the gamut of industrial firms using this equipment extends from prime space-age equipment contractors to small-job shops.

But many companies — particularly the smaller manufacturers — do not use electronic instrument kits widely. Yet it is they who can benefit most. And here the ultimate user — engineers and technicians — can demonstrate best how low-cost kit equipment can benefit their respective companies.

Kit-type test instruments were not developed to compete with or replace sophisticated instruments. They can't and won't. Kits in this area were designed to adequately perform specific jobs where sophisticated instruments are not required.

Application Range

Kit instruments find widest industrial application in the routine testing and checking encountered in production and quality control work.

←

A kit-form citizens band hand-held transceiver mounted on this forklift truck keeps the operator in communication with the warehouse foreman.

Many of the standard tests performed by component engineers or engineering technicians can also be handled by kit-type instruments. It is the versatility of the kit product which makes it particularly well suited to these areas. Low unit-cost permits the equipment to be permanently installed in one location to perform one job. The simple, dependable circuitry usually employed in kit products will provide many hours of trouble-free operation. Should maintenance become necessary, the technican can easily and quickly locate the trouble and repair it.

The employment of kit-type instruments in the research and development lab is limited only by the level of design activity. Even in the most critical work, selected kit-type instruments can do many of the more mundane tasks and free expensive test equipment for essential applications. Most kit VTVMs, power supplies, VOMs, resistance and capacitance decades and substitution boxes can be employed in almost all instances where more expensive counterparts are used. A general purpose kit oscilloscope can do a surprising number of jobs in the R&D lab, leaving the "many-featured" dc, wideband scope free to do more demanding work.

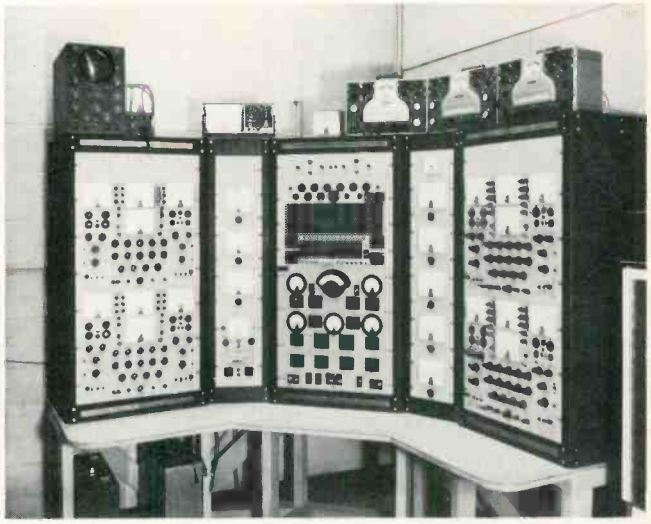
In many instances, kit-form electronic instruments are incorporated in special custom test consoles and perform their intended functions in a new package. This saves time in designing a rather ordinary circuit for use in a special purpose test console.

But test equipment is not the only kit-type product that can be employed in industry. The alert engineer or technician may discover

Kits For Industry

many advantages

A low-cost intercom built from a kit provides communications between this supervisor and his personnel.



This impressive console, used in deriving roll chart data for tube testers, contains five kit-form testers built in special rack-mounted panels.

many areas where a piece of amateur radio or Hi Fi equipment may make a test procedure easier or permit it to be done in less time. If time can be shaved from any production operation, the resultant savings amply justify use of the simple, versatile, kit approach.

Consider these specific applications: Amateur radio type transmitter kits have been used as low-cost exciters for ruby lasers. Silicon controlled rectifier motor speed-controls find wide usage in production and model shops for matching the speed of power tools to the job at hand. Amateur radio type variable frequency oscillators (VFOs) have been modified to provide special frequency coverage for plotting narrow pass band filter response curves. Electronic switches used with general purpose scopes, have been employed to check phase relationships on color TV deflection yoke assemblies. The accurate calibration of high performance amateur radio receiver kits aid in aligning various RF generators. Alignment of receiver "front-ends" is simplified by detecting the IF output and amplifying the signal by a low-cost audio amplifier for increased meter indication. Voltage regulated power supplies provide a number of special power requirements in performing quality control checks. Audio generators coupled with high power audio amplifiers provide variable frequency power sources. A low-cost strip chart recorder made by one kit manufacturer is used in its quality control department to plot potentiometer curves.

Many unique in-plant communications problems can be neatly solved by kit-form citizens band equipment, public address systems and simple intercoms.

Most on-premise vehicles can be conveniently dispatched through base station, mobile and hand-held CB transceivers — available in kit form. Fixed short range communications between two offices can be easily handled by kit-type intercoms. Kit-type amplifiers can provide a low cost, easily maintained public address or background music system tailored to specific plant needs.

Distinct Advantages

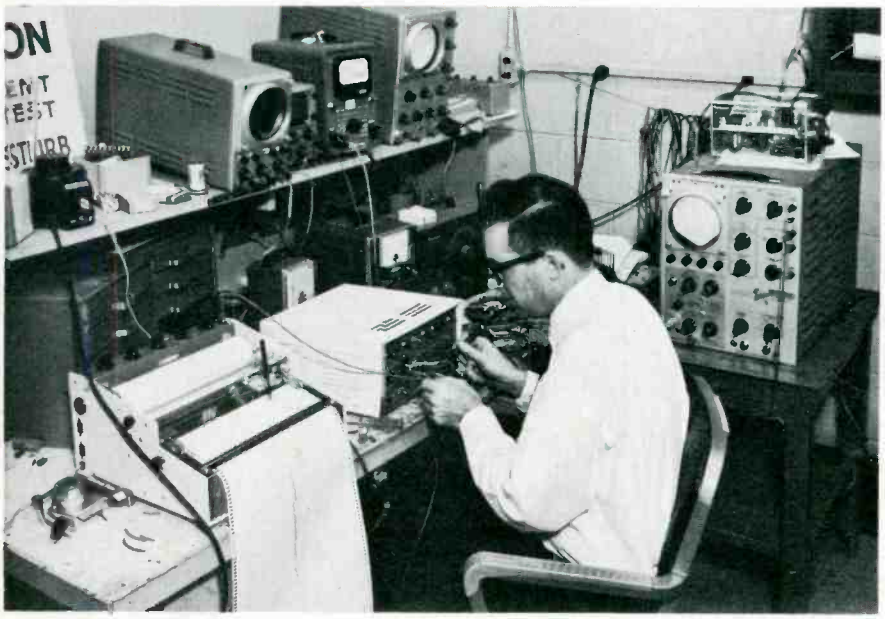
The primary advantage of kit-type instruments and equipment is the savings that accrue through in-shop assembly and wiring. Additional savings accrue through low purchase prices which are made possible in turn primarily by large-quantity, mass-production methods.

Because kit-type instruments can relieve expensive, sophisticated equipment for other work or from unnecessary wear-and-tear, kits can and do lower over-all instrumentation costs. And in many cases, even factroy-wired versions offer distinct savings over more sophisticated test equipment when it is being used in a lower category for which it was designed.

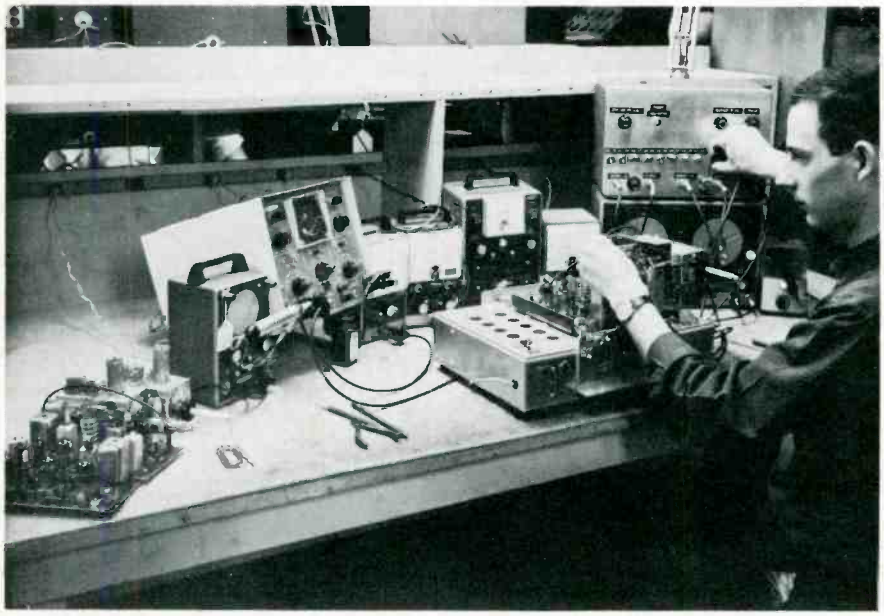
. . . Instrument Kits For Industry

In-plant assembly of kit-type equipment permits modification of the equipment for special applications. Frequently, an instrument is used on a production line for repeated measurements of a single parameter between certain limits. In these cases, other ranges and features of the instrument — except those of interest — can be omitted, resulting in an essentially go, no-go device.

Assembly by in-plant personnel also provides familiarity with the equipment — making maintenance much easier at a later date.



Engineer uses a logical combination of kit-form test equipment and more sophisticated test equipment in solving a design problem.



Test equipment at a factory TV IF alignment station includes kits and custom-built equipment.

Product Lines

A review of the product lines offered by various kit manufacturers reveals that prices and basic offerings are fairly uniform. The method of merchandising varies among manufacturers, with some having retail distribution through dealers, while others rely heavily on direct-mail distribution.

In the test instrument areas, the kit lines vary somewhat in their breadth and the market level they are intended to serve. The basic instrument line is usually directed to the TV-radio service trade. Some lines, however, offer more sophisticated test equipment kits which can be used in research and development work. One manufacturer has branched out into the scientific instrumentation market with a line of factory assembled equipment for teaching and research in both academic and industrial environments.

Most kit manufacturers offer some or all of their products in factory-wired form to circumvent the reluctance some industrial users may have toward assembling kits. Kit manufacturers also offer discounts to industrial firms and the discount varies with the type of prime distribution employed and the quantity of the order. On inquiry, some manufacturers will supply kits in assembled form which are normally not offered already assembled and, again depending on quantity, will sometimes modify products to suit a particular application.

In general, the final selection of a particular make and kit model depends on the application and the kit manufacturer's reputation — frequently based on previous purchases.

It seems fairly obvious then, that the electronic instrument and equipment kit *does* have a significant place in industry. The extent of application and the savings that can be realized through using it is limited only by the imagination of the technical staff. ■

PHASE SHIFT PART III (Conclusion)

Understand these circuits and make your color-servicing jobs easier

■ In previous articles we described a number of phase shift circuits and their applications—including PSK, SSB and others.

Another useful application of phase shift is phase modulation (PM). A simple circuit for producing phase modulation is shown in Fig. 1. Here a crystal oscillator supplies a stable RF carrier signal to an RC phase shift circuit. The phase shift is produced by capacitor C1 and the dynamic plate resistance of the tube. The other components are R3, the plate load, R1, the input grid resistor, R2, cathode bias resistor for class A operation, and capacitor C2 which bypasses R2 to minimize degeneration.

The output signal across the tube resistance leads the crystal oscillator signal, the exact amount of phase shift being determined by the values of C1 and the tube plate resistance. C1 has a fixed value, but the tube resistance can be changed by varying the grid voltage. When an AF modulating signal is applied to the grid, the tube resistance and the amount of phase shift will change accordingly. The amount of phase shift is directly proportional to the instantaneous amplitude of the modulating signal.

The amount of phase shift can vary from 0 to 90 deg, but it is usually limited to something less than 25 deg. This is done so that amplitude changes in the output signal, as a result of changes in tube resistance, are held to a minimum.

Phase modulation itself is of little use, but because it can easily be converted to frequency modulation (FM) it has found wide application. Frequency modulation is actually produced by the PM circuit of Fig. 1, but it is not true FM where the amount of frequency deviation is directly proportional to the amplitude of the modulating signal. The frequency deviation produced by the phase modulator circuit is proportional to the AF modulating frequency.

To convert a PM signal into an FM signal it is only necessary to add a correction network to the circuit of Fig. 1. The AF modulating signal is passed through a 90 deg RC phase shifter before it is applied to the grid of the tube. The correction network introduces characteristics that enable the PM circuit to produce an output in which the frequency deviation is proportional to the amplitude of the modulating signal as it should be for FM.

Frequency modulation produced by converting a PM signal is called indirect FM. It is very popular since phase modulation circuits are generally simpler than the circuits used to produce direct FM. An example of the application of indirect FM is its wide use in VHF two-way mobile transmitters.

Phase Detector

The circuit in Fig. 2 is a phase detector. It is used to compare two signals of the same frequency and to produce a dc output voltage proportional to the phase shift between the two signals. The reference signal $_{e}$l is applied to the circuit through a 90 deg phase shifter. This is done so that when $_{e}$1 and $_{e}$2 are in phase the output voltage across X and Y will be zero.

The voltages across the two transformer secondary windings add and operate the diodes in the circuit. The rectifying action of the diodes causes a pulsating dc to flow through the load resistors. The capacitors across the load resistors filter out these pulsations so that a pure dc voltage appears between X and Y. The polarities of the voltages across the load resistors R1 and R2 are shown. These voltages oppose one another so the output voltage between X and Y is the difference between the voltages across R1 and R2. If the voltages are equal they will cancel and the output will be zero.

The amplitude of the voltage between X and Y will depend on the amount of phase difference between $_{e}$1 and $_{e}$2. The polarity of this dc voltage will tell whether $_{e}$1 leads or lags $_{e}$2. Assuming that the transformers in the circuit introduce no 180 deg phase shift, if $_{e}$2 leads $_{e}$1, terminal Y will be positive with respect to X. As the phase lead increases the voltage between X and Y increases, Y becoming still more positive. If $_{e}$2 lags $_{e}$1 then terminal X will be positive with respect to Y. Again increasing the angle of lag increases the output. When $_{e}$1 and $_{e}$2 are in phase the output is zero.

The output voltage amplitude also depends on the magnitudes of $_{e}$1 and $_{e}$2 as well as their phase relationship. Care should be taken when using this circuit to ensure there is no change in the amplitude of $_{e}$1 or $_{e}$2 when the phase is changed otherwise an erroneous output reading will result. A limiter is generally used before the phase detector circuit to minimize amplitude variations.

The phase detector circuit is very popular. It is used as an FM detector (Foster-Seeley discriminator), and as an error detector in servomechanisms. It is also found in automatic frequency control (AFC)

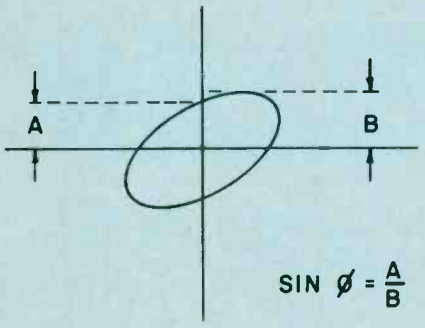


Fig. 3—Measuring phase shift with lissajous patterns.

circuits and in many industrial control applications.

Other Applications

These are only a few of the applications of phase shift; there are many more. For example, many radio broadcast stations are required by law to transmit their signals in certain directions to avoid interfering with other stations. A station may also want to increase its radiation in one direction to thoroughly cover a given service area while avoiding others. To do this the stations use a special directional antenna array which contains phase shift networks. The directivity pattern of the array depends upon the number of antennas in the array, their spacing with respect to one another, and the phase of the signals fed to each antenna. The networks used to control antenna phasing are made up of inductors and capacitors and are specially designed for the antenna problem involved. They usually include provisions for varying the phase so that the directivity pattern can be changed.

The transmission lines feeding the antennas also affect the phasing. The length of the transmission line will determine the amount of phase shift it introduces. This must be taken into consideration when figuring the over-all phase shift involved.

Phase shift circuits are also used in color TV transmission and reception. The Q and I (chrominance) signals that contain the color and saturation information of the TV picture are each fed into a balanced modulator. A 3.58 Mc subcarrier is also fed to each balanced modulator, but a phase shift is introduced so that there is a 90 deg phase difference between the subcarrier signals. This makes the Q and I sideband signals at the balanced modulator outputs 90 deg out of phase. This is done so that when these signals are mixed together, multiplexed into the composite TV signal, there will be some method of detecting and separating the Q and I signals at the receiver. Special phase sensitive circuits in the receiver perform this separating operation.

Detrimental Phase Shift

Up to this point only desirable phase shift has been discussed. But phase shift is also an undesirable quantity in many cases and must be minimized or eliminated. A good example of this is the phase shift that occurs in the wideband, RC coupled video amplifiers in TV receivers. These amplifiers are required to pass both very low and very high frequency video signals to produce a suitable TV picture. At very low frequencies the reactance of the coupling capacitors in these amplifiers increases and produces a loss in amplitude and a leading phase shift. The lower the frequency, the more pronounced the condition. The result is displaced picture information and a picture that looks smeared or streaked.

At the high video frequencies the shunt wiring and tube capacities produce attenuated signals and lagging phase shifts. Here again picture information is displaced, and in this case the result is loss of details in the picture.

Normally video amplifiers are designed to pass the needed range of frequencies without excessive phase shift for a good picture, but a defective component in the circuit could cause undesirable phase shift and the conditions mentioned.

All electronic circuits and networks that contain reactive components (inductors, capacitors, or both) will produce phase shift. In some cases, it is of no consequence, but in others like the TV set mentioned above, phase shift is troublesome.

The detrimental effect of phase shift in a circuit is called phase distortion. Circuits that must pass complex waveforms containing many frequencies may distort these signals because of poor frequency response and phase shift. In the

Continued on page 92

Fig. 2—Basic phase detector.

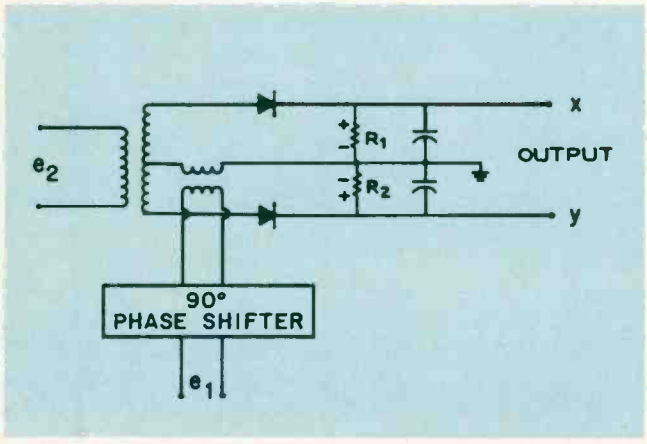
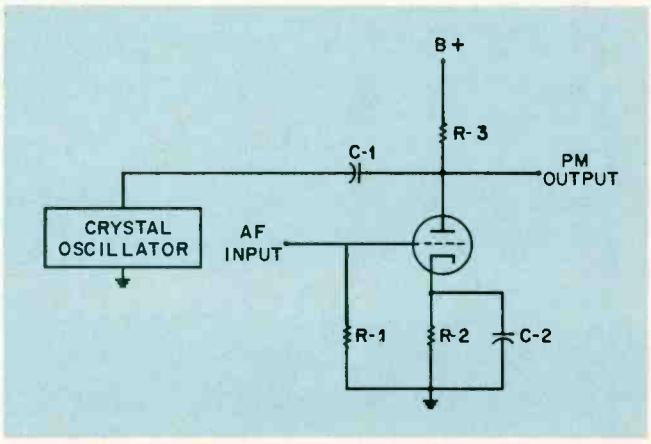
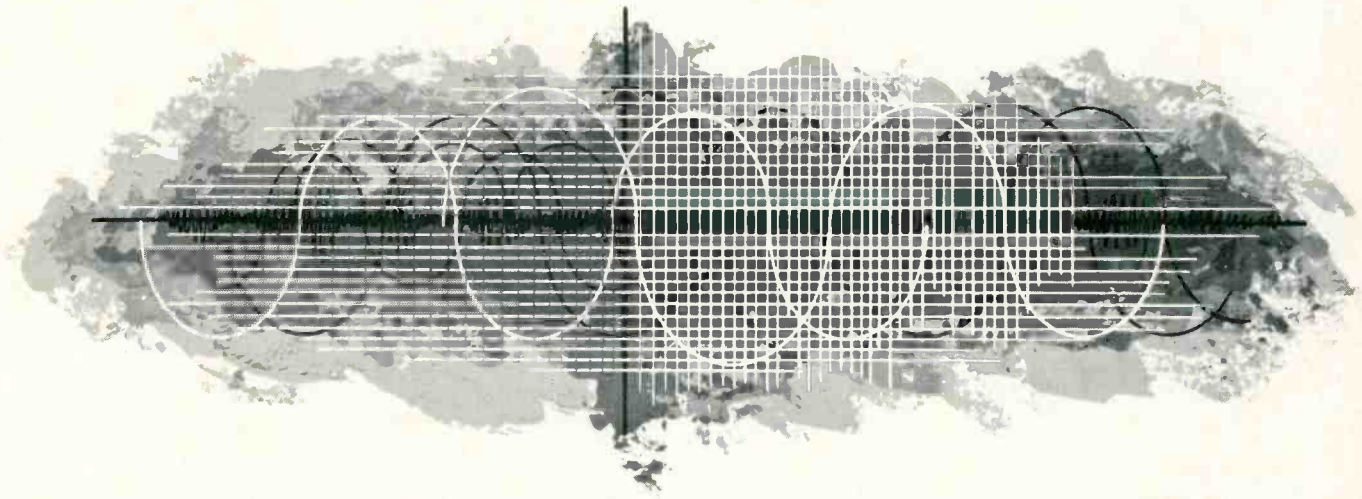


Fig. 1—Simple phase shift modulator.





Choosing and Using Audio Oscillators

Precision frequency response measurements for line amplifiers in series

PART IV (conclusion)

■ A previous article (ELECTRONIC TECHNICIAN, December 1964), covered methods for preventing extraneous ground-loop signals from entering measurements when driving sensitive input circuits with low level signals. A prime example, using a high quality consumer-type power amplifier, detailed practical steps to follow. One more example will demonstrate the considerations which are called for by a more exacting problem. A case will be described (Fig. 1) which shows the value of having the full facilities of a signal generator.

Amplifiers in Series

In a complex studio system it may sometimes be necessary to route a signal through as many as eight line amplifiers in series. We want to know what frequency response may be expected of the amplifier chain. As a practical matter, we have only one amplifier to test and must extrapolate from this.

Following are the amplifier specifications which we will consider:

Maximum CW output: +20 dbm into 600 Ω.
Gain: Adjustable 20 to 40 db in internal feedback loop.
Frequency Response: ±0.5 db, 20 to 20,000 cps.
Input: Internally terminated in 600 Ω, balanced, center tap internally grounded.
Output: Balanced, center-tap internally grounded, nominal 600 Ω.

Before we make any tests, we realize that if each amplifier barely meets its frequency response spec we might find an 8 db difference between points of most and least response, across the audio spectrum, when we gang eight amplifiers. Why? If response of the amplifier is +0.5 db from reference at one frequency, and −0.5 db at another, the spread is 1 db. If the same deviation occurs in each ganged amplifier, they will add arithmetically, giving 8 db spread, or over-all frequency response of ±4 db. We realize, however, that real amplifiers made by reputable manufacturers characteristically perform much better than spec, if only because most must, if the worst few are to be within spec. We realize, too, that we are taking a risk that our one amplifier may not be representative of the eight we may get later.

Looking further at the practical question, we see that we need to know very exactly what are the *variations* in gain vs. frequency through the amplifier. We will not be dependent, in this case, on the absolute accuracy of the two meters, but instead on the equivalence of the two meters' frequency response. Probably the easiest way to assure equivalent response would be to select meters known to be flat. It is not necessary that both meters have extremely flat response, but we

would have to rely on their having the same departures from flatness, if any. This is because we will be using a precision attenuator as our measurement standard with our oscillator and meters. We will see how this is true as we make the measurement.

The Set-Up

We set the generator output impedance selector to 600 Ω. We will leave the ground and center tap terminals of the signal generator *unterminated,* floating the signal generator output circuit. This will avoid a ground loop in the highly sensitive input circuit of the amplifier.

The G terminal of the generator connects directly to the chassis, and thus to the ground pin on its ac power plug. The CT terminal at the amplifier is specified as internally grounded, so it is connected to its power supply's ground, which in turn is connected through the ac supply cable safety ground on the bench to the generator's ground. If we were now to strap the generator's G terminal to the amplifier CT terminal and then to the amplifier, we would complete a loop back to the amplifier input through the connecting line.

We connect the push-pull signal output terminals on the generator to their counterparts on the line amplifier input. All conditions for proper drive are now met: a nominal 600 Ω source is connected to a 600 Ω internal load in the amplifier; ground loops have been eliminated.

Next we will terminate the amplifier output, connecting a 600 Ω resistor, or somewhat more, across the output terminals. The value is only critical to the extent that we want to use it to calculate absolute power output; and as we have seen already, small variations in load have even smaller effects on power. To make our output measurement we will use a voltmeter which has a floating input. (403B Fig. 1). Leaving its G terminal unconnected, we connect its two input terminals directly across the amplifier output.

It would be possible to use one of the usual single-ended electronic ac voltmeters, having only two input terminals, one of which is grounded internally. Again, looking carefully at the interrelation between meter and tested amplifier, we would see in such a case that the meter would short out one half of the amplifier's output transformer if connected across the amplifier output terminals. This is because the amplifier output center-tap is internally grounded, and one side of the voltmeter is internally grounded; if the grounds are inseparable, connecting the G terminal of the voltmeter to either side of the amplifier output will short that side to ground. In such a case, we solve the problem by connecting the voltmeter G terminal to the amplifier output center-tap, the other voltmeter terminal to either side of the amplifier output, and then reading *half* the output center-tap, the other voltmeter terminal to either value. With a 600 Ω load across its whole output, this would leave the amplifier properly terminated and operating normally. We *will* have a ground loop, but its importance is small at those high signal levels.

So we connect the 600 Ω load resistor across the amplifier output and the floating connection to the meter. Now ground loops have been avoided and proper termination has been achieved.

Next we decide at what level the test will be made. We want to work high on both meter scales, where accuracy and consistency of response are at their best. And we want to work high in the range of output powers which the amplifiers will actually handle in service, yet well within the amplifier's rating. To be high on the ac voltmeter scale we find we should be near 1 or 3 volts, or some decade multiple of these. The relation between dbm and voltage is conveniently displayed on the face of the voltmeter: 3 v across 600 Ω is not quite +12 dbm. This is a high power level, but one we may often reach momentarily in a system working at 0 vu; it is 8 db below rated maximum, so 3.0 v is a good selection.

We might think it necessary to make the frequency-response check at several settings of amplifier gain, but since we know the amplifier gain is controlled by its feedback loop, we may expect the worst case to be at 40 db gain, so we start with this setting.

We select a reference frequency; 400 cps. and 1000 cps. are commonly used values. With the generator's attenuator set to some high value of attenuation, say 70 or 80 db, we adjust the generator's level control so as to bring its meter to some high level. This meter is ahead of the attenuator, and all we want is that it should remain at a steady reference throughout the measurement. The attenuator is now reduced until a reading somewhere on the 1 v scale is obtained on the voltmeter at the amplifier output. We will use the 0.1 db, and possibly the 1 db attenuators for our measurement. With a little juggling of these and the oscillator level control we will find settings which produce the desired 3.0 v at the amplifier output, while keeping the generator meter at some high reading, right on a calibration mark where any variation is easily observed.

The Measurement

Now we start making the measurement. For plotting, it is convenient to start at the reference frequency and work in either direction. Point by point, as the frequency is changed, we watch for a change in the reading of either meter. If there is the slightest change in the *generator* meter, we bring it back to reference *with the level control.* So long as this meter remains constant, we are supplying a constant signal to the attenuator. If there is any change in the amplifier *output* meter, we again make certain the generator meter is on the reference setting, and then bring the output meter back to its reference *with the attenuator controls.* From them we can read, in 0.1 db steps, the variation in its drive that is required to keep the amplifier's output constant. If at some frequency we require a 0.1 db reduction in attenuation, to return the output meter to reference, then the amplifier's gain is down 0.1 db at that frequency. All the controls are arranged logically for just this type of measurement, so it will go quickly.

Why have we used the attenuator method to measure frequency response here? Why not just spin the frequency dial and watch the output meter? Only be-

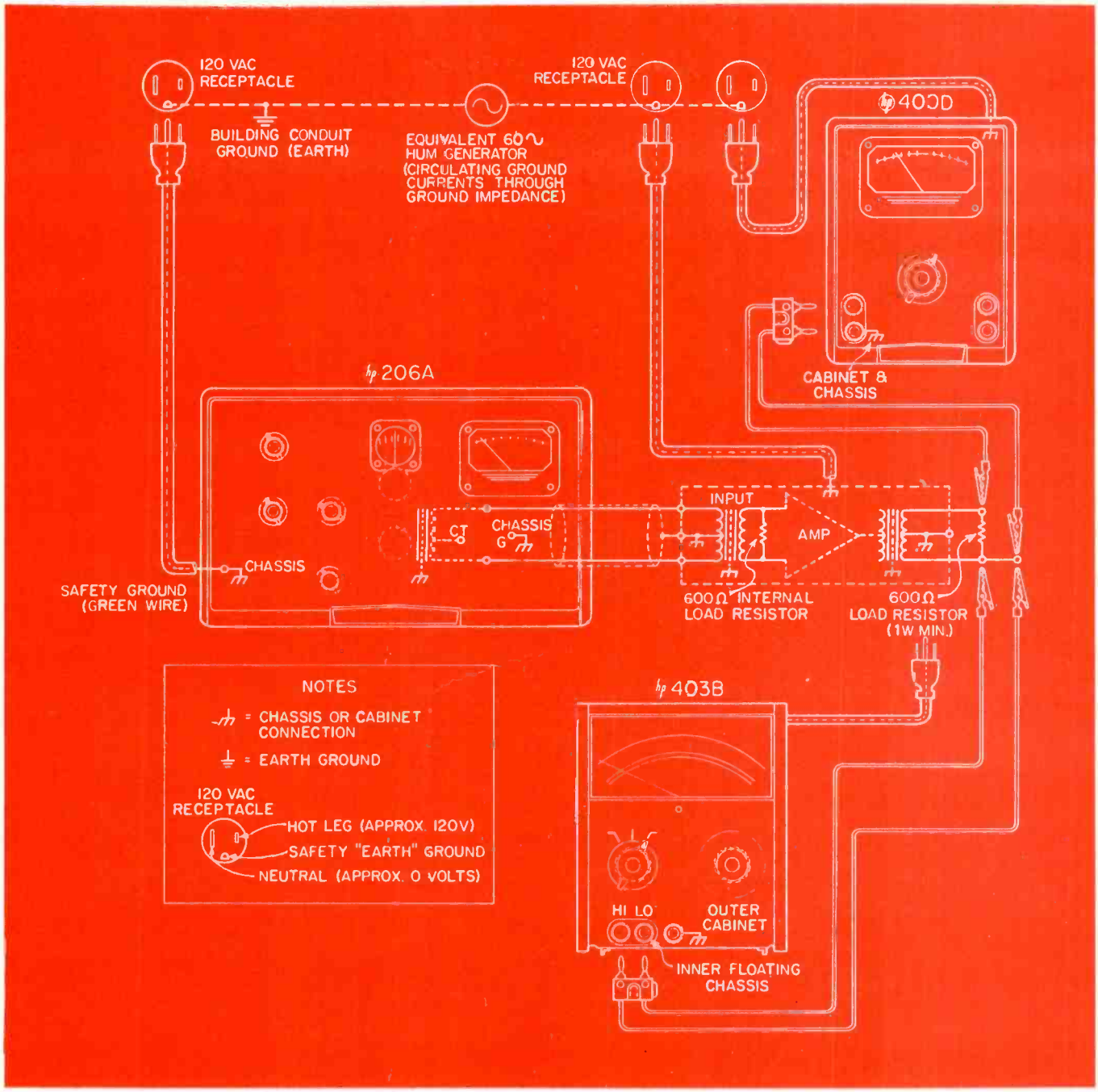


Fig. 1—Instrument set-up for making precision frequency response measurements in line amplifiers connected in series.

cause we want precision. The 0.1 db steps of the attenuator are accurate to a small fraction of 0.1 db. 0.1 db is a voltage variation of only 1½ percent, which is hard to measure with precision, on a voltmeter face. With the attenuator we can define variations in response sharply, to the nearest 0.1 db. Although we made no effort to measure input or output level more than roughly, we measured variations with precision, and that is what we set out to do. Our meters, for *this* purpose, had only to respond alike to different frequencies. Precise calibration was, for this one purpose, unimportant. We selected a precision voltmeter here because it is known to have consistently flat response in this range, and thus its response is likely to be the same as that of the high-quality meter in the generator.

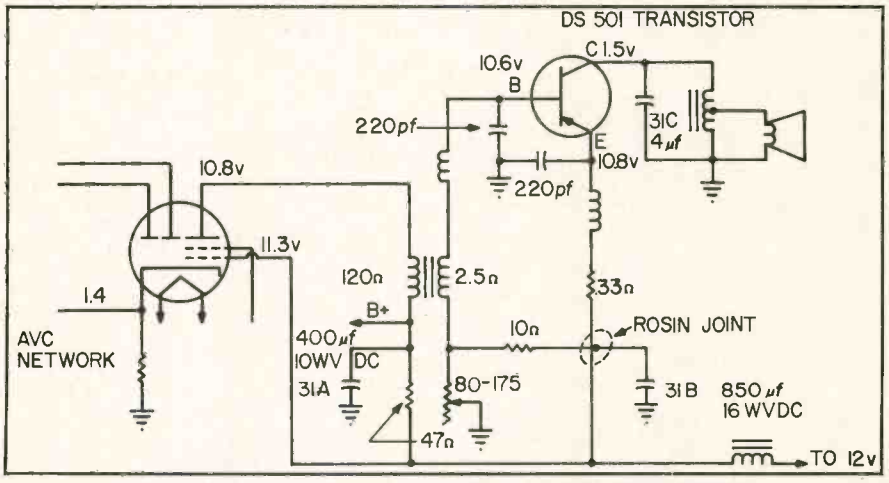
Why, in this case, was it necessary to read variations with such accuracy that we were pressing the limits of unusually accurate instruments? We will want something better than 1 db response from our 8-amplifier chain. Even a 0.1 db variation, when multiplied eight times, approaches the limit of acceptability. This much care in set-up and measurement, and the use of such highly accurate instrumentation, were thus entirely justified. ■

TOUGH DOG CORNER

Difficult Service Jobs Described by Readers

Rosin Joint

This 1961 Chevrolet Delco Radio Model 988414 was removed from the car for bench service. The 0.33 fuse resistor was open, the 10Ω resistor was "swollen." DS501 transistor had an emitter-collector short. The above components were replaced and the set started operating, but at about half volume. At minimum setting of the output transistor current, distortion and squeal were present. Increasing the current of the transistor would remove the squeal but the set still had low volume. Removing the 12DS7 driver tube would kill the squeal. All filter capacitors were bridged at the capacitor terminals and no improvement noted. The filter capacitor is mounted on the rear of the set with leads running from the capacitor to the printed boards. In double checking the capacitor it was bridged at the printed board and the squealing and distortion cleared and volume increased substantially. A closer inspection revealed a rosin joint where the lead from the filter entered the printed board. I resoldered this joint and adjusted the output transistor current. The radio then worked fine.—*Harold Wolff, San Antonio, Texas.*



Rosin joint caused low volume in Chevrolet radio Model 988414.

Elusive Convergence

I was recently called upon to adjust a newly delivered color TV set. I switched the set on and found it to be very poorly converged. The set was installed within a room divider so the owner helped me move it out into the room. I then proceeded with a complete color setup job. Everything went fine and after completing the job the set was in prefect convergence. The back was replaced and with the owner's help the set was put back into its niche. The set was switched on and to my amazement it was completely out of convergence. Thinking that something had moved on the CRT neck, we removed the set again, took off the back and checked the connections to the convergence panel and cloverleaf. Everything seemed OK so the set was again switched on and the convergence looked good. With the set on, the owner and I slowly reinserted the set into the divider. When we had it about halfway in I noted the set was slightly out of convergence. When it was moved back into the room the convergence corrected itself. The set was now removed completely and I checked the divider for metal strips or bars and found none. I noticed a record changer on one of the shelves of the divider. The owner then told me that the speaker for the stereo was located directly above the TV set. I removed the speaker grille cloth panel and revealed a ten in. permanent magnet speaker. The speaker had an extra large magnet and was approximately 14 in. from the cloverleaf on the CRT neck. I removed the speaker, reinserted the color TV into its opening and the set worked perfectly. The owner then relocated the speaker on the divider and the TV has been working fine ever since.—*Elio J. Cavalet, Akron, Ohio.*

This One 'Breathed'

Here's one that wasn't so tough but it sure was a stumper for a while. It was a Zenith chassis 14120/U. The owner said the bottom of the picture would "crawl" up an inch or more then go back to a full picture. This would take place at intervals of approximately every fifteen-seconds. The owner was right. We put the set on the bench and the picture would shrink, then expand—it looked like it was "breathing."

We first suspected that thermistor R-64 was going haywire. A check showed it was OK because the voltage to the vertical multivibrator plate was steady as a rock. One by one we ran checks on all of the components in the vertical section and not a single component appeared defective. This left our thinking machinery completely occupied by a big fat question mark.

A brainstorm forced us to suddenly connect a scope to the B+ supply. A very slight ripple appeared. We put the capacitor checker on a four section filter (C2) and it showed that all sections of this filter were about half capacity or less. A new filter pack cured the trouble. We didn't suspect ac because the picture was perfect except for the "breathing."—*J. Stepanich, Chicago, Ill.*

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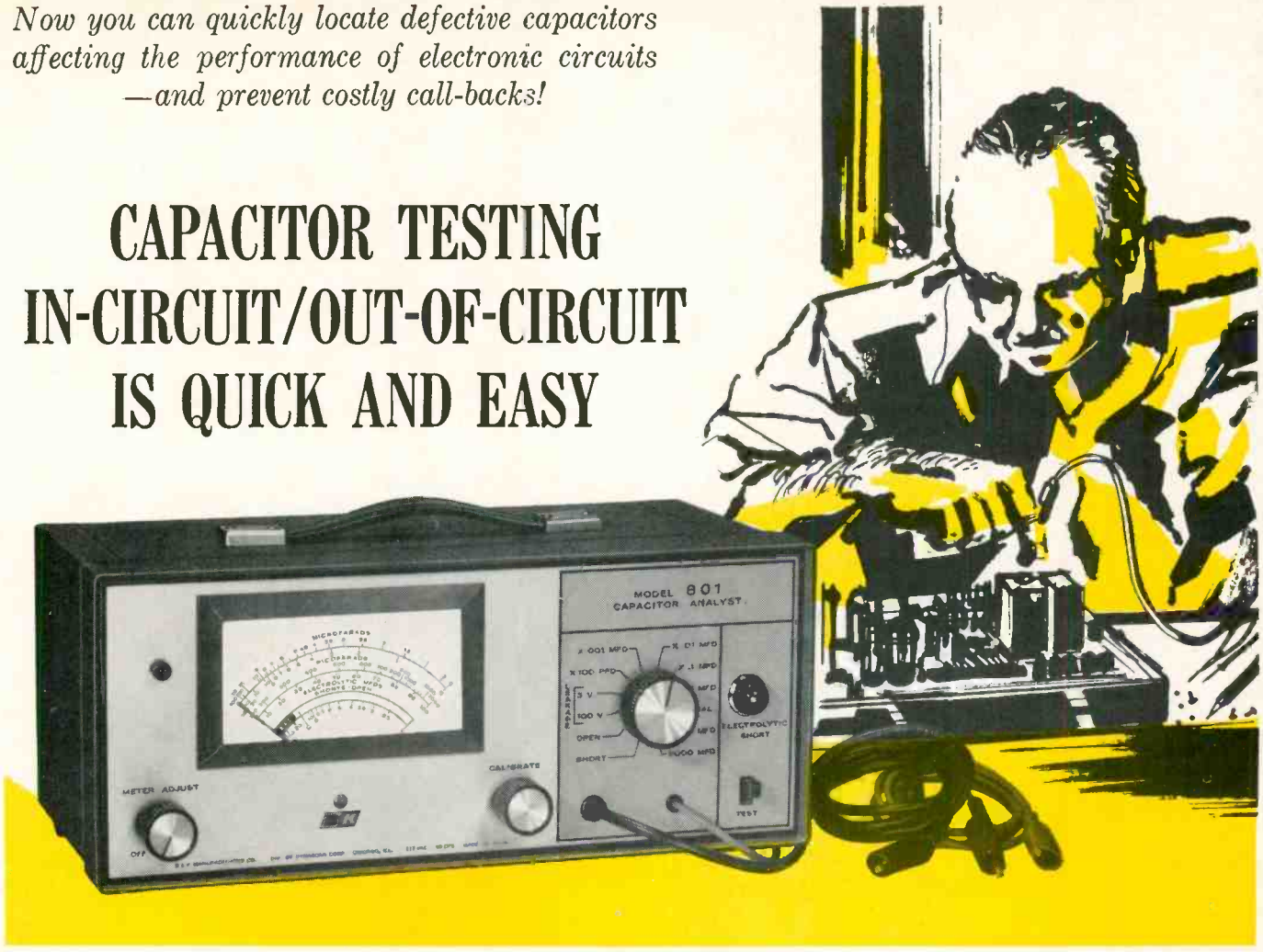

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COLORFAX

Sears — Toshiba

An unconfirmed report from the West Coast indicates that Sears plans to resume importing 16 in. color TV sets from Toshiba of Japan. It was said that a previous disagreement over prices had temporarily stopped shipments. The report also indicated that fewer than 4000 sets per month would be imported.

Color TV Market

According to a report published in BUSINESS WEEK, RCA led the field in color TV sales with 42 percent of the market, followed by Zenith at 14 percent, Sears 9 percent, Motorola 8 percent and Admiral 7 percent. Emerson, Magnavox and Sylvania each sold 4 percent of the total with the remaining 8 percent divided among all other manufacturers. A total of 1.4 million sets were sold in 1964.

The report also states that industry estimates for 1965 indicate that approximately 2.2 million sets will be sold. This figure added to the sets now in use will bring the total number of color TV homes to about 5,000,000 by the end of the year.

CBS Position on Color

At a recent stockholders meeting William S. Paley, CBS chairman of the board summed up his networks position on color telecasting in this way: "We are watching color television very closely, and we are ready to move very fast. Less than 4 percent of the homes in America are now equipped to receive color television. (Ed. Note: The current estimate is closer to 5 percent.) We will make it available to advertisers who want to pay for it. Very few have asked us to provide that service."

Paley continued, "The degree of color television acceptance, we think, might be up to 10 percent for 1966 or 1967, but we will be gradually, as more and more sets are distributed, getting into a larger and larger color schedule. And, as I say, if it goes through faster than we anticipate, we can move very quickly."

Paley also said that all of the new CBS studios have been designed, constructed and equipped so that, "with the addition of color cameras and monitors and a minimum amount of other equipment, color programs can originate from them. These additions can be made on relatively short notice." (Ed Note: See CBS Feature Film Purchase.)

CBS Feature Film Purchase

SPONSOR, the weekly broadcast magazine, reports that CBS has purchased 102 feature films from Universal Pictures. Of the total 58 are in color. Films slated for telecasting early next year, include such properties as "Written on the Wind" and "Pillow Talk."

Reports of this type are encouraging to color TV sales outlets. It lends fact to the rumor that CBS intends to color the airwaves this coming season.

Four Vidicon Tube Color Film Units

More than a year ago G-E developed a "four tube" color film unit. The unit contains a fourth vidicon tube which adds a monochromatic channel to the color signal. RCA has also begun delivery on a color film system which utilizes an additional tube for adding the brightness component to the color information. RCA compares this four tube concept to

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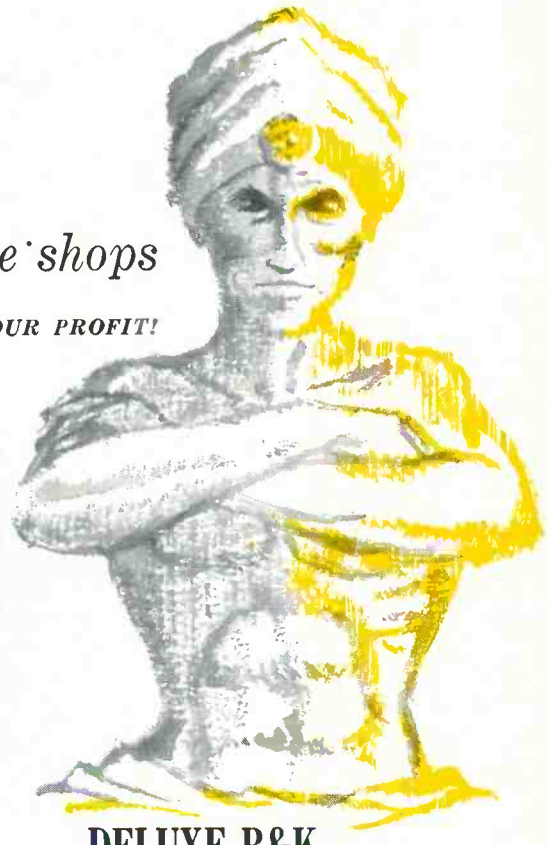

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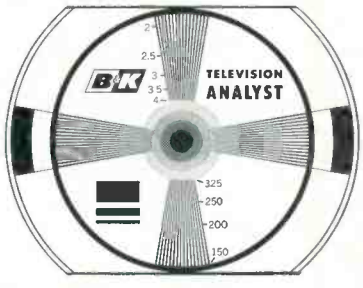

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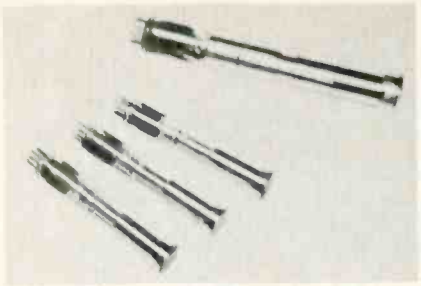
COLORFAX

four-color printing in which the imposition of black on the three primary (red, green and blue) colors enriches hues and sharpens definition.

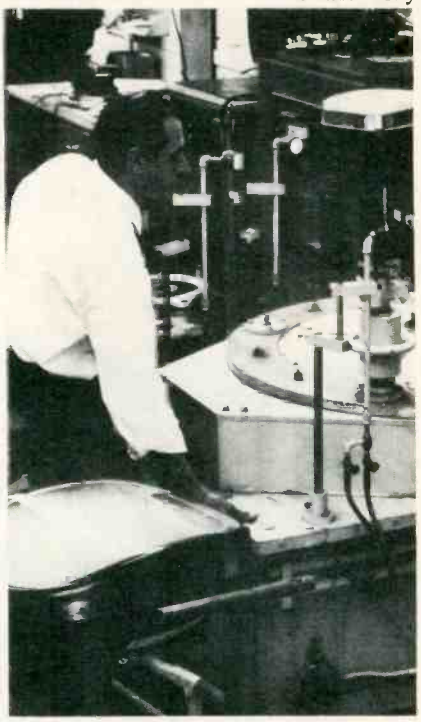
The bulk of color production is on film — both at the network and local levels — because of economics of production and distribution. Several TV stations have reported that four-vidicon color film equipment has improved their local color quality considerably and that they plan to increase their use of color film locally.



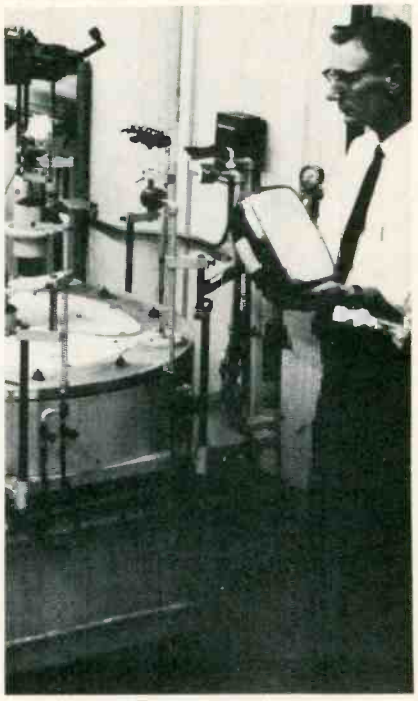
Vidicon tubes used in RCA "four tube" color film unit.

Chromatron Tube Status

Paramount Pictures Corp., developers of the chromatron color tube, has shown the tube to various American manufacturers. But to date the only licensing agreement signed has been with Sony Corp. of Japan. Reports indicate that the Sony color set containing the chromatron tube will be marketed in this country during 1965.



The Chromatron color tube in pilot production at Chromatic Div. Paramount Pictures. At left is new 22 in. tube. Leonard Minutillo readies device for sealing tube's single electron gun into tube neck.



John McQueen, Paramount engineer, holds 11 in. Chromatron tube. All Chromatron tubes have single gun rectangular face, 90 deg deflection angle.

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- Time an egg
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- Bake a cake
- Remind her to call you
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Your Cost $ 16.95

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220	MMF	±10%	1KV	DD-221	5 pcs
470	MMF	±10%	1KV	DD-471	10 pcs
.001	MFD	±10%	1KV	DD-102	20 pcs
.002	MFD	±10%	1KV	DD-202	10 pcs
.005	MFD	GMV	1KV	DD-502	10 pcs
.010	MFD	GMV	1KV	DD-103	20 pcs
.020	MFD	+80—20%	600V	DD-203	10 pcs
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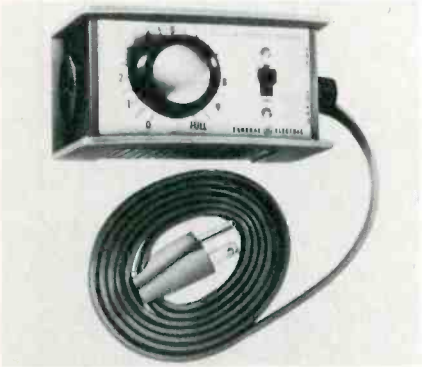
NEW PRODUCTS

FOR MORE INFORMATION CIRCLE NEW PRODUCT NUMBERS ON POSTCARD INSIDE LAST COVER.

Speed Control **200**

An electronic variable speed control for portable power tools is introduced. The G-E 5260-9 can be used



with tools powered by universal ac-dc motors rated up to 10 amp at 120 v — drills, sanders, sabre saws, buffers and grinders. The control employs a silicon rectifier and two diodes to maintain constant torque throughout the speed range. It has a separate ON-OFF switch and a built-in overload protective device. G-E.

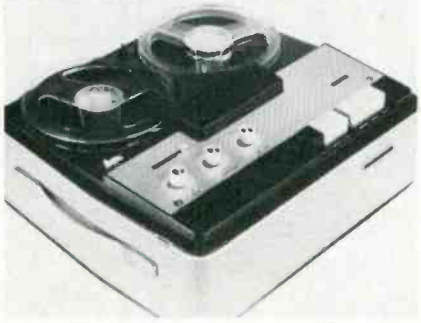
Cable Assemblies **201**

Cable assemblies for applications in testing, equipment hook-up and communications are introduced. The

cable consists of RG 63/U wire which has a capacitance of 10 pf/ft and a nominal impedance of 125Ω. Termination consists of a UG type 21D/U connector on one end and a IPC E950 connector on the other end. Fairhill.

Tape Recorder **202**

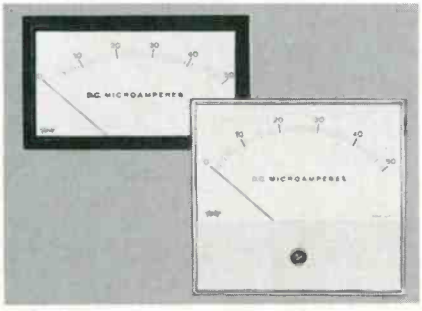
A two-speed, four-track tape recorder is introduced. The monophonic recorder has dual preamplifiers for stereophonic playback through an external high fidelity system. The unit can also be used as a self-contained public address system. The "Continental 201" operates at 7½ or 3¾ ips., providing up to eight hours playing



time from a single seven-in. reel. Complete with a moving coil microphone, the recorder has a frequency response of 60 to 16,000 cps, the manufacturer claims. It weighs 18 lb. Norelco.

Panel Instruments **203**

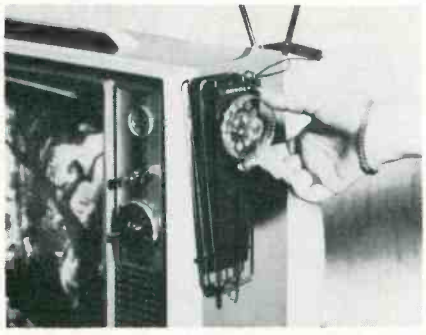
A line of panel instruments available in three sizes: 2½, 3½ and 4½ in. is announced. The G-Series con-



tains panel instruments with ac ranges from 10 ma, and dc ranges from 5μa. Triplett.

Antenna Accessory **204**

A self-adhering TV antenna accessory, designed for receivers with built-



in antennas is announced. It is attached to the built-in antenna staffs with small clamps. Snyder.

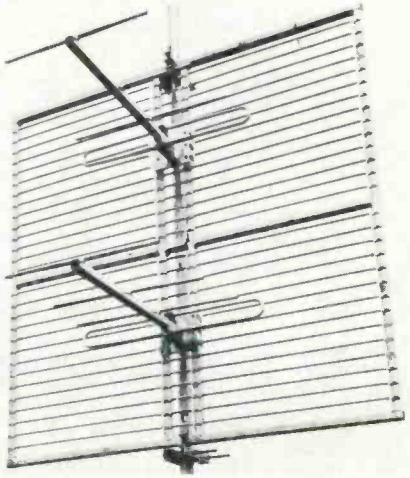
Degaussing Coil **205**

A 7 in. degaussing coil, Walsco model #2592, is molded in a plastic

case, provided with an extension cord and built-in switch. Walsco.

Screen Yagi **206**

A screen "Yagi" type antenna, model SY-42-13 with direct coaxial input for either 50 or 75Ω is intro-

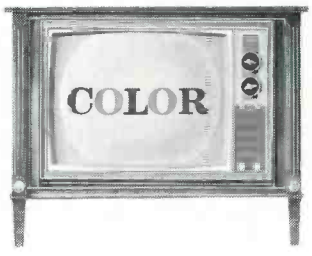


duced. The reflector measures 60 x 60 in. with a frame of 1¼ in. sq aluminum and screening of ⅜ in. diameter tubing. Elements are ½ in. diameter with ⅝ in. reinforcing sleeves. An internal balun provides for balanced to unbalanced transformation. Taco.

RCA Solid Copper Circuits

replace old-fashioned "hand wiring"...RCA Solid Copper Circuits are the circuits of the space age

RCA Solid Copper Circuits are made by methods as modern as tomorrow. They give greater dependability . . . better TV performance. It's typical of the advanced design you'll find throughout every RCA Victor home instrument. It all adds up to sets that are easier to service so that owners are more satisfied with results.



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NEW PRODUCTS

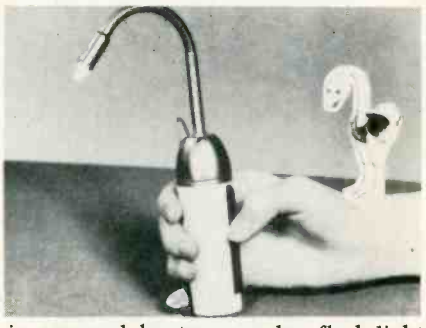
Ceramic Cartridges 207

A miniature line of four stereo ceramic cartridges is announced. A single cartridge weighs 1 gram and measures 1 in. — end to end. The four cartridges, Models 25T, 26T, 27T and 28T, are available with three different

mounting brackets: a metal bracket for standard tonearms; a plastic molded bracket/cartridge combination, also for standard type tonearms, and a cartridge without bracket (this type is designed for direct replacement in shroud and tubular type integrated tonearms.) Sonotone.

Inspection Light 208

A flexible-neck light with a chrome-plated neck that bends up to 270 deg



is powered by two regular flash-light C cells. Meredith.

Lectern 209

A sound column lectern is now being supplied with a walnut Formica finish. The self-contained unit has a

25w all-transistor push-pull amplifier that handles 40 w peak, and six built-in loudspeakers in an integrated sound column. Perma-Power.

Tube Tester 210

A tube tester that can be used in TV-radio service, on the bench or as

a self-service unit on the counter is introduced. The model 202-E is 11½ x 19 x 20½ in. Mercury.

NEW PRODUCTS

Cooling Spray **211**

This aerosol spray for chilling suspected faulty components is packaged with a long plastic extender tube. It

is offered in two sizes, the 8-oz aerosol can at $1.98 and the bench technician's 16 oz can at $2.70. Chemtronics.

Inverter **212**

A transistorized inverter which can be used with any TV set requiring 175

w or less power, is announced. It converts 12-vdc into regulated 110-vac. Dynamic Instrument.

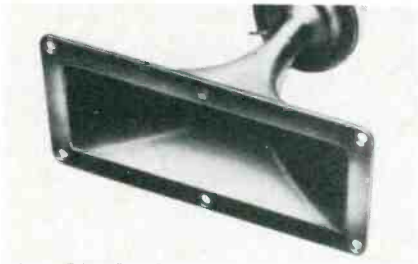
Portable Radio Line **213**

A portable radio line containing 25 models is introduced. More than one-

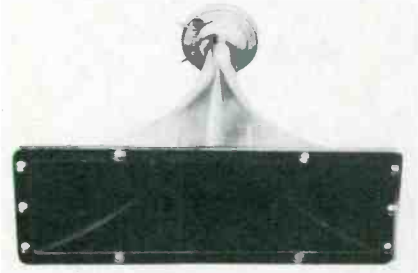
third of the sets incorporate either short wave or FM. G-E.

Horns 214

An addition of two mid-range and high frequency tweeter horns to a line of speakers is announced. Model



CH26BO8G is 2 x 6 in. and is designed for high frequency applica-



tions. It has a frequency response of 1500 to 20,000 cps, the manufacturer says. Model CH39B08G may be used to reproduce both middle and high frequencies. Its size is 3 x 9 in. and its frequency response is claimed to be rated from 900 to 20,000 cps. Oxford.

Portable Phonograph 215

This portable phono uses a transistorized amplifier and plays all standard record sizes and speeds. It has a

manual, four-speed, recessed turntable with built-in 45-rpm adapter, and a monophonic crystal cartridge with flip-over dual synthetic sapphire styli to accommodate 16-, 33-, 45-, and 78-rpm disks. The unit also incorporates a 4-in. speaker, plus record storage space in the lid. G-E.

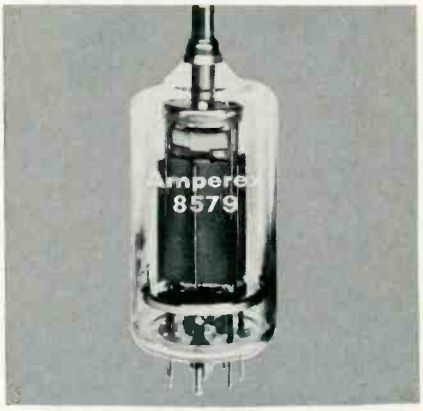
Portable Recorder 216

A portable tape recorder is introduced. This battery powered unit is fully transistorized and weighs about one lb. The manufacturer says that the unit is suited to law enforcement and field interviewing needs. S.A.C. Electronics.

NEW PRODUCTS

Single Sideband Tube 217

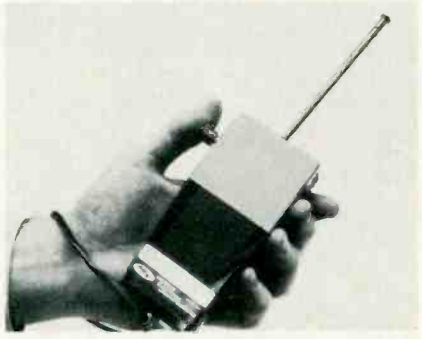
The 8579, a beam power tetrode designed primarily as a linear RF amplifier in single sideband transmit-



ters for frequencies up to 60 Mc is announced. The tube has double ended construction and a common basing arrangement with hard glass envelope. Amperex.

Personal Survival Beacon 218

A miniature radio transmitter designed to assist in locating personnel during search and rescue operations



is announced. The miniature transmitter, a personal survival beacon, broadcasts a signal which may be picked up by search aircraft and rescue vessels 50 to 100 miles away, the manufacturer says. The six-oz transmitter measures ¾ x 2½ x 3⅝ in. The transmitter generates a swept audio tone on 121.5 Mc, the commercial emergency frequency, or 243 Mc, the military frequency, and the beacon has an RF output power of 0.1 w. AEL.

VOM 219

A line of VOMs with the meter movement protected by a diode is introduced. The meters are available in prewired or kit form. EMC.

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NEW CAPABILITIES IN: ELECTRONIC TUBES • SEMICONDUCTORS • MICROWAVE DEVICES • SPECIAL COMPONENTS • DISPLAY DEVICES

NEW PRODUCTS

Coax Kit 220

A kit used for coaxial cable installation including coaxial antenna, cable, indoor matching transformer, tri-mount and hardware, is introduced. Jerrold.

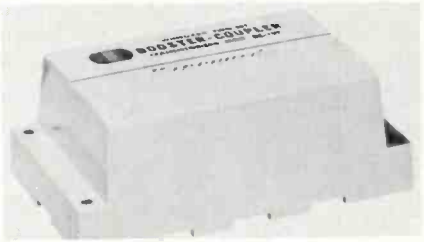
AM/FM Boat Radio 221

An auto or boat radio that can

be unsheathed from its mounting bracket and used as a battery-powered portable is introduced. The model 769 is 5 x 5¾ x 2 in. with a 2¾ in. speaker. It contains nine transistors, six diodes and one thermistor. Hoffman.

Booster Coupler 222

A 2-set booster coupler is announced. The BC-107 is capable of delivering 7 db gain to each TV or



FM set, the manufacturer says. An extra set of terminals has been added so that it can be used as a booster only with a single TV or FM set. Winegard.

Antistatic Agent 223

An antistatic agent for use on both plastic and glass surfaces is announced. This transparent conducting

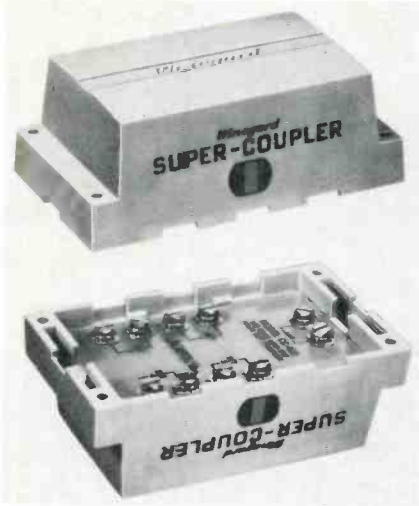
agent reduces instrument error due to static charges, the manufacturer says. It can be used either to re-treat old surfaces or as an initial treatment. Westinghouse.

Miniature Radio 224

A miniature pocket size AM/FM radio is introduced. The radio is housed in a plastic cabinet of sculp-

tured design, decorated with a chrome grille. The dimensions are 4⅜ x 2¾ x 1¼ in. The chassis has 9 transistors and 5 diodes. Continental.

TV Set Coupler 225



A 4-set TV coupler, called the model CC-400 "Super Coupler," is announcd. It was said that a different approach to signal splitting is used in the coupler by employing three double-wound ferrite core transformers. It was also said that an insertion loss of −6.23 db is achieved. A theoretically perfect 4-set coupler would have an insertion loss of −6 db. Winegard.

CB Crystals 226

A line of CB crystals is announced. According to the manufacturer, the crystals have a frequency tolerance of 0.005% or better and cover all 23 CB channels. The line is said to fulfill 95% of all popular replacement requirements. The two-toned plastic box packaging is bright and compact for efficient impulse sales.

NEW PRODUCTS

Automatic Degaussing Kit **227**

An automatic degaussing kit for all 1963-1964 color TV sets is announced. The kit comes with detailed

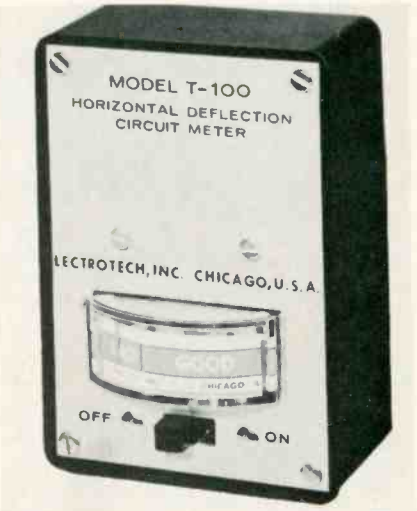
instructions and consists of two degaussing coils, an automatic degaussing control and all the necessary wiring. Colman.

Amateur Band Receiver **228**

The HQ-88 is a general coverage communications receiver for popular amateur bands from 10 through 160 meters, including MARS, Citizen Band, WWV and Marine Band Sensitivity is a measurable 0.75 μv for a 10 db AM signal-to-noise ratio, and better than 0.4 μv for SSB and CW, the manufacturer says. Hammarlund.

Horizontal Meter **229**

A horizontal deflection circuit meter is introduced. The T-100 permits checking of horizontal deflection cir-



cuitry, without making or breaking any connections. It measures 2⅞ x 3⅞ x 1½ in., and can be stored in your service caddy. Lectrotech.

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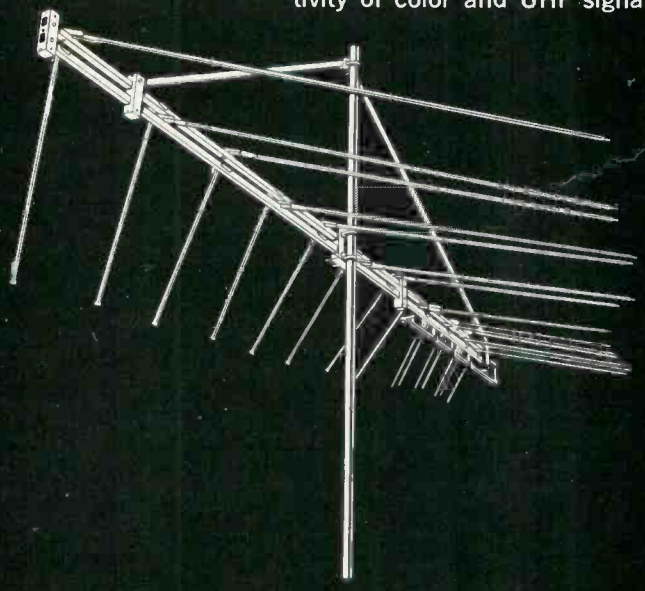
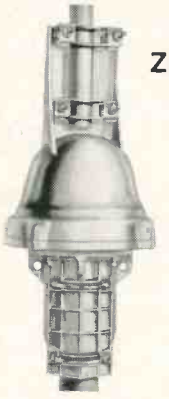
More color TV sets and new UHF stations mean new antenna installation jobs for you. Proper installation with antennas of Zenith quality is *most* important because of the sensitivity of color and UHF signals.



ZENITH ALL-CHANNEL VHF/UHF/FM AND FM-STEREO LOG-PERIODIC ANTENNAS

The unusually broad bandwidth of the new Zenith VHF/UHF/FM and FM-Stereo log-periodic resonant V-dipole arrays pulls in all frequencies from 50 to 900 mc—television channels 2 to 83 plus FM radio. The multi-mode operation provides high gain and good rejection of ghosts.

These frequency independent antennas, developed by the research laboratories at the University of Illinois, are designed according to a geometrically derived logarithmic-periodic formula used in satellite telemetry.



ZENITH QUALITY HEAVY-DUTY ANTENNA ROTORS

Zenith quality antenna rotors are heavy-duty throughout—with rugged motor and die-cast aluminum housing. Turns a 150-lb. antenna 360 degrees in 45 seconds. The weatherproof bell casting protects the unit from the elements. Each rotor mounts easily to either a mast or tower without an adapter.

ZENITH QUALITY WIRE AND CABLE

Zenith features a full line of quality packaged wire and cable. Also especially designed UHF transmission wires, sold only by Zenith. Zenith wire and cable is engineered for greater reception and longer life, and is available in various lengths to suit every service man's needs.

Check the Yellow Pages for the Zenith Distributor nearest you.
Or write to Zenith Sales Corporation, Parts and Accessories Division,
5801 West Dickens Avenue, Chicago, Illinois 60639,
for Distributor name plus complete catalogue and technical information on Zenith Quality antenna installations.

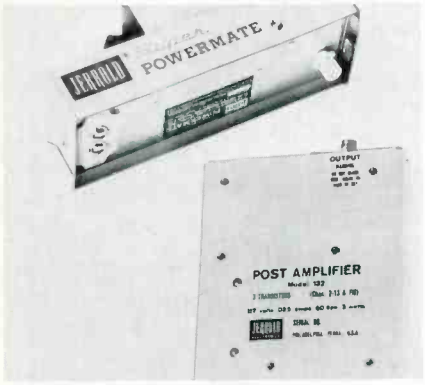
Specifications subject to change without notice.

. . . for more details circle 70 on postcard

NEW PRODUCTS

TV/FM Amplifier **230**

TV/FM amplifier, consisting of two separate units, is announced. The model SPC132 is a combination of two units — SPC and 132 — and



combined to form a powerful home TV reception device, according to the maker. The SPC is a boom mounted two transistor preamplifier and the 132 is a combination remote power supply and three transistor post amplifier. A single coax cable between the SPC and 132 units transport power up to the preamp and signals down to the post amplifier. Jerrold.

FTC Final Order

■ The Federal Trade Commission announced that four trade associations of television and radio technicians have consented to an order prohibiting them from unlawfully conspiring to suppress competition.

Joined in the order are the following associations and their officials or former officials, who are cited as representative of the entire membership of the respective associations: *Television Service Dealers Association of Delaware County,* 1626 Providence Ave., Chester, Pa.; Peter Rapagnani and Leon Skalish, *Television Service Dealers Association of Delaware,* 403 Philadelphia Pike, Wilmington, Del.; Henry Dale and James A. Mayhart. *Allied Electronic Technicians Association, Inc.,* 518 Market St., Camden, N. J.; Joseph J. Papovich and Anthony J. Defranco. *Radio Servicemen's Association of Trenton, N. J., Incorporated,* 343 Williams St., Trenton, N. J.; Michael E. Toth, Henry F. Leverence, Frank C. Guest and Lewis M. Edwards.

Summarily, the agreed-to order would prohibit respondents from entering into or carrying out any conspiracy or agreement which would: Coerce any wholesale or other distributor of television, radio or electronic equipment or component parts (1) from doing business with or soliciting business from any class of customers, or (2) to engage in or refrain from engaging in any acts or practices relating to the conduct of his business (including hours of operation, window displays or advertising); or "black list" any wholesale or other distributor of television, radio or electronic equipment or component parts who sold, sells or offers to sell, or "white list" any distributor who refuses, has refused or does not offer to sell, such products to any customer or class of customers.

According to the FTC's complaint, all or virtually all of the members of the trade associations are engaged in repairing and servicing electronic devices, and purchase various supplies from wholesalers or distributors who also sell such supplies to non-members of the associations and to ultimate consumers.

Continued on page 102

ĕth′ĭks

Ethics. Where have they gone?

Ethics, says the dictionary, is "the science of human duty; moral science."

In today's world, so complicated with gadgetry and machines that we often lose sight of others and of our own best selves, it isn't always easy to keep "human duty" in mind.

As life gets more complicated, men lose their sense of identity, value and purpose. Life, in a sense, becomes "cheap" and "unimportant." And with that, it becomes ever easier to take the easy way, to ignore the principles of right—and our human duty to others.

The one place where human values are kept in proper focus is where you worship. Nowhere is the individual more valued. *And if you care*, the place where you worship can become, with your help, a rallying point for lifting all the deteriorating values you see around you. Worship this week —and put your faith to work *all* week.

Worship this week

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PROBES . . .

Continued from page 51

an appropriate multiplier resistor.

Most VTVMs have a standard input resistance of 11 M Ω on every dc voltage scale. This permits a single multiplier resistor to be used in the HV probe. A voltage multiplication factor of 100 can be obtained by using a multiplier resistor of 1090 M Ω. This value, combined with the meter's input resistance, will multiply each dc voltage range by 100. For example, the 100 v range will be increased to 10000 v and the 150 v range to 15000, etc.

Although high voltage probes are designed to protect the user from shock, care should be exercised when making measurements in a TV receiver's high voltage section. Some precautions that should be observed are: (1) Do not work alone. Notify others that you are making high voltage tests. (2) Always work with a dry probe and be sure that your hands are dry. (3) Measure the supply voltage at the anode of the CRT if possible. (4) Be sure that your probe has no cracks and that the lead insulation is OK. (5) Put one hand in your pocket. In this way you will be sure not to accidentally touch ground potential.

HV probes supplied by the various manufacturers may vary some, so individual manufacturer's instructions should be followed closely.

VTVM RF Probe

An RF probe designed for a VTVM is very similar to the demodulator probe used with an oscilloscope. The two are, in fact, interchangeable in some applications. The probe shown in Fig. 5 can be used to measure the RMS value of sinewaves from 50 Kc to 250 Mc. The crystal-diode functions as a half wave rectifier and the resistor-capacitor combination forms an RF filter. The impedance of the probe must be high to avoid loading the circuit under test.

The dc voltage developed at the output of the probe is equal to the RMS voltage of the sinewave being measured. The peak value can be obtained by multiplying this by 1.414.

An RF probe is very useful for signal tracing in the RF and IF stages of a TV receiver. A VTVM equipped with a probe of this type can be used in the same manner as the scope with a demodulator probe. The vertical amplifier of the scope enables it to be much more sensitive than the VTVM for this type of testing. For this reason the scope is more effective in measuring RF voltages in TV RF or mixer stages. The voltage available at these points is extremely low so the VTVM would not register an indication. ■

NEW LITERATURE

Solid State Line **300**
This short form catalog features a solid state line of electronic equipment. Stereo/Hi Fi components, test instruments, citizen bands and amateur gear are included in the publication. EICO.

Transistors **301**
This reference guide details interchangeability information of over 1500 transistors. In addition the brochure affords interchange data for approximately 150 diodes. Tungsol.

Columnar Speakers **302**
A number of data sheets feature information on a line of columnar speaker systems. The sheets contain characteristics and specifications of the systems designed for public area use. Bozak.

Ceramic Microphones **303**
This catalog describes the physical and electrical characteristics of a line of ceramic microphones. Sonotone.

Antenna Line **304**
A line of indoor and outdoor antennas, intercom systems, and related accessories is described in full-color catalog sheets. RMS.

Power Tools **305**
This 76-page illustrated guide contains specifications and applications of a line of electric and pneumatic power tools. Skil.

Tools **306**
This 48-page catalog describes a variety of hand tools, optical equipment, miniature lathes and a line of clean room supplies. Techni-Tool.

Test Instruments **307**
This eight-page booklet describes a line of TV test instruments. Specifications on tube testers, scopers, color generators, field strength meters and multiplex generators are included. Sencore.

Power Supplies **308**
This catalog describes the performance features of a line of regulated

NEW LITERATURE

dc power supplies. Also included are descriptions and specifications on adjustable power supplies. Acme.

MATV Equipment **309**

This eight-page catalog covers a line of MATV equipment — amplifiers, converters, housings, attenuators, matching transformers, splitters, mixers, fitters, traps and other equipment and accessories — for educational, institutional and industrial use. Blonder-Tongue.

Myograph **310**

This two-page brochure describes an electronic device which can measure the strength of any muscle in which a diagnostician or therapist is interested. F.K.F.

TV System Guide **311**

This planning guide designed especially for architects and consulting engineers provides information about TV system products and services. The guide which can be updated as information becomes available, contains application data, product specifications, design data, general specifications and prices. Blonder-Tongue.

HV Power Supplies **312**

This 14-page illustrated catalog contains information about a line of high voltage power supplies, insulation testers and power packs. Kilovolt.

Plastic Boxes **313**

This six-page brochure describes a line of plastic boxes used for packaging electronic components. Akro-Mils.

Reed Relays **314**

A six-page brochure features electrical and physical data on a line of reed relays. Technical specifications are listed at minimal, rather than ideal, environmental conditions. Kidde.

Starting Capacitors **315**

This 12-page bulletin contains design data, typical performance curves, and dimension drawings and standard listings for a line of motor starting capacitors. Sangamo.

BOOK REVIEWS

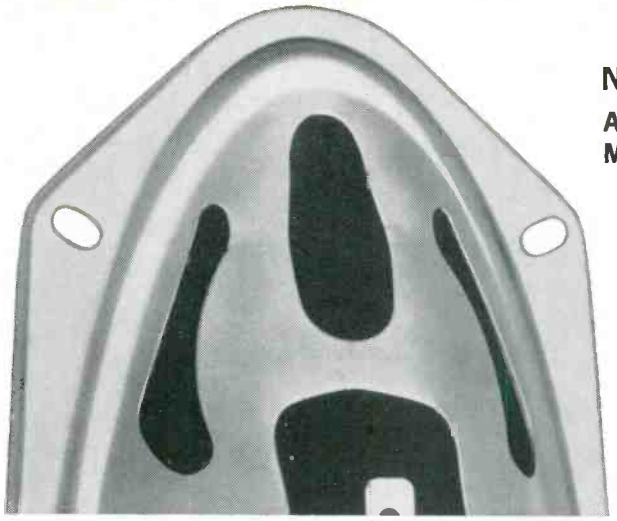
RADIO OPERATING, QUESTIONS and ANSWERS. *By Jules L. Hornung and Alexander A. McKenzie, Published by McGraw-Hill Book Co. 598 pages, hard cover. $8.25.*

This updated and expanded edition is filled with clear, concise and pertinent facts which are helpful to the candidate preparing to take an FCC license examination. The book is written in a question-and-answer format and covers such topics as commercial broadcasting, frequency modulation, monochrome and color television, radiotelephone and radiotelegraph communications, transistors and many other subjects. It also contains information designed to aid TV-radio technicians and engineers to obtain any class of radiotelephone or radiotelegraph license.

PLANNING and INSTALLING MASTER ANTENNA TV SYSTEMS. *By Lon Cantor. Published by John F. Rider Publisher, Inc. 136 pages, soft cover. $3.95.*

This book explains the economic and technical considerations involved in setting up an effective master antenna system. It provides both detailed, factual information for businessmen and the important technical data needed by designers and installers. Many different types of projects are discussed — from a simple MATV system for a home, TV repair shop and showroom to elaborate projects for hotels, high-rise apartment houses, and community TV systems. Buyers of the systems — building owners, architects, consulting engineers, electrical contractors — are given ample information for choosing the proper system to fit their needs. TV technicians will learn how to enter this field with all the necessary background to sell and install all types of systems. A special chapter shows how to lay out a system — from a preplanning investigation right through all the technical details and specifications necessary for building a quality system. Installation and servicing techniques and troubleshooting procedures are clearly given.

The addition of extras such as background music and closed circuit TV to existing MATV systems is also covered. One chapter delves into the requirements of a CATV system and a translator operation. The advantages and disadvantages of each type of system are explained.



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12½% EXTRA is a *big deal!* It's three times savings account interest . . . twice the yield of good bonds . . . more than the final net profit of many a business enterprise.

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Can you afford *not* to use JENSEN Viking replacement speakers? Better see your distributor soon!

Write for Jensen Catalog 1090.

Nominal Size	Model No.	Magnet* Wt. Oz.	Imp. Ohms	List Price
3	3K7	.68	3.2	$3.80
3½	35K7	.68	3.2	3.80
4	4K5	.55	3.2	2.90
4	4K7	.68	3.2	3.55
5	5K5	.55	3.2	3.25
5	5K7	.68	3.2	3.85
5¼	525K7	.68	3.2	4.35
6	6K7	.68	3.2	4.35
7	7W3	1.00	3.2	6.55
8	8W3	1.00	3.2	5.85
10	10J10	1.73	3.2	9.00
12	12J10	1.73	3.2	10.50

*DP—Alnico 5 Magnets

Nominal Size	Model No.	Magnet* Wt. Oz.	Imp. Ohms	List Price
3x5	3X5K5	.55	3.2	$4.10
4x6	4X6K7	.68	3.2	4.80
4x8	4X8W3	1.00	3.2	6.00
4x8	4X8W9	1.00	8-10	6.00
4x10	4X10W3	1.00	3.2	6.50
4x10	4X10W9	1.00	8-10	6.50
5x7	5X7W3	1.00	3.2	5.35
5x7	5X7W9	1.00	8-10	5.35
5x7	5X7V3	1.47	3.2	5.40
5x7	5X7V9	1.47	8-10	5.40
6x9	6X9W3	1.00	3.2	5.95
6x9	6X9W9	1.00	8-10	5.95
6x9	6X9V3	1.47	3.2	6.40
6x9	6X9V9	1.47	8-10	6.40

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JENSEN LOUDSPEAKERS

. . . for more details circle 34 on postcard

PHASE SHIFT . . .

Continued from page 62

latter case, the phase shift produced by the network is different for each frequency in the waveform. In some cases this condition can be corrected by adding a phase equalizer. This is a circuit that has essentially a flat frequency-vs-attenuation response. The phase response is made equal and opposite to that of the network causing phase distortion so that the network phase shift is corrected without disturbing the frequency response. Phase equalizer networks can be made in a variety of configurations and are made up of resistive and reactive components.

Measuring Phase Shift

Since proper phase is such an important quantity in electronic circuits, we must be able to measure it. This will enable us to detect unwanted phase shift and accurately setin desired phase shifts.

Every technician should know how to measure phase shift with lissajous patterns on an oscilloscope. The lissajous is an elliptical shaped pattern that shows the amount of phase shift present in the circuit. If we desire to check the phase shift between the input and output of a circuit, we connect the circuit input signal to the vertical input terminals of the oscilloscope and the circuit output signal to the horizontal input terminals. The gains of the horizontal and vertical amplifiers are then adjusted until equal amplitude signals appear at the horizontal and vertical deflection plates of the CRT. A properly shaped lissajous pattern will appear on the CRT face.

A typical lissajous pattern illustrating phase shift calculations is shown in Fig. 3. Values A and B should be measured carefully from the scope screen. Any convenient units (inches, centimeters, etc.) can be used. The sine of the phase angle is A/B.

There are three special cases of lissajous patterns you should know. With no phase shift (0 deg), the pattern is a straight line slanting downward from right to left. The lissajous pattern is a perfect circle when the phase shift is 90 deg; and when phase inversion is present (180 deg), a straight line slanting downward from left to right will appear on the scope screen.

The lissajous method of phase measurement is fairly accurate if care is taken in measuring A and B.

A dual trace oscilloscope with an accurately calibrated sweep can also be used to measure phase shift. The sinewaves are displayed on the scope screen and the time shift between them is measured on the calibrated graticule. Knowing the frequency and the amount of time displacement the phase shift can be calculated.

If greater accuracy in measurement is desired, a phase meter should be used. A phase meter is an instrument designed to measure phase shift over wide frequency and amplitude ranges. The phase angle is read out directly on a front panel meter.

Several types of phase meters with varying degrees of accuracy and a selection of frequency ranges are available. ■

In Shop Service Training

by Tex Smiley

Motorola

■ Most electronic technicians are well aware of the rapid developments taking place in technology. Strange and exotic circuits appear almost daily in both domestic and foreign electronic devices. Repair technicians have learned not to be surprised at what they may find underneath a chassis of a new set or instrument. In electronics, innovation is a way of life.

Very often, however, this change goes unrecognized by those who are not part of the design, manufacture or repair processes of these products. Consumers have come to expect constant improvement in the electronic products they buy and little thought is given to the complex electronic configurations which make possible these improvements.

Iet's look at this change, especially from a communications technician's viewpoint.

Winds-Of-Change

For years, change in two-way radio equipment was moderate. State-of the-art changese in tubed equipment were readily assimilated by technicians as new instruction books for the equipment were received. The introduction of transistorized circuity, however, ushered in an era so different as to require sweeping changes in servicing techniques. These changes continue to occur rapidly.

The two-way communications service manager now faces the problem of continuously training his servicing personnel, not only on new techniques and inventions, but training on equipment modifications, revisions and new applications. Communications equipment manufacturers can assist through company sponsored technical training schools both at their headquarters and in the field, but in-shop training contineus to be a most effective method.

The Plan

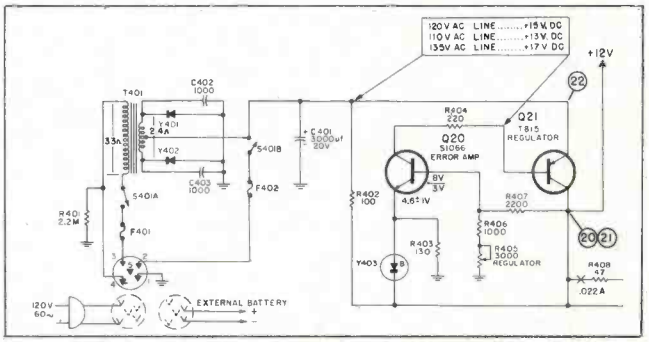
In-the-shop training plans have followed many patterns but one of the most used is the weekly informal meeting between service manager and technicians. At the

Continued on page 103

TECHNICAL DIGEST

Continued from page 34

series voltage divider which consists of R407, R406, and R405, the regulator potentiometer. The cathode of the zener diode, Y403, is connected to the collector of Q21, which is the output of the dc supply. Its anode is connected in series with R403 to chassis ground. The emitter of Q20 is connected at the junction of R403 and Y403. A constant reference voltage equal to 6.3 vdc is developed across Y401 through its zener diode action. The emitter voltage for Q20 will always be equal to the difference between 6.3 v and the collector voltage of Q21.



Assume for a moment the ac line voltage rises; the output voltage from Y401 and Y402 will rise and the collector voltage of Q21 will also rise. This will cause the base voltage of Q20 to go more positive, but by a smaller amount, in comparison to its emitter rise, effectively decreasing the amount of forward bias applied across its emitter base junction. This is in the direction to lower the emitter-collector current of Q20 which is flowing through the emitter-base junction of Q21. The effect of this current change will decrease the amount of forward bias applied to the emitter-base junction of Q21 and the transistor will not conduct as heavily. The internal resistance of Q21 will rise and the voltage drop across it will be higher. This change in resistance will lower the output voltage to its original 12 v.

R402 assures that the regulator circuit starts to function when power is applied to the receiver by supplying an initial voltage to the base of the error amplifier Q20. Since R402 is connected between the emitter and collector of Q21, its resistance has no effect when Q21 is functioning because the resistance of Q21 is less than 8 ohms while it is conducting.

R405 is the regulator bias control which is adjusted to produce an output of 12 v at the collector of Q21 to power the receiver.

SYLVANIA

Color TV Chassis 580 — Color CRT Setup Procedures

Sylvania 580 chassis color sets using the Color Brite 85 picture tube may show excessive blooming at high brightness settings.

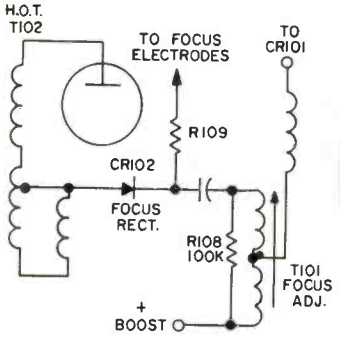
To reduce the effect of this blooming a new CRT set-up procedure should be used. (1) Set the Kine Bias switch to its lowest bias position. This is the position towards the base of the TV set and causes maximum brightness. (2) Move the Service Switch to the service position. Set the background controls to ¾ full clockwise and all screen controls to their maximum counterclockwise position.

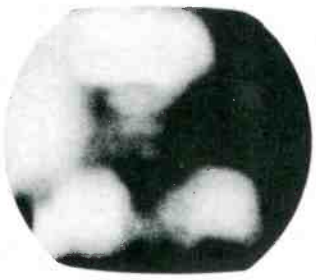
(3) Advance one screen control until a horizontal line is noticed; then turn it counterclockwise until the line just disappears. Repeat the procedure for the remaining two screen controls. (4) Return Kine Bias switch to its maximum bias position; in this position the switch will be toward the top of the cabinet. Move the Service Switch back to its normal position. With the adjustments made as outlined above the picture should barely bloom as the brightness control is turned to maximum. Using a normal picture adjust the green and blue drive controls for optimum tracking at all brightness levels.

PHILCO

TV Chassis 14M91, Model M-52414MR—Picture Out of Focus

Shorted focus rectifier CR102 causes overheating and rise in resistance of R109. This condition results in insufficient brightness, blooming and poor focus. Color and sound are OK in this instance.





NEWS OF THE INDUSTRY

USL Reps

Six manufacturer's representatives have been selected by United Scientific Laboratories, Long Island City, N.Y., to handle its complete line of CB transceivers, according to I. Bernard Sussman, sales manager. Roy Haught and Associates, Indianapolis will handle Indiana and Kentucky. Jack Lehner and Son, Columbus, Ohio will represent the company in Ohio. Robert Milsk Company, Detroit will handle Michigan. Reptronics of Dallas, Texas, will distribute the line in Texas, Oklahoma, Arkansas, Louisiana, Mississippi and western Tennessee. Irving Rose Associates, Chicago, will service northern Illinois and Echo Communications, Cedarburg, Wisconsin will handle that state.

Tuner Production

Oak Manufacturing Company produced nearly 2¾ million tuners in its domestic and overseas plants during 1964, says E. A. Carter, chairman and president. Tuner facilities are located in Elkhorn, Wisconsin, Crystal Lake, Illinois, Hachioji, Japan and Hong Kong. The Hong Kong plant began production of tuners only recently and is expected to reach a rate of 70,000 tuners a month in mid-1965.

FM/Stereo Adapter

A transistorized stereo adapter, designed by Delco for Chevrolet, allows owners of 1965 cars to enjoy FM stereo radio reception in their automobiles. The stereo adapter is a separate unit that plugs into the 1965 AM/FM radios with no modification to the radio receiver. The adapter can be installed either as a factory option or later by a dealer.

IRC Reports Earnings

International Resistance Co. earnings for the first 42 weeks of 1964 were $1,596,252 or $1.07 per share, which is better than the entire year of 1963, when the same 42-week period produced a net profit of $1,391,309 or $ .93 per share. Sales through October 18 were $23,674,818 compared with $24,107,960 in the same period last year. Per share figures are based on 1,491,662 shares currently outstanding.

Bendix Radio Intercom Tested

A new walkie-talkie system designed especially for airline personnel working amid the thundering roar of taxiing jet aircraft — such as deafening noise heard at the arrival and departure gates of airports — was demonstrated recently at New York's Kennedy International Airport to Pan American Airways officials. The new system provides "clear-voice" communications between a ground crew and the pilot and co-pilot

of a plane leaving or arriving at a passenger ramp. Heart of the system, which is expected to take the place of the hand wig-wag signals now used, is a tiny radio receiver and transmitter. The units tested fit inside acoustically insulated "big-ear" pods. As the external noise level varies, the radio automatically senses this variation and adjusts its audio gain to compensate for it. A specially designed "lip" microphone reduces background noise transmitted by the radio.

Pocket-Page/Intercom System

A combined pocket-page and intercom system has been demonstrated by Executone. The 200 series intercom system, and a full range of administrative and industrial communications and sound equipment, was also demonstrated.

RCA Reports Record Sales and Earnings

Sales and earnings of RCA in 1964 set new all time records for the third consecutive year chairman David Sarnoff and president Elmer W. Engstrom said in the RCA annual report. Profits after taxes in 1964 rose to a new high of $82,495,000 from $66,033,000 a year earlier, while sales amounted to $1,812,459,000, compared with $1,789,277,000 in 1963. By 1970, the report said, the number of color receivers in use is expected to increase more than six times, from slightly under three million today to approximately 19 million sets.

NEWS OF THE INDUSTRY

Speaker Patent

A patent protecting a number of the exclusive features in the Hartley-Luth 220MS loudspeaker has been granted by the U.S. Patent Office, Robert Schmetterer, president of Hartley Products Corp., announced. Patent 3,160,716, awarded to Harold J. Luth, Hartley's chief engineer, last December 8, covers the dual voice structure, the coaxial cone, the principle of magnetic suspension, and other improvements incorporated in the Hartley speaker.

Administrative Assistant

Daniel S. Roher has resigned as advertising manager of Channel Master Corp., to accept an appointment as administrative assistant to Congressman Joseph Y. Resnick in Washington, D.C. He had been with the electronics and aluminum firm since 1950. Congressman Resnick is the founder and Board Chairman of Channel Master Corp.

Belden Expands

Belden Manufacturing Company, Chicago, announced construction of a two building addition to its plant in Richmond, Indiana. Robert W. Hawkinson, president, said in making the announcement, "This addition to our manufacturing and raw material storage space will enable us to improve service to our customers." He went on to say that this is part of a five year expansion program. The buildings are scheduled for completion by September 1, 1965.

Color TV for Europe

The U.S. Commerce Department is working with the Electronic Industries Association (EIA) to inform the nations of the world about the advantages of the U.S. system of color television as the time nears for a decision that will carry preponderant weight with European nations on their individual choice of the color TV system they will adopt from among the U.S. system and two others developed in France and West Germany. EIA also petitioned the White House Office of Science and Technology for support in its efforts to get the U.S. color system accepted as standard in other countries. Executive Vice President James D. Secrest said the petition noted that U.S. industry until recently has been making such efforts unassisted by the administration while the British, German and French broadcasting systems have had the full support of their governments behind them. The other systems besides NTSC (U.S. system) are SECAM ("sequential avec memoire"), a French development and PAL (phase alternation line) developed in West Germany. SECAM was developed principally by Compagnie Generale du Telegraphie sans Fil (CSF) and PAL largely by Telefunken.

IRC Forms Microcircuits Division

International Resistance Company has formed the Microcircuits Division to manufacture its broad line of microelectronic products. The new facility will produce standard and custom hybrid microelectronic circuits for linear and digital applications, as well as a wide variety of passive networks.

Bardwell gets the Action-People*. Do you?

"We've found that our Yellow Pages ads reach people at just the right time—when they need service," says Ashby W. Bardwell, President, Bardwell Appliance Service, Inc., Cleveland, Ohio. "During twenty-three years in business, we've noticed that no matter how people first hear our name — from a newspaper ad, word-of-mouth, or from the sticker we leave behind on all jobs — when they need service they look in the Yellow Pages. When they do, they see our ad, recognize our name, and we have a good chance of getting their business. We have a lot of faith in the Yellow Pages . . . that's why we put a major part of our ad budget in there."

Advertise for action... Yellow Pages

*The 3 out of 4 busy Americans who shop the Yellow Pages way.

Display ad (shown above reduced) runs under REFRIGERATION SERVICE. Call your Yellow Pages man to plan your program. Find him in the Yellow Pages under: ADVERTISING — DIRECTORY & GUIDE.

. . . for more details circle 10 on postcard

pervision of a qualified technician who will follow a training plan set by NATESA. Simultaneously, the trainee will receive further correspondence training with monthly progress tests. The trainee's wage schedule would be $1.50 per hour to begin and 10¢ per month increase if he passes each month's quiz. The actual length of the course would depend on the trainee's ability to absorb.

CATV Regulation

There was little for CATV people to be happy about in last week's get-together between Sen. John Pastore's Communications Subcommittee and the six members of the FCC. Commission chairman E. William Henry said CATV's impact on UHF was a big source of worry, and a decision on CATV regulation had top priority. Commissioner Kenneth Cox made it a little rougher for CATV by noting that even if it never reached out-size proportions, even a comparatively small impact — well under 20 percent of TV homes — of CATV in a market could kill marginal UHF audience and revenue. Cox said the FCC "has figures on audience segmentation by CATV." Sen. Pastore emphatically and impatiently said: "The time is now" for FCC to decide on whether it has authority to control both wire and microwave CATV, and whether it wants to go ahead, wait for legislation — or what.

Subscription TV

According to a report issued by Zenith Radio Corp., the company plans to file with the FCC a major new petition on broadcast subscription TV. This petition will be based on the results of the Hartford, Conn. test operation

NEWS OF THE INDUSTRY

Replacement TV Tubes

Raytheon has added a number of replacement television tubes to its entertainment tube line, according to Boyd B. Barrick, corporate manager of distribution marketing for the company. Barrick said the tubes are those appearing in a number of late-model imported sets. The Raytheon line of entertainment tubes already numbers more than 480 different types including Nuvistor and Compactron types. Recently added to the line are the improved versions of the 7189 and 7591.

NATESA Training Institute

A training program for new TV technicians is being offered by the National Alliance of Television and Electronic Service Associations (NATESA) in conjunction with local member TV shops. Applicants must be 18 to 30 years of age and have a high school diploma. Candidates will be given aptitude and personality tests. Those who qualify will undertake a NATESA prepared correspondence course of 30 days at their own expense, with grading each week. This course covers basic electronics needed to understand service procedures. Applicants with acceptable grades are then placed in shops under the su-

units for December 1964, compared to 711,243 for the previous month, a 14.1 percent increase, and were 6.8 percent above the 759,521 units sold in December 1963. Total for the entire year was 7,684,960, a rise of 12.5 percent from the 6,828,383 figure for 1963. Radio distributor sales, excluding auto, totaled 1,482,883 for December 1964, up 29.1 percent from the 1,148,658 total for the previous month and 7.5 percent from the 1,379,021 total for December 1963. Sales for the entire year of 1964 totaled 10,771,276, a rise of 8 percent from the 9,975,209 total for 1963. Monochrome TV *production* totaled 785,896 in December 1964, up 3.4 percent from 760,238 in November and 13.9 percent from 690,043 in December 1963. Production for all of 1964 totaled 8,-107,404 units, a rise of 13.7 percent from the 7,130,351 total in 1963. Color TV *production* totaled 145,677 in December, down 5.2 percent from 153,611 in November. The 1964 total was 1,462,981.

LTV University Expansion

LTV University, a division of Ling-Temco-Vought, Inc., announced the opening of an east coast warehouse and service facility in White Plains, New York. This makes the fifth regional warehouse and service facility the company has opened throughout the country. The other facilities are located in Portland, Oregon, Los Angeles, San Francisco and Chicago.

IHS Seeks Excise Tax Relief

Special counsel has been retained in Washington, D.C. by the Institute of High Fidelity, Inc. to work with IHF General Counsel to obtain relief from the Excise Tax.

which is now in its third year. The report states that Zenith considers the Hartford test a success because, with improved programing in 1964, subscriber expenditures have reached their highest levels since the initial weeks of operation.

Zenith Sales and Earnings

Zenith Radio Corporation sales and earnings during the year ended December 31, 1964 were the highest in the company's history, Joseph S. Wright, president, announced today in a preliminary report to stockholders. This marked the fourth successive year in which both sales and earnings set new records, and the seventh time in eight years that sales and earnings had increased over the preceding year. Net earnings for the year of $24,282,811, after provision or Federal income taxes of $24,100,000, were equivalent to $2.61 per share on the 9,307,537 shares outstanding at December 31, 1964. This represented a 16 percent increase over the previous record earnings reported for the year 1963 of $20,852,548, or $2.27 per share on the shares then outstanding. Consolidated sales for the year of $392,017,888 were 12 percent above the previous record sales of $349,802,290 reported for 1963.

TV-Radio Sales

Distributor sales of monochrome television sets and radio sets in December 1964 were up from the previous month (November), from the corresponding month of December 1963 and for the entire year of 1964 over 1963, the EIA's Marketing Services Department reported. Distributor sales of monochrome TV sets totaled 811,466

FTC FINAL ORDER . . .

Continued from page 84

The complaint alleges that early in 1960 the trade associations banded together in an unincorporated organization designated as the Tri-State Council. It charges that members of each of the trade associations, or some of them, acting in collaboration through the Tri-State Council as early as 1960, caused it to begin publication of "The Vanguard" (a monthly trade bulletin which was distributed to members and others in the radio, television and electronic industry). In it, the complaint alleges, there were issued to television, radio and electronic repairmen proclamations upon the "evils" of sales by wholesalers to consumers and the efficacy of selective buying as a weapon to control or eradicate such practices, and exhortations to eliminate the wholesaler as a competitor for the business of the ultimate consumer through use of collective and combined purchasing power to limit and control the channels of distribution of television, radio and electronic equipment and component parts.

In February 1960, the complaint charges, the respondents conspired with each other and others not named as parties to this proceeding to restrict and limit the channels of distribution of television, radio and electronic equipment and parts by the elimination or diminution of sales by wholesale distributors who sold to consumers by, among others, the following methods: Communicated to these wholesale distributors threats of concerted withdrawal of patronage; combined and united to boycott these wholesale distributors to coerce them to discontinue selling such equipment or parts at retail in competition with individuals or organizations engaged in servicing and repair; dictated or attempted to dictate practices to be followed by wholesalers in the conduct of their business involving such matters as hours of operation, display windows and advertising; caused publication to be made of a "white" list or lists of wholesalers who cooperated with respondents in refusing to sell at retail; policed sales made by wholesale distributors by employing individuals or committees for the purpose of shopping at the business places of distributors; advocated, urged and preached, by way of published slogan, exhortation and appeal, that independent servicemen, both members of respondent associations and non-members, should discontinue purchasing from wholesale distributors who sold television, radio and electronic devices and their component parts at retail to consumers.

The complaint alleges that these activities and practices constitute unfair acts and methods of competition, the effect of which is (1) now and may be to injure, eliminate or prevent competition, (2) to tend to create a monopoly, (3) to unduly hamper the flow of commerce in such equipment and parts, (4) to deprive the public of the advantage and opportunity to purchase from vendors engaged in active and bona fide competition unimpeded by artificially imposed restraints, or (5) to curtail the breadth of choice of vendors from which purchasers may buy.

The agreement containing the order is for settlement purposes only and does not constitute an admission by respondent that they have violated the law. ■

Continued from page 93

weekly service meeting, new products and technical data are revised, service problems are discussed and especially difficult service problems are solved.

It's important that technicians receive technical instructions on each new product before they are called upon to install or maintain it. The service manager should personally review the product, study the accompanying technical literature, bench test the unit and prepare to give a thorough, if brief, review of its design, features, it's application and it's servicing peculiarities.

As manufacturers distribute technical literature applicable to the equipment already employed, the service manager should review it as quickly as possible. To rely on an "initial and pass on" technical literature distribution system, is to invite haphazard study and possibly lost material.

No doubt you have encountered cases where the same problem has been solved twice by different technicians working independently. The weekly service meeting affords a favorable time for each technician to discuss those unusual service problems encountered and overcome. Sharing this type of information gives newer technicians "instant experience"—without actually having come into contact with the problems. This segment of the weekly service meeting can also be used to describe methods of work, procedures and reporting.

Occasionally a unit will be received which defies all efforts and disrupts a technician's entire day. Similarly, a system problem can arise which is beyond the scope of a single technician. The weekly service meeting can accept these problems and with collective thinking may find early solutions. A spirit of competition sometimes emerges which makes the most difficult technical problem interesting. The combination of experiences of all the technicians can often produce fast results in difficult situations.

As planned or spontaneously produced products of the weekly service meeting, much can be done to uncover potential personality conflicts, employee complaints, and other possible problem areas as well as to offer an opportunity to openly praise those technicians who have performed exceptionally well.

To Make It Succeed

Postpone all service calls and bench work. As in any other meeting, interruptions can destroy rapport, neutralize concentration and render the instruction ineffective.

Key the meeting to informality. Meet in the shop where test equipment, tools and radio units are at hand. Demonstrate servicing techniques and ask others to do the same. Encourage questions, especially from the new or inexperienced man, being sure each man has a chance to participate.

The weekly service meeting can become a gainful segment of the work week. It may be the only training ground provided or a supplement to a formal training program, but used properly, can become the difference between an efficient and an otherwise inefficient communications facility. ■

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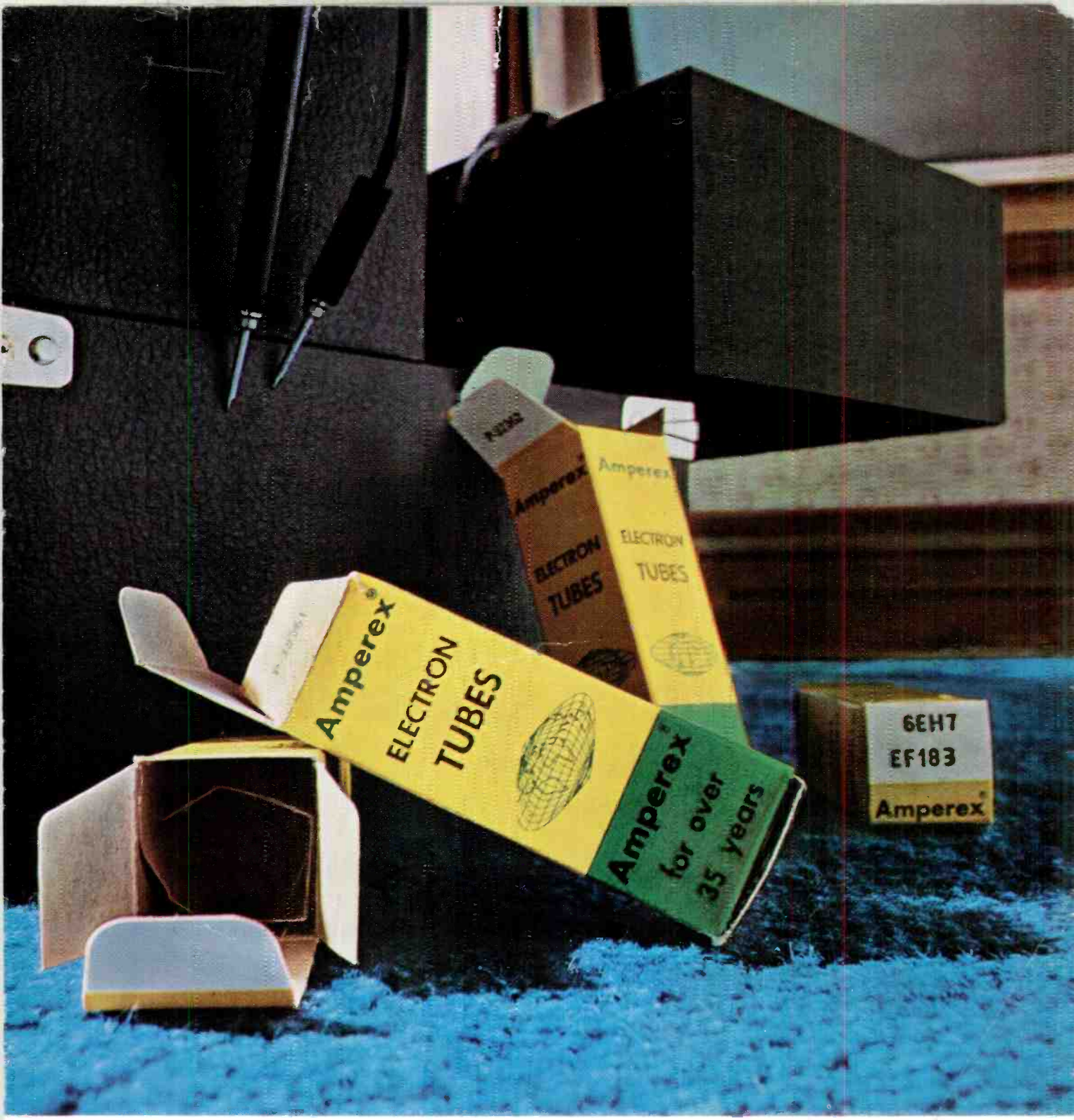

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2ER5	2GK5	2HA5	3EH7	3GK5	3HA5	4EH7	4EJ7	4ES8	4GK5	4HA5	5GJ7
	6EH7	6EJ7	6ER5	6ES8	6FY5	6GJ7	6GK5	6HA5	6HG8	7HG8	8GJ7

If your distributor does not yet have all the Amperex types you need, please be patient—in some areas the demand keeps gaining on the supply. Amperex Electronic Corporation, Hicksville, Long Island, New York 11802.

. . . for more details circle 11 on postcard

LET'S GET DOWN TO BUSINESS

...in Color-TV Service

Make your shop look like it means business. You can with business-like technical, promotional, business and service aids from RCA . . . with the emphasis on color TV service. Remember, more and more of your service jobs will be color TV jobs.

TECHNICAL AIDS . . . to help you further develop your professional skills.

The famous RCA Color TV Troubleshooting Pict-O-Guide. Completely revised and updated, it's the quick and easy, all in one, profusely illustrated guide to proper troubleshooting and alignment of color TV sets. A **MUST** reference book, if you want to make money in color TV service. Form #1A1389.

Also available (not shown): **RCA Institutes Color TV Home Study Course,** the basic definitive course in color servicing; 8 graded lessons, counselling and examination service. Form #1A1325.

PROMOTIONAL AIDS . . . to help you attract more customers.

Illuminated Flashing Window Display (at left on counter). A real attention grabber for your window or counter. Alternates between full color and black and white to dramatize both services. Form #1A1491.

Color TV Service Banner (on wall). In rich red satin, for door, wall or window display. Form #1A1492.

Also available, (not shown) are a transparent window streamer, ad mats for local newspapers, post cards and envelope stuffers all promoting your color TV service capabilities.

BUSINESS AND SERVICE AIDS . . . to help make your job easier.

RCA Receiving Tube Floor Merchandiser (left) Spacious, 6 foot gravity feed metal shelving unit in bright red baked enamel finish. Seven shelves with adjustable dividers for each shelf. Helps you keep a really good supply of tubes in one well organized area. Form #1A1504.

RCA Receiving Tube Wall Merchandiser (rear) Three feet high and three feet wide, a metal gravity feed shelving unit finished in red baked enamel to hang on wall or rest on counter. Form #1A1503.

RCA TV Tool Kit (on counter) Contains 12 most needed TV tools: 3 aligners, aligning wrench, tuning wand, 3 trimming tools, standard and recessed screwdriver, solder aid, heat sink and clamping type tweezers . . . just about everything you need on a service call in one container; also handy in the shop. Form #1A1509.

RCA Superweld Tube Caddies. Large "Treasure Chest" caddy (1A1001A) shown on counter at right holds up to 362 receiving tubes. Junior version (1A1002A) (not shown) holds up to 234. Both feature a Superweld vinyl covering that protects like armor.

You'll also want to ask your RCA distributor about store hours signs, door knob hangers, and weekly work schedule pads from RCA.

These are the aids you really need in your business.

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