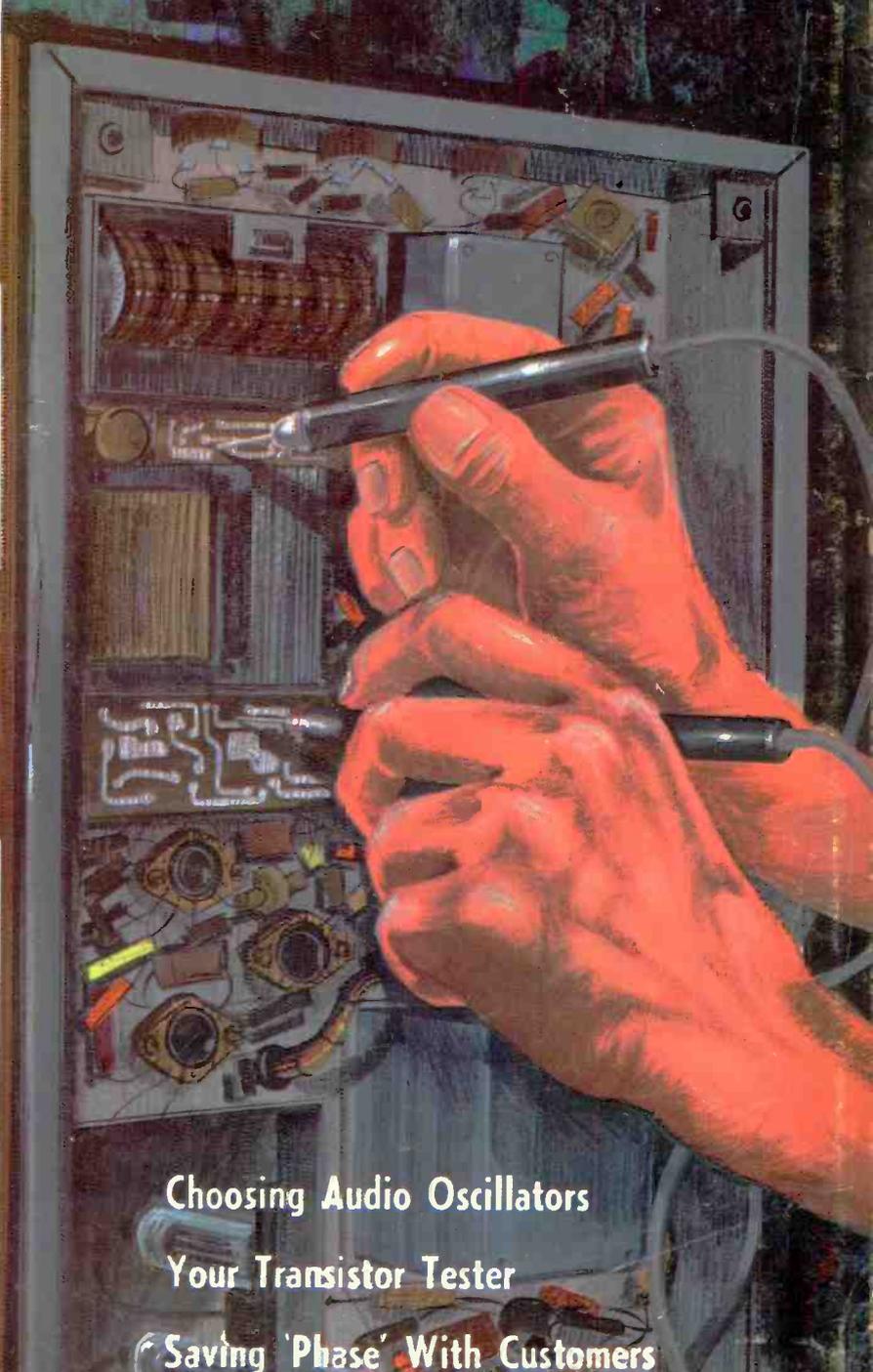
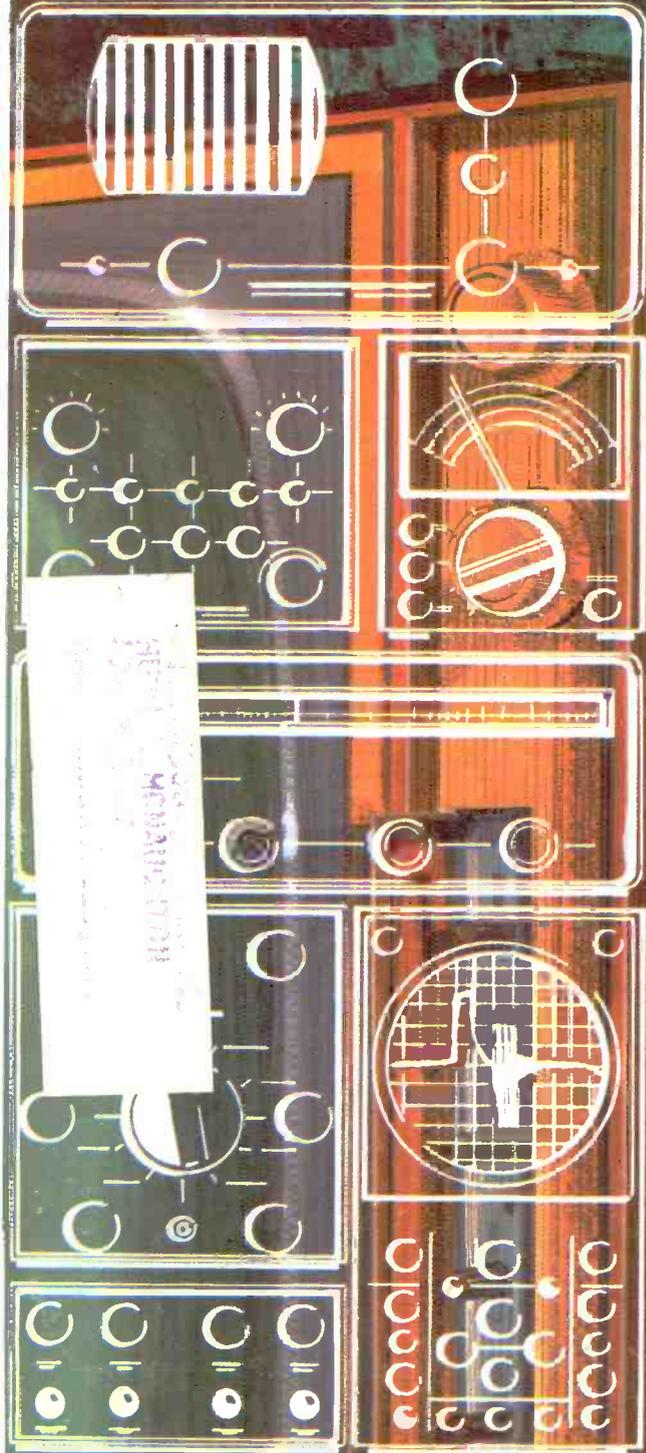


ELECTRONIC TECHNICIAN

WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION



OCTOBER 1964



Choosing Audio Oscillators

Your Transistor Tester

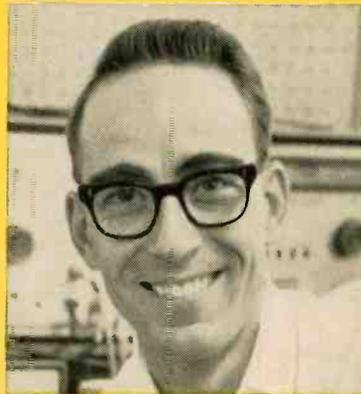
Saving 'Phase' With Customers

TRAVEL FAST!



**RALPH LEENDERS, LEENDERS' TV,
EVERSON, WASHINGTON**

"We use Paralog Antennas because of their outstanding performance and their rugged construction."



**RALPH CLARK, VALAS TV CORP.,
DENVER, COLORADO**

"As the largest TV sales and service company in Colorado, we can't afford to use anything but the best. After extensive comparisons and field testing, we found the Paralog to be exactly the antenna we had been looking for."



**W. B. WEIDNER, ED MARLING
STORES, INC., TOPEKA, KANSAS**

"I've found that it pays to sell up to a Paralog. Profits are much better than on the economy antennas, and I wind up with a more satisfied customer every time."



**EUGENE DOLL, DOLL'S TV,
PERHAM, MINNESOTA**

"Business has been terrific on Paralogs in our territory. And no wonder. Everybody who buys a Paralog is happy with the reception. We've gone to Paralog 100%."



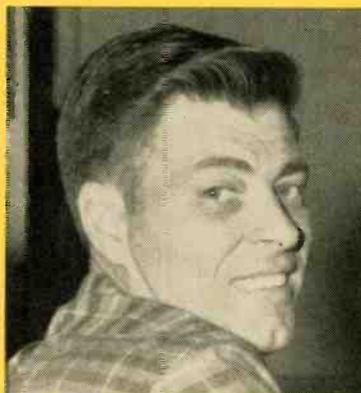
**TED WAINSCOTT,
T & H SERVICE & SALES, INC.
ANDERSON, INDIANA**

"The Paralog has proven to be far superior to any other antenna in this area. You can't beat the performance, especially on the hard-to-get channels."



**RAY MAGER,
MONTGOMERY WARD, LIMA, OHIO**

"Paralog works better than any other VHF antenna ever made. We had 200 calls within two weeks. Some of our customers pull in Cleveland, over 160 miles away, consistently."



**RUSSELVESTON, MAKEFIELD TV,
MORRISVILLE, PENNSYLVANIA**

"It's very tough to get New York channels in this area, but since I've been using Paralog antennas, I can offer guaranteed reception to my customers. My antenna business is growing faster than ever now."



**W. RAYMOND JONES, JONES TV
& RADIO SERVICE,
WINSTON-SALEM, N. CAROLINA**

"We've been using TACO antennas for 15 years. In fact, we've installed several thousand. The new Paralogs are the most powerful and rugged antennas we've ever used."



Quick cure for focus problems in color television sets

SYMPTOMS:

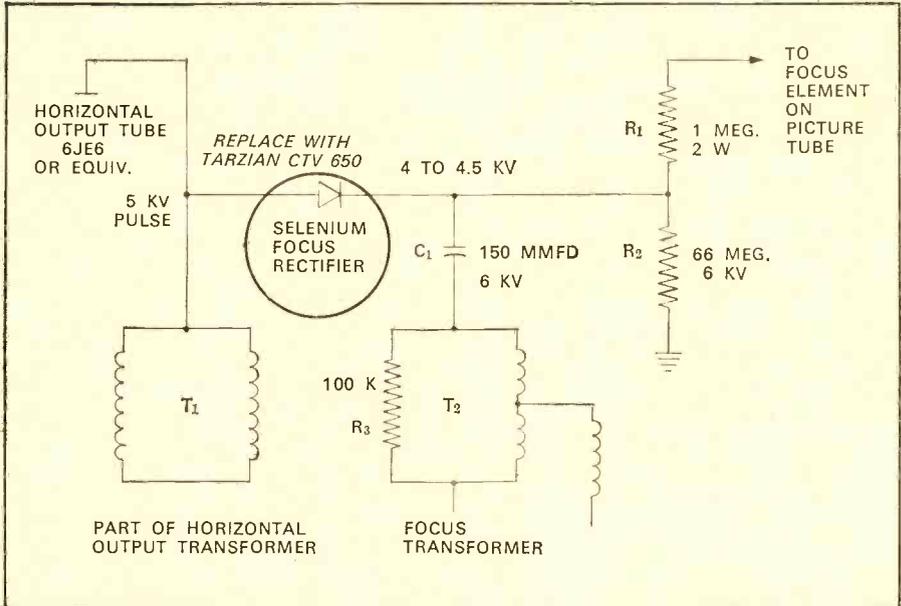
- The colors have become indistinct, smeared, or "washed out."
- You agree with the customer that it is impossible to focus the television receiver by normal controls.

CAUSE:

- Focus control has been lost because the selenium Focus Rectifier has "aged," upsetting circuit parameters.

CURE:

- The selenium Focus Rectifier must be replaced. To do the job, select a Sarkes Tarzian Type CTV650 silicon rectifier. Because these devices exhibit no aging characteristics, they will continue to deliver full performance for the life of the set.



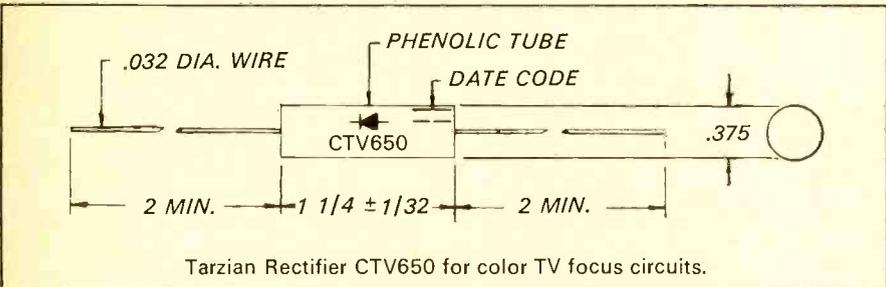
Insertion of Tarzian Silicon Rectifier CTV650 provides improved focus control for the life of the set.

**Tarzian Silicon Rectifier Type CTV650
Is a Direct Replacement For:**

Color TV Receiver	Part No.	Color TV Receiver	Part No.
Airline		Magnavox	530096-1
(Wells Gardner)	66X0035-001	Packard Bell	72110
Dumont	1440977-1	Philco	34-8053-2
Olympic	1440977-1	Silvertone (Warwick)	86-44-3
RCA	1440977-1	Sylvania	16106-1
Emerson	817123	Zenith	212-48

Tarzian CTV650 replacement rectifiers are available from your distributor.
List price for this life-of-the-set device is only \$8.35.

The complete Tarzian replacement line includes silicon rectifiers and conversion kits for a variety of electronic jobs, plus tube replacement silicon rectifiers and "condensed stack" selenium rectifiers. All are immediately available from distributors throughout the United States and Canada, in the quantities and ratings you want most. FREE CATALOG 63-SI-6 is crammed with 48 pages of interesting technical information and product specifications about Tarzian Silicon Rectifiers. Send for your copy today—be sure your files (and your shelves) are up to date on the rectifier line voted first choice among service technicians year after year.



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 World's Leading Manufacturers of TV and FM Tuners • Closed Circuit TV Systems • Broadcast Equipment • Air Trimmers • FM Radios • Magnetic Recording Tape • Semiconductor Devices
SEMICONDUCTOR DIVISION • BLOOMINGTON, INDIANA
 Canadian Licensee: Marsland Engineering Limited • 350 Weber Street North, Waterloo, Ontario
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 ELECTRONIC TECHNICIAN

OCTOBER 1964
VOL. 80 NO. 4

ELECTRONIC TECHNICIAN

WORLD'S LARGEST ELECTRONIC TRADE CIRCULATION

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55802. BE SURE TO SEND ALONG THE AD-
DRESS LABEL FROM YOUR MOST RECENT
ISSUE.

COVER:

The instrument probes—held by hands that keep 65,000,000 U. S. TV sets in 'go' condition—are attached to 'bread-and-butter' equipment that symbolizes this month's emphasis on some major test instruments.

FEATURES

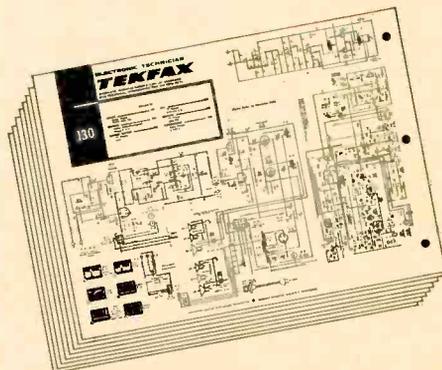
Choosing and Using Audio Oscillators Part I	55
<i>Arthur Walters begins a top-drawer series that most technicians will place in their instrument-data files</i>	
Color Convergence in 15 Minutes	59
<i>Al Nanni tells how to negotiate this important color TV job with a major test and alignment instrument</i>	
Why You Need a Transistor Tester	61
<i>Engineers Pudol and Stephens outline the simplest transistor-testing approach ever revealed</i>	
Saving 'Phase' With Your Color TV Customers	64
<i>The pun ends with the headline of this story and Don Multerer shows how 'Tom' and 'Phil' 'wrap-up' a complicated troubleshooting and alignment job with a dot/bar generator</i>	
Selecting a Scope for Industrial Work	66
<i>John Potter Shields pinpoints the fundamental requirements of an effective scope for maintaining industrial electronic equipment</i>	
Installing Audio Distribution Systems Part II (conclusion)	69
<i>Chuck Overstreet concludes this important audio series</i>	
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<i>Joe Hayes outlines the elements of a field that more TV-radio technicians are finding highly remunerative</i>	

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TEKFAX 16 PAGES OF THE LATEST SCHEMATICS



DUMONT: TV Chassis 120708, 712, 725

EMERSON: AM/FM Tuner Chassis 120732
5 watt amplifier Chassis 120716

GENERAL ELECTRIC: TV Chassis TA

PACKARD BELL: TV Chassis 88-16

RCA: TV Chassis KCS 136X

ZENITH: TV Chassis 14M23

The antenna that challenges

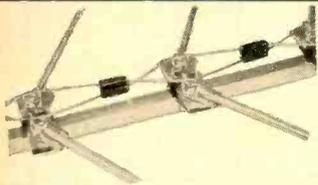
NEW Swept Element

"COLOR-VE-LOG"

BY

FINCO

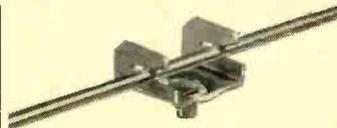
Finco's Color Ve-Log challenges all competition on color or black and white reception and stands behind this challenge with a "Guarantee of Supremacy". ■ The swept element design assures the finest in brilliant color and sharply defined black and white television reception — as well as superb FM monaural and stereo quality. ■ FINCO precision-engineered features make these advanced-design antennas indispensable to good home sight-and-sound systems. And, of course, they carry the famous unconditional guarantee from the leading manufacturer in the field — FINCO. ■ Promote the Color Ve-Log Antennas with pride, sell them with confidence, and profit handsomely.



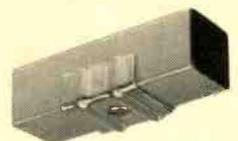
One-piece cross-over drive line assembly has no joints between adjacent driven elements. Eliminates loose connections, shorts, broken drive line sections. Polystyrene snap-lock spacers, with center 'air insulator' space.



Elements are made of triple thick aluminum to stand up in severe weather. Die stamped bracket fastened with tough, thick-gauge rivet holds proportional length sleeve reinforcing shell into which element fits.



First from Finco and exclusive — double contact between drive line and driven element bracket assembly for perfect drive-line support and electrical continuity. Positive, vibration-free, non-corrosive contact.



Boom reinforcing back up brackets at elements add triple strength to the riveted assembly, mounted on a rigid, non-crushable 1" heavy duty square boom. Boom rolled square from 1¼" diameter round aluminum for increased strength.

Write for color brochure #20-307, Dept. 110.

all competition!

LOG

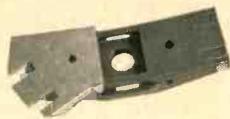


VL-10
9 driven elements
1 parasitic element
List price \$34.95

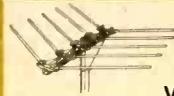
Featuring Finco's Exclusive Gold Corodizing



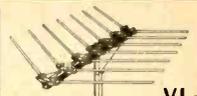
Finco's boom-mast bracket, rust-proofed by zinc plate-gold di-chromate dip process, is the finest available. It has positioned cleats to assure sag-free positive direction of the antenna. Locks tight. Can't tilt. Antenna stays in proper position at all times.



High impact polystyrene insulators are reinforced with strong aluminum shields. This gives quadruple strength in supporting triple-thick snap-in elements. Lifetime assembly with fitted aluminum cup to hold oversize aluminum rivet.



VL-5
5 element VHF-FM
5 driven elements
List price \$16.95



VL-7
7 element VHF-FM
7 driven elements
List price \$23.95



VL-15
15 element VHF-FM
9 driven elements
6 parasitic elements
List price \$46.95



VL-18
18 element VHF-FM
9 driven elements
9 parasitic elements
List price \$54.50

The FINNEY Company • 34 Interstate Street • Bedford, Ohio

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FREE!

2 EXTRA DE-SOLDERING TIPS WORTH \$1.20...



when
you buy
the *Ungar* #270
De-Soldering Kit

ONLY \$5.83 EACH AT YOUR AUTHORIZED DISTRIBUTOR

Buy this kit, and mail the enclosed bonus coupon to Ungar. We will send you #861 Triangle Tip and #863 Cube Tip... a \$1.20 value - absolutely FREE.

The Ungar #270 Kit meets every requirement for fast, safe, easy component desoldering and removal. Avoids lug breaking, shorting and printed board rupturing.

Ungar's De-Soldering Kit speeds up work and increases efficiency. Here's how: The slotted tip melts solder quickly so that lugs bent close to the

printed board can be lifted and straightened out in a fraction of the time.

The bar tip makes it easy to desolder all multiple straight line network components.

A variety of cup tips is a must for de-soldering tube sockets or i-f transformers. The Ungar kit includes the 3/8", 1/4", and 1" size - a complete assortment for most jobs.

The two FREE tips are ideal for electrolytic capacitor removal, tube socket pins, and harness leads.

BONUS OFFER

FREE...A DE-SOLDERING BOOKLET

For Just Visiting Your Authorized Ungar Distributor! Get it now!

UNGAR ELECTRIC TOOLS

ELECTRONIC DIVISION OF ELDON INDUSTRIES, INC. Hawthorne, Calif. 90252

LETTERS TO THE EDITOR

Engineering Certification

I read with great interest your article, "Look Up—Move Up," in the August issue of *ELECTRONIC TECHNICIAN* Magazine. I personally think this is a very fine idea. Please see that I receive further information.

JOHN WITKESKI
McDonald, Ohio

... After reading your article "Look Up—Move Up," I've become very interested. Would like any information you could pass on to me. I feel this is a very big step forward . . .

DONALD V. URBYTES
Grand Rapids, Mich.

... Please forward me additional information regarding Engineering Certification . . .

WILLIAM I. CHURCHILL
Clear, Alaska

... Please send me information and application materials for the Certified Engineering Technician Program . . .

ROBERT C. ANDERSON
Technical Specialist
Louisville, Ky.

... Please send information . . . our school catalog is enclosed . . .

FRANK J. ANDREWS,
Registrar
Penn Technical Institute
Pittsburgh, Pa.

... Please send information.

JOHN W. MORTON, JR.
Wilmington, Del.

... Please send more information on how to become a certified engineering technician.

RICHARD A. LOUNGE
Brockton, Mass.

... I am requesting further information about becoming a certi-

... for more details circle 64 on post card

QUESTION:

ANSWER:

When it comes to electrolytic capacitors, why do more than half of the nation's Radio-TV Service Technicians prefer to do business with Sprague Distributors?

Because they don't want makeshift substitutions or multi-rating "fits-all" capacitors. They insist on exact replacements, which are always available through Sprague Distributors everywhere.

SPRAGUE **TWIST-LOK**[®] CAPACITORS... 1863 different ratings and sizes... the world's most complete selection of **EXACT** replacements!



We don't have to tell you that it's easier to service with exact replacements. And we don't have to tell you that it's better, too. When sets are designed, specific capacitance values are used for peak operation, so it takes exact replacements to restore original set performance.

And who better than Sprague knows which values and sizes are needed in the replacement market? Sprague, the world's largest component manufacturer, has the most complete specification file on original set requirements. That's why you're always right when you service with Sprague TWIST-LOK exact replacements!

Wouldn't you really rather have what the set manufacturer recommends? An exact replacement in capacitance, voltage, and size is easier to install and less expensive, in most cases, than substitutes!

GET YOUR COPY of Sprague's comprehensive Electrolytic Capacitor Replacement Manual K-107 from your Sprague Distributor, or write Sprague Products Company, 65 Marshall Street, North Adams, Massachusetts.



WORLD'S LARGEST MANUFACTURER OF CAPACITORS

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LETTERS

TO THE EDITOR

**exciting new product!
exciting new profits!**



e.c.i.

Courier 23

EASY TO SELL... EASY TO USE... EASY TO MAINTAIN 2-WAY RADIO FOR THE BOOMING CB MARKET!

Never before this performance breakthrough! Never before this big chance for you to cash in on the fast-growing 2-way radio market . . . for car, boat, home, business, office. The Courier 23 has unequalled performance with dollar for dollar value others can't match. It features dual conversion, transistor power supply, 23 crystal controlled channels and more features CB users want. It is priced at \$189.50 . . . and that includes all crystals, mounting brackets, power cords and noise-cancelling microphone. Best of all, the Courier 23 is "hot" . . . with wide acceptance everywhere!

CAN YOUR FIRM QUALIFY AS AN AUTHORIZED e.c.i. DEALER?

A sound knowledge of radio and/or communications equipment . . . the desire to install and service this equipment . . . an established business reputation and a good credit rating . . . a real interest in a dynamic new product with dramatic profits. These are the requirements. Write today for details!

**e.c.i. electronics communications inc., Dep't ET-10
56 hamilton ave., white plains, n.y.**

Please send full details on the Courier 23 and an e.c.i. dealership.

name

firm name

address

city zone state

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fied engineering technician . . . I would qualify for the Engineering Technician Class.

DALE SCHMERTMAN
Senior Electronic Tech.

Freeport, Ill.

. . . I would appreciate information on becoming a certified engineering technician.

ANTHONY MADDEN
Baltimore, Md.

. . . Please send further info . . .

GEORGE S. STROPERA
Linden, N. J.

. . . Please send information on Engineering Certification.

A. P. ZIMMERMAN
Lawrence Radiation Lab
Livermore, Calif.

. . . I feel it is one more step ahead for the electronics industry . . .

JACOB SCHLEPP, JR.
Wolf Point, Mont.

. . . I am a graduate of the Royal Canadian Air Force Radar and Communications school and have 14 years experience in electronics . . .

R. W. GRANT
Centralia, Ontario

● *These are excerpts from a few of the hundreds of letters received as a result of the article "Look Up—Move Up," which appeared in the August Issue of ELECTRONIC TECHNICIAN Magazine. Letters are continuing to arrive at the rate of about 30 a day. They will be processed as quickly as possible.—Ed.*

Help!

As a subscriber to your very fine magazine I wonder if any of your readers could tell me where I can obtain a schematic for a German Radio. It is an EMUD radio, ULM44. I suppose this is the model number. It has 3 bands—

EICO's complete new color TV lab for the pro



Color TV servicing is a job for professionals—and Eico's new color TV test equipment is designed to their requirements. Professional service engineers can't afford to waste time on apparent set troubles caused by makeshift, inaccurate test signals, or on test equipment that is inherently difficult to use or incapable of fast, accurate determinations. Critical professionals know they can depend on EICO for accuracy, reliability, and laboratory standard performance. Moreover, EICO has now successfully reduced equipment size while improving performance, to permit convenient on-location servicing. No wonder the pros choose EICO!

PROFESSIONAL PERFORMANCE IN COLOR TV TEST INSTRUMENTS/ (A) MODEL 380 SOLID STATE N.T.S.C. STANDARD COLOR SIGNAL & DOT-BAR GENERATOR (PAT. PEND.) Entirely unique in both providing completely standard 100% fully saturated N.T.S.C. color signals, including both chrominance and luminance signals exactly as specified, and in being completely transistorized. Color burst is precisely gated and delayed according to N.T.S.C. standards, and phase angles are permanently established by taps on a linearly distributed delay line, so that no adjustments are ever required. Use of saturated transistor for switching and delay provides square "clean" waveforms without significant overshoots or ringing for excellent signal definition. The design of the 380 is an absolute protection against obsolescence, and assures the professional service engineer that apparent set trouble is not caused by a non-standard test signal. In addition to generating 11 different color signals, one at a time, for hue and demodulator adjustments, the Model 380 generates dots, crosshatch, horizontal lines, and vertical lines for convergence and linearity adjustments. Both video and RF outputs are provided, with gain controls. Three crystal-controlled oscillators are employed for color burst and color information, convergence and sync signals, and RF output on TV channel 3 (exchangeable for TV channel 4). Entirely stable and inherently rugged by solid state design, the Model 380 is also outstandingly compact and weighs only 4 lbs. SIZE (HWD): 8½ x 5¼ x 6¾ inches. Kit \$129.95. Wired \$169.95.

(B) MODEL 369 TV-FM SWEEP & POST-INJECTION MARKER GENERATOR (CRYSTAL-CALIBRATED) For easiest, fastest visual alignment of color or B&W TV, and FM receiver RF & IF circuits. Five sweep ranges from 3-220 mc and four marker ranges from 2-225 mc, plus a crystal marker oscillator that turns on when a crystal is plugged into the panel socket (4.5 mc crystal supplied for TV sound alignment). Controllable inductor sweep circuit is purely electronic and has no mechanical parts to wear out. Retrace blanking, and a 3-stage AGC circuit that keeps the amplitude of the swept signal even when the widest sweep width of 20 mc is used. With the 369, circuit response is not affected by markers and markers are not affected by traps in the circuit. Only the sweep signal is applied to the circuit under test. A demodulator cable picks up the output signal and feeds the demodulated signal to a mixer stage in the 369 where the markers are added, then the combined signal is led to a 'scope. Separate trace size and marker size controls can be used independently. SIZE (HWD): 8½ x 12½ x 7½ inches. Kit \$89.95. Wired \$139.95.

(C) MODEL 435 DC WIDEBAND 3" OSCILLOSCOPE You'll be able to complete many more color or B&W TV service calls on location if you can take your 'scope with you. EICO's 435 is really portable (½ the size of conventional 5" scopes) and fully equipped to do the job. Quality equal to or better than the finest 5" TV service scopes is achieved with a far sharper, brighter trace on a flat-face CRT. Direct-coupled, push-pull V amplifier, with 4-pos. frequency-compensated decade attenuator has no low frequency phase shift, and is flat from DC-4.5mc (-1, -3db). Far more accurate p-p voltage measurements than ever before with a Zener diode-controlled

square wave calibrating voltage, and an edge-lit calibration grid. Easier to use for TV servicing with pre-set TV-V and TV-H positions in addition to 4 sweep ranges, automatic sync limiter and amplifier, and full retrace blanking. Amazingly easy to build because of professional interior packaging that has eliminated crowding and permits easy access to any component. SIZE (HWD): 8½ x 5¼ x 12½ inches. Kit \$99.95. Wired \$149.95.



ONE MORE MATCHING INSTRUMENT EQUIPS YOU FOR FM STEREO SERVICING MODEL 342 FM MULTIPLEX SIGNAL GENERATOR. The EICO Model 342 is a compact, efficient instrument essential for test or alignment of the multiplex circuits of FM Multiplex Stereo tuners, receivers, and radios. FM Stereo is a field as fast-growing as color TV, and a multiplex generator is an absolute must for getting a share of the increasingly important and profitable service business. The circuitry of the Model 342 is of the design lab quality needed for restoring original performance quality to the costliest equipment, but the controls have been simplified for fast, un-

complicated operation. With it, you can quickly measure and adjust channel separation and balance, or the input level needed for synchronization or switch-over to stereo operation. The Model 342 provides signals as perfect as those available from generators costing many hundreds of dollars. It provides both a controlled amplitude composite audio output for direct signal injection beyond the detector into a multiplex section, and the same signal modulating an FM RF carrier at about 100mc (adjustable) with controlled deviation ± 75kc (100% modulation) for connection directly to the antenna terminals. Either a built-in 1kc oscillator (below 0.3% distortion) or an external audio oscillator may be used to provide the left only, right only, difference, or sum signals. The 19kc pilot signal is crystal controlled and may be switched on or off independently of the composite signal. The signal may be obtained without audio information and only the 19kc pilot injected. An oscilloscope sync output is provided, with a choice of either 19kc sync or internal 1kc/external oscillator sync. In addition, an input is provided for connecting an external audio oscillator to provide an SCA signal when required. Another important and valuable feature of the Model 342 is dual inputs and amplifiers for a stereo source to permit FM MULTIPLEX STEREO demonstrations to customers when there are no stereo programs being broadcast. Modern compactron tubes are used to obtain a lightweight, compact package that is easily portable. SIZE (HWD): 8½ x 5¼ x 12½ inches. Kit \$119.95. Wired \$179.95.

Visit the EICO exhibit in the Pavilion of American Interiors at the World's Fair.

EICO EICO Electronic Instrument Co., Inc.
131-01 39th Avenue, Flushing, N.Y. 11352

Send new 1965 catalog featuring more than 230 EICO Products.

Name _____

Address _____

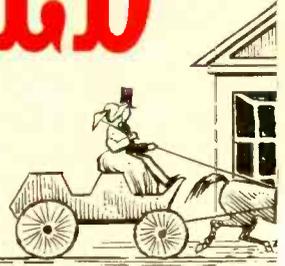
City _____ Zone _____ State _____

ET 10



Receiving Tubes

AN OLD FASHIONED GOOD DEAL



Get in on a deal like you haven't seen for years.

From October 15 through December 15, your General Electric Receiving Tube Distributor is offering an old fashioned good deal on top quality merchandise. It is all available to you with the purchase of G-E tubes.

During this limited time, only you limit how much and how often you choose. And, from the wide choice of merchandise, you can select gifts for yourself, your wife, your home, or your shop.

Ask your G-E Distributor*, he can tell you how easy it is to have AN OLD FASHIONED GOOD DEAL on General Electric Receiving Tubes. Stock up on merchandise and tubes at the same time. *Distributor Sales, Owensboro, Ky.*

*Premiums available at option of your G-E Distributor.



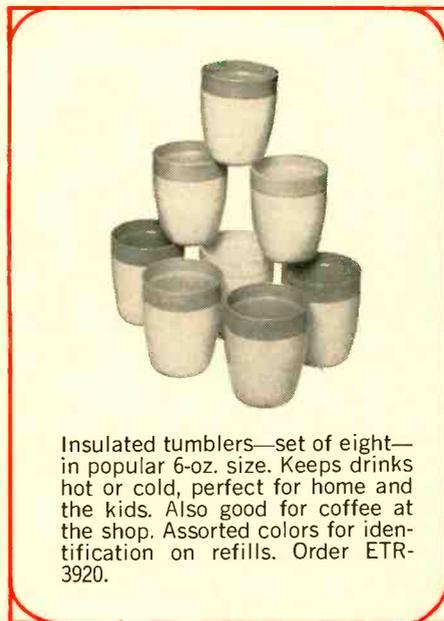
Perfume set by D'Orsay comes in gift box. "Intoxication" scent will send you as well as your playmate. Order ETR-3916.



General Electric alarm clock is compact, fits crowded night table. Beige case with white dial and contrasting numerals. Order ETR-3917.



Steak knives—four to a set—have serrated edges, stainless-steel blades. Knives have good looking stag handles. Order ETR-3927.



Insulated tumblers—set of eight—in popular 6-oz. size. Keeps drinks hot or cold, perfect for home and the kids. Also good for coffee at the shop. Assorted colors for identification on refills. Order ETR-3920.



Party-Perk makes 25 cups of coffee—keeps perfect serving temperature too, all automatically. Plenty of coffee for parties at home—or for a coffee break at the shop. Order ETR-3922.



Black and Decker 1/4" utility drill is the jack-of-all drills... the handiest home tool you ever saw. UL listed drill from a top-name manufacturer. Order ETR-3918.



G-E electronic speed control lets low cost power tools do work of costly more powerful tools. Use at work or home for any universal motor-driven tool with nameplate rating up to 5A, 120V, ac. Particularly good for resistive type soldering irons to give low-heat tip temperatures for printed circuits. Order ETR-3921.

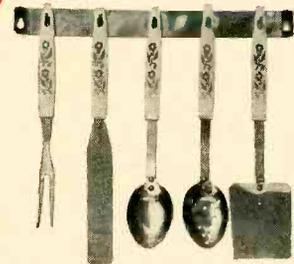


G-E "Penline-120" soldering iron is small and fast. Tucks in a tool kit and has 40 watts power. Three interchangeable tips do almost any soldering job. Ideal for tight spaces in radio, TV and hi-fi sets. Order ETR-3919.

Three pair of Anchor Knit stretch nylon socks in stylish Fisherman knit, Vyrene elastic tops. One each of blue, brown and black. Order ETR-3923.



Shirt-jacket of 100% Ban-Lon[®] with long or short sleeves. A style introduced this summer and now available in winter weights. Your choice of assorted colors. Order ETR-3924.



5-piece stainless steel kitchen set with wall bracket. Heavy-duty insulated handles with popular provincial decoration. Order ETR-3925.

GENERAL  **ELECTRIC**

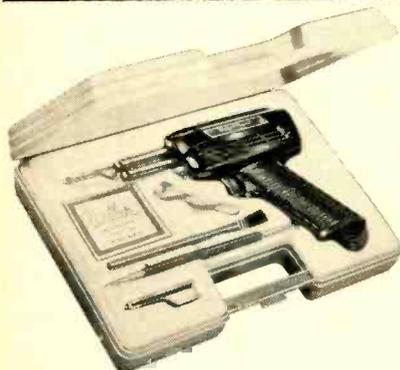
270-04

Weller[®] for all soldering

Dual Heat Soldering Guns

Weller dual heat soldering guns give time-saving instant heat. Two trigger positions let you switch to low heat, for soldering near heat-sensitive components, or high heat when needed. Spotlight illuminates work. Three models available.

100/140 watts—Model 8200—\$9.95 list
145/210 watts—Model D-440—\$9.95 list
240/325 watts—Model D-550—\$10.95 list



Soldering Gun Kits

“Expert” Kit (shown) includes 100/140 watt gun, 3 soldering tips, tip wrench, flux brush, soldering aid and solder in a plastic utility case. Model 8200PK—\$8.95 list.

Heavy-Duty Kit features 240/325 watt gun; soldering, cutting and smoothing tips; tip-changing wrench; solder; plastic utility case. Model D-550PK—\$12.95 list.



“Pencil” Soldering Iron

For miniature type soldering. A 25 watt, 115 volt soldering pencil that's small and lightweight. So efficient it does the work of irons that are much heavier and require much higher wattage. Rapid recovery. Cool handle. Complete with 1/8" screwdriver tip and cord set. Model WP—\$5.20 list.

Temperature-Controlled Low-Voltage Soldering Pencils

Temperature control of this new Weller soldering pencil is in the tip. Interchangeable tips give a choice of 500°F, 600°F, or 700°F controlled temperatures. Operates on 24 volts. Small, lightweight, highly efficient. Complete with 3/16" 700°F tip and 60 watt, 120 volt, 50/60 cycle power unit with stand for soldering pencil attached. Model W-TCP—\$26.00 list.

Also available: a soldering pencil controlled by thermistor and SCR (silicon controlled rectifier) circuit. It gives a choice of controlled temperatures between 200°F and 450°F. Highly efficient. Model W-TCP-2.



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- - - for more details circle 65 on post card

LETTERS TO THE EDITOR

short, long and broadcast. Tubes are 1-UCL-81, 1-UCH-81 and 1-UC-92.

ROBERT ULSCHMID
Glendale, N. Y.

When You Move

... Why not print the change-of-address form on a page that has an ad on the back? It's a shame to ruin a good article by cutting part of it out and sending it back to you. Thanks for producing a swell magazine.

DON NITSCHKE

(No Address)

● *You moving again? If you move very often we'll send you a supply of forms. Of course, you could just type up one.—Ed.*

One of Many

I have long been an avid reader of your magazine. It is as helpful as the instruments we use, in some cases more so. I find nothing wrong with it at all. There are articles that should appeal to technicians in most areas of the electronics field. Continue with the excellent work.

CLEVELAND GARNER
Tupelo, Miss.

Hey Scoot!

In regard to “Vertical Lines” in the July issue. It states that lines from Barkhausen Oscillations are always on the left side of the screen. Well, we have seen them more on the right than on the left. In fact, can't recall seeing them on the left. Have a set on the bench now with Barkhausen on the right. If we change the 12CU6 they disappear.

JACK'S TV
Milwaukee, Wisconsin

● *This is strictly a semantic problem. The author's reply follows.—Ed. “Barkhausen lines always appear somewhere between the far left and the center of the picture. These are oscillations that are set up as the plate of the HO tube goes negative with respect to the screen and thereby sets up oscillations. By definition, these are*



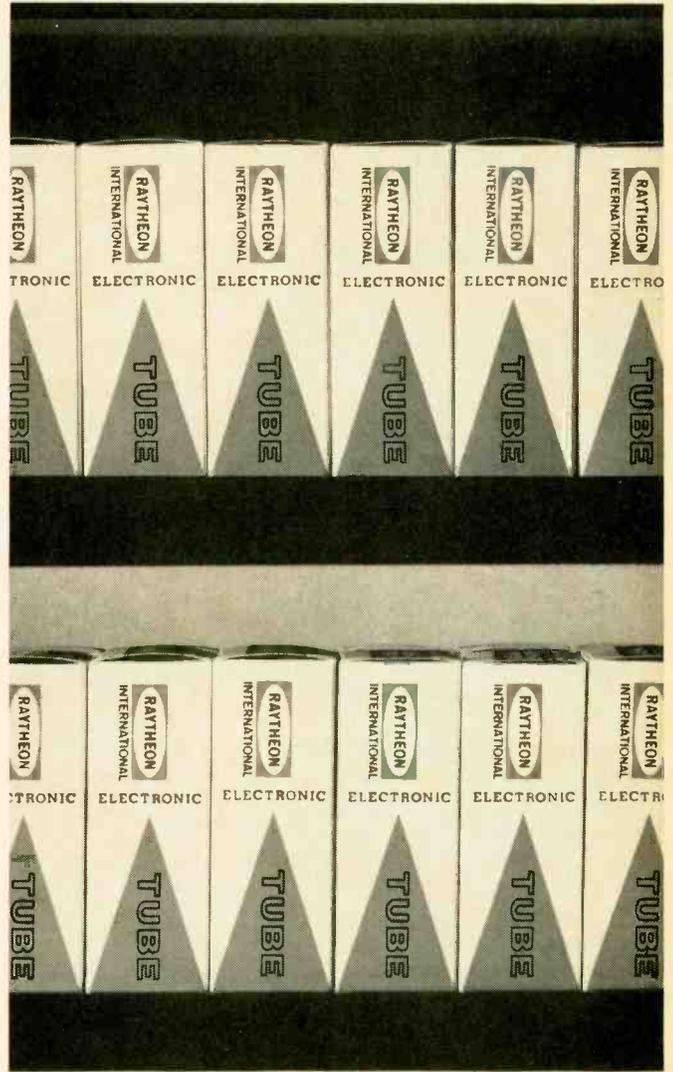
service faster

The new Raytheon Fast-Fax helps cut valuable servicing time. With Fast-Fax you can quickly and easily locate tube characteristics for 600 types including the 100 most popular types.

Fast-Fax stays up-to-date with supplements provided as a service to every user. The current supplement covers new types in the 1965 TV sets. And, new tube characteristics can be popped into place without disassembling the unit or rearranging the cards.

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200,000 OHMS PER VOLT

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**Model 630-NS
VOLT-OHM-
MICROAM-
METER**

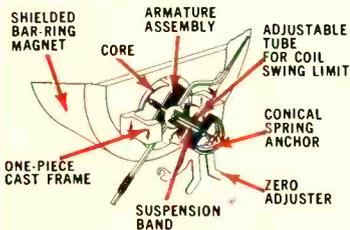
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no jewels . . . thus NO FRICTION



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Low voltage ranges and high input impedance make the 630-NS especially useful in transistor circuit measurement and testing. Input impedance, at 55 volts D.C. and above, is higher than most vacuum tube voltmeters.

The unit is designed to withstand overloads and offers greater reading accuracy. Reads from 0.1 μ a on 5 μ a range. Special resistors are rigidly mounted and directly connected to the switch to form a simplified unit. Carrying cases with stands are priced from \$9.90.

TRIPLET ELECTRICAL INSTRUMENT CO., BLUFFTON, OHIO

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LETTERS TO THE EDITOR

called Barkhausen when this happens at the end of the flyback pulse. When this happens as the tube is ending its heavy conduction period, it occurs at the right side of the screen and is called "snivets." Although the cause and cure is the same, the names are different. Barkhausen occurs at the end of the cutoff period and snivets just before cutoff. At both of these times a negative going pulse appears at the plate of the HO tube. Since this is an RF frequency, both of these interferences have been showing up more in the UHF band in heavy UHF areas. Actually, there's no better chance that it will occur in the UHF band but the band is larger and therefore more susceptible to it."

Stop Thief!

You have such a good magazine. The gang in the shop has already near tore the book apart robbing me blind of the goodies in it. You may get some new subscribers from around here soon because I've really declared myself. Keep up the good work. This type of book we need badly

WILLIAM LEE

Daly City, Calif.

Quick, Joe!

Please begin the three year subscription as advertised. Send it to the attention of my husband. Frankly, I hate your magazine and have trouble understanding the advertisements, but my husband tells me that for the field of electronics, ELECTRONIC TECHNICIAN offers the best in technical information, articles, schematics, and he raves all night about how great it is. Since it isn't sold on newsstands, he is anxiously waiting his subscription (and begging and borrowing copies from other subscribers), so please rush the order . . . he's driving me crazy! Why don't you feature fashions for unfortunate wives of TV technicians so we can read your magazine too? And please don't forget his schematics.

(MRS.) PATRICIA E. ROBRES

Valinda, Calif.

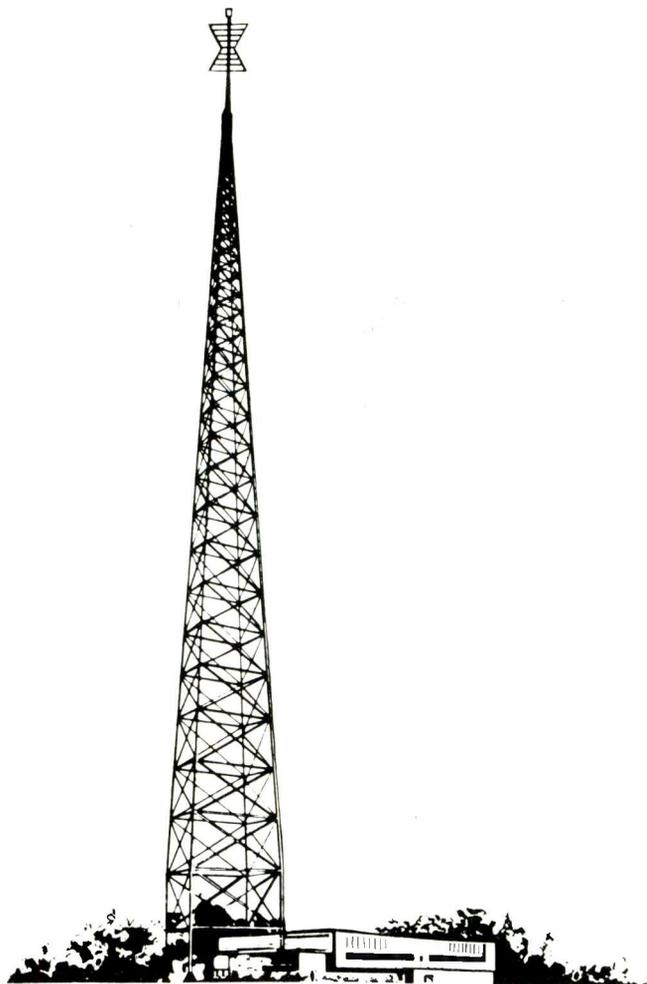
Surveillance System

As a member of the Milwaukee, Wisconsin County Board of Supervisors and a practicing technician in the field of electronics, I wonder if any of your readers could put me in touch with any organization now using electronic surveillance systems suitable to a juvenile detention facility. We are especially interested in knowing where such systems have been installed and the experience of the people using such systems.

RUDOLPH P. POHL
Supervisor, 20th District

Milwaukee, Wis.

How to deliver the best signal...



from here...



to here

BLONDER-TONGUE leader in UHF and VHF product design
dedicates Fall, 1964 to better TV reception with the

BLONDER-TONGUE VAL·U·RAMA

UHF converter and antenna guide

Selection of right converter and antenna critical for UHF

by I. S. Blonder

Chairman of the Board,
Blonder-Tongue Laboratories, Inc.



There has been a long-standing prejudice against UHF. Since the band opened in 1952, many otherwise knowledgeable technicians have considered UHF reception to be inferior to VHF. Yet the recent New York City tests conducted by the FCC have proved that this is simply not so.

There is a reason for this paradox — equipment. In 1953, the state of the UHF art was relatively primitive. Today, experienced manufacturers like Blonder-Tongue are able to produce equipment capable of providing UHF reception that is, in many ways, superior to VHF.

The latest advance in UHF converters is solid-state circuitry. The use of transistors and tunnel diodes insures longer-life and generally lower noise figures. Also, the Blonder-Tongue patented tuners provide pinpoint, drift-free tuning. The result is brilliant color pictures and sharp black and white reception.

As for antennas, UHF has a definite advantage over VHF. Because the UHF wavelength is so small, high gain, efficient antennas are small and cost little. The periodic principle proved so successful in the U.S. Satellite program is especially applicable to UHF. The Blonder-Tongue Golden Dart (outdoor) and Golden Arrow (indoor) antennas utilize this principle.

While they are compact, these antennas provide more gain than the large VHF yagis. What's more important, their patterns are clean, rejecting unwanted "ghost" signals. With a little extra care in selecting and installing UHF equipment, you can often provide your customers with better UHF pictures than they've been watching on VHF.

Blonder-Tongue UHF converters

These all-channel UHF converters, your best investment in TV enjoyment, add channels 14-83 to your present set. They are particularly suited to meet the critical demands of color TV. The new BTX-11 and BTX-99 converters retain traditional Blonder-Tongue features such as peak performance on all UHF channels, easy installation and reliable, long-term operation. To these well-known features have been added the advantages of all-transistor circuitry; maximum stability for drift-free performance and lower noise figure for snow-free reception. The BTD-44 employs a tunnel diode circuit for excellent, low cost battery operation.

Blonder-Tongue UHF antennas

The UHF antennas are designed to match the high performance standards on all UHF channels of our famed UHF converters. They employ the well-known Periodic principle, to provide uniform, high gain across the entire UHF spectrum for sharp, ghost-free pictures. Full bandwidth makes these UHF antennas excellent for color and black & white TV.

The Golden Dart is an outdoor UHF antenna which comes completely pre-assembled with nothing to snap out, no screws to tighten. The Golden Arrow is an indoor UHF antenna, which outperforms all other available indoor UHF antennas.

ALL-CHANNEL UHF CONVERTERS

DESCRIPTION	EFFECTIVE RECEPTION RANGE*	INPUT CHANNELS	OUTPUT CHANNELS	NET
BTX-11 — Deluxe all-channel, all-transistor UHF converter/amplifier. Adds all UHF channels to any set. Triples TV signal strength. Easiest tuning with dual-speed channel selector.	Used with an outdoor antenna anywhere up to 50 miles from station. With indoor antenna, up to 25 miles.	14-83	5 or 6	\$31.20
BTX-99 — All-channel, all-transistor UHF converter. Adds all UHF channels to any set. Provides maximum signal power. Drift-free, distortion-free.	Can be used with indoor antenna for prime signal areas and outdoor antenna up to 25 miles from station.	14-83	5 or 6	\$19.85
BTD-44 — All-channel, tunnel diode UHF converter. Utilizes tunnel diode for maximum reliability. Operates on ordinary flashlight battery which lasts from 6 to 9 months.	Can be used with indoor antenna for prime signal areas and outdoor antenna up to 25 miles from the station.	14-83	5 or 6	\$13.20

ALL-CHANNEL UHF ANTENNAS

DESCRIPTION	EFFECTIVE RECEPTION RANGE*	FRONT-TO-BACK RATIO	NET
GOLDEN DART outdoor UHF antenna Uses Periodic principle, 11 working elements for uniform high gain across the entire UHF spectrum.	Up to 50 miles.	20db min.	\$3.55
GOLDEN ARROW indoor UHF antenna Employs 10 working elements to provide constant high gain and matched impedance. Full Bandwidth — flat response.	Up to 20 miles.	20db min.	\$2.70

*In weak signal areas, use a model Able-U2 UHF amplifier.

ENJOY BETTER TV RECEPTION WITH BLONDER-TONGUE.

SAVE DURING THE VAL-U-RAMA NOW GOING ON.

provide exceptionally low noise and last longer than ordinary tubes. If interference occurs, attenuation filters can be used.



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Keener . . .

We've just glanced over an old editorial in the January 1963 issue of *ELECTRONIC TECHNICIAN*. It was titled "Are You Ready for '63?" It said, among other things, "Whatever the future may bring, for TV-radio service-dealers and technicians, one thing is certain: *competition will be keener.*"

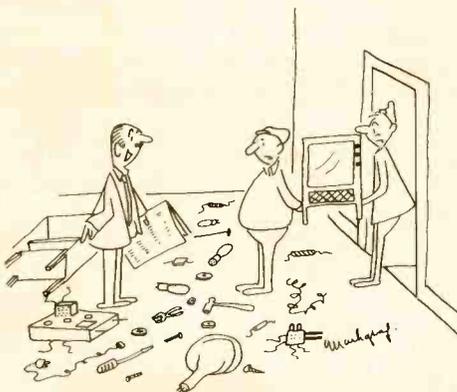
And today we heard a loud, haunting echo come back from the not-too-distant hills of tomorrow: "KEENER . . .!" This could become downright disturbing if we didn't know how to face it intelligently . . .

Automated test equipment is now being used by industry to make thousands of tests in a minute. One device does in a half hour what formerly took skilled technicians days to accomplish with conventional test equipment. All this results in savings, more work done in an hour — more profit. And one of the major secrets of staying alive today in this business is to use better test equipment.

With properly diversified services and modern, efficient business practices, better test equipment will make it possible for you to survive and prosper. You can find that shorted yoke faster, isolate the cause of that low B+ more quickly — get the job finished in minutes instead of hours — and give top-quality service at the same price, or lower, than the "big outfits" can.

But don't go hog-wild and buy everything in sight. Sit down and figure out first where you're wasting a lot of time. Check the test equipment available and see if it will speed up your operations. Compare the different brands. Compare prices, capabilities, and use-life expectancies. When you've figured out what you need and *know* that it will speed up your operations, then don't waste time — buy it and get going.

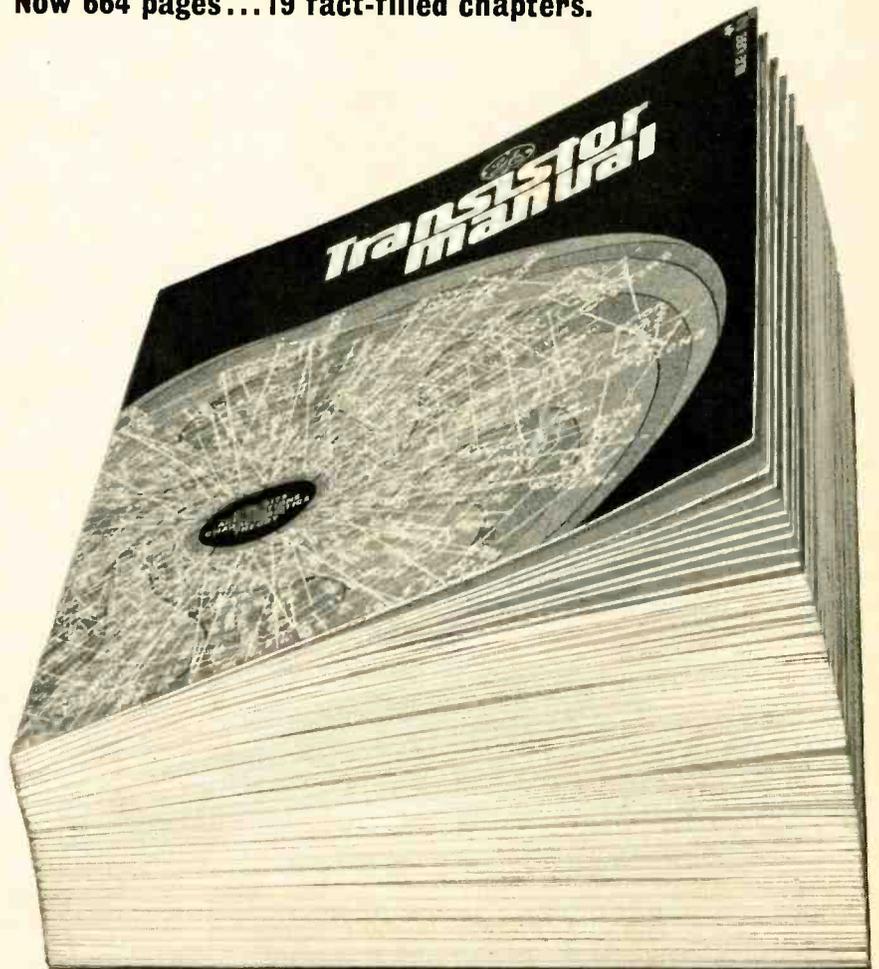
If you do, then you'll soon find that all this "fluff-and-feathers" about "belt-tightening" in this business is strictly for the birds. And you'll be able to sleep nights—sans "competition nightmares."



"Thank's fellows—you'll find my trade-in here . . . and there."

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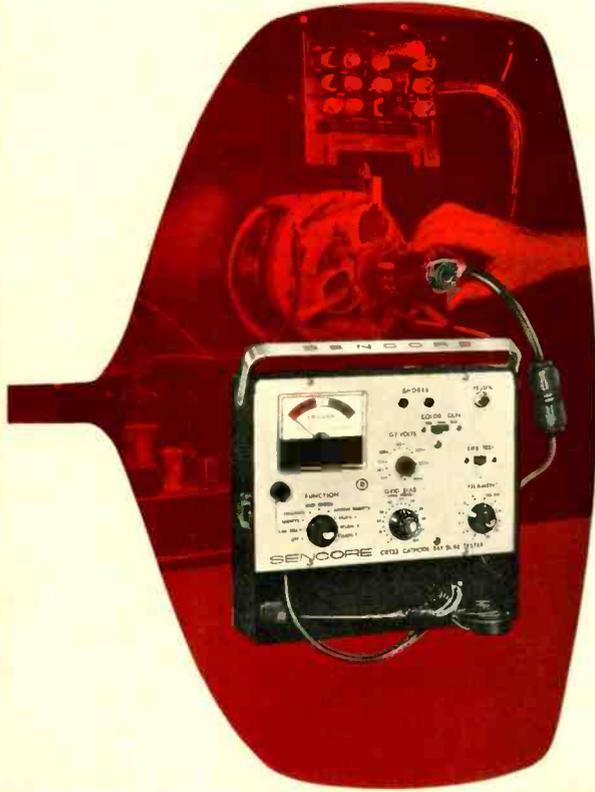
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The new, improved CR133 CRT Checker is designed to test all present picture tubes—and it's ready for future tubes too! Two plug-in replaceable cables contain all sockets required. The compact, 10 lb., CR133 checks CRT emission, inter-element shorts, control grid cut-off capabilities, gas and expected life. Checks all tubes: conventional B&W, new low drive B&W, round color tubes and new rectangular color picture tubes. Exclusive variable G2 Volts from 25 to 325 Volts insures non-obsolescence when testing newly announced "semi-low" G2 CRT tubes. New Line Voltage Adjustment insures the most accurate tests possible. Uses well-filtered DC for all checks to avoid tube damage and reading errors. Color guns are individually tested as recommended by manufacturers. Exclusive automatically controlled rejuvenator applies rejuvenation (ACR) voltage as required by individual tube condition; precisely timed to prevent over-rejuvenation or tube damage. The ACR feature is most useful for color tube current equalization to insure proper tracking. Hand-wired and steel-encased for protection of meter and panel in truck or shop, the new improved CR133 is only **\$89⁹⁵**

The famous CR128 CRT Checker and Rejuvenator is similar to above, but with a three position G2 slide switch and without Line Voltage Adjustment at \$69.95

professional quality — that's the difference!

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TECHNICAL DIGEST

DUMONT

TV Chassis 120734-A and 120735-B—
Circuit Variations and Parts Changes.

R109, connected to the negative side of CR102 (focus rectifier) is changed to 4.7 Ω (formerly 1 Ω). R110, 1 Ω ±10 percent 1 w, has been added between pins 2 and 6 of V101 (3A3). R120, volume control and ON-OFF switch assembly has a shorter shaft than on previous chassis (new part number). R126, connected to the positive side of the 140 v filter capacitor (C124C) has been changed to 1000 Ω 5 w wirewound (formerly 1200 Ω 4 w). R127, connected to the positive side of the 270 v filter capacitor (C124B) has been changed to 1100 Ω 20 w wirewound (formerly 1400 Ω 18 w). R128, connected to the positive side of the 270 v filter capacitor (C124B) has been changed to 100 Ω 10 w wirewound (formerly 1200 Ω 7 w). R541, connected in the plate circuit of V503A (6KA8) has been changed to 4.7 (formerly 10 Ω). R147 connected to pin 3 of V501B (6GF7), has been replaced by R164 and R165, 2200 Ω 3 w and 1800 Ω 2 w, respectively. The junction of these two resistors is connected to pin 8 of V105 (6JE6), which was previously grounded. C138, connected to the junction of CR101 and R107, has been changed to 0.01 μ f 1000 v (formerly 500 v rating). T105, the power transformer, is no longer equipped with a 128-v tap.

EMERSON

Various TV Chassis—Production Changes

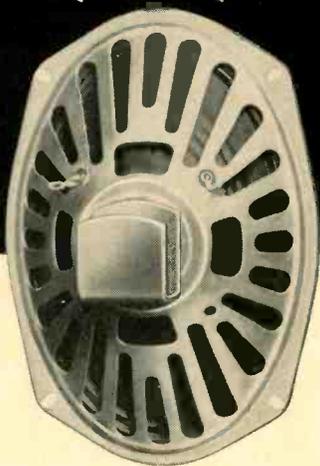
Ch. 120671 and 120673 coded with a triangle containing the letter "A" (or any higher letter), as well as all other chassis coded with an empty triangle (indicating initial production), incorporate the following circuit modification: To increase the sensitivity of the sound IF amplifier, R1 was changed to 33,000 Ω , ½ w.

Ch. 120671 and 120673 coded with a triangle containing the letter "B" (or any higher letter), as well as all other chassis coded with an empty triangle (indicating initial production), incorporate the following circuit modification: To allow a wider range of vertical output tube manufacturing variations, R71 was changed to 47 Ω , ½ w.

Ch. 120673 coded with a triangle containing the letter "C" (or any higher letter), as well as Ch. 120740, 743 and 744 coded with an empty triangle (indicating initial production), incorporate the following circuit modification: To provide safeguard against the possibility of "snivets" on UHF reception in difficult areas, the horizontal output tube (V9) was changed to a type 16GY5. This tube is not directly interchangeable with the previously used 13GB5 and requires the use of a different socket (part no. 500144).

Ch. 120671, 673, 698 and 702 coded with a triangle containing the letter "D" (or any higher letter), as well as all other chassis coded with an empty triangle (indicating initial production), incorporate the

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- Input impedance . . . 300 ohms or 75 ohms with plug-in transformer
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professional quality — that's the difference!

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TECHNICAL DIGEST

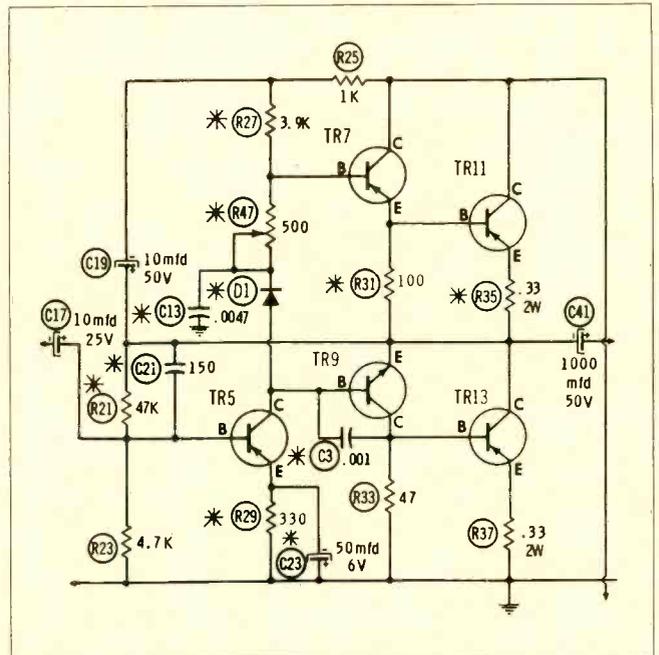
following circuit modifications: V8 (formerly 6K11 or 6Q11 changed to type 4HA7 or 4HC7, R21 changed to 4700Ω, ½ w and returned to chassis ground, R44, R45, R57, R59 and C30 removed from the circuit.

GENERAL ELECTRIC

Transistor Amplifier T-100, RC4530—Production Changes

Shown is a schematic for the driver-output stages of the T-100 amplifier. All circuit components that have been added, deleted, or changed during production are denoted with an asterisk.

To maintain ac/dc feedback buss "center point"



voltage at half of supply voltage with production tolerance, resistor R21 was changed from 120K to 47K. . . . To increase I_C of TR5 and provide more current drive for TR7 and TR9, resistor R27 changed from 10K to 3.9K. . . . To facilitate adjustment of I_C of TR11 to 1 ma, diode D5 was removed and bias adjust potentiometer R47 was changed from 200Ω to 500Ω. . . . Resistor R31 is changed from 100Ω to 47Ω and diode D7 is removed and replaced by resistor R35 0.33Ω 2 w. The output is more thermally stable with the resistor in place of the diode. . . . To keep the output stage from generating high frequency (1 Mc) when TR11 is switching out of saturation, capacitor C13.0047 μf ceramic is added from junction of D1 and TR5 collector to common. . . . To provide the correct amount of high frequency roll-off for the power amplifier stage and prevent transient voltages in output circuits, capacitor C21 was changed to 100 pf.

These changes shown as applied to the illustrated right channel are also made in the identical left channel.



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You can't know if he'll be smiling or angry, wearing a suit or a sports shirt, or driving a 6 or an 8. One thing you can be reasonably sure of, though. You'll be able to service his radio with Delco parts. That's because nearly half the

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Boston.....Wells 3-3100	Cleveland.....671-6460	Charlotte.....Edison 4-8671
Chicago.....437-5300	Denver.....Keystone 4-0273	Jacksonville.....Exbrook 8-5755
Detroit.....584-1025	Indianapolis.....Melrose 6-4351	Houston.....Jackson 6-4338
Los Angeles.....Dunkirk 5-6487	Buffalo.....TF 2-5362	Washington, D.C.....Juniper 8-7494
Minneapolis.....331-4811	Philadelphia.....Garfield 3-8200	El Paso.....Keystone 3-1651
Newark.....297-3300	St. Louis.....Jefferson 3-4230	New York.....Judson 2-3824
San Francisco.....Landscape 6-8221	New Orleans.....523-4281	Kansas City.....Fairfax 1-3900
Seattle.....Parkway 2-4477	Pittsburgh.....Court 1-6551	
	Omaha.....558-0225	
	Memphis.....Jackson 5-6471	

add an fm-stereo service center
with this one new
sencore unit!



THE SENCORE MX129 FM STEREO MULTIPLEX GENERATOR & ANALYZER

FM-Stereo growth continues to mount and is fast becoming as big a field as Color TV. This means more FM-Stereo service business for you, now and in the future. Is your shop equipped? It can be — completely and economically — with the MX129, the FM-Stereo "Service Center in a Case." The instantly stable, 19-Transistor, crystal controlled MX129 is the most versatile, most portable (only 7½ pounds), most trouble free and efficient multiplex unit on the market — just like having your own FM-Stereo transmitter on your bench or in your truck. Powered by 115 volts AC, it produces all signals for trouble shooting and aligning the stereo section of the FM receiver . . . can be used to demonstrate stereo FM when no programs are being broadcast. Self-contained meter, calibrated in peak to peak volts and DB, is used to accurately set all MX129 controls and as an external meter to measure channel separator at the FM-Stereo speakers. **NO OTHER EQUIPMENT IS REQUIRED.** only **\$169⁵⁰**

SIGNALS AVAILABLE FOR ALIGNMENT, TROUBLE SHOOTING AND ANALYZING:

FM-RF carrier with composite multiplex audio signal with 38kc suppressed carrier, 19kc pilot and 67kc SCS signals • Multiplex signal formed by 60 or 1000 cycle internal tones or any external signal • Full control over left and right channel amplitude (modulation) • External 67kc SCA signal available for trap adjustment • Composite signals available for signal injection FM detector •

professional quality — that's the difference!

SENCORE

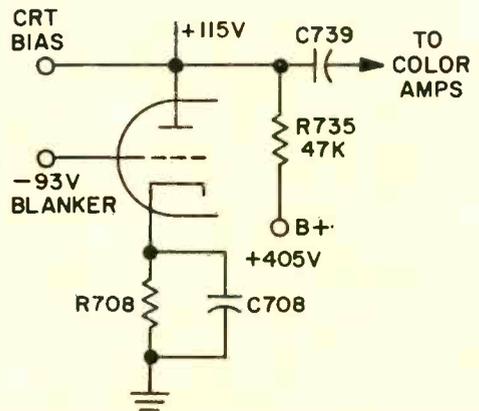
426 SOUTH WESTGATE DRIVE • ADDISON, ILLINOIS
- - - for more details circle 59 on post card

TECHNICAL DIGEST

PHILCO

TV Chassis 14M91, Model M 52414MR—Excessive Blooming

Open load resistor R735 in the blanker stage will cause excessive blooming and too much contrast. The blanker stage is chiefly responsible for dc restora-



tion. Color is present and sound is normal under this condition.

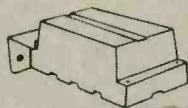
RCA

All 1960-'65 RCA TV Chassis—UHF Conversion

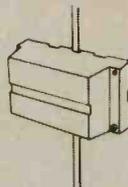
UHF conversion of RCA TV instruments (1960-1965) may be made by using one or more of the following kits: **DK32** all channel tuner kit. A, B & C versions differ only in hardware. **DK71** all channel tuner kit. **DK86** all channel tuner kit. **DK87/DK70/-DK60/DK40** single channel strip insert. **LF902**, **DK89/DK74/DK50** antenna adapter (UHF input). **DK152/DK152B/DK152C** all channel tuner kit. **DK152** does not contain hardware required for 9AB3M Model Series. "C" version employs a transistor UHF tuner. **DK153/DK153A** all channel tuner kit. "A" version employs a transistor UHF tuner. **DK156/DK156B** single channel strip insert. "B" version has an additional channel indicator tab used on 9AB3R Model Series. **DK163** all channel tuner kit. **DK165** supplementary kit. Contains additional hard-

ELECTRONIC TECHNICIAN

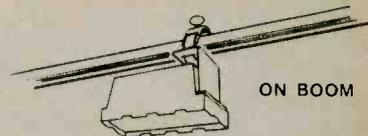
MOUNTS 5 WAYS



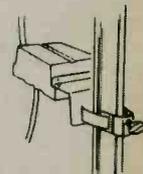
ON OUTSIDE OF HOUSE



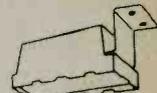
INSIDE OF HOUSE



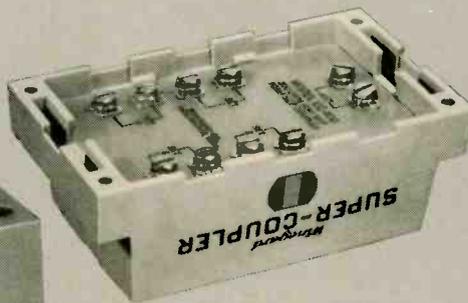
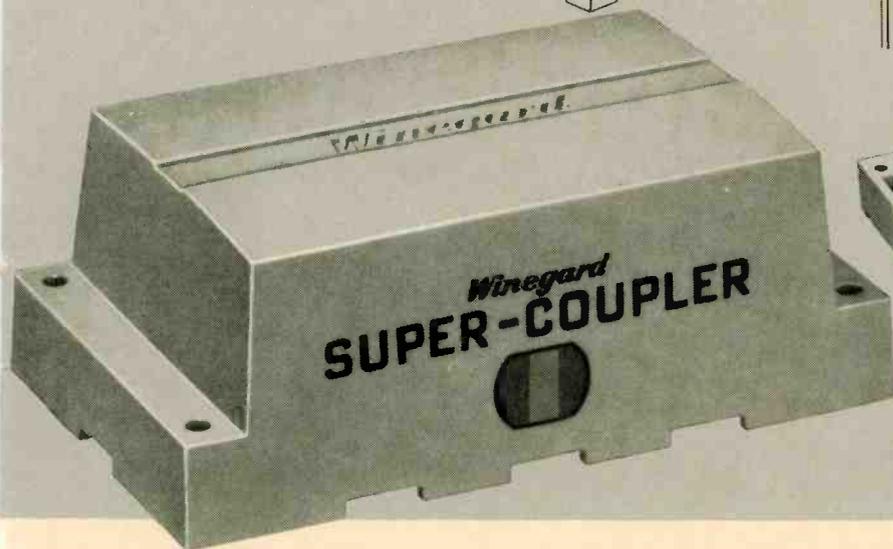
ON BOOM



ON MAST



UNDER EAVE



Never before couplers like these! New Winegard Super Color Couplers ... the 2 most efficient TV-FM 2 and 4 set Couplers ever built!

- Constant Isolation between sets... 22db minimum across all channels (2-13 and FM)
- Lowest Loss of Any Coupler... -3.2db maximum
- Best Impedance Match from Antenna to Coupler and Set to Coupler
- Allow Best Possible Reception on Color or Black & White Sets

There is a wide difference in the performance of TV-FM couplers. And now, with the new Winegard 2-set and 4-set Super Color Couplers, there is a greater difference than ever.

For example, no resistors are used for isolation of outputs. No resonant coils are used in the circuit. Instead, our research labs have developed an entirely *new coupler circuit* using three high frequency, ferrite core transformers in a unique "Balanced Bridge" circuit.

What does this do to performance? Well, for one thing, the 2-set Super Coupler provides an isolation figure of 22db minimum across *all* channels (2-13 and FM). Until now, the minimum isolation between sets with 2-set couplers was about 10db or 3 times, and was not constant on all channels. With the new Super Color Couplers, it's 12.8 times—*four times better* than the previous best. In fact, isolation is so good, you can put a dead short across one set of output terminals without affecting the set connected to other output.

LOSS is another key factor in measuring the performance of a coupler. The lowest possible theoretical loss in a 2-set coupler is -3db but no coupler on the market had ever approached this ideal. Now, with Winegard's new 2-set Super Coupler (CC200), the MAXIMUM loss is -3.2, nearly perfect and by far the best on the market.

One more very important factor—IMPEDANCE. There are two impedance matches to consider... "Forward" from coupler to antenna, and "Backward" from set to coupler. A perfect coupler would have a VSWR of 1.1:1 on both matches. Some couplers have good match one way but, until now, no coupler ever had a good match both ways. Winegard Super Couplers have a near perfect VSWR of 1.2:1 both *forward and backward*... and on *all* channels. This far exceeds other couplers on the market.



NEW COUPLER
6 PACK DISPENSER

What does all this mean to your customers? Most important, it means that the Super Coupler will not spoil picture resolution by adding smear or halos. *The Super Coupler is especially recommended for color installations* where preservation of picture quality is even more critical than on black & white.

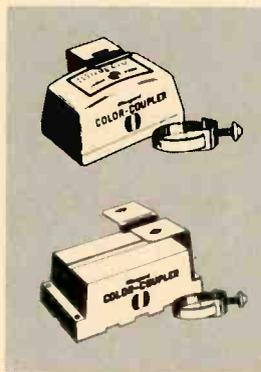
What besides performance? Construction and price. The new Winegard Super Color Couplers have a unique 5-way mount, sleek new weather-proof coupler housing, pre-notched transmission line outlets, 1/4" slotted Hex terminal screws and no-strip terminal connections... the price is only \$4.50 for the CC200 which includes the special inside-outside mount.

Try the new Winegard Super Couplers now and *see* the difference. Ask your distributor for a 6 pack dispenser. Try them on your next six installations. If they aren't the finest you've ever used, take them back for a *full refund*.

CC200 — For VHF and FM Specifications as above.
List \$4.50 includes 5-way mounting bracket and strap.

CC400 — For VHF, UHF and FM (replaces LT-43).

Max. loss — 6.23DB (A theoretical loss for perfect 4 way coupler would be -6.0DB); Isolation 12DB min; Response $\pm 1/4$ DB per 6MC; VSWR: Input 1.15:1; Output 1.4:1 Max; Bandpass 20MC-1000MC; Impedance: Input 300ohm, Output 300ohm. List \$5.50 including 5-way mount and strap.



Winegard's Famous CC23 Color Coupler
Finest VHF/FM color coupler on the market next to our new Super Color Couplers. List Price \$3.95.

Winegard All New CVU-2 UHF-VHF Coupler Efficiently transfers UHF and VHF signals from antennas to sets. Serves as coupler or splitter for channels 2-83 (UHF-VHF). List \$3.95.

	UHF	VHF/FM
Splitter loss	3.5db	4.3db
Isolation	20 db	12 db
VSWR	1.4:1	2:1



Winegard Co.

ANTENNA SYSTEMS

3019-K Kirkwood, Burlington, Iowa

--- for more details circle 66 on post card

america's most popular
tube tester

... because it
finds the
"tough dogs"
others miss!



THE NEW SENCORE TC130 MIGHTY MITE III TUBE TESTER

New in looks and compactness, updated with many exclusive features. The MIGHTY MITE tester, long America's most popular tube checker because it has the versatility and reliability professional servicemen demand! The MIGHTY MITE III checks them all — more than 2,500 tubes plus picture tubes, including the new frame grid tubes (has four extra sockets for latest tubes). It's fast and thorough, checks for control grid leakage, then, with the flick of a switch, tests for interelement shorts and cathode emission at full operating levels. Uses costly moving coil meter for high sensitivity (100 megohms) to find those "tough dog" tubes other low-sensitivity testers miss. In versatility, reliability, portability and operating simplicity, the TC130 is your best buy in tube checkers at

\$74.50

COMPARE THESE MIGHTY MITE III FEATURES:

Lower voltage for Nuvistors and all frame grid tubes • Unique circuit tests for inter-element shorts, each and every element • Checks cathode emission at full operating levels • Checks control grid leakage at 100 megohms sensitivity, like "eye tube" testers. Speed-indexed set-up cards greatly reduce look-up time • Simplified panel layout speeds checks, prevents errors • Burn-out proof, stick-proof meter • Sturdy, all-steel case, rubber feet • Styled for modern, professional look

professional quality — that's the difference!

SENCORE

426 SOUTH WESTGATE DRIVE • ADDISON, ILLINOIS

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TECHNICAL DIGEST

ware and instructions for mounting the DK154 in the 14H98, 99RV Series receiver. LF901 single channel strip insert. **Note: The DK89** adapter kit may be used whenever the DK74 or the DK50 adapter kit is specified. **The DK87** strip kit may be used whenever the DK70, DK60 or DK40 strip kits are specified. **The DK32C** all channel UHF kit may be used whenever the DK32B, DK32A or DK32 kits are specified. **The DK154** all channel UHF kit may be used wherever the DK86 UHF tuner kit is specified. **Note:** Color television receivers previous to the 1963 line are not field convertible to UHF.

A table denoting the proper UHF conversion kit or kits to be used for conversion of a particular model RCA TV receiver for UHF reception is published in the July 10, 1964 issue of "RCA Television Parts and Tips." This publication is distributed by RCA Sales Corp., Product Performance, 600 N. Sherman Dr., Indianapolis, Ind.

SYLVANIA

MPX 112 Decoder—Alignment Using Transmitted Signal

The Sylvania MPX 112 Stereo FM locked oscillator decoder may be aligned by using only the transmitted stereo FM signal and an oscilloscope.

To make the complete alignment proceed as follows:

1. Tune in a local multiplex station, signal must be fairly strong for accurate alignment.

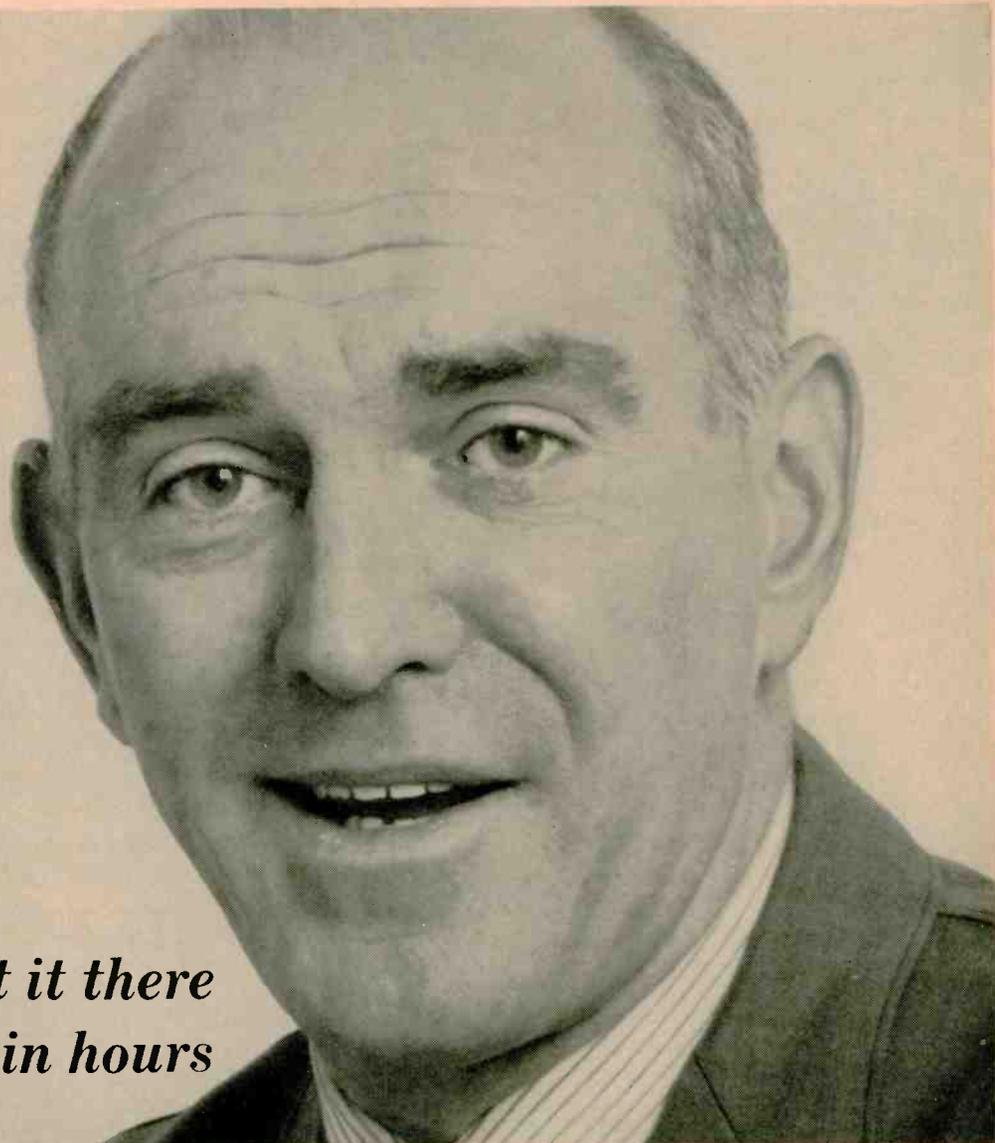
Connect vertical input of scope to pin 1 of the stereo indicator amplifier, (V200) point D in schematic.

Tune L101 and L102 for maximum scope deflection indicating that these coils resonate perfectly with the 19 kc pilot carrier.

2. Connect a potentiometer, any value from 10 to 100 k will work, from point A to chassis ground and connect the horizontal input of scope to either point B or C, the secondary of T100. Leave the vertical input of the scope connected to point D.

3. Adjust T100 for "Figure 8" scope pattern shown. Weaken signal with control installed in step 2 until oscillator falls out of lock, indicated by scope pattern "rolling" and zero beat heard in speakers, and carefully adjust T100 so pattern remains locked in or rotates slowly.

4. Most FM Multiplex stations make announcements and broadcast news on one channel only. To make a final "touch up" adjustment for maximum separation, turn balance control on amplifier for maximum sound on the "reject" channel during such announcements and carefully adjust T100 for minimum sound on this channel. It is easier to adjust for minimum sound on the unused channel than for maximum on the channel being used for announcements or news broadcasts.



*“I can get it there
in hours*

...that's why I ship by Greyhound Package Express!”

You can depend on Greyhound Package Express to get your shipment where it's going, FAST! Packages you ship hundreds of miles, often arrive the very same day.

Your shipment travels aboard regular Greyhound buses on fast, frequent schedules. Greyhound buses travel over a million miles a day, providing package express service to thousands of communities not reached by any other form of public transportation.

Ship anytime, twenty-four hours a day, seven days a week, week-ends and holidays. Improve your customer service. Save time and money too! Ship by Greyhound Package Express. Convenient C.O.D., Collect, Prepaid or special charge account service.

For information on service, rates and routes, call Greyhound or write today: Greyhound Package Express, Dept. 53K, 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.*
LOS ANGELES— SAN FRANCISCO	28	9 hrs. 20 min.	\$2.10	\$2.45	\$2.80
PITTSBURGH— CLEVELAND	15	2 hrs. 55 min.	1.60	1.85	2.15
INDIANAPOLIS— CHICAGO	10	4 hrs. 15 min.	1.70	2.00	2.30
DALLAS— SAN ANTONIO	10	7 hrs. 15 min.	1.90	2.15	2.45

*Other low rates up to 100 lbs.

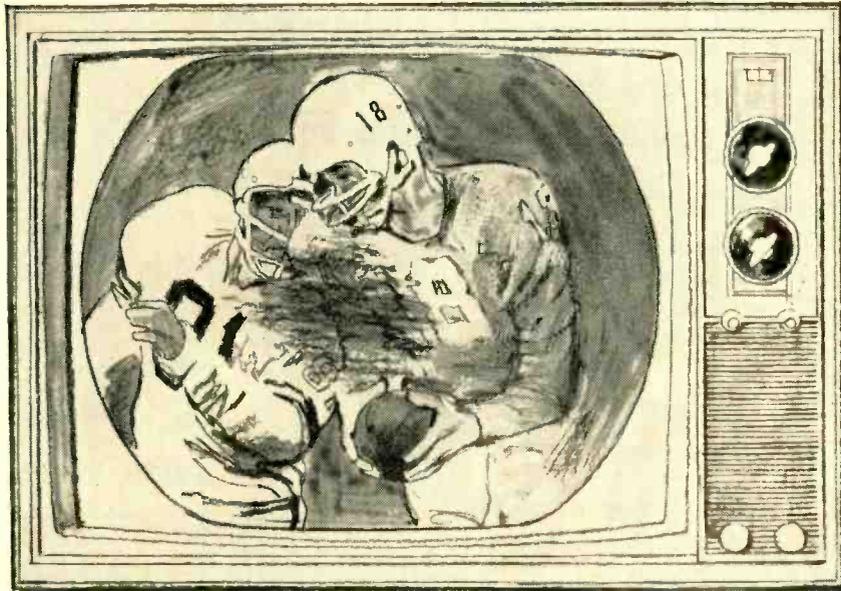


One of a series of messages depicting another growing service of The Greyhound Corporation.

--- for more details circle 33 on post card

Available Now

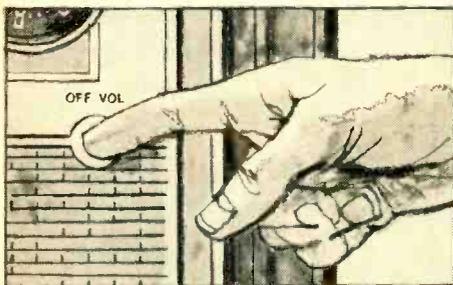
RCA Victor Color TV



Magnetism can cause impurities...

in the color picture—and unwanted color areas in the black and white picture. In the home, as you know, magnetic distortions may be caused by moving the set in relation to the earth's magnetic field or they can sometimes be caused by nearby electric appliances.

To “cancel” the magnetism and restore natural color...



simply turn off the set, let it cool 4 or 5 minutes, then turn it back on. That's all—no more need for a separate degaussing coil! The RCA Victor Automatic Color Purifier acts *every time the set is turned on* from a cool start. Color is bright, sharp, true—free of impurities caused by magnetism. The RCA Victor Automatic Color Purifier also removes unwanted color areas from the black and white picture. Here's another major “first” from RCA Victor that can give you a profitable advantage in extra sales . . . and in service savings!

degausses itself!

Gives you 3 big advantages!

1

Floor models always ready for best color picture!

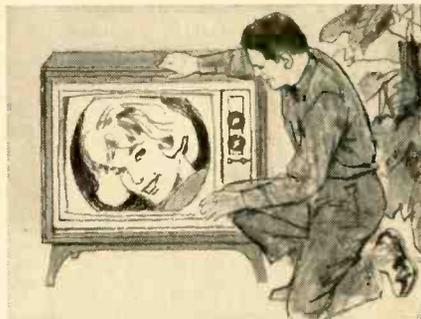
Ever lost a sale because your floor demonstrator needed degaussing? The RCA Victor Automatic Color Purifier cleans up that problem . . . helps make the sale easier for you. And with a swivel or caster model, you can quickly demonstrate how color TV can now be moved about without worry of magnetic distortion!



2

Faster, easier setup in customer's home!

The RCA Victor Automatic Color Purifier eliminates the need for you to perform time-consuming degaussing when you deliver the new Mark 10 color TV set. This makes setup faster, easier . . . freeing you for more profitable TV servicing. The Automatic Color Purifier is standard on all Mark 10 models except the price leaders.



3

Reduces unprofitable callbacks!

The RCA Victor Automatic Color Purifier will end those degaussing "nuisance" calls that can eat up service time and profits. They're a nuisance to customers, too! Increased customer satisfaction is sure to follow from this new RCA Victor "first"—and remember, a satisfied customer is very often your best salesman.



"HIS MASTER'S VOICE"

Make sure you get your share of the big Color TV sales forecast for '65...get with RCA Victor!



The Most Trusted Name in Television

Tmk(s)®

SEE THE RCA COLOR TV CENTER AT THE WORLD'S FAIR

NEW LITERATURE

VARIABLE CONTROLS 300

A 4-page brochure describes solid-state, semiconductor variable voltage controls in 24 and 48 kva 480 v, 60 cps types. Superior.

CONTROLS 301

This catalog lists all controls and accessories necessary for the assem-

bly of exact replacements for single, dual, triple and quad single shaft controls, dual concentric controls and units with switches. Centralab.

MICRO TOOLS 302

A series of data sheets describe a full line of micro tools. Circon Component Corp.

EQUIPMENT MANUAL 303

An equipment and idea manual lists hundreds of items including off-heat radar speed-trap detectors, wire

farmers, label makers, plastic laminating equipment and others, including standard items. Precision.

PARTS 304

A 516-page catalog offers a line of electronic parts and equipment for home and industrial use, Lafayette.

TAPE HEADS 305

A 16-page tape recorder head reference guide fully illustrates head specifications, dimensions, pole con-

TWIN TRANSISTOR SUPER COLORTRON

Not 10 DB, not 15 DB but a whopping 33 DB gain on the low band and FM—33 DB gain on the high band actually amplifies the signals 45 times



TWIN TRANSISTOR STANDARD COLORTRON

18 DB gain on the low band and FM—18 DB gain on the high band



NEVER BEFORE —33 DB gain!

NEVER BEFORE —Same gain on every channel 2—13 plus FM!

NEVER BEFORE —3.5 DB noise figure or less on all channels!

nections and installation instructions for a line of recorder heads. Robins.

POTENTIOMETERS 306

A complete line of controls, both composition and wire wound are listed in this 20-page catalog. Also included are specifications on a line of sound system controls. Clarostat.

OSCILLOSCOPES 307

A 92-page scientific instrument catalog contains detailed specifications on a full line of high-frequen-

cy, solid-state oscilloscopes. DuMont.

SPADE DRILLS 308

A bulletin gives specifications for a line of spade drills used for drilling short holes over 1 in. in diameter. Production.

PHOTOELECTRIC ACCESSORIES 309

A bulletin describes a complete line of accessories for photoelectric controls. Photomation.

CC-TV CATALOG 310

A closed-circuit TV catalog covers a full line of CC-TV equipment—cameras, monitors, lenses, housings, video and distribution equipment and accessories. Blonder-Tongue.

PHONO DRIVE WALL CHART 311

A complete phono drive cross reference chart updates and cross references all available phono drives through June 1964. Walsco.

... WHEN MOVING
Be sure to let us
know your new address.

POTENT NEW PRE-AMPS

from Winegard have Super High Gain

- First Pre-amps That Have Same Gain on Both TV Bands plus FM.
- Will Take Highest Signal Input of Any Twin Transistor Antenna Amplifiers Made.
- Have Lowest Noise Figure Ever Obtained on TV Antenna Pre-amps.
- Can Be Used on Any TV Antenna for Black and White, Color or FM.

Up to now there have been two serious drawbacks to *all* antenna pre-amps (including our own)—

First—there have never been antenna pre-amps that had enough gain for *every* application. Second—all antenna pre-amps have had from 4 to 6DB gain less on the high band. This is unfortunate because the high band channels normally need pre-amplification more than the low band due to greater reception losses at the higher frequencies.

NOW Winegard has created two big solutions to this problem—the Super Colortron with a flat 33 DB measured gain on all channels 2—13 and the Standard Colortron with a flat 18 DB gain on all channels 2—13. For example, the Super Colortron will blow up a 50 microvolt signal to 2250 microvolts even on 13, the highest channel. Compare this with the best twin transistor pre-amps previously available where a 50 microvolt

signal would be amplified only to 175 microvolts—a tremendous difference in signal power. This increase in amplification will cover *all* applications—particularly for *fringe* area color. (See comparison charts to the right).

Of equal importance to gain is the noise figure of a pre-amp. Winegard engineers have lowered the noise figure on these new pre-amps as much as 2 DB over any other TV pre-amp available. They will bring perfect color even to deep fringe areas.

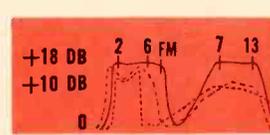
Compare these new Winegard antenna pre-amps with any others on the market today. Compare construction—totally weather-proofed polystyrene case, even the terminals are protected . . . convenient, rugged mounting bracket that snaps-on boom. Compare performance—highest gain . . . lightning protected circuit . . . lowest noise! Then try a new Twin Transistor Colortron and see it in action!

The Super Colortron (AP75T) uses a 75 ohm system with RG59U Coaxial cable. Has three RG59U Connectors. For runs of over 70 ft., RG11U is recommended. The AP75T supercedes the AP215N. Model AP75T lists for only \$79.95.

SPECIFICATIONS: GAIN: +33 DB per band. BAND PASS: 54MC-108MC, 174MC-216 MC. RESPONSE = 1/4 DB per 6 MC channel. VSWR: Input 1.5:1. Output: 1.75:1. MAX. SIGNAL INPUT: 55,000 MV. MAX. SIGNAL OUTPUT: 2,000,000 MV. INPUT IMPEDANCE: 300 ohm. DOWNLEAD IMPEDANCE: 75 ohm. OUTPUT IMPEDANCE 75 or 300 ohm. 117V 60 CPS 1.8 watts.

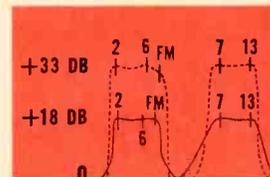
The Twin Transistor Colortron Antenna Amplifier (AP220T, 300 ohm) lists for only \$44.95. The AP275T (75 ohm) amplifier lists for \$49.95.

SPECIFICATIONS: GAIN +18 DB per band. BANDPASS: 54 MC-108 MC, 174 MC-216 MC. RESPONSE = 1/4 DB per 6 MC channel. VSWR: Input 1.5:1. Output: 1.75:1. MAX. SIGNAL INPUT: 80,000 MAX. SIGNAL OUTPUT: 660,000 MV. INPUT IMPEDANCE: 300 ohm. OUTPUT IMPEDANCE: AP-220T—300 ohm, AP275T—75 ohm. 117V, 60 CPS. 1.8 Watts.



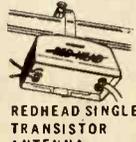
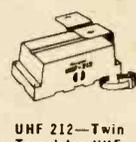
COMPARE THESE GAIN CURVES AGAINST COMPETITIVE MAKES. CURVES TAKEN FROM SCOPE PHOTOS.

--- BRAND J
- - - BRAND B
— WINEGARD COLORTRON (AP220T)



ACTUAL MEASURED CURVES PROVE A FLAT 18 OR 33 DB GAIN . . . HIGH BAND, LOW BAND, FM, TOO.

--- WINEGARD AP75T
— WINEGARD AP220T

 <p>COLORTRON TWIN NUVIATOR (AP220N). 300 ohm. Input: 400,000 microvolts . . . highest of any amplifier, tube or transistor. List \$39.95. AP275T (75 ohm) List \$44.95.</p>	 <p>TWIN NUVIATOR FM AMPLIFIER ONLY. (AP320). 18 DB gain. 180,000 Microvolts Input. List \$39.95. AP375—same, but coax. List \$44.95.</p>	 <p>REDHEAD SINGLE TRANSISTOR ANTENNA AMPLIFIER (RD300) Most reliable, highest gain single transistor model available. Input: 20,000 microvolts. 300 ohm input and output. List \$29.95.</p>	 <p>UHF 212—Twin Transistor UHF antenna amplifier has 12 DB gain on all UHF channels 14-83. Noise figure 8 DB at 900 MC. List \$44.95.</p>	 <p>UHF 110X Single transistor UHF antenna amplifier has +8 DB gain on channels 14-72. List \$34.95. UHF 110T (translator model) —same, but has 12 DB gain on channels 72-83. List \$34.95.</p>
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Winegard Co.
 ANTENNA SYSTEMS

3019-K Kirkwood, Burlington, Iowa
World's most complete line of TV&FM reception equipment.

- - - for more details circle 67 on post card

BOOK REVIEWS

PRESSURE - FIT RECTIFIERS.
An application manual by Tung-Sol Electric Inc. 90 pages, soft cover. \$0.75.

Arranged in three parts — Basic Rectifier Theory, Pressure-Fit Rectifier Ratings & Characteristics, Applications — this manual covers mounting methods, standard and

special electrical applications. Mounting methods detail pressure fitting, fuse clip mounting, resistor clamp, battery clip and solder mounting. Standard electrical application information deals with rectifier circuits, paralleling silicon rectifiers, series string and high voltage stacking and protection schemes. Special electrical applications are comprehensive, including static forward voltage drop test circuits, static voltage leakage test circuits; fullwave bridge battery charger, power supply regulator, lab

power supply, light dimming switch circuit and many others. It is an excellent source of information for circuit designers.

HORIZONTAL SWEEP SERVICING HANDBOOK. By Jack Darr. Published by Gernsback Library, Inc. 224 pages, soft cover. Price \$4.10.

This is no "ivory tower" approach to TV horizontal sweep servicing. It was written by a practical technician, for practical technicians. And just in case you have forgotten your theory, portions of the first few brief chapters zero you back in on the essentials. The rest of the book deals with troubles, testing techniques, shop testing, "dogs" and intermittents. This is a down-to-earth book we can heartily recommend. It is well illustrated with photos, drawings and schematics.

UNIVERSITY TECHNOLOG ON LOUDSPEAKERS. Compiled by the Technical Service Department, University Loudspeakers, Inc., N.Y. 64 pages, soft cover, \$1.00.

If you are now in, or seriously considering the audio communications and sound distribution business, here's a book that covers the works. It is full of technical facts concerning driver units, directional reflex trumpets, heavy duty wide-angle reflex trumpets, radial reflex projectors, paging and talk-back speakers for general applications, super-power projectors, explosion-proof speakers, submergence-proof speakers, line matching transformers and other subjects. Architects' and Engineers' specifications appear at the end of each section.

BASIC PULSE CIRCUITS. By Richard Blitzer. Published by McGraw-Hill Book Co., Inc. 436 pages, hard cover. \$11.75.

This book discusses electronic pulse circuitry used in radar, computers, and guided missiles. Eleven chapters deal with Network Circuits, Pulse Amplifiers, Linear and Nonlinear Wave Shaping, Multivibrators, Time Base Oscillators and Generators, Binary and Octal Systems and Electronic Counters, Gates, and other pertinent subjects. Problems are posed at the end of each chapter. Photos, drawings and schematics illustrate the text.

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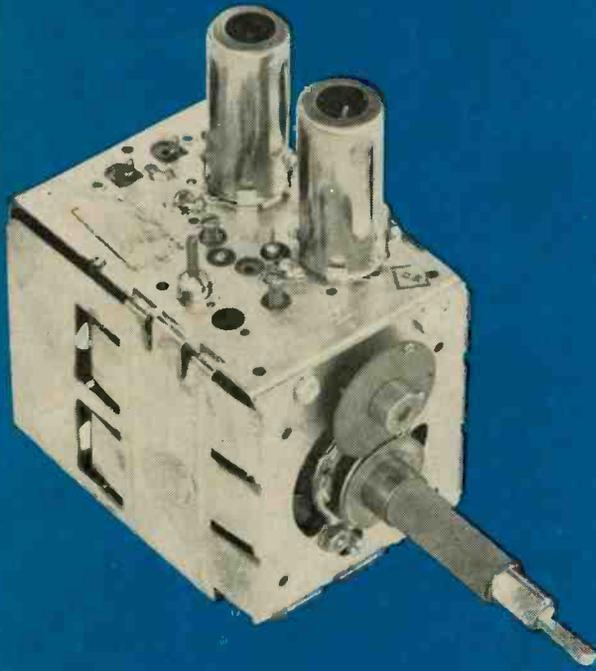
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$$\frac{1}{\sqrt{C}} = f = \frac{1}{C}$$

Choosing and Using AUDIO OSCILLATORS

The frequency of LC circuits varies inversely with the square root of C but the RC wien-bridge oscillator varies inversely with C

PART I

by Arthur M. Walters

Hewlett-Packard Co.

■ For years, the most commonly used audio oscillators have been dial-setting sine wave generators with a frequency range from less than 20 to more than 20,000 cps. Recently, smaller battery-powered solid-state units have become popular.

Wien-bridge RC Oscillator Circuits

Several circuit configurations have been used for audio oscillators, but the Wien-bridge RC oscillator circuit has largely superseded the others. Below the RF range these oscillators are less cumbersome than the LC types, and they are more stable and simpler to operate than the beat frequency types formerly used.

AUDIO OSCILLATORS

Continued

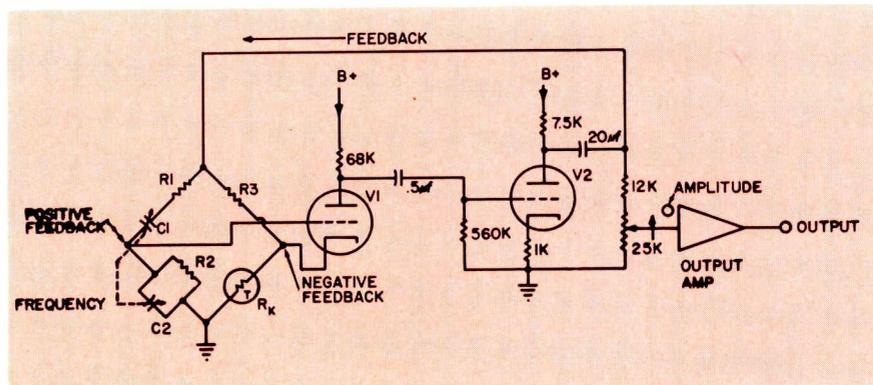


Fig. 1—Basic RC Wien-bridge oscillator circuit.

The basic RC Wien-bridge oscillator circuit, shown in Fig. 1, is a two-stage amplifier with both positive and negative feedback loops. To sustain oscillation, positive feedback, is applied through the frequency-selective network, R1 C1/R2 C2. The amplitude and phase shift responses of this simple network, with respect to its driving voltage, are shown in Chart I. The amplitude is maximum at the same frequency at which the phase shift is zero. Therefore oscillations are sustained at this frequency. When $R_1 = R_2$ and $C_1 = C_2$, the frequency of oscillation, $f_0 =$

$$\frac{1}{2\pi RC}$$

One reason why this circuit is preferred is now obvious: unlike LC circuits, where the frequency varies inversely with the square root of C, the frequency of the RC Wien-bridge oscillator simply varies inversely with C. Thus it allows greater frequency variation with the same capacitor. Leaving R constant, variation in frequency of more than 10-to-1 is obtainable with a single sweep of an air-tuned capacitor. Range switching is accomplished by switching resistors.

The negative feedback loop involves the other pair of bridge arms, R_N and R_K . Presence of a negative voltage feedback loop in the circuit has all of the effects usually associated with this type of feedback. Overall gain is reduced; waveform variations—produced by non-linearities in the amplifier—are reduced; and source impedance is lowered. The circuit

is a natural generator of low distortion sine waves. If the gain of the two-stage amplifier is high, R_K becomes a sensitive control of the oscillator's output voltage level.

Any oscillator's amplitude will increase until some form of limiting occurs. In crystal and LC oscillators, amplifier saturation is the usual limitation, so waveforms are naturally distorted. The amplitude limiting factor in the RC Wien-bridge oscillator, by contrast, is R_K , the cathode resistor in the negative feedback loop. By making it a varying element—with resistance increasing as the signal increases—it becomes an automatic leveling control. When the output signal tends to rise, R_K increases. Since it is the lower arm of the voltage divider which determines negative feedback, the feedback will increase and the output level will decrease. The converse will occur when signal level drops. Level, therefore, will strongly tend to remain constant.

In the practical circuit, the varying resistance element is simply the filament of an appropriately chosen incandescent light bulb. Its resistance, of course, increases as temperature increases. Operating well below the illuminating level, it responds slowly enough to avoid distorting the oscillations, but rapidly enough to stabilize average ac output level over a broad range of frequencies.

Variations in output across the largest part of each frequency range will typically be imperceptible on a conventional ac voltmeter and drop-

off at the range extremes will usually be under 1 db. Waveform distortion is typically ¼ percent. (Conservative manufacturers' specifications are somewhat worse than actual performance.) It is entirely practical to design an oscillator with this circuit so that hum and noise, in the worst case, do not exceed 0.05 percent (66 db below the sine wave output level). Total range depends mainly on the number of ranges provided. Even the simpler examples are designed to deliver from below 20 cps to about 40 kc.

The commonest uses for these more basic instruments are amplifier testing, testing modulator response, modulating other signal generators, synchronizing pulse generators and making loudspeaker resonance tests.

Push-Pull Types

With some refinement, the same basic circuit is used in instruments of lower and higher output frequency, and still lower distortion. A balanced-to-ground or push-pull circuit is used (Fig. 2). The output stage has 100 percent feedback to achieve an output source impedance approaching zero. Series resistors added in each balanced output leg then make the source impedance 600Ω which is optimum for most applications.

Resistive pads also make oscillator distortion and frequency independent of a load range from zero to open circuit. In the balanced push-pull circuit, no dc passes through the lamp—its current is

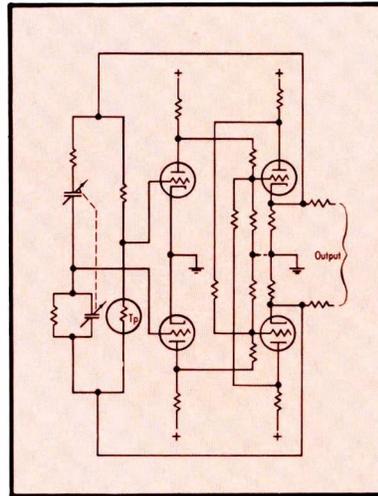
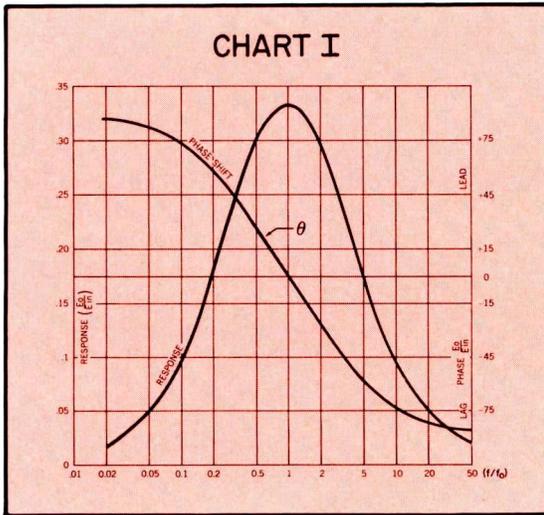


Fig. 2—Balanced-to-ground (push-pull) oscillator circuit.

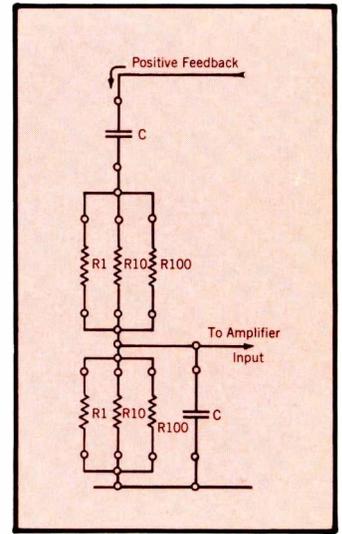


Fig. 3—Adding conductances is the same as adding resistances in parallel.

pure ac. Hence, lamp heating occurs at twice the oscillating frequency, allowing the circuit to operate to half the limiting frequency of the single-ended oscillator. Additionally, the capacitor's tuning rotors are near ground potential, which reduces leakage effects and permits longer RC time constants and lower frequencies.

Oscillators using the aforementioned circuit will typically deliver 10 v or more into balanced loads of 600 Ω or higher. Response flatness matches that of the single-ended oscillator, and waveform distortion is half or less. Ranges of 1 cps to 100 kc, or 5 cps to 600 kc are available. They serve all the applications of the simpler oscillators. In addition, their low-frequency capabilities find use in testing vibration systems, making stability measurements and checking electro-cardiograph, electroencephalograph, and geophysical equipment working in the subsonic range. Their extended high frequency output is useful in designing feedback audio amplifiers, and in testing sonar, ultrasonic, carrier telephone and video circuits. Special versions with extended ranges and bandwidth are used for interpolation and frequency measurements where frequencies must be known and re-settable with great accuracy.

Battery-powered Oscillators

Telephone or mobile equipment testing is simplified with lightweight, portable, battery-powered oscillators. Wide frequency range, good wave form, reasonable level, reliable output flatness and floating line operation, of course, will still be required.

For this purpose, as one would expect, solid-state circuitry is used. Current normally required for tubes and for the incandescent-bulb feedback stabilizer of traditional RC Wien-bridge circuits are incompatible with long term battery operation. But the same basic circuit is retained. RC frequency-selective networks are used in a bridge configuration to retain the advantages of wide-range tuning and freedom from balance or null control requirements. Negative feedback is used for waveform and level control.

To maintain constant output level, the portable oscillator uses a voltage comparison system which continuously compares the output voltage to a reference. This is fixed by a breakdown (zener) diode, and adjusts the amount of negative feedback accordingly. One unit has been designed in a six-pound package. Its frequency ranges from 5 cps to 560 kc. Output level is constant within ± 3 percent, waveform

distortion is typically under $\frac{1}{2}$ percent, with an output of $2\frac{1}{2}$ v (+10 dbm) or more into 600 Ω . Battery life of more than 300 hr should be expected, since solid-state circuitry makes possible a current drain of 7 ma or less. A nickel-cadmium battery supply with built-in ac charging system is often substituted for the usual mercury battery supply. Hum and noise is well below 0.05 percent.

Pushbutton Oscillator

Another variety of battery-powered oscillator, using the solid state version of the basic RC Wien-bridge circuit, is controlled by a pushbutton keyboard. Push buttons provide maximum simplicity and repeatability, in selecting discrete frequencies from 10 cps to 1 Mc. It is especially useful in production testing.

The pushbutton scheme with frequency selection is best seen by analyzing the oscillation equation

$$f_0 = \frac{1}{2\pi RC}$$

$$\text{since } \frac{1}{2\pi} = \frac{1}{6.28} = 0.159$$

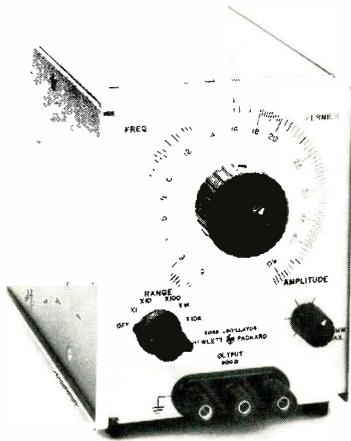
$$\text{you can say } f_0 = 0.159 \frac{1}{RC}$$

$$\text{Now conductance} = G = \frac{1}{R}$$

$$\text{so you can also say } f_0 = \frac{0.159}{C} G$$



This audio oscillator uses traditional RC Wien-bridge circuit.



Battery powered, solid-state circuitry audio oscillator.



Push-button, battery-powered, solid-state circuit oscillator provides 4500 discrete frequencies.

If you want to select a frequency to three significant digits, you can break the conductance term G down into

$$(N_u G_o + 0.1N_{10} G_o + 0.01N_{100} G_o \dots)$$

where G_o = a basic conductance to obtain the digit "1" and N_u = digit number in units column

N_{10} = digit number in tens column

N_{100} = digit number in hundreds column

$$f_o = \frac{0.159}{C} (N_u G_o + 0.1N_{10} G_o + 0.01N_{100} G_o)$$

To get any number then, you add conductances to a basic conductance. Adding conductances is the same as adding resistances in parallel (Fig. 3). Thus you use push buttons to parallel resistors which have conductances that are multiples of a basic conductance to get the whole numbers 2-3-4-5- etc. and of $\frac{1}{10}$ and $\frac{1}{100}$ of a basic conductance to get the second and third digits. A vernier variable resistor is included in the circuit to provide continuous tuning between switched steps.

To change ranges, fixed capacitors having a decade relationship of 10-100-1000, etc., are switched.

The oscillator has 4500 different switch-selected frequencies available over the range from 10 cps to 1 Mc. They can be selected with three digit resolution to 1 percent

accuracy and 0.02 percent resetability.

Low Distortion Oscillators

Many modern sound-transmission systems are designed to deliver very high fidelity. These include studio amplifying and mixing systems, recording amplifiers, FM broadcast facilities and high quality reproducing or playback equipment. Measurements of high precision are necessary. For these, more exotic test oscillators are made.

Where very low distortion levels are generated by the apparatus under test, even lower test signal distortion levels are required. It is possible to reduce the harmonic content of any waveform by passing it through a filter which attenuates all components above the fundamental. A typical basic single ended RC oscillator uses a tuned amplifier which automatically tracks with the oscillator. High selectivity of the tuned amplifier reduces harmonic voltage present in its input signal. Typical total harmonic content is much less than 0.1 percent.

Total harmonic distortion analysis is commonly made with an instrument which efficiently rejects the fundamental wave, then measures the relative total of the remaining components. Such a measurement will thus include any superimposed hum and noise. It is therefore necessary that these, too, be very low in the test signal, in relation to the fundamental signal. 100 db suppression of these components is achieved in the more elaborate instruments. This is equivalent to 1/1000 of 1 percent hum and noise content.

An instrument of this accuracy usually has a precision output attenuator to facilitate equipment measurements over a broad range of levels.

If the control is in front of an amplifier in the instrument, the unattenuated hum and noise generated by that amplifier will remain constant, no matter what signal level is selected. If level is lowered, relative hum and noise would increase. With the attenuator at the output, signal and noise change together at the same high ratio. ■

COLOR CONVERGENCE in 15 Minutes

by Al Nanni

Jackson Electrical Instrument Co.

■ TV service fundamentals are like those of any other profession and once you become a master of these fundamentals the job becomes easier and more profitable. Overlook this fact and you're a dead duck.

All you need to service color, in addition to the tools you already own for servicing black and white TV, is a degaussing coil having a heavy duty ON/OFF switch, a good quality mirror and a color bar/dot generator. The generator must be dependable, preferably portable, sharp in line and dot size.

Preliminary Procedure

While the generator and TV set are warming up, make necessary adjustments or measurements in high voltage, degauss the CRT and set up the purity. Do not make purity adjustments a complicated procedure. Make sure the room is darkened; if this is not possible use a piece of dark muslin cloth as a hood (like a photographer uses) to block out the light. These preliminary steps, if overlooked, will make the difference between fast, well-done convergence and failure.

Check center dots for static convergence, if too far off, converge them with magnets on the CRT neck, then proceed with purity

Some service technicians are confused regarding the simple steps involved in converging color TV sets. Many try to remember verbatim each step prescribed by all the different set manufacturers. If we stop and analyze these steps, we will find each manufacturer is actually saying the same thing in slightly varying terms.

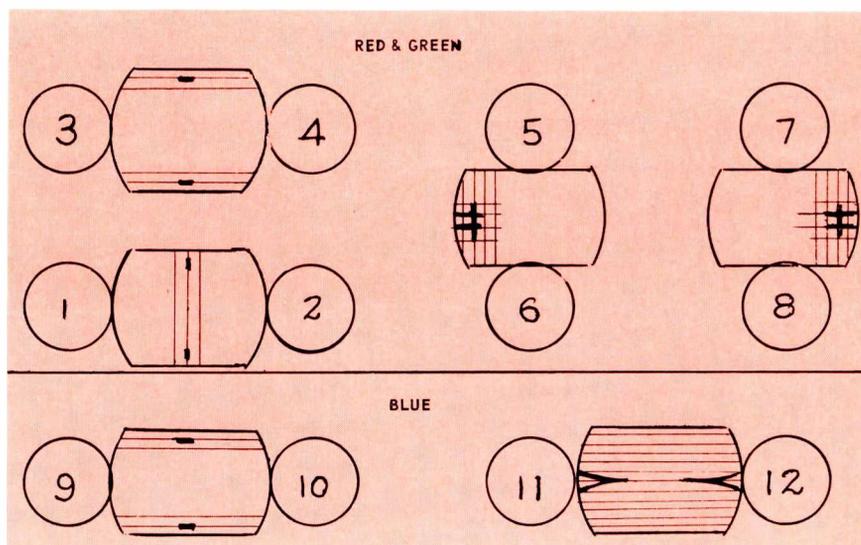
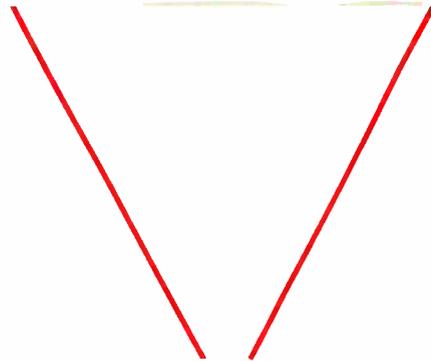


Fig. 1—Learn to concentrate only on the particular areas you are converging.



COLOR CONVERGENCE

Continued

check. Move the yoke fully forward or back, whichever you prefer. Adjust the purity rings on the CRT neck for best red center, move the yoke back or forward for good all around red color and check the blue and green raster. Next, set up black and white tracking and gray scale, most manufacturers set up procedure is the same but some may vary.

I have found that setting up background controls to give a gray appearance, with a very slight tint of green, produces a better black and white picture and much better skin tones. This also allows for better tint control. I have used this procedure for two years and it has proven most successful. This will not track properly, but it will not create any ill effects.

Final Steps

The next steps are final and are quite important as to sequence. Before we go into these steps, an important word of advice: learn to

concentrate only on the particular areas you are converging. (Fig. 1) If you take your eyes away, you will see things that you will subconsciously try to correct. This is the quickest way to lose time and get into trouble. Using the different patterns will have a tendency to help you concentrate and also keep your eyes rested.

Set up your TV by adjusting the fine tuning. Some generators have a 4.5 Mc sound signal to help find the best setting. Cut contrast completely off then turn the control up about 10 percent. Cut brightness to minimum. If you have to use more brightness and contrast, it will overdrive the phosphor and create large dots and wide lines and display a tendency to hide distortions of lines and dots. Some generators do this on purpose to hide double lines that exist in generators because of the frequencies used to develop the different patterns. These double lines don't create problems. In fact, I've found them most helpful, es-

pecially in focusing. They also allow for more critical convergence, resulting in nearer perfect convergence over 85 to 90 percent of the CRT.

How To Do It

Step one: Set center convergence first with dots as accurately as possible with all three guns. When this is completed, cut off blue gun and leave it off for the following steps.

Step two: Adjust vertical convergence at top and bottom with vertical line pattern. After completion of this step, check center convergence again with dots (maintaining center convergence is extremely important).

Step three: Do horizontal convergence at top and bottom with horizontal line pattern, then again check center convergence.

Step four: Switch to crosshatch and do left side, horizontal and vertical convergence, then right side for same.

Caution: Do not linger on any one particular sequence too long. It is better to do it quickly, then go over the steps again if necessary.

Now turn on blue gun if red and green are satisfactorily converged. Use dots and converge center. Then adjust top and bottom, left and right sides.

Practice this sequence, become thoroughly familiar with it. Memorize the convergence board as a particular group of twelve controls. Work with them in pairs, you will find this will become second nature to you and will be as easy as driving your automobile. ■

WARNING!

Reports indicate that ELECTRONIC TECHNICIAN is being purloined, clipped and robbed of its goodies by a few non-subscribers.

Watch for your NOVEMBER ISSUE! It will be stuffed with delectable details on 1965 TV-set circuitry. Non-subscribers will find it even more difficult to restrain their petty-larcenous appetites.

And when your ET reading is interrupted, don't just lay it down. LOCK IT IN THE SAFE!

Why You Need a TRANSISTOR TESTER

*Understand the basic principles
of semiconductor testing*

by Gene Pudil and Chet Stephens

Simpson Electric Co.
Project Engineers

■ TV-radio technicians today are faced with the task of repairing electronic equipment employing transistors instead of electron tubes. To the untrained and ill-equipped technician this circuitry, at times, presents insurmountable problems. But the problem is greatly simplified for those who have studied basic transistor circuitry and acquired necessary equipment for testing semiconductor devices.

The transistor, under normal conditions, has an operating lifetime that can be measured in tens of years whereas the electron tube is frequently the first circuit element to be suspected in event of circuit failure. Transistor usage will continue to grow as semiconductor manufacturing techniques improve and circuit designers utilize these improvements.

It is extremely important, then, for service technicians to know as much about semiconductor devices as they do about electron tubes. Technicians are primarily concerned with the performance of semiconductor devices in specific circuits.

To determine the quality of a semiconductor, some knowledge of what tests to perform is necessary. Transistors must meet certain specifications established by the manufacturer. A number of test circuits are used to evaluate these basic requirements. And transistor testers embodying these principles are

marketed by a number of test equipment manufacturers.

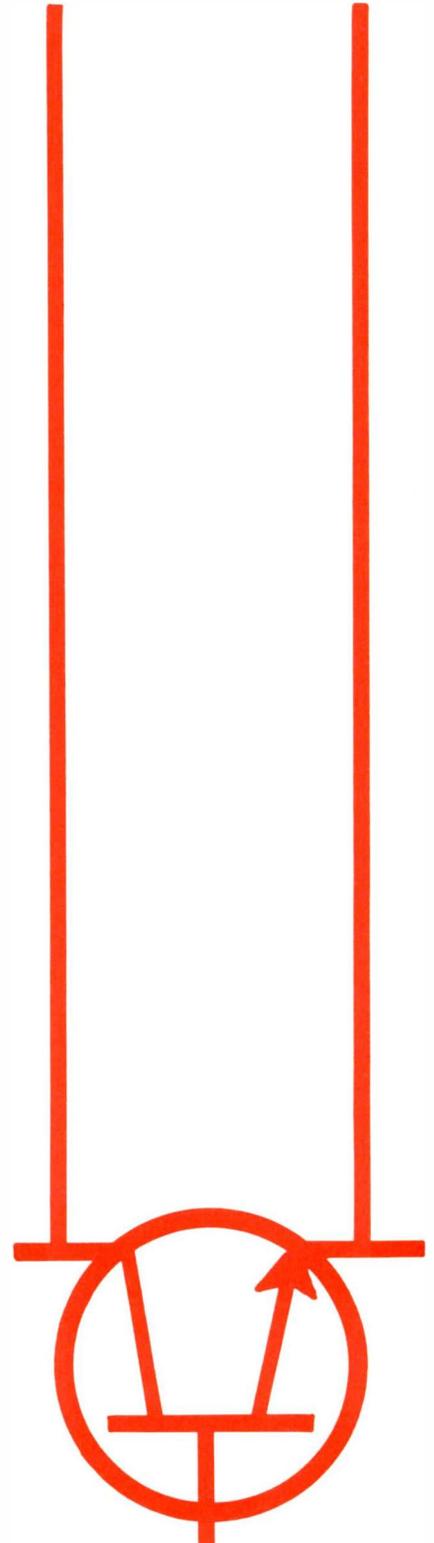
Beta Measurement

Since the transistor is a current control device, the value of the common-emitter current gain (represented by h_{FE} or sometimes called dc Beta) is one of the most important of the transistor parameters. It is defined as the dc collector current, I_C , divided by the dc base current, I_B , or $h_{FE} = I_C/I_B$, and is usually specified at a particular value of collector current and collector to emitter voltage, V_{CE} .

The test circuit shown in Fig. 1 can be used to make a qualitative measurement of h_{FE} . As an example, let us test a transistor that has a minimum value for h_{FE} of 20 at $I_C = 10$ ma and $V_{CE} = 1$ v; adjust I_B for $I_B = I_C/h_{FE} = 10$ ma/20 or 500 microamps, adjust I_C to its specified value or 10 ma. If V_{CE} as read on the voltmeter is less than 1 v, then h_{FE} is greater than 20. If V_{CE} is greater than 1 v, h_{FE} is less than 20 and the transistor will not perform adequately.

Collector-to-Emitter Voltage Measurement

Another test that may be performed easily is the measurement of collector-to-emitter voltage while biased in the collector saturation region. It is represented as V_{CE} (sat) and is specified at a given





TRANSISTOR TESTER Continued

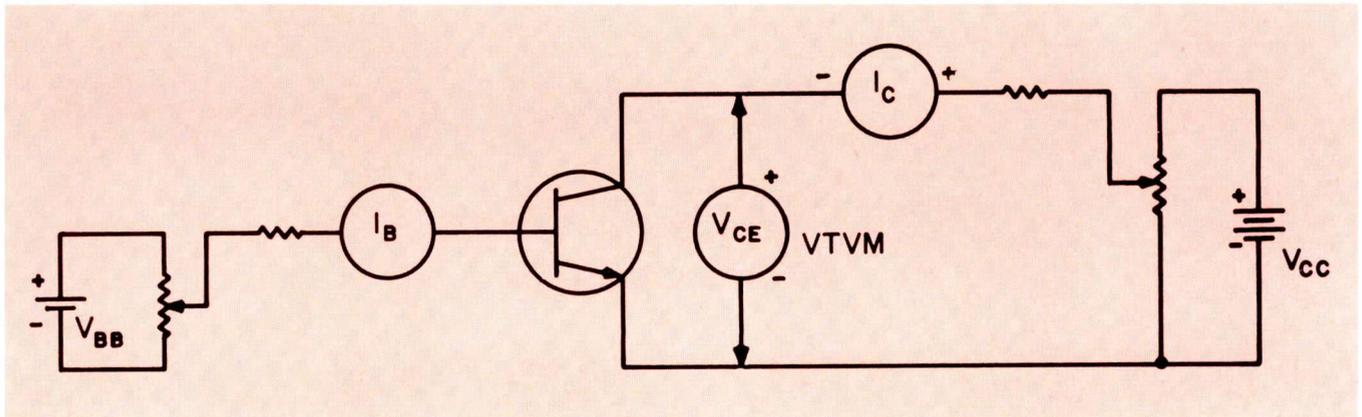


Fig. 1—Measuring h_{FE} of NPN transistor. For PNP transistors, reverse polarity of power sources and meters.

base current and collector current. The same test circuit used to measure h_{FE} (Fig. 1) can also be used to measure V_{CE} (sat). Adjust I_B and I_C to their specified values. If V_{CE} as read on the voltmeter is greater than the specified value of V_{CE} (sat), it indicates a deteriorating transistor and the device should be replaced.

Leakage Currents

Leakage currents are unwanted features inherent in all semiconductor devices and plague the circuit designer. These currents are both temperature and voltage dependent and if not compensated for can cause serious instability problems. Circuits to test for those leakage currents most often included in transistor specification sheets can be easily utilized.

The circuit necessary to measure collector to base current (I_{CBO}) with the emitter circuit open, is shown in Fig. 2A. Since this current is temperature and voltage dependent, it is specified for a certain ambient temperature (usually room temperature) and a certain collector to base voltage, V_{CB} . The voltage is applied so that the collector-base junction is reverse biased—collector negative with respect to the base for a PNP transistor and collector positive with respect to the base

for a NPN transistor—and then adjusted until V_{CB} is the specified voltage. I_{CBO} is read directly from the meter; it should be equal to or less than the value specified on the specification sheet.

Emitter to Base Current

The test circuit necessary to measure the emitter to base current (I_{EBO}) with the collector circuit open, is shown in Fig. 2B. This current is also temperature and voltage dependent so the emitter to base voltage, V_{EB} , and ambient temperature must be certain values. The voltage is applied so that the emitter-base junction is reverse biased—emitter negative with respect to the base for a PNP transistor and vice-versa for a NPN transistor—and then adjusted until V_{EB} is the specified voltage. Again, the test current is read directly on the meter and should be equal to or less than the specification sheet value.

Semiconductor devices with excessive leakage currents should be replaced; this is an indication of deterioration and depending on the application various circuit malfunctions could result.

Ohmmeter Tests

Another simple test used as a qualitative measure to determine

the worth of a transistor can be performed with an ohmmeter whose output power is limited. An individual measurement of the front and back resistances of the emitter-base and collector-base junctions will reveal shorted or open junctions. For this test it is necessary to know the polarity of the ohmmeter being used. How to connect the ohmmeter to measure the forward resistance of the emitter-base junction on a NPN transistor is shown in Fig. 3A. The connection for measuring the back resistance of the emitter-base junction on the same transistor is shown in Fig. 3B. Connections for measuring the forward and back resistances of the collector-base junction are shown in Fig. 3C and 3D.

For a PNP transistor the polarity of the test leads from the ohmmeter would be reversed in each case—that is, to measure the forward resistance of the emitter-base junction on a PNP transistor, the positive lead will be connected to the emitter and the negative lead to the base. When measuring the forward resistances the ohmmeter should be set to the low ohms range and a relatively small resistance measured. When measuring the back resistances the ohmmeter should be set to the high ohms range and a relatively high resistance measured.

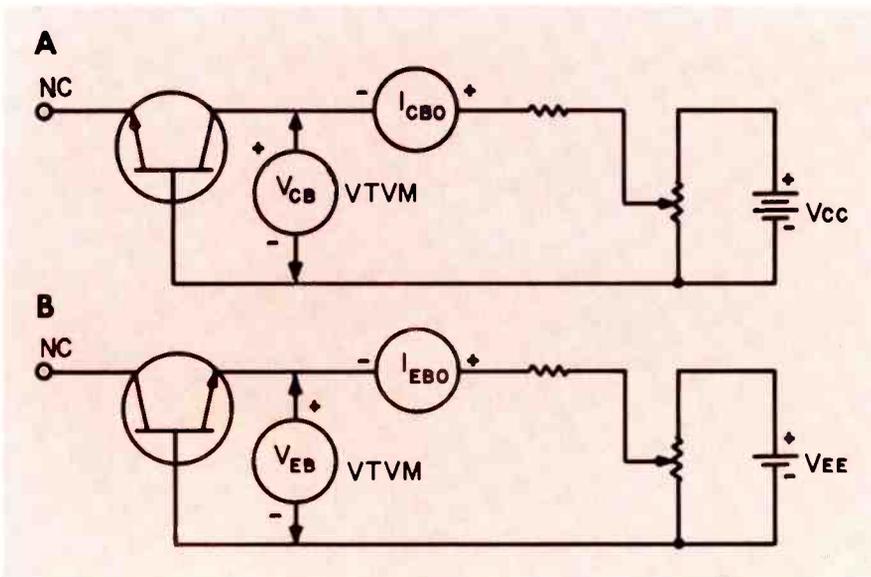


Fig. 2 (A)—Measuring I_{CBO} for NPN transistor. (B)—Measuring I_{EBO} for NPN transistor.

No rule of thumb can be made concerning the resistance values one should expect when making these tests since the values will vary greatly between germanium and silicon transistors. They also vary somewhat between different types of germanium or silicon transistors. However, it is a good test to determine shorted junctions (both forward and back resistance measurements low or zero), or open junctions (both forward and back resistance high or infinite). With a little practice some feeling for the resistance to be expected can be gained.

A note of caution must be injected here. As mentioned previously the output power of the ohmmeter must be limited so as not to exceed the parameters of the device under test. A conventional VOM is a dangerous instrument to use for checking transistors. When used on the low ohms range, some instruments are capable of supplying upwards of 75 milliwatts of power and 200 ma of current. This power applied to the base of most small signal transistors is enough of an overload to permanently damage the transistor.

Happily though, test instrument manufacturers have acceded to the needs of those who must test semiconductor circuits and there are

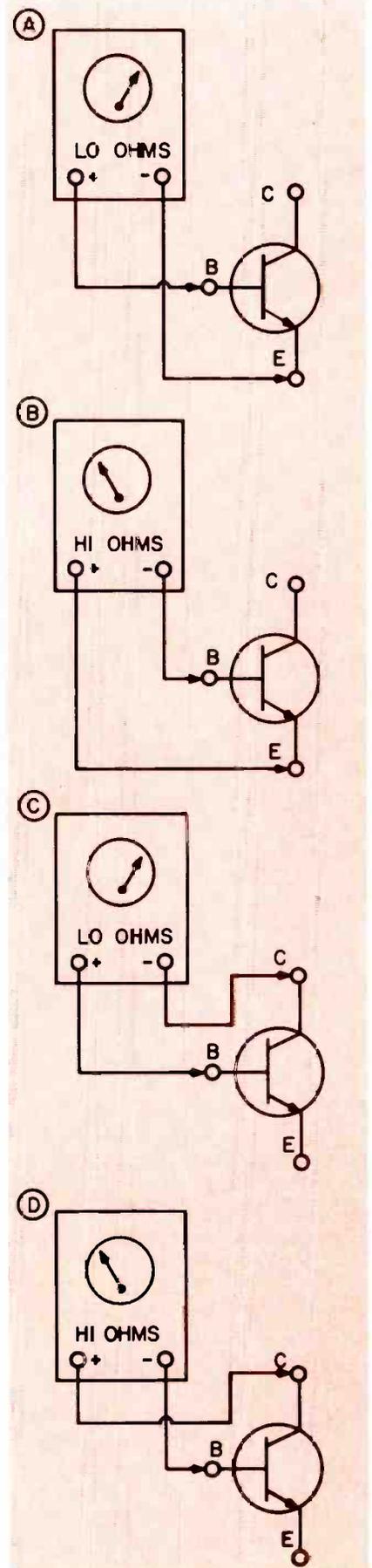
available VOM's with low power ohmmeter circuits. Usually the lowest or lower two ohmmeter ranges are low power circuits while the higher ranges use conventional ohmmeter circuits.

A wide range of transistor testers is available in all price ranges, from low priced testers whose functions are limited, to testers selling for several hundred dollars or more. Technicians normally choose one of the medium priced testers, preferably an in-circuit type. An in-circuit tester enables the technician to test the transistor while it is still connected in the circuit. Because most transistors used today are soldered in the circuit, a tester of this type will save valuable time.

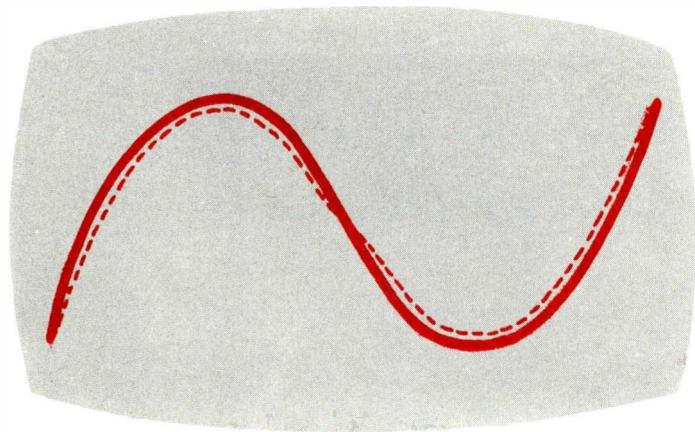
Transistors are used today in all types of consumer electronic products such as Hi Fi, TV, auto ignition systems and many others.

Technicians should consider the transistor tester as important as the electron tube tester. They should learn the fundamental operation of the tester, which will help them better understand transistors and transistor circuitry. ■

Fig. 3—Forward and back resistance measurements of individual P-N junctions. (A)—Circuit to measure e-b forward resistance. (B)—Circuit to measure e-b back resistance. (C)—Circuit to measure c-b forward resistance. (D)—Circuit to measure c-b back resistance.



Saving 'Phase'



Selecting the proper instrument to use
is a valuable key to
solving every service problem

by Don Multerer

■ "Rural Radio and TV, Tom speaking. Oh! Hello, Mrs. Jonas. What's the problem? Not again! Did you try the adjustment we showed you last time? OK, I'll send someone out right away, Mrs. Jonas. That's right. OK, bye.

"Hey, Phil, shoot out to Mrs. Jonas's and pick up her color set."

"What's the trouble this time, Tom?"

"I don't know. She says it's the same thing as last time. Anyway, when you pick it up, tell her we'll bring it back soon, probably this evening. She was rather peeved. And while you're gone, I'll get the gear set up on the bench so we can start as soon as you get back."

"Good idea, Tom. And this time I'll stick around. I want to see that new analyzer in action that you keep raving about."

"You bet, Phil. See you later."

• • •
"Well, that takes care of the bench and tools," Tom said to himself. "Now for that color analyzer. This little baby could save the day."

"Say, Tom," Phil's shout interrupted Tom's thoughts, "can you give me a hand with this set?"

"Sure thing, Phil. Let's put her on the bench here. I've got everything set up."

"Is this the new analyzer, Tom?"

"That's right, Phil. Sure is a honey, isn't it?"

"Yes, It's not as complicated as I pictured it. Everything is pretty simple. Tuning, IF frequencies, audio, video, even sync frequencies. Say, this pattern switch thing is pretty cute, too."

"OK, Phil, slow down and let's put her to work if we are to keep Mrs. Jonas a happy customer. Let's see, the last time we were out there, the trouble was transmission and not the receiver."

"That's right, Tom. The color picture had stripes in it as if the 3.58 Mc oscillator was not set properly. Then, when I connected our little generator to the set, the color bars came in as nice as you please."

"Yes, but it sure took some talking to get Mrs. Jonas to understand that the fault was caused by a bad head on the station's video tape recorder and not by her receiver."

"Yes, but this time she claims the colors fade after a while, and even change; mostly to blue, according to her. But, of course, when I showed up, the set was working fine."

"Well, we'll just have to give it a thorough check-up this time. Let's connect the generator and feed a

color bar signal in and see how she looks . . . Not bad. Even the purity is good."

"Just the way it was at Mrs. Jonas'. Move it to this side a bit, Tom. I can't see over your shoulder too well. Hey! the red and green bars jumped out and in for a second. Mrs. Jonas was right."

"Yes, I guess we're going to have to dig in. You get the schematic while I pull the chassis from the cabinet," Tom directed.

"Apparently, the trouble is in or about the demodulators. At least that's the way I figure it," Phil said.

"That's my basic assumption too, Phil. We're going to need the wide-band scope on this one. I think we can save time by injecting a composite signal before the demodulators and take some wave form measurements as we move in. The schematic calls for 2-v P-P at the input of the first chroma bandpass amplifier. Let's see, that's right after the video detector. I'll connect it right here."

"Oops! You've lost the sync, Tom."

"Oh, I forgot. This is a Zenith chassis. They take the sync off before the video detector. That's OK, we'll just take a sync signal right

With Your Color TV Customers

off this jack on the generator and adjust for proper polarity. How's that, Phil?"

"It's OK now."

"Good. Let's check a few of the waveforms. With the 2-v P-P input into the first chroma bandpass amplifier, we should get 1-v P-P on the grid after the 4.5 Mc trap."

"On the nose, Tom."

"OK, what do we have on the grid of the second chroma bandpass amplifier?"

"The scope reads 4-v P-P."

"And at the output of the second amp?"

"8-v P-P, Tom."

"Seems OK. Try tapping the second amp, Phil. I'll watch the scope."

"Anything?" Phil asked.

"No. I thought a possible intermittent in the tube or tube socket might show up since we're scoping off the feed to the B-Y demodulator."

"Try the R-Y demodulator feed, Tom."

"Hmmm. We're about half a volt low," Tom said.

"What about the blanking input?"

"Checks out, Phil. Are you thinking what I'm thinking?"

"Right with you, fella. Wiggle it. That's it, Tom. The L4 coil is intermittent at the top or near enough to it to limit R-Y signal?"

"Sure, Phil, and even if it is making contact, the contact still offers resistance that affects the reactance of the coil, so that a weak color signal will tend to affect the phase and change the color of the picture. Then a stronger signal is fed from a strong local station or our generator, and the small change in L4 reactance isn't as effective as with the weaker signal and she snaps

back to the proper or near proper phase."

• • •

"I guess we'll have to run a demodulator phasing check now that the coil is replaced."

"We had better, Phil. Mrs. Jonas is a good customer. I want to be sure she stays that way."

"I have never done this before, Tom. What's the general procedure?"

"Well, we'll have to interrupt the guns and check the signal at the grids for correct phase. All we need is this adaptor socket which fits right on the base of the CRT. The switches on the front panel of the analyzer indicate which gun is being interrupted. There are pins on the adapter which make it easy to measure grid bias and cathode voltage without having to look for the connections because they are conveniently labeled."

"That's great, Tom. This analyzer is sure saving us time."

"First we'll interrupt the red and green guns and take a look at the signal on the red grid," Tom said.

"It appears to be a sine wave with notches in it, Tom."

"That's what we want, Phil. Now the sixth notch from the left should be crossing the O axis for improper phasing of the R-Y demodulator."

"It's a little off, Tom."

"All we have to do is adjust the burst amplifier slugs so it's right on."

"OK. Now, next step."

"We return the blue gun to normal and switch the red and green gun to interrupt. Now we connect the scope to the blue grid and see if the third and ninth bars pass through the O axis for the B-Y demodulator check."

"Looks OK, Tom."

"Last step is to check the green grid so that the first and seventh bars of the color bar pattern pass through the O axis of the notched sine wave for proper phasing of the G-Y demodulator."

"Well, does that take care of the phasing adjustments, Tom?"

"Yes, if the G-Y pattern hadn't come in we would have to go back through the procedure again until it did come in. With the composite signal feeding the chroma circuits the color bars come in nice and sharp. Let's check and see how the bars look with the RF lead back on and the composite signal return to zero on the generator."

"The signal is weak, Tom; faded like Mrs. Jonas mentioned."

"That's right, Phil, but the signal was stronger when we started. Did you check the tubes in the tuner and IF strip?"

"They all checked out."

"We'll let the generator find the trouble then. We'll bypass the tuner and inject the same modulated signal on the first IF grid and switch the calibrated IF switch to first IF."

"No difference on the first IF grid. Let's try the second IF. Oops! Have to bring in the sync pulse again. The sync is tapped off at the first IF."

"Just for curiosity, Phil, check this tube again."

"Emission checks OK."

"The Grid Leakage test is what I'm interested in."

"You're right, Tom. The tube checks up in the bad area. But it didn't before when I checked these tubes. They were all good."

"Sure, Phil. But remember you checked the tubes cold. The tube

Continued on page 79

Know the fundamental requirements of an effective oscilloscope for industrial maintenance and repair

SELECTING A SCOPE for

by John Potter Shields

■ Oscilloscopes, long respected for the important role played in research and production, now serve electronics technicians throughout industry.

Before you can intelligently evaluate a particular scope as an industrial maintenance and troubleshooting tool, it is necessary to know just what is expected of the instrument. A scope intended for radio and TV servicing is generally inadequate for most industrial electronics jobs. On the other hand, a very sophisticated scope intended primarily for R&D work will be impractical because of its complexity and consequent high cost. What then, is the best choice? Let's examine some of the features that an industrial electronics type scope should have.

Vertical Amplifier

You should pay particular attention to the vertical deflection amplifier.

Vertical amplifier response of most TV - radio "service type" scopes, and some R&D scopes for that matter, have a low frequency limit of approximately 10 cps. For maximum usefulness, your industrial scope should have excellent frequency response down to 1 or 2 cps—preferably to dc. This is understandable because the signals developed by a large number of industrial electronic devices are extremely low frequency and slowly varying dc.

Consider for example, the output

signals from vibration pickups, flow detectors, low frequency choppers, etc. Also, while the signal frequency being observed is fairly high, it may be superimposed on another very slowly varying signal (perhaps a reference), which must also be observed for proper interpretation.

The high frequency response limit of the industrial scope's vertical amplifier should be at least 500 kc, preferably extending to several Mc if fairly sophisticated industrial equipment is to be maintained. With a few specialized exceptions, just about all quality scopes contain vertical amplifiers with adequate frequency response.

Vertical amplifier sensitivity is another major consideration. Signal levels of many types of industrial electronic equipment are extremely low—down in the low mv region. To do an adequate job here, the vertical amplifier must be capable of providing sufficient amplification so that input signals will provide adequate trace size.

It is wise to select a scope equipped with a full push-pull vertical amplifier. This permits the application of balanced (with respect to ground) input signals with considerable reduction in stray field interference from the leads connecting the test unit to the scope. You can see how this reduction in stray field pickup is possible by referring to Fig. 1. A simplified vertical amplifier input stage with a balanced signal applied to its input, is shown in Fig. 1A. Notice

that the signal appearing at the grid of V1 is 180 deg out of phase with the signal appearing at V2's grid. This is typical of any balanced, (push-pull) signal. V1 and V2 amplify their respective signals, resulting in an amplified replica of the input signal appearing (inverted) in their respective plate circuits.

The same simplified vertical amplifier with an unbalanced input signal applied to the grids (this signal could be induced in the connecting leads by stray fields), is shown in Fig. 1B. These unwanted signals cancel out in the plate circuits of V1 and V2 because as the plate current of V1 varies in accordance with the input signal, so does V2's—at the same rate. There is no difference in potential between the plates of V1 and V2 as shown in Fig. 1B but in Fig. 1A a voltage difference does exist.

This "common mode rejection" operation, as it is sometimes called, is useful in amplifying low level signals originating in areas of troublesome magnetic or electrostatic fields.

The Horizontal Amplifier

The main role of the oscilloscope's horizontal amplifier is to boost the signal from the sweep generator to adequately deflect the cathode ray tube's electron beam. The frequency response of the horizontal amplifier is determined primarily by the range of sweep frequencies produced by the sweep generator. If the sweep generator

Industrial Work

has a frequency range from 20 cps to 50 kc, then the horizontal amplifier must have a corresponding frequency response.

Almost all scopes have provisions for feeding an external signal into the horizontal amplifier. This is useful when it is desired to feed an external sweep signal, such as a sine wave, into the scope. As a general "rule of thumb," the horizontal amplifier's frequency response must extend at least five times beyond the fundamental frequency of the scope's sawtooth sweep frequency on both ends of the spectrum. This bandwidth is necessary for minimum distortion of the sawtooth sweep signal.

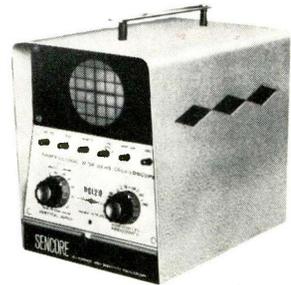
The Sweep Section

The purpose of the sweep generator is to move the electron beam across the face of the scope's cathode ray tube. The frequency range of the sweep generator determines frequencies that can be displayed by the scope. For example, if the sweep generator has a top frequency of 100 kc, then the scope will display one complete cycle of a 100 kc input signal, or 10 complete cycles of a 1 Mc input signal. (The frequency response of the vertical amplifier will have to at least equal the frequency range covered by the sweep generator.)

The scope chosen for industrial servicing should have excellent low frequency response, preferably down to dc. This would indicate that the sweep generator should be



Heathkit Model 10-10 dc oscilloscope.



Sencore Model PS 120 oscilloscope.



Eico Model 460 dc oscilloscope.

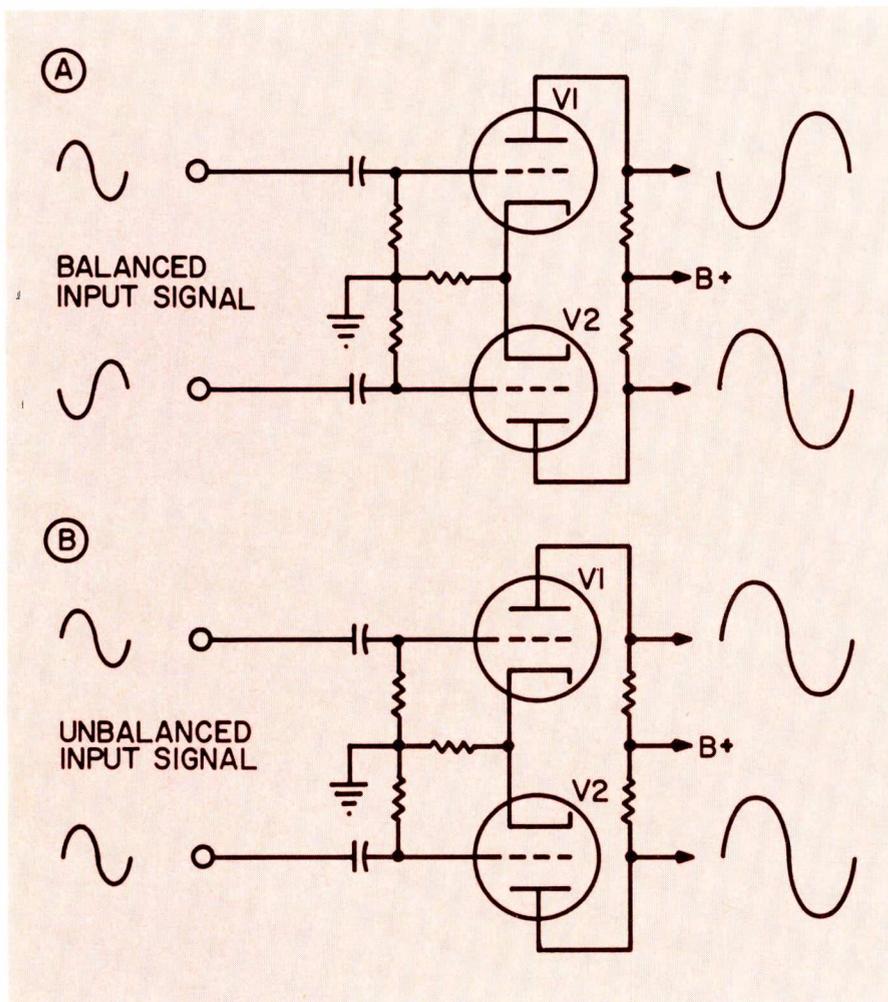


Fig. 1 (A)—Simplified schematic of a push pull vertical amplifier input stage with balanced signal applied. (B)—Same stage with an unbalanced signal applied.

capable of producing correspondingly low frequencies—extending down to one cps, or even less. To accomplish this low frequency sweep rate with a minimum of switching, some scopes are provided with “external capacitor” terminals which permit the connection of an external capacitor into the sweep generator. Addition of the proper capacitor will allow the sweep rate to be slowed down to a fraction of one cps.

Sweep Synchronization

All scopes provide a method for synchronizing the sweep generator with vertical input signals so that a stationary trace appears on the CRT.

Synchronization is generally accomplished by taking a portion of the signal appearing in the vertical amplifier and feeding it to the sweep

generator to “lock” it in step with the vertical input signal. Most scopes also provide a method of synchronizing the sweep generator with either the 60 cps power line or an external input other than the vertical input signal.

Another method of synchronization, known as “triggered sweep,” is available in more sophisticated scopes. With this type of sync, the beam of electrons remains stationary at the left edge of the screen until a “trigger pulse” is applied to the sawtooth oscillator. The beam travels across the face of the CRT from left to right and returns to its original position. The beam remains at the left side until another pulse is applied.

Triggered sweep is advantageous when “non-recurrent” signals are to be observed. A non-recurrent signal is a signal of random nature,

viewed in a scope equipped with “continuous” sweep.

Mechanical Considerations

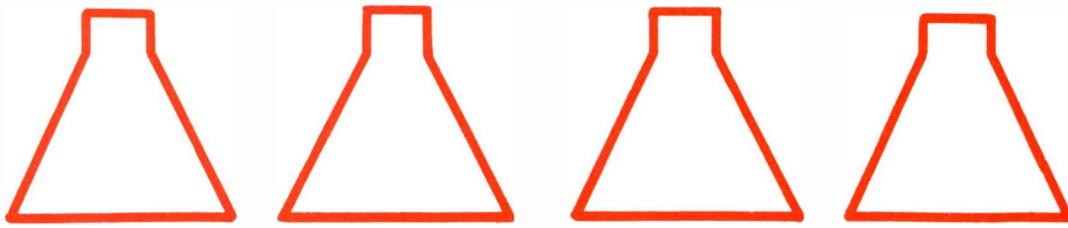
Mechanical, as well as electrical characteristics, determine the adaptability of a particular scope to industrial electronics. The scope selected should be relatively portable. It should be either light enough to be carried by one man, or in the case of a larger unit, a cart should be provided for easy portability.

Logical grouping of a scope’s operating controls can add much to its ease of use. For example, centering, focus, and brightness controls should be located in one specific area, controls associated with the vertical and horizontal amplifiers located in their own respective areas, etc.

Cost

It goes without saying that the cost of the scope is a consideration in its selection. Although the unit must be capable of performing the necessary functions outlined earlier, it is poor economy to purchase an overly sophisticated scope with features which will seldom be used.

Along these lines, it is well to consider the possibility of assembling an oscilloscope kit. A number of kit-type scopes are available from various sources. ■

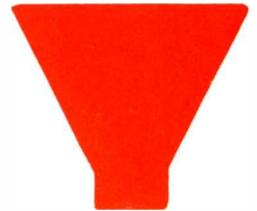
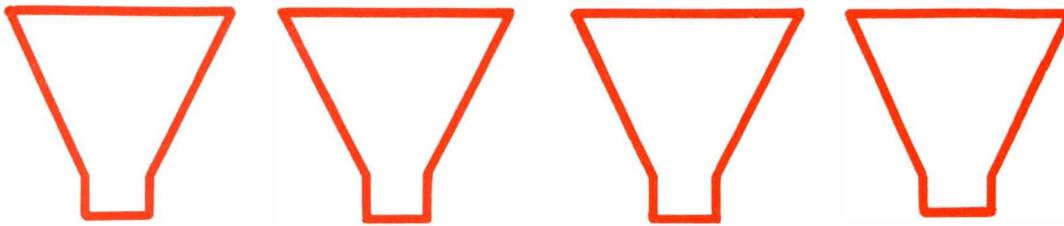


INSTALLING AUDIO DISTRIBUTION SYSTEMS



PART II

(Conclusion)



Phasing and impedance matching are often overlooked but play an important role

by Chuck Overstreet
University Loudspeakers

■ When two or more loudspeakers are used in a system, proper phasing becomes a consideration. If the speaker voice coils are connected "out-of-phase" each speaker will tend to cancel the sound of the other and create a dead sound area between them. Phasing is particularly important when loudspeakers face in the same direction or toward one another. To insure proper phasing, connections to all speakers must be identical. That is, voice coils, matching transformers, etc., must all be connected so that all voice coils in the system move in the same direction.

If two driver units are connected to a single horn, for example, and wired out-of-phase it can easily be seen that the sound from one unit would almost completely cancel sound from the other. To phase the units correctly, like terminals must be connected together for parallel speaker operation and un-

like terminals must be connected together for series speaker connections.

When two speakers are located some distance apart, phasing problems may be insignificant. But as speakers are brought nearer each other, or turned so their axis angle is less, it becomes more important. Sometimes speakers are purposely driven out-of-phase in an attempt to kill reverberation effects. In this case, proper phasing can only be determined by experimentation.

Paging Speakers

The SOUND SYSTEM DESIGN CHART found in part one of this series should be the determining factor in selecting an amplifier. But you will remember that it was necessary to make a choice of relative speaker efficiency—either high, medium or low. Actually, the type of speaker you select is determined by the type of system

you are striving for or must use because of environmental or economic considerations.

A prime factor in selecting a loudspeaker type is whether the system is to be high or low level. Each speaker in a high level system is required to have a relatively high sound level. High level systems are those that use a few speakers but must blast through very high noise levels.

High level systems might be indicated where no fixed points of reception are foreseen, where mounting facilities are limited or where the speakers must be mounted some distance from the desired reception points. Speakers for high level output systems are generally the trumpet driver types. It should be kept in mind, however, that when high level speakers are implied, people nearest the speakers may experience discomfort. Of course, if the ambient noise level is high, this "brute

Audio Distribution Systems

Continued

force" method does not create such problems since public address sound is normally just above the noise level.

Low level speaker systems may also be used in high level noise areas by simply increasing the total number of speakers and driving them only at very moderate power levels.

Speakers can be placed in the conventional manner—if noise conditions are not too bad—and the distance from the speaker to the floor, or to the general listening

area in front of the speaker, can be used as the determinant. If the area is noisy, speakers may be placed at discrete locations and by supplying a different sound output to each speaker, depending on the requirements for that area. That it does contribute much to the overall ambient noise level is the biggest advantage of the low level speaker system.

Speaker Quantity and Talk-Back

The number of speakers required is a matter of angular coverage

consistent with the dispersion ratings of the speakers selected. The amplifier power selected on the DESIGN CHART is the total power based on a sound pressure 5 db above the ambient noise level. As the power is divided among the number of speakers required, the speaker power handling capacities may be determined. Make sure you allow for enough reserve speaker and amplifier power handling capacity to handle unforeseen operating conditions.

In many installations where intercom facilities are incorporated, economy can be achieved by employing high efficiency speakers as microphones. The pickup angle of most speakers is about the same as their dispersion angle. Fidelity is not good but voice communications can be easily understood and this does not normally cause concern when used with intercom systems.

Controlling Loudspeaker Volume

Since it is desirable in many installations to have variable volume for individual loudspeakers, a constant impedance attenuator should be used.

As you might assume from their name, constant impedance controls do not change their input impedance as the control is varied. Hence, changing the volume level of any given speaker does not change the level of others in the same system.

Constant impedance controls differ from conventional volume controls: they may have as many as three ganged elements. The most commonly used controls for this purpose are the unbalanced "T" pad and the "L" pad. Both are shown in Fig. 1. Although the "L" pad is not exactly a constant impedance type, the small variations in it make it suitable for most applications. The expense of the "T" pad is rarely justified in regular PA installations.

The power handling capacity of the pots used in these pads is particularly important since the power not used by the speaker must be dissipated by the control. When a control is chosen for a pad its wattage should be equal to the power handling capacity of the

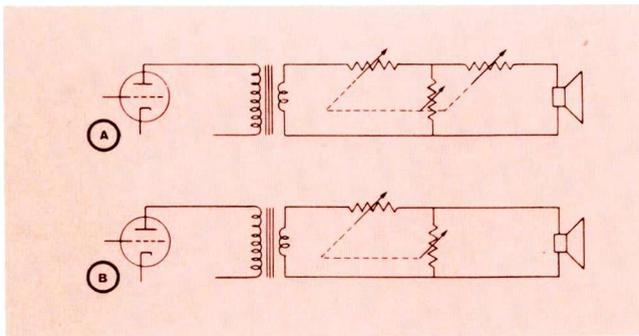


Fig. 1 (A)—Unbalanced "T" pad. (B)—The "L" type pad.

Table I

Room Volume in Cubic Feet	Acceptable Limits in Seconds	
	Half Audience	Full Audience
10,000	0.9 - 1.2	0.6 - 0.8
25,000	1.0 - 1.3	0.8 - 1.1
50,000	1.2 - 1.5	0.9 - 1.3
100,000	1.5 - 1.8	1.2 - 1.5
200,000	1.8 - 2.0	1.4 - 1.7
400,000	2.1 - 2.3	1.7 - 2.0
600,000	2.3 - 2.6	1.8 - 2.2
800,000	2.5 - 2.8	1.9 - 2.3
1,000,000	2.6 - 2.9	2.1 - 2.5

Calculation of Reverberation Time:

$$\text{Time in Sec.} = \frac{0.5 \times \text{volume of room in cu ft}}{\text{Total absorption}^*}$$

*Where total absorption is obtained by adding up all the individual areas, each area multiplied by its own absorption coefficient.

speaker or the matching transformer which it drives. The control's impedance must be the same as the speaker and transformer as well.

In an emergency, a simple series potentiometer may be used to control the volume. If this is necessary, you should choose a ten watt unit with a value from 15 to 50 Ω . It is also possible to reduce speaker volume by creating a mismatch between the speaker and the driver transformer by connecting the speaker to the wrong terminals. Experimentation is the only way to find the proper terminals using this method.

Reverberation

The total sound arriving at any one point in an auditorium, ballroom or studio, etc., is composed of the original sound wave directly from the source (the loudspeaker) plus successive sound waves arriving at the same point from the walls, ceilings and other objects capable of such reflections. Reverberation is the term applied to the time these reflections persist after the original source has ceased to emit sound.

A slight amount of reverberation may be desirable at higher frequencies since this often improves intelligibility. If the reverberation is too long, however, the successive sound waves tend to "clash"—resulting in an overall loss of clarity. Where the distance covered by the reflected wave is substantially greater than the direct wave path an echo is heard. Of course, such conditions are highly detrimental to good reproduction. Acceptable limits for reverberation time are shown in Table I.

A common but expensive way to cope with such reflections is to simply absorb the wave by covering the potential reflector with acoustical materials. There is a wide variety of such materials available. Normally they are made from cork, fiberglass, rockwool or asbestos. Each product designed for this purpose is rated in its ability to absorb sound by an "absorption coefficient." The absorption coefficient for common material employed as acoustic absorbers is shown in Table II.

Table II

Absorption Co-efficients of Commonly Used Acoustical and Building Materials

Cushions:	
Cotton under canvas, 2 3/4 sq ft, short nap, plush	2.8
Canvas and plush	1.7
Vegetable fibre under canvas and damask	1.6
Hair under canvas, thin leatherette	1.3
<hr/>	
Rock Wool 1 inch .....	.80
<hr/>	
Balsam Wood, soft wood fibre, paper backing, screen facing 1 inch thick, .254 lb per sq in .....	.68
Felt, standard 1 inch thick, all hair .....	.66
<hr/>	
Drapery, velour, 18 oz per sq yd, hung 4 inches from wall .....	.50
Drapery, velour, 18 oz per sq yd .....	.45
Drapery, cotton fabric, 14 oz per sq yd .....	.22
Carpet, 4 inch pile, on concrete .....	.26
<hr/>	
Acousti-Celotex:	
Type A, perforated fiber board, 13/16 inch thick, 441 holes per sq ft 3/16 inch dia, 1/2 inch deep, plain side exposed .....	.19
Type B, same as above but with perforations exposed .....	.46
<hr/>	
Masonite, standard 1/2 inch board, laid on 1 inch furring, 18 inch o.c. ....	.32
<hr/>	
Sheathing, 8 inch pine .....	.081
Plaster, Lime on wood lath on wood studs, rough finish .....	.085
Plaster, same as above but smoothly finished .....	.037
Brick wall, 18 inch, unpainted .....	.042
Brick wall, 18 inch, painted .....	.020
Cork, 3/4 inch floor slabs, waxed and polished .....	.11
Average ceiling, plaster on wire lath .....	.033
<hr/>	
Plain wood seat .....	.1
Audience, per person	4.7

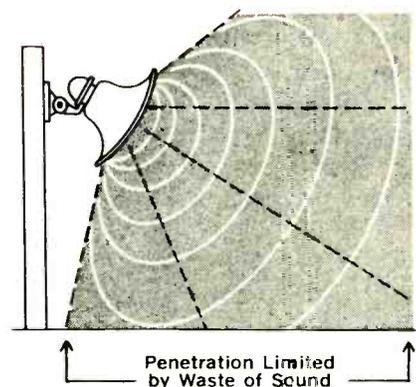
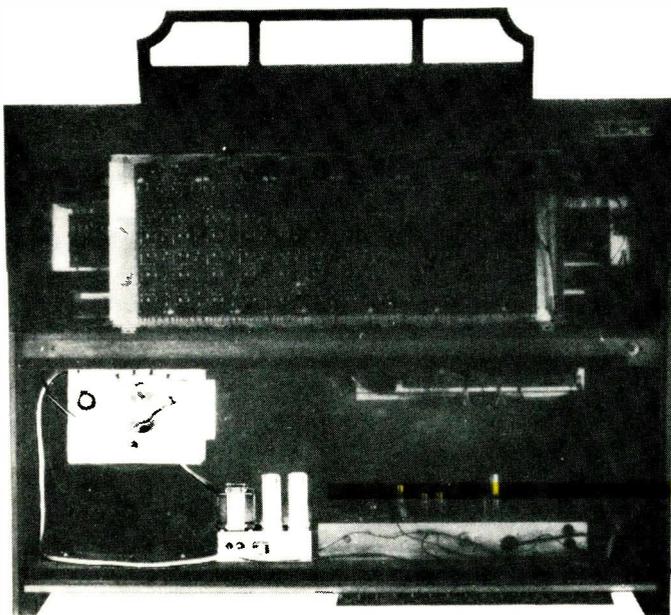


Fig. 3—This wide angle horn illustration was inadvertently omitted from page 86 of the July ET issue which carried Part I of this article.



Rear of Schober organ showing unit which varies reverberation up to six sec to simulate the sound of an organ in large halls.

A study of musical elements
as applied to another field for
maintenance diversification

ELECTRONIC ORGAN PRINCIPLES

by Joe Hayes

■ Electronic organs are becoming more popular each year. Music and instrument stores located in almost every city in the country sell thousands of organs annually and many organ kits have been assembled by laymen for churches and homes. It is difficult to get technicians to maintain electronic organs. There are a few specialists in the field but because of excessive travel costs their employment is prohibitive in many cases.

Most TV technicians think electronic organs are beyond their scope and they are reluctant to repair them. These organs are, in fact, audio electronic equipment with some variations from common circuitry but standard troubleshooting procedures can be applied to most of the circuits.

A brief study of musical principles will greatly aid technicians in troubleshooting electronic organs.

The Octave System

The music system presently in use in the western hemisphere is a scale or set of twelve notes. Each note has a particular frequency which is precisely related to every other note. Actually, every twelfth note is twice or half the frequency of the preceding or succeeding twelfth note, respectively. And each succeeding and adjacent note is 6 percent greater in frequency than

the preceding note. This twelve-note system is called an *octave* system. Any given instrument may be capable of several octaves of range. The organ is generally considered to have the widest range.

In the organ, each note is associated with a key on the organ's keyboard or *manual* and each of the twelve notes in an octave is named by the letters A through G. An octave is a succession of twelve notes beginning with any given note and ending with the first harmonic of the same note. A sample octave, as shown in Fig. 1, would be from middle C at 261.7 cps (key No. 40) to C² twelve notes higher at 523.3 cps (key No. 52). The notes forming this octave are designated by the letters C, C#, D, D#, E, F, F#, G, G#, A, A#, and B. The five notes containing the sharp (#) suffix are represented by black keys and the other seven notes by white keys. The frequency relationship of all notes is illustrated by Fig. 1.

Chords

When more than one note is played simultaneously it is called a *chord*. Chords that are pleasing to the ear are said to be *harmonious* while those that offend the ear are said to be in *dischord*. When a chord is played on the organ (or any instrument) one note stands

out. This note is called the *master* note. Most popular music written today is written so that the right hand plays the *melody* or tune, while the left hand plays a chord which is pleasing when they are played together. It is very important for each note to be in proper relationship to the others.

On instruments such as the piano it is necessary to play each note in a chord by striking the proper notes simultaneously. This is also true of some organs. Many organs sold today contain a set of chord keys. Usually, these are mounted at the extreme left of the keyboard and may look like the buttons on an accordion or may look like a separate keyboard.

By depressing one chord key or button all the notes in that particular chord are played simultaneously. This enables many people with little musical background to play the organ quite well. It is as simple as playing the melody one note at a time with the right hand while playing the chords one button at a time with the left hand.

Organ Construction

Most organs have more than one keyboard or manual. These are usually offset slightly and situated one above the other. Although some organs have more than two keyboards this is uncommon in

electronic types. The upper manual is called the *Swell*. This set of keys is generally played one note at a time. Some organs will not play more than one note at a time on the Swell manual. The number of keys found on a manual varies widely. A standard manual normally has 61 keys on it.

The lower manual is called the *Great* and will usually play any combination of notes. In effect, this is the "chord keyboard." Often organs with two manuals have chord buttons or keys.

At the foot of the organ there are up to 32 pedals. These are called the *Pedals* and are used to produce the very low bass accompaniment also usually one note at a time. When the pedals are depressed between the chord notes and are associated with the master note it is called *contra bass*.

Another pedal, usually controlled by the right foot is used for volume control of the organ. This is often called the *expression* control.

In combination, the Swell, Great and Pedals are called *claviers*. Each clavier is associated with a particular range or pitch. The highest pitch being the Swell and the lowest being the Pedals. All pitches from the highest to the lowest are included. By proper filtering, the sounds of every instrument can be imitated by an organ.

Organ Types

Several types of electronic organs have been commercially marketed. The goal set for some of these instruments has been to imitate the sound of a pipe organ while others have been designed to have a distinct sound of their own. Most types have been widely accepted though it is generally agreed that an electronic instrument capable of imitating the pipe organ is most acceptable.

An organ which exactly duplicates the sounds of a pipe organ has not been perfected yet. With continuing research this goal will probably be reached in the future. The electronic organ which most closely duplicates the pipe organ uses actual organ tone recordings in its tone generator. This is accomplished by recording the sound

of a pipe organ on a circular tone disc. The method is very similar to the one used in motion picture sound systems, where a varying light beam is converted to varying electrical energy by a photo electric cell. In an organ the light beam is modulated by the rotating circular disc. The sound disc is rotated at a constant rate and the signal from the photo cell is amplified when the key associated with that pitch is pressed on the manual.

Other popular organs use electronic tone oscillators. These may be sine wave oscillators, square wave oscillators, sawtooth oscillators or all three. Each type has a particular advantage and each type requires different circuitry to produce the proper tones.

A third type which still has some popularity is the mechanical tone generator. This type uses a revolving metal disc which has edge irregularities. The edge of the disc is rotated near a pickup coil which causes an ac voltage to be generated at the coil's output. With proper

filtering this signal can be amplified and fed to loud speakers.

Tone Generator

The most common tone generators use master oscillators and frequency dividers to derive other frequencies. Since in the octave system each note an octave below any given note is half the frequency one oscillator can be employed to obtain several notes each one octave apart. In other words, if we use a master oscillator for high A to generate 3520 cps, by dividing this frequency in half, we can get 1760 (A an octave lower) and by dividing this one in half, the A in the next lower octave and so on.

Using this system, twelve oscillators may be used to generate all the notes for any number of octaves for one manual. In some cases the same oscillators are employed to generate notes on more than one manual. In most instances the frequency divider system is used on the Great manual and separate oscillators are employed for the Swell and Pedal claviers.

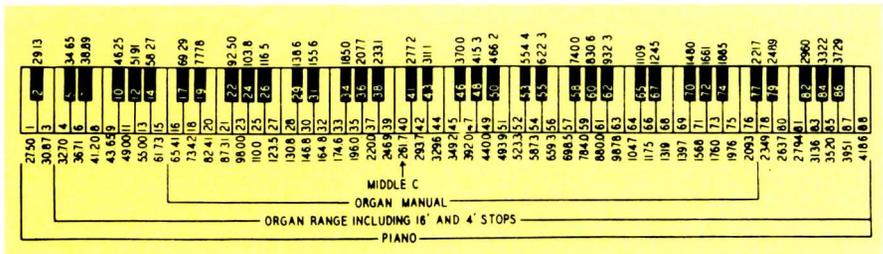


Fig. 1—Frequency chart for organ and piano keys.

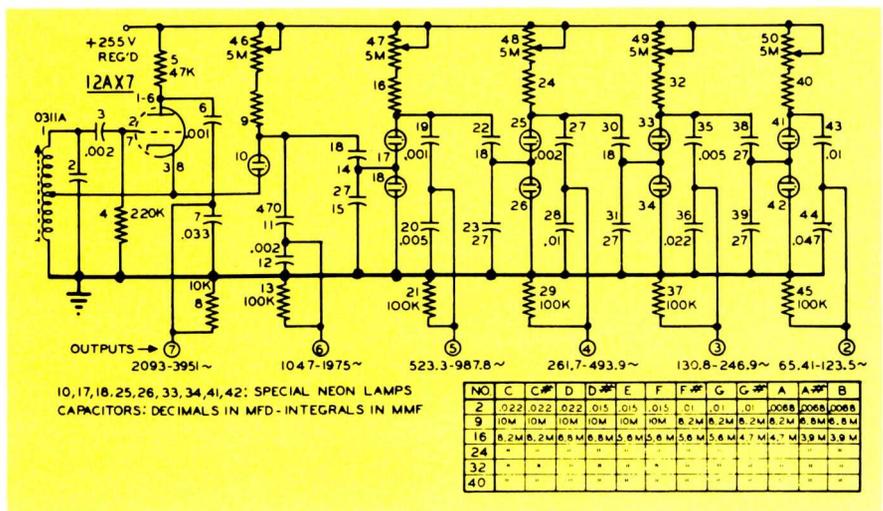


Fig. 2—Neon lamp tone generator.

A typical tone generator schematic using neon lamps is shown in Fig. 2. Several methods are used to obtain frequency division. The multivibrator system is popular and, of course, the output is a square wave. Both the Eccles-Jordan or flip-flop and the free running types are used. The first must be turned on by a signal from the oscillator ahead of it while the free running type has a normal period which is slightly longer than the desired frequency so it is tripped by every second alternation of the preceding oscillator.

Since the square wave possesses only odd harmonics, all notes produced in this manner sound like a pipe organ which employs only "stopped" pipes. That is, pipes with one end closed. Pipe organs generally use both open and closed pipes and purists often frown on the square wave tone generator.

The sawtooth wave form contains all harmonics, both odd and even, as does the open pipe. And as a bonus, when two sawtooth waveforms are added and one is

twice the frequency of the other, a square wave results. Thus, it is possible to simulate both open and closed pipe sounds with a sawtooth tone generator.

Blocking oscillators are also employed as master oscillators and frequency dividers as well. These are most common, however, in electronic instruments other than organs.

Tone Development

Amplifying a waveform directly from a multivibrator, sawtooth generator or even a blocking oscillator produces a rather irritating, raspy sound. This is because the signal is very rich in harmonics. Since these harmonics are necessary to create certain other sounds, they are desirable. Formant circuits are sometimes used to remove unnecessary harmonics. Actually, the formant method of tone generation is a subtractive process whereby the signal rich in harmonics is passed through filters.

Where pure signals are generated by sine wave generators and

other process called tone synthesis is employed. In this method, the proper amount of other pure tones are added to the main signal until the desired result is obtained. This system most accurately imitates pipe organs and other instruments.

Both the aforementioned systems are in wide use and the merits of either is academic. A system which uses the formant principle is shown in Fig. 3.

When square wave signals are added to form a sawtooth and then filtered, a combination of synthesis and formant methods are actually being used.

Voicing or formant filter circuits (Fig. 4) are actually very simple circuits that are switched in or out by the tabs or stops. The circuits are generally simple resistance-capacitance networks but may employ inductors as well. When a tab is switched in or out of the circuit the result is that the waveform of the signal is changed.

Since the removal of the unwanted portion of a signal often involves the resonance of components in a filter circuit, a separate formant circuit is usually employed for each range of keys for any given instrument.

Special Effects

The special effects most commonly found on the electronic organ include *tremelo*, *vibrato*, *percussion* and *sustain*. *Vibrato* and *tremelo* are quite similar and in some instruments are treated in the same manner. Actually, *vibrato* is a slow variation in pitch while *tremelo* is a variation in volume at about the same rate—usually five to ten cps.

Several manufacturers achieve the effect of both by rotating the speakers or by installing a rotating vane in the path of the sound. When the speakers are rotated, a pair of slip rings feed the signal to the speakers.

Electronic methods of creating this effect are more popular now, however, and a phase shift oscillator is frequently connected to the master oscillator tube or to a modulator tube in the signal path.

Percussion and sustain are frequently confused. Percussion is the effect achieved when two bodies are struck together such as the drum or xylophone. The wave-

Continued on page 79

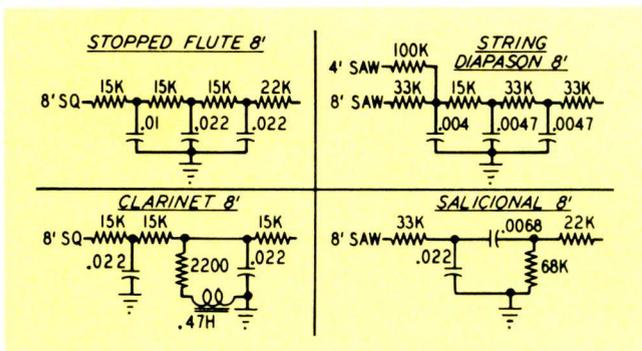


Fig. 4—Diagrams of four typical stop filters.

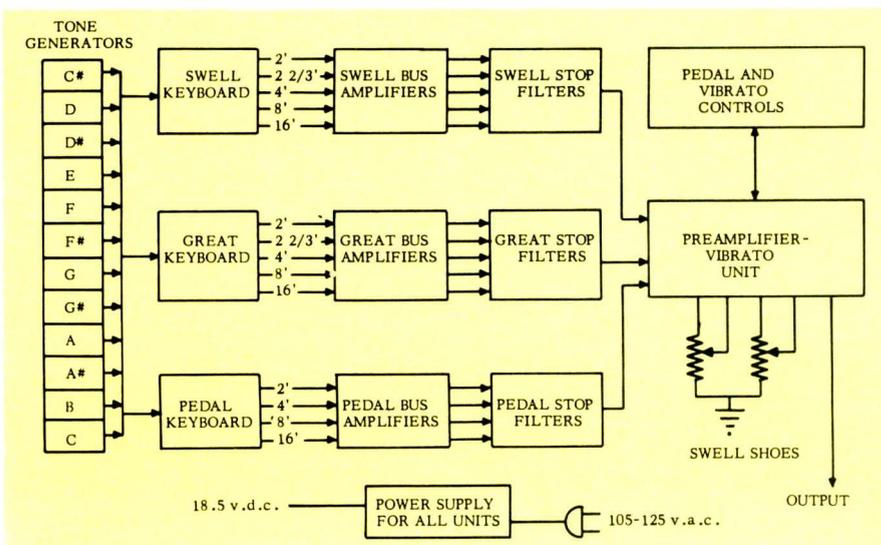


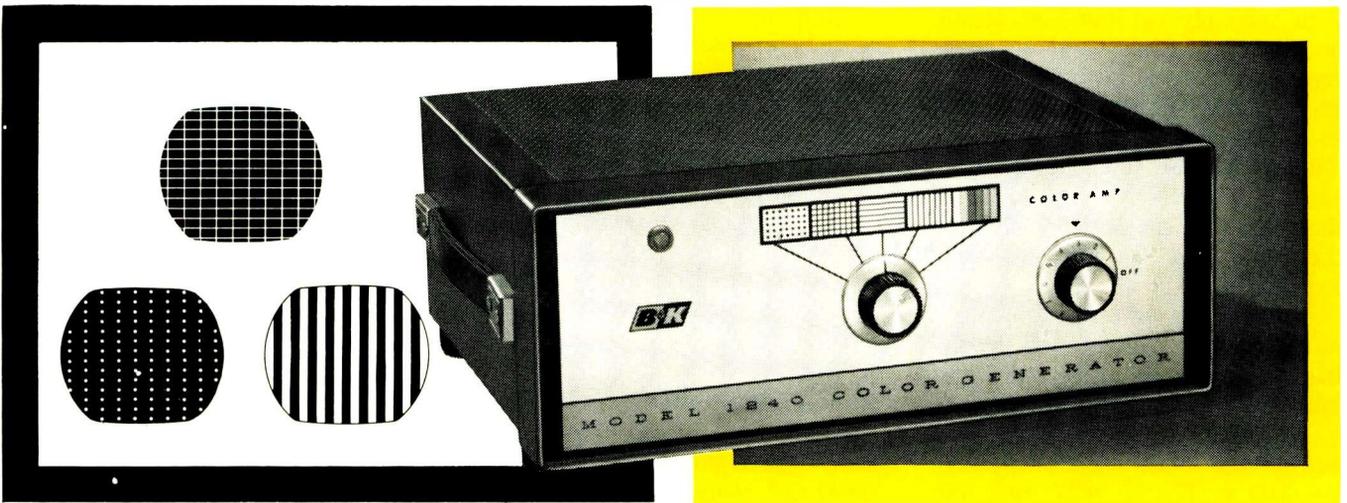
Fig. 3—System employing formant principle.

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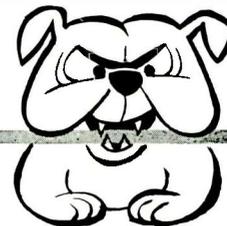
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Difficult Service Jobs Described by Readers

Foxy Dog

This is another "simple" case where the symptoms pointed in one direction but the fault lurked elsewhere. The set was a Motorola TS 449 Series. It worked fine in the owner's home for about 10 minutes, then suddenly cut out—no sound, no picture, no hash—only the raster remained. Assuming a defect prior to the video amplifier, I proceeded to change tuner and IF tubes, including the AGC tube. No favorable results. I decided it had to go to the shop. On the bench I checked the tuner and IF strip B+ and found both in good order.

I scoped the waveform on pin 6 of the AGC tube and found the flyback pulse present at the AGC grid but the video signal was missing.

Next I measured the tuner AGC voltage and found it extremely high — -105 v. The IF AGC was also high— -82 v. This lead me to believe I had the trouble "treed" in the AGC circuit. I began checking here. Voltage on pin 2 of the 9A8 was +115 instead of the normal +30 v. Since this circuit utilizes the composite video signal to develop AGC voltage, I then checked

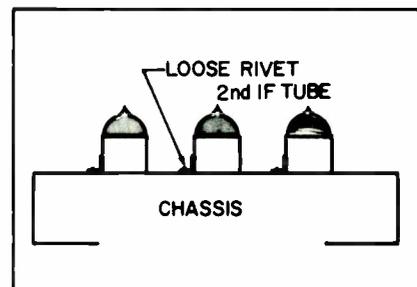
the voltage on the video output tube plate (15HB6). The plate read +140 instead of +35 v. This didn't make sense until I decided something must be wrong with the 15HB6 tube. It had an intermittently open cathode!

Naturally, this open cathode caused the video output plate voltage to rise considerably, killing the composite video signal fed to the AGC tube grid. Also, this abnormal B+ on the AGC tube grid, in turn, permitted the negative AGC voltage to rise sky high, cutting off picture and sound.

Needless to say, a new 15HB6 solved the problem.—*John Yenneti, Pittsburgh, Pa.*

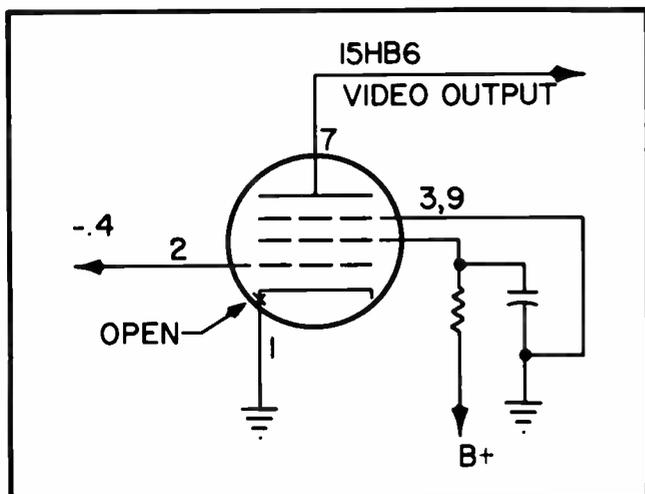
Spurious Oscillations

A 21 in. Sylvania TV on our bench had a no picture, no sound, raster OK condition. There was no snow on the screen, indicating IF or video trouble. The IF and video tubes were checked and all found to be normal. Voltage and resistance readings of the IF and video stages were within prescribed limits. A composite video IF signal was injected at the grid of the 3rd IF



Poorly riveted connection at 2nd IF tube socket caused spurious oscillations.

with my analyzer. A fine pattern appeared on the screen. The signal was now injected at the grid of the 2nd video IF. With signal injection at this point the screen was blank. This isolated the fault to the 2nd IF stage. Voltages were rechecked and all components were checked or substituted and everything appeared to be OK. While replacing the 2nd video IF tube the third time the tube shield was moved slightly. I noticed when this shield was touched, picture flashed on the screen. The tube shield is riveted to the chassis (see drawing) and after close inspection it was found that the rivet was loose, causing a poor ground connection. This bad ground apparently caused spurious oscillations which blocked the signal on all channels. I soldered the connection—the oscillation ceased and the set operated normally.—*Clarence A. Bell, Lewiston, Pa.*



An intermittently open cathode on the video output tube made this a 'foxy' dog.

TOUGH DOGS WANTED

\$10.00 paid for acceptable items. Use drawings to illustrate whenever necessary. A rough sketch will do. Photographs are desirable. Unacceptable items will be returned if accompanied by a stamped envelope. Send your entries to "Tough Dog" Editor, ELECTRONIC TECHNICIAN, 1 East First St., Duluth, Minnesota 55802.



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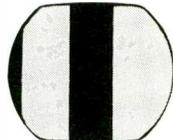


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SHOP HINTS

TIPS FOR HOME AND BENCH SERVICE

Safety First!

The safety conscious service technician handles all voltages with the utmost respect; even a so-called minor electrical shock can result in a reflex action which can cause a painful cut or bruise when one becomes careless in servicing.

When servicing electronic equipment on the bench, make sure that sufficient lighting is available—make use of the isolation transformer when recommended in the service data—be sure a solid ground connection is provided for on the bench and make use of an insulated floor mat in the interest of safety.

A well equipped service shop should include a fire extinguisher suitable for electrical fires. It is good policy to have a poster outlining the procedure for artificial respiration, as well as the phone number of a nearby doctor and the phone number of the fire department.

Inspect your shop facilities periodically with a view toward eliminating any hazardous conditions—remember that the manufacturer has gone to great lengths to qualify his product for the UL seal which attests to a well designed, safe instrument—team this up with safety consciousness on your part and you will eliminate accidents before they can happen.—*RCA Victor, Home Instruments Operation.*

Vertical Convergence

When performing convergence adjustments on some FY, CY and CX chassis TV receivers, you may have had some difficulty in attaining vertical dynamic convergence. Specifically, a red-green crossover occurs which cannot be corrected by the normal adjustment of either R811 or R814. Sometimes R814 even reaches its extreme clockwise position. These two controls converge the red and green vertical lines located at the center of the crosshatch display.

Inability to converge is caused by improper phase of the vertical correction voltage. This may be improved by making the following minor changes to connections from the vertical output transformer T104.

1. Disconnect the center tap lead (black/green) from ground and tape the uninsulated end.

2. Ground the outside winding lead (black/red) and leave it connected to Terminal 4 of J101.

3. If Steps 1 and 2 do not give the required improvement, ground the opposite winding (green/red) and leave connected to Terminal 5 of J101. If Step 3 is used, ignore Step 2, as only one side of the winding should be grounded.—*G-E TV Product Service.*

Cleaning Record Changers

I have found the following method ideal for cleaning record changer mechanisms: Fill an old ice cube tray with a cleaning agent and dunk the individual parts in the tray and let them soak. Remove after soaking and wipe remaining grease off. I have found this to be the best and fastest way to do a proper cleaning job. This method also saves the cleaning agent which would normally be wasted on the bench. The cleaner can be poured back into the container for the next job. The bench is also kept cleaner.—*Dave Edwards, Walnut Creek, Calif.*

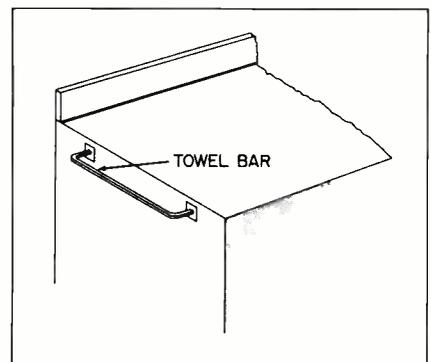
Functional Tool Holder

A busy technician sometimes has a difficult time finding a nutdriver or screwdriver as most shops do not have a handy rack holding these tools. A series of ordinary finishing nails driven into the wall above the bench form an easily accessible rack. A ¼ in. hole is drilled through the handle of the nutdriver or screwdriver and the tool is hung on a nail. The hole can also be an aid when using the tool, a judi-

cious amount of torque can be applied with another screwdriver inserted in the hole.—*F. M. Burton, Grand View, Idaho.*

Clip Lead Holder

I use an inexpensive towel bar bolted to the end of my work bench



to keep test leads and cables neat and handy.—*E. P. Skretka, Sioux Lookout, Ontario, Canada.*

Collaring 'Dogs'

Whenever a tough dog comes into the shop, and the trouble is finally located, it is profitable practice to mark the defective part on the schematic, and the symptoms it causes. In a short time, your schematics become a gold mine of information, making them much more valuable.—*Gilbert Clemons, Georgetown, Del.*

SHOP HINTS WANTED

\$3 to \$10 for acceptable items. Use drawings to illustrate whenever necessary. A rough sketch will do. Unacceptable items will be returned if accompanied by a stamped envelope. Send your entries to Shop Hints Editor, ELECTRONIC TECHNICIAN, Ojibway Building, Duluth, Minn. 55802. The hints published in this column have not necessarily been tried by ELECTRONIC TECHNICIAN editors and are the ideas of the individual writers.

... SAVING 'PHASE'

Continued from page 65

has been operating now much longer and has had time to develop the grid leakage. Remember just one microamp of leakage through the grid will reek havoc with the bias. This causes excessive gain in the stage and of course, a poor picture."

"You're right as usual, Tom, and the set is functioning properly. It didn't turn out to be such a dog after all."

COMING EVENTS

Oct. 12-15: 19th Annual Instrument Automation Conference & Exhibit, Park-Sheraton Hotel and Coliseum, N. Y.

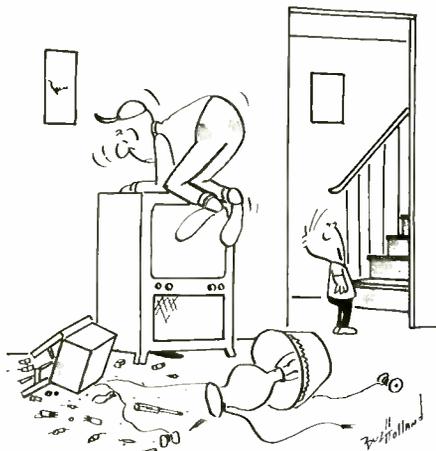
Oct. 12-16: Annual Fall Convention, Audio Engineering Society, Barbizon-Plaza Hotel, N. Y.

Oct. 19-21: National Electronics Conference and Exhibit, McCormick Place, Chicago.

Oct. 29-30: Electron Devices Meeting, Sheraton-Park, Washington, D. C.

Nov. 4-6: Northeast Electronics Research and Engineering Meeting, Boston, Mass.

Nov. 16-18: 17th Annual Conference on Engineering in Medicine & Biology, Sheraton-Cleveland Hotel, Cleveland, Ohio.



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... ELECTRONIC ORGANS

Continued from page 74

form has a very fast rise time and a rapid decay. This effect is most

commonly used to simulate bells or chimes.

Sustain circuitry is used to hold a note from a fraction of a second to more than a second after the key or pedal has been released.

With some study and the application of basic electronic knowledge, TV technicians will be able to maintain the growing number of electronic organs. Forthcoming articles will discuss in greater detail circuitry used in organs and other musical instruments. *Illustration credit: Schober Organ Corp.* ■



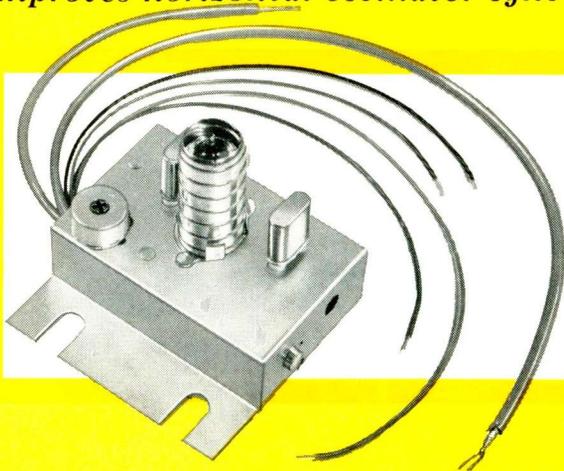
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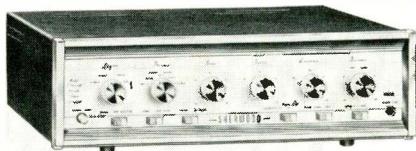
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NEW PRODUCTS

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STEREO AMPLIFIER 200

The S-5500IV is a stereo amplifier which features a front panel stereo headset jack and speaker dis-



abling switch. The component also has a powered center channel for a middle channel or extension speaker. Music power is 80 w, phono sensitivity 1.2 mv, and noise and hum measure 72 db below rated output, the maker said. The unit has 9 tubes and 4 silicon rectifiers. Price \$179.50. Optional walnut leatherette case \$7.50. Sherwood.

STEREO PHONO 201

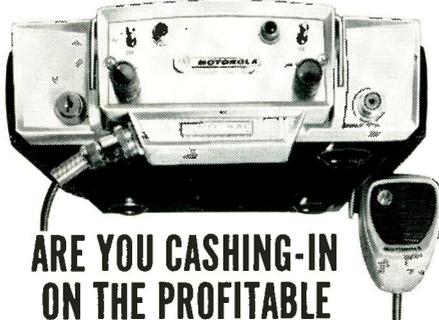
The "Stereo Transistor 600" (RP2260) offers a distinctive drop-down full deck holding both the 4-speed changer, and 4 controls—base, treble, balance, and volume mounted against a brushed aluminum escutcheon. A special friction hinge "floats" the deck down into operating position and swingout speakers with permanently attached extension cords allowing up to 25 ft separation are provided. The recently developed synthetic "Man-



Made" diamond stylus is included. It is equipped with one 8-in. and one 3-in. speaker in each enclosure. Other specifications include: Tonal I professional tone arm system, 14 w peak power, bass boost for increased bass response at low listening levels, and a stereo headphone jack, the announcement said. Price \$159.95. G-E.

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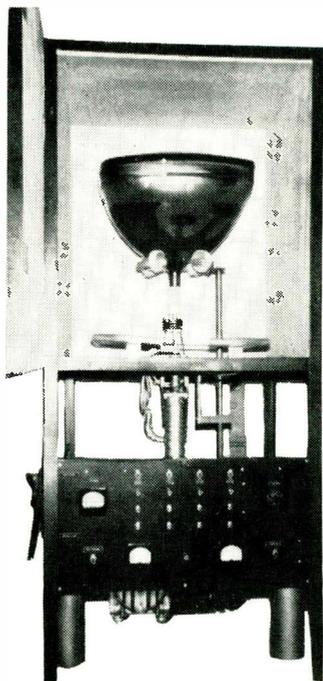
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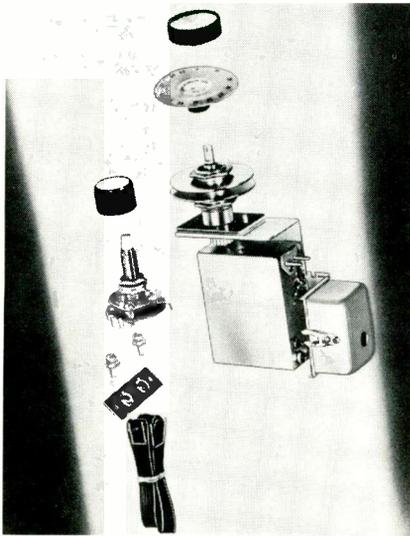
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WINDSOR ELECTRONICS, INC.

Equipment Division
 999 N. Main St., Glen Ellyn, Illinois

... for more details circle 45 on post card
 ELECTRONIC TECHNICIAN



kit fits in any table model TV set, console and most portables giving them a "built-in" appearance, the maker said. Standard Kollsman.

COLOR TV STEREO 203

Highlighting a 1965 color TV line is a combination color TV/Stereo "theater" with hand-crafted



walnut veneer cabinet in Danish modern styling. The unit has a solid state stereo amplifier with 60 w peak output, and solid state FM/AM tuner with built-in FM stereo multiplex, the maker reported. Admiral.

PUBLIC ADDRESS DRIVER 204

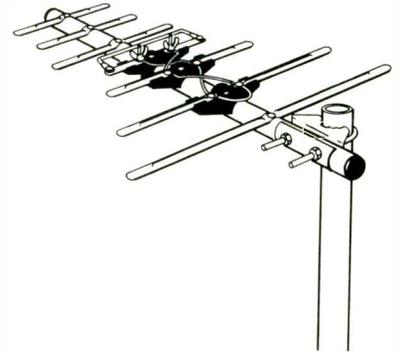
The Model ID-75, a 75 w driver designed for high power and special purpose installations, is announced. It was said that the 4 1/4 x 3 3/4 in.



unit would help solve some problems of sound installers who have been faced with the space versus power problem. Frequency response 150 to 7000 cps. LTV University.

UHF ANTENNA 205

A UHF antenna designated the "TRACER" uses a modified high gain yagi type design. It is said to have flat frequency response across the entire UHF-TV band of 470-890 Mc (Ch. 14-83). It is factory



preassembled of gold anodized aluminum for permanent corrosion protection. Price \$5.95. Winegard.

ARTIFICIAL RESPIRATION FOR CRT'S

CREATES MORE PROFIT FOR YOU



Easy, professional way to check and correct B&W and Color Picture Tubes

TESTS AND REJUVENATES

- all picture tubes at correct filament voltage from 1 to 12 volts.
- all Hi G-2 and Lo G-2 picture tubes, including tubes that require as low a G-2 voltage as 30 volts.
- 110° tubes and the new 19" and 23" tubes.
- color picture tubes, including the new 90° 23" 23EGP22. Checks and corrects each gun of color tube separately.



ALL-IN-ONE B&K CRT 445

THE INDUSTRY'S STANDARD
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Does the job in a few minutes right in the home without removing tube from TV set.

Gives new life to weak or inoperative tubes. Checks for leakage, shorts, open circuits and emission. Removes inter-element shorts and leakage. Repairs open circuits and low emission. Restores emission and brightness. Life Test checks gas content and predicts remaining useful life of picture tube.

Quickly pays for itself.

Net, \$74.95

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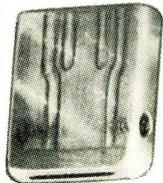
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Here's a Calling Card that will guarantee customer satisfaction. While on your next service call, leave this MOSLEY calling card



311



304

FAST * SIMPLE * SOLDERLESS

The MOSLEY 304 Input Adapter is an ideal connector for TV sets, boosters, etc. Just attach to the antenna terminal strip on chassis of TV and mate with the MOSLEY 311 Universal Transmission Line Socket.

THE FINISHING TOUCH FOR A LASTING IMPRESSION

The installation provides a handy plug-in antenna line for Customer Convenience!

A moment of your time, at a cost of pennys, will buy you a Public Relations job that Pays Off In

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Send for your FREE **Mosley** Catalog. The one and only complete line of TV/FM accessories available on the market today!

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... for more details circle 46 on post card

NEW PRODUCTS

RECTANGULAR COLOR TUBE 206

Measuring 25 in. on the diagonal a new developmental rectangular color TV picture tube is announced.



All U. S. color set manufacturers are being given complete technical details about the tube. Limited production of the rectangular tube will begin during the latter part of 1964, it was said. RCA.

PORTABLE STEREO RECORDER 207

The model 1640 tape recorder is encased in satin-finished Burmese gold and speaker ports are trimmed



with hand-rubbed walnut. A luggage-grained case eliminates the "engineers-only" appearance. Price \$259.95. Roberts Electronics.

REEL DEMONSTRATOR 208

A point-of-sale sound recording



Be a wise owl!

How to save time, increase profit with Admiral antennas!



Simplified for easier installation... priced for bigger profits! All Admiral antenna kits are designed to help you increase outdoor antenna sales and installations. New "All-Snap" assembly overcomes customer complaints of slow installation and high cost.

Each kit is prepacked in its own carton with all the necessary hardware. There's nothing more to buy! No need to have extra hardware lying around your shop—or in your service vehicle.

You can sell every antenna need with conical, in-line, yagi, uhf, and new parabolic styles. Many are available with gold anodizing for custom installations.

And the remarkable Admiral price gives you bigger profits from the expanding antenna market.

Call your Admiral Distributor today... start saving installation time, pocketing new profits tomorrow.

Be wise... standardize on

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"ALL-SNAP" ASSEMBLY ANTENNAS

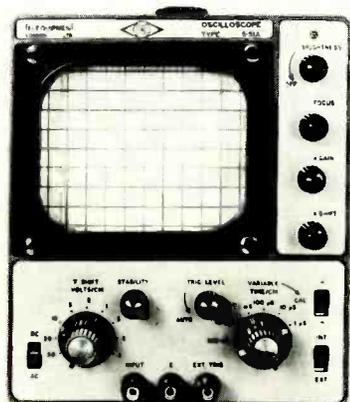
Always Precision Crafted Quality

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ELECTRONIC TECHNICIAN

tape demonstrator kit is announced. The demonstrator kit comes complete with easy set-up instructions, tape reels—one with a tape sample. The unit quickly shows how the tape is engaged and ready for immediate operation. Complete instructions on the demonstrator's simple operation are printed on the back of each unit. The reels have a matte surface for writing and reel identification, and large, easy-to-read numbers for side identification, the announcement said. IRC.

TRIGGERED OSCILLOSCOPE 209

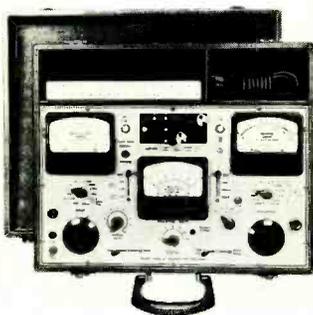
An oscilloscope with a Miller time base which allows automatic triggering on repetitive signals up to



1 Mc, is introduced. The instrument features Schmidt trigger level control and dc coupled unblinking. The unit's dc to 3 Mc vertical amplifier is critically damped and is preceded by a fully compensated attenuator for better squarewave characteristics, the report said. Most of the circuit components are on a single high-grade printed board. Other features listed by the manufacturer include: input attenuator, 9 compensated steps, 100 mv/cm-50 cm, accuracy ± 5 percent; triggering, automatic to 1 Mc plus trigger level control; phosphor, P31 standard, (P-7 available). Dimensions: 7 x 15½ x 8 in. Weight: 16 lb. Price \$235. Data Instruments.

TRANSISTOR TESTER 210

A transistor analyzer which reads leakage current down to 100 amp on a 6 μ amp full scale meter is announced. The device analyzes both power and signal type transistors at specified voltages and currents, the announcement said.



The tester features continuously adjustable current—up to 30 amp collector. It tests dc Beta, ac Beta, Icco leakage, Ico leakage, Ieo leak-

age, zener diodes, punch through, saturation, floating potential, alpha, diodes and rectifiers and SCRs. Weight approx 30 lb. Price \$399.-50. Triplett.

STEREO TAPE RECORDER 211

Designated Criterion 1000, this unit is a self-contained 4-track stereo tape recorder incorporating transistorized stereo preamplifiers and push pull power amplifiers. It is reported that three speed operation gives frequency responses



- Tests TV and Radio Tubes —both old and new
- Tests all Novars
- Tests Nuvistors, 10-pin Tubes, and 12-pin Compactrons
- Tests Voltage Regulators, Thyratrons, Auto Radio Hybrid Tubes, European Hi-Fi Tubes, and Many Industrial Types

B&K PROFESSIONAL QUALITY AT LOW COST

Model 600 Compact Portable Dyna-Quik Makes Tube Testing Quick, Accurate, Profitable!

It's amazing how quickly you can accurately check out tubes on every call—sell more replacements, and make more money—with this up-to-date, low-cost professional quality tube tester. Checks for all shorts, grid emission, leakage, and gas. Checks each section of multi-section tubes separately. Checks tube capability under simulated load conditions. Rejects bad tubes, not good tubes. Quickly reveals tube condition, saves customers, stops call backs, increases servicing profit.

Exclusive adjustable grid emission test. Sensitivity to over 100 megohms. Phosphor-bronze socket contacts.

Complete tube listing in handy reference index. Handsome, sturdy leatherette-covered carry-case.

Size 8½" x 11" x 4½". Net, \$74⁹⁵



**QUICK, DIRECT, ERROR-FREE
READINGS WITHOUT MULTIPLYING**

Model 375
VTVM
Net, \$89.95

Model 360
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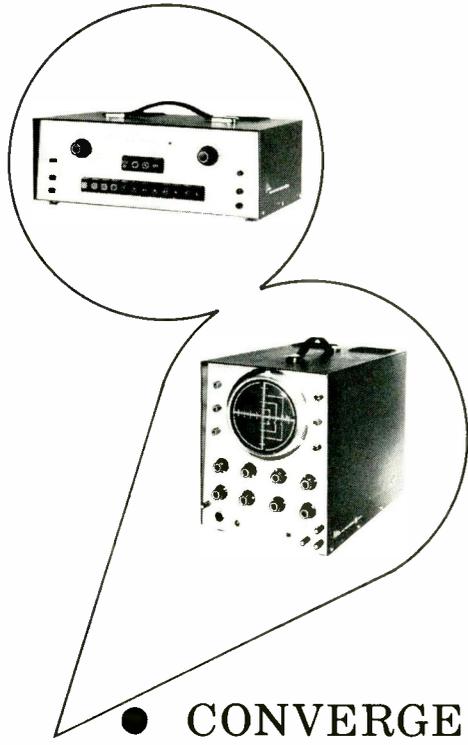
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**Color bar-dot generator
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- EXCLUSIVE PUSH BUTTON PANEL - MAKES SEPERATE PATTERN OR COLOR SELECTION EASIER AND FASTER, CLEARLY MARKED FOR ERROR FREE SELECTION - STAND BY - ON-OFF - PATTERN - SOUND - CROSSHATCH - HORIZONTAL LINES - VERTICAL LINES - DOT PATTERN - EIGHT DIFFERENT COLORS
- CONVERGENCE IN 15 MINUTES - SIMPLE STEPS TO FOLLOW
- EASY TO SET UP - COLOR CODED CLIP-ON CONNECTIONS
- FRONT PANEL JACKS - ALLOWS EASY ACCESS OF VIDEO, SYNC OR COLOR DEMODULATOR SIGNALS
- VIDEO LEVEL CONTROL AND VIDEO OUTPUT JACK - PROVIDES EITHER POSITIVE OR NEGATIVE VIDEO INFORMATION
- COLOR GUN KILLER SWITCH - ALLOWS EASY SELECTION OF ANY COMBINATION OF 3 COLOR GUNS
- OPERATES ON TRANSFORMER - ISOLATED 117 VOLTS 50-60 CYCLE AC

DEALER NET \$239.95

**5-inch wide-band
high sensitivity oscilloscope
model CRO-3**

- WIDE BAND AMPLIFIER, FLAT WITHIN 1 DB FROM 20 CYCLES TO 4.5 MC
- TWO-RANGE VERTICAL DEFLECTION SENSITIVITY FROM 0.018 RMS VOLTS PER INCH
- HIGHLY STABLE AMPLIFIER CIRCUITS - NO BALANCING REQUIRED
- POSITIVE OR NEGATIVE INTERNAL HORIZONTAL SYNC
- LINEAR SAWTOOTH SWEEP OSCILLATOR, 20 CYCLES THROUGH 50 KC
- INPUT CALIBRATING VOLTAGE, 10 VOLTS PEAK TO PEAK
- VERTICAL POLARITY REVERSAL
- HORIZONTAL SWEEP EXPANSION
- RETURN TRACE BLANKING
- Z-AXIS MODULATION - EXTERNAL OR INTERNAL 60-CYCLE
- DIRECT CONNECTIONS TO DEFLECTION PLATES WHEN REQUIRED

DEALER NET \$234.95

- ACCESSORY PROBES FOR THE JACKSON CRO-3
- LC21P LOW CAPACITY PROBE.....\$19.95
 - LC10P HIGH VOLTAGE LOW CAPACITY PROBE.....7.95
 - DM-P DEMODULATION PROBE.....9.95



Jackson Electrical
Instrument Co.

124 McDonough St. / Dayton, Ohio

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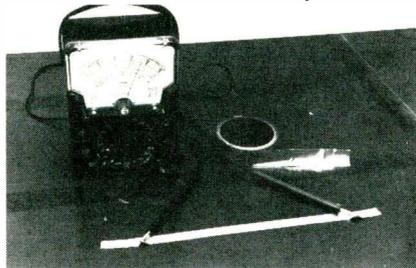
NEW PRODUCTS



of 50-15,000 cps @ 7½ ips, 50-10,000 cps @ 3¾ ips, and 55-5,000 cps @ 1⅞ all ± 3 db. Wow and Flutter is kept at a minimum by using a heavy duty 4-pole capacitor-start motor it was said. Two 6 x 4 in. speakers with adjustable wing panels deflect sound for proper/stereo separation. The unit comes with two dynamic microphones, cables, 7 in. take up reel and is housed in a teakwood cabinet. Price \$199.50. Lafayette.

CONDUCTIVE TAPE 212

Reported is an electrically conductive, pressure sensitive tape, suitable for RF shielding. It em-

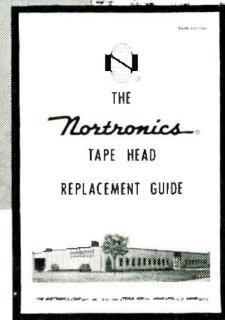


employs an aluminum foil backing with a conductive, pressure sensitive adhesive liner. It is available in 18-yd rolls. Known as No. X-1170, it has a surface resistivity of 0.2-0.4 Ω/sq. maximum, measured with an ohmmeter, the report said. 3M Co.

TRACKING MARKER 213

A tracking marker subsystem that permits checking local oscillator alignment across the entire UHF frequency band, is introduced. The unit is used by TV tuner and receiver manufacturers for aligning UHF tuners. The subsystem generates two markers that appear at the top of the bandpass waveform

**after
ten
years
of
research**



NORTRONICS

now offers—for the benefit of electronic service specialists and dealers—the most comprehensive gathering of tape head replacement data ever published! This easy-to-use Replacement Guide lists Nortronics replacement heads for more than 500 different tape recorders.

Let your customers enjoy the extra quality and precision of Nortronics laminated core, all-metal hyperbolic face tape heads. Demand the best! Find out how you can increase your sales and service business. Write today for your FREE copy of Nortronics Tape Head Replacement Guide.



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ELECTRONIC TECHNICIAN

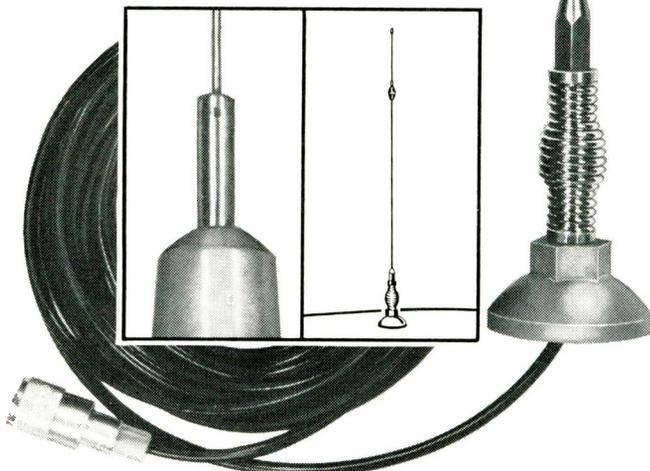
NEW! *Hy-Gain* SOLID STATE Mobile Toppers for Citizens Band

- Hy-Q Solid State Loading Coil
- 23 Channel Broadband Performance
- Precision Adjustable Tuning

Now...a major advance in the state of the art...new Hy-Gain Mobile Toppers...featuring a space-age Hy-Q solid state loading coil expressly designed to deliver a new dimension in performance on all 23 channels of the 27 megacycle Citizens Band. New concept adjustable tuning rod allows "no cutting" lifetime precision tuning for optimum performance on any vehicle.

New Hy-Gain Mobile Toppers are virtually indestructible...Hy-Q solid state loading coils are totally encapsulated in ever-enduring molded polystyrene...whip sections and tuning sections are of low wind resistant top quality stainless steel (except telescoping model where whip section is chrome plated brass) . . . all mounts are field tested to take maximum abuse. New Hy-Gain Mobile Toppers are available for mounting any place on any vehicle...roof mount, deck mount, cowl mount, fender mount...you name it, there's a Hy-Gain Topper that will fill the bill! They're available now from your favorite Hy-Gain distributor or dealer.

Write for fully illustrated performance-comparison Technical Data Report on the new Hy-Gain Topper line...it's FREE!



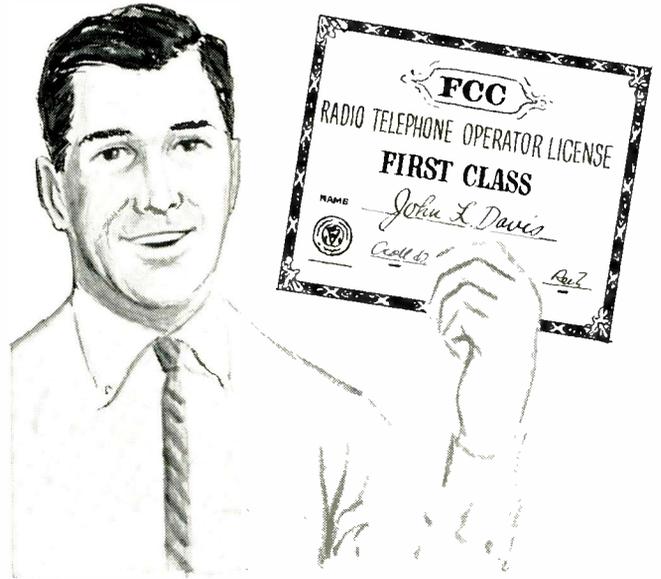
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Where there's a contact... or a relay...

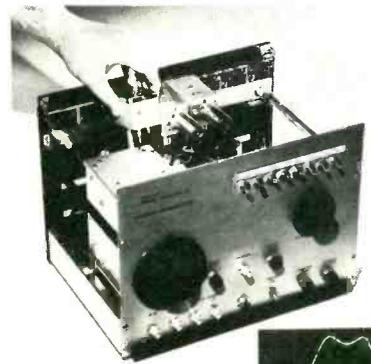
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APPLICATIONS INCLUDE:

- Bowling Alley Automatic Pin Spotters
- Vending Machines
- Slot Machines
- IBM Computers and other data processing equipment
- Industrial Equipment using relays, such as welding machines, etc.
- Pinball Machines
- Telephone Switchboards

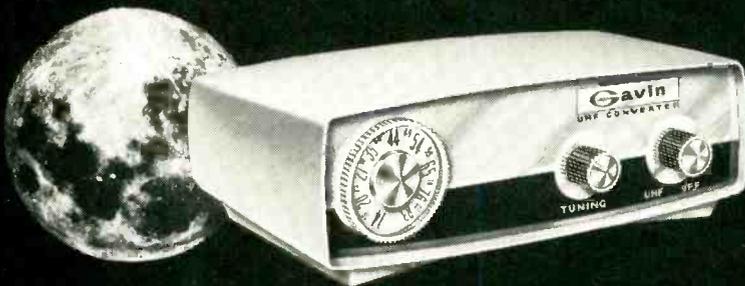
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NEW PRODUCTS



displayed on an oscilloscope. The position of these markers with respect to the waveform indicate when the local oscillator is out of alignment so that necessary adjustments may be made. The marker subsystem consists of three basic units; a transistorized IF amplifier and two fixed IF marker generators (C-markers). To complete the set-up, cabling, a lowpass filter and mounting hardware are also included in the subsystem. The model LO-3 marker subsystem is used as an accessory to the Model SN-3 sweep generator. Telonic.

a new world of UHF performance



"VENUS" DELUXE UHF CONVERTER

World's finest, accented in elegant gold. High gain built-in amplifier, years-ahead circuitry assure peak all-channel reception. Exclusive Ultrascope® fine tuning. For all areas, even deepest fringe. Model 503.



"SATURN" UHF CONVERTER

In mellow walnut, yet only the look is expensive! Powerful new solid state circuit for metropolitan locations. Model 502.



"JUPITER" ECONOMY UHF CONVERTER

Decorator designed in sleek, dramatic brass. Clear, all-channel reception. The price? New and nice. Model 501.

WRITE FOR FREE CATALOG showing world's most advanced UHF converters, antennas and VHF equipment.

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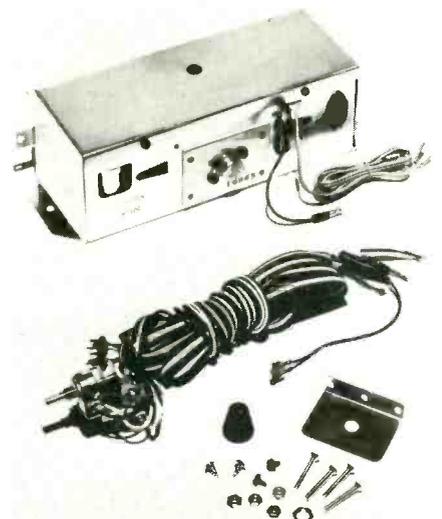
GAVIN Instruments, Inc. General Offices: Somerville, N.J.

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REVERBERATION KIT

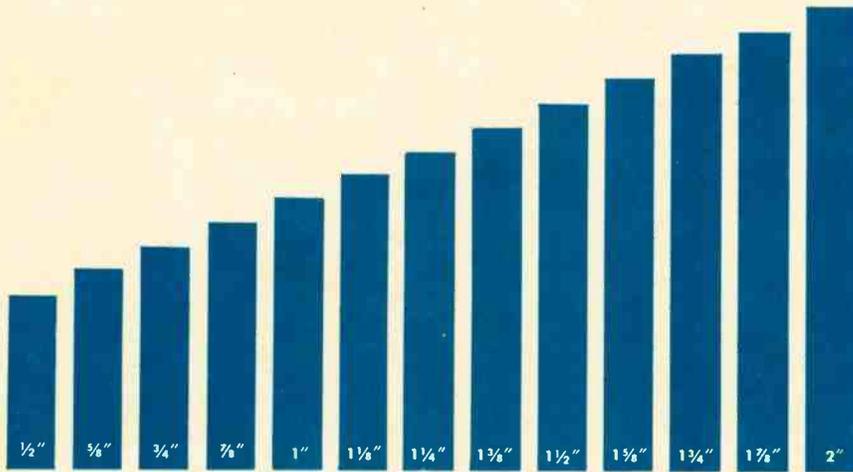
214

An all-transistor reverberation kit for use with 12-v negative ground car radios is announced. This unit has an electromechanical device to reverberate the incoming sound which then amplifies and plays through a separate speaker so that the listener feels that he is surrounded by music. Its power supply



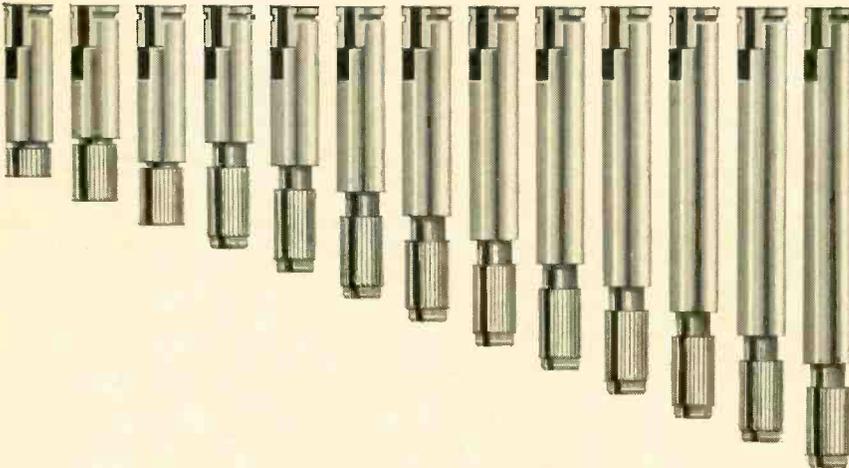
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MORE CONVENIENT AND
VERSATILE THAN EVER!

now
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gives you



SINGLE SHAFT CONTROLS

with exact length shafts



Need a control with a flat shaft—or split knurled—or screwdriver slot?

Maybe you need it with—or without—an attached line switch.

But two things are sure: You need a certain *exact* shaft length—and your Centralab distributor can supply it!

Centralab's new exact length solid shafts provide exact replacements for ALL your single control requirements, as well as twins for stereo, triples, and quads.

If you have the FRK-100 Fastatch II Kit, you can add these exact length shafts as you need them; they snap right into place on the Fastatch II front controls. Or, you can always get the exact control you need, instantly, from your Fastatch II distributor.

For a complete catalog on the Fastatch II Control System, write to Centralab or contact your distributor.

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In Canada: Centralab Canada Ltd., P. O. Box 400, Ajax, Ontario

B-6420

OCTOBER 1964

Centralab

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5-CHANNEL MIXER-PREAMP, MODEL E-5P

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PATHFINDER P.A.



20 WATT E-20

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40 WATT E-40

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75 WATT E-75

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NEW PRODUCTS

is 12.6 dc (negative ground) with a 2 w output and a current of 0.7 amp. It includes a complete fader control between speakers with switch off and a volume control of the rear speaker with switch on. Cleveland Electronics.

MINIATURE TAPE RECORDER 215

A 32 ounce, transistorized, miniature tape recorder that features a "double-decker" tape cartridge for



quick loading is announced. It is called the Lodestar, model 6546. It measures 6-1/2 x 3-1/2 x 1-3/8 in. Price \$69.95. Channel Master.

PACKAGE STEREO 216

A Spanish Provincial unit stereo package features a solid-state amplifier and tuner. It also features a



dual 1009 automatic professional turntable, 200 w EIA, and an air-suspension speaker system, specifications indicated. The unit has a 10-push button function control center and AM/FM and FM stereo. A complete jack system for tape recorders and a headphone system for private listening are included. Sylvania.

PORTABLE PLATFORM 217

Here is a new safety aid for truckers and freight handlers who

NEW CONTACT CLEANER



FORTIFIED with SILICONE NOT HARMFUL TO PLASTIC!

JIF away dust, dirt and corrosion on contacts, switches, controls with this NEW siliconized cleaner. JIF cleans and lubricates, providing contacts and controls with the longest possible protection. Fast and efficient, JIF saves time and money. CLEAN — LUBRICATE — PROTECT. Safe, quick-easy to use — JIF won't harm plastics.

Part No. Net
8670-6 New 6 oz. spray can 1.79
8670 New 3 oz. Pocket size spray can .99



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GC CATALOG FR-65
WRITE TODAY!



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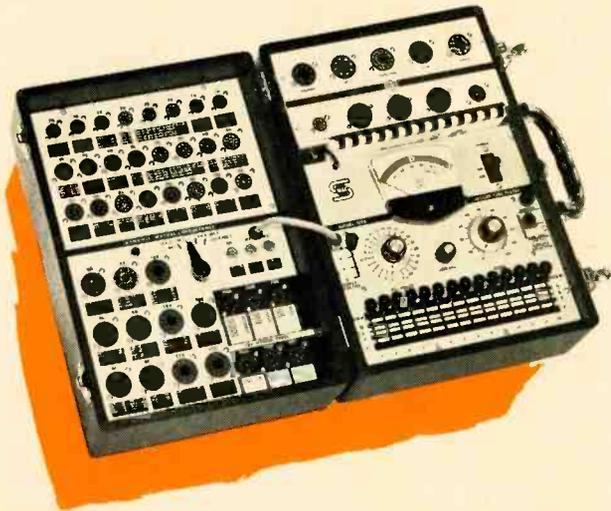
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ELECTRONIC TECHNICIAN

MODEL 107B FEATURES "NO-SET-UP" TESTING

40 prewired sockets accommodate 63 basic pin arrangements for testing all modern TV, radio, industrial and foreign tubes. Also included is a plug-in chassis with 8 sockets wired to 14 lever type pin selectors for testing tubes circuit by circuit. To eliminate errors in reading, all information reads on *one* meter and *one* scale. Three comprehensive tests—Grid Circuit Test, Dynamic Mutual Conductance Test and Cathode Emission Test. Model 107B is always up to date—data book pages covering new tubes are mailed periodically to registered owners. ONLY \$189.50 net.



SECO'S patented Grid Circuit Test detects "hard to find" tube faults

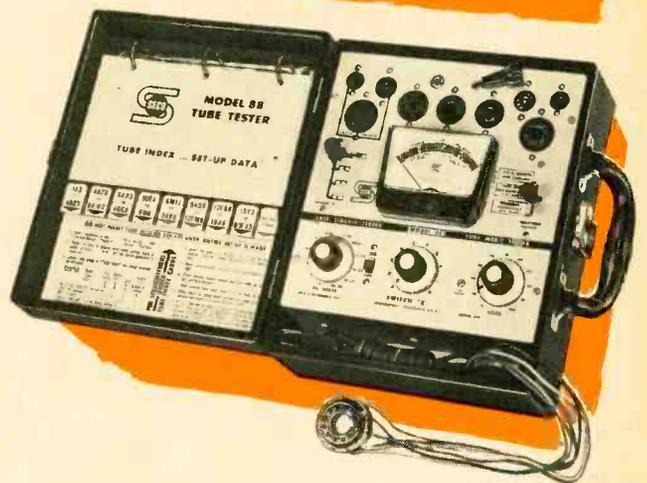
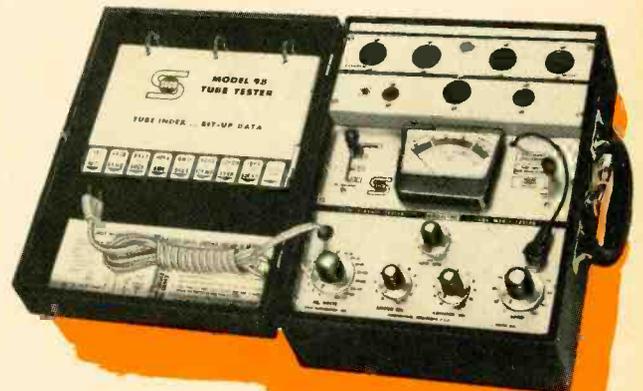
**GRID CIRCUIT TEST makes up to 11 simultaneous checks
for leaks, shorts and grid emission**

MODEL 98 FEATURES PICTURE TUBE TEST

Tests over 400 cathode ray picture tubes including 110° deflection types—has 12-pin picture tube socket. Also has replaceable plug-in chassis for receiving tubes—guaranteed up-to-date including novars, nuvistors, 10-pin types, compactrons and magnovals. This chassis can be replaced for new tubes or customized for special uses. Dial controls isolate or transpose tube circuits and select test current—Grid Circuit Test, Tube Merit Test and Heater Current Test. Removeable cover holds speed-indexed tube data cards, pin straighteners and condensed operating instructions. ONLY \$99.50 net.

MODEL 88—COMPLETE TESTER AT LOW COST

Performs the same picture tube test as Model 98. Tests all receiving tubes including novars, nuvistors, 10-pin types, compactrons and magnovals. Grid Circuit Test, Tube Merit Test and Filament Continuity Test—you can find cathode emission, leaks, shorts, grid emission, gas error, filament continuity and cathode-to-heater emission. Stationary receiving tube chassis. Unit comes complete with speed-indexed setup data, pin straighteners and 12-pin picture tube socket on a 3-foot cable. ONLY \$74.50 net.

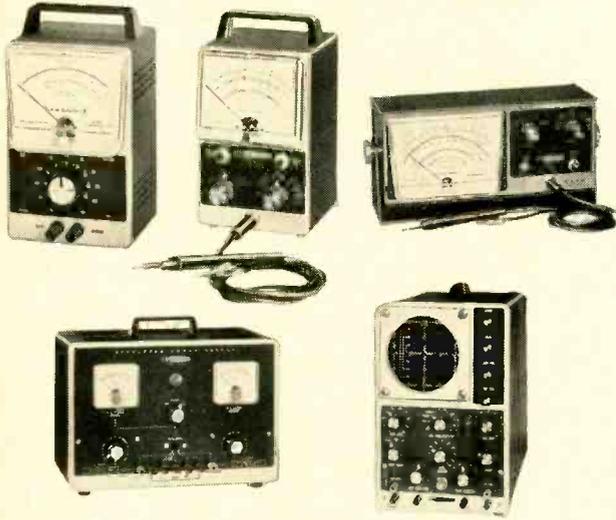


For complete information on Seco test equipment, see your electronic supply distributor or write:

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Either Way, These HEATH Instruments Are Your Best Buy!

Heathkit IM-21 Laboratory AC VTVM!

• 10 voltage ranges—0.01 to 300 volts RMS full scale • ± 2 db, 10 cps to 1 mc • 10 megohm input impedance for high accuracy • Calibrated DB scale • VU-type ballistic damping of meter movement.

Kit IM-21, 5 lbs...\$33.95 Assembled IMW-21...\$52.95

Heathkit IM-11 VTVM... World's Largest Selling VTVM!

• 7 AC (RMS & Peak to Peak), 7 DC, 7 Ohms ranges • Wide frequency response ± 1 db, 25 cps to 1 mc • Easy-to-read 4½" 200 UA meter • 1% precision resistors • Single AC/Ohms/DC probe with switch.

Kit IM-11, 5 lbs...\$24.95 Assembled IMW-11...\$39.95

Heathkit IM-13 "Service Bench" VTVM!

• 7 AC, 7 DC, 7 Ohms ranges • Separate 1.5 & 5 v. AC scales • ± 1 db, 25 cps to 1 mc • Large 6" 200 UA meter • Tilts to any angle • 1% precision resistors • Single AC/Ohms/DC probe with switch • Mounts anywhere.

Kit IM-13, 7 lbs...\$32.95 Assembled IMW-13...\$49.95

Heathkit Variable-Voltage Regulated Power Supply!

• Ideal for design & development • B+, Bias & Filament voltages • DC output variable 0-400 volts, 125 ma max. • Output varies less than 1%, no load to full load • Ripple less than 10 mv • Voltage & Current Panel Meters.

Kit IP-32, 16 lbs...\$56.95 Assembled IPW-32...\$84.95

Heathkit "Extra-Duty" Wide Band 5" Oscilloscope!

• Professional styling & features • 5 MC bandwidth, ideal for color servicing • Rise time 8 microseconds or less • Sweep range 10 cps to 500 kc plus 2 switched preset frequencies • Push-pull vertical & horizontal output.

Kit IO-12, 24 lbs...\$76.95 Assembled IOW-12...\$126.95



FREE CATALOG

Fully describes these and over 200 other different and exciting Heathkits at savings of 50% or more! Fill out the coupon below and send for your FREE copy today!



HEATH COMPANY, Dept. 24-10-1
Benton Harbor, Mich. 49023

Please send my free 1965 Heathkit Catalog.
 Enclosed is \$ _____, plus postage. Please send model(s) _____

Name _____
(Please Print)

Address _____

City _____ State _____ Zip _____

TE-132

... for more details circle 35 on post card

NEW PRODUCTS

want firm footing when they wrestle heavy loads in and out of vehicles. The 4-step, 38-in. high portable access platform has treads formed of non-slip grating. It incorporates in its rigid, all-welded frame a safety handrail placed so that the worker has a solid handhold until he gains footing inside the truck. Bustin Steel.



ANTENNA PREAMPS

218



Three twin transistor antenna preamplifiers are announced to complete a preamplifier series. The announcement said the units have the same gain on every channel, 2 through 13. It was also said that the average noise figure measurement is lower than 3-½ db on

every channel. Units come in weatherproof plastic housing. Transistors: 2N2495, 2N2966. Gain: +18 db. Bandpass: 54 Mc-108 Mc, 174 Mc-216 Mc, Response: $\pm 1/4$ db per 6 Mc channel. VSWR: input 1.5:1 max., output 1.75:1 max. Noise figure: 3.5 db. Signal Input: 5 to 80,000 μ v. Max. Signal Output: 660,000 mv. Input and output Impedance: 300 Ω 117 v, ac, 50-60 cps, 1.8 w, according to specifications. Winegard.

FM/STEREO KIT

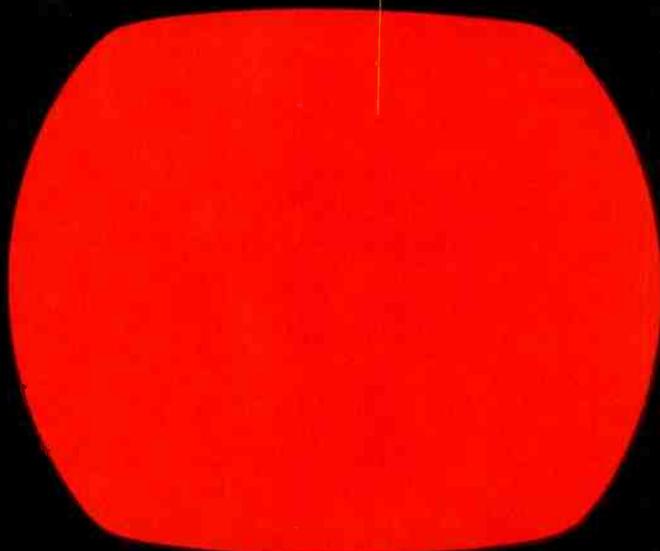
219

An all-transistor FM - stereo/multiplex tuner/amplifier kit is announced. Known as the model 3566, the tuner/amplifier may be used independently with a pair of loudspeakers for FM stereo and mono radio reception. Tape recorder jacks allow recording of

you get **PRODUCT PLUS** *from your Sylvania Distributor*

Suddenly

**COLOR TV
HAS A NEW
RED STANDARD**



Sylvania's new EUROPIUM RED.

New COLOR BRIGHT 85 picture tube brings more natural color to television and increases monochrome brightness 43%.*

The startling news in the television industry is Sylvania's new picture tube, and its new, truer red phosphor.

EUROPIUM RED, developed at GT&E Laboratories, is the brightest red known to the industry. And, to match it, now the full brightness of blue and green is used. The result is a color picture tube that gives the entire television industry a boost.

Because the COLOR BRIGHT 85 tube is *really* bright, dealers can demonstrate color TV effectively in normally lighted showrooms. As the set's brightness is adjusted, the colors remain true—not shifting to unnatural tones in the highlights of the picture.

Another thing, black and white performance is far better than you've ever seen before in a color tube. Be-

sides the increased brightness, there's improved contrast in a sharp, vivid picture.

The new, exciting COLOR BRIGHT 85 picture tube is a product plus from Sylvania for the entire color television industry, and particularly for dealers. In color, as in black and white, you know it's good business to handle the Sylvania line.

SYLVANIA
SUBSIDIARY OF
GENERAL TELEPHONE & ELECTRONICS GTE

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

*Tests show the COLOR BRIGHT 85 tube is 43% brighter, on the average, than standard color picture tubes.



Pre-packaged Pre-tuned IF Strip

**NOW IN STOCK AT
YOUR DISTRIBUTOR**

Model 8902 pre-tuned 455 KC IF Strip provides excellent gain (55 db) and selectivity (6 db bandwidth: 8 KC). No alignment is required. Included among the 21 components on the PC board are a mechanical filter, 2 transistor amplifiers and a diode detector capable of driving earphones. Overall dimensions: 1/2" x 1/2" x 1 1/2".

Model 8901 input IF transformer adapts the IF strip for use with a converter in capacity detectors, AM and CB receivers. Both units are included for \$5.75 net.



J. W. MILLER COMPANY

5917 South Main Street • Los Angeles, California 90003

See your local distributor for the full line of RF and IF coils, chokes, filters and transformers.

--- for more details circle 44 on post card

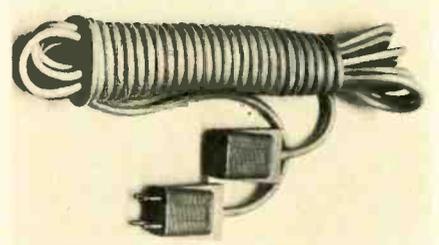
NEW PRODUCTS



FM radio programs. An output jack for stereo headphones is provided on the front panel. EICO.

EXTENSION CORD 220

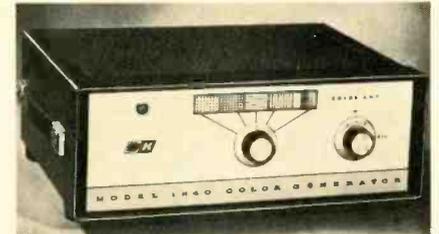
A 25-ft telephone extension cord equipped with standard telephone jack and plug for simple plug-in



operation, is announced. It makes it possible to take the phone to any room in the house, upstairs, in the basement or out-of-doors for convenience. Telephone Equipment Co.

COLOR GENERATOR 221

A portable color generator for in-home, as well as shop, color TV set-up and servicing is announced.



The model 1240 color generator is designed for quick and accurate convergence and color adjustment of TV sets, the announcement said. It provides crystal-controlled keyed rainbow color display on TV screen to test color sync circuits, range of hue control, and align color demodulators, the maker said. B & K.

NEW SUPER HUSH

TV TUNER CLEANER

**ENGINEERED FOR TUNERS
MADE WITH PLASTIC PARTS**

From the purest chemicals available for cleaning plastic boards with printed circuits. HUSH lubricates with Electro-Silicone for longest possible protection. Will be available in 8 oz. and 16 oz. Spray Can with plastic needle.

**CHEMICAL ELECTRONIC
ENGINEERING, INC.**

MATAWAN, N. J.



NEW!

**A BETTER WAY
TO REPLACE
SOLDERED
COMPONENTS**
LENGTH 8"
WEIGHT 3 1/2 OZ.

ENDECO
**Pencil
Desoldering
Iron**
MODEL 300

Now—remove miniature soldered components in seconds—without damage

Hollow tip fits over connection; vacuums all solder for easy removal of component. Leaves terminals and mounting holes clean. Then, with 360° contact, it resolders even faster and better than regular irons. Handles miniature and standard components in printed circuit boards and conventional wiring. Self-cleaning. All parts replaceable. 40 watts, 115-v. 5 tip sizes. Pays for itself in time saved. \$9.95 net East of the Rockies.

Larger model available. See your distributor or write:

ENTERPRISE DEVELOPMENT CORPORATION
1102 E. 52nd • INDIANAPOLIS, IND. 46205

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--- for more details circle 23 on post card

Continued from page 52

SOLVING TV TOUGH-DOGS.
By Robert G. Middleton, published by Howard W. Sams & Co., Inc. 128 pages, soft cover. \$2.50.

A thoroughly knowledgeable author begins this book by explaining what makes a tough-dog, how to analyze them and reveals some "tricks" of the TV trade. Chapters cover No-Picture Troubles, Poor-Picture Troubles, Framing and Display Troubles, Video-Sound Problems and Raster Problems. The leading sentence in the first paragraph of Chapter 1 is a classic: "The dividing line between servicing jobs that are *pushovers* and those that are *dogs* is not sharply defined—instead there is a twilight region which is entered when the time spent on the problem can no longer be charged to the customer." This is frequently an unhappy fact which few technicians discovered until after years of practical experience in TV servicing. Photos, drawings and schematics enhance the text material which is very well written.

ELECTRONIC NAVIGATION MADE EASY. By John D. Lenk. Published by John F. Rider Publisher, Inc. 167 pages, soft cover. \$3.95.

Although the preface of this book makes it clear that it was written for the boat owner, and the entire text material is oriented to boat owners, the information can prove helpful to those technicians who are thinking of expanding into pleasure boat electronics sales, installation and servicing. It will serve as an introduction to practical operation of radio direction finders, console, depth sounders, radar, loran and automatic pilots, and at the same time it will increase technicians' knowledgeability of things navigational—which cannot but expand the technician's image in the eyes of his small boat electronic equipment customers. The text is well illustrated with photos and drawings. Appendices include answers to navigation practice ques-

tions, standard piloting symbols, a sample compass deviation card, and a glossary of terms. A fold-in sample navigation chart is also included.

FUNDAMENTALS OF COLOR TELEVISION. A Color TV Training Course Published By Technical Services Dept., National Service Dept., Motorola Consumer Products, Inc. 81 pages, soft cover. \$3.50.

Here's a book that has the essentials of color TV stripped down

to the bare, red meat. The nature of light is explained in eight pages. The compatible color TV system takes only a few more pages. Color receiver circuits — demodulators, synchronizing circuits et al—are covered adequately. Chapter 4 digs into the color CRT and Chapters 5 and 6 concentrate on convergence and adjustment of convergence circuits. Many color illustrations are used to enhance the text material. The book is worth having on your color-service bench even if you've "graduated" from color school.

**FOR UNEXCELLED PERFORMANCE
FOR CUSTOMER SATISFACTION**

**These two will do
the best job for you!**



**HALLMARK
3000**

**30 WATT TRANSCEIVER FOR BUSINESS AND INDUSTRIAL SERVICE:
FCC TYPE ACCEPTED.**

A top performer for dependable, long range business communications in the 25 to 50 MC band. The compact, rugged design make best use of the features of tubes and transistors. Receiver sensitivity is 0.3µv for 10db S+N/N ratio. Selectivity is better than 30db. Transistorized modulator gives maximum "talk power." Power to antenna is 20 watts. Transistorized mobile power supply. Available in 115 VAC and 12 VDC models. Suggested list: \$269.50.



**HALLMARK
1250**

12 CHANNEL, CRYSTAL CONTROLLED CB DESIGNED LIKE A 15 WATT UNIT.

A unique hand-wired modular chassis gives a new small size that fits any vehicle. The sensational 1250 features a silicon rectifier full wave bridge, electronic switching and an improved ferrite speaker. Four rugged latches provide easy access for maintenance and to crystal sockets. Sensitivity is 0.3µv for 10db S+N/N ratio. Adjacent channel rejection better than 45db. Modulation exceeds 95%. RF power output is 3.4 watts or better. Dual powered. Suggested list: \$169.50.

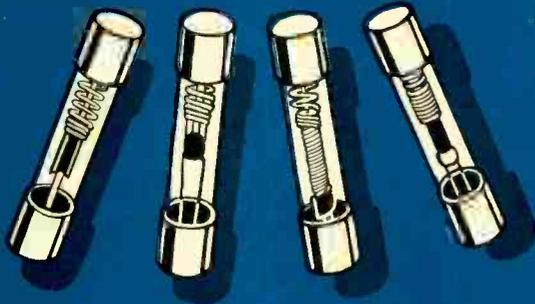
SPECIAL OPTION: Model 1250X — Has plug-in transistorized power supply. Suggested list: \$189.50.

Write for complete information.

HALLMARK INSTRUMENTS

2620 Freewood • Dallas, Texas 75220 • FL 7-0184

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FUSETRON dual-element Fuses

time—delay type

“Slow blowing” fuses that prevent needless outages by not opening on motor starting currents or other harmless overloads—yet provide safe protection against short-circuits or dangerous overloads.

BUSS

Write for BUSS
Bulletin SFB

BUSSMANN MFG. DIVISION, McGraw-Edison Co., St. Louis, Mo. 63107

ponents field with a powerful 250 w solid state stereo system incorporating six pieces with matching walnut veneer finish on hardwood.

Free Albums

Roberts Electronics, a Division of Rheem Mfg. Co., has announced the production of Hi Fi Stereo LP pre-recorded tape. LP tape recording capability is currently being demonstrated with a Collectors Album of Hi Fi stereo music recorded by famous artists, the equivalent of 10 LP record albums contained on one 7-in. tape reel. Playing time of the demonstration reel is over 5 hrs at 1 7/8 ips. Roberts has authorized its dealers throughout the U. S. to include a copy of the Collectors Album demonstration reel as a free gift with every purchase of the Roberts 770 Crossfield tape recorder.

Olympic Radio & TV

Olympic Radio & TV announces an “all-at-once,” three-way radio-television-phonograph combination with solid state automatic frequency control to head the list of ten July “Models of the Month” introduced at the Chicago Music Show.

Career Committee

The Associated Radio Television Service Dealers of Columbus, Ohio reports establishment of a used equip-

BUSS: 1914-1964, Fifty years of Pioneering...

NEWS OF THE INDUSTRY

Weston Sales Training

The sales training program for field personnel has been re-established by Weston Instruments and Electronics. The announcement was made by Harold L. Russell, director of marketing. Salesmen from 20 Weston district offices and 15 field offices of representative firms were invited to participate in the program being held at Weston home offices in Newark, N. J.

B & K and Jerrold At Fair

Jerrold Electronics Corp. has supplied a comprehensive Video, Audio and RF distribution system in the Communications Demonstration Center and Hall of Education Pavilion at New York's World's Fair. At the Audiovisual Learning Center Exhibit, six B&K Model 1076 Analysts were provided by Dynascan Corp., parent company of the B&K Manufacturing Co. Division.

Admiral Solid State Hi Fi

Admiral Corp. has entered the modular Hi Fi com-



All Types Available

for Every
Application

BLOCKS for BUSS FUSES

Single pole, multiple pole, small base, full base, molded base, laminated base, porcelain base for fuses from 1/4 x 5/8 inches up. Also signal fuse blocks and special blocks of all types.

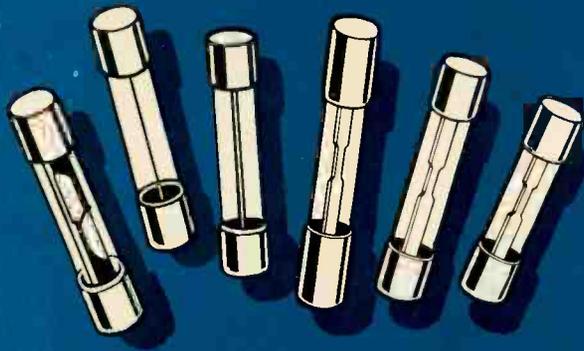
Tell us what you need or . . .

BUSS

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ELECTRONIC TECHNICIAN



BUSS quick-acting Fuses

"Fast Acting" fuses for protection of sensitive instruments or delicate apparatus;—or normal acting fuses for protection where circuit is not subject to starting currents or surges.

BUSS

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BUSSMANN MFG. DIVISION, McGraw-Edison Co., St. Louis, Mo. 63107

Bendix-Dage Deal

Bendix Corp. announces that a purchase contract to acquire the business and assets of Dage Electric Co. of Franklin, Ind. was signed recently. It said the purchase will be made through an exchange of stock for assets.

TV Radio Sales Increase

Monochrome TV and radio distributor sales showed a marked increase in June, according to figures released by the EIA Marketing Services Dept. There were 613,124 monochrome sets sold in June, compared to 396,528 in May, and 868,247 radios were distributed in June, against 571,989 the month before. During the first six months of this year, 3,443,073 monochrome sets were distributed, against 2,956,808 during the comparable period last year. In June 1963, 541,810 sets were sold. Color TV sets produced in June totaled 123,725, against 97,075 the month before. A total of 599,345 color sets were produced during the first six months of this year. Distributor sales for radio (excluding auto) totaled 4,019,448 in the January-June period, compared to 3,935,670 in 1963. There were 811,923 radios sold in June 1963. Total TV set production for June (including both color and black and white) was 835,510. Year-to-date total was 4,492,801. Of the production total, 711,785 sets were monochrome, compared to 487,148 the month before. The January-June total was 3,893,456, against 3,459,921 during the same period last year. There

...New Developments in Electrical Protection

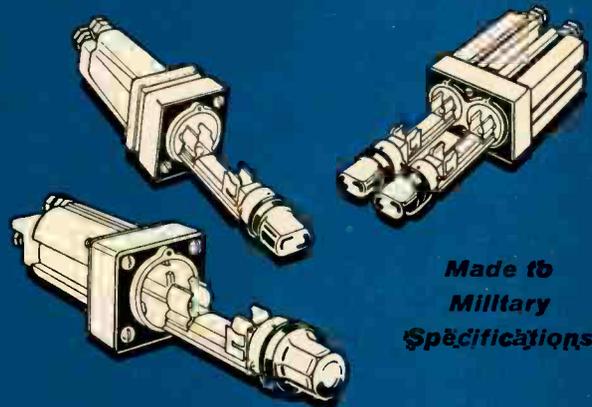
ment pool. The used but workable radios, TV sets and test apparatus, donated by members of the Association, are loaned out for indefinite periods to parents or legal guardians of youngsters who can show a real need and a definite interest in TV servicing as a career. A Careers Committee, coordinating the project, has been created as a special and permanent part of the ARTSD. This project is jointly sponsored with WTVN-TV.

Business Management School

The fourth annual school of business management, jointly hosted by the Indiana Electronic Service Association and the Television Service Association of Ohio, was conducted recently in Fort Wayne, Indiana. It was reported that dealers in attendance heard interesting talks on how to improve their business practices.

Emery Opens Terminal

Emery Air Freight announces opening of a new midtown Manhattan terminal at 548 West 29 St., between 10th and 11th Ave. Expediting pickup and delivery for midtown and downtown shippers of electrical and electronics equipment and parts was a major reason for selecting this site, according to Emery management. The new facility is called the Emery Air Freight City Terminal and Receiving Station.



Made to
Military
Specifications

BUSS FUSEHOLDERS ● LAMP INDICATING SERIES HG

Quick, positive, visual identification of faulted circuit. Transparent knob permits indicating light to be readily seen.

Fuses held in clips on fuse carrier which slides into holder and locks in place with bayonet type knob.

Holder designed for panels up to 1/8 inch thick.

BUSS

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Bulletin SFB

BUSSMANN MFG. DIVISION, McGraw-Edison Co., St. Louis, Mo. 63107

NEWS OF THE INDUSTRY

were 665,004 monochrome sets sold in June 1963. Total radio production for June was 1,770,884, compared to 1,410,660 in May. Year-to-date totals were 8,939,238 this year and 8,585,238 in 1963. There were 1,653,866 radios produced in June 1963.

Dunes Gets TVs

The commercial products division of Admiral Corp. has installed 406 19-in. remote control TV receivers and 38 color TV sets in the newest addition to the Dunes Hotel in Las Vegas, Nev. The current installation brings to more than 900 the number of TV receivers and related equipment in the Dunes vacation resort.

Ten New Tubes

Tung-Sol Electric Inc. announces the addition of ten new entertainment type tubes to its line. The new tubes are: 3CA3 6 Pin, T-9 High Voltage Rectifier; 6HB7 9 Pin, T-6½ Min. Triode-Pentode; 6J10 T-12 Compactron Dual Pentode; 6KE8 9 Pin, T-6½ Min. Triode-Pentode for Color TV; 6LF8 9 Pin, T-6½

Triode-Pentode for Color TV; 6U10 T-9 Compactron Triple Triode; 8LC8 9 Pin, T-6½ Min. High Mu Triode Sharp Cutoff Pentode; 12GT5 T-12, 9 Pin Novar Beam Power Pentode; 15BD11 T-9, Compactron T-9, Compactron Dissimilar-Double-Triode Pentode; 17BF11 T-9 Compactron Dual Control Pentode and Power Pentode.

RCA Color CRT

RCA has recently given complete technical details on its new 25-in., 90-deg rectangular color CRT. RCA is providing manufacturers with technical details, pertinent application and circuit information as well as its marketing plans regarding the new color tube.

Jensen Rep

Appointment of Richard A. Albrecht & Co. as manufacturer's representative in the state of Michigan for Jensen needles, cartridges and phonograph drives was announced by Karl Jensen, president of Jensen Industries of Addison, Ill.

On-The-Job Training

In a move to aid the U.S. Department of Labor in its efforts to reduce unemployment, ITT General Controls Inc. has launched a program to train 250 persons on the job as Assemblers, Class I at the company's plant in Des Plaines, Ill.

NOW

from ALLIANCE—the world's leading antenna rotator manufacturer . . .

NEW

T-45

TENNA-ROTOR®



The new Alliance T-45 Tenna-Rotor® will meet the most exacting requirements of today's TV viewers. It has the same built-in quality that has won millions of satisfied customers for other Alliance products.

A new, patented five wire bridge circuit provides a precision system that's unaffected by motor current, cable length and line voltage variations. This improved electrical system, plus stable indication and expanded meter scale, assures positive antenna direction and readability through a stepless 360° cycle.

The T-45's motor is stronger — has more torque — to support, hold and turn the largest new antennas. Outstanding engineering — and smart styling — make the T-45 America's finest manually operated antenna rotator. Order the T-45 and other quality Tenna-Rotors® from Alliance — the world's leading manufacturer of antenna rotating devices.

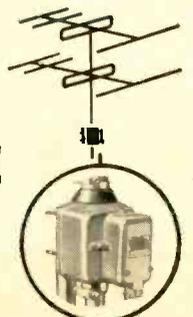
"TV's better color getter"

For Complete Details write . . .

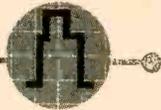


The
ALLIANCE
Manufacturing Co., Inc.
Alliance, Ohio

(Subsidiary of Consolidated
Electronics Industries Corp.)



... for more details circle 11 on post card
ELECTRONIC TECHNICIAN



Transistor circuit design was pushed another step forward recently by a well-known audio engineer, Norman Crowhurst. Details of the contribution to transistor amplifier technology were not announced. It was said that a patent on the circuit is now being processed.



Crowhurst



A telephone 'Call Diverter' attaches to the phone and electronically switches incoming calls from one telephone to another, regardless of location. The user



sets the number of the second telephone in a series of thumb wheels and switches the 'diverter' on. It then automatically dials the pre-set number—whether it is in the same building, another part of town, or in a distant State.



The personal portable transistor television market will grow considerably during the next year, an executive of the Sony Corporation stated at the Chicago Music Show at the end of June. He said that the reported introduction of 9-in. transistor TV sets by G-E and Philco will help "considerably to popularize the small TV sets and broaden the market."



'See-in-the-dark' TV cameras were used by the American Broadcasting Company to penetrate the smoke-filled rooms of the GOP convention and provide intimate closeups of the political personalities. According to Bendix, who developed the cameras, they are capable of clearly showing the features of a person in a room illuminated only by the glow of a cigar or cigarette.



A semiconductor type spark plug with circumferential firing instead of the conventional spark gap has passed a 'no fouling' test at the Breeze Corp. plant. The plug, made by Champion, is a vital part of a new

Model 300

By simply adding an Alliance Genie-Color Booster to their present antennas, your customers can greatly improve color as well as black and white TV reception. ■ Genie-Color Booster makes the difference between average TV reception and full viewing pleasure by providing a rated average output of 11.5 decibel boost in signal strength. Constant gain circuitry maintains signal strength on all TV channels. ■ Genie-Color Booster employs FM traps, and complies with FCC regulation Part 15. Its built-in two-set coupler provides amplified outputs for two TV sets. Molded plastic booster unit mounts quickly and easily on any antenna mast.

- mounts easily on any antenna
- fast, easy installation
- high overload factor... linear frequency response on all TV channels

Order this sales and profit booster today from the world's leading manufacturer of antenna rotators.

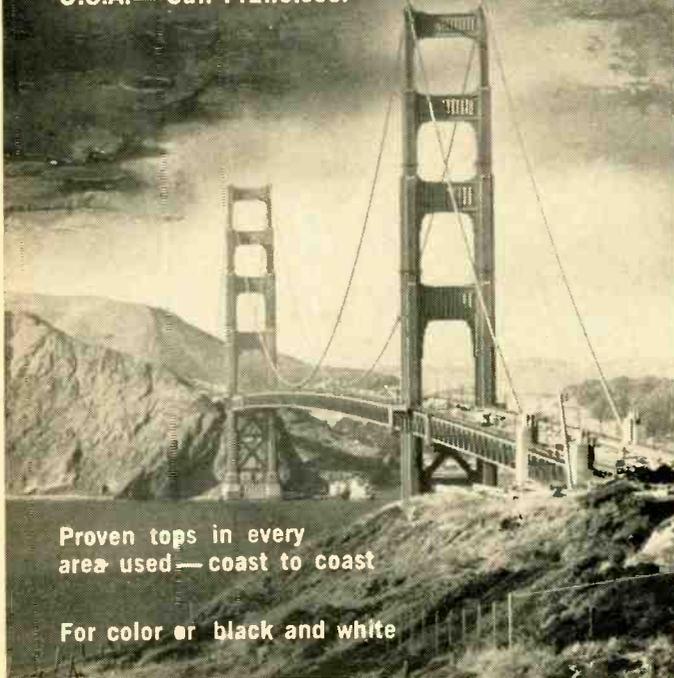


'TV's better color getter'

ALLIANCE Manufacturing Co., Inc.
(Subsidiary of Consolidated Electronics Industries Corp.)
ALLIANCE, OHIO

The greatest indoor TV antenna ever made

Tops all others in the roughest TV reception area in the U.S.A.— San Francisco.



Proven tops in every area used— coast to coast

For color or black and white



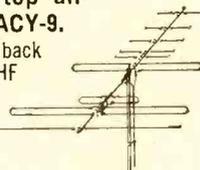
The Hi-Lo 202 covers all channels VHF (2-13) and UHF (14-83). Exclusive patented spiral feature match from antenna to where — on top of TV You gain 2 ways — top satisfaction

covers all channels (14-83). Exclusive patented spiral feature match from antenna to where — on top of TV set, in closet, or attics. full profit to you — from customers.

List Price ... **9⁹⁵**

Outdoors — install the industry's top all-color, all-channel Yagi, the Tricraft ACY-9.

High gain, sharp directivity, high front to back ratio. Outstanding fringe reception on all VHF channels. Pre-assembled for rapid installation with Hi-Lo's patented "Allsnap" method of assembly. List Price **16⁷⁵**



Hi-Lo

See your distributor or write.

MANUFACTURING CORP.

1124 W. Newport Ave., Chicago 60657

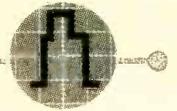
Send complete details

Dept. ET-10

Name _____
Street _____
City _____

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SYNC ON BUSINESS



low-tension transistorized ignition system for engines in autos, trucks, tractors, boats and other vehicles.



The National Home Study Council accrediting commission recently accredited two additional schools, Humboldt Institute of Minneapolis, Minn., and Philco Technological Center, Philadelphia, Pa.



A new authorized repair station for Wen Products is at Camp Electric Company, 647 Madison Avenue, Memphis, Tenn. The station will aid in the fast repair service and delivery of products, accessories or replacement parts in the state of Tennessee.



TV-radio technicians in the Seattle, Washington area cost an employer \$3.95 an hour, \$30.66 for an 8-hour day, and \$8216 for a 52-week year, according to TSA Service News, the King County TV Service Association journal. This includes basic hourly wage, health and welfare, payroll taxes, fringe benefits, two weeks vacation, seven paid holidays, industrial insurance, unemployment insurance, old age benefits, etc.



Allergy sufferers can obtain a new 16-page booklet, "Helpful Hints for Sufferers of Airborne Irritants." by writing to Radex Corp., Preventive Medicine Dept., 2076 Elston Ave., Chicago, Ill. 60614.

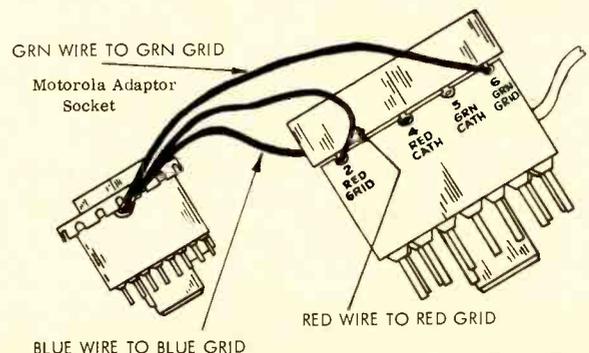


Budget your time and get more done every day is the subject of a folder, "How to Get More Done Every Day." It concerns "Magic Minute Saver" timing devices. Write Value Village, Box 501-MT, Buffalo, N. Y. 14205.



An adaptor to interrupt the guns of the new rectangular Motorola color tube is being made by Sencore for the CA122 color analyzer. It enables

Present CA 122 Socket



technicians to use the present interruptor switches on the front panel of the analyzer.

The 'Swimmie-Talkie' developed by Jetronics' works this way: You speak into the microphone which converts the sound into electrical energy. The electrical energy is then raised to a higher frequency band, amplified to a higher power, then changed to acoustical energy, and radiated to the water via the transducer atop the helmet. The unit also enables the acoustical energy received to be presented to the ears via the earphones, using the reverse process. It is said the unit is now being used extensively in tests by the Navy under actual operating conditions in the Virgin Islands. Communication's range is from 0.5 to 1 mile, depending on conditions.



Radio dispatched travel service is offered by Greyhound at the 1964 World's Fair in New York. Included in the company's fleet of more than 300 specially designed vehicles will be "Glide-a-Rides," each consisting of a motorized unit and three trailers carrying 60 persons, and four-passenger lounge cars. Movement of the vehicles is

coordinated by an extensive Motorola two-way radio system. Included are dispatching facilities at Greyhound's exhibit building at the Fair, and 20 lightweight portable radios which will be assigned to roving supervisors.



A tube characteristics reference file, Fast-Fax, by Raytheon, is designed to help you speed up your servicing. Conceived as an industry service, Fast-Fax includes all tube types registered with EIA during 1962, 1963, and the first quarter of 1964 irrespective of who may make them. A supplement service brings you up to date when the new TV sets with new tube types appear on the market. Ask your distributors for this new and up-to-the-minute servicing aid with 18 months supplement service.



Time and Frequency standards, schedules and content changes are announced by the National Bureau of Standards. Stations WWVB (60 kHz) and WWVL (20 kHz) at Fort Collins, Colo., resume continuous service, around-the-clock seven days a week, except for the biweekly silent periods previously announced. WWVL began suspension of operations on alternate weeks for 12 hours from 1300 UT Tuesday, until 0100 UT Wednesday, on July 7, 1964. Station WWVB began suspension of operations during the same hours on Tuesday, July 14, 1964, and on alternate Tuesdays thereafter. Transmissions of station WWVH (on 5, 10 and 15 MHz) from Maui, Hawaii now include voice announcements of the station identification and time (in 150° West, or Hawaiian Standard, time) every five minutes. Also added in International Morse Code are radio propagation forecasts every five minutes (in place of the previous 30-minute period), and the currently used frequency offset from atomic standards is given every hour, following the "on-the-hour" announcement. The continuous 60-kHz carrier of station WWVB is advanced abruptly in phase 45 deg for five minutes at the start of the 11th minute and returned at the start of the 16th minute of each hour.

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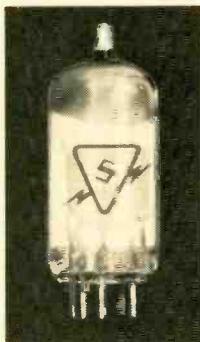
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SECTION

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Thinking Smaller 102

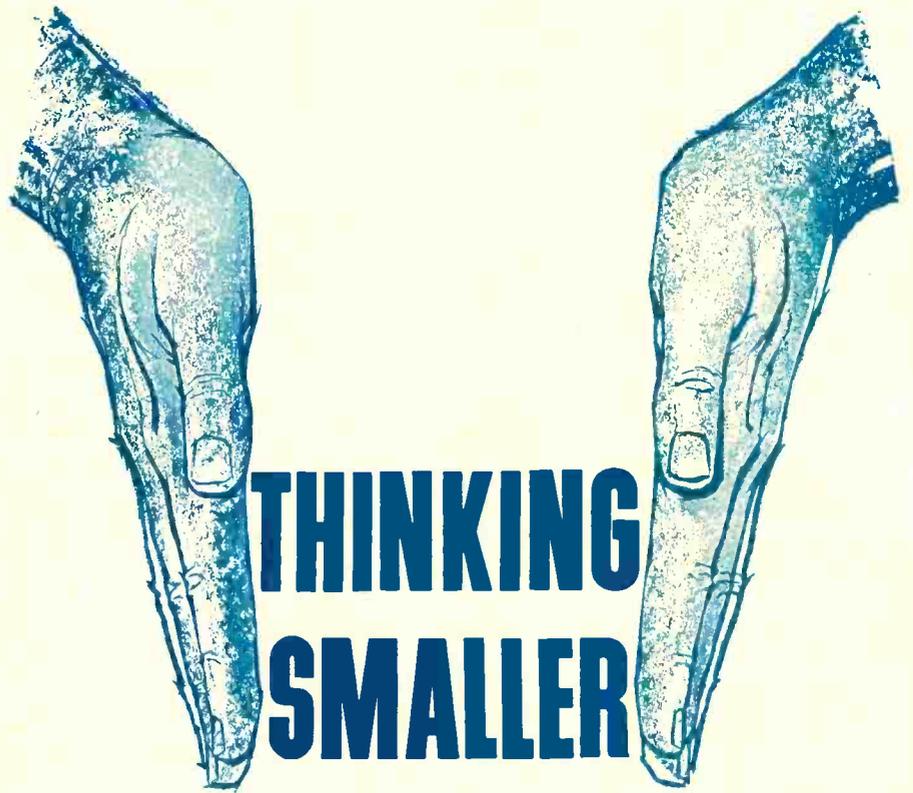
Time to begin preparations for the microelectronic revolution

Relays 104

William Lamb concludes this important article series with details on the care and maintenance of relays

New Products 108

OCTOBER • 1964 • VOL. 80 • NO. 4



Microelectronics is just over the horizon. Will you be prepared for it?

■ Complete radios made from a few semiconductor crystals, a digital computer in a shoe box—these are typical of the many electronic devices, created through the miracle of microelectronics, that technicians will eventually be called on to maintain.

Although research engineers and scientists have been working with microelectronics for more than 20 years, only recently has the concept been translated into actual hardware. Even now its primary use is in military and space applications where cost is secondary to small size, high reliability and low weight.

It won't be long, though, until microelectronics begins to find its way into industrial equipment, and it's to your advantage to be ready for it when it comes. But what is "microelectronics," anyway?

The "Small" Concept

There are several types of microelectric circuitry. One type consists simply of extremely small components referred to as "discrete components" (Fig. 1) to indicate that they are separately produced items that must be individually connected in a circuit, perhaps by wires,

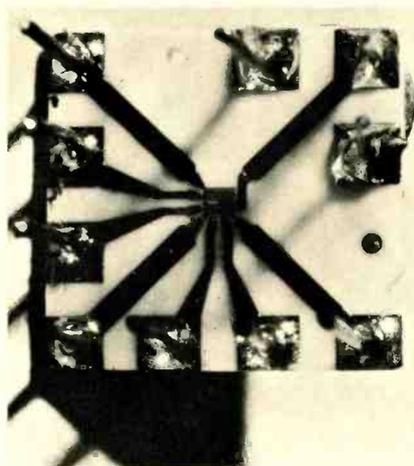


Fig. 1—NOR gate resistor network. Resistive paths are metal oxide, conductor paths and lands are copper metallizing and substrate is Corning-made glazed alumina.

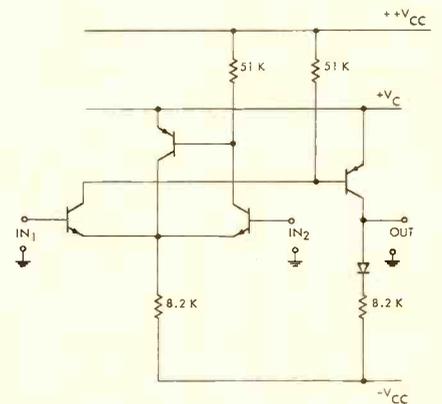


Fig. 2—Basic dc operational amplifier fabricated by "semiconductor" techniques. Each network contains six resistors and seven transistors. Not all the transistor sections are used in this circuit, but the diode shown is actually one of the transistors.

just as the "ordinary" size components are. Some microminiature discrete components are so small that 100,000 of them can be crammed into one cubic foot!

Another type of microelectronics is that in which the active circuit (diodes, transistors, etc.), passive elements (components such as resistors, capacitors, etc.) and interconnections are all made on the same piece of substrate (usually a piece of nonconducting material that serves as the "chassis"). There are several ways of making such units. In one, called "thin film" technology, alternating layers of conducting and nonconducting materials are deposited on the substrate to form the components and circuitry.

In the second method, the so-called "semiconductor" approach, the components are created by modifying the impurity content of sites inside tiny pieces, or "chips," of semiconductor material. Aside from the different methods of fabrication, a significant difference between the two types of circuitry is that ordinary transistors and diodes must be mounted on "thin film" type units separately, while such active elements can be made integral parts of the "semiconductor" type circuitry.

Circuit Types

There are two basic types of microelectronic circuits: linear and digital.

A typical linear "semiconductor" type microelectronic circuit (a basic dc operational amplifier) is shown in Fig. 2. Each network shown contains six resistors as well as two

PNP and five NPN transistors, all diffused from a single block of silicon. The packaged circuits (Fig. 3) measure 0.25 x 0.125 x 0.03125 in. and weigh less than 0.1 gram.

Another application of linear microelectronic amplifiers is shown in Fig. 4, a schematic of the front end of an experimental citizen's band receiver. The microelectronic units (enclosed by the dashed lines) are fabricated on single chips of silicon by planar epitaxial techniques. Each of the equivalent circuits shown consist of two stages of direct-coupled amplification with degenerative feedback loops for stability over the operating temperature range.

Production

"Thin film" type microelectronic circuits are made through multiple evaporation, sputtering or decomposition of appropriate materials. Chrome, "Nicrome" and tantalum are among the materials used in making thin film resistors, although almost any material that can be evaporated or sputtered can be used.

The ultimate configuration of the circuit is determined by an overlay or mask, through which the sputtered or evaporated materials must pass before they are deposited on the substrate.

"Semiconductor" type microcircuits, on the other hand, start out as lapped and polished wafers of silicon (either N or P type). A silicon dioxide layer is formed over their surfaces and the wafers are coated with a photo resist and exposed to ultra-violet light through a mask, which outlines the areas for transistors or capacitors after

which development and etching define the corresponding areas on the top of the wafer.

P-type impurity is then diffused into the wafer through the bottom and through the channels opened in the top silicon dioxide layer, which is then regrown over the areas previously opened.

These operations form a sandwich consisting of two layers of silicon dioxide enclosing what is now essentially a P-type silicon substrate containing discrete "islands" of N-type silicon. These "islands," within which the circuit elements are to be formed, are actually large-area diodes.

Next, another photo etching sequence produces a new set of windows over the "islands" of N-type material, the mask used defining the shapes of diode structures, resistors, and transistor bases. Again, the wafer is subjected to a P-type diffusion and the silicon dioxide coating is regrown.

Another photo-etch sequence opens windows over the P-type material of the transistor bases, the window defining the emitter structures, and this is followed by an N+ diffusion and silicon dioxide regrowth.

Fabrication is now complete except for connections between the circuit elements. To make the connections, the wafer is subjected to still another photo-etch cycle which opens the oxide over the appropriate connection points on each circuit element. A thin film of aluminum is then deposited over the top of the wafer, and this film, in turn, is selectively photo-etched to form the required conductive pattern. ■

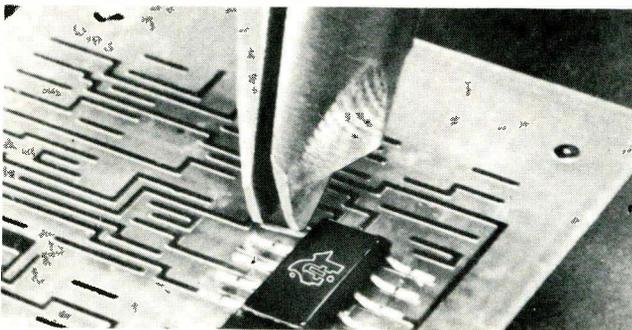


Fig. 3—Packaging configuration of microelectronic circuit shown in Fig. 2. The unit measures about 1/4 x 1/8 x 1/32 in. and weighs less than 1 gram.

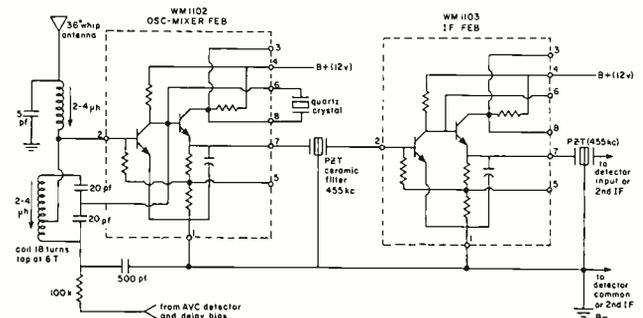


Fig. 4—Front end of experimental fixed-frequency communications receiver. The values given for resonators are appropriate for the 27 Mc citizens band.

RELAYS

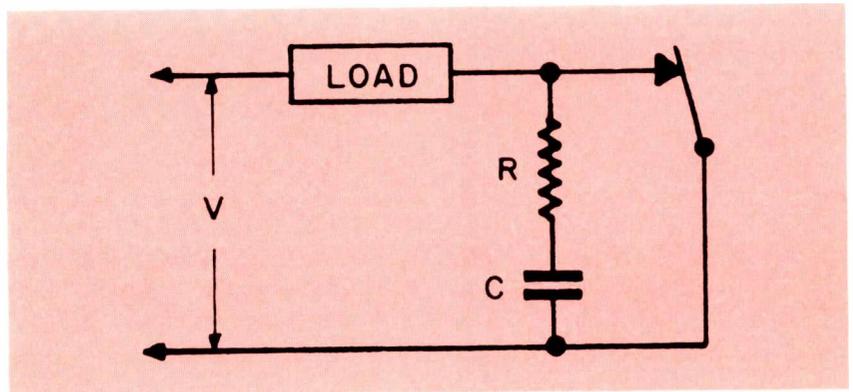


Fig. 1—RC Contact Protection Circuit.

*Proper care and maintenance can extend relay life,
lower overall costs and increase reliability*

Part III

by William B. Lamb

Applications Engineer
Potter & Brumfield

■ Maintenance can be a big job or it can be relatively easy, depending on the environment in which relays are required to function and the jobs they are required to do. Long, trouble-free operation cannot be expected when the relay is subjected to severe environments such as dirty, oily, or contaminated atmosphere. Contact life will be greatly shortened if they are required to make and break their loads while being subjected to corrosive fumes or contaminants, which cause additional burning or heating at the contact surface.

For example, recently a manufacturer building small packaged units which included a reversible motor and two relays had considerable field trouble with the motors failing to shut off.

The trouble was found to be caused by a sticky combination of oil residue and dust particles which under continued pounding between the armature and core, holding the relay armature energized (and the motor on) even after this voltage

was removed from the coil.

In this case the relay was mounted just below the motor and directly in its exhaust airstream when the motor was running in the reverse direction. The sticky material was formed by the combination of oil fumes from the motor bearings, wear particles from its brushes and normal dust in the air which settled on the relay parts.

Some types of relays and many contactors can be given preventive maintenance in the field, but the readjustment or maintenance of most relays should not be attempted by other than qualified adjusters with considerable experience with the type of relay concerned.

Special tools are often required for properly adjusting different relay types. Special pliers with ends ground down to give a thin, smooth surface with which to give a stroking action to a contact arm are often used. A small stroking or bending tool can be used to advantage especially when the arm to be adjusted is hard to get at. Con-

tact pressures must be checked with gram gages capable of measuring from as little as 5 to as much as 150 or more. Thickness gages from 0.001 to 0.125 in. are also used to check contact gap or for measuring overtravel.

These are just a few of the reasons why it is often best for most people to limit relay maintenance to merely keeping a good environment. The following check points will help assure reliability, long life and minimum maintenance:

- Keep areas around relays as clean as possible.
- Protect relays from airflows containing contaminants harmful to contacts, moving parts, etc.
- Keep unsealed relays out of corrosive fumes.
- Provide adequate ventilation to keep the ambient temperature within the relay design limits.
- Make sure the voltage supply is within relay tolerance (nominal voltage ± 10 percent is preferable).
- Keep contact loads within the manufacturer's rating.

● When mounting relays, try to position them to allow contact erosion particles to fall through the relay without becoming lodged in the magnetic structure.

● Use good soldering techniques when replacing relays, and protect the contacts from flux deposits.

● Do not allow untrained personnel to tamper with relay adjustments.

● Be sure that leadwires are not placing undue strain on the terminals.

If proper adjustment equipment and personnel are not available for servicing, it is usually best to replace defective or worn relays with new ones and return the old ones to the manufacturer for rework. Obviously, there are some drawbacks to this, especially where low-cost

relays are concerned — it may be more economical to just throw away the old relays and order new ones to replenish the parts stock.

When trained personnel and adjusting tools are available for preventive maintenance, effective relay life can often be extended by carefully checking relay adjustments and wear and then making necessary corrections.

Trouble Shooting Guide

<u>Trouble</u>	<u>Possible Causes</u>	<u>Remarks</u>
Relay fails to operate or pulls in slowly when coil is energized	Low voltage at coil or poor supply regulation. Check for dirt between armature and core and other moving parts. Hook-up wires may be impeding armature movement. Normally closed contacts welded. Check coil resistance to determine if open or shorted. Combination of too low coil voltage and too high ambient temperature. Energizing pulse too short.	Voltage at coil terminals should be at least 80% of coil nominal at 25°C. Check for overloading. Ventilate area where relay is mounted and correct line voltage.
Pulls in properly but armature chatters loudly.	Dirt between armature and core. Armature may be hitting unshaded portion of core due to wear. Dc relay substituted instead of ac. Check dc voltage supply for too much ripple.	Clean with a piece of plain coarse paper. ¹ Sand unshaded portion with fine grade of emery paper. ² Some dc relays will not operate on unfiltered half wave rectified 60C.
Relay energized but contacts will not conduct.	Dirty contacts. Tarnished contacts. No contact pressure.	Clean contacts with alcohol. ³ Clean with burnishing tool. Relay worn out or damaged.
Will not drop-out when coil energy is removed or reduced to drop-out specification.	Sticky substance on core surface. Magnetic structure has developed residual magnetism. Switching device allowing enough leakage current to hold in armature. Normally open contacts welded. Core may have worn into armature causing low drop-out point. Check for hook-up wire or other armature obstruction.	Use cleaning solvents to remove. Replace entire relay. Check for overloading. Relay worn out and should be replaced.
Short contact life.	Load exceeds manufacturer's rating. Combination of heavy contact load and high ambient temperature. Contacts becoming contaminated from airborne dust particles. Corrosive atmosphere. Relay being switched by bimetal thermostat. Armature chattering.	Ventilate relay area and check for contact overload. Dirt on contacts will burn causing increased contact temperature. Use positive acting thermostats. ⁴
Premature coil failure.	High voltage transients breaking down insulation. Continuous overvoltage or high ambient temperature. Coil polarized at 50 vdc or more above relay frame in humid atmosphere. Rough treatment of coil terminals.	Nearby equipment may produce transients. Electrolysis action on coil wire. Causes breakage of fine magnet wire.
Too much contact bounce	Dirty contacts. Chattering armature. Coil voltage too high. Relay worn. Contact pressure low. Device switching relay has excessive bounce.	Armature hits core harder and adds to contact bounce.

NOTES:

¹ Hold armature closed while pulling paper between armature and core.

² Be careful to keep particles off contacts and clean with air hose to remove all particles from moving parts. Air should be well filtered and dry.

³ Hold armature so that contacts are closed and pull a strip of clean white paper slightly saturated with alcohol between contact surfaces.

⁴ The contacts on some slow moving bimetal switches will chatter considerably when coming together and will cause the relay to amplify the chatter thus burning relay contacts.

RELAYS

Part III

Continued

A telephone relay operating at full rated load (with a life expectancy of 100,000 operations) that has its contacts burnished, cleaned and readjusted every 50,000 operations will have a much longer-than-rated life — with a very light load and a dc coil, it could survive

as many as 10 million operations before servicing would be required.

General purpose relays are most likely to be in the lower cost bracket where field servicing or returning to the manufacturer is uneconomical. However, if mounted in an easily accessible location, a qualified adjuster can sometimes per-

form maintenance on these relays without removing them from the equipment.

It is usually difficult to set up a timetable for service on general purpose relays because of the variations of designs which tend to cause some to wear much more rapidly than others. Normally, an acceptable schedule would be to thoroughly check each relay when it has received 50 percent of the manufacturer's rating for expected electrical life while operating at full rated load. For very light loads, a periodic check with necessary corrections will add to over-all life. Servicing intervals for these loads cannot be definitely determined, but every 10 percent of rated mechanical life would be a fair estimate. Naturally, many factors play important roles in relay life, so these figures vary widely.

Field servicing relays, even by experienced personnel, should be limited to readjusting only. This would include setting contact gaps, pressures and overtravels and checking pull-in, drop-out and possibly timing characteristics if equipment is available. Normally, for replacement of parts, most manufacturers recommend the relays be returned to the factory, where proper jigs and building fixtures are available. Unless the relay is specifically designed for field replacement of parts, this job can become difficult and expensively time-consuming. There are, however, relays especially designed for parts replacement in the field. The Government Service Administration (GSA), for instance, requires that all the relays used in elevator controls installed in government buildings be designed with removable coils and contacts which can be replaced by average control panel maintenance crews. This necessitates a design whereby very little adjustment is necessary.

Detecting relays ready to fail but not yet failing could save valuable downtime and keep equipment in good running order, but this is not easy to do. Usually, only personnel with considerable experience with relays can know when a relay is approaching failure. Someone who has used a particular type of relay in large quantities and for a long time can develop a backlog of knowledge which will help. If he

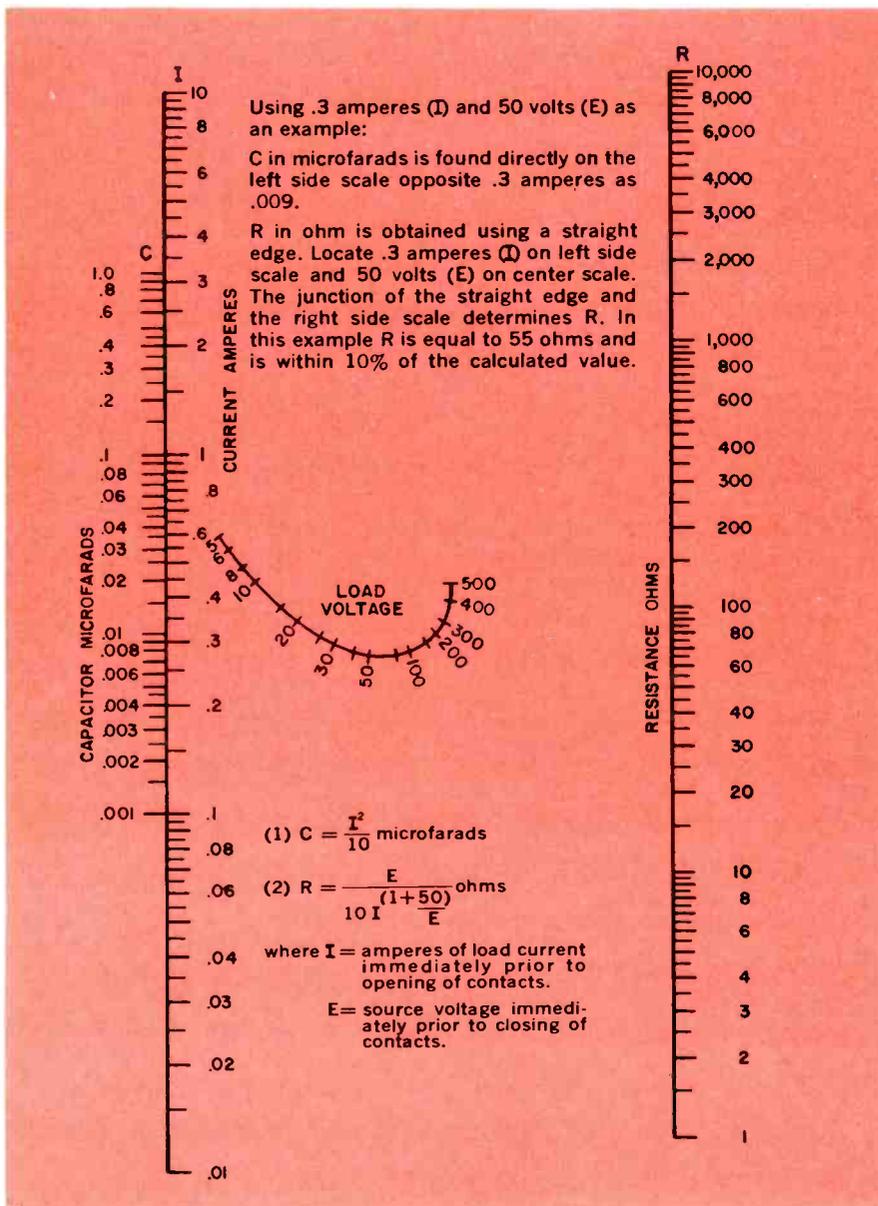


Fig. 2—Nomogram illustrating method of obtaining values of R and C for effective arc suppression.

has available the minimum adjustment specifications of the particular relay in question he can check its settings and observe for values decreasing to the point where trouble will occur.

Contact Arcing

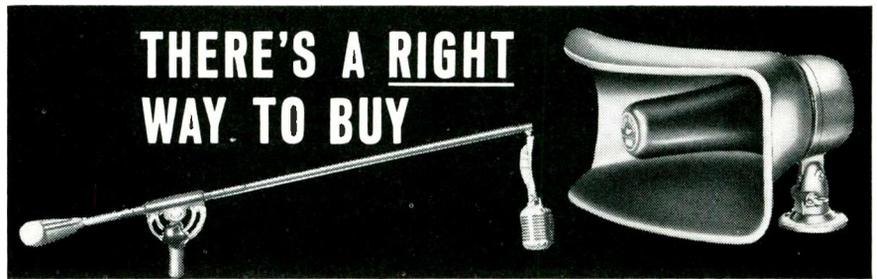
Contact life can be extended by reducing arcing. A very effective arc-preventive measure, especially on dc loads and one which will achieve the ultimate in longevity, is the use of an RC contact-protection circuit consisting of a resistor and capacitor in series, as shown in Fig. 1. Installation as close as possible to the relay terminals is required. The peak voltages in inductive circuits can be reduced to safe levels by increasing the value of C in the protective circuit. Nominal values can be calculated by using the equations in the nomogram of Fig. 2.

The RC network will also be somewhat effective on ac contact loads, but remember to use peak voltage and current values in your calculations. Also, keep in mind that this series circuit is a conductive path for ac. A low value of R and a high value of C may cause excessive leakage current.

For effective suppression, R should not be less than 0.5Ω and C should not be below $0.001 \mu f$. It should also be remembered that the equations and nomogram of Fig. 2 do not always produce the best results — they merely give a good starting point. Contact loads vary in nature and, thus, for proper suppression, so will R and C.

For values of E less than 70 v, R may need to be as high as three times its calculated value. R may vary ± 50 percent of its computed value if E is between 70 and 100 v or ± 10 percent if E is between 100 and 150 v. When E is greater than 150 v, R may only vary ± 5 percent of its equation value. Since these values vary widely in some instances, it is always best to check the suppression network on the actual load, observe its action with an oscilloscope, and vary R, if necessary, to produce the best results.

Table I lists a few common troubles encountered with the use of relays, the causes and suggested remedies. While not a cure-all, this table should help put equipment back into operation sooner. ■



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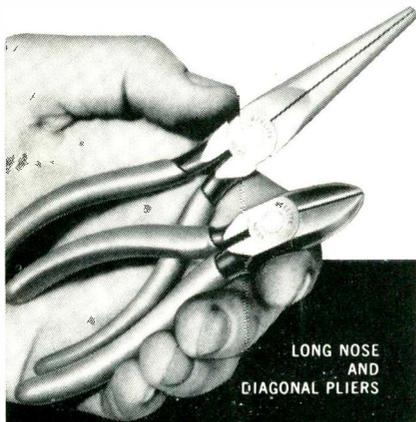
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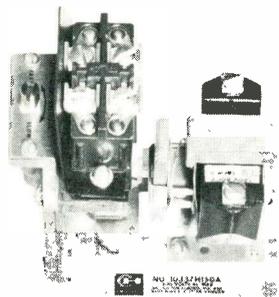
108



NEW PRODUCTS

PNEUMATIC TIMING RELAY 400

A 1-minute pneumatic, industrial-rated timing relay for general purpose application is announced. The



timer, rated at 600 v maximum, features a completely enclosed timing head with a silicone rubber diaphragm that is unaffected by low ambient temperatures, the announcement said. It offers a minimum reset time of only 0.02 sec and an effective timing range of 0.05 sec to 1 minute, the maker claims. Cutler-Hammer.

PHOTOCONDUCTIVE CELL KIT 401

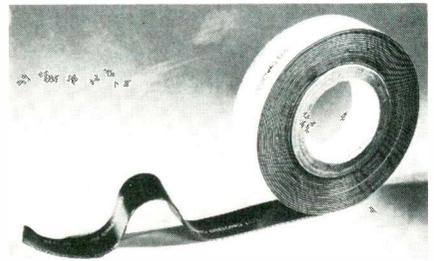
A kit containing a special selection of photoconductive cells plus technical data is introduced. Five



different types, in both Cadmium Sulphide and Cadmium Selenide, are included in the kit. The CL505, CL603A, CL704L, CL707 and CL902 comprise the selection, which varies sufficiently in sensitivity, spectral response, speed and size to suit most applications. Price \$10. Clairex.

SHIELDING TAPE 402

A conducting shielding tape, that is also self-bonding, is announced. Applications include shielding high voltage splices and terminations on



5 kv to 35 kv power cables, the announcement said. It may be used as a combination strand shield and bedding tape for primary insulating tapes on HV splices operating up to 90°C conductor temperature, and becomes an integral part of the insulating tape itself through its bonding properties. The manufacturer also recommends it for shielding stress cones on URD terminations, for static shielding on high-voltage splices and for filling indents in compression connectors. Bishop.

TETRODE RF AMPLIFIER 403

Tube type 8516, a coaxial version of the 6076 has been announced. It is a forced air cooled



tetrode of the 3 kw plate dissipation class designed for use as an RF amplifier for frequencies extending throughout the VHF range. Both the control grid and screen grid connections are made to ring-type connectors brought out through the tube envelope. This facilitates operational performance by eliminating discontinuity in the impedance versus frequency characteristics. Amperex.

PORTABLE TEST SETS 404

Announced in a series of compact portable test sets for making calibration checks of millivoltmeters and pyrometers. The test sets, Models 2706, 2707 and 2708, are combinations of portable potentiometers and the Model 2747 Run Up Unit mounted in the same case.

The Run Up Unit has a dual range current source of 0 to 12 mv and 0 to 120 mv and also provides manual reference junction compensation and adjustment for external lead resistance. A thermocouple-negative position permits the unit to be used for temperature measurements



below table reference temperatures without reversal of thermocouple leads. Honeywell.

RELAY TOOL KIT 409

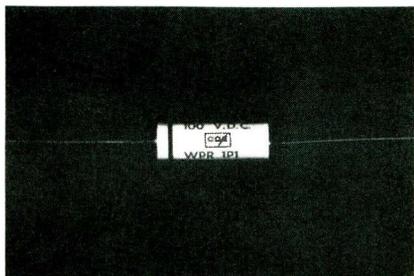
A line of tools for adjusting and maintaining relays and telecommunications equipment is introduced.



Tools are also designed for production of electronic and all other delicate equipment and instruments. Jonard.

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A dc tubular capacitor Type WPR is designed for precision timing circuits, high-Q tuned circuits,



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POLARITY REVERSAL SWITCH. Reverses polarity of test leads without need for re-connecting. Handy for checking front-to-back resistance ratio of electrolytic capacitors and many types of semiconductor devices.

39 DIFFERENT MEASUREMENT RANGES.

MEASURES CURRENT from 50 microamps full scale to 10 amps full scale.

SPECIAL 0.25 volt and 1.0 volt (full-scale) DC ranges... useful in checking transistor circuits.

... and many additional features that have made this instrument the best V-O-M buy on the market today. **Only \$47.95***. Kit version, WV-38A(K), only \$29.95*.

See it at your Authorized RCA Electronic Instrument Distributor.

*Optional distributor resale price. Prices subject to change without notice. Prices may be higher in Alaska, Hawaii and the west.

RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.



The Most Trusted Name in Electronics

Winegard

Dealer of the month

No. 27 of a Series

Jim Miyagawa says: "With Colortron C-44's and 220N Amplifiers, we pull in Chicago and Detroit ... both over 100 miles away."



Shown in photo: Ronald Poling (left) antenna-installation expert for George's Appliance Co. and Ralph Swagler, Service Mgr.

Winegard salutes George's Appliance Co., Kalamazoo, Michigan, and their distributor, Electronic Supply Corporation, Battle Creek, Michigan.

Jim Miyagawa has been going strong in Kalamazoo since 1940 and today maintains a thriving, 7000 sq. ft., 10-man operation in one of Kalamazoo's modern shopping centers.

"In our 20 mile service area," said Jim, "our problem is achieving top quality reception with weak fringe area signals. We need an antenna we can depend on to pull in the rough ones, especially an unpredictable channel 13 transmitting from 85 miles away. Winegard is the one. It sure saves us a lot of time otherwise spent in hunting down stations. And we sure have made a lot of customers happy by coupling up the Colortron C-44 with a 220N amplifier to pull in Chicago and Detroit."

The confidence Jim Miyagawa has shown in Winegard products has come from installing them and seeing them in action. He's one more important service man who knows Winegard's standards of excellence first hand.

Winegard Co.

Antenna Systems

D3019J Kirkwood • Burlington, Iowa

... for more details circle 68 on post card

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UTICA

HAS THE COMPLETE LINE



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T & C
III

The ultimate in Citizens Band equipment, 23 channel. \$259.95



UTICA
T & C
II

Powerful 6 channel Citizens Band Transceiver, many outstanding features. \$162.50



UTICA
MC-27

6 channel xtal control, built-in dual power supply, a powerful unit. \$142.50



UTICA
'650 A'

New improved and powerful. 117VAC and 12VDC transistorized supply. CW and phone operation plus even greater features. \$199.95



UTICA
CD '652'

6 meter Civil Defense transceiver for operation on 50-52 Mc or 52-54 Mc. 15W input, receives AM, SSB, & CW. \$150.00



UTI-COM

FM Transceiver for assigned frequencies in the 150-175 Mc FM commercial band. \$359.95



UTI-COM

Remote head accessory for FM transceiver includes speaker and controls. \$41.50



UTICA FMR-12

UTI-COM FM Receiver — the 12VDC mobile monitor for any assigned frequencies on the 150-175 Mc FM commercial band. \$149.95



UTI-CALL

TONE SIGNAL DEVICE
UTI-CALL tone signal alert for selective calling of your operators. Fully automatic. \$89.95



UTI-COM '30'

AM Business radio transceiver for use on the 30-50 Mc AM band, 30W input, dual power supply. A powerful unit. \$234.95



UTICA SIGNAL OPTIMIZER

Single unit to test CB equipment for: antenna power in watts, mod., field strength, additional features. \$47.50

UTICA
COMMUNICATIONS CORPORATION

GET THE
FACTS FAST!

2917 W. Irving Park Road Chicago, Illinois 60618

NAME _____

ADDRESS _____

CITY _____ STATE _____

10-ET

... for more details circle 70 on post card



How to replace top quality tubes with identical top quality tubes

Most of the quality TV sets you are presently servicing were designed around special Frame Grid tubes originated by Amperex. More and more tube types originated by Amperex are going into the sets you'll be handling in the future.

Amperex Frame Grid tubes provide 55% higher gain-bandwidth, simplify TV circuitry and speed up your servicing because their extraordinary uniformity virtually eliminates need for realignment when you replace tubes.

Amperex Frame Grid Tubes currently used by the major TV set makers include:

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 13 on post card

TOY Festival!

RCA presents a...

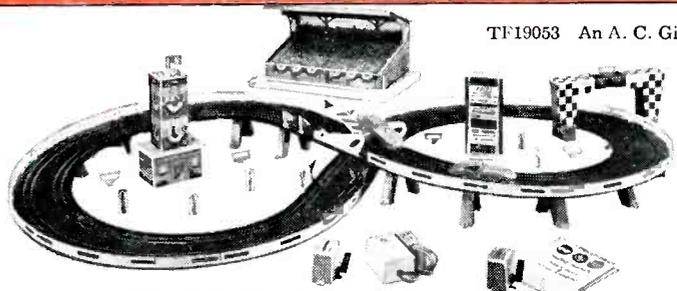


Get these and other wonderful toys *now*—in plenty of time for Christmas. **THEY'RE AVAILABLE WITH YOUR PURCHASE OF FAMOUS RCA ENTERTAINMENT RECEIVING TUBES FROM YOUR PARTICIPATING RCA DISTRIBUTOR.** Shown below are some of the toys.



AMF ROADMASTER 26" BICYCLE.
The sleek "Skyrider" in both boys' and girls' models. Chrome-plated headlight and other "most wanted" features will make it the hit of the year under your Christmas tree.

Boys (TFP-9675): red with white trim
Girls (TFP-9685): blue with white trim



TF19053 An A. C. Gilbert Toy



AUTORAMA SPEEDWAY RACE. Action car racing with separate speed controls for each car. New "See-Saw Ramp" can be used as a jump ramp for extra thrills. Comes with all accessories to simulate a race track.



DELI-CAT.
Cute as a button. Comes with brush for stroking her long silky hair. Prettiest little cat a girl ever owned.



TF7325-0 An Ideal Toy



TINY PEBBLES DOLL. From the "Flintstone" family of TV fame...a prehistoric peach of a doll. Jointed arms and legs. 12" high.



TF0720-3 An Ideal Toy

TF4722-5 An Ideal Toy



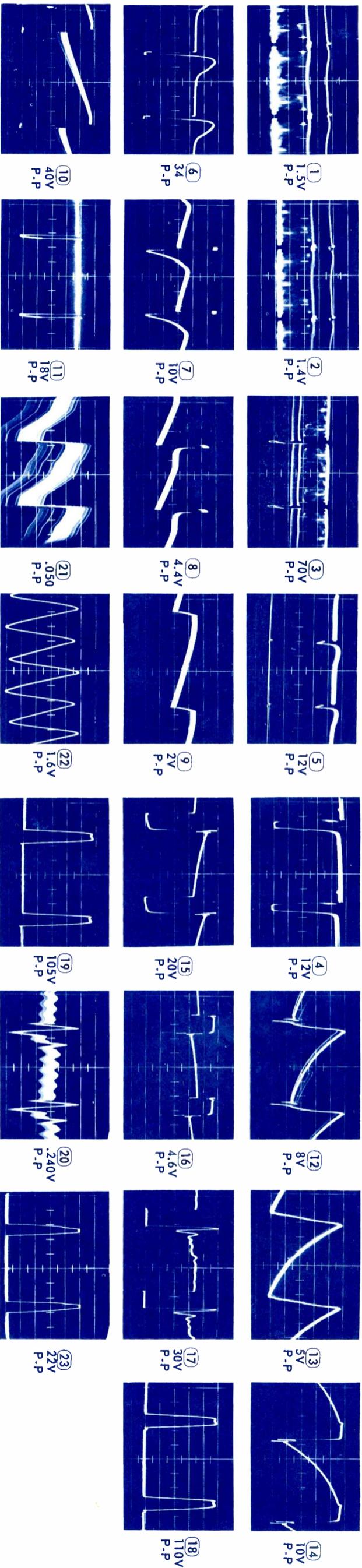
U.S.N. ANZIO INVADER. A 31" landing craft complete with tank destroyer, helicopter and pilot, 14 combat-ready soldiers with weapons. Made of rugged plastic.

These and other exciting toys are available **NOW** with your purchase of RCA Entertainment Receiving Tubes. See your nearest participating RCA Distributor for details.

RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.



The Most Trusted Name in Electronics

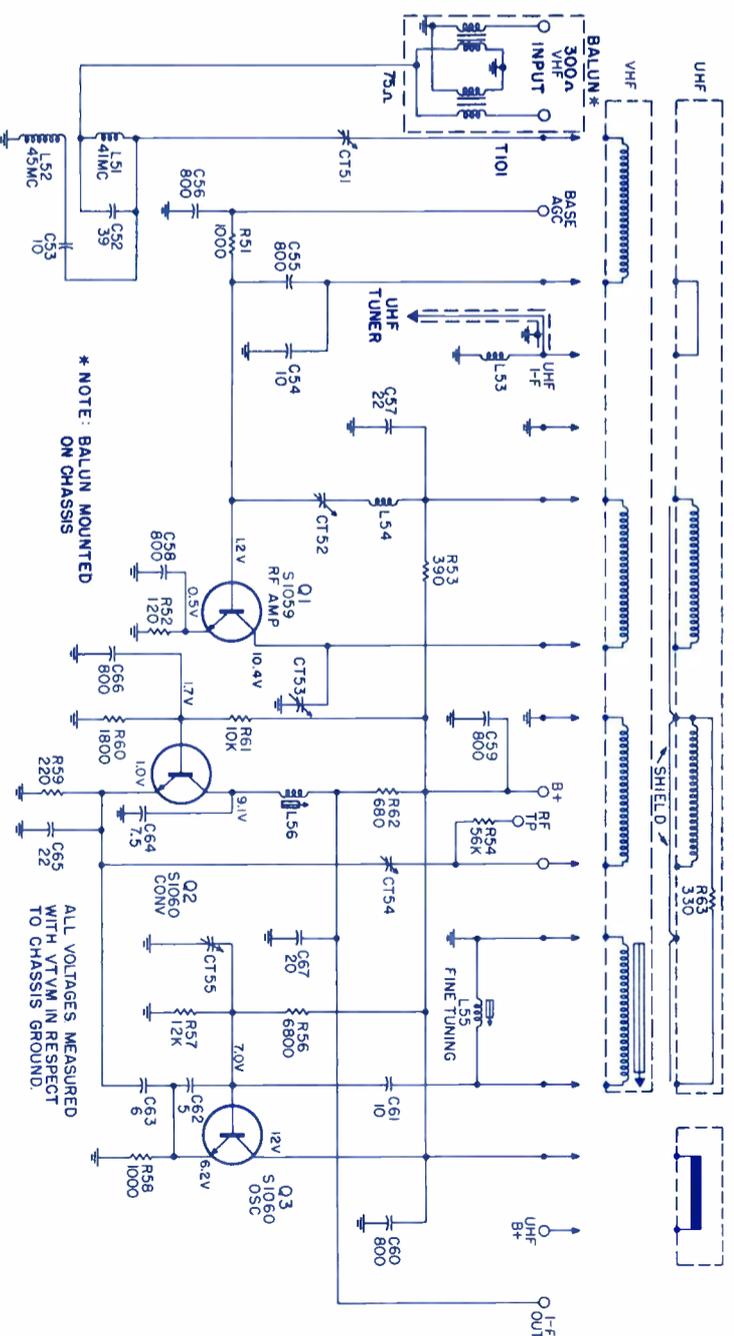
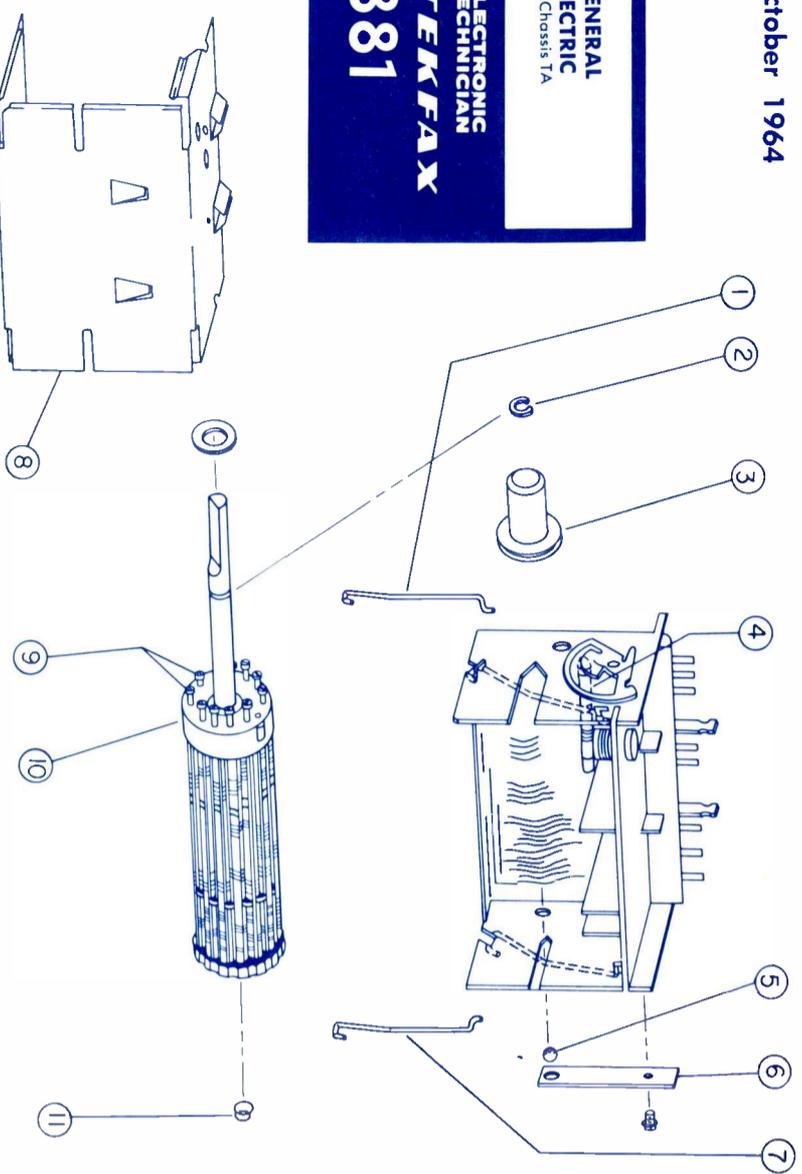


OSCILLOSCOPE AT VERTICAL RATE

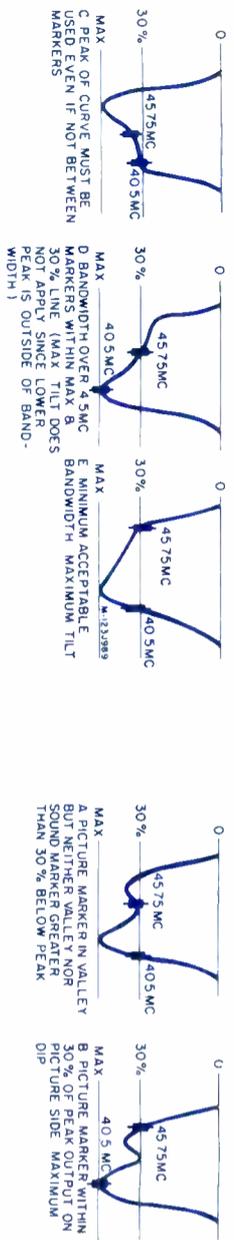
OSCILLOSCOPE AT HORIZONTAL RATE

October 1964

GENERAL ELECTRIC
ELECTRIC
TV Chassis TA
TEKFAK
881



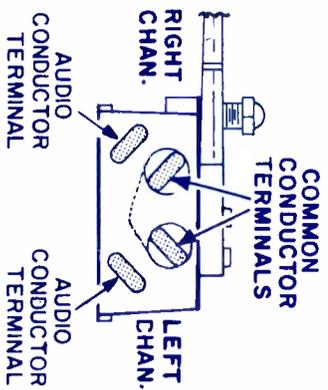
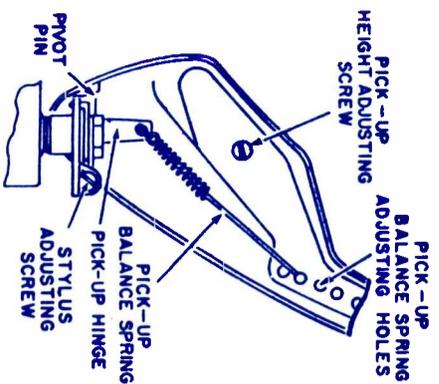
More Data on Reverse Side



880

EMERSON
AM/FM Tuner
Chassis 120732
5 watt amplifier
Chassis 120716

October 1964

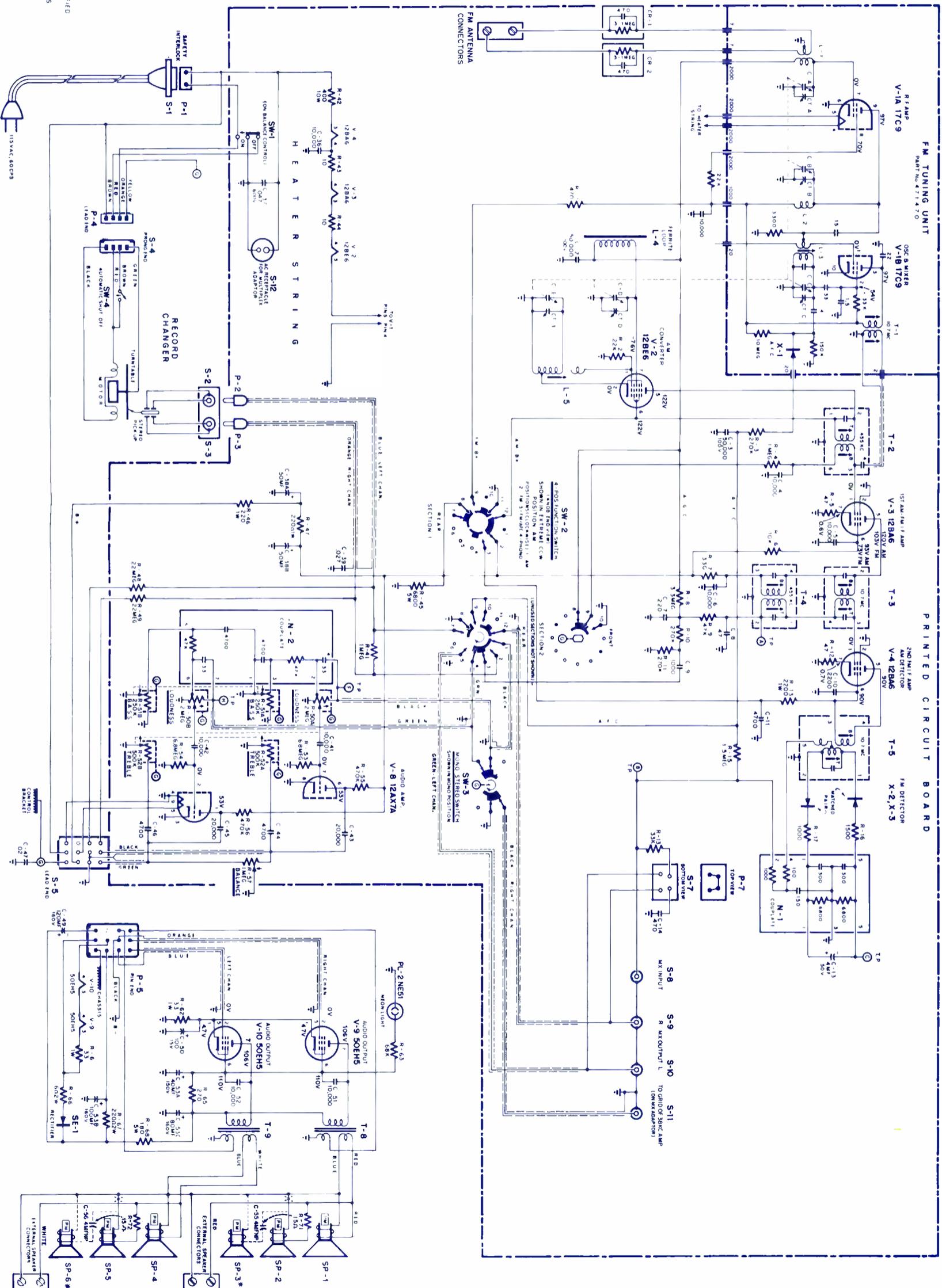


⊖ CERAMIC CAPACITORS CAPACITY IN PICOFARADS (P.F.) 1 p.f. = 0.001 μF
⊖ TUBULAR CAPACITORS CAPACITY IN MICROFARADS (μF)
ALL CERAMICS 500V. ALL TUBULARS 400V UNLESS OTHERWISE SPECIFIED
RESISTORS IN OHMS (Ω), 1000 (K) AND 100,000 (M) UNLESS NOTED
TOP COIL (T-8) BOTTOM COIL (T-9) IN DOUBLE TUNED TRANSFORMERS
ARROWS AT CONTROLS INDICATE CLOCKWISE ROTATION
ALL ⊕ POINTS ARE TIED TO CONTROL BRACKET

ELECTRONIC TECHNICIAN

TEKFAAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS
AND TECHNICAL INFORMATION FOR SIX NEW SETS



- NOTES:
- (1) PROPER PHASING OF SPEAKERS MUST BE OBSERVED
 - (2) *SP-3 & SP-6 USED ON MODEL P-1937A ONLY
 - (3) R-718-R-72 USED IN MODEL P-1936A. MODEL P-1937A UTILIZES TWO 4 MFD. NON-POLARIZED CAPACITORS (NO. 925391) IN PLACE OF THESE RESISTORS TO PROVIDE HIGH-FREQUENCY CROSSOVER.

VOLTAGE READINGS

V-1, 4	- SW-2 IN FM POS.
V-2	- SW-2 IN AM POS.
V-3	- SW-2 AS INDICATED
V-8, 9, 10	- SW-2 IN AM OR FM POS.

(SEE ALSO CONDITIONS FOR READINGS SHOWN ON PAGE 2 OF THIS SERVICE NOTE)

877

**PACKARD
BELL**
TV Chassis 88-16

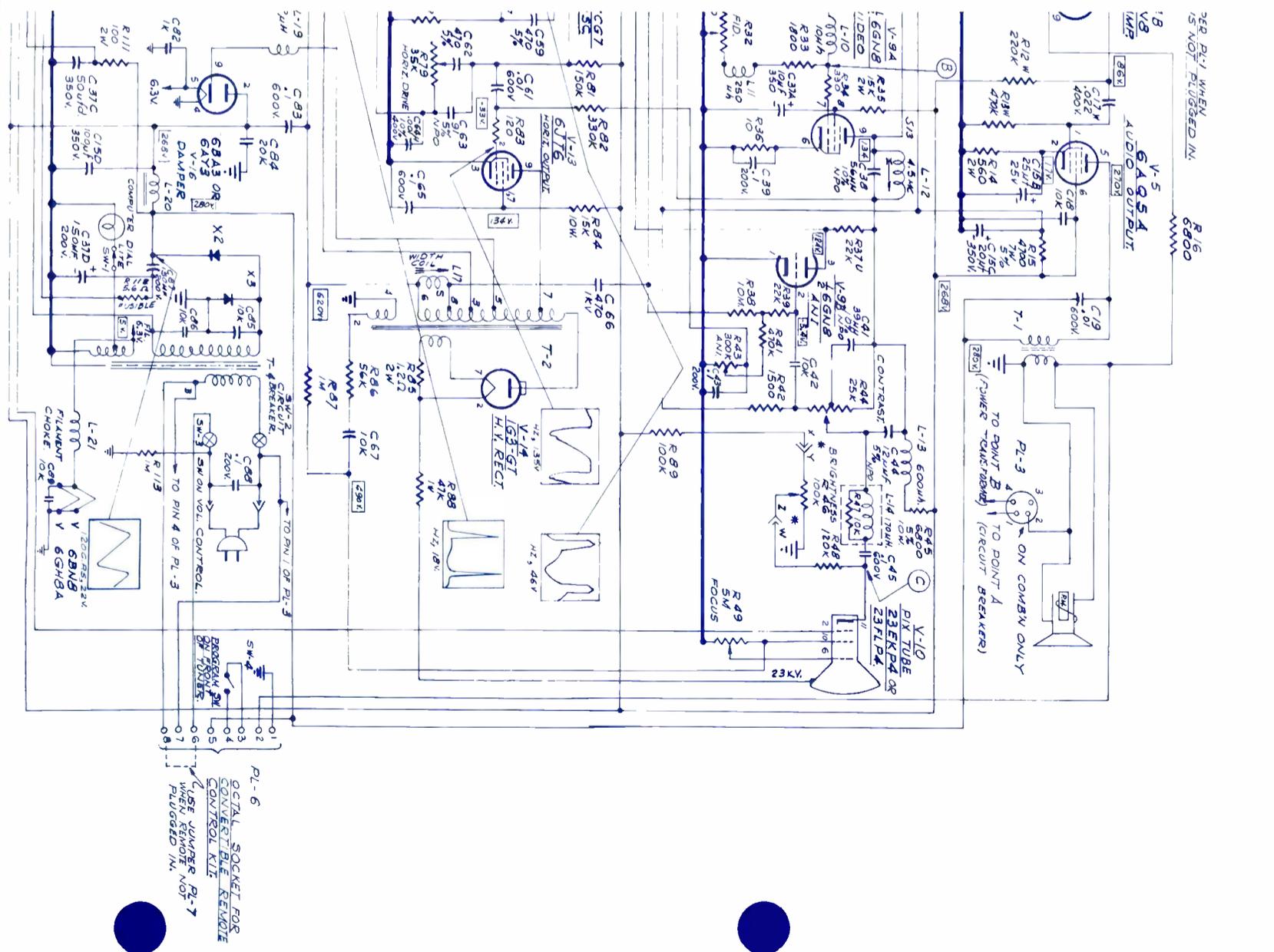
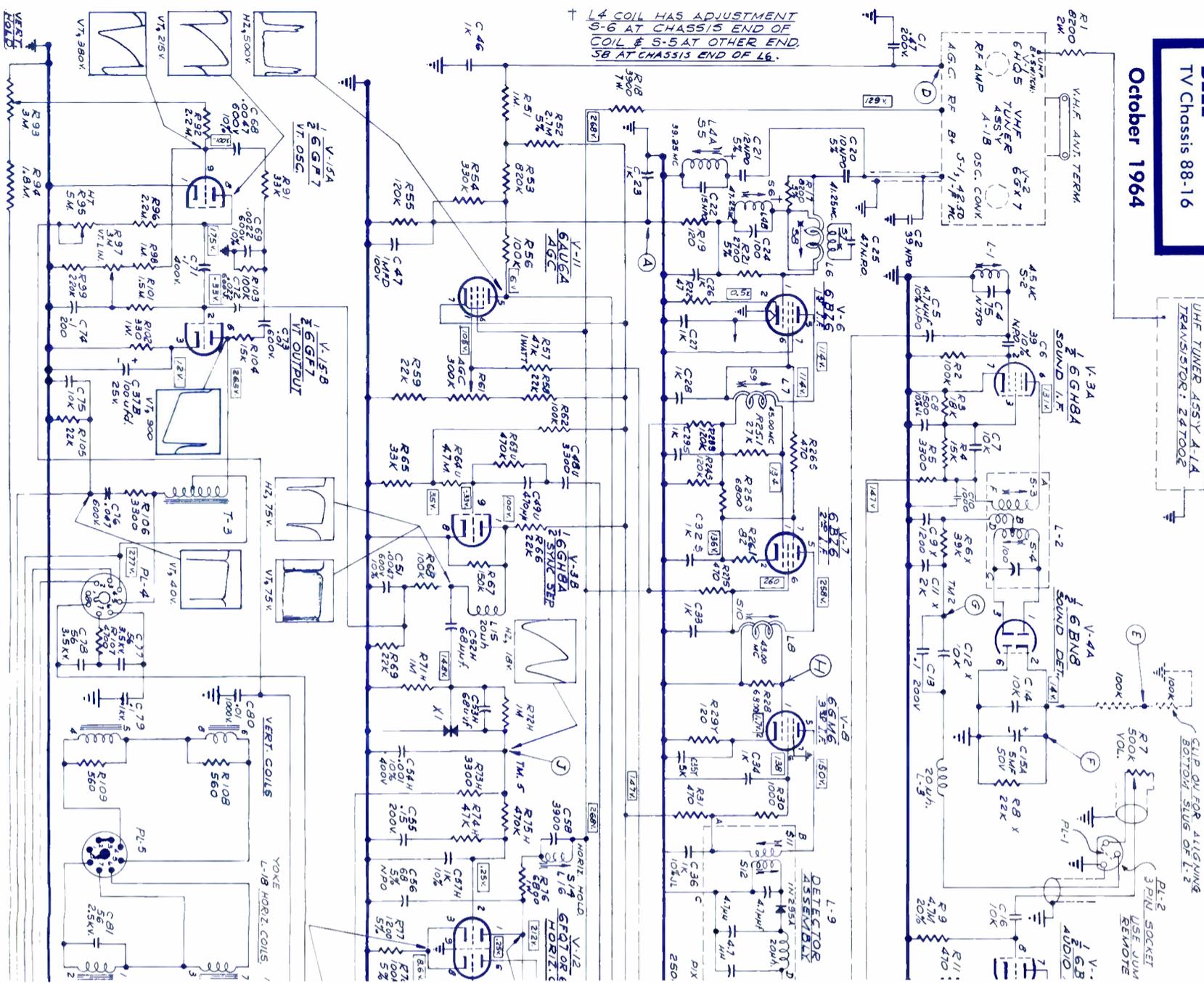
October 1964

ELECTRONIC TECHNICIAN TEKTRAX

COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS
AND TECHNICAL INFORMATION FOR SIX NEW SETS

* W CONNECTED TO I AND X CONNECTED TO Y UNLESS A CORD REMOTE IS USED IF SO W AND X ARE CONNECTED TO BRIGHTNESS CONTROL ON THE CORD REMOTE.

NOTES:
1- UNLESS NOTED TO THE CONTRARY, D.C. VOLTAGES WERE MEASURED WITH NO SIGNALS, CONTROLS WERE SET FOR NORMAL PICTURE RECEPTION, AND THEN SIGNAL WAS REMOVED. LINE VOLTAGE/100V WAS MEASURED WITH 120 VOLT LINE, NORMAL SIGNAL, & ZERO BEAM CURRENT.
2- 23KV MEASURED WITH 120 VOLT LINE, NORMAL SIGNAL, & ZERO BEAM CURRENT.
3- A LETTER AFTER THE REFERENCE SYMBOL (R25) INDICATES THAT THE COMPONENT IS PART OF P.E.C.
4- ALL RESISTORS 1/2W. & 10X UNLESS SPECIFIED, EXCEPTION: R.E.G. UNITS ARE 1/4W. & 20X.
5- SWEEP FREQUENCY (H.Z. OR VZ) & PK. TO PK. VOLTAGE IS INDICATED BESIDE EACH WAVE FORM.
6- ALL RESISTORS 1/2W. & 10X UNLESS SPECIFIED, EXCEPTION: R.E.G. UNITS ARE 1/4W. & 20X.
7- SWEEP FREQUENCY (H.Z. OR VZ) & PK. TO PK. VOLTAGE IS INDICATED BESIDE EACH WAVE FORM.



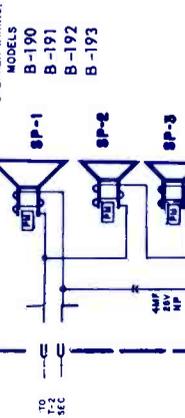
ELECTRONIC TECHNICIAN TEKFAKX

COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS
AND TECHNICAL INFORMATION FOR SIX NEW SETS

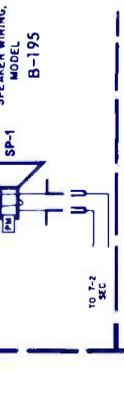
GROUP
146

Schematic No.	Model	Manufacturer
876	PACKARD BELL TV Chassis 88-16	RCA
877	PACKARD BELL TV Chassis 88-16	RCA
880	EMERSON AM/FM Tuner Chassis 120732	KCS 136X
881	GENERAL ELECTRIC 5 watt amplifier Chassis 120716	ZENITH
878	GENERAL ELECTRIC TV Chassis TA	ZENITH

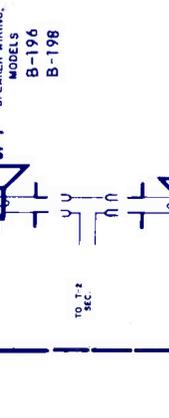
SPEAKER WIRING



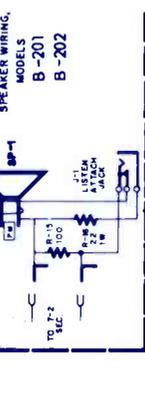
SPEAKER WIRING



SPEAKER WIRING



SPEAKER WIRING



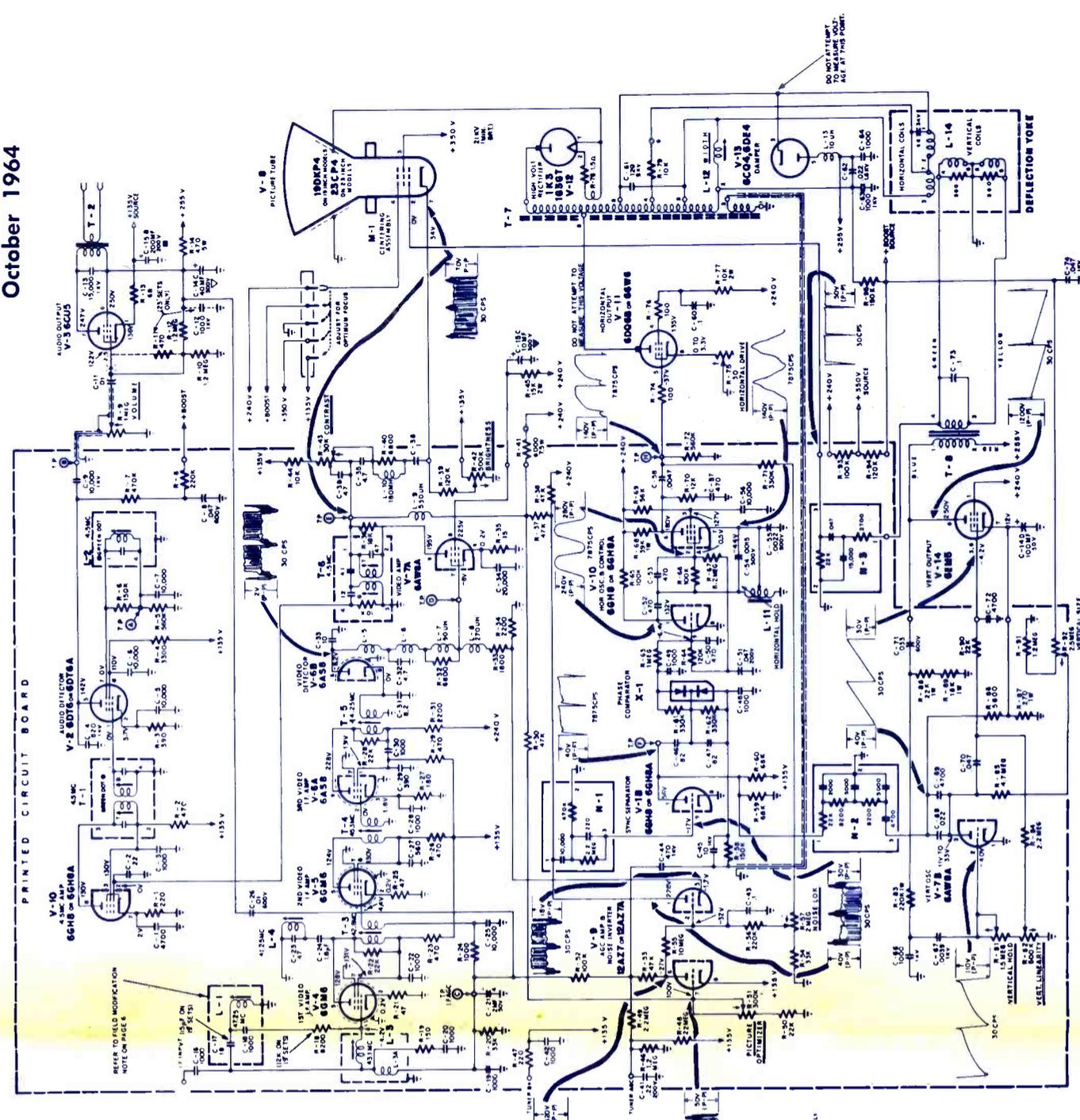
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ELECTRONIC TECHNICIAN TEKFAKX

COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS
AND TECHNICAL INFORMATION FOR SIX NEW SETS

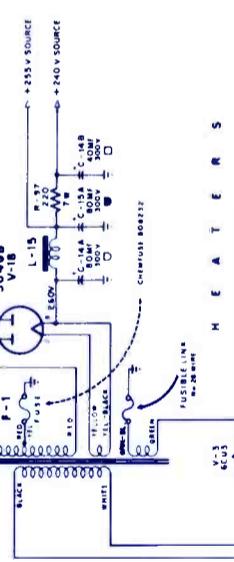
DUMONT
TV Chassis
120708, 712, 725

October 1964

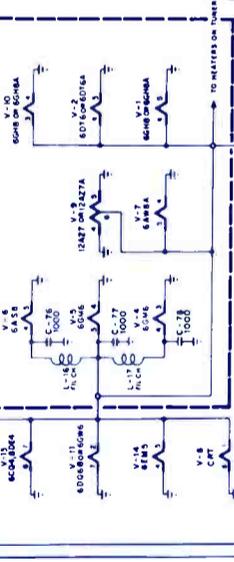


CHASSIS No. 120708, 712, 725.

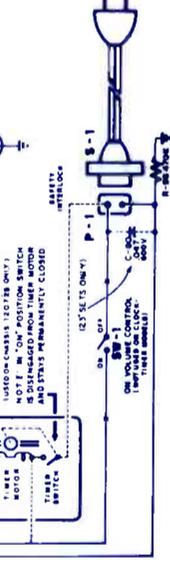
T-10



HEATERS



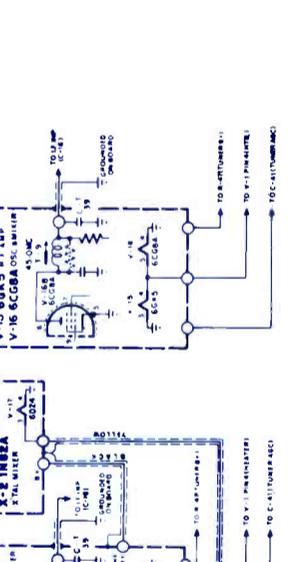
CLOCK TIMER



UMF SECTION



VHF SECTION





MALLORY

Tips for Technicians

Mallory Distributor Products Company
A division of P. R. Mallory & Co. Inc.
Indianapolis, Indiana 46206

How to break the capacitor replacement habit

Ever hear of "original capacitor-itis?" It's a habit that has been plaguing service technicians for decades. Here's what it means. If you need to install a new capacitor, you automatically get one *exactly* like the one that was in the circuit. The original capacitor, in theory, is the best one for the job.

But... it ain't necessarily so. And breaking the habit can often save you money.

When you need to replace a mica capacitor, for instance... consider ceramics. They'll often do a better job, for less cost (and we mean up to $\frac{1}{2}$ as much) than mica capacitors in most circuits. Ceramic capacitors often give you an extra safety factor in voltage rating, too; except for a few miniature and special types, their standard rating is 1000 volts DC. Some up to 30 KV. You can almost always replace mica with ceramic. But... you seldom can replace ceramic with mica, because ceramics are often selected by original equipment designers for temperature compensating functions.

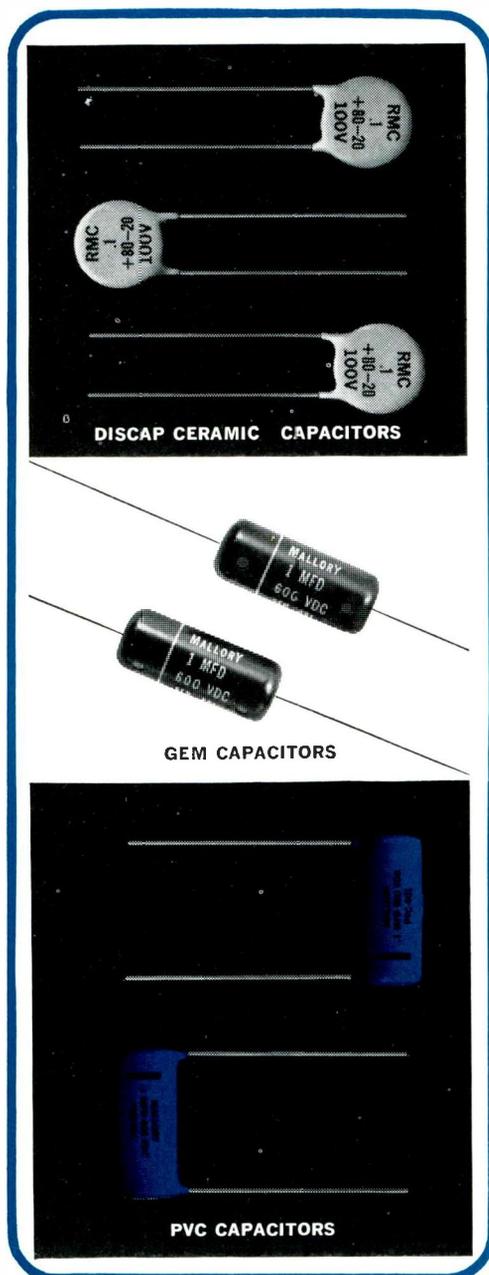
Don't forget to think of ceramics, too, when you need to replace a molded tubular capacitor. They cost about the same or even less, value for value. If you've got 'em, you can use 'em.

Here are two tips that may save you time and money.

First... when you're replacing a capacitor, all you need 9 times out of 10 is the same microfarads and voltage rating. Not a round one. Or a square one.

Second... when you need capacitors, see your Mallory Distributor. He carries not only a complete line of Mallory Discap[®] ceramic capacitors... the finest in the industry... but also Mallory GEM[®] and PVC[®] Mylar* tubulars. Plus Mallory electrolytics, batteries, volume controls, switches, semi-conductors. All of them at famous Mallory quality, at sensible Mallory prices.

*Registered Du Pont Trademark



GOOD VIEWS

Servicemen across America agree ...

JERROLD PARALOG

FOR BEST PERFORMANCE, MOST SATISFIED CUSTOMERS

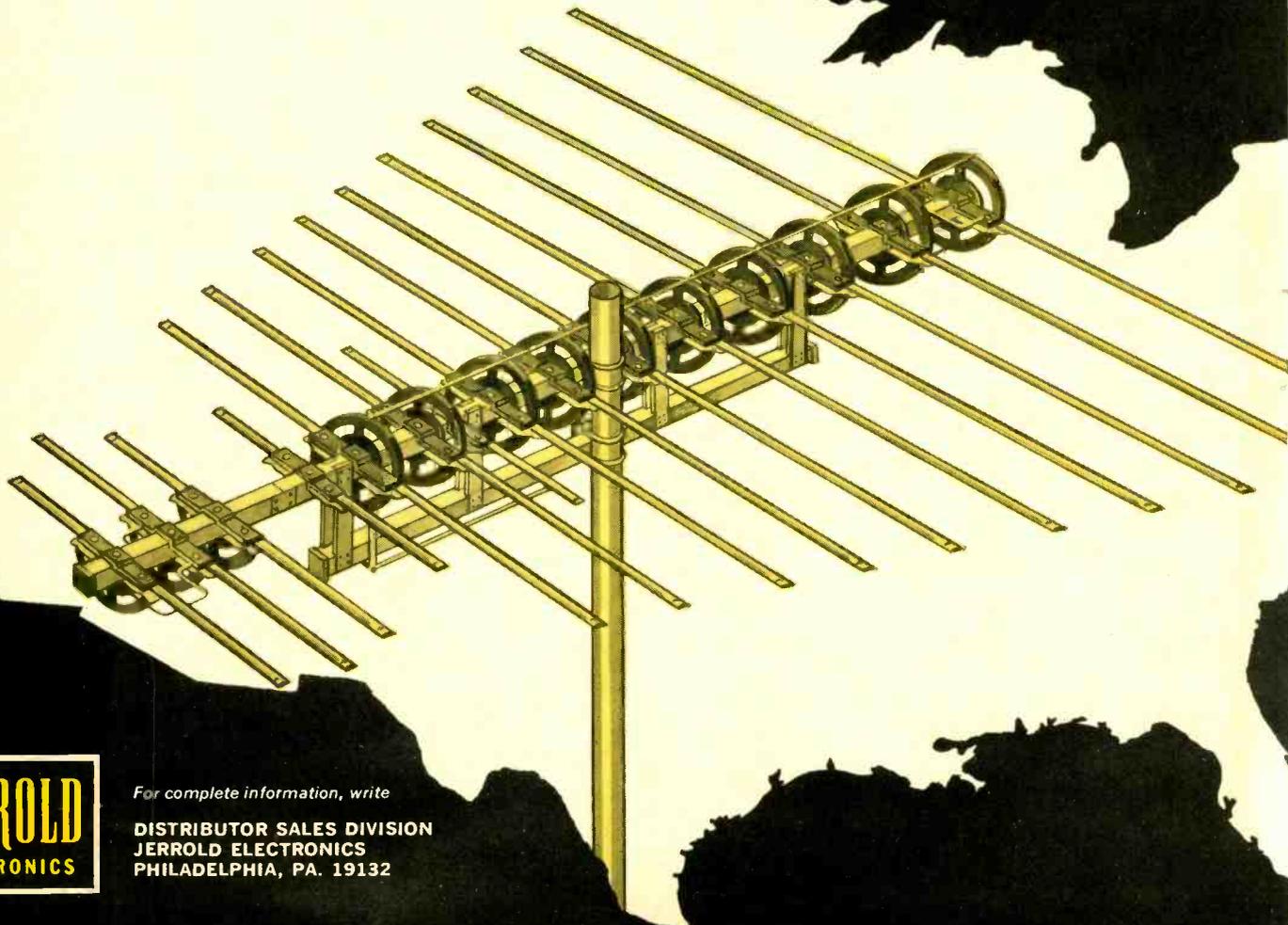
Paralog is sweeping the country . . . and it's no wonder! From Washington to Winston-Salem, TV service dealers tell us that Paralog performance is outstanding—even in the toughest reception areas. Dealers in every part of the U. S. find that customer satisfaction is a sure thing with powerful Paralog antennas.

What's more, these are men with years of antenna experience, and the kind of know-how that made them make extensive comparisons with competitive antennas before taking on the Paralog line. Has it paid off? Well, Russ Helveston, of Morrisville, Pa. says that "My antenna business is growing faster

than ever now," while Eugene Doll of Perham, Minn. tells us that "Business has been terrific on Paralogs."

Best of all, rugged, easy-to-install Paralog antennas come with better, built-in profits, the kind that make it mighty worthwhile to "sell up to a Paralog."

What about *your* antenna requirements? Have you made a side-by-side comparison of your present antennas against the Jerrold Paralog line? If not, be ready to switch! Have your Jerrold distributor show you *why* Paralog is the fastest-growing antenna line in the country today.



JERROLD
ELECTRONICS

For complete information, write

DISTRIBUTOR SALES DIVISION
JERROLD ELECTRONICS
PHILADELPHIA, PA. 19132



**Keep Inventories Low!
Save Time and Money!
Speed Up Repairs!**

NOW, WITH ONLY 10 RCA "TOP-OF-THE-LINE" TRANSISTORS YOU CAN REPLACE OVER 1900 ENTERTAINMENT TYPES

RCA's ten new "Top-of-the-Line" transistors can solve nearly every transistor replacement problem you will encounter in your servicing of phonographs, tape recorders, battery-operated portable radios, auto radios, and other entertainment-type equipment.

With an inventory of only 10 types, the RCA SK-Series transistors can quickly, easily, and economically provide you with hundreds of replacements—over 1900 in all, including many types of foreign manufacture.

For example, if you are active in the servicing of auto radios, you will find that just three types, the SK-3008, SK-3009 and SK-3012, will speed up repairs by providing you with replacements for virtually every transistor type used in auto radios.

RCA Type

SK-3003
SK-3004
SK-3005
SK-3006
SK-3007
SK-3008
SK-3009
SK-3010
SK-3011
SK-3012

Application

pnp type, AF Driver and Output Stages (9 V Supply)
pnp type, AF Driver and Output Stages (15 V Supply)
pnp type, RF, IF, and Converter Stages of Broadcast Receivers
pnp type, RF, IF, and Converter Stages of FM and AM/FM Receivers
pnp type, RF, IF, and Converter Stages of All-Wave Receivers
pnp types, RF, IF, and Converter Stages of Auto Radios
pnp type, Audio Output Stages of Auto Radios
nnp type, AF Driver and Output Stages of Broadcast Receivers
nnp type, RF, IF, and Converter Stages of Broadcast Receivers
pnp type, Audio Output Stages of Auto Radios

Ask your RCA Distributor for your copy of the new RCA replacement wall chart. It lists in alphabetical-numerical order the more than 1900 types which the 10 RCA SK-Type Transistors can replace.

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



The Most Trusted Name in Electronics