HUGO GERNSBACK, Editor-in-chief ■ SEPT. 50¢

Radio-Electronics

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ACCURATE TRANSISTOR TACHOMETER
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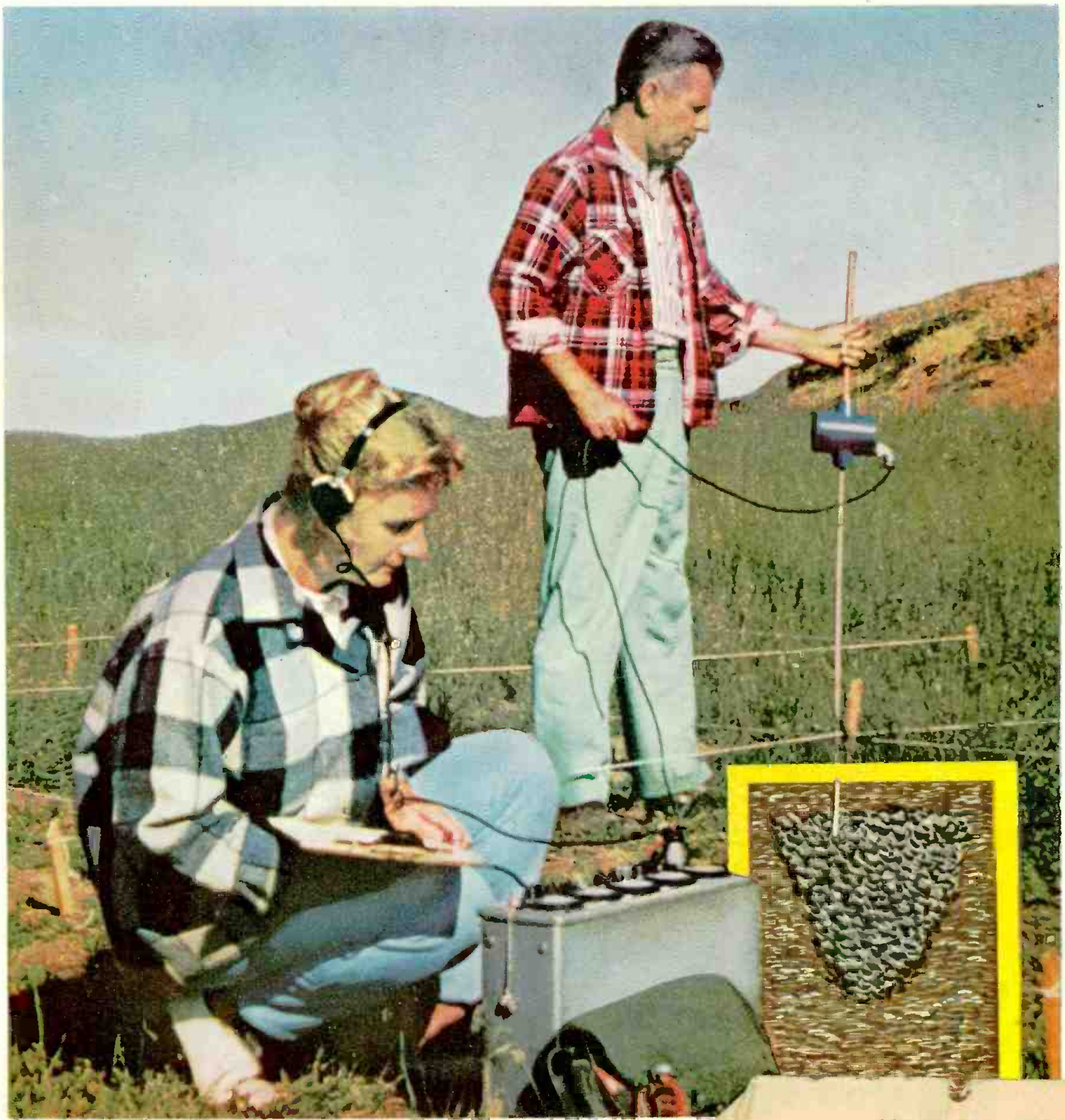

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1X2B	5HG8	6CB6A	6HA5	9A8
3BZ6	5U8	6CG7	6HG8	10CW5
3CB6	6AL5	6DT6	6S4A	12AT7
3GK5	6AU4GTA	6EH7	6SN7GTB	12AU7A
3HA5	6AU6A	6EJ7	6U8A	12AX4GTB
4BL8	6AV6	6GB5	6U9	12AX7A
4EH7	6AX4GTB	6GJ7	6X9	15CW5
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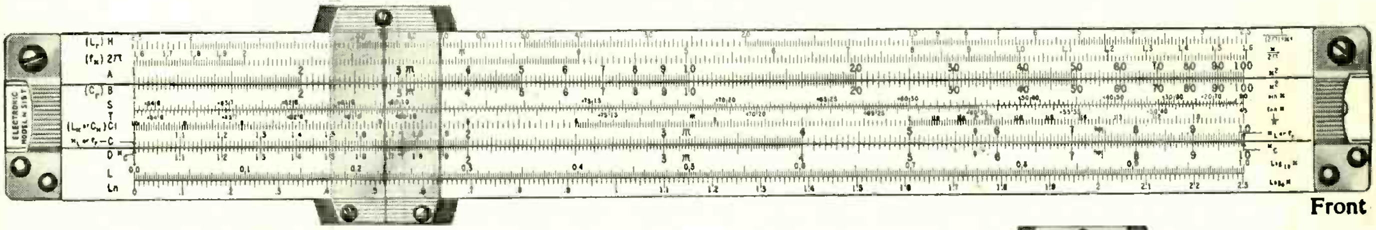
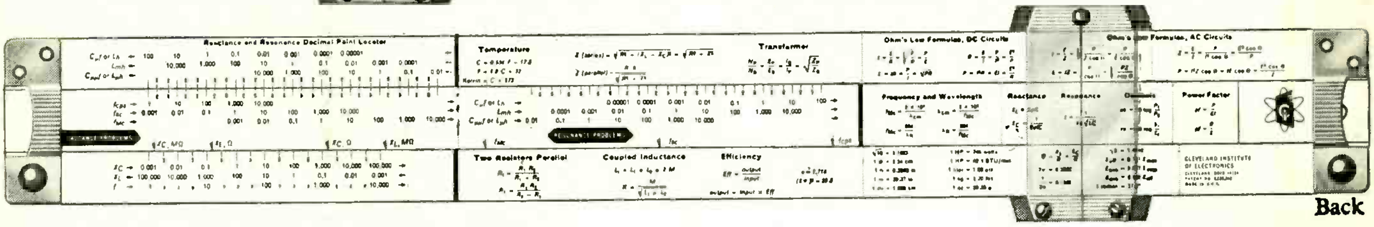


Front



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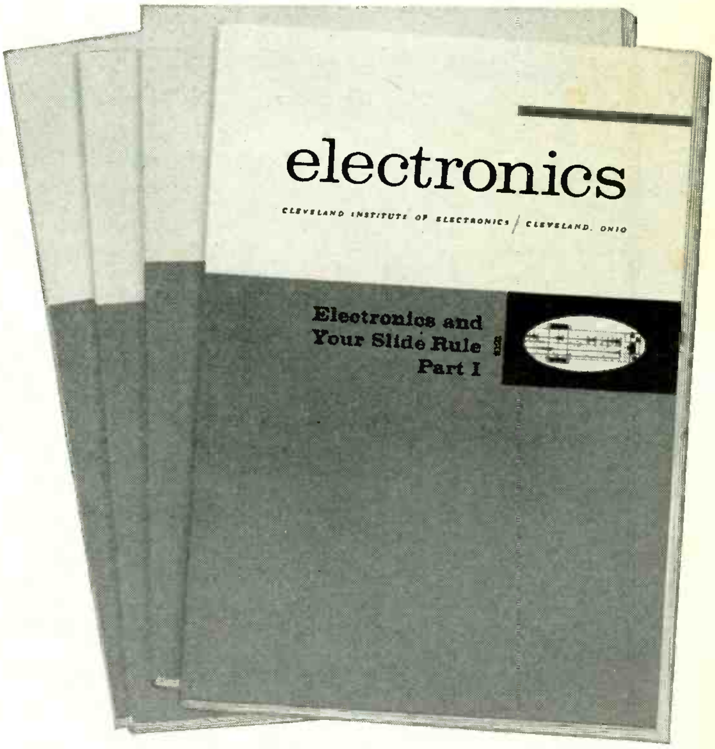

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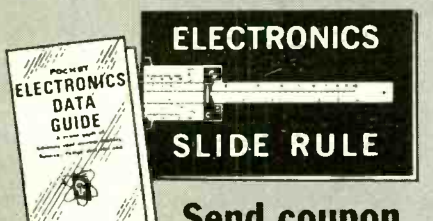

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Radio-Electronics

SEPTEMBER 1965 VOL. XXXVI No. 9

Over 55 Years of Electronic Publishing

Member, Institute of High Fidelity
Radio-Electronics is indexed in Applied Science & Technology Index (Formerly Industrial Arts Index).

ON THE COVER: Color original courtesy Scripps Institute of Oceanography. Section in yellow rectangle is artist's conception of underground area with magnetic anomaly (ashes of old firepit).

HUGO GERNSBACK, *editor-in-chief and publisher*. M. HARVEY GERNSBACK, *editor*. Fred Shunaman, *managing editor*. Robert F. Scott, W2PWG, *technical editor*. Peter E. Sutheim, *associate editor*. Jack Darr, *service editor*. I. Queen, *editorial associate*. John J. Lamson, *eastern sales manager*. Wm. Lyon McLaughlin, *technical illustration director*.

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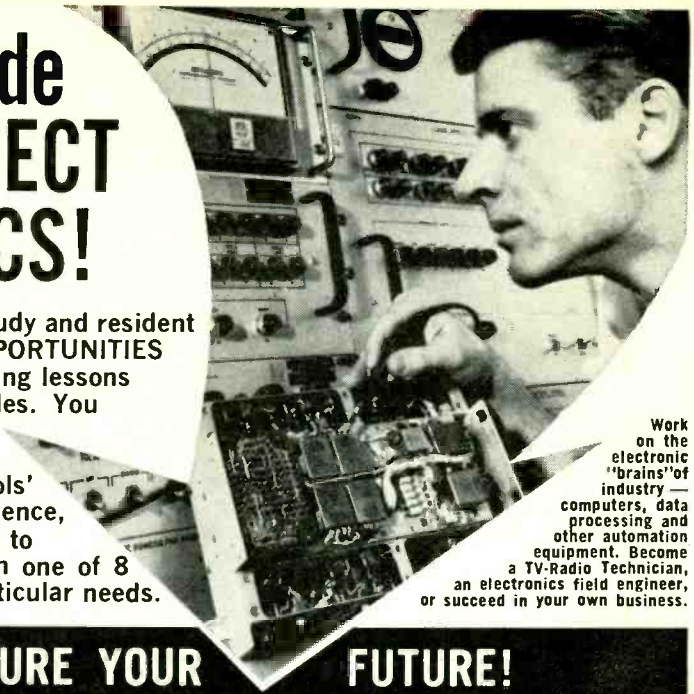

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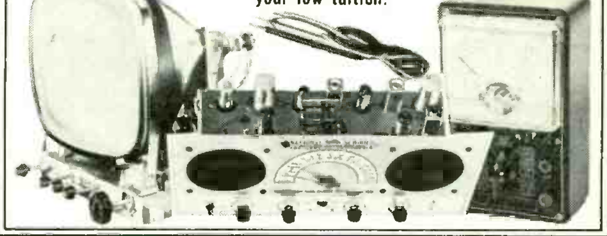

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POSTMASTERS: Send Form 3579 to 154 W. 14th St., New York 10011.

NEWS BRIEFS

TV PRODUCTION TO DOUBLE IN TWO YEARS, SAYS RCA

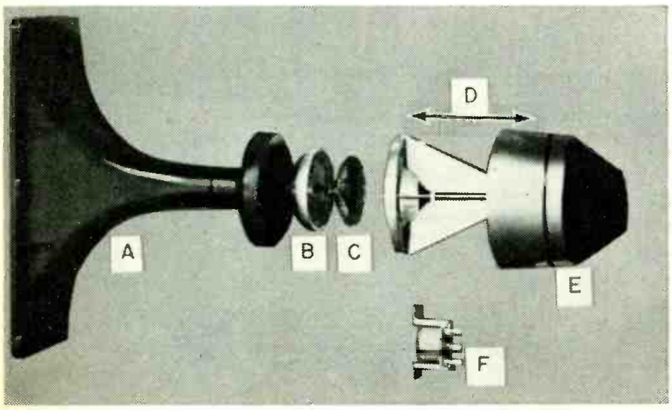
The Radio Corporation of America announced an expansion program that will double its color TV set production capacity within 2 years, and will double color tube output within 3 years. This expansion is "in response to the explosive increase in consumer demand, which has made color television the fastest-growing industry in the world," according to W. Walter Watts, RCA group executive vice president. A total of $36.4 million will be spent to expand color tube production, and $13.3 million to increase color receiver facilities. More than 2.3 million color sets will be sold in 1965, Mr. Watts believes, and this number, he predicted, will increase to well over 5 million sets by 1970. At least 25% of all TV sets sold this year will be color units.

ASTRONAUTS PLAN COMMUNICATION TO EARTH WITH LASER BEAM

Maj. Frank Borman and Lieut. Commdr. James A. Lovell, Jr. will try to talk to earth over a laser beam during their planned orbit next year, they report. The laser experiment was originally set for much later in the Gemini project. It will be one of about 20 experiments that the astronauts will carry out, Commander Lovell stated. The laser transmitter is expected to be able to put out 10 watts.

SOLID-STATE HORN TWEETER ANNOUNCED BY MOTOROLA

A new solid-state exponential horn tweeter, with a response from 4,000 to 15,000 cycles, has been announced by Motorola. It operates by the expansion and contraction of semiconductor material, according to *Television Digest*. A zirconate titanate tube is partially surrounded with metal, but insulated from it. The tube and the surrounding metal are connected to opposite ends of the secondary of an output transformer (a stepup transformer for this type of circuitry). A diaphragm, attached to the end of the zirconate tube, vibrates in accordance with the signal across the secondary of the transformer.



The new Motorola solid-state tweeter. A rod of lead zirconate and lead titanate changes its length according to the applied voltage and thus vibrates the diaphragm.

BOYCOTT CAMPAIGN ENCOURAGES GOOD TASTE IN COMMERCIALS

A campaign, started by O. A. Kemper of East Orange, N. J., is rapidly gaining supporters in "chain-letter fashion," claims its founder. It asks viewers to abstain for one month from buying the product advertised in any commercial which is too loud, contains singing, exceeds 30 seconds, or is used for over one month. Kemper claims that 409,900 households were participating as of the middle of June.

RADIO-FREQUENCY INTERFERENCE INJURES SPACE VEHICLES

Radio-frequency interference at altitudes where it could affect orbiting satellites and other space vehicles is increasing at an alarming rate, according to Larue A. Hoffman of Aerospace Corp. (California).

"There is already suspicion that a number of missiles and payloads may have been prematurely activated by RFI," Mr. Hoffman said.

The most dangerous sources of RFI at orbital altitudes are high-power radars operating from 200 to 3,000 mc. Less important, but still significant, are radar transmitters in the 3,000- to 10,000-mc range. Mr. Hoffman stated that Aerospace Corp. has launched a program which includes both analytical studies and experimental and exploratory effort to obtain data on the more significant suspected sources of RFI. The program would probably include a low-cost spaceborne monitoring system.

J. E. SMITH, NRI FOUNDER RECEIVES GODDARD AWARD

Mr. J. E. Smith, founder of the National Radio Institute, America's largest and oldest radio–TV–electronics home-study school, has been given the Robert H. Goddard Award for outstanding professional achievement.

The award was made under the joint sponsorship of the Worcester (Mass.) Polytechnic Institute Alumni Association and College Board of Trustees. It is presented annually to one of the alumni, in memory of Professor Goddard, the "father of modern rocketry," one of the most outstanding graduates of Worcester Polytechnic.

Mr. Smith graduated from Worcester Polytechnic Institute in 1906 as an electrical engineer. In 1914 he founded the National Radio Institute, which has since enrolled over three-quarters of a million men throughout the world in its home-study programs.

NEW VIDEO TAPE RECORDER FOR BLACK-AND-WHITE OR COLOR

Ampex has demonstrated a line of video tape recorders operating at two speeds—9.6 and 4.8 inches per second. At the 9.6 ips speed it will record an hour of television, both picture and sound, on a single 2,900-foot reel of 1-inch video tape. At 4.8 ips, 2 hours of TV can be recorded. The tape is a high-quality video type especially designed by Ampex for the new unit. Cost per reel is $64.95. Smaller reels will also be marketed at $39.95.

"Tape costs at the higher standard are approximately half that of an equivalent amount of processed 8-mm color-sound movie film," William A. Roberts, Ampex president, pointed out. "At the lower speed, the cost advantage is even more dramatic."

Frequency response extends to 3.2 megacycles at 9.6 ips, and to more than 2 mc at 4.8 ips.

The recorder will play back black-and-white television programs through nearly any home television re-

The new Ampex home video tape recorder.

ceiver, either color or black-and-white, by adding special extension components at an estimated cost of about $25. No internal modification of the receiver circuitry is necessary. Home recorders are interchangeable. The tapes made on one machine may be played back on any other.

Price of a one-speed machine is listed $1,095. For the two-speed type, $1,295. Four furniture console systems run from $1,795 to $2,495, depending on choice of one- or two-speed recorders and color or black-and-white receivers. A line of television cameras and other accessories will be offered with the equipment.

TOM JASKI DEAD

Thomas Jaski, prolific RADIO-ELECTRONICS author, died suddenly July 4, some weeks after an automobile accident, from which he was making an excellent recovery.

RADIO-ELECTRONICS is published by Gernsback Publications, Inc.,
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Editorial, Advertising, Subscription and Executive offices: 154 West 14th Street, New York 10011.

Subscribers: When requesting change of address please furnish an address label from a recent issue. Allow one month for change of address.

ADVERTISING REPRESENTATIVES: East: John J. Lamson, Eastern Sales Manager, RADIO-ELECTRONICS, 154 West 14th Street, New York 10011, 212 AL 5-7755; **Midwest:** P. H. Dempers Co., 740 North Rush Street, Chicago, Illinois 60611, 312 MI 2-4245; **Southeast:** Neff Assoc., 15 Castle Harbor Isle, Ft. Lauderdale, Fla. 33308, 305 LO 6-5656; J. Sidney Crane, Assoc., 22 8 St., N. E., Atlanta, Ga. 30309, 404 TR 2-6720; **Texas/Arkansas:** Media Representatives, Inc., 2600 Douglas Avenue, Irving Texas 57060, 214 BL 5-6573; **West Coast/Oklahoma:** Husted-Coughlin, Inc., 1830 W. 8th Street, Los Angeles, Calif. 90057, 213 389-3132; Husted-Coughlin, Inc., 444 Market Street, San Francisco, Calif. 94111, 415 GA 1-0151; **United Kingdom:** Publishing & Distributing Co., Ltd., Mitre House, 177 Regent St., London W.1, England.

← *Circle 6 on reader's service card*

Between September 1955 and August 1965, Mr. Jaski contributed 60 articles to this magazine. He was also the author of two books published by the Gernsback Library, *Industrial Electronics Made Easy*, and *How to Get the Most out of Your VOM*.

Besides being a licensed professional engineer in the State of California, he had recently acquired the degree of Master of Science in psychology, and was working in the field of programed instruction. It was on this subject that he wrote the editorial in last month's issue.

MARTIAN IONOSPHERE WEAK, MARINER OBSERVATIONS FIND

The ionosphere on Mars is very much less dense than had been expected before Mariner sent back information last July, scientists report. This might make it impossible to communicate from one point on the planet to another on the opposite side as is possible on Earth. In addition, the layer is only half as high as had been supposed.

WASTELAND IN MONTE CARLO

UNESCO reports that the tiny country of Monaco has the highest concentration of TV receivers in the world, more than 52 sets per hundred persons, compared to 33 sets per person in the USA. (But the United States has 100 *radio* sets per 100 people.) Japan is number two, after the U.S., in numbers of TV sets (US 60 million, Japan 13 million).

MARINER-EARTH TRANSMISSIONS USE DIGITAL TELEVISION

Television pictures of Mars sent to Earth by Mariner IV were made possible by a digital system of television, in which the varying intensities of light and darkness along a scanned line were represented by a series of numbers, rather than by continuously varying signal strength as in ordinary television. (Ordinary television transmission would be known as an *analog* system in the language of computers.)

The principal purpose of the digital technique was to allow exact reconstruction of the image even when the signal was almost drowned in noise.

Each picture was broken down into 200 lines. Each of these lines was separated into 200 components, or dots. A signal value was given to each dot, ranging from zero for pure white to 63 for pure black. These digits were transmitted in a six-bit code—six impulses or spaces (no impulse) per number. Thus, the receiver on earth could allot the right light intensity to any element of the picture, as long as the signal was good enough to make it possible to distinguish between a signal and the absence of a signal. Variations in propagation conditions, or noises other than those strong enough to blot out the signal entirely, would have no effect—the original signal could be amplified, or *reconstructed*, to give exactly the signal that started from Mars.

The pictures were taken with a single exposure on a 1-inch vidicon tube and exposed to the light of Mars for .08 to 0.2 second, depending on the variable light. The light was then shut off while the picture was read out onto the tape in 24 seconds. Then another 24-second period elapsed to prepare the vidicon for the next picture. The playback was very much longer. It required 1,284 seconds to play back 1 second of recorded data.

CALENDAR OF EVENTS

6th International Conference on Medical Electronics & Biological Engineering, Aug. 23–27; Tokyo, Japan

20th National Meeting, Association for Computing Machinery, Aug. 24–26; Sheraton-Cleveland Hotel, Cleveland, Ohio

Wescon (Western Electronics Show & Convention), Aug. 24-27; Cow Palace, San Francisco, Calif.

1965 International Antenna & Propagation Symposium, Aug. 30–Sept. 1; Sheraton Park Hotel, Washington, D. C.

Salon International de Radio et de la Television, Sept. 9–19; Hall Monumental du Parc des Expositions a la Porte de Versailles, Paris, France

International Conference on Thermionic Electrical Power Generation, Sept. 20–24; IEE, Savoy Place, London, England

New York High Fidelity Music Show, Sept. 29–Oct. 3; New York Trade Show Building, New York, N. Y.

Second International Exhibition of Industrial Electronics, Sept. 7–11; Swiss Industries Fair, Basel, Switzerland

1965 Fall URSI Meeting (US National Committee of the International Scientific Radio Union, URSI), Oct. 4–6; Dartmouth College, Hanover, N. H.

1965 Canadian Electronics Conference, Oct. 4–6; Automotive Bldg., Toronto, Ont.

17 Annual Audio Engineering Society Convention, Oct. 11–15; Barbizon Plaza Hotel, New York, N. Y.

FCC RAPS LOUD COMMERCIALS

Objectionably loud commercials are contrary to the public interest, the FCC declared in a statement of policy issued July 12. The FCC also singled out commercials that, in addition to being loud, are delivered in a "rapid and strident manner," as well as commercials well above the volume level of the programs they interrupt.

Answering the objection of many broadcasters and TV advertisers that subjective factors play a great part and that what sounds loud to one may not to another, the FCC points out that matters have reached a point where "the complaints obviously cannot be dismissed on the ground that 'commercials aren't really loud—they just sound loud'."

Broadcasters have been instructed to take appropriate measures to eliminate the nuisance. END

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America's oldest and largest Electronic, Radio-TV home-study school

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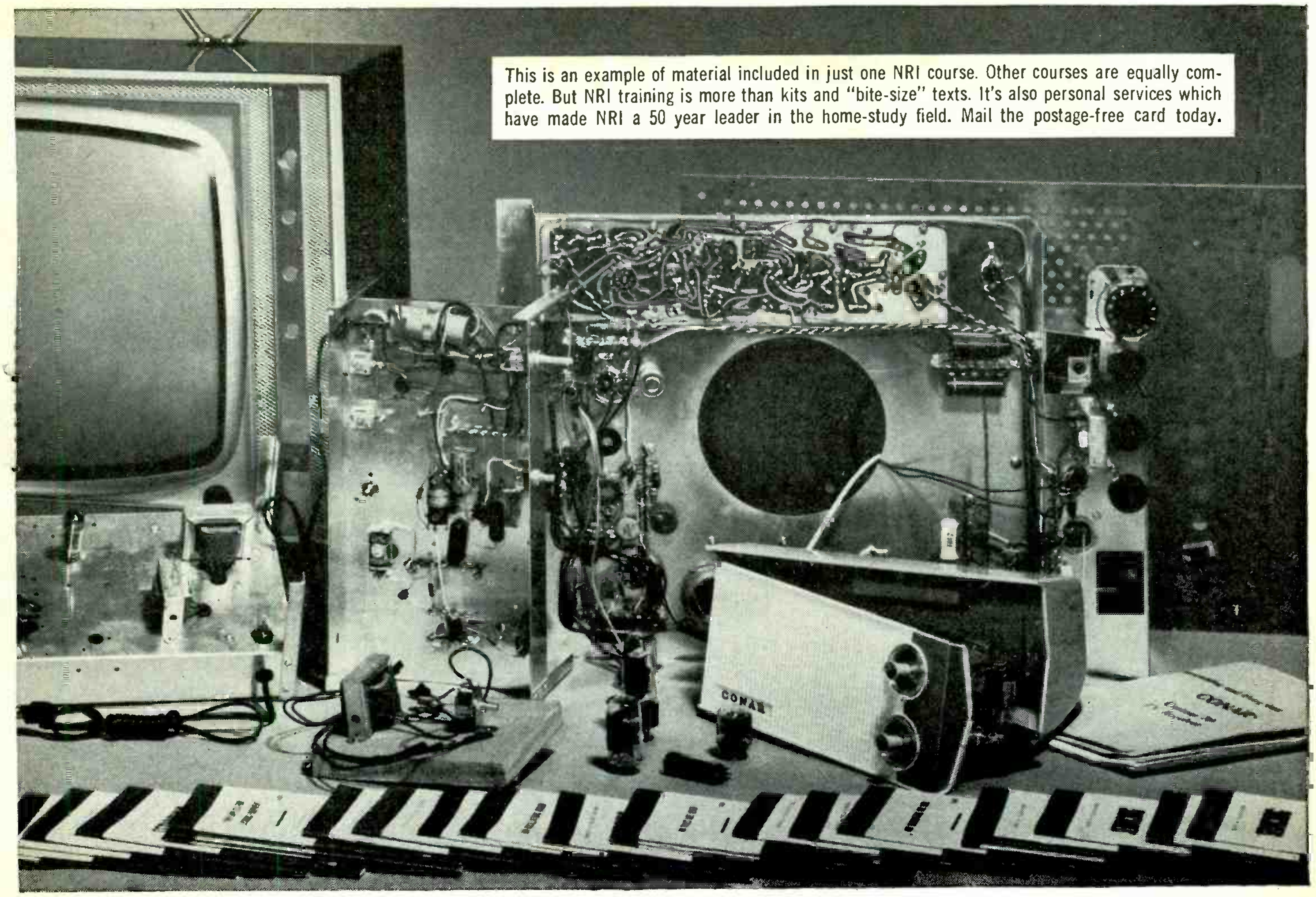
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CONAR

Correspondence

TAKES MORE THAN A GIMMICK TO GET ALL THE TV CHANNELS

Dear Editor:

Without in any way depreciating the very interesting article by L. W. Reinken, "Get All the TV Channels" (May R-E), I believe he missed one important "gimmick."

The most crucial gimmick for adjustment on production tuners is "spiking": precise-tuning coils by moving a turn, or part of a turn. A "spiking slack" is usually allowed for in production of these coils.

The tool used is a Bakelite or polystyrene rod shaped for the job—hence the name "spike" and "spiking".

I believe Mr. Reinken will agree that neither gimmick nor spiking alone is a panacea. Both together, judiciously applied, make an unbeatable combination.

Using a gimmick means adding something—a twisted pair of wires and sometimes a capacitor—and soldering and twist-and-cut. Spiking requires only low-loss cement to seal the winding after adjustment.

One last point: with either approach, the coil never *looks* quite neat, and there is always the temptation, for a novice, to clean it up. A young friend, an engineering junior working with me, very proudly showed me two tuners that he had "de-messed" after I had painstakingly spiked them the previous evening. So, I counted ten, and

---

Meyer evaluates . . .
TRANSISTOR OUTPUT CIRCUITS

Daniel E. Meyer, well known to RADIO-ELECTRONICS readers as the designer of several outstanding transistor amplifier and preamp construction projects, describes a variety of transistor output circuits, exploring their merits and drawbacks. Now that things have settled a bit, most manufacturers stick with two or three tried-and-true circuits.

Coming in . . . October RADIO-ELECTRONICS

---

p-a-t-i-e-n-t-l-y explained to him the facts of life about spiking.

The moral: no matter how messy a coil looks, if its windings are sealed, *don't touch* unless you know what you are doing.

A. D. EMURIAN
Westwood, N. J.

SERVICERS GET LOUSY DEAL ON LONG WARRANTIES

Dear Editor:

A letter appeared in the correspondence column of your June, 1965 issue, by Mr. Kenneth Conley, opposing Frank Moch's critical appraisal of TV manufacturers' extended warranties.

I feel that Mr. Conley has misunderstood Mr. Moch's motives and does not understand the problems in retail TV sales and service.

If manufacturers want to place 5-year warranties on their products, then they should up-grade the quality of those products to make such a warranty practical.

A dealer cannot service a TV set over a long period of time, free of charge, without some help from the factory. Some manufacturers seem to want the authoritity to extend long warranties, without shouldering the responsibility of executing these warranties. Instead, this task is assigned to the dealer, who has to carry on with very little help from the factory.

This is the point that Mr. Moch is trying to get across. He is not disturbed because members of his profession will lose opportunities to "gouge" customers. (You will find customer gougers and incompetent men in all professions. They receive much publicity, although they are few in number.)

As Mr. Conley is an electrical engineer, I am sure he understands the complexity of a TV set and has a nodding acquaintance with its service problems. I sincerely hope he will come to a better understanding of the men who use their knowledge and skill to perform this work.

ORIGEN DANIELS
Radio & Television Service
Niantic, Conn.

SOME COMMON MISUNDERSTANDINGS ABOUT TRANSISTOR IGNITION

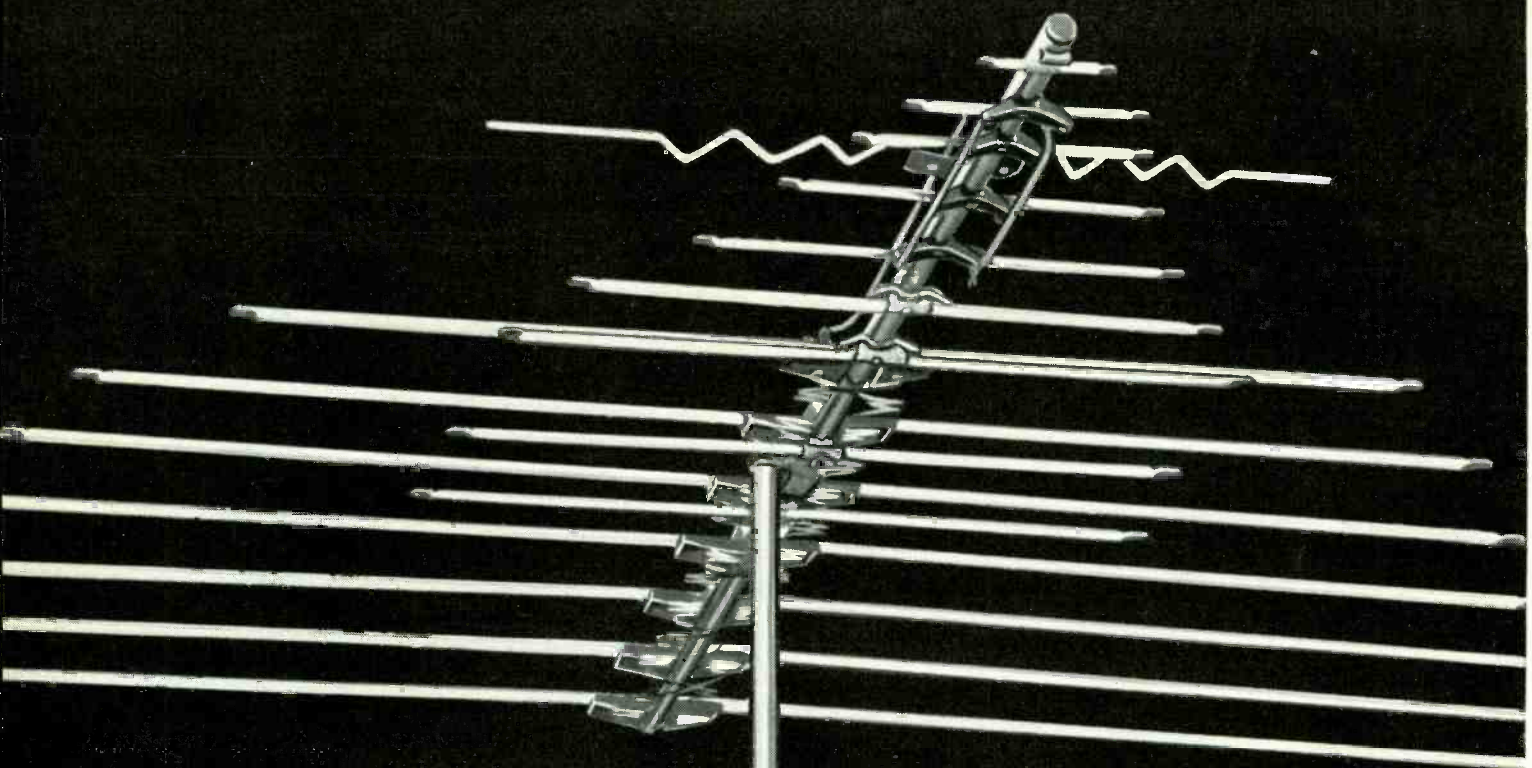
Dear Editor:

About Mr. James K. Hall Jr.'s disenchantment with transistor ignition systems (Correspondence, May): he notes the performance of the transistor ignition system as being nothing more than "satisfactory". This points out a common problem, the Madison Avenue

continued on page 16

Circle 10 on reader's service card

Circle 11 on reader's service card



HOW DID WINEGARD PUT FULL SIZE POWER IN A ½ SIZE ALL-BAND (UHF-VHF-FM) COLOR ANTENNA?

WITH

WINEGARD CHROMA-TEL

the new super-compact high gain antenna designed specifically for all-band UHF-VHF Color Reception and FM

A big disadvantage of most all-band (UHF, VHF, FM) antennas is that they are larger and heavier than necessary. This is because they are really VHF antennas with UHF antennas tacked on the front end. *Chroma-Tel isn't*. It's super-compact and the *first integrated* antenna designed specifically for all-band UHF-VHF color operation.

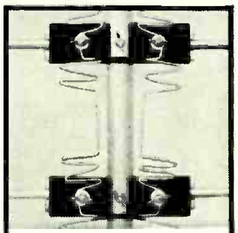
How did we reduce the size so drastically without sacrificing performance?

Two ways. First with our new *Chroma-Lens*

Director System. With this unique system, we are, for the first time, able to intermix *both* VHF and UHF directors on the same linear plane without any sacrifice of performance.

Second, with *Impedance Correlators.* These are the special phasing wires that automatically step up the impedance of Chroma-Tel's 72 ohm driven elements to 300 ohms. The correlators make sure each element has an accurate 300 ohm impedance at its given frequency. No other antennas with multiple driven elements have this! They also allow us to place the elements *only* 5¾″ apart instead of 10″ to 14″ apart as on other all-band antennas, reducing antenna length by one-half.

With the new Winegard Chroma-Tel antenna, we have eliminated *half* the bulk, *half* the wind loading, *half* the storage space, *half* the truck space, and *half* the weight . . . yet still have the best working, easiest installing UHF-VHF-FM antenna ever developed!



Exclusive Winegard Impedance Correlators insure 300 ohm impedance on each element

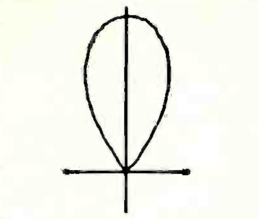
You give your customers a neater installation that performs as well or better than any other all-band antenna on the market . . . and at a much lower price.

Compare Performance. You can't find an all-channel UHF-VHF-FM antenna that will give you better results than Chroma-Tel. Look at the polar patterns. There are no side lobes with Chroma-Tel because the elements are straight . . . unlike V'd elements that offer an element surface sideways to the signal, Chroma-Tel's straight elements will not pick up ghosts from sides or back. Chroma-Tel's front-to-side ratio is practically infinite—Chroma-Tel's exceptional front-to-back ratio is up to 30 db.

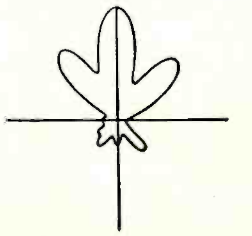
Compare Construction. The Chroma-Tel is Winegard quality throughout . . . from its sales-making compact 4-color box, to its weather resistant Gold Vinylized Finish, to its first quality snap-lock hardware.

For complete information on the exciting new Winegard Chroma-Tel All-Band Antenna, ask your distributor or write for Fact-Finder #242 today.

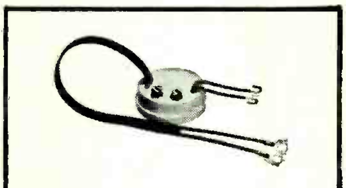
So compact it fits in the back seat of a car



Typical Chroma-Tel Polar Pattern

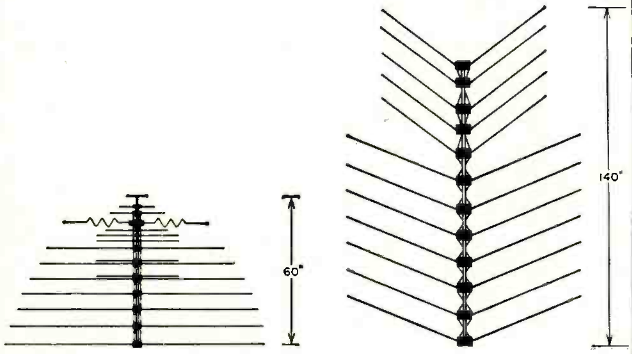


Typical V Type Antenna Polar Pattern

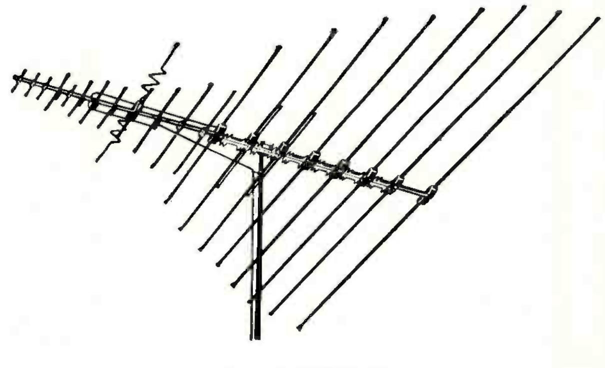


All Chroma-Tels include Winegard's model CS-283 UHF-VHF signal splitter. Splitter hangs conveniently behind TV set. Separates UHF and VHF signals coming from antenna to the two sets of terminals on your set. It's yours FREE when you buy Chroma-Tel.

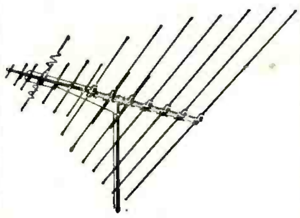
Compare Size and Price. We've illustrated the super-compact Chroma-Tel CT-80 and a comparable V type antenna. Note the difference in size, price and weight for equal or better performance. Because it's even much smaller than ordinary VHF antennas of comparable performance, it is perfect for attic installations, too!



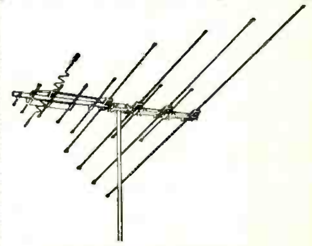
	Winegard Chroma-Tel	V type (Approximate Figures)
Boom Length:	60″	140″
Total Weight:	5 lb., 1 oz.	10 lb., 3 oz.
Carton Size:	.97 cu. ft. (less than 1)	5.8 cu. ft.
Number of Elements:	17	12
List Price:	$27.50	$50.00



Model CT-90 $37.50



Model CT-80 $27.50



Model CT-40 $17.50

Winegard Co.
Antenna Systems
3000 Kirkwood • Burlington, Iowa

Circle 12 on reader's service card

selling approach, in which all is promised but little is delivered.

The main advantages of transistor ignition are neither an increase in gas mileage nor an increase in acceleration. The major advantages may be stated in brief as: Transistor ignition extends the time required between tuneups; it maintains correct tuneup for a much longer time; it simplifies tuneup to a check of point gap spacing, sparkplug gap spacing, and timing; it extends greatly the life of breaker points; and it extends (less) the life of the sparkplugs. Adding these advantages, we find that the *improved performance of a tuned-up engine over an extended time* is the major advantage. Coupled with this improved performance is the reduction in the need for replacemest parts. *Both* advantages will then provide a *long-time* savings in costs.

As to the difficulty with a defective system, as I have noted in my book on transistor ignition systems (scheduled to be published by John F. Rider Publisher, Inc.), it would be prudent to keep the original system intact and have it wired as a standby so that it may quickly be substituted for the transistor system. This permits a quick check of the transistor system to determine if it is defective. It also permits the use of test instruments that will not work with transistor ignition systems. And most important, it permits operating the engine with the conventional ignition system should the transistor system become defective.

MARVIN TEPPER
Milton, Mass.

BUT IF YOU WANT TO *WORK* AT BEING A FOOL . . .

Dear Editor:

In Peter Sutheim's interesting article on "Output Protection for Transistor Amplifiers" (page 45, June issue), our simple protection system is described as "foolproof," a word that has a delightful ring to it in our ears. Foolproof, he says, however, except when the transistors are already near maximum temperature. Mr. Sutheim is quite right. If the junctions happen to be as hot as a three-dollar pistol (prices have gone up), a transistor or two will join its ancestors if you short the output.

We'd like to complete the picture, however, for those few undiscriminating souls who don't subscribe to R-E and may have missed Pete's full report on the TR-2 in the May issue. The fact is that neither we nor Mr. Sutheim have found any way to get the transistors even perceptibly warm in actual service—so the user can actually short the output or overload the input (or both) all he likes, if that's how he gets his kicks, without even popping the circuit breaker.

Both we and Mr. Sutheim (we learned by phone) *have* found a way to burn up transistors in the TR-2, if this happens to be your project for the month. First you run a steady tone from an audio generator through the amplifier for several minutes (you can't do this with program material), with the output set at 40 to 50 watts into a dummy load. This is the only way to heat up the transistors. Short the output continuously for at least 15 seconds, then give the one or two dead transistors a decent burial.

RICHARD H. DORF
President
Schober Organ Corp.
New York, N. Y.

IN HARMONY ON ELECTRONIC MUSIC

Dear Editor:

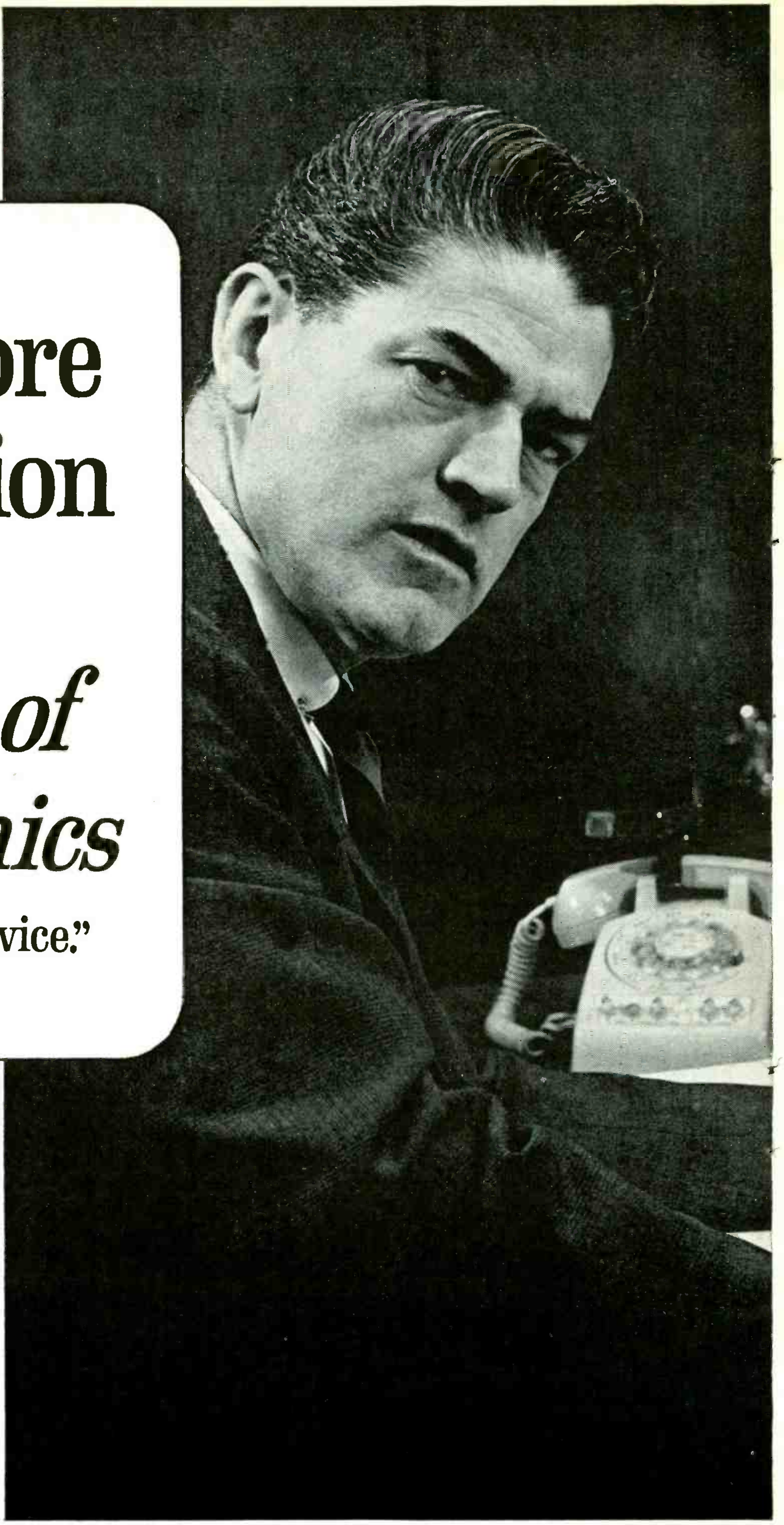
Congratulations on your cover and article in the June 1965 issue. It is going to help the cause of electronic music a great deal, because it proves that the field has reached a certain maturity, and that it is quite literally "in tune with our times."

The only point I would like to see more thoroughly emphasized is that it is not absolutely necessary to have a million-dollar studio to enter the field of electronic music and begin composing. My compositions are beginning to get attention even though they are composed on homemade instruments and quite ordinary tape recorders. The field is so vast that anyone caring to explore it will have plenty of room.

And this is a good opportunity to commend RADIO-ELECTRONICS for the enthusiastic backing you have given the cause of electronic music, in many phases, down through the years.

IVOR DARREG
Los Angeles, Calif. END

"Get more education or *get out of electronics* ...that's my advice."



SERVICE CLINIC

By **JACK DARR** Service Editor

"Do Not Measure!" (Why Not?)

FOR TOO MANY TV TECHNICIANS, THE points marked DO NOT MEASURE on a TV chassis are just like a wet-paint sign! We don't get off easy, though, if we disobey. It's easier to wipe paint off an inquiring fingertip than to send off a meter to be repaired. Cheaper, too.

"But," someone says plaintively, "why not?" Here's why not. The warnings are placed on these points because they carry not only high dc voltages, but *very high pulse* voltages! These can play whacky with the input circuits of our test equipment—the voltage dividers of vtvm's, vom's and the input blocking capacitors of scopes.

It's not so much the breaking down of the resistors themselves, but the flashing over of selector-switch contacts, wafers, etc. You might have a large resistor in the circuit, enough to block the voltage, but mounted on a pair of switch contacts that are only about 50–75 thousandths of an inch apart! This is close enough to let an arc start, if you get a pulse of thousands of volts.

Every so often, we get letters: "I measured the boost voltage like you said. Now my meter don't read right no more!" You know where he measured it—on the damper *cathode!* Pulse voltages there can go to *15,000 volts* or more! Fig. 1 shows what they look like. This pattern was made by holding the direct probe of a scope *near* the insulated damper cathode lead. The scope attenuator was set at about 100 volts p-p per inch! This pattern reads about 300 volts p-p!

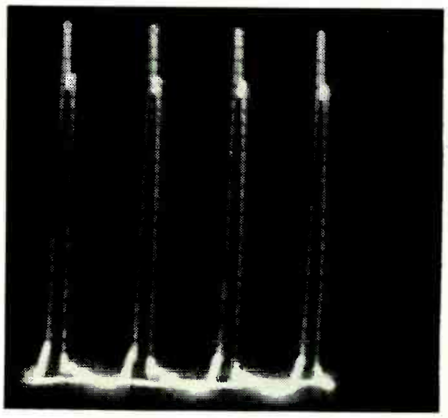


Fig. 1—Spikes this big, from holding probe near damper cathode! Think what would happen if you touched it!

Horizontal pulses like these are found on the damper cathode, on the plate of the horizontal output tube, and on the hv rectifier plate. Most of us know that, and stay away from them. But it's hard to remember that the innocent-looking plate of the *vertical* output tube can have pulses almost as high—high enough to cause meter damage too.

So stay away from these places. Actually, *you don't have to take readings here anyway.* You can get the same

This column is for your service problems—TV, radio, audio or general and industrial electronics. We answer all questions individually by mail, free of charge, and the more interesting ones will be printed here.

If you're really stuck, write us. We'll do our best to help you. Don't forget to enclose a stamped, self-addressed envelope. Write: Service Editor, Radio-Electronics, 154 West 14th Street, New York 10011.

The new Amphenol 860 Color Commander cuts alignment time in half!

Ever finish a convergence job to find the raster off center. Lose convergence when you re-centered? Can't happen with the Amphenol Color Commander, battery-powered, solid-state color generator. A special, single-crossbar pattern consists of one horizontal and one vertical line, crossing just where the center of the raster should be. No need to guess when centering the raster with this new pattern.

See dots before your eyes when you want only one to start static convergence? The 860 gives you that single dot, right at center screen. You'll be switching back to this important dot during dynamic adjustment to make sure you haven't gone off the track.

Even the old patterns offer something new. Line spacing in the cross-hatch pattern is rigidly maintained for the 4:3 aspect ratio. You can rely on it for linearity, height, and width adjustments. The pattern gives you finely etched line width at normal brightness levels. What good is perfect convergence at reduced brightness if you lose it when the set's readjusted for normal viewing? This special crosshatch also eliminates receiver fine-tuning error. Among the 860's nine (most generators have only 5 or 6) are: multiple-dot, single vertical line, single horizontal line, vertical lines only, and horizontal lines only.

Finally, the Color Commander's unique color bar pattern (just three bars: R—Y, B—Y and —R—Y) simplify color adjustments. You can get a rapid, overall check of color circuits. Then adjust color demodulator phase or pre-set the hue control and check its operating range. In each step, you know precisely how the color bars should look and how they should change during adjustment.

A new timing circuit eliminates instability and loss-of-sync problems. Silicon transistors maintain built-in precision and stability indefinitely. RF output is on channel 3 or 4, switch selected. An attenuator simulates weak-signal conditions. It has gun killer circuit. Uses 9 penlight cells. Weighs 3½ lbs. in compact leatherette carrying case. $149.95. Optional AC power supply, $19.95.

AMPHENOL CRT COMMANDER, MODEL 855. Solid-state. Checks all black-and-white or color CRT's with the same techniques used by tube manufacturers. Rejuvenates where others fail. Versatile 5-socket cable accommodates 7 different sockets. With CRT chart, $89.95.

See the new Color Commander test instruments at your Amphenol distributor.

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Circle 17 on reader's service card

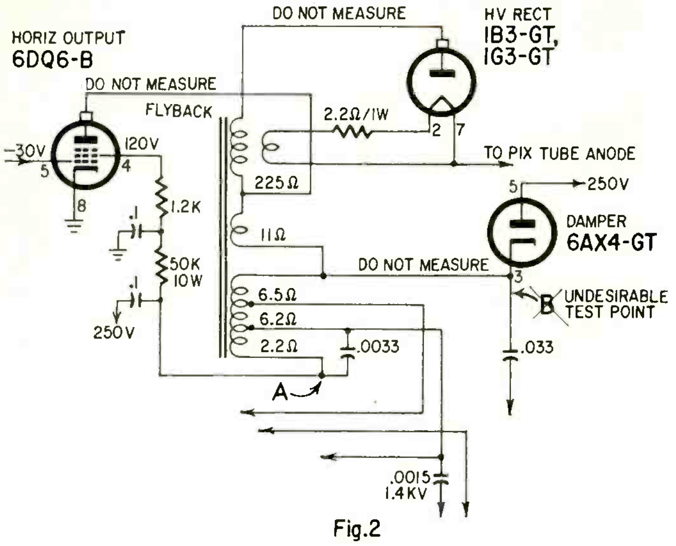

Fig.2

Measure at A, after spikes have been filtered out by inductance of part of flyback, and by bypass capacitor—not at B where they're still hot and heavy!

information in safer places. For example, read the boost voltage after it's been filtered a little. By the time it gets to the bottom terminal of the flyback, it's passed through some inductance, and there's a bypass capacitor, too; so the pulses are gone and we can check the voltage safely (Fig. 2).

This voltage measurement plus one resistance measurement (of the flyback primary) will tell you if there is plate voltage on the horizontal output tube. Vertical output, too: read the voltage at the supply point on the primary winding, then check the dc resistance of the primary (Fig. 3).

Incidentally, while checking around these circuits with substitute electrolytic capacitors, stay off those high-pulse points. While the apparent dc voltage may be well within the rating of the capacitors, those pulses aren't. Someone borrowed my pet electrolytic "sub-box", and it hasn't been the same since. Three of the big capacitors were just slightly shorted! Upon threats of violence, the borrower admitted that he'd been trying to "find out if the set needed a boost

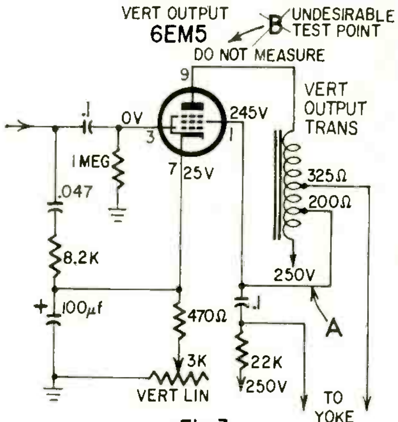

Fig.3

Same with vertical circuits: check voltage at A, where it's filtered, not at B.

filter"! And that he "just might" have touched the damper cathode with the sub-box lead. He said the set needed a new filter, all right. Now, so do I (in my sub-box)!

"Diamonds" in vertical blanking bar

In a Curtis-Mathes 425-21 color TV receiver, I can see a series of "diamonds" that get smaller from left to right, in the vertical blanking bar between pictures. These show on the screen. What are they, and should they be visible—G.B., Oakland, Calif.

These are "cueing" signals, transmitted on color TV network shows. On the TV station's monitor scopes, they tell the operator how to set up the controls for the best picture.

They shouldn't show on the TV screen. From your description of the trouble, it looks as if you are underscanning just a little bit. Set up the vertical linearity and height until these "diamonds" or the blanking bar are not visible.

Vertical creep in G-E 21C1548

The picture creeps up from the bottom, after a short while, in a G-E 21C1548. Takes about a half hour, on the bench. This chassis uses a 6BL7 vertical oscillator/output tube. — J. S., Rome, N.Y.

First, change the tube; then change it again. I have found this necessary in quite a few sets like this. Some tubes are OK, but you may find one that still creeps, even though it checks good.

Check the temperature-compensating resistor in the plate circuit. This is supposed to be 1 megohm cold and go to about 600,000 ohms hot. I've

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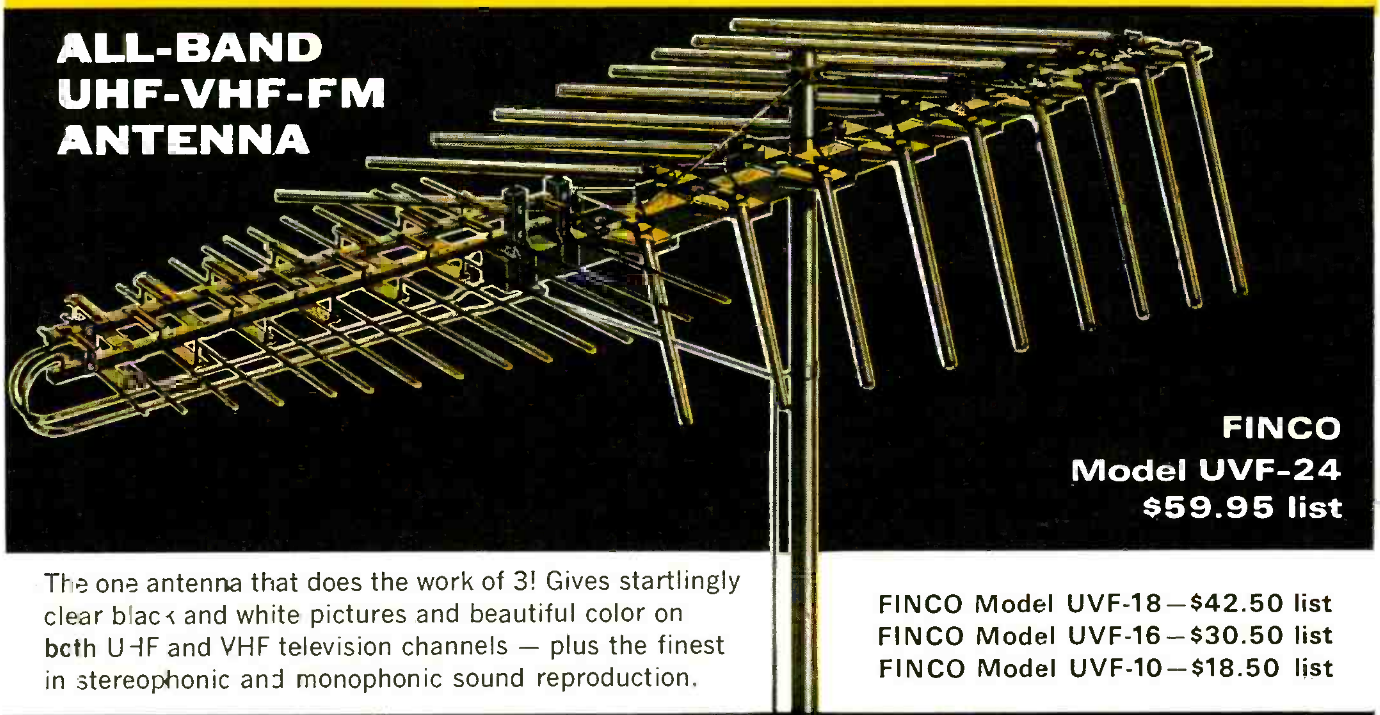
FOR UHF, VHF, FM RECEPTION

ALL-BAND UHF-VHF-FM ANTENNA



FINCO
Model UVF-24
$59.95 list

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

FINCO Model UVF-18—$42.50 list
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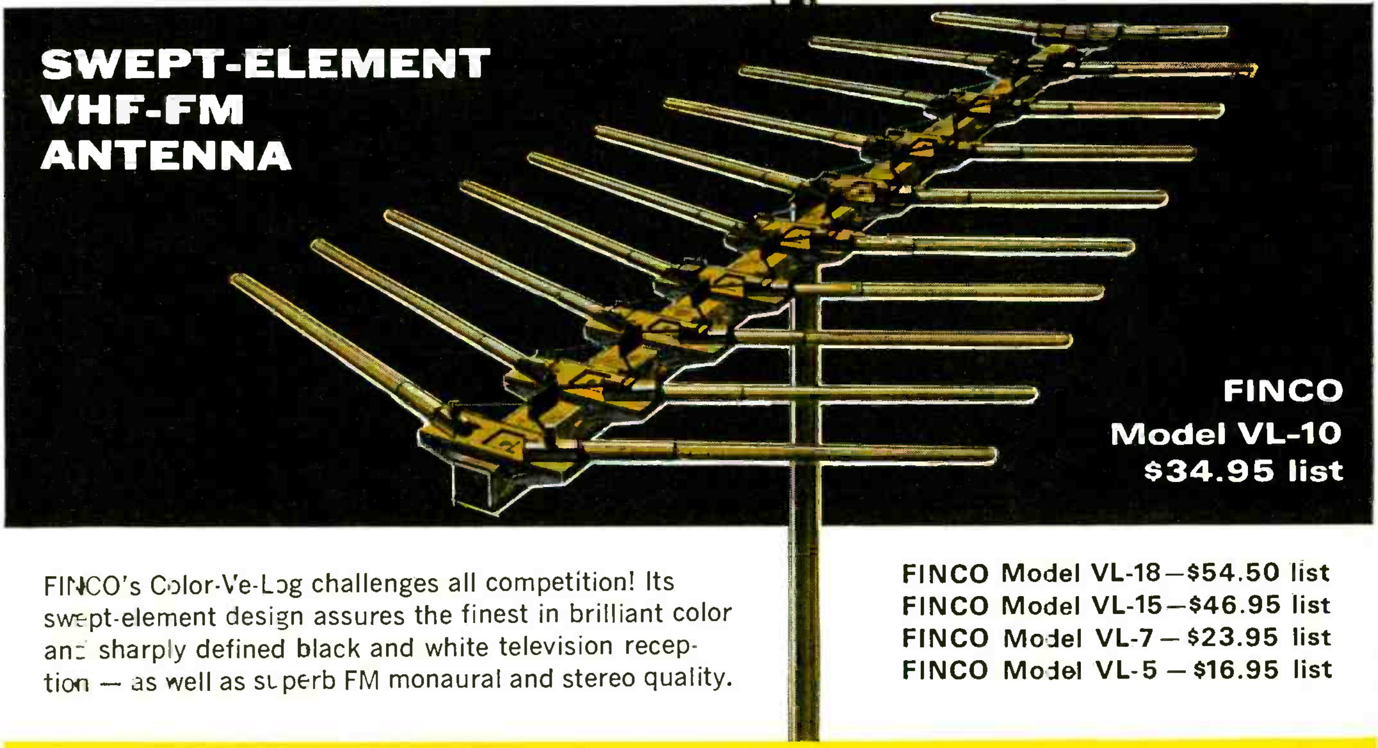
FINCO Model UVF-10—$18.50 list

SWEPT-ELEMENT VHF-FM ANTENNA



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

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Circle 19 on reader's service card

found some go too far and get down to about 300,000 or so hot; this, of course, drops the plate load impedance so far that the tube can't give the right amount of sweep amplitude.

Changing rf coils in Westinghouse radio

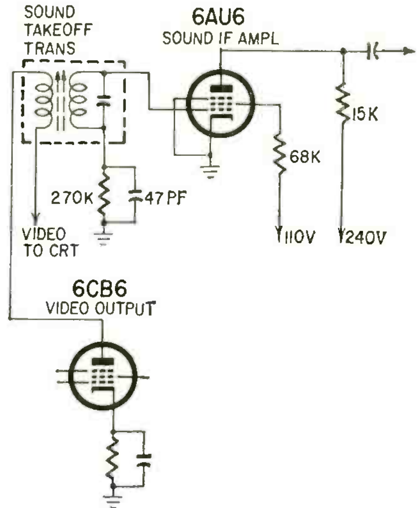
Can I change the rf coil in a Westinghouse Y2102? Now covers 5–8 mc, and I want to cover 20–30 mc.—D. K., Rochester, N. Y.

You should be able to, with the right coil. (Can I smell a CB rig coming up?) Try a Miller D-5495 rf coil; this is an unshielded type with an iron core for tuning. Use your present trimmers to adjust the high-frequency end, and set the core at the low-frequency end. You'll probably have to repeat this several times to get the right adjustment.

You *may* be able to throw the oscillator up to cover this range. If not, there is an oscillator coil, D-5495-C, in the same series that will do it.

Poor sound in Tele-King K21 TV

I've got a Tele-King TV in my shop with very bad sound. All dc voltages, etc., in the sound i.f. seem to be OK, and the audio stages are clear. Picture OK. 6BN6 detector OK. Where is it?—L.K., New York, N.Y.



Check the sound takeoff transformer. You may have a short in the secondary winding, or an open circuit. This wouldn't affect the video amplifier. Try feeding a 4.5-mc signal in at the video amplifier grid. If this comes through, the the transformer is OK; if not, then check the transformer.

Audio feedback in "MC'S P.A."

I built the "MC's P.A." system (p. 26, Feb. 1964 issue). It works fine when I feed the output of a transistor radio into the mike input. If I hook a mike to it, it howls when the volume is advanced. What causes this?—B. L., Denver, Colo.

Plain old audio feedback! Sound from the speaker is getting into the microphone. The only way to get away from this is reduce the volume, reduce the "bounces" in the room, or get the speaker farther away from the mike. In some cases, using a very directional mike will help.

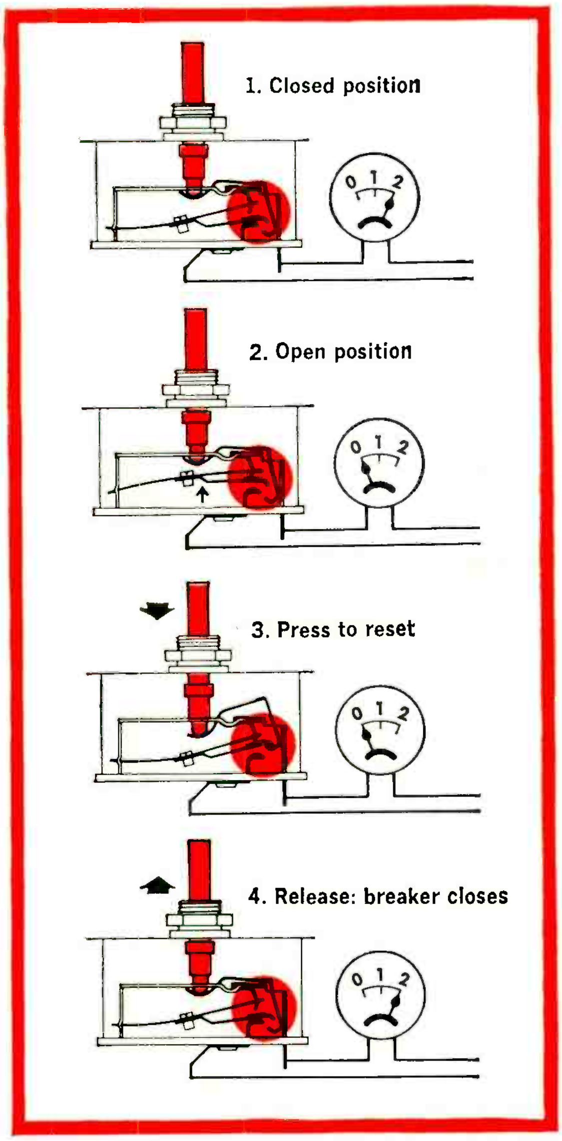
The "feedback" control in this system reduces the treble: treble (high-frequency) sounds bounce around more than lows; so, cutting down the treble sometimes helps cut feedback. A close-talking mike helps. END

MYSTERY RADIATION FROM 42-MC-I.F. TV SETS

A Nebraska sheriff kept getting TV sound (from various channels) on his 39.9-mc public-service receiver, in spite of months of experiments with filters, traps, suppressors. Finally someone realized that dozens of TV sets were reradiating programs on that frequency. It could be happening in your town! Read what was done about it.

COMING IN . . . OCTOBER
RADIO-ELECTRONICS

Tips on replacing circuit breakers



That little red "breaker reset" button that sticks out of the back of nearly every television chassis can be a time-saver or a trouble-maker, depending on what's wrong inside the set, and who's pushing the button. As you well know, when a transient fault has popped the breaker, you can get the set back in business just by pressing the reset. But if there has been a short-circuit failure and some uninformed tinkerer presses the button and *keeps* it pressed, there's a good chance that more power keeps flowing into the fault. Result: a minor trouble becomes a calamity.

This is why Underwriters' Laboratories require that breakers should be "cheat-proof"—that is, they should not allow current to pass when the reset button is held depressed. Some of the replacement breakers you'll find on the market *aren't* cheat-proof. We have one that *is*. It has features that you'll find valuable any time you need to install a new breaker, or when you're working on a breadboard circuit that needs over-current protection.

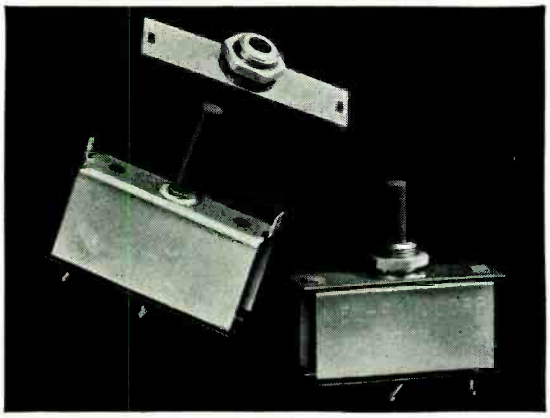
Take a look at how this breaker works, and you'll see what we mean.

At top (Picture 1) is the way the breaker mechanism looks when it's in the "on" position.

Along comes an overload (Picture 2). The bi-metal strip heats, snaps into the "break" position, opening the current carrying contacts.

Now you press the button to reset (Picture 3). As long as you hold the button down, the contacts at the right remain open.

Release the button and the contacts go back to closed (Picture 4). If the overload is still there, the breaker will open again. You can't keep it closed on a short circuit!

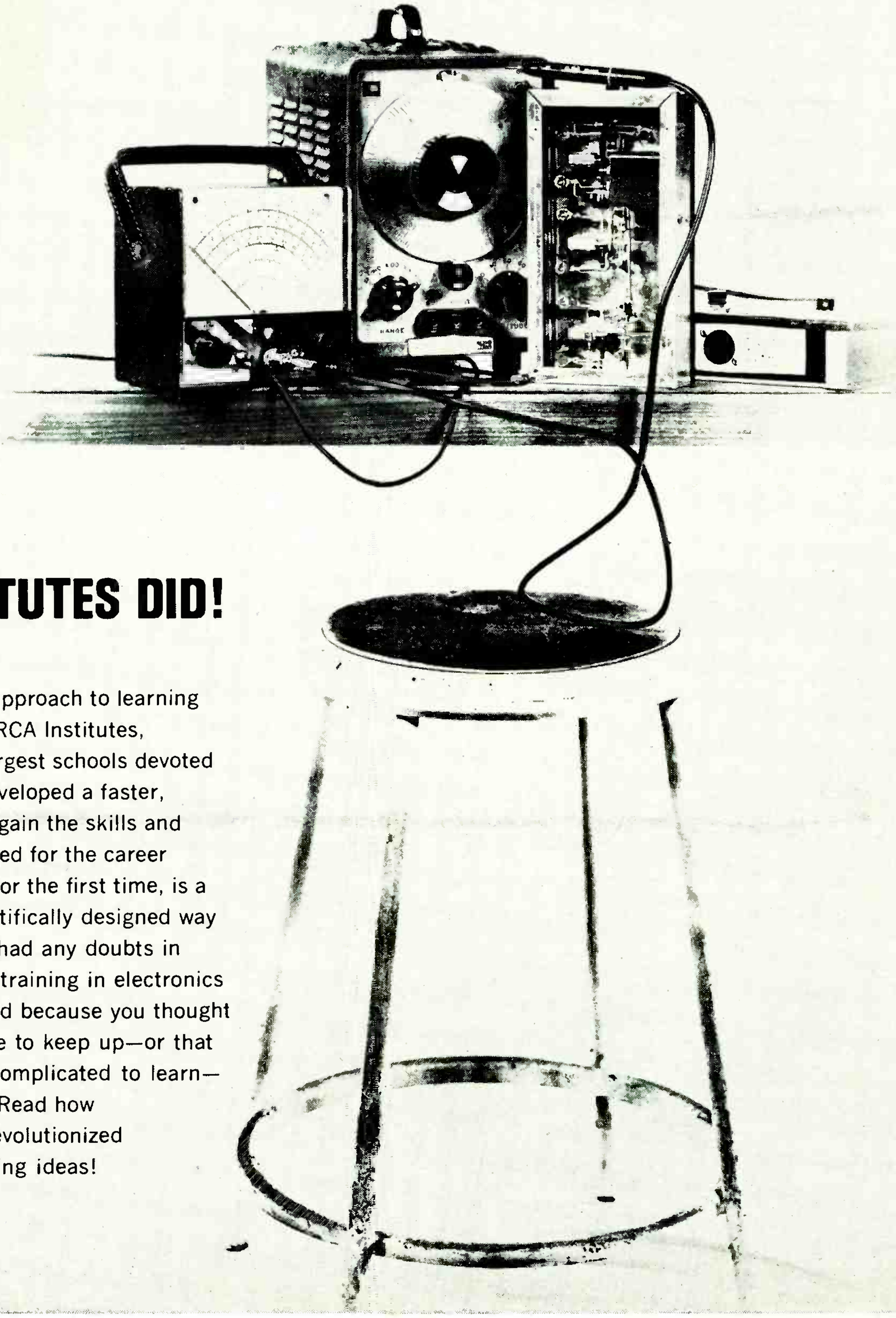


No wonder this particular breaker is used as original equipment on the majority of all television sets. They're made for Mallory by Mel-Rain Corp. to the same specifications as for original equipment, and they're available from a Mallory distributor near you. Off-the-shelf ratings go all the way from 0.5 to 7 amperes break current, and include all the values you'll need for service replacement or for industrial equipment maintenance. And as an extra convenience, you can get them with either a twist-tab or bushing mount. See your Mallory distributor, or write to Mallory Distributor Products Company, a division of P. R. Mallory & Co. Inc., P. O. Box 1558, Indianapolis, Indiana 46206.

Circle 21 on reader's service card

SOMEONE SHOULD DEVELOP AN EASY WAY

TO LEARN ELECTRONICS AT HOME



RCA INSTITUTES DID!

Here is a whole new approach to learning electronics at home! RCA Institutes, one of the nations' largest schools devoted to electronics, has developed a faster, easier way for you to gain the skills and the knowledge you need for the career of your choice. Here for the first time, is a student-proved, scientifically designed way to learn. If you have had any doubts in the past about home training in electronics—if you have hesitated because you thought you might not be able to keep up—or that electronics was too complicated to learn—here is your answer! Read how RCA Institutes has revolutionized its entire home training ideas!

End of the Service Technician?

...He is a long way from being finished...

FRED SHUNAMAN, Managing Editor

The twilight of the service technician is fast approaching, according to "well informed sources." What are the causes? The increased reliability of transistor circuits is said to be one. The expected takeover of integrated circuitry—practically impossible to service—is another. In spite of the tremendous expansion—almost explosion—of electronics in industry and domestic use, the service man is seen as doomed.

No one has stopped to ask who is going to discover and replace the defective integrated circuit modules, nor has anyone pointed out that the supposed reliability of transistors is by no means absolute, and if there is less servicing of transistor equipment it may be because it is cheaper to throw away a $9 radio than to try to repair it. This will not be the case with transistor TV's, nor will it be the case with solid-state industrial equipment.

While talking about the spread of automation, which usually means electronic control of industrial processes, the "well informed source" has also overlooked the fact that controls need maintenance, and that in many factories the electronic maintenance technician will have a full-time job.

Nor has anyone, apparently, realized that the spread of electronics into household appliances will mean that repair of kitchen devices may become a job for the electronic technician. Already it has been suggested that electrical watches are more likely to get understanding service in the electronic service shop than at the watchmaker's.

Such a change of repairmen will be a good thing for the homeowner and the housewife. The electronic repair man has been derided by many of his critics, accused of lack of technical knowledge and held up to scorn as a screwdriver artist. But even a good screwdriver mechanic is often sought after in some other types of household service.

Not long ago I needed a new fuel pump in my oil burner. It was installed by a presumably competent repairman, an employee of the company that installed the burner and which does not service any but its own fuel customers. I asked him timidly about the supposed pressure of 100 pounds at which the oil was to be injected into the furnace. He snarled: "The fuel pump is set up at the factory—you can't touch it."

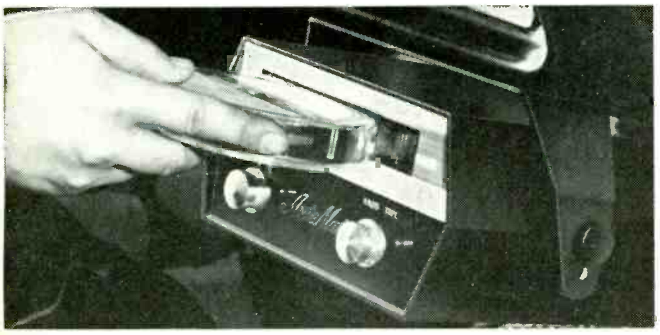
A few weeks later I noticed a large black cone of carbon had built up at one side of the nozzle, and had to adjust the needle valve myself for best performance. This reminded me that of all the three repairmen who had serviced my furnace, none had any instruments whatever. Yet any oil-burner guide will tell you not only about fuel pressure but of the partial vacuum supposed to exist—and be measured—in the combustion chamber, not to mention stack temperatures.

This indifference is not peculiar to oil-burner men. My gas drier goes out periodically at certain periods of the day, and at some times of the year will work only between midnight and 8 o'clock in the morning. These working periods, interestingly enough, coincide with periods of low gas use and of an accumulation of gas in the company's gasometers —in other words, of highest gas pressure. Obviously, the pressure valve on the drier is not properly adjusted.

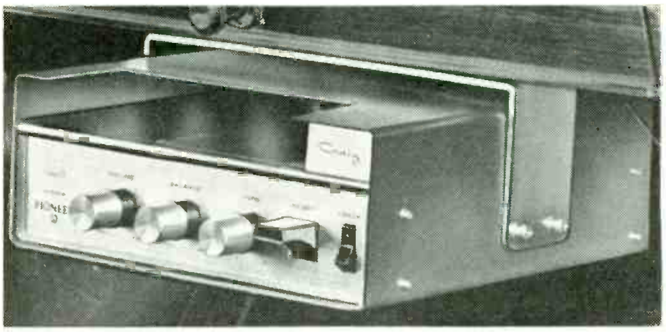
I will not touch adjustments on illuminating-gas equipment—it can be too dangerous. But, when I explain my problem to the various service technicians, they simply shake their heads and go about replacing heating coils that supposedly ignite the gas which is not supplied to them. Apparently not one man so far—and we have had at least one from the company that supplied the washing machine and one from the gas company—has any notion of what the pressure control valve is about, nor has any of them any instrument for measuring gas pressure or any other quantity in their work.

The coming of the electronic service technician—who at least tries to understand what he is doing—will be a boon to people who have been up against that kind of service. Possibly one reason why the television technician is berated so is that he is expected to turn out good work, whereas with the automobile mechanic or household-appliance technician, we simply hope for the best and trust to luck. Those people will not be able to service electronic equipment, whether it is in automobile ignition systems or washing-machine timers.

The electronics technician may find himself with a different kind of work, but as long as electronics continues to expand at its present rate, he is extremely unlikely to be out of a job. As he developed from a radio to a TV technician and got a foothold in industrial electronics, so will he continue to go with electronics into the other fields it will conquer in the future. That expansion will far more than make up for the results of increased reliability, both in the equipment he is now servicing and in the newer equipment he is already beginning to be called on to service, and which may well make up the bulk of his work in the future.



Orr AutoMate



Craig Pioneer

TAPE PLAYERS FOR YOUR CAR

Noise-free, fade-free stereo (or mono) while you drive. See chart on page 35.

By FRED BLECHMAN

THE LATEST ELECTRONIC WIZARDRY TO hit the country by storm is tape players for your car. Most of them feature four-track stereo playback through door-mounted speakers. Traveling along, fixed between the speakers, you'll find driving sheer pleasure.

The stereo separation is especially good since the speakers are mounted on each side of you. The acoustic characteristics of the car add to the stereo effect with a "full" sound that is startling to hear. There are no commercials, no FM reflection, fading or multipath distortion. Neither are you limited to being within a certain distance from a broadcasting station. Also, the static and incessant chatter on AM are completely eliminated.

Most of the designs use four-track stereo tapes playing two ¼-track stereo programs endlessly in prerecorded cartridges that need neither rewinding nor turning over.

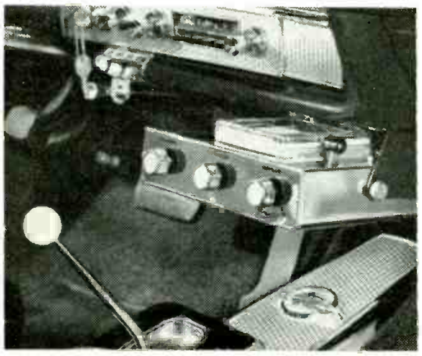
These tape players are unique in several ways besides their low cost and fine performance. A typical unit is enclosed in an attractive 4-inch high, 10-inch wide, 9-inch deep black case (bright metallic finish usually optional at higher price), and is installed under the dashboard, although above-the-dashboard, glove-compartment and between-the-seat installations are not uncommon. Installation, including four door-mounted 5-inch speakers, takes only an hour or two and is often included in the quoted price.

Except for the AutoMate, all units contain built-in transistor hi-fi amplifiers, using either 10 or 12 transistors and providing from 2 to 5 watts output per channel; this is more than enough volume even *at high speed* with the windows open. Quarter-track playback heads are used, except in AutoMate, which is a two-track unit.

On most units the head is mechanically coupled to a lever that positions it for the desired track pair. This eliminates the bother of turning over the tape cartridge to change tracks. On some units, a switch is used for track selection and the head is stationary.

Except for the Riverside unit, all tracks run in the *same direction*, which makes these tapes incompatible with Bell or RCA cartridge machines. So don't plan on recording your own tapes. Most manufacturers have an adequate library of prerecorded cartridges at reasonable prices, and the tapes are interchangeable in most cases.

The Conley Electronics Fidelipac automatic tape cartridge, used on all the units described except as indicated in the text and chart, uses an endless-loop principle. Specially lubricated 1-mil Mylar tape is pulled from the center of the reel, drawn across the playback head and fed back to the outside of the wound tape. Therefore, no rewinding is necessary, and the tape plays over and over without attention. The entire cartridge is constructed of plastic (don't leave it in the sun or it'll melt!). The tape is enclosed under a transparent cover, protecting it from dust, tearing, marring and other mishandling. Pinch-roller engagement holds the cartridge in position without jarring, vibration or flutter from road bumps.



Muntz Stereo-Pak

The tape speed is 3¾ inches per second, and the cartridges come in three sizes, providing from ½ to over 2½ hours of stereo per cartridge.

Claiming to be the originator and developer of this new listening pleasure is Earl "Mad-Man" Muntz. No longer affiliated with Muntz TV, he began developing the Muntz Music System in 1958, producing the first units and prerecorded cartridges in 1962. The name was later changed to Muntz Autostereo. Desiring to produce units for the popular market (they were priced for the Cadillac crowd at that time), Muntz set about re-engineering and improving the tape player for mass production, and succeeded in reducing the price drastically. Other manufacturers have entered the field, and competition has tended to lower all prices.

The proper dubbing of the tapes, according to Earl Muntz, was the biggest headache he had in developing this system, and he now claims to be the first to record four-track stereo in a Fidelipac tape cartridge.

Prerecorded tape prices vary with the manufacturer. Muntz tapes, for example, sell for a price determined by

UNIT NAME & SOURCE	POWER OUTPUT (WATTS PER CHANNEL)	NUMBER OF HEADS	FREQUENCY RESPONSE (CPS)	DISTORTION	FLUTTER & WOW (% RMS)	SIGNAL-TO-NOISE RATIO (db)	TEMP. RANGE (EXCEPT CARTRIDGE) (°F.)	POWER REQUIRED	POSITIVE GROUND UNIT AVAIL.?	PRICE: UNIT BLACK	PRICE: UNIT METALLIC	PRICE: SPKRS (four)	PRICE: INSTALLATION
AUDIO SPECTRUM Audio Spectrum 10 Columbus Circle New York, N.Y. 10019	(1) (10)	2	70– 9,000 ±3 db	2%	0.2	NF	–5 to +150	10–12V 1A	YES		$69.50	(1)	(7)
AUTOMATE P-600RF J. Herbert Orr Enterprises, Inc. 309 Williamson Ave. Opelika, Ala.	(1) (10)	1	50– 10,000	2% @ 1 kc	0.25	35	–10 to +170	9–15V 350 MA (9)	YES $7.50 Extra	$89.95 (3)	—	(1)	$5.00
AUTOMATIC RADIO Automatic Radio 2 Main St. Melrose, Mass.	5	(11)	100– 15,000	NF	0.3	50	+15 to +165	10.5 to 14.4 1.7A	YES	—	$125.00	Incl.	—
AUTOPHONIC Quality Audionics, Inc. 39 West 55 St. New York, N.Y. 10019	3	2	40– 10,000 ±3 db	2% @ 1 kc	0.2	35	NF	10.7–14.5V 1 A	NF	—	$119.95	$17.00 (4)	$15.00 (4)
AUTO-SONIC ST-400* SJB, Inc. (Mfd. by Martel) 2356 So. Cotner Ave. Los Angeles, Calif. 90064	3	1	40– 10,000 ±3 db	2% @ 1 kc	0.2	35	+20 to +130	9–16V 500 MA	YES	—	$129.95 (5)	Incl. (6)	(7)
AUTOSTEREO Autostereo, Inc. 14617 Keswick St. Van Nuys, Calif.	4	1	50– 12,000 ±2 db	1.2% @ 10 kc	0.2	46–52	–20 to +156	9–20V Less than 1 amp (9)	YES $5.00 Extra	$139.50	$159.50	Incl.	$15.00
CRAIG C502 Craig Panorama, Inc. 3412 So. La Cienega Blvd. Los Angeles, Calif. 90016	3	2	100– 6,000 ±3 db	3%	0.3	40	0 to +120	12 V 1 A	NO	$119.00	—	—	(7)
FORD Ford Motor Co. PO Box 608 Dearborn, Mich.	3	1	50– 8,000	NF	0.3	40	NF	12 V 2 A	NO	NF	NF	NF	NF
LEAR Lear Jet Corp. Wichita, Kan.				SPECIFICATIONS NOT YET AVAILABLE (11)									
METRA Metra Electronics Corp. 660 McDonald Ave. Brooklyn, N.Y. 11218 (Also: Lafayette Radio, Cat. 650, P.381)	4	1	60– 10,000 ±3 db	2%	0.3	50	NF	11–14.5V 1 A	YES	$149.95 (Grey)	$169.95	(4) (8)	(7)
MUNTZ STEREO-PAK Muntz Stereo-Pak 16032 Arminta St. Van Nuys, Calif.	5	1	50– 10,000	1.2% @ 10 kc	0.2	50	+20 to +140	9.5–18V 500 ma	YES	$99.50 $79.50	$119.50 —	Incl. $10	Incl. $10
OLSON Olson Electronics, Inc. 260 S. Forge St. Akron, Ohio 44308				SIMILAR TO AUTOPHONIC							$79.88	$15.90 for two	(7)
PORTA-TAPE Telepro Industries, Inc. Cherry Hill, N.J. 08034	(1) (10)	1	80– 5,000 ±2 db	2%	0.4	NF	+20 to +140	12 V 300 ma	NO	$69.95 (Sim. Leather)	—	(1)	(7)
RIVERSIDE Montgomery Ward Oakland, Calif. 94616 (1965 Spring/Summer Catalog, P.631)			SPECIFICATIONS NOT YET AVAILABLE (Another model similar to Porta-Tape)					12 V 2 A	NO	$109.00 (Walnut)	—	Incl.	(7)
TRANS WORLD Transworld, Inc. PO Box 482 Metairie, La.	5	1	40– 10,000	2% @ 1 kc	0.25	40	+25 to +130	9.5–16 V 250 ma	YES	$119.50		Incl.	
VIKING AUTO-TAPE 500 Viking of Minneapolis, Inc. 9600 Aldrich Ave. South, Minneapolis, Minn. 55420	2	1	60– 10,000 ±3 db	2%	0.3	50	NF	11–14.5 V 1 A	NF	$149.35	$169.95	Incl.	Incl.
WHITNEY J. C. Whitney & Co. 1917 Archer Ave. Chicago, Ill. 60616	NF	NF	APPEARS TO BE IDENTICAL TO AUTOSTEREO UNIT IN LISTED FEATURES, ILLUSTRATION & SPECIFICATIONS. DO-IT-YOURSELF INSTAL.							$99.50	$114.50	Incl.	(7)

NOTES: EXCEPT AS NOTED, all units are 4-track stereo, capstan drive, run at 3¾ IPS, playback only, and use interchangeable Fidelipac endless-loop tape cartridges. NF = INFORMATION NOT FURNISHED BY MANUFACTURER. All data in table are manufacturers' specs.

* WEST COAST DISTRIBUTION ONLY

(1) Uses car AM radio for amplifier & speaker.
(2) Consists of preamp & rf oscillator only.
(3) Unit price includes 1-hr recorded tape.
(4) Can be connected through special switch to use car radio speakers.
(5) Unit price includes ½-hr. recorded tape.
(6) Choice of either four custom 5-inch round speakers & grilles or two do-it-yourself speakers in chrome enclosures.
(7) Installation is do-it-yourself.
(8) Insta-Mount speakers available separately.
(9) Electronically regulated speed.
(10) Monaural.
(11) Uses 8-track Lear cartridge.

tape length and recording artist, running from as low as $3.98 for 30 minutes to $24.98 for 2½ hours.

[Muntz cartridges and players will be sold by Montgomery Ward under its Riverside label this fall.—*Editor*]

All the units described are capstan drive and use a tape speed of 3¾ inches per second, and are playback units only. Most are stereo, and most use Fidelipac cartridges except as noted in the chart. Two use the new 8-track Lear cartridges. They are all 12-volt units, so they can be used on 6-volt cars only with an additional battery in series with the car battery. All are designed for a negative-ground system, but some offer positive-ground units (usually at extra cost). In most units the motor is governor-controlled to maintain a constant speed from about 9 to 16 volts.

Total power requirements vary from one brand to another, mostly due to the motors used, but the typical unit draws only ½ to 1 ampere—not much more than a 7-watt night light! Service warranties vary from 90 days to one year, and one manufacturer (Muntz) boasts "never a charge for service."

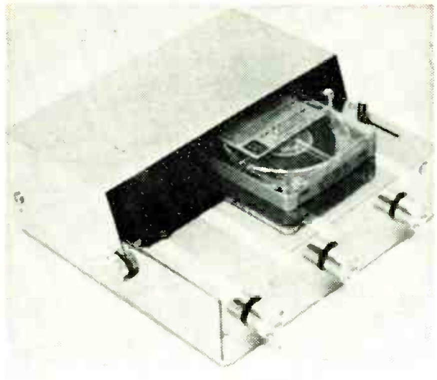
Since some of the features of individual brands are not self-explanatory in the chart, we'll look at each unit in a little more detail.

The Orr *AutoMate* is one of a small class of unusual units. It is a two-track *monaural* unit, and uses special Cousino endless-loop cartridges available from Orr Enterprises. A *U-Tape-It Kit K-6* can be used with most reel-to-reel recorders to make your own tapes for the AutoMate. The AutoMate output is a modulated 800–1000-kc rf signal, tunable on the AM broadcast band. Installation consists simply of mounting the unit, connecting it to the battery, plugging the car antenna into the AutoMate and plugging the output of the AutoMate into the automobile radio antenna jack. [The Telepro Porta-Tape uses a similar arrangement.—Ed.]

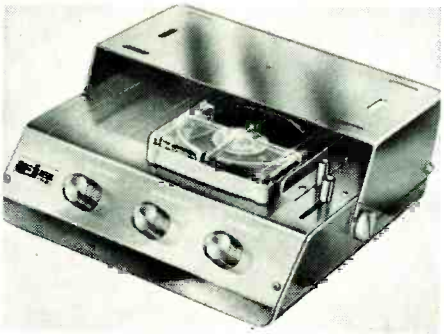
A simple switch on the AutoMate disconnects the vehicle's antenna when the tape is being played, or reconnects the car antenna to the radio when the player is turned off. Of course, the sound comes through the car radio speakers, so adding a rear-speaker reverberation unit can provide a stereo-like sound.

The *Autophonic* unit is fairly typical of the stereo Fidelipac-cartridge units, but is the only one listed that has two heads. A special switch is available that allows you to use the car's existing front and rear speakers for the stereo separation, thus saving the cost and installation of Insta-Mount door speakers, which are also available. This unit is available only in a bright metallic finish, and has a pilot light.

The *Audio Spectrum* player is cartridge-activated (no lever to push) and has a solenoid-actuated mechanism that disengages the pinch roller and cartridge when the car's ignition switch is turned off, to prevent flat spots.



Autostereo MC-5



Auto-Sonic ST-400

The *Auto-Sonic* unit is somewhat different in style from the others and is also available only in the bright metallic finish. This unit features optional do-it-yourself speakers in chrome enclosures that don't require large mounting holes.

Autostereo is one of the pioneers in this field and one of the few made with American parts and labor. The chassis is hand-wired (printed circuits are used on other units). The 5-inch speakers are manufactured by Oaktron, and are not subject to rupturing when the volume is turned all the way up—a potential problem with lower quality speakers. A special adapter ring allows for simple speaker installation. The amplifier uses driver transformers with a special core material for flat response.

Particular attention has been paid to motor life in the design of these units, with speed electronically regulated, and regulator contact current reduced by using a principle similar to that used in transistor ignition systems. The result is motor life exceeding 1,000 hours, speed regulation from 9 to 20 volts, and operation down to -20°F.

Autostereo also makes a special fungus- and moisture-proofed unit with waterproof speakers for boats.

The *Metra* units, available in either baked gray enamel finish or high-luster stainless steel, appear to be identical to the *Viking* units, which were probably the first on the market. Metra Electronics features the Insta-Mount speakers for do-it-yourself installation. Metra units and Insta-Mount speakers are also available from one of the country's largest mail-order houses, Lafayette Radio Electronics Corp., which also offers a switch and wiring harness allowing use of the existing car radio speakers.

The most highly promoted unit is the *Muntz Stereo-Pak*, which is also the least expensive. However, the low price seems to be a result of high production rather than corner-cutting. Also, Muntz will install your unit in another car, complete with four new speakers, for only $20, so there's no big loss when changing cars.

The *Riverside*, marketed by Montgomery Ward, uses the common RCA-Bell type of cartridge which must be turned over when the selection is completed. With this system you can record your own tapes if you have an RCA or Bell cartridge tape recorder. The Riverside unit has only recently come out, and information is sketchy.

Viking appears to be the first company to have offered automotive tape players for sale (the history of the development of these machines is clouded by conflicting claims), but it appears to have lost ground to the newer, more aggressively promoted units, and detailed information on Viking units has not been available to me. (Two letters asking for specific information were never acknowledged, let alone answered!)

J. C. Whitney & Co., a large auto parts and accessories mail-order house, is selling a unit that in appearance, description and listed specifications is identical to the Autostereo unit. Even the tape series designations are the same as Autostereo. This is sold strictly for do-it-yourself installation, so the price is considerably lower than the Autostereo price.

The market potential for these units is so vast that you can be sure you'll be running into one of these units soon if you haven't already. Many listeners comment that these car units sound better than anything they have at home, and they must be heard to be appreciated.

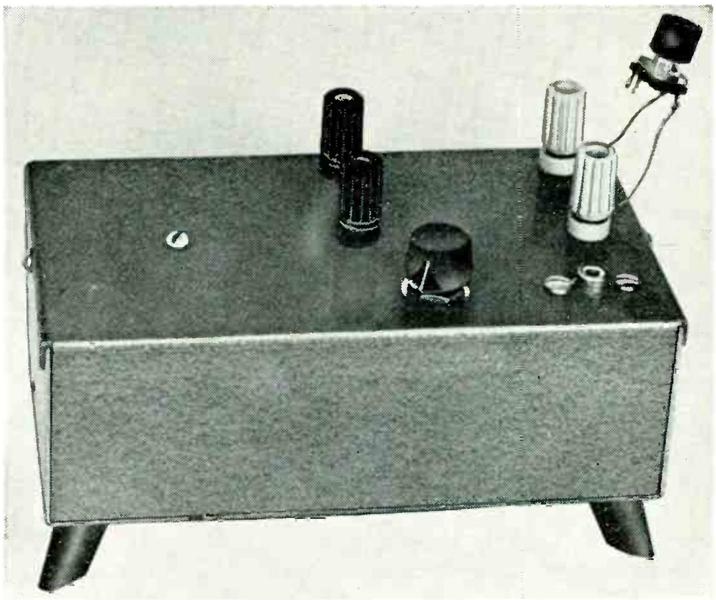
And If That Isn't Enough. . .

An auto adapter for the Norelco Carry-Corder portable tape recorder is about to make its entry. The Adapter will sell for about $30; the recorder costs about $120. The adapter consists of a Cycolac tray in a metal frame that mounts under the dashboard. A 1-mc amplitude-modulated oscillator takes its power from the recorder (not from the car) and the signal is picked up on the car's AM radio, tuned to about 1000 kc. Norelco expects to make available recordings from Mercury, Deutsche Grammophon and Philips masters, all in its nonstandard two-reel miniature cartridges. END

Easy Alignment with the Semi-Sweeper

By DONALD L. STONER

Three-Semiconductor Sweep generator covers range from below 100 kc to 60 mc



Here, Semi-Sweeper uses 455-kc transistor i.f. transformer as rf oscillator inductance. Many other coils are suitable, depending on center frequency you want.

THE SEMI-SWEEPER ISN'T A PART-TIME janitor. It is an all-solid-state sweep generator that will save considerable alignment time compared to the few hours required to construct it. You can use it to align all radio and TV i.f.'s, filters, plot response curves, check bandwidth. The unit has been stripped of all superfluous controls and is designed to operate between 100 kc and 60 mc without a complicated bandswitching mechanism (lower frequencies are practical). It can be used on higher frequencies by utilizing harmonics or by modifying the circuit slightly.

Basically the Semi-Sweeper consists of a sawtooth generator, a variable-capacitance diode and a transistor oscillator. The rf output of the generator is a constantly sweeping frequency which is fed into the input of a receiver or i.f. strip. A scope is connected to the receiver detector, and dc changes cause the spot to deflect. Thus the amplitude waveform on the scope is a direct indication of signal strength and therefore of the amplifier gain. By using the sawtooth output of the Semi-Sweeper as a time base, the pattern displayed is a near-perfect replica of the receiver alignment curve. Each time a tuned circuit is adjusted, the effect will be instantly apparent on the screen. Thus broad-band alignment and tuning of discriminators or crystal filters is made infinitely easier.

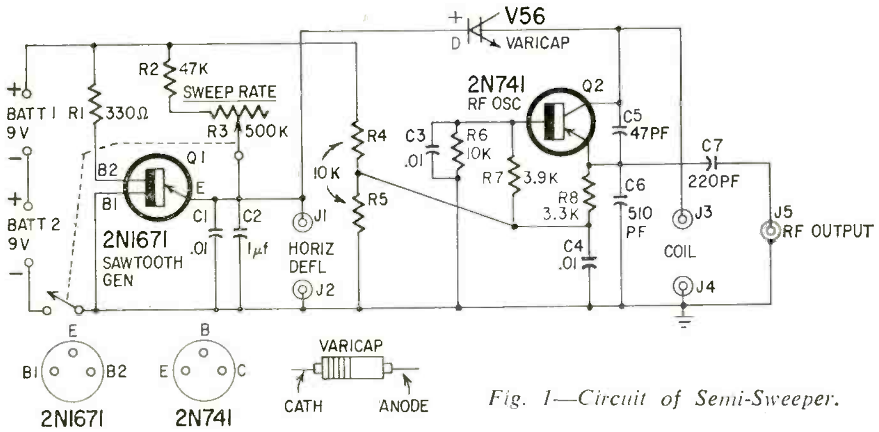


Fig. 1—Circuit of Semi-Sweeper.

BATT 1, BATT 2—9-volt batteries (RCA WS-322 or equivalent)
C1, C3, C4—.01 μf, disc ceramic
C2— μf, 100 vdc
C5—47 pf, silver mica
C6—510 pf, silver mica
C7—220 pf, silver mica
D—V-56 Varicap (Pacific Semiconductor)
J1, J2, J3, J4—binding posts (E. F. Johnson Co. 111-series or equivalent)
J5—RCA style phono jack
Q1—2N1671 (G-E)
Q2—2N741 (Motorola, Sylvania)
R1—330 ohms
R2—47,000 ohms
R3—500,000-ohm pot, with switch (Centralab B-60 or equivalent)
R4, R5, R6—10,000 ohms
R7—3,900 ohms
R8—3,300 ohms
All resistors ½ watt, 10%
Cabinet (LMB 138 or equivalent), vector board.

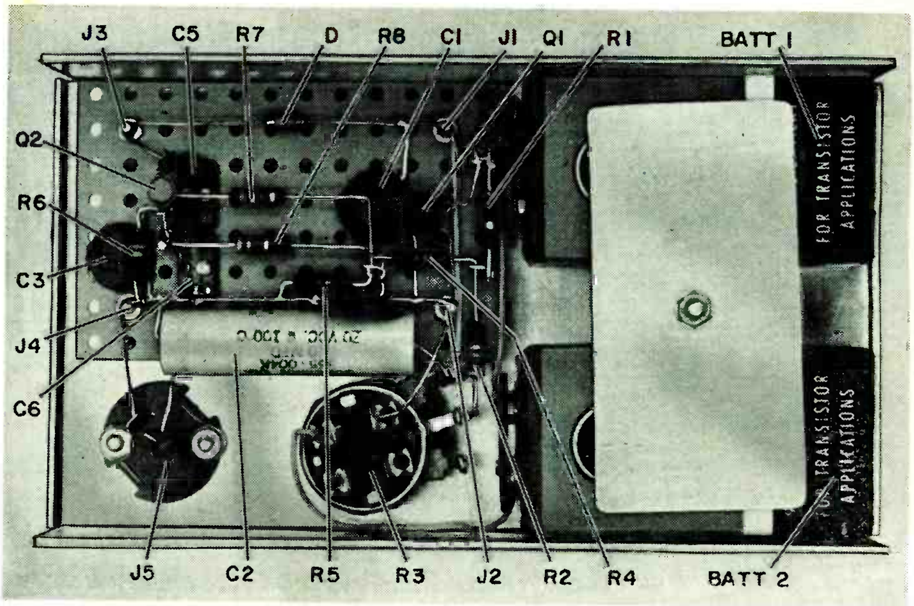
To aid experimenters in duplicating this project, a circuit board is available from the W. H. Paulin Co., Box 122, Upland, Calif. for $1.00, postage paid.

Circuitry

The sawtooth waveform is generated by a unijunction transistor. The sawtooth drives a variable-capacitance diode, another interesting semiconductor. Reversed-biased, the diode has a capacitance between the two terminals. As the reverse voltage is decreased, the junction capacitance increases. The Pacific Semiconductors V-56 Varicap, used in the Semi-Sweeper, has a junction capacitance of 56 pf at −4 volts. The sawtooth applied to the V-56 causes the capacitance to vary in proportion to the amplitude of the sawtooth. The sawtooth waveform is also brought out to terminals on the Semi-Sweeper to provide a time base for the oscilloscope.

Fig. 1 is the schematic. Power is supplied by two 9-volt transistor batteries. R2 and R3 determine the charge time of C2. R3 adjusts sweep frequency between 5 and 30 cycles per second. Capacitor C1 is an rf bypass. The sawtooth appears across J1 and J2, which connect to the external horizontal input on the oscilloscope. The appropriate inductance for the desired sweep frequency is connected across terminals J3 and J4 to complete the oscillator circuit.

The oscillator consists of a Motorola 2N741 (Q2) in a Colpitts configuration. A capacitive voltage divider (C5 and C6) is connected across the external inductance, and feedback occurs between collector and emitter through this network. The variable-capacitance diode is connected in parallel with the tuned circuit and causes its frequency to sweep back and forth at a rate determined by the sawtooth frequency. Rf output is coupled from the low-impedance emitter of Q2 to jack J5 through a 220-pf capacitor. Oscillator B-plus comes from a voltage divider connected across the battery (R4 and R5). The oscillator is operated at a reduced voltage to prevent the rf cycles from exceeding the 2N741's collector breakdown rating.



Simple wiring takes little space and looks neat on perforated board. Circuit lends itself nicely to printed-circuit design. A circuit board is available—see the parts list.

Construction

The Semi-Sweeper is constructed in an LMB chassis box 2 x 3½ x 6 inches. The circuitry is mounted on a piece of Vector board 2 x 3 inches. Vector pins are used to make connections and junctions as required. The board is supported on binding posts J1–J4. The method of mounting the batteries is crude but seems effective: a bolt through the front panel pulls down on an aluminum plate which bridges the two batteries. A phono connector is used for the rf output jack.

Using the Semi-Sweeper

The method of connecting the Semi-Sweeper is shown in the block diagram (Fig. 2). The scope is usually connected across the detector load, as shown. The output of the generator is coupled to the input of the circuit being aligned through a shielded cable and potentiometer. The length of the cable or the impedance it feeds is not critical but simply changes the tuning slightly. The only precaution in using the sweep generator is to avoid overloading the circuit under test. Overload is usually evidenced by a perfectly flat top on the alignment curve. It is seldom possible to get such an ideal curve, so you'll recognize it as overload. Always keep scope

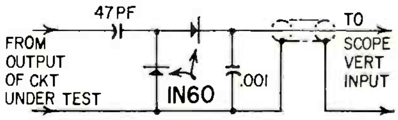


Fig. 3—Rf "probe" (demodulator network) you can make for amplifier without detector. Regular rf probe designed for vtvm or scope will work fine.

gain as high and generator signal as low as possible.

If you need more generator output, increase the value of the potentiometer. For sweeping single stages, when maximum gain is required, the potentiometer can be eliminated altogether. A suitable detector probe for single-stage alignment (where there is no detector) is shown in Fig. 3.

Virtually any inductance can be used externally to determine the sweep (center) frequency. For 455-kc alignment, one winding of a discarded i.f. transformer makes an excellent tuned circuit. There is no need to remove the internal capacitor unless the sweep frequency is too low to hit 455 kc. I.f. and rf transformers can also be used at other common alignment frequencies. Above 4.5 mc it is more convenient to use slug-tuned coils. At 27 mc and above, a few air-wound turns make an excellent coil. The turns may be spread or compressed to vary the frequency.

If you are not sure of the sweeping frequency, tune it in on a general-coverage receiver. You'll recognize the signal immediately by its distinctive sound. The external inductance can also be checked with a grid-dipper. Turn the sweeper on when you dip the coil.

Sweep linearity is intentionally rather poor. As the frequency is varied, and the alignment curve moves across the scope trace, the pattern width will change. Thus, when you align selective circuits, change the frequency until you get the broadest curve. If you're working with broad-tuned circuits, change the frequency to move the curve to the opposite end of the scope trace to narrow the alignment curve. Sweep width can be decreased by adding capacitance across the external inductance to reduce the effect of the diode capacitance change.

Always use the slowest possible sweep speed to obtain the most faithful reproduction of the alignment curve. Crystal filter alignment is particularly critical. If the speed is increased beyond 20 cycles or so, crystal ringing will distort the curve.

For best results, use the oscilloscope on the dc-coupled position. At slow sweep speeds, the coupling capaci-

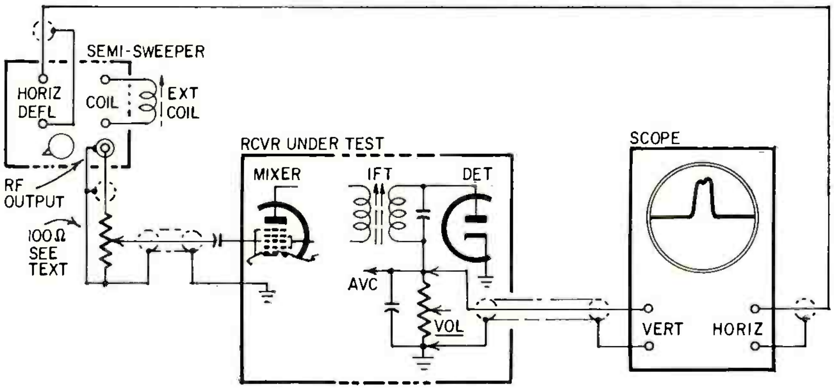


Fig. 2—How to connect Semi-Sweeper to scope and receiver or amplifier to be aligned.

tors in an ac-coupled scope cannot pass the low-frequency components of the waveform and distortion occurs. If a dc scope is not available, increase the generator sweep speed to a compromise setting.

Although 100 kc is an arbitrary minimum, the sweeper will work at lower frequencies. Below 100 kc, comparatively large capacitances are required to resonate a coil to a given frequency. This shunt capacitance across the Varicap reduces the effective sweep width. When you use the sweeper below 100 kc, always use a large inductor so that only a small amount of external parallel capacitance is required. The J. W. Miller multiplex adapter coils (such as No. 1351) are excellent inductors down to 50 kc or so.

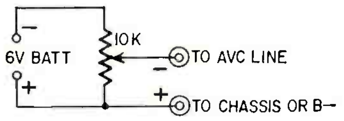


Fig. 4—"Bias box" for replacing avc/agc voltage with fixed voltage for alignment.

For an accurate alignment curve, disable the avc. Otherwise, the rectified sweep signal from the detector will be fed back via the avc circuit as a correcting voltage. When the sweep curve changes direction or amplitude, the avc tries to counteract the change. Obviously this results in a distorted curve. Use a "bias box," as shown in Fig. 4. By connecting it across the avc line you have complete control over the gain of the i.f. simply by adjusting the potentiometer.

The oscillator is so strong that just about any external coil is satisfactory. If you don't have a junkbox full of old coils, you can make suitable inductors out of old slug-tuned coil forms. They can be scramble-, solenoid- or layer-wound with equal success. The more turns you use, the lower the resonant frequency. If you own a grid-dip meter, you can check the tuning range of the coils by tacking a 50-pf capacitor across each. This represents the approximate capacitance inside the sweeper.

As you go higher in frequency, you may find the sweep range excessive. This is because the capacitance of the Varicap has a greater effect on the frequency of the tuned circuit as the inductance is made smaller. Sweep width can be reduced by paralleling the external inductance with additional capacitance and withdrawing the slug or removing turns to maintain the same resonant frequency.

My Semi-Sweeper has been used almost daily since it was constructed. Cost of construction should be about $20, far less than the cost of a comparable ready-made or kit instrument. END

FOOLPROOFING THE TRANSISTOR DUO

By RUFUS P. TURNER

A two-terminal p-n-p-n semiconductor device, such as the four-layer diode, has many interesting and useful applications in simple circuits: low-voltage relaxation oscillator, flip-flop, static switch, power inverter, negative resistor, among others. But this is an expensive component.

Many articles have stated that the four-layer diode corresponds to a p-n-p and n-p-n transistor connected in series in a regenerative loop, as in Fig. 1-a. And people have asked immediately, "Why can't I hook up two inexpensive transistors to get the same operation?" Most who have tried such a *transistor duo* have gotten nothing but straight dc conduction, no bistable operation. The secret to foolproofing the arrangement is to connect a small resistance (R) between the base and emitter of the n-p-n transistor, as in Fig. 1-b. This allows the p-n-p collector current to develop a signal voltage drop across R, which is high enough to drive the n-p-n vigorously.

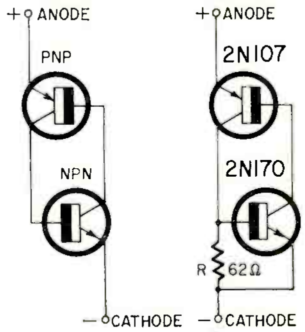


Fig.1

Without the resistor, the current flowing into the n-p-n base is not always high enough to trigger the circuit. I found a 62-ohm ½-watt resistor just right, but some adjustment in one direction or the other may be needed with individual transistors.

Fig. 2-a shows response of the duo. When dc is supplied from a current source (variable voltage source in series with a 100-ohm resistor, Fig. 2-b), the voltage drop from anode to cathode first increases rapidly from zero to 1.9 as the current is raised from zero to 400 μa. Then as the current is further increased, the voltage drops rapidly to 0.35 at 10 ma. And as the current is increased still further, the voltage again rises to 0.40 at 16 ma, as shown.

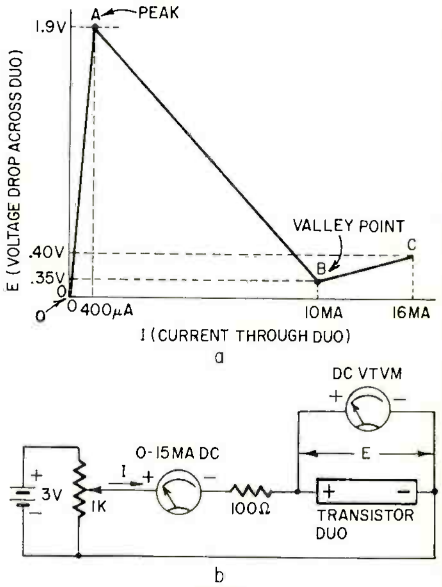


Fig.2

Region AB indicates negative resistance, whereas OA and BC represent positive resistance. When the duo is driven from a dc voltage source, the current increases slowly to 400 μa (*off* state of the duo) as the voltage is increased from zero. When the voltage reaches 1.9, however, the current suddenly jumps to 10 ma (*on* state of the duo).

In many circuits, the duo is used simply as a neon lamp might be used at higher voltages; in other circuits, as a 10-ma tunnel diode. This combination is cheap when compared with higher-priced p-n-p-n units; at current prices, the 2N107, 2N170 and ½-watt resistor total $1.54. Larger transistors may be used, of course, if heavier-current operation is desired. To make a simple, compact unit for wiring into circuits and for experimentation, the wired transistors and resistor may be enclosed in a small plastic tube, encapsulated with wax or other potting material, and a single pigtail brought out at each end. END

DIODE RF SWITCHES

Practical circuits—like a transmit/receive switch—demonstrate possibilities for reliable remote rf switching

By IRWIN MATH

ORDINARY COMPUTER DIODES MAKE excellent rf switches. Because switching is completely electrical, there are no moving relays or closing contacts. This results in sure and noiseless contact each time.

It is well known that a forward-biased diode presents a very low impedance—a couple of ohms or less. A reverse-biased diode offers a high impedance, into the megohm region. Thus, by placing a diode in series with a signal source and properly biasing it, one can produce a very satisfactory "electronic" switch.

Fig. 1 shows a typical diode switch. When a positive control voltage is applied, the diode is reverse-biased and will cause as much as a 10,000:1 reduction in signal (40 db). With a negative voltage, however, the diode is forward-biased. Now, the rf sees a low impedance path, and passes through the circuit quite easily. Using this idea, we can come up with a very useful rf switch for coaxial lines. Fig. 2 shows a single-pole triple-throw switch. The dc bias voltages are the only ones switched mechanically.

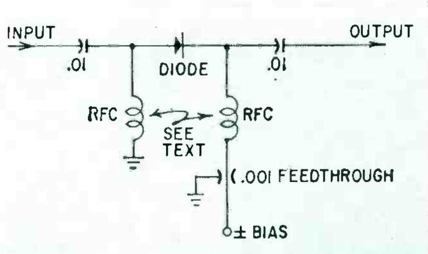
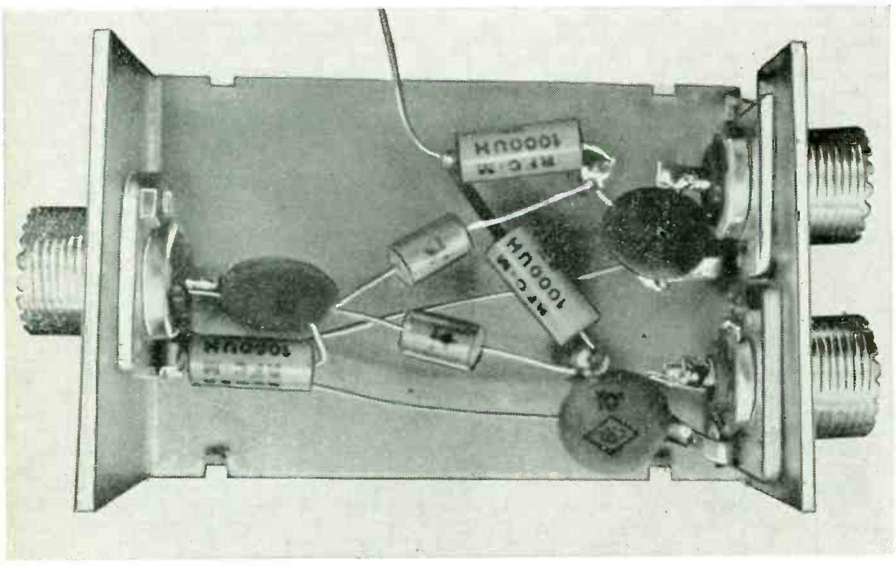


Fig. 1—Basic diode spst switch. The .01-μf capacitors block dc.



Author built his antenna-changeover switch into a tightly shielded aluminum box. Free wire in bottom photo is bias connection, brought through feedthrough capacitor in box cover.

Diodes used for these applications should be chosen for very high front-to-back ratios and small forward resistances. For low-power work, computer diodes such as the 1N118 and 1N100 do well. At higher powers, the typical germanium or silicon "top-hat" type, such as the 1N91 series, will be useful. In the uhf region, the 1N21 series would probably prove a good choice for an rf switch.

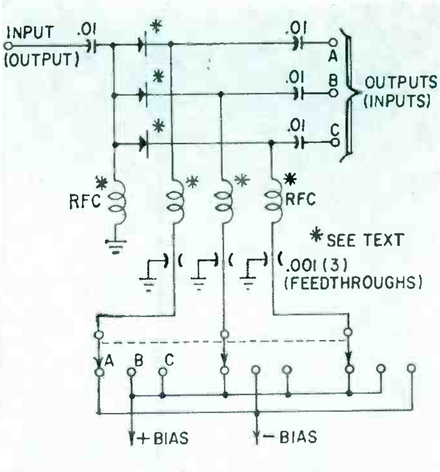


Fig. 2—An sp3t diode rf switch.

Again—the most important characteristic of the diode chosen for rf switching is the front-to-back ratio. This should be as high as possible. The forward resistance, on the other hand, should be as low as possible. At vhf, the capacitance of the diode structure becomes important.

The unit in Fig. 1 was used specifically for test purposes. The diode is

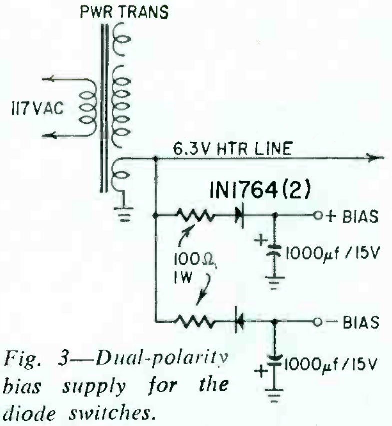


Fig. 3—Dual-polarity bias supply for the diode switches.

an RCA type 1N1764. The 1-mh chokes should be all right from 3 or 4 mc to about 50. Above that, use 100-μh chokes; below that, 2.5-mh or larger ones. With this circuit, a positive bias closes the switch. This bias may be anything from about 3 to 6 volts. A convenient source of bias voltage is the 6.3-volt heater supply. Fig. 3 shows a simple method of obtaining either positive or negative voltage from this supply. The 100-ohm resistors limit the current.

After experimenting for some time with diodes, I decided to build a diode-operated antenna changeover relay.

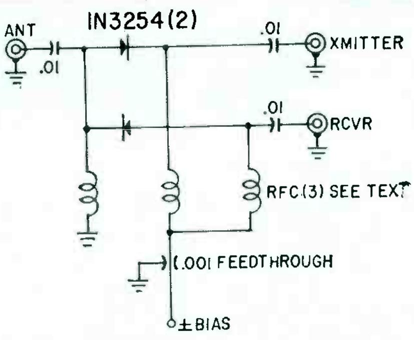


Fig. 4—Practical diode antenna-changeover (transmit/receive) switch. This amounts to an spdt switch.

The final device is shown in Fig. 4 and the photos. Switching is accomplished with the 6-volt supply described. The unit has been tested with 10 watts of rf in the 6-meter band (50–54 mc) and has up to 40 db of isolation between transmitter and receiver. As far as the rf from the transmitter to the antenna is concerned, there is only about ¼ to ½ db loss through this path. I did not try the switch at frequencies much higher than 50 mc, but with the proper lead dress and component layout, it seems quite practical. For higher power, use some of the newer stud-mounted diodes on the market. END

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What's Your Modulation % ?

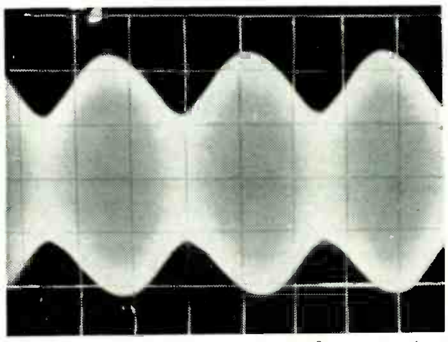
It's easy to find out with a scope

By FRED BLECHMAN, K6UGT

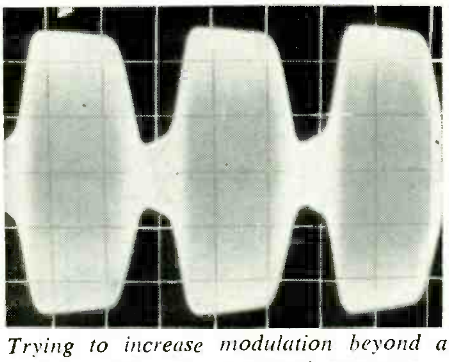
You've often heard "How's my modulation?" on the air. You know it's important—that the receiver responds to the modulation rather than to the carrier strength. But do you know how to measure your own modulation percentage? It's easy if you own (or can borrow) an oscilloscope.

The scope doesn't have to be an expensive one, just so it has direct connections usually through dc blocking capacitors) to the vertical deflection plates of the CRT. Also, you will need a pickup coil—three turns of ordinary insulated hookup wire around a 1-in. diameter form, close-wound. Remove the loop from the form and tape it together for convenience in handling. Now solder a twisted pair of wires about 2 feet long to the ends of the pickup loop. Connect the ends of the twisted pair to the (direct) vertical-deflection terminals of the scope, then turn on the scope.

Now place the pickup coil near your transmitter final coil, and turn on the transmitter. You'll get a band across the scope screen, the height depending upon the position of the pickup coil with respect to the transmitter coil. Adjust the pickup coil so you get about an inch-high scope pattern if you can. Be careful of exposed high voltages in the transmitter. The scope's vertical gain control, being bypassed, will have no effect on the height of the trace.



Modulation in this waveform figures to just over 30%. Distortion is low.



Trying to increase modulation beyond a certain point only increased distortion—now bad enough to reduce intelligibility and widen band occupied by transmitter beyond reasonable limits. This rig is simply incapable of modulating beyond about 70-75%.

Now talk into the transmiter mike. The pattern on the scope should jump wildly. Adjust the scope horizontal width and sweep frequency for a comfortable display. Whistling (hold the mike farther away than when you talk) can give a remarkably clean wave-envelope pattern if you adjust the sweep frequency properly. The best arrangement is to use an audio signal generator as a modulating source; either feed it direct to the modulator input, or hook the generator up to a speaker and hold your mike near the speaker.

Here's how to measure the modulation percentage:

1. Speak as you normally do. Don't shout!
2. Measure the maximum pattern height in any convenient units. Call this height "A".
3. Measure the minimum height of the modulated pattern. Call this "B".
4. Now use this simple formula:

$$\text{Modulation } \% = \frac{A - B}{A + B} \times 100$$

You may find that you can drive your microphone harder without exceeding 100% (bright dots on the trace center line), but your distortion will probably increase. If you use an audio generator to feed the modulator, your display can be a stationary trace (see the photos) and you can pretty well tell where you begin trading clean modulation for distortion.

What do you do if the modulation of your rig is hitting 100%? Back away from your mike or you'll splatter all over the band. If your modulation is too low, speak closer to the mike, speak louder, try a mike with higher output or check the modulator tubes.

The sad fact is that many transceivers are design-limited to a low modulation percentage, since modulator power costs the manufacturer more dollars. If your modulation seems to be limited, you will probably find it worth your while to use one of the several speech-compression amplifiers on the market; these will make the most of the modulation percentage you do have. END

The Proton Magnetometer: New Tool for Archeologists and Treasure-Hunters

This exciting electronic prospecting instrument has opened new paths to the past

By E. H. MARRINER

Elsec Proton Magnetometer—a commercial unit.

ARCHEOLOGISTS CAN SAVE PRECIOUS TIME with a new instrument: the *proton magnetometer*. Just recently, it has found stone-age civilization sites in England and probed Etruscan tombs in Italy. Now investigators are using it in the USA. No longer must archeologists drill holes and dig trenches just to learn whether there might be anything down there worth looking for. With the proton magnetometer, the center of a site can be plotted on a map long before anyone brings out the shovels.

An electrical method of probing has been used for some time. It works by passing a current into the ground through two outer electrodes in a line of four. The resistivity can then be calculated from a simple formula involving the measured resistance between the inner pair of electrodes and their distances apart. The success of a site survey depends on having a measurable contrast in resistivity between the structures sought and the surrounding ground. The contrast depends on the moisture content of the ground; this, being a variable, can be compensated for on the chart. Information is gathered by making a measurement spread through a right angle. Then the data are processed. A pattern 25 feet wide and 55 feet long can be plotted in 1 hour, against days of digging by the old method.

This method of locating sites has been used in Europe for several years but has only recently been tried in this country. The University of California found a new San Dieguito Indian complex in San Diego County, California, on the first field trial. But the resistivity method is being supplanted by a new method, using the *proton magnetometer*.

Any instrument that measures a magnetic field is called a magnetometer. Such instruments have been used in geophysical studies for many years.

The original magnetometer was called the Swedish mining compass. It was developed about 100 years ago and used only to detect ore bodies. About the turn of the century the Hotchkiss dip needle and super-dip were developed. During World War II, aircraft detection of submarines came out of this principle, although these devices were actually a type of variometer (instrument used to measure variations in magnetic fields).

In 1956 a group of research geophysicists developed the proton magnetometer. This instrument measures the magnitude of the earth's magnetic field. The operator of the device can detect a *magnetic anomaly* spatially on a chart (Fig. 1).

Systematic variations in the physical properties of the earth are what enable the magnetometer to find the structures that cause them. These variations are called *anomalies*. Anomalies due to magnetic material can be detected by the proton magnetometer. Two distinct types sought by the archeologist are those produced by soil of high susceptibility in comparison with its surround-

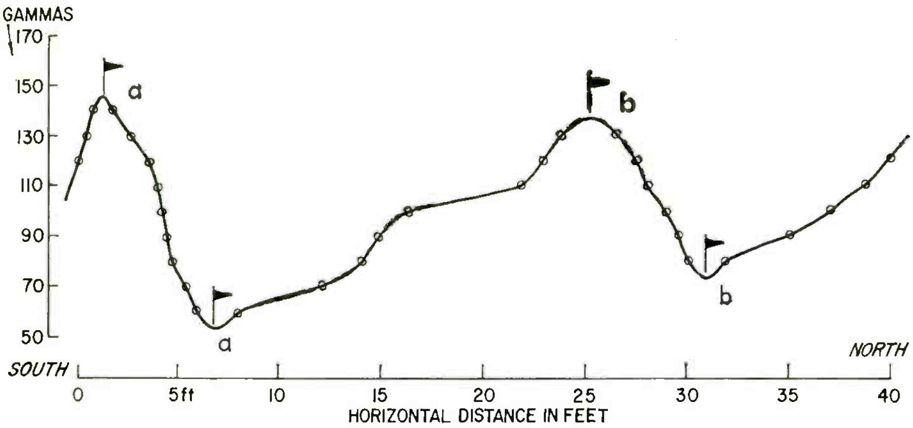


Fig. 1—Magnetometer readings are plotted along a straight line. Points between which magnetic susceptibility changes rapidly (as between the little flags a-a and b-b) define the areas where the searcher looks for objects of interest.

ing material, and those caused by the ferrimagnetic properties of heated material, which is termed *thermoremanent* magnetism.

The magnetometer is one of the few devices that have been adapted in the past few years to archeological surveying.

The first use of the proton magnetometer for archeological surveying was in the winter of 1957 at Huntingtonshire, England, by a group of Oxford University scientists. They detected a number of Roman and medieval walls and house outlines made of clay.[1]

A few years later a group from the Indiana Historical Society used the device to find a pre-Columbian village in southern Indiana and produced enough evidence to map in detail the entire fortified village.[2]

A proton magnetometer of different design was used in the German Rhineland. This instrument produced readings unaffected by diurnal variations or magnetic storms. It proved of real value in this area since there is a great variety of subsoils in the pits and ditches. The Roman city of Xanten was explored with the proton magnetometer, and the survey data produced detailed maps of the city's foundations and defenses.[3]

Physical description

The proton magnetometer is composed of a control box and the *bottle* (Fig. 2). In the bottle is a plastic container called the sensing head, 1.85 inches in diameter. The bottle holds about a pint of distilled water. (Alcohol is used in arctic climates.) The bottle is surrounded by a coil of wire (1,250 turns of No. 22 SWG) which serves the dual purpose of polarizing the protons and receiving the signal produced by the precession of the protons. In the receive position, the weak signal is amplified by an amplifier connected to the bottle unit by a cable. Digital indicators read this amplified signal and record the measurements.

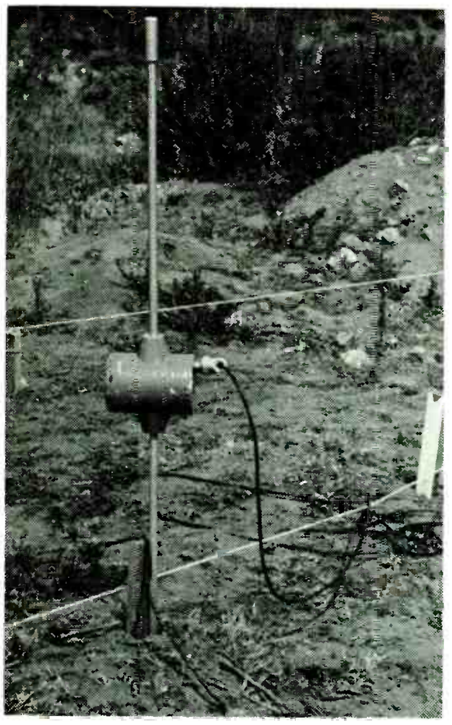
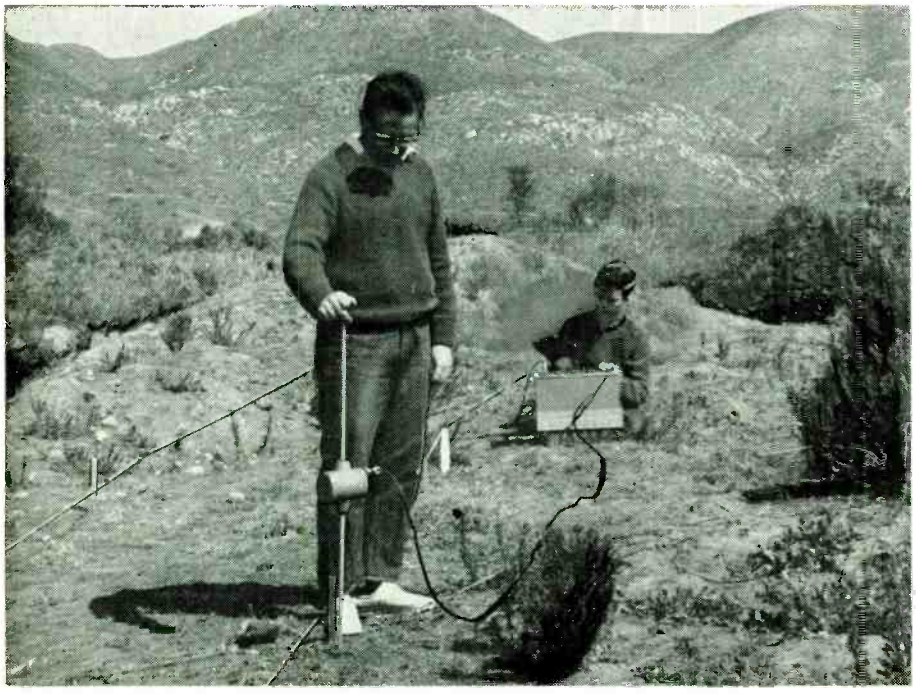


Fig. 2—The "bottle" section of a proton magnetometer.

A magnetometer is a rather simple device, though it depends on nuclear reactions. It can best be described in the words of an article by Dolan Mansir in the April 1960 issue of RADIO-ELECTRONICS, which also showed some of the electronic circuitry used to amplify and detect the magnetometer output. Part of the article is reprinted here.



Two archeologists make a field survey with the proton magnetometer.

How a magnetometer works

"Protons are simply the nuclei of hydrogen atoms, and there are two reasons why they can be used to measure magnetic fields: Protons have magnetic moments, like very small bar magnets, and they spin on an axis through their magnetic poles—or at least their behavior indicates they do.

The magnetic moment and spin determine a property known as a gyromagnetic ratio. This merely means that the tiny bar magnets, spinning on their axes will *precess* at a given frequency (like a spinning gyro, which will wobble but not fall if tipped) if they are placed in a given magnetic field—and if you follow the right sequence of steps to cause the precession to occur.

Causing and detecting precession

What does it take to cause a free precession and how do you detect it? If a bottle of water or other substance containing many hydrogen atoms is placed in a strong nonoscillating magnetic field, the nuclei of a majority of the atoms will align themselves with the applied magnetic field. Now, if the magnetic field is suddenly removed, the spinning atomic gyroscopes are given a "push" by the earth's magnetic field, and they start to precess in phase. After a few seconds, the phase relationship is lost as the nuclei align with the earth's field and it is necessary to start over with the aligning process.

If the aligning field is exactly in the same direction as the earth's field, the protons do not get a push and no precession occurs. For best signal amplitude, the aligning field should be at right angles to the earth's field. Alignment affects only the signal amplitude, not the signal frequency.

In practice, the protons are actually placed in a bottle which is put in the center of a simple coil of wire. The coil does double duty—it furnishes the strong magnetic field to align (polarize) the protons, and the precessing magnetic moments of the protons induce the signal voltage in it. This is exactly analogous to an ac generator."

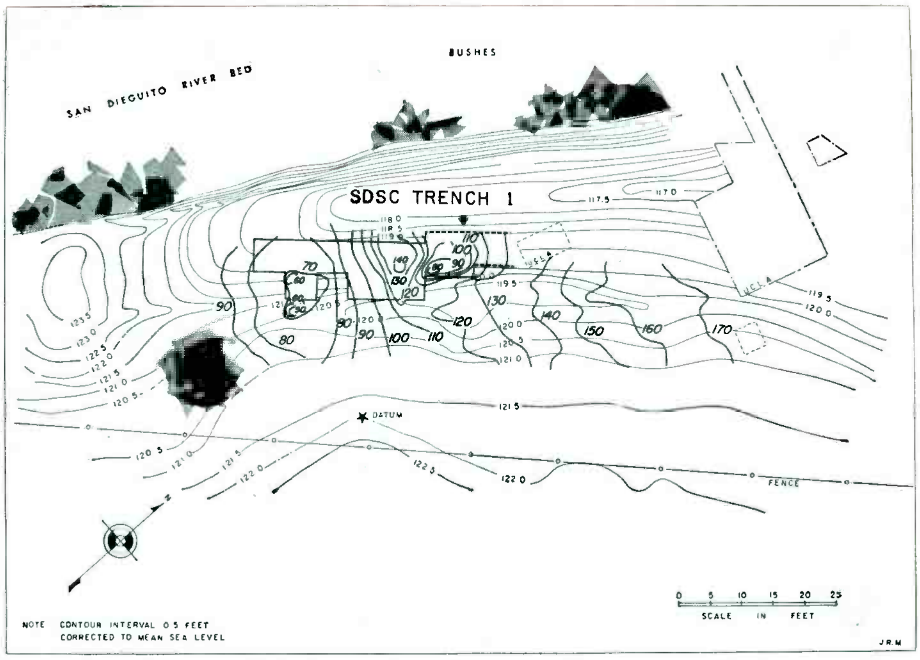
Magnetic susceptibility

Magnetic susceptibility determines the magnetic moment induced in a sample when it has been placed in a magnetic field. By the susceptibility method the proton magnetometer can detect pits, ditches, walls and tombs. The amount of susceptibility in a pit is related to the amount of organic matter in the soil from food, waste material, burials or charcoal. Many tombs have air pockets which cause a change in susceptibility from the surrounding material, as was discovered by Dr. Lerici at a few sites in Italy.[4]

Iron oxides in pottery shards, kilns and furnaces produce the second type of variation, thermoremanent magnetism. The overall content of iron oxides on the earth's surface ranges from 0–1%. The oxide is normally magnetite, hematite, or maghemite, a structural combination of the first two. As pottery is fired, its temperature is raised, resulting in the alignment of the ceramic magnetic properties with the earth's field; on cooling, the domains are fixed in one direction, forming a weak permanent magnet.

Anomalies produced in these ways vary in range from 0–100 gammas,[5] which is equal to about 1/500 of the earth's magnetic field. Iron artifacts or deposits can produce even larger anomalies depending on their size and the depth at which they are buried.

The primary reasons for the success of the proton magnetometer are simplicity of operation, fast surveying, reduction of manual labor and relatively low cost compared with prices of other geophysical instruments.



Magnetic contour map. Light lines and numbers are ordinary topographical contour lines; heavy lines and numbers are contours of magnetic susceptibility. Bunched contours represent sharp gradations in magnetic susceptibility and are the areas that interest researchers.

The future of the device looks very promising. Many more discoveries, made with its help, will enlighten our record of man. **END**

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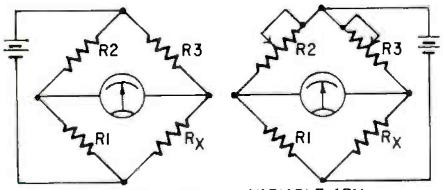
WHO INVENTED IT?

By Robert G. Middleton

Three stupid questions? Not all all! The upside-down answers may surprise you.

The Wheatstone Bridge

Who invented the Wheatstone bridge? Who invented the variable-arm Wheatstone bridge?



WHEATSTONE BRIDGE   VARIABLE-ARM WHEATSTONE BRIDGE

The Wheatstone bridge was invented by S. H. Christie of the Royal Military Academy at Woolwich, England, and was described by him in the *Philosophical Transactions* of Feb. 28, 1833. Christie's name was unknown, and his invention was ignored. Ten years later, Sir Charles Wheatstone called attention to Christie's circuit, with full credit. Sir Charles was well known, and the bridge was thereupon recognized and is called the Wheatstone bridge to this day. No one has yet had the courage to identify the bridge as a Christie bridge. The variable-arm Wheatstone bridge was invented by Werner Siemens. The Siemens bridge, used on most service benches in R-C checkers, is also called a Wheatstone bridge.

Who Discovered Coulomb's Law?

Coulomb's law states that the force exerted between two electric charges is equal to the product of the charges and is inversely proportional to the distance between them: $f = q_1q_2/r^2$. Who discovered this law?

Henry Cavendish, a wealthy scientist and philosopher, discovered the law $f = q_1q_2/r^2$. He did not publish this discovery, which he made several years before Coulomb discovered the law independently. James Clerk Maxwell published the scientific notebooks of Cavendish in 1879, describing his experiments and conclusions. However, about 100 years had passed, and Coulomb's name was firmly associated with the law. It has been claimed that Coulomb was the true discoverer because he made the law known to other scientists promptly.

Who Invented the Meter Movement?

The first meter which indicated current values was invented by whom? What is this type of instrument called?

The current meter was invented by Claude Pouillet in 1837. However, the inventor fell into obscurity. Later, his invention was named the galvanometer after Galvani, whose name was well known. One of Galvani's students discovered that a frog's leg twitched when it was touched by metal, with a static machine operating nearby. Galvani followed up this observation, and discovered that a frog's leg also twitched when two different metals were placed together at one end, and the other ends touched to the dissected leg. He supposed that electricity from the nerves was discharging through the metal circuit. Galvani was a famous physiologist, though he explained the frog-leg reaction incorrectly. His fame was responsible for attaching his name to Pouillet's invention. **END**

TV TUNER TROUBLES

TV front-ends need be no more frightening than any other part of a set

By JACK DARR

SERVICE EDITOR

LOTS OF US HAVE TROUBLE WITH THESE little tin boxes, and too many of us won't even try to repair them. Worst of all, now and then we have a tuner overhauled, get it back and install it, and *still* have the same trouble. (Because we weren't *sure* it was tuner trouble.) So, let's see if we can't find some tests that'll tell us definitely that we have a bad tuner. While we're at it, let's see if we can't fix more of them "at home." Tuner repair services are invaluable, but we *do* ship a lot that could be fixed on our own benches.

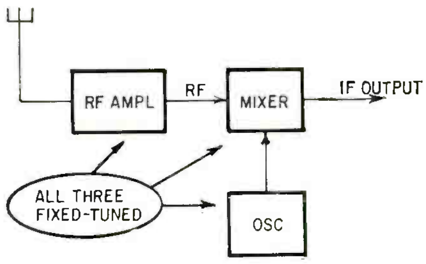


Fig. 1—Three fixed-tuned stages, that's all.

Electrically, a tuner is about as simple as you can get. Three stages: rf, mixer and oscillator (Fig. 1). All fixed-tuned—the only adjustment is a wee capacitor in the oscillator circuit. All the rest are fixed, and we select the right coils with some kind of switch (Fig. 2). It's only the physical construction of a tuner that's complicated.

A tuner tunes by amplifying the rf signal, beating an oscillator signal with it, and selecting the right beat frequency for the i.f. Heavy wire coils are used, with only a few turns, since we're working in vhf. These are tuned mostly by their own, plus some stray, self-capacitance. So, they're not going to give you much trouble, if you let them alone. (Just like a rattlesnake!)

Most tuner troubles turn out to be things like dirty switch contacts, bad tubes and burned resistors. More trouble is caused by unskilled attempts to *repair* than by actual part failures! **So, here's Axiom No. 1, in all tuner work: "Let it alone until you're sure where the trouble is!"** We'll show you how to make all necessary tests on any tuner, without ever taking the cover off.

What's the simplest test for any electronic circuit? Performance. See if it's doing what it's supposed to. The tuner's supposed to deliver an i.f. signal to the i.f. amplifier input, so let's see if it does. Here are the symptoms of tuner troubles:

1. Picture flashes on and off, and you see streaks and flashes on the screen when the channel selector knob is turned, or the tuner is jarred.
2. Heavy snow, weak pictures.
3. High channels gone, lows fair or good.
4. Low channels gone, highs OK.
5. White-out: no sound, no pix.

Now, this is where we have to watch out! A couple of these symptoms, most especially No. 5, can be due to other things: agc, weak i.f. tube and so on. Too quick a diagnosis can get us into trouble deep. So let's test carefully and eliminate the other causes *before* we go digging into the tuner, huh?

Quick-check: Override the agc with a bias box. If this brings the picture back, then we fix the agc trouble and let the tuner alone. *Best test:* feed a test i.f. signal into the i.f. input. If this produces a good picture, but we can't get anything through the set's tuner, then we know that the trouble must be there. Incidentally, we don't have to get a perfect picture on this test; as long as we get a very decided improvement, this is the answer we want. Practice tells you what kind of picture to expect.

Common tuner troubles

There are a lot of switch contacts in a tuner: 96 in even the smallest! If *any one of these* is dirty or intermittent, you've got trouble. Just to be sure, I asked a lot of technicians what the most common tuner trouble was, and got the same answer from all of them. "Dirty switch contacts!"

Test: Turn the channel-selector knob. If you have to wiggle it to make the picture come on, and if there are flashes and streaks on the screen when the knob is moved, that's it. Step 1, spray the tuner thoroughly with tuner cleaner compound. There are several on the market, all good. Use a long thin plastic tube on the nozzle, and push it through the holes in the tuner housing to get closer to the switches. Turn the knob continuously while spraying, to work the dirt loose and flush it out.

In about 8 out of 10 tuners, this will fix the trouble. If it won't, then you're going to have to go inside. This is a shop job. Don't try to do it with the tuner balanced on your knee!

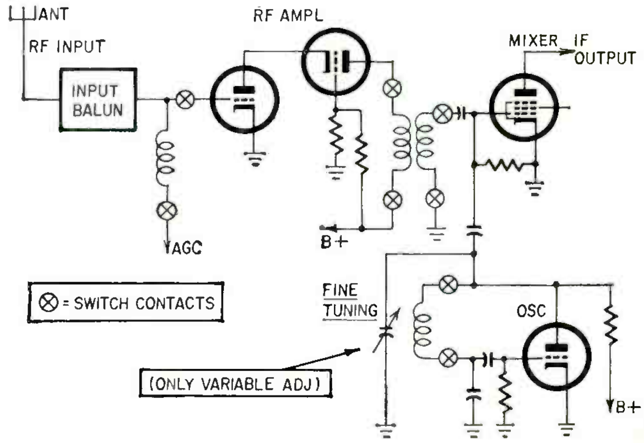
Tuner cleaning, in the shop

Because of the way a tuner works, the best way to test it is in actual operation. Coil resistances are so small you can't measure them. So we need a method that will let us get to the tuner, and at the same time leave it working normally.

Many of the late tuners are mounted separately, on a cable long enough to let you take them loose and examine them, leaving the rest of the chassis in the cabinet. *Any* tuner can be handled that way! Make up a test cable of insulated wires, about 5 of them. (Handiest: fasten one end to a terminal strip, then screw the wires to that.) Take the wires off the tuner, being sure to mark the color of each on the top near the connection. Tack your extension wires to the tuner; make the cable long enough to let you get the tuner on the bench. The length isn't critical at all, with these.

The i.f. output lead is usually a short piece of coaxial cable. If you want to, make up a plug and socket for extending it, but you'll get about as good results

Fig. 2—Same basic circuitry appears in most tuners. Some may have neutralized triode rf's, some cascodes, some old ones even pentodes—but they all have rf's!



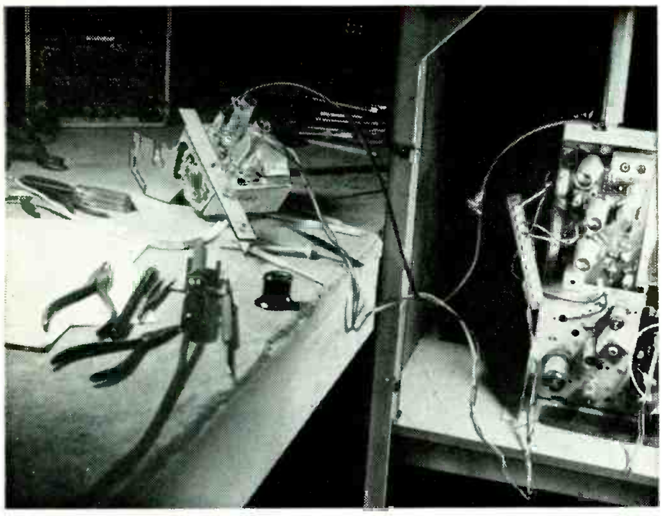


Fig. 3—*Extension cables make work easier.*

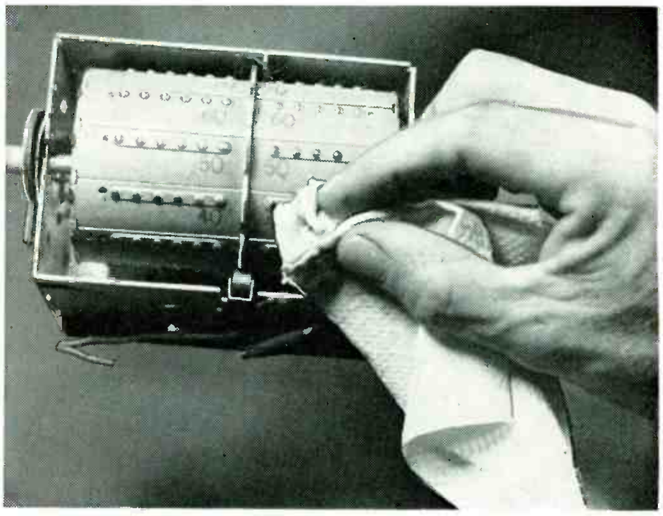


Fig. 4—*Shine contacts with a paper towel.*

with a piece of insulated wire. Fig. 3 shows this setup in use. You'll be surprised at the good picture you get. Only one thing: don't try to align a tuner out in space like this; wait till you get it back on the chassis.

You'll need one more wire for a ground: if you forget that, the tubes may not light! Also, put a piece of spaghetti or tape on the B+ connections; otherwise, they bite! Now you're all ready to go.

Set up so you can see the screen. Sometimes your cables will let you turn the cabinet far enough. Other times, you'll have to use the mirror. Hook up the antenna, and try the set.

You need the right tools. Right now, before we take the cover off that tuner, let's get that straight! *Suggestions:* a couple of nylon tuning tools, preferably with a screwdriver tip; small long-noses and cutters, or a pair of locking tweezers; a couple of metal "soldering-aid" tools, with a slotted tip; and a long, thin soldering iron of some kind, and we're ready to go. A magnifying glass is a big help, too.

Check to see which channels are giving trouble. Usually, only one or two are really bad. Look at the switch contacts: you'll usually see the dirt on them. If this is a turret tuner, take the drum out by unhooking the spring clips at each end. Clean the contacts on the turret by rubbing them with a clean, dry paper towel (Fig. 4). [Better yet, use a special switch and tuner kit such as Standard Kollsman's Conta Care that contains a special cleaning cloth and sulphur-free contact oil.—*Editor*] *Leave them dry; no lubrication.* Now look at the fixed contacts. Fig. 5 shows a set, before cleaning. Give these the paper-towel treatment, too.

In a few cases, these contacts will lose their spring. Using a soldering-aid tool, you can bend them to make contact firmly again. If they've lost tension, slip a short piece of plastic spaghetti through the "loop" to build up the tension. **While cleaning these, or any other tuner, contacts, be sure you don't move any parts or wires; this will throw the unit out of tune!**

Wafer-switch tuners are more difficult, but not impossible to get into. A strong magnifying glass is a big help, preferably something like the one shown in Fig. 6. Prop the tuner up on a small cardboard box, to keep it still while you're working on it.

In these tuners, caution is even more important. While working "inside," be VERY sure that you don't move any of the coils, wiring, etc. Spray cleaners on the switches. If necessary, give them a brushing at the same time. Get a kid's water-color brush at the dime store, and clip the bristles off about ¼ inch long. Pipe cleaners leave bits of fuzz on the switch, which could cause trouble.

To find the channel switch that's giving the trouble, look on the switches for the "junction" between the low-band coils, made up of several turns of wire, and the high-band coils, which will be just a half-turn of wire. The last low-band coil will be channel 6, and the first tiny coil, next to it, is channel 7.

With the tuner set on a bad channel, carefully touch the slider on each deck with one of the nylon tools. When

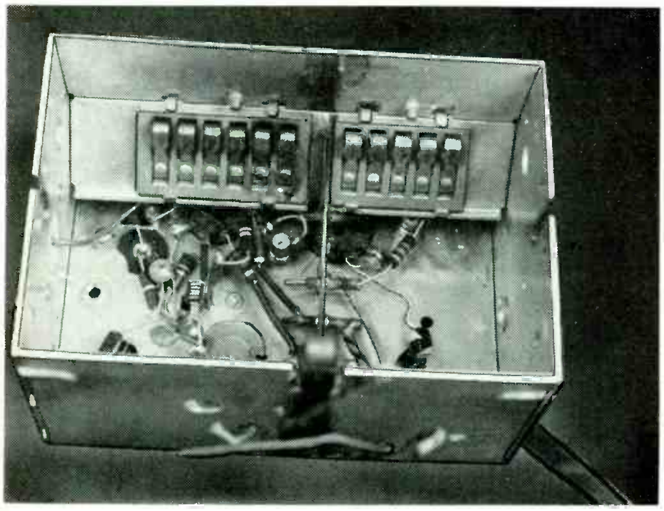


Fig. 5—*Shine turret-drum fixed contacts, too.*

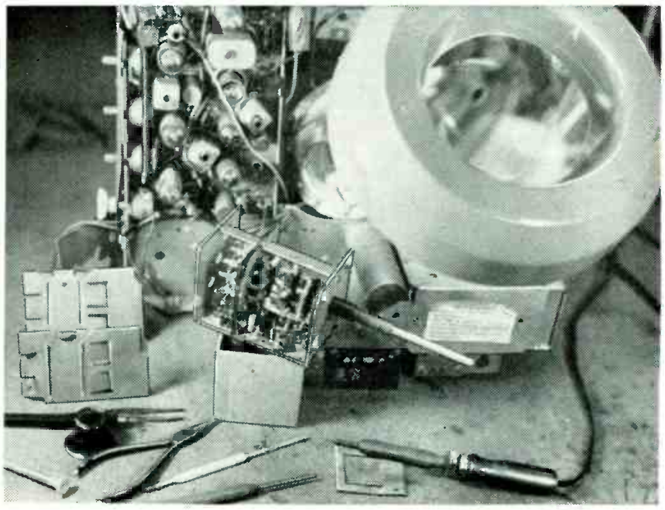


Fig. 6—*A big magnifier (upper right) is a big help.*

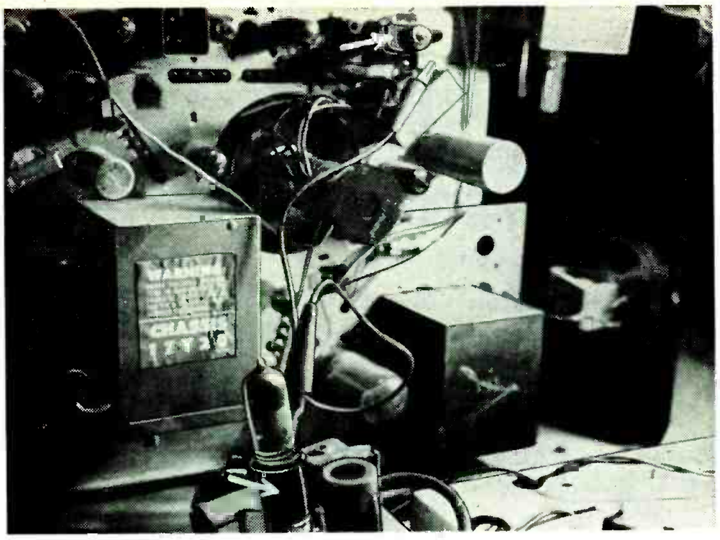


Fig. 7—Injecting an i.f. signal from a working tuner (bottom left) usually establishes definitely whether set's tuner is bad. Use adapter sockets and a clip lead.

you hit the bad contact, the picture will come on. To cure this, turn the tuner to another channel (to get the slider out from between the fixed contacts), and *very carefully* bend the contacts, just a wee bit! Now, try it again.

On some tuners, watch out for bad contact between the slider itself, on one side of the wafer, and rivets on the other. If you find this kind of trouble, touch the *rivet* with a very fine-pointed soldering-iron tip, and put just a tiny gob of solder on it. Don't do this on the slider side, as you may get solder on the metal slider which would be hard to get off. If you use soldering paste or flux, use it *very* sparingly.

Along this line, watch out for bad solder joints, on coils or anything else, especially tube sockets. You can find these by *very gently touching* the suspected coil with an insulated tool.

Tuner tests without teardown

To sum up: what we need is full information about this tuner without having to go inside to get it. Fortunately, we have gadgets that'll let us do that easily.

First, make a signal substitution test. Feed a test signal at the i.f. from a pattern generator into the i.f. input. If this brings the picture back, and we have already checked out all the other possibilities, like agc, etc., then we can be fairly sure the trouble's in the tuner. You can get a good test signal from another TV set with the same i.f. Simply connect a test lead, with a clip on each end, from tuner output of the good set to i.f. input of the bad one. This can be done easily with two tube adapters (Fig. 7). Here, we connected from the mixer plate to the i.f. grid.

Now where do we go? To detailed tests of the bad tuner, to find out just why it won't work. Always remember this: this tuner *was* working, and suddenly quit. So, what's the most likely reason? Some *part* has failed! We checked the tubes by replacement, before we left the house with the set, so that takes care of them. Now, we must find out what part has failed and replace it.

Set the tubes up on the test adapters, in Fig. 7, and measure the operating voltages. The most common trouble here will be burned resistors in the plate circuit of the rf amplifier. This is caused by a short in the old tube. If the resistor is burned badly enough, it'll change value and upset the rf plate voltage. If the voltage is off (and, remember, the only way you can get the *correct* B+ voltage distribution in a cascode rf amplifier is *with the tube in the socket*!), the chances are that it's this resistor. Confirming check: turn the set off and measure the resistor by connecting your ohmmeter between plate of the tube and the B+ terminal on the tuner (Fig. 8). You can measure all other resistors in a tuner with this method: measure between the correct terminal on the tube socket, and the supply connection (agc, heater or whatever).

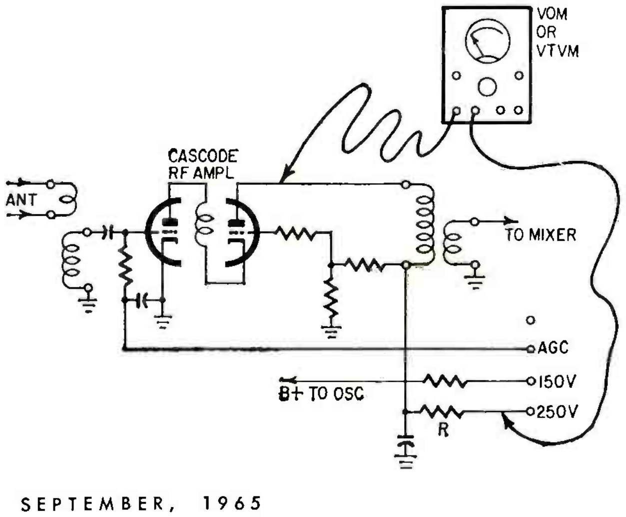


Fig. 8—Plate dropping resistor or agc isolating resistor can be checked between terminal on tuner chassis and correct tube-socket pin.

Part replacement

OK, the resistor's bad. Its usual location is between two decks of the wafer switch, in a pretty tight place. *Don't* try to unsolder it. Take the small diagonals and clip it out, leaving as much lead as you can. Now clip the leads on the new resistor to a bit longer than what's left on the bad resistor, tin them nicely, and hold one end on one of the connections. Solder quickly, to keep from overheating the resistor. Now, bend the other end into place, and tack it too. (No strain on these joints, since the resistor is small.) Don't hold the iron on too long, "hit it and git", but be sure to make a good solder joint!

You won't have trouble with oscillators very often. They're so simple that they usually work pretty well, given good tubes and correct voltages. The worst trouble with oscillators is misalignment. This is usually the result of "screwdriver drift," and not of a fault in the oscillator itself. Watch out for dirty tube-socket contacts; they cause a lot of trouble in oscillator circuits, including *drift!*

Finally, always check the balun coils at the input for continuity. If lightning has paid a visit to the neighborhood lately, there is always the chance that one of the coils is open. Symptoms: snowy pictures, or the same "high channels OK, low channels out" (and vice versa) symptom that you can get from a bad rf amplifier tube, and, in some cases, no pictures at all.

Replace with exact duplicates, to hold your front-end impedance match to the antenna. *Quick-check*: touch one side of the antenna lead-in to ground (tuner chassis) and touch the other end, with a very small capacitor in series to prevent shorting out the agc, to the input grid of the rf amplifier. To get at the grid, set the tube up on the test adapter. If the picture gets a lot better, then you've probably got an open balun coil. Be sure to check the agc first, though, for you can get some very peculiar results from this test if you don't!

Suggestion: try all the tests outlined here on sets you know are in good shape. That way, you'll know more about what kind of results to expect when you try them on bad ones. END

40 Watts in 40 Ounces– Building the Two-State Amplifier

Full construction and testing details on 40-watt switching-mode PA amplifier introduced last month

By NORMAN CROWHURST

Last month we printed the schematic, parts list and description of a unique 40-watt public-address amplifier that used the output transistors as two-state (on or off) switches rather than as linear amplifiers, producing a tremendously efficient amplifier with very little dissipation in the output transistors. The schematic is reprinted here for convenience. (A full discussion of the theory of the Two-State amplifier was printed in the July issue on page 54.)

This month we build the amplifier, test it and put it to work.

ONCE YOU HAVE THE SUBCHASSIS AND main chassis (case) drilled, clean off burrs and rough spots from around all the holes, but especially from around all holes in the case that will pass the pins or mounting screws of power transistors Q13 and Q14. Sharp metal bits there may puncture the mica insulators between the chassis and the transistor cases (common to the collectors). That could blow a fuse, or, worse, burn out the output transformer.

Lay the outer chassis (case) aside. All the work will be done at first on the subchassis.

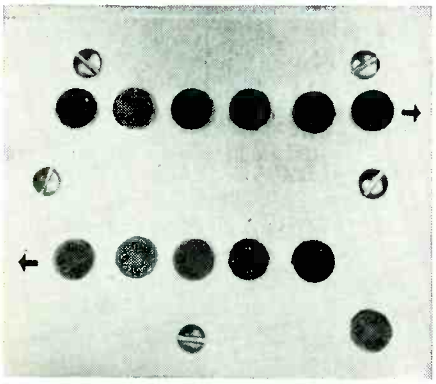


Fig. 1—Line up transistor sockets exactly this way.

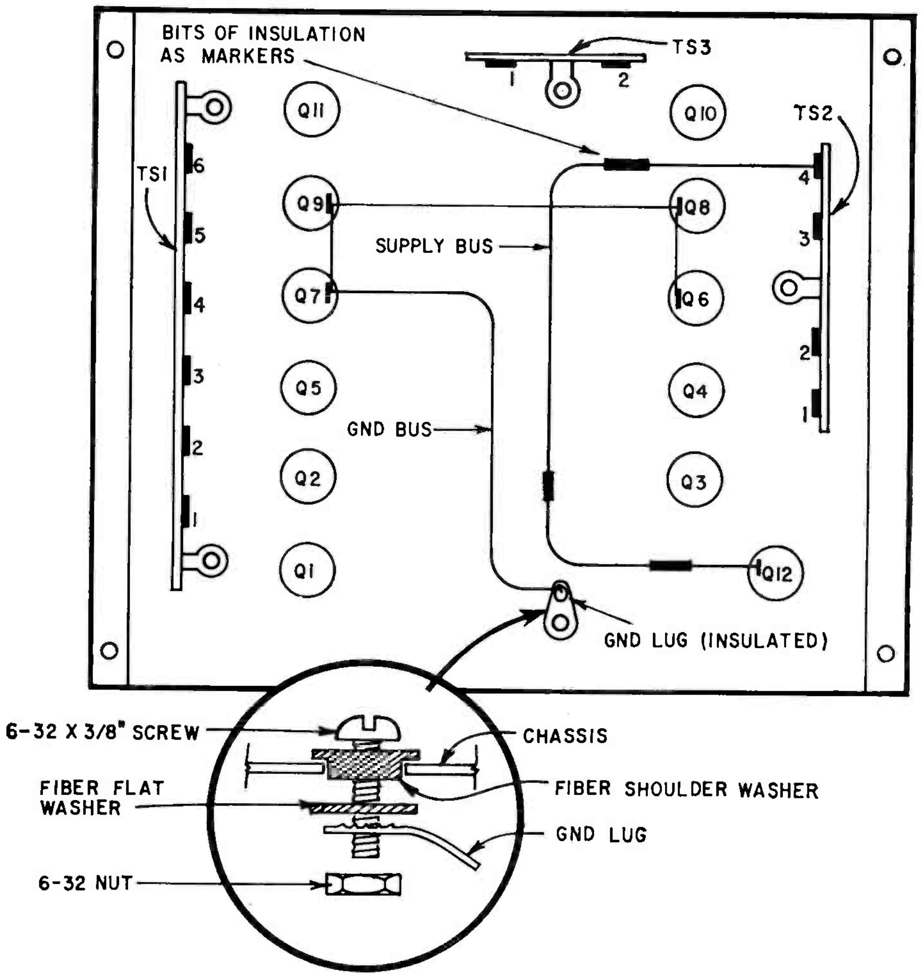


Fig. 2—Terminal-strip positions, ground and supply bus paths, and details of insulated mounting for ground lug. Flat and shoulder fiber washers are available in small plastic-box assortments at almost any electronic parts store.

Mount the twelve transistor sockets with their snap-on rings as shown in Fig. 1. Align the sockets exactly as shown—note that the base (center) holes "point" one way in one row and the opposite way in the other. Mount terminal strips TS1, TS2 and TS3 as shown in Fig. 2. Opposite TS3, mount a ground lug with one flat and one shoulder fiber washer to insulate it from the chassis; the only connection to chassis should be via the microphone jack on the case (this comes later).

Use lockwashers under all nuts! The vibration of a moving vehicle will loosen nuts in an amazingly short time if you don't.

Form the ground bus by connecting together the emitter pins of Q6, Q7, Q8 and Q9 with a piece of bare tinned No. 20 solid wire, then run the wire down the center of the chassis to the ground lug (Fig. 2). Solder all connections as you make them, with a small, hot iron and a *minimum of solder*. The ground bus should be clear of the chassis (by about ¼ inch) everywhere. You can trace its path approximately in Fig. 3; the insulated ground lug is at the bottom of the photo.

Make up a supply bus (which will carry the negative side of the 12-volt supply) by running a piece of bare tinned No. 20 solid wire from TS2-4 to the emitter terminal of Q12 socket (Fig. 2). Run it down along the chassis slightly above and to the right of the ground bus. You'll find it helpful to slip a few scraps of colored insulation over it before you wire it in, so that you can distinguish it at a glance from the ground bus during wiring and testing.

Try to lay parts parallel or at right angles where possible, at least at the beginning—not for beauty, but because leads will be far easier to follow after you get the first few dozen parts in, than if you haywire the chassis.

Now begin wiring resistors and capacitors, beginning with emitter resistors R3, R8, R13, etc., and the large 2-watt resistors R36 and R40. Parts that the photo shows you are close to the chassis should go in first, of course—don't wire yourself into a hole. (Keep in mind the picture of the man painting a floor, finishing in a corner opposite the only door to the room.)

All pigtail-wired parts are called out in Fig. 3, and in most cases you can see exactly where the leads go. Use spaghetti tubing wherever it seems desirable; better an extra minute now than an hour later tracking down shorts.

Occasionally you will have to make a floating junction—several leads soldered together without the support of a lug. (R20, R35 and C22, for example.) In such spots, join the floating leads first, while the parts are still loose. Grab, say, the two resistors between thumb and forefinger, crossing the leads at one end of each. With long-nose pliers, grip the leads just beyond the point where they cross and twist tightly three or four times. Then solder—hot, and with as little solder as possible. Clip off the excess lead, and you have a junction almost as rigid as one supported by a tie point.

The wiring is easy if you proceed systematically. Wire with foresight!

Main-chassis wiring

Mount all parts on the case, including the sockets for Q13 and Q14, but not the transistors themselves. Wire the ground connection (Fig. 4) between the mike jack J and the volume control. (The volume control used in this version of the amplifier is somewhat unusual—a surplus item; in the more common type of control the ground connection is the right-hand terminal as you look along the shaft.)

Connect R31 and C16 (if used—see text and table in last month's article) in parallel across the terminal strip (Fig. 4). Connect the speaker terminals to the outermost lugs of the output transformer with No. 18 or heavier wire (ordinary plastic-insulated "zip"-cord is OK). Use equally heavy wire for the connections between Q13 collector and output transformer lug (ditto

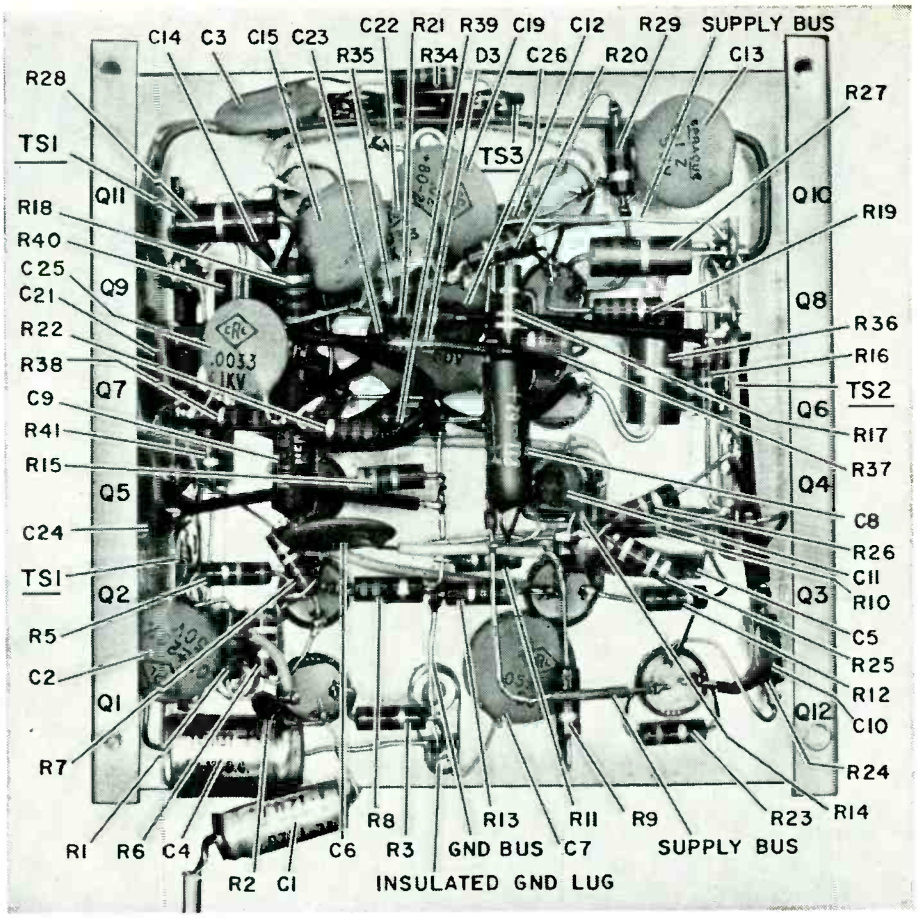


Fig. 3—Completely wired subchassis. D4 and R30 are hidden from sight; C16, C17, C18, C20, D1, D2, R4, R31, R32 and R33 are all part of the main-chassis wiring and do not appear here.

Q14). Connect 18-ohm resistors R32, R33 between base and emitter of Q13 and Q14, respectively. Wire in, according to schematic and photos, C17, C18, C20, D1 and D2. The cathodes—striped ends—of D1 and D2 must be joined. The anodes go to the second and fourth transformer lugs (collectors of Q13 and Q14).

Install the battery cable. Be sure polarity is correct. Determine the polarity of the car electrical system with which this amplifier will be used, and be sure that the *negative side goes to the transformer center terminal.* The positive side will be connected to the subchassis ground bus and ultimately to chassis via the mike jack.

Now lay the subchassis inside the main chassis approximately as shown in Fig. 5. Set it on a small box or block of wood to raise it so that you can get at

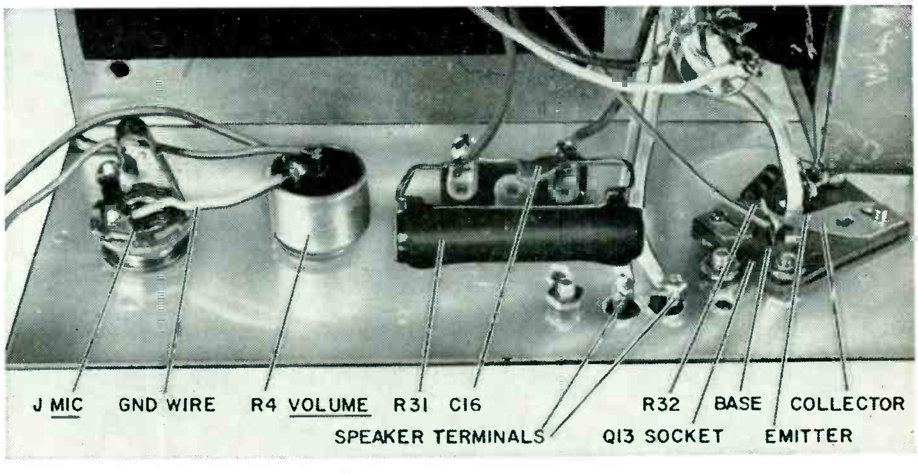


Fig. 4—Parts and wiring along the front of the main chassis.

all connections easily.

Finish all wiring by interconnecting parts on the main chassis to parts on the subchassis according to the schematic and photos. Leave enough slack in the wires to allow maneuvering the subchassis into its final place, but don't overdo the excess length. Stranded wire will be easiest for this job. Figs. 5 and 6 will help you.

Line the main chassis with plastic electrical tape under the area of the subchassis, just in case. Now you're ready to check the circuit stage by stage.

Checking out

For checking out, you need either a 12-volt battery or a supply that will give you a controlled 12 volts. If loading the supply causes the voltage to drop, you'll have to adjust accordingly, as current changes. Be very careful not to put excessive voltage onto the transistors when you take the load off (such as by turning off input signal). Don't forget that when you run the amplifier with signal on, it takes heavy current and when you remove the signal, current drops. Then voltage could rise and cause damage. To play it safe, cut off supply voltage *before* you reduce the input signal.

Checking the amplifier with an oscilloscope and audio oscillator is more fun, but it can be done without the oscillator and even without the scope. You do need a good vom. See that every-

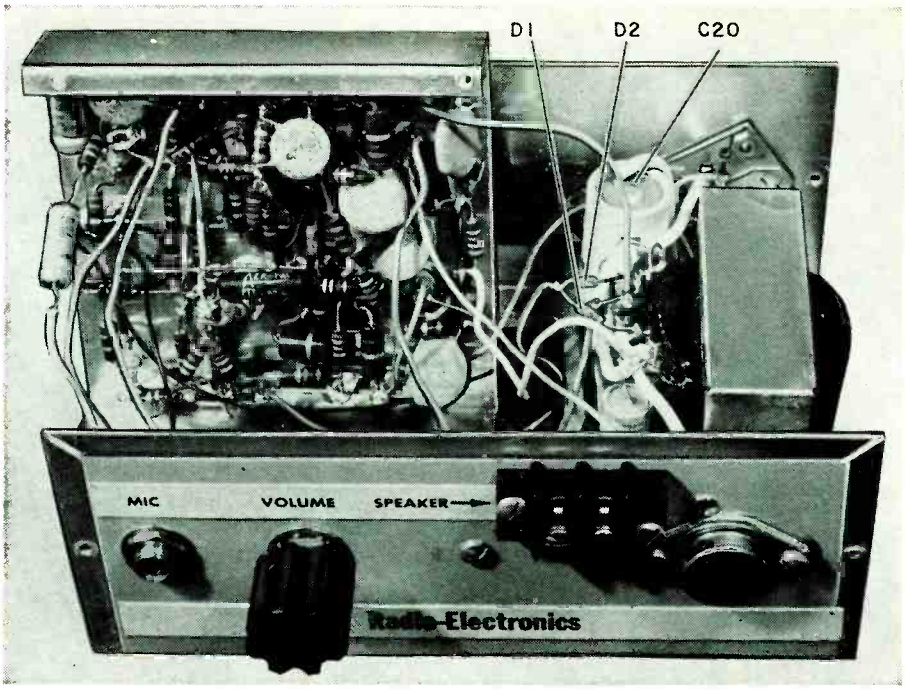
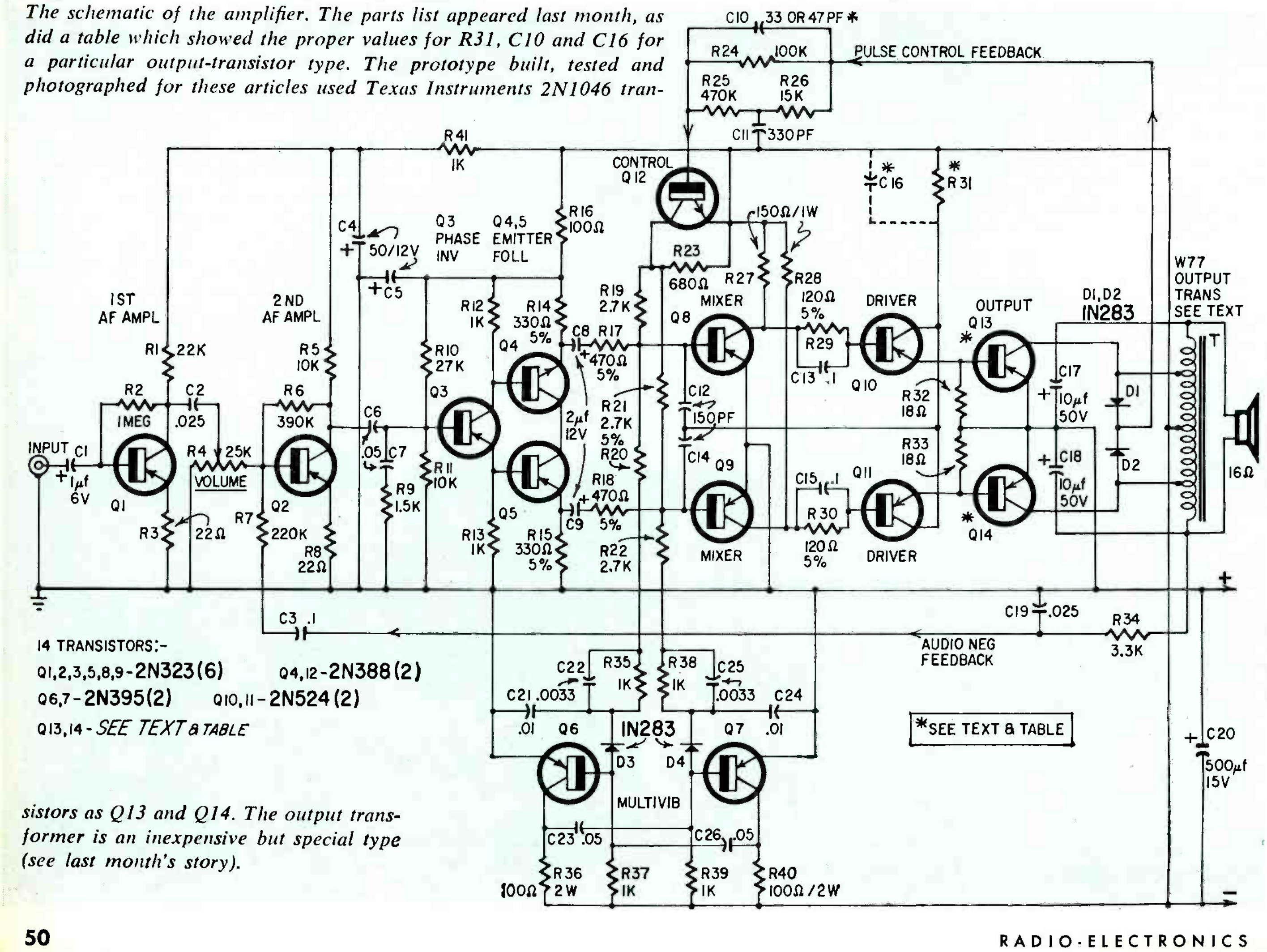


Fig. 5—Interconnecting sub- and main chassis takes only a few minutes.



The schematic of the amplifier. The parts list appeared last month, as did a table which showed the proper values for R31, C10 and C16 for a particular output-transistor type. The prototype built, tested and photographed for these articles used Texas Instruments 2N1046 transistors as Q13 and Q14. The output transformer is an inexpensive but special type (see last month's story).

thing is what it should be at each step, before proceeding. If it is not, look to see what has been done wrong, or if a component is faulty or off value, and correct it before proceeding.

First connect the two chassis together with a clip lead, and put a piece of paper or cardboard over the edge of the main chassis where the subchassis may touch it. The cases of the small transistors are "hot" (common to the collectors) and can cause shorts if they touch chassis. Connect your supply (*watch polarity!*) and, if you use a scope and oscillator, connect their grounds to the ground lug of the subchassis. Connect the oscillator through a voltage divider as shown in Fig. 7-a.

First get the multivibrator working. Insert Q6 and Q7 (2N395's). Adjust the supply to 12 volts. If the multivibrator is working, you should see waveforms as in Fig. 8-a at the collectors, and as in Fig. 8-b at their bases. At lugs 4 and 5 of TS1, waveforms should be as in Fig. 8-c. At the junction of C22, R20 and R35, it should be as in Fig. 8-d. (Ditto for junction of C25, R22 and R38.) If you don't have a scope, check the collector voltages. (See the voltage chart.)

Next check the pulse generating system. Insert Q8 and Q9 (2N323's) and check waveforms at their collectors, which should be as in Fig. 8-e. If you don't have a scope, remove one 2N395 (to stop the multivibrator) and the voltage at Q8 and Q9 collectors should be close to zero (measured to ground). Re-insert the 2N395, and the voltage should rise just a little (go more negative), showing that pulses are being formed.

Now check the phase splitter, Q3 (2N323). Check voltages: emitter should be about 2.5, collector 8, or thereabouts. Voltage at junction of R16 and C5 should be about 11.5. Now insert emitter followers Q4 (2N388) and Q5 (2N323). Voltage at the junction just mentioned should now be about 11, and the emitters of Q4 and Q5 should have voltages almost identical with the voltages on the collector and emitter, respectively, of Q3.

If you have scope and oscillator, check the whole audio section next. Insert Q1 and Q2 (2N323's) and check waveform at successive collectors. Check the action of the volume control and that waveforms at the collector of Q2, the emitter and collector of Q3 and the emitters of Q4 and Q5, are all of very nearly the same magnitude. They should also show overload at the same point as audio level is raised. If you don't have an oscillator or scope, check voltages: collector of Q1 should be around 5 volts, and collector of Q2 in same region. Neither is highly critical.

Now revert to pulse-system checking and for the time being remove Q1

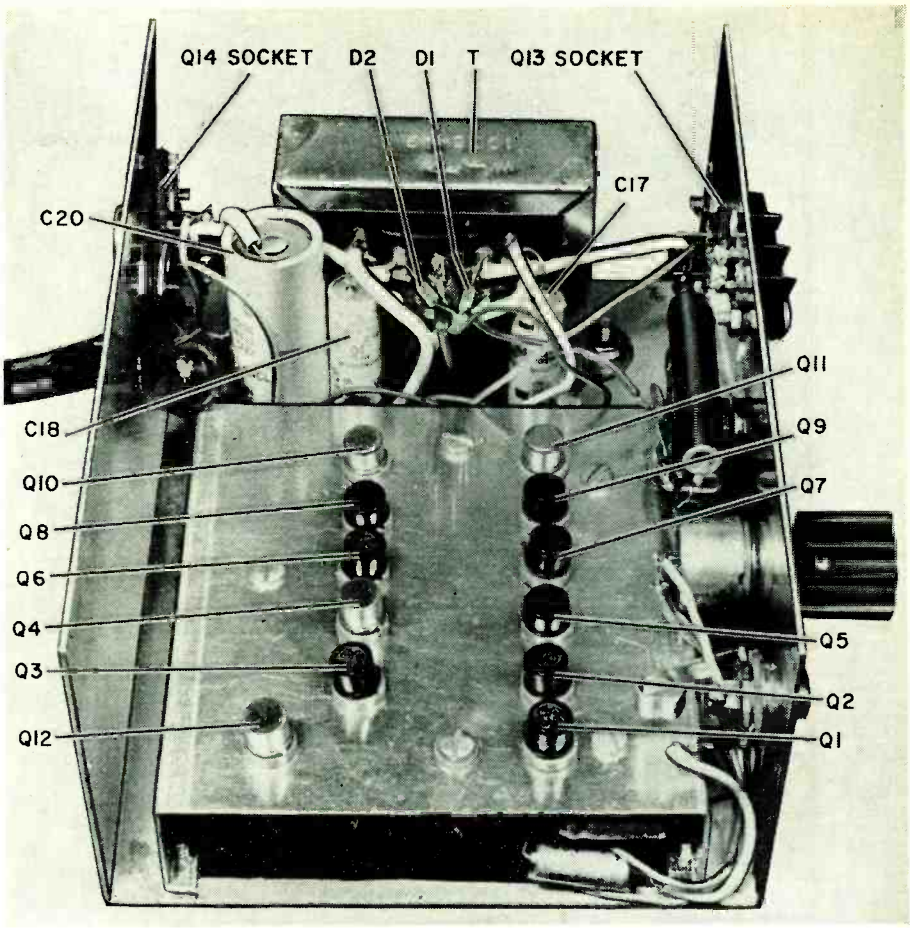


Fig. 6—This is how the amplifier looks with the subchassis wired and fastened down.

and Q2. Connect shorting wires between base and emitter of the output transistors (Q13 and Q14) and insert the drive transistors Q10 and Q11 (2N524's). If you look at the voltage at the collectors of Q10 and Q11 (which are paralleled and therefore the same), it should show both pulses, inverted as compared with those at the collectors of Q8 and Q9.

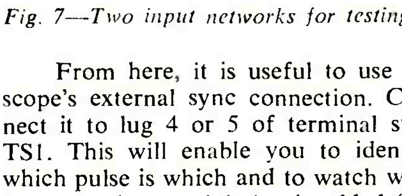


Fig. 7—Two input networks for testing.

From here, it is useful to use the scope's external sync connection. Connect it to lug 4 or 5 of terminal strip TS1. This will enable you to identify which pulse is which and to watch what happens when modulation is added (audio input) without having the trace jump all over the screen. If the pulses are uneven—in alternate pairs—but otherwise steady (Fig. 8-f), everything is fine. But if there is any jittering, check pulses in closer detail. By going back to collectors of Q8 and Q9, you will be able to identify which pulse is which, because they will hold the same places, due to the way sync is locked.

If you don't have a scope, check voltage across R31 (this returns to the supply bus instead of to ground). With one 2N395 (Q6 or Q7) widthdrawn it should be zero, and rise to a small value when the 2N395 is replaced.

If everything is OK so far, reinsert Q1 and Q2 and turn on some audio (the level at the input jack should be around 1 mv). On the scope, you should see the pulse modulated now, with multiple traces (Figs. 8-g and -h). You can look at this another way, by using the audio as the horizontal scope input (Fig. 9). Then the corresponding traces will look like Figs. 10-a and -b. If you want to check what each pulse modulator is doing separately, take your scope input from the collector of Q8 or Q9. One of the traces should look like Fig. 10-c and -d, and the other should be the same thing, but reversed left to right.

Phase of these scope traces can be improved by inserting some phase shift at the input (Fig. 7-b) and adjusting frequency to eliminate the loops. Then traces of Figs. 10-a through -d become those of Figs. 10-e through -h.

If everything checks OK this far, you can put in the output transistors

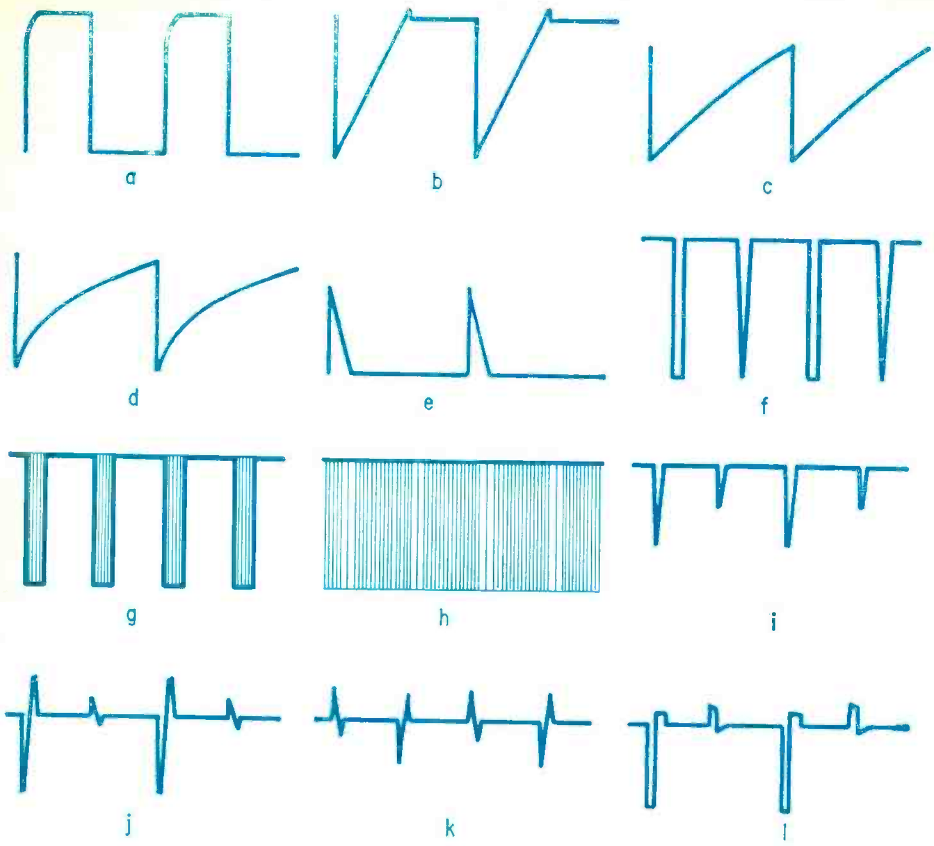


Fig. 8—Waveforms you should find at various circuit points. (See text.)

VOLTAGE CHART

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14
Emitter	<0.1	0.1	2.6	8.6	2.5	0	0	0	0	0.2	0.2	*	0	0
Base	0.1	0.2	2.8	8.4	2.7	−1.9	−1.5	0.3	0.3	*	*	*	0.2	0.2
Collector	4.6	4.0	8.4	2.6	2.6	5.8	4.8	0.6	0.6	*	*	*	12	12

All voltages are negative to ground bus except as indicated by minus signs, and rounded to nearest tenth. Variations of 10% either way are unimportant.

Voltages were measured with 20,000 Ω/v meter, no signal input, multivibrator oscillating, supply maintained at 12 volts.

***Depends on choice of output transistors and associated parts.**

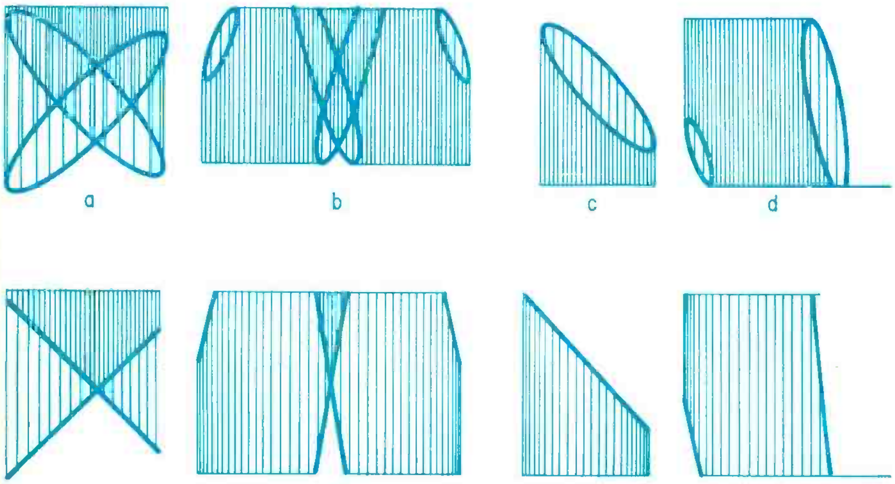


Fig. 10—Lissajous patterns, made with the setup of Fig. 9. (See text.)

and Q12 (2N388). But for the time being remove Q1 and Q2, before reconnecting voltage, and check pulse operation again. The pulse should be shortened and sharper at quiescent (Fig. 8-i). The waveform at the collectors of Q13 and Q14 should be as at Figs. 8-j and 8-k. Ideally, they should be identical, but inevitably there is a little difference. We show a typical pair of traces, using either 2N2832 or 2N1046 outputs. If you use 2N1905, the traces will be more like Fig. 8-l.

If you don't have a scope, the voltage across R31 should be lower than without the output transistors.

Now finish the job by putting in Q1 and Q2 again, and applying audio. The waveform on the collectors of Q13 and Q14 will be quite similar to that at the common collector of Q10 and Q11, except that there will be reflections.

A final check puts input against output and verifies loop gain characteristic. Take the scope vertical input from TS3-1 and the horizontal from the audio oscillator. This takes advantage of the feedback filtering to eliminate most of the pulses from the trace. You can also take the vertical from one side of the output load (16 ohms, for which use three 50-ohm 20-watt resistors in parallel, unless you have a 16-ohm 50-watt load handy).

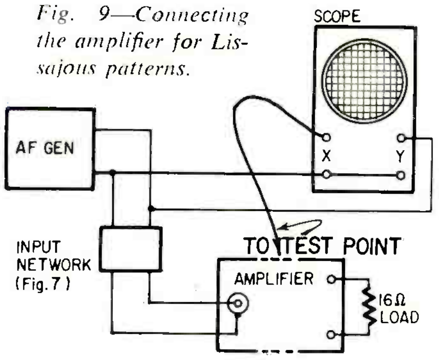


Fig. 9—Connecting the amplifier for Lissajous patterns.

Check gain reduction with feedback by lifting 0.1-μf capacitor C3 from lug 1 of TS3. This should raise gain by about 4 times. With feedback connected again, run frequency down to about 100 cycles and up to about 3 kc, having first set a 45° line on your scope at a middle frequency (somewhere between 500 and 1,000 cycles). The trace should go into an ellipse, without peaking (going higher than at mid-band) as it does so.

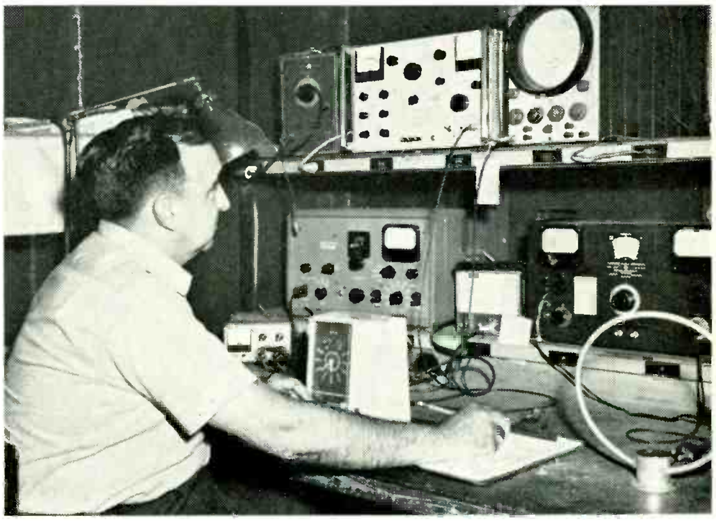
Finally, button the subchassis down. Lower it into place gently, taking care not to pinch wires or cause shorts. Insert and tighten the four No. 6 sheet-metal screws.

When you've checked the amplifier out with mike and speaker, you can mount the main chassis cover on the speaker frame and fasten the main chassis in its cover, and you're ready to go. END

The Engineers' Right-Hand Men

By ERIC LESLIE

THOMAS LESKOSKI IS A QUALITY-CONTROL specialist at the Westinghouse TV–Radio Division in Metuchen, N.J. He built crystal sets as a schoolboy. On entering military service at 17, he went to electronics school and got a full year's training in the operation and repair of naval electronic equipment. He was a radio and radar repairman on navigational aids, ground-control-approach and similar equipment for 3 years. Upon discharge from the service, he studied electronics for two years at Newark Technical Institute, with the main accent on TV.



Tester Thomas Leskoski puts a production sample of a clock radio through its paces in an rf-field-free "cage", to make sure it meets original specifications.

Tom put his schooling to use in local TV service shops, but soon decided that his future would be brighter if he went back to school. He enrolled in Seton Hall University and studied engineering for 2½ years, until he was forced to drop out for personal reasons. At about the same time, Westinghouse opened its assembly plant at Metuchen. Tom got a job as a quality-control inspector on electronic apparatus that Westinghouse was making for the Navy. Moving to TV when production started in the plant, he worked for a couple of years as an electronic troubleshooter on the assembly line.

Now, as a quality-control man, his work is varied, but essentially his job is to be certain that the products of the plant meet the established reliability standards. This sometimes calls for checking components or complete equipment under unusual environments. Products are taken off the line by random sampling and then compared carefully with engineering specifications to make sure they meet those specs, or, if they don't, to find out why and recommend corrections.

Another of Tom's jobs: watch over dozens of TV sets in a life test and check each set regularly; failures are recorded, analyzed to see whether a pattern appears.

His responsibilities growing as the company grew, Tom has had several promotions, but he'd like to advance to more complex electronics. He feels that electronics offers "a great future to the young men coming out of school who can't get a college education," but points out that a good 2-year technical school—for a person with a strong interest in electronics—is an undeniable help.

Like most electronics men, Tom lives electronics even after hours; he spends much of his spare time with remote-control planes. He's married and lives in nearby North Brunswick (N.J.) but spends as much free time as possible at his vacation cottage in Maine.

Fred Hoffman, another employee at the Westinghouse Metuchen plant, is called a *lab specialist*. Like many other radio technicians, Fred's interest in radio started while he was still in his pre-teens, working over old tuned-radio-frequency receivers. His father worked for a transformer manufacturer and there were always a number of sets and parts of sets around the house. During high school he had a cellar workbench shop, complete with a signal generator, and repaired neighbors' sets for spending money.

While still in school he started with Acme Electric Co., a transformer manufacturer in Cuba, N. Y., working in the engineering department after school and during summers. On graduating from high school, he took a steady job with Acme for about 2 years. Entering the Navy in 1948, he went through a 42-week accelerated course in the Navy electronics school, afterward spending 3 years aboard the repair ship Yosemite, working on radar, loran and other complex electronic equipment.

Fred was discharged from the Navy in 1952 and worked about a year at Bell Aircraft, Buffalo, N.Y., in the components group. Most of the work was designing test equipment for missile checkouts. On the recommendation of a friend from Acme, during a vacation he came to Metuchen to investigate the possibilities of working at Westinghouse. Starting that same year (1953) as a lab technician, he worked about 5 years with Westinghouse, then took a position in neighboring New Brunswick with a communications maintenance company (Mobile Radio Dispatch) which service police, fire, marine and industrial communications equipment. The company closed out its New Brunswick branch, however, and Fred soon returned to Westinghouse.

Fred's present position is halfway between that of engineer and technician. He works chiefly on new designs and prototypes. He checks out and improves circuit designs, and tests and measures new materials and components. He has done basic color TV research and worked with "transistors when they were new." He is taking a mathematics course at Rutgers, hoping at last to become an engineer. At home, he relaxes with photography and amateur radio (Technician class). Fred is married and lives in East Brunswick, N.J. END

A Reliable Transistor Tachometer

This 3-transistor instrument is inexpensive and yet surmounts most of other units' disadvantages—temperature and voltage sensitivity, excessive dependence on pulse characteristics

By STEPHEN GROSS

HERE AT LAST IS A TACHOMETER CIRcuit insensitive to variations in input, pulse width, amplitude, rise time and noise content. A voltage-regulating circuit minimizes the circuit's sensitivity to variations in battery voltage, and a temperature-sensing device (thermistor) corrects for circuit drift due to temperature change.

An ignition pulse contains much noise and ringing due to point bounce and the inductive reactance of the spark coil. It also varies in amplitude, rise time and width as engine speed changes. The voltage available to operate the tachometer will also vary as the engine speed and electrical load changes. Changes in the ambient temperature will also produce an error. If the tachometer is to be a reliable working instrument, it should maintain an accuracy of at least 5% under all operating conditions.

The schematic of the transistorized tachometer is Fig. 1. Low-voltage ignition pulses, from the points, are applied to the filter (R1, R2, R3, C1 and C2), which eliminates much of the noise due to contact bounce and inductance. The filtered signal goes to the amplifier and wave shaper (Q1, Q2), where the power level of the signal is increased, and a signal is generated which is independent of input pulse rise time, amplitude and width. The output of the amplifier and wave shaper goes to the power amplifier (Q3), where the power level of the signal is further increased. The output of Q3 is displayed on the meter. Capacitor C4 helps integrate the pulses.

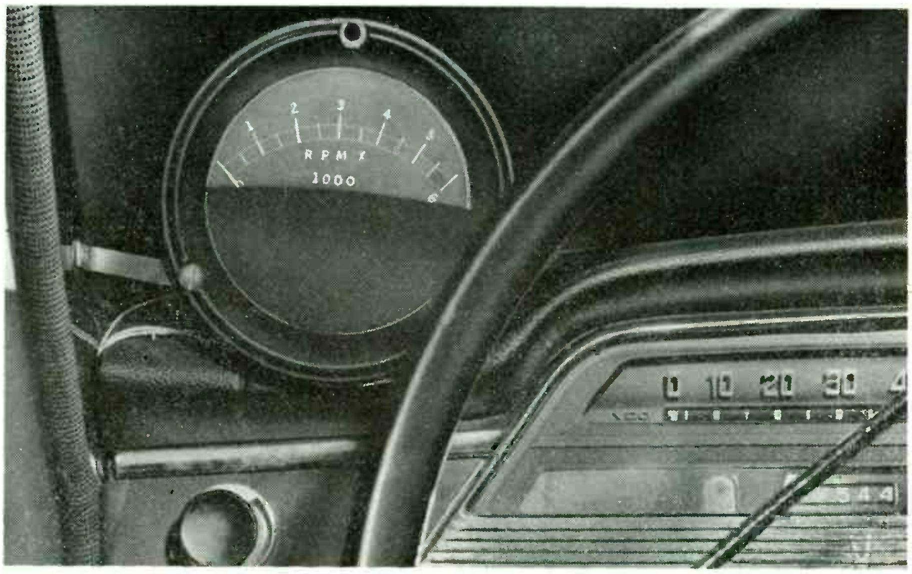
A calibrating potentiometer (R7) is included in the power amplifier stage. Its use is discussed in the calibration section.

Circuit operation

With no pulse present, the base of Q1 is at ground potential. The emitter-to-collector impedance of Q1 is then large. Thus, current flows into the base of Q2 through diode D1, since D1 is forward-biased. R4 is chosen so that under these conditions Q2 is saturated. The voltage on the collector of Q2 will be about 0.5. D4 clamps the input pulse.

The Q1 stage is so designed that an input of 4 volts or more will completely saturate the transistor. When a positive pulse arrives at the base of Q1, current flows into the base, causing its emitter-to-collector impedance to decrease. Thus, the current allowed to flow into the base of Q2 can no longer keep D1 forward-biased. At this point, the impedance of D1 becomes high and reduces the current flowing into the base of Q2. The alpha of Q2 falls, its emitter-to-collector impedance becomes large and collector voltage rises to V_{cc}.

Because of the nonlinear diode characteristics, a small change in the impedance of Q1 causes a large change in the impedance of D1. Thus, the time required for D1 to switch is relatively independent of the rise time of the input ignition pulse. The time Q2 takes to switch from its low-impedance to its high-impedance state depends primarily on how fast diode D1 switches from low impedance to high. Thus the out-



Tach indicator mounted in corner of windshield in author's Volvo.

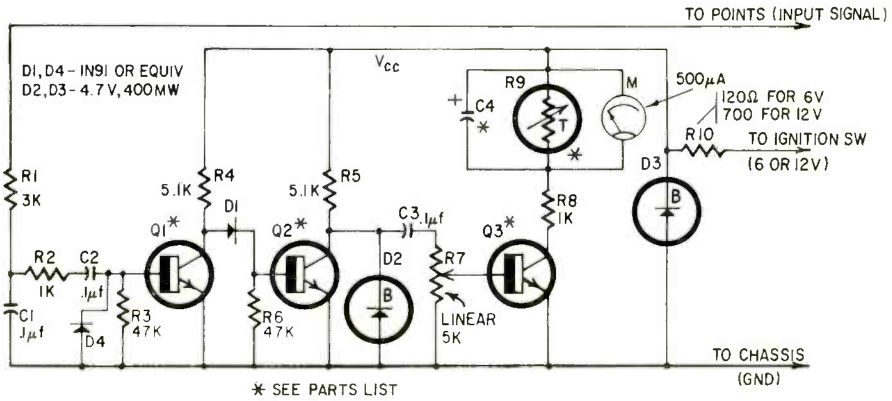


Fig. 1—Circuit of the reliable tach. Note well that C3 is 0.025 μf, not 0.1.

C1, C2—0.1 μf
C3—.025 μf
C4—20 to 200 μf, 15 volts, electrolytic
D1, D4—50-volt germanium rectifier (G-E 1N91 or equivalent)
D2, D3—4.7-volt, 400-mw Zener diode (Int. Rect., TI or Hughes 1N750 or equivalent)
M—500-μa meter
Q1, Q2, Q3—general-purpose n-p-n transistors, minimum beta = 20, minimum V_{CES} = 15 volts (2N339, 2N1302, 2N696). For positive-ground electrical systems, use equivalent p-n-p transistors
R1—3,300 ohms
R2—1,000 ohms
R3, R6—47,000 ohms
R4, R5—5,100 ohms, 5%
R7—5,000 ohms, pot, linear taper
R8—1,100 ohms
R9—Thermistor: 3,000 ohms @ 25°C, temp. coeff. .04 (Fenwal JA33J1 or equivalent)
R10—120 ohms for 6-volt battery, 700 ohms for 12-volt battery
All resistors ½ watt, 10% unless specified
Perforated boards, aluminum box, miscellaneous hardware

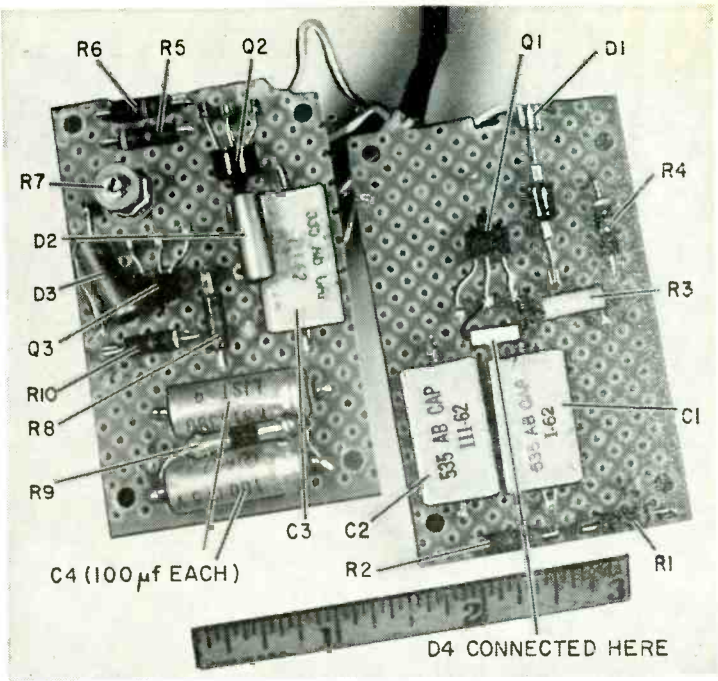
put-pulse rise time is relatively independent of the input-pulse rise time.

The pulse appearing at the collector of Q2 is limited by Zener diode D2 and differentiated by C3 and R7. By differentiating the collector waveshape, we generate a drive for Q3 that is independent of the width of the ignition pulse, and further isolate any effects of input variation. The base of Q3 is driven by the waveform at the wiper arm of calibrating pot R7. Q3 acts as a current amplifier and drives meter M, which acts as an integrator. Capacitor C4 maintains the integrating properties of the meter at low pulse-repetition rates.

As the ambient temperature of the circuit increases, the gain of Q3 increases, causing a reading on the meter greater than the true rpm. Thermistor R9 is a temperature-sensitive resistor with a negative thermal coefficient of resistance. As it heats, its resistance decreases, loading the meter and effectively canceling the effects of temperature change.

Zener diode D3 and resistor R10 form a voltage-regulating circuit which maintains a constant supply voltage to the rest of the tachometer circuit.

Two small perforated phenolic boards carry all parts except the meter. Layout is optional; leads can be practically any length. D4 was added, as shown, to improve performance.



Construction

The circuit was built on two phenolic boards (Vector type), each 1¾ x 2¾ inches. The boards were then mounted in a small 1 x 2 x 3-inch aluminum box for protection. Instead of using a connector as I did, you can pass the leads through a hole in the box.

The external electrical connections are simple. The 6-volt lead is connected to the battery through the ignition switch; the ground is connected to the chassis of the vehicle, and the signal lead is connected to the side of the points tied to the coil. Two unshielded leads, as long as needed, are connected to the meter.

The circuit is designed so that variations in the characteristics of the semiconductors have little effect on operation. Any general-purpose n-p-n audio transistors, any germanium diodes and 4.7-v Zener diodes may be used. However, if the circuit is to be installed in a vehicle with a positive ground (circuit shown is for a negative ground), p-n-p transistors will be needed. *In addition, for positive ground, the connections to D1, D2, D3, D4, M and C4 must be reversed.* For a 12-volt ignition system, R10 must be changed to 700 ohms. The rest of the circuit remains the same. Component placement is not critical.

Calibration

The unit may be calibrated by using a sine-wave, square-wave or pulse generator. In any case, the input amplitude to the filter section must be set so that further increase in amplitude has no effect on the meter reading. The pulse-repetition frequency of the input is then set to correspond to the rpm at which full-scale deflection is desired. This frequency (f) may be calculated by using the formula 2N × rpm/60C, where *rpm* is desired full-scale reading in rpm, N is number of cylinders, and C is 2 for a two-cycle engine and 4 for a four-cycle engine.

With this signal supplied to the input of the filter, scaling potentiometer R7 is adjusted for full-scale deflection of the meter.

Stability

Much effort was expended to minimize meter variation with changing temperature, ignition pulse and bias voltage. A known pulse-repetition frequency was supplied to the circuit and, with the formula, converted to an rpm reading. The supply voltage was varied and the error* between the true rpm reading (from the formula) and that observed on the meter recorded. The supply voltage was then fixed and the unit subjected to changes in temperature. Again the error between true rpm and observed rpm was recorded. The results of these tests are shown in Fig. 2-a and 2-b. Over the voltage range from 5.7 to 7.0 and temperature range of 38°F to 120°F, the meter indicator has a stability of better than 5%. Varying the input pulse width, rise time or amplitude produces no variation in the meter deflection.

In operation, the entire unit draws 100 ma when using the Zener voltage-regulating stage. This is only 0.6 watt out of the 300 the average auto system is capable of supplying. It is recommended that the circuit be mounted under the dashboard near the heater, since the temperature variation there is usually less throughout the year than in other locations during operation of the vehicle. END

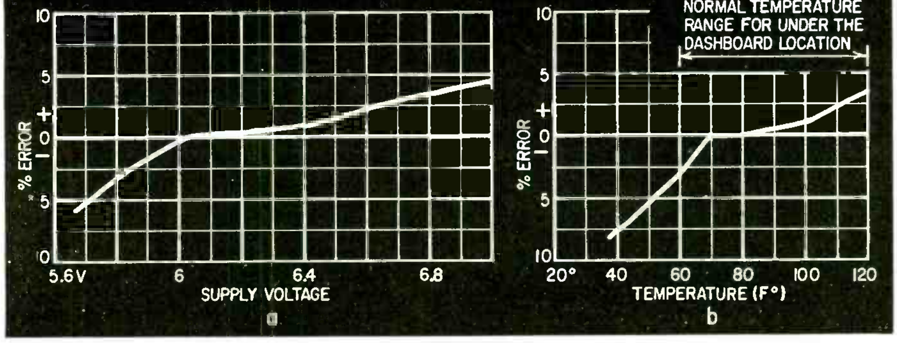


Fig. 2—a—Percent error between indicated and true rpm versus supply voltage. b—Percent error between indicated and true rpm versus temperature.

$$*\text{Error} = \frac{rpm_T - rpm_I}{rpm_T} \times 100$$

rpm_T = true rpm (computed from formula)
rpm_I = rpm indicated on meter

WHAT'S A DELAY LINE?

Delay lines crop up in color TV, hi-fi audio, computers, radar and hundreds of other applications. Read what they are and how they're used

By ARTHUR S. KRAMER

YOU MAY BE ASTONISHED TO LEARN that many of our most sophisticated electronic devices could never have been perfected without delay lines. Color TV, radar target simulators, radar moving-target indicators (MTI), several types of digital computers, and many others would be unbelievably crude or completely impractical if delay lines didn't exist. What *is* a delay line?

A delay line is basically *a transmission line compressed into a small volume*. Its function is to delay information for a specific length of time, usually in the microsecond range.

You might well ask, "Why slow down an electronic signal?" The reason is that it enables you to compare the delayed signal with a later one, or to make another check on the delayed signal, using proper instrumentation. Or it may be used—as in color TV—to keep two signals in step, though one has to travel a longer circuit path than the other.

The whole field of delay lines can be broken down into three broad categories: *high-frequency ultrasonic*, *ultrasonic wire* and *electromagnetic*. These broad categories can be further subdivided.

In Fig. 1 is shown a distributed-constant electromechanical delay line suitable for printed-circuit mounting. It comes in sizes from 2 in. long to 6¼ in. long, and from .05 to 1.1 μsec in delay. A long-wire magnetostrictive (ultrasonic wire) type is pictured in Fig. 2. Delay of this model is 80 μsec, working in the longitudinal mode. A third type, a high-frequency ultrasonic type, is shown in Fig. 3. Two piezoelectric transducers are shown attached to the glass block. These serve as the input and output circuits.

You can specify resistors in ohms and watts, capacitors in farads and volts. How do you specify delay lines?

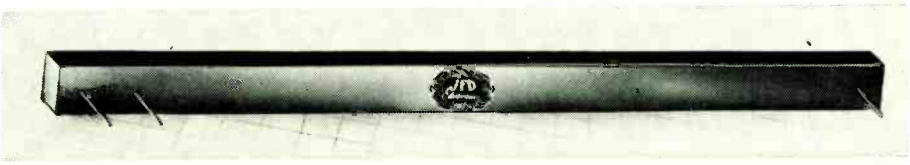


Fig. 1—A distributed-constant electromechanical delay line. JFD

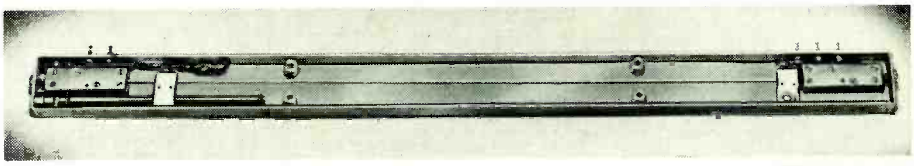


Fig. 2—Long-wire magnetostrictive delay line. ESC Electronics

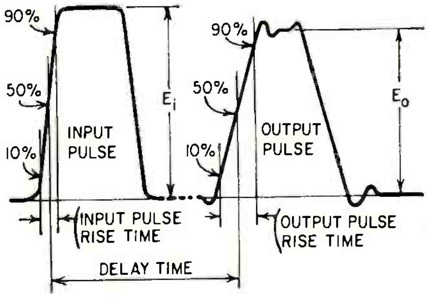


Fig. 4—Pulse waveforms help define some delay-line terms.

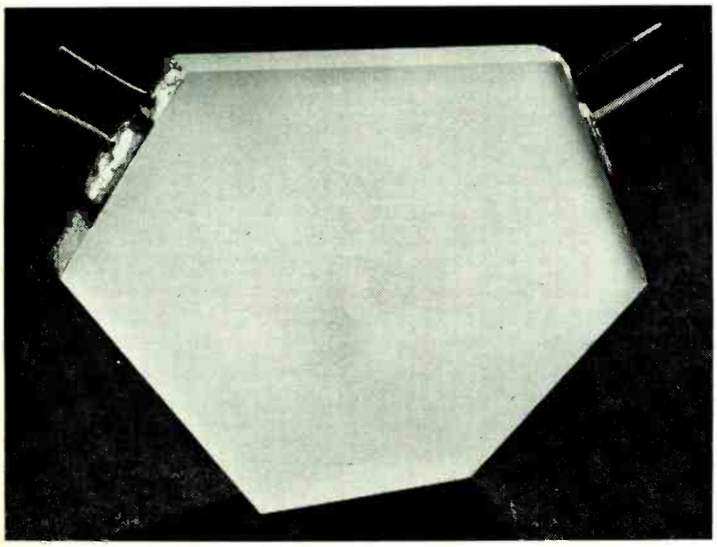


Fig. 3—Glass ultrasonic delay line. Connections are made to pairs of pins on opposite faces.

Corning Glass Works

Some of the terms used are:

Delay time. The elapsed time between the 50% amplitude points of the input-pulse leading edge and the output-pulse leading edge. (See Fig. 4.)

Rise time. The elapsed time between the 10% and 90% amplitude levels of the leading edge of the output pulse.

Characteristic impedance. Just as in other transmission lines, this is equal to the value of terminating impedance that results in minimum power reflected to the input of the delay line.

Attenuation. The difference in amplitude between the input and output pulses when the delay line is terminated in its characteristic impedance. It can be expressed in db as

$$\text{atten} = 20 \log_{10} \frac{E_i}{E_o}$$

E_i, E_o are input and output amplitudes,

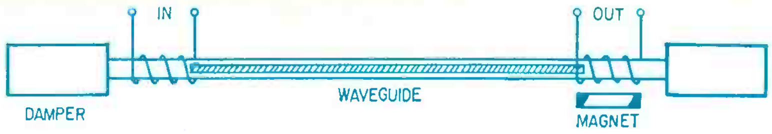


Fig. 5—Simplest magnetostrictive delay line.

respectively, and must be expressed in the same units.

Longitudinal mode. This is a mode of operation in a magnetostrictive line in which sound waves are propagated along a wire from one end to the other by the sonic expansion and contraction of waves in the wire. It is similar to the way sound waves travel along a pipe hit on the end with a hammer.

Torsional mode. A mode of operation in a magnetostrictive line in which sound waves are propagated along a wire by a twisting or torsional stress on the wire. The mechanical stress waves are transferred along the wire in a helical or spiral mode to the other end of the wire. This is similar to turning a length of pipe with a wrench at one end and noting that the pipe tends to revolve about its long axis.

Storage capacity. The number of binary digits (bits) that can be stored on a line is called its "storage capacity."

Center frequency. The mid-frequency of the delay-line frequency range or response is called "center frequency."

Now just how do these different delay lines work?

Magnetostrictive type

The simplest possible magnetostrictive delay line that could be built is diagrammed in Fig. 5. It consists of an input transducer coil with a magnetostrictive core attached to a wire sonic waveguide. A similar transducer is attached to the output end. Sound waves travel at a much lower velocity than do electrical waves. The incoming electrical wave is converted to a sound wave, and travels down the line in the "longitudinal mode." This sound wave is reconverted to an electrical wave at the output end. The delay is proportional to the length of the line.

Glass type

Here, the input transducer transmits a mechanical vibration through a glass block when energized by an electrical signal. At the output, the vibration is reconverted to electricity. Again, delay is proportional to the length of the path taken by the mechanical signal as it travels through the glass.

Photoelastic type

This type is becoming increasingly important. Optical properties of certain kinds of glass vary with mechanical stress. The input to this delay line is through a conventional piezoelectric (crystal or ceramic) transducer, but the output is fed into an optical arrangement. Because the refractive index (light-bending property) of the glass block varies with electrical input signals, optical signals (modulated or chopped beams) passed through the glass will be delayed in accordance with the electrical input signal. Advantages of this type are that the output circuit requires no direct mechanical connection and the line can be "tapped" for intermediate values of delay without affecting the acoustical signal.

How delay lines are used

Anyone who lives in an area over which aircraft fly has experienced the annoyance of "aircraft Doppler" on his TV screen. In my own case, before I can even hear the aircraft, my picture goes slowly in and out of focus. This is followed by severe ghosts and, at times, the vertical sync is lost and the picture shifts rapidly up or down. Occasionally, the picture is badly torn for a short period.

Some work has been done in England to improve TV receivers so that this annoyance will be eliminated. Since Doppler signals from aircraft are not always available, a device to generate these signals has been developed. It uses sonic delay lines as shown in the partial block diagram of Fig. 6, and is capable of generating a picture like that shown in Fig. 7-a.

To simulate the Doppler effect realistically, the delay line is made variable and its delay control is motor-driven so that the delayed signal slides in and out of phase with the direct signal. Fig. 7-b shows a test pattern with a delay of 120 μsec, having equal amplitudes of direct and delayed signal.

Delay lines in color TV sets

Delay lines are essential to the proper operation of a color receiver. The rectified video signal is separated into its brightness and color components at some point after the video detector. These brightness and color components are amplified separately and then fed to a matrix network where they recombine with each other to produce the red, green and blue signal voltages that modulate the color CRT. For good color reproduction, the brightness and color signals must arrive at the matrix within about .05 μsec of each other.

The amplifiers used for the color and brightness signals have different inherent time delays—the narrower the bandpass of the circuit, the longer it takes a signal to pass through. A delay line is inserted in the brightness (video) amplifier chain so these signals arrive at the color matrix

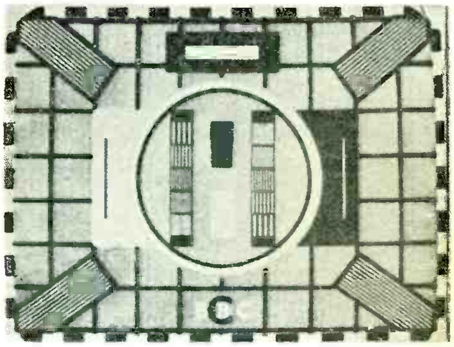
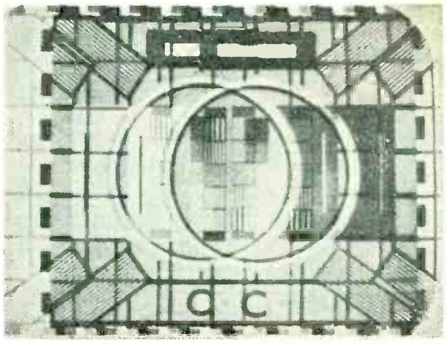


Fig. 7-a (above)—Original signal. (b, below) Signal with shift of 120 μsec.



Electronic Engineering

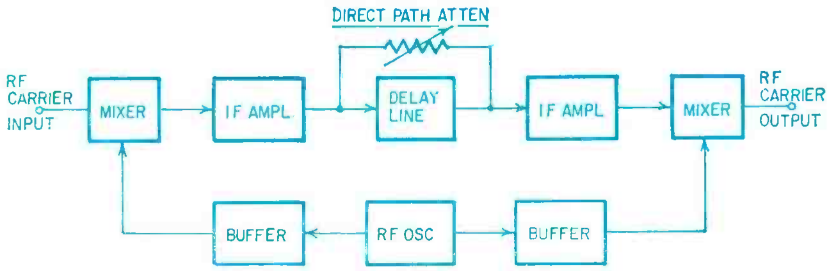


Fig. 6—Aircraft simulator uses delay line to cause doppler-like shift to help study effects on TV reception.

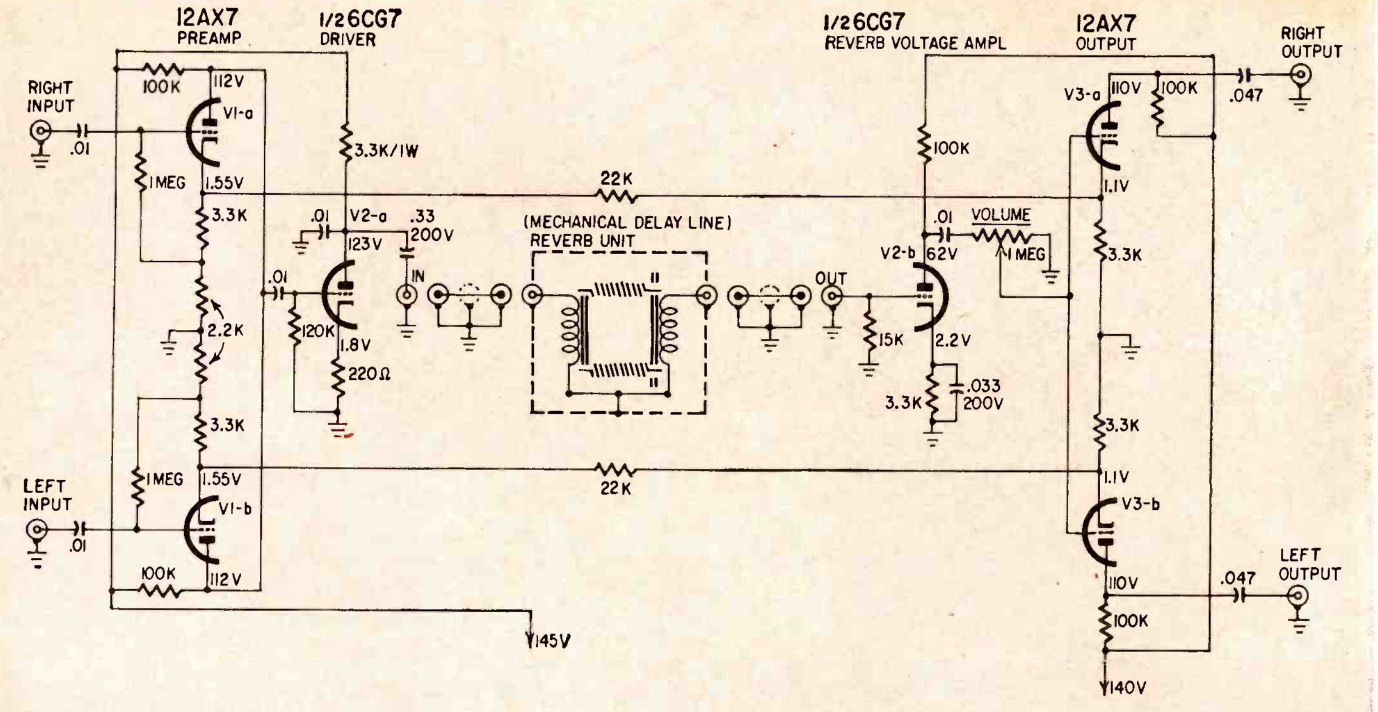


Fig. 8—Artificial reverb portion of Philco hi-fi system uses mechanical delay. Sum of left and right channels is fed through amplifier and electromechanical delay line. Delayed signal is mixed with left and right channels to simulate acoustic reverberation.

at the same time as the slower color signal.

The delay line may be a lumped-constant network, a coil of wire with specific inductance and capacitance values or a length of special type of coax.

Home sound reverberation system

Fig. 8 is a schematic of a special audio amplifier for simulating reverberation effects. The direct path for audio signals is from cathode to cathode of the two sections of each 12AX7, and out to the 12AX7 plate outputs and the output terminals. The right and left signals are mixed in V2-a, amplified and fed through the delay line, through V2-b, and then into the grids of V3-a and V3-b. By varying the pot in V3's grids, the amount of reverberation can be closely controlled for greatest realism.

In a computer application, a delay line adds 50 μsec delay to the amplifier chain, and is a hermetically sealed ultrasonic type.

Radar applications

One of the earliest, and still one of the most important, applications for delay lines is in MTI (moving-target indicators). This technique is based on two discrete radar scans, one delayed so that it arrives at the indicator at the same time as a second scan. If the indicator is equipped to cancel out information which has not changed between scans, only moving targets will be seen. This technique is very valuable for tracking aircraft and ships.

For ranging markers, a line of precisely measured delay is used to calibrate a radar sweep. A part of the transmitted pulse is fed into the radar receiver through the delay line. This will cause marker blips to appear on the display at a distance exactly equivalent to the delay of the line.

Often it is desirable to have available a group of pulses that can be used to simulate radar targets that are moving, fixed or moving superimposed on fixed. This can be done with a radar test set by using delay lines to generate simulated echo pulses. The rf signal from the system under test is heterodyned to an i.f. signal which can drive the delay line. The delay line drives another amplifier, which in turn feeds back a portion of the delayed signal to the i.f. amplifier which drives the delay line. The output is the desired group of pulses.

My thanks to the following companies, without whose assistance this article could not have been written: Arenberg Ultrasonic Laboratory; Laboratory for Electronics; Corning Glass Works; Deltime, Inc.; JFD Electronics Corp.; Gray and Kuhn Div., Burnell and Co.; Columbia Technical Corp.; Philco Corp.; Tempo Instrument, Inc.; Control Electronics, Inc.; ESC Electronics Corp.; Consolidated Avionics, and the editors of *Electronic Engineering* of London, England. END

COMPANY SUPPLIES PACKAGE TV STATIONS FOR INEXPERIENCED OWNERS

Electronics Leasing Corp. has joined with Kamen Associates, a design-marketing consulting group, to make a new proposal to assist "the little guy who wants to get into TV but is frightened and bewildered." It would supply him with a complete TV station ready to go on the air, would provide and train the staff and even obtain programing (which would be supplied to a group of stations).

According to Ira Kamen, president of Kamen Associates, the problem of obtaining legal and engineering services, dealing with contractors, etc., scares off many small community groups and others who might need a station but lack experience. By telling a would-be broadcaster beforehand exactly what costs would be and supplying him with a going station, Kamen believes many who now would not attempt to enter the field will no longer be afraid of the numerous unknowns facing the novice going into television. A further attraction is that the stations would be supplied on monthly payments ($2,000–$5,000 monthly). Arrangements would be made by the individual communities to continue on a leasing basis or eventually to purchase the station.

New Concept in Color Bar Generators

Tiny, versatile, battery-powered color test generator is small enough to be carried anywhere and offers a number of new, extra-useful signals

By WALTER CERVENY*

THIS NEW GENERATOR IS SO SMALL AND light that it can be carried in a conventional tube caddy. It is completely transistorized and is battery- or ac-operated. The power required for operation is approximately $\frac{3}{10}$ watt—less power than a flashlight lamp takes.

One major problem in color bar generators has been loss of timer synchronization. This problem, among others, has been overcome in the Amphenol Color Commander.

Patterns and how they're used

The centering pattern. It consists of single horizontal and vertical lines, as seen in the first switch position (lower left pattern in the photograph). The horizontal and vertical crossbars are generated in proper time placement to appear in the electrical center of the pattern when the raster is properly centered. The slight differences in blanking time between the generator blanking and standard broadcast blanking, which might cause an error, have been compensated with delaying networks.

The prime purpose of this pattern is to enable the service technician to center the raster accurately before starting convergence. Centering after convergence can cause misconvergence.

The second most important function of the single cross-bars is in dynamic convergence. Most TV manufacturers' alignment instructions call for a crosshatch pattern for initial dynamic convergence alignment. The instructions call for picking a vertical line in the center of the screen when starting the dynamic vertical convergence adjustment. With the single cross-bar pattern, this adjustment is easier since only one vertical line is present, in the center of the screen.

The single dot. This vitally important pattern (second switch position in photo) is entirely new and not found in any other generator. The accuracy of convergence alignment depends on the initial setting of static convergence in the center of the raster. Normally, this is set with a multiple-dot pattern. The operator selects dots near the center of the screen and makes his adjustments there. This is a very broad and inaccurate adjustment, since it's difficult to concentrate on a single dot when other dots are present. With only a single dot, in the exact center of the screen, the adjustment can be made very simply and accurately.

The single vertical and horizontal bars (positions 3 and 4) are used in connection with the standard vertical and horizontal bar patterns in dynamic convergence. Where the technician is asked to concentrate on a single vertical or horizontal bar at the center of the screen, he switches in these patterns and is not distracted by the other bars.

The crosshatch pattern. Although this kind of pattern is not new, the one generated by the Color Commander contains many desirable features: a 4 to 3 aspect ratio, finer lines and closer-spaced lines. The pattern contains 20 vertical and 15 horizontal lines. With an aspect ratio of 4 to 3, the height and width or proportioning adjustments are made easily; the operator merely adjusts the controls for perfect squares over the entire screen.

The lines are extremely fine—approximately one scanning line wide. The pulses that produce the lines have short rise and fall times, yet are not steep enough to ring the receiver circuits. The horizontal lines start and end in the blanking region, so there is no discontinuity in the lines. In some other generators, the horizontal lines start and end on the screen, making convergence adjustments difficult.

Some generators produce lines from pulses that have long rise and fall times. Then the brightness control must be set to minimum to produce fine lines and the convergence adjustments must be made in practically total darkness. When the set is tuned to a station with the controls set to normal, convergence adjustments are off slightly. This is due to small differences in beam deflection at various beam current levels.

Another unique feature of this generator is that it enables the service technician to set the fine tuning properly and accurately. In the crosshatch position, the vertical line pulses are adjusted to a lower amplitude than the horizontal line pulses. This is done at the factory during calibration.

The vertical line frequency is 315 kc and contains high-frequency components up to 3 mc. The horizontal line frequency is 450 cycles. Thus the vertical line frequency when modulated on a picture carrier frequency will generate high-frequency sidebands, approximately 315 kc to 3 mc either side of the carrier. The horizontal line frequency, being much lower, will generate lower frequency sidebands immediately adjacent the carrier. The Color Commander

*Vice president, Engineering, Cadre Division, Amphenol Corp.

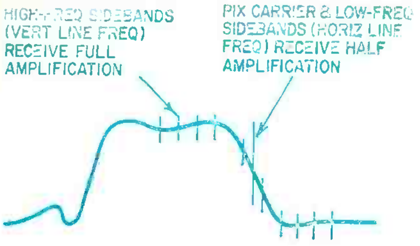


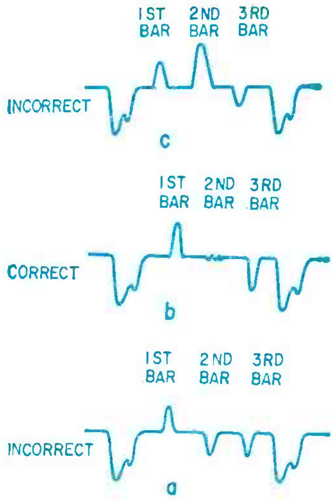
Fig. 1—Automatic fine-tuning adjustment is based on correct amplitude relationship of vertical and horizontal pulses. When vertical and horizontal lines are equally bright on screen, fine tuning is correct.

rf output contains double sidebands along with the picture carrier. Thus, when the fine tuning is adjusted so that the vertical and horizontal lines are the same brightness or intensity on the face of the picture tube, the picture carrier will be set halfway down on the i.f. response curve. The reason for this is immediately evident in Fig. 1.

This shows that the lower-frequency sidebands (horizontal line frequency) are amplified less than the high-frequency sidebands (vertical line frequency). Therefore, when the horizontal- and veritcal-line pulse amplitudes are in the proper ratio, the receiver can be fine-tuned simply and accurately without a sound carrier. Once the fine tuning is set with the crosshatch pattern, it will not have to be reset for the color pattern.

The multiple-dot pattern also has an aspect ratio of 4 to 3 and contains 300 dots, less those lost in the blanking region. The chief use of this pattern is for critical inspection of convergence alignment when the job is done. The dot pattern can be used for convergence alignment, though the vertical and horizontal line patterns are somewhat easier to work with.

The horizontal and vertical line patterns are standard and are used individually in convergence alignment where the service technician prefers to view only the vertical lines during vertical convergence and only the horizontal lines for horizontal convergence. However, some technicians prefer to use the crosshatch pattern, so that, if interaction does occur, it is immediately evident.



Figs. 2-a and 2-c are incorrect waveforms; second bar should be suppressed as in 2-b.

The color bar pattern generated by the Color Commander is new and not found in any other color bar generator. It was designed to make color adjustments very simple. The generator produces three color bars on the screen: R–Y, B–Y and –R–Y or, in color phase, respectively, 90°, 180° and 270°.

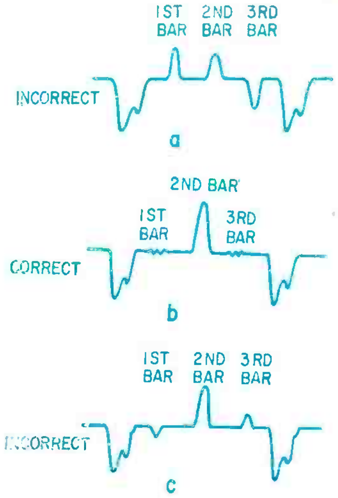
The first two bars (R–Y and B–Y) are used for demodulation alignment. The third bar is used to check the range of the hue control and to preset the hue control accurately to the proper phase before a broadcast color transmission.

The color adjustments can be made with or without an oscilloscope. The scope method is usually used in the shop. This is how it's used:

First, the fine tuning has to be set properly. This is done by switching the Color Commander to the crosshatch position and adjusting the fine-tuning control so that the vertical and horizontal lines have the same intensity. This insures that the picture carrier is tuned halfway down on the i.f. response. It also places the color subcarrier in its proper location on the i.f. response curve. The conditions are now correct for color alignment. The generator is then switched to the color bar position. The hue and color saturation controls are adjusted to midposition.

Three color bars should be seen. (If color locking circuits are not operating properly—lack of color or movement of color through the bars—readjust the locking circuits according to the TV manufacturer's alignment instructions.) Connect the vertical input of the scope to the red grid terminal of the color picture tube. The scope sweep and triggering controls are adjusted to stop one 15,750-cycle waveform. Typical waveforms are shown in Figs. 2-a, -b and -c. With the hue controls in the center of its range, the coarse R–Y adjustments are made so the middle bar as shown in Fig. 2-b is at base line level. The scope input is then switched to the blue grid. The B–Y or quadrature adjustment is then made so that the first and last bars are at base line levels (Fig. 3-b).

Some TV receivers do not have provisions for adjusting B–Y demodulator phase—the adjustment is fixed. However, this method can be used to verify that the fixed phase-shift network is proper. The alignment is now complete since the G–Y output is matrixed from R–Y and B–Y and does not require adjustment. However, if the oscilloscope is connected to the green grid, the waveform of Fig. 4 should be seen if the G–Y channel is operating properly.



Figs. 3-a and 3-c are incorrect waveforms: first and third bars should be suppressed as in Fig. 3-b.

The other method of alignment does not require a scope and therefore can be made in the customer's home:

The fine-tuning control is adjusted as in the scope method. The hue and saturation controls are set to midposition. Screen controls on the blue and green guns are turned to minimum to cut off the guns. The screen should have a dark red background. With the hue control at mid-range, the coarse R–Y adjustment is made so that the middle bar blends into the red background.

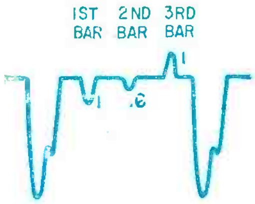


Fig. 4—Just as a double check, waveform at green CRT grid should look like this.

Next, the red and green guns are cut off and the blue gun is turned back on, using the same method as before. The screen should have a dark blue background. While viewing the screen, the B–Y adjustment is made so that the first and last bars blend into the blue background. Alignment is now complete. The guns are then restored for normal operation.

In many cases, the color circuits may not need alignment. However, they should be checked to make certain that alignment is not necessary. To make this check, connect the Color Commander to the antenna. Adjust the fine tuning properly as described earlier. On a well-aligned set the first bar will be red, an

R–Y red, which has a very slight touch of blue. The second bar will be blue. The third bar will be cyan, a blue-green color. Vary the hue control to check its range. At one end of its range, the last bar should be blue. At the other, it should be green and at approximately mid-rotation, it should be blue-green. This is a very critical setting for correct fact tones when the receiver is tuned to a color broadcast.

The circuit

The heart of this generator is the crystal-controlled timer. The silicon unijunction transistors it uses are stable devices ideally suited for count-down circuits. A unijunction oscillator's frequency stability depends largely on the external R-C timing circuits and, if high-quality resistors and capacitors are used, the circuit will be stable.

The timer starts with a 315-kc crystal oscillator. The output is fed through a buffer to trigger a divide-by-5 stage with a 63-kc output, then through another buffer to trigger a divide-by-2 stage to 31,500 cycles. A sync buffer then provides triggering pulses to the 15,750 stage (÷ 2) and to the 4,500 stage (÷ 7). The output of the 15,750 oscillator then triggers the 2,250 oscillator (÷ 7). That oscillator output triggers the 450 oscillator (÷ 5). The output of the 4,500-cycle oscillator also triggers the 900 stage (÷ 5), and it triggers a 300-cycle divider, which in turn synchronizes a 60-cycle stage.

Outputs from the 15,750- and 60-cycle oscillators are fed through pulse-forming networks to the sync gate where the composite sync is formed. The outputs of the 315-kc and 450-cycle oscillators are fed to shaping networks and then through the function selector switch to the video gates to form the video composite for the dot-crosshatch vertical and horizontal line patterns. The outputs of the 31,500-cycle and 60-cycle oscillators are fed through delay networks and then through the function selector switch to the video gates to form the video composites for the single cross-bars, single dot, single horizontal and vertical lines.

The output of the chroma crystal oscillator is fed through an attenuator to the chroma gate. Also fed to the gate is a 63-kc pulse after a suitable delay. The output of the chroma gate consists of chroma bursts which will form the color bar video composite.

All the video composite signals are then fed to the sync gate and adder stage. Here the composite video signals are added to the composite sync signals to form the complete composite signal. Only one composite video signal is on at any one time, depending on where the function selector is set. The complete composite signal is fed to the video output jack, where it can be used for signal injection or monitoring. The complete composite is also fed to a modulator, where it is used to modulate a carrier from the channel oscillator. The channel oscillator carrier is adjustable to channel 3 or 4 by a channel switch on the front panel. The output of the modulator is fed through an attenuator to the panel jack. A cable is supplied to connect the panel jack to the antenna of the TV receiver. END

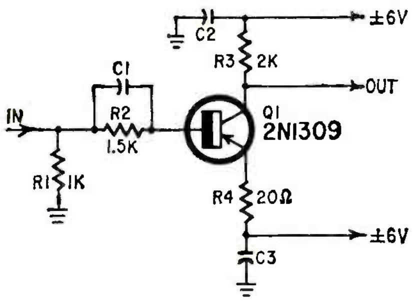
WHAT'S YOUR EQ?

Conducted by
E. D. CLARK

Will It Work?

As a conventional inverting amplifier, 6 volts is applied to the emitter and −6 volts to the collector of the transistor shown in the diagram.

A second operating condition reverse-biases Q1 by placing −6 volts on the emitter and +6 volts on the collector.

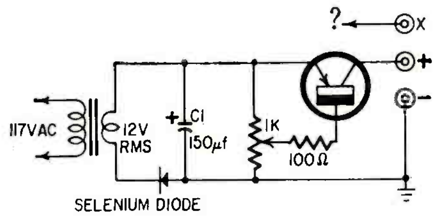


With Q1 biased this way and an input of positive and negative pulses, will there be an output from Q1, and if so, what will a positive and negative input pulse produce, and how? The transistor is operating well within its design limits.—*David Kaplan*

Three puzzlers for the students, theoretician and practical man. Simple? Double-check your answers before you say you've solved them. If you have an interesting or unusual puzzle (with an answer) send it to us. We will pay $10 for each one accepted. We're especially interested in service stinkers or engineering stumpers on actual electronic equipment. We get so many letters we can't answer individual ones, but we'll print the more interesting solutions—ones the original authors never thought of.
Write EQ Editor, Radio-Electronics, 154 West 14th Street, New York, N. Y. 10011.
Answers to this month's puzzles are on page 101.

Power-Supply Problem

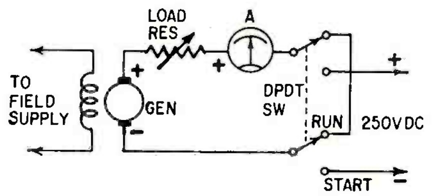
You have a black box containing the power-supply circuit shown in the diagram. The transformer primary is connected to an ac line, and there are three terminals—common ground, positive output and one called X, unknown. When a capacitor is connected between terminal X and ground, the ripple in the output increases.



Where is terminal X connected in the circuit, and what capacitance (connected between X and ground) will produce an 8.4-volt peak-to-peak half-wave output?—*Randolph B. Gold*

Two-Way Meter

A dc shunt generator driven by an experimental gasoline engine serves as a dynamometer to load the engine during testing by feeding current through a variable resistance. A knife switch is provided so that the generator may be used as a motor to start the engine, taking power from a 250-volt dc line and using the load resistor to limit the starting current. Unfortunately dc ammeter A, intended to measure the load current during testing, is useless during starting since the current through it is reversed.



How may the meter be arranged to read both starting and load currents without the need for any additional equipment?—*Robert L. Nelson Jr.*

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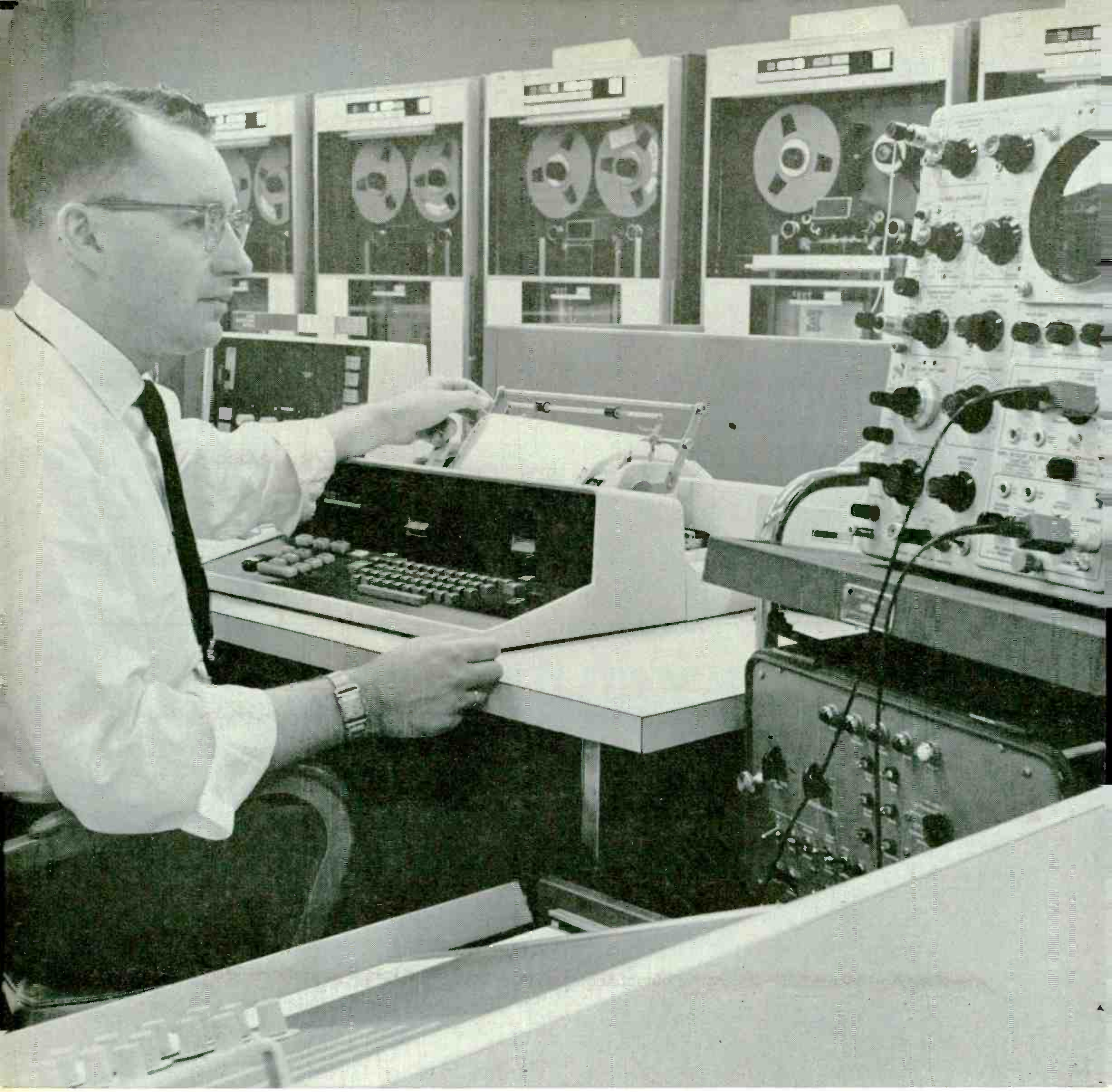


Why Fred got a better job...

I laughed when Fred Williams, my old high school buddy and fellow worker, told me he was taking a Cleveland Institute Home Study course in electronics. But when our boss made him Senior Electronic Technician, it made me stop and think. Sure I'm glad Fred got the break . . . but why him . . . and not me? What's he got that I don't. There was only one answer . . . his Cleveland Institute Diploma and his First Class FCC License!

After congratulating Fred on his promotion, I asked him what gives. "I'm going to turn $15 into $15,000," he said. "My tuition at Cleveland Institute was only $15 a month. But, my new job pays me $15 *a week* more . . . that's $780 more a year! In twenty years . . . even if I don't get another penny increase . . . I will have earned $15,600 more! It's that simple. I have a plan . . . and it works!"

What a return on his investment! Fred should have been elected most likely to succeed . . . he's on the right track. So am I *now*. I sent for my three *free* books a couple of months ago, and I'm well on my way to Fred's level. How about you? Will you be ready like Fred was when opportunity knocks? Take my advice and carefully read the important information on the opposite page. Then check your area of most interest on the postage-free reply card and drop it in the mail *today*. Find out how you can move up in electronics too.

EQUIPMENT REPORT

Mercury Model 1400 In-Circuit Capacitor Tester

For manufacturer's literature, circle No. 24 on Reader's Service Card

The Mercury Electronics Corp. model 1400 In-Circuit Capacitor Tester will find ever-increasing use on the modern service bench because printed circuitry requires new testing techniques. You can't keep unsoldering and lifting out components to check them because you'll often loosen the foil from copper-clad boards. Desoldering and resoldering is time-consuming and expensive especially when you ruin a good component.

A technique called *in-circuit testing* has become necessary.

Capacitors can be particularly troublesome. Electrolytics dry out and their capacitance decreases as they get old. Substitution is one method of finding such aged units, but the decrease in capacitance in borderline units is not apparent and does not show up when using test equipment and techniques that are quite suitable for wired chassis.

The proper way to find a changed capacitance value is to measure for it. With electrolytics, this measurement does not have to be very exact since their tolerances are very broad. Some units listed in the current catalogs are − 10% to + 100%—others have tolerances so broad they are not mentioned.

Values between 2 and 40 μf are measured using the basic circuit given in Fig. 1. Values from 40 to 450 μf use the same circuit except that part of dual potentiometer R is shorted out of the circuit by the range switch.

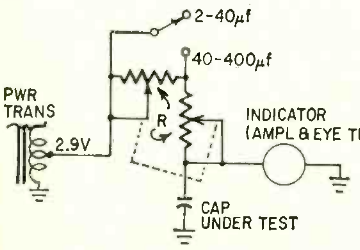


Fig.1

A tap on the heater winding of the transformer supplies 2.9 volts which is applied across the series-parallel resistance network in series with the capacitor under test.

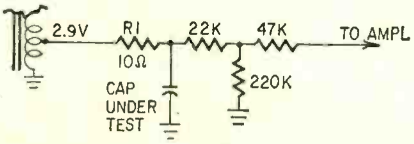


Fig.2

The dial of the dual potentiometer is calibrated in μf. The knob rotates the wiper arms which change the voltage drop across the capacitor in the test circuit. The effective resistance (reactance) of the capacitor under test decreases as the capacitance increases, and a different series resistance is needed to make the electron-ray (eye) tube just close.

Changing the resistance or the capacitance increases or decreases the voltage that goes to the grid of the 6C4 triode amplifier. The triode is direct-coupled to the grid of the EM84 electron-ray tube.

The shorted-capacitor check uses a similar circuit (Fig. 2). The 2.9-volt tap on the power transformer is applied to the capacitor under test through a current-limiting resistor (R1). A capacitor with more than 10 ohms of leakage resistance will not show as shorted—but there will be some "eye" closing. Leakage resistances higher than 30 ohms will have practically no "eye" movement.

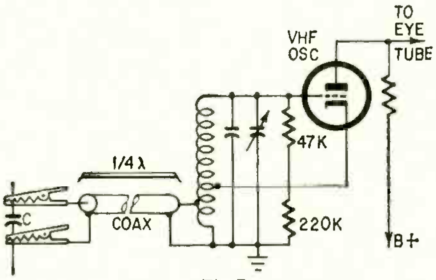


Fig.3

To find an open capacitor, an entirely different principle is used (Fig. 3). A vhf oscillator develops the test frequency. Its plate is direct-coupled to the grid of the "eye" tube. The coaxial test lead, one-quarter wavelength long at the test frequency, is connected across a few turns at the ground end of the oscillator coil. (A quarter-wave line acts as an impedance-reversing transformer. If we connect a high impedance across one end, it appears as a low impedance or a short circuit at the other.)

If the capacitor being tested is *open*, it represents a near-infinity impedance and appears as a short circuit across a section of the oscillator coil. This loads the oscillator and increases the drop across the plate resistor. This increases the bias on the indicator tube and the "eye" closes.

When a good capacitor, *or a shorted one*, is connected between the clips, the quarter-wave line transforms its relatively low impedance into a high impedance that does not affect oscillator loading. The "eye" remains open. Both OPEN and SHORT tests *must* be used to determine the condition of a capacitor.

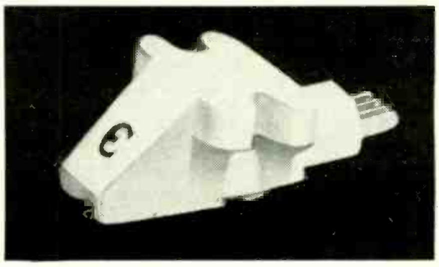
Warning: The 3-volts ac (rms) is nearly 9 volts peak-to-peak, and may damage capacitors with a lower voltage rating.—Elmer C. Carlson

---

Euphonics "Miniconic" Semiconductor Stereo Pickup

For manufacturer's literature, circle No. 25 on Reader's Service Card

ON PAGE 6 OF THE JANUARY 1965 issue, RADIO-ELECTRONICS published the first news of a remarkable new pickup cartridge that is actually a silicon semiconductor diode. It modulates a dc bias to produce a signal. The Euphonics "Miniconic" is a tiny stereophonic pickup with a frequency response from dc to about 30 kc. Its compliance is among the highest in pickups today, and its dynamic mass among the lowest.



Other salient features of the cartridge are its low output impedance (about 1,000 ohms), its high output level and its complete insensitivity to interference fields, either electromagnetic or electrostatic.

The cartridge comes ready for mounting in any standard tone arm. With it comes a power supply—a neat little box with a line cord, a special plug-in cable and a pair of permanently attached cables with phono plugs at their ends. The power supply provides the operating bias and optional equalization.

On the box is a slide switch marked H—L. In the H (high) position, the

Continued on page 70

Congress DIDN'T GO FAR ENOUGH!

PUBLIC LAW 87–529; 76 STAT. 150

[H. R. 8031]

An Act to amend the Communications Act of 1934 in order to give the Federal Communications Commission certain regulatory authority over television receiving apparatus.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That:

Section 303 of the Communications Act of 1934 (47 U.S.C. 303)[34] is amended by inserting at the end thereof the following:

"(s) Having authority to require that apparatus designed to receive television pictures broadcast simultaneously with sound be capable of adequately receiving all frequencies allocated by the Commission to television broadcasting when such apparatus is shipped in interstate commerce, or is imported from any foreign country into the United States, for sale or resale to the public."

Sec. 2. Part I of title III of the Communications Act of 1934 is amended by inserting at the end thereof a new section as follows:

THEY SHOULD HAVE ALSO REQUIRED...

"—that all 82-channel television receivers* must use an 82-channel television antenna."

Of course, you can't take the law into your own hands—but you *can* take advantage of today's ready-made opportunities to sell an 82-channel antenna with each 82-channel TV set.

Our Antenna Research Laboratories in Champaign, Illinois knew what they were doing when they teamed the acclaimed Log Periodic concept of the University of Illinois Antenna Research Laboratories with our new antenna design advance—the capacitor-coupled electronic dipole. Proof is the fact that the JFD LPV-VU is America's No. 1 82-channel TV/FM antenna!

Who says you can't have everything you want in a TV antenna—VHF?... UHF?... FM Stereo?—with a *single* down-lead to boot!

MOST EFFICIENT PERFORMANCE EVER ON VHF, UHF, FM/STEREO FROM *ONE* ANTENNA USING *ONE* DOWN-LEAD!

- *Cap-electronic* dipole design makes more elements resonate on channels 7 to 13 with a corresponding increase in gain.
- *Higher mode* operation in UHF band achieves higher gain on channels 14 to 83—and FM stereo.
- *Narrower* beamwidths . . . higher front-to-back ratios step up ghost rejection . . . intensify color.
- *Patented frequency independent* design maintains peak performance characteristics regardless of channel or band tuned.
- Includes 3-way splitter so single down-lead can be tied into individual VHF, UHF and FM system inputs.

REMEMBER – AN 82-CHANNEL TV SET IS NOT AN 82-CHANNEL TV RECEIVER UNLESS IT HAS AN 82-CHANNEL TV *ANTENNA!*

*Lest we forget—every *color* set is also an *82-channel* set requiring a color-perfect antenna. In fact, many color TV shows are broadcast on UHF channels.

JFD

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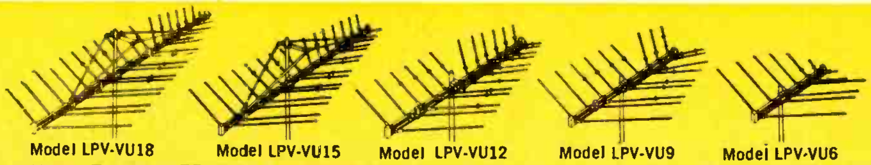

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Circle 26 on reader's service card

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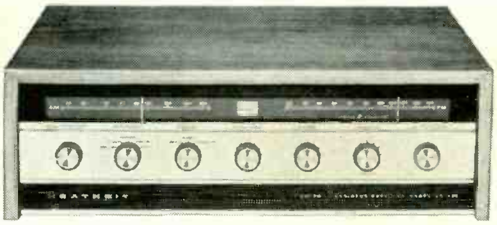

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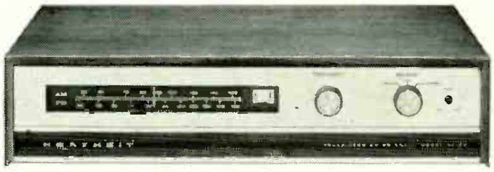

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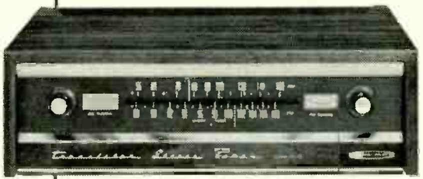

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$109.00
(less cabinet)

Deluxe Transistor AM/FM/FM Stereo Tuner

25-transistor, 9-diode circuit; automatic switching to stereo; stereo indicator light, stereo phase control; filtered outputs. 15 lbs. Optional cabinets, (walnut $12.95), (metal $6.95).

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70 watts RMS power at ±1 db from 13 to 25,000 cps; 26-transistor, 10-diode circuit; inputs & outputs for any source; 4, 8 & 16 ohm speaker impedances. Opt. cabinets, (walnut $12.95), (metal $6.95). 23 lbs.

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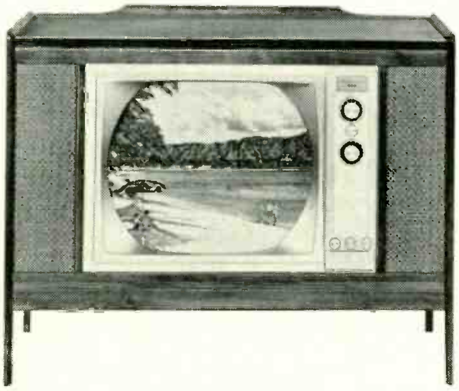

Kit GR-53A
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Ends costly color TV servicing . . . only set you adjust and maintain yourself. Only Color TV you can install 3 ways . . . wall, custom or Heathkit cabinets. Tunes all channels for 21" of the best color pictures in TV plus true hi-fi sound. Assembles in just 25 hours . . . no special skills needed . . . all critical circuits preassembled and aligned. 1-year warranty on picture tube, 90 days on all other parts. 127 lbs. Also new low prices on preassambled Heathkit cabinets: GRA-53-7, walnut cab. (illust.) 85 lbs...$108; GRA-53-6, walnut-finish hardboard cab., 52 lbs...$46.50

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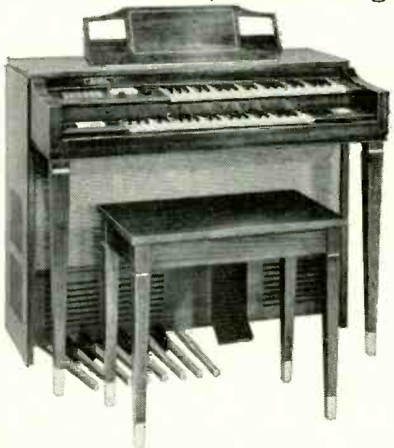

Kit GD-983
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The Heathkit/Thomas "Coronado" Transistor Organ, (illust.) boasts 17 organ voices, two 44-note keyboards, Leslie plus 2-unit main speaker system, 28 notes of chimes, 13-note heel & toe pedalboard, color-tone attack & repeat percussion, matching bench, plus many more professional features. 242 lbs. Also the Heathkit/Thomas "Artiste" Transistor Organ with 10 voices, two 37-note keyboards, repeat percussion, etc. now at only $332. 154 lbs. Both organs have all genuine Thomas factory fabricated components.

Circle 27 on reader's service card

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World's easiest to build stereo/hi-fi kit . . . takes 6 hours or less! 14-transistor, 4-diode circuit for cool instant operation, natural transistor sound. Phase control assures best stereo performance. 4-stage IF for high sensitivity. Filtered outputs for direct stereo recording. Automatic stereo indicator light, preassembled & aligned "front-end." Install in a wall or either Heath cabinet; walnut ($7.95), metal ($3.50). 6 lbs.

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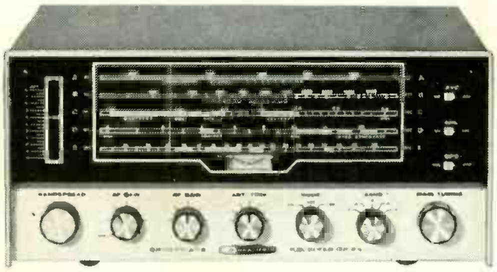
(less cabinet)

New Deluxe Shortwave Radio



Compare it to sets costing $150 and more! 5 bands cover 200-400 kc, AM, and 2-30 mc. Tuned RF stage, crystal filter for greater selectivity, 2 detectors for AM and SSB, tuning meter, bandspread tuning, code practice monitor, automatic noise limiter, automatic volume control, antenna trimmer, built-in 4" x 6" speaker, headphone jack, gray metal cabinet, and free SWL antenna. Assemble in 15 hours. 25 lbs.

Kit GR-54
$84.95

New 23-Channel, 5-Watt Transistor CB Transceiver

23-channel transmit & receive capability. All-transistor circuit for instant operation, low battery drain . . . only .75 A transmit, .12 A receive. Only 2⅞" H x 7" W x 10½" D . . . ideal for car, boat, etc. ½ uv sensitivity for 10 db signal plus noise to noise ratio. Front-panel "S" meter, adjustable squelch, automatic noise limiter, built-in speaker, ceramic PTT mike, charcoal gray aluminum cabinet. 8 lbs.

Kit GW-14
$89.95
(Assembled GWW-14, $124.95)

New 6-Meter SSB Ham Transceiver

Full SSB-CW transceive operation on 6 meters. 180 watts PEP SSB—150 watts CW. Operates fixed or mobile; PTT and VOX. Switch-selection of upper sideband, lower sideband, and CW. Covers 50-52 mc with crystals supplied, total coverage 49.5-54 mc. Famous Heath SB series Linear Master Oscillator for true linear tuning. Built-in 100 kc calibrator and antenna switching. Accessory mobile mount SBA-100-1 . . . $14.95. 23 lbs.

Kit SB-110
$320.00

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Model	Description	Weight	Price

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All prices & specifications subject to change without notice. CL-216 pickup system produces a high-level, flat-response signal, of about the same amplitude as that from a tuner, suitable for feeding directly to an auxiliary input of a stereo amplifier without equalization. The playback curve of the system follows the RIAA standard.

In the L (low) position, the output of the pickup is attenuated and "de-equalized" so that it can be fed into the equalized phono input of an amplifier. Assuming that the amplifier's equalization is accurate, either mode of operation should give equally pleasing results, except that the signal-to-noise ratio will inevitably be better when the Euphonics system is used with a high-level, auxiliary input.

How does the Miniconic system stack up against other pickups? As far as performance goes, very well. Specified tracking-force limits for the CK-15-LS professional model (the one I checked) are ¾ to 2 grams; I found it tracked well down to 1 gram on all music even with an inferior arm. (On test-record cuts with extremely high modulation levels, there was some skipping, but much of this was undoubtedly due to the tone arm.) The cartridge tracked a square wave (CBS test record STR 111) very neatly; there was some rounding of the tops (viewed on an oscilloscope), but not a trace of ringing or overshoot.

The sound was clean and crisp, equal to that from the best magnetics I have heard. Stereo separation is adequate (given as 25 db at 1 kc). Few if any stereo records exceed that. The Miniconic delivers unobtrusive sound, and keeps its head during loud orchestral passages with percussion.

As far as the mechanics of the unit are concerned—well, that's up to you. I am always suspicious of gadgetry, and of any unjustifiable complications. The Miniconic system is more complex than a magnetic or ceramic cartridge. But it's a *simple* complexity. The only extra is a small box, hardly bigger than two packs of cigarets. And there's always room for another ac plug. Second, it is an installation complexity only; once the cartridge and power supply are installed, they require no further attention. There are no controls or switches except that single slide switch, which is set once and then ignored forever after.

Third, the results seem to justify the complication. Whether the Miniconic system really sounds better than any other cartridge is a personal matter. But it can certainly solve some hum and magnetic-attraction problems. Its already-equalized high-level output can make it useful in some installations where a ceramic or crystal cartridge might otherwise be necessary. For practical purposes, then, you might compare the system to an ordinary pickup with an outboard preamplifier. (But remember that it is nothing like that in its operation.)

The pickup is a *modulating* device, like a carbon or condenser microphone or a strain gage, rather than a generating device, like most other mikes and pickups. Fuller details, including a schematic diagram of a suggested input circuit for the cartridge, were given in the *News Briefs* of our January 1965 issue.

If you're in the market for a new cartridge, don't overlook this one because it's new or offbeat. It's a fine piece of design, sounds good and may solve a hum problem you didn't even realize you had.—*Peter E. Sutheim*

MANUFACTURER'S SPECIFICATIONS

Frequency response: dc to beyond 30 kc
Separation: more than 25 db at 1 kc
Compliance: 20×10^{-6} cm/dyne
Weight: 2 grams
Output: 0.4 volt, high level; 8 mv, low level
Mounting: standard ½- and 7/16-in. centers
Effective vertical tracking angle: 15°
Stylus: model U-15-LS, biradial low-mass, .0009 by .0002 in.; model U-15-P, circular low-mass, .0005 in.
Tracking force: model U-15-LS, ¾ to 2 grams; model U-15-P, 1 to 3 grams
Price: CK-15-LS conversion kit for existing tone arms (reviewed here), $55; conversion kit for changers, $39; complete with special arm, $71.50 and $87.50

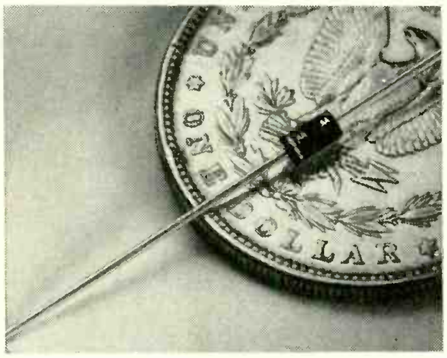
Circle 28 on reader's service card

Circle 29 on reader's service card

NEW SEMI-CONDUCTORS AND TUBES

ECONOMICAL SUBMINIATURE 1-WATT ZENER DIODES

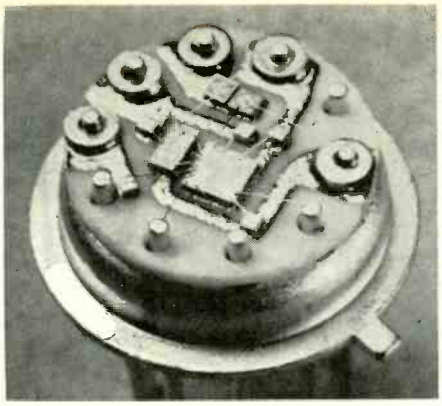
A new series of Zener diodes with breakdown voltages from 3.3 to 100 has been introduced by Motorola. The diodes, about the size of the ordinary ¼-watt diode or resistor, are rated at 1 watt at 50°C ambient, and up to 3 watts with proper heat-sinking. Voltage ratings are available in 5% or 10% tolerances. The diodes are numbered 1N4728 through 1N4764.



Oxide-passivated silicon "dice" for stable operation, and silver leads for effective heat dissipation are among the features of the new line. All the diodes are encapsulated in Motorola's *Surmetic* process, with a flameproof, void-free silicon polymer plastic. Prices of most of the units fall between $1 and $2.

1 WATT, DC TO 100 KC—IN A LITTLE PILL

This 1-watt integrated-circuit power amplifier is more or less flat between dc and 100 kc, and is packaged in a single TO-5 can (about ⅜ inch in diameter by about ⅜ inch high). Harmonic distortion is claimed to be "as low as 0.5%."



Designated the MC1524, this Motorola IC has three external taps to offer a choice of three internal negative feedback loops. The purpose of that is to insure low distortion and high gain stability under all sorts of conditions from −55 to 125°C.

A glance at the circuit diagram shows that the unit uses a class-B complementary output circuit, which permits coupling it direct to low-resistance loads, like a speaker or a servomotor. Its output (source) impedance is typically 0.5 ohm, which provides high damping for the load.

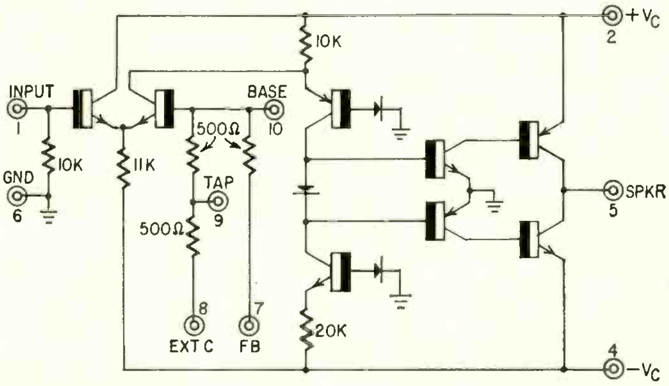
The MC1524 can be used for servomechanisms, low-power audio, telemetry or as an operational amplifier. Zero-signal current drain is less than 4 ma. It needs no heat sink even at 1-watt output.

Only trouble is, for low-power people like us, it costs $70.

19-INCH COLOR PIX

The Electronic Tube Div. of Sylvania announced "limited availability" of a rectangular 19-inch, 90°-deflection-angle color picture tube. It is claimed to be even brighter than the Sylvania 21-inch Color Bright 85 tube introduced in June 1964.

The new tube uses a europium-activated yttrium vanadate phosphor for the red parts of the picture, and improved blue and green phosphors. Its viewing area is 180 square inches. Face-to-socket length is about 18 inches, and the tube weighs 20 pounds (24 with bonded faceplate.) END



Circuit of Motorola MC1524 integrated-circuit amplifier.

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INTERNATIONAL CRYSTAL MFG. CO. (Pg. 70, 112) Circle 29 & 148
Catalog on citizens radio transceiver and name of your nearest International dealer
JFD ELECTRONICS CORP. (Pg. 67) Circle 26
Brochure on 82-channel TV antenna
JENSEN MANUFACTURING DIV. (Third Cover) Circle 149
Information on Jensen Model HS-2 stereo headphones
JERROLD ELECTRONICS CORP. (Pg. 89) Circle 120
Information on new Jerrold coloraxial TV reception system
JUDSON RESEARCH & MFG. CO. (Pg. 70) Circle 28
Descriptive literature and technical data folder on electronic magneto ignition system
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Radio-Electronics

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Cut out the postcard. Clearly print or type your name and address where indicated – and mail. (Canadian and foreign affix postage.)

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NEW PRODUCTS

More information on these new products is available free from the manufacturers. Each item is identified by a Reader's Service number. Turn to the Reader's Service Card facing this page and circle the numbers of the new products on which you would like further information. Detach and mail the postage-paid card.

SOLDERING GUN KIT. Wen *Hot Rod model 222-K5,* includes gun, single-post medium/heavy-duty tip (heat range –100 to 200 watts), fine line tip (heat range–25 to 100 watts), a plastic cutting attachment, flat iron attachment, roll of

solder, red plasic carrying case, 6-ft line cord. Gun uses on–off trigger switch, has built-in spotlight, operates on 120 volts ac. Kit case: 2¾ x 7½ x 10 in.; weight complete 2 lbs, 12 oz.

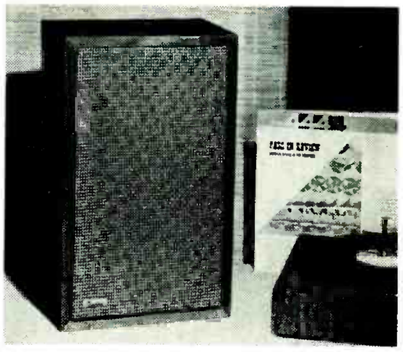
Circle 46 on reader's service card

BUSINESS/INDUSTRIAL TRANSCEIVER, E. F. Johnson Co.'s *Messenger 303,* is adaptable for base station, mobile or portable field pack use; accessory

speaker converts it to PA system. Designed for use on business/industrial frequencies between 25 and 50 megacycles AM, FCC type-accepted. Precision crystal filter.

Circle 47 on reader's service card

SPEAKER SYSTEM, *Sonomaster RM-2,* from Sonotone. 8 ohms; power rating, 50 watts average program material, 100 watts peak program material; response 40-20,000 cycles; crossover frequency 4,500 cycles. One 8-in. linear high-com-



pliance woofer; one 3½-in. cone tweeter. 19 x 11½ x 8⅞, ¾-in. panels, oiled walnut veneer, 22 lb.

Circle 48 on reader's service card

BOOKSHELF SPEAKER SYSTEMS, *Lafayette Criterion 50, 100* and *200. Model 50* 2-way system has 8-in. woofer, and 4-inch cone-type tweeter, 30–18,000 cycles. 100: 10-in. woofer, and 4-in. tweeter, 25–19,000 cycles. 200: 12-in. woofer, 8-in. mid-range and 3-in. dome-type super tweeter, 25–25,000 cy-

cles. Handle 20, 30 and 40 watts respectively. Impedance 8 ohms. ¾-in. wood enclosures. Models *50* and *100* are 19 x 10¾ x 8⅞ in., *200* is 24 x 14 x 12 in. *100* shown.—**Lafayette Radio Electronics Corp.,** 111 Jericho Turnpike, Syosset, N. Y. 11791.

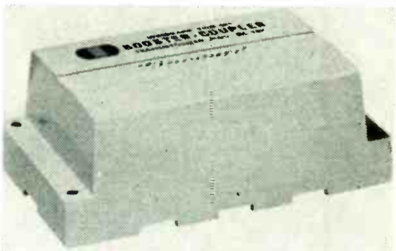
Circle 49 on reader's service card

15-WATT AM/FM STEREO RECEIVER, Lafayette *LR-300.* 3-μv in gives 20-db quieting. Switchable afc. Tuner has multiplex separation of 25 db at 400 cycles. Amplifier produces 7.5 watts per

channel with harmonic distortion at 1%. Response: 20–20,000 cycles ±2 db. Hum and noise –55 db at low level and –75 db at high-level inputs. Output impedances switch-selected at 8 and 16 ohms, input selector controls AM, FM stereo search, FM-MPX, phono and auxiliary music sources. 15 tubes, 7 diodes, EM-84 tuning eye. 16¾ x 5 13/16 x 12¼. Stock No. 99-0003WX.

Circle 50 on reader's service card

BOOSTER/COUPLER, Winegard *BC-107,* has 7 db minimum gain to TV or FM. Has extra set of terminals to use as booster only with single TV or FM, 12 db gain; can also be used to extend rabbit-ear range. Linear frequency response across



TV and FM bands and an exact match into 300 ohms. Polystyrene housing. 117 vac, 1 watt.

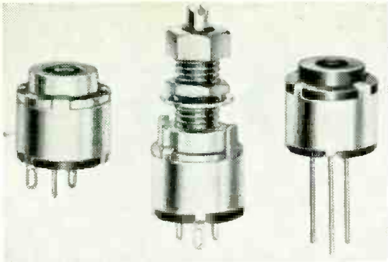
Circle 51 on reader's service card

PORTABLE AM RADIO KIT, the Heathkit *GR-224,* has 6 silicon transistors and 2 silicon diodes—performance equal to 8-transistor portables. Powered by 6 size-D flashlight batteries; 4 x 6 in. oval speaker; rf stage and double-tuned i.f. stage; diode-biased audio output stage.

Batteries enclosed in plastic holder. Slide-rule dial, built-in ½-in. diameter rod antenna.

Circle 52 on reader's service card

TRIMMING POTENTIOMETERS, *Series 63* line, from Clarostat Mfg. Available with wire leads for printed circuit mountings, standard solder lugs, molded or metal shafts, molded or metal bearing



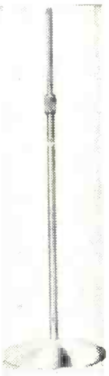
caps. Basic pot dimensions: ½-in. diameter by 3/64-in. maximum height. Power rating: ¼ watt, maximum rated voltage of 350 volts. Resistance: 100 ohms to 1 megohm.

Circle 53 on reader's service card

NEW MIGHTY MITE TUBE CHECKER, *model TC136* (*Mighty Mite IV*), from Sencore, has new socket to

test the Amperex and Mullard 10-pin tubes used in many '65 color receivers. Special hinge on cover so it can be left on or removed and held in steel handle. New plastic holder in cover to hold pages of setup booklet open. Setup chart covers more than 3,000 tubes.

Circle 54 on reader's service card



MICROPHONE STAND SERIES, *MS-11C* and *MS 12C* (Atlas Sound), features low profile bases with weight concentrated at outer edge. Heights from 34 to 62 in., base 10 in., extra-long clutch.

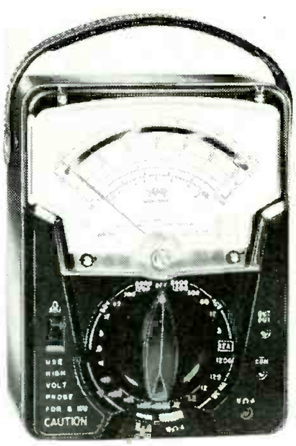
Circle 55 on reader's service card

COLOR CRT CHECKER-REJUVENATOR, the Amphenol *CRT Commander*, tests each electron gun for relative life, cutoff, contrast range, gun balance in multi-gun tubes, has voltmeter measuring up to 50,000 volts. With adapter probe, meter can be used as 0–1,000 and 0–50,000 volt, 20,000-ohm-per-volt meter. As rejuvenator, Commander revitalizes cathode by exposing

new electron-emissive material and enlarging grid apertures. 9 x 12 x 5 in., 7½ lb. Uses 117-volt/50–60 cycle ac power.

Circle 56 on reader's service card

ONE MILLION OHM PER VOLT VOM, Triplett *630-M*. No amplifiers, no zero drift, no warmup, no power requirements. Has basic 1μa-dc suspension movement which includes Triplett's bar-ring magnet. Makes current measurements



from 20 nanoamperes, voltage measurements from 5 millivolts. 20,000 ohm-per-volt ac sensitivity, ±1½% dc accuracy, ±3% ac accuracy.

Circle 57 on reader's service card

AUTO SPEAKER REAR-SEAT KITS, 11 models from Oxford Transducer, designed for solderless installation. Feature heavy-gage plastic-coated wire, chrome-plated hardware, moisture-resistant switches and controls. *Custom Series* has impedance of 10–20–40 ohms, 5 models. *Deluxe Series,* 4 models, impedance of 8 ohms, 3-position switches (*Custom* and *Deluxe* have special model for Impalas and convertibles). Standard series, 2 models, 6 x 9 speaker and 5 x 7-in. size, 8-ohm impedance.

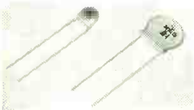
Circle 58 on reader's service card

AMPLIFIER AND TRANSDUCER SET (from Edmund Scientific) designed for variety of electronic, vibratory, light and sound tests and measurements, includes amplifier in pen-like housing and 8 basic probes: crystal diode, 3 attenuators, vibration pickup, tape head, inductive and photovoltaic pickups, also earphone and miniature dynamic microphone. Amplifier may be used alone, or

output can be fed to earpiece, or voltmeter. Amplifier powered by 1.5-v Penlite battery. Case measures 10¾ x 7½ x 1½ in.

Circle 59 on reader's service card

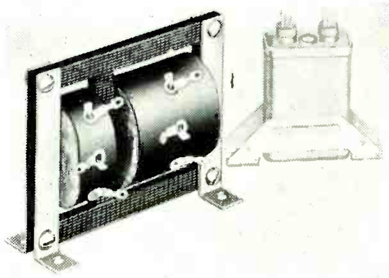
FLAT-BOTTOM DISC CAPACITORS for circuit-board mounting (applications up to 500 volts), from the Hi-Q Div. of Aerovox Corp., prevent rock 'n



roil on printed circuit boards, eliminate electrode exposure encountered with bare-bottom discs, permit lower circuit-board height without kinked leads. Long or short lead lengths.

Circle 60 on reader's service card

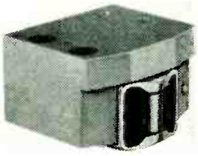
CONSTANT-VOLTAGE TRANSFORMER for 2.5–7.5-volt-ampere requirements has been added to the O.E.M. line by Neshaminy Transformer Corp. 3¼ x 2½ x 1¼ in.; can provide from



6.3 to 118 volts. Normal input voltage: 118 volts ac, 60 cycles. Output constant within ± 1% rms with input-voltage fluctuations from 95 to 130 volts.

Circle 61 on reader's service card

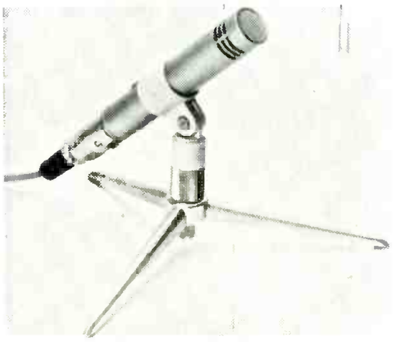
TAPE HEADS AND ADAPTER MOUNTS, Nortronics *QK 76 Quik-Kit*, replacements for heads on Ampex pro-



fessional recorders. Adaptable to shield cups of Ampex head nests with one-time use of Quik-Kit. Rapid changeover of track styles on Ampex 300, 350, 351, 400, 3,000 and 3,200 series tape recorders.

Circle 62 on reader's service card

LINEAR-ADMITTANCE CARDIOID MIKE, the *Neumann U-64,* distributed by Gotham Audio Corp. Frequency response from angles of sound-pickup great as ± 135° from on-axis incidence.



This condenser mike includes amplifier using 7586 nuvistor; built-in switchable 10-db overload protection; foam-rubber anti-pop screen. Interconnect cable between U-64 mike and power supply uses 5-pin Cannon XLR connectors. Audio output is 3-pin XLR; mating connector and swivel microphone stand mount. Matte-satin chrome finish.

Circle 63 on reader's service card

TEMPERATURE AND ELECTRICAL TESTER, *model 255* includes vom functions of Simpson's *260* plus addition of temperature range package of

+ 100° to + 1050°F. With ac clamp-on adapter, currents through 250 amps can be checked without disconnecting leads. With test leads and prods, 5-ft thermocouple lead and operator's manual.

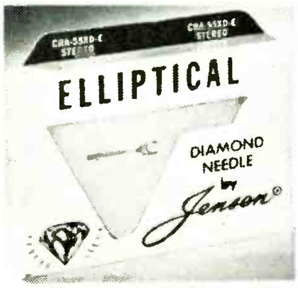
Circle 64 on reader's service card

GHOST-KILLING ANTENNA, the Channel Master *Coloray* for metropolitan

TV, FM and FM stereo, has transposed phasing harness with impedance-balancing power equalizer circuit which kills ghost images and provides higher front-to-back ratios than 10-element Yagis cut to each specific channel. FM gain higher than turnstile type units. 23-in. crossarm; no external power required; matched for direct connection to standard 300-ohm receiver input; EPC gold coating.

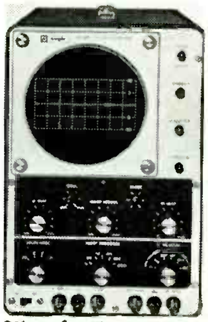
Circle 65 on reader's service card

JENSEN INDUSTRIES has introduced 36 types of elliptical diamond needles to equip most hi-fi sets, particu-



larly recent models of phonographs with lightweight force of less than 6 grams on record grooves.

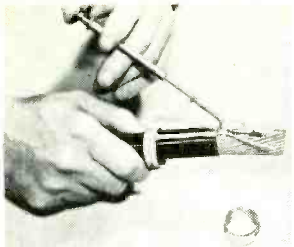
Circle 66 on reader's service card



WIDE-BAND SCOPE KIT, *KG-635,* from Allied Radio. **Vertical** sensitivity: 17 mv rms per in. Response: ±1.5 db, dc to 5.2 mc. Overshoot less than 6%. Rise time 70 nanoseconds. Input impedance: 3 megohms shunted by 35 pf. Attenuator: frequency-compensated and calibrated .05, .5, 5 and 50 volts peak-to-peak per in. **Horizontal** sensitivity: 0.6 volt rms per in. Response: ±1.5 db, 1 cycle to 400 kc. Expansion 2 times. Inputs: internal time base, 60 cycles phase-controlled, and external. Input impedance 7 megohms shunted by 25 pf. Linear time-base ranges: (5) 10–100 cycles; 100–1,000; 1–10 kc; 10–90 kc; 90–400 kc. Synchronization: "+" internal, "−" internal, 60 cycles and external. Locks from waveform fundamentals up to 5 mc, will sync on display amplitudes as low as 0.1 in. Line synchronization: phase-variable. Calibration voltage available at front panel jack. Accelerating potential: 1,650 volts. Z axis input impedance: 1 megohm. 10 tubes plus CRT and 2 rectifiers. 11⅞ x 7⅞ x 15⅝ in., 25 lb. Power: 110–130 volts, 50–60 cycle ac.

Circle 67 on reader's service card

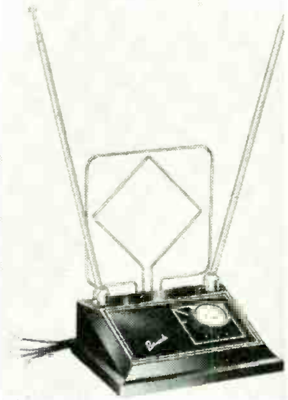
EXTRACTOR TOOL FOR SHIELDED CABLE from Thomas & Betts Co., Plunger type device extracts center conductor. Available in 5 sizes which accommodate shield diameters of .055 in. through 0.248 in. Color-coded. After stripping insulation and flaring



braid, conductor tube slips over insulated wire until desired breakout point. With braid held firmly, wire is bent down and plunger is pushed, extracting lead from braid.

Circle 68 on reader's service card

UHF-VHF INDOOR ANTENNA, *series 66* from Brach Mfg. for black-and-white and color TV reception. *Model 6651* in chromate gold finish; *model 6652*



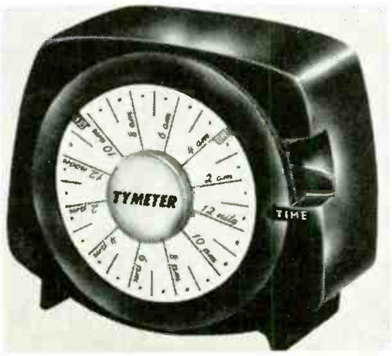
in chrome finish. Has elements with individually spring-loaded ball sockets for complete pivoting in critical signal areas.

Circle 69 on reader's service card

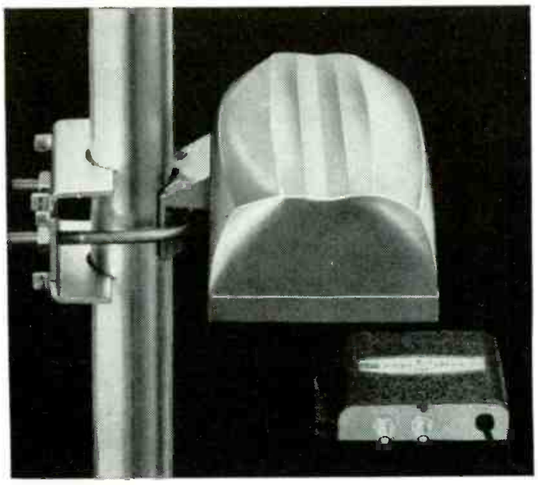
TRANSISTOR WALKIE-TALKIE, *model RA-731* from Olson Electronics. Battery meter built into front panel. 45-in. telescoping antenna. Push-to-talk button and on–off volume switch on side of black wrinkle enamel case. Operates on 8 standard penlight batteries. Includes carrying strap and batteries.

Circle 70 on reader's service card

ALL-PURPOSE TYMETER, *APT-65* from Pennwood Numechron turns



"A professional quality TV system priced for the home?"



"Try this!"

"I understand that professional TV systems use 75 ohm coax."
"That's right. Because coax minimizes interference and ghosting."
"How's that?"
"It's shielded—doesn't pick up noise. Also, it's unaffected by changing weather conditions. With 300 ohm twinlead, moisture can play havoc with the signal."
"So, that's it."
"What's more, you can feed coax thru all types of surfaces, even near metal, without interfering with performance."
"I'd like to have a system with TV outlets all over the house—bedrooms, kitchen and patio."
"The new two-transistor Blonder-Tongue Vamp 2-75 is easy to install and it can deliver sharp, clear pictures to as many as 8 TV outlets."
"Sounds real professional. What about the cost?"
"The rugged, weatherproof amplifier with remote power supply lists for only $44.95."
"I'm on my way to my dealer."

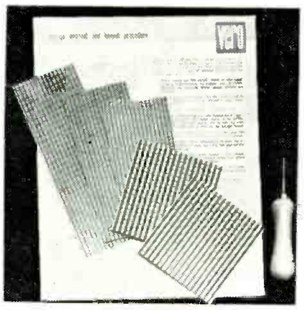
(This message was paid for out of the gross profits of **BLONDER-TONGUE,** 9 Alling St., Newark 2, N.J.)

Circle 112 on reader's service card

lights and appliances on and off. Time range: minimum ON time, 15 mins; minimum OFF, 1 hr; maximum ON time, 23 hr; maximum OFF, 23 hr and 45 min. 5 x 4 x 2½ in., 2 lb, 6-ft cord.

Circle 71 on reader's service card

BREADBOARD KIT *model BK-6* from Vero Electronics, has 6 assorted Veroboard universal wiring boards, Vero spot face cutter and complete instructions on designing component layout directly on wiring board.

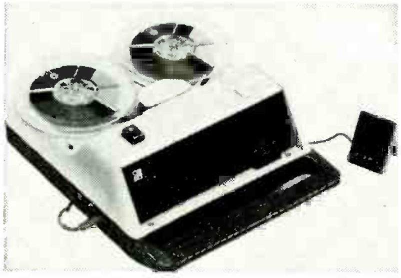


Circle 72 on reader's service card

SUPPRESSKITS, *types SK-10, -20* and *-30,* from Sprague Electric, each specifically designed for installation in Chrysler, Ford and General Motors vehicles having alternator electrical supply systems. Include L-C networks and heavy-duty Thru-pass capacitors to handle the hash and eliminate whine caused by alternator output. Effective interference suppression through 400 mc.—

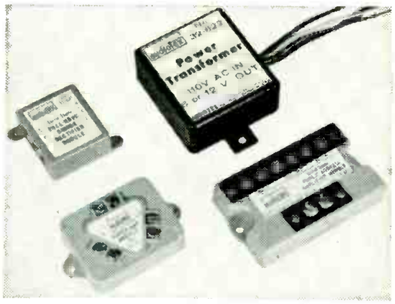
Circle 73 on reader's service card

TAPE RECORDER, Sony Superscope *model 135,* dual-track, monophonic. Power 117 volts, 60 cycles. Speeds 3¾ and 1⅞ ips. Response: 90–9,500 cycles at 3¾. Signal-to-noise better than 40 db. Flutter and wow less than 0.3%. No level indication required. One mike, one auxiliary input. Monitor headset output. 9½ x 11 x 5½ in., 7¾ lb. 5-in. reel capacity, tube amplifier.



Circle 74 on reader's service card

SOLID-STATE MODULES, *Home Electronics,* (Audiotex), consist of 12 compatible modules including several amplifiers, a preamp, code oscillator, flasher, power supply, etc.

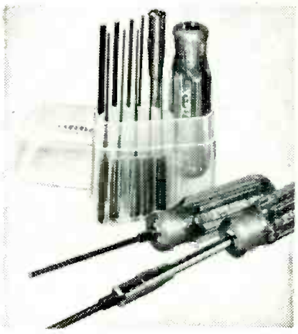


Circle 75 on reader's service card

UNDER-DASH REVERBERATION UNIT, *Stereo Magic,* from the Tenna Corp., is 1⅞ x 9 x 4 in. 3 models: *RR-13-R* has 6 x 9 in. speaker; *RR-14-R* with special 6-in. round speaker for convertibles and *RR-15-R* without a speaker for cars already equipped with speaker. Chrome with brushed aluminum and wood grain finish.

Circle 76 on reader's service card

COMPACT BRISTOL MULTIPLE-SPLINE SCREWDRIVER SET *99PS-60,* from Xcelite, consists of regular-size 4⅛-in. screwdriver handle, 9 interchangeable 4-in. Bristol multiple-spline blades with major diameters from .048 to 0.183 in. and 4-in. extension shaft. Handle and extension feature new positive locking device. END



Circle 77 on reader's service card

NEW LITERATURE

All booklets, catalogs, charts, data sheets and other literature listed here are free for the asking (except where a price is given). Each item is identified by a Reader's Service number. Turn to the Reader's Service Card facing page 72 and circle the number of items you want. Then detach and mail the card. No postage required!

NEW COMMERCIAL COMPONENTS CATALOG, *Amphenol Connector Div. No. CC-1.* 68 pages, looseleaf-punched; photos, diagrams and specs on relay plugs and sockets, microphone connectors, 110- and 125-volt plugs and receptacles, rack and panel units, printed-circuit connectors, miniature power connectors and hermetic seal units.

Circle 78 on reader's service card

BROCHURE, The Open Door to TV Profits, describes Windsor Electronics' television picture-tube rebuilding equipment, which will rebuild black-and-white, bonded-face and color cathode-ray tubes. 16 pages, photos.

Circle 79 on reader's service card

COMMERCIAL TV ANTENNAS, TACO *Catalog No. 610.* 6-page foldout, drawings and callouts, specs on 5-, 8- and 10-element ruggedized Yagi antennas, and cylindrical parabola antennas.

Circle 80 on reader's service card

PAMPHLET, *Some Plain Talk from Kodak About Sound Recording Tape,* 24 pages, many photos, explains: difference between low-print, general-purpose and high-output tapes; how bias settings affect overall performance; how tape-surface smoothness relates to high-frequency response; what torture tests tell about break strength.

Circle 81 on reader's service card

COMPACTRON FOLDER, *ETG-3980.* 4-page folder gives information on General Electric's space-saving compactrons for small TV units, including operation, mounting versatility and other application details, plus comparison with typical complement of conventional tubes, transistors or diodes needed for "tiny vision" sets.

Circle 82 on reader's service card

SOLDERING BULLETIN, *TR 1014,* illustrated, 5 pages, from Alpha Metals, discusses four major considerations: properties of joints, selection of materials, geometric design of the soldered connections, determination of production methods.

Circle 83 on reader's service card

DESIGN AID BROCHURE, *RF and Microwave Dielectric Heating System Design Parameters,* from the Industrial Applications Lab of Eitel-McCullough, contains: means of generating rf power at microwave and lower frequencies; means of coupling rf fields to material to be processed; detailed information on parameters of materials such as dielectric constants, loss constants.

Circle 84 on reader's service card

BOOKLET, *What's This Stuff?,* describes the Photo/Phonic School (audio-visual courses on how to use a still or movie camera to tell a story) of National Camera. An adjunct to their camera-repair correspondence course.

Circle 85 on reader's service card

FERROXCUBE ENGINEER, Vol. 7, No. 2, has features on designing linear transformers, digital recording heads and light-dependent resistors. 8 pages, looseleaf-punched.

Circle 86 on reader's service card

DATA SHEET *TM-103* gives specs and block diagram of Philco's model 351A Solid-State Tracking Signal Generator, which covers 10 kc to 15 mc.

Circle 87 on reader's service card

FASTENER CATALOG, *No. 65,* 100 pages, punched, illustrated of Active Screw & Mfg. Co.'s line of: hexagon-head cap, lag, machine, metallic drive, set, tapping, thread-cutting and wood screws; carriage and machine bolts, inserts, lock nuts, nylon fasteners, retaining rings, sems, spring pins, thread-utting sems, flat washers.

Circle 88 on reader's service card

TV ELECTROLYTIC-CAPACITOR REPLACEMENT GUIDE, form No. AFG-465, pocket-size, 82 pages. Lists replacements for every American make from Admiral to Zenith, 1948 to early 1965, color and black-and-white, without gaps or missing series. Send 50¢ to Aerovox Corp. (Dist. Div.), 740 Belleville Ave., New Bedford, Mass. END

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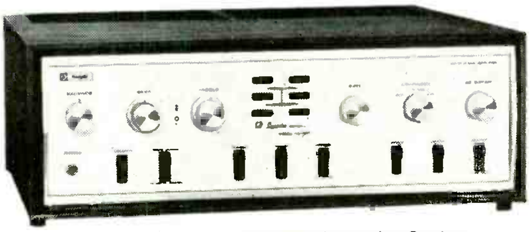
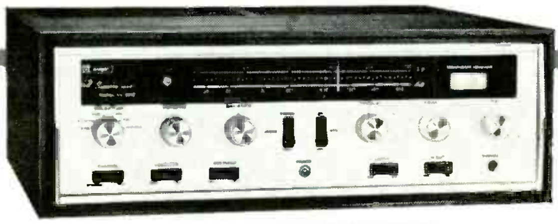
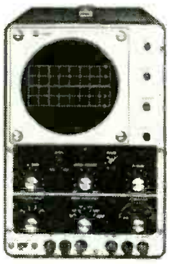


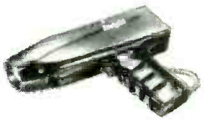
KG-895 Superba Series 120-Watt Solid-State Stereo Amplifier Kit. $149.95



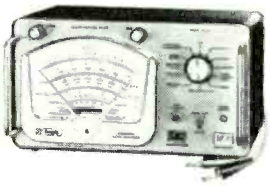
KG-964 Superba Series 64-Watt Solid-State FM-AM Stereo Receiver Kit. $189.95



KG-635 5-Inch DC to 5.2 Mc Wide-band Oscilloscope Kit. $99.95



KG-371 Solid-State Auto DC Power Timing Light Kit. $19.95

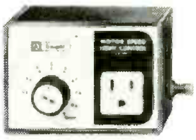


KG-375 Solid-State Universal Auto Analyzer Kit. $49.95

Safari-I Deluxe 23-Channel Citizens Band Transceiver Kit. $129.95

C-540 Low-Cost 5-Watt Citizens Band Transceiver Kit. $49.95

KG-221 FM Monitor Receiver Kit (police, fire, marine, weather bands, etc.) $39.95



KG-201 Solid-State Motor-Speed/Light Control Kit. $9.95

KG-415 Superba Series Professional Solid-State Stereo Tape Deck Kit. $249.95

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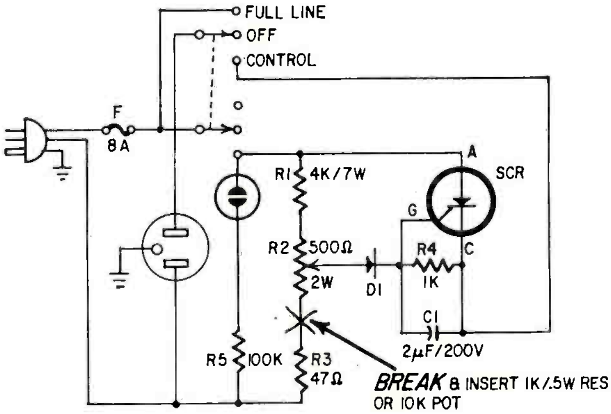
Circle 115 on reader's service card

TECHNOTES

HEATH GD-973 SCR SPEED CONTROL

This unit was found to have a very limited speed-control range. The speed control functioned only over about 10° of rotation and speed was unaffected over the remaining 350°. The trouble seemed to be a silicon controlled rectifier with very low gate sensitivity. To overcome this defect, I increased



the value of resistor R3 from 47 to 1,000 ohms. This increased the gate voltage, thereby increasing the speed control range.

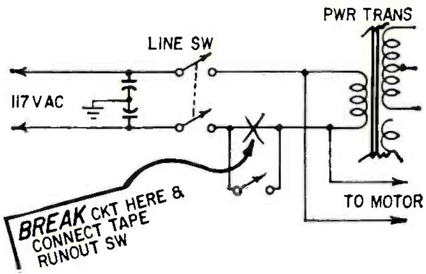
If the unit is to be used with several devices having different power requirements or in areas where the line voltage varies, I would recommend that a 10,000-ohm potentiometer be inserted in series with R3 to vary the control range more easily.—*Sol Libes*

GRUNDIG MONO RECORDER TK14

Symptom: Record and playback OK, level-indicator tube does not show record level.

Fault: Bare jumper between pins 9 and 7 on level-indicator socket shorting to pin 8.

Cure: Insulate jumper. Be careful not to alter the position of the level-indicator while doing this—adjustment is difficult. The tube must line up correctly with the slot in the cover panel. To remove the cover panel, hold all the function keys down on both sides about halfway. This will allow the plate to slip off easily.—*Steve P. Dow*



KORTING 158 AND 158S STEREO RECORDER

The Korting 158 and 158S recorders are equipped with an automatic limit switch which stops the motor on play or record when the tape runs out. It opens the common lead in the synchronous-motor feed circuit from the secondary of the power transformer. Rewiring the switch as shown in the diagram will allow the automatic limit switch to turn the entire machine off when the tape runs out. The leads going to the switch should be dressed away from all audio circuits. Follow the same wiring path that the original leads took to the switch from the power transformer. Don't forget to connect the original leads together after removing them from the limit switch.

The mechanism bypasses the automatic shutoff if the tape is being wound fast in either direction. When the stop button is pressed, that bypass interlock switch is reset, allowing the unit to warm up while tape is being loaded.—*Steve P. Dow*

SAFE WAY TO KILL HORIZONTAL "HASH" DURING TV ALIGNMENT

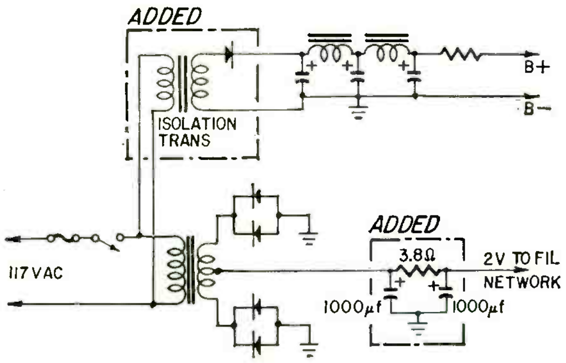
It is usually necessary to disable the horizontal sweep when aligning TV tuners or i.f. strips, to eliminate "hash" from the response curve trace. Pulling the horizontal output tube or fuse reduces B-plus loading enough to affect the alignment, and pulling the horizontal oscillator overheats the output tube.

Try pulling the horizontal *oscillator* tube after applying a negative bias to the horizontal *output* tube grid. You can make up a bias box in minutes with a 45-volt battery and a potentiometer.—*Glen H. Bryant*

OLD G-E 250 RADIO GETS A NEW POWER SUPPLY

This three-way set had been dead and forgotten for years when the owner decided to have it looked at. I found it needed a new 2-volt wet battery, synchronous vibrator and buffer capacitor. The owner said he didn't want the portable feature any more—just ac operation. That still required the vibrator, because B-plus came from the vibrator transformer and was rectified by the synchronous vibrator.

I decided to eliminate the vibrator supply, and installed



a new isolation transformer with a selenium rectifier for B-plus. The filament supply was retained, but I added some filtering as shown in the diagram.

The modified set worked very well, and the owner was especially pleased that the hum he remembered was gone. Cost of the new parts was less than that of replacing the old ones, and the new supply will need almost no maintenance.—*Paul B. Lavallee*

THE TV UPSTAIRS

Seems like the reason I stick to this business is I never know what I'm going to run into on a service call.

I get a call from this fellow and it's not his set he wants fixed, it's his neighbor's upstairs. We go upstairs and the neighbor lets us in. He's got a RCA KCS-68-C chassis. The set plays just fine, sometimes an hour, sometimes 2 hours, sometimes all night. When it goes off, the raster disappears, the fellow gets up, does a little Indian rain dance on the floor, and the raster reappears. Well, the downstairs neighbor has lost a lot of sleep over this and has agreed to have the set fixed if the fellow will stop stamping on his ceiling.

I took the back off and, when the raster was off, I found plenty of high voltage on the top cap of the 1B3 but no rectified high voltage. With the lights in the room off I looked for the filament glow in the 1B3. There was none. But just then I saw some arcing underneath the socket. I shut the set off and examined the socket. There was a fracture in the solder joint that connects the rectifier winding to the 1B3 socket. I resoldered the joint and went away, leaving everyone smiling.—*Sid Elliot*

REVERSED-POLARITY ELECTROLYTICS IN FORD RADIOS

Two 1962 and 1963 Ford Radios (models 2TBO and 3TBO) were in the shop with the same complaint: oscillations and motorboating. The same repair cured both.

In the rf amplifier (Fig. 1) and the first audio stage (Fig. 2), sections A and B of C2 are both connected the

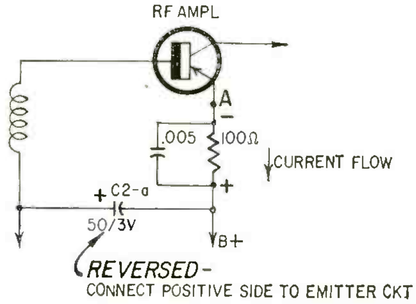


Fig.1

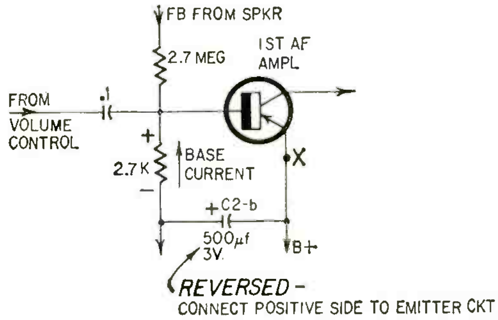


Fig.2

wrong way. I found this in both receivers and I assume it is so in all because Bendix service literature shows the capacitor hooked up with the wrong polarity.

Because the dual capacitor has the negative lead common to both sections, one at least has to be replaced. I replaced the 50-μf section. I re-formed the 500-μf, 3-volt unit and it checked OK. The lead from C2-A should be clipped.

The problem does not arise immediately because the low reverse voltages do not ruin the electrolytics for quite some time.—*James R. Giles*

LESSON WITH RELUCTANCE

I whipped the little foreign car around another tight corner. No use: the siren came closer. Another block and a red light glared as a gruff voice yelled "Pull it over!" I did, dreading what I knew would come. "Follow us!" and I did. They ran away from me. After all, a Volkswagen can't beat a police cruiser. But I was pretty close when we got to the police station. Grabbing my kit, I rushed inside. A burly cop shoved me into an inner room.

On the desk sat the remote control unit for the police radio. "Fix it!" said the cop.

"What's the matter?"

"It won't talk!"

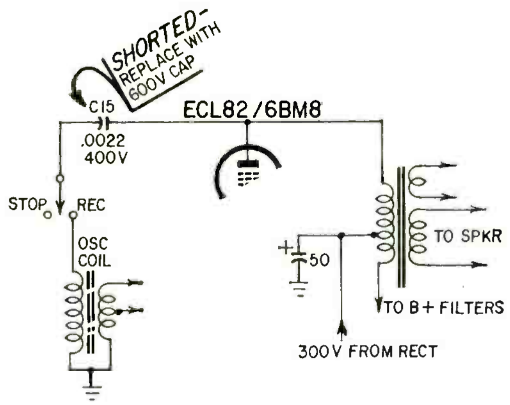
Picking up the mike, I spoke the magic words: "City PD testing, 1, 2, 3, 4." The db meter barely moved. Cranked up the mike gain control. No soap.

On the way to the shop, I thought, "This is a variable-reluctance mike. I've got a replacement cartridge for it. Or have I? The one on the shelf's not in a box! Golly, maybe it's an old one! Have to test it and see."

In the shop—eee-gad! All benches full! Audio signal tracer out of order! *Now* you remember it! What to do? Hey! TV set on bench, disassembled; sound still good, even if nothing else works. Ah-ha. Connect mike to sound input, use audio amplifier stage for audio signal tracer. Smart idea, there, boy. Good thinking.

Take out cartridge of mike. Clip it to top of volume control and chassis. Now blow in it. Hm. No blow. Bad. Try new (?) one. Oops. No blow there either! Now you're up the creek, smart alec! Think. Turn the volume down on TV, so the sound won't bother you. There. Hey! Where's that sound coming from? The mike? Oh, yes, the mike's still hooked across the volume control, and any mike will act as a speaker. Hey, wait a minute. This is the "new" cartridge, and it sounds clear, and pretty loud. Try the old one. Hmm. Very weak, distorted; try new one again. Loud and clear. Hooray.

Back in the shop, after putting the police back on the air. Remember, knucklehead, from now on, that you can test about any kind of microphone except a carbon or a ribbon (velocity) type, by feeding a low-level audio signal into it and listening, just as well as hooking it to an amplifier and talking into it.—*Jack Darr*



NORELCO/PHILIPS 300 (EL 3542A)

Symptom: No recording. Playback OK. When recording button is depressed, level-indicator tube extinguishes. Hum in speaker.

Trouble: C15, a .0022-µf bias coupling capacitor, is shorted, grounding plate 6BM8 through oscillator coil. This shorts the B-plus feeder through the output transformer and kills the voltage to indicator tube, causing hum in speaker. Replace with 600-volt capacitor.—*Steve P. Dow*

G-E M3 AND OTHER SETS WITH HORIZONTAL MULTIVIBRATOR

Symptoms: Off channel, the set had a normal bright raster with the usual noise. When the tuner was turned to an active channel, the horizontal sweep would collapse with loss of brightness and then complete loss of high voltage at the CRT anode. The audio remained normal at all times. When the tuner was turned off channel, the raster would return with good brightness.

The trouble turned out to be a shorted diode in one section of the germanium phase detector. Due to the biasing in this circuit, the oscillator ran near to normal frequency when no sync pulses were present; but when a video signal was applied, the sync pulses biased the oscillator so that the frequency was out of range of the horizontal output transformer.—*Fred W. Rodey*

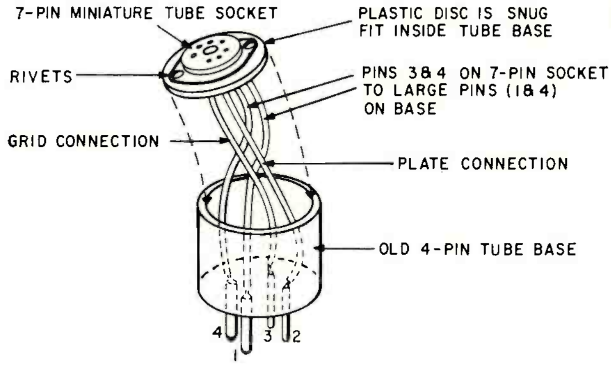
END

TRY THIS ONE

MODERN TUBES FOR ANTIQUE RADIOS

Briefly, the antiquer the radio, the unavailabler the tube. If you want to restore antique sets to working order, you will have to use modern tubes, but if you modify the sockets or wiring you destroy the radio's value as an antique.

Here is a way to make adapters that fit seven-pin miniature tubes to old four-pin sockets.



Get a base from an old four-pin tube, remove it and clean out the old wires and glue. Cut a disc of Micarta to a snug fit inside the old base. Then cut a ⅝-inch hole in the center of the Micarta disc to take a seven-pin miniature-tube socket (which can be a ring-mount type, or fastened with rivets). Now solder short wires from the seven-pin tube's plate, grid, heater and cathode terminals to the corresponding pins of the four-pin base. Consult a tube manual for base connections.

For example, to replace a 201-A with a 6AB4, wire pins 3 and 4 of the 6AB4 socket (the heater) to pins 1 and 4 (the large ones) of the four-prong base. Run a jumper at the seven-pin socket from the 6AB4 cathode terminal (pin 7) to whichever heater (filament) terminal is negative in the antique set. The 6AB4 grid (pin 6) goes to pin 3 on the four-pronger, and the plate (pin 1) to pin 2.

In many old sets, regeneration was controlled by the filament rheostat. If a converted antique is to be operated on ac, it is best to use a pot to control the plate voltage instead.—*Robert E. Flanagan*

USE YOUR VOLT-OHM-MILLIAMMETER TO SET IGNITION DWELL ANGLE

Many readers of RADIO-ELECTRONICS tune up their own cars. Those of you who don't own a dwell-angle meter may wish you did. It so happens that you already have a pretty fair dwell-angle indicator but never realized it—your vom. Here's how to use it to indicate point dwell:

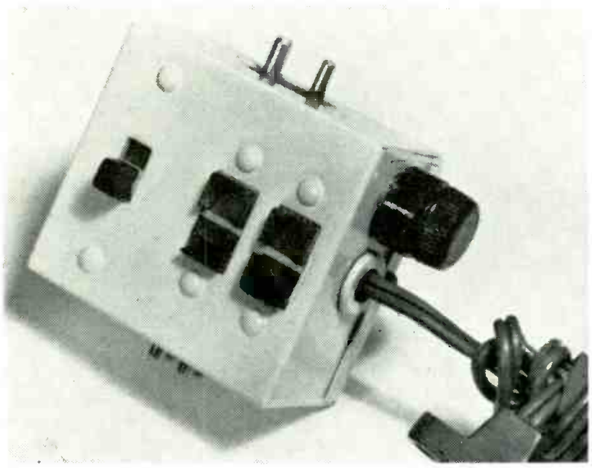
1. Disconnect the low-tension lead from distributor breaker points to the coil primary.

2. Zero your vom on any of its ohm ranges.

3. Connect the ohmeter leads between ground and the disconnected breaker-point lead. Use the starter to crank the engine and read the meter.

4. The meter will read, as a percentage of full scale, the percentage of time the breaker points are closed. Read a dc voltage (not ohms) scale to determine this percentage. For example, a 6.66-volt reading on a 10-volt scale (or an 8-volt reading on a 12-volt scale) means the points are closed two-thirds of the time. This means that the dwell angle would be 30° for an 8-cylinder car or 40° for a 6-cylinder car. The relationship between meter reading and dwell angle is expressed by the formula $D = \frac{360R}{N \times S}$ where R = meter reading in volts, D = dwell angle in degrees, N = number of cylinders, S = meter range you're using (dc volts).—*James G. Barr*

FUSE YOUR CHEATER BOX



After blowing fuses in a customer's home, I decided it would be less embarrassing to blow my own. So I installed a bayonet type cartridge-fuse holder in my Sencore cheater box (photo). A 3-amp fuse serves me well.—*William Cotton*

MAKE YOUR OWN CLOSE-TOLERANCE RESISTORS

When you need a 1% resistor, you can make one to the exact value you need with an ordinary 5% or 10% carbon resistor, a hot soldering iron and a Wheatstone bridge.

Since resistance of a carbon resistor increases when it is heated, choose a resistor lower in value than the one desired. Connect it to the bridge. Heat it by applying the soldering iron directly to the body, then allow it to cool. Check it on the bridge. By repeating this heating and cooling cycle a few times, you will push the resistance to the desired value.

I have made close-tolerance resistors this way whose accuracy is near the accuracy of the bridge.

This method is far superior to filing the resistor, since dirt and moisture cannot get to the carbon. Contamination will change the value of filed resistors quickly.

After you hit the right resistance, slip a piece of spaghetti over the body of the resistor and ink the new value on it so that others aren't led astray by the color bands.—*R. C. Apperson, Jr.* END

NEWS FROM THE SWINDLE DEPT.

Our bid for a little criminal thinking ("A Tube with a Sense of Time?", July, p. 64) was received with enthusiasm by our readers. We had asked for suggestions on ways to make a tube in a television set fail predictably about 48 hours after being installed, as some sharpie swindlers had apparently managed to do. A few readers suggested conventional timing devices (even washing-machine timers), but these are all obviously impractical, since any large, conspicuous (and quite probably ticking) device would arouse the set-owner's suspicion.

Reader James Morall of Brooklyn, N. Y., wrote us that, from his experience, the most likely prospect for such a gimmick is a tube with an octal base, since such a base is usually prone to poor solder connections between base pins and element leads.

He experimented with a set that used a 6K6-GT as vertical output stage. "I removed all solder from pin 3 [the plate] so that the wire did not make contact, placed the tube back in the set and made sure vertical sweep was out.

"A mothflake [paradichlorobenzene] was pulverized and tediously packed into the pin-3 sleeve. The pressure forced the wire to make good contact with the sleeve. Warm air . . . causes a very slow evaporation of the powdered crystal, reducing the pressure on the inner wire forced against the sleeve.

"With this system, vertical sweep was lost after 57 hours; the set was on for 15. It seems that with precise powder measurements, packing, and varied chemical mixtures, a break may be controlled from . . . 48 hours to 30 days."

Frank Salerno, known to many RADIO-ELECTRONICS readers for his TV-service cartoons, wrote us this:

"Getting electronic equipment to fail by prearrangement is really very simple if we remember certain electromedical theories. In the case of the TV sets that were rigged to conk out after 48 hours, I'm sure the perpetrators utilized the 24-hour virus principle. After stacking two virus germs in series, one can use a sensing device to detect the demise of the germs and then use the detected signal (after amplification) to disable any given tube. (Of course, it is most expedient to disable a relatively inexpensive tube to keep the cost of the operation down.)

"The possibilities of such a system are almost limitless. Any number of 24-hour periods can be arranged by stacking the appropriate number of virus germs—the main difficulty lying in getting large numbers of germs to cooperate. Experiments have shown that when the number exceeds five the germs tend to break rank and wander about, sometimes forming parallel combinations and upsetting the timing system. Scientists are now working with a foreign strain of virus (discovered quite by accident on a banana stalk) that promises greater predictability in such timing circuits." END

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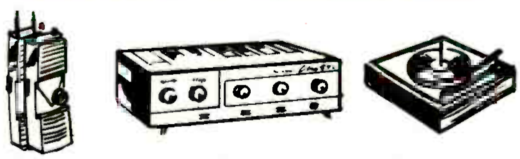

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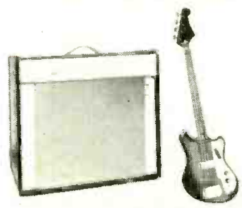
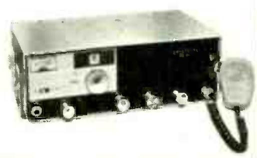


New! 25-Channel, Solid-State C.B. Transceiver Model HB-600



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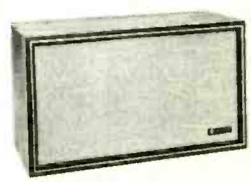

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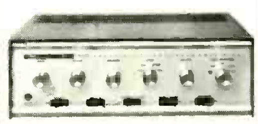

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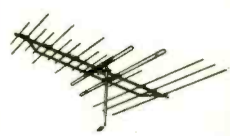

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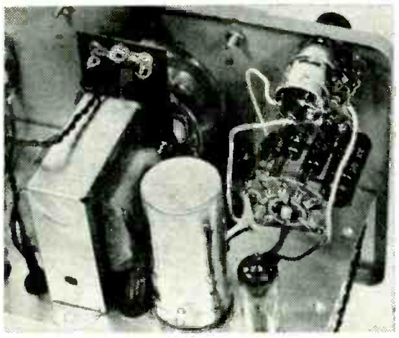
NOTEWORTHY CIRCUITS

CONTINUOUS TUNING FOR HEATH IG-72

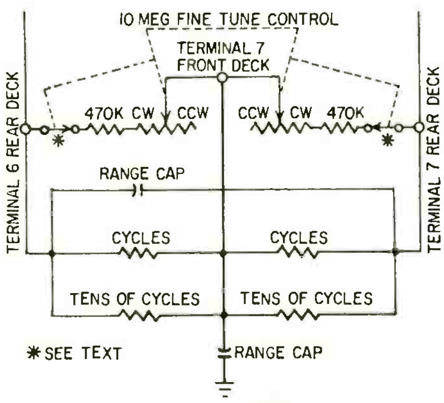
The Heathkit IG-72 audio signal generator is a most attractive instrument because of its low distortion, metered output, eight-position output attenuator and low cost. The switch type frequency selectors provide accurate settings with rapid resetability, but they have a serious drawback when the generator must be adjusted exactly to the resonant frequency of a circuit or when it must be tuned to an exact multiple or submultiple of an unknown for comparison by Lissajous figures.



A simple modification, costing about $3, permits adjusting the IG-72 to any frequency within its basic range of 10 cycles to 100 kc. The frequency selector switch for "10's of cycles" varies each of the two resistors of a bridged-T circuit from 100,000 to 10,000 ohms as the frequency is increased over a 10-to-1 range in 10 steps. In effect, the CYCLES switch shunts each of these with one of 10 resistances which range from approximately 100,000 ohms to 1 megohm.

The modification to the generator (see diagram) simply consists of a dual 10-megohm variable resistor shunting these resistors to adjust the generator to those frequencies which are skipped over by the CYCLES switch. A dpst switch (optional) isolates this fine-tuning control from the circuit when not in use. If the switch is not incorporated, the control may be turned fully counterclockwise (10-megohm position) to minimize its effect on calibration. The switch is not really necessary, since it removes only a very small error (1% maximum) remaining after the control has been turned fully counterclockwise. Each section of the dual control is in series with a 470,000-ohm resistor which is the lower limit of shunting resistance. The ratio from maximum to minimum is thus greater than 10 to 1, which provides a needed overlap between positions of the CYCLES switch.

The control was assembled from IRC PQ11-143 and M11-143 sections and a type 76-2 switch. I mounted it just above the multiplier switch (see photo). The two wipers are connected to terminal 7 on the front deck of the multiplier switch. The clockwise control terminals



← Circle 125 on reader's service card

Circle 127 on reader's service card

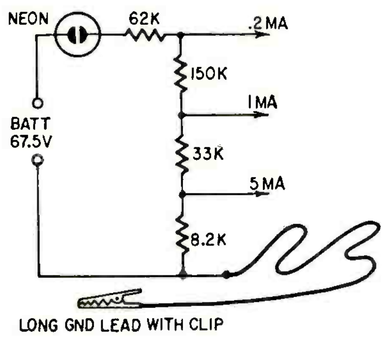
are connected to 470,000-ohm resistors which are connected through the dual switch to terminals 6 and 7 on the rear deck of the multiplier switch.

This modification allows the generator to be adjusted for zero beat or stationary Lissajous figures at higher frequencies, and has greatly increased versatility without detracting from the original excellent performance.—*Glendon C. Smith*

LEAKAGE DETECTOR

Transformerless radios and phonographs, electric tools and many household electric appliances may develop leakage currents that can lead to a fatal shock. The simple leakage detector shown here was developed by Peter Lefferts of Carter-Princeton, and described in *Signalite Application News.*

The original model was assembled and cast in an epoxy block, with the three probes and the ground lead coming out one end. The glow lamp (Signalite type LT2-27-1) was recessed into the top of the block.



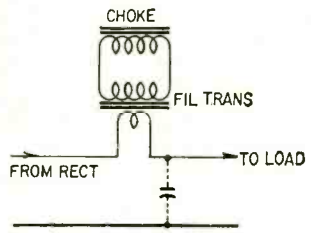
To use, clip the ground lead to a good ground or cold-water pipe and then touch the probes, one at a time, to the equipment being tested while watching to see if the indicator lights. Currents greater than 5 ma (rms) are dangerous and may prove fatal. Less than 0.1 ma is acceptable and less than 1 ma produces a slight shock. Currents from 1 to around 4 ma are borderline but every effort should be made to greatly reduce or completely eliminate them.

LOW-INDUCTANCE HIGH-CURRENT CHOKES

Low-voltage power supplies and ac power-source filters often use chokes with inductance measured in fractions of a henry, together with current ratings measured in amperes.

Such chokes are manufactured, but cost (as compared to more common varieties) is rather high. Fortunately, a simple method exists by which the common 8-henry 50-ma ac-dc choke may be made to serve the purpose.

The schematic shows the hookup. An inexpensive filament transformer is used in reverse, with its secondary connected as the low-inductance choke and its primary connected to the 8-henry unit. With a 6.3-volt transformer, resulting inductance will be *approximately* equal to .0029 times the choke inductance, or a little more than 23 millihenries. Alternating-current rating will be 18.6 times the rating of the choke, or 930 ma. The direct-current rating will be that of the filament-transformer secondary.



This hookup is now being used to provide the inductance for a 400-cycle low-pass filter in a bench power supply for testing aircraft instruments. The choke and transformer together cost less than a tenth as much as the low-inductance choke listed in the catalogs.

Inductance stepdown is equal to the secondary rated voltage, squared, divided by the primary rated voltage, also squared. Current stepup equals primary voltage divided by secondary voltage (neglecting transformer losses). For transformers other than the 6.3-volt unit, these ratios are:

SECONDARY VOLTS	INDUCTANCE RATIO	CURRENT RATIO
2.5	.00046	47
5	.0018	23.5
7.5	.0041	15.6
10	.0073	11.7
12.6	.0126	9.3
24	.0420	4.9

Why not try this circuit as a substitute for the high-current choke in your next battery charger or eliminator?—*Jim Kyle* END

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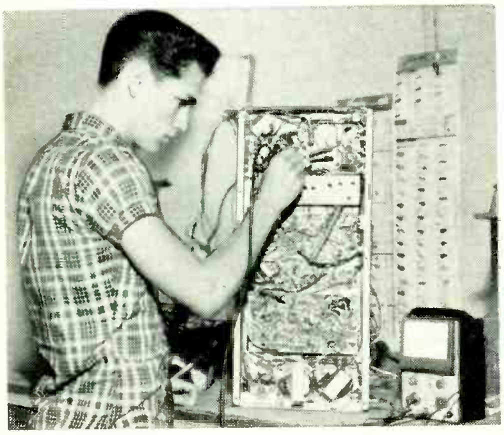

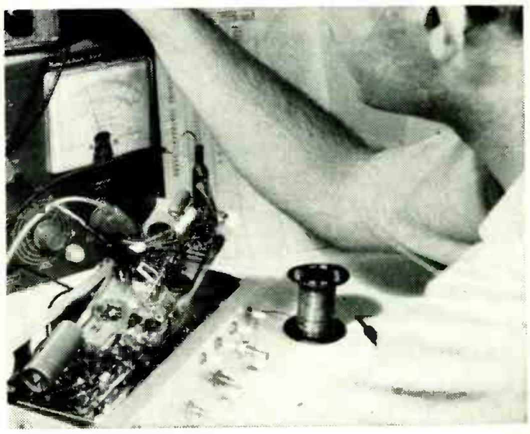

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Coax Isn't All *That* Great

Dear Editor:

After withstanding the test of time for two decades of television reception, 300-ohm ribbon lead, the venerable standby for antenna installations, is now being attacked as unsuitable for color reception. It is too easily affected by environment, reads the indictment. When wet, for example, it attenuates signal drastically compared to when it is dry. Worse than mere attenuation is the fact that impedance of the line is altered. The results are standing waves on the line and phase shift, which play havoc with color signals. Still worse, these effects are exaggerated by nearby metal, including the very iron-ring standoffs that support the flat lead-in. The only solution, the argument concludes, is to substitute coaxial cable.

Widespread acceptance of this position, which is based on a rather exaggerated presentation of what can happen when *one particular type* of ribbon lead is improperly installed, could lead to serious consequences. The fact that many people will be put to unnecessary trouble and expense is just one of these. Worse yet, *coax has it own drawbacks*. One of these could have a damaging effect on an important area of television growth.

Ribbon lead of high quality, still inexpensive compared to coax, overcomes most of the problems cited. Signal fields surrounding the conductors of an encapsulated 300-ohm line, for example, remain confined within the line, as is the case with coax. This avoids the "drastic changes" wrought by water, ice and metals. Using the wrong type of standoff or staple, or using them improperly, can impair the function of *any* transmission line. Those who condemn ribbon line and recommend coax are themselves careful to specify certain precautions in the handling and stapling of coax. Why they consider vulnerability to abuse reasonable in one type of line but unforgivable in another is never explained. As to standoffs (a good idea for any downlead), inexpensive ones are available with all-polyethylene heads that do not surround the line with metal rings.

Even so, one may question *how* harmful nearby metals, including standoff rings, *actually* are with good ribbon lead. A recent series of tests by Belden Manufacturing Co., which makes both coax and 300-ohm lead, is interesting. Identical signals were fed to identical lengths of RG59/U coax, 8285 encapsulated 300-ohm line in air and *8285 run through a metal pipe*. Signal in the pipe-enclosed line was attenuated somewhat compared to the same lead in air, but output was nevertheless higher than at the end of the coax cable. Line impedance was *not* drastically changed.

The matter of attenuation brings us to the serious but entirely unmentioned flaw in coax. Even in the low vhf band, *half* the signal sent down by the antenna can be consumed by coax before reaching the set, in a typical run. On uhf, of course, coax is impossible. In fact, few wire manufacturers even bother specifying losses above 400 mc. Toward the low end of the uhf band, signal loss will run about 9 db or more per 100 feet. Toward the high end of the band, with considerably shorter runs, attenuation can be great enough to negate the gain of the most sensitive uhf antennas now available. In other words, an elaborate outdoor array feeding through coax may deliver less signal to a TV set than a simple indoor bowtie or uhf loop at the receiver itself!

We have still to assess the matching transformers needed with coax, which involve more expense and more trouble. These, too, can introduce attenuation and mismatch at certain frequencies. When two are used—and most antennas will require one at each end of the coaxial line—the problem is multiplied. Again we return to the very color-degrading deviations we are trying to avoid.

The only remaining justification for choosing coax is the rare case of severe interference picked up primarily on the downlead. Coax is immune to that.

The outlook for *shielded* 300-ohm ribbon is good. Manufacturers are working on the problem today. Until it comes along, high-quality ribbon remains the obvious choice except for the rare interference problem. This is recommended by wire manufacturers who make both coax and 300-ohm lead.

JFD is in a similar position. We are proud of our matching transformers, antenna amplifiers, couplers and other accessories, and are pleased to sell them *when they are needed*. We see no point, however, in saddling a customer with a signal amplification and distribution system for his home that one would expect to find in a hotel, just to make up for deficiencies introduced by an artificial problem.

It does little good to condemn a time-tested type of antenna line categorically by an exaggerated presentation of problems that occur only with the least expensive, flat-ribbon members of its family. It does even less good to promote another type of line that may have more serious drawbacks.

EDWARD FINKEL
Vice President, Sales
JFD Electronics Corp.
Brooklyn, N.Y.

WHAT'S YOUR EQ?

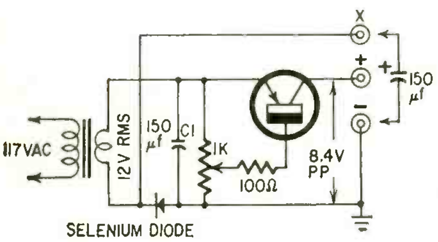
These are the answers. Puzzles are on page 61.

Will It Work?

Reverse-biasing Q1 makes emitter act like collector, and collector like emitter. Effectively, we now have an emitter follower, and an incoming positive or negative pulse produces an output positive or negative pulse respectively.

Note: This circuit is used as a digital inverter in an electrostatic printer capable of 15,625 characters per second.

Power-Supply Problem

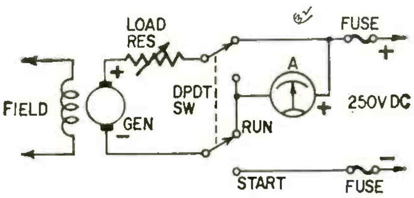


The capacitor is connected across the diode, permitting current flow in both directions. A sine wave will be present across C1 as long as the impedance of the external capacitor is as low as the forward resistance of the diode, which is comparatively high in a selenium diode.

When the external capacitor is 150 μf, the two capacitors form an ac voltage divider with equal legs. Consequently, 6 volts rms (16.9 p–p) is developed across each capacitor. The transistor is used as a nonlinear amplifier, and will cut off on alternate half-cycles, producing a half-wave output of about 8.4 volts p–p.

Two-Way Meter

The ammeter is connected as shown in the diagram.



Note: Overcurrent protection (fuses) should be provided in the 250-volt line. The neutral of such a system is ordinarily at ground potential. As the generator is still connected to one side of the dc line with switch in "run" position, an accidental ground on the negative lead of the generator would probably destroy the meter. END

50 Years Ago

In Gernsback Publications

In September, 1915

Electrical Experimenter

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BUILD THIS FASCINATING COLORGAN

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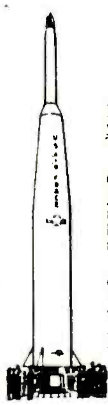

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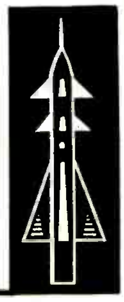

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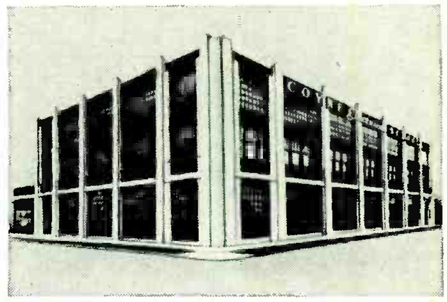

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01A	2.75
0A2	.90
0A3	.90
0A4G	1.55
0B2	.80
0B3	1.20
0C3	.85
0D3	.75
0G3	2.75
0Y4	1.20
0Z4	.95
1A3	1.95
1A5	1.49
1A6	1.49
1A7	1.95
1AB5	.75
1AD4	1.75
1AE4	1.30
1AF4	1.45
1AG4	2.20
1AH4	1.75
1AJ5	1.05
1AU3	1.25
1AX2	1.10
1AY2	.98
1B3	.97
1B4P	2.00
1C5	1.10
1C6	1.25
1D5GP	1.25
1D7	1.25
1DN5	.95
1E5GP	1.49
1E7	1.50
1F4	1.50
1F5	1.50
1F6	1.20
1G3	.97
1G4	1.75
1G6	1.50
1H4	1.50
1H5	1.19
1H6	1.25
1J3	.97
1J5	1.25
1J6	1.25
1K3	.97
1L4	.85
1L6	2.60
1LA4	1.95
1LA6	1.95
1LB4	2.49
1LC5	1.95
1LC6	1.95
1LD5	1.95
1LE3	1.95
1LG5	2.20
1LH4	2.69
1LN5	2.25
1N5	1.85
1P5	2.25
1Q5	1.95
1R4	.80
1R5	.99
1S2A	1.19
1S4	1.49
1S5	.99
1T4	.99
1TI	1.00
1U4	.99
1U5	.97
1V	1.85
1V2	.79
1X2B	1.10
1Z2	3.25
2A3	3.25
2A5	2.95
2A6	3.75
2A7	1.50
2AF4A	1.39
2AH2	1.19
2AS2	1.19
2AU2	.95
2AV2	.95
2B3	2.70
2B7	1.95
2BN4	.98
2CY5	1.15
2D21	.75
2DZ4	1.95
2EA5	1.45
2EN5	.83
2ER5	1.60
2FH5	1.40
2FQ5	1.95
2FS5	2.55
2FY5	1.49
2GK5	1.57
2GU5	1.69
2GW5	2.40
2HK5	.98
2X2	.60
2X2A	1.30
3A2	1.45
3A3	1.29
3A4	.74
3A5	1.25
3A8GT	1.25
3AF4	1.49
3AL5	.87
3AT2	1.25
3AU6	.50
3AV6	.68
3AW3	1.31
3B2	1.29
3B7	1.35
3BA6	.90
3BC5	.89
3BE6	.86
3BN4	1.18
3BN6	1.35
3BU8	1.27
3BY6	1.05
3BZ6	.90
3CB6	.85
3CE5	.89
3CF6	.98
3CS6	.95
3CY5	1.18
3D6	1.48

Type	Price
3DG4	1.35
3DK6	.92
3DT6	.79
3DZ4	1.59
3EH7	1.42
3EJ7	1.42
3ER5	1.35
3FH5	.95
3FS5	1.18
3GK5	1.55
3GS8	1.27
3GW5	.98
3HA5	1.49
3HK5	1.23
3HS8	1.29
3Q4	1.35
3Q5	2.00
3S4	.99
3V4	.93
4AU6	.89
4AV6	.70
4BA6	.85
4BC5	.90
4BC8	1.02
4BL8	1.00
4BN6	1.48
4BQ7	1.40
4BS8	1.35
4BU8	1.25
4BZ6	.85
4BZ7	1.49
4CB6	.87
4CE5/4CB5	.89
4CS6	.59
4CY5	1.10
4DE6	1.01
4DK6	.88
4DT6	.87
4EH7	1.47
4EJ7	1.47
4EM6	1.19
4ES8	1.79
4EW6	1.01
4GK5	1.59
4GM6	1.25
4GS8	1.25
4GZ5	.91
4GZ6	1.15
4HA5	1.85
4HC7	1.39
4HM6	.91
4HS8	1.18
4HT6	1.24
4JC6	1.35
4JD6	1.35
5AM8	1.34
5AN8	1.50
5AQ5	.52
5AR4	1.72
5AS8	1.72
5AT8	1.35
5AU4	1.25
5AV8	1.52
5AW4	1.00
5AZ4	2.15
5B8	2.09
5BC3	.89
5BE8	1.27
5BK7	1.25
5BQ7	1.45
5BR8	.80
5BT8	1.25
5BW8	1.31
5CG8	1.25
5CL8	1.01
5CM8	1.47
5CQ8	1.52
5CZ5	1.70
5DE8	1.15
5DJ4	1.00
5EA8	1.21
5ES8	2.21
5EU8	1.29
5EW6	1.01
5FG7	1.07
5FV8	1.21
5GH8	1.50
5GJ7	1.62
5GM6	1.00
5GX6	.89
5HC7	1.49
5HG8	1.69
5J6	1.00
5KE8	1.90
5T4	1.50
5T8	1.35
5U4	.74
5U8	1.25
5V3	1.59
5V4	1.45
5V6	.65
5W4	1.75
5X4	.99
5X8	.84
5Y3	.60
5Y4	1.45
5Z3	2.00
5Z4	2.00
6A3	2.75
6A4	2.00
6A6	1.75
6A7	3.15
6A8GT	2.50
6A8M	2.50
6AB4	.82
6AB5	3.10
6AB7	2.10
6AC5	2.25
6AC7	1.75
6AD7	3.25
6AE5	2.50
6AF3	1.10
6AF4	1.45
6AF4A	1.35
6AF6	2.65
6AF11	1.95
6AG5	.95
6AG7	1.75
6AH4	1.25
6AH6	1.55
6AJ5	2.25

Type	Price
6AJ8	1.95
6AK5	1.50
6AK6	.94
6AL3	1.00
6AL5	.73
6AL7	1.95
6AL11	1.65
6AM8	1.25
6AN4	2.45
6AN5	1.95
6AN6	2.45
6AN8	1.50
6AQ5	.79
6AQ6	.99
6AQ7	1.55
6AQ8	1.29
6AR5	.99
6AR6	1.50
6AR8	2.00
6AR11	1.65
6AS5	.79
6AS6	1.00
6AS7	2.85
6AS8	1.45
6AS11	1.95
6AT6	.49
6AT8	1.40
6AU4	.95
6AU5	1.60
6AU6	.52
6AU7	.54
6AU8	1.40
6AV5	1.45
6AV6	.44
6AV11	1.52
6AW8	1.35
6AX3	1.05
6AX4	.94
6AX5	1.15
6AX7	1.25
6AX8	1.34
6AY3	1.05
6AZ8	1.18
6B4	5.50
6B5	4.00
6B6	1.00
6B7	2.75
6B8	2.50
6B10	1.35
6BA3	1.05
6BA6	.49
6BA7	2.15
6BA8	1.48
6BA11	1.45
6BC4	2.10
6BC5	.62
6BC7	1.47
6BC8	1.55
6BD4	7.00
6BD5	1.20
6BD6	.94
6BE3	1.15
6BE6	.84
6BF5	1.39
6BF6	.72
6BF8	1.65
6BG6	2.50
6BH6	1.00
6BH8	.94
6BJ6	.69
6BJ7	1.19
6BJ8	1.35
6BK4	2.95
6BK5	1.42
6BK7	1.29
6BL7	1.50
6BL8	1.25
6BM8	1.10
6BN4	1.10
6BN6	.74
6BN8	1.18
6BQ5	.83
6BQ6/6CU6	1.45
6BQ7	1.40
6BR8	1.34
6BS8	1.42
6BU8	.74
6BV8	1.19
6BW8	1.35
6BX7	1.62
6BY5	1.65
6BY6	.98
6BY8	1.01
6BZ6	.72
6BZ7	1.45
6BZ8	1.60
6C4	.54
6C5M	1.60
6C6	2.00
6C8G	2.95
6C10	1.53
6CA4	.77
6CA5	1.20
6CA7	1.95
6CB5	3.25
6CB6	.55
6CD6	2.05
6CF6	.95
6CG7	.95
6CG8	.85
6CH8	2.00
6CK4	1.00
6CL6	1.12
6CL8	.94
6CM6	1.29
6CM7	.95
6CM8	1.45
6CN7	.92
6CQ4	1.25
6CQ7	1.80
6CQ8	1.15
6CR6	.91
6CS6	.85
6CS7	.99
6CU5	.84
6CU6	1.45
6CU8	1.59
6CW4	1.69
6CW5	1.39
6CX8	1.49
6CY5	.99

Type	Price
6CY7	1.22
6CZ5	1.59
6CZ7	1.95
6D4	1.75
6D6	2.50
6D10	1.59
6DA4	.99
6DA5	1.08
6DB5	.99
6DB6	1.01
6DC6	1.29
6DC8	1.25
6DE4	1.03
6DE6	.93
6DE7	1.29
6DG6	.95
6DJ8	1.95
6DK6	.89
6DN6	2.74
6DN7	1.35
6DQ5	2.75
6DQ6	1.50
6DR7	1.29
6DS4	1.69
6DS5	1.21
6DT5	.95
6DT6	.75
6DT8	1.35
6DV4	1.39
6DW4	1.39
6DW5	1.55
6DX8	1.19
6DZ4	1.53
6E5	1.95
6EA5	1.55
6EA7	1.47
6EA8	1.19
6EB5	1.75
6EB8	1.60
6EH5	1.10
6EH7	.79
6EH8	1.21
6EJ7	1.39
6EM5	1.29
6EM7	1.93
6EQ7	1.10
6ER5	1.35
6ES5	1.15
6ES8	1.19
6ET7	1.60
6EU7	1.03
6EU8	1.25
6EV5	1.10
6EW6	.92
6EW7	1.52
6EY6	1.23
6EX6	2.79
6EZ5	1.39
6EZ8	1.41
6FA7	1.10
6FD7	1.73
6F4	4.75
6F5GT	1.50
6F5M	1.72
6F6G	1.95
6F6M	2.19
6F7	3.95
6F8	3.25
6FG5	1.99
6FG6	1.25
6FG7	1.10
6FG8	1.75
6FH5	.92
6FJ5	2.25
6FJ7	1.39
6FM7	1.31
6FQ7	.89
6FS5	1.19
6FV6	1.33
6FV8	1.15
6FW5	1.59
6FW8	3.49
6FY5	1.11
6GS	2.50
6G6G	1.55
6G11	1.69
6GB5	1.81
6GC5	1.19
6GE5	1.59
6GE7	1.19
6GF5	1.42
6GF7	1.69
6GH8	1.19
6GJ5	1.69
6GJ7	1.37
6GK5	1.55
6GK6	.99
6GL7	1.95
6GM5	1.21
6GM6	.91
6GN8	1.35
6GQ7	1.89
6GR7	1.42
6GT5	1.49
6GV5	1.65
6GV6	1.85
6GW6	1.55
6GW8	1.21
6GX6	.88
6GX8	1.31
6GY5	1.89
6GY6	.87
6GZ5	1.16
6HA5	1.45
6HB5	1.69
6HF5	2.79
6HF8	1.45
6HG8	1.69
6HJ8	1.25
6HK5	1.19
6HL8	1.19
6HS8	1.21
6HT6	1.19
6HZ6	.99
6H6M	.79
6J4	2.95
6JB6	1.76
6JC8	1.15
6JE6	2.99
6JE8	1.49
6J5M	1.35
6J5GT	1.20
6J7GT	1.49

Type	Price
6J6	.72
6J7	1.70
6J7G	1.25
6J8	2.50
6J11	1.82
6JH6	.99
6JH8	1.69
6JK8	1.30
6JS6	2.95
6JT8	1.69
6JV8	1.49
6JZ8	1.44
6K6GT	.95
6K7	1.70
6K7GT	1.49
6K8GT	1.25
6K8M	2.75
6K11	1.49
6KD8	1.39
6KT8	1.23
6KU8	1.15
6LB8	1.49
6L5G	1.50
6L6G	.98
6L6GA	1.50
6L6GB	1.50
6L6GC	1.61
6L6M	3.30
6L7M	2.50
6L7G	1.75
6M11	1.81
6N5	3.10
6N7G	1.49
6N7M	1.85
6N7GT	1.75
6P5	2.50
6Q7GT	1.95
6Q7M	2.00
6Q11	1.29
6R7	1.75
6S4	.89
6S7	1.95
6S8GT	1.50
6SA7GT	1.39
6SA7M	1.49
6SB7Y	2.35
6SC7	1.65
6SD7	1.49
6SF5	1.19
6SF5GT	1.20
6SF7	1.95
6SG7	1.65
6SG7GT	1.45
6SH7	1.21
6SJ7GT	1.49
6SJ7M	1.49
6SK7GT	1.25
6SK7M	1.45
6SL7GT	1.25
6SM7GT	.93
6SQ7GT	1.25
6SQ7M	1.45
6SR7	1.42
6SU7	2.00
6SS7M	1.95
6SS7GT	1.89
6SZ7	1.25
6T4	1.15
6T8	1.29
6U5/6G5	1.95
6U8	1.29
6U8GT-G	1.10
6V3	1.79
6V4	.59
6V6GT	.79
6V6M	2.39
6W4	.92
6W6GT	1.03
6X4	.60
6X5GT	.75
6X8A	1.30
6Y6GA	1.65
7A4	1.95
7A5	1.95
7A6	1.85
7A7	2.25
7A8	2.75
7AD7	1.25
7AF7	2.10
7AG7	2.85
7AH7	1.95
7AU7	.67
7B4	2.25
7B5	2.75
7B6	1.25
7B7	2.50
7B8	2.00
7C4	1.15
7C5	1.35
7C6	2.75
7E5	2.00
7E6	1.75
7E7	1.95
7EY6	1.10
7F7	2.10
7G7	1.65
7F8	3.10
7H7	1.65
7HG8	1.29
7J7	2.50
7K7	3.00
7L7	1.99
7N7	2.75
7Q7	1.85
7R7	2.25
7S7	1.79
7V7	1.81
7W7	2.45
7X6	1.35
7X7	2.75
7Y4	2.25
7Y7	1.79
7Z4	2.15
8AU8	1.50
8AW8	1.50
8BH8	1.36
8HQ5	.99
8CG7	.95
8CM7	1.07
8CN7	1.05

Type	Price
8CS7	.98
8CX8	1.60
8EB8	1.50
8EM5	1.19
8ET7	1.60
8FQ7	.95
8GJ7	1.31
8GN8	1.27
8JV8	1.42
8KA8	1.55
9A8	1.40
9AU7	1.05
9BR7	1.32
9CL8	1.10
9EA8	1.49
9U8	.99
10AL11	1.69
10BQ5	1.45
10C8	1.49
10DE7	1.18
10DX8	1.37
10EG7	1.49
10EM7	1.75
10EW7	1.45
10GN8	1.30
10HF8	1.69
10HT8	1.21
10JA8	1.35
10JY8	1.49
10KU8	1.15
10Y	.95
11CY7	1.10
11JE8	1.49
11KV8	2.35
12A4	.95
12A5	1.25
12A6	.89
12A8	2.95
12A11	1.69
12AB5	.95
12AC6	.75
12AD6	.79
12AE6	.79
12AE7	1.25
12AF3	.95
12AF6	.98
12AG6	1.49
12AJ6	.94
12AL5	.71
12AL8	2.45
12AL11	1.62
12AQ5	.85
12AT6	.55
12AT7	1.05
12AU6	.69
12AU7	.90
12AV5	1.50
12AV6	.59
12AV7	1.25
12AW6	1.10
12AX3	1.03
12AX4	.75
12AX6	.91
12AX7	.96
12AY3	1.05
12AY7	1.55
12AZ7	1.00
12B4	1.05
12BA6	.64
12BA7	1.90
12BD6	.72
12BE3	.99
12BE6	.69
12BF6	.68
12BH7	.91
12BK5	1.22
12BL6	.89
12BN6	1.48
12B96/CU6	1.55
12BR7	1.15
12BQ6/CU6	1.55
12BV7	1.32
12BW4	1.07
12BY7	1.20
12BZ6	.76
12BZ7	.95
12C5/12CU5	.89
12CA5	1.00
12CN5	1.20
12CR6	1.00
12CS6	.95
12CT8	1.60
12CU6/BQ6	1.65
12CX6	1.05
12D4	1.05
12DB5	1.05
12DE5	.92
12DE8	1.19
12DK7	1.05
12DL8	2.20
12DQ6	1.65
12DQ7	1.29
12DS7	1.40
12DT5	1.15
12DT7	1.10
12DT8	1.40
12DW7	1.19
12DY8	3.20
12DW8	1.25
12EC8	1.35
12EA6	.99
12DZ6	.98
12ED5	.98
12EG6	1.03
12EK6	.78
12EL6	.71
12EL8	.95
12EM6	1.14
12EZ6	.83
12F5	1.60
12F8	.99
12FA6	.97
12FK6	.83
12FM6	.81
12FQ8	1.19
12FR8	1.48
12FX5	.96

Type	Price
12FX8	1.27
12GA6	.91
12GC6	1.15
12GE5	1.46
12GW6	1.15
12H6	1.40
12J5	1.21
12J8	1.21
12JT6	1.97
12JB6	2.30
12JN6	1.43
12K5	1.19
12K8G	1.50
12K8M	2.95
12L6	.79
12L8	.50
12Q7GT	1.39
12Q7M	1.50
12R5	1.19
12SA7	1.60
12SA7GT	1.65
12SC7M	1.95
12SF5GT	1.19
12SF5M	1.59
12SF7M	2.15
12SJ7GT	1.35
12SG7M	1.39
12SH7	1.55
12SJ7M	1.39
12SK7GT	1.39
12SK7M	1.45
12SL7GT	1.30
12SN7	.89
12SQ7GT	1.40
12SR7	1.95
12U7	.95
12V6	.95
12W6	.89
12X4	.59
13DE7	1.12
13DR7	1.29
13EM7	1.83
13FD7	1.89
13FM7	1.15
13GF7	1.79
13J10	1.95
14A4	1.45
14A5	1.35
14A7	1.39
14AF7	1.65
14B6	1.69
14B8	1.95
14C5	1.75
14C7	2.35
14E6	1.39
14E7	1.39
14F7	3.00
14F8	2.40
14F8	2.40
14GT8	.95
14H7	1.95
14J7	1.95
14N7	1.95
14Q7	2.10
14R7	2.40
14S7	1.95
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14X7	1.75
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17AX3	1.03
17AX4	1.05
17AY3	.98
17BE3	1.15
17BF11	1.75
17BQ6	1.49
17BS3	1.15
17C5	2.35
17C9	1.95
17D4	1.05
17DA4	1.10
17DE4	1.25
17DM4	1.19
17DQ6	1.60
17DQ7	1.75
17EW8	.99
17GE5	1.50
17GJ5	1.75
17GV5	1.69
17GW6	1.49
17H3	.93
17HC8	1.24
17JB6	1.95
17JM6	1.65
17JN6	1.70
17JZ8	1.19
17L6	1.45
17LD8	1.35
17W6	1.15
18A5	1.55
18FW6	.75
18FX6	.79
18FY6	.69
18GD6	.81
19	1.00
19AU4	1.45
19BQ6	2.35
19C8	1.25
19CL8	1.25
19EA8	1.19
19CQ7	1.99
19HV8	1.41
19JN8	1.20
19Q9	1.15

Type	Price
19T8	1.25
2050	1.25
21EX6	1.95
21GY5	1.49
21HB5	1.65
22BH3	1.15
22BW3	1.21
22DE4	1.15
22JG6	1.95
25A7	3.25
25AC5	2.50
25AK4	1.19
25AV5	1.65
25AX4	1.05
25BK5	1.15
25BQ6	1.45
25B8	1.93
25C5	.66
25CA5	1.15
25CD6	2.10
25CU6	1.70
25DN6	2.10
25EH5	.82
25F5	1.29
25L6	.75
25W4	.95
25Z5	1.70
25Z6	1.10
27GB5	1.49
32ET5	.89
32L7	.85
33GY7	2.45
34DG5	.95
34GD5	.83
35A5	2.30
35B5	1.20
35C5	.80
35EH5	.83
35L6	.91
35W4	.42
35Y4	1.80
35Z3	1.49
35Z5	.65
50A5	2.35
50B5	.99
50C5	.84
50DC4	.64
50EH5	.87
50FY8	2.50
50HC6	.86
50HC8	.89
50L6	.95
50X6	2.35
50HK6	.86
50Y6	1.75
50Y7	1.70
60FX5	.95
70L7	.89
117L7	3.40
117N7	3.95
117P7	3.95
117Z3	1.50
117Z6	2.75
22	1.15
24A	1.35
26	1.40
27	1.60
28D7	1.50
30	1.25
31	1.50
32	1.15
33	1.15
34	1.15
35-S1	1.50
36	1.50
37	1.10
38	1.10
39/44	.95
41	1.40
42	1.98
43	2.85
45	3.25
45Z3	.55
46	.95
47	3.00
48	4.00
49	3.50
50	1.75
53	3.50
55	2.75
56	1.25
57	1.50
58	1.50
59	2.49
71A	1.25
75	2.62
76	1.50
78	1.65
80	1.25
81	1.35
82	1.49
83	1.75
83V	3.00
84/6Z4	1.00
85	.98
89	.75
89Y	1.85
3881	2.05
417A	5.25
6146	2.50
6146W	5.95
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6550	3.25
7258	2.50
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750 Ma-Silicon Diodes "Epoxy" or "Top Hat"

PIV		PIV		PIV		PIV	
50	5¢	300	12¢	600	21¢	900	40¢
100	7¢	400	14¢	700	25¢	1000	55¢
200	10¢	500	18¢	800	32¢	1100	70¢

Full Leads, All tests, Guaranteed, American made

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Amps	50 PIV	100 PIV	150 PIV	200 PIV
3	8¢	14¢	16¢	22¢
15	25¢	50¢	65¢	75¢
18*	18¢	40¢	60¢	70¢
35	60	80	1.15	1.30
Amps	**300 PIV**	**400 PIV**	**500 PIV**	**600 PIV**
3	25¢	28¢	35¢	40¢
15	90	1.30	1.40	1.65
18*	85	1.25	1.35	1.60
35	1.90	2.25	2.50	2.90

*Press Fit Package for Alternators

10 Watt Sil. Zener Stud 6v-150v. .... 95¢ ea.
1 Watt Zener diode, axial leads 6v-200v ...... 50¢ ea.
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2N1038	28¢	2N1042	35¢
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50	48	70	300	1.60	2.20
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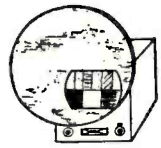

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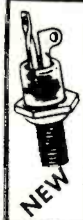

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200	☐ 1.75	☐ 2.25
250	☐ 1.95	☐ 2.75
300	☐ 2.25	☐ 2.95
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500 MC POWER TRANSISTOR Silicon Planar

$1.49

(ACTUAL SIZE)
Fairchild

	Watts	V_{CE}	h_{FE}	ma
☐ PNP ☐ NPN	3	12	30-120	1000

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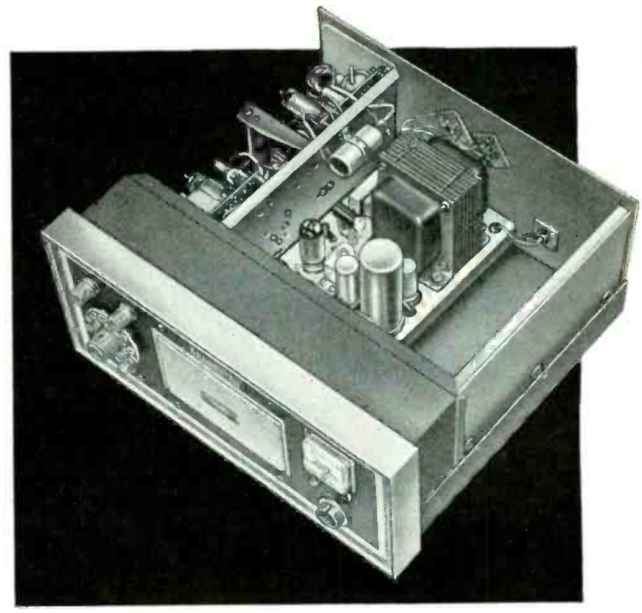

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Circle 148 on reader's service card

Circle 149 on reader's service card

RCA announces a zero defects program

through...

Personal
Quality
Performance

RCA's effort to apply some of the concepts of missile-type reliability to the production of commercial receiving tubes

You lose time and money whenever a tube fails.

To minimize such losses, RCA has initiated *still another quality control measure* to guard against tube failure and *keep profits in your pocket*.

It's our ZERO DEFECTS program, an attempt to eliminate as far as possible the factor of human error from commercial receiving tube production.

RCA personnel engaged in the production of RCA receiving tubes have voluntarily signed a pledge of PERSONAL QUALITY PERFORMANCE...a pledge to strive for error-free performance in every task they undertake in the making of RCA receiving tubes.

Their pledge is one more assurance to you of tube reliability and greatest possible reduction in callbacks when you sell and install RCA receiving tubes.

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

The Most Trusted Name in Electronics