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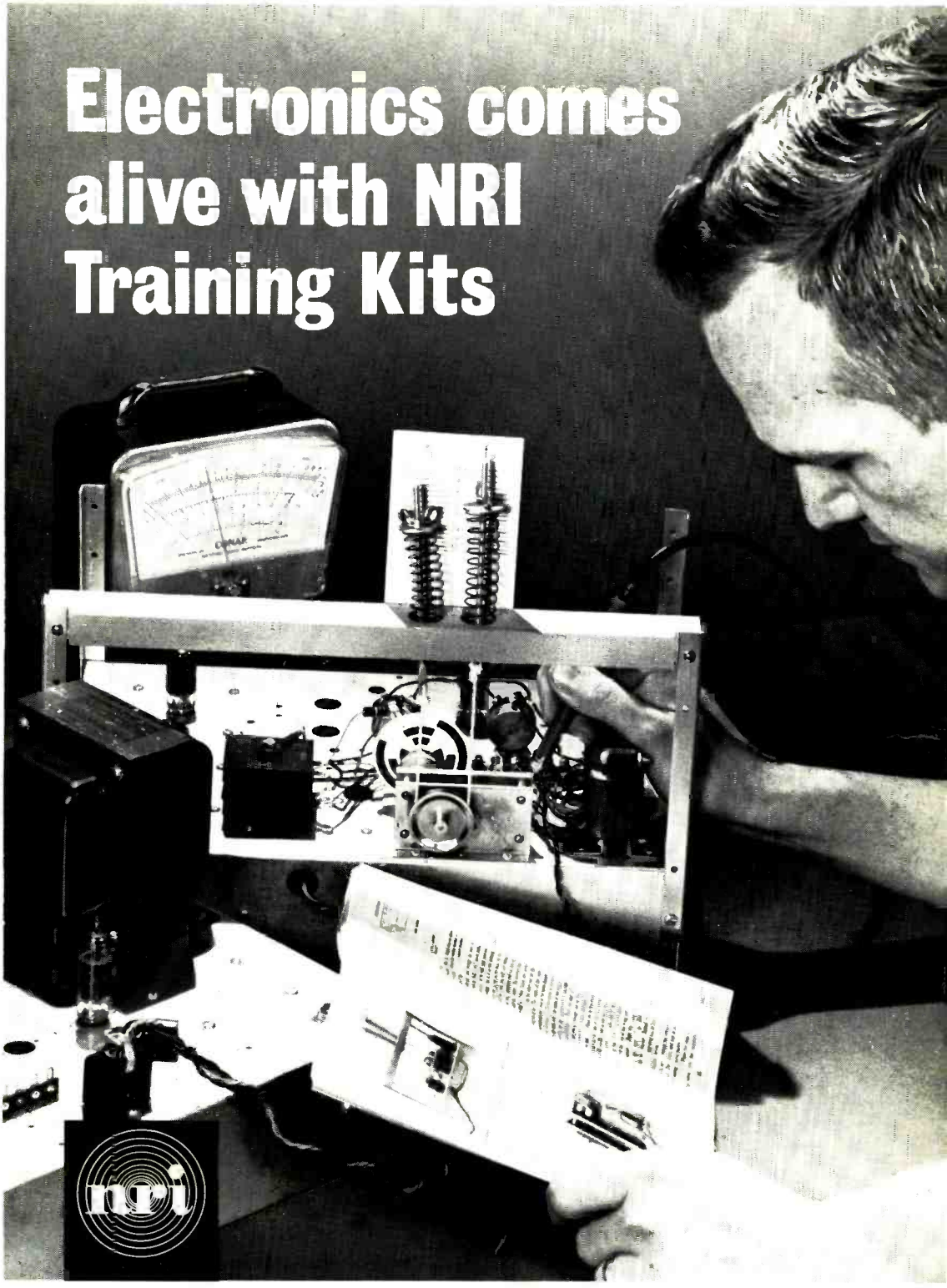

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POPULAR ELECTRONICS

VOLUME 27 NUMBER 6 DECEMBER, 1967

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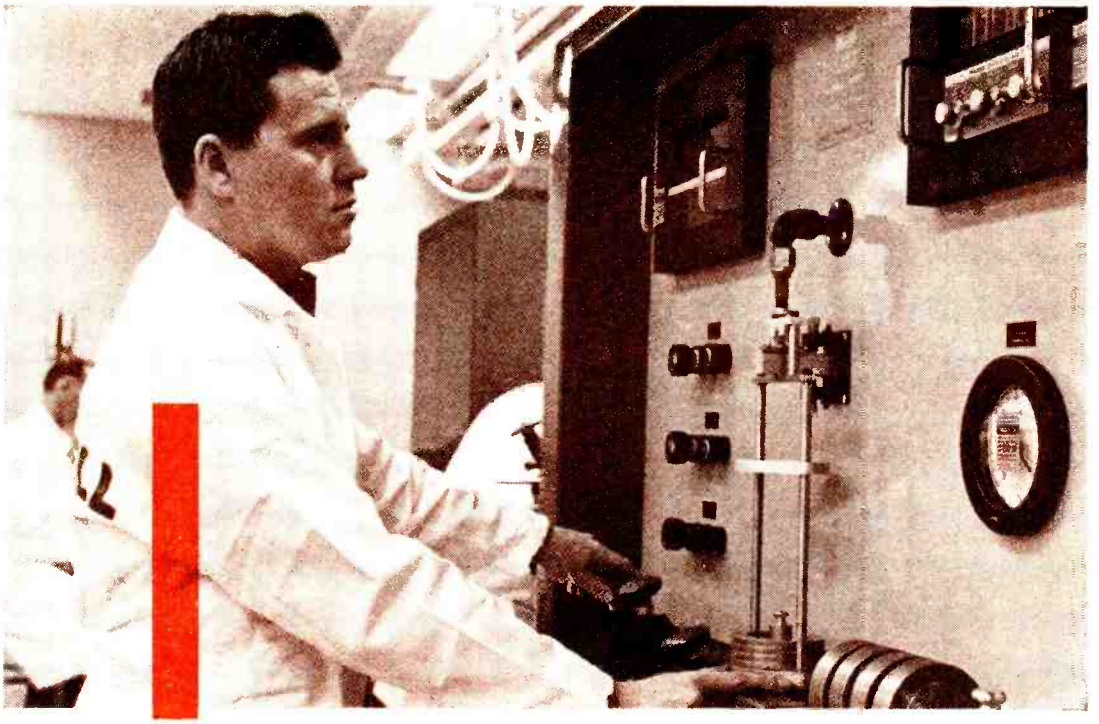

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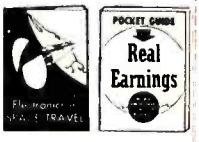

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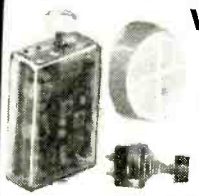

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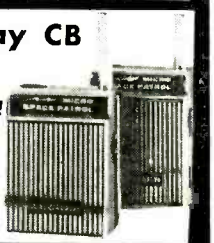

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CIRCLE NO. 26 ON READER SERVICE PAGE

letters
FROM OUR READERS

Address correspondence for this department to: Letters Editor, POPULAR ELECTRONICS One Park Avenue, New York, N. Y. 10016

SEVENTEEN COMBINATIONS CAN OPEN LOCK

Charles Schauers erred in designing the Electric Combination Lock ("Information Central," October, 1967, page 77). The door will certainly open when the switches are set to the 5253 combination, but it will also open with combinations of: 1353, 2353, 3353, 4353, 1453, 2453, 3453, 4453, 1553, 2553, 3553, 4553, 1653, 2653, 3653, and 4653 without setting off the alarm buzzer. I don't feel that this design offers the protection the reader requested.

ROBERT DALLEY
Brampton, Ontario, Canada

Very good, Bob. We're sure that a lot of POPULAR ELECTRONICS *readers who had decided to build the Electronic Combination Lock will*

be indebted to your sharp observations. We'll just have to send Mr. Schauers back to the drawing board for this one.

I WISH TO PROTEST

I wish to protest your answer to R.W. Lippoth in "Letters From Our Readers" (October, 1967). My experience is that inexpensive and most high-quality motors used in phonographs base their speed on the 60-Hz line frequency rather than the voltage or current supplied to them. The manufacturer decided to use the motor's inductance to limit the current and voltage through the tube filament, thus saving the cost of a voltage-dropping resistor.

WALLACE BRITTEN
San Jose, Calif.

Wallace, you're right about the motor's inductance being used to limit filament circuit current. However, your objection to our an-

TODAY'S TAPES, TOMORROW'S TREASURES

WHY IMMORTALIZE ECHOES, DISTORTION, AND ROOM REVERBERATIONS? Whether you're building an audio chronology of your children, practicing speech, using tapes to develop vocal or instrumental technique, or compiling tapes of live lectures and concerts—your microphone is the vital link between you and distortion-free, professional sounding tapes. It is a fact that microphones supplied with tape recorders (even on relatively expensive models) are significantly below the performance capabilities of the recorder itself. Further, with a good unidirectional microphone that picks up sound from the front while suppressing sound entering from the back and sides (such as the incomparable Shure Unidyne® III shown above) you can control objectionable background noise, room echoes and reverberations, and the "hollow" sound common to most amateur tapes. The Shure Unidyne microphone actually represents the lowest cost investment you can make in upgrading your entire tape system, yet, the difference in sound is astounding!

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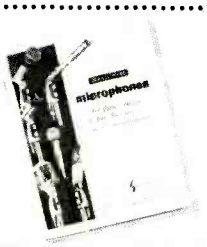

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CIRCLE NO. 30 ON READER SERVICE PAGE

LETTERS (*Continued from page 8*)

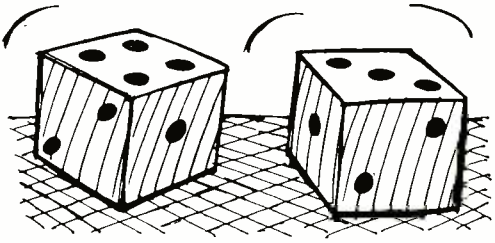
swer to Mr. Lippoth would be valid only if all phono motors were induction-type line-frequency-sensitive units. Because many motors were of the shaded-pole variety—and thus voltage-sensitive—in early model phonographs, the answer we gave was correct.

THE DICE ARE LOADED

I built the electronic dice project ("Spots Before Your Eyes," September, 1967). Although the completed gadget worked very well, it may be worthwhile to point out to others interested in building this project that the lead labeled "Bulb J" should go to bulb "L" (Fig. 5, lower right)—unless you want loaded dice.

BILL WINTON
Medford, Ore.

Good observation, Bill. Although the electronic dice will work if the unit is wired as directed in Fig. 5, this slight error will certainly



"load" the dice. So, anyone who plans to build the project—or who has already built it—should make this correction in the interest of fair play. Also, note the "Out of Tune" item on page 12.

DWELL METER ADAPTER FOR 2.5-VOLT RANGE

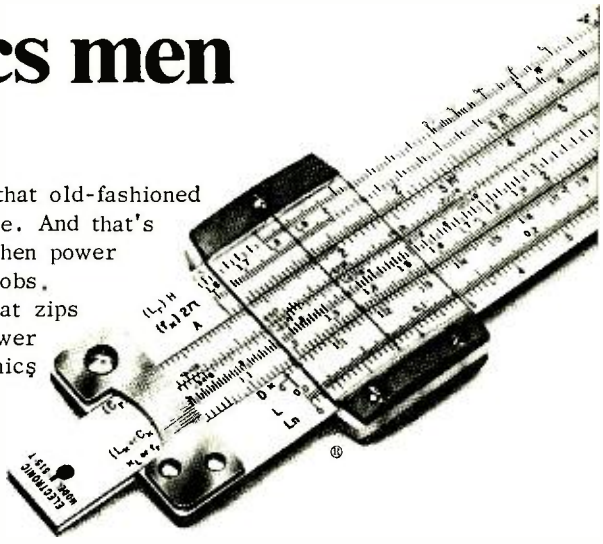
I built the "Dwell Meter Adapter" (February, 1966), but this device is for use with meters that have a 5-volt range. My 20,000-ohms/volt multimeter goes from 2.5- to the 10-volt range. Is it possible to obtain a conversion chart for the 2.5-volt range?

I had intended to use the adapter with my 11-megohm input VTVM (on the 3-volt scale), but I can't get the meter to zero. Could this be because of the high input impedance?

MARVIN L. ROSEBERRY
Jeffersonville, Ind.

Marvin, you don't need a conversion chart; a slight modification of the circuit shown in the article is quicker and more convenient. Since your meter is rated at a sensitivity of 20,000 ohms/volt and you have a 2.5-volt scale, it is a simple matter to extend this range to read 5 volts full-scale by adding a 50,000-ohm resistor in series with R1 in the circuit. Then use the 50-volt scale for your readings, remembering to drop the zero for each reading. The "VOM Range Splitter" article (January,

Amazing "power tool" for electronics men



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CIRCLE NO. 7 ON READER SERVICE PAGE

LETTERS

(*Continued from page 10*)

1967) goes into more detail on how a.c. and d.c. ranges for VOM's can be extended. As for your second question, your suspicion is correct: the high input impedance of a VTVM affects the time constant of the circuit so that the results are not the same as those obtained with a VOM.

EXPANDED COVERAGE FAVORED

In the "English-Language Broadcasts To Western North America" preface (October, 1967), you asked for comments about continuing the expanded schedule. I say YES! DEFINITELY! I belong to several radio clubs that send very helpful bulletins to their members, but find that I use your schedule more regularly than the bulletins. If anything, expand your coverage even more.

COL. HARRY S. LEON, WPE6FRY
San Diego, Calif.

I greatly appreciate the expansion of your listing of "English-Language Broadcasts To Western North America," and I hope you will continue this expansion as a service to the large numbers of western SWL's.

ARIS BOURAS, WPE6GQK
San Mateo, Calif.

PARTS KITS BY SPECIAL ARRANGEMENT

What do your authors use for labeling their projects? Also, making a kit available (as for the electronic dice in "Spots Before Your Eyes," September, 1967) is a very good idea. If you can't provide kits for all your projects, how about furnishing a package of parts (at a discount)? This would be a big help on projects that call for parts that cannot be obtained in local electronics parts stores.

JOHN REESE
Hollywood, Calif.

Our authors use "Datak" and/or "Prestype" (both available from most art supply stores) for labeling their project prototypes. When kits of parts are offered—as noted in project Parts Lists—it is through special arrangement between the authors and suppliers. It would not be practical—or even possible—for POPULAR ELECTRONICS *to become involved in furnishing parts. However, we do check out parts availability using catalogs from mail order suppliers.*

OUT OF TUNE

Spots Before Your Eyes *(September,* 1967, *page* 29). In Fig. 1, on page 30, the leads to *A* and *B* of *IC4* should be interchanged; the connection is shown correctly in Figs. 3, 4, and 5. Also, in Fig. 5, on page 32, the third bulb listing down (on the right) should be bulb L (instead of bulb J). —30—

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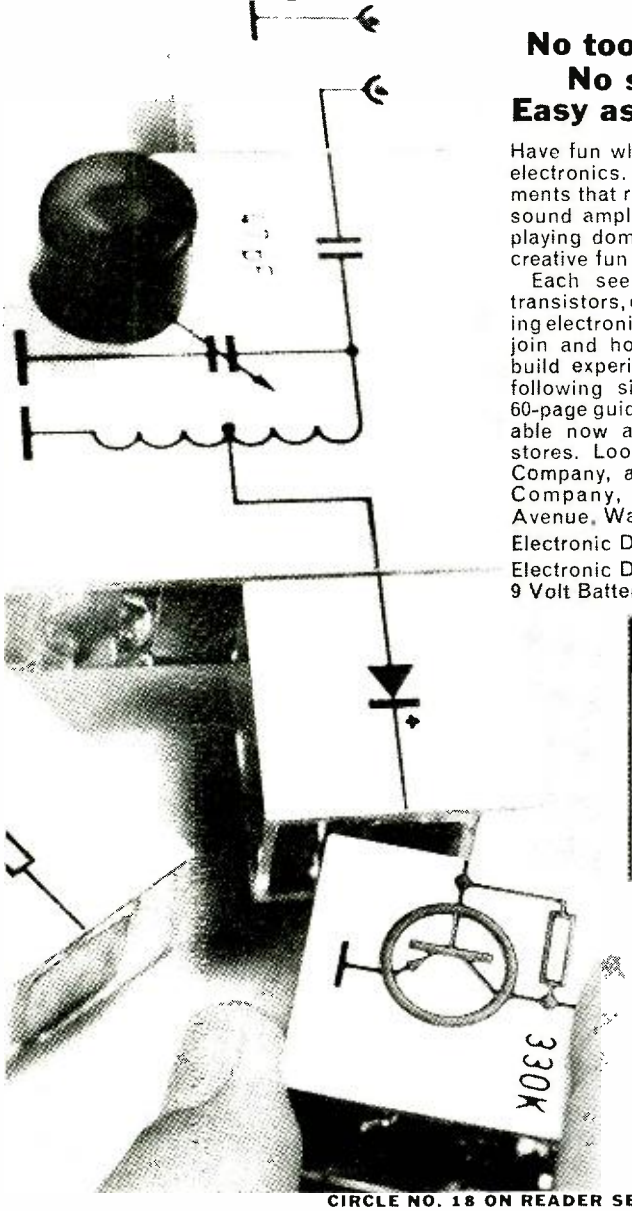

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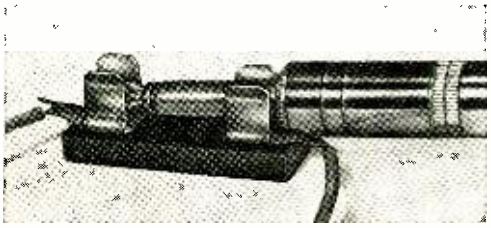
CIRCLE NO. 18 ON READER SERVICE PAGE

PARTS/METHODS/IDEAS/GADGETS/DEVICES

tips & techniques

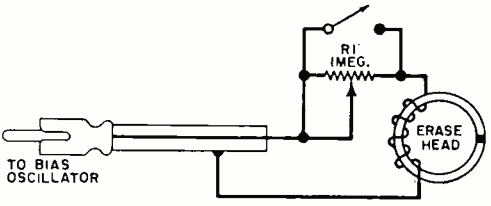
FUSE HOLDER DOUBLES AS PHONE JACK

A snap-in type fuse holder can come in handy when you need a phone jack in a hurry and can't find one in your spare parts box. These fuse holders will accommodate almost any conventional ¼"-diameter phone plug, as shown in the photo. All you need do is solder a pair of wires or shielded audio cable to the lugs on the holder and clip in the phono plug. Then connect the wires or cable from the fuse holder into the circuit where it is to be used. If necessary, bolt the fuse holder to your workbench or to the case of the device. —*Dave Edlund*



FADE OUT UNWANTED SOUNDS FROM YOUR TAPE RECORDINGS

Installing a 1-megohm potentiometer and a s.p.s.t. switch in each of the erase head circuits in your tape recorder will enable you to fade out unwanted sounds like a professional. (See schematic drawing for connections; value shown for the potentiometer is typical for most tape recorders.) When you use your tape recorder in the normal manner, make sure the switch is closed. After you finish a tape, listen for unwanted sound and note where it appears on the tape. Rewind the tape to about 12" to 18" ahead of the sound, and stop the tape. Actuate the record mode control (tape not running), while setting the



READER SERVICE PAGE

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1. Print or type your name and address on the lines indicated. Circle the number(s) on the coupon below that corresponds to the key number(s) at the bottom of the advertisement or editorial mention(s) that interest you. (Key numbers for advertised products also appear in the Advertisers' Index.)

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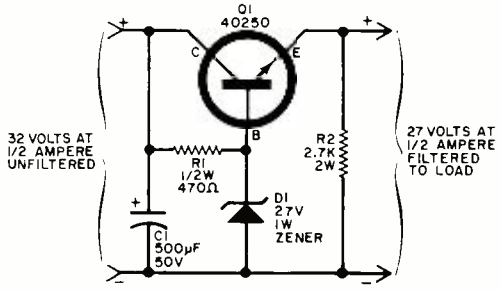
12

TIPS (*Continued from page 14*)

record level control to its fully counterclockwise position. Set the newly installed potentiometer to its maximum resistance position, open the switch, and start the tape moving. Then slowly decrease the resistance of the potentiometer to zero. Stop the tape motion when you're sure the sound has passed the tape heads. —*Thomas Goldberg*

VOLTAGE REGULATOR DOUBLES AS RIPPLE FILTER

If you have been planning to build a power supply—or to redesign one you may already have on hand—chances are you want good voltage regulation and the high degree of ripple filtering often demanded for solid-state circuits. Instead of designing two separate circuits, the single voltage regulator shown here will double as an efficient ripple filter. It occupies minimum space while at the same



time delivering maximum current to the load. (The current delivered will depend on the power transformer and rectifier chosen.) Ripple filtering depends largely on the dynamic resistance of zener diode *D1*. Power dissipation of the transistor in the circuit shown is only about 2.5 watts, and mounting it with Z5 silicone compound and the supplied insulating hardware on the aluminum chassis of the power supply will usually provide all that is needed in the way of a heat sink. —*Frank H. Tooker*

PORTABLE TAPE RECORDER IS BONANZA OF SPARE PARTS

If you're like many electronics hobbyists, you probably cannibalize old radios, TV sets and phonographs for spare parts. A cheap old portable transistor tape recorder is an excellent source of useful spare parts and assemblies. The average portable transistor recorder yields two low-voltage d.c. motors, an audio amplifier PC board, a miniature loudspeaker, and a carbon microphone—in addition to a pair of potentiometers, several miniature phone jacks and plugs, and two tape heads. You can usually pick up a junk recorder for about $2 if it is not in operating condition, yet the parts you can salvage from it would cost about $15. —*Glenn Anton*

Introducing the world's first 5-channel, solid state, Citizens Band Radio with a Class B push-pull audio amplifier, super-sensitive receiver, and full-powered transmitter, that comes with either palm microphone or telephone handset at no extra cost.
Total weight: 3 pounds. Total price: $99.90.

How can anyone put so much into one radio, for so little, without cutting corners?

Anyone can't. Pearce-Simpson can.

In simple, unvarnished terms, Pearce-Simpson makes more marine radio telephones than anyone in the world.

Period.

Which means that Pearce-Simpson buys more components for marine radio telephones than anyone in the world.

In other words, because we buy in such quantity, we save money when we buy our components.

You save money when you buy our radios.

And because we have our own plastics factory and make our own telephone handsets, our own cabinets and many of our own parts, we know we start out with quality.

You know you end up with quality.

But probably the most significant part of the story is this:

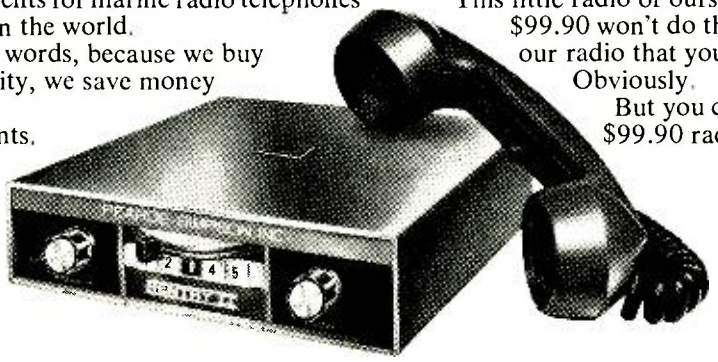
The $99.90 Sentry II, pictured here, is designed by the same tough engineers, and goes through the same tough production line and quality check points as our most sophisticated $1,000 radio.

Result?

This little radio of ours that you buy for $99.90 won't do the same things as our radio that you buy for $1,000.

Obviously.

But you can't buy a better $99.90 radio from anyone.



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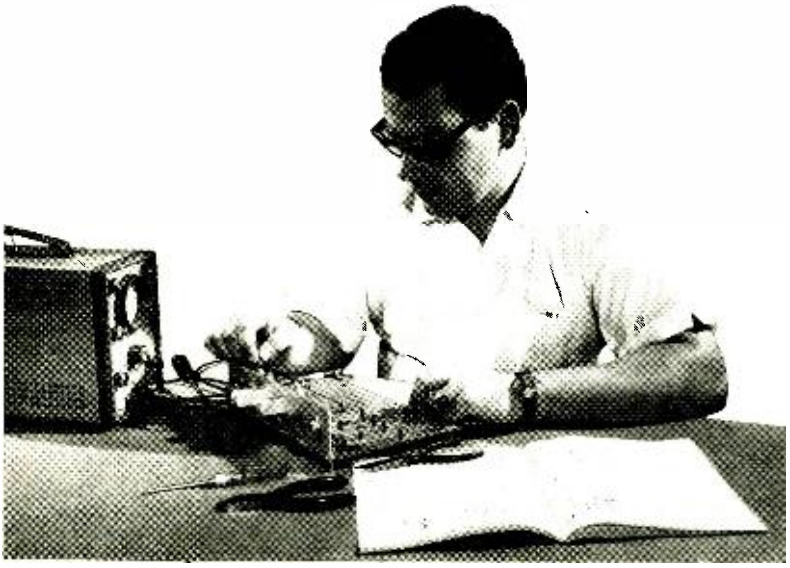
Your best investment for a rewarding career in electronics:



Performing transistor experiments on programmed breadboard — using oscilloscope

1 LEADER IN ELECTRONICS TRAINING

When you think of electronics, you immediately think of RCA...a name that stands for dependability, integrity and pioneering scientific advances. For over a half century, RCA Institutes, Inc., a service of Radio Corporation of America, has been a leader in technical training.

2 RCA AUTOTEXT TEACHES ELECTRONICS FASTER, EASIER, ALMOST AUTOMATICALLY

Beginner or refresher, AUTOTEXT, RCA Institutes' own method of programmed Home Training will help you learn electronics more quickly and with less effort, even if you've had trouble with conventional learning methods in the past.

3 THOUSANDS OF WELL PAID JOBS ARE NOW OPEN TO MEN SKILLED IN ELECTRONICS

RCA Institutes is doing something positive to help men with an interest in electronics to qualify for rewarding jobs in this fascinating field. Every year, literally thousands of high paying jobs in electronics go unfilled just because not enough men take the opportunity to train themselves for these openings.

4 WIDE CHOICE OF CAREER PROGRAMS

Start today on the electronics career of your choice. On the attached card is a list of "Career Programs", each of which starts with the amazing AUTOTEXT method of programmed instruction. Look the list over, pick the one best suited to you and check it off on the card.

5 SPECIALIZED ADVANCED TRAINING

For those already working in electronics or with previous training, RCA Institutes offers advanced courses. You can start on a higher level without wasting time on work you already know.

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All during your program of home study, your training is supervised by RCA Institutes experts who become personally involved in your efforts and help you over any "rough spots" that may develop.

7 VARIETY OF KITS YOURS TO KEEP

To give practical application to your studies, a variety of valuable RCA Institutes engineered kits are included in your program. Each kit is complete in itself. You never have to take apart one piece to build another. At no extra cost, they're yours to keep and use on the job.

8 FROM RCA INSTITUTES ONLY — TRANSISTORIZED TV KIT, VALUABLE OSCILLOSCOPE

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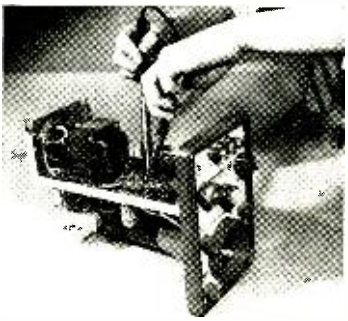
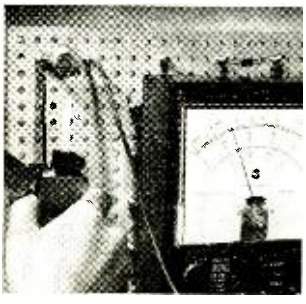


Construction of Oscilloscope.

Temperature experiment with transistors.

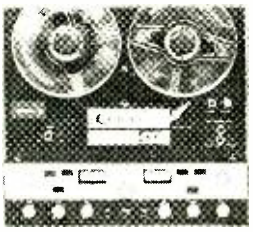


NEW PRODUCTS

Additional information on products covered in this section is available from the manufacturers. Each new product is identified by a code number. To obtain further details on any of them, simply fill in and mail the coupon on page 15.

SOPHISTICATED HOME TAPE RECORDER

Viking's Model 433 tape recorder has an eight-position master switch (with color-coded indicator windows) for the recording and playback modes. Other features include sound-on-sound, echo, a tape monitoring facility, separate controls for mixing the various inputs, a pause control, three tape heads, and two illuminated recording level meters. The recorder is designed around three motors and has three playing speeds. Frequency response is from 40 to 18,000 Hz at 7½ in/s; signal-to-noise ratio, 54 dB or better.



Circle No. 75 on Reader Service Page 15

PUBLIC SERVICE MONITOR RECEIVERS

You can monitor police, fire, and other Public Service transmissions on the 25-50 MHz and 150-175 MHz bands with *Sonar*'s Model FR-104 and Model FR-105 receiver, respectively. These receivers are fully solid-state, feature a dual limiter, Foster - Seeley discriminator, quadruple-tuned r.f. stage for greater image rejection, and noise-free squelching. They are available with six crystal-controlled frequencies for drift-free operation; plug-in crystals permit instant frequency change. Audio output is 1.5 watts.

Circle No. 76 on Reader Service Page 15

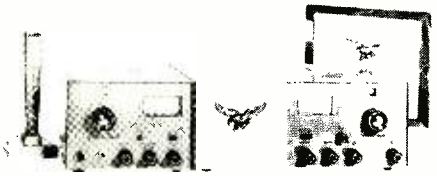
NON-INSULATED SOLDERLESS TERMINAL KIT

Now available from the *Aerovox Corporation* is a non-insulated solderless terminal kit called the Model ATK-902. The kit contains a supply of ring and spade terminals in a variety of sizes, and a crimping tool (Model 10001) which is used for attaching the non-insulated terminals to wires and cables, for cutting wire, and for stripping insulation from wire.

Circle No. 77 on Reader Service Page 15

CB BASE STATION

Superseding the well-known *Browning* "Eagle," this company's "Golden Eagle" CB base station retains many of the features of the "Eagle" and incorporates new ones. The new receiver utilizes a Collins-type mechanical filter to achieve more than 80 dB adjacent channel rejection and a three-position a.g.c. switch for distant, normal, and local reception. The transmitter features a modulation SWR meter, paging facilities (with separate volume controls for remote speakers), and extremely accurate miniature crystals. A microphone is included.



Circle No. 78 on Reader Service Page 15

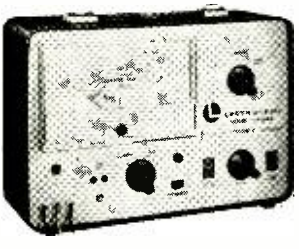
OUTDOOR RADIO CALL BOX

The "Poly-Communicator" is a single-channel, all solid-state radio call box—the latest product to join *Polytronics*' line of two-way radios and accessories. For use on either the Citizens or Business Bands, the "Poly-Communicator" is said to be completely impervious to weather and ideal for any outdoor purpose. Powered by long-lasting, rechargeable batteries, it comes complete with utility pole and antenna.

Circle No. 79 on Reader Service Page 15

GOOD/BAD TRANSISTOR ANALYZER

There are no numerical readings to interpret with the Model TT-250 Good/Bad Transistor Analyzer announced by *Lectrotech, Inc.* It tests transistors in or out of circuit, and you get positive Good/Bad readings. Transistor leads do not to have to be unsoldered or clipped for in-circuit tests, which measure a.c. gain. Out-of-circuit tests measure *beta* or gain on two scales: 0-250 and 0-500. Biasing is automatic and no calibration is required. The TT-250 measures transistor leakage directly



PRODUCTS (*Continued from page 22*)

in microamperes. It also measures reverse leakage and forward conduction of diodes and rectifiers, and leakage current of electrolytic capacitors, with 6 volts. Housed in an all-steel case, the unit features an easy-to-read 6" meter.

Circle No. 80 on Reader Service Page 15

CASSETTE TAPE RECORD/PLAY SYSTEM

The "PRO-540" stereo cassette tape record and playback system introduced by *Lafayette Radio* can be employed with almost any audio amplifying system. Using four-track, reel-to-reel tape cassettes, the all solid-state recording system provides up to 90 minutes of playing time. Controls for all tape modes and the cassette ejector are piano-key type push buttons, and a three-digit tape counter, automatic shut-off, and a vu meter for monitoring are standard features. Frequency response is from 50 to 12,000 Hz; overall distortion, less than 1.5%. Channel separation is better than 35 dB.

Circle No. 81 on Reader Service Page 15

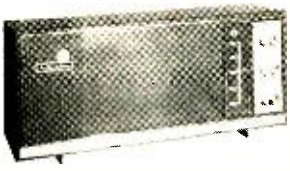
TV/FM ANTENNA WIRING SYSTEM

Up to four TV sets and/or FM radios can operate simultaneously with a new antenna system introduced by *Mosley Electronics*. The "Golden Arrow TV Antenna" system permits the clearest possible monochrome and color-TV reception. It is available in two forms: a builder kit; and a remodeling kit. The kits include all parts necessary to perform a comprehensive wiring job—from antenna and distribution system to non-electrical outlets. A Mosley PC-4 antenna coupler (included in the kits) does away with the need for separate antennas for TV and FM.

Circle No. 82 on Reader Service Page 15

AIRCRAFT MONITOR RECEIVER

Such professional monitoring features as an automatic gain control, automatic noise limiter, and a squelch circuit are incorporated in *Hallicrafters'* Model CRX-104 aircraft monitor receiver. This solid-state table model superhet for 108-135 MHz has one r.f. and three i.f. stages, and there is a built-in transformer power supply for 117-volt a.c. operation. A push-pull dual-transistor audio amplifier delivers a full watt of sound power to a front-mounted 4" x 6" oval speaker. A wire-type antenna to pull in local signals is supplied, and an antenna terminal on the back of the receiver permits connection of an outside antenna.



Circle No. 83 on Reader Service Page 15

HOOKUP WIRE KIT

A handy, portable hookup wire kit, No. 8816, designed for workbench or wall-mounting, was recently made available by *Belden Corporation*. The kit includes eight spools of 18-gauge stranded hookup wire and an attractive metal dispenser rack. Each spool contains 25 feet of vinyl-insulated wire. Wire insulations come in eight different colors.

Circle No. 84 on Reader Service Page 15

FM WIRELESS MICROPHONE

The Model RA-963 FM wireless microphone available from *Olson Electronics* is completely free of unsightly and potentially hazardous cables—power is supplied by a self-contained 9-volt battery. Essentially a low-power FM transmitter, the RA-963 broadcasts to any radio receiver capable of tuning across the 88-108 MHz FM broadcast band. Frequency response of the microphone is from 100 to 10,000 Hz.

Circle No. 85 on Reader Service Page 15

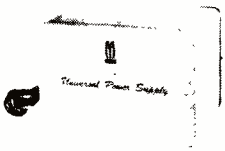
MONO-STEREO HEADPHONE

You can choose stereo or mono mode and high (2000-ohm) or low (600-ohm) impedance with the "4-way" headphone offered by *Radio Shack*. This Realistic "Hi-Lo DuoFone" under-the-chin unit has a hi-fi frequency response (40 to 12,000 Hz), yet it weighs only 1¼ ounces. It features a unique moving-coil element, and the mode and impedance switches are built into the standard phone plug. Also available is an 8-ohm switchable stereo-mono version.

Circle No. 86 on Reader Service Page 15

UNIVERSAL POWER SUPPLY FOR CB RADIO

Conversion from 117 volts a.c. to 12 volts d.c. for driving ANY solid-state CB transceiver (1.7 amperes or less) is possible with *Regency Electronics'* Model 103 universal power supply. Model 103's d.c. output is short-circuit protected and momentary shorts will not affect the supply's fuse or the transceiver's operation. The unit is housed in a compact aluminum cabinet, finished in light blue baked-on enamel.



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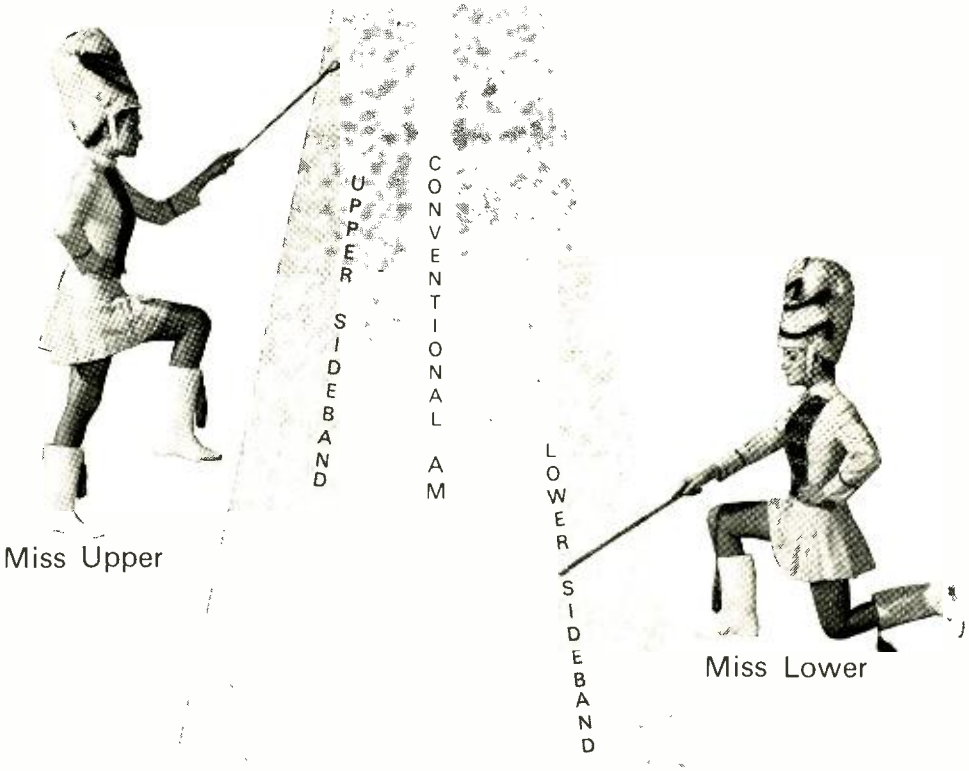

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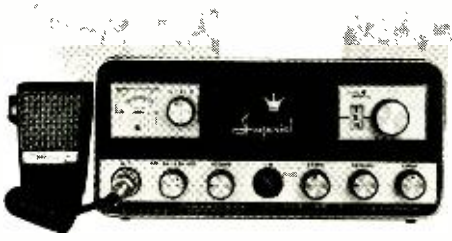
Exclusive transmissions get through skip and interference on the upper and lower sidebands of the Regency Imperial . . . to other Imperials.

And when our sideband leaders must contact "Brand X" sets on conventional AM, a flip of the sideband switch puts them in touch on any of 23 channels.

Imperial leaders have the advantage of transmitting on any of 46 modes; receiving on any of 69 modes. It's their way of combining versatility with selectivity for delivery of an outstanding performance.

Sound interesting? You can join our leaders for only $299. Just ask your Regency Distributor . . . or write us.

The Imperial CB Transceiver



by Regency

Regency Electronics, Inc., 7900 Pendleton Pike, Indianapolis, Indiana 46226

we make a CB transceiver for every purpose . . . every purse

Range Gain II Ranger Pacer II Charger Bronco

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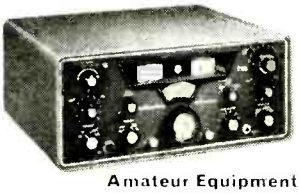
only hallicrafters...

offers precision engineered radio receivers, transmitters and two-way transceivers covering *every known amateur, professional and entertainment frequency in the world.* Which do you want to enjoy next?



Model SR-2000 transceiver

Amateur Equipment

Amateur equipment—High-performance, equipment in every price range, from the great SR-42A and SR-46A VHF transceivers to the incomparable SR-2000 full-coverage kilowatt transceiver.

Citizens 2-way Radio

Model CB-24, 23-channel transceiver

Citizens Two-way Radio—Complete line of "REACTER" solid-state transceivers featuring new advanced "Dual Noise Suppression" that drastically reduces mobile interference.

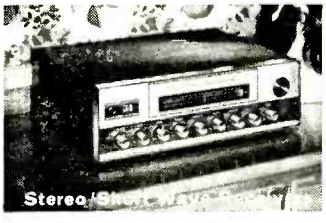
Model SR-240 five-band receiver

General Coverage Receivers—Communications-type SWL/FM/AM receivers from $59.95 to $395. All the professional features such as BFO, slide-rule dials, electrical bandspread or new S-P-R-E-A-D tuning.

Special Frequency Receivers

Model CR-44 five-band portable

Multi-band portables—Outstanding new multi-band portables covering marine, aviation, police, fire, civil defense, etc., plus FM/AM. Some with "DIRECTION FINDER" capability.



Model CR-3000 FM/AM Short Wave

High-Fidelity—with Short Wave! New Hallicrafters engineering triumph—superb high fidelity reception on FM stereo, AM plus three short wave bands.

Model CRX-102 (144-174 MHz) pocket portable

Special-frequency receivers—New high-performance pocket portable and table model receivers for aviation and industrial/public service frequencies.

Write for complete specifications today!

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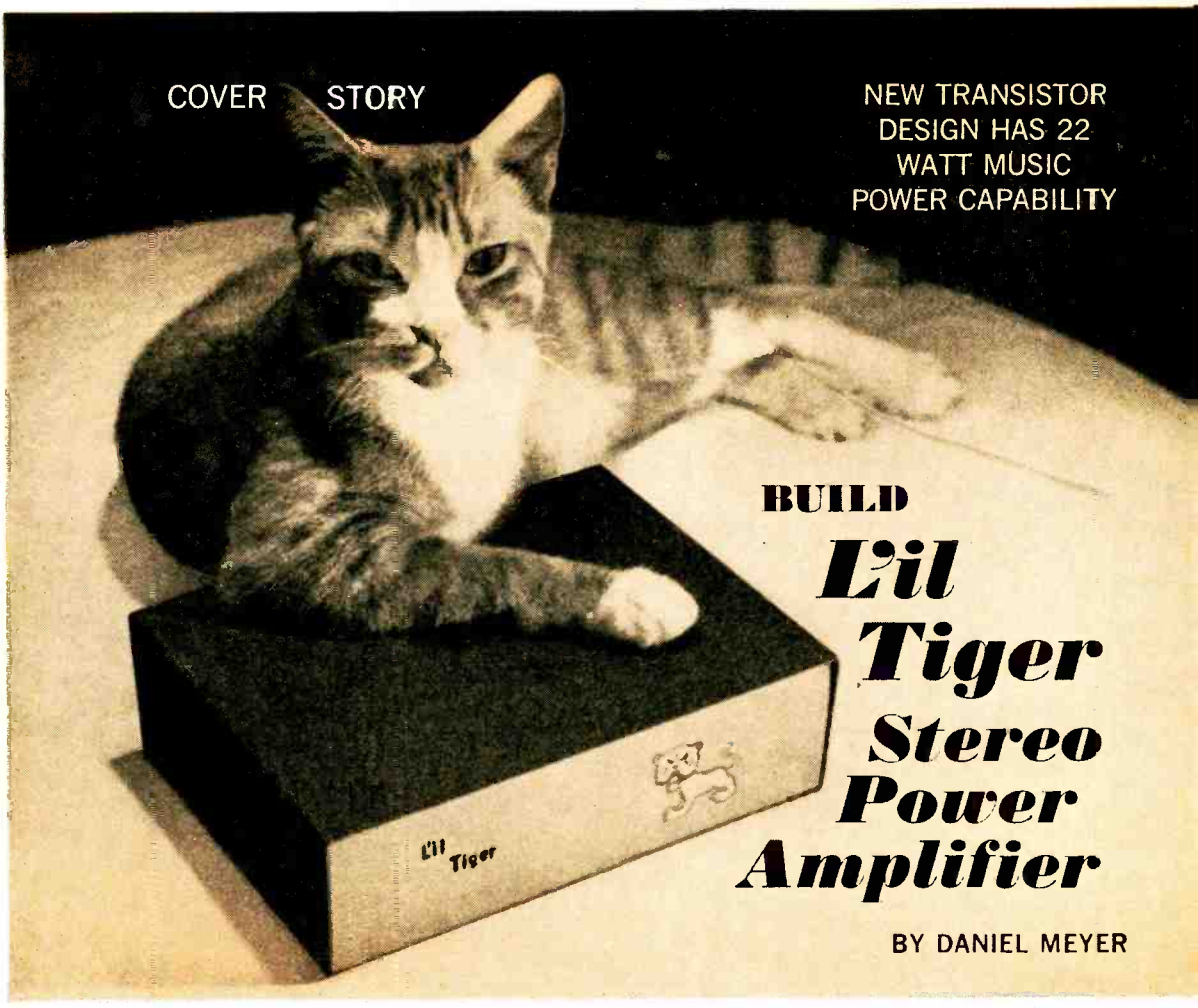


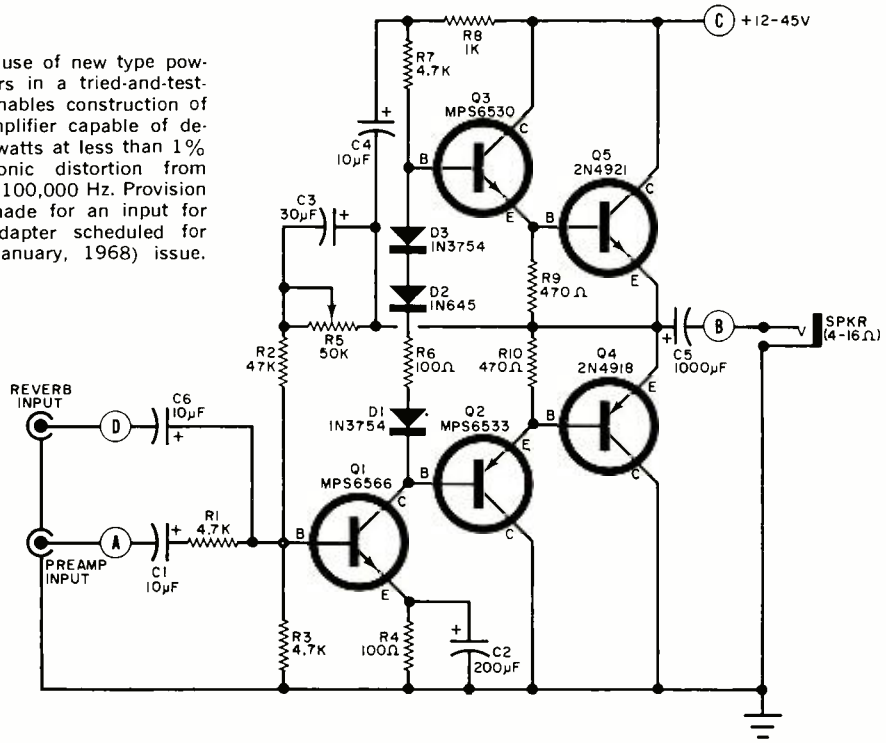
IF YOU would like to update your present audio system with a low-cost, superior-quality, cool-running, low-distortion transistor power amplifier—try the "L'il Tiger." This small but versatile amplifier will put out a very clean 18 watts per channel r.m.s. with 8-ohm speakers, or a total of 36 watts for a stereo system.

Supply voltage can be anything from 12 to 45 volts, depending on the amount of output power you want, while the speaker can be rated anywhere from 3.2 to 16 ohms. The full electrical specifications given on page 33 clearly demonstrate the "L'il Tiger's" capabilities.

The amplifier owes most of its outstanding characteristics to a new breed of transistors—uniquely designed plastic complementary silicon power transistors.

Circuit Development. Circuit designers realize that a complementary transistor output stage would be the most desirable arrangement in an audio power amplifier, but until recently, *pnp* power transistors complementary to existing *npn* types either were not available, or were so expensive that they could not be considered practical. Attempts to design around this problem led to the quasi-complementary circuit (much as was used in the "Brute-70," POPULAR ELECTRONICS, February, 1967). This type of circuit uses power transistors of the same polarity, with the result that one output transistor operates as a common emitter and the other as a common collector. The output impedances are not the same for positive and negative half cycles of the audio signal, but negative feedback produces a reasonably good amplifier.

Fig. 1. The use of new type power transistors in a tried-and-tested circuit enables construction of a power amplifier capable of delivering 22 watts at less than 1% total harmonic distortion from about 20 to 100,000 Hz. Provision has been made for an input for a reverb adapter scheduled for the next (January, 1968) issue.



Another solution to the problem has been to use one silicon and one germanium power transistor in the output stage. This combination can lead to thermal (heat) compensation problems, and the transistors are usually far from complementary in their characteristics. Again, lots of negative feedback can produce a pretty good amplifier, but feedback is used to correct for circuit nonlinearities, rather than the circuit being inherently linear with feedback used only to make it better.

The unusual construction of the Motorola transistors used in the "L'il Tiger" makes it possible to manufacture them at a reasonable cost while also making heat-sinking both simple and inexpensive. With the duty cycles found in speech and music, a simple heat sink is sufficient for operation at ambient temperatures of up to 120°F.

These transistors have excellent high frequency response. Unlike many previous power transistors, the new types will produce nearly full output up to at least 100 kHz. Since feedback is used only in one voltage amplifier of the "L'il Tiger" amplifier stage (see Fig. 1), the overall circuit is extremely stable and needs no tricky amounts of high-frequency compensation.

A suitable 45-volt power supply for the "L'il Tiger" is presented in Fig. 2. Power output for various values of supply voltage and load impedance is given in Fig. 3, while Fig. 4 delineates the performance possible with a 45-volt power supply and an 8-ohm speaker. All of this performance can be had at a cost of around 50-cents-per-watt (less the cost of the power supply).

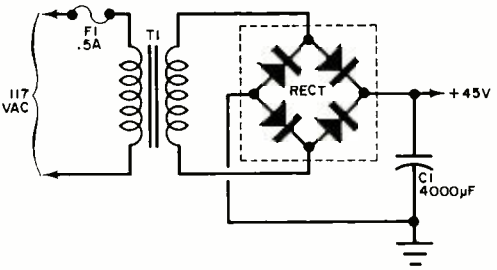


Fig. 2. Power supply for the "L'il Tiger" uses a conventional bridge rectifier and capacitor filter.

Construction. Figure 5 is an actual-size PC board foil layout, while Fig. 6 shows

HOW IT WORKS

The "L'il Tiger" circuit consists of a pair of compound emitter followers (*Q2-Q4*, and *Q3-Q5*), and a voltage amplifier (*Q1*). To prevent crossover distortion in the Class B output and driver stages, the emitter followers are biased *on* slightly by a network consisting of *D1*, *D2*, *D3*, and resistor *R6*. This method of operation results in excellent thermal stability under almost any load and temperature conditions.

The audio signal on the output line (to terminal B on the PC board) is also coupled to the junction of *R7* and *R8* via capacitor *C4*. This coupling causes the instantaneous voltage at the junction of the two resistors to follow any variation in output voltage. The immediate result is that the voltage across *R7*, which is the collector load resistor of *Q1*, remains constant and does not drop to zero when a large, positive half-cycle signal is applied to the amplifier. The end result is the reduction of distortion by the emitter followers with decreasing supply voltage.

Voltage amplifier *Q1* is a common-emitter stage having a small amount of emitter resistance (*R4*) to compensate for variations in the transistors used. The bias point for *Q1* is stabilized by d.c. feedback from the output through *R5* and *R2*. Capacitor *C3* passes the audio signal around *R5*, thus producing a.c. feedback which is not affected by any setting of *R5*. Potentiometer *R5* sets the bias for the output stages. To prevent the driving source (preamplifier, etc.) from affecting the feedback loop, resistor *R1* is introduced between the signal input and the base of *Q1*.

Output from the amplifier is taken via capacitor *C5*, whose value determines the low-frequency 3-dB point, which is about 20 Hz. The high-frequency cutoff (3-dB point) is determined by the transistors and feedback circuit. High-end cutoff is about 100 kHz.

the parts location and connection points to the printed board. The leads of the power transistors must be bent as shown in Fig. 7 so that each transistor mounting hole is aligned with the mounting hole on the printed board.

Figure 7 also shows the method of installing the heat sink and diode mounting clip to each power transistor. When the transistors are installed, the leads of *Q4* face *C5*, while the leads of *Q5* face toward *Q3*. Figure 8 shows *Q4* positioned and ready for heat sink and diode clip mounting. (Also see front cover.)

The cup-type #4-40 lock washer shown in Fig. 7 *must* be used to prevent cracking the power transistor case when it gets warm and expands. Silicone grease *must* be used between each transistor and its heat sink. Diode *D1* is connected to the clip mounted on the *Q4* heat sink, while diode *D3* is clipped to the *Q5* heat sink.

If you are planning to use the amplifier with 12- to 18-volt power supplies,

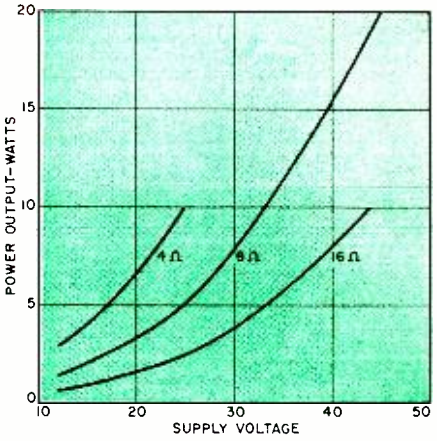


Fig. 3. If you know supply voltage and speaker impedance, amplifier power output can be determined.

AMPLIFIER PARTS LIST

C1, C6—10-μF, 15-volt electrolytic capacitor
C2—200-μF, 6-volt electrolytic capacitor
C3—30-μF, 6-volt electrolytic capacitor
C4—10-μF, 25-volt electrolytic capacitor
C5—1000-μF, 25-volt electrolytic capacitor
D1, D3—1N3754 diode
D2—1N645 silicon bias diode, or similar
Q1—Motorola MPS 6566 transistor
Q2—Motorola MPS 6533 transistor
Q3—Motorola MPS 6530 transistor
Q4—2N4918 transistor
Q5—2N4921 transistor
R1, R3, R7—4700-ohm, ½-watt resistor
R2—47,000-ohm, ½-watt resistor—see text
R4, R6—100-ohm, ½-watt resistor—see text for R6
R5—50,000-ohm, ¼-watt trimmer potentiometer (CTS X-201, or similar)
R8—1000-ohm, ½-watt resistor
R9, R10—470-ohm, ½-watt resistor
2—Staver V1-1 heat sinks
2—Diode mounting clips (RCA S42100, or similar)
*1—Printed circuit board**

*An etched and drilled circuit board is available from Southwest Technical Products Corp., 219 W. Rhapsody, San Antonio, Texas 78216, for $2.25 postpaid: specify #140 when ordering. A complete set of parts, including the circuit board, is available for $10 postpaid: specify #CA-140 when ordering.

POWER SUPPLY PARTS LIST

C1—4000-μF, 50-volt electrolytic capacitor
F1—0.5-ampere fuse
RECT—100-PIV bridge rectifier (Varo VS-248, or similar)
T1—Power transformer: primary, 117 volts; secondary, 34 volts, 1.5 ampere (Southwest Technical Products T34P15, or similar)

A kit consisting of the above parts plus chassis and hardware (for stereo version) is available from Southwest Technical Products Corp. for $15; specify #P-140 when ordering.

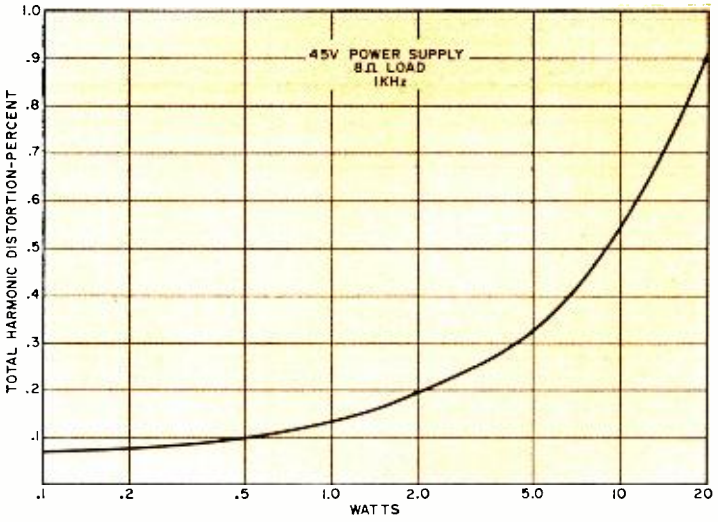


Fig. 4. Performance that can be expected from the "L'il Tiger" amplifier when using an 8-ohm speaker and a 45-volt power supply. Total harmonic distortion hits 1% at about 22 watts output.

Fig. 5. Actual-size photo of amplifier printed circuit board can be copied or the board can be purchased etched and drilled (see note in Parts List).

the value of *R2* should be changed to 22,000 ohms. You will note that the schematic and PC board show an extra input terminal marked "Reverb Input." This input has been provided to make possible the use of a reverb adapter scheduled for the next issue (January, 1968). The extra input can also be used as a mixer input by adding a 4700-ohm resistor in series with capacitor *C6*—for public address work, for example, where a microphone and phonograph are both fed into the same amplifier.

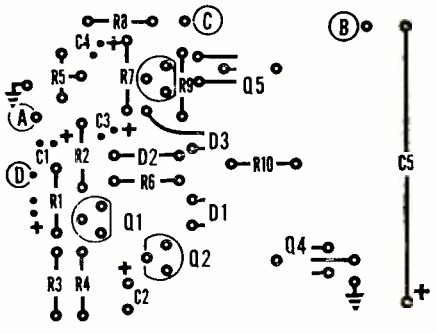


Fig. 6. Component layout on the reverse side of the circuit board. The unidentified transistor is Q3.

Testing and Use. The only adjustment that should be necessary is setting *R5*

SPECIFICATIONS

Power Output	18 watts r.m.s., 22 watts IHFM per channel into an 8.0-ohm load with 45-volt power supply
Distortion	Less than 1% total harmonic up to full rated output
Frequency Response	3 dB down at 20 and 100,000 Hz
Input Impedance	Approximately 5000 ohms
Output Impedance	Approximately 0.1 ohm (damping factor of 80 with 8-ohm load)
Hum and Noise	More than 80 dB below 1 watt
Sensitivity	1.5-volt input for 20-watt output
Supply Voltage	12 to 45 volts d.c.

to a point that puts half of the power supply voltage across each of the output transistors. When balancing the supply voltage, measure the voltage from ground to the emitter of *Q5*.

The idle current of the amplifier should be between 5 and 10 milliamperes. If other than a 40- to 45-volt supply voltage is used, the value of *R6* should be increased slightly to bring the idle current into this range. The amount of resistance needed can be found by inserting a milliammeter in series with the power supply voltage source and using a 500-ohm potentiometer in the circuit in place of *R6*.

(*Continued on page* 98)

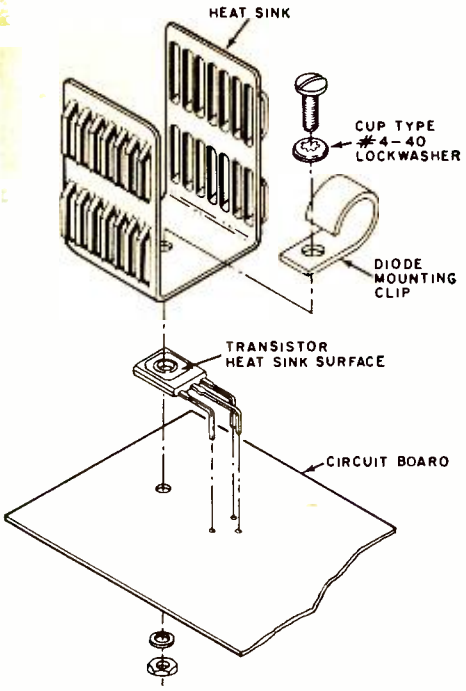


Fig. 7. Method of installing each power transistor, heat sink, and diode mounting clamp. The cup-shaped lock washer is necessary to prevent cracking the power transistor when it gets hot after long use.

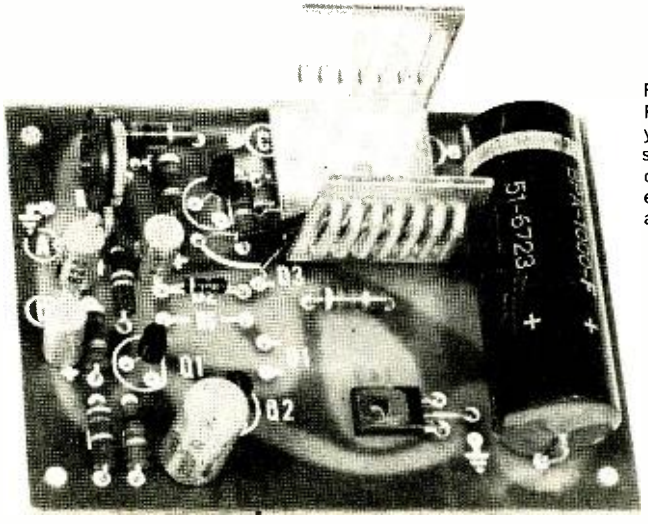
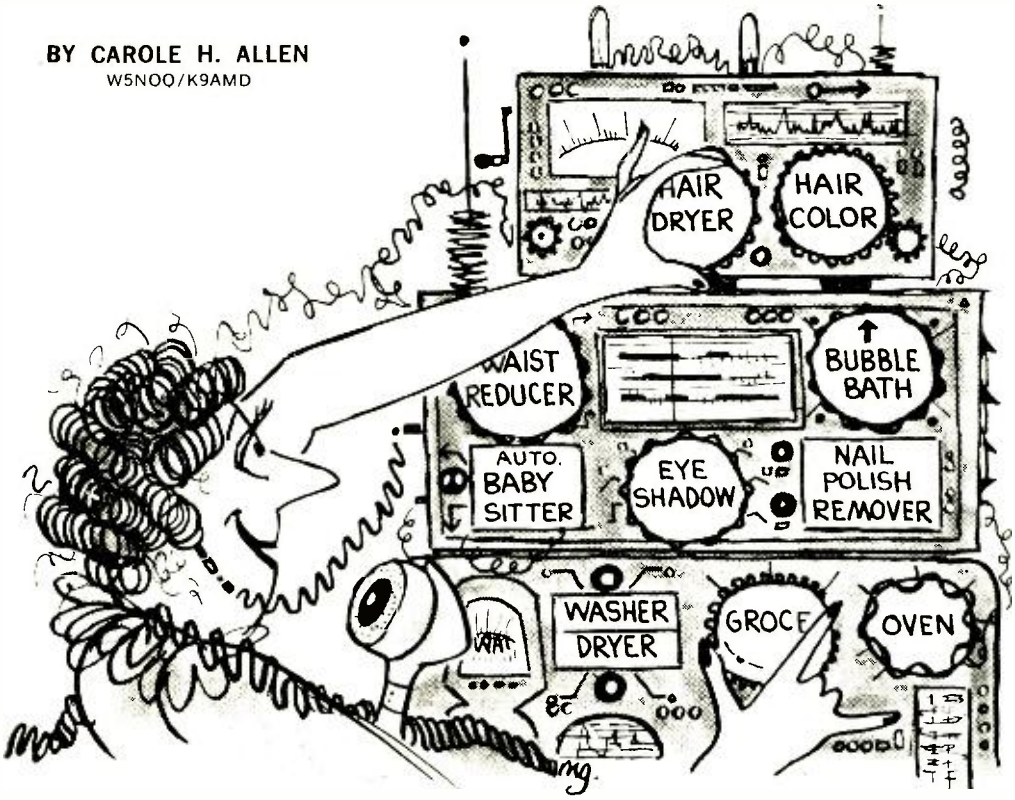


Fig. 8. This is the way the PC board should look after you install one power transistor/heat-sink/ diode-clamp combination. The other power transistor is mounted and awaiting its remaining parts.

BY CAROLE H. ALLEN
W5NOQ/K9AMD



Why Not A Ham License

Or, Who Wants To Be an Electronics Technician Anyhow?

"BUT, Bill," I wailed, "You told me if I worked real hard and got my General ticket I'd be set for life! You should hear all the talk on twenty about the new licenses. I'm going to be a 'second-class' ham if I don't get another license!"

My OM shrugged his shoulders and sighed, probably in chorus with hundreds of other shrugging, sighing husbands around the country. I'm no dumb brunette, but I'm not exactly a Madame Curie-type either, and learning what makes a ham rig run took more than just reading the ARRL Handbook. There were hours of study, evenings of talk sessions, many visual aids, and countless prayers, before I was ready to go before the examiner. The License Manual I studied looked shaggier than a public phone directory when I finished, and my code records wore thinner than my husband's patience.

ILLUSTRATION BY MORT GERBERG

Just For Ladies?

But now what do I hear? My precious "General Class" will become the lesser-license as others attain the Advanced and Amateur Extras and move to their exclusive areas of the bands. This drastic action by the powers-that-be is forcing my hand! Maybe no one in a high place will admit it, but I contend there is a minority group that will be discriminated against even more in the future than in the past. Who? The licensed ladies, of course!

Granted, every gal on the air should know every rule and regulation, and I for one am glad I studied inductance, capacitance, transformers, swinging chokes, and the whole works. But from now on, there really is no point in my burning the midnight oil to study for a more difficult examination. One rarely works for skills and knowledge he will not put to use; and let's face it—how many women would really use the highly technical data required to pass the new examinations? No, I don't know what the questions will be, but I can guess.

Frankly, it wouldn't matter if I had a First Class Commercial license, an Amateur Extra, and had orbited the earth—my OM wouldn't allow me to modify, repair, or do anything but turn the knobs of his super-sophisticated transceiver. Furthermore, he doesn't particularly appreciate my opinions when there is a rig break-down, even if it's just a blown fuse. Not that he resents my having a license—not in the least. He encourages me to use the equipment every day and actually goads me into working DX and entering contests. But when it comes to touching the equipment with anything other than my pinky, well, that's his department.

And practically every male operator on the bands today would never ask a YL or an XYL for a technical opinion other than a modulation report, and wouldn't believe her answer if he did. So, why should I leave the dirty dishes in the sink, have peanut butter sandwiches for weeks, and develop tension headaches to get an Advanced or Amateur Extra license? However, I would do all that and more if there were a license for the minority group of lady operators that we could really use. And there could be such a license.

It's a well-known fact that most ladies promote a more appealing image of ham radio and of the United States than men do. And aren't these skills needed as desperately today as the ability to repair radar and work a formula a foot long? Where but on the ham radio bands can there be casual people-to-people contacts with other countries of the world? One QSO between a friendly Yankee and a resident of an iron-curtain country can probably help the U.S. image more than tons of propaganda brochures.

Why can't we ladies officially be given this assignment? We'll tackle it with more pep than we use behind the scrub mop. We'll study a public relations manual a foot thick to pass a day-long exam for a license we can really use. We'll take the Novice, the General, and then the Ambassador Class license, if there could be one.

And we'll train especially well for handling disaster traffic and maintaining communications to earthquake, flood, tornado, and hurricane-ravaged areas. After all, a lot of women are free to stay at a rig during the hours when their OM's are working at their jobs.

In conclusion, I'm only asking that lady hams be allowed to do what they can do better than anyone else. Let us be Ambassadors for Uncle Sam while performing the public services for which ham radio has earned such a fine reputation. -30-

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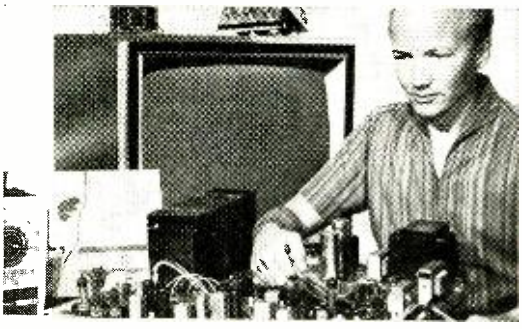

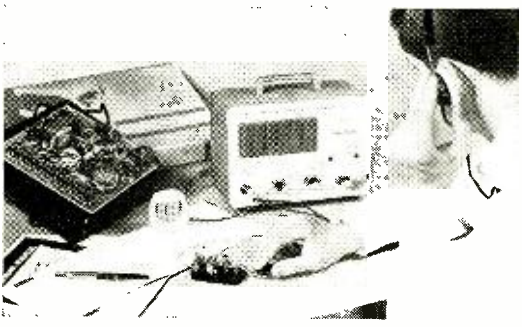

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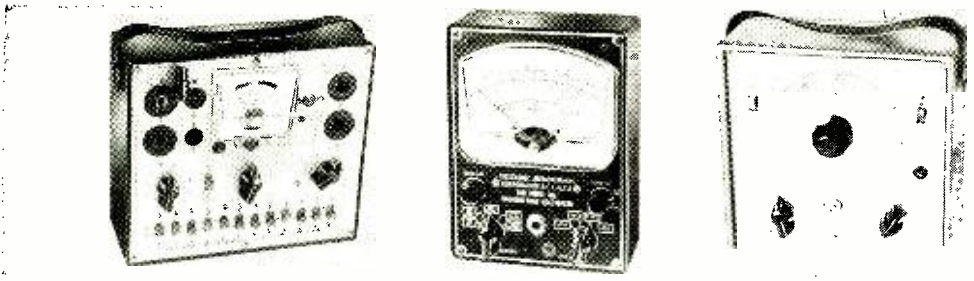

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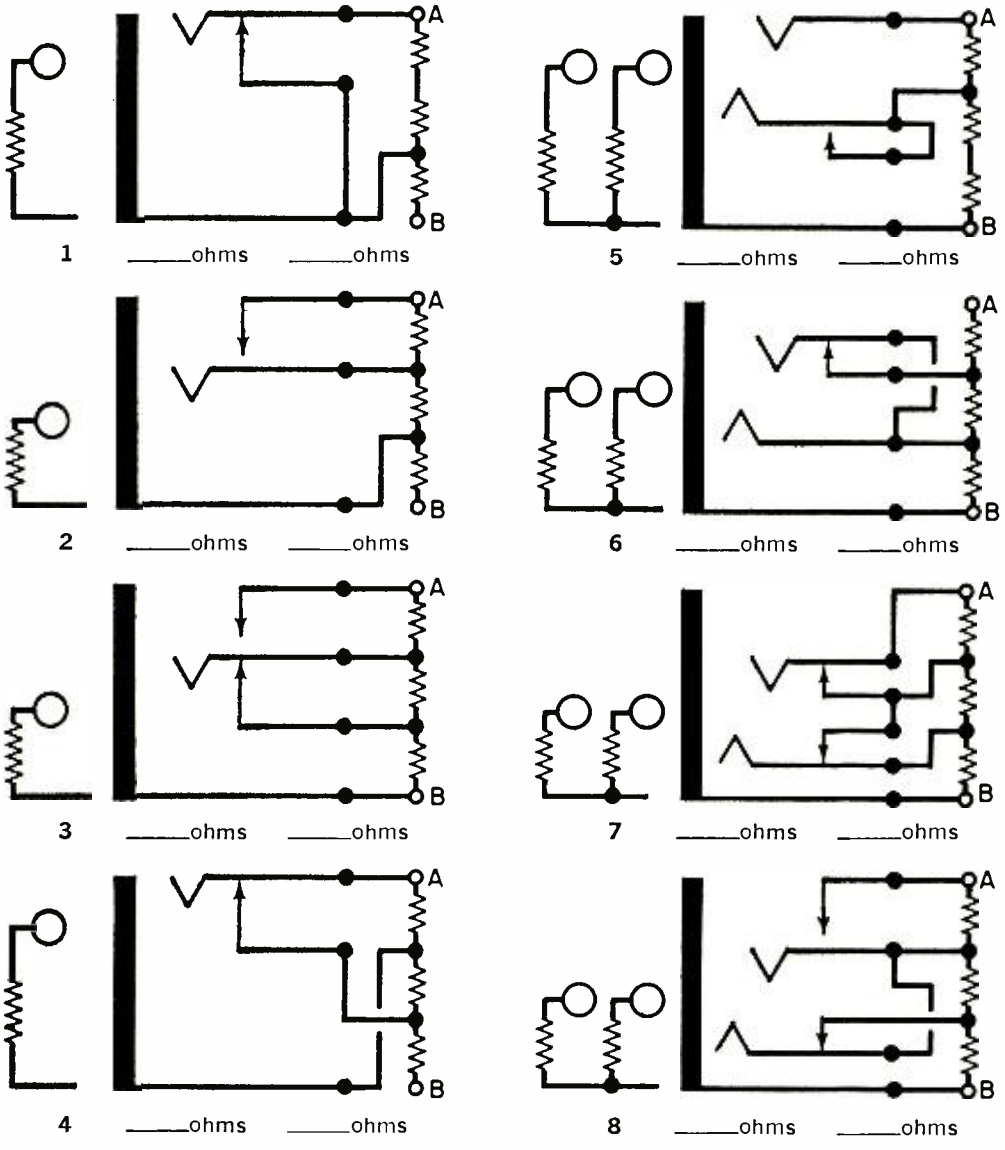
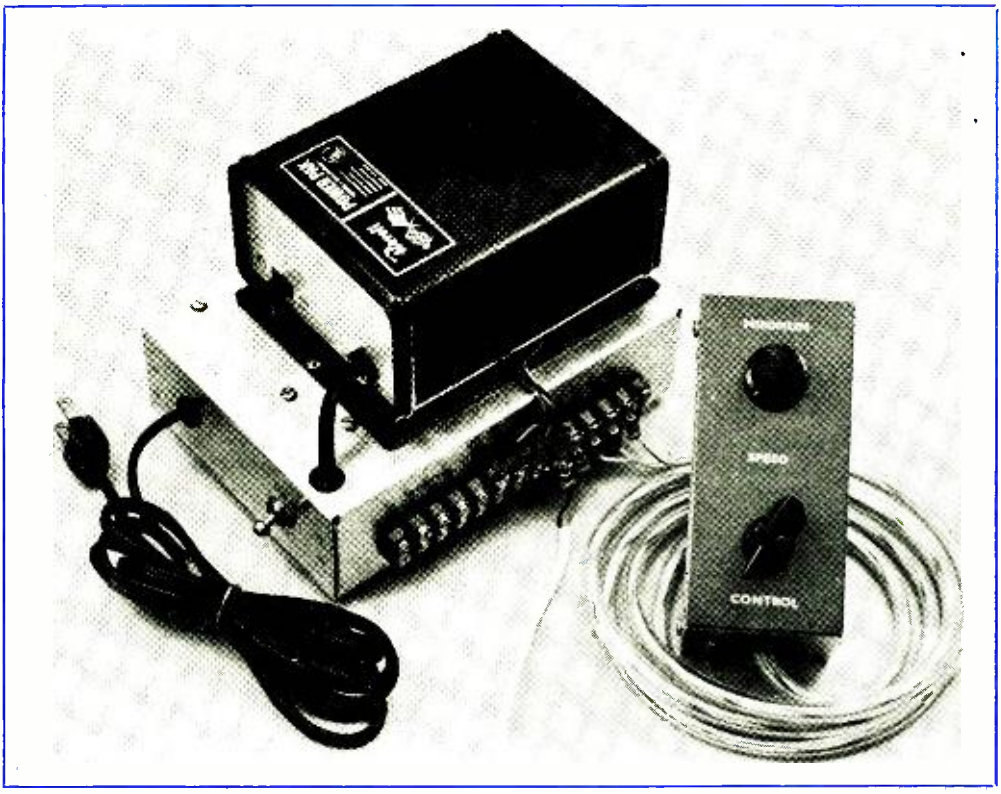
Plug and Jack Quiz

BY ROBERT P. BALIN

Plugs and jacks are used not only to connect various units of electronic equipment together, but also to perform a variety of switching operations at the same time. To test your ability to analyze plug and jack connections, sharpen your pencil and try working the circuit problems (1-8) shown below. Determine the total equivalent resistance between points A and B in each circuit BEFORE and AFTER the plug is inserted in the jack. All of the resistors are 6-ohm units.

(*Answers on page 115*)





Modern Slot-Car Controller

ANY SPEED AT MAXIMUM TORQUE WITH ELECTRONIC BRAKING AS A BONUS

BY BRIAN C. SNOW

IF YOU are a slot-car racing enthusiast, you probably have lost your patience with the conventional hand control. Although these hand controls *can* be mastered, they frequently cause more trouble than they are worth. If, however, you are both a slot-car and electronics enthusiast, you can build an electronic speed controller which will give you complete control over your slot car—at all times—at speeds ranging from a slow crawl to all-out.

Unlike rheostat control of motor speed which wastes power in heating the rheostat and loses motor torque, the pulse method of power control used in this controller is very efficient and produces a wide range of slot-car motor speed control *with* optimum motor torque at all speeds. As a bonus, this circuit includes an efficient electronic brake.

The speed controller described in this article contains two electronic assemblies on the same PC board, so that one assembly controls two tracks independent of each other, with each track having its own hand controller. A common power supply handles both assemblies.

The controller is connected between your conventional track power supply

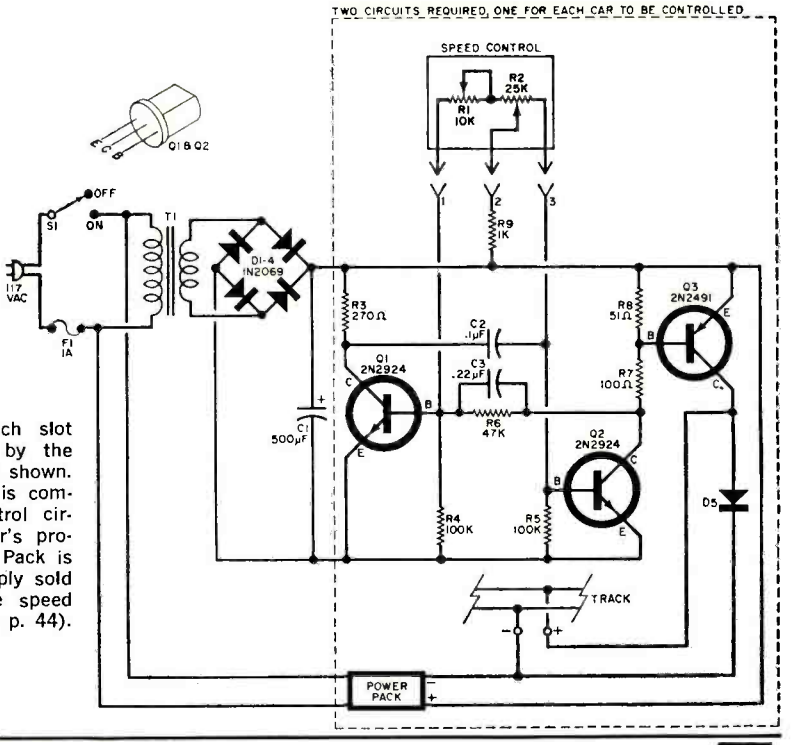
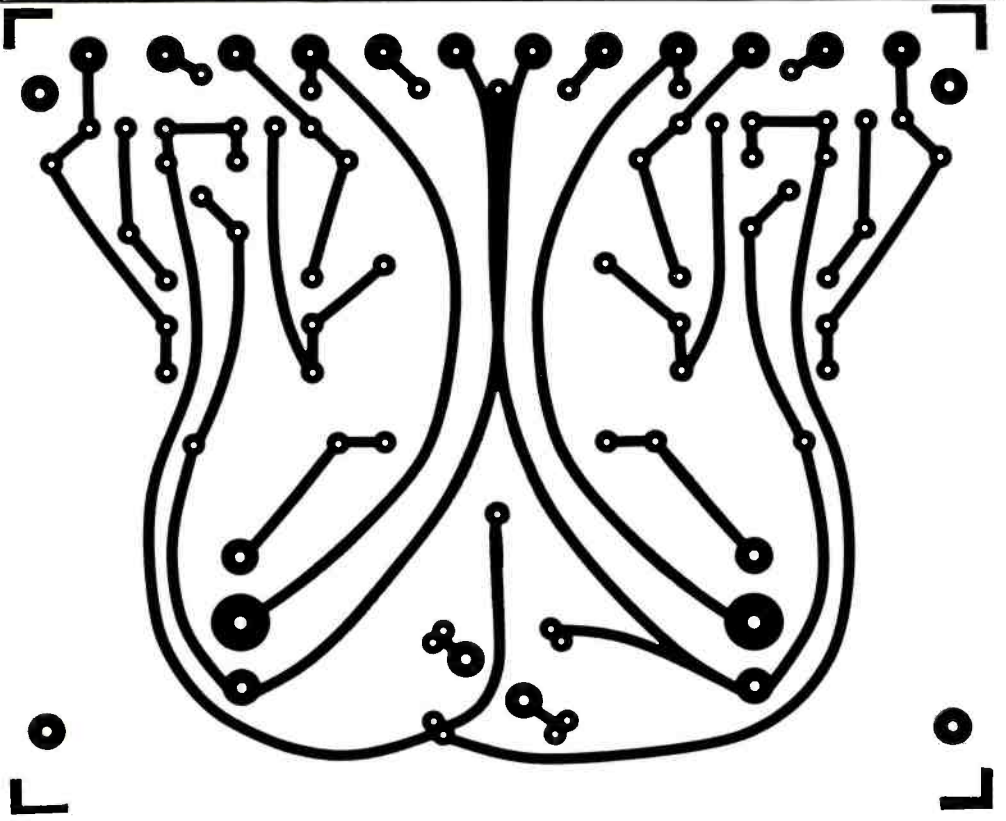


Fig. 1 (right). Each slot car is controlled by the 3-transistor circuit shown. The power supply is common to both control circuits in the author's prototype. The Power Pack is the usual d.c. supply sold for slot cars. The speed control is new (see p. 44).



PARTS LIST

C1—500-μF, 25-volt electrolytic capacitor
C2—0.1-μF capacitor (2 needed)
C3—0.22-μF capacitor (2 needed)
D1, D2, D3, D4, D5—1N2069 diode (6 needed)
F1—1-ampere fuse with holder
Q1, Q2—2N2924 transistor (4 needed)
Q3—2N491 transistor (2 needed)
R1—10,000-ohm linear taper potentiometer (2 needed)
R2—25,000-ohm linear taper potentiometer (2 needed)
R3—270-ohm, ½-watt resistor (2 needed)
R4, R5—100,000-ohm, ½-watt resistor (2 needed)
R6—47,000-ohm, ½-watt resistor (2 needed)
R7—100-ohm, ½-watt resistor (2 needed)
R8—51-ohm, ½-watt resistor (2 needed)
R9—1000-ohm, ½-watt resistor (2 needed)
S1—S.p.s.t. switch
T1—Power transformer: primary, 117 volts a.c.; secondary, 6.3 volts a.c., 0.6 ampere
1—5" x 7" x 2" metal chassis
2—5" x 2¼" x 2¼" metal boxes
1—12-terminal barrier strip (Cinch-Jones 12-140-Y or similar)
4—#6 x ¼" x ½" standoffs
Misc.—Solderless crimp terminals, ¼"-i.d. rubber grommets, knobs, cable clamps, 6-32 screws, 10-32 nuts and washers to mount both Q3's, line cord, decals, wire, solder, etc.

The circuit board and heat sinks are available for $3, and a complete kit for $25, both postpaid, from Brian Snow, Box 228D, RR2, Russiaville, Ind. 46979.

HOW IT WORKS

The output of transformer *T1* is full-wave rectified by *D1* through *D4*, while capacitor *C1* acts as a filter. The remainder of the circuit is in duplicate, one for each track. Only one track system is discussed in the following paragraphs.

Transistors *Q1* and *Q2*, together with their associated components, make up a multivibrator whose oscillation rate is determined by the setting of potentiometers *R1* and *R2*. Variation in the setting of these potentiometers causes the multivibrator to oscillate from zero to a median of 400 Hz. The output of *Q2* is directly coupled to control transistor *Q3*, causing *Q3* to switch on and off in step with *Q2*.

The d.c. output of the power pack (usually supplied with the slot-car track as a means of powering the cars) has its negative lead connected directly to one track, and its positive lead connected to the other track through series transistor *Q3*. Therefore, the slot-car track will receive power only when *Q3* is turned on.

When the multivibrator is operating at a high repetition rate, the track is supplied with a series of narrow power pulses. When the multivibrator is operating at a slower rate, the track receives a series of wider power pulses. The inertia of the slot-car integrates these power pulses so that the narrow pulses represent a simulated throttle reduction (with high torque, however), while the wider pulses represent a simulated throttle opening.

Diode *D5* protects *Q3* and simultaneously acts as an electronic brake for the car being controlled. During the intervals when *Q3* is turned off, the track receives no voltage from the power pack. However, the car is still in motion and its motor acts as a voltage generator, feeding an undesired voltage into the track. It is possible for this voltage to reach a value capable of breaking down *Q3*. Diode *D5* acts as a short circuit to this voltage, removing the breakdown danger, while also acting as an electronic fast-acting brake.

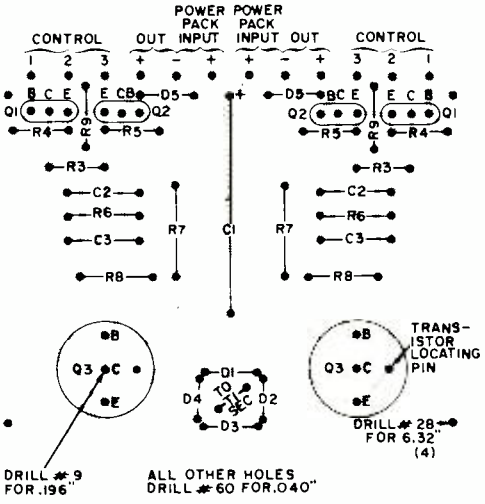


Fig. 3 (above). Component placement for circuit board. Note duplication of parts; one PC board controls two slot cars.

Fig. 2 (left). Actual-size layout of printed circuit board used by author.

and the track proper—no modification is required for most installations. This controller has been used with the Aurora HO and the Revell 1/32-scale slot-car sets.

When not used with slot cars, the speed controller can be employed to vary the r/min of any small d. c. motor requiring up to about 30 volts, but not drawing more than 4 amperes in its "worst-case" (usually stalled) condition.

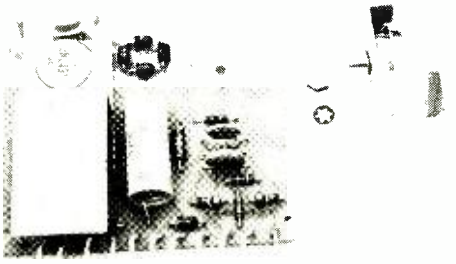


Fig. 4 (right). Transistor Q3 (and heat sink) were temporarily removed from the PC board to show mounting arrangement.

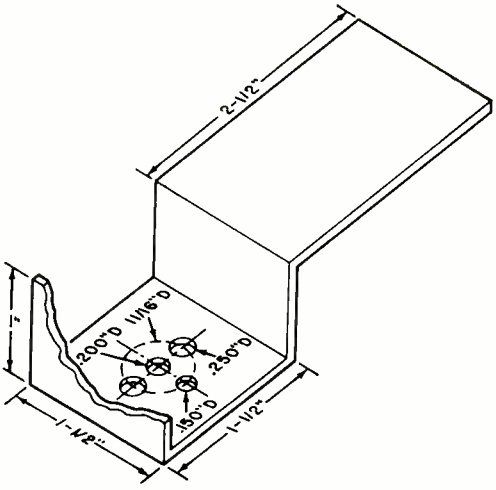


Fig. 5. Drilling and bending details for the heat sinks used at Q3. Cut from aluminum sheet stock.

Construction. The speed controller consists of three sections (see photo on page 41 and Fig. 1): the electronic switcher whose chassis also mounts the track power supply; and a pair of remote speed control units (one for each track) connected to the electronic switcher via lengths of three-conductor cables.

The electronic switcher uses a printed board, the actual-size layout for which is shown in Fig. 2. Figure 3 illustrates the parts layout. Heat sinks for the output transistors (both *Q3*'s) are fabricated as shown in Fig. 5, and a completed PC board is shown in Fig. 4.

When assembling each *Q3* and its heat sink, cut off the flat-lip portion of the emitter and base leads to allow the terminals to slip through the heat sink and into the PC board. A *10-32* washer between the heat sink and the circuit board (on *Q3*'s stud) provides the necessary clearance for the transistor's locating pin. The transistor and heat sink are then mounted to the circuit board.

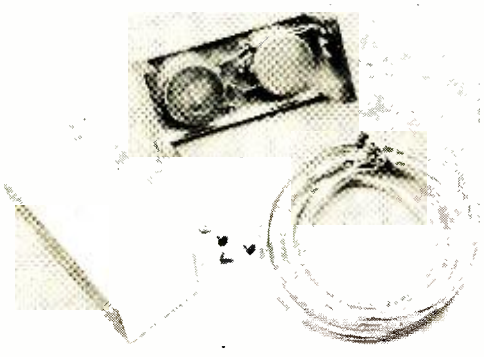


Fig. 6. Speed control is simply two potentiometers.

Mount the printed board assembly within a chassis (5" x 7" x 2") as shown in the photo on page 92, along with transformer *T1*, fuse *F1*, power switch *S1*, and a 12-terminal barrier strip to provide the external connections called for in Fig. 3. Note that 12 holes (approximately ¼"-diameter) must be drilled in the chassis so that the terminal pins of the barrier strip protrude into the chassis for wiring to their respective points. Use four ½" standoffs to separate the PC board from the chassis.

(*Continued on page* 92)

WHAT IS PULSE POWER?

The d.c. motor in the slot car requires a certain minimum current (from the track power supply) before it starts to rotate and drive the car. At this minimum current point, the motor is barely rotating and has very little torque ("guts"). It is only when the applied motor current exceeds this minimum that it starts to drive solidly.

Many conventional speed controllers use a hand-controlled rheostat (variable resistance) to control motor current—the less the resistance, the faster the motor runs. Unfortunately, at the low motor speeds, the current flow through the rheostat/motor combination is at borderline minimum, thus affecting motor speed, torque, and car handling. This is also the reason why rheostat-controlled cars always start with a "jerk." If the rheostat is released to cut power from the track, the car remains in motion and it coasts until friction brings it to a stop.

Unlike a rheostat controller, the pulse controller described in this article applies full power to the track in the form of short, full-power pulses only a few milliseconds in duration. The motor immediately starts up at full torque, but before it can overcome the slot-car inertia and get going at high speed, the power is shut off as the pulse comes to an end. However, the car does move. A few milliseconds later, another short pulse of power is applied, and the sequence is repeated.

As more and more power pulses are applied (via the speed control potentiometer), the mass of the slot car integrates these motor power spurts into a smooth flow of power, until the car is moving at a rate dependent on how wide the power pulses are and how often they occur. As the pulses become wider, and occur more often, the average motor power increases to the maximum of the track power supply capabilities.

Build a Stopclock

ELECTRONIC TIMER TURNS ON OR TURNS OFF AT ANY PRESET INTERVAL FROM ONE SECOND TO TEN MINUTES

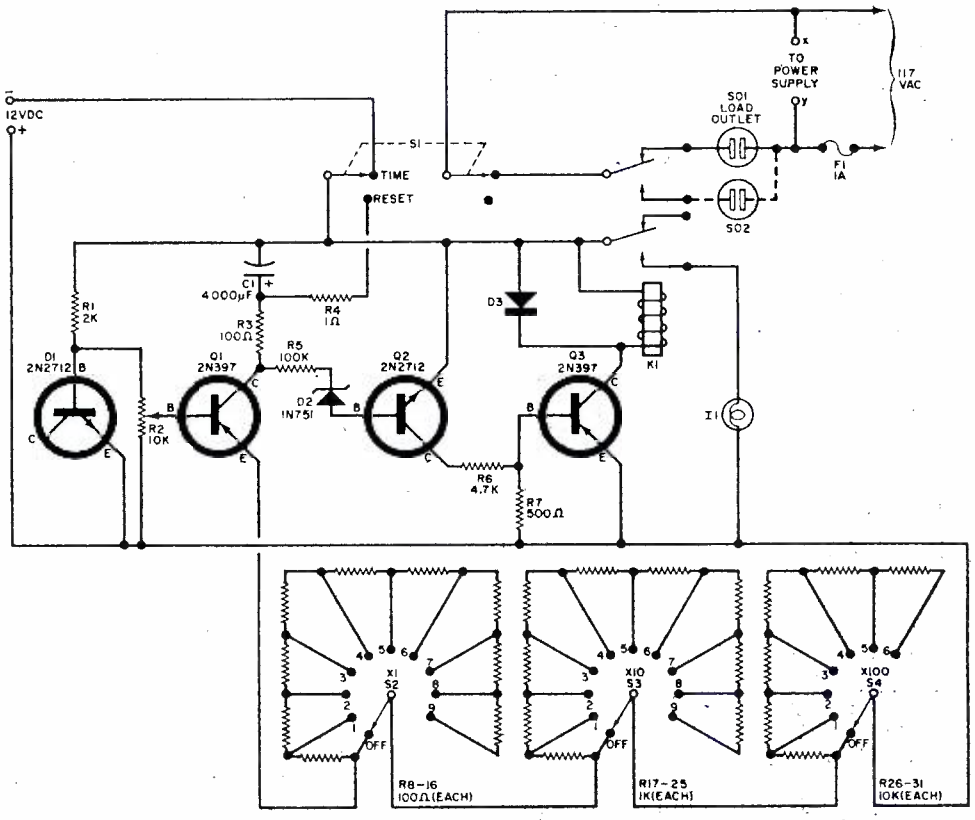
BY W. T. LEMEN

"TIMING IN" or "timing out" makes no difference to the "Stopclock." Easy to build, simple, and reliable, it is accurate enough for most photography, game, or other hobby purposes, turning lights or low-wattage appliances on or off, or for any other use where accurate timing between one second and 10 minutes is required.

Unlike most other electronic timers, this circuit (see Fig. 1) uses a transistor constant-current generator to charge the timing capacitor (*C1*). The rate is relatively linear over most of its charging curve. Since the rate of charge of the capacitor is independent of voltage, overall timing is not seriously affected by the normal variations in the 117-volt a.c. power line. Timing errors of less than 5% can be expected.

To increase the timing versatility, a second load outlet (SO2, shown connected by dotted lines in Fig. 1), can be tied to the unused contacts of the relay (*K1*) so that contact is made when the relay is energized.

Construction. The circuit, including the power supply, can be assembled on a 3½"



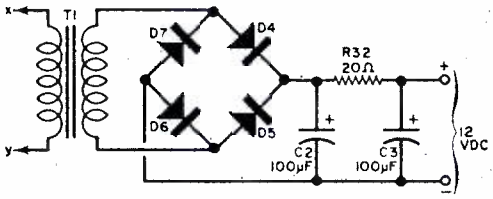
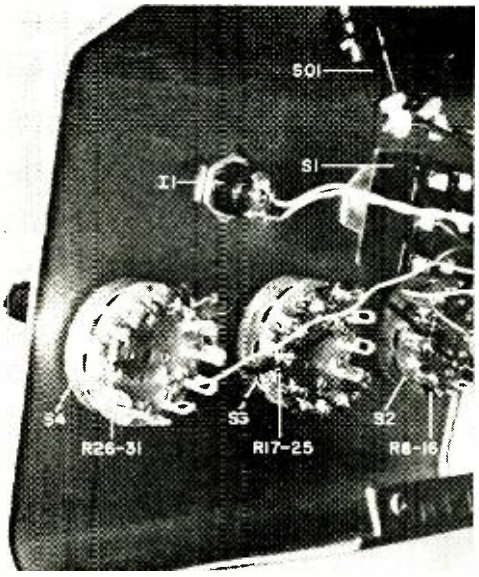


Fig. 1. The Stopclock circuit uses an R/C time base, but the charging current is at a constant rate. Details on circuit operation appear on page 47. Note optional connections to a second a.c. outlet (SO2) which is activated when the Stopclock is turned on and shuts off when the selected timing interval has been reached—just the reverse of the normal operation (SO1).

PARTS LIST

C1—4000-μF, 15-volt electrolytic capacitor (Mallory 15-40A, or similar)
C2, C3—100-μF, 25-volt electrolytic capacitor (Sprague TE1211, or similar)
D1—2N2712 transistor (only base and emitter used)
D2—1N751 zener diode
D3-D7—750-mA, 200-volt rectifier diode
I1—14-volt indicator lamp, with mounting (preferably red window)
K1—D.p.d.t. relay, 12 volts, 80 mA (Potter & Brumfield KM11D, or similar)
Q1, Q3—2N397 transistor
Q2—2N2712 transistor
R1—2000-ohm, ½-watt resistor
R2—10,000-ohm potentiometer
R3—100-ohm, ½-watt resistor
R4—1-ohm, 1-watt resistor (value not critical)
R5—100,000-ohm, ¼-watt resistor.
R6—4700-ohm, ¼-watt resistor
R7—500-ohm, ¼-watt resistor
R8-R16—100-ohm, ¼-watt resistor
R17-R25—1000-ohm, ¼-watt resistor.
R26-R31—10,000-ohm, ¼-watt resistor
} *All ¼-watt resistors ± 10% (see text)*
R32—20-ohm, 5-watt resistor
S1—D.p.d.t. toggle switch
S2, S3, S4—1-pole, 12-position, non-shorting rotary switch (Mallory 32112J, or similar)
SO1, SO2—Chassis-mounting a.c. socket (Cinch-Jones 2R2 or similar; SO2 is optional—see text)
T1—Filament transformer: primary, 117 volts; secondary, 12 volts
Misc.—5¼" x 3½" perforated circuit board; metal cabinet of suitable dimensions; a.c. line cord; hardware; dialplates (2 Mallory 389, 1 Mallory 386); solder, wire, etc.



Timing resistors R8 through R31 are soldered to the terminals of rotary switches S2, S3, and S4. If you use 5% resistors, cut the wire leads short, but use a minimum amount of heat to make connections.

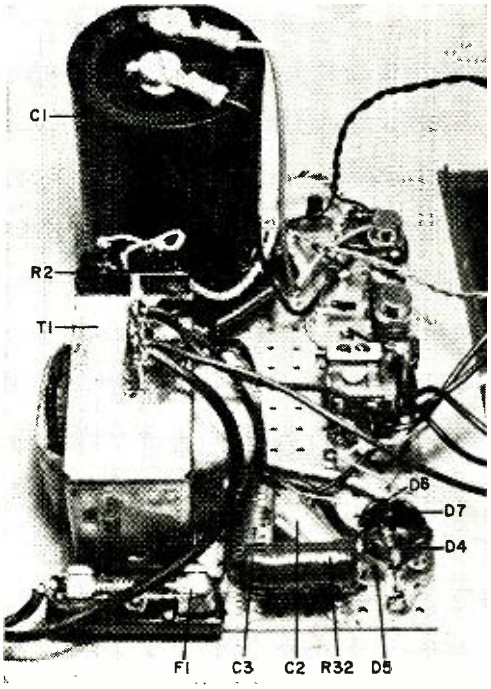
HOW IT WORKS

Constant-current transistor *Q1* has its base voltage controlled by the base-emitter junction of *D1* (actually a 2N2712 transistor without a collector connection). This voltage is applied to *Q1* via timer-calibrate potentiometer *R2*. The collector current of *Q1* is determined by the value of resistance placed in *Q1*'s emitter lead.

This resistance value is selected by *S2*, *S3*, and *S4*, and the circuit has been arranged so that each 100 ohms of resistance added to the emitter of *Q1* equals one second of time. A look at the schematic will show that each step of *S2* adds 100 ohms of resistance; therefore, it can set up to nine seconds. The values of *S3* are one decade larger; therefore, it can set from 10 to 90 seconds. Switch *S4*, still another decade higher, can set from 100 to 600 seconds. By combining switch settings, it becomes possible to insert from one to 699 seconds (11.65 minutes) into the timer. If, perchance, all three timing switches were to be set to their zero state, the current through *Q1* would become excessive, and it is for this reason that limiting resistor *R3* is added to the circuit.

When *Reset-Time* switch *S1* is in the *Reset* state, timing capacitor *C1* is completely discharged by *R4*, and the circuit to the load is opened. When *S1* is placed in the *Time* position, and a time has been selected via *S2*, *S3*, and/or *S4*, the load is supplied with voltage through contacts of *S1* and relay *K1*. Simultaneously, timing capacitor *C1* starts to charge.

As the voltage across *C1* exceeds the breakover point of zener diode *D2* (about 4.5 volts), current flows through *R5* and *D2*, causing transistor *Q2* to saturate. This transistor, in turn, turns on power transistor *Q3*, energizing the coil of relay *K1*. The relay closes, breaks the circuit to the external load, and turns on front-panel indicator lamp *I1* to show that the timing has been completed. Diode *D3*, across the *K1* coil, effectively suppresses the transient high-voltage spikes that are generated across the coil when the current suddenly starts and stops.



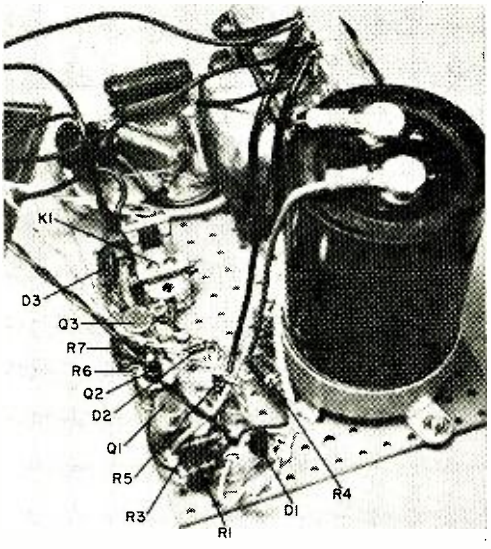
Any layout plan convenient to the builder can be used to duplicate construction of the Stopclock. The author used perforated phenolic board because the circuit was totally enclosed in a metal cabinet.

x 5¼" piece of perforated circuit board. Although the author used a sloping panel cabinet (as shown in photo at right), any other type of cabinet can be used. Mount the *Reset-Time* switch, *S1*, indicator lamp *I1*, and the three timing switches *S2*, *S3*, and *S4* on the front panel. The controlled outlet(s) is mounted on the top surface of the cabinet. No input power on/off switch is provided, because when the unit is not actually timing, power consumption is negligible.

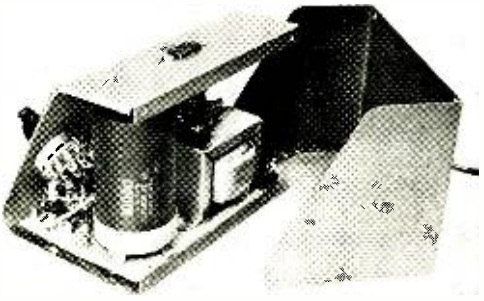
All resistors in the time-setting circuit are ±10%, sorted for 1% tolerance between values. Precision (±1%) resistors can be used if price is not the main consideration.

No heat sinks are required for the semiconductors specified. However, if you attempt to build a timer of great precision, the transistors can be heat-sinked for better temperature stabilization.

Calibration. After completing the timer and inspecting it for correct wiring, plug it into a 117-volt a.c. power line. Adjust potentiometer *R2* to about center range and place the three timing switches in the zero position (one detent below 1).



Parts placement is not critical in circuits like the Stopclock. Point-to-point wiring using small terminals and transistor sockets proved convenient for the author. As mentioned in the caption to the photo above, the size of C1 is larger than need be for this project. Use any metal enclosure to house your duplication of this unusual timer project.



The author managed to squeeze everything in a Bud sloping panel aluminum box (Type AC-1612). A phenolic board bearing most of the wiring is supported away from the metal bottom of the box with short insulating spacers. Size of the box used will be determined by the physical size of charging capacitor C1. A smaller and cheaper capacitor to use would be a Sprague Type 39D electrolytic measuring only 2¼" x 1 1/16" (Allied Radio 43B6509—$2.43 each).

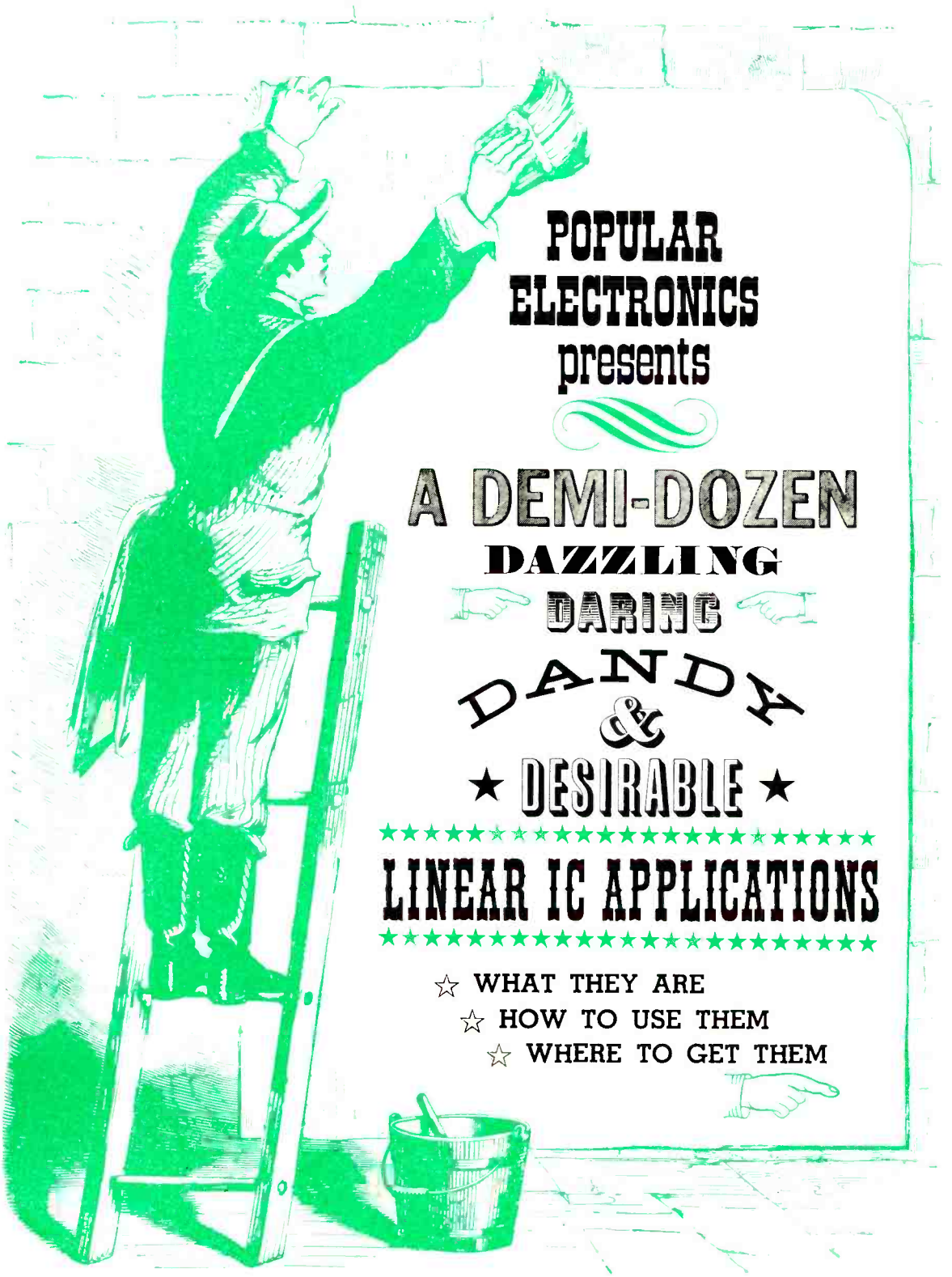
When switch *S1* is placed in the *Time* position, the indicator lamp (*I1*) should come on instantly.

Leaving timing switches *X1* (*S2*) and *X100* (*S4*) in the zero position, set the *X10* (*S3*) switch to position 6 (60 seconds or one minute). Place *S1* in the *Time* position and adjust *R2* until the indicator lamp turns on at exactly one minute.

Most timing errors will occur in the time periods over five minutes. If more accuracy is desired, the 10,000-ohm resistors that make up the *X100* range will have to be independently adjusted as required.

Operation. Connect the "Stopclock" to a 117-volt a.c. source and place the *Reset-Time* switch in the *Reset* position. Connect the load to be controlled to the *Load* outlet socket, then set the *X1*, *X10*, *X100 Seconds* switches to the desired number of seconds. For example, to set up for 4 minutes, put the *X100* switch at position 2 and the *X10* switch at position 4. For 7 minutes and 15 seconds, put the *X100* at position 4, the *X10* switch at position 3, and the *X1* switch at position 5 (total: 435 seconds).

If you wired your model to include a "time-out" provision, the timing function remains the same, but the a.c. output connections will work in reverse. Place the *Reset-Time* switch at *Time* and the "Stopclock" will automatically "time out" to the desired interval. —30—



SIX LINEAR IC APPLICATIONS

BY DON LANCASTER

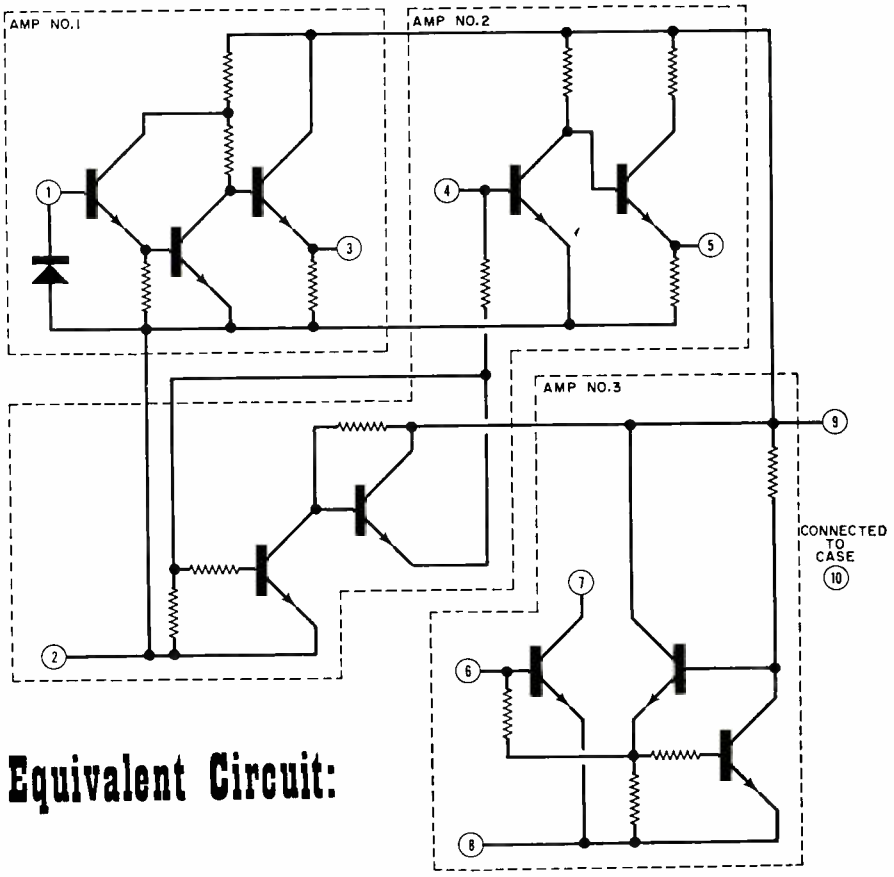
Integrated circuits are basically tiny "active" packages of various combinations of transistors, diodes, and resistors, requiring only connection to external elements to produce complete operating systems similar in most respects to discrete component transistorized systems familiar to most electronics experimenters. Here are six, readily available, low-cost linear IC's and circuits that lend themselves to a number of projects.

1 CA3035 REMOTE CONTROL AMPLIFIER

What It Is:

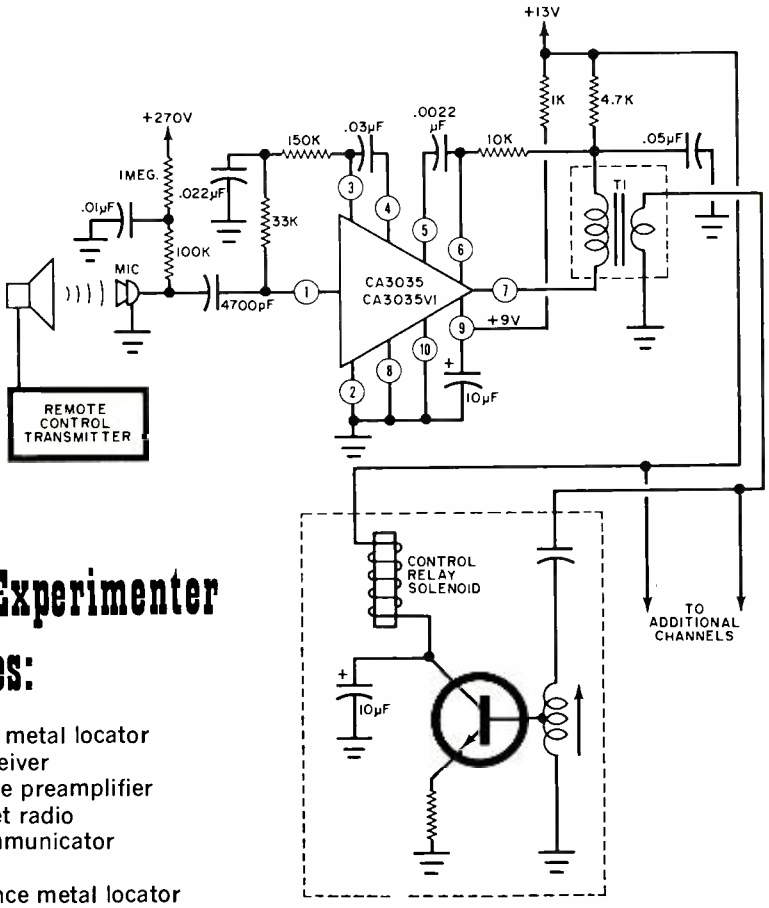
Three separate voltage amplifiers (each X100) in a single package, two having a d.c. to 2-MHz frequency response and one having a d.c. to 500-kHz frequency response and high input impedance. One amplifier will directly drive a headphone.

Equivalent Circuit:



Quickie Project:

ULTRASONIC REMOTE CONTROL activates a control relay if a 40 kHz audio transmitter or tuning fork is activated anywhere within operational range.



Other Experimenter Uses:

Beat-frequency metal locator
Light-beam receiver
General-purpose preamplifier
TRF or superhet radio
Ultrasonic communicator
Burglar alarm
Induction-balance metal locator

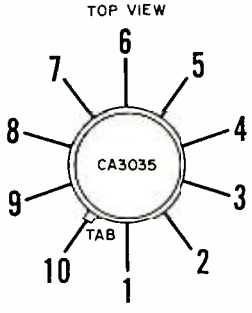
IC Data Sheets Available From:
Radio Corporation of America
Electronic Components and Devices
Harrison, New Jersey

Stocking Distributor:
Allied Radio Corporation
100 N. Western Avenue
Chicago, Illinois 60680
Part Number: 50-E-1-CA3035

Price Each: $2.40

Supply Voltage:
+9 V d.c. at 5 mA, + to lead 9
ground leads 2, 8, and 10

Package:
10-pin TO-5 metal can

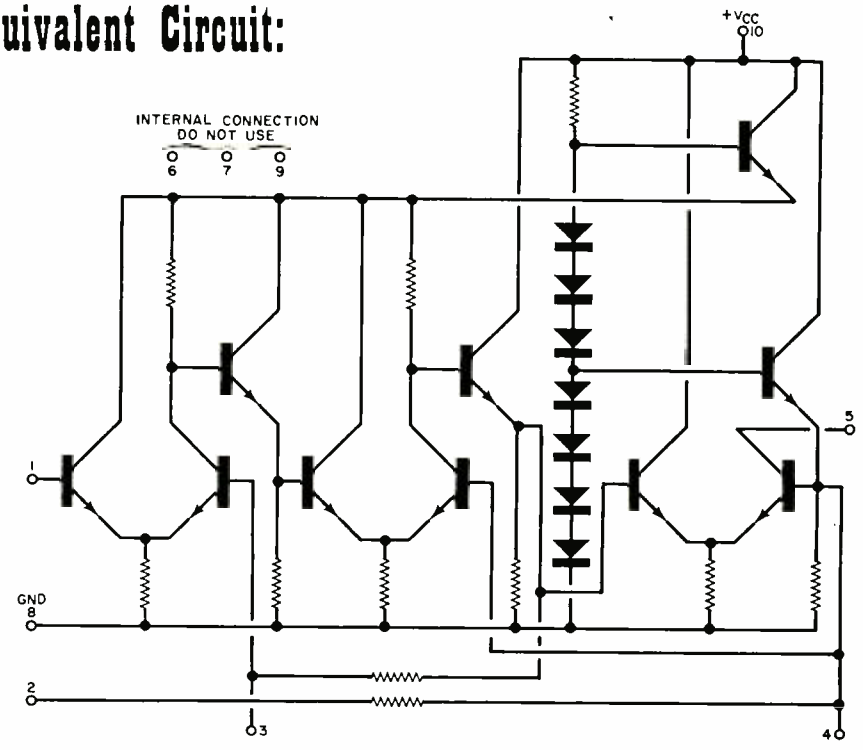


2 CA3011 WIDE-BAND AMPLIFIER & LIMITER

What It Is:

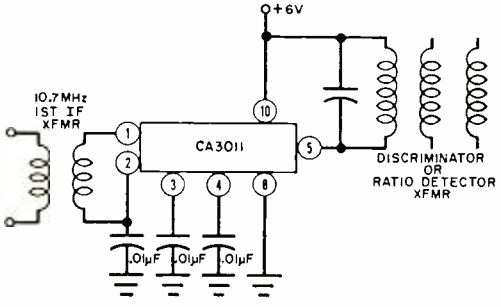
A three-stage, self-limiting r.f. amplifier with a gain of 3000, and an internal regulated power supply. Useful from d.c. to 10 MHz, it limits with 100 microvolts input. Limiting action is symmetrical and of high quality.

Equivalent Circuit:



Quickie Project:

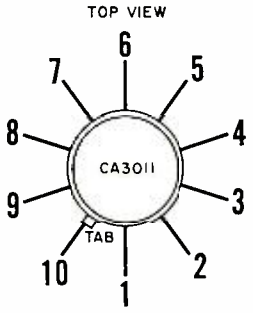
10.7 MHz I.F. STRIP FOR FM RECEIVER replaces conventional FM i.f. from the first i.f. transformer to the discriminator. Unit has an excellent capture ratio.



Other Experimenter Uses:

Phase meter
Audio clipper/limiter
TV sound i.f. strip
Receiver for FM carrier communicator
Square-wave generator
Low-level r.f. amplifier

Data Sheets From:
Radio Corporation of America
Electronic Components and Devices
Harrison, New Jersey
Stocking Distributor:
Allied Radio Corporation
100 N. Western Avenue
Chicago, Illinois 60680
Part Number: 50-E-1-CA3011
Price Each: $2.00
Supply Voltages:
+6 volts at 18 mA,
+ to pin 10, ground pin 9
Package:
10-lead TO-5

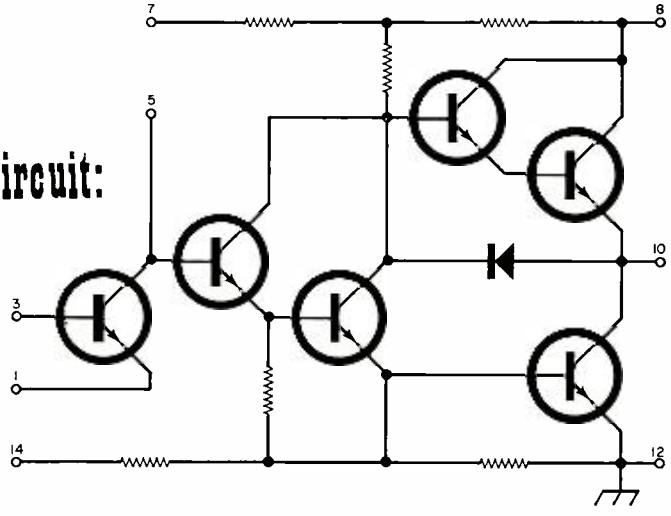


3 PA222 ONE-WATT AUDIO AMPLIFIER

What It Is:

This IC uses a quasi-complementary six-transistor circuit to directly drive a speaker. If it is properly heat-sunk, one watt of audio over a 55- to 15,000-hertz frequency range can be obtained. The typical power gain is over ten million.

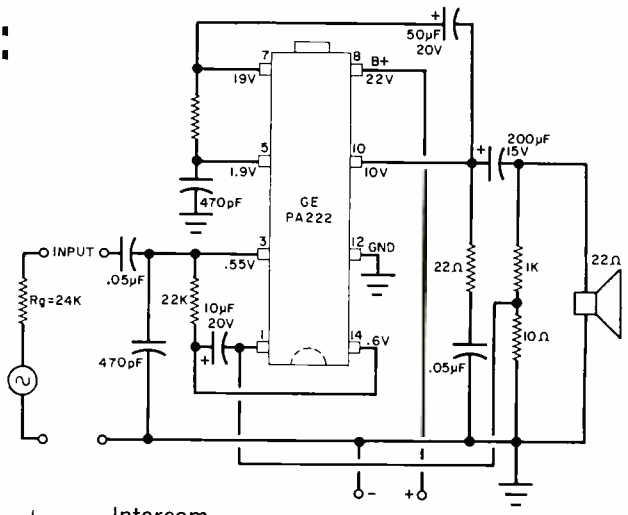
Equivalent Circuit:



Quickie Project:

GENERAL-PURPOSE
ONE-WATT AMPLIFIER

circuit directly drives a 22-ohm speaker without a transformer. Input impedance is 40,000 ohms. Resistor between pins 7 and 5 equals value marked on the IC. The IC must be heat-sunk. Circuit is susceptible to r.f. oscillations unless all leads are short.



Other Experimenter Uses:

Intercom
Radio or phonograph output stage
Walkie-talkie output stage
Monitor amplifier
Electronic crossover network

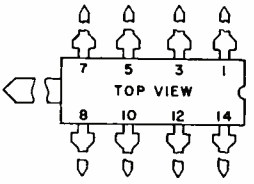
Data Sheets From:
General Electric Semiconductor Products
Electronics Park
Syracuse 1, New York

Stocking Distributor:
Allied Radio Corporation
100 N. Western Avenue
Chicago, Illinois 60680
Part Number: 50-E-3-PA222

Price: $3.70

Supply Voltage:
+22 V at 22 mA, + to pin 8, ground pin 12

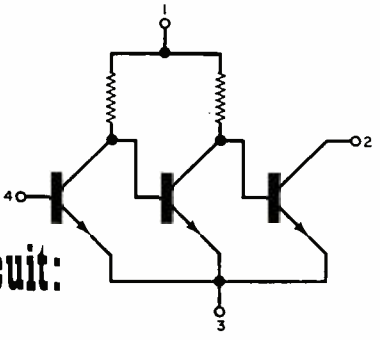
Package:
8-lead, dual in-line package with special heat-sink tab



4 TAA103 SUBMINIATURE AUDIO AMPLIFIER

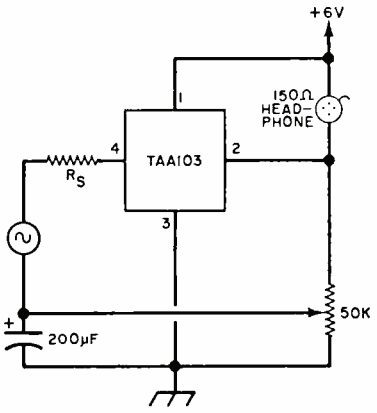
What It Is:

An 0.1"-square by 0.04"-high amplifier that can deliver 10 milliwatts to a headphone; requires 1 nanowatt of input for full output.



Equivalent Circuit:

Quickie Project:

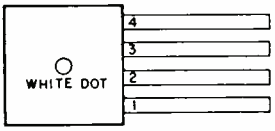


TINY, HIGH-GAIN HEADPHONE AMPLIFIER
provides 70 dB of gain from d.c. to 600 kHz. Volume is controlled by 50,000-ohm potentiometer. R_s should be 1000 ohms or less. A transformer can be added to drive high-impedance phones.

Other Experimenter Uses:

Hearing aid	Stethoscope
Signal tracer	Vibration monitor
Electronic "bugs"	Miniature radio

IC Data Sheets From:
Amperex Electronic Corporation
Slatersville, Rhode Island 02876
Price Each: $2.55
Supply Voltage:
+6 volts at 15 mA, + to lead 1, ground lead 3
Package:
Special subminiature four lead

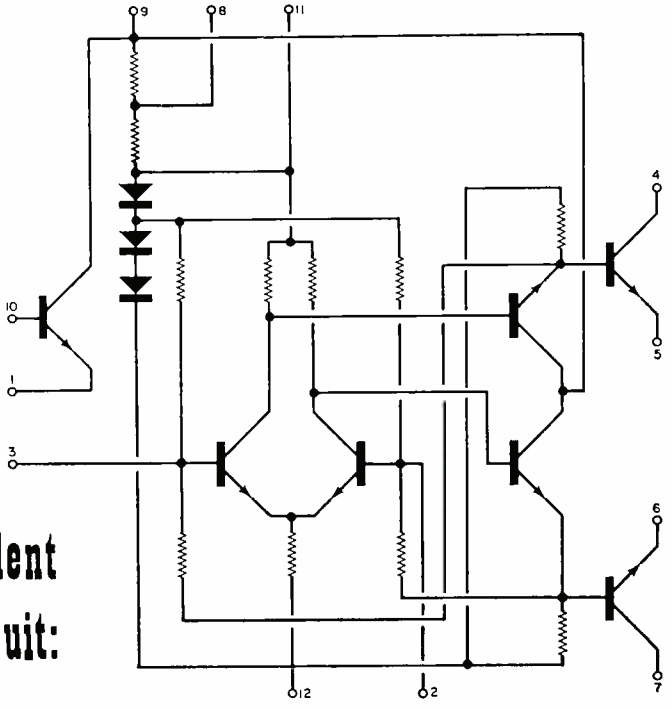


5 CA3020 HALF-WATT AUDIO AMPLIFIER

What It Is:

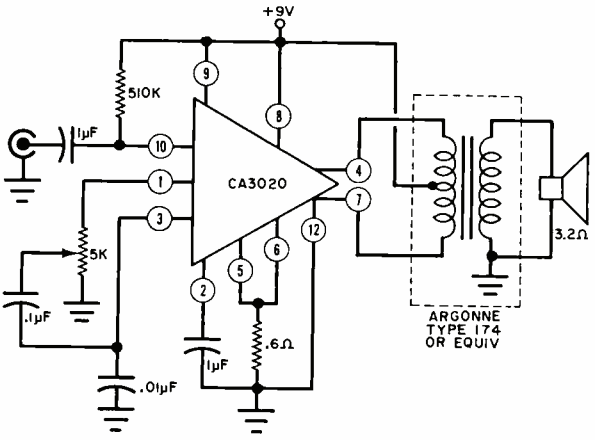
A tiny one-half watt audio amplifier that needs no heat sink and will directly drive a speaker; has high gain and reasonable distortion figures. It consists of a Class B amplifier, a Class A preamplifier and a regulated power supply.

Equivalent Circuit:



Quickie Project:

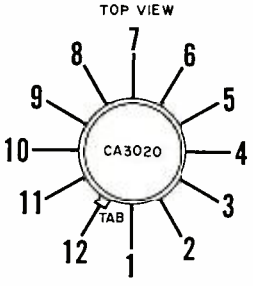
HALF-WATT GENERAL-PURPOSE AMPLIFIER requires 45 millivolts of input signal for full output. Distortion is 3%; input impedance, 50,000 ohms.



Other Experimenter Uses:

Portable phonograph amplifier
Driver for higher-power amplifiers
Signal tracer
Tape recorder monitor
Power supply regulator
Radio output stage

Data Sheets From:
Radio Corporation of America
Electronic Components and Devices
Harrison, New Jersey
Stocking Distributor:
Allied Radio Corporation
100 N. Western Avenue
Chicago, Illinois 60680
Part Number: 50-E-1-CA3020
Price Each: $2.80
Supply Voltage:
+ 9 volts at 22 mA standby, 145 mA at full output, + to pin 8 and 9, ground 12
Package:
12-pin TO-5 metal can

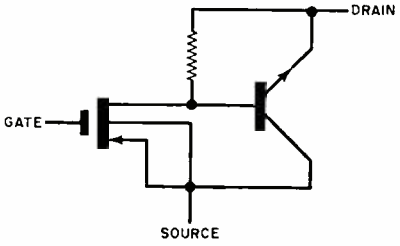


6 TAA-320 BIFET AMPLIFIER

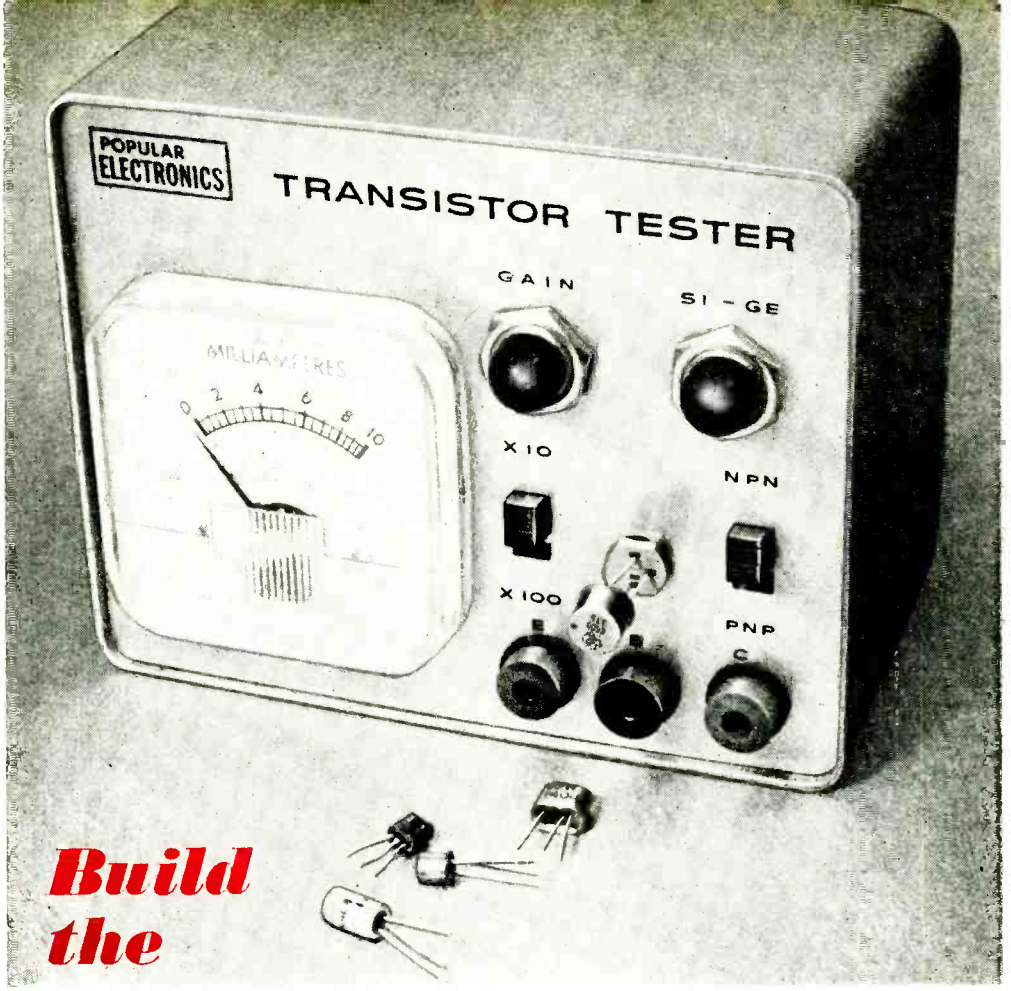
What It Is:

An integrated amplifier having a MOSFET input stage and a conventional transistor emitter-follower output stage. It has an extremely high input impedance and a low output impedance. The only low-cost IC with an input impedance comparable to that of a vacuum tube.

Equivalent Circuit:



(*Continued on page* 118)



Build the NGW Transistor Tester

STOP WONDERING—
THE "NO-GUESS-WORK"
TESTER CHECKS FOR
SILICON-GERMANIUM
AND NPN OR PNP

BY DON LANCASTER

HAVE YOU been tempted to buy a package of those transistor assortments that are being offered for only pennies-per-transistor? Perhaps you have some unmarked transistors (or transistors with production numbers that are meaningless to you) collecting dust in your spare parts box. How can you tell what types of transistors you have and what condition they are in? The answer is simple: build the transistor tester described on the following pages.

This transistor tester is a simple instrument that you can construct for $10 or less. It will check just about any transistor or semiconductor diode for interelement shorts, opens and leakage, and will check transistors for gain. The tester will tell you if a transistor under

test is *npn* or *pnp* and whether it is silicon or germanium.

Construction. The transistor tester's circuitry can be housed in any convenient size metal or plastic case, and since the parts arrangement is not critical, almost any type of chassis construction can be used. The photo on page 59 shows the method used in the prototype.

Since most transistors you are likely to test will have a TO-5 type case con-

HOW IT WORKS

When a small amount of base current controls a large amount of collector current in a transistor, amplification takes place. In most modern transistors, d.c. current gain is essentially equal to the small-signal a.c. current gain all the way up to the low MHz region. This tester measures d.c. current gain by applying a known amount of base current to the test transistor, and then displays the collector current gain on meter *M1*. (When the collector current is divided by the base current, the result will be the d.c. gain of the transistor under test, and this is the figure that will be indicated on the meter.)

All transistors are tested under 1 to 10 mA collector current conditions—about the operating range of most small-signal transistors. Gain for power transistors will be lower than for small-signal types since the power transistor's gain curve peaks somewhere between 100 and 1000 mA. Resistor *R1* serves as a collector load—or current limiter—for all transistors under test, and *R2* and *R3* (when *S3* is set to *X100*) control base current.

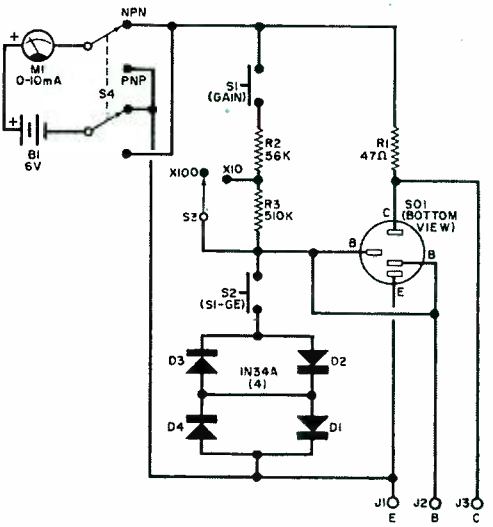
Switch *S2* and diodes *D1* through *D4* form the *SI-GE* test circuit. For normal bias, the base voltage of a silicon transistor will be 0.6 volt and base voltage of a germanium transistor will be 0.2 volt. Two germanium diodes connected in series (*D1* through *D4* are germanium types) require 0.4 volt to conduct—a potential halfway between *GE* and *SI* base voltages. To eliminate complex switching, two germanium diodes are operated in each direction, providing *npn* and *pnp* testing capability.

Diodes are tested on a go/no-go basis when they are connected to the tester as described in "Testing Diodes" (see text).

PARTS LIST

B1—Four 1.5-volt "AA" penlight cells
D1, D2, D3, D4—1N34A germanium diode
J1, J2, J3—Banana jack (one red, one blue, one green)
*M1—0-10-mA d.c. milliammeter**
*R1—47-ohm, ½-watt resistor**
R2—56,000-ohm, ½-watt resistor
R3—510,000-ohm, ½-watt resistor
S1, S2—S.p.s.t. momentary-action, normally-open push-button switch
S3—S.p.s.t. slide switch
S4—D.p.d.t. slide switch
SO1—TO-5 transistor socket
1—3" x 4" x 5" aluminum box—see text
Misc.—Double AA battery holders (2), external test leads (3), banana plugs (3), #10 nylon cup washers for feet (4), wire, solder, hardware, etc.
Optional—Metalphoto hard-anodized aluminum dialplate, available from Reill's Photo Finishing, 4627 N. 11th St., Phoenix, Ariz. 85014, in silver color for $2.75, in red, gold, or copper for $3.25, postpaid in U.S.A.; specify stock #TRT-1

*The combined resistance of *R1* and *M1* should lie between 200 and 300 ohms.

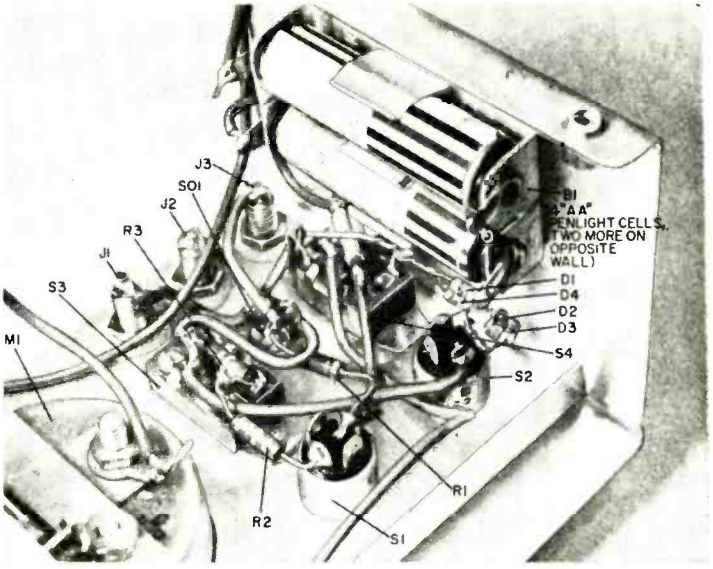


Note that there are two base contacts on SO1 to accommodate both the TO-5 triangular lead configuration and the older in-line arrangement.

TESTING TRANSISTORS

1 Set multiplier switch to X100 and identity switch to NPN. Insert transistor into socket or connect transistor to appropriate leads
2 Meter should not deflect—if meter does deflect, discard transistor; it is shorted.
3 Depress SI-GE push button. If meter deflects, transistor is PNP. If meter does not deflect, transistor is NPN. If there is no meter reading in either position of identity switch, transistor can be discarded; it is open.
4 Change identity switch to proper position for type of transistor and note meter reading—it should be very low. Silicon transistors produce a zero reading; germanium transistors (non-power) will read less than 1 mA.
5 Depress GAIN push button and adjust multiple switch for less than full-scale reading. This reading is d.c. current gain of transistor (scale times multiplier).
6 Verify silicon/germanium transistors by depressing both GAIN and identity push buttons. If meter reading remains the same or drops slightly, transistor is germanium. Drop of meter reading to zero indicates silicon.

If you wish, you can cut out this convenient chart and paste it on the case of the transistor tester.



Internal layout of the author's model showing location of all parts. This layout is recommended for best duplication.

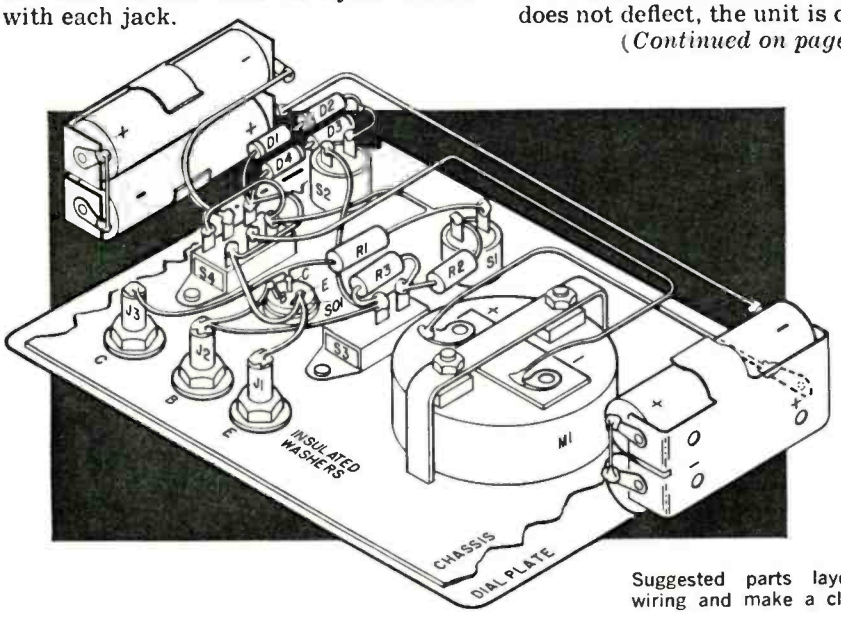
figuration, you should mount a TO-5 transistor socket in a convenient and accessible location on the front panel of the instrument (see photo on page 57). For transistors with other than a TO-5 case configuration, three banana jacks are mounted at the bottom of the front panel to make the proper connections via short test cables.

The banana jacks (*J1* through *J3* in the schematic diagram) must be insulated from the chassis, using one shoulder and one flat fiber or nylon washer with each jack.

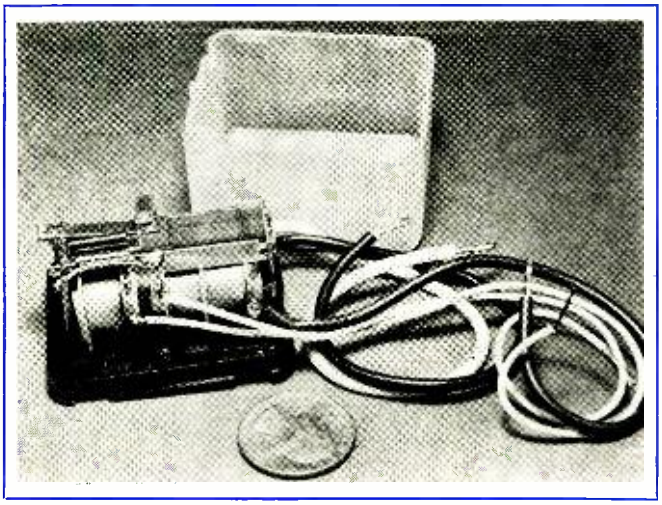
Testing Transistors. The approach to testing a given transistor is simple and straightforward. The procedure need not take more than a minute, and with practice, you can cut the testing time down to a few seconds.

First set switches *S3* and *S4* to the *X100* and *NPN* positions, respectively, and connect the transistor to be tested via the external test cables or plug it into the transistor socket. If the pointer of meter *M1* should swing fully up-scale, the transistor is shorted; if the pointer does not deflect, the unit is okay.

(*Continued on page* 98)



Suggested parts layout to simplify wiring and make a clean-looking unit.



Meet Mr. Versatile

LOW-COST ISOLATION RELAY IS IDEAL FOR EXPERIMENTERS

BY LOUIS E. GARNER, JR.

HAVE YOU EVER SEEN an electric lamp that behaves like a kerosene lamp? Outwardly, such a "magic" lamp appears to be the same as any other kerosene lamp converted for 117-volt a.c. operation. The big difference is that to turn on the lamp you have to strike a match and touch the flame to the envelope of the bulb. Conversely, you must also blow on the bulb to extinguish the light. The lamp is really electronically "gimmicked," but it's guaranteed to be a hit conversation piece.

The heart of the magic lamp is ALCO Electronic Products' new Model FR-101 isolation relay. This plastic-dust-covered relay sells for only $3.85. Included with each relay is a "Design Ideas" brochure. The low cost of the FR-101 makes it ideal for the hobbyist or experimenter who likes to design fire and burglar alarms, automatic lawn sprinklers, remote volume controls, TV sound killers, and literally scores of other electronic devices. In fact, the number of devices in which the FR-101 relay can be used to replace current amplifiers, triggering circuits and switching circuits are limited only by your imagination and ingenuity. Consequently, the FR-101 relay has been dubbed "Mr. Versatile."

This article will describe how to build a "magic" lamp, a remote sound killer for TV commercials, and a slot-car lap counter. Carrying out these construction ideas will probably lead to ideas of your own for using Mr. Versatile.

About the Relay. Mr. Versatile is a unique combination of step-down transformer and separate relay (see *K1* inside the dashed line box in Fig. 3), which share a common core. This arrangement allows the transformer to electromagnetically bias the relay section for very sensitive operation. (The entire FR-101 relay draws less than 40 mA of current.)

Power requirement for Mr. Versatile is 117 volts a.c., applied across the primary as shown. The stepped-down voltage (less than 30 volts a.c.) is applied to some form of external control device that is a virtual open circuit in one state and essentially a short in another state. The external control device is, in turn, connected to the relay winding.

As with any relay, Mr. Versatile depends on the electromagnetic field surrounding the core for proper operation. In the FR-101, the common core acts as the core of the step-down transformer and the core of the solenoid. When no current is drawn by the secondary winding, the magnetic field induced is not strong enough to close the relay contacts. However, when the impedance of the external control circuit drops to 100 ohms or less, enough current is drawn to energize the relay and close the contacts.

Magic Lamp. Referring to Fig. 1, note that in addition to a lamp and the FR-101 relay, the only other parts needed are a switched line cord and plug, a GE-X6 photocell (*PC1*), and a 117-volt

lamp. Wiring of the circuit is simple and straightforward.

Any kerosene or other type lamp that has a brass or metal base can be used for the magic lamp. Drill several holes

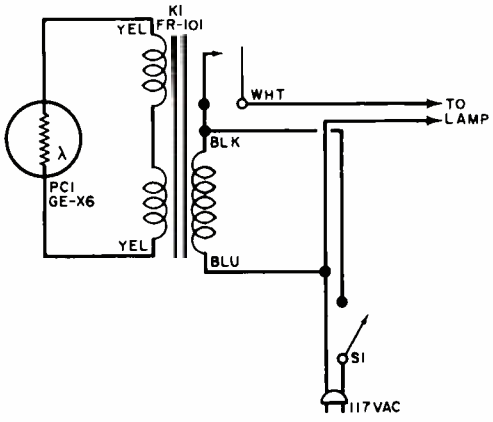


Fig. 1. In presence of light, PC1's resistance decreases sufficiently to allow magnetizing current to close K1's contacts and apply power to lamp.

around and as near as possible to the bulb socket (see Fig. 2). Then use clear epoxy cement to mount the photocell inside the lamp base and directly in line with one of the drilled holes. When the cement sets, mount *K1*, route the line cord through a rubber-grommet-lined hole in the base of the lamp, and connect the parts using Fig. 1 as a guide.

Plug the lamp's line cord into an a.c. outlet, and close *S1* (keep the lamp's socket switch in the *ON* position at all times). Now strike a match and touch the flame to the bulb, directly over the photocell hole. The light from the flame will cause the resistance of the photocell to reduce, allowing the relay to energize and the light to flash on.

When you want to extinguish the light, steady the lamp base with one hand, and blow on the bulb. The hand steadying the lamp is just a ruse that lets you place a finger over the photocell's hole, blocking the light. The resistance of the photocell will go up again, the relay will de-energize, and the light will go out.

To prevent bright room lighting from triggering on the magic lamp, always set *S1* to *OFF* when the lamp is not in use.

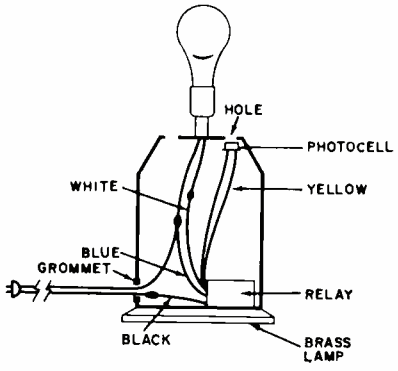


Fig. 2. When building "magic lamp," use clear epoxy cement to mount photocell behind and directly in line with hole drilled near electrical socket.

Remote Sound Killer. The circuit for a light-activated remote sound killer shown in Fig. 3 is essentially identical to that used for the magic lamp. The only exception is that *K2* (117-volt a.c., s.p.s.t. relay) has been added to isolate line power from the external circuit.

Relays *K1* and *K2* should be insulated from the box in which they are housed. Photocell *PC1* must be located so that it

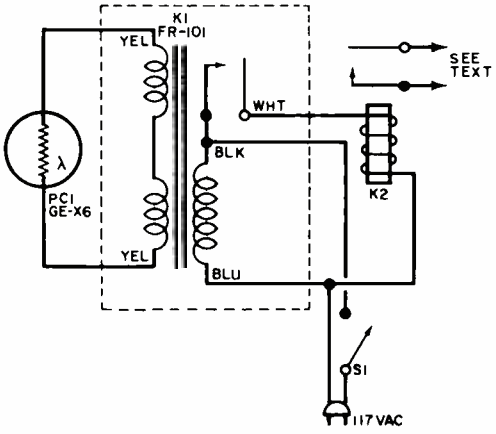


Fig. 3. If TV set has transformer-coupled output, K2's contacts can be connected to speaker voice coil lugs. Do not attempt to connect contacts of relay to voice coil for direct-coupled outputs.

can "see" light from a remote source. A 12" to 36" length of insulated stranded hookup wire should then be soldered to each of the contacts on *K2* as shown; terminate these wires in small alligator clips.

To use the remote sound killer, connect one alligator clip to each of the outer contacts on the volume control (or

(*Continued on page* 92)

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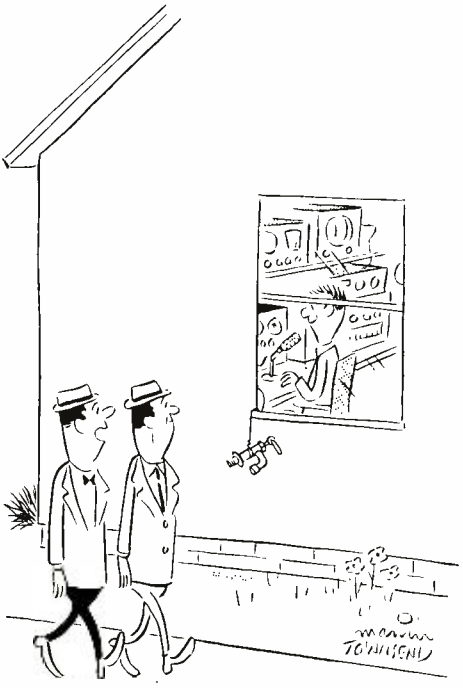
"Hey, Mom, . . . why's he playing taps?"



"I'd say he doesn't know much about grounding equipment."

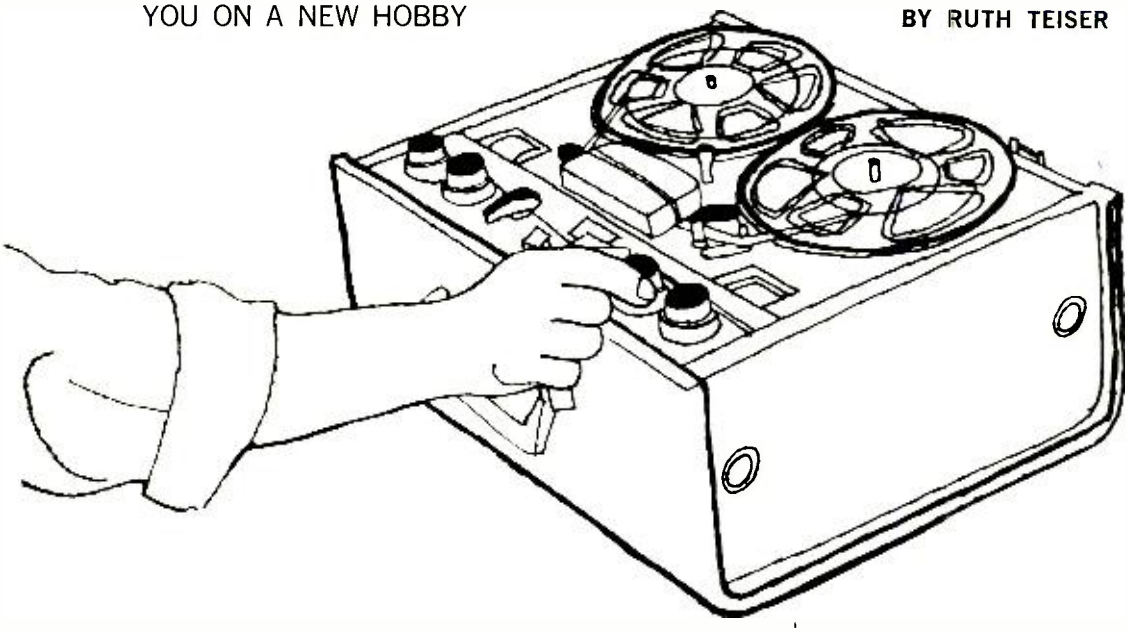
"I'll give you a hint—I'm NOT from your Friendly Credit Corporation!"

"Cartridge troubles again, Mr. Wilson?"

Oral History Collecting

A TAPE RECORDER AND THE ABILITY TO LISTEN TO OTHER PEOPLE TALK ABOUT THEMSELVES CAN START YOU ON A NEW HOBBY

BY RUTH TEISER



IF YOU THINK every event in history is already recorded in books, you are wrong. The recent past, reminisced by people who participated in or witnessed its events, is material for "oral history" —as professional historians term tape-recorded recollections. With the aid of a portable tape recorder, the ability to listen to people talk about themselves, and an interest in history, you can begin a new hobby as an "oral history" collector.

Every area of interest has its share of people who are willing and often eager to tell what it was like in the "good old days." So you can choose your history collecting subject from a broad list. For example, there are people who remember the development and early uses of radar and the transistor. There are also many old-time radio hams who recall when the vacuum tube was a cranky, experimental miracle. The man who remembers when bare-knuckle bouts were feature attractions in the prize fight arena, and war veterans who recall famous battles are all potential sources of historical data. Their stories, related to you during an interview, can add the life and personal involvement that is so often lacking in textbook accounts of famous events.

The subject you cover does not have to be an earth-shaking event that changed the course of history. The smaller things that set the stage for history —such as the politics and social structure of the times, little-known inventions and discoveries, etc.—make good subjects. Above all, people are history, people like the gas station attendant who pumped gas when there were more horses on the roads than automobiles, or like the actor who remembers when the vaudeville stage was the heart of show business.

History does not come knocking at a collector's door. If you plan to start a history-collecting hobby, you will have to seek out your subjects. The steps to successful history collecting are elementary but important. With a little practice, they will become second nature.

About the Equipment. If you already own a tape recorder, you're in business—assuming your unit has the features

needed for good interviewing. If, on the other hand, you are starting your history collecting hobby cold and need a tape recorder, perhaps the following discussion will help you select the "right" unit.

There are four basic but extremely important requirements for any interview tape recorder: good voice fidelity in the record and playback modes, portability, capstan drive, and a speed control or tape reel capacity (5" to 7" in diameter) to allow at least one hour of uninterrupted running time. In addition to these features, recording and playback level controls, a suitable recording level indicator, and resettable digital tape counter are needed. (For real convenience, remote stop and start and automatic shut-off are desirable.)

Whether you select a line-operated or battery-powered tape recorder is a matter of personal preference. Most interview sessions are conducted in areas that are near an a.c. outlet, so you might want to choose a line-operated unit. However, there is always the possibility that the person you are interviewing will want to talk to you under a shade tree far from an outlet, in which case only a battery-powered unit will be of any use.

Battery-powered tape recorders can also be of value when you have to interview a person who is nervous or active and wants to move around a lot. A small unit that can be carried by a shoulder strap is ideal in these circumstances. These units generally use cartridge tapes or reel-to-reel cassette tapes. Cartridges and cassettes are compact and easy to store. (The cartridge is also erase-proof if you take the precaution to push out a certain plastic tab.)

Note comfortable and informal atmosphere as man at left tells of his experiences during World War II.

Most table model tape recorders are equipped with "interviewing" features, and since their numbers and types are numerous, you should have no difficulty in selecting one to meet your needs. If you choose a unit of hi-fi quality, try to obtain one with at least a 3¾ in/s—and possibly a 1⅞ in/s—speed.

The microphone should be a low- or medium-impedance dynamic type with an omnidirectional pickup pattern. A 12'-long microphone cable (with appropriate connectors at each end) and a supply of blank recording tapes and empty tape reels will round out the equipment you need to make a success of your oral history collecting. The tape should be of the best quality you can reasonably afford—preferably the low-print, polyester-backed kind—if you want your collection to last.

Before The Interview. Once you have selected a subject to cover, and know who might be of help to you, make an appointment to interview that person. Always remember to ask the person you plan to interview to select a time and date that will be most convenient to him.

Next, practice with your wife or a friend to determine the optimum settings for controls, placement of the microphone, etc. Then, just before leaving for your interview appointment, carefully check out your tape recorder, accessories, and recording tapes. Be sure you take at least two blank recording tapes, whether you anticipate a long session or not. And if you use a battery-powered tape recorder, check the batteries.

Finally, if possible, call the person you have an appointment to interview and confirm your appointment.

During The Interview. Once your appointment is confirmed, make every effort to be punctual—do not arrive ten minutes early or ten minutes late. Upon arriving, thank the person for permitting you to take up his time. Then get right to work setting up your equipment when the interview location has been decided upon. Place the microphone in an ap-

propriate location, set recording levels, thread the tape, and plug in the power. (When setting recording level, have the person you are going to interview speak a few words into the microphone from where he will be seated.)

You should be seated opposite the person being interviewed—or to one side of him—approximately the same distance away from the microphone. If you are farther away from the microphone, raise your voice slightly to compensate for the difference in distance.

Robert Grabhorn, famous San Francisco printer, is interviewed in his office by the author. A battery-powered tape recorder was used for this session.

A relaxed atmosphere is a must for interview sessions, and it is your responsibility to keep it relaxed. If you did your homework correctly, you will have a list of questions that will get the session started (and if the person you are interviewing is well known, you should acquaint yourself with his accomplishments and casually mention a few of them during the session).

To be a good interviewer, you must be a good listener, and the questions you do ask should guide the interview along the lines you are interested in. This does not mean that if the person you are interviewing begins to ramble you should immediately interrupt him. Let him ramble. He will eventually come back to the subject of the interview—and during his ramblings he may even tell an amusing and pertinent anecdote that will make his story come alive.

Don't rush to fill in silences when the person being interviewed may be thinking about what he wants to say next. Conversely, don't keep him talking past the allotted time of the appointment. An hour is enough for most people. Even if your interview is going along smoothly after an hour has gone by, the next time he pauses, ask him if he would like you to come back another day.

When the interview is completed, pack your equipment quickly, and express your thanks again. A little courtesy goes a long way.

Oral History Sources. With most hobbies, there are usually sources from which you can get information about the hobby or people with whom you can exchange experiences. Oral history collecting is no exception.

The American Association for State and Local History, 132 Ninth Avenue, North, Nashville, Tennessee 37203 will send you (for just 25 cents) an excellent "Tape Recording Local History" leaflet. This leaflet contains useful information on both interviewing and equipment.

Elwood R. Maunder (left) of the Forest History Society, interviews internationally known American Forester David T. Mason in the latter's office.

If you want to tie in with a lively organization, the History Section of World Tapes for Education, write to Bill Weaver at Box 855, Chinle, Arizona 86503. A United States Forest Ranger by profession, Bill is a history-hunting hobbyist with a wealth of experience and enthusiasm. -30-

INFORMATION CENTRAL

By CHARLES J. SCHAUERS, W6QLV

TRYING to make a ham or SWL radio receiver of ancient vintage perform as if it were manufactured yesterday is similar to trying to make a Model-"A" Ford step out like a Mustang! Nevertheless, your *Information Central* columnist continues to receive letters from many readers who say, "Look, I'm attached to my old radio receiver and I just want it to perform as well as the one I saw last week in my local radio store. What can I do to perk up my old model XYZ?"

Although there are certain reasonable modifications that can be made on just about any vintage radio receiver, most hams and SWL's simply do not have the test equipment on hand to do a complete modification job which is worth all of the effort required. Certainly, the front-end r.f. amplifier tube can be changed, a product detector for SSB reception can be added, or even a Q-multiplier attached to the i.f. strip for better selectivity. But regardless of how you slice it, when you are finished with all of these changes, you'll have only a slightly better receiver. Changing the receiver's inherent noise level, overall i.f. gain, and some of the other important parameters requires more than just a few minutes of time, a soldering iron, and a pair of pliers.

Don't buy a second-hand receiver and expect to be able to perk it up to a 1967-68 performance level. A good receiver is moderately expensive, but there are bargains to be had—particularly so far as kits are concerned—and you will be surprised at the job you can do if you, the operator, know what you're doing, and the receiver is connected to a good antenna.

Transistor Parameters. *Why aren't the important parameters of transistors used in* POPULAR ELECTRONICS *projects listed in each article?*

Generally speaking, the editorial space available does not permit this practice. Also, trying to match parameters between transistors is a very difficult task and one that should be reserved for the accomplished engineer. Even if you have all of the manufacturing specification sheets at hand, matching transistors for possible substitution is a time-consuming and exasperating job. Besides, POPULAR ELECTRONICS doesn't usually publish articles calling for transistors which are not readily available.

HB-400 CB Troubles. *My Lafayette HB-400 transceiver has always worked perfectly, but the other day a friend of mine inserted an SWR meter in the coax antenna line and we were unable to get any sort of SWR reading. My panel meter indicating r.f. output shows about ¾ scale and my signal range is more than adequate. What could be wrong?*

Well, certainly something is wrong. How sure is your friend that his SWR meter is in perfect operating condition? Were the connections to the meter good and was the meter being properly used? There is a slight possibility that the place in the transmission line where you inserted the SWR meter may have had some effect, but this is unlikely. Try to keep the SWR meter within two or three feet of the transceiver. If everything checks out, try decreasing the length of the coaxial cable from the SWR meter to the transceiver. A good SWR meter should never affect a transceiver's normal operation.

Meter Protector. *I understand that there is a gadget on the market which will protect my multimeter from overload damage. What is it and where can I buy one?*

The gadget is called a "Metergard" and is available from most mail order electronics suppliers—including Lafayette Radio Electronics (catalogued as #38H6801). It sells for $2.95 and is simply wired in across the meter terminals. The gadget consists of a pair of specially selected diodes to shunt any "over-current" accidentally fed to the meter.

"Star Roamer" on SSB. *I would like to modify my "Star Roamer" receiver for SSB reception. Would I be better off with an improved BFO or a product detector?*

Always use a product detector for SSB reception. It produces less audio distortion, and the BFO will need much less readjustment as you tune from signal to signal.

S-120 Receiver TVI. *Now that the 10-meter band is open, I find that when I tune my Hallicrafters S-120 receiver to 10*

meters it starts interfering with TV reception. What can I do about this problem?

Check to be sure that your receiver chassis is adequately grounded—to a good water-pipe ground or to an external grounding rod. Pull the power plug, then open up the chassis and connect two 0.001-μF ceramic capacitors in series across the primary transformer winding—literally across the 117-volt a.c. line input. Ground the center connection of these two capacitors to the metal chassis. This should help eliminate interference which is getting to your TV receiver through the power lines.

If the capacitors don't help, put a low-pass TV transmitting filter in series with your receiving antenna. Although normally this filter is used for transmitting, it is just as effective on a receiver. If filtering your ham receiver input doesn't help (although I am sure it will), insert a high-pass filter on the input of your TV receiver. Undoubtedly, your S-120 receiver is radiating a signal from its local oscillator and the harmonics of this oscillator are affecting the TV reception.

VOX Intermittent Drop-Out. *How can I eliminate intermittent drop-out of the VOX on my Collins 32S-3?*

Write directly to Collins for a copy of revised Service Bulletin No. 1 dated August 8, 1967. This bulletin will give you full details on correcting the drop-out fault, as well as improving the operation of the first audio amplifier in this fine SSB transmitter.

Transistor Failure. *I am a radio-TV repair technician and I seem to be replacing an awfully large number of audio and power conversion transistors in both TV and radio receivers. When the transistors are replaced, all of the voltages seem to check out; but then, within a month or two, the same component fails all over again. Why?*

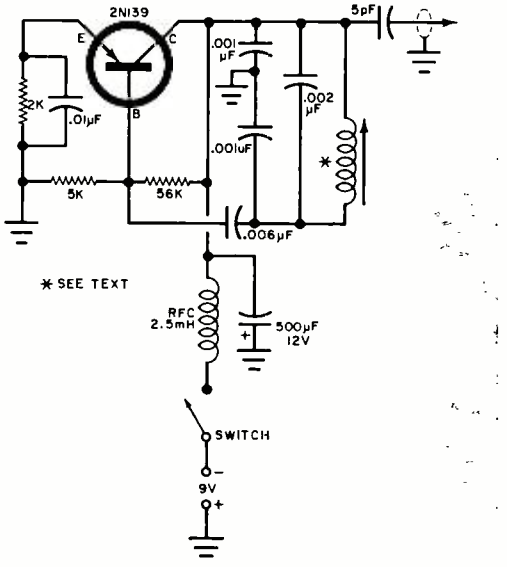
Transistor manufacturers have never solved the bugaboo concerning heat dissipation, and this is probably the principal cause of transistor failure. Make sure that the transistors you replace are "seated" in silicon grease and use a good heat sink. Some transistor failure is due to excessive voltage or voltage transients. These effects can be eliminated by close voltage regulation and use of transient-suppression diodes, but most TV receivers and radio sets are not protected in this manner.

Homemade TV Recorder. *I am toying around with the idea of converting my old tape transport so that I can record video signals off the air. I plan on using ¼"-wide tape and running the speed up to 60 or 75 in/s. Do you think this idea will work?*

It would certainly appear doubtful that a home experimenter could build a video tape recorder. Also, the amount of recording that you will be able to do at 60 in/s is going to be very small. If your tape-handling mechanism and tape recorder heads will take this speed, you may be able to see a few blurry and scratchy images—but certainly not anything worth a lot of effort.

Transistorized BFO. *Like many SWL's, I would like to add an outboard BFO to my inexpensive receiver. I am sure that there must be something that is transistorized, battery-operated, and small enough to be inconspicuous. The i.f. of my receiver is 455 kHz. Can you help me?*

Try building the simple single-transistor BFO shown in the diagram below. You



can use just about any good r.f. transistor in this circuit, including a 2N139, 2N247, 2N371, or 2N1380. The slug-tuned coil is about ⅜" in diameter and the coil itself consists of 126-128 turns of No. 40 cotton-covered wire which is random-wound in a space about ½" long. Couple the output of this BFO to the last i.f. stage of your receiver (preferably at the grid), or if you have a transistorized receiver, connect the output to the collector of any i.f. stage. Be sure to use silver mica capacitors so that the BFO will be fairly stable.

TV X-Rays. *I was surprised to find a label stuck to the picture tube of my old black-and-white TV receiver stating: "Potentially dangerous x-rays may be emitted if this tube is operated above 16,000 volts." How dangerous is a set like this to the nearby TV viewer?*

Unless someone has been tinkering with your TV set, it is very doubtful that the second anode voltage is anywhere near 15,000-16,000 volts. But even if the voltage is this high, the x-rays emitted by most TV picture tubes are generally of the soft type and are easily scattered and absorbed. In other words, to have any effect—at any time—the voltage must be very high and your face (or other portion of the body) within a few inches of the TV screen.

Auto Timer Light. *Is there any reason why I can't operate my a.c. automobile timing light (strobe-type) from a converter and the 12-volt car battery?*

Theoretically, no, but before buying a 12-volt to 117-volt a.c. converter, I would try the system out to be sure it will work. Some of the cheaper converters are not "fixed" at the 60-Hz frequency but this frequency variation should not affect the timing rate.

Trap Noise. *Each of the traps on my beam antenna is housed in a round aluminum case which has a breather or humidity dissipation hole. When a strong wind is blowing, the traps start whistling and make a very annoying noise. I obviously don't want to plug up the holes. How can I get rid of this noise?*

Your best bet is to tune the holes so that the noise is outside of the audio spectrum. Try inserting a small piece of plastic tubing (about 1½" long) in each of the holes. Make sure that the tubing fits snugly into the holes and use an appropriate glue so the tubing will not drop out when the elements vibrate. This trick will stop the noise, but be sure to turn the traps so that the drainage holes point to the ground.

EICO 753 Transceiver to 10. *How can I convert my EICO 753 transceiver for operation on the 10-meter band?*

Your columnist has seen no plans for this particular conversion, nor does EICO indicate that it can be done. From looking at the circuit, the job would seem to be extremely difficult since parts space is at a premium in this transceiver and such conversion circuitry would be complicated.

Preamp Oscillation. *I recently constructed an r.f. preamplifier for my SWL receiver according to plans I found in another magazine, but the unit oscillates over most of the frequencies I tune. Can you tell me how I can solve this oscillation problem?*

The most common cause of oscillation in an r.f. preamplifier is not having the input and output properly isolated. I saw one schematic calling for the use of 300-ohm twin lead which could only result in the development of a feedback loop and oscillation. Make sure that your input and output connections are coaxial lines. With some r.f. preamplifiers, it is necessary to install shielding between the grid and plate sections of the tube socket. With other amplifiers, it may be necessary to neutralize the circuit. Not knowing exactly which circuit you built, it is difficult to offer adequate servicing suggestions.

Low-Strength TV Signals. *I live in an area where TV reception is apparently not the very best. When an airplane flies over my house, I can "see" it on my TV screen. What's the most effective means of curing this interference?*

Try either of two things. Raise your present antenna higher above ground and/or install an antenna that has more forward gain and more forward directivity. There are many TV antennas that will give you more gain to override the bounce signal from a passing airplane.

Crossband on CB. *I have a business use for CB and was wondering if I could contact a neighboring industrial radio station in the 30-50 MHz band and talk crossband?*

Absolutely not! Crossband operation between CB operators and industrial radio licensees is not permitted.

JAN Parts. *Are the radio parts and components that I buy, including transistors, better if they are manufactured under JAN conditions and have JAN numbers?*

The U.S. Government requires very rigid quality control, and components manufactured to meet JAN specifications are invariably of top quality. Nevertheless, most non-JAN parts are perfectly okay and will work in most POPULAR ELECTRONICS construction projects. Although JAN parts are desirable, don't forget that they cost much more.

Short-Wave Stations. *As an avid SWL, I am constantly searching for rare stations on the short-wave broadcast bands. And I'm curious about those droning, squeaking and other "strange noise" signals scattered among the short waves. What are they?*

Major portions of the short-wave bands are used for specialized communications. Some of the signals heard are very high speed Morse code, a few are facsimile and telemetry signals, and others are from various types of diathermy and industrial heaters. Because many of these "noise" signals originate in various parts of the world, it is almost impossible to identify them—even if you use a scope across the speaker leads of your receiver and attempt to analyze their "noise" content. -30-

the product gallery

REVIEWS AND COMMENTARY ON ELECTRONIC GEAR AND COMPONENTS

FROM THE EDITOR:

I frequently think it would serve the readers of POPULAR ELECTRONICS best if a page or two could be devoted to every new product brought to my attention. Obviously, this is impractical—first, from the viewpoint of the number of editorial pages which would be required, and second, because of the large number of new items announced each month. Prior to the introduction of this column, discussion of new products had been confined to the "New Products" pages in the front of the magazine, special feature articles, and an occasional mention in one of the other monthly columns ("Short-Wave Listening," "Amateur Radio," "On the Citizens Band," etc.). At best, such a format is a compromise.

The "Product Gallery" is a new and different approach to acquainting readers about new gear that my staff finds of outstanding interest. This column will not confine itself to any one particular type of product—hi-fi, CB, household items, etc.—or to kits vs. wired units. The scope will be far-ranging: some new products will be cheap, others unusual, some expensive; but every one should be worthy of note by the POPULAR ELECTRONICS reader.

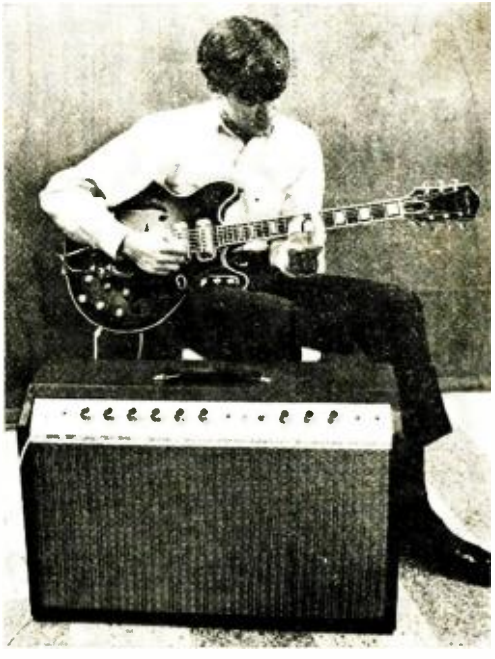
OLIVER P. FERRELL

HEATHKIT GUITAR and GUITAR AMPLIFIER (Models TG-46 and TA-16)

December is an ideal time to think about building a guitar and/or guitar amplifier. Either or both of these kits make perfect Christmas gifts. Jeff, the 21-year-old shown at right, assembled the amplifier in just under 10 hours; the guitar itself went together in 2 hours. Neither kit presented any assembly problems, and the whole project has worked perfectly ever since.

The guitar was designed by Harmony, and when purchased from Heath as a kit for $189.95, the builder saves about $100 over going out and buying a ready-built guitar. There are 7 pickup combinations on the guitar and 6 controls for adjusting pickup volume and tone. The construction is superb with double cut-away styling, acoustic hollow body, and Bigsby vibrato tailpiece control. Any musician would be proud to handle a guitar that looks and fingers as smoothly and effortlessly as this Heathkit TG-46.

Of course, no electric guitar is complete without an amplifier—and the more powerful the better. However, there's a lot to be said for the middle ground in guitar amplifier power, and Jeff wisely chose the TA-16. In terms of power output, the TA-16 ("Star-



Combination of Heathkit guitar (Model TG-46) and guitar amplifier (Model TA-16) will please any member of the younger generation. Amplifier has two separate channels with reverberation and tremolo.

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maker") is rated at 25 watts EIA music power, topping out at 60 watts peak power—which is the measurement most frequently seen in print in conjunction with guitar amplifiers.

The TA-16 is all solid-state, and the power output transistors are used in a fail-safe complementary circuit. There are also two circuit breakers (one in the a.c. primary and the other in the secondary of the power transformer). When assembled, the TA-16 is a heavy package (slightly under 50 lb.), due mostly to the twin 12" special ceramic magnet guitar amplifier speakers.

Priced at $134.95 as a kit ($199.95, wired and assembled) this amplifier could be favorably compared to units selling in the music shops for $300-plus. If you doubt that, shop around and be convinced. Don't forget to look for a 2-channel amplifier, because the TA-16 has two separate channels, one channel for musical accompaniment or a singer, and the other channel fitted out with reverb and tremolo—both controlled from a footswitch (not seen in the photo on page 73). Tremolo depth and speed are preset by controls on the front panel of the TA-16. Each channel has separate tone and volume controls.

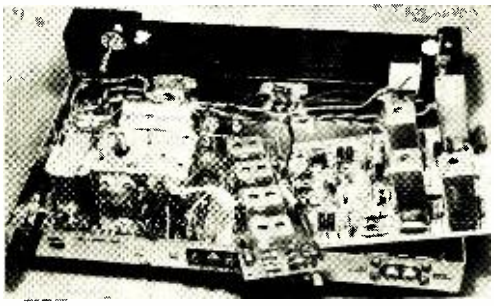
Summary: The Heath Company (Benton Harbor, Mich. 49022) reports that both kits are in stock for immediate shipping. Totaling $324.90 (credit terms are available), these two kits save the budding musical genius $250 and require only a minimum investment in assembly time.

EICO "CORTINA" STEREO TUNER (Model 3200)

If you are an experienced kit builder, you're aware that the average per hour monetary saving in buying and building a kit vs. buying a factory-wired unit is on the order of $5.00. If you put in 10 hours of wiring and assembly time, you should expect to save about $50.00.

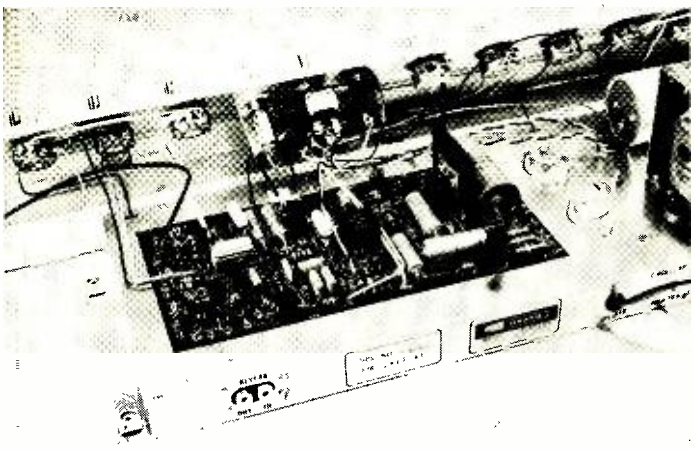
How would you like to double that $5 per hour saving? And, double it again? If you buy the EICO "Cortina" kit in preference to the wired tuner, you will save $40, which boils down to about $20 per hour because the "Cortina" tuner can be assembled in only 2 hours and 10 minutes!

We were surprised when we opened the box containing the "Cortina" tuner kit. EICO sells it as a kit, it may look something like a kit, but an experienced builder would laugh at it—this is not a kit at all in the real sense of the word.



EICO's "Cortina" tuner is too simple to build to be called a kit. The r.f./mixer, i.f. strip, and multiplex decoder are preassembled and prealigned.

Inside the shipping container are small boxes. In one is the imported tuner assembly; in a second box is the assembled and



Assembling the TA-16 amplifier takes less than 10 hours. All wiring is open and the circuit features extra protection for foolproof operation. Each channel preamp has individual tone and volume controls. Tremolo speed and reverb amplitude are controlled from the front panel, too.

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prealigned i.f. strip; and in yet a third box is the whole carefully assembled and aligned multiplex decoder, the latter two items being on printed circuit boards. The "tough" things that the *kit builder* does are wiring together a power supply, bolting the three assemblies to the chassis, and then stringing a dial cord.

Total time used, including unpacking: 2 hours and 45 minutes. Total wiring time (soldering iron in hand): 1 hour and 30 minutes. Total for actual assembly (nothing to tune up): only 2 hours and 10 minutes—a new record of some sort.

The EICO "Cortina" stereo tuner kit sells for $89.95 and the wired unit sells for $129.-95. In tests by POPULAR ELECTRONICS (in mid-Manhattan, a notoriously poor spot for good FM-MPX reception), the "Cortina" was almost the equal of FM tuners that are a lot bigger, a lot fancier, and a lot more expensive.

Distortion, noise, and a.c. hum were well down below the point of audibility, while sensitivity and stereo separation were perfectly adequate in a location where FM-MPX tuners marketed three years ago have a job gathering sufficient signal for noise-free stereo reception.

Summary: EICO Electronic Instrument Co., Inc., (131-01 39th Ave., Flushing, N.Y. 11352) reports that stocks of the "Cortina" tuner have been placed in the hands of hundreds of electronics retail outlets. A matching amplifier (size) is available at the same price as the tuner. The pair makes an ideal bookshelf stereo installation.

RADIO SHACK ALL-WAVE RECEIVER (Model DX-150)

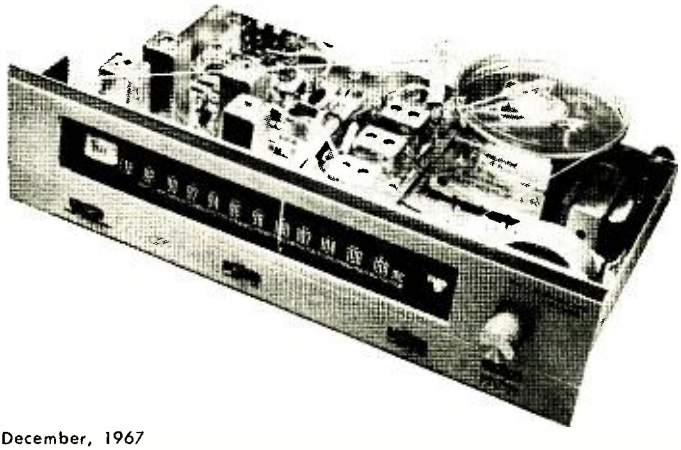
What may be the first really noteworthy advancement in communications receivers is wrapped up in the new Radio Shack imported DX-150. Featuring continuous coverage from the top of the AM broadcast band (535 kHz) to the bottom of the 10-meter ham band (30 MHz), the DX-150 is a single-conversion superhet with a tuned r.f. stage, two i.f. stages, full-wave product detector for SSB/CW reception—and it's 100% solid-state.

Selling at $119.95, the DX-150 has the flexibility of a communications receiver that a ham or SWL is used to buying for $175-

Radio Shack's solid-state DX-150 receiver makes an ideal Christmas gift for the budding SWL or Novice.

plus. To rattle off a few more "features": there is a front panel antenna trimmer, fast or slow a.v.c. attack, a cleverly concealed built-in monitor speaker, plenty of calibrated bandspread, and noise limiting in both the i.f. and audio stages.

Because of the solid-state circuitry, the usual warm-up drift expected with a tube-type receiver is virtually absent here. And, although the DX-150 is primarily a base station receiver with a 117-volt a.c. power connection, it can be operated from an out-



Although the EICO "Cortina" tuner is small, it has good selectivity and a.f.c. action. Your POPULAR ELECTRONICS reviewer was amazed at the saving possible between wiring a kit and buying the assembled tuner.

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board d.c. power supply consisting of only eight D-cells. Radio Shack claims that the receiver will operate for 100 hours—continuously—using only the d.c. supply. Ideal for Field Day and emergency work!

The proof of the pudding so far as any communications receiver is concerned is how well it works "on the air." At POPULAR ELECTRONICS, the DX-150 was hooked up to a 125-foot long-wire antenna and tuned across the AM broadcast band. Needless to say, the S-meter was pinned on just about every single channel, and the audio quality with Radio Shack's voice-selective speaker (extra, $7.95) was crystal-clear.

Tuning the band between 1.55 and 4.5 MHz, your reviewer got a chance to appreciate the comfortable handling on SSB reception. Going a little higher (4.5-13.0 MHz), the 25- and 31-meter bands were "alive" and signals appeared to leap out of the air—possibly due to the very quiet background of the DX-150. While quietness is usually regarded as a lack of sensitivity, that wasn't the case with the DX-150. On the top band (13-30 MHz), the sensitivity still seemed high; and on the CB frequencies, the DX-150 could hold its own against a dual-conversion receiver built just for CB work.

Summary: Radio Shack (730 Commonwealth Ave., Boston, Mass. 02215) has the Model DX-150 in most of its 160 retail outlets. Take a look at it, and get the "feel" of this unusual receiver.

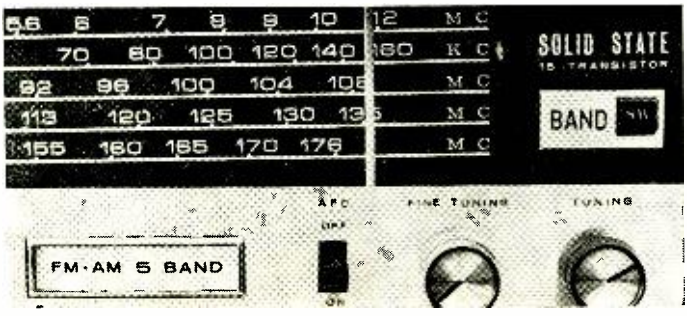
ALLIED 5-BAND PORTABLE RECEIVER (Model 2671)

Here's a transistorized portable that does just about everything. Not only can you listen to AM, FM, and the 49-, 41-, 31-, and 25-meter short-wave bands, but the new Allied 2671 also tunes the VHF aircraft band (108-140 MHz) and the Public Service Band (144-176 MHz). With such wide-range coverage, there isn't anything going on that you can't intercept—from ham to fire and police transmissions, from jets in flight to *Radio Australia*.

Allied's Model 2671 sturdy 5-band unit has built-in antennas for AM and the short waves. A telescoping 25" antenna is extended for FM and VHF.

The 5-band portable performed perfectly in tests at POPULAR ELECTRONICS. Selling for $59.50, this receiver looks like one of the best buys around. Using only the 25" telescoping antenna, your reviewer pulled in aircraft 150 miles away, and the 162.55-MHz weather forecasts at a distance of 40 miles. On the short waves, *Radio Cairo* was dug out of the QRM, and on FM and AM the tone quality was excellent. Both selectivity and sensitivity were fair to good on all five bands, with no "dead" spots.

Summary: The Allied (Allied Radio Corp., 100 N. Western Ave., Chicago, Ill. 60680) Model 2671 portable receiver is ideal for the amateur pilot, boating enthusiast, etc. Allied will ship in time for the Christmas rush. —30—



Lightweight portable uses 15 transistors in novel circuit to tune AM, FM, short waves, aircraft and police/fire signals. Bandspread control (Fine Tuning) helps separate stations on the short-wave bands. The Model 2671 operates on C-cells or a built-in 117-volt adapter.

ON THE CITIZENS BAND

By MATT P. SPINELLO, KHC2060, CB Editor

YOUR CB Editor has lost count of the proposals, declarations, and plans that have been made on behalf of CB during its nine-year existence. The various governments, national groups, state-wide associations, and local clubs have brought forth reams of ideas, suggestions, warnings, and proposals for the future of the Citizens Band. Too many brainstorms worthy of action have unfortunately fallen by the wayside without follow-up; and much of the emergency action by CB'ers continues to pass unnoticed by the public—without recognition or evaluation.

VENEZUELA SANCTIONS REACT

But at least one country has taken a step toward recognizing (and utilizing) the CB service for what it can be under adequate organizational guidance and preparedness. According to Henry B. Kreer, National Director of REACT (Radio Emergency Associated Citizens Teams), the Venezuelan government, as a result of the actions of the Venezuelan REACT team, has officially modified its rules governing REACT and the CB service by setting aside channel 11 for use in emergency situations *only!*

Rooters for an emergency channel have been waving the "channel 9" flag (as first proposed by POPULAR ELECTRONICS) for a number of years. The FCC recognizes the use of channel 9 for emergencies and as a calling channel, "unofficially," and on a voluntary basis. Channel 9 is also the channel used by REACT teams in this country, but a second channel is sanctioned as needed.

REACT is sponsored by Hallicrafters, Chicago, Ill. Director Kreer says that teams continue to be added across the country at the rate of about seven or eight per week. The last national count was near the 1200 mark.

Citizens Radio Manufacturers Report. The engineering group of the Citizens Radio Manufacturers Section of the E.I.A. (Electronic Industries Association) has been working on standards for better use and understanding of CB equipment by the general public. This group has also kept the FCC up to date on the state of the art and assists in developing reasonable standards for the FCC type acceptance rulings.

Commenting on the Commission's recent rulings, W. I. Thomas, Chairman of the Citizens Radio Manufacturers Section, in-

(*Continued on page* 101)

Citizens Band radios used in security operations at Expo '67 have proved effective and popular. The management of Canada's World Fair purchased 70 hand-held and 8 base station units from Amphenol Corporation's Canadian division. Shown against the background of the United States pavilion are Security Officer G. Poulin and Expo '67 Hostesses Suzanne Gagnon (center) of Montreal and Isolde Weigelt of Toronto.

BROADCASTS IN ENGLISH FROM ASIA AND OCEANIA

Prepared by ROGER LEGGE

Many broadcasting stations in Asia and Oceania that do not beam English-language transmissions directly to North America nevertheless can be picked up in this country. Some will be heard well, others with difficulty. Listed below are the best times (and frequencies) for logging English-language broadcasts from these stations.

COUNTRY	CITY	TIME—EST	TIME—GMT	FREQUENCIES (MHz)
AUSTRALIA	Brisbane Sydney Perth	5-9 a.m. 5-9 a.m. 5:30-11 a.m.	1000-1400 1000-1400 1030-1600	9.66 6.09 9.61
CAMBODIA	Phnom-Penh	7:30-8 a.m.	1230-1300	4.907
CEYLON	Colombo	7:30-10 a.m.	1230-1500	9.67
FIJI ISLANDS	Suva	4-5:30 a.m.	0900-1030	3.935
INDIA	New Delhi	5-6 a.m. 8:30-10 a.m. 3-5:30 p.m.	1000-1100 1330-1500 2000-2230	11.71, 15.165 11.81, 15.375 9.912, 11.62
INDONESIA	Djakarta	6-7 a.m. 9:30-10:30 a.m.	1100-1200 1430-1530	9.865 9.865
JAPAN	Tokyo (FEN)	5-10 a.m.	1000-1500	6.155
KOREA (North)	Pyongyang	6-7 a.m. 9-10 a.m.	1100-1200 1400-1500	6.48, 7.58 6.48, 7.58
MALAYSIA	Kuala Lumpur	6:15-7:15 a.m. 5:30-9 a.m.	1115-1215 0930-1400	6.175, 9.75, 11.90 4.985
MONGOLIA	Ulan Bator	9:20-10:20 a.m.	1420-1520	9.54, 11.85
NEPAL	Kathmandu	10-10:20 a.m.	1500-1520	7.105
NEW GUINEA	Rabaul Wewak	5-8 a.m. 5-7:30 a.m.	1000-1300 1000-1230	3.385 3.335
NEW ZEALAND	Wellington	6-11 p.m. 4-6:45 a.m.	2300-0400 0900-1145	15.11, 17.77 9.52, 11.83
PAKISTAN	Karachi	8:35-8:50 a.m. 2:45-3:30 p.m.	1335-1350 1945-2030	15.09, 21.59 11.672, 15.365
PAPUA	Daru Port Moresby	4-5:30 a.m. 5-9 a.m.	0900-1030 1000-1400	3.304 4.89
PHILIPPINES	Manila (FEBC)	6:45-7 a.m. 6-7 p.m.	1145-1200 2300-0000	11.89 15.385
RYUKYU ISLANDS	Okinawa	5-11 a.m.	1000-1600	7.165
SABAH	Jesselton	6-6:45 a.m.	1100-1145	4.97
SARAWAK	Kuching	6-7:30 a.m.	1100-1230	4.95, 7.16
SINGAPORE	Singapore	5-9 a.m.	1000-1400	5.052, 11.94
SOLOMON ISLANDS	Honiara	4-6:30 a.m.	0900-1130	3.995, 7.115
THAILAND	Bangkok	5:25-6:30 a.m. 11:15 p.m.-12:15 a.m.	1025-1130 0415-0515	11.94 11.94
UZBEK S. S. R.	Tashkent	7-7:30 a.m. 9-9:30 a.m.	1200-1230 1400-1430	9.60, 11.925 9.60, 11.925
VIETNAM (North)	Hanoi	7-7:30 a.m. 9:30-10:30 a.m.	1200-1230 1430-1530	9.76, 11.76, 11.84 9.76, 11.76, 11.84

SOLID STATE

By LOU GARNER, Semiconductor Editor

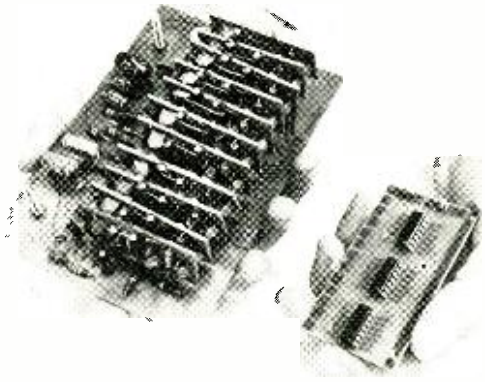
ALTHOUGH FAR DIFFERENT in application and overall appearance, electronic organs and digital computers can be surprisingly similar so far as their circuit design details are concerned. Both instruments require relatively large numbers of repetitive circuits which, in themselves, are basically simple. Both use multivibrators—as "clocks" in computers, as basic tone generators in organs. Both employ digital flip-flop stages—as counters in computers, and as frequency dividers in organs. Both require signal modification circuits—limiters and squaring circuits in computers, wave-shaping filters in organs. Both have switching circuits that can be "programmed" for various modes of operation. Both accept key-controlled manual instructions—supplied by typewriter keys in a computer, piano-type keys in an organ. And both deliver physical outputs—with a computer furnishing a visual display, typewritten material, or punched cards or tapes, while an organ supplies audible sound vibrations.

Considering these similarities, it is not too surprising that someone has thought of adding a "memory" circuit to an organ—one circuit feature which, heretofore, computers and organs have not shared. It seems logical, also, to apply integrated circuits to organ design and construction, for, after all, these tiny semiconductor devices found their first widespread commercial use in digital computers.

The "someone" who made these logical steps was Motorola Semiconductor Products, Inc. (P.O. Box 955, Phoenix, Ariz. 85001). To demonstrate their IC capability, Motorola's engineers designed and built an experimental electronic combo organ which, among other interesting features, includes a built-in musical memory dubbed "Storachord."

The "Storachord" memory circuit enables a player to preselect a variety of bass and chord combinations appropriate to a given musical selection. Afterwards, he can play the accompaniment by using simple push buttons. The instrument, then, offers the operating advantages of a simple chord organ, but features a much wider selection of chord and bass combinations.

A 61-note keyboard, with 18 function and voicing stops, and a unique memory circuit are packed into the 36" x 20" x 6" Motorola electronic combo organ.



These two Motorola circuit boards are electrically identical. Note difference in size between the IC design (right) and discrete component design (left).

The combo organ is a lightweight "portable" instrument designed for operation with an external audio amplifier. Motorola's instrument measures only 36" x 20" x 6" overall (excluding its detachable legs), yet features a 5-octave, 61-note keyboard with 18

function and voicing stops. Extensive use of IC's in the instrument's design and construction eliminates up to 80% of the detailed assembly work necessary with comparable circuits using discrete components.

Motorola has developed two special IC's for use in electronic organ designs: the MC1124P frequency divider, which contains four toggle flip-flops; and the MC1120P dual keyer gate. Both are available in large quantities at prices competitive with conventional thick-film or discrete component circuits.

Reader's Circuit. Recognizing the time-saving advantages of square-wave analysis as a troubleshooting technique, reader Eugene Richardson (Alexandria, Va.) devised the relatively simple audio square-wave generator circuit shown in Fig. 1. He reports that he has used his model to check both home-built and commercially assembled equipment. Providing both low-and-high-frequency signals and a variable output level, the instrument should be suitable for tests of p.a. amplifiers, hi-fi systems, intercoms, paging installations, and the audio sections of radio and TV receivers.

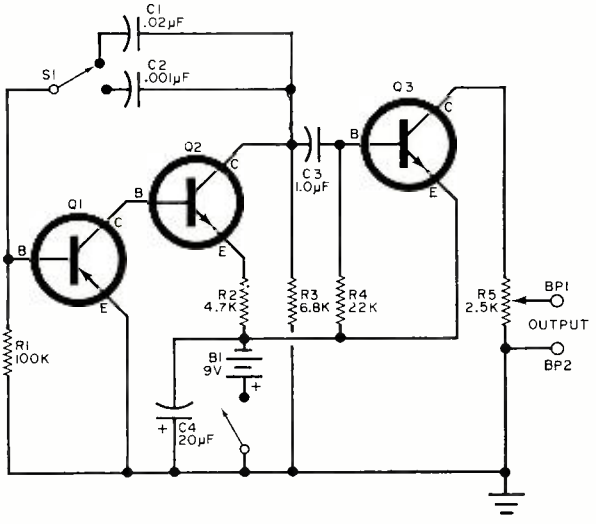


Fig. 1. Eugene Richardson's square-wave generator is useful in testing any type of audio equipment. Two different frequencies are selected by C1 and C2.

Eugene used a straightforward, reliable design approach. In operation, *Q1* and *Q2* form a complementary relaxation oscillator, developing a rectangular signal waveform across *Q2*'s collector load, *R3*. The feedback necessary to start and sustain oscillation is furnished by a switch-selected capacitor, *C1* or *C2*, with the choice of capacitor value determining the circuit's repetition rate (frequency). The signal developed by the oscillator stage is coupled through *C3* to buffer amplifier *Q3*. This stage is operated without fixed bias and, therefore, serves as a clipper-limiter, further squaring the signal waveform, and developing a good-quality output signal across its collector load, level control *R5*. Operating power is furnished by battery *B1*, bypassed by *C4*.

Conventional, readily available components are used in the circuit. Except for linear potentiometer *R5*, all resistors are half-watt types; *C1*, *C2*, and *C3* are Mylar or polystyrene capacitors (working voltages not critical), while *C4* is a 10- to 15-volt electrolytic. General-purpose transistors are used with *Q1* a *pnp* unit, *Q2* and *Q3* *npn* types; and any 9-volt battery will do for *B1*. Outputs *BP1* and *BP2* are conventional binding posts in Eugene's model, but other types of output connectors can be used, if preferred.

According to Eugene, neither layout nor lead dress is critical, and you can follow your own inclinations when assembling a duplicate instrument, using point-to-point wiring on a small chassis, perforated board, or a properly designed etched circuit board. However, he suggests mounting the completed unit in a small aluminum box or plastic case for convenience.

Manufacturer's Circuit. Most experimenters have had experience working with zener diodes as voltage-regulating devices. Now, a new breed of diode that regulates current flow—independent of voltage—has been introduced by Motorola. There are 32 of these devices covering the range from 0.22 to 4.7 mA. Present specifications are 10% tolerance, a peak operating voltage of 100 volts, 600-mW power dissipation, and an operating temperature range of −55 to +200°C. You insert the desired current range diode in series with the circuit, and regardless of how high the voltage climbs above a certain

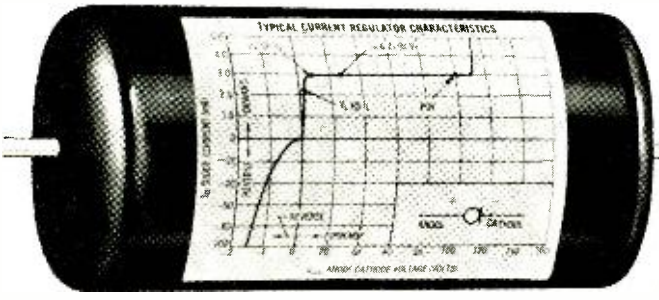
minimum level, the diode acts to keep the current flow at its diode-marked value.

These diodes can lead to some new, simple, and interesting circuits. For example, a sawtooth generator having a minimum of parts, yet a very linear ramp, can be created as shown in Fig. 2. In this circuit, *D1* is the current-regulator diode, while *D2* is a conventional four-layer diode. The design equation is $T = (C\ V_{BR})/I_P$, where T is the period of one cycle, I_P is the pinch-off current of diode *D1*, C is the timing capacitance in μF. and V_{BR} is the breakover voltage of the four-layer diode.

which can deliver relatively high light outputs at low power levels.

For example, General Electric's newest unit, Type SSL-6, although no larger than a thumbtack, has a brightness of 40 foot-lamberts while requiring only 3.5 volts at 50 mA. Its peak light output is at a wavelength of 5900 Angstrom units, which is very close to the maximum responsiveness of the human eye. Featuring an all-glass case with a molded-in lens, the SSL-6 employs a silicon carbide crystal.

If you'd like to experiment with these new units, you can obtain sample quantities of



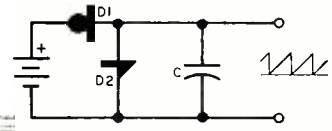


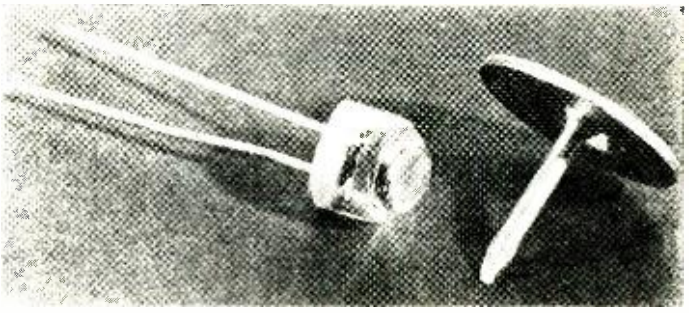
Fig. 2. Only four parts are needed to make a linear sawtooth generator: a new Motorola constant-current diode (D1), shown enlarged at left, a conventional 4-layer diode (D2), a capacitor, and a battery.

Note the presence of a new symbol for a current-limiting diode in Fig. 2. The ball is the anode of the diode while the bar is the cathode. This symbol also appears in the photo showing a 3-mA diode characteristic curve.

Let There Be Light. Chances are your decorative holiday lights are incandescent lamps, but the day may come when they will be solid-state devices. In fact, if cost

the SSL-6 as well as the earlier type SSL-1 directly from GE's Miniature Lamp Department. (P.O. Box 2422, Cleveland, Ohio 44112). Both types are $9.50 each.

Overseas Development. Would you believe a transistorized shower? You'd better believe it, for one has been patented and is being manufactured in Stockholm, Sweden. A complete system, the shower includes a cabinet which features side as well as over-



General Electric's SSL-6 solid-state light source (shown alongside an ordinary thumbtack) is both vibration- and water-proof, and comes with a built-in lens. The SSL-6 represents the latest in the "cold light" breed that probably will supplant both filament and gas light sources.

isn't a factor, you could switch to these interesting units this season, for such devices are now being produced by several major semiconductor manufacturers.

"First cousins" to the fabulous diode laser, solid-state lamps are often called L.E.D.'s (for Light-Emitting Diodes). They are highly efficient semiconductor devices

head sprays and a transistorized control circuit which automatically cycles invigorating alternate hot and cold sprays.

Transitips. Almost all the firms who offer "universal" replacement transistors also publish Cross Reference Guides or Inter-

(*Continued on page* 101)

ENGLISH-LANGUAGE BROADCASTS TO NORTH AMERICA

FOR THE MONTH OF DECEMBER

Prepared by BILL LEGGE

TO EASTERN AND CENTRAL NORTH AMERICA

TIME—EST	TIME—GMT	STATION AND LOCATION	FREQUENCIES (MHz)
6:15 a.m.	1115	Melbourne, Australia	9.58, 11.71
7:15 a.m.	1215	Montreal, Canada	5.97, 11.72
7:45 a.m.	1245	Copenhagen, Denmark	15.165
9 a.m.	1400	Stockholm, Sweden	21.585
6 p.m.	2300	London, England	6.11, 9.58, 11.78
		Moscow, U.S.S.R.	9.665, 9.685
7 p.m.	0000	Peking, China	15.06, 17.68
		Sofia, Bulgaria	9.70
		Tirana, Bulgaria	7.263
7:30 p.m.	0030	Budapest, Hungary	6.235, 9.833, 11.91
		Johannesburg, South Africa	9.705, 11.97
		Kiev, U.S.S.R. (Mon., Thurs., Sat.)	7.29, 9.685
		Stockholm, Sweden	5.99
7:50 p.m.	0050	Vatican City	6.145, 9.69, 11.875
8 p.m.	0100	Berlin, Germany	9.505, 9.73
		Havana, Cuba	6.17
		Madrid, Spain	6.13, 9.76
		Prague, Czechoslovakia	5.93, 7.345, 9.55
		Rome, Italy	9.575, 11.81
8:30 p.m.	0130	Berne, Switzerland	6.12, 9.535, 11.715
		Bucharest, Rumania	9.51, 11.94
		Cairo, Egypt	9.475
		Cologne, Germany	9.64, 11.945
		Hilversum, Holland	9.59 (Bonaire relay)
8:45 p.m.	0145	Copenhagen, Denmark	9.52
9 p.m.	0200	Lisbon, Portugal	6.025, 6.185, 9.68
		London, England	6.11, 7.13, 9.58
		Moscow, U.S.S.R.	7.205, 9.665, 9.685
		Stockholm, Sweden	5.99

TO WESTERN NORTH AMERICA

TIME—PST	TIME—GMT	STATION AND LOCATION	FREQUENCIES (MHz)
7 a.m.	1500	Tokyo, Japan	9.505
6 p.m.	0200	Melbourne, Australia	15.22, 17.84
		Taipei, China	15.125, 17.72, 17.89
		Tokyo, Japan	15.135, 15.235, 17.825
6:30 p.m.	0230	Johannesburg, South Africa	9.705, 11.97
7 p.m.	0300	Madrid, Spain	6.13, 9.76
		Peking, China	9.457, 11.82, 15.095
		Seoul, Korea	15.43
7:20 p.m.	0320	Yerevan, U.S.S.R. (Tues., Wed., Fri., Sat.)	15.14, 15.18
7:30 p.m.	0330	Prague, Czechoslovakia	5.93, 7.345, 9.55
		Stockholm, Sweden	11.705
7:45 p.m.	0345	Berlin, Germany	9.56, 9.65
8 p.m.	0400	Lisbon, Portugal	6.025, 6.185, 9.68
		Moscow, U.S.S.R. (via Khabarovsk)	9.735, 11.85, 15.18
		Peking, China	9.457, 11.82, 15.095
8:30 p.m.	0430	Bucharest, Rumania	9.51, 11.94
		Budapest, Hungary	6.235, 9.833
		Kiev, U.S.S.R. (Mon., Thurs., Sat.)	7.29, 9.685
8:45 p.m.	0445	Cologne, Germany	9.735, 11.945
9:15 p.m.	0515	Berne, Switzerland	6.12, 9.695
10:30 p.m.	0630	Havana, Cuba	6.10

SHORT-WAVE LISTENING

By HANK BENNETT, W2PNA/WPE2FT
Short-Wave Editor

TIPS FOR THE MEDIUM-WAVE DX'ER

LAST MONTH we discussed DX'ing the medium-wave band, or, as it is also popularly known, the standard AM broadcast band; and we listed a few of the split-channel stations you could hear—if you tuned very carefully. Readers with small or inexpensive AM receivers might like to know how to go about tuning a split-channel frequency, such as 647 kHz (England) or 1223 kHz (Sweden).

Tuning a split channel frequency well enough to obtain readable reception isn't always easy, even with fancy high-priced receivers. With the smaller receivers, it's even more difficult. But it can be done!

(Your Short-Wave Editor does not recommend trying to tune these frequencies with a small, imported transistor radio having a built-in ferrite antenna. A good outdoor antenna will give you best results.)

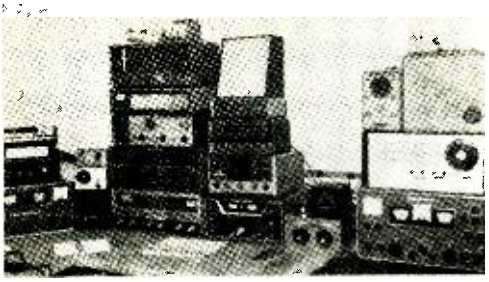
First, learn to use your BFO control. This is a built-in oscillator which enables a listener to read Morse code signals. If you turn on the BFO while listening to your favorite program, you will hear a loud heterodyne whistle. By manipulating the BFO knob, you will be able to zero-beat the whistle to the center of the carrier frequency used by the station that you have tuned.

Now glance over the list of split-channel stations on the next page. Choose one that is not directly adjacent to a channel used by a strong broadcasting station in your vicinity. As an example, if you are not in the primary coverage range of WHO, Des Moines, Iowa, on 1040 kHz, try to tune in that station and set your BFO to zero-beat with respect to WHO. Leave your BFO on and very carefully tune two or three kilohertz higher to see if you can hear a faint whistle around 1043 kHz. If you can hear it, tune in the receiver bandspread on that whistle as clearly and sharply as you can, turn off the BFO, and listen carefully. It just might be Dresden, East Germany, with 250 kilowatts of power.

Keep in mind that the best times to try for DX stations are during periods of darkness. East Coast listeners may, with exceptionally good receiving conditions, begin picking up Europeans as early as 3 p.m. (local time) on the short winter days while West Coast DX'ers may find the trans-Pacific stations coming through as late as two or three hours after their local sunrise.

In any event, DX'ing on the broadcast band for foreign stations is no simple task. It's one that requires hours of patience and diligence. But after you have finally logged that first one, you will be amazed at the

Vincent De Meis, WPE3FEE, Philadelphia, Pa., is shown at the controls of his Hammarlund HQ-180A receiver. At the left, partially hidden, is a General Electric solid-state tape recorder; at his right is a National NC-60 receiver. To date Vincent has 24 countries verified, all 50 states, and 6 Canadian provinces. He must be an avid certificate hunter—look at that wall!



This impressive array of equipment fills up the listening post of Lee Gilbert, WPE9HJ, Edgerton, Ohio. Some 14 receivers, made by Drake, Hammarlund, Heath, Hallicrafters, and National, give him coverage from 150 kHz all the way up to 245 MHz! The black box with the dial (right of center) is a remote control unit that selects and automatically shuts off the B+ only and turns on any specified receiver. Lee services all of his own equipment.

number of other foreign stations you will be able to find on the split channels.

As a starter, you might try for one of the stations that your Short-Wave Editor heard almost on a daily basis last winter: *Radio Clube Portugues*, in Miramar, Portugal, on 782 kHz. The power is 100 kW and the s/off time was (and probably still is) 0200 GMT. Listen for the close/down with the Portuguese National Anthem.

If any of our western DX'ers would like to make up a list of trans-Pacific stations that can be heard in the western states, we would be happy to publish it. Please prepare the list in a form similar to the trans-Atlantic list below, with frequency, station name, location, and (if known) power, and send it to Short-Wave Listening, Box 333, Cherry Hill, N.J. 08034.

(*Continued on page* 111)

SPLIT-CHANNEL STATIONS THAT CAN BE HEARD IN NORTH AMERICA

During the 1967-1968 winter season, European medium-wave stations will be coming through on split-channel frequencies. Many of these stations operate on a 24-hour schedule, but the best time for listening is from the onset of darkness to midnight (local time) and again in the period just prior to dawn. The following listing will serve as a guide for the BCB DX'er.

FREQUENCY (kHz)	STATION	LOCATION	POWER (kW)
566	R. Telefis Eireann	Athlone, Ireland	100
647	Radio 3 (formerly Third Network)	London, England	150
683	Radio Nacional Espana	Seville, Spain	250
737	Radio Nacional Espana	Barcelona, Spain	250
755	Radio Portugal	Lisbon, Portugal	135
782	Radio Clube Portugues	Miramar, Portugal	100
818	Sud-Radio	Andorre-La-Vielle, Andorra	300
845	Roma II	Rome, Italy	150
899	Milano I	Milano, Italy	600
908	Radio 4 (formerly Home Service)	London, England	140
989	R. I. A. S.	Berlin, West Germany	300
1016	Rheinsender	Baden-Baden, West Germany	300
1043	Radio DDR I	Dresden, East Germany	250
1187	Radio Caroline (may now be inoperative)	Off the English Coast	60
1205	Bordeaux I	Bordeaux, France	100
1214	Radio 1	Brookman's Park, England	50
1223	Sveriges Radio	Falun, Sweden	100
1313	Stavanger I	Stavanger, Norway	100
1421	Radio Saarbrucken	Saarbrucken, West Germany	400
1439	Radio Luxembourg	Villa Louvigny, Luxembourg	350
1457	British Broadcasting Corp.	Clevedon, England	20
1466	Radio Monte Carlo	Monte Carlo, Monaco	400
1475	Wien I	Vienna, Austria	150
1502	Warszawa III	Warsaw, Poland	500
1538	Deutschlandfunk	Mainflingen, West Germany	300
1554	Nice I	Nice, France	60
1562	Radio Veronica	Off the Holland Coast	5
1578	Emissores Do Norte Reunidos	Porto, Portugal	10
1586	Westdeutscher Rundfunk	Langenburg, West Germany	400

AMATEUR RADIO

By HERB S. BRIER, W9EGQ
Amateur Radio Editor

FCC ACTION TAKEN ON INCENTIVE LICENSING

ON August 24, 1967, the Federal Communications Commission released its new amateur regulations based on Docket 15928—the "Incentive Licensing" proposals. The new regulations go into effect on November 22. As of that date, the Novice license will be issued for a two-year period, but after November, 1968, Novice 2-meter phone privileges will be withdrawn.

In addition, the new regulations reinstate the former Advanced Class license (last issued in 1952) instead of authorizing a new First Class license. Requirements for the Advanced license are a 13-wpm code test and a 50-question written exam about halfway in difficulty between the General and Extra Class written exams. Present holders of the Advanced Class license retain their privileges, and General Class licensees will receive code credit when applying for an Advanced Class license. Others applying for the license will be required to take the complete General Class exam before being handed the envelope containing the Advanced Class written examination.

The Advanced Class examination will be available at FCC offices as soon as possible after November 22, and the American Radio Relay League "License Manual" and other publications containing the Advanced Class study guide should be available by the time you read these words.

As of November 22, 1968, the first 25-kHz segments of the low-frequency ends of the 80- through 15-meter CW bands and the 75- and 15-meter phone bands will be reserved for Extra Class licensees. Also, 3825-3850, 7200-7225, 14,200-14,235, 21,275-21,300 kHz and 50-50.1 MHz will be reserved for Advanced and Extra Class licensees.

Then, a year later, in November, 1969,

AMATEUR STATION OF THE MONTH

Homer P. Schulz, WØHNP, of Valentine, Nebr., became a ham some 36 years ago using a 30-watt self-excited CW transmitter. Today, Homer has a Heathkit SB-100 SSB/CW transceiver which feeds 80- and 20-meter dipole antennas through a Heathkit SWR bridge. Rag-chewing, DX, traffic-handling—you name it and Homer has done it. In addition, he sports a First Class Commercial license. WØHNP will receive a one-year subscription for submitting the winner for December in our Amateur Station of the Month photo contest. To enter the contest, send a clear picture of your station with you at the controls and some details on the equipment you use and your ham career to Amateur Radio Photo Contest, Box 678, Gary, Ind. 46401.

The 1967 Illinois Radio Amateur of the Year is Julian E. Gannon, K9BCJ, of Chicago, Ill. Julian, 72 years old, and blind, was awarded the title at the 33rd Annual Hamfest of the Hamfesters Amateur Radio Club, in recognition of the hours he spends daily handling "phone patches" for U.S. military, Peace Corps, and Embassy personnel throughout the world. K9BCJ uses two Central Electronics 100V transmitters, two Hallicrafters HT-32B linear amplifiers, a Hy-Gain TH-6 rotary beam, a Drake R-4 receiver, and two tape recorders, all modified as necessary for sightless operation.

the next 25-kHz segments of the 80- through 15-meter CW bands will be reserved for Extra Class licensees; and 3825-3900, 7200-7250, 14,200-14,275, 21,275-21,350 kHz, and 50-50.25 MHz will be reserved for Advanced and Extra Class use.

Extra Class licensees who have been licensed amateurs for at least 25 years will be issued a "2-letter" call upon application and the payment of a $20 fee, and Novices will still be issued distinctive call-signs. With these exceptions, the plan to issue distinctive call letters for each class of amateur licensee has been dropped. But—and probably not just by coincidence—starting with the Fall, 1967, issue, the Radio Amateur *Callbook* includes the class of license held by each amateur listed in the book.

Incidentally, the FCC reports that two-thirds of the 4000 people who filed comments regarding Docket 15928 were in general agreement with its proposals.

Fairbanks, Alaska, Flood Alert. It had been raining in Fairbanks, Alaska, and in the surrounding mountains for days before August 14, and it was still raining. The rising waters crept inexorably over more and more of the city, telephone and power lines kept going out of service, and people were being constantly evacuated from their flooded homes.

But not until early morning, August 15,

(*Continued on page 103*)

Eddie Meath, TV and radio personality of WHEC, Rochester, N.Y., and Eddie Dunn, WA2KMI, of the Rochester Amateur Radio Association, discuss the annual Eddie Meath Christmas Fund program which raises thousands of dollars to provide Christmas gifts for needy children in Rochester. Members of the radio club cooperate in the effort by using their radio-equipped cars to pick up donations pledged by viewers and listeners.

punchy galore

Was it possible to put *extra* punch, *extra* power and *extra* performance into a 5 watt CB mobile radio . . . and sell it for only $99.95? B&K, creators of the famous Cobra CAM 88, thought so—and built the new Cobra V. The 5 channel Cobra V is solid state, all-the-way. Those who have heard it and tested it say it is a most remarkable achievement in miniaturization—in CB technology—in selectivity, sensitivity and 100% modulation. It's true; this one's got punch galore. We've proven it . . . now you can. At B&K Distributors.

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WHERE ELECTRONIC INNOVATION IS A WAY OF LIFE

CIRCLE NO. 4 ON READER SERVICE PAGE

You can earn more money if you get an FCC License

...and here's our famous CIE warranty that you will get your license if you study with us at home

NOT SATISFIED with your present income? The most practical thing you can do about it is "bone up" on your electronics, pass the FCC exam, and get your Government license.

The demand for licensed men is enormous. Ten years ago there were about 100,000 licensed communications stations, including those for police and fire departments, airlines, the merchant marine, pipelines, telephone companies, taxicabs, railroads, trucking firms, delivery services, and so on.

Today there are over a million such stations on the air, and the number is growing constantly. And according to Federal law, no one is permitted to operate or service such equipment without a Commercial FCC License or without being under the direct supervision of a licensed operator.

This has resulted in a gold mine of new business for licensed service technicians. A typical mobile radio service contract pays an average of about $100 a month. It's possible for one trained technician to maintain eight to ten such mobile systems. Some men cover as many as fifteen systems, each with perhaps a dozen units.

Coming Impact of UHF

This demand for licensed operators and service technicians will be boosted again in the next 5 years by the mushrooming of UHF television. To the 500 or so VHF television stations now in operation, several times that many UHF stations may be added by the licensing of UHF channels and the sale of 10 million all-channel sets per year.

Opportunities in Plants

And there are other exciting opportunities in aerospace industries, electronics manufacturers, telephone companies, and plants operated by electronic automation. Inside industrial plants like these, it's the licensed technician who is always considered first for promotion and in-plant training programs. The reason is simple. Passing the Federal government's FCC exam and getting your license is widely accepted proof that you know the fundamentals of electronics.

So why doesn't everybody who "tinkers" with electronic components get an FCC License and start cleaning up?

The answer: it's not that simple. The government's licensing exam is tough. In fact, an average of two out of every three men who take the FCC exam fail.

There is one way, however, of being pretty certain that you will pass the FCC exam. And that is to take one of the FCC home study courses offered by the Cleveland Institute of Electronics.

CIE courses are so effective that better than 9 out of every 10 CIE-trained men who take the exam pass it... on their very first try! That's why we can afford to back our courses with the iron-clad Warranty shown on the facing page: you get your FCC License or your money back.

There's a reason for this remarkable record. From the beginning, CIE has specialized in electronics courses designed for home study. We have developed techniques that make learning at home easy, even if you've had trouble studying before.

In a Class by Yourself

Your CIE instructor gives his undivided personal attention to the lessons and questions you send in. It's like being the only student in his "class." He not only grades your work, he analyzes it. And he mails back his corrections and comments the same day he receives your assignment, so you can read his notations while everything is still fresh in your mind.

Mail Card for Two Free Books

Want to know more? The postpaid reply card bound-in here will bring you free copies of our school catalog describing opportunities in electronics, our teaching methods, and our courses, together with our special booklet, "How to Get a Commercial FCC License." If card has been removed, just send your name and address to us.

Matt Stuczynski, Senior Transmitter Operator, Radio Station WBOE

"I give Cleveland Institute credit for my First Class Commercial FCC License. Even though I had only six weeks of high school algebra, CIE's AUTO-PROGRAMMED™ lessons make electronics theory and fundamentals easy. I now have a good job in studio operation, transmitting, proof of performance, equipment servicing. Believe me, CIE lives up to its promises."

Chuck Hawkins, Chief Radio Technican, Division 12, Ohio Dept. of Highways

"My CIE Course enabled me to pass both the 2nd and 1st Class License Exams on my first attempt...I had no prior electronics training either. I'm now in charge of Division Communications. We service 119 mobile units and six base stations. It's an interesting, challenging and rewarding job. And incidentally, I got it through CIE's Job Placement Service."

Glenn Horning, Local Equipment Supervisor, Western Reserve Telephone Company

"There's no doubt about it. I owe my 2nd Class FCC License to Cleveland Institute. Their FCC License Course really teaches you theory and fundamentals and is particularly strong on transistors, mobile radio, troubleshooting and math. Do I use this knowledge? You bet. We're installing more sophisticated electronic gear all the time and what I learned from CIE sure helps."

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All CIE courses are available under the new G.I. Bill. If you served on active duty since January 31, 1955, or are in service now, check box on reply card for G.I. Bill information.

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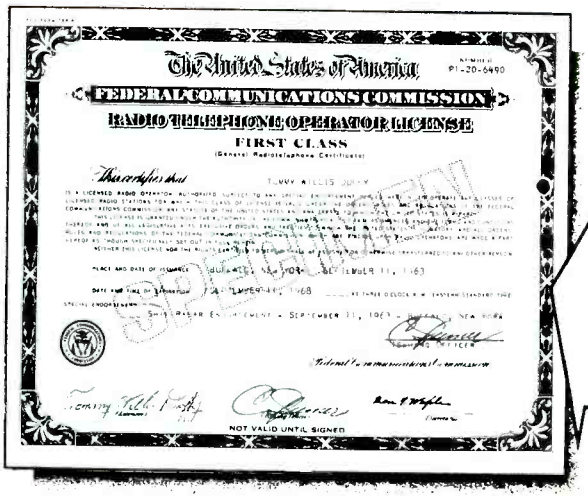


Better than 9 out of 10 CIE men win their "ticket" the very first time they try

NATIONAL AVERAGE IS ONLY 1 OUT OF 3

Cleveland Institute of Electronics

WARRANTY

of success in obtaining a Government FCC License

The Cleveland Institute of Electronics hereby warrants that upon completion of the Electronics Technology, Broadcast Engineering, or First-Class FCC License course, you will be able to pass the FCC examination for a First Class Commercial Radio Telephone License (with Radar Endorsement);

OR upon completion of the Electronic Communications course you will be able to pass the FCC examination for a Second Class Commercial Radio Telephone License;

AND in the event that you are unable to pass the FCC test for the course you select, on the very first try, you will receive a FULL REFUND of all tuition payments.

This warranty is valid for the entire period of the completion time allowed for the course selected.

G. O. Allen
President

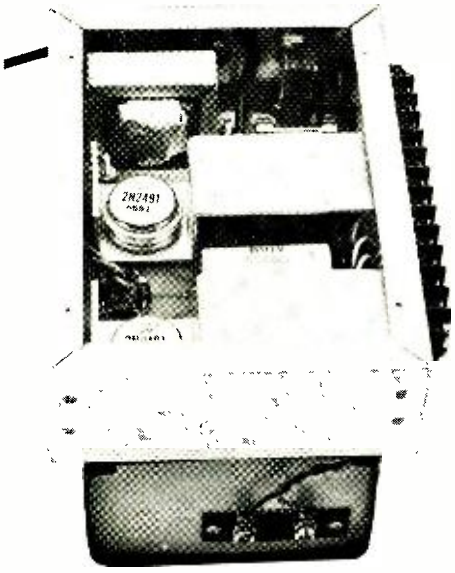
CIRCLE NO. 8 ON READER SERVICE PAGE

SLOT-CAR CONTROLLER

(*Continued from page* 44)

Each hand-control assembly (see Fig. 6) consists of *R1* and *R2* mounted within a 5″ x 2¼″ x 2¼″ metal box with the two potentiometers wired as shown in Fig. 1.

Interconnecting Sections. Each hand-control assembly is interconnected to the main chassis via a convenient length of



In this underchassis view, PC board has been put in place and leads brought out to a 12-tag strip.

three-conductor cable, the far ends of which are terminated in solderless crimp lugs for attachment to the barrier strip. The leads should be color-coded (or otherwise identified), and the front surface of both hand controllers should be marked (with press-on lettering, or tape-writing) so that *R1* is labeled "Minimum" and *R2* is "Control." Both controls are further identified as "Speed" controls. (See photo on page 41.)

When attaching each hand-control assembly to the main chassis, make sure that the terminals are connected correctly. In each case, potentiometer *R1* is used to set the car's minimum speed while *R2* is adjusted for variable speed operation. -30-

MEET MR. VERSATILE

(*Continued from page* 61)

the speaker's voice coil if a transformer output is used) of your TV set and switch *S1* on. The room should be darkened before proceeding. With the TV turned on and the sound turned up, direct the beam of a flashlight at the photocell. The sound will immediately cease without disturbing the picture.

Slot-Car Lap Counter. For this device you need only the usual switched line cord, an FR-101 relay, an electromagnetic counter, a magnetic reed switch, and a small but strong permanent magnet. As can be seen in Fig. 4, wiring is, again, simple and straightforward. The reed switch must be mounted as near to the path of the slot car as possible—preferably under the track.

Set your slot car up for use, and set *S1* to *ON*. Start the slot car moving, and

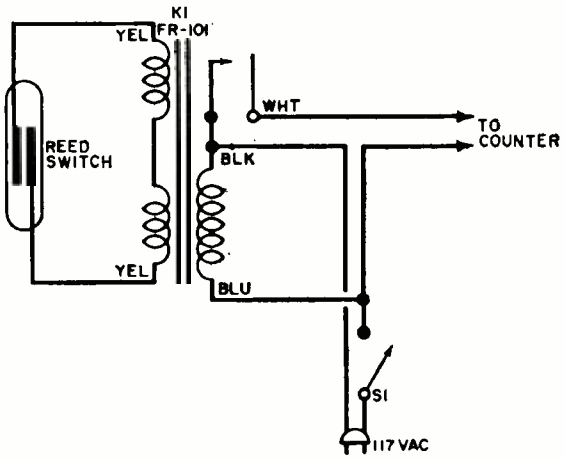


Fig. 4. When permanent magnet's influence closes reed switch contacts, K1 energizes and delivers a pulse of power to counter. Counter registers one digit each time K1 is energized and de-energized.

each time it passes the place where the reed switch is mounted, one digit will register on the counter. The influence of the permanent magnet in passing the reed switch momentarily closes the switch contacts, energizing *K1* which, in turn, delivers a pulse of electricity to the counter. -30-

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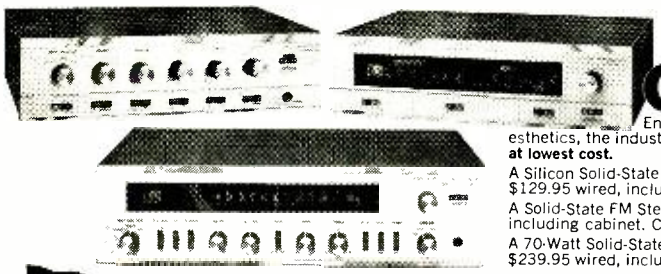

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A Silicon Solid-State 70 Watt Stereo Amplifier for $89.95 kit, $129.95 wired, including cabinet. Cortina 3070.

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Fun to build and use. Expandable, interconnectable. Great as "jiffy" projects and as introductions to electronics. No technical experience needed. Finest parts, pre-drilled etched printed circuit boards, step-by-step instructions.

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Two years ahead! Model 7923
All Solid-State 23-Channel 5W Transceiver. 4 exclusives: dual-crystal lattice filter for razor-sharp selectivity; efficient up-converter frequency synthesizer for advanced stability; precision series-mode fundamental crystals; Small: only 3"H, 8"W, 8¼"D. $189.95 wired only.

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Model 20A3, 20,000Ω/V, $12.95.
Model 4A3, 4000Ω/V, $8.95.
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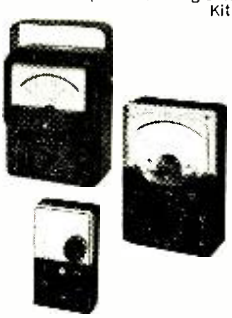

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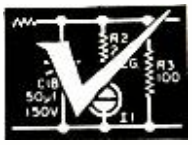

OPERATION ASSIST

Through this column we try to make it possible for readers needing information on outdated, obscure, and unusual radio-electronics gear to get help from other P.E. readers. Here's how it works: Check the list below. If you can help anyone with a schematic or other information, write him directly—he'll appreciate it. If you need help, send a postcard to Operation Assist, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016. Give maker's name, model number, year of manufacture, bands covered, tubes used, etc. State specifically what you want, i.e., schematic, source for parts, etc. Be sure to print or type everything legibly, including your name and address. Because we get so many inquiries, none of them can be acknowledged. POPULAR ELECTRONICS reserves the right to publish only those items not available from normal sources.

Victrola Radio Model R-32 BCB receiver, circa 1926-1938. Five No. 26 tubes needed. (Leon Roose, 333 Donald Pl., S.E., Grand Rapids, Mich. 49506)

Radio City Products Co. Model 70 signal generator; tunes 100 kHz to 25 MHz on 5 bands. Schematic and operating manual needed. (TSgt. Allan E. Rice, 4361 Amelia Dr., Sumter, S.C. 29150)

Kalimar Courier transistorized capstan drive portable tape recorder, circa 1961. Schematic, servicing data, and source of parts needed. (R. L. Clark, 1512 East Main, Richmond, Ind.)

Ampro Precision 16-mm. sound projector, C U A 33870-2839-5 1N, 120 volts, a.c. or d.c. Schematic or operating manual needed; also source for #4 (3-prong) photoelectric cell. (Colin A. Atkins, 66 Hibernia St., Yarmouth, N.S., Canada)

Teletest Instrument Co. D.M.-456 tube tester. Source needed. (Lou Levin, 2575 S.W. 24th Ave., Miami, Fla. 33133)

Atwater Kent Model 43 receiver, S/N 84223; tunes broadcast band. Schematic needed. (Ken Gandenberger, 8010 Burleson Rd., Austin, Texas 78744)

Zenith Model 26-298 receiver, ser. A579954, circa 1945; tunes 550 kHz to 18.0 MHz; has 10 tubes. Schematic and operating manual needed. (David Kell, 9529 Dulles Ct., St. Louis, Mo. 63123)

Tape Recordio Model 592 tape recorder, circa 1960; made by Recordio Corp., Charlotte, Mich. Schematic needed; also explanation for socket (5-prong, 1 unused) labeled "S-3." (W. Mahoney, 56 N. Marguerite Ave., Ferguson, Mo. 63135)

Comco VRC-33/RT-408A FM transceiver; tunes 30-45 MHz; has crystal-controlled receiver and transmitter. Schematic and operating manual needed. (Robert Hess, 4104 41st Ave., Sacramento, Calif. 95824)

Zenith "Trans-Oceanic" receiver, 8G005TZ1Y, circa 1940; BC, s.w. on 6 bands; has 8 tubes. Schematic and source for 1LD5, 1LN5, and 1LE3 tubes needed. (Jim Campbell, 654 S. Xenon Ct., Denver, Colo. 80228)

Supreme Model 500 automatic tube checker and multi-tester, circa 1936. Source for replacement or repair of meter needed. (Raphael Finkelstein, 6072 E. 22nd St., Tucson, Ariz. 85711)

Pyramid Model CRA-1 capacitor-resistor analyzer, circa 1954. Information on how to make a set of quick-check test leads needed. (Peter Askervitch, 46 Berlin St., Auburn, Mass. 01501)

Heath TS-2 TV alignment generator. Operating manual, specifications for absorption marker coils and variable oscillator coil and output cable termination needed. (D. E. Fell, 185 Oxley Rd., Columbus, Ohio 43228)

Arvin 950-T2 receiver; has 5 tubes; tunes 550-1600 kHz. Schematic needed. (Karl Bullock, Box 97, Faulkner, Miss. 38629)

GE Type CG-43AAG radio transmitter-receiver, 1941; has 12 tubes. Schematic, source of parts, and operating manual needed. (Dennis Tolomei, 577 Carlisle Way, Sunnyvale, Calif. 94087)

Westinghouse WD 11 set, circa 1921; has 1 tube. Battery hookup information needed. (T. D. Hartley, 4219 Daisy Ave., Cleveland, Ohio 44109)

Black-Hawk receiver by T.R. Corp., circa 1930, ser. 182523; has 5 tubes; tunes 550-1500 kHz, 1.5-4 MHz. Schematic needed. (Curtis A. Cook, 5821 Winona Ave., W. Des Moines, Iowa 50265)

Dumont Type 274-A cathode-ray oscillograph. Schematic and operating manual needed. (J. A. Carpentier, 2959 Wilson Pkwy., Harrisburg, Pa. 17104)

RCA Model K60 receiver, pre-World War II; tunes BC and s.w. from 5.8 to 18 MHz; has 6 tubes. Schematic and operating manual needed. (Tom Treacy, 1311 Laurel Ave., Asbury Park, N.J. 07712)

Atwater Kent Model 84 receiver; has 6 tubes; tunes broadcast band. Schematic, servicing data, and source for parts needed. (Robert L. Smith, RFD 2, Farmington, Me. 04938)

Knight 100-mW wireless broadcaster; has 3 tubes; transmits on broadcast band. Schematic needed. (Lewis White, 4 Mansfield Rd., Trenton, N.J. 08628)

Atwater Kent Model 33 receiver. Battery hookup information, schematic, and parts source needed. (Dale Blanchard, 216 Carson Way, Henderson, Nev. 89015)

Philco 38-39 receiver, code 125, circa 1938; has 6 tubes; tunes broadcast and marine bands to 3.6 MHz. Schematic needed. (David Wilk, 3174 Wabash Ave., Pittsburgh, Pa. 15234)

VkS Mobile tape recorder, manufactured in W. Germany. Schematic, parts source, service notes, and instruction manual needed. (Randall Williams, 5659 N. 86th St., Milwaukee, Wis. 53225) —30—

HELP PROMOTE INTERNATIONAL FRIENDSHIP

Many POPULAR ELECTRONICS *readers in foreign countries request technical information, parts, or electronics publications which they find difficult or impossible to obtain in their own countries. Most of these readers offer, in exchange for these services, gifts of items made in their own countries. If you are interested in obtaining token gifts from the Orient, eastern Europe, Africa, etc., or would just like to correspond with people who share a common hobby interest, check the list below. Maybe you can become a Goodwill Ambassador.*

Anis Shikari, 231, Lal Mohan Shaha St., Dacca-1, East Pakistan, wants to exchange items made locally for electronics parts.

A.S. Osibo, Ministry of Economic Planning & Social Development, Statistics Department, Ibadan, Nigeria, would like to find an American sponsor or sponsors interested in helping pay his first year's tuition to a technical school in the United States.

Joe Homaidan, P.O. Box 2541, Accra, Ghana, needs help in obtaining electronics parts.

K. Harvant Singh, 31, (774), Upper Museum Road, Taiping, Perak, States of Malaya, Malaysia, would like to correspond with hams and SWL's who are interested in helping a new radio society. Books, magazines, radio parts, and electronic equipment are needed.

Lin Yun Po, Room 412, Central Building, Pedder St., Hong Kong, wants to buy two or more RCA 2N1213 thyristors or find out what could be substituted for them.

Mani Joseph Vadakkettu, Kurumannu, P.O. Via Palai, Kerala, S. India, would like to exchange hand-carved ivory and other items for parts, books, and magazines.

R.K. Panjabi, 11-C Golden Crown Court, 66-70 Nathan Rd., Kowloon, Hong Kong, wants to exchange items made locally for electronic parts.

Ljubomir, Skrinjar, Zagreb, Kresiceva 45, SFR, Yugoslavia, would like to obtain parts and books.

Wong Ewe Hung, 12-14 Ipoh Rd., Kuala Lumpur, Malaya, Malaysia, would like to correspond for technical information.

Albert Zinner, Santiago de Chile, Av. Santa Maria 0112, Depto. 1, needs parts and technical information.

—30—

12 KIT-GIVING IDEAS FROM HEATH . . .

For The Whole Family . . . New Deluxe "227" Color TV

Kit GR-227
$419.95 (less cabinet) $25 mo.

Exclusive Heathkit Self-Servicing Features. Like the famous Heathkit "295" and "180" color TV's, the new Heathkit "227" features a built-in dot generator plus full color photos and simple instructions so *you* can set-up, converge and maintain the best color pictures at all times. Add to this the detailed trouble-shooting charts in the manual, and you put an end to costly TV service calls for periodic picture convergence and minor repairs. No other brand of color TV has this money-saving self-servicing feature.

Advanced Features. Boasts new RCA Perma-Chrome picture tube for 38% brighter pictures . . . 227 sq. in. rectangular viewing area . . . 24,000 v. regulated picture power . . . improved phosphors for brilliant, livelier colors . . . new improved low voltage power supply with boosted B+ for best operation . . . automatic degaussing . . . exclusive Heath Magna-Shield to protect against stray magnetic fields and maintain color purity . . . ACC and AGC to reduce color fade and insure steady, flutter-free pictures under all conditions . . . preassembled & aligned IF with 3 stages instead of the usual 2 . . . preassembled & aligned 2-speed transistor UHF tuner . . . deluxe VHF turret tuner with "memory" fine tuning . . . 300 & 75 ohm VHF antenna inputs . . two hi-fi sound outputs . . . 4" x 6" 8 ohm speaker . . . choice of installation — wall, custom or optional Heath factory assembled cabinets. Build in 25 hours.

Kit GR-227, (everything except cabinet). . . $42 dn., as low as $25 mo. . . . 114 lbs. **$419.95**
GRA-227-1, Walnut cabinet. . . no money dn., $6 mo. **$59.95**
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Now change channels and turn your Heathkit color TV off and on from the comfort of your armchair with this new remote control kit. Use with Heathkit GR-227, GR-295 and GR-180 color TV's. Includes 20' cable.

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(less cabinet & cart)
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NEW! VOX "Jaguar" Transistor Combo Organ By Heathkit

Save Up To $150 on the world's most popular combo organ with this new Heathkit version. Features the most distinctive sound of any combo organ. Has a special bass output that gives a brilliant stereo bass effect when played through a separate or multi-channel amplifier, 4 complete octaves, vibrato, percussive effects and reversible bass keys. Includes hand crafted orange and black cabinet, fully plated heavy-duty stand, expression pedal and waterproof carrying cover and case for stand. Requires a bass or combo amplifier like Heathkit TA-17 (opposite page).

Kit TO-68, 80 lbs.... $35 dn., $30 mo..... **$349.95**

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Amplifier
Kit TA-17
$175
$17 mo.
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Speaker System
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$120
$11 mo.
(Assembled TAW-17-1 $150)

Special Combination Offer
Amplifier & Two Speaker Systems
Save $20
Kit TAS-17-2
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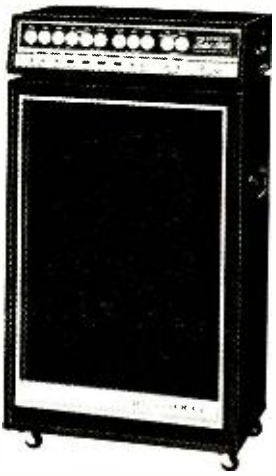

All the "big sound" features every combo wants . . . tremolo, built-in "fuzz", brightness, reverb, separate bass and treble boost and more. Delivers a shattering 120 watts EIA music power (240 watts peak power) through two TA-17-1 speakers . . . or 90 watts through one TA-17-1 speaker. Features 3 independent input channels, each with two inputs. Handles lead or bass guitars, combo organ, accordion, singer's mike, or even a record changer. All front panel controls keep you in full command of all the action.

Speaker system features two 12" woofers, special horn driver and matching black vinyl-covered wood cabinet with casters & handles for easy mobility.

Kit AR-17
$72.95
(less cabinet)
$8 mo

NEW! Lowest Cost Solid-State Stereo Receiver

Features wide 18-60,000 Hz response @ ±1 db at full 5 watts RMS power per channel . . . 14 watts music power . . . inputs for phono and auxiliary . . . automatic stereo indicator . . . outputs for 4 thru 16 ohm speakers . . . adjustable phase for best stereo . . . flywheel tuning . . . and compact 9⅞" D. x 2⅞" H. x 11⅞" W. size. 12 lbs. Optional factory assembled cabinets (walnut $7.95, beige metal $3.50).

Kit AR-17, (less cab.) 12 lbs. . . . no money dn., $8 mo.. **$72.95**
Kit AR-27, 7-Watt FM Mono Only Receiver (less cab.) 9 lbs. . . . no money dn., $5 mo..... **$49.95**

Kit IM-17
$19.95

NEW! Solid-State Portable Volt-Ohm-Meter

So Handy, So Low Cost we call it "every man's" meter. Just right for homeowners, hobbyists, boatowners, CBer's, hams . . . it's even sophisticated enough for radio & TV servicing! Features 12 ranges . . . 4 AC & 4 DC volt ranges, 4 ohm ranges; 11 megohm input on DC, 1 megohm input of AC; 4½" 200 uA meter; battery power; rugged polypropylene case and more. Easy 3 or 4 hour kit assembly. Ideal gift for any man! 4 lbs.

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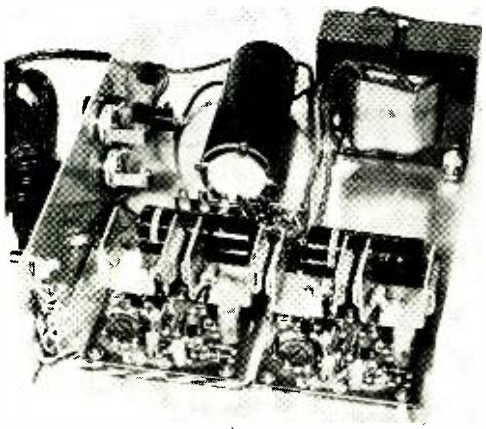
Prices & specifications subject to change without notice. CL-312

CIRCLE NO. 13 ON READER SERVICE PAGE

L'IL TIGER

(*Continued from page 33*)

Just set the 500-ohm potentiometer for minimum resistance, apply voltage to the circuit, then reset the potentiometer for a current reading of about 5 mA. Measure the resistance of the potentiometer and install a fixed resistor of the next largest standard value in place of it. Make sure that this new resistor does not cause the idle current to increase above 10 mA; reduce the value of the resistor used for *R6* to the next smaller standard value if it does.



A pair of "L'il Tiger" amplifiers and common power supply can be mounted in a chassis for stereo use.

The "L'il Tiger" can be used with almost any transistor preamplifier, but the 5000-ohm input impedance is too low for many tube preamps.

Caution: Be careful not to short the heat sinks to each other while you are working on the amplifier with the protective cover removed. Remember that the heat sinks are connected directly to supply voltage and ground, respectively. Shorting them together will not harm the circuit, but will blow the fuse. Conventional microphone jacks have been used as output connectors to minimize chances of shorting the output of the amplifier. With no signal applied, a shorted output will cause no harm, but it could damage the output transistors if a large signal were applied. —30—

NGW TRANSISTOR TESTER

(*Continued from page 59*)

Depress the *SI-GE* (*SI* for silicon and *GE* for germanium) switch (*S2*). If the meter pointer goes to full-scale deflection, the transistor is a *pnp* unit; if no deflection is observed, it is an *npn* unit. If the meter deflects, move switch *S4* to *PNP* and the pointer should return to zero. If no deflection is observed in either position of *S4*, the transistor is open.

With the *NPN-PNP* switch (*S4*) in the proper position, as determined above, read the transistor's leakage current. Leakage for a germanium transistor should generally be less than 1 mA, zero for silicon transistors. (Consult a transistor manual if you observe excessive leakage for germanium power transistors. Leakage in excess of 1 mA for some germanium transistors can be normal.)

Depress *GAIN* switch *S1*, and if the meter shows less than 1 mA, set *S3* to *X100*. Multiply the meter reading by the value indicated by the position of *S3*. This is the d.c. current gain of the transistor. No meter indication means that the transistor has an interelement open.

With *S1* closed, depress *S2*. If the meter pointer deflection remains the same or drops slightly, the transistor is a germanium unit. If the indication should drop to zero, the transistor is silicon. A simplified step-by-step testing procedure that can be pasted on the tester appears on page 58.

Testing Diodes. Connect the anode of the diode to be tested to the *C*ollector jack (*J3*); the cathode goes to the *E*mitter jack (*J1*). When *S4* is then set to *NPN*, the meter should deflect fully upscale. Now set *S4* to the *PNP* position; there should be no deflection. (Full-scale deflection is obtained in both positions of *S4* when the diode under test is shorted; there is no deflection when the diode is open.)

Zener diodes with less than 6 volts breakover potential (E_{bo}) will normally produce a slight meter indication when *S4* is set to *PNP*. The tester will *NOT* check tunnel diodes, trigger diodes, constant-current diodes, or four-layer diodes. —30—

ELECTRONICS library

QUIET

RCA TRANSISTOR MANUAL SC-13

The latest edition of this ever-popular manual has been revised and expanded (there are 64 more pages) to include the latest information on more than 770 different types of semiconductors, including bipolar and MOS field-effect transistors, thyristors (SCR's and triac's), and tunnel and other semiconductor diodes. Active transistor and thyristor types are covered extensively, the transistor selection charts have been updated, and the revised circuits section contains over 40 representative circuits—complete with parts lists.

Published by Electronics Components and Devices, Radio Corporation of America. Available from RCA distributors, or from Commercial Engineering, RCA Electronic Components and Devices, Harrison, N.J. 07029. Soft cover. 544 pages. $2.00.

ENCYCLOPEDIA OF ELECTRONICS COMPONENTS

Allied Radio's "Encyclopedia of Electronics Components" alphabetically lists, describes, and illustrates the basic components currently being used in electronics. The descriptions are in down-to-earth language. Each component is clearly identified, its uses carefully explained, and there are special notes on handling and installation. A handy reference for anyone involved in electronics.

Published by Allied Radio Corp., 100 N. Western Ave., Chicago, Ill. 60680. Soft cover. 112 pages. $1.00.

AUDIO AMPLIFIER DESIGN

by Farl J. Waters

This is a "one-book course" that tells you how to design hi-fi audio amplifiers—from a single stage to a multi-stage stereo system. The theory of how each stage works is discussed, then an example is given to demonstrate how component values are arrived at, and finally how the design problem is solved. At the end of each chapter, you will find review questions, the answers for which appear after the last chapter. Liberal use of nomographs and load-lines in the body of the text does away with the need for an extensive mathematical background. *Audio Amplifier Design* can help you to design and build your own amplifier from the ground up.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, Ind. 46206. Soft cover. 160 pages. $4.25. -30-

SOLID STATE

(*Continued from page 81*)

changeability Charts. Generally free on request, these booklets can be extremely valuable to the experimenter or hobbyist who uses them properly, and who needs a transistor which—as is often the case—he doesn't have on hand.

Simply look up the "universal" replacement type for the unit needed for your project. Cross-check this type against the "universal" replacement types for the units you have on hand until you find a pair that match. In most cases—probably 8 out of 10 times—you'll have a substitute unit in your lab stock, and you'll save yourself the price of a new transistor, not to mention a time-consuming trip to your local distributor.

An example may help. Let's say your planned project calls for a 2N404. You don't have any of these in stock, but you do have a few 2N140's, three or four old 2N43's, and a pair of 2S109's salvaged from a small imported receiver. Checking, for example, the "Transistor Cross Reference Guide" published by Workman Electronic Products, Inc. (Box 3828, Sarasota, Fla. 33578), you'll find that Workman's Type AA1 is listed as a general replacement for all of these transistors, including the 2N404. Chances are you can use any of the three types you have on hand as a replacement for the specified unit, although you might have to readjust base bias resistor values for optimum performance—but that might have been necessary even if you had a 2N404.

Take two important precautions when applying this technique: (1) if the specified type is used at a higher-than-normal voltage, make sure the replacement type has at least as high a rating, and (2) make sure that your lab stock units are in good condition! —*Lou*

ON THE CITIZENS BAND

(*Continued from page 77*)

formed your CB Editor that "We, as manufacturers, were particularly disappointed that most editorials on the type acceptance ruling were written as though the FCC were taking something away from the user, when in actuality, this type acceptance is directed towards the manufacturer in an attempt to protect the user. Under existing regulations, the user is the only person subjected to punishment and fine when improper equipment is operated, whereas the manufacturer who produced and sold the improper equipment carries no legal responsibility. The new rulings will give the responsibility for proper equipment to the manufacturer, where it should justly be."

Another activity of the CRM Section is to encourage the use of channel 9 only for emergencies by CB operators and club members. The industry is officially recommending and supporting the channel 9 concept, and Chairman Thomas states that while the FCC has approved this action on a voluntary basis, it will be up to all concerned to cooperate to help the CB Radio Service become a more useful instrument in maintaining the safety of the traveling public.

Club News. The following reached us the long way 'round the grapevine. See if you can figure it out! In the August issue of the *Frequency Beat*, CB publication of the Five Watters of Lake County, Willoughby, Ohio, a reprint from the June issue of *National CB News* stated that their president was the first woman president in the United States. To that, *CB Chatterbox Editor, George* Gemrose, KRM9159, of the Cereal City Citizens Radio Club, Inc., Battle Creek, Mich., boldly replies: "I'm afraid that you are a bit late, President Pearl Knerem, because

the 5 Watters of Lansing, Mich., has a past president of the year just passed. Past-President Lois Boogaard was succeeded in office by Charles Draper, KLO1172. Sorry about that."

And the *York CB Journal* staff, York CB Assistance Club, Inc., York, Pa., recently reported to its membership as follows: "You are very lucky to receive the York CB Journal this month. The truth of the matter is we had to print and write the addresses for this (issue) by CANDLELIGHT."

1967 OTCB CLUB ROSTER

The following is the last round-up of CB clubs reporting to OTCB for the year. If your club has not reported to the column in the last 12 months, why not be one of the first to head the 1968 roster by forwarding us the vital statistics: membership totals; club or rescue team activities; photos of members, teams, or individuals in action; a sample club decal and membership card, and your club publication on a monthly basis. Send all material to Matt P. Spinello, CB Editor, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016.

Thousand Oaks, California—*The Tri-Valley Radio Club.* With a membership of 29 families, this club serves the southern half of Ventura County as a REACT team. Yearly projects include a Halloween Safety Patrol, traffic control at Fourth of July celebrations, patrol assignments at the Conejo Valley Days parade and fairgrounds, and assistance to the Thousand Oaks Sheriff's station. Officers are: Andy Miller, KEJ3841, president; Ed Lynch, KMX8294, vice president; Nancy Renner, KEJ7264, secretary; and Pat Benedict, KOX4673, treasurer.

Springfield, Virginia—*The Association of Volunteer Emergency Radio Teams* (AVERT). As the name implies, AVERT's major purpose is to aid as an emergency radio team in any manner needed. Their newsletter is one of the finest we have ever received; no recipes, no off-color jokes or unrelated items just to fill space. The print, format, and articles are all excellent. AVERT will send its newsletter to teams and clubs, and is interested in printing news from other parts of the country. Write to AVERT, 7430 Hastings St., Springfield, Va., 22150, if you would like to have their newsletter, or exchange publications with them.

White Rock, B.C., Canada—*Peace Arch Radio Klub* (PARK). Group sports its own clubrooms, sponsors CB jamborees and dances, and at least one member has been known to monitor a riding academy endurance ride from the top of a horse, holding two walkie-talkies and reins. He is now being considered as a monitor for "live" coverage of a sky-diving group, via walkie-talkies and parachute shrouds.

Whittier, California—*10-12 News Break.* This is not a CB club, but an excellent CB newspaper published monthly by the 10-12 Committee as a courtesy and information medium for all CB'ers. There is no charge for the publication; all costs are covered by the paper's many advertisers. A staff of 18 puts the *10-12 News Break* together each month under the guidance of Editor Buckhorn, KOX6200, and Chairman Paul Carter, KMX3575. If you're struggling with a first issue, or having hang-ups with a broken-down setup, drop a note to 10-12 for a sample copy. You're almost guaranteed ten new ideas to incorporate into your own sheet. Send the request to the 10-12 Committee, 11829 S. Louis Ave., Whittier, Calif. You'll be glad you did.

I'll CB'ing you,

—Matt, KHC2060

AMATEUR RADIO

(*Continued from page 86*)

did the outside world realize the seriousness of the situation. At that time, Steve Barnes, KØYKJ, Boulder, Colorado, contacted the Alaska Centennial Station, KL7ACS, located on the houseboat *Nenana*. James McGuire, KL7DUW, who was operating KL7ACS, quickly briefed KØYKJ on the desperate conditions in Fairbanks. Steve then telephoned Colorado Senator Donald Brotzman in Washington, D.C., who brought Congressman Howard W. Pollock, from Anchorage, Alaska, in on the call.

By radio to Boulder and by telephone to Washington, Jim McGuire graphically described most of Fairbanks under six feet of water, and it was still raining! The Senator and the Congressman took it from there, and Washington immediately dispatched all available help to Fairbanks.

In spite of being wiped out by the flood himself, Jim McGuire kept KL7ACS on the air almost continuously for several days, sending flood news and messages from Fairbanks. Many of his reports were tape-recorded in amateur stations in the "lower 48" and broadcast over radio and TV stations. Steve, KØYKJ, also spent many hours on the air, having been authorized by his employer, the U.S. Environmental Science Services Administration (ESSA), to stay away from work until he was no longer needed for flood communications.

Five people drowned in the Fairbanks flood, and it did over 100 million dollars' worth of damage. During the course of it, hundreds of amateurs in and outside of Alaska spent countless hours monitoring and handling messages in and out of Fairbanks.

West Virginia QSO Party. Between 0000, GMT, December 16 (7 p.m., EST, Dec. 15) and 2400, GMT, December 17 (7 p.m., EST, Dec. 17), the world will try to work West Virginia amateurs while West Virginia amateurs try to work the world. Outsiders should send QSO numbers, signal reports, and ARRL section or country; West Virginia stations will send QSO numbers, signal reports, and name of their county. The same station may be worked once on phone and once on CW on each band.

Your total score is the number of contacts multiplied by the number of West Virginia counties worked—or the number of ARRL sections and countries worked if you are located in West Virginia. Suggested op-

Eric Skaggs, WN6WFN, operating out of Concord, Calif., works all Novice bands with a Heathkit DX-40 transmitter, a Hallicrafters SX-111 receiver, and a war-surplus "522" 15-watt, 2-meter rig.

erating frequencies: near 3570, 3890, 3903, 7050, 7205, 14,050, 14,300, 21,050, 21,410, 28,050, 28,800, and 50,250 kHz. Logs must be in GMT and mailed to: West Virginia QSO Party, c/o Don Thompson, WA8YNT, Route 1, Box 376, Hurricane, W.Va. 22526.

Other News. Via *Short-Wave Magazine*, London, we have learned that John Dormois, WØGDH, Kansas City, recently earned the first 50-state, 160-meter WAS (Worked All States) certificate ever issued. Add to that the rumor from the Oklahoma Central VHF Amateur Radio Club *News* that Australia has been heard on the West Coast on 50 MHz. Interesting things are happening at both ends of the spectrum.

The Rochester Amateur Radio Association, P.O. Box 1388, Rochester, N.Y., offers code and theory classes at Greece Olympia High School at 7:30 p.m. every Friday.

NEWS AND VIEWS

Dan Shine, WA1GGN, 9 Colonial Blvd., West Haven, Conn. works AM and CW with a Johnson "Ranger" transmitter running 75 watts driving an inverted-V antenna 40 feet high. He receives on a Lafayette HE-30 and has worked 35 states. Dan's most thrilling contact was with an SSB station in Hawaii on 15 meters, although he spends most of his time on 40-meter CW (he has a 20-wpm code certificate). You can find him on 75-meter phone occasionally. Whatever class of amateur you are, Dan will sked you if you need a Connecticut contact . . . **Lawrence Vaksman, WA3FDC,** 5855 Drexel Rd., Philadelphia, Pa., worked all states and 35 countries in a year as a General. He DX'es on 40- and 15-meter CW and rag-chews on 40- and 15-meter AM phone. A Heathkit DX-60 transmitter, Hammarlund HQ-110A receiver and 40- and 20-meter dipoles are Larry's tools of opportunity. Larry is an amateur juggler, too; when you work him, ask him about the 3-member National Jugglers' Association . . . **Bob, W6SUP,** Roseville, Calif., has an interesting method of handling phone patchers who are constantly asking for a clear

channel. Whenever possible, Bob runs overseas phone patches on request. *But* he tells the other operator, "If you ask for a clear channel for a phone patch, I'll immediately terminate the patch, because I don't think that you or I have any right to a clear channel just because we would like one."

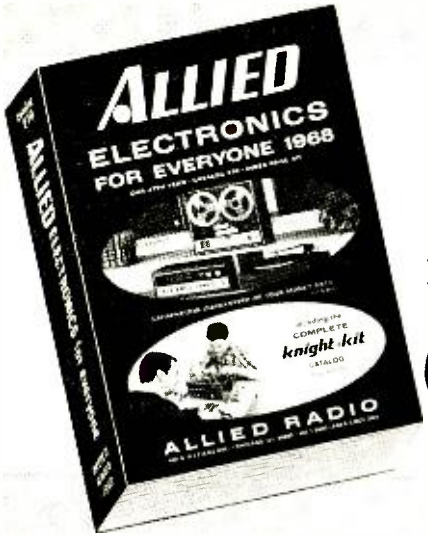
Eric Skaggs, WN6WFN, 4638 Lincoln Drive, Concord, Calif., works all the Novice bands, using a Heathkit DX-40 transmitter and a Hallicrafters SX-111 receiver on the lower frequencies and a war-surplus SCR-522 on 146 MHz. Various dipoles and a ground plane do the actual radiating. Sixteen of Eric's 20 states worked were picked up on 80 meters . . . **Daniel Sullivan,** WN4ERT, 1522 Shadylawn Drive, Burlington, N.C., has worked one more country than he has worked states in his six-month amateur career. The scene is 15 meters, the equipment a Knight T-50 transmitter, a Hy-Gain 18-V vertical antenna, and a Hallicrafters S-118 receiver. The record: 41 countries and 40 states; and when the promised card from Australia comes through, Dan will apply for a Worked-All-Continents (WAC) certificate . . . **PFC JIM Millsap, W9CTO,** US 54804560, HHB III Corps Arty, Ft. Sill, Okla., was a commercial VHF technician in civilian life and has gone through Radio Mechanics School, Radio Operators School, and Radio-Teletype School in the Army—and his Army job is pounding a typewriter in an office.

Bill Schiffrin, WA2IZU/NØHKE (Navy MARS), 15 Family Lane, Levittown, L.I., N.Y., uses his amateur equipment mostly for phone-patch contacts with Navy ships and overseas points. The 1967 count isn't in yet, but he ran 3683 "patches" in 1965 and 4068 in 1966! Included in these totals are two medical emergency patches and an 18-hour stretch during the Alaskan Earthquake catastrophe. Telrex beams atop a 105' tower, Collins "S" line, and a Henry 2-K linear amplifier give Bill's signal the sound of authority. And with four 24-hour clocks in a row, he always knows what time it is where he is and where you are, too . . . **Bill Carney, WA3GLX,** 1552 Stevens St., Philadelphia, Pa., closed out his Novice career with a record of 44 states and 20 countries worked. His playgrounds were the 80-, 40-, and 15-meter Novice bands, and his equipment included a Heathkit DX-40 transmitter, Hallicrafters SX-110 receiver, and 40-meter dipole antenna . . . **Gary L. Carlson, KL7FRZ,** P.O. Box 185, Haines, Alaska, says that he, KL7IR, KL7PI, and KL7CQF very often see mobile hams traveling through Haines (because Haines is on the northern road connection to the Alaska Ferry System) but very seldom hear any of them on the air. He points out that Alaska has a great number of *active* hams, but you have to make calls to get results. You can usually find the Haines gang around 3960-3970 kHz at night (and the nights are plenty long in the winter) and around 14.23-14.33 MHz during the day.

Stanley Hiriak, WN2BUP, 270 Church St., Woodbridge, N.J., has worked seven states in three weeks on 40 meters. A Hy-Gain 18-V vertical radiates the power fed into it from a Knight-Kit T-60 transmitter, and a Lafayette HA-230 receiver handles the reverse process . . . **Kenny Reynard, WA5QPA,** 4888 Loyola Dr., Baton Rouge, La., has found that a good receiver is the most important part of an amateur station: he uses a Drake R-4A. His transmitter is a Heathkit "Apache," and he has an SB-10 SSB adapter. The antennas are a Mosley TA-33 up 42' and an 80-40 meter dipole. As a Novice, Kenny worked 48 states. Since March, when the beam went up, he has worked the missing two states and 52 countries. Most of this work was on 15- and 20-meter CW, but he likes 10-meter AM phone when "skip" is in.

Keep your "News and Views," pictures, club papers, and contest announcements coming (allow plenty of time for the latter) to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P.O. Box 678, Gary, Ind. 46401. Merry Christmas and

73, Herb, W9EGQ



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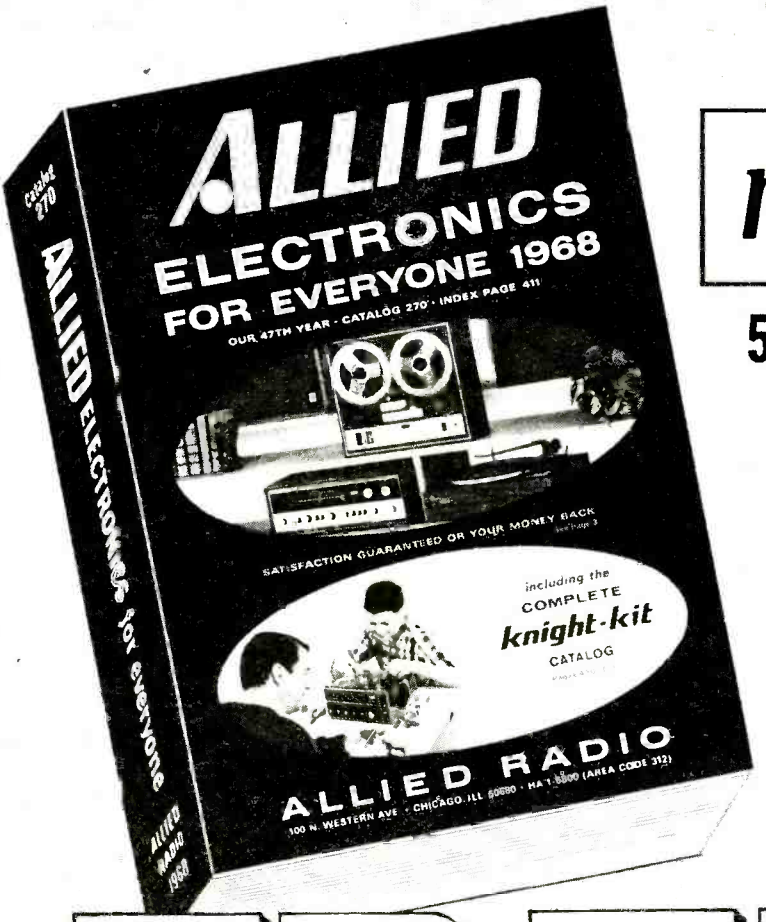

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To obtain a copy of any of the catalogs or leaflets described below, simply fill in and mail the coupon on page 15.

Trimmer capacitors, potentiometers, counting dials, and instrument motors are covered in depth in *Amphenol's* new 120-page catalog. A detailed cutaway drawing of each item is accompanied by a complete list of mechanical, electrical, and environmental specifications.

Circle No. 88 on Reader Service Page 15

H.H. Scott's "At Home With Stereo" brochure for 1968 features a new line of stereo consoles in an exclusive collection of decorator-styled room settings. In color and well illustrated, the 24-page brochure contains informative articles on hi-fi and the role of music in the home, how to choose the correct console to match individual room decor, and explanations—in layman's terms—of the more technical aspects of stereo consoles.

Circle No. 89 on Reader Service Page 15

The lightning rod industry is currently being revitalized, according to an 8-page booklet available from the *Lightning Protection Institute.* This illustrated booklet, titled "Business Opportunities in the New Lightning Protection Field," traces the history of lightning protection, starting in 1753, and tells why the Space Age is opening up new opportunities.

Circle No. 90 on Reader Service Page 15

Availability of the *Conar* (Division of National Radio Institute) Fall and Winter Catalog has just been announced. New items in the catalog are Conar's "Custom 600" television receiver kit and Model 680 solid-state color generator. Other featured products include TV antennas and antenna rotators and a radically new design of hi-fi speaker.

Circle No. 91 on Reader Service Page 15

An attractive 30″ x 40″ three-color wall chart put out by *Polarad Electronic Instruments* contains tables, nomographs, and charts on the most often used spectrum analysis data, signal and transmission data, and receiver information. The wall chart encompasses communications, radar, and microwave systems equipment design and conversion data, and is designed primarily for engineering departments, test labs, and drafting rooms.

Circle No. 92 on Reader Service Page 15

SHORT-WAVE LISTENING

(*Continued from page* 84)

CURRENT STATION REPORTS

The following is a resume of current reports. At time of compilation all reports are as accurate as possible, but stations may change frequency and/or schedule with little or no advance notice. All times shown are Greenwich Mean Time (GMT) and the 24-hour system is used. Reports should be sent to SHORT-WAVE LISTENING, P.O. Box 333, Cherry Hill, N.J., 08034, in time to reach your Short-Wave Editor by the fifth of each month; be sure to include your WPE identification, and the make and model number of your receiver.

Albania—*R. Tirana* has Eng. to N. A. on 9710 kHz at 0230-0300 that comes through, on the West Coast, as only a fair signal at best.

Andorra—*R. Andorra* has moved from 719 to 701 kHz. This station no longer operates on 5995 kHz.

Angola—Station CR6RR, *R. Diamang*, Dundo, 11,685 kHz, has been noted from 1905 to 1920 with music and to 1926 with talks. This is a private station with broadcasts only for the employees of the mining fields of Lunda. Presumably, all programs are in Portuguese.

Canary Islands—One of the most consistent stations on the air currently is *R. Nacional Espana*, Tenerife, on 15,380 kHz. It is audible from as early as 2000 to past 0200 with all-Spanish programming. It has been noted from 2315 to 2345 with semi-classical music and at 2345 with a talk; signals at this time were excellent.

Chile—Station CE955, *R. Valentin Letelier*, Santiago, has suddenly become audible on 9550 kHz from 0200 to 0305 s/off with classical music and a few ID's. The s/off is accompanied by a choir. According to one listing, this station is operated by the University of Chile.

Cuba—Havana is currently being noted from 0345 in Eng. for North, Central, and South America on 11,720 kHz. The 11,735-kHz outlet (announcing as 11,760 kHz) was not in parallel at this time. Other Eng. was heard at 0330 on 6170 kHz; news and editorials.

Ecuador—One of the most surprising stations in this country continues to be HCOT1, *R. Zaracay*, Santo Domingo de los Colorados, 3390 kHz. Very strong, it is best around 0400-0600 with Ecuadorian Indian music and Spanish anmts. The power is listed as 200 watts.

Egypt—*R. Cairo's* new 13-meter outlet operates on 21,615 kHz, and can be heard with chanting and talks in Indonesian at 1130-1230.

Ethiopia—Station ETLF, Addis Ababa, was noted on 15,155 kHz with a 4-note drum IS, Eng. ID, then Malagasy language at 1515, and on 7125 kHz from 0330 with s/on in Eng. and programming in Swahili beamed to Africa.

France—Paris operates in French to Antilles and Caribbean areas at 2100-2200 on 15,120 kHz, down from 15,130 kHz to avoid QRM. English to N. A. on 15,130 kHz is at 0515-0530. (*Editor's Note:* Our latest schedule from Paris shows no Eng. at this time on this frequency and no Eng. whatever to N.A. Can anyone confirm the existence of this program?) Spanish to Latin America is aired at 2345-0000 on 11,845 kHz.

Germany (East)—*R. Berlin International* is now operating to the East Coast of N.A. at 0100-0130 and 0230-0300 on 9730 and 11,895 kHz, and to the West Coast at 0345-0415 and 0445-0515 on 9650 and 9560 kHz.

Ghana—*R. Ghana*, Accra, has Eng. to Caribbean areas at 2000-2100 on 11,845 kHz (up from 11,800 kHz) with news, native folk music, talks and a documentary. English can also be tuned on 4915 kHz at 2230-2300.

Greece—Athens is excellent on 15,345 kHz with

about three minutes of news in Eng. at 2212-2215, then French. The Eng. xmsn appears to be a regular feature.

Guyana—*R. Demerara* closes at 0345 on Sundays, an extension in time over their regular weekly schedule on 3265 kHz.

Holland—Two new outlets for *R. Nederland*, Hilversum, are: 21.505 kHz, from 1900 s/on in Eng. to Africa; and 17,880 kHz, from 2310 opening in Spanish.

India—As we go to press, word is just in that *All-India Radio*, Delhi, is operating on 15.175 kHz from at least 1335 to 1500 s/off with news (1335 and 1455), commentary, music, and program schedules. This xmsn is part of the Eng. General Overseas Service.

Indonesia—Broadcasts from *Voice of Indonesia* on 9865 kHz in Eng. are still audible on the West Coast at times around 1500 but the signals are very inconsistent and sometimes only fair.

Station YDR, *Djakarta*, a home service station on 6045 kHz, is audible from early morning (local time) to past 1500 with good but decreasing signals. News in Indonesian may be heard at 1500 and music at 1515. Scheduled to run to 1630, it fades out about an hour before that time. The xmtr is listed as 100 kW—higher than the foreign service xmtr—which may be why it is the strongest Indonesian most of the year and particularly during the winter months.

Japan—*R. Japan*, Tokyo, was noted on 15,105 kHz at 1700 with Eng., and at 1715 with Japanese in the General Service xmsn to the Americas, and on 11.780 kHz from 1015 s/on in Eng. to S. E. Asia.

Korea (North)—Listen on 16.298 kHz if you want to find *R. Pyongyang* on a new frequency. This channel is generally covered by heavy QRM but check around 0015; the xmsn will be in native language.

Leeward Islands—Montserrat is reported to have a 200-kW outlet under construction for operation "some time in 1967 or 1968" on 930 kHz. Other details are lacking.

Libya—Libyan Broadcasting & TV Service, Tripoli, is being noted consistently on 5965 kHz with s/on at 0430 in Arabic. The s/on is preceded by a rather distinctive IS of bells or chimes. The xmtr is a 100-kW unit.

Malawi—Chief Engineer S. K. Macdonald of the Malawi B/C Corp., Blantyre, sent the following current schedule: Monday to Friday at 0345-0605 and 1530-2105 on 3380 kHz and at 0700-1515 on 5995 kHz; Saturdays at 0345-0605 and 1530-2305 on 3380 kHz, and at 0620-1515 on 5995 kHz; Sundays at 0355-0605 and 1530-2105 on 3380 kHz and at 0620-1515 on 5995 kHz. The xmtr is a 10-kW unit in each case.

Maldive Islands—The Maldive Islands B/C Service, Comores, is using the following schedule, according to an overseas source: 0500-0700 and 1500-1730 on 1507 kHz (5 kW), 0300-0500 and 1200-1330 on 3000 kHz (2700 watts), 1330-1800 on 3329 kHz (15 kW), 0100-0300 and 0930-1200 on 7225 kHz (2700 watts), and 0700-0930 on 9552 kHz (15 kW). Does anyone know their verification policy?

Pakistan—*R. Pakistan*, Karachi, has Eng. news at 1900, then Turkish at 1905 on 15.365 kHz. A new frequency in use is 17.855 kHz, at 0300 heard with native language. The station would like to have reports from N.A. on its xmsn to the United Kingdom from 1945 to 2030 on 11,675 and 15,365 kHz.

SHORT-WAVE ABBREVIATIONS

anmt—Announcement	kW—Kilowatts
B/C—Broadcasting	N.A.—North America
Eng.—English	QRM—Station interference
ID—Identification	R.—Radio
IRC—International Reply Coupon	s/off—Sign-off
	s/on—Sign-on
IS—Interval signal	xmsn—Transmission
kHz—Kilohertz	xmtr—Transmitter

SHORT-WAVE CONTRIBUTORS

Conrad Baranowski *(WPE1GXX)*, Boston, Mass.
David Coelho *(WPE1HBW)*, Danbury, Conn.
Linwood Frantum *(WPE1HDA)*, Millbury, Mass.
Mark Connelly *(WPE1HGI)*, Arlington, Mass.
Arthur Delibert *(WPE2HJR)*, Lynbrook, N. Y.
Richard Kline *(WPE2MUV)*, Englewood, N. J.
John Zapisek *(WPE2OKD)*, Wading River, N. Y.
Michael Lampert *(WPE2ONS)*, Massapequa Park, N. Y.
Peter Macinta, Jr. *(WPE2ORB)*, Kearny, N. J.
Craig Rice *(WPE2OXR)*, Webster, N. Y.
Alan Snyder *(WPE2OXW)*, Plainfield, N. J.
Bernard Lansing *(WPE2PBA)*, Rochester, N. Y.
Rick Charnes *(WPE2PBV)*, Cherry Hill, N. J.
Edward Fulton *(WPE2PIR)*, Fulton, N. Y.
David Palfrey *(WPE2PKC)*, Kearny, N. J.
Roger Dooley *(WPE2PKT)*, Buffalo, N. Y.
John Hopkins, Jr. *(WPE2PMJ)*, Rockville Centre, N. Y.
Stephen Sant Andrea *(WPE2POI)*, West Hempstead, N. Y.
David Simon *(WPE2POP)*, Brooklyn, N. Y.
Fred Webster *(WPE2PRD)*, Jersey City, N. J.
Steven Bertollo *(WPE2PST)*, Hawthorne, N. J.
Kenneth Stern *(WPE3FDZ)*, Philadelphia, Pa.
Bruce Eisenhard *(WPE3HFC)*, Lafayette Hill, Pa.
Grady Ferguson *(WPE4BC)*, Charlotte, N. C.
Don Lee Fortner *(WPE4CSS)*, Greer, S. C.
Alvin Pollock *(WPE4IRE)*, Clinton, N. C.
Dave Meisel *(WPE4IRS)*, Charlottesville, N. C.
Danny Jamison *(WPE4IEK)*, Richmond, Va.
John Mayo *(WPE4JNG)*, Oxford, N. C.
Bruce Tindall *(WPE4JQQ)*, Chapel Hill, N. C.
Jack Stephenson *(WPE5NX)*, Oklahoma City, Okla.
Trevor Clegg *(WPE6FAF)*, Fresno, Calif.
Roger Treskunoff *(WPE6GOJ)*, San Francisco, Calif.
D. J. Weber *(WPE8IPJ)*, Westlake, Ohio
Bill Ratnoff *(WPE8IWF)*, Shaker Heights, Ohio
G. L. Beam *(WPE9HUG)*, Indianapolis, Ind.
Bill Vogt *(WPE9IXD)*, Tinley Park, Ill.
A. R. Niblack *(WPE9KMJ)*, Vincennes, Ind.
John Beaver, Sr. *(WPEØAIE)*, Pueblo, Colo.
Billy Kournikakis *(VE2PE1MJ)*, Montreal, Quebec, Canada
Wilmer Staub *(XE2PE1J)*, Gomez Palacio, Durango, Mexico
Clem Akins, Jr., APO, New York, N. Y.
David Alpert, Morton Grove, Ill.
Leo Alster, Rahway, N. J.
Douglas Anderson, Tampa, Fla.
Roy Ashkenaz, Brooklyn, N. Y.
James Bochantin, DuBois, Ill.
Roy Carroll, Neptune, N. J.
Paul Eisenstein, Hazlet, N. J.
Werner Funkenhauser, Guelph, Ontario, Canada
Nick Grasso, Cleveland Heights, Ohio
Curtis Phillips, Hellertown, Pa.
George Shardy, Brookfield, Ohio
A. J. Wendt, Freeport, Texas
Robert White, San Francisco, Calif.
Radio New York Worldwide, New York, N. Y.
Sweden Calling DX'ers Bulletin, Stockholm, Sweden

Panama (Canal Zone)—*Alpha Charlie Alpha*, a U.S. Army station operating on single sideband on 6855 kHz, will verify correct reports if they are sent to: USASTRATCOM Facility, Transmission Division, Drawer 924, Fort Clayton.

Panama (Rep.)—*Tropical Radio Telegraph Co.*, Panama City, has been noted with Eng. and Spanish running marker tests on 9132.5 kHz (HPI) and 17,382.5 kHz at such varied times as 2015, 0102, and 0200. They will definitely verify correct reports. Direct your report to Mr. Gregory J. Nixon, Plant Engineer, and enclose an IRC.

Portugal—Station CSA26, Lisbon, 6125 kHz, has been heard at 0145-0315 with music, talks, and news in Portuguese, then "Voice of the West" program in English.

Ryukyu Islands—*Voice of United Nations Command*, Deragawa, is noted on 13,832 kHz with Korean or Chinese talks at 1030, and on 9845 kHz with old U.S. pop records and anmts in Korean at 1130. The latter is readable in mid-U.S.A. from about local sunrise. This station verifies with a plain card which has the U. N. insignia at the

DX STATES AWARDS PRESENTED

To be eligible for one of the DX States Awards designed for WPE Monitor Certificate holders, you must have verified stations (any frequency or service) in 20, 30, 40, or 50 different states in the U. S. The following DX'ers have qualified for and received the 20 States Verified Award.

TWENTY STATES VERIFIED

Stuart Feldschuh (WPE2OTD), Long Beach, N. Y.
Patrick Flanagan (WPE8IQI), Loveland, Ohio
Mike Mergler (WPE8JCG), Dayton, Ohio
James Macumber (WPE2NXF), Binghamton, N. Y.
Joseph Paradise (WPE2NUZ), North Bergen, N. J.
L. Eugene Purdum, Jr. (WPE3GRB), Westminister, Md.
Don Summerhill (WPE5EJJ), El Dorado, Ark.
Gordon Schiff (WPE9IBI), Chicago, Ill.
Terry Steeden (WPE5DRN), Amarillo, Tex.
Mike Thompson (VE7PE1BE), Vancouver, B. C., Canada
Anthony J. Buczko (WPE2OSP), Pennsauken, N. J.
R. Leon Bridwell (WPE6ELW), Waipahu, Hawaii
Dave Carlson (WPEØEOB), St. Louis, Mo.
Richard P. Caldeira (WPE6GID), Waipahu, Hawaii
David Cox (WPE4FSM), Carrollton, Ala.
Philip Della Jacova (WPE2OXI), Ozone Park, N. Y.
Dan Danielson (WPE9ILW), Berwyn, Ill.
Don Garrett (WPE9IOH), Muncie, Ind.
Frank Holden (WPE1GRY), Riverside, Conn.
Bill Migley (WPE8JEL), Lancaster, Ohio
Robert Rowen (WPE9IHZ), Stevens Point, Wis.
William Sprague (WPE8IRV), Saginaw, Mich.
Douglas Tabor (WPE7CMY), Layton, Utah
Kenneth Stern (WPE3FDZ), Philadelphia, Pa.
Jonathan Wolfert (WPE2OKI), Great Neck, N. Y.
David Harmacek (WPE8IVZ), Chesterland, Ohio
Tom McDonald (WPE8IMN), Findlay, Ohio
Werner Breitkopf (VE2PE1JA), Montreal, Que., Canada
Bill Fries (WPEØEPA), Omaha, Nebr.
Ronald Miller (WPE6GLB), Santa Ana, Calif.
H. Zimberg (VE4PE6Q), Winnipeg, Man., Canada
Barry Campbell (VE3PE2IV), Belleville, Ont., Canada
Geoffrey Samuel Tobias (WPE2HGO), Freeport, N. Y.
David Laskowski (WPE8JAP), Detroit, Mich.
Thomas Gracie (WPE2FXL), Collingswood, N. J.
Joseph Basile (WPE1GKV), Brighton, Mass.
William Dornbusch (WPE1FZD), Waban, Mass.
Jim R. Eisenhauer (WPE9FPN), Belleville, Ill.
Barry Staehr (WPE8JAG), Lakewood, Ohio
Stephen Tepper (WPE3HAM), Wheaton, Md.
Martin Yoskowitz (WPE2OMF), Bronx, N. Y.
C. Terenzini (WPE1GBG), Pittsfield, Mass.
Don Davis (WPE6FXQ), Monterey Park, Calif.
Eugene D. Aker (WPE6EVR), Eureka, Calif.
Richard Belser (WPE2PAZ), Somers Point, N. J.
Elwyn Young (WPE1BYL), Dorchester, Mass.
Percy R. Kesteven (VE6PE7F), Edmonton, Alta., Canada
John Conder (WPE6FTE), Paramount, Calif.
Jarrett Frame (WPE8ITG), Gassaway, W. Va.
John S. Hill, Jr. (WPE4JEE), Virginia Beach, Va.
James Pogue (WPE9HLJ), Farmland, Ind.
Randall Kane (WPE1GLO), Malden, Mass.
Carl L. Downie (WPE3EGP), Brookwelle, Pa.
William Scholz (WPE1GKK), Ansonia, Conn.
Ronald J. Ponke (WPE8HZJ), Centerline, Mich.
Kendall Porter (WPEØEVD), Overland Park, Kan.
James Clay Smith (WPE4IZJ), Cynthiana, Ky.
Milton J. Ross (WPEØRWQ), Nebraska City, Nebr.
David Stettler (WPE3GYU), Allentown, Pa.
Doug Weary (WPE3GZH), Carlisle, Pa.
Fred McCormack (WPEØDSU), Des Lacs, N. D.
Peter Mokover (WPE2PGE), Great Neck, N. Y.
David Conder (WPE9IHV), Centralia, Ill.
Phillip L. Correll (WPE4IPF), Roanoke, Va.
Tom Holic (WPE2OAA), Endwell, N. Y.
James Clark (WPE3HCU), Enon Valley, Pa.
Kenneth Westover (WPE8HZI), Allen Park, Mich.
Michael Hogan (WPEØEPI), St. Louis, Mo.
George Kass (WPE2NLF), New York, N. Y.
Patrick Miller (WPE7CMZ), Moxee City, Wash.
D. C. Marden (WPE7CNC), Kendall Park, N. J.
David Schoeller (WPE9IQQ), Elmhurst, Ill.
Paul Heffler (WPE4ITJ), Mountain Brook, Ala.
Eugene Floda (WPE2OFH), Bronx, N. Y.
Thomas Feeney (WPE1GZC), Newport, R. I.
Rudy Roben (WPE6GNW), Sepulveda, Calif.
Alan Farley (WPE2PHL), Highland Park, N. J.
James Talley (WPE4IRH), Columbus, Ga.
Frank Priore (WPE2MYB), College Point, N. Y.
Jeffery Kelley (WPE4HQC), Elizabethton, Tenn.
Leonard Adamik (WPE9IQY), Chicago, Ill.
Dayton Hypes (WPE4ISM), Staunton, Va.
S. L. Cooper, Jr. (WPE5EOZ), Houston, Texas
Donald Christensen (VE2PE1DF), Villa La Salle, Que., Canada
Gary Draper (WPE8GCW), Farmington, Mich.
Irvin Knarr (VE3PE2HM), Elmira, Ont., Canada
Marshall Goodman (VE3PE2JZ), Willowdale, Ont., Canada
Robert Inouye (WPE3HBZ), Elkins Park, Pa.
Bob Hertzberg (WPE9IIK), Mequon, Wis.
Leonard Mack (VE7PE1BI), Vancouver, B. C., Canada
Don Fortner (WPE4CSS), Greer, S. C.
Ronald Strickler (WPE4JGD), Key West, Fla.
Gordon Meyers (VE6PE6T), Medicine Hat, Alta., Canada
G. L. Beam (WPE9HUG), Indianapolis, Ind.
Bill Fait (WPE8INP), Cleveland, Ohio
Richard Nelson (WPE9IIC), Chicago, Ill.
Gizella Szilagyi (WPE8ILO), Cleveland, Ohio
Alvin Pollock (WPE4IRE), Clinton, N. C.
Perry Werner (WPE2PKD), Brooklyn, N. Y.
William Parkinson (WPE2NAM), Northport, N. Y.
Jerry Cooley (WPEØEYK), Madison, S. D.
Kevin Slater (WPE7CNF), Salem, Ore.
Charles Milhans (WPE7COE), Tacoma, Wash.
Barry Dill (WPE4JKB), Hermitage, Tenn.
George Gera (WPE2PPH), Glen Rock, N. J.
Michael Richerson (WPEØFBK), Wichita, Kans.
Paul Hill (WPE4JCW), Virginia Beach, Va.
Robert March (VE7PE1CF), Victoria, B. C., Canada
K. John Corcoran (WPE4JCV), Orlando, Fla.
Kenneth Werner (WPE2NYZ), Port Ewen, N. Y.
Jules Mencher (WPE2OLD), Bronx, N. Y.
Martin Lev (WPE2OWI), New York, N. Y.
Steven Lipman (WPE2OYE), Vineland, N. J.
Art Morris (WPE2OPJ), Fair Lawn, N. J.
Dennis Katona (WPE2OSG), Trenton, N. J.
Thomas Osif (WPE3GQS), Hazleton, Pa.
Gilbert Kruska (WPE2PCM), N. Merrick, N. Y.
Algis Butkus (WPE2OTA), Woodhaven, N. Y.
Andrew Cooper (WPE8JNC), Westland, Mich.
Richard Hansen (WPE9IYB), Elmwood Park, Ill.
Elliot Susseles (WPE2LQE), Brooklyn, N. Y.
Don Shelley (WPE9IUG), Milwaukee, Wis.
Mike Vander Stouwe (WPE4JFD), Newport News, Va.
O. Neal Chambers, Jr. (WPE9ISF), Lockport, Ill.
Douglas Robinson (WPE2OVM), Schenectady, N. Y.
Mark Maersch (WPE3HEK), Severna Park, Md.
Donn Jones (WPE8IWM), Marion, Ohio
Barton Adrian (WPEØEWV), Canistota, S. D.
Tom Taggart (WPE8IHL), Lakewood, Ohio

DX AWARDS PROGRAM RULES

Here's an easy way to get a copy of the rules and regulations for each of the three phases of the DX Awards Program to date (Countries, States, and Provinces). Just supply a postage stamp or return envelope, and your Short-Wave Editor will send you a leaflet containing the rules for all three phases—plus a copy of the official Countries List for DX Awards. The stamp or envelope, with your request, should go to: DX AWARD RULES, P. O. Box 333, Cherry Hill, N. J. 08034.

upper left and a microphone drawn at the lower left with the words "Support By Truth" in between.

South Africa—With sunset coming earlier, some South Africans are beginning to appear in the lower bands during the late evening hours. The Commercial Service *(Springbok Radio)* is back again on the familiar frequency of 4945 kHz, where it is audible from 0430 to past 0500 with Eng. and Afrikaans commercials and pop music. The Afrikaans Service was noted on 4875 kHz (a new frequency for this service) at 0445 with news, at 0458 with music box IS *(Ver in die Wereld Kietie)*, and at 0500 with music.

Spanish Sahara—Station EAJ103, El Aiun, now operates a 50-kW xmtr on 656 kHz at 0900-1600 and 2000-2300. Reports are wanted and should be sent to Apartado 7, El Aiun, Spanish Sahara. This station provides a good chance of logging a comparatively rare country if you can split the channel between WSM, Nashville, and WNBC, New York, on 650 and 660 kHz, respectively. But beware of other stations on 656 kHz; several Italians are operating there, plus Israel, all with higher power.

Switzerland—Two new frequencies are in use by the Swiss B/C Corp., Berne: 6015 kHz at 0150-0200 with religious talks; and 21,540 kHz at 1520-1530 with world news.

U.S.S.R.—*R. Vilnius*, Lithuanian SSR, recently aired this schedule: Fridays & Sundays at 2100 and 2230 on 1554, 1106, and 665 kHz; repeated between 2230 and 2300 on 11,730, 11,970, 15,210, 15,260, and 15,460 kHz. Reports should be sent to *Lietuvos Radijas*, Vilnius, Lithuanian SSR.

Vatican City—*Vatican Radio*, opening many new frequencies in recent weeks, has added still another: 11,720 kHz, noted from 1800 s/on with IS and a native-language xmsn.

Windward Islands—Two new frequencies are now in service from St. Georges: 17,835 kHz at 2130 with pop music and a very bad heterodyne; and 21,695 kHz, with news at 2030 and from 2035 with a music request program beamed to England.

Zambia—*R. Zambia*, Lusaka, has Eng. news at 0400, pop records and commercials following until fade-out around 0500, on 2395 kHz. This xmsn is believed to open at 0345. —30—

QUIZ ANSWERS

(Quiz appears on page 40)

1	6 ohms	10 ohms	5	18 ohms	3.8 ohms
2	18 ohms	9 ohms	6	12 ohms	14 ohms
3	12 ohms	4 ohms	7	6 ohms	4.3 ohms
4	6 ohms	15 ohms	8	12 ohms	2.4 ohms

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AMATEUR RADIO

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PRODUCT REPORTS

SCIENCE FAIR PROJECTS

SHORT-WAVE LISTENING

SOLID-STATE CIRCUITS

TEST EQUIPMENT

—30—

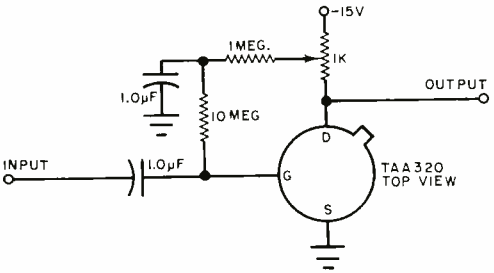
LINEAR IC APPLICATIONS

(*Continued from page* 56)

QUICKIE PROJECT:

AUDIO PREAMPLIFIER

Has voltage gain of 10. Input impedance is 10 megohms; output impedance less than 100 ohms. Adjust potentiometer for best combination of gain and linearity.



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Phase-shift audio oscillator
Photo timer
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Proximity alarm
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Price Each: $2.25

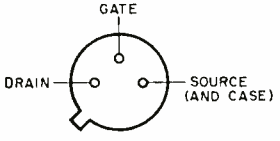
Supply Voltage:

—15 volts at 10 mA, — to drain through 1000 ohms, + to source

Package:

TO-18 metal can

BOTTOM VIEW



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GENERAL INFORMATION: First word in all ads set in bold caps at no extra charge. Additional words may be set in bold caps at 10¢ extra per word. All copy subject to publisher's approval. Closing Date: 1st of the 2nd preceding month (for example, March issue closes January 1st). Send order and remittance to: Hal Cymes, POPULAR ELECTRONICS, One Park Avenue, New York, New York 10016.

FOR SALE

FREE! Giant bargain catalog on transistors, diodes, rectifiers, SCR's, zeners, parts. Poly Paks, P.O. Box 942, Lynnfield, Mass. 01940.

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INVESTIGATORS, FREE BROCHURE, LATEST SUBMINIATURE ELECTRONICS SURVEILLANCE EQUIPMENT, ACE ELECTRONICS, 11500-L NW 7TH AVE., MIAMI, FLA. 33168.

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CONVERT any television to sensitive, big-screen oscilloscope. Only minor changes required. No electronic experience necessary. Illustrated plans, $2.00. Relco-A33, Box 10563, Houston, Texas 77018.

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JAPANESE PRODUCTS CATALOG by air mail $5, sea $3. Intercontinental, CPO 1717, Tokyo, Japan.

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RECTIFIERS, transistors, other components. Catalog free. Electronic Components Co., Box 2902C, Baton Rouge, La. 70821.

ELECTRONIC Ignition. Kits, components, systems. Diagrams. Anderson Engineering, Epsom, N.H. 03239.

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