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VOLUME 29 NUMBER 5 **NOVEMBER, 1968**

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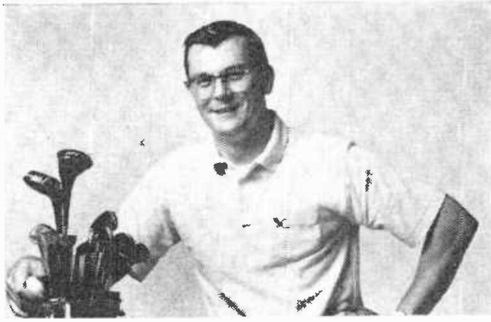
Pat Powers, Computer Technology



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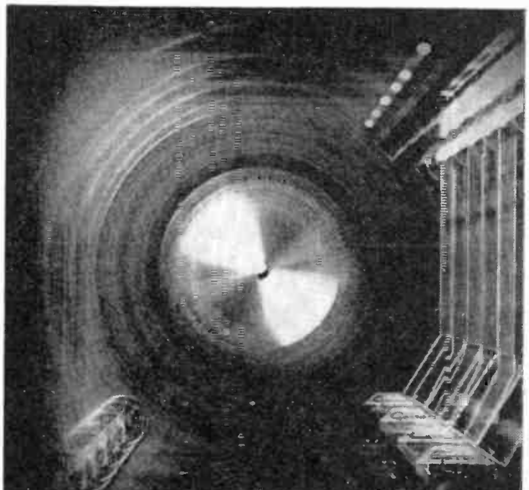

letters

FROM OUR READERS

ARE PULSES INVERTED?

Mr. Robert E. Devine's Article, "Your Own Little Photoplethysmograph" (July, 1968) excellently explains the electrical operation of the photoplethysmo-transducer. The only thing I find at fault is the fact that the peripheral pulse tracings shown on the CRT of the oscilloscope (cover photo) are physiologically impossible. Assuming that the sweep on the oscilloscope was from the left to the right, the pulses are shown inverted. This condition can be corrected simply by switching the polarity of the input to the oscilloscope.

JAMES J. GREENE
ST. ELIZABETH HOSPITAL
UTICA, N.Y.

The orientation of the pulses seems to be a matter of interpretation. However, you are wrong about changing the connections to the oscilloscope to invert the waveshape. The special bridge circuit will still show the pulses as they are displayed on the front cover.

LOW-COST SUBSTITUTE

The article "Build The Automobile Omni-Alarm" that appeared in the August, 1968, issue of POPULAR ELECTRONICS is excellent. Our "Bleeptone," however, will functionally replace this circuit. The "Bleeptone" is essentially a ready-made "Omni-Alarm;" you simply mount it and connect the external circuits. The output signal of the "Bleeptone," is in the high-sensitivity frequency range of the human ear—a feature that comes in handy to get your attention. The "Bleeptone" sells for $5.35 from C.A. Briggs Company, P.O. Box 151, 114 Keswick Ave., Glenside, Pa. 19038. (Sent COD or prepaid)

C.A. BRIGGS
President, C.A. Briggs Co.

SHOW A LITTLE COOPERATION!

After reading many articles on Amateur radio and Citizens Band radio I have discovered that hams profess a general dislike for CB'ers. What is worse, the same dislike is reciprocated by CB'ers toward hams. Hams feel that CB'ers are guys who just couldn't make the grade. But, in an emergency, which one is most prepared and organized to help with communications?

It is not my intention to chew out either group. Instead, my point is that hams and CB'ers shoud get together to determine how their concerted efforts can best be utilized by

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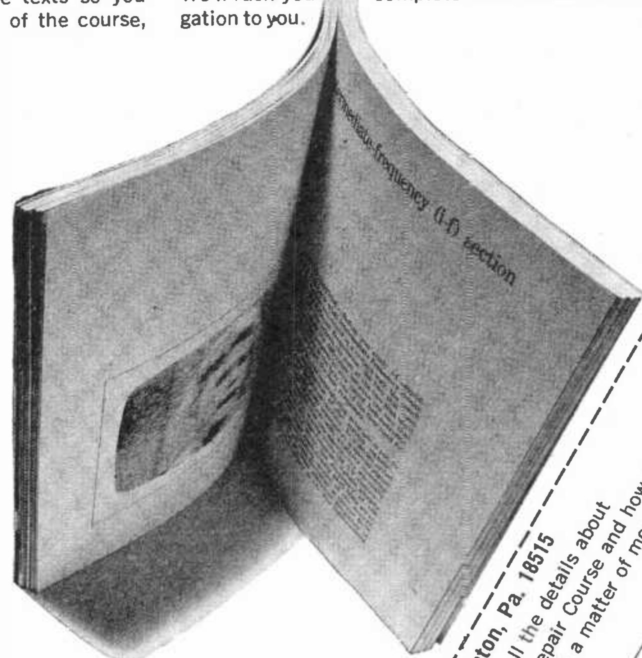
Remember, the sooner you get started on your course, the sooner you'll be turning your spare time into real money. Fill out the coupon and mail today. We'll rush you complete information at no obligation to you.



ICS, Dept. J9468K, Scranton, Pa. 18515

Yes, I would like to have all the details about your new TV Servicing/Repair Course and how I can break into TV work in a matter of months.

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the communities in which they live. Let's face it, hams have the equipment and power, and CB'ers have the organization. If they would try to help instead of eliminate each other, what a useful union would result. The union could be accomplished if each side would just show a little cooperation.

DIRK EDWARDS, WN7HMN
Beaverton, Ore.

"BIG BROTHER" READS P.E.

POPULAR ELECTRONICS did a nice job on my Soviet electronics story ("Soviet Electronics: A 1968 Reappraisal," September, 1968). Many thanks. You misspelled my name, but I guess that was because you didn't want the "bad guys" (the Russians) to know who I am.

THEODORE M. HANNAH
Silver Spring, Md.

PHOTOCELL OR PHOTORESISTOR

In the Parts List for the "Build Your Own Little Photoplethysmograph" article (July, 1968), PC1 is referred to as a photocell. However, in the text it is referred to as a photoresistor. Which is it?

GREGG COLASARDO
Canoga Park, Calif.

This is an either/or case. The part referred to can be described by either one name or the other. Almost all light-activated devices are, by definition, photocells. However, there are different types of photocells available. In this case, PC1 is a photoresistor-type photocell. The Parts List specifies photocell because this is the name the manufacturer lists his product under. We could just as easily have specified photoresistor, making it a bit more difficult to locate in the mail-order catalogs.

INDEPENDENT SUPPLIER

I can supply a complete kit of wood parts for the "Mighty-Mag Speaker System" (March, 1968). All parts are cut to fit, and enclosure walls are ¾" furniture-grade Philippine plywood with beautifully grained Narra, Dao, or Philippine mahogany. Dao has the fine grain and texture of teak. To the first two takers, I will throw in a hand-carved figurine. Cost of the kit of parts is $10.90 postpaid (allow about 30 days for surface mail to San Francisco). Also, I can make available wood parts cut to order for any other type of enclosure at low cost.

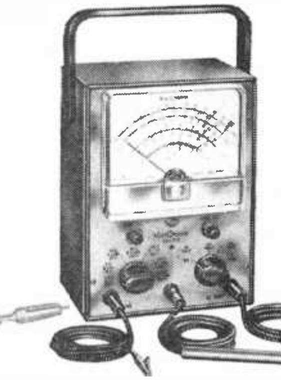
I would like to swap two sets of enclosures for just one set of Maximus woofer and TS-6070 tweeter.

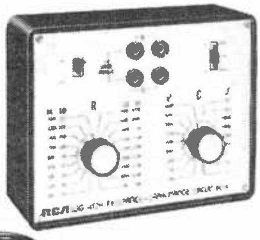
ROLAND R. TRINIDAD
64, 12 Ave.
Quezon City, Philippines

NIMBUS/ESSA ENTHUSIASTS

I'm in the process of building an automatic picture taking reception station for the current Nimbus and ESSA series of weather satellites. My station is the type being built for amateur use (similar to the one designed

measure





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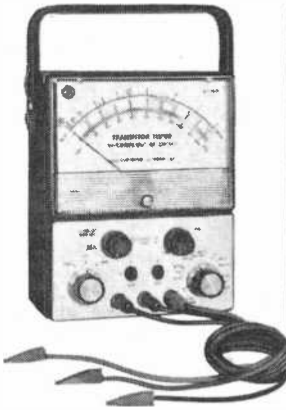

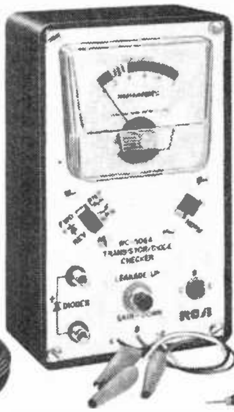

For a complete catalog with descriptions and specifications for all RCA test instruments, write RCA Electronic Components, Commercial Engineering, Dept. K133W, Harrison, N.J. 07029.

*Optional Distributor resale price. Prices may be slightly higher in Alaska, Hawaii, and the West.

The RCA-WT-501A in-circuit out-of-circuit transistor tester is battery operated, completely portable. It tests both low and high power transistors, has NPN and PNP sockets for convenient transistor matching for complementary symmetry applications. Only $66.75.*

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RCA

LOOK TO RCA FOR INSTRUMENTS TO TEST/MEASURE/VIEW/MONITOR/GENERATE

CIRCLE NO. 27 ON READER SERVICE PAGE

LETTERS (*Continued from page 10*)

by K2RNF in 1965). I would like to contact other readers—especially those in clubs that have already been formed—who share my interest in this hobby. Can you help me?

CONRAD J. BARANOWSKI
109 Peterborough St.
Boston, Mass. 02215

We have included your complete name and address so that interested readers can contact you direct.

ACKNOWLEDGEMENT IS ONLY FAIR RETURN

I have replied to several readers who requested information about out-dated electronic equipment through "Operation Assist" without once receiving an acknowledgement. I feel that the reader who uses your column to make a request should be obligated to answer all replies he receives in answer to his request.

WILLIAM H. KELLEY
Hempstead, N.Y.

This subject has cropped up several times in the past, and all we can say is that we support your suggestion. After all, those who answer such requests are doing so because they want to help, and such help given deserves at least a word of thanks. However, from the volume of enthusiastic mail we receive concerning "Operation Assist," we must conclude that the great majority of readers who have had requests answered were well mannered enough to show their appreciation.

PLYWOOD IS BEST

Why is it that ¾"-thick plywood is stipulated for building speaker enclosures. Wouldn't solid lumber be as good? Also, where can I get tubing for the ports in ducted enclosures?

CONRAD PHILLIPS
Bunkie, La.

Ideally, any speaker enclosure should be as rigid as possible. An elastic enclosure will readily resonate, and resonance has the effect of coloring the sound reproduction. For this reason, plywood, which is much more rigid than solid board of similar thickness, is the most commonly used enclosure material. In fact, flakeboard, when its surfaces are properly treated, is even better than plywood.

Aside from the acoustical advantages plywood has over solid lumber, there are other things that make it more desirable. It is much more durable, easier to work with, and is less expensive than hardwoods. True, plywood finishes are generally less than ideal for the finished furniture look, but plywood can be finished with a thin veneer to suit any taste.

As for where you can obtain tubing, you might try a sationery store that sells mailing tubes. Of course, the tube you use should be fairly heavy.

Everybody bulls, bluffs and brags about their tape recorders.

This new Ampex will clear the air.

It seems like all tape equipment manufacturers chatter about all sorts of features.

One talks automatic threading. Others boast automatic reverse. Still more hit you with 4 heads, sound-with-sound, dual capstan drive, automatic tape lifters, 3-speed operation and on and on.

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Even stereo headphone output.

Just one great feature after another.

Sure, you can find some of these features on other machines. But not all on *one* machine. Except ours. So see an Ampex Sound Idea Dealer today. He has the outfit that has it all.

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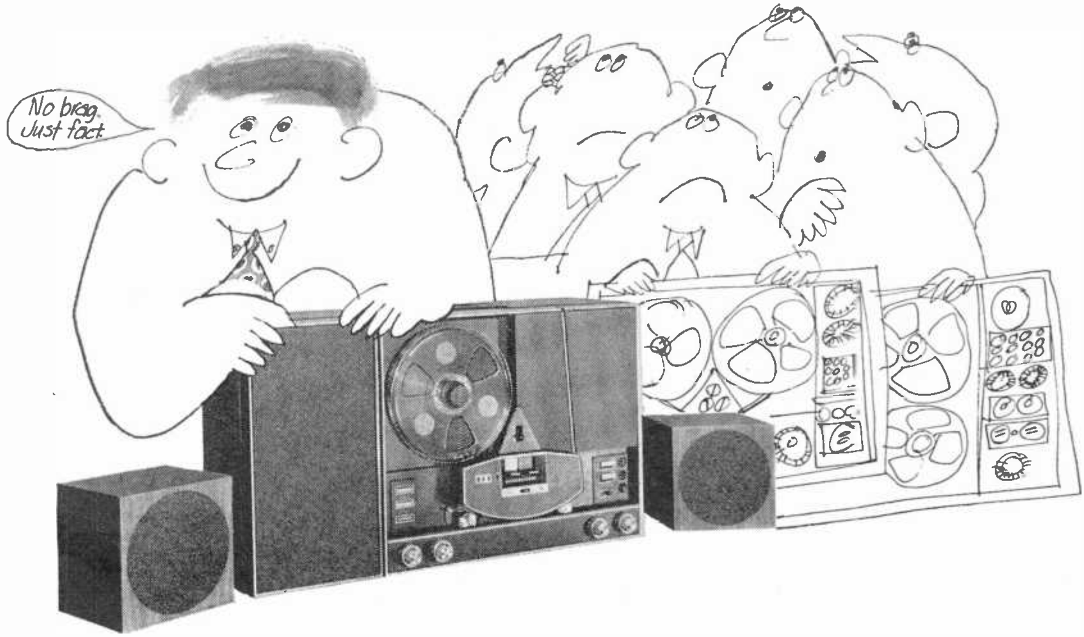

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ELECTRONICS library

QUIET

VOLTAGE AND POWER AMPLIFIERS

by Robert E. Sentz

Written primarily for technical institutes and junior colleges, this book is also well suited for home study. An integrated transistor/vacuum-tube approach places emphasis on transistors, keeping in step with current technology. This is an intermediate-level textbook for students who understand a.c. and d.c. network theorems and transistors and vacuum tubes as single-stage amplifiers. A working knowledge of algebra and trigonometry is required; differential calculus is helpful but not essential. Hybrid circuit equivalents are employed extensively for small-signal transistor amplifier analyses, and the high-frequency hybrid-pi equivalent is used where applicable. Graphical analysis is employed as an aid in analyzing large-signal amplifiers. The scope of this book makes it a must for advanced hobbyists, junior engineering students, and technicians.

Published by Holt, Rinehart and Winston, Inc., 383 Madison Ave., New York, N.Y. 10017. 282 pages. Soft cover. $3.95.

PULSE AND LOGIC CIRCUITS

by Angelo C. Gillie

In three broad categories, this book gives a comprehensive treatment of both pulse and logic circuits. Categories include passive pulse circuits; switching circuits; and matrix, counting, and register circuits. Since nonsinusoidal waveforms are a basic foundation for much of the text, the first chapter introduces and defines the basic nonsinusoidal waveforms without mathematics. All circuit analysis is developed so that it is equally appropriate for integrated and discrete circuits. Only solid-state circuits are considered in the analysis of switching and logic systems. The only prerequisite for understanding the material presented is a basic understanding of elementary algebra.

Published by McGraw-Hill Book Co., 330 West 42 St., New York, N.Y. 10036. Hard cover. 401 pages. $9.95.

FUNDAMENTALS OF INTEGRATED CIRCUITS

by Lothar Stern

Although the IC is still in its infancy, its

(*Continued on page* 112)

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TAKE ONE new literature

To obtain a copy of any of the catalogs or leaflets described below, simply fill in and mail the coupon on page 15 or 115.

The 1968 edition of the *Lafayette Radio Electronics* annual catalog, 512 pages, is a complete buying guide for almost everything in electronics for the home, car, or workshop. The catalog features Lafayette's own brand of hi-fi equipment, the latest in ham gear and two-way CB radios, test equipment, optics, etc. In addition to the Lafayette-brand listings, the catalog gives complete rundown of all major hi-fi components made by leading manufacturers.

Circle No. 75 on Reader Service Page 15 or 115

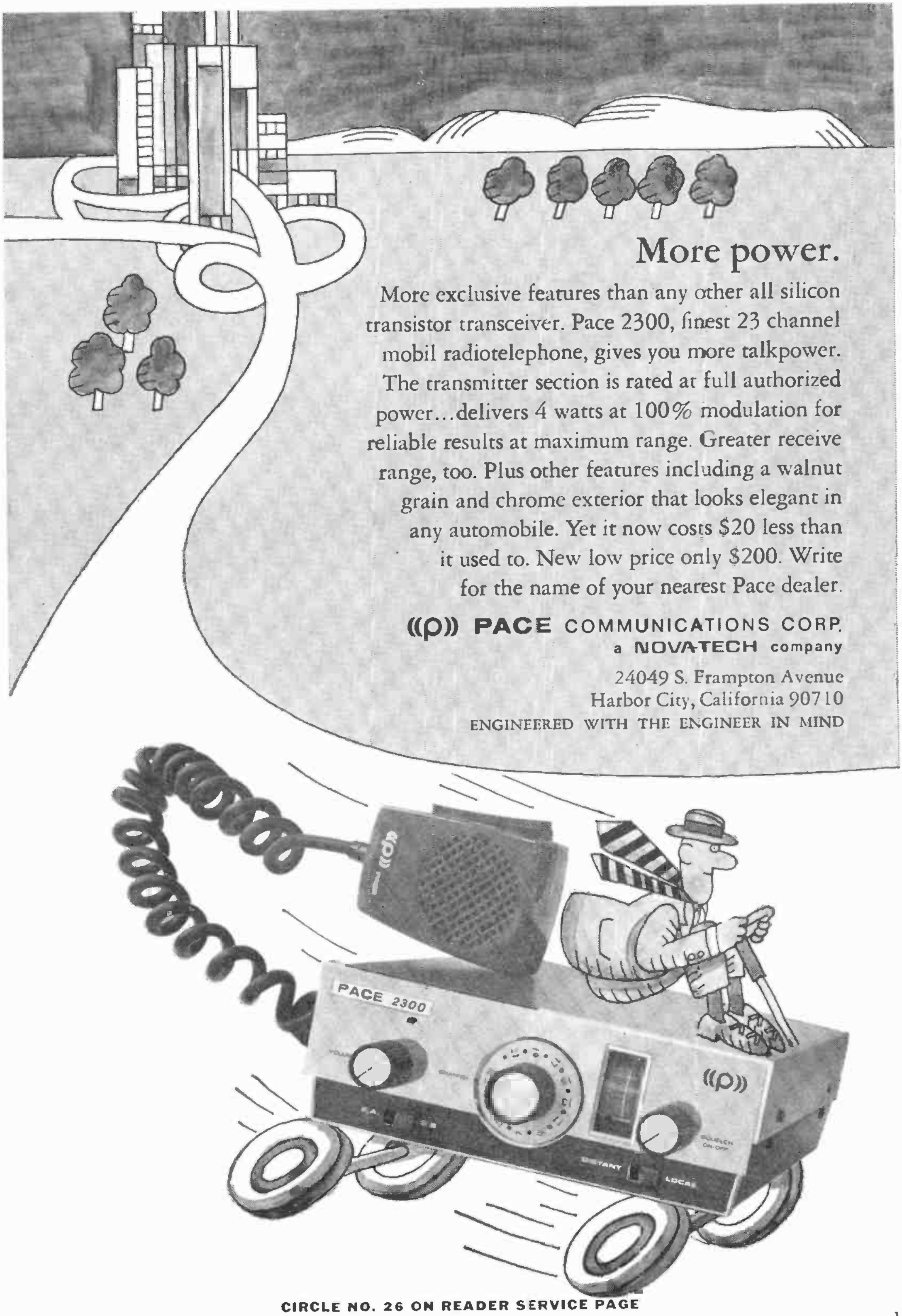
Three complete sound systems for the traveling entertainer and professional musician are illustrated and technically described in *Altec Lansing*'s brochure number AL-1370-1. The 16-page booklet lists 585-, 365-, and 145-watt (peak music power) systems, all of which are built around Altec Lansing's "Voice of the Theatre" speaker systems. The music systems include all-solid-state mixer/power amplifier consoles which have built-in reverb and are capable of controlling five independent inputs.

Circle No. 76 on Reader Service Page 15 or 115

An illustrated four-page Monitor Brochure describing its line of monitor receivers is available from the *Hallicrafters Company*. The brochure gives details on the frequency coverage and special features of the new Models CRX portable hand-held and table-type receivers. Written for the prospective user of monitor equipment, the brochure answers many questions he might have concerning monitor radio.

Circle No. 77 on Reader Service Page 15 or 115

"Professional Methods For Record Care And Use," by Cecil E. Watts, is a recently revised edition of a book that has long been a favorite of record collectors. As its title implies, the booklet describes the modern record, how to care for it, and the devices used to keep it in good shape. The format used in the book is semi-technical, aimed at the person who really appreciates recordings. For a copy of this book, send 50¢ to Elpa Marketing Industries, Inc., New Hyde Park, N.Y. 11040.



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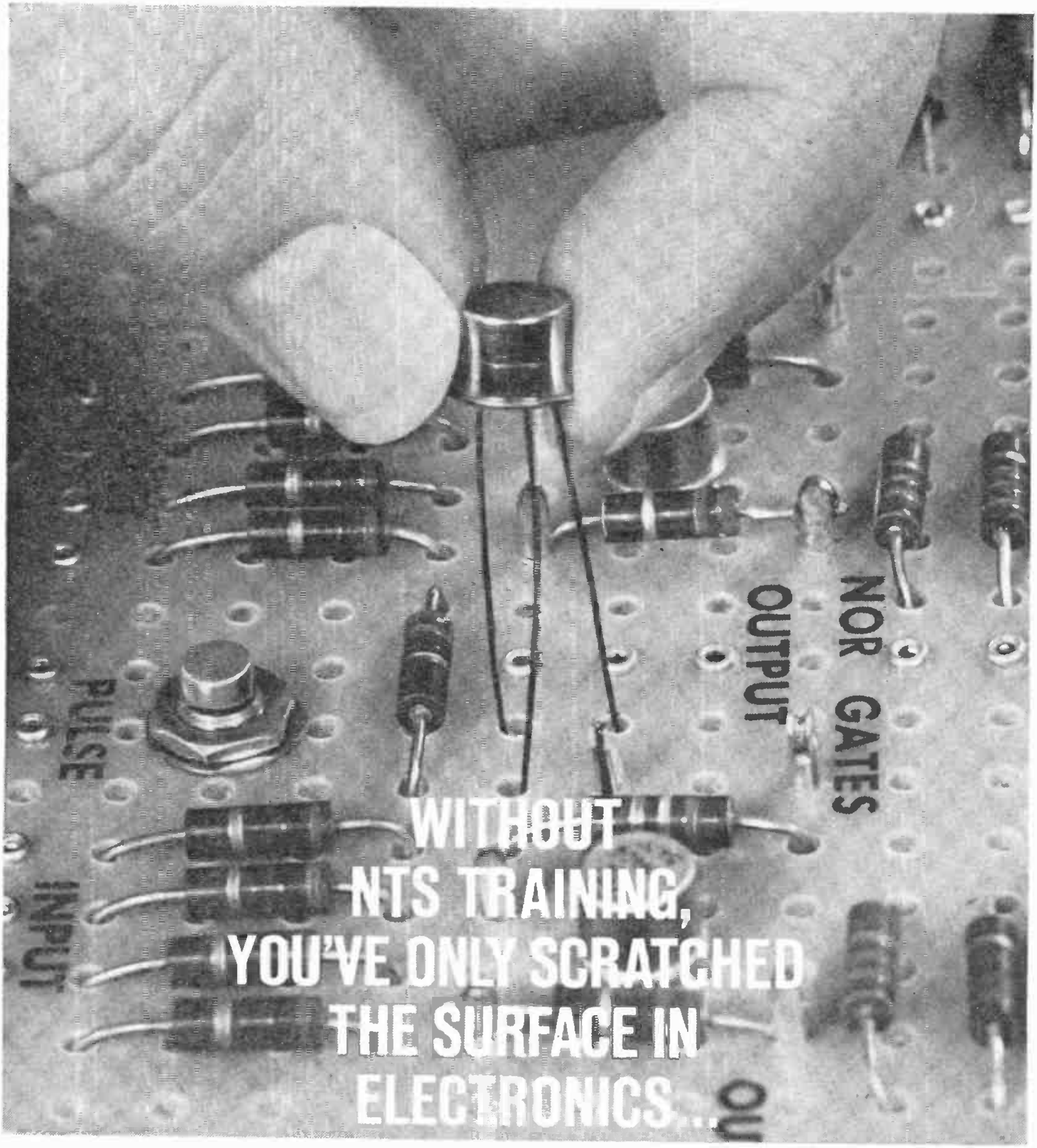

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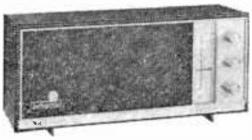
Additional information on products covered in this section is available from the manufacturers. Each new product is identified by a code number. To obtain further details on any of them, simply fill in and mail the coupon on page 15 or 95.

SOLID-STATE COMMUNICATIONS RECEIVERS

A new line of low-cost table model monitor receivers is available from the *Hallicrafters Company*. Models CRX-103, CRX-104, and CRX-105 are ideal for firemen on call, policemen, private pilots, emergency civil defense workers, businessmen, or just plain radio enthusiasts. The CRX-103 tunes the low band (27-50 MHz), while the CRX-104 portable aviation communications center tunes 108-135 MHz. The frequency band between 144 and 174 MHz is available with the CRX-105 receiver. The receivers are all solid-state, featuring stable operation, noise-eliminating squelch controls, and class-B push-pull amplifiers. The tunable superheterodyne circuits receive both AM and FM signals with high sensitivity and extended range.



Circle No. 78 on Reader Service Page 15 or 115

IN-CIRCUIT TRANSISTOR TESTER

The *Heath Company's* new Model IT-18 transistor tester measures d.c. beta both in and out of circuit in two ranges and I_{ceo} and I_{cbo} leakage in transistors out of circuit. It also checks diodes in and out of circuit for forward and reverse current to indicate open or short circuits. In addition to matching transistors of the same or opposite types, the IT-18 also identifies *pnp* and *npn* transistors and the anodes and cathodes of unmarked diodes. All tests are non-destructive—even if the device under test is connected improperly. Other features include a 4½" 200-μA meter movement, ten-turn calibration control, and complete line-independent portable operation.

Circle No. 79 on Reader Service Page 15 or 115

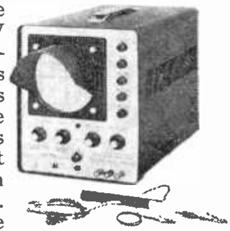
AUTOMATIC TURNTABLE

Constant synchronous speed under all conditions, regardless of voltage variations, is the big feature in *Garrard's* new Model SL95 automatic transcription turntable. The Synchro-Lab motor that forms the heart of the turntable is actually two motors in one. An induction section imparts instant start and high driving torque, and a synchronous section automatically locks onto the 60-Hz line frequency, thus eliminating the need for a heavy turntable platter. A low-mass dynamically balanced pickup arm that rests on gimballed pivots for minimal friction eliminates pickup arm vibration. An auto-rise platform allows records to be played automatically, yet can be lowered into the floor of the turntable when the turntable is used manually.

Circle No. 80 on Reader Service Page 15 or 115

COMBINATION SCOPE

With the flick of a switch, the Model PS148 "Combination Scope" available from *Sencore, Inc.*, converts from a conventional wide-band oscilloscope to a professional vectorscope. The PS148, a versatile TV service instrument, produces vector patterns that enable technicians to view patterns at the chroma detector, besides facilitating alignment of the chroma section of color TV receivers. The combination scope can also be used to touch up bandpass amplifier alignment with the aid of any conventional color bar generator. Vertical amplifier response of the instrument is flat to 6 MHz.



Circle No. 81 on Reader Service Page 15 or 115

LOW-COST HI-FI STEREO HEADPHONES

The "Encore" Model EN-5 stereo headphones made by *Telex Communications Division* are said to be the only less-than-ten-dollar headphones on the market with a frequency response of from 50 to 18,000 Hz. They have removable foam-filled cushions, an 8'-long super-flexible cord, and a molded three-circuit plug. The EN-5 is lightweight, molded from tough, durable Cycolac plastic.

Circle No. 82 on Reader Service Page 15 or 115

HIGH-PERFORMANCE CB CAMPER ANTENNA

An easy-to-install, high-performance two-way mobile CB antenna, designed for pickup trucks with campers, camping trailers, vans,

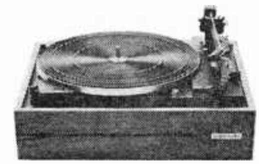
PRODUCTS (*Continued from page 22*)

and buses, is available from *Antenna Specialists Company*. The new Model M-189 antenna employs "Maggie Mobile" designs, utilizing a precision-wound true-base loading coil to provide extremely low VSWR for maximum range. Universal mounting bracket has a large bearing area for sturdy mounting, and an angle adjustment allows the CB'er to mount the antenna in any position on the side or the roof of his camper. Base-loaded antenna has a stainless steel whip, mounting bracket, RG-58 coax and PL-259 connector.

Circle No. 83 on Reader Service Page 15 or 115

MEDIUM-PRICED RECORD CHANGER

Top-of-the-line features are incorporated in the *Dual* Model 1212 medium-priced record changer. These features include a balanced pickup arm, variable pitch control, direct-dial tracking force, anti-skating, automatic cuing, constant-speed motor, and a non-ferrous, cast platter. The tracking force range is 0-5.5 grams. The pickup arm can track as low as 1 gram, qualifying it for use with high-compliance cartridges. Anti-skating is synchronized to tracking force so that when tracking force is set for any number of grams, the required amount of anti-skating is set simultaneously by a special coupling. The variable pitch control allows all three speeds (33⅓, 45, and 78 r/min) to be varied over a range of 6%. The high-torque motor maintains a 0.1% speed tolerance even if voltage varies between 80 and 135 volts. The heavy 3¾-pound platter has an anti-static mat with ribbed rim.



Circle No. 84 on Reader Service Page 15 or 115

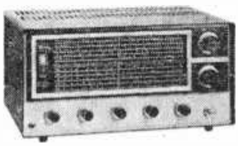
SOLID-STATE VOM

The high input impedance of the VTVM and the convenience of VOM battery operation come together in *Simpson Electric Company*'s Model 313 solid-state VOM. The meter's FET input circuit can handle large overloads, while its 7" taut-band meter movement is varistor protected against even 200,000% overloads. The 313 provides eight ranges for each of the a.c. and d.c. voltage functions—from 0-0.3 volts to 0-1000 volts, ±3% full-scale accuracy. Input impedance on d.c. is 11 megohms; on a.c. 10 megohms. The d.c. current ranges are: 0-0.1, 1, 10, 100, and 1000 mA. Seven resistance ranges (RX1 to RX1 meg), with measurement accuracy of ±3° of arc, are also provided.

Circle No. 85 on Reader Service Page 15 or 115

HAM AND SWL RECEIVER

Designed for the SWL as well as the ham, *Allied Radio*'s Model A-2515 solid-state receiver tunes from 150 kHz to 30 MHz in five selectable ranges. The r.f. section of the receiver utilizes two FET's to provide 2 μV sensitivity (3.2 μV for standard AM broadcast band). Four mechanical filters are used for sharp station separation. Also featured are a built-in BFO and product detector for clear reception of CW and SSB. Visual tuning is made easy with an illuminated S-meter and an illuminated slide-rule dial (has calibrated band-spread). The receiver can be operated on 117 volts a.c. and 12 volts d.c. Selectivity is 1.5 kHz bandwidth at 6 dB down and 5 kHz at 50 dB down; signal-to-noise ratio is 30 dB down; and i.f. rejection is 40 dB. Audio output is 1.3 watts.



Circle No. 86 on Reader Service Page 15 or 115

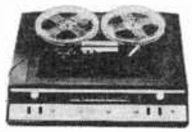
STEREO HEADSET

The Clark/300 headset, retailing for just $19 from *David Clark Company, Inc.*, puts quality stereo reproduction within reach of even the most modest budget. The frequency range of the headset is 20-17,000 Hz with a sensitivity for 1 mW input at 1000 Hz of 105 dB reference 0.0002 dyne/sq cm. Each of the two earpieces will handle a maximum power input of 1 watt. Nominal impedance is 8 ohms. The headset comes with a coiled cord which is terminated in a molded-on plug.

Circle No. 87 on Reader Service Page 15 or 115

RECEIVER/TAPE-DECK HI-FI CENTER

The Model TDC33 receiver/tape-deck home recording studio available from *Harman-Kardon* is said to be the first such combination on the market. Dubbed the "Nocturne," it has an FM-stereo receiver and the TD-3 three-speed, three-head tape deck. The balanced-coil tape heads have extremely narrow gaps to provide extended record/playback frequency response. Receiver technical specifications: 60-watts power output (IHF) into 4 ohms; 8-45,000-Hz ±1 db frequency response at 1 watt; less than 1% harmonic distortion; 2.5-μV FM sensitivity; 45-db FM image and 70-dB spurious response rejection; 80-dB FM i.f. rejection; and 30-dB multiplex separation. Tape speeds are 7½, 3¾ and 1⅞ in/sec with frequency responses of 30-22,000 Hz at 7½ in/sec and 30-15,000 Hz at 3¾ in/sec. Crosstalk is better than 60 dB.



Circle No. 88 on Reader Service Page 15 or 115

CIRCLE NO. 12 ON READER SERVICE PAGE→

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no matter *what* you're willing to spend!**

Take today's most advanced electronic concepts. Add today's most wanted CB conveniences. Put them together with surgical precision. And you've got the 23-channel COURIER Royale. Years ahead of any other all-channel CB transceiver — including the ones with stratospheric prices!

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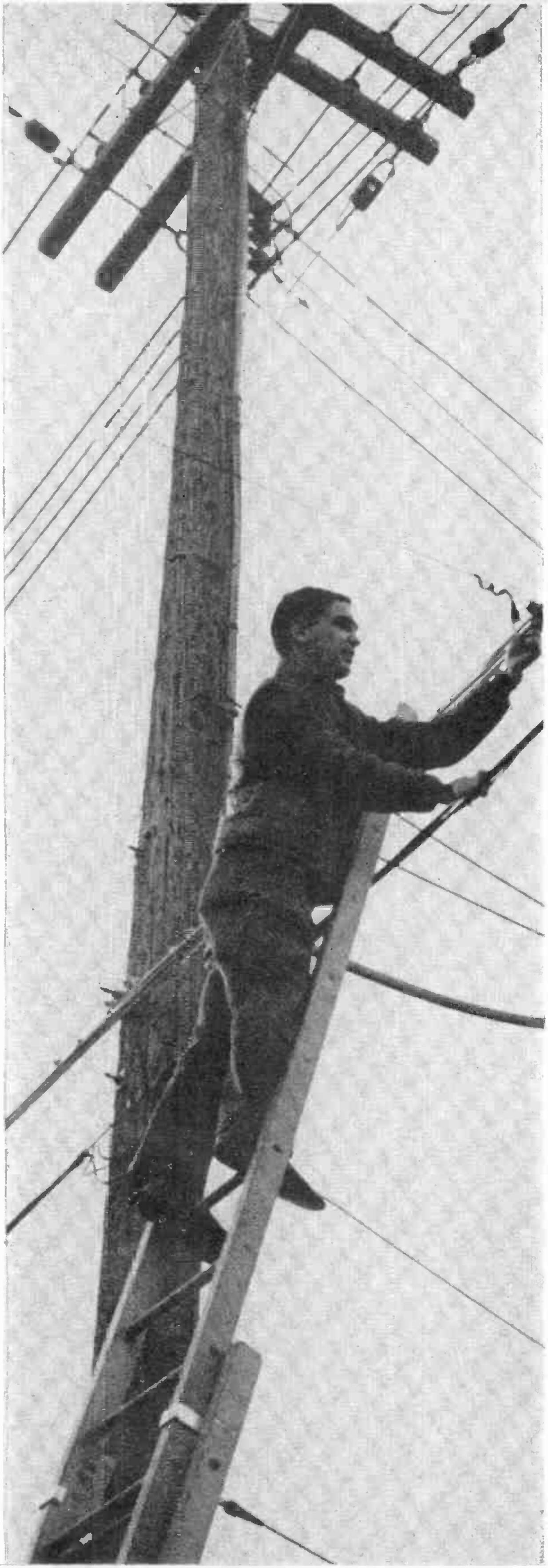


10,000 TECHNICIAN JOBS IN CATV

Cable TV is here to stay and a technician shortage is in the offing

BY EDWARD A. LACY

WITH HUNDREDS OF COMMUNITY antenna television (CATV) systems springing up all over North America, there are thousands of job opportunities for electronics technicians. Regardless of the outcome of numerous court cases pending on CATV and probable Congressional legislation regulating CATV, the fact remains that it is here to stay.

While favorable court decisions may give CATV a tremendous boost, it's obvious that CATV has already created a demand for good technicians to keep the systems running. Jobs probably exist now in your hometown or nearby; and you don't have to go hundreds of miles to find an opportunity.

The story is the same all over the country: "Virtually every system in the United States and Canada is confronted with a shortage of trained technicians," says Patrick T. Pogue, co-publisher of *TV Communications* magazine and president of National Cable Television Institute.

In Minnesota, Gary Nelson, manager of Winona TV Signal, says: "There is, always has been, and no doubt always will be a great shortage of good technicians in the CATV industry." In Arkansas H. R. Lindsey, manager of Trans-Video of Arkansas, says: "There is a definite deficiency of good men for the jobs." In New Hampshire, Richard L. Blais, general manager of Paper City TV Cable Corp., reports: "Last spring we put an ad in a national CATV publication for a chief technician 'in the Northeast.' We had only two answers—one was checking the pay, the other had just been fired."

When the CATV system in Cortland, N. Y., offered a special of 99¢ instead of the usual $25 for hook-up charges, hundreds lined up, despite the rain, to take advantage of the bargain.

And in Texas, Byron D. Jarvis, president of National Trans-Video, Inc., says: "Currently there is a terrible deficiency of qualified people and this situation is going to become even worse in the next few years."

No one knows for sure just how many technicians are needed, but look at it this way: The number of technicians employed in a CATV system varies from one to twenty, depending of course on system size. A typical smaller CATV system will employ a chief technician, two technicians, and two installers.

With more than 2000 CATV systems (plus 350 in Canada) now in operation, an average of only three technicians per system gives an estimated total of over 6000 technicians currently employed in CATV. But franchises have been granted for another 1800 systems not yet in operation, and when these systems become operational, approximately 5400 more jobs should open up.

As CATV systems start originating their own studio-type productions, there will be an even greater need for CATV technicians. Most CATV systems already have an automatic time, weather, and music channel which they produce. Recently, however, about 10 percent of the systems have gone into local productions, primarily for public service programming: city council meetings, PTA, Little League baseball, etc. As more and more systems go into local program production, there will be new jobs for technicians to set up cameras, lighting, sets, audio and video tape recorders, etc.

One system reports that, as they expand and go into more cablecasting, they expect to double their technician crew, from four to eight. Even if most systems will not require this many additional technicians, most of them will probably need at least one additional technician to take care of the increased workload caused by cablecasting.

The present demand for CATV technicians, however, is almost insignificant compared to future demands. Approximately 2300 applications for CATV franchises are now pending. Many of these applications have been frozen by the FCC. A nervous FCC recently asserted its jurisdiction over CATV and stopped its expansion into the top 100 markets (which essentially are the top 100 population centers in the country). Probably 92% of the TV sets in America are within these cities. To provide CATV for these sets, the CATV industry would need many more technicians.

"When the FCC's freeze is lifted, the demand for CATV technicians will resemble the California gold rush," says William J. Bresnan, executive vice president of Jack Kent Cooke, Inc., the parent company of American Cablevision. "Should the FCC's restrictions be lifted at this time, it's reasonable to assume a minimum of 20,000 CATV technicians would be required in the next five years."

Job Titles and Duties. The work performed by CATV technicians varies with the size and complexity of the system. All CATV systems have one objective: to keep the customer happy by providing him with more TV channels than he can get with an outdoor antenna. They must of course give him dependable reception, free of ghosts, snow, and smears.

Once the customer obtains excellent reception, he expects it to be consistently available, just like water and electricity. A cable TV blackout or breakdown may result in hundreds of phone calls from disappointed, even enraged, customers.

Last year during the Chicago White Sox and Boston Red Sox game in the American League pennant race, a Florida CATV system went blank and dozens of fans went through the ceiling. More than 200 customers immediately reported the failure. One of the disappointed fans was the manager of the CATV firm!

After a major breakdown, prominent newspaper articles the next day give the gory details of the blackout, which certainly shows how important CATV is to some communities. It shows too the responsibility the technicians have for keeping the system relatively trouble-free.

To keep the public happy, a CATV technician needs to be part technician and part salesman. A major part of his work is making troubleshooting calls to a customer's home. Such calls can require considerable tact since most customer complaints are found to be the fault of the receiver and not the cable. And, the smaller the system, the more likely it is that the technician has a wide variety of duties.

Low man in the system is the *installer*, who connects customers to the system, relocates outlets, performs disconnections, and helps construct line extensions. (In some systems, installation work may be subcontracted to local TV servicemen.)

Presently, most CATV cables are above ground, on utility poles. Consequently, installers and technicians in some systems must learn to use pole-climbing equipment. (A ladder is a nuisance and is too slow.) Bucket-lift and cherry-picker trucks are useful in some areas but can't be used in backyards, etc. As CATV moves into the larger cities, however, many of the cables may be placed underground, so that climbing ability may not be so important.

The *technician* repairs equipment, adjusts amplifier levels (balances the system), makes troubleshooting calls, and performs routine monthly maintenance checks. He may be involved in trunk maintenance, head-end maintenance, or in bench work. The equipment he maintains may include wideband amplifiers, microwave relay, performance monitoring devices, and miles and miles of coax cable.

A Jerrold technician (installer) prepares a receiver for connection to the CATV system.

Much of the troubleshooting is now done with a simple field-strength meter and a portable TV (color for color TV customers). However, more sophisticated test equipment such as time-domain reflectometers and spectrum analyzers is being used in some of the larger systems.

"As CATV systems become more sophisticated in the programming field and auxiliary services," says Gary Nelson, "the technicians will very likely be faced with an ever-expanding number of responsibilities or duties."

Already some systems are gradually breaking their men into cablecasting. In cablecasting, CATV technicians must learn TV camera, lighting, switching, and video-tape recording techniques, as well as simple television programming.

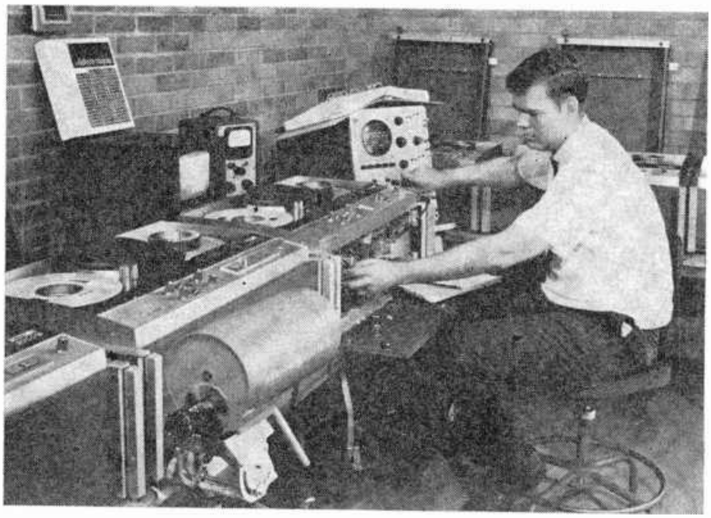
Once the technician gets a few years experience, he may be able to advance to *chief technician,* where he has overall responsibility for service and preventive maintenance of the system; as a foreman, he assigns duties to technicians and installers. He may be called upon to design a system layout and to direct the bulk of the purchasing of new system equipment. In a small system, he also does most of the bench work.

What Do CATV Technicians Earn? Salaries depend on geographical location and on the size of the system; the chance of promotion and the pay are better in large systems. Installers, at the bottom of the totem pole, earn from \$1.60 to \$3.92 per hour. Technicians make from \$90 to \$190 a week, and a chief technician makes from \$150 to \$200 a week.

Education and Experience. "Almost any kind of electrical experience or education would qualify a man to break into CATV," reports one CATV executive. "However, if his experience or education is extremely limited, he may start out as an installer and then eventually work up to a position of technician. We have found that experience in radio and television broadcasting and television repair work provides a very helpful background for CATV technicians."

James R. Palmer, chairman of the Technical Training Committee of the National Cable Television Association and also president of C-COR Electronics, Inc., says: "The electronics experience and education required runs the full gamut from a graduate engineer to a man off the street who, with a few hours of training, can start at the bottom of the ladder as an installer. Many positions are filled with on-the-job trainees but the better jobs, of course, are for those who have a trade school background or a two-year associate-degree program. Many chief technicians have completed the two-year associate education and have a few years experience."

A large operating system can often take on inexperienced technicians; how-



At Telemation, manufacturer of cablecasting equipment, a technician checks videotape recording instruments.

ever, a small system in the planning stage requires personnel with relatively high training and experience levels.

While two or more years of trade school or military electronics school or at least a basic knowledge of electronics is a minimum requirement for CATV technicians, sometimes it is waived; on-the-job training is still important.

"The more electronics experience and education, obviously the better," says H. R. Lindsey. "However, we now operate a successful system, and we have trained all of our technicians ourselves. None of them had previous experience or electronics backgrounds."

The only formal training for CATV technicians until recently has been the short training courses given by manufacturers like Blonder-Tongue and Jerrold to insure the proper use of their equipment. But, within the past year, two resident schools—Colorado Electronic Training Center and Pennsylvania State University—have begun courses in CATV.

Robert W. White, president of the Colorado Electronic Training Center, Manitou Springs, Colorado, describes their CATV course: "It presupposes no background in electronics and teaches basic circuit theory with necessary math along with vacuum-tube- and transistor-amplifier theory, basic television theory, and transmission-line theory. The last four weeks of the 16-week course are devoted to making measurements on our system mock-up as well as field work on the local CATV system. During this time, the student learns system and subsystem troubleshooting techniques using typical test equipment."

The College of Engineering of Pennsylvania State University has developed for the Pennsylvania Community Antenna Television Association a two-part training program for CATV installation-service and technical-service personnel. These courses will be given at eight cities in Pennsylvania.

In contrast to the resident school courses, home study courses have been considered to be of little direct benefit to fledgling CATV technicians, other than to provide basic electronic knowledge, since the courses have not offered specific lessons on CATV.

"Home study courses provide some of the education required, but can never completely serve," according to James R. Palmer. "Home study courses combined with on-the-job training with an alert supervisor, could perhaps provide a man with a good background."

However, new developments may change the industry's opinion about correspondence courses.

The RCA Institute's Home Study School plans to add CATV lessons to its TV and communications courses this fall. Within the past year, a new correspondence school—the National Cable Television Institute—has started courses in CATV. The Institute's catalog describes its two main courses as follows:

In a week-long seminar conducted by Jerrold's CATV Systems Div. for its chief technicians, Jack Forde discusses some of the details of CATV system layout.

(This photo and those on pp. 27 and 28 courtesy Jerrold Electronics.)

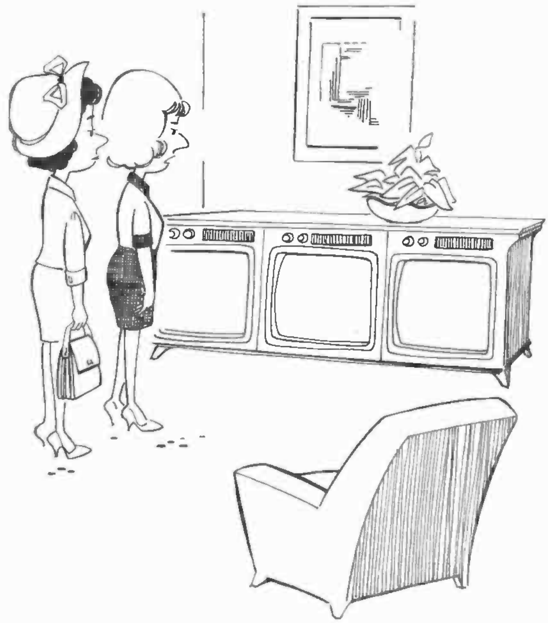
"*CATV Installer/Technician.* Covers the basic fundamentals of electronics, television, CATV. and customer relations. Specifically designed for the beginner who has just entered, or desires to enter, the cable television field, the course shows how to make a drop installation, check amplifier levels. select tap devices.

"*CATV Chief Technician.* Deals with state-of-the-art cable television and proper operation and maintenance of a system. It includes a study of advanced sys-

(*Continued on page* 118)

Popular EleComics

BY HOWARD STRINGER

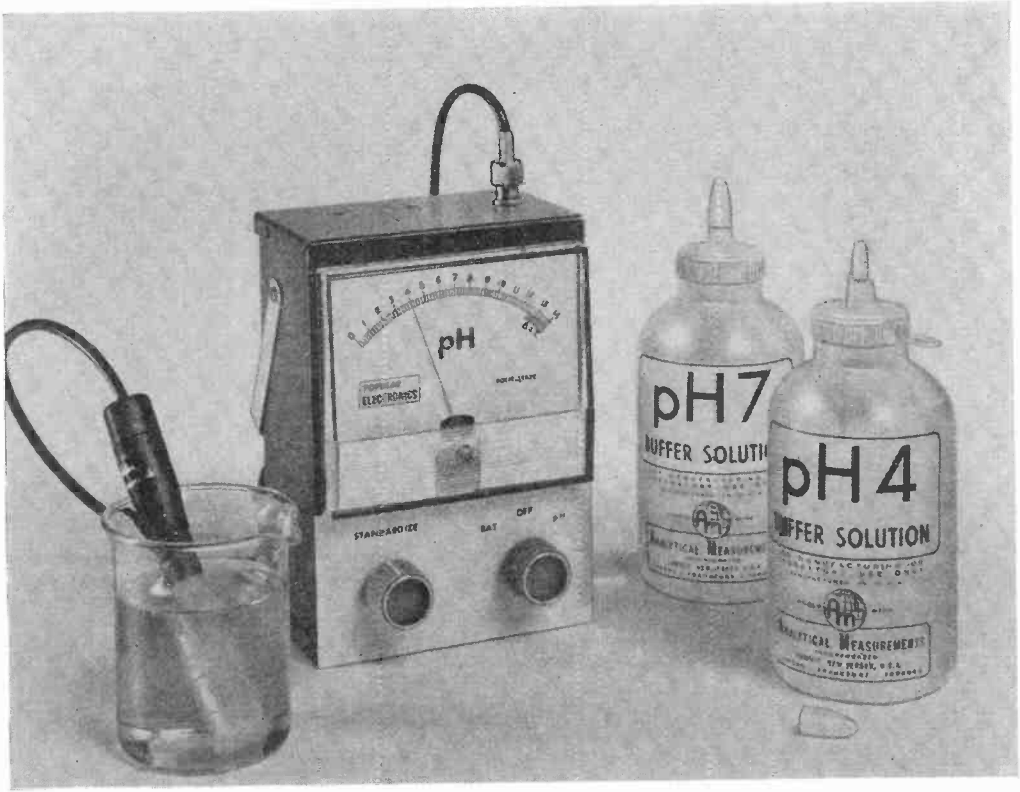


It's one of my husband's inventions—specially adapted for the football season.

Now I can see how I was able to get this mail-order ham set for $3.98.

Love—Uncle—Nan—Charlie—How!

Very ingenious. But there are a lot of things I need more than an AM/FM toaster.



solid-state pH meter

electronics IN THE chemistry LAB

ACID OR ALKALINE? HOW MUCH? THIS LOW-COST, HIGHLY ACCURATE PROJECT HAS DIRECT READOUT

COVER STORY BY R. C. DENNISON

THE HIGH COST of pH meters ($100 to $500) has ruled out their use in many small schools and laboratories. Now, through the use of low-cost metal-oxide-semiconductor field-effect transistors (MOSFET's), it is possible for any amateur scientist to have his own high-quality pH meter. It can be built for about $26. The recommended pH probe (see Parts List) is specially designed for student use with its delicate glass electrode surrounded by a protective polyethylene shield. Its price of $20 is about half that of most other probes.

The circuit (see Fig. 1) uses two MOSFET's in a differential-amplifier configuration. An advantage of this symmetrical circuit is that temperature and drain-voltage variations tend to affect the currents in *Q1* and *Q2* equally and are effectively cancelled in their effect on the meter reading. Stability is further improved by the use of a zener diode (*D1*) to regulate the drain voltage.

A portion of the meter scale (between pH 12.5 and pH 14) is colored green and is used to determine whether or not the battery is in good condition. With the function switch (*S1*) in the BAT position, only the battery with normal loading is connected to the meter. The battery's condition is good if the meter

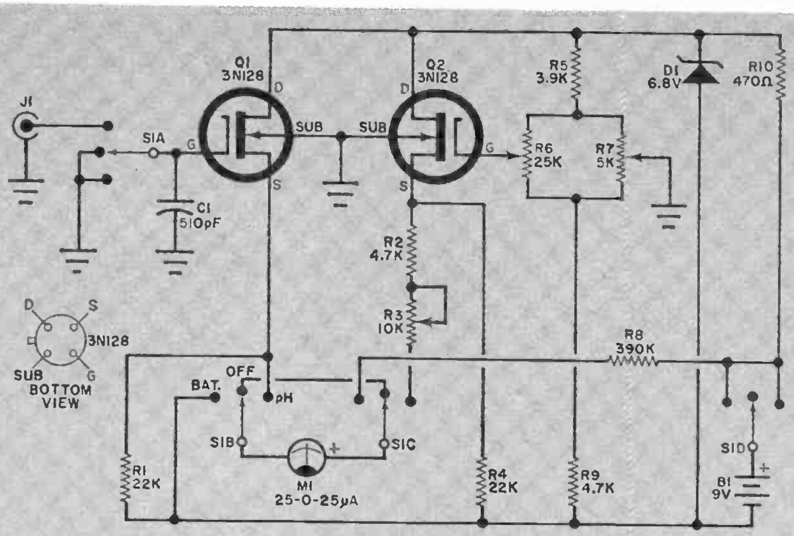


Fig. 1. The symmetrical configuration of the differential-amplifier circuit cancels errors caused by temperature and drain-voltage variations in MOSFET'S.

PARTS LIST

B1—9-volt battery
C1—510-pF. dipped mica capacitor
D1—6.8-volt, 400-mW zener diode (TI 1N3514 or similar)
J1—BNC jack, UG-1094/U
M1—25-0-25 microammeter, 4½-inch
Q1, Q2—3N128 n-channel MOSFET (RCA)
R1, R4—22,000-ohm
R2, R9—4,700-ohm
R5—3,900-ohm
R8—390,000-ohm
R10—470-ohm
(All resistors ½-watt)
R3—10,000-ohm, trimmer potentiometer, (Mallory MTC14L1 or similar)
R6—25,000-ohm, ½-watt linear potentiometer
R7—5,000-ohm, trimmer potentiometer (Mallory MTC53L1 or similar)
S1—Five-pole, three-position, non-shorting ceramic switch (Centralab PA-2015) (Do not substitute.) Note only four of the poles are used.
Misc.—3" x 5" x 7" metal cabinet (Bud CU-3008-A or similar), aluminum handle, thumbscrew, ¼" metal spacers, knobs, battery connector, screws, nuts, wire, solder, Print-Kote, etc.
The following items are available from Analytical Measurements, Inc., 31 Willow St., Chatham, N. J. 07928: pH probe with BNC fitting—$20; KCl refill solution for pH probe, 4-oz bottle—$1; buffer kit, (3) 500-ml plastic bottles, 3 pkgs each of powdered buffer salts, 4, 7, 9 pH—$6. Include postage & N. J. tax.

reading is in the green portion of the scale.

When *S1* is in the OFF position, the meter is shunted to protect the sensitive movement during transportation. All pH measurements are made with *S1* in the pH position.

Construction. The transistors, resistors, and other small components are mounted on a printed-circuit board shown full size in Fig. 2. Use glass-epoxy-base copper-clad board instead of the ordinary paper-phenolic type to maintain high input resistance in humid weather. After the board is etched, wash it at least ½ hour in running water; then dry it thoroughly and drill it. Install all components, except the transistors, but including one circuit jumper and two temporary jumpers as shown in Fig. 3. A finished board is shown in Fig. 4.

MOSFET's are easily damaged by static electric charges unless certain precautions are observed. They are shipped with their leads inserted in a metal ferrule. Do not remove this ferrule until you are ready to solder the transistor to the board. Solder all the other components in place first. Make sure that the temporary wire jumpers are in place as shown in Fig. 3. These jumpers protect the MOSFET's during assembly and wiring. Now remove the ferrules and bend the MOSFET leads to fit into the holes in the board. Get the soldering iron hot but

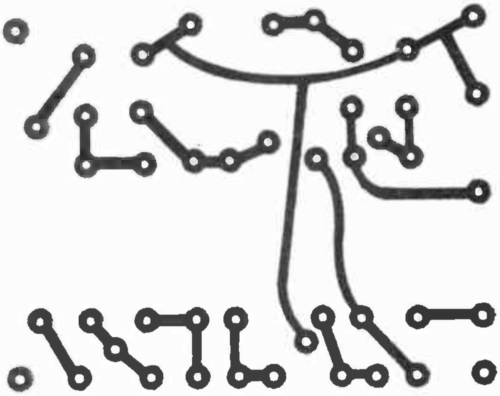


Fig. 2. Use best-quality copper-clad glass - epoxy - base board to maintain high input resistance of pH meter.

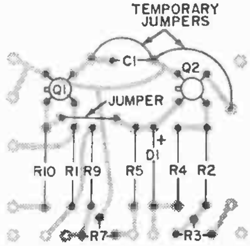


Fig. 3. To protect MOSFET's against damage, connect temporary jumpers as shown until meter is fully assembled.

WHAT IS pH?

An acid is a substance that yields hydrogen ions (H^+) when dissolved in water. Actually, each hydrogen ion attaches itself to a molecule of water to form a hydronium ion (H_3O^+). The concentration of hydronium ions in a solution is a measure of the strength of the acid.

Chemists usually measure concentration in moles per liter. For example, 0.1 molar hydrochloric acid contains 3.65 grams (0.1 mole) of hydrogen chloride in one liter of solution because the molecular weight of hydrogen chloride is 36.5. Since HCl tends to dissociate completely into ions in solution, the concentration of hydronium ions in this solution would also be 0.1 mole per liter. Some substances dissociate only slightly. Thus, in acetic acid, only 1.36% of the molecules in a 0.1 molar solution dissociate. Therefore, the hydronium ion concentration would be 0.00136 moles per liter.

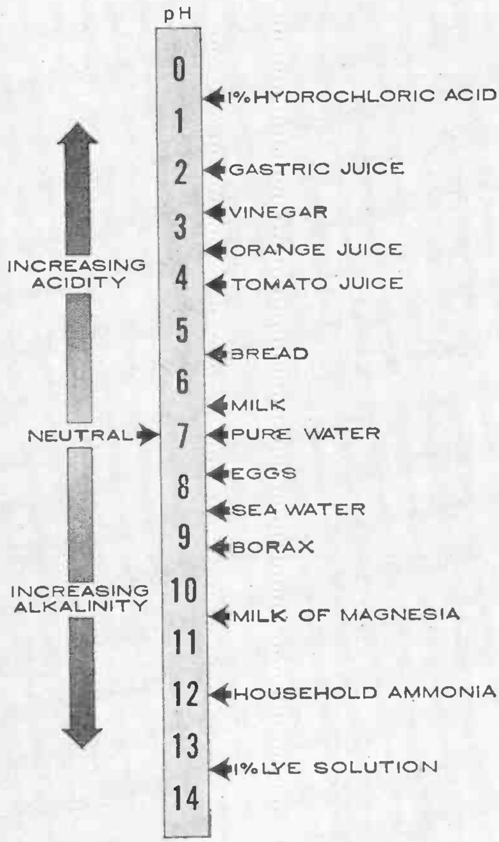
To avoid the use of such small, inconvenient numbers, it is customary to express the hydronium-ion concentration in terms of pH values defined by the equation

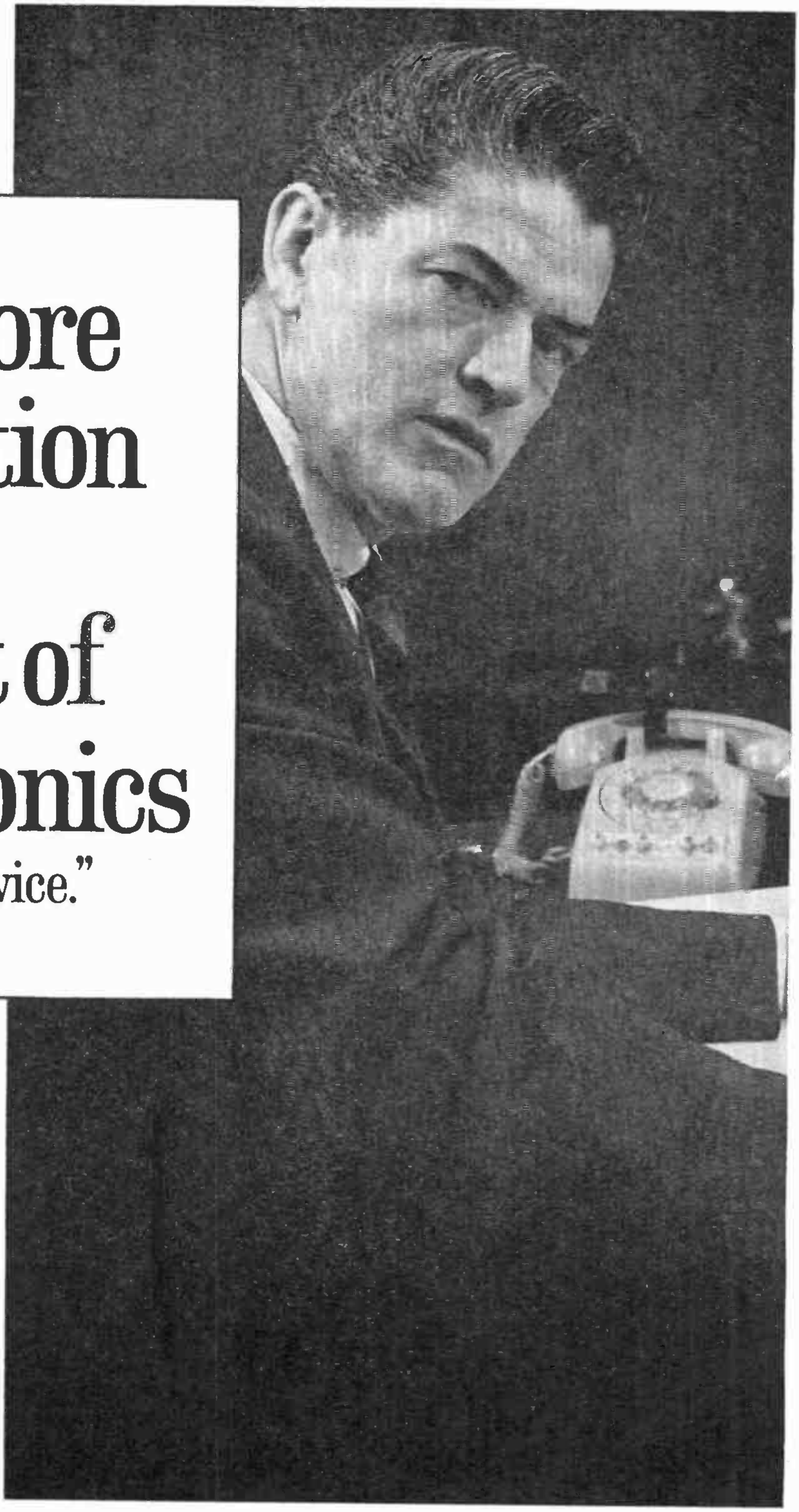
$$pH = \log (1/H_3O^+)$$

where H_3O^+ is the hydronium ion concentration in moles per liter. Thus, in the examples above, the 0.1 molar solutions of hydrochloric and acetic acid have pH values of 1.0 and 2.87 respectively.

The pH scale is a logarithmic scale similar to that of the decibel. Each 10-fold change in acidity changes the pH value one unit. The pH values of some common substances are shown on the accompanying scale. From this, we see that orange juice is 1000 times more acidic than milk. Note that the scale runs from 0 to 14. Pure water is neutral with a pH of 7. Lower pH values indicate an acidic substance while higher values indicate alkalinity.

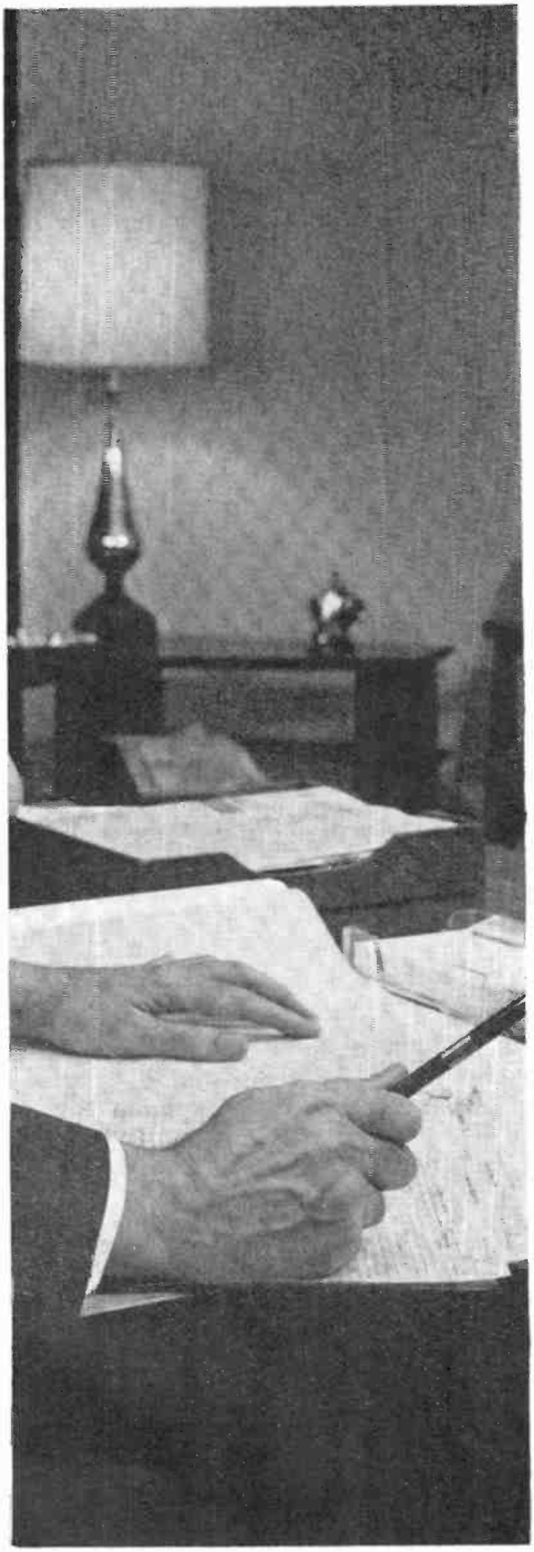
Many chemical processes are greatly affected by small changes in the degree of acidity or pH value. Some examples are the speed of chemical reactions, the growth of micro-organisms, the quality of electroplated deposits, the polymerization of synthetic rubber, the growth of plants and the tendency of jellies to gel. Thus the accurate measurement of pH assumes great importance in chemical laboratories, medical and biological research, food preparation, agriculture, and industrial quality control. Often, pH instrumentation is used in continuous closed-loop (feedback) systems in process control.





"Get more education or get out of electronics

...that's my advice."



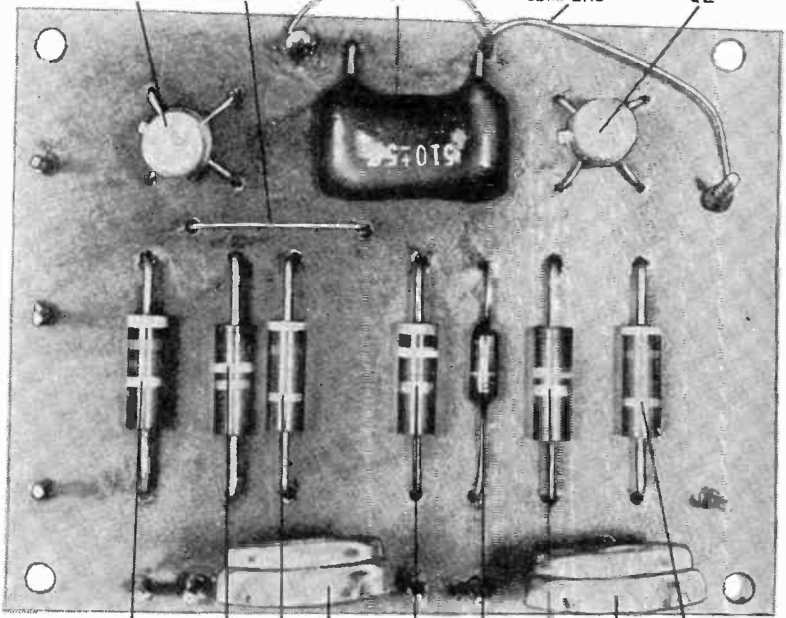


Fig. 4. Make sure that temporary jumpers are in place before soldering the MOSFET's into the circuit. When handling Q1 and Q2, and when mounting them on circuit board, do not remove the shorting rings. See text for precautions to take while soldering.

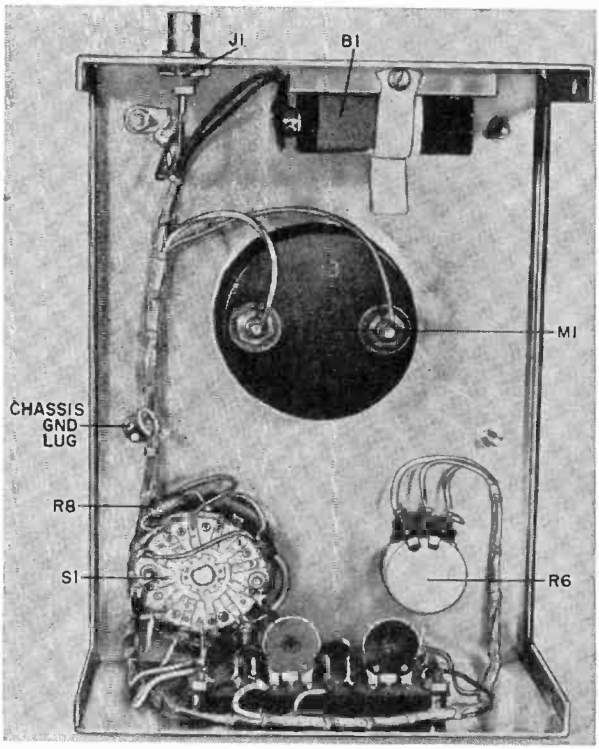


Fig. 5. After components and circuit board are mounted in their respective locations on the metal box, wire them together. To obtain a neat, professional appearance, use lacing cord to bundle the wires into harness configuration as shown in this photo.

then unplug it while soldering the transistors to the board. You may have to re-heat the iron to get all of the connections made, but be sure to have it unplugged while attaching the transistors. Failure to do so may result in permanent damage to the gates of the MOSFET's.

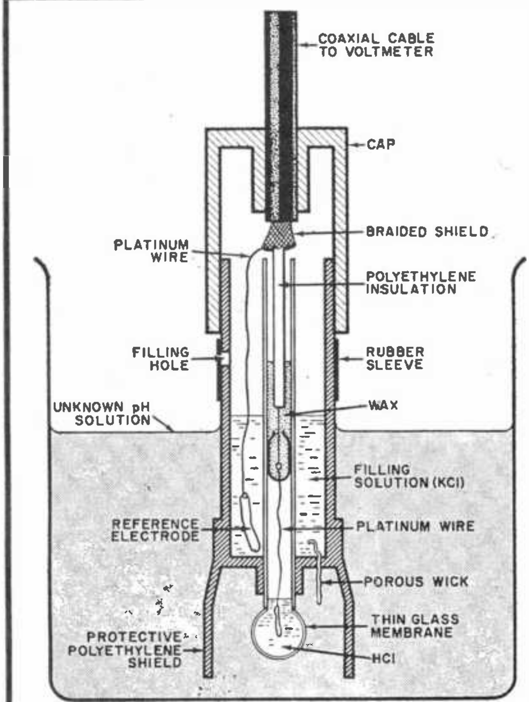
As in all work with printed circuits and semiconductors, use a low-wattage iron (25 to 35 watts) to avoid damage due to excessive temperatures. Remove all flux from both sides of the board using alcohol and a clean cloth. Dry the board thoroughly and then coat both sides with a silicone resin such as GC Print Kote to moisture-proof the board.

Mount potentiometer *R6*, switch *S1*, and BNC connector *J1* to the front of the chassis as shown in Fig. 5. The battery is supported on a 2" × 1" × ¼" block of plastic by a piece of ⅜"-wide dressmaker's elastic secured to the plastic with screws. The elastic band holds the battery securely, and the plastic base insulates the battery from the metal chassis.

The original scale of the meter must be removed and replaced with a linear scale calibrated from zero to 14 with 7 in the middle. Subdivide each major segment into five minor segments. (See photo of meter front panel.) The section between 12.5 and 14 should be colored green for the battery test described earlier.

Mount the board to the bottom of the chassis using ¼" metal spacers and appropriate hardware. Complete the wiring using only high-quality wire. If the wire from *J1* to *S1* is to be laced with the other wiring, it should have teflon, polystyrene, or polyethylene insulation. If the wires are laced, coat the wire harness with low-loss coil dope to exclude moisture. Do not substitute a phenolic switch for the ceramic switch specified. Keep all insulation clean and free of grease and soldering flux. A small packet of silica-gel desiccant may be kept inside the pH meter to remove the last traces of moisture.

The handle is made from a piece of ½" × 1/16" aluminum and may be secured in any position by means of a thumbscrew on one side. The thumbscrew engages a small piece of threaded brass which is held in place by flat-headed screws. The other side of the handle is fastened to the case by a free-turning



HOW pH IS MEASURED

Every schoolboy knows that litmus paper can be used to determine whether a substance is an acid or a base. Other chemical indicators which change color at various pH values are also available. However, the modern way to measure pH is by means of the electronic pH meter. Its operation is based on the use of a glass electrode and a reference electrode, often combined into a single probe similar to that shown in the diagram.

The thin glass membrane is permeated by the charge-carrying hydrogen ions, the number of ions that pass through the membrane being determined by their concentration in the liquid being tested. Therefore, when the probe is placed in a solution, it develops a voltage at its terminals which is proportional to the pH of the solution.

Because the resistance of the glass electrode may be as high as 200 megohms, the voltmeter portion of the pH meter must have a very high input resistance. Since some MOSFET's have input resistances of 10 million megohms or more, they may be used to make an excellent low-cost pH meter.

screw. This lockable handle can be used to support the pH meter in a tilted position to make it easier to use and read.

Adjustment and Calibration. After all wiring has been carefully checked, snip out the jumper associated with *Q2*. Rotate the STANDARDIZE control, *R6*, and the zero-adjust potentiometer, *R7*, to their mid-positions and set the calibrate potentiometer, *R3*, to maximum resistance. With *S1* set to OFF, install the battery. Put *S1* in the BAT position and check that the meter deflects nearly full scale (within the green region). Turn *S1* to the pH position and rotate the zero-adjust potentiometer to bring the meter pointer to center scale (pH7). Turn *S1* off and snip out the other temporary jumper (around *C1*). A note of caution: to protect the input MOSFET, *Q1*, switch *S1* shunts the gate to ground in both the OFF and BAT positions. Do not turn the switch to the pH position unless the pH probe is connected and immersed in a solution. (An exception to this rule occurs during calibration. Follow the calibration instructions below carefully to avoid damaging *Q1*.)

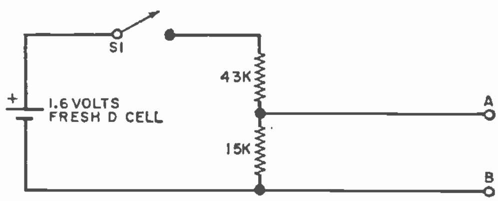


Fig. 6. The outboard calibration circuit for pH meter must be assembled around new, fresh D cell.

The meter is calibrated using the circuit shown in Fig. 6. Make sure the meter is off while making the following connections. Connect point B to the metal case of the meter and connect point A to the center terminal of the meter input jack, *J1*. Alligator-type clips are ideal for these test leads. Place the function switch on pH and adjust the STANDARDIZE control if necessary to make the meter read pH7. Close switch *S1* on the calibration circuit and the meter should deflect toward the left. Adjust calibration potentiometer *R3* to make the meter indicate 0 pH. Turn the function switch to OFF and disconnect the test circuit. The pH meter is now calibrated for use with solutions having a temperature of 25°C, which is typical room temperature. A formula to be given later can be used to correct the meter reading for temperatures other than 25°C.

Standardizing Buffers. Before the pH of a solution can be measured, it is necessary to standardize the meter. This is done by dipping the pH probe into a solution of known pH and rotating the STANDARDIZE control until the meter indicates the known pH. After the meter is thus standardized, the probe is rinsed in distilled water, wiped dry with a lint-free cloth, and then placed in the solution whose pH is to be measured. These standardizing solutions are called *buffer* solutions and are selected on the basis of their tendency to maintain a constant pH value in spite of small amounts of contamination or dilution during use. You can buy buffer solutions at a reasonable cost or you can make your own. For greatest accuracy, choose a buffer whose pH is close to that of the unknown.

- Buffer No. 1. pH = 4.01. Dissolve 5.1 grams of potassium hydrogen phthalate in sufficient water to make 500 milliliters of solution.
- Buffer No. 2. pH = 6.86. Dissolve 1.7 grams of potassium dihydrogen phosphate and 1.77 grams of anhydrous disodium hydrogen phosphate in sufficient water to make 500 milliliters of solution.
- Buffer No. 3. pH = 9.18. Dissolve 1.85 grams of sodium tetraborate decahydrate in sufficient water to make 500 milliliters of solution.

Use distilled water and keep the buffer in a tightly stoppered bottle. A small crystal of thymol may be added to the bottle to inhibit the growth of mold.

Temperature Compensation. Assume the temperature of the standardizing buffer and the unknown is T (in degress centigrade). The error in instrument reading, to be substracted from the indicated pH, is then

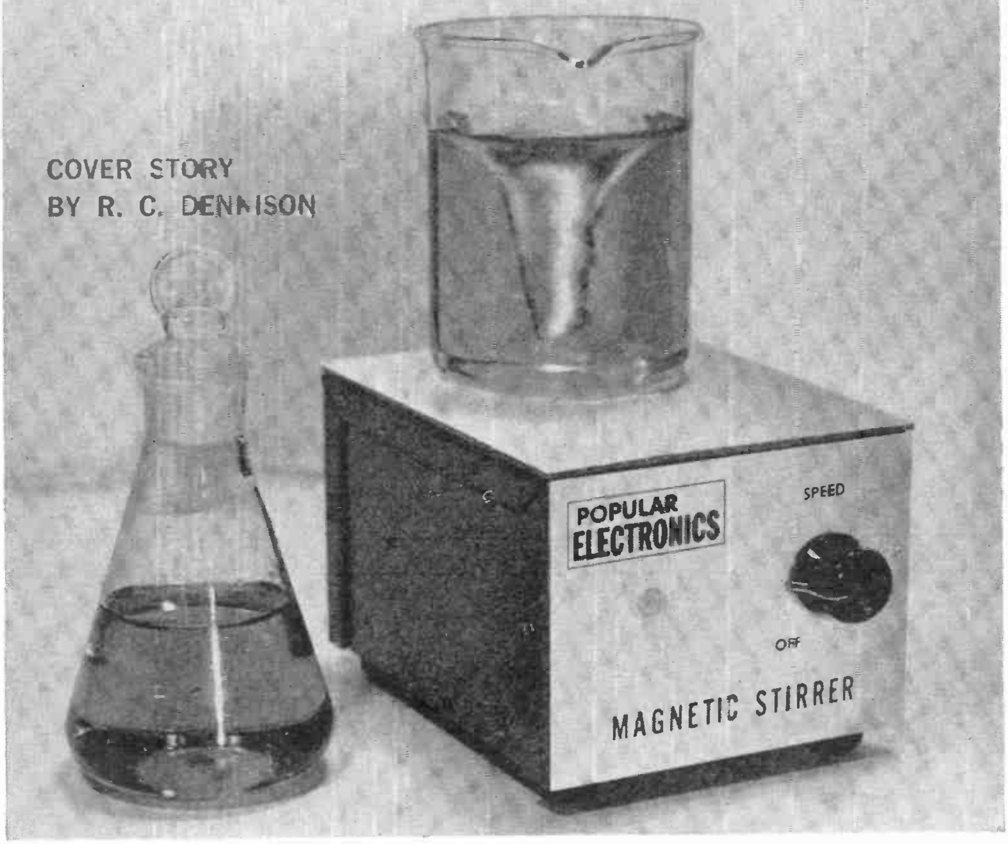
$$\text{pH error} = \frac{(T-25)\ (pH_r - pH_s)}{T + 273}$$

where pH_r is the instrument reading and pH_s is the pH of the buffer. -30-

BUILD **VARIABLE-SPEED MAGNETIC STIRRER**

BUILD VARIABLE-SPEED MAGNETIC STIRRER

COVER STORY
BY R. C. DENNISON



electronics IN THE chemistry LAB

UNIFORM MIXING AND STIRRING WITH ELECTRONICS

A MAGNETIC STIRRER that mixes chemical solutions smoothly, thoroughly, and without splashing is here. A photographer can use it to mix developers or hypo, and chemists, pharmacists, biologists, and other lab workers will find many uses for it.

Laboratory procedures are speeded up, or made more exact, by uniform stirring action while reagents are being added or while various ingredients are being blended. For example, during a titration, an acid or base is added to a solution until the proper pH is obtained. (See article on page 33.) Without constant stirring, it is easy to overshoot the balance point and thus waste time and materials. Other applications involve mixing or stirring toxic, volatile, or flammable solutions which must be kept stoppered and mixing dyes or colored solutions before they are analyzed in a

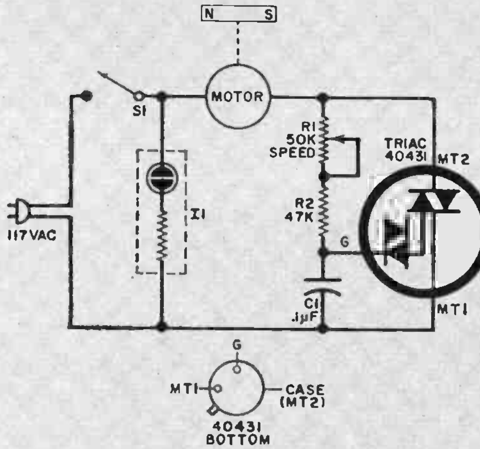


Fig. 1. Use of a triac with built-in trigger simplifies circuit design and provides smooth control of motor speed from creep to maximum.

PARTS LIST

C1—0.1-μF, 200-volt capacitor
I1—Neon indicator lamp with resistor assembly (117-volt)
Motor—Shaded-pole a.c. motor (R.M.S. M4RK or similar)
R1—50,000-ohm linear potentiometer (with attached switch)
R2—47,000-ohm, ½-watt resistor
S1—S.p.s.t. switch, part of R1
Triac—RCA type 40431 (do not substitute)
Misc.—Triac heat sink (Wakefield 254-SI or similar), aluminum posts ¼" diameter by 1½" long internally threaded for 6-32 screws (H. H. Smith 8349 or similar) two required, 6-32 binding-head screws (four required), 4-lug terminal strip, aluminum box 5" x 4" x 3", sheet of thin (1/16"-thick) cork to cover top of box, self-adhesive plastic (white), epoxy glue, grommet, rectangular driving magnet 1" x ½" x ¼", stirring magnet, wire, rubber feet (4), knob.
Note: Plastic-coated stirring magnets and retrievers are available from Arthur H. Thomas Co., Box 779, Philadelphia, Penna. The driving magnet is available from Maryland Magnet Co., 5412 Gist Ave., Baltimore, Md. 21215.

colorimeter. One non-chemical use has been suggested—mixing alcoholic drinks without a shaker!

The magnetic stirrer consists of two magnets, a low-power a.c. motor, and an electronic motor-speed control. One of the magnets (called the driver) is attached to the shaft of the motor so that it rotates in a horizontal plane as the motor revolves. The other magnet (called the stirrer) is placed within the beaker, flask, bottle, or other non-magnetic container which is placed atop the magnetic stirrer, directly over the driver magnet.

As the motor and the driver magnet rotate, the stirrer magnet attempts to keep in magnetic alignment, and in the process, constantly stirs the liquid in the container.

There are many ways to control the speed of the motor. The simplest would be to use a power rheostat in series with the motor. While this is low in cost, it generates heat which might be undesirable in some applications. A Variac could be used, but this is a bulky, relatively expensive component. By making use of a triac, however, a simple low-cost elec-

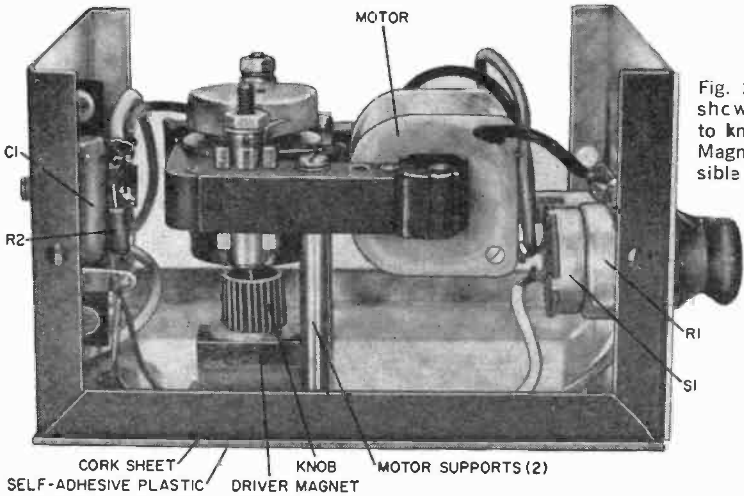


Fig. 2. View of inverted chassis shows driver magnet fixed to knob secured to motor shaft. Magnet must be as close as possible to non-magnetic frame top.

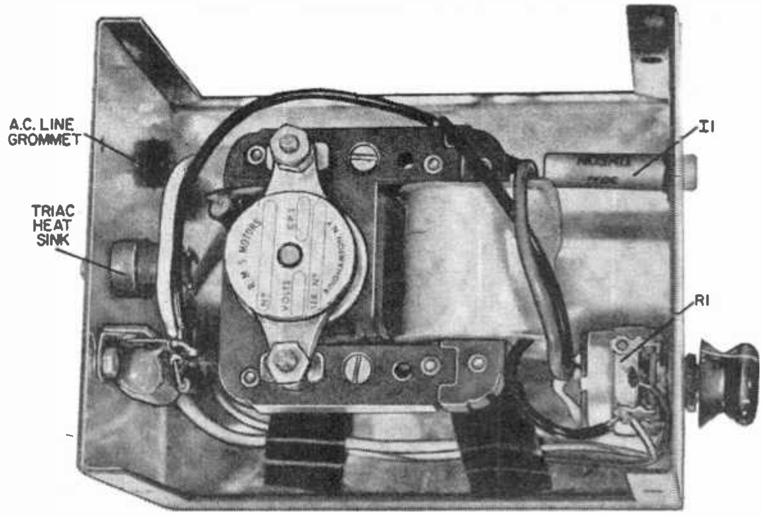


Fig. 3. When testing the magnetic stirrer with the top off, be sure not to touch any of the wiring since all of the circuit is connected to the a.c. power line. Do not use the metal chassis as a common tie point for any of the circuit.

tronic circuit such as that shown in Fig. 1 can be constructed. This circuit does not generate heat and provides for infinite variation of motor (therefore, stirring) speed. Remember that a triac is similar to an SCR, but has the advantage of being bidirectional so that only one triac is required for full-wave control. Gating of the triac and actual speed are controlled by the phase-shifting network consisting of *R1*, *R2*, and *C1*.

Construction. The motor and speed-control circuit are assembled in a 5″ × 4″ × 3″ aluminum box as shown in Figs. 2 and 3. To get a good fit within the close confines of the box, shorten the motor shaft by approximately ⅜″. A small knob from an old radio is used to attach the driver magnet to the motor shaft. To do this, first enlarge the hole in the knob until it is a snug fit on the motor shaft. Slide the knob on the shaft, and hold the ¼-inch thick driver magnet to the top of the knob. The distance from the top of the magnet to the laminations of the motor should be slightly less than 1½″. Using a good quality cement, preferably epoxy, secure the knob on the shaft. Then cement the driver magnet to the upper surface of the knob taking care to center it for good balance. Place the finished motor assembly to one side and allow the cement to dry.

Drill a hole in the side of the chassis to accept the triac heat-sink mounting bolt, then secure the heat sink to the chassis (see Fig. 3). Mount the four-lug terminal strip near the heat sink. Slide the triac into the heat sink and secure it in place using a flat spring. The heat sink has a built-in insulator so that no external insulating washers are needed. Mount capacitor *C2* and resistor *R2* on the terminal strip. On the other side of the chassis, drill holes to mount potentiometer *R1* and power-on indicator *I1*.

Using the two mounting holes on the motor as a guide, drill two holes in the upper surface of the chassis. Making sure that the driver magnet is secure to the knob and that the knob is firm on the motor shaft, mount the motor to the chassis using 6-32 binding-head screws and two internally threaded aluminum mounting posts ¼″ in diameter by 1½″ long. The driver magnet should be free to rotate as close to the top of the chassis as possible. Wire the circuit as shown in Fig. 1. Triac MT2 terminal is the case of the triac which is plated to accept a soldered connection. Use a low-wattage soldering iron to make this connection, so as not to damage the triac by overheating it. Pass the a.c. line through the chassis using a rubber grommet as an insulator.

(*Continued on page* 116)

Crackerjack OR Clown?

TEST YOUR KNOWLEDGE OF THE
ELECTRONIC SERVICING BUSINESS

By VIC BELL

(*Answers on page* 113)

1 Servicing transistorized equipment requires more test instruments than servicing vacuum tube equipment. TRUE____ FALSE____

2 The sync separator in a TV receiver separates horizontal and vertical sync pulses. TRUE____ FALSE____

3 A good black-and-white TV technician does not need additional test equipment to service color-TV receivers. TRUE____ FALSE____

4 Inability to get good color-TV convergence is generally caused by a convergence board malfunction. TRUE____ FALSE____

5 The color killer circuit blocks color noise sometimes present in color broadcasts. TRUE____ FALSE____

6 Since the color signal goes through more stages, the luminance signal is delayed with a delay line. TRUE____ FALSE____

7 Color convergence generators must have both dots and bars if the technician is to do the best possible job setting up a color set. TRUE____ FALSE____

8 It is not yet practical to transmit color TV on UHF channels. TRUE____ FALSE____

9 If the delay line in a color set opens, the color signal can still be seen on the screen. TRUE____ FALSE____

10 Mostly vertical-rate waveforms are used in the convergence circuitry to correct misconvergence. TRUE____ FALSE____

11 Vertical linearity and height adjustments may be changed without affecting convergence. TRUE____ FALSE____

12 25-inch color sets use about 40 kV at the CRT ultor anode. TRUE____ FALSE____

13 The horizontal stripes often seen across a color picture are generally caused by poor bandpass transformer alignment. TRUE____ FALSE____

14 If you remove the back panel of a tube-type color TV receiver you will increase the set's life. TRUE____ FALSE____

15 In 1968, for the first time, color TV receivers will outsell all other TV consoles. TRUE____ FALSE____

BY GLENN M. RAWLINGS

THE PROWLER HOWLER

ALARM SYSTEM
WARNS OF INTRUDERS

ONE THING ABOUT sleeping in the woods—you never know when one of our furry friends is going to seek the warmth of the campfire or the leftovers from the evening meal. Sometimes just the thought of it can keep you awake all night. But thoughts like that are not peculiar to sleeping in the woods. Worrying about prowlers or fire even when you're safe in your own bed can cause many a sleepless night.

What you need is a warning system to alert you to any intrusion or impending danger. The "Prowler Howler" does just that simply and economically. It can be operated from a low-voltage battery or commerical line power when it is available and can be constructed in a single evening. Maximum cost is $15 and depends on what you can scrounge from your old junk box.

The sensing system depends basically on the use of a very thin wire, which is broken by an intruder. This may seem at first to be a rather crude way of doing things—ultrasonic warning systems having been so widely touted—but tests have shown that the very thin wire breaks with relatively little pressure and, in almost all cases, without the intruder's knowledge. The wire is almost invisible, is easily concealed, and costs very little. In fact, most cheap spools contain a mile or more of wire. Long lengths of very thin wire can be salvaged from old transformers or other windings at no cost.

Construction. The Prowler Howler is constructed on a piece of perf board cut to fit a 3" × 6" plastic utility case. The components of the circuit shown in Fig. 1 are mounted on the perf board and on the front panel as shown in Fig. 2. The BATT-AC switch *S1*, fuse *F1*, indicator lamp *I1*, and the Sonalert *A1* are mounted on the front panel. A pair of binding posts is located on one side of the box for connecting the exterior sensing loop.

The sensing loop is part of a closed

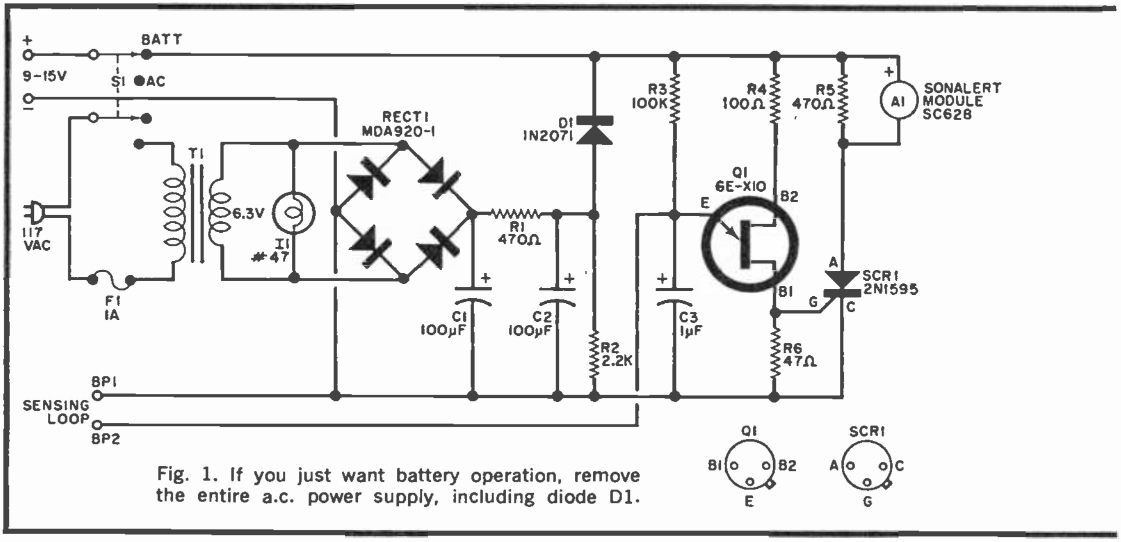


Fig. 1. If you just want battery operation, remove the entire a.c. power supply, including diode D1.

circuit that does not allow the Prowler Howler to sound off until the circuit is broken. Depending on the installation, there are several ways in which the closed loop can be produced. A typical home installation is shown in Fig. 3. For windows and doors, you can stretch a length of very fine wire (#38 magnet wire is recommended) across the opening, with each end secured by a piece of adhesive tape, thumbtacks, or small brads or nails. If desired, a normally open, pressure-sensitive switch can be installed at each window or door so that, if it is opened, the circuit continuity is broken.

An alternative is to use a low-cost magnetic-reed switch with a permanent magnet attached to the door or window. Then, when the opening is closed, the

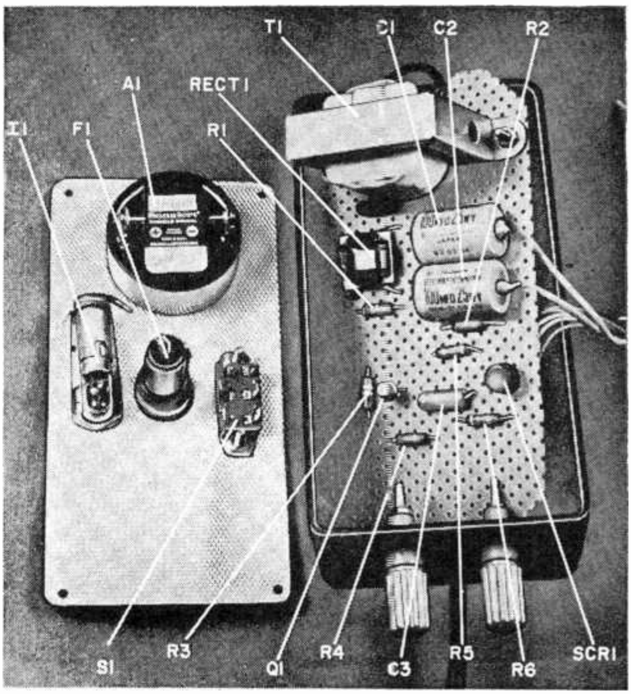


Fig. 2. The Prowler Howler is built in a 3" x 6" x 2" plastic case as shown here. If you elect to use battery only operation, the space now occupied by the a.c. power supply components can be used to mount a conventional 9-volt radio battery.

PARTS LIST

A1—Sonic alarm module (Mallory SC628 Sonalert, Minilert Sensilarm, or similar)
BP1, BP2—Five-way binding posts
C1, C2—100-μF, 25-volt electrolytic capacitor
C3—1-μF, 25-V electrolytic capacitor
D1—1N2071
F1—1-A fuse and holder
I1—#47 lamp and holder
Q1—Unijunction transistor (GE-X10 or similar)
R1, R5—470-ohm
R2—2200-ohm
R3—100,000-ohm
R4—100-ohm
R6—47-ohm
(all resistors ½-watt)
RECT1—Full-wave bridge rectifier (MDA920-1 or similar)
S1—D.p.s.t. switch
SCR1—2N1595 silicon controlled rectifier
T1—Filament transformer; secondary 6.3-V (Stancor P-6465 or similar)
Misc.—3" × 6" × 2" case with cover, perf board to fit case, spool of #38 wire, hookup wire, line cord, etc.

cessively, it stretches, lowering the wood block to break the sensing wire. Be sure that, when the block descends, it does break the wire and doesn't fall to one side. A more elaborate fire-sensing scheme can be built using commercially available bi-metallic sensors, but this makes the Prowler Howler more expensive.

Once various portions of the sensing loop have been installed, they are all connected together in series to the binding posts on the Prowler Howler.

For outdoor use, where commercial line power is not available, *S1* is put in the BATT position. Since quiescent current is about 1.5 mA, the drain on the battery is not high and batteries should last a long time. The current increases to about 5 mA when the alarm sounds.

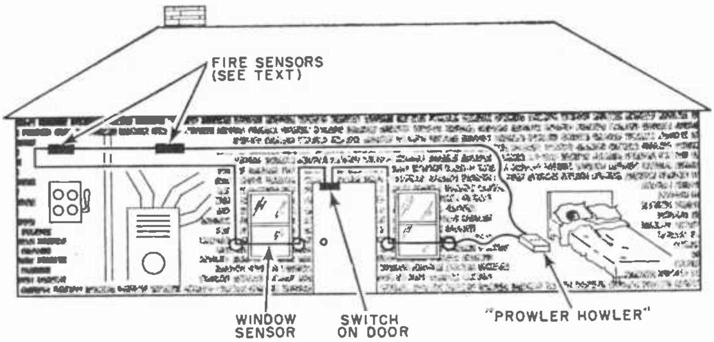


Fig. 3. Suggested layout for house intruder and fire protection. Almost any method of sensing will suffice as long as you remember that the system operates when any part of the closed loop is opened.

magnet keeps the reed switch closed; and when the door or window is opened, the reed switch is opened.

Fire or excessive-heat sensors can be built in accordance with Fig. 4. The thin sensing wire is stretched taut between two joists and secured with thumb tacks. A wood block is suspended by a rubber band a short distance above the sensing wire. When the rubber band is heated ex-

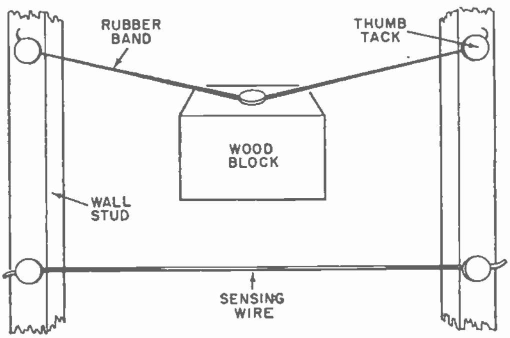


Fig. 4. Simple fire sensor. Make sure that when the wooden block comes down, it breaks the alarm wire.

When using the alarm outdoors, string the sensing wire in a loop between bushes and trees surrounding your campsite. The height of the wire above the ground depends on what type of animal you expect as an intruder. This alarm has been operated with six miles of wire surrounding the campsite. -30-

HOW IT WORKS

The circuit uses *SCR1* to apply power to the Sonalert module *A1*. The SCR does not conduct unless triggered by a signal from unijunction transistor *Q1*. The transistor circuit is actually an oscillator which does not oscillate as long as capacitor *C3* is shorted out by the sensing loop. When the loop is broken, *Q1* starts oscillating and a triggering signal is applied to *SCR1*.

The alarm module can be replaced with a 12-volt, low-current relay whose contacts are used to supply power to lights or other alarm devices. Diode *D1* is included to keep current consumption at a minimum when operating on battery power.

Four-Band SWL Antenna

RESONANT DIPOLES FOR 60-, 41-, 19-, AND 13-METER BANDS

BY THOMAS M. TURNER, K8VBL

IF YOU DO ANY SWL'ING, why make do with a 65-70' piece of wire hung between two trees? You can put the same area to better use with a low-cost dipole antenna that can be made to resonate on four of the more important international short-wave broadcasting bands.

Essentially, this antenna consists of two dipole sections, one about 65' long that resonates on 41 meters, and a second just under 100' that resonates on 60 meters. The ends of the longer dipole section droop so that it requires a cleared path of only about 70'. As a bonus, the 41-meter dipole is very efficient on its third harmonic and thus makes an excellent receiving antenna for the 13-meter international broadcasting band.

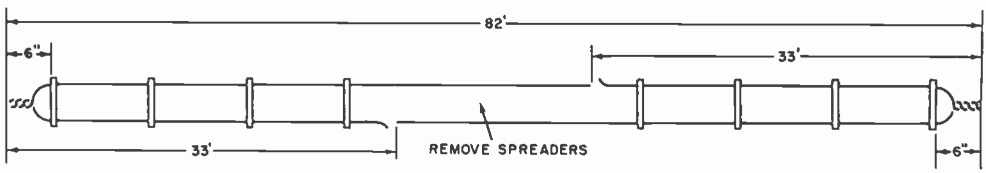
Even though the ends of the 60-meter dipole section droop, the third harmonic of this antenna occurs at 19 meters. Thus you have four efficient antennas for the price of two.

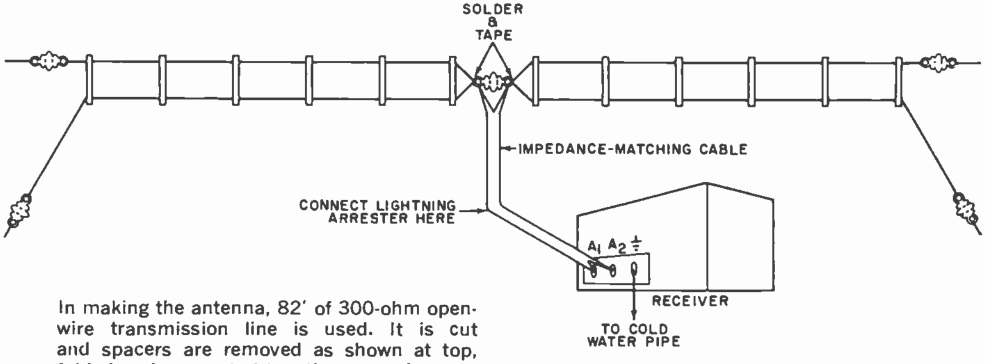
Construction. For ease in assembling and erecting your four-band SWL antenna, the two fundamental dipole sections are cut from 300-ohm open-wire transmission line. This is the sort of line commonly used for long runs to UHF-VHF TV antennas.

Measure off 82' of the 300-ohm transmission line. Measure in 33' from one end and snip one of the parallel wires. Do the same from the other end, but snip the wire on the other side of the transmission line. (See Fig. 1). Now remove all of the plastic spreader bars from the center section between the two cut wires.

Remove one plastic spreader bar from each end of the 82' section. If enameled, clean off the wires at these two ends and twist together to make a pig-tail lead. Bring the two ends of the 82' section around and loop them through the holes

(*Continued on page* 58)





In making the antenna, 82' of 300-ohm open-wire transmission line is used. It is cut and spacers are removed as shown at top, folded and connected together as at bottom.

Getting To Know The Zener Diode

Unique Component Disregards Ohm's Law

BY NORMAN CRAWFORD

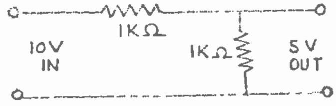
AMONG THE SCORES of semiconductor devices available to the modern electronics enthusiast, none seems to be more underestimated and misunderstood than the zener diode. Since the zener diode has the unique ability to regulate voltage within precise limits, regardless of changes in load impedance or supply voltage, this is indeed a strange situation.

The zener diode is not only unique among solid-state devices: it is also one of the most important in terms of circuit efficiency and safety. The experimenter or hobbyist who fails to take advantage of its properties works under a handicap. Even so, its relatively uncommon usage suggests that many experimenters do not fully understand how the zener diode works—or they dismiss it as being of dubious value.

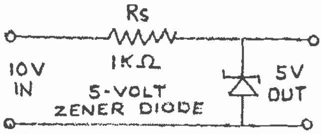
While there are several good books on the market dealing with zener diodes, most of them are written for engineering-level readers. The few books that are less technical rarely do more than inform the reader that such devices exist. This article bridges the gap between little or no useful information and information that is unnecessarily top-heavy with technical details.

Voltage-regulator circuits are most commonly employed in electronic power supplies, but they are applicable to any circuit in which a constant-level voltage is required. To understand why voltage regulation is so important, it is necessary to review the conditions that exist when there is no regulation.

Consider the output circuit of an unregulated electronic power supply. In its simplest schematic representation, the circuit consists of an input voltage, a supply resistance, and an output resistance. The input "sees" the two resistances as a voltage-divider network. If both resistances are of equal value—say, 1000 ohms—the output voltage is just half of the input. Therefore, with 10 volts input, the output is 5 volts; for 15 volts input, the output is 7.5 volts, and so on.



The important point to bear in mind here is that these output voltages are ideal; no load has been connected across the output. Now, replace the output resistor with a 5-volt zener diode, and apply 10 volts to the input.

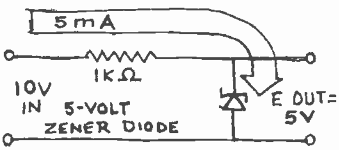


As before with the two 1000-ohm resistors in the circuit, the voltage divides exactly in half so that 5 volts appears at the output. What happens when the input potential is raised to 15 volts? Oddly enough, the output remains at 5 volts as a result of the regulatory ability of the zener diode.

In the voltage-divider circuit, according to Ohm's law ($I = E/R$), current flow through the circuit is 5 mA when the input is 10 volts. Therefore, the output potential must be $E_{out} = I \times R = 0.005 \times 1000 = 5$ volts.

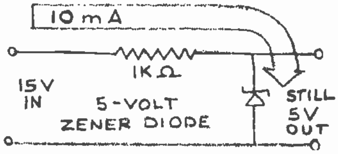
By applying Ohm's law for a 15-volt input, it can be determined that the current flow becomes 7.5 mA and output voltage jumps up to 7.5 volts.

When a 5-volt zener diode is substituted for the output resistor, however, a strange phenomenon takes place when the input voltage is increased. With a 10-volt input, 5 mA must circulate to produce a 5-volt output.



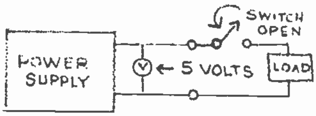
Thus, the same current-voltage relationship as in the voltage divider network exists when the zener diode is substituted and a 10-volt potential is applied to the input.

Raising the input to 15 volts causes the zener diode to conduct more current so that 10 mA must flow through it to maintain a 5-volt output.

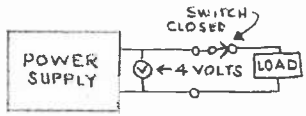


This shows that, while a resistor behaves according to Ohm's law, the zener diode disregards it, changing its effective resistance as needed to provide a constant output voltage.

To see how this unique ability of the zener diode can be put to good use, consider a hypothetical power supply whose 5-volt output (unloaded) is unregulated.

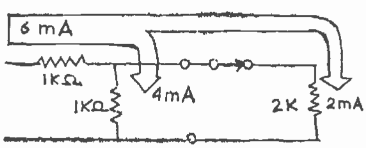


When the load is switched into the output circuit of the power supply, its output drops to 4 volts.



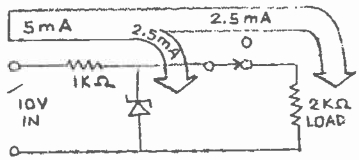
Now, give a few values to the hypothetical components inside the power supply: 1000 ohms each for the supply and output resistances, and 10 volts for the source. To keep the example simple, assume that the load is an ordinary 2000-ohm resistor.

With the switch open and the load disconnected, the output is 5 volts with 5 mA in the output resistor. Closing the switch puts the 2000-ohm load in parallel with the output resistor so that the 6 mA now drawn from the source divides: 4 mA through the output resistor and 2 mA through the load resistor.



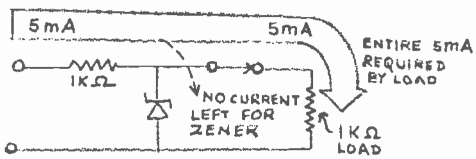
Using Ohm's law, $E_{out} = 2000 \times 0.0002 = 4$ volts. What happens is that the load resistance shunts the output resistance, decreasing the total resistance "seen" by the source and reducing the voltage drop across the load.

How can the zener diode help? Well, first, substitute a 5-volt zener diode for the output resistor. With the switch open, there is a 5-volt drop across the diode as in the example discussed earlier. The difference is that, when the switch is closed and the load is connected to the output of the power supply, the current still divides—2.5 mA going to the zener diode, and 2.5 mA going to the load.



The reduction in current through the zener diode has little or no effect on it (up to a certain point), and the diode maintains a constant 5-volt output. As a result, the 2000-ohm load has 5 volts across it. Because the load is a resistor (it can be any other type of load for that matter), it cannot ignore Ohm's law, so it draws current: $I_{load} = E/R = 5/2000 = 2.5$ mA.

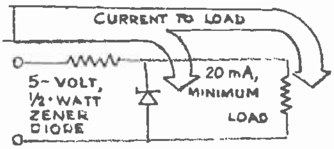
At this point, you might well ask what would happen if the load were to drop to 1000 ohms. To find out, simply apply the above formula again, substituting 1000 ohms for the 2000 ohms in the denominator. Thus, the current now required by the load is 5 mA; but with this new drain, the zener diode is completely deprived of current.



With no current available for the zener diode, it ceases to conduct, and the voltage across the load begins to decrease with further decreases in load resistance.

Even before complete current starvation, however, most zener diodes indicate their inability to maintain regulation by allowing the output voltage to sag.

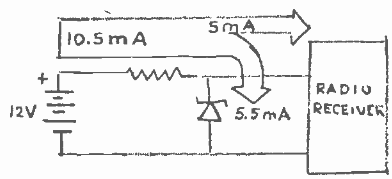
A good rule of thumb is to keep about 20% of the zener diode's maximum current flowing through it when the load is heavy. To determine maximum current handling ability, you need only apply the power formula: $P = IE$. Let us assume you have a 5-volt, ½-watt zener diode and you want to know its maximum current handling ability. Since $P = IE$, $I = P/E = 0.5/5 = 100$ mA. The current through the diode should not be allowed to fall below 20 mA.



All of the foregoing may be very interesting, but what practical applications are there for zener-diode regulation?

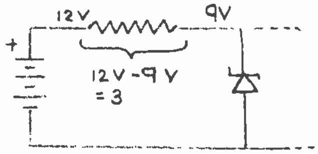
One of the more common uses for the zener diode is in reducing and maintaining voltages to and at a safe level. To demonstrate, let us say that you have a portable radio receiver that requires a 9-volt d.c. supply and you wish to operate it from the 12-volt cigarette lighter accessory in your car. Obviously, you need a 9-volt zener diode.

Designing the regulator circuit is relatively easy. If the radio receiver draws 5 mA of current, and the battery potential is 12 volts, you must first determine the maximum zener diode current allowable. Let's take a guess and start with a ¼-watt zener diode. Using the power formula, $I_{max} = P/E = 0.25/9 = 27.8$ mA. Twenty percent of 27.8 is 5.56 mA. Hence, 10.5 mA must be drawn from the voltage source—5 mA for the load, and 5.5 mA (minimum) for the diode.



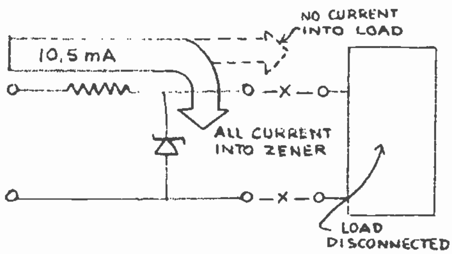
We know now that 10.5 mA must flow

through the resistor, that the battery is holding 12 volts on one side of the resistor, and that the drop across the diode is 9 volts.

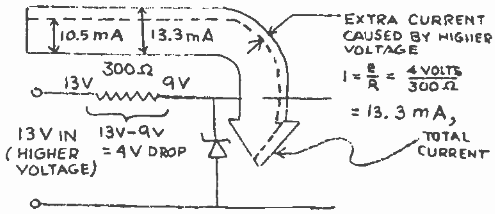


The result is that 3 volts is dropped across the resistor. Ohm's law now tells us the value of the resistor: R = E/I = voltage drop/current = 3/0.0105 = 286 ohms. Because 286 is not a standard ohmic value, we would use a 300-ohm resistor. Next, we use the power formula to determine the power rating required: P = 0.0105 × 3 = 31.5 mW. Almost any commercially-made 300-ohm resistor can be used; it just has to dissipate more than 31.5 mW.

While the circuit components thus selected will almost certainly work, let's find out how they will bear up under "worst-case" conditions. First, assume that power is suddenly disconnected from the receiver.



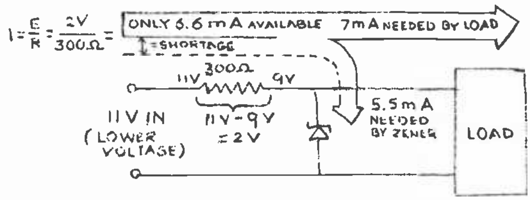
Just as suddenly, the entire 10.5 mA is now diverted to the zener diode—and while we're at it, let's assume that the input voltage chooses this instant to jump up to 13 volts.



As you can see, the current through the diode jumps to 13.3 mA. Back to the power formula: P = 0.0133 × 9 = 119.7 mW—still well below the ¼-watt (250 mW) maximum for the zener diode.

But we're not finished yet. We still have to check on what is happening to the resistor; P = 0.0133 × 4 = 53.2 mW—again well within the maximum ¼-watt rating. Everything checks out.

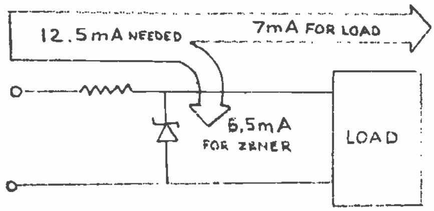
Now, assume that 1 or 2 mA more current is drawn (as a receiver with a class-B output circuit is likely to do on high-volume settings) and that the source suddenly decides to drop to 11 volts.



This leaves only 2 volts, dropped across the source resistor, to drive the current through the resistor. As a result, current drops to about 6.67 mA.

Unfortunately, the receiver requires 7 mA to operate properly. Deprived of current, the zener diode stops regulating, and the output voltage drops until there is enough of a drop across the resistor to supply the receiver's needs. As the supply voltage drops, the receiver will probably operate less than satisfactorily. The regulator circuit is a failure, and something has to be done to rectify the problem.

All is not lost, and because of the simplicity of the circuit, the solution is also simple. Something must obviously be done about the resistor. Since we know that the zener diode requires 5.5 mA of current to operate and the receiver requires an additional 7 mA, 12.5 mA must come through the resistor.



(*Continued on page* 117)

PART 2

The Ubiquitous NEON LAMP

BY JIM KYLE

Voltage Regulation. The maintaining voltage of a neon diode is almost constant over the full operating range of current. With proper design, the voltage can be held to within 0.5 volt—and even an indicator neon will hold voltage constant within 5 volts under most circumstances.

This fact makes the neon lamp an excellent source of reference voltage for any type of voltage-regulator circuit. For low-current operation, the lamp can be used in the same manner as a VR tube. Such an application is shown in Fig. 12. Here, a neon lamp regulates the screen voltage for a crystal oscillator to provide improved frequency stability.

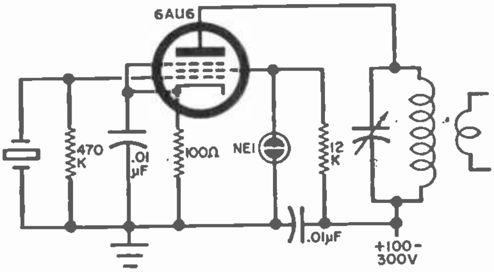


Fig. 12. In a crystal oscillator circuit such as this, the constant maintaining voltage of the neon lamp is used to regulate the screen voltage on the 6AU6, thus providing improved frequency stability.

For moderate-current applications, the circuit of Fig. 13 can be used. The 6U8A tube specified is capable of providing up to 20 mA to a load, and output voltage may be set to any value between 75 and 150 volts. Regulation is to within 1.5 volts under worst conditions; when output voltage is set to 75 (best case), voltage drops by only 0.5 volt at maximum load. For slightly more current, a 6JT8 may be substituted with modification of the pin connections, or separate 6AU6 and 6AQ5 tubes may be employed.

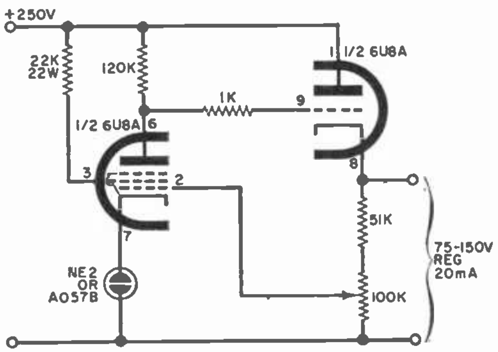


Fig. 13. Here the neon lamp holds a constant voltage on the anode of the first stage of a 20-mA regulated supply. The output is adjustable from 75 to 150 volts due to the feedback to the screen grid. Regulation 0.5 volt for the 75-volt output.

An unusual precision voltmeter which makes use of a neon lamp as its voltage reference is diagrammed in Fig. 14. This circuit's requirements are critical when it comes to the neon; the Z82R10 Signalite unit specified provides a reference voltage across *R2* of 1 ±0.012 volt. Resistor *R1* must be initially adjusted to provide calibration, but the circuit then maintains its accuracy indefinitely. The unknown input is applied to voltage di-

Editor's Note. Part I of this article appeared in our September issue. In it, the author discussed the theory of operation and characteristics of neon lamps with applications in oscillator circuits, frequency dividers, timers, and digital devices. The story continues here with other applications.

vider *R3* and compared to the accurate reference. When the null indicator (an inexpensive 50-0-50 μA FM tuning indicator, zero-center) indicates zero, the input voltage is equal to the ratio of the total resistance of *R3* to the resistance between its rotor and ground. If a 10-

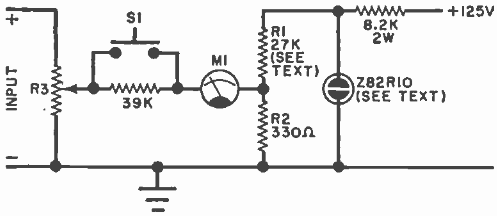


Fig. 14. The neon lamp specified here provides a reference voltage across R2 of 1 ± 0.012 volt. This is compared to the input in the null-indicating meter, making a highly accurate precision voltmeter.

turn indicator and an accurate 10-turn potentiometer are used, voltage can be read directly. The 39,000-ohm resistor avoids damage to the null indicator in initial stages; when the null is approached, *S1* shorts out this resistor to provide maximum sensitivity.

Miscellaneous Applications. The list of ways in which neon lamps can be used (in addition to the general circuit applications already discussed) is virtually endless. Some specific circuits designed for various purposes are described here.

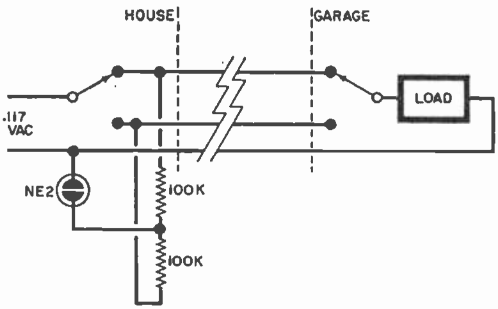


Fig. 15. In a circuit designed to indicate when a remote load is energized, the neon lamp is lit only when switches at both ends are connected to the same side of the power line. The neon indicating circuit can be repeated at load end of the line.

If you have three-way switches in your home or business, you may frequently have wondered whether the circuit they control is *off* or *on*. Since the *off* position is determined entirely by the position of the remote second switch, there's no direct way of determining the position of this switch. But one neon, used as an indicator, together with two resistors, provides a pilot light which may be installed at either end of the circuit. A bonus is the fact that the condition of the bulb or device operated by the switches is also indicated.

The circuit is shown in Fig. 15. It may be duplicated at both switches if desired although the illustration shows only one. Operation depends on the neon's requirement for breakdown voltage before firing. When both switches connect to the same line, both the load and the neon are across the 117-volt circuit and both are on. One of the resistors limits neon-lamp current while the other is disconnected. When the switches are on opposing lines, the load is *off*. Should the load circuit form a voltage divider which permits only half the line voltage to be applied to the lamp; this is insufficient to fire it and it remains dark indicating that the load is *off*. Should the load circuit open, as in the case of a burned-out light bulb, one of the two resistors is disconnected and the neon lamp lights.

Thus, if the neon is *on* and stays *on* when the switch is operated, the load circuit is open. If the neon is *on* but goes off when the switch is operated, the circuit is complete but *on*. If the neon is *off*, the circuit is complete and the load is *off*.

Another neon-indicator circuit provides indication of the sequence in which four s.p.s.t. switches are operated. This circuit, shown in Fig. 16 and requiring a dozen neon lamps, can become the basis of a game to test individual reaction time or can also be applied to more serious problems.

All switches are single-pole single-throw with locking action. The first switch to close causes all three lamps connected to it to light. Each of these three is in parallel with one lamp of another switch, and the supply voltages for these other lamps are reduced to below the breakdown point. Thus, the second switch permits only two lamps to light. This reduces voltage for a second lamp associated with each of the remaining switches, so that the third switch lights only one lamp. Similarly, the final switch cannot light any indicators.

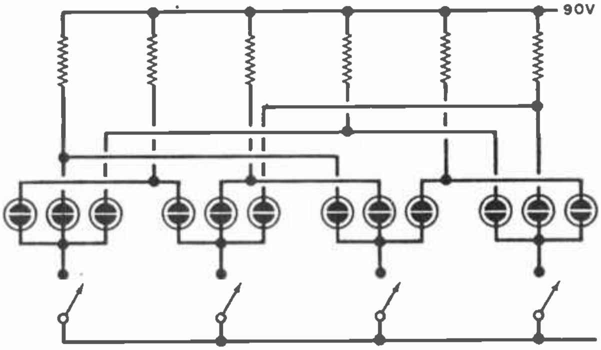


Fig. 16. In this sequencing circuit, when only one switch is closed, three lamps associated with it are lit. Subsequent closing of another switch lights only two of its lamps due to lowered voltage drop across one resistor. Last switch lights no lamps.

Resistor values are not critical—anywhere from 10,000 ohms to 1 megohm should suffice—and neon lamps need be matched only to the extent necessary to assure that none of them breaks down at a level less than the maintaining voltage of any of the others.

An inexpensive VTVM capable of indicating either 9 or 12 volts with an accuracy of 0.2 volt, yet having no moving parts is shown in Fig. 17. While a zener diode is shown for voltage reference, it could be replaced by a third neon lamp and voltage divider if desired. In operation, both plate-circuit lamps glow; and, if the input voltage is correct, both glow with equal brightness. If the input voltage is higher than desired, the HI lamp glows brighter; and vice versa.

The final circuit is a safety tester to check leakage current of a.c.-operated devices. According to Consumers' Union, a leakage current of 100 μA r.m.s. is acceptable, 100 μA to 1 mA is dangerous, 1 to 5 mA shows that repair is needed, and greater than 5 mA is unacceptable. The circuit, shown in Fig. 18 tests for 200 μA, 1 mA, and 5 mA with three different probes. The battery and voltage divider maintain voltage across the neon just below the breakdown level. The ground (GND) lead is fastened to the ground point against which leakage is to be checked, power is applied to the device to be tested, and the probes are touched to the device case one at a time, starting with the 5-mA probe.

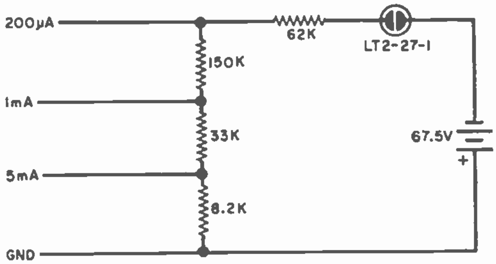


Fig. 18. To check a.c.-operated devices for safety where leakage currents are concerned, this simple circuit uses one neon lamp in series with a 67.5-volt battery. Three separate probes are used. If lamp lights when the 5-mA probe is used, leakage is too high and device is considered unacceptable.

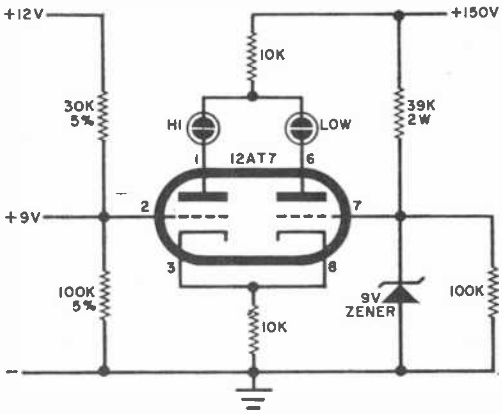


Fig. 17. Inexpensive VTVM has two lamps that glow with equal brightness if the 9- or 12-volt input is correct. If input is high, HI lamp glows brighter, and vice versa. Third neon could be used to replace zener diode as voltage reference if desired.

If leakage current exceeds the probe rating, the voltage developed across that part of the voltage divider by the leakage current brings the neon-lamp voltage above breakdown and it fires; otherwise it remains dark and the next more sensitive probe can be tried. If the lamp remains dark for all three probes, leakage current is well within bounds.

Summing Up. Neon lamps have far more uses than most of us suspect. Those given here, although extensive, are only a small sampling chosen to illustrate the variety of possible applications. -30-

SWL ANTENNA

(*Continued from page* 50)

of a porcelain- or glass-center dipole antenna insulator. Clip the remaining two leads near the drooping extensions (see Fig. 2) and twist them around an appropriate insulator. Put an insulator at the end of each drooping antenna section. To feed this antenna, use a 72-ohm transmission line (such as Belden #822). This line should be split for about 6″, the ends stripped for about 2″ and then twisted and soldered securely to the wires at the dipole center insulator. The "down" part of the lead-in should run at right angles to the dipole for at least 30-40′. From that point it may be attached to a house wall by TV-type standoff insulators. A TV-type lightning arrestor should be connected to the lead-in and grounded outside of the house with #8 aluminum wire. -30-

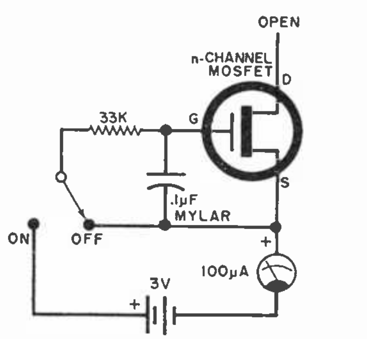
Checking the MOSFET Barrier

BY FRANK H. TOOKER

THE PRINCIPAL DIFFERENCE between a JFET (junction field-effect transistor) and a MOSFET (metal-oxide-semiconductor field-effect transistor) is that the former employs a reverse-biased junction (gate to source and drain) to obtain its high input resistance, while the gate of a MOSFET is electrically insulated from the rest of the device by a thin oxide film. The barrier caused by this film gives the MOSFET an input resistance many times greater than that of the JFET.

Since it takes very little electrical power to puncture the oxide film in a MOSFET—even common electrostatic potentials will do it—great care must be taken in the use of these transistors. A very small puncture in the film may not affect a MOSFET's performance significantly but a larger hole can reduce the input impedance to that of a JFET biased normally in the reverse direction. A MOSFET in this condition can still be used in a number of applications.

A serious rupture in a MOSFET's gate insulation can reduce its input resistance to a value similar to that of a JFET biased in the *forward* direction. A transistor in this condition cannot be used as a JFET, however, and is fit only for the trash can!



If there is a sustained deflection of the meter needle, the MOSFET barrier is damaged.

Testing for Damage. The circuit shown here can be used to check the condition of a MOSFET's gate insulation. If the transistor is usable, there will be no deflection of the meter needle (other than that occasioned by initial charging of the capacitor) regardless of the polarity of the potential applied to the gate. A *sustained* deflection of the meter needle, even though small, indicates a serious rupture of the barrier.

It is best to check an *n*-channel MOSFET with the gate positive and a *p*-channel MOSFET with the gate negative, although a seriously damaged transistor of either type will usually show a needle deflection regardless of the polarity. If the MOSFET has a lead brought out from its substrate, connect it to the source lead during the test.

The capacitor between the gate and the source in the schematic protects the MOSFET from damage due to transients during testing. Note that no connection is made to the drain of the transistor. -30-

BUILD

Electronic Metronome

WITH ACCENTED BEAT

Solid-state portability in a convenient package

WHETHER YOU ARE musically inclined or not, you have probably heard or seen a conventional mechanical metronome. Traditionally, the metronome involves a pyramid-shaped case, containing a clockwork mechanism. A spindle emerging from the base of the metronome supports an upright steel pendulum that carries a weight which can be locked in any desired position.

When set in motion, the pendulum oscillates from side to side at a rate governed, externally at least, by the position of the weight. In so doing, it produces an audible click which can serve as a guide to musical tempo or beat.

In this electronic age, many people who might not otherwise buy or build a metronome are attracted by the idea of building an electronic equivalent. Transistors lend themselves particularly well to producing a compact, portable, line-independent electronic metronome. The "Electronic Metronome With Accented Beat" described in the following pages not only provides an average of between 50 and 160 clicks/min, it also accents certain clicks in a sequence that simulates the down-beat at the beginning of each musical bar. A simple adjustment lets you accent every beat, one beat in two, and so on up to one beat in ten, as desired.

This accented-beat feature will be appreciated by photographers as well as musicians. Preset for a specific accented beat sequence, the metronome can "tell" the photographer when to move on to the next step in his darkroom while the darkroom is in total darkness.

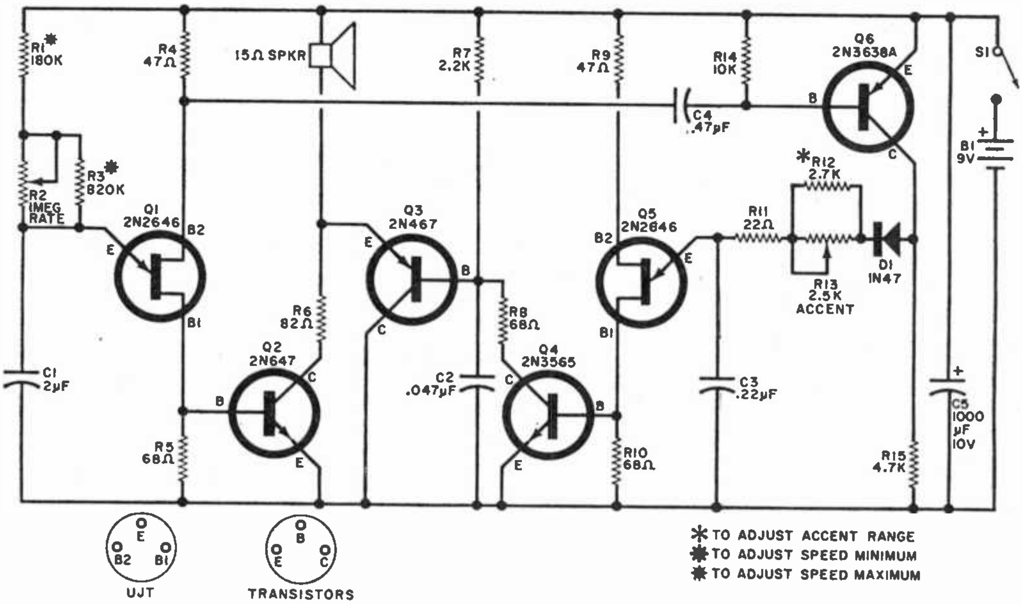


Fig. 1. Beat rate is established by relaxation oscillator Q1, amplified by Q2. The beat is accentuated by circuit Q3 to Q6.

PARTS LIST

B1—9-volt battery
C1—2-µF, 10-volt plastic capacitor
C2—0.047-µF ceramic capacitor
C3—0.22-µF ceramic capacitor
C4—0.47-µF ceramic capacitor
C5—1000-µF, 10-volt electrolytic capacitor
D1—1N47 silicon diode (30 mA, 150 PIV)
Q1, Q5—2N2646 unijunction transistor
Q2—2N647 transistor
Q3—2N467 transistor
Q4—2N3565 transistor
Q6—2N3638A transistor
R1—180,000-ohm, ½-watt, 5% resistor
R2—1,000,000-ohm, linear-taper potentiometer
R13—2500-ohm, linear-taper potentiometer
R3—820,000 ohms
R4, R9—47 ohms
R5, R8, R10—68 ohms
R6—82 ohms
R7—2200 ohms
R11—22 ohms
R12—2700 ohms
R14—10,000 ohms
R15—4700 ohms
(R3 through R15 above: *All ½-watt 5% resistors*)
S1—S.p.s.t. switch
SPKR—3"-diameter, 15-ohm speaker
1—6½" × 4½" × 2" metal chassis
1—20-pair (min.) tag strip or terminal board
Misc.—Control knobs (2); extruded-aluminum grill for speaker; brass or copper strap for battery and tag-board brackets; hookup wire; solder; hardware; etc.

About the Circuit. The basic beat output of the metronome is produced by relaxation oscillator *Q1* and power switching transistor *Q2*. The characteristics of unijunction transistor (UJT) *Q1* are such that virtually zero emitter current flows until *Q1* is triggered into conduction (see Fig. 1).

When *S1* is closed, *C1* begins to charge at a rate determined by the combined resistance of *R1, R2* and *R3* in series with it and the battery. Charging action continues until the potential across *C1* is great enough to cause *Q1* to conduct. When *Q1* does conduct, *C1* immediately discharges through the low resistance presented by the UJT's emitter-to-base-one junction, supplying a current pulse to the base of *Q2*. As a result, *Q2* switches into full conduction, producing an audible click at the speaker.

The charge-and-discharge cycle continues indefinitely as long as *S1* is closed and power is applied to the circuit. The rate of charge—and thus the operating frequency of the relaxation oscillator—can be varied over the metronome's entire beat range by changing the setting of RATE control *R2*. (The limits on the basic beat rate could be expanded to cover a wider range, but limiting it provides the advantage of less critical adjustments of *R2* and consequently greater accuracy.)

Accentuation of selected beats is produced by the circuitry beyond *Q2*. When *Q1* conducts, its B1-B2 current momentarily increases. A series of negative-going pulses (in step with the selected beat rate) is then available at the B2 electrode. These pulses, coupled through *C4*, drive *Q6* into full conduction and deliver a +9-volt pulse (for each pulse received) to *R15*.

Unijunction transistor *Q5* is in a circuit similar to that of *Q1* except that *Q5* has *C3* in its base circuit. In addition, the charging path is through *D1* instead of directly from *B1*. Thus, *C3* charges only in short "staircase" pulses resulting from the on-off action of *Q6*.

The extent to which *C3* charges during each pulse is controlled by the total resistance of *R11, R12* and *R13*. The charge rate can be varied by adjusting the setting of the ACCENT control, *R13*, which in effect varies the height of the steps (amplitude of pulses).

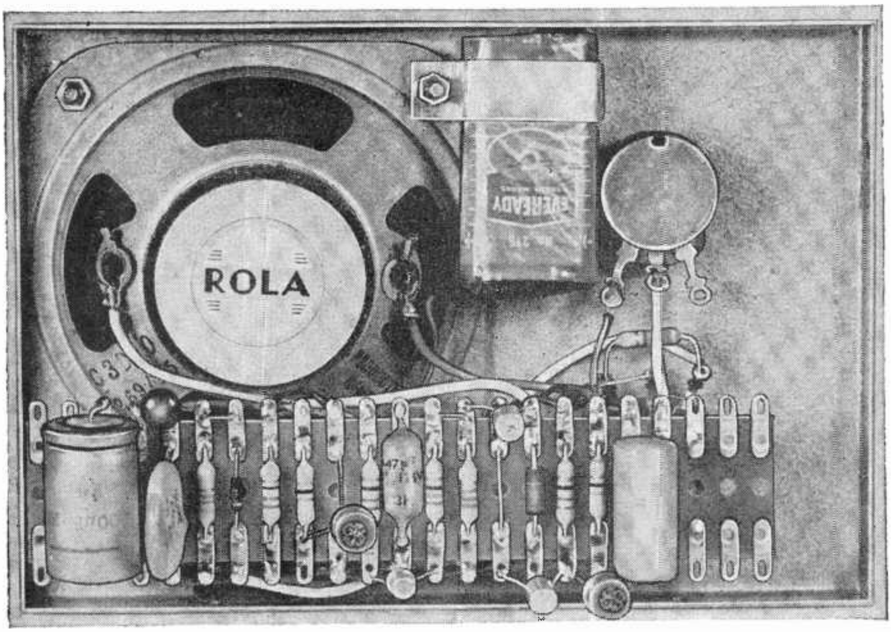
Between pulses, the charge on *C3* remains fairly constant and is prevented from leaking off by the blocking action of *D1* and the emitter-to-base-one resistance of *Q5*, which is very high when the UJT is cut off.

When the potential across *C3* reaches some critical amplitude, *Q5* conducts, allowing *C3* to discharge. After that, the action of the *Q4*-*Q5* circuit combination is identical to that of *Q1*-*Q2*. In *Q3*, the output pulses of *Q4* are "stretched" so that they produce an output click that has significantly higher energy than those coming from *Q2*. Proper adjustment of *R13* allows the stretched pulses to be superimposed upon and thus accentuate the selected pulses of the basic beat.

Construction. The relatively small size of the cabinet specified in the Parts List accounts for the portability of the metronome. Construction is reasonably simple, with all components and subassemblies being fixed to the front panel as shown in Fig. 2. The speaker, power switch, and RATE and ACCENT controls are mounted directly on the front panel. (A piece of extruded aluminum grill of a suitable size should be sandwiched between the speaker and the panel to protect the speaker cone.)

With the exception of *R12* which is

Fig. 2. Except for controls on the front panel, battery, speaker, and one resistor, all circuit components are mounted on a terminal board tag strip (seen at the very bottom of this photo).



"CIE training helped pay for my new house," says Eugene Frost of Columbus, Ohio

Gene Frost was "stuck" in low-pay TV repair work. Then two co-workers suggested he take a CIE home study course in electronics. Today he's living in a new house, owns two cars and a color TV set, and holds an important technical job at North American Aviation. If you'd like to get ahead the way he did, read his inspiring story here.

If you like electronics—and are trapped in a dull, low-paying job—the story of Eugene Frost's success can open your eyes to a good way to get ahead.

Back in 1957, Gene Frost was stalled in a low-pay TV repair job. Before that, he'd driven a cab, repaired washers, rebuilt electric motors, and been a furnace salesman. He'd turned to TV service work in hopes of a better future—but soon found he was stymied there too.

"I'd had lots of TV training," Frost recalls today, "including numerous factory schools and a semester of advanced TV at a college in Dayton. But even so, I was stuck at $1.50 an hour."

Gene Frost's wife recalls those days all too well. "We were living in a rented double," she says, "at $25 a month. And there were no modern conveniences."

"We were driving a six-year-old car," adds Mr. Frost, "but we had no choice. No matter what I did, there seemed to be no way to get ahead."

Learns of CIE

Then one day at the shop, Frost got to talking with two fellow workers who were taking CIE courses . . . preparing for better jobs by studying electronics at home in their spare time. "They were so well satisfied," Mr. Frost relates, "that I decided to try the course myself."

He was not disappointed. "The lessons," he declares, "were wonderful—well presented and easy to understand. And I liked the relationship with my instructor. He made notes on the work I sent in, giving me a clear explanation of the areas where I had problems. It was even better than taking a course in person because I had plenty of time to read over his comments."

Studies at Night

"While taking the course from CIE," Mr. Frost continues, "I kept right on with my regular job and studied at night. After graduating, I went on with my TV repair work while looking for an opening where I could put my new training to use."

His opportunity wasn't long in coming. With his CIE training, he qualified for his 2nd Class FCC License, and soon afterward passed the entrance examination at North American Aviation. "You can imagine how I felt," says Mr. Frost. "My new job paid $228 a month more!"

Currently, Mr. Frost reports, he's an inspector of major electronic systems, checking the work of as many as 18 men. "I don't lift anything heavier than a pencil," he says. "It's pleasant work and work that I feel is important."

Changes Standard of Living

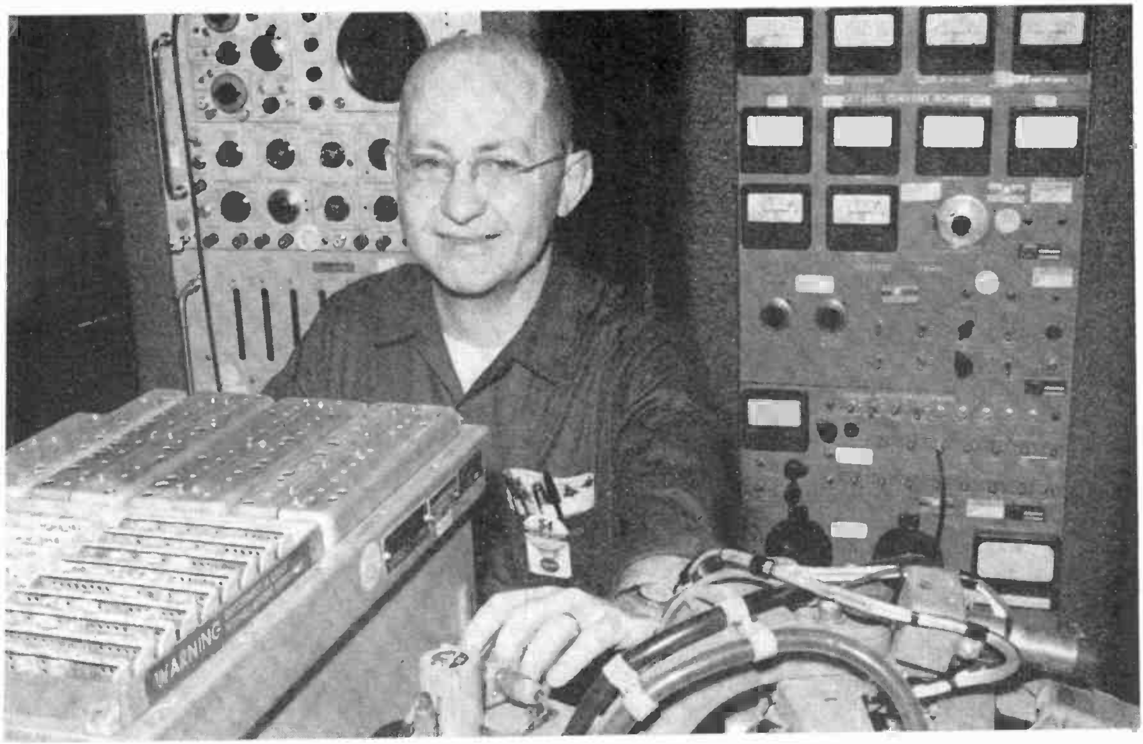
Gene Frost's wife shares his enthusiasm. "CIE training has changed our standard of living completely," she says.

"Our new house is just one example," chimes in Mr. Frost. "We also have a color TV and two good cars instead of one old one. Now we can get out and enjoy life. Last summer we took a 5,000 mile trip through the West in our new air-conditioned Pontiac."

"No doubt about it," Gene Frost concludes. "My CIE electronics course has really paid off. Every minute and every dollar I spent on it was worth it."

Why Training is Important

Gene Frost has discovered what many others never learn until it is too late: that to get ahead in electronics today, you need to know more than soldering connections, testing circuits, and



replacing components. You need to really know the fundamentals.

Without such knowledge, you're limited to "thinking with your hands" ...learning by taking things apart and putting them back together. You can never hope to be anything more than a serviceman. And in this kind of work, your pay will stay low because you're competing with every home handyman and part-time basement tinkerer.

But for men with training in the fundamentals of electronics, there are no such limitations. They think with their heads, not their hands. They're qualified for assignments that are far beyond the capacity of the "screw-driver and pliers" repairman.

The future for trained technicians is bright indeed. Thousands of men are desperately needed in virtually every field of electronics, from 2-way mobile radio to computer testing and troubleshooting. And with demands like this, salaries have skyrocketed. Many technicians earn $8,000, $10,000, $12,000 or more a year.

How can you get the training you need to cash in on this booming demand? Gene Frost found the answer in CIE. And so can you.

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Thousands who are advancing their electronics careers started by reading our famous book, "How To Succeed In Electronics." It tells of the many electronics careers open to men with the proper training. And it tells which courses of study best prepare you for the work you want.

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CIRCLE NO. 10 ON READER SERVICE PAGE

wired directly across the ACCENT control, all small components are wired to a tag strip or terminal board as shown in Fig. 3. The job will be easier if you wire the resistors in place first, then the diode, capacitors, and transistors, in that order. Be sure to mount *C3* on the underside of the tag strip and route under the strip the wiring shown by the dashed lines.

The components should be kept as close as possible to the tag strip, and transistor leads should be shortened so that the tops of the transistors are no more than an inch from the strip.

Now, remove the machine nuts from the upper-right and lower-left speaker mounting screws (viewed from rear). Bend a fairly heavy-gauge, ½″-wide copper, brass or aluminum strap around the battery, forming two ½″-wide tabs at the ends. Drill a hole through both tabs, and mount the battery in place over the upper-right speaker mounting screw. Solder the positive lead from the battery to one side and a 3″-long piece of hookup wire to the other side of the power switch.

Form two U brackets from the same material used for the battery clamp. The crown of the bracket should be about ½″ across, the legs 1″ long, and the tabs ½″ wide. Drill a hole through the crown of each bracket, and bolt the brackets at opposite ends of the tag strip. Solder or bolt the tabs to the front panel.

Finally, complete the wiring of the metronome, using Figs. 1 and 3 as guides. Assemble the cabinet, rotate the RATE control fully clockwise, and set the power switch to ON. Time the number of clicks/min produced by the metronome—there should be 150-160 of them. Set the control to its maximum counterclockwise position and again count the number of clicks/min—there should be 46-50.

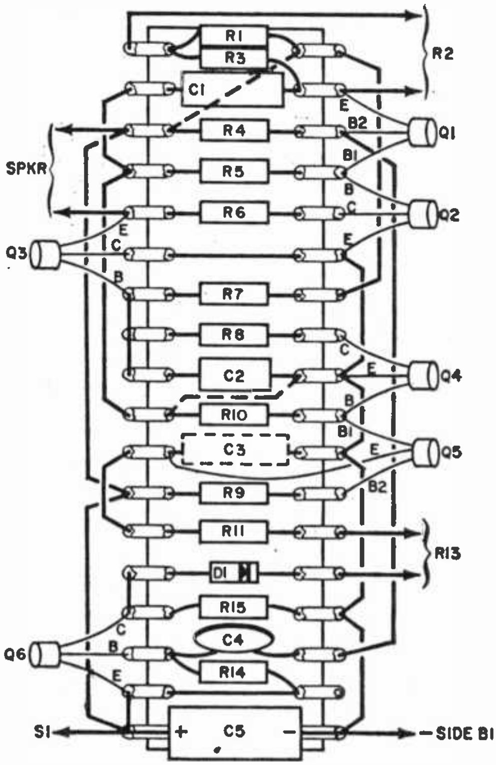

Fig. 3. Route capaciter C3 and wiring indicated by dashed lines along the underside of the tag strip.

Calibrate the ACCENT control as follows: Starting with the control set fully clockwise, adjust the setting for an accent every beat, and mark this position. Then locate and mark the position of the control that produces accentuation every second beat, and so on up to every tenth beat. The Electronic Metronome With Accented Beat is now ready for use.

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SEMICONDUCTOR CROSS-REFERENCE GUIDE

Almost 18,000 semiconductor device numbers with their equivalents from Motorola Semiconductor Products' HEP line are listed in the Semiconductor Cross-Reference Guide. This new 64-page guide lists 1N and 2N, foreign, and many "equal-or-better" house number replacements. Copies of the Semiconductor Cross-Reference Guide, No. HMA07-4, are available for 25¢ from Motorola distributors, or by writing to Motorola Semiconductor Products Inc., Technical Information Center, P.O. Box 2094, Phoenix, Ariz. 85036.

ALL-PURPOSE

NIXIE® READOUT

Minimum-component decimal counting unit uses high-visibility glow-discharge tube

By LESLIE SOLOMON
Technical Editor

and ALEXANDER W. BURAWA
Associate Editor

THE APPEARANCE of the decimal-counting unit article by Don Lancaster ("Build a Low Cost Counting Unit," February, 1968) intrigued thousands of hobbyists, experimenters, and engineers. We at POPULAR ELECTRONICS have since been deluged with mail telling us of literally hundreds of unusual circuit applications in which readers have used the DCU. And many requests have been coming in asking us for instructions for converting the original DCU from readouts using incandescent lamps to glow-discharge (Nixie® tube) readout.

The major objection to converting the original DCU to Nixie tubes is cost—it would have been almost twice the original kit price. Add to this the facts that the circuit would be overly complex and the circuit-board size would be increased. Hence, a totally new DCU had to be developed. The "Professional DCU" described here is the result of the new design.

Nixie-tube readout is a distinct improvement over the incandescent readout. The circuit-board dimensions are smaller, and whereas the original DCU required four IC's, seven transistors, six resistors, and ten incandescent lamps, the new unit uses only two IC's, one resistor, and a Nixie tube. Although fewer parts are required, the new DCU is somewhat more expensive than the original circuit. However, for $30, you can construct a professional DCU that has all of the advantages of many commercial units costing two or three times as much.

The DCU described here has other advantages: Transistor-transistor logic

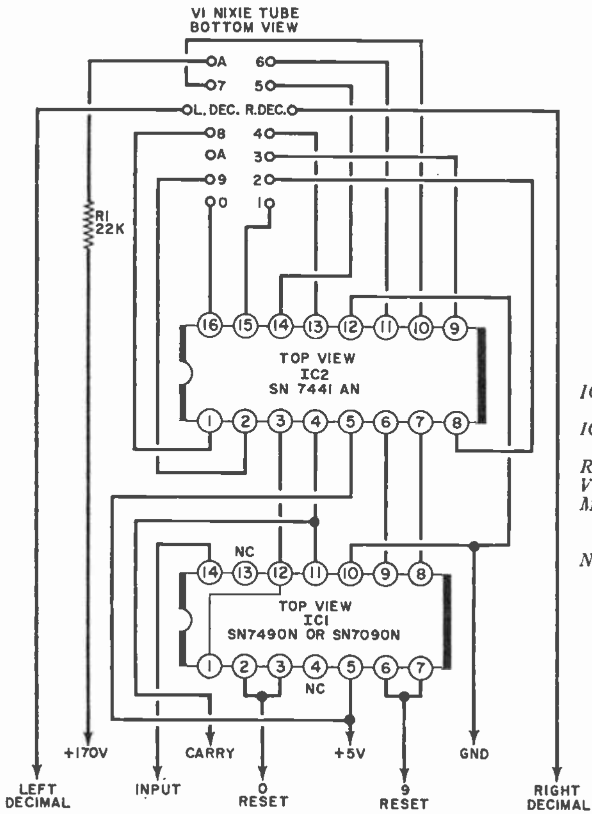


Fig. 1. Entire counting circuit is made up of four components—demodulator IC1, driver IC2, glow-discharge tube V1, and current-limiting resistor R1. Value used for R1 is determined by number of counting units operated from a given power supply, as described in text.

PARTS LIST

IC1—Integrated-circuit decade counter, (Texas Instruments SN7490N or SN7090N)
IC2—Integrated-circuit decoder driver, (Texas Instruments SN7441AN)
R1—22,000-ohm, ½-watt resistor (see text)
V1—Nixie indicator tube, (Burroughs B-5750)
Misc.—Printed-circuit board, wire for jumpers, PC-board edge connector (Amphenol 142-010-01 or similar)
Note: A complete kit of DCU components, including PC board, is available from Southwest Technical Products Corp., 219 W. Rhapsody, San Antonio, Texas 78216, for $30. The PC board alone is available for $2.25. A cabinet for mounting six DCU's with power supply components capable of driving six DCU's is available for $12. A special Polaroid window is also supplied with the cabinet kit.

(TTL) is used; this gives the unit an operational speed of 18 MHz, twice that of the older circuit, which uses resistor-transistor logic (RTL). Also, because TTL requires a much larger input trigger level, erratic indications due to line transients or other electrical noise have been almost eliminated.

Construction. The DCU, whose schematic is shown in Fig. 1, is best assembled on a printed-circuit board similar to that shown actual size in Fig. 2. Once the board has been made or purchased (see Parts List), the two IC's, one resistor, one jumper, and the Nixie readout are mounted on the board as shown in Fig. 3. Note that the terminals on the board for the Nixie tube are not arranged in the same pattern that they are on the tube itself. (The actual Nixie-tube terminal arrangement is shown in Fig. 1.) Also, the PC board has been arranged so that it can be connected either directly into a circuit (via soldered connections)

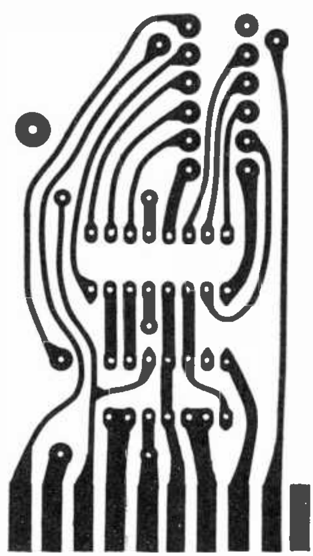


Fig. 2. This actual-size etching guide is used for circuit board employing edge connector (heavy mark at lower right serves as connector key), or for circuit board to be soldered into circuit.

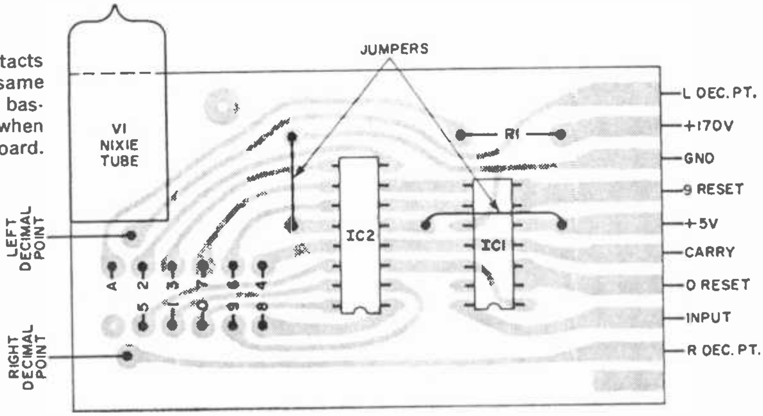


Fig. 3. Circuit board contacts for Nixie tube are not in same arrangment as actual tube basing. Keep this in mind when soldering V1's leads to board.

or used with a PC-board edge connector. After mounting and soldering *IC1* in place, install the second jumper.

A 22,000-ohm resistor is specified for *R1* in Fig. 1. This resistance is used when three or less DCU's are operated from the suggested power supply and it keeps the Nixie from being too bright. If four or more DCU's are driven from the same power supply, reduce the value of *R1* to 10,000 ohms.

The Nixie tube is mounted on its side as shown in the photos. Be sure that the viewing side is placed as shown. The plastic pin guide that comes with the Nixie tube can be secured to the PC board with a bead of cement; do not cement the glass to the board. Install the Nixie tube by first bending the "left decimal" lead directly at the pin guide and feeding it into its hole on the board. Put the leads of the first row into the appropriate holes, using insulating tubing over each lead. Finish with the upper row of leads and the "right decimal" lead. Note that there are two anode leads on the tube. The anode connected to pin 10 is not used and can be cut off at the base. The short leads will be sufficient to support the tube.

Power Supply. Each counter requires

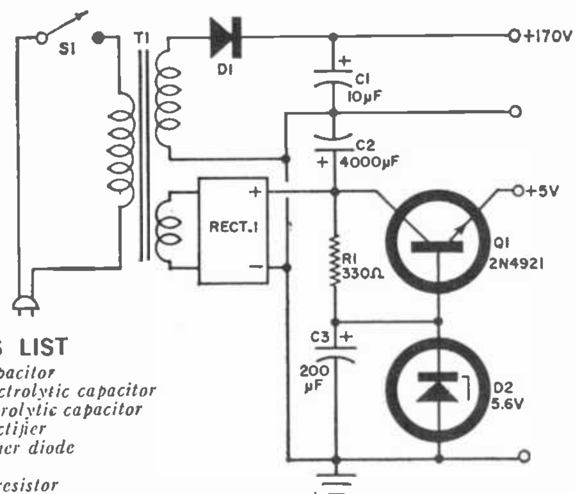


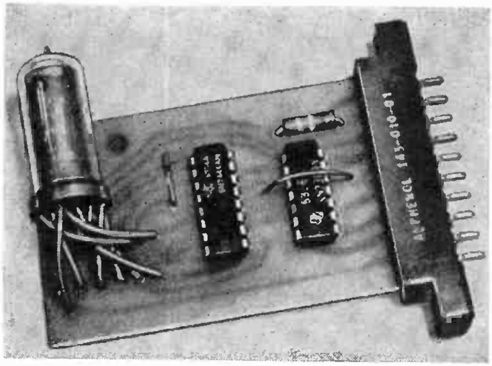
Fig. 4. Up to six DCU's can be efficiently driven with power supply shown here. Don't skimp on component quality in +5-volt circuit, or DCU's will operate erratically.

PARTS LIST

C1—10-µF, 250-volt capacitor
C2—4000-µF, 6-volt electrolytic capacitor
C3—200-µF, 6-volt electrolytic capacitor
D1—1-ampere silicon rectifier
D2—5.6-volt, 1-watt zener diode
Q1—2N4921 transistor
R1—330-ohm, ½-watt resistor
RECT1—2-ampere silicon rectifier bridge
T1—Power transformer. Secondary: 125 and 6.3 volts.
Note: A complete power-supply kit with chassis is available. See Parts List for Fig. 1.

170 volts d.c. to drive the Nixie readout, and 5 volts d.c. for the IC's. The schematic of a power supply sufficient for six DCU's is shown in Fig. 4. If any other power supply is used, be sure that its outputs do not exceed 170 and 5 volts, since the Nixie tube and the IC's can be irreparably damaged by voltages that are too high.

The power supply is assembled in the case as shown in Fig. 5. The various components are mounted on terminal strips and point-to-point wiring is used. Use an insulated mica washer and silicone grease when mounting transistor *Q1*.



The jumper wire shown at center of photo should not be allowed to touch case or leads of decoder.

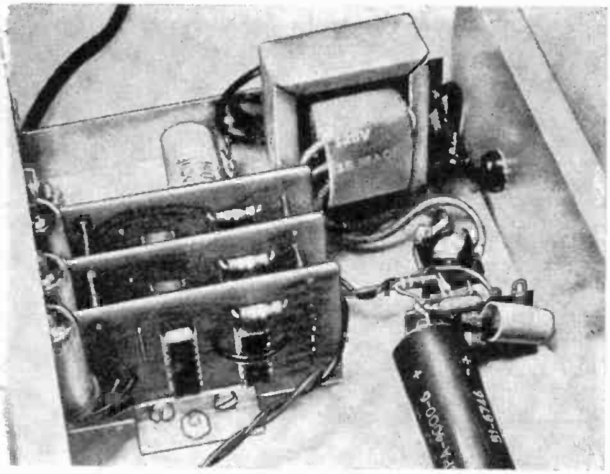


Fig. 5. Terminal strips and point-to-point wiring should be employed when assembling power supply.

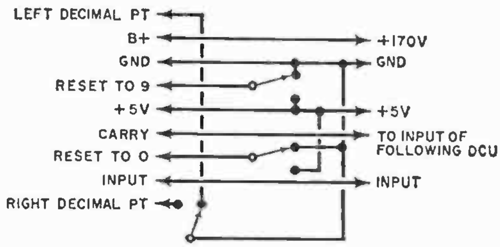


Fig. 6. Prior to wiring them into chassis, test individual DCU's using this circuit.

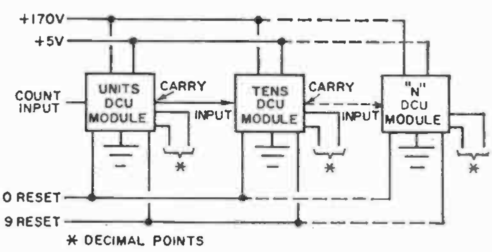
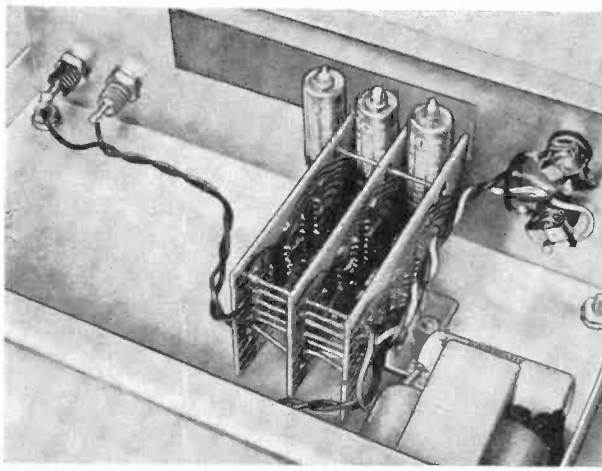
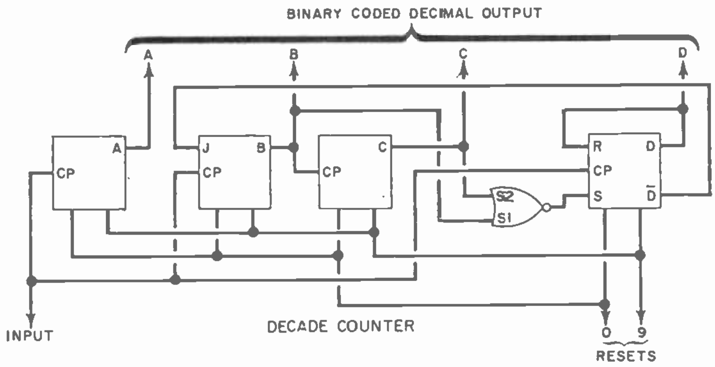
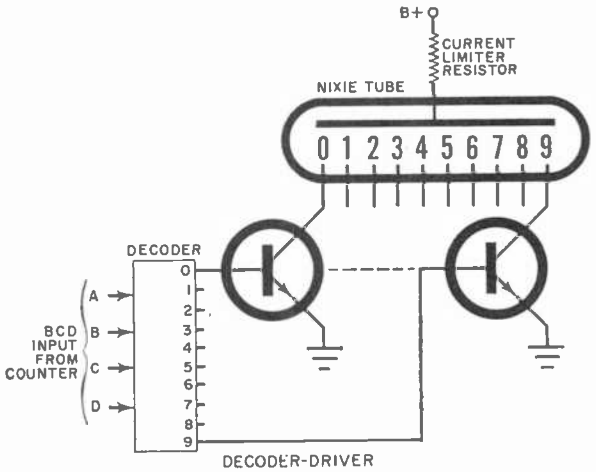


Fig. 7. Carry output of each module provides input for following module. As many modules as desired can be used; units, tens, hundreds, etc., modules.



By mounting DCU's side by side so "common" holes line up with each other, assembly is simplified, and possibility of wiring errors is minimized.





HOW IT WORKS

Decade Counter. Integrated circuit *IC1* is a decade counter consisting of four master-slave flip-flops with gating and internal connections designed to perform the desired counting functions. The output is a binary-coded-decimal signal which drives the companion decoder-driver module.

The monolithic counter uses transistor-transistor logic with a counting rate of about 18 MHz. It will accept positive-going input pulses of 2 volts or more and the shape of the input waveform is not important.

Decoder-Driver. Integrated circuit *IC2* is a monolithic BCD-to-decimal decoder having relatively high-voltage output transistors for direct driving of gas-filled readouts, miniature lamps, or low-power relays.

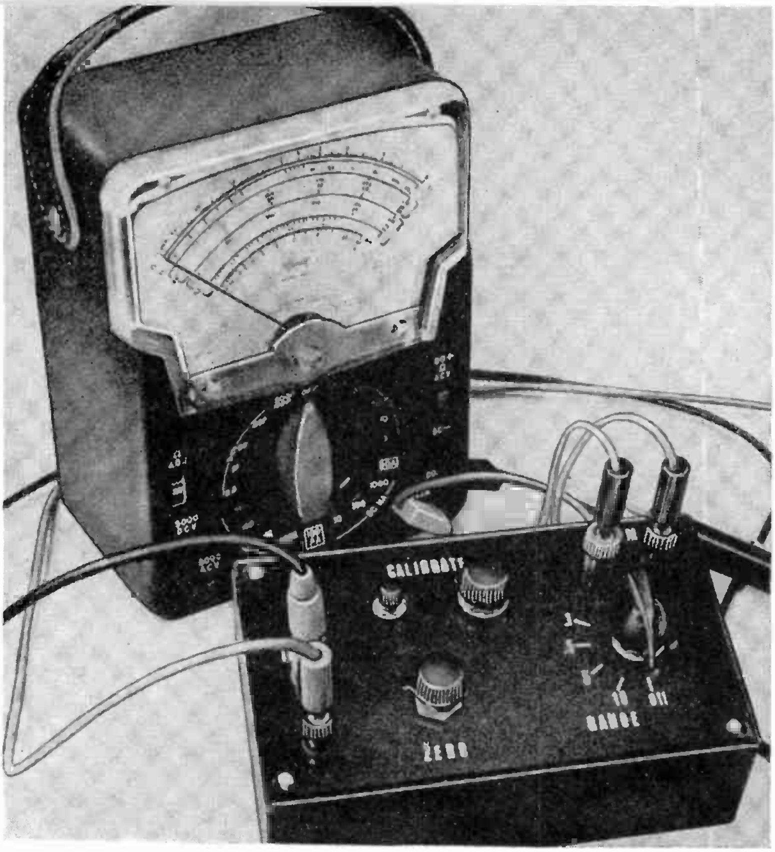
It has ten output transistors which are connected to the appropriate terminals of the readout tube. The BCD input is decoded and applied to the appropriate output transistor to turn it on and supply current to the proper element in the tube.

Testing. Connect the DCU to a test circuit such as that shown in Fig. 6. Operating the zero-reset switch should cause the Nixie tube to indicate the numeral zero. Operating the nine-reset switch should produce a nine indication on the tube. (The nine-reset connection is used in "nines complement" decimal operations.) Operating the decimal-point switch should cause either the right or the left decimal point to glow. Reset the unit to zero before making the next test.

Any a.c. waveform that has a magnitude of at least 2 volts can be used to test the DCU. A low-frequency audio generator makes a convenient source for an input signal. Apply a signal of less than 10 Hz to the input of the DCU and you should see the numerical progression in the Nixie tube. During the transition from 9 to 0, a pulse should be observed at the "carry" output. This pulse is used to drive succeeding Nixie-readout stages.

A number of DCU's can be connected together as shown in Fig. 7. All power leads and resets are connected in parallel, while only the units module receives the input signal to be counted. The carry output of this module is fed to the input of the second (or tens) module. The carry of the tens module drives the hundreds module, etc. The decimal points are connected to a switching system (optional) to indicate the correct decimal point position.

Various auxiliary circuits for use with the Professional DCU will appear in future issues of POPULAR ELECTRONICS. We will also show how circuits and components can be combined to make up digital voltmeters, frequency counters, etc. —30—



FET REJUVENATES VOM

ADAPTERS IMPROVE SENSITIVITY OF ORDINARY VOLT-OHMMETER

BY SOL D. PRENSKY

THE OVER-WORKED VOM has been the best friend of the electronics experimenter for many years. While usable for most measurements, there comes a time when the faithful VOM must be shunted aside for the VTVM, especially when it comes to measuring the low-level voltages in semiconductor circuits, or when probing around in high-impedance circuits.

The reason for dropping the VOM by the wayside? Low input resistance—typically 20,000 ohms per volt—which puts an excessive load on critical circuits under test and produces false voltage indications. Also the VOM lacks sufficiently low full-scale voltage ranges. Most VOM's cannot measure below 1.0 or 1.5 volts at best. Since voltages in some semiconductor circuits do not exceed 0.1 volt, it is impossible to read them on a VOM, even if it has a suitably high input resistance to avoid circuit loading. Even VTVM's have their faults—the older ones do not have low enough full-scale voltage ranges.

Now the field-effect transistor (FET) has come along to allow the VOM to retrieve its rightful place on the workbench. A pair of FET's can be added to your VOM to convert it into a very high-input-resistance (10 megohms) voltmeter and also give it two more low-voltage ranges—0.5 and 0.1 volt full scale. Because both the FET adapter (powered by internal batteries) and the VOM require no power, you are not dependent on the a.c. power line.

PARTS LIST

BP1-BP4—5-way binding post, two black, two red
B1—6.75-volt mercury battery (2), (Mallory TR235R or similar; see text)
D1—5.6-volt zener diode 1N5232 (Motorola) or 1N1520 (International Rectifier)
Q1, Q2—N-channel FET TIS58 (Texas Instruments) or MPF103 (Motorola)
R1—8-megohm
R2—1.8-megohm
R3, R4—100,000-ohm
R5—50,000-ohm
R6, R8—15,000-ohm
R7—2000-ohm
R9—10-megohm
R10—220-ohm
R11—2700-ohm
R12—47-ohm
(R1–R12: all resistors ½-watt, 5%)
R13—10,000-ohm linear potentiometer
R14—50,000-ohm linear potentiometer
S1—D.p.d.t. momentary pushbutton switch (Lafayette 99H6183 or similar)
S2—5-position, 2-pole rotary switch (Lafayette 30H4234 or similar)
Misc.—Plastic case, transistor sockets (2), perf board, knobs, mounting hardware, etc.

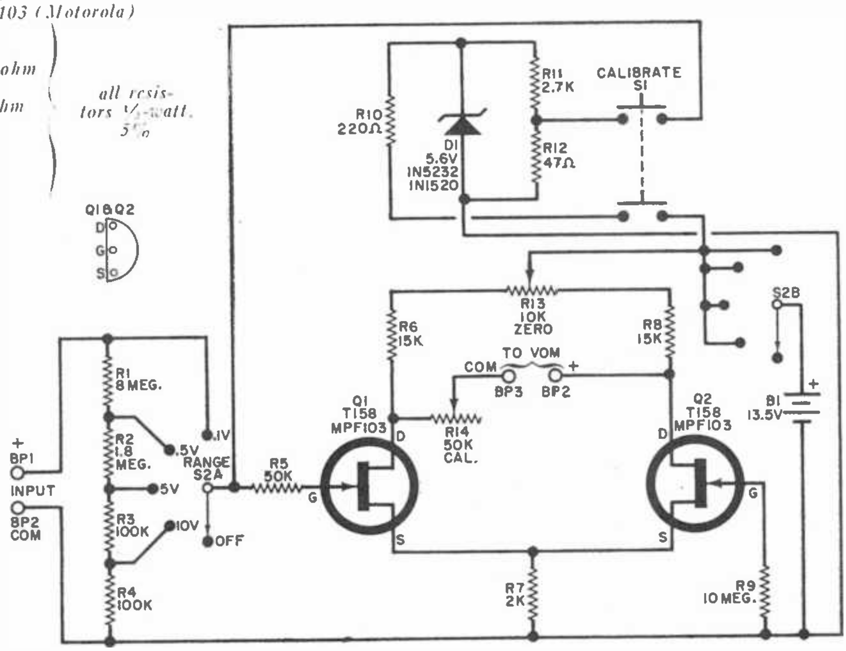


Fig. 1. Designed for use with 20,000 ohms/volt VOM's equipped with a 0·1-volt d.c. range, this circuit provides the VOM with effective input resistance of 10 megohms.

Construction. If your VOM is of the popular 20,000-ohms-per-volt type, use the circuit shown in Fig. 1. If you have a 1000-ohms-per-volt VOM, use the circuit in Fig. 2. Note that the Fig. 2 circuit provides only 1-volt full-scale range at five megohms input resistance.

The circuit may be assembled on a perf board which is then mounted in a plastic case. The case also contains the

(*Continued on page* 114)

PARTS LIST

BP1-BP4—5-way binding post, two black, two red
B1—6.75-volt mercury battery (2), (Mallory TR235R or similar; see text)
Q1, Q2—N-channel FET TIS 59 (Texas Instruments)
R1, R3—4.7-megohm
R2—2000-ohm
R4, R5—3600-ohm
(R1–R5: all resistors ½-watt, 5%)
R6—10,000-ohm linear potentiometer
R7—50,000-ohm linear potentiometer
S1—S.p.s.t. switch
Misc.—Plastic case, transistor sockets (2), perf board, knobs, mounting hardware, etc.

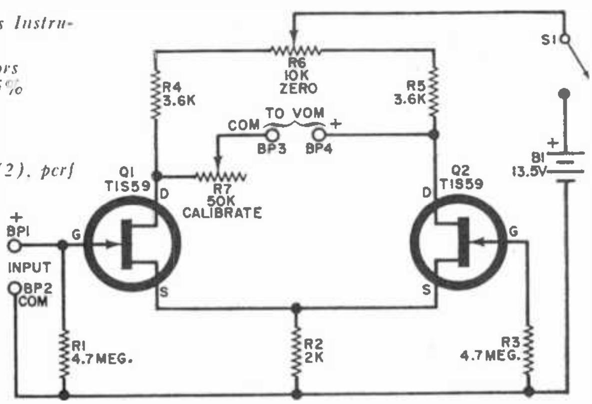


Fig. 2. For VOM's with only 1000 ohms/volt sensitivity, this simple circuit is used to provide d.c. input resistances on the order of five megohms.

the product gallery

REVIEWS AND COMMENTARY ON ELECTRONIC GEAR AND COMPONENTS

CB MOBILE TRANSCEIVER
(Squires-Sanders "Skipper")

When your reviewer first looked at one of the new "Skipper" CB transceivers, it occurred to him that, if this industry keeps shrinking the size of its products, we'll be carrying them in our watch pockets. We haven't seen every 12-volt-input CB unit, but we find it hard to believe that there is anything smaller than the Skipper. What makes the Skipper so amazing is that it is a 23-channel rig with a measured 3.1-watt output crammed into a pancake measuring 1 5/16" high, 6¼" wide, and 7¼" deep.

Squires-Sanders, Inc. (Martinsville Rd., Liberty Corner, N. J. 07938) is not a Johnny-come-lately on the CB scene. A manufacturer of quality radio equipment, Squires-Sanders has announced a new line of CB gear wherein each unit bears a "nautical" name. Just so you don't get the impression that the modestly priced Skipper is for maritime use only, let's state right here that it's a very fine mobile for any car with a 12-volt negative-ground electrical system.

From a compactness viewpoint, it's obvious that the Skipper is 100% solid-state. Liberal use is made of silicon transistors, including several field-effect transistors in the front end of the receiver. An integrated circuit is used for one of the i.f. amplifiers. The 12-volt power input is safety-protected from accidentally reversed polarity and the main voltage feed to the critical circuits is regulated to 9.1 volts by a zener diode.

Receiver selectivity is excellent due to the special high-Q i.f. stage transformers. Noise limiting and squelch operation are more than adequate for normal mobile operation.

The frequency-synthesis transmitter portion of the "Skipper" uses no changeover relay and features a modulator with built-in speech compression and limiting. So-called "talk power" is very good. Our test model had an output of 3.1 watts at 50 ohms.

Functionally, the Skipper has a lot of plus features going for it. The VOLUME, CHANNEL, and SQUELCH controls are thumb wheels and positioned on the front panel so that any adjustment is easy even in total darkness. Below the S-meter are five pushbuttons switching (from left to right) power on-off, internal speaker to external speaker, noise limiter on-off, receiving attenuator on-off, and public address on-off.

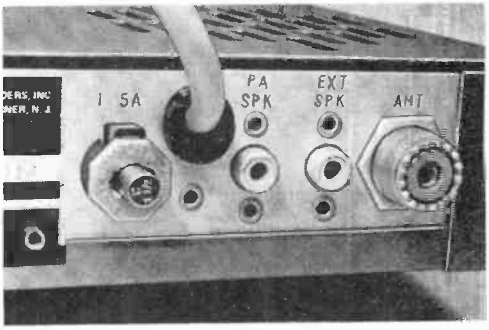
Maybe it's one of our eccentricities, but we particularly like the PWR control switch. This pushbutton turns the 12-volt power on and off and is a welcome relief from the switch that is usually part of the rotatable volume control. Once the Skipper is set for optimum volume and squelch, you can leave it that way indefinitely.

Squires-Sanders has also come up with something new in a mounting bracket. It's called a "breakaway" mount and the idea is that, should anything strike the face of the Skipper, the unit slips backward under the dashboard. It sounds like a good idea and should save many a kneecap.

POLICE MONITOR
(Regency Model MR-10D)

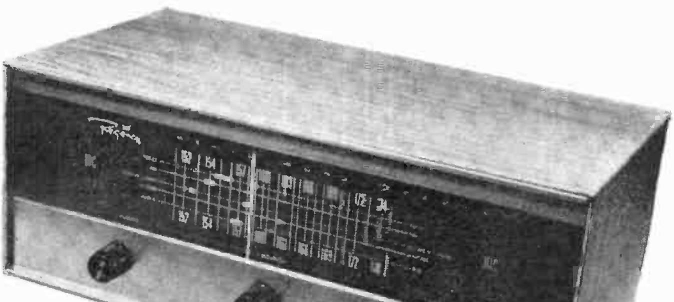
A newly styled version of the Regency MR-10D (Regency Electronics, Inc., 7900 Pendleton Pike, Indianapolis, Ind. 46226) high-band police receiver is now seen on many dealers' shelves. Although the basic receiver circuit remains much the same—the tube rectifier has been replaced by a pair of diodes—the MR-10D features a smart-looking new dial, unlike anything seen on comparable receivers. The dial reads not only frequency and has a logging scale, but has also been divided graphically into 5 bands. The frequency limits of particular radio services are screened in on the glass in several colors. The services are: Weather, Common Carrier, Police, Fire, and Marine. Gone are "dot" markers of the old MR-10. The volume of the receiver cabinet has been cut by at least 25% and the new styling is in gold.

The receiver is a straightforward superhet with 2 i.f. stages and a single r.f. stage. There is an FM ratio detector and a very sensitive squelch circuit. Compared to other police/fire receivers, the MR-10D is very quiet, sensitive and somewhat more selective than you might expect for a receiver with 10.7-MHz i.f. stages.



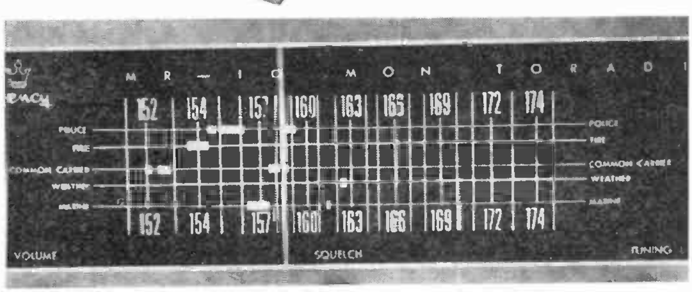
SQUIRES-SANDERS "SKIPPER"

Slim pancake design is featured in this new transceiver. Tube in lower right corner is for comparison purposes. Circuit uses 19 transistors and one integrated circuit. Controls on panel are either thumb wheels or push buttons. Rear view of this unit shows that fuse is not in-line type, but a special fuse that can only be inserted in this particular holder. This extra protection is for safety should car battery polarity be reversed.



REGENCY MR-10D MONITORADIO

Newly-styled receiver features sliderule tuning dial. Five of the VHF services are shown in attractive colors for easy identification. Police, Fire, Marine and Weather markings denote obvious services. The Common Carrier service pertains to mobile radiotelephones. This type of dial is new to VHF receivers and is long overdue.



SOLID STATE

By LOU GARNER, Semiconductor Editor

ALTHOUGH a number of TV receiver manufacturers continue to use vacuum-tube circuitry in their main chassis, the majority is shifting to solid-state "front ends" or tuners. In fact, if you've purchased a new TV set recently (or plan to buy one in the near future), the odds are virtually overwhelming that it will be equipped with a semiconductor-operated tuner, even if the rest of it uses tubes.

Four firms supply most of the TV tuners used by U.S. set manufacturers: Standard Kollsman Industries (Melrose Park, Ill. and Syosset, N.Y.), Oak Electro/Nectics (Crystal Lake, Ill.), Sarkes Tarzian (Bloomington, Ind.), and General Instrument Corp. (Chicopee, Mass.). The last firm concentrates exclusively on the design and production of UHF types.

In our August, 1968 issue, we described the new varactor-tuned TV front-end introduced by Standard Kollsman at the IEEE Convention. As a result, we received a mildly chiding letter from Bob Brown, public relations representative for Oak Electro/Netics, pointing out that his firm also manufactures solid-state tuners. With engineering research facilities in Madison, Wis. and the Netherlands and production facilities in Crystal Lake, Ill., Hong Kong, and near Seoul, Korea, Oak is considered by some to be the largest TV tuner manufacturer in the world. The firm offers a variety of solid-state tuners, many of which are custom modifications of basic designs to meet individual customer requirements.

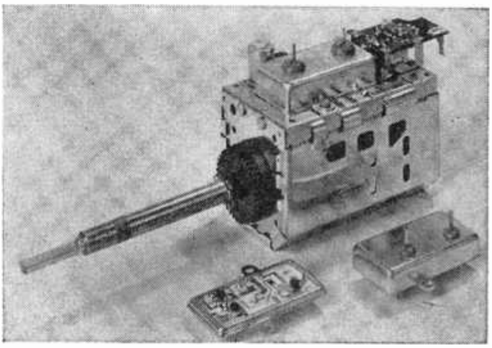


Fig. 1. New VHF tuner by Oak Electro/Netics has basic tuner in a thick-film hybrid integrated circuit which combines with channel-selector switch.

One recent Oak innovation is a thick-film hybrid IC which removes practically all discrete components (except for tuning elements) from the basic tuner-switch assembly. A sealed unit about the size of a matchbox, it contains every transistor, resistor, and capacitor essential for complete VHF TV tuner operation. A complete tuner is assembled simply by coupling the IC module to a suitable inductance channel-selector switch as shown in Fig. 1. Currently, the two basic IC tuners have been developed. One uses a common-base r.f. amplifier while the other has a typical common-emitter configuration.

Another new development from Oak is the industry's first competitive all-channel VHF/UHF TV tuner. Previously, two separate tuners had been required in each set to meet the demand for both VHF and UHF reception. Often the consumer was unaware of this dual-tuner requirement because VHF is predominant in many areas and the common panel styling tends to make channel tuning appear to be a single operation.

Designated the Mark IV all-channel tuner, Oak's new unit measures 1⅛" × 3½" × 4". It has tuned r.f. amplification in addition to oscillator and mixer circuits and employs three active transistors. A unique switching concept made the all-channel design practicable.

Inside the Mark IV, stator lines from the UHF tuner enter the VHF area through a metallic shield which divides the tuner into two sections. When the tuner is switched to UHF, a plastic cam spreads apart two flexible leaves of each stator line until positive contact is made with the chassis-ground wall section, converting the tuning capacitor stator into a tuned quarter-wave UHF transmission line. When switched to VHF, the stator's flexible switching leaves are trapped between the rotor blades of a modified switch element, converting the previous UHF transmission line section into a low-loss capacitor which, in turn, tunes VHF coils located on the rotary switch section.

According to Oak Electro/Netics, the

Mark IV tuner has unusually low oscillator energy radiation, reduced cross-modulation, improved noise figure, and superior image rejection, when compared to more conventional designs.

Reader's Circuit. Challenged by a friend to devise an electronic fishing lure, a 16-year-old reader, Paul Schmitt, Jr. (5562 N. Bay Ridge, Whitefish Bay, Wis. 53217), picked up the gauntlet and did just that. His circuit, shown in Fig. 2, is a modified collector-coupled multivibrator with two *pnp* power transistors. Feedback capacitors *C1* and *C2* are chosen for asymmetrical operation to insure an harmonic-rich pulse-like output waveform which simulates the sounds produced by some insects. Operating power is furnished by a 9-volt battery, while a conventional 1000-ohm earphone serves as an output transducer. Conventional components are specified in the design.

With neither layout nor lead dress critical, the circuit may be assembled using point-to-point wiring, printed-circuit, or perf-board construction. Paul writes that he assembled his original unit on a small PC board, cementing the earphone to a half-inch hole in the cover of a water-tight jar. The circuit board and battery were further protected by a small plastic bag.

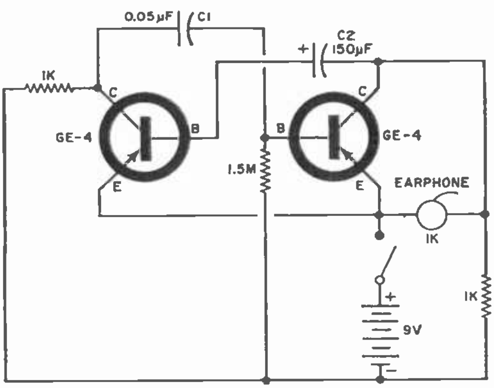


Fig. 2. Two power transistors are combined in a collector-coupled multivibrator to produce an audio output for use in an electronic fishing lure.

In use, Paul suggests that a string be tied to the jar, with the entire assembly lowered about 12 feet into the water. He reports excellent results, especially with large game fish.

Manufacturer's Circuit. At first glance, the circuit shown in Fig. 3 may appear to be a familiar single-stage audio amplifier. Actually, it is an unusual circuit with quite literally dozens of potential applications in laboratory, industrial, and commercial equipment. One of several related circuits described in an eight-page catalog/brochure published by Stow Laboratories, Inc. (Stow, Mass. 01775), its versatility lies not in the circuit itself but in the characteristics of its active component, *Q1*, which is not a conventional transistor but a solid-state pressure-sensitive transducer called a *Pitran* (for piezotransistor).

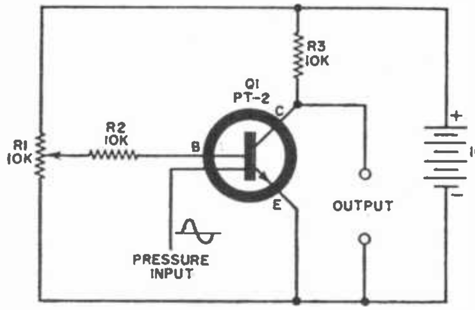


Fig. 3. The Pitran is a pressure-sensitive transducer which can be used in a standard transistor audio-amplifier circuit for various applications.

Relatively expensive at present, the Pitran is essentially a silicon *npn* planar transistor that has its emitter-base junction mechanically coupled to a diaphragm on top of the small metal can. When pressure (or point force) is applied to the diaphragm, a large but reversible change is produced in the device's characteristics. With an excellent high-frequency response as far as electromechanical devices are concerned, the Pitran is extremely sensitive to both mechanical movement and pressure differentials and can deliver comparatively large output-voltage swings. It may be used as the sensing transducer in such products as phonographs, high-intensity microphones, load cells, accelerometers, flow meters, electronic scales, displacement meters, and level gauges.

As shown in the diagram, *Q1* is a type PT-2 Pitran and bias control *R1* is a linear potentiometer. Bias limiting is provided by *R2* and collector loading by *R3*. If the bias is adjusted for a 2-volt d.c. output level, a mechanical input of as little as ¼-gram point force will produce a 1-volt output variation, with excellent linearity over the range (1% typical).

Transitips. The contents of our mail bag indicate a healthy reader interest in the characteristics of *regenerative* and *reflex* circuits. Unfortunately, a number of readers seem to feel that these two types of circuits are identical—that the names, in fact, are more or less interchangeable. Such is not the case, though there are some similarities: both circuits are attempts to squeeze maximum performance from one or more stages; both employ feedback techniques; and both are used extensively in simple receiver designs.

The basic difference between regenerative and reflex circuits lies in the *type* of feedback signal. In a regenerative circuit, a portion of the amplified output signal is coupled back to reinforce the input and thus to help reduce circuit losses. If the feedback is of sufficient amplitude, the circuit becomes a self-sustaining generator—that is, an oscillator. In a reflex circuit, on the other hand, the feedback signal is a *modified* version of the original input and is handled as if it were an entirely different signal. In effect, the stage simply amplifies two different signals at the same time.

A typical regenerative circuit with a *pnp* transistor is shown in Fig. 4(a). Component values vary with the supply voltage, type of transistor used, and other factors.

In operation, r.f. signals picked up by the antenna-ground system are coupled from *L1* to tuned circuit *L2-C1* and applied to *Q1*'s base-emitter circuit. Base bias is established by *R1* (bypassed by *C2*) in conjunction with emitter resistor *R2* (bypassed by *C3*). A portion of the amplified r.f. signal is coupled back in phase with the input by feedback coil *L3*, thus reinforcing the input and developing a stronger output signal. As signal amplitude increases, detection takes place and an audio output signal is developed across collector load resistor *R3*, bypassed for r.f. by *C4*.

The reflex circuit illustrated in Fig. 4(b) is similar in some respects. R.f. signals picked up by the antenna-ground system are coupled from *L1* to tuned circuit *L2-C1* and applied to *Q1*'s base-emitter circuit with an amplified output signal developed across *T1*'s primary winding, tuned by *C3*. Base bias is established by *R1* (bypassed by *C4*) in conjunction with emitter resistor *R3* (bypassed by *C2*). Note, however, that there is no r.f. feedback. Instead the r.f. signal is coupled through *T1* to diode detector *D1*, with an audio signal developed across diode load *R4*, bypassed for r.f. by *C6*. This detected audio signal is then coupled back to *Q1*'s input circuit through d.c. blocking capacitor *C5* and isolation resistor *R2*. The detected (audio) signal is amplified by *Q1*, with the audio output developed across the earphone serving as the collector load for audio.

In effect, the reflex circuit uses *Q1* as both an r.f. and an audio amplifier at the same time. Coil *L2* is virtually a short as far as audio signals are concerned, and *C1* represents an open circuit. Similarly, *T1*'s primary is essentially a short at audio frequencies and *C3* is an open circuit. Neither the feedback network (*R2-C5*) nor the audio load have any effect on the r.f. signal since these circuits are bypassed (for r.f.) by *C4* and *C7* respectively.

With practice, you should have no trouble recognizing the difference between regenerative and reflex circuits. Just identify the type of feedback signal—if it is identical to the input signal, you are dealing with a regenerative circuit, and if different (whether

(*Continued on page* 98)

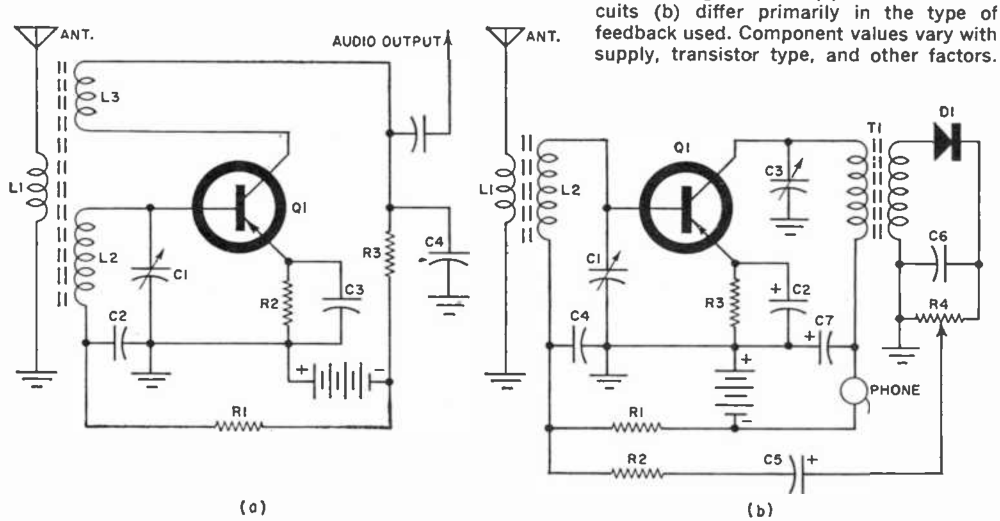
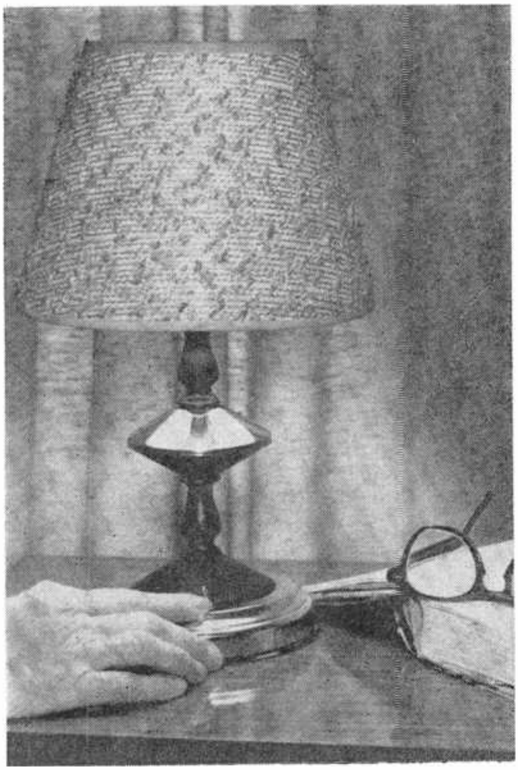


Fig. 4. Regenerative (a) and reflex circuits (b) differ primarily in the type of feedback used. Component values vary with supply, transistor type, and other factors.



BY JACK SMALL

Mannerly Table Lamp

TIME-DELAY TRICKERY

THE TABLE LAMP described here was designed to be a safety device for the home. The lamp is said to have "manners" because, when it is switched off, the light remains lit long enough for you to get into bed or leave the room before it is automatically extinguished. Objects you would not ordinarily see in the dark can be avoided.

The circuit for the "Lamp with Manners," shown schematically below, is simple and virtually foolproof. When *S1* is ON, a.c. power is applied to the lamp and the heater element of thermal relay *K1* is out of the circuit. When *S1* is OFF, both the heater of *K1* and the lamp are in the circuit. As power is applied to *K1*, the bimetallic contacts open, and power is removed from the lamp.

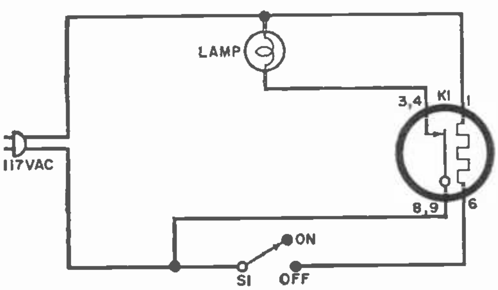
Once *S1* is set to OFF, power is continuously applied to the relay's heater (which uses less than 3 watts). As a result *K1*'s contacts remain open until shortly after *S1* is returned to ON.

Almost any hollow-based table lamp can be equipped with manners. The only additional parts you need are a miniature thermal time-delay relay, a nine-pin tube socket, a s.p.d.t. switch, and some hardware.

The relay with the time delay desired can be selected from Amperite's 115C series (115C30T for 30 seconds, 115C60T for 60 seconds, and 115C120T for two minutes). Other delay times are also available.

The method used to mount the switch and relay depends on the amount of space available inside the lamp's base. One suitable method is shown in the

(*Continued on page* 97)



With S1 at OFF, lamp and K1 receive power until thermal action opens relay's bimetallic contacts.

ENGLISH-LANGUAGE BROADCASTS TO NORTH AMERICA FOR THE MONTH OF NOVEMBER

Prepared by ROGER LEGGE

TO EASTERN AND CENTRAL NORTH AMERICA

TIME—EST	STATION AND LOCATION	FREQUENCIES (MHz)
7:15 a.m.	Helsinki, Finland (Sat., Sun.)	15.185
	Melbourne, Australia	9.58, 11.71
	Montreal, Canada	9.625, 11.72
7:45 a.m.	Copenhagen, Denmark	15.165
6:00 p.m.	Montreal, Canada	9.625, 11.725, 15.19
6:45 p.m.	Tokyo, Japan	15.135, 17.825
7:00 p.m.	London, England	6.11, 9.58, 11.78
	Moscow, U.S.S.R.	7.15, 9.665, 9.685
	Sofia, Bulgaria	9.70
7:30 p.m.	Budapest, Hungary	6.235, 9.833, 11.91
	Johannesburg, South Africa	9.705, 11.875, 15.22
	Kiev, U.S.S.R. (Mon., Thu., Sat.)	9.665, 9.685
	Stockholm, Sweden	5.99
7:50 p.m.	Brussels, Belgium	6.125
	Vatican City	6.145, 9.69, 11.76
8:00 p.m.	Berlin, Germany	9.50, 9.73
	Havana, Cuba	9.525
	Madrid, Spain	6.13, 9.76
	Peking, China	15.06, 17.675, 17.90
	Rome, Italy	9.575, 11.81
8:30 p.m.	Berne, Switzerland	6.12, 9.535, 11.715
	Bucharest, Rumania	5.985, 9.675, 11.94
	Cologne, Germany	9.64, 11.945
	Hilversum, Holland (via Bonaire)	9.59
	Tirana, Albania	6.20, 7.30
9:00 p.m.	Cairo, Egypt	9.475
	Lisbon, Portugal	6.025, 9.68, 11.935
	London, England	6.11, 7.13, 9.58
	Melbourne, Australia	15.32, 17.84
	Moscow, U.S.S.R.	7.15, 9.665, 9.685

TO WESTERN NORTH AMERICA

TIME—PST	STATION AND LOCATION	FREQUENCIES (MHz)
7:00 a.m.	Tokyo, Japan	9.505
6:00 p.m.	Melbourne, Australia	15.32, 17.84
	Quito, Ecuador	9.745, 11.915, 15.115
	Taipei, Taiwan	15.125, 15.345, 17.89
	Tokyo, Japan	15.235, 17.825, 21.64
6:30 p.m.	Johannesburg, South Africa	9.705, 11.875, 15.22
7:00 p.m.	London, England	6.11, 7.13, 9.58
	Madrid, Spain	6.13, 9.76
	Peking, China	15.095, 17.675, 17.795
	Seoul, Korea	15.43
7:20 p.m.	Yerevan, U.S.S.R. (via Khabarovsk) (Tues., Wed., Fri., Sat.)	11.85, 15.18, 17.88
7:30 p.m.	Berlin, Germany	9.56, 9.65
	Bonaire, Neth. Antilles	9.695
	Stockholm, Sweden	11.705
8:00 p.m.	Havana, Cuba	9.525
	Lisbon, Portugal	6.025, 9.68, 11.935
	Moscow, U.S.S.R. (via Khabarovsk)	11.85, 15.18, 17.88
	Peking, China	15.095, 17.675, 17.795
	Sofia, Bulgaria	9.70
8:30 p.m.	Bucharest, Rumania	5.985, 9.675, 11.94
	Budapest, Hungary	6.235, 9.833, 11.91
	Kiev, U.S.S.R. (Mon., Thu., Sat.)	9.665, 9.685
8:45 p.m.	Berne, Switzerland	6.12, 9.72
	Cologne, Germany	9.545, 11.945
9:00 p.m.	Havana, Cuba	9.525
	Tokyo, Japan	15.105
10:00 p.m.	Moscow, U.S.S.R. (via Khabarovsk)	9.54, 11.755, 11.85
10:30 p.m.	Havana, Cuba	9.655

SHORT-WAVE LISTENING

By HANK BENNETT, W2PNA/WPE2FT
Short-Wave Editor

TRISTAN DA CUNHA IS ON THE AIR

ANOTHER OF THOSE really rare stations has turned up in the DX news. It's *Tristan Radio* located on Tristan da Cunha, near the settlement area on the northwest corner of the island. Alan Hemming, ZD9BE, Director of Broadcasting, writes that the station, with a call sign of ZOE, is operating with 40 watts on 3290 kHz with English scheduled for Wednesday, Friday and Sunday at 1900-2200 GMT. Programming, of a local nature, is intended only for listeners within a radius of 250 miles although reports have been received from ships 700 miles away. The signature tune is "Scottish Soldier" (sung). International Reply Coupons (exact number not stated, but send two—Ed.) are requested for confirmation of reception reports.

Tristan da Cunha is located in the South Atlantic, roughly 2200 miles west-southwest of Cape Town, South Africa and nearly on longitude zero. Your Editor has not seen any actual reports of reception of this station but it's a good one to try for during the winter period of early darkness. You'll need a sharp receiver and a good antenna-ground system on this one!

Another country that's very rarely heard on the airwaves is Qatar. This Persian Gulf shiekdom is reported to be on the air with *Qatar Radio*, Doha, with 100 kW on 9570 kHz. The transmission schedule is reportedly 0430-0600 (Fridays until 0800) and 1500-1800 in Arabic only. Tests have been said to be at 1300-1500. A medium-wave outlet is listed for 674 kHz. Again, we've seen no reports on this station. Has anyone heard it?

Program to Continue. A statement in a recent issue of a foreign publication said that 1968 would be the concluding year of "The Happy Station Program," which has been produced and conducted by Eddie Startz for the past 40 years. The program is aired Sundays by *R. Nederland*. More recently it has been learned that Mr. Startz completely denied the story of his retirement and that he will continue to do the program. While we do not wish to state that our good friend Eddie certainly does not deserve a well-earned vacation, I'm sure that many of us will be pleased to know that he will continue to brighten up the world every Sunday for many years to come. And congratulations, too, Eddie, on your 40th anniversary this month!

A letter has been received from B. L. Manohar, a monitor in India, regarding *Radio Nepal*. In the letter he states that this station definitely has its 100-kW transmitter on the air. Sign-on time is at 1325 on 9590 kHz with Nepali, Hindi songs and commercials; sign-off is at 1620 and there are *no* parallel channels in use on either 7105 or 4600 kHz. These latter two channels continue to operate mornings with s/on at 0220 in Nepali; the medium-wave outlet on 1500 kHz also continues to operate as usual.

Returning to *R. Nederland*, they are building a new station in Bonaire which will use two 300-kW transmitters. These will be able to be coupled together for 600 kW and will

Wayne Ayers, WPE4JND, a student at Indiana University's Graduate School, is shown seated near his Drake SW-4 receiver and a Sony Super Sensitivity receiver. Wayne also uses a Panasonic tape recorder. He has verified 23 countries out of 53 logged.

be in service to North, Central and South America, the Pacific and West Africa. Completion date is set for February, 1969.

From the Swiss Broadcasting Corp., Berne: "Due to a temporary shortage of staff and the impending reorganization of our Listener's Mail Service, we will, unfortunately, not be in a position to answer letters and verify reports for some weeks to come. However, all accurate reports will be forwarded for evaluation to the Engineering Department . . . Your requests for program schedules and report forms will be filled in due

One listener post halfway around the world is capably manned by Samson Voron, VK2PE2R, of Coogee, New South Wales, Australia. Samson has a National NC-88 receiver and an antenna that is 30-36 yd long. A member of the Australian Radio DX club, Samson would like a correspondent in any age group.

course . . . 'Melody Train' requests, 'Mailbag' questions and DX queries will be handled by the respective program producers."

One of our servicemen in Vietnam sent us a list of medium-wave stations that would make good DX catches especially since they all operate on standard US channels rather than on split channels. West Coast listeners might give these a try from time to time: Saigon, 540 kHz; Qui Nhon, 650 kHz; Da Nang, 870 kHz or Chu Lai, 1200 kHz, all with 10 kW, or Pleiku, 570 kHz, 50 kW. Reception reports are definitely welcomed.

CURRENT STATION REPORTS

The following is a resume of current reports. At time of compilation, all reports were as accurate as possible, but stations 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, before the fifth of each month; be sure to include your WPE identification and the make and model number of your receiver.

Afghanistan—*R. Afghanistan,* 15,265 kHz, has been logged from 1758 with IS of flute and native instruments until 1827 s/off with news and weather, Afghan music, commentary, talks, jazz and pop music. This English service is beamed to Europe and was well received, but with some polar flutter, in mid-U.S.A.

Angola—*Emisora Oficial,* Luanda, noted on 7235 kHz prior to s/on at 0500 with IS on a xylophone-type instrument, the anthem and into pop music.

Bolivia—*R. La Cruz del Sur,* La Paz, is good on 5025 kHz from 0115-0301 s/off with classical and light music, news in Spanish; English programming noted from 0230. An English ID is given at s/off.

Botswana—ZND, Gaberones, 3356 kHz, was heard with pop tunes in African and European languages to 0500 when they had an ID, an English time check and news. They verify promptly by personal letter.

Brazil—*R. Nacional de Brasilia* has a new international service in Portuguese Monday through Saturday at 2035-2130, 0000-0100 and 1235-1330 on 6065, 9665, 11,720 and 15,445 kHz. Reports go to the station at Av. W-3, Setor de Radio e Televisao, C.P. 1620, Brazilia, D.F., Brazil. Return postage required. A low powered station being heard at times on 3285 kHz is *Emissora da Educacao,* Rural, Natal, in Portuguese with s/off time, at least on weekends, at 0200. To date they have not verified.

Ceylon—*R. Ceylon,* Commercial Service, Colombo, has a relay of BBC news at 0200 on 9675 and 15,230 kHz. At 0210 "The Musical Clock" program continues until another newscast at 0300; all in English.

Chile—CE956, *R. Portales,* Santiago, is good on 9560 kHz at 0100-0204 in Spanish with news and talks. The station on 9700 kHz is listed as *R. La Voz de Chile* but ID's are definitely *R. Cooperativa. R. Sociedad Nacional de Mineria,* Santiago, 9753 kHz, is good at 0100 with Esso news, sports, "El Moticierio Anaconda," weather, home and world news, editorials and light music. "Musica en la Noche" is presented from 0300-0400 and s/off is at 0430.

Colombia—A new station is *R. Reloj,* Bogota, 4795 kHz, heard 0100-0500 with music, commercials and brief anmts. It is a member of "Caracol" network.

Cyprus—Your Editor has noted for a number of Sundays a series of tests from Nicosia on 17,820 kHz from 1445-1500 or later with variety music and all English anmts.

Ecuador—HCFA4, *La Voz de Manabi,* Portoviejo, listed for 4810 kHz, is on 4825 kHz with L.A. pop tunes and a few anmts after 0200. Do not confuse with *R. San Jose,* Peru, which closes daily at 0200. HCJS1, *Ondas El Angel,* El Angel, 4829 kHz, has listeners' request music and time checks around 0320.

England—The BBC Morning Service, beamed to Europe, is aired on single-sideband on 12,180 kHz, in Czech at 0515 and in Bulgarian at 0530.

Finland—Helsinki has Swedish to N.A. on Tuesday at 1300-1310. Another xmsn has Finnish around 1246 with music and talking. Both xmsns were on 15,185 kHz.

France—Paris has French with pop music at 1400 on 21,525 kHz and English with news and commentary at 0600 on 15,445 kHz.

Germany (West)—*Radio Free Europe,* Biblis, 17,735 kHz, is on this new frequency in Rumanian beamed to Rumania and Eastern Europe from 2145-2230.

Greece—*R. Athens* is now in English to Cyprus at 0700-0815, 1030-1300 and 1830-1900 on 7295 and 9605 kHz, to the Near East at 1630-1700 and to Turkey at 1330-1515 on the same channels; to Egypt at 0900-1000 on 9605 and 11,720 kHz; to France and United Kingdom at 1730-1800 and to N. W. Europe at 1930-2100 on 11,720 and 15,345 kHz.

Grenada—*Windward Islands Broadcasting Ser-*

(*Continued on page* 100)

AMATEUR RADIO

By **HERB S. BRIER,** W9EGQ
Amateur Radio Editor

NEW AMATEUR FREQUENCIES

MARK 3:00 A.M., EST, November 22, 1968, on your calendar in big red letters. At that hour (2:00 a.m. CST, 1:00 a.m. MST, 12:00 midnight PST), the new amateur frequency assignments as shown in the table go into effect.

The two amateur groups apparently most concerned by the changed frequency allocations are the dedicated DX chasers and some phone operators—especially the 75-meter net operators. The DX chasers fear that not being able to operate in the bottom 25-kHz slots of the 80-, 40-, and 15-meter CW bands and the 75- and 15-meter phone bands will be a handicap in working rare DX, especially in contests. Many 75-meter phone nets that have been operating in the Advanced and Extra class segments of the band have already or soon will be moved above 3.9 MHz. On the other hand, the number of amateurs who have qualified for Advanced and Extra class licenses indicates that the new segments will not lack for activity after November 22. Incidentally, there is no truth

AMATEUR STATION OF THE MONTH

George R. Clark, WA5QYK, 2212 W. 25 St., Oklahoma City, Okla. 73107, waited until he was 76 (two years ago) to discover amateur radio! He is active on 50 MHz with a Knight-Kit TR-106 transceiver, and in Navy MARS with a Heathkit HW-12A transceiver and a DX-40 transmitter and Hallicrafters SX-117 receiver. George should have his General license by the time you read this. We are awarding WA5QYK a one-year subscription to POPULAR ELECTRONICS for submitting the winning entry in our Monthly Amateur Station Photo Contest. To enter the contest, send a clear photo (black and white preferred) of you at the controls of your station and details of your amateur career to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P. O. Box 678, Gary, Indiana 46501.

AMATEUR FREQUENCIES (Nov. 22, 1968 to Nov. 21, 1969)	
CLASS OF LICENSE	FREQUENCIES
Novice	3.7-3.75, 7.15-7.2, 21.1-21.25, and 145-147 MHz (CW only)
Technician	All amateur frequencies above 50-1 MHz*
Conditional & General	All amateur frequencies except 3.5-3.525, 3.8-3-3.85, 7-7.025, 7.2-7.225, 14-14.025, 14.2-14.235, 21-21.025, 21.25-21.3, and 50-50.1 MHz*
Advanced	All amateur frequencies except 3.5-3.525, 3.8-3.825, 7-7.025, 14-14.025, 21-21.025, and 21.25-21.275 MHz
Extra	All amateur frequencies

**FCC has not ruled on ARRL's requested postponement of requiring an Advanced or Extra class license to operate on 50-50.1 MHz.*

to the story passed around by a few phone men that General class operators will still be allowed to operate CW in the Extra and Advanced class segments of the phone bands after November 22.

Contests. Two of the year's most popular amateur contests occur in the next few weeks: *CQ*'s "World-Wide DX Contest," and ARRL's "Section-Sweepstakes (SS) Contest." Both are divided into phone and CW weekends. The phone section of the DX contest starts at 0000 GMT, October 26 (7:00 p.m. EST, October 25) and ends at 2400 GMT, October 27 (7:00 p.m. EST, October 26); and the CW contest occurs between the same hours on the weekend of November 23-24. Work any or all amateur bands and exchange contest numbers with foreign stations. Each exchange consists of sending a signal report and your zone number and receiving the same information from the station worked. Each station may be worked once per band.

If you plan on winning either the phone or CW section of the contest, send a large, stamped envelope (18 cents postage) to CQ WW DX Contest, 14 Vanderventer Ave., Port Washington, N. Y. 11050, for scoring rules (which are a little tricky), free zone map, and log sheets. DX men will be watching the CW half of the WW DX contest with close interest because it will be the first major contest held under the new frequency allocations. Will the Extra class operators run away with the U.S. scores?

For the ARRL Sweepstakes Contest (the 35th annual event), the phone weekend is from 2100 GMT (4:00 p.m. EST) Saturday, November 9 to 0300 GMT (10:00 p.m. EST) Monday, November 11. The CW portion will be the same period the following week. The goal in this contest is to work as many different stations as possible in the 73 ARRL sections in the U.S. (and territories) and Canada, exchanging "message preambles" with each station worked. Two points are earned for each 2-way exchange; the total score is the number of points multiplied by the number of different sections worked, multiplied by 1.25 if your power is less than 150 watts on CW. The multiplier is 1.5 for phone. Novices are especially invited to participate in the Sweepstakes, and high-scoring Novices are eligible for certificates. Write to the Communications Dept., American Radio Relay League, Inc., 225 Main St., Newington, Conn. 06111, for official ARRL SS log sheets and rules (which were not finalized when this was written.

Other November contests of interest include: YLRL Anniversary Phone Party, for YL operators only, Nov. 6-7; OK (Czechoslovakian) CW Contest, Nov. 9-10; RSGB 7-MHz Phone Contest.

Digital Communications. What will be the next big advance in amateur communications after SSB? Writing in *Auto Call,* Editor R. V. "Andy" Anderson, KØNL, predicts that it will be digital communications. In digital phone communications, the audio signal is fed into a group of filters that produce a series of pulses to be transmitted. At the receiver, these pulses control audio oscillators that reconstitute the original audio signal. Among the claimed advantages of digital communications are narrow bandwidth, high efficiency, and good immunity

(*Continued on page* 110)

Francis Rose, G2DRT, operates GB2BP in behalf of English High Wycombe Boy Scouts at their annual September show. At home, G2DRT likes to ragchew on 21 and 28 MHz—no "rubber-stamp contacts."

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CIRCLE NO. 23 ON READER SERVICE PAGE

INFORMATION CENTRAL

By CHARLES J. SCHAUERS, W6QLV

Wireless Intercom Interference. *I bought and installed two wireless intercoms. When I use my AM radio, I can pick up conversations from the intercoms at about 600 kHz. The signals are very weak, but I was wondering if our neighbors could also hear the intercom conversations on their radios —this might prove embarrassing.*

I doubt it. You are probably picking up a harmonic of the low-frequency output of the intercom and this would not travel far. But for peace of mind, why not check with the neighbors? If one of your neighbors has the *same* intercoms and both of your homes are supplied via the *same* power line, you could hear each other's conversation *if* the sets are tuned to the same frequency.

DX-40 Choke Burn-Out. *As you no doubt know, Novice hams try to save money by buying second-hand equipment. Well, I have a Heath DX-40 transmitter which I obtained for $40.00. After I used it a while, the parasitic choke on the final tube burned up. Can you tell me why?*

Improper loading of the final could be the cause or perhaps a *very high* VSWR.

Generator Differences. *What is the principal difference between a signal generator and a sweep generator?*

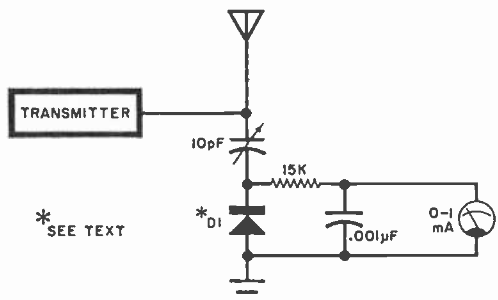
The signal generator puts out a signal on one particular frequency whereas the sweep generator not only puts out an r.f. signal on a given frequency (center frequency) but its output is FM-modulated, resulting in a signal that varies up and down from the center frequency.

SB2-LA Noise. *I just bought a used SB2-LA linear amplifier, and I am using an SR-150 transceiver to drive it. In the standby position, there is some receiver hash. How can I get rid of this hash?*

First, check the bias adjustment. During the receiving function, some bias is applied to the tubes (6JE6's) to prevent receiver noise. On transmit, this bias is reduced for proper linear operation. Also, make certain that the tubes are good and are matched types. A weak or "unbalanced" tube will cause the load to be unevenly distributed and thus lower r.f. output efficiency. Check the tubes on a good mutual conductance tester; the amplification factor (mu) of each tube should be in the same range.

CB R.F. Output. *My CB transceiver is not fitted with an r.f. output indicator. Because I would like to know if it is putting out, please suggest a simple means of measuring r.f.*

Although a relative field-strength meter is preferred to indicate transmitter output be-



cause it also tells what the antenna is doing, the circuit shown above can be wired into your rig. The diode, *D1*, can be almost any signal diode you have at hand.

Tonal Quality Determination. *What determines the tonal quality of sound? Is it the harmonic content?*

It has been demonstrated that the attack and decay times have much more to do with tonal quality than harmonic content. Transient or "staccato" sounds can and do contribute to distortion in a system that can generally reproduce sounds with fine tonal quality. A sound system must have no phase distortion, very wide frequency range, and little "hangover," if distortionless reproduction of short sound pulses is to be accomplished.

Inexpensive L-Pad. *Where can I buy an inexpensive L-pad for use as a brilliance control (to vary the tweeter level) in my hi-fi system?*

(Continued on page 96)

Scott's new LR-88 receiver takes the

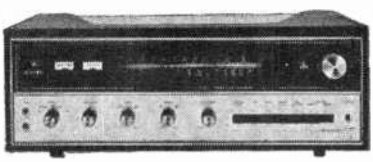
out of kit building

Building a kit used to be something you couldn't do with ladies and children present, but Scott's new LR-88 AM/FM stereo receiver kit has changed all that. First, there's the instruction manual. In clear and simple language, it leads you, step-by-step, through every stage of the assembly process. And each stage is illustrated . . . full-size, full-color. Next, there's Scott's ingenious new Kit-Pak®. The parts for each assembly stage are in individual compartments, keyed to the instructions. All wires are color-coded, and pre-cut and pre-stripped to the proper sizes. Difficult or critical sections are pre-wired, pre-aligned, pre-tested, and factory-mounted on printed circuit boards. Is soldering your bugaboo? Scott has provided push-on solderless connectors for the hard-to-get-at spots.

About thirty painless hours after you've started, you've completed one great receiver. The LR-88 is the 100-Watt kit brother to Scott's finest factory-wired beauties. It includes the famous Scott silverplated Field Effect Transistor front end, Integrated Circuit IF strip, all-silicon output circuitry . . . in fact, all the goodies that would cost you over a hundred dollars more if Scott did all the assembling. Performance? Just check the specs below . . . and you'll be amazed at how great a receiver sounds after you've built it yourself. Treat yourself to a weekend of fun and years of enjoyment . . . see the Scott LR-88 at your dealer's today.

LR-88 Control Features: Dual Bass and Treble; Loudness; Balance; Volume compensation; Tape monitor; Mono/stereo control; Noise filter; Interstation muting; Dual speaker switches; Stereo microphone inputs; Front panel headphone output; Input selector; Signal strength meter; Zero-center meter; Stereo threshold control; Remote speaker mono/stereo control; Tuning control; Stereo indicator light. **LR-88 Specifications:** Music Power rating (IHF), 100 Watts @ 4 Ohms; Usable sensitivity, 2.0 μV; Harmonic distortion, 0.6%; Frequency response, 15-25,000 Hz ± 1.5 dB; Cross modulation rejection, 80 dB; Selectivity, 45 dB; Capture ratio, 2.5 dB; Signal/noise ratio, 65 dB; Price, $334.95.

You'll swear by it



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CIRCLE NO. 31 ON READER SERVICE PAGE

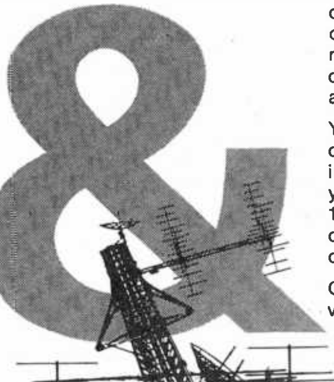
Two more examples of how RCA Institutes provides up-to-the-minute Home Training in all phases of electronics:

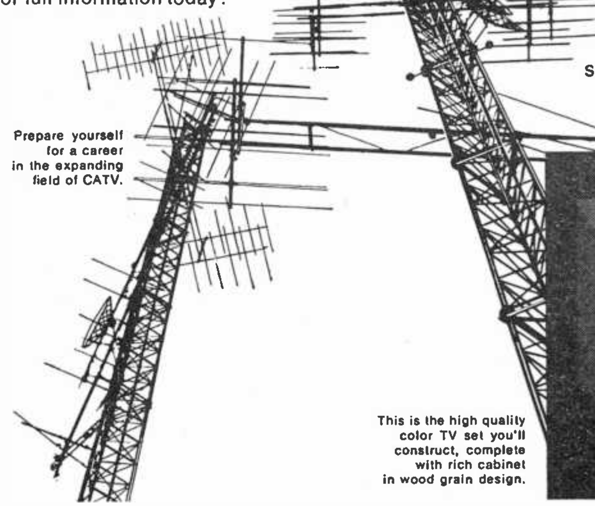
NEW CATV LESSONS

The demand is heavy for technicians in the booming field of CATV (Community Antenna Television Systems).

CATV was initially used to make it possible for large numbers of television receiver users to get good reception in remote areas through the use of a common antenna. It now brings to more people more programs than are available from local stations. It also improves reception where multipath signal transmission exists.

RCA Institutes includes two comprehensive lessons, covering the practical phases of CATV systems and servicing in Television Servicing and Communications courses and programs at no additional total tuition cost. Get in on the ground floor of this rewarding and expanding field. Send for full information today!





Prepare yourself for a career in the expanding field of CATV.

NEW COLOR TV KIT

To make courses even more practical and to better prepare you for a more rewarding future, RCA Institutes now includes an exciting Color TV Kit in both the beginner's program and the advanced course in color TV servicing. The cost of the kit is included in the tuition—nothing extra to pay. You also get five construction/experiment manuals plus a comprehensive service manual.

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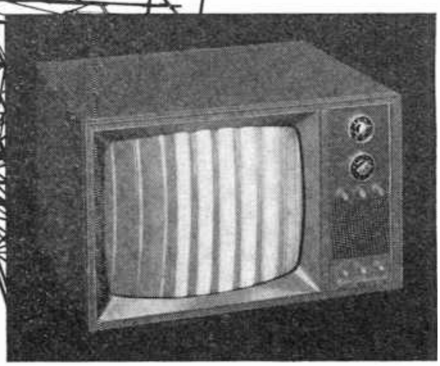


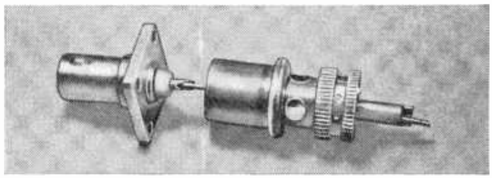
This is the high quality color TV set you'll construct, complete with rich cabinet in wood grain design.

PARTS/METHODS/IDEAS/GADGETS/DEVICES

tips & techniques

EMERGENCY COAX CONNECTOR

What do you do when you have to connect a PL259 plug to a UG 261/U BNC-type jack? Well, you could change the connector on either the cable or the piece of equipment the cable must be connected to. However, this means you'll just have to change the connector again when you're finished. A quick



way out of this problem is to make an adapter. A type UG 261/U single-hole mounting BNC connector makes a good slip fit into the stem of a PL259 plug for the adapter assembly. First, solder a length of bare, solid hookup wire into the BNC connector, and slide the wire through the stem of the PL259 plug as shown in the photo. Now, bend the end of the wire over the center contact of the PL259, bringing the flange of the BNC into contact with the PL259 plug. Solder the wire in place and also solder together the outer conductors of both connectors. For this application you can discard the shell of the PL259. Shrink some heat-shrinkable tubing over the assembly, and you have a good emergency adapter.

—*Robert Runnels*, WA8UGT

ADD POWER LAMP/STROBE ACCESSORY TO YOUR TURNTABLE

You can add a power indicator light and strobe light accessory to your turntable for making quick and frequent checks of turntable speed. If your turntable doesn't already have a power indicator, mount a bayonet socket (with built-in resistor for operating neon lamps at 117 volts) on the front skirt of the turntable's base. At one end of the length of coaxial cable, solder a plain bayonet socket; at the other end a spare bayonet-type lamp base. In both cases, the center conductor of the coax goes to the "hot" contact, while the coax braid goes to the shell or "common" contact. Insulate any exposed metal with heat-shrinkable tubing. Plug the coax into the turntable-mounted lamp socket, and in-

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CIRCLE NO. 6 ON READER SERVICE PAGE

TIPS (*Continued from page 92*)

sert an NE51 or NE51H (if you want a brighter light, choose sockets to accept the brighter NE51H lamp.) Then read turntable speed with a conventional strobe disc.

—*Henry R. Rosenblatt*

TV LEAD-IN DOUBLES AS CABLE TIES

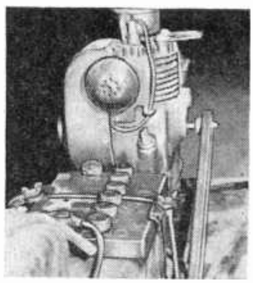
One of the most unsightly—and possibly most dangerous—things in ham shacks and workshops is dangling wires and cables. If you have some extra 300-ohm twin-lead TV lead-in cable handy, however, you can fabricate your own cable tie/hangers and eliminate the problems. Cut the lead-in to the approximate lengths needed, square at one end, and at an angle at the other end. Then punch a hole at the squared end to facilitate hanging, and a slot (slightly shorter than the twin-lead is wide) directly below the hole. (See photo for details.)

Wrap the fabricated cable tie/hanger around the cables to be bundled together and pass the angled end of the tie through the slot. Pull tight and anchor the tie with a nail or screw where desired. For low voltage, use the twin-lead as is; for high voltage, tear or cut out the conductors.

—*Stan Mosher*

MOWER ENGINE SAVES GAS WHEN CHARGING BATTERY

The camper usually has to rely on his car's electrical system for power to operate lights and radios, and this generally means that his car's engine must be kept running to keep the battery fully charged. However, with the aid of an old lawn mower engine and some hardware, the battery can be kept fully charged with a very small outlay for gas. First, use four heavy bolts to mount a metal plate semipermanently inside the car's engine near the generator or alternator. Then mount the mower engine on the metal plate. In use, you simply remove and save the fan belt, and run another belt from mower engine to generator. The generator's mounting bracket provides belt adjustment. Overcharging is prevented by the car's voltage regulator. When not in use, the fan belt goes back in place and the mower engine stores neatly away in your car's trunk.



—*Harry I. Miller*

CIRCLE NO. 18 ON READER SERVICE PAGE

INFORMATION CENTRAL

(*Continued from page 86*)

Lafayette Radio has one for $1.19 (99 H 6134 for 8 ohms and 99 H 6135 for 16 ohms). Most of the other major parts distributors also have good values.

Tubes To Transistors? *Is it possible to replace the tubes in my EICO Model 232 VTVM with transistors?*

It is possible but not practical; a complete re-design of the unit would be involved.

Downward Modulation of 525A. *I have a Lafayette CB transceiver (Model 525A), and I have been experiencing downward modulation. What could be the cause?*

Generally, overloading the final too heavily. Keep the loading down below that recommended by the manufacturer.

Converted Transceiver Use. *I modified a pair of 1-watt CB transceivers (handheld) for operation on the 10-meter band and they work very well. May my son, who has no ham license, operate one of the sets on 10 meters legally because of the low power involved? Also, if I use the sets in another call area for a couple of months,*

The answer to your first question is no; regardless of power, operation in the Amateur Radio Service requires a license. Yes, to your second question.

6146B and 6146 In Parallel? *Can I connect a 6146 and a 6146B in parallel without ill effects?*

This practice is not recommended if you want maximum power output. The two tubes, although close in characteristics, are not the same.

Disappointing Hi-Fi. *When I use my stereo tape recorder as an amplifier with my good Grado cartridge and Garrard turntable the sound lacks bass. Even re-recording records and discs sounds lifeless. Can't I solve this problem without an expensive amplifier?*

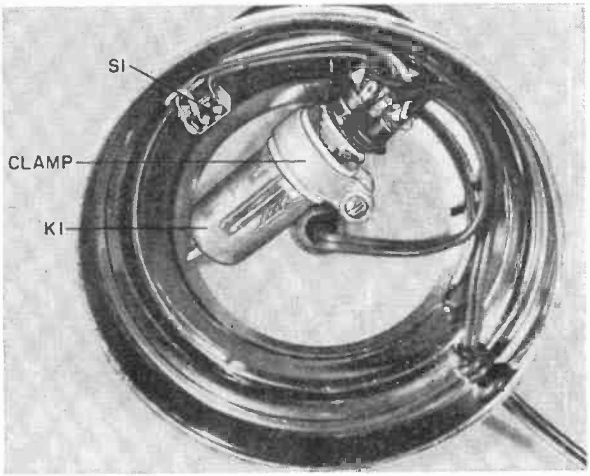
Your problem is one of lack of equalization in the tape recorder amplifier. In all probability that amplifier was not designed to work from a phono cartridge. Look into the possibility of buying an Olson (record equalization) preamplifier—Model AM-297. They are not too expensive and it will permit you to use most of your present equipment.

MANNERLY LAMP

(*Continued from page* 79)

photo. A clamp is used to hold the relay in place. First wrap a couple of layers of adhesive tape around the envelope of the relay, slip the relay into the clamp, and anchor the assembly to the lamp with appropriate hardware. Tighten the hardware just enough to hold the relay in place—not too tight, or the glass envelope may fracture. Now, affix a heat-resistant cover plate over the base of the lamp. Stiff fiberboard or two thicknesses of sheet asbestos will be perfect.

That's it! You now have a lamp with manners. —30—



Thermal relay and switch can be conveniently mounted inside hollow base of most lamps. Glue sheet asbestos and layer of felt over base to conceal tube and a.c. line cord.

SOLID STATE

(*Continued from page* 78)

a detected audio signal or d.c. components), a reflex circuit. But watch out for those combination regenerative-reflex designs!

Modified Design. An improved version of the headphone amplifier circuit given in our January. 1968 column is shown in Fig. 5. This modified design was abstracted from Application Bulletin APP-157, published by Fairchild Semiconductor (313 Fairchild Dr., Mountain View, Calif. 94040).

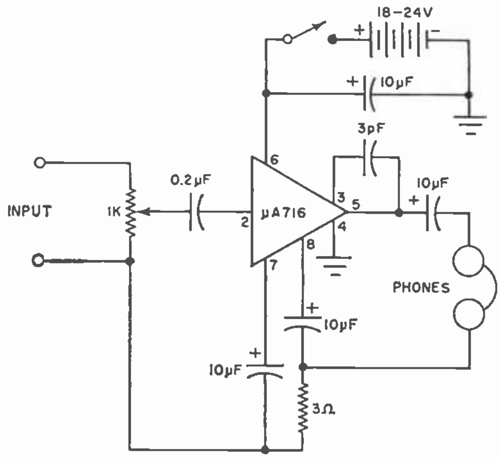


Fig. 5. Integrated-circuit headphone amplifier has good match to 600-ohm headset for high efficiency.

Like the earlier circuit, the amplifier has a rated gain of 100 and an output of approximately 50 mW. It differs from the previous design, however, in that it provides a better match to a 600-ohm headset, thus insuring higher efficiency and better quality of reproduction. It may be paired for use in stereo headphone systems or used singly for tape monitoring, in communications work or in language laboratories.

The amplifier may be assembled on a suitably designed etched circuit board or wired on perf board. Neither layout nor lead dress is critical, but good audio wiring practice should be observed, with all d.c. polarities noted and ample spacing provided between the input and output circuits. The assembled amplifier may be housed in a small metal or plastic case with commercial jacks for the input and output connections.

Who's On First? If there were a World Series among semiconductor manufacturers, the umpires would have a difficult job, indeed, in deciding who deserved first place. The firm which manufactures the most powerful silicon transistor, for example, might be completely out of the running in terms of voltage rating or high-frequency response. In addition, with competition keen and design engineers working overtime, there's a good chance the standings would have to be revised on a month-to-month, if not a day-to-day, basis.

From the standpoint of voltage ratings, the present leader would be Motorola with its 1500-volt MJE 8401 *npn* power transistor. On the other hand, Westinghouse would take first place in both the power dissipation and collector current contests with its 625-watt type 1401 and its 150-ampere (at 120 volts) type 1441. The present champion in terms of microwave power, however, is TRW Semiconductors with a newly introduced series capable of delivering up to 30 watts at 2 GHz.

In the SCR (or thyristor) games, General Electric would be unchallenged with its 1200-ampere, 1800-volt water-cooled type C500X1, but Westinghouse would be the top contender in the air-cooled league with its 550-ampere, 1500-volt type 282.

The price wars would find such firms as Motorola, Texas Instruments, and RCA slugging it out. Motorola would win a double header with its new budget-priced MPF106 and MPT107 *n*-channel FET's. With a noise figure of only 2.0 dB at 100 MHz, Motorola's new units can be used as amplifier's from d.c. to above 400 MHz, yet sell for as little as 75¢ each in quantities over 100. Texas Instruments, on the other hand, can counter with its new line of plastic-encapsulated *npn* and *pnp* complementary silicon power transistors. These units are rated for 30 to 90 watts power dissipation at 40 or 60 volts, depending on type, yet sell for as little as 70¢ each in moderate quantities. But competition is tough, for RCA can offer an unbroken series of wins with its metal-cased, hermetically sealed PHP series of silicon planar transistors, ranging from a mere 19¢ for the 2N5183 (in OEM quantities of 1000 up) 1-ampere, general-purpose amplifier to 39¢ for the 2N5179 low-noise UHF amplifier.

Over in the IC league, Motorola and Fairchild are fighting a see-saw battle for first place in terms of digital devices, while RCA has nearly everyone "running scared" with perhaps the most comprehensive line of low-cost linear devices in the industry.

If the situation seems confused, it is! There's a pretty good chance that almost any semiconductor manufacturer could be considered the leader, at least as far as a specific type of device is concerned.

Play ball! —Lou

SHORT-WAVE LISTENING

(Continued from page 82)

vice, St. Georges, is good on 15.095 kHz at 1613 with commentary and religious program, 2100-2200 with music requests and 2250-2300 with sports roundup. A new channel in use is 21.690 kHz found at 2035 with news to the British Isles.

Honduras—Jack Bacon in Minnesota reports that HRN, *La Voz de Honduras,* Tegucigalpa, often overrides *WMAQ,* a 50-kW Chicago station on 670 kHz. The 5875-kHz outlet is also good at times around 1200 in Spanish.

India—*All India Radio,* New Delhi, is excellent on 15,235 kHz at 2300-0115 s/off in English to N.E. Asia.

Indonesia—Djakarta, 6045 kHz, was good at 1200 with an organ IS, 1201 news, 1212 a "magazine" type program and some music until 1230. This is dual to 9770 kHz and is the Indonesian National Program.

Italy—Rome has a new channel: 17,795 kHz, as tuned at 0350 with English news and 0440 with an ID and music. The 11,810 kHz has been noted at 2230 in Spanish.

Jordan—Amman to So. Am. is on 15,170 kHz from 2330 s/on in Spanish to 0000 and to 0025 in Arabic. If it'll help, the opening ID is "Huna Amman, Idhas'at Al Mamlakate Al Urdoniete Al Hashemiya . . .".

Lebanon—Beirut has English to N. A. daily at 0230-0300 on 15,285 kHz. New frequencies in service include 17,750 kHz at 0020 with ID and into Arabic, and 21,610 kHz at 1905 closing English and to 1928 in Arabic.

Malagasy Republic—Tananarive, 3288 kHz, opens in French at 0330 with a full ID and anthem and follows with variety pop tunes until fadeout at 0400.

Malaysia—*R. Malaysia,* Kuala Lumpur, 9665 kHz, has pop music at 1255, "Malaysian Gazette" at 1315, "Top Tunes" at 1330, sports scores at 1345, English news at 1400 and a commentary at 1410. Throughout the program are sprinkled ID's and commercials. The program is in English but the ID, in Malay, is "Ini-lah Radio Malaysia."

Netherlands Antilles—*Trans World Radio,* Bonaire, has been logged on 9590 kHz at 0730 with news in Dutch, on 11,820 kHz at 0050 with an English religious program, on 15,180 kHz at 2030-2055 in German and to 2125 in English, and on 15,435 kHz in English to Europe at 2100.

New Hebrides—*R. Vila* is currently scheduled as follows: Tuesday to Friday at 0030-0115 on 7260 kHz and 0600-0720 on 3905 kHz. Programs are in English, Pidgin and French. French is aired from 0700 to s/off which varies between 0710-0720.

New Zealand—The schedule given last month for *R. New Zealand* was incomplete. Please add: To Samoa at 0720-0750 Tuesday and to the Cook Islands at 0810 Wednesday on 6080 and 9540 kHz. No English is given on either xmsn. Also please change the Australian xmsn to read: 2000-2145 on 11,705 kHz and 2200-0545 on 17,770 kHz.

Nigeria—Lagos, 21,450 kHz, is using this 13-meter outlet for their external service between 1300-1400 French, 1500-1600, and 1800-1900 English, 1400-1500 Hausa and 1600-1700 Arabic. We've found this one easy to log during their English xmsn. The 15.155-kHz channel is also noted at good level at 0600 with English news and commentary.

Papua/New Guinea—*R. Bougainville,* Kieta, 3322.5 kHz, 3600 watts, operates 0800-1105 weekdays (to 1205 Saturdays); Midwestern reports indicate it is being heard at 1035-1055 with pop music and in vernacular. VL9BR, *R. Rabaul,* 3385 kHz, is also heard in the Midwest mornings in Pidgin and English.

Peru—OBZ4I, *R. Erpa,* Canete, is a seldom-heard station, but pop music may be heard at times along with usual L.A. style programming at 0200; anmts are in Spanish and the frequency is 3320 kHz.

Portugal—*R. Lisboa* has been found on a new and unlisted frequency of 15,315 kHz in Portuguese to Brazil and L.A., at 2230-0000; pop Portuguese music, documentary, news and pop/folk music make up the program. This channel operates parallel to 11,840 kHz.

SHORT-WAVE ABBREVIATIONS

anmt—Announcement	kW—Kilowatts
BBC—British Broadcasting Corp.	L.A.—Latin America
GMT—Greenwich Mean Time	N.A.—North America
ID—Identification	R—Radio
IS—Interval Signal	s/off—Sign-off
kHz—Kilohertz	s/on—Sign-on
	xmsn—Transmission
	xmtr—Transmitter

USSR—Petropavlovsk was heard in Russian with a drama at 0850 on 4485 kHz and running dual to 7380 kHz and, at times, to 9500 kHz. Six time-pips are given at 0900, the usual Moscow ID and into music at 0901.

Vatican City—*R. Vaticano* has an 1840 s/on in language on seldom-heard 15,185 kHz. New channels in use include 15,200 kHz at 1650 in Arabic and 21,570 kHz at 2315 in Portuguese and 2330 in Spanish to L.A.

Vietnam (North)—Hanoi is weak in language at 1400 on 15.018 kHz. Others report it on 15.044 kHz at 1400 with time-pips, news at 1401, a march at 1405, commentary at 1406. Vietnamese folk music at 1410, a speech at 1411, and a talk at 1424. This is the Vietnamese Home Service and the ID is "Day la Tieng Noi Viet-Nam phat thanh tu Hano."

Clandestine—A QSL has been received from *R. Libertad, La Voz Anticomunista de America*; the reception report had been sent to NTS, 125 bis Rue Blomet, Paris 15, France; the QSL was postmarked Caracas, Venezuela. Mailing addresses as indicated on the QSL itself are P. O. Box 2214, Miami Beach, Fla. and P. O. Box 5650, Caracas. The return address on the envelope is DYTA, Apartado 20.064, z.p. 5, Caracas. The QSL card, printed by an American Ham radio card printer, had a message on the back indicating that the operation is a function of the NTS, a secret organization dedicated to overthrowing the Communist government of the USSR. Waiting time for the QSL was five months.

We've also received one report in the past few days that showed *R. Americas*, Swan Island, to be operating again on 6000 kHz. However, this report is thought to be in error since operations there ceased last May.

73, Hank, WPE2FT/W2PNA

SHORT-WAVE CONTRIBUTORS

William Bancroft *(WPE1CLK)*, Pittsfield, Mass.
Chris Lobdell *(WPE1GCI)*, Reading, Mass.
Bob Raymond *(WPE1HOE)*, Bradford, Mass.
Ronald Christen *(WPE2NZI)*, Cheektowaga, N. Y.
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Robert Kennicutt, Jr. *(WPE2PRR)*, Port Crane, N. Y.
Andy Rodau *(WPE2PRX)*, Hewlett, N. Y.
Daniel Girard *(WPE2QEV)*, Utica, N. Y.
David Perry *(WPE2QFK)*, Pleasant Valley, N. Y.
James Farrell *(WPE2QIJ)*, Ridgefield Park, N. J.
Tom Shultz *(WPE2QJJ)*, Cherry Hill, N. J.
Marc Bacharach *(WPE3HEM)*, Philadelphia, Pa.
Henry Eggles *(WPE3JX)*, Philadelphia, Pa.
Dan Ferguson *(WPE4AUL)*, Coral Gables, Fla.
Grady Ferguson *(WPE4BC)*, Charlotte, N. C.
James Hawkins *(WPE4HD)*, FPO (Vietnam)
Wayne Ayers *(WPE4JXD)*, Decatur, Ga.
Randy Flynn *(WPE4JRV)*, Vienna, Va.
David Potter *(WPE4JXO)*, Key West, Fla.
Ray Lindquist *(WPE4JVB)*, Miami, Fla.
Paul Roddy *(WPE5EVH)*, Edna, Texas
Stewart MacKenzie *(WPE6AA)*, Huntington Beach, Calif.
Don Kenney *(WPE6AET)*, Santa Monica, Calif.
Bruce Brolsma *(WPE6GMD)*, Northridge, Calif.
Steve Higgins *(WPE6HAS)*, Covina, Calif.
Dan Seibel *(WPE6HCU)*, San Leandro, Calif.
George Schnabel *(WPE8EMO)*, Rochester, N. Y.
Wendell Way *(WPE8HVV)*, Canton, Ohio.
Henry Gac *(WPE8JST)*, Detroit, Mich.
Louis Schulman *(WPE8JTX)*, Cleveland Heights, Ohio
William Jordan *(WPE8JYI)*, Newberry, Mich.
Gerry Dexter *(WPE9HDB)*, Lake Geneva, Wis.
Richard Pistek *(WPE9HOA)*, Chicago, Ill.
Richard Doering *(WPE9IXG)*, Hinsdale, Ill.
Gary Bullinger *(WPE9JCZ)*, Aurora, Ill.
Greg Buchanan *(WPE9JGK)*, South Bend, Ind.
Donald Zank *(WPE9JGM)*, Milwaukee, Wis.
Fred Lynch *(WPE9JHD)*, Girard, Ill.
Dwight Snyder *(WPE9JHV)*, Farmersville, Ill.
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John Beaver, Sr. *(WPEØAE)*, Pueblo, Colo.
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R. Lucht, Key West, Fla.
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Gordon Nelson, Watertown, Mass.
John Patterson, Oswego, Ill.
Bob Penn, Atlanta, Ga.
Jim Renfrew, New Canaan, Conn.
Leo Song, Jr., Los Angeles, Calif.
Brian Walls, Fullerton, Calif.
Radio New Zealand, Wellington, N. Z.
Sweden Calling DX'ers Bulletin, Stockholm, Sweden

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 and model number of the unit. If you don't know both the maker's name and the model number, give 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.*

Power Unit PE-103-A. Radio Transceiver BC-222. Operating manuals and schematics needed. (Marvin D. Foster, 901 Orchard Dr., Fayetteville, N.C. 29303)

Butler Bros. Model 921-S TV. Schematic and source for parts needed. (Robert Layton, 118 N. Locust St., Pauls Valley, Okla. 73075)

Hallicrafters Model 5R33A. Schematic and manual needed. Emerson Model BM206. Schematic, manual, and parts source needed. (William G. Murray, 96 Brush Hill Rd., Milton, Mass. 02187)

Precise Model 315B oscilloscope. Replacement of power transformer needed. (Thomas L. Keister, Jr., 1046 Matthews St., Jackson, Miss. 39209)

Gonset G-66 mobile receiver. Schematic and operating manual needed. (William H. Hardy, Jr., 204 Sunset Dr., Lower Burrell, Pa. 15068)

Gonset 50 six-meter transceiver. Schematic and operating manual needed. (H. Vandergrift, Warwick Hotel, St. Louis, Mo. 63103)

Sonar Model MR-3 10, 20, and 80 meter receiver. **Harvey Wells Electronics** Model AT-3B-12 transmitter. Schematics and service data needed. (George C. French, 4326 Avon Dr., La Mesa, Calif. 92041)

Harvey-Wells TBS-50-D deluxe bandmaster, circa 1950-55. Schematic, alignment, and operating instructions needed. (Bruce Hibbert, 559 Oriole Ln., Corona, Calif.)

DeForests Training 2", 3-tube CRT oscilloscope. Schematic and parts list needed. (Richard Mundwiler, 20122 Nightbird Trail, Crosby, Texas 77532)

Knight-Kit T-60 transmitter. Manual needed. (Arthur Fisher, Rte. 4, College Ave., Ellicott City, Md. 21043)

Sparton Model 301 radio, 1933. Schematic needed. (John Kusek, 821 E. Hector St., Conshohocken, Pa. 19428)

Pilot Model T 601 FM "Pilotuner." Schematic and hookup instructions needed. (Thomas K. McNally, Fine Rd., High Bridge, N.J. 08829)

Pentron Pacemaker tape recorder; belts by Telton. New belts needed. (John F. Wittlinger, 248 E. 293 St., Willowick, Ohio 44094)

Hallicrafters Model S-38. Schematic, operating manual, and alignment data needed. (Paul Tran, 1126 Miles Ave., Pacific Grove, Calif. 93950)

Heathkit Model O-8 oscilloscope. Schematic and operating manual needed. (Rick Rumack, 7941 W. Lake St., Morton Grove, Ill. 60053)

Radio City Products Model 664 VTVM. Schematic needed. (Donald Rochford, 3560 Olinville Ave., Bronx, N.Y. 10467)

Triumph Model 830 3" oscilloscope; Navy type CTU 60018. Schematic needed. (Don Jeppesen, 2318 Second Ave., Council Bluffs, Iowa 51501)

RCA Model AR88D receiver. Manual, schematic, and source for parts needed. (Robert R. Collins, 490-A Esteli Dr., MCAS Beaufort, S.C. 29902)

Heath Model DX-20 transmitter. Schematic and operating manual needed. (Bernard Skoch, 1001 N. Gray, Jacksonville, Ark. 72076)

Philco Model 38-116 receiver. Schematic, operating manual, tuning instructions, and source for parts needed. (Bill Harrison, 2020 Olga Ave., Nashville, Tenn. 37216)

Truetone CB radio, 12-channel. Schematic and manual needed. (Andy Fredlund, 5324 Malibu Ct., Cape Coral, Fla. 33904)

Brunswick Model 22 floor model radio. Circuit diagram needed. (William Pepe, 112 N. 17 St., Bloomfield, N.J.)

Atwater Kent Model 82. Schematic and source for plug-in electrodynamic speaker needed. Also operating instructions and alignment data. (John Szychulda, 13937 Bora Dr., La Mirada, Calif. 90638)

Aviola Model 502 receiver. Schematic, source for parts, and any information needed. (Karl Salmon, 2915 5th Ave., York, Pa. 17402)

Packard-Bell Model 861 phonocord radio and disc recorder. Schematic and source of parts for a General Industries automatic record changer and disc cutter needed. (Keith Headley, 10514 Buford Ave., Lennox, Calif. 90304)

Hallicrafters Model S-22 receiver. Schematic and alignment data needed. (Doub Zimmer, 14332 35th N.E., Seattle, Wn. 98125)

Heathkit Model EA-2 amplifier and preamp. Schematic and operating manual needed. (Stephan Perhacs, 5201 Shirley St., Verona, Pa. 15147)

Barker & Williamson Model 380B T-R switch. Operating manual and/or schematic needed. (Robert F. Malone, Jr., 21 Joysan Terr., RFD #1, Freehold, N.J. 07728)

Crestwood Model 404 mono tape deck. Source for parts needed. (Paul Gottlieb, 3224 Grand Concourse, Bronx, N.Y. 10458)

National Model NC100A. Schematic and operating manual needed. (Mike Corrigan, 828 8th St., S.W., Rochester, Minn. 55901)

GE Model RC125 FM. Schematic, tune-up, and tube location needed. Industrial Model HM-PS40 two-way radio. Schematic, tube line-up and tune-up needed. (Ed Galovic, 86 Egbert Rd., Beford, Ohio 44146)

Hallicrafters Sky Ranger Model S-39 receiver. Schematic and alignment data needed. (Bing Zamora, P.O.B. 2184, 431 Sales St., Sta. Cruz, Manila, Philippines)

GE Model CRO-3A oscilloscope. Schematic needed. (Donald B. Price, 141 Court St., Chardon, Ohio 44024)

Superior Instruments Model 670A super meter. New D'Arsonval movement or circuit to be used with conventional meter needed. (T.A. Harmon, 1020 Barbara Pl, #2, Salt Lake City, Utah 84102)

Philco Model 39-116 with remote control. Schematic, service manual, and source for parts needed. (Marlin D. Strickland, 443 Claudia Dr., Sonoma, Calif. 95476)

Philco Model 635 receiver, code 121. Power transformer, schematic, and parts list needed. (Ken Croston, 1603 N. High, Independence, Mo. 64050)

Crosley Model J13 AM/SW radio; made by Mohawk Radio. Schematic needed. (Lawrence Meikle, R.R. #1, Richmond Hill, Ont., Canada)

Precise Model 630 RF-AF and TV marker generator. Schematic, alignment instructions, and other information needed. **Trio** Model TR-2M antenna rotator. Schematic of control head needed. (Robert Vicek, 2328 Bellevue Ave., Maplewood, Mo. 63143)

Harvey-Wells Model R9A receiver. Schematic and instruction manual needed. (Howard M. Rickert, 1916 18th Pl., Yuma, Ariz. 85364)

E.H. Scott AM/SW receiver, circa 1937; has 15 tubes; tunes .55-22 mHz in 4 bands. Operating manual and schematic needed. (Wesley Bacon, 114 Andover St., N. Wilmington, Mass. 01887)

Hallicrafters Model 5R10A receiver. Schematic and instruction manual needed. (Cliff Reno, 75 Parish Rd., New Canaan, Conn. 06840)

Atwater Kent Model 35, 1926-1938. Schematic, power supply data, and source for tubes (CK-301-A) needed. (Gerald W. Rutter, 3413 Clayton Ave., Wilmington, Dela. 19808)

RCA Model 813K SW receiver. Schematic, operating manual, and cabinet design needed. (Mark Carro, 539 Acton Rd., Columbus, Ohio 43214)

RCA Model AR-88 communications receiver. Alignment instructions needed. (Dale Hall, Box 3631 HSRC, Hot Springs, Ark. 71901)

"Echomatic" microphone tape unit built by Meazzi Co. of Italy. Schematic needed. (George H. Winter, 21 Briarwood, Tuscaloosa, Ala. 35401)

Weston Model 772 type 1 analyzer. Schematic and operating manual needed. (Peter Delenick, P.O. Box 665, Pottsville, Penn. 17901)

Paco Model S55 oscilloscope. Power transformer and 5UP1 CRT or junk scope for parts needed. (Robert Wurth, 495 Myrtle, Florissant, Mo. 63031)

Triumph Model 839 oscillograph. Operating manual and schematic needed. (Stan Sudol, 1009 Grandridge Ave., Monterey Park, Calif. 91754)

Superior Model TV-12 tube tester. Operating manual and latest roll chart needed (John Meador, 2621

(Continued on page 104)

ASSIST

(Continued from page 103)

Drakestone, Oklahoma City, Okla. 73120)

Pentron Model XP-60 tape recorder. Parts needed. (Paul F. Earhart, 5427 Florence Blvd., Omaha, Neb. 68110)

Airline Model 8A55 SW/AM receiver. Schematic, manuals, and 6U5 tuning eye needed. (Pat Griffith, 2956 Eliot Circle, #4, Westminster, Colo. 80030)

Link type 2210 ED-2 FM transceiver. Schematic and servicing information needed. (Tom Lucas, 410 E. Bellefonte Ave., Alexandria, Va. 22301)

Lafayette Model 20k AM/FM tuner, amplifier. Tube location and/or instruction manual needed. (Gary Epstein, 1252 N. Pierce Ave., N. Bellmore, N.Y. 11710)

Sparton Model 3498 AC7 receiver. Schematic, tube location chart, input voltages, and input terminal information needed. **Tuska** Model 300 receiver. Schematic and tube numbers needed. **Crosley** Tridyn 3-R-3 #65547 receiver, circa 1914. Schematic, tube numbers, and operating voltages needed. (John M. Rosenbaum, 25245 Roosevelt Rd., South Bend, Ind. 46614)

Heathkit Model A-7 amplifier. Schematic needed. (Bill Mangahas, 1010 Ocean Ave., Brooklyn, N.Y. 11226)

Magnavox tuner chassis CR321-A, amp 111-A. **RCA** Model 9K. Schematics, parts lists, and other information needed. (John A. Graham, Jr., 2160 Cowley Way, San Diego, Calif. 92110)

Philco tropic Model 39-750. Schematic, operating manual, alignment data, and source for Philco "E" tubes needed. (Irving Leiboff, 667 E. 34 St., Brooklyn, N.Y. 11203)

Zenith Model 5DO15Z "long distance" receiver. Operating manual and output transformer (Zenith part 202-549) needed. (Robert Gormley, 5 Cantitoe Rd., Yonkers, N.Y. 10710)

Majestic Model 92 receiver. Model G-3 speaker and schematic needed. (Terry Loving, RR #1, Loami, Ill. 62661)

Philco Model 90 radio receiver. Schematic, parts, list, and source for parts needed. (B. J. Maxwell, 139 Oswald St., Breaux Bridge, La. 70517)

Atwater Kent Model 42. Schematic, tubes, service data, history needed. **Atwater Kent** Model 33. CX301 tube, schematic, service data, and history needed; also tube diagrams and filament voltages for CX301A, CX371A, UX280, UX226, and UY227. (Eugene P. Schmitt, 2401 W. Glenbrook Ln., Mequon, Wis. 53092)

Melody Masters Model J-700 radio. Schematic or size of selenium rectifier and electrolytic capacitor and connections to both. (James P. Clark, 107 N. 23rd St., Kenilworth, N.J. 07033)

RCA Radiola Model 18 BCB receiver, circa 1927. Volume control needed. (Michael D. Brooks, 111th Ave., Rte. 1, Box 45B, Allegan, Mich. 49010)

Gonset Model G-33 receiver. Schematic and service manual needed. **Heath** Model AR-3 receiver. Operating Manual and source for parts needed. (T. Mangels, S. King St., Danbury, Conn. 0690)

National Radio Model RCL receiver, circa 1940. Alignment information and coils for first band needed. **Hallicrafters** Model SX-28 receiver, circa 1940. Alignment information, S meter, and selectivity switch needed. (Paul Mendoza, 4030 Laconia Ave., Bronx, N.Y. 10466)

Eico Model HF-87 dual power amplifier. Construction manual needed. (Peter E. Parker, 615 NE 160 Terr., N. Miami Beach, Fla. 33162)

Delco Model R-1179 receiver. Schematic and servicing data needed. (Gary R. Sparks, 1012 Avalon Ln., Chesterfield, Ind. 46017)

Acrosound Model S-1001 preamplifier and Model 20/20 dual 20-W power amplifier. Manuals and/or schematics needed. (M. Friess, Box 6411, Surfside, Fla. 33154)

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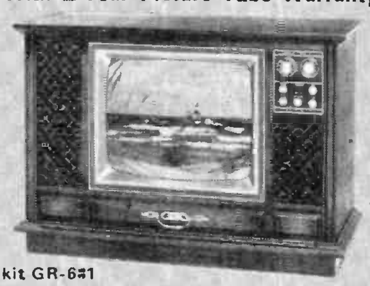

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GRA-227-1, Walnut cabinet shown **$59.95**
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GRA-180-5, table model cabinet and cart **$39.95**
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Now, Wireless Remote Control For Heathkit Color TV's

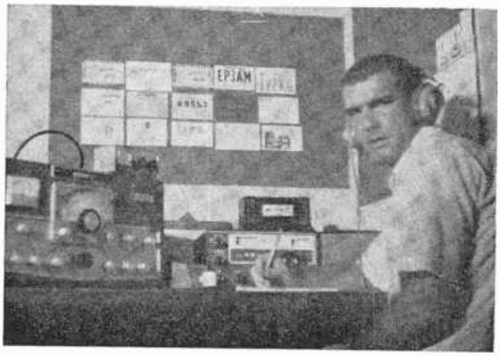
Control your Heathkit Color TV from your easy chair, turn it on and off, change VHF channels, volume, color and tint, all by sonic remote control. No cables cluttering the room . . . the handheld transmitter is all electronic, powered by a small 9 v. battery, housed in a small, smartly styled beige plastic case. The receiver contains an integrated circuit and a meter for adjustment ease. Installation is easy even in older Heathkit color TV's thanks to circuit board-wiring harness construction. For greater TV enjoyment, order yours now.

kit GRA-681-6, 7 lbs., for Heathkit GR-681 Color TV's **$59.95**
kit GRA-295-6, 9 lbs., for Heathkit GR-295 and GR-25 Color TV's **$69.59**
kit GRA-227-6, 9 lbs., for Heathkit GR-227 and GR-180 Color TV's **$69.95**

AMATEUR RADIO

(*Continued from page* 84)

to distortion and interference. Digital techniques are already in use on long-distance telephone circuits.



Steve Glickman, WB4HFJ, worked 150-plus countries in 8 months as a General (see "News And Views").

FCC News. In late July, the Federal Communications Commission proposed that anyone who has not held an amateur license within the past 12 months will be eligible for a Novice license. The action was taken as the Commission denied the petition of the Amateur Radio Committee of the Electronic Industries Association (EIA) to make the Novice license good for 5 years, renewable, to decrease the code-speed requirements, to continue Novice 2-meter phone privileges after November 22, and to permit Novice phone operation on 10 meters. Undoubtedly, the FCC will hold hearings before setting the date when the new proposal becomes law.

Also in July, the FCC authorized slow-scan television in Advanced and Extra class sections of the amateur phone bands. The SSTV signals cannot occupy more channel width than a normal amateur phone signal.

NEWS AND VIEWS

Jim Kassel, WN9YQC, 2280 Mayflower St., Aurora, Ill. 60506, uses the rain gutter around his house for an antenna. Although only eight feet high and fed with 300-ohm TV lead-in, the antenna has been used to work 28 states, including Alaska, in the first month on the air. The Heathkit DX-60B transmitter and HR-10B receiver combination complete Jim's station . . . **Ann Zarodnansky, WA2BUU,** P.O. Box 2016, Trenton, N.J., takes issue with women who object to their ham husbands spending too much time in their shacks fooling around with their ham gear. Ann says, "Much better than having them running around fooling with other women!" Ann once had a ham husband—what happened to him, she didn't say—and, now that she's 40 with her own General license she wishes she had another. Guess we're habit forming . . . **Mike Hindson, WN6IDP,** 5041 Dovewood Dr., Huntington Beach, Calif. 92647, receives on a Knight-Kit Star Roamer and transmits on an EICO 723. A Hy-Gain 14-AVQ vertical antenna does the radiating. His record is eight states in five days of operation.

Via Ray Meyers, W6MLZ's column "Ham on The Air" in the Los Angeles *Herald Examiner*, the U.S. Hospital Ship *Repose* stationed off the coast of Vietnam can be heard on 14,345 kHz at 1500 GMT most mornings. **Cpl. Frank J. Ayd, USMC, WA3ILR,** signing "Maritime Mobile Region 3," is the operator. Captain Engle of the *Repose* reports that the messages and phone patches handled by its amateur station are the biggest morale boosters on the ship . . . **John Pokluda, WN2GMP,** 1212-91 St., North Bergen, N.J. 07047, worked 25 states, including Alaska, plus Sweden his first 17 days on the air. A Johnson Valiant transmitter cranked down to 75 watts, a National NC-303 receiver, and a trap vertical antenna in the back yard made all contacts on the single frequency of 21,250 kHz . . . **Joe Rutledge, WB4ESE,** P.O. Box 211, Lewisburg, Tenn. 37091, started as a Novice in 1966 and now has his Advanced ticket. Joe's Drake TR-4 transceiver can be fed into either of two dipoles or into a vertical antenna. Although Joe prefers working in traffic nets or ragchewing to DX'ing, he has 47 states and a number of foreign countries confirmed. Oh yes, WB4ESE is the Net Control Station (NCS) of the Tennessee Teen-Age Net on 40 meters and is a member of Navy MARS.

Amateurs and would-be amateurs in the Detroit, Michigan, area interested in joining a live-wire club might investigate the Oak Park Amateur Radio Club. Meetings are the second Monday of each month at the Oak Park, Mich., Community Center, 14300 Oak Park Boulevard. Contact **Jerry Blumenthal, W8TWJ,** by phone (353-7529) or **Jeff Mazur, WN8ZZZ,** 14231 Vernon, Oak Park, Mich. 43237, for more information . . . **Greg Rainwater, WN7JEG,** 12 W. Intercity Ave., Everett, Wash. 98201, has worked New Zealand and the Marshall Islands running 50 watts on 15 meters. He uses a homebrew ten watter to ragchew with the locals on 80 meters and also works a little 40 meters . . . In two months as a Novice and eight as a General, **Steve Glickman, WB4HFJ,** 7835 SW 133 St., Miami, Fla. 33156, has earned Worked All States (WAS), Worked All Continents (WAC), RagChewers' Club (RCC), and DX Century Club (DXCC) certificates. He has also picked up a 25-wpm code certificate along the way. Steve had 119 countries confirmed out of the 150+ worked when he wrote. All work is on CW with a Johnson Valiant transmitter and a Drake 2C receiver. The first 75 countries were worked with a vertical antenna, the rest with a tri-band, 2-element Quad, 33 feet high on a home-built tower . . . **Gary Cohen, WN1JBB,** 70 Kenwood Drive, New Britain, Conn. 06052, excites 15- and 40-meter dipoles

Jim Kassel, WN9QYC, has worked 28 states in a month—using the house rain gutter for an antenna, no less! For information, see "News and Views."

with an ancient Heatkit DX-40 transmitter, and he receives on an even older Hammarlund HQ-129X receiver. His record of 43 states and nine countries indicates that Gary knows how to use the equipment. A General class license is on the way . . . Do you like SPAM? SWL Mrs. George P. Douglass, 2232 Dunseath Ave., N.W., Apt. I-5, Atlanta, Ga. 30318, does. SPAM is the "Society For The Preservation of Advanced Modulation" against SSB. W4CJL is the president of the group. Mrs. Douglass has a valid point in saying that shortwave listeners usually can tune in AM signals easier than SSB signals; however, few amateurs—whether they use CW, AM, SSB, FM, or RTTY—select their mode of transmission primarily for the convenience of SWL's, although I don't know of any who object to SWL's listening to their transmissions . . . **Page Pyne, WA3EOP,** 717 Oak Hill Drive, Hagerstown, Md. 21740, after two years as a Technician, has obtained his General ticket and spends much of his time on the QRP'ers (Low Power Club) frequency of 7040 kHz. As a Tech, he worked 20 states on 50, 144, and 220 MHz with low-power Tecraft equipment. He worked 150 miles on 220 MHz, but he found little activity on that band, except in various VHF contests.

Whatever sections of the bands you operate in these days, may you have a fine Thanksgiving. Keep your "News and Views," pictures, and club bulletins coming; so your friends can read about *you* in these pages. The address is: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P.O. 678, Gary, Ind. 46401.

73, Herb, W9EGQ.

LIBRARY (*Continued from page 14*)

technological impact has been so dramatic that it already heralds a new era in electronics. This book, therefore, provides the basic information needed to bring the benefits of the IC to all areas of electronics. It bridges the gap between the design and marketing concepts associated with discrete-component equipment and the considerations involved in the use of integrated systems. Every area of the electronics industry is treated—from engineering to servicing, from equipment to product marketing—to provide each with an understanding of its role. With mathematics kept to a minimum, the reader needs only a basic knowledge of electronics and a familiarity with semiconductor principles. Numerous charts, graphs, and tables highlight key points.

Published by Hayden Book Company, Inc., 116 West 14 St., New York, N.Y. 10011. Hard cover. 198 pages. $8.95.

INTEGRATED CIRCUITS FUNDAMENTALS AND PROJECTS

by Rufus P. Turner

While integrated circuits have only recently become available to the average hobbyist, there is already a pressing need for an authoritative book to explain their many facets. In doing just that, this book gives the historic background of the development of the IC, explains its characteristics, discusses the types of IC's available, and gives some examples of IC applications. Written in a non-technical style, the book is easy enough for even a novice to electronics to understand. Included are complete assembly details for six IC projects.

Published by Allied Radio Corp., 100 N. Western Ave., Chicago, Ill. 60680. Soft cover. 95 pages. 75¢.

MODERN TV CIRCUIT AND WAVEFORM ANALYSIS

by Stan Prentiss

This book emphasizes the efficiency of the triggered-sweep oscilloscope for diagnosing color and monochrome TV circuit troubles. The discussions include both the tube-type TV chassis as well as the newest in solid-state (including IC) chassis. The text leads off with an analysis of basic and typical waveforms that are found in the average TV receiver. Then, each chapter includes descriptions of various types of circuits, liberally illustrated with the waveforms that would be observed when typical troubles develop. For the more hardy professional TV service technician, just enough math is included to promote a working knowledge of basic principles.

Published by Tab Books, Blue Ridge Summit, Pa. 17214. Hard cover. 256 pages. $7.95 (soft cover, $4.95).

FET REJUVENATES VOM

(Continued from page 73)

batteries used for power. Although the author used a pair of 6.75-volt mercury cells, you can use any combination of batteries to produce between 9 and 13 volts for satisfactory operation. The two FET's draw only 0.5 mA during a measurement, while the seldom-used calibration circuit takes 15 mA. Batteries should last a long time.

Operation. Place the VOM range switch in the 1-volt d.c. position, then connect the VOM to the FET adapter output binding posts, making sure that proper polarity is observed. Connect a pair of test leads to the adapter input binding posts and short these two leads together. Then place the FET adapter RANGE switch (*S2*) in any position other than OFF. Rotate the ZERO potentiometer (*R13*) until the VOM needle is on zero.

Separate the two test leads on the input of the adapter and place the RANGE switch in the 0.1-V position. Depress the CALIBRATE pushbutton (*S1*) and adjust the CALIBRATE potentiometer (*R14*) until the VOM indicates exactly 1-volt d.c. Release the pushbutton.

If your VOM has a full-scale range of 1.2 or 1.5 volts, adjust *R14* for an exact 1-volt reading. In either case, the scale markings of the VOM must be multiplied by 100 to give you a reading in millivolts. Once calibration has been performed for the 0.1-V position of *S2*, the calibration will hold true for the other three ranges.

In the case of the 0.5-V position, multiply the VOM reading by 500 to obtain the value in millivolts (or divide by two to get the value in volts); in the 5-V position, multiply the VOM scale by 5 to get the value in volts; and in the 10-V position, multiply the VOM scale by 10 for the value in volts.

Because of the very high input resistance and the 0.1-volt full-scale lowest range, the FET adapter can be used to measure very small current flow through a circuit. This is done by measuring the voltage drop across a resistor with a low ohmic value in series with the current flow. Apply Ohm's Law (E=I/R) to find the current. —30—

HOW IT WORKS

The circuit takes advantage of the very high input impedance of FET's to provide a 10-megohm non-loading impedance to the circuit under test and also supply power to a low-input-im pedance VOM. The circuit is a differential amplifier using a common source resistor (*R7*, see Fig. 1), with the variable d.c. input to one FET (*Q1*) compared with the fixed gate voltage of the other FET (*Q2*). Once both FET's have the same d.c. drain voltage, determined by zero control *R13*, any difference between the gate voltages is reflected as a change in drain current between the FET's. The voltage difference produced by the change in drain current is measured on the VOM.

A voltage divider at the input—*R1* through *R4*—is used to select the measured range. The VOM adapter is not required for voltage measurements above 10 volts because above this voltage range the input impedance of the VOM is quite sufficient for most applications. For example, a 20,000-ohm-per-volt VOM on the 1200-volt range has an input resistance of 2 megohms, while a 1000-ohm-per-volt VOM on the same range has an input resistance of 100,000 ohms.

Zener diode *D1*, voltage-divider *R11* and *R12*, and resistor *R10* form a calibration circuit. The 13.5 volts of battery *B1* is converted to a precise 100-mV source and is fed to input FET *Q1* when pushbutton switch *S1* is operated. This enables precise setting of the calibration control (*R14*) so that the external VOM will indicate exactly 1 volt.

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11 b

MAGNETIC STIRRER

(Continued from page 45)

Clean the top outside surface of the chassis, and glue on a sheet of 1/16"-thick cork that just covers the top. The appearance of the stirrer will be enhanced by covering the cork surface with white self-adhesive plastic sheet. White is used so that the true color of the liquid being stirred is visible. Allow the cork cement to dry thoroughly before applying the plastic or wrinkles will appear.

Testing and Use. Apply power to the circuit by rotating the speed-control potentiometer (*R1*) until switch *S1* closes and power-on indicator *I1* lights. As *R1* is rotated, the motor (and driving magnet) should spin faster and faster. Make sure when you wire the potentiometer, that the slowest motor speed occurs just after *S1* turns on. Turn off the power before the next step.

Fill a small beaker with water and place it on the white upper surface of the magnetic stirrer, directly above the driver magnet. Drop in a steel paper clip or small bar magnet. It will instantly align itself with the driver magnet. Position the beaker until the paper clip or bar magnet is centered within the beaker. As *R1* is rotated and power comes on, the stirring magnet will start to rotate (with the motor), and as *R1* is rotated up its range, the stirrer will rotate faster and produce a vortex in the water.

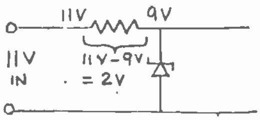
To avoid chemical interactions with the liquid being stirred, especially with corrosive or very active solutions, it is best to use a stirring magnet having a protective plastic coating. A magnet with a teflon coating is available (see Parts List).

A very handy gadget to have is a stirring-magnet retriever. This enables you to extract the stirring magnet without putting your fingers in the solution (with possible disastrous results if the solution happens to be corrosive or toxic). You can make a retriever by sealing a small magnet within a long plastic tube, or you can purchase one at low cost (see Parts List). —30—

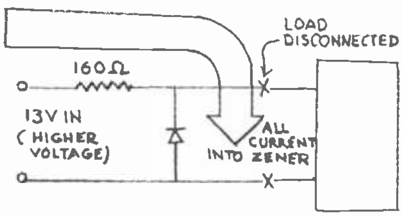
ZENER DIODE

(*Continued from page* 54)

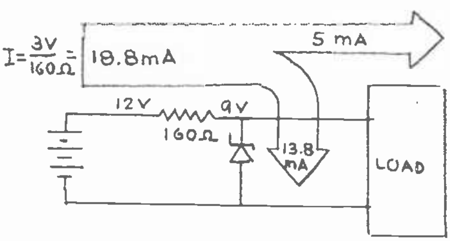
We also know there is only two volts driving the current through the resistor.



Ohm's law tells us that R = E/I = 2/0.0125 = 160 ohms. To handle our "worse case" conditions, the resistor value must be halved. Such a large change requires us to determine what would happen if someone disconnects the receiver and battery voltage is up to 13 volts.



Fortunately, Ohm's law shows that a ¼-watt resistor will adequately handle the current. Now we have a regulator circuit we can build with confidence.



We have paid a price for our regulator, however, in the form of 13.8 mA wastage current through the zener diode. The advantage is that the receiver will operate reliably no matter what happens.

Now you know what a zener diode is and, more important, how it is used effectively. Our hypothetical example revolved around a radio-receiver load. But the load could just as easily have been a hi-fi amplifier, oscillator, or even a test instrument. —30—

CRACKERJACK QUIZ ANSWERS

(*Quiz appears on page* 46)

1 **False.** The well-equipped shop can service transistorized equipment with no additional instruments. However, equipment specially designed for transistor service can make the job easier.

2 **False.** Sync separator circuits separate the composite sync from the video signal.

3 **False.** Optimum convergence can only be obtained with the proper test equipment.

4 **False.** Convergence circuitry is rarely responsible for poor convergence. The cause is almost invariably the service technician himself or the yoke and the picture tube, in that order.

5 **False.** The color killer disables the color circuits and prevents color noise during monochrome broadcasts.

6 **False.** Although the delay line is added for timing, the color signal is slowed because it travels through narrow bandpass amplifiers.

7 **False.** Bars, dots, or both may be used by the set up technician. It's a matter of preference.

8 **False.** Several areas of this country rely on UHF TV entirely. Color transmission and reception in UHF areas is as good as in VHF areas.

9 **True.** With the luminance gone, color is still visible on the screen; however, the picture will be distorted due to the missing luminance (Y) signal.

10 **True.** Many outputs are taken from the vertical output transformer and vertical output tube cathode circuit to operate convergence circuitry.

11 **False.** Changing height or linearity almost always causes a change in convergence.

12 **False.** Most color sets develope 25 kV for the picture tube.

13 **False.** Horizontal stripes are generally caused by slight recording head phase shifts on video tape recorded shows.

14 **True.** The life may be extended but the extra dust, and the potential electric hazard of an open receiver rule against removal of the back panel.

15 **False.** Color TV consoles have outsold monochrome consoles for the past three years.

CATV

(*Continued from page* 31)

tem concepts, television signal analysis, antennas, wave propagation, head-end theory and operation, and amplifier operation and maintenance. Course was written for men with a minimum of two years practical experience as a Cable Technician (not merely an installer) or men with an FCC First Class Radiotelephone License."

RECOMMENDED READING

101 Questions and Answers About CATV and MATV, Robert E. Baum and Theodore B. Baum. Howard W. Sams & Co., Inc., 1968. softbound, 96 p, $2.50. Provides a good, brief view of the industry.

CATV System Engineering, 2nd edition, William A. Rheinfelder, TAB Books, 1967, hardbound, 256 p, $12.95. Gives a good, theoretical background without getting into a mathematical approach. More practical information, however, is in **CATV System Maintenance,** Robert B. Cooper, Jr., TAB Books, 1967, comb-bound, 192 p, $12.95. It concentrates on how to locate and correct equipment failures and has chapters on antenna and head-end requirements, the service drop, troubleshooting and measuring equipment, auxiliary services, and technician-customer relations.

The magazine **TV Communications,** published by the parent company of National Cable Television Institute, is called "the professional journal of cable television" and includes a "CATV Technician" section, which can certainly keep a technician up to date.

Future. What's the future of CATV? "CATV is a young, dynamic industry offering a tremendous opportunity for bright, sincere technicians to get in on the ground floor," says William J. Bresnan. "I emphasize bright and sincere because being a service business, it is extremely important that the system be operated in a reliable and responsible manner. There are thousands of technicians in the electronics industry who cannot or will not apply themselves in such a manner as to provide this type of service."

"But for those who can," one CATV executive told the author, "there is no limit to the opportunities for advancement in the CATV field. The technician of today can become a fully-qualified engineer, or go into sales or management depending solely on his ability to learn and his determination to become fully conversant with all phases of CATV." —30—

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REMOTE BURGLAR ALARM USES TELEPHONE, TIN CAN & PENCIL. FULLY ILLUSTRATED METHOD $10, HERMITRONICS, 2783 E Market, San Diego, California 92102.

PRINTED circuit board kits, materials. Free catalog. Seneca Electronics, P.O. Box 2022A, Kokomo, Indiana 46901.

COLOR TV CROSSHATCH GENERATOR. Make money covering color TV's only $34.95. For details write Linear Electronics, Box 284, East Setauket, N.Y. 11733.

REGULATED POWER SUPPLIES, need only transformer. 5V-15V .6-4A, $2.75—$8.50. GE Triac 10A $1.75. Catalog. Murphy, 204 Roslyn, Carle Place, New York 11514.

SLEEK GENUINE SEALSKIN KEY HOLDER $3.98. Dept. 22, P.O. Box 2007, Van Nuys, Calif. 91404.

HOBBYIST. NEED AN ELECTRONIC DEVICE for one of your projects? Send us a written verbal description and $1.00 for estimate to Bronsonic Engineering, Box 1203, Northland Center Sta, Southfield, Mich. 48075.

CATHODIC protection instructions $1.00. F.F. Knapp, P.O. Box 854, Scottsdale, Arizona 85252.

GARRARD Record Changers, Hi-Fi Components, Cartridges, Needles, Tape, TV Parts, Schematics. Write for Unbelievable Prices. Gregg Electronics, P.O. Box 184, Glen Head, N.Y. 11545.

A GUIDE TO OVER 700 ELECTRONIC CONSTRUCTION PROJECTS! 4 years in the making; covers plans to every project imaginable! $3.95. **BEL ENTERPRISES,** P.O. Box 381-E3, Bellflower, Calif. 90706.

EXCITING values in Portable Monitor Receivers, Ameco Converters, accessories. Details, Free Antenna Offer: Griffin's, 322 West State, Ithaca, N.Y. 14850.

PLANS AND KITS

BEGINNERS Allwave $5.00, Two Band $5.00, F-M Tuner Chassis $10.00, Headset $2.50, Two Band Wired $10.00. Ekeradio, Box 131, Temple City, Calif. 91780.

BUILD-IT-YOURSELF. Save big dollars. Transistor stereo amplifiers. Color organs. Speakers. Write Workshop, Box 393, Bethpage, New York 11714.

"COIL WINDING" Handbook—50¢. Experimenter's catalog includes 250 exclusive items—25¢, refundable. Laboratorie, 12041-L Sheridan, Garden Grove, Calif. 92640.

CUT out TV commercials—plans, $3.00. Griffins Electronics, P.O. Box 2213, Huntsville, Texas 77340.

INTEGRATED CIRCUIT KITS; COMPUTER CIRCUIT KITS; Others. New catalog free. **KAYE ENGINEERING,** Box 3932-A, Long Beach, California 90803.

TRANSISTOR amplifiers, psychedelic lighting shows, strobes. Send stamp for list. **PLANS,** 1336 Louisiana, Akron, Ohio 44314.

IN-CIRCUIT TRANSISTOR CHECKER. You can build. Plans $1.50. Lab Electronics, P.O. Box 6213, San Diego, Calif. 92106.

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FREE! Send for money saving stereo catalog #P11E and lowest quotations on your individual component, tape recorder, or system requirements. Electronic Values, Inc., 200 W. 20th St., New York, N.Y. 10011.

HI-FI Components, Tape Recorders, at guaranteed "We Will Not Be Undersold" prices. 15-day money-back guarantee. Two-year warranty. No Catalog. Quotations Free. Hi-Fidelity Center, 239 (P) East 149th Street, New York 10451.

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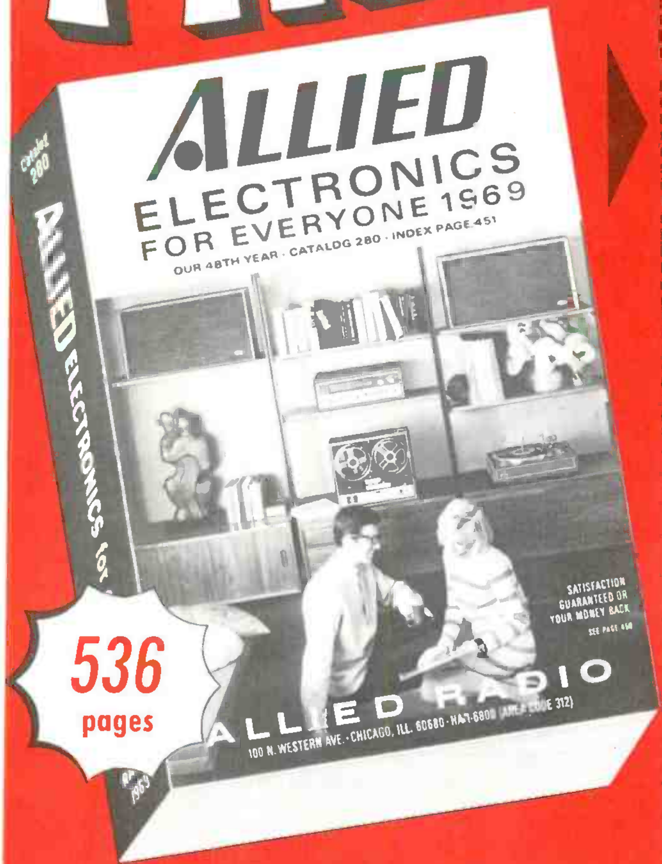

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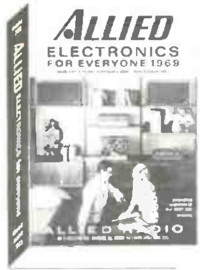

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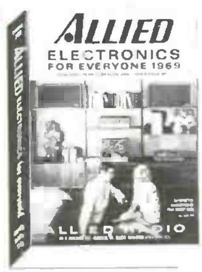

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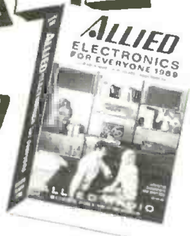

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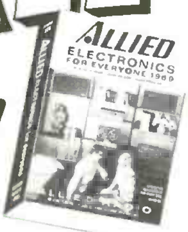

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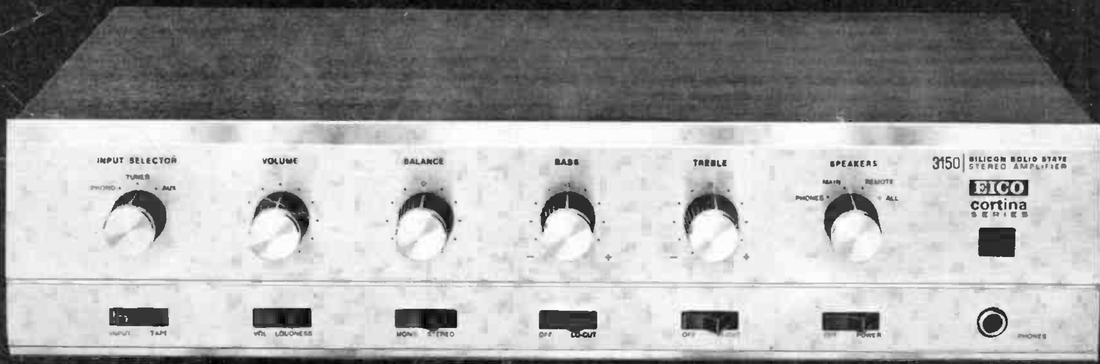

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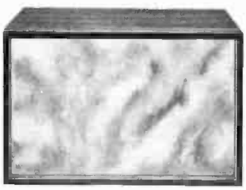

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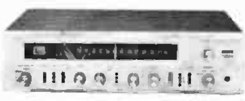

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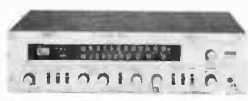

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