

Build Voice-Operated Controller

POPULAR ELECTRONICS

JANUARY
1967

50
CENTS

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Build Wireless Remote Control

Make CB Call Monitor

Build Sequence Lock

BUILD

Deep Searching "IC-67"
Treasure/Metal Locator

(page 10)



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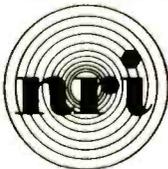
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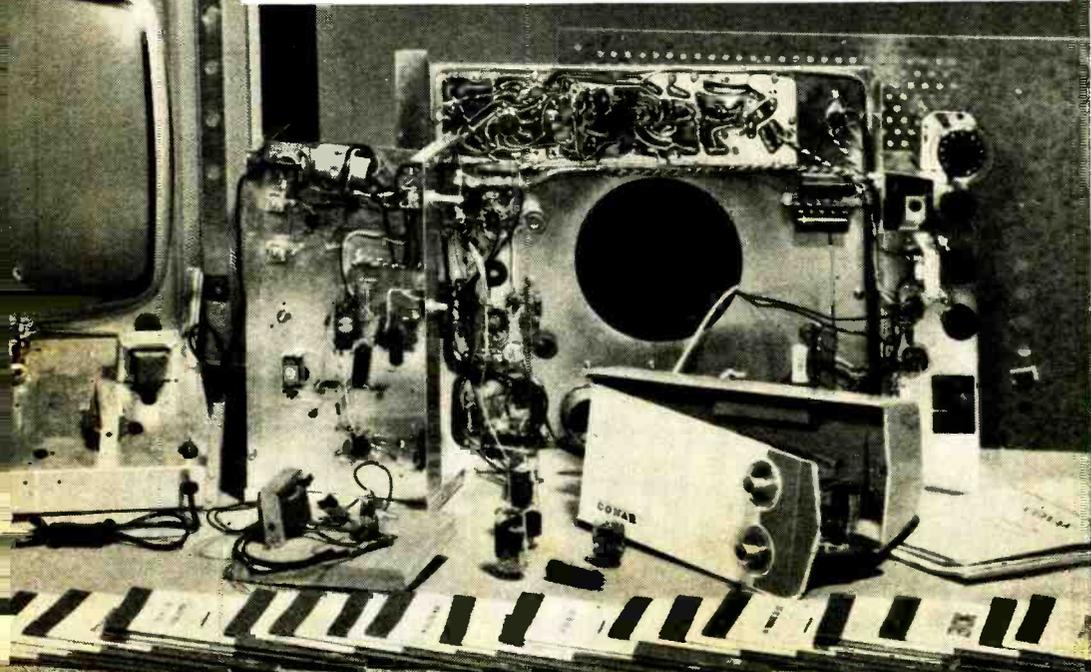
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January, 1967

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POPULAR ELECTRONICS

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VOLUME 26

JANUARY, 1967

NUMBER 1

SPECIAL CONSTRUCTION FEATURE

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Professional-, precision-, highly-sensitive, deep-type—and reliable, too

FEATURE ARTICLES

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- R. ZARR **50** **CARRIER-CURRENT REMOTE-CONTROL SYSTEM**
Put a signal into an outlet to switch your appliances
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Simple device listens to all calls but "hears" only yours
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POPULAR ELECTRONICS is indexed
in the Readers' Guide
to Periodical Literature

This month's cover photo by
Dan Rubin

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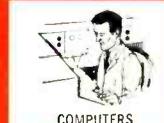
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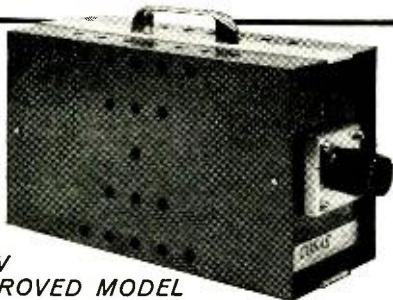
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M. P. SPINELLO, KHC2060
Contributing Editors

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Advertising Sales Manager

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Editorial and Executive Offices
One Park Avenue, New York, New York 10016
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Eastern Advertising Manager, RICHARD J. HALPERN

Midwestern Office

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312 726-0892

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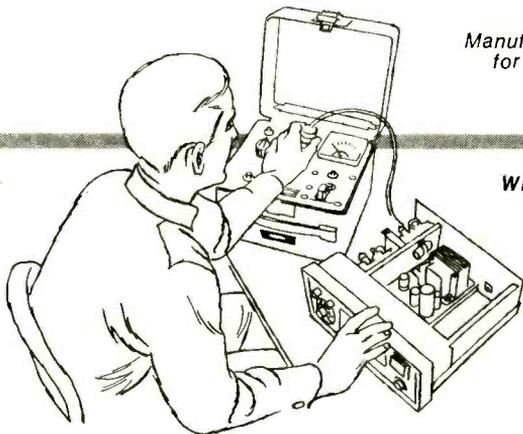
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CIRCLE NO. 10 ON READER SERVICE PAGE

LETTERS FROM OUR READERS

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THIS IS THE MID-RANGE!

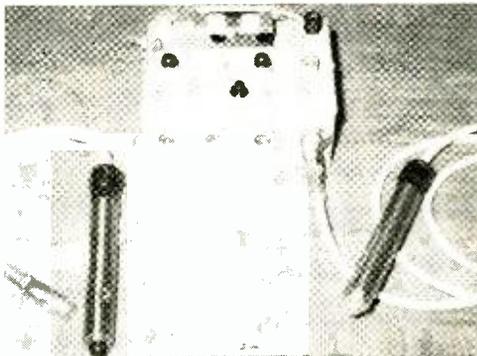
Your article "Why Are They Still Inventing Speakers" (November, 1966) nonchalantly states that "special mid-range units tackle the frequency range from about 800 to 30,000 Hz." The author must be kidding. Is that a sonar tweeter?

BOB CONWAY
Austin, Texas

Sorry, Bob; it was just a case of a cipher too many—3000 Hz is the correct figure.

"REFLEXOMETER" WINNER

I was very pleased to find that you thought my modification of the "Reflexometer" (Oc-



tober, 1966) worthy of winning a cash prize. Enclosed is a photograph of my unit.

A1C DONALD O. WURST
Wright-Patterson AFB, Ohio

Nice work, Donald. Your project looks good; and we're pleased that you're pleased.

FM STATIONS ON CHANNEL 6

The other night while changing channels on my TV set, I heard a French-language program on Channel 6, right here in New York. (There is nothing on Channel 6 in this area.) It turned out to be Columbia University's FM radio station. I wish you'd explain, if you can, how it got over on Channel 6?

DOUG LAMERSON
Richmond Hill, N.Y.

The program you heard, Doug, was from the university's FM station WKCR on 89.5 MHz. They are on the air weekdays from 4

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CIRCLE NO. 7 ON READER SERVICE PAGE

LETTERS

(Continued from page 8)

p.m. to midnight, and on weekends from noon to midnight. The Channel 6 frequency band is from 82 MHz to 88 MHz, but your TV set can tune broadly enough on this channel to pick up any one of several FM stations in your area.

INEXPENSIVE RECORD PLAYER

I am interested in your article entitled "Inexpensive Integrated Solid-State Stereo Record Player" (July 1966), but it calls for a ceramic or crystal cartridge and my cartridge is magnetic. What can I do?

W. K. ARNSPARGER
South Ft. Mitchell, Ky.

W. K., you should either get a ceramic or a crystal cartridge as recommended or you should not modify your record player. Of course, it is possible to build a suitable pre-amp to work a magnetic cartridge, but then you would be adding to the expense of the project.

FROM TEEN-AGERS TO ADULTS

I think you'll get a chuckle out of this human nature story. As a high school teacher, my biggest complaint about teen-agers is that they rarely follow directions properly. But I guess many adults are the same way. For some time now, I've been writing to a man who has been trying unsuccessfully to modify a BTC-99 UHF converter for 450-460 MHz as per my article a couple of years ago ("Tuning Up On the New 460-Mc. Police Frequencies," May, 1964)

I went over the procedure step by step with this man in minute detail, and even drew pictures. Time and time again he assured me that he followed my directions to the letter,



but he still could not get any 450-460 MHz stations. He seemed like an intelligent fellow from his letters and I was curious to find out why his unit wouldn't work. So, last week I told him to send the converter to me and I'd do what I could to make it work. Here's what I found: A 35-turn coil was specified—he wound 40 turns; enameled wire was specified—he used bare wire; number 24 wire was specified—he used #22; close winding was specified—he wound it loose; one quarter inch (max.) leads on the coil were specified—he made them one inch; and, replacement of the



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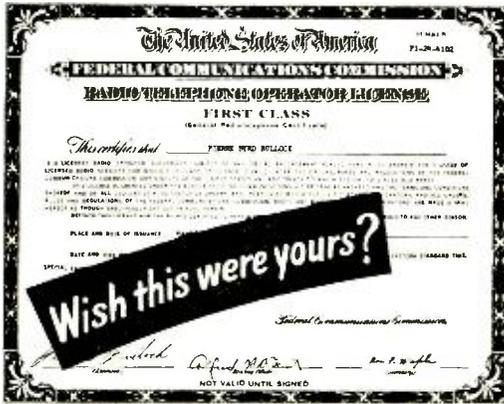
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LETTERS (Continued from page 10)

oscillator compartment cover was mentioned --he didn't replace it.

In five minutes, I wound and installed the proper coil in his converter, and it worked perfectly. I thought you'd appreciate this story because I bet that in 9 out of 10 cases where a P.E. project doesn't work, the builder did not follow instructions.

KEN GREENBERG
Chicago, Ill.

WHAT'S A DIT AMONG FRIENDS?

Why did you run 9 dits in Carl Kohler's story (November, 1966) and claim they stood for the CW error signal? Seven dits is correct.

CARLTON BLAKE
Ft. Smith, Ark.

Our Art Director says it looked better with 9 dits than with 7, and what're you doing "reading" the title, anyhow? You're supposed to listen to the sound.

The correct number of dits is 8, not 9.

FRED RUZECKI, WA8GQQ
Dayton, Ohio

Our Art Director says, "See, the readers can't even make up their minds." Actually, an experienced operator would be able to detect an error even after a series of only three, four, or five dits. However, according to the Telegraph Regulations, Paris Revision 1949, annexed to International Telecommunications Convention Atlantic City 1947, and the 1967 COMMUNICATIONS HANDBOOK, the correct number of dits is eight. Diddahdiddahdiddah.

PLEASE SEND MONEY

In response to my listing in "Ham Hobby Clearinghouse," I received a letter from a foreign student which, after translation, reads in part: "I would like to build a transmitter and a receiver that will be able to work 80 to 10 meters. Can you let me have money to make this apparatus? Thank you very much."

DAVID CANTOR, WB2UGP
Patchogue, N. Y.

David, why not answer his letter and try to find a mutual trade arrangement?

OUT OF TUNE

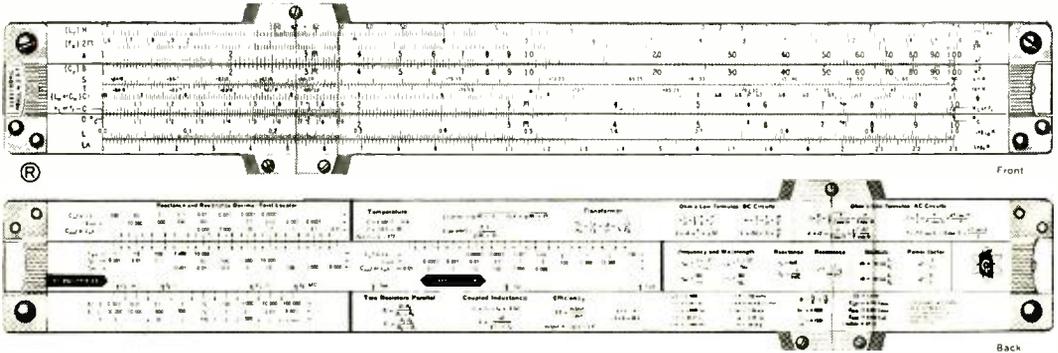
"Square Deal" Audio Generator (November, 1966, page 60). In Fig. 1, move the lead from pin 1 on IC1, which is connected to the junction of R1a and R3, to the other side of R3. In the caption for Fig. 2, change IC2 to read IC1. —30—

Be the man who's always
first to say: "I've got
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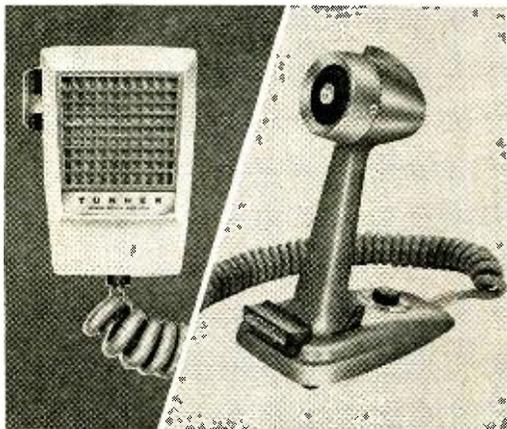


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CIRCLE NO. 6 ON READER SERVICE PAGE

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Both “+2” series microphones use a two-transistor pre-amp to return life to your old transceivers; and both work efficiently with all transistor and tube sets. So why settle for a limited signal range, or a base station mike that’ll do the job and a mobile mike that falls short? Talk to your CB dealer or distributor soon, to find out just what the Turner “+2” series can do for you.

And remember — it’s no fun to hear if you can’t talk back. Get the last word in microphone performance — the “+2” and the “M+2” . . . from Turner.



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PARTS

METHODS

IDEAS

GADGETS

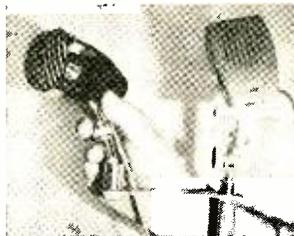
DEVICES

TIPS & TECHNIQUES

A DUMMY MIKE WILL PREVENT “BLAST” EFFECTS

If you haven’t at some time or other had someone “blast” your microphone with what looks like “mouth-to-mike resuscitation,” you’re one of the very few fortunate tape recorder owners. However, you can prevent “blast” effects if you use a dummy mike. Mount the dummy mike on the same stand with the live one and tell the speaker to talk directly into the dummy. The live mike will be pointed at the speaker’s mouth. To make the setup even more convincing, have two mike cables disappear into the tape recorder. The resulting tape should be blast-free.

—Glen F. Stillwell

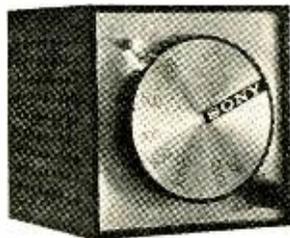


PIPSQUEAK IN SIZE BUT MITE-T-LITE

A combination pilot light and dial light assembly for battery-powered equipment can be made with a short length of plastic tubing and a miniature lamp—such as the Sylvania ML-202A Mite-T-Lite. First coat the leads of the lamp with lacquer to insulate them; slot the tubing and slip it over the lamp. Then drill a hole to fit the covered lamp in line with the dial position indicator mark. Use a drop of cement to hold the assembly in place. Since the lamp operates at between 1 and 2 volts, if a 1-volt source isn’t available, connect a resistor that drops all but 1 volt in series with the on/off switch and lamp (about 330 ohms for a 6-volt battery). The Mite-T-Lite doesn’t add appreciably to current drain (15.5 mA); and for its size (0.176” long and 0.055” in diameter), it gives off a surprisingly bright light.

—William S. Gohl

(Continued on page 105)



POPULAR ELECTRONICS

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ELECTRONICS LIBRARY

101 WAYS TO USE YOUR COLOR TV TEST EQUIPMENT, Second Edition

by Robert G. Middleton

Written to encourage technicians to make wider use of their test equipment and updated to include the latest techniques, this book is actually in the advanced technician category because a solid background in color TV theory is needed. It takes the reader through logical steps to show him how to make total use of his test equipment. While the text becomes progressively complex, it never loses sight of the main objective, and practically nothing is left to chance because actual photos of waveforms and discussions of likely troubles are covered in full. For technicians who want to get the most out of their test equipment investments, this book is a must.

Published by Howard W. Sams & Co., 4300
West 62 St., Indianapolis, Ind. 46206. 160
pages. Soft cover. \$2.95.



PRACTICAL SCIENCE PROJECTS IN ELECTRICITY/ELECTRONICS

by Edward M. Noll

This is a very basic project and demonstration book for junior high school students. The writing and illustrations are adequate but undistinguished.

Published by Theodore Audel & Co., 4300 West
62 St., Indianapolis, Ind., 46206. 472 pages.
Hard cover. \$4.95.



FM RADIO STATION OPERATIONS HANDBOOK

Here's an authoritative guide to modern commercial FM broadcasting. Actual experiences of successful FM radio pioneers outlined in this book give the reader an insight on the engineering, management, and sales techniques involved in this rapidly growing industry. The book covers such subjects as building an FM station, the equipment needed for FM stereo broadcasting, SCA background music, and a host of other interesting features, each subject written by an expert in the field. Whether you're planning to build a station of your own or are just interested in what makes an FM station tick, this handbook should prove to be both interesting and informative.

Published by Tab Books, 18 Frederick Rd.,
Thurmont, Md. 21788. Soft cover. 196 pages.
\$9.95.

—30—



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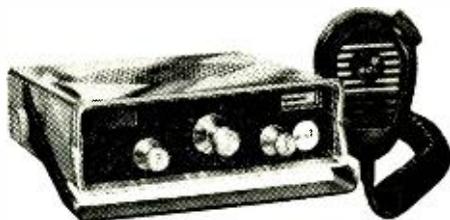
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CIRCLE NO. 8 ON READER SERVICE PAGE →

The CB rig you can't kill.



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See it at your Courier dealer, or mail coupon for full data.

 **COURIER COMMUNICATIONS, INC.**
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56 Hamilton Avenue, White Plains, N. Y.

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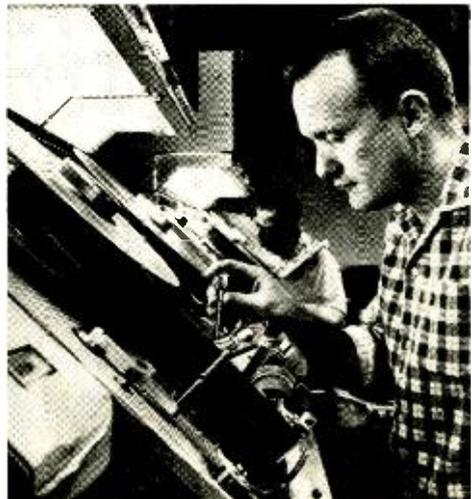
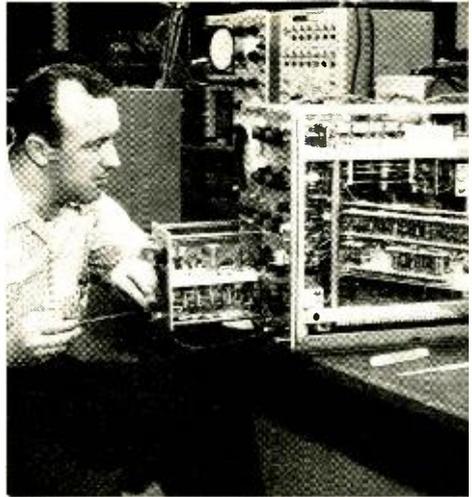
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To help meet the need for qualified men in the electronics field, RCA Institutes has created a wide variety of Home Training Courses, all aimed toward a profitable, exciting electronics career in the shortest possible time. Included are exclusive "Career Programs" designed to train you quickly for the job you want! Your study program is supervised by RCA Institutes experts who work with you, help guide you over any "rough spots" that may develop along the way.

OFF TO A FLYING START WITH AMAZING RCA "AUTOTEXT" METHOD

Each "Career Program" starts with the amazing "AUTOTEXT" Programmed Instruction Method — the new, faster way that's almost automatic! "AUTOTEXT" helps even those who have had trouble with conventional learning methods in the

past. It is truly the "Space Age" way to learn everything you need to know with the least amount of time and effort.

RCA INSTITUTES ENGINEERED KITS SPEED YOUR PROGRESS

To speed you on your way to a successful electronics career, your "Career Program" will include a variety of RCA Institutes engineered kits at no extra cost—each complete in itself. As a bonus, you will also receive and build a valuable Oscilloscope. You'll get the new Programmed Electronics Breadboard for limitless experiments, including building a working signal generator and a fully transistorized superheterodyne AM receiver and Multimeter.

CHOOSE YOUR CAREER PROGRAM NOW

To get a head start today on the electronics career of your choice, look over this list of RCA Institutes "Career Programs", pick the one that appeals most to you, and check it off on the attached card:

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To meet other specific needs, RCA Institutes also offers a wide variety of separate courses which may be taken separately from the "Career Programs". These range from Electronics Fundamentals to Computer Programming. They are described in the material you receive.

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If you are already working in electronics or have some experience but want to move on up, you may start RCA Institutes training at an advanced level. No tedious repetition of work you already know!

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RCA Institutes Resident School is one of the largest schools of its kind in New York City with classroom and laboratory training available in day or evening sessions. Coeducational classes start four times a year. Just check "Classroom Training" on the attached card for more details.

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In recent years, 9 out of 10 Resident School students who used the Free Placement Service have been placed before or shortly after graduation. This Service is now available to Home Study students.

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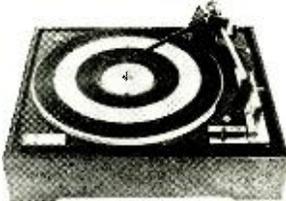


NEW PRODUCTS

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

UPSIDE-DOWN TURNTABLE?

Can your turntable operate upside down? *BSR (USA) Limited* says that its new low-cost "McDonald 500" automatic turntable can. The 500 has a low-mass pickup that is so well counter-balanced, both vertically and horizontally, that the entire turntable can actually be tilted while in use, without interrupting the record. Stylus pressure is controlled by a micrometer-like pressure setting which permits precise 1/8-gram adjustment from 0 to 6 grams. The 500 also boasts a precision cueing lever—the pickup arm can be raised or gently lowered to the record's surface at any desired spot without record or stylus damage. A four-speed unit (16, 33, 45 and 75 r/min), the changer will accommodate 7-, 10-, and 12-inch records.



Circle No. 75 on Reader Service Page 15

UNIVERSAL ANTENNA

Vertical or horizontal mounting anywhere, and under any conditions, is claimed for *Cush Craft's* Model TS-1 "TriK Stik" universal antenna. A half-wave, omnidirectional, vertically polarized unit, the Model TS-1 can be used for the Citizens Band, short-wave listening, amateur radio, monitoring police, fire, and other emergency services, Business Radio (both low and high bands), tuning in aircraft, and even for TV and FM reception. Complete instructions are supplied with measurements for setting the "TriK Stik" to the correct dimensions for any of the above services. Assembly can be accomplished in minutes.

Circle No. 76 on Reader Service Page 15

SOLDERING GUN KITS

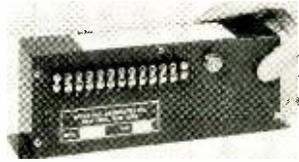
Wen Products' single-post heavy- and medium-duty soldering gun kits (Model 450K4 and 222K5) now come in shock-resistant, plastic, luggage-type carrying cases. The Model

450K4 contains the automatic 3-in-1 Model 450 gun, three separate tips for heavy, medium, and light duty, plus a roll of rosin core solder. The 222K5 contains the Model 222 Wen "Hot Rod" gun with medium- and light-duty tips, plus a plastic cutting attachment and a flat iron attachment for sealing plastic bags, plus solder. All of the accessories are card-mounted and plastic shrink-packed to keep them dust-free, and storage nests are provided.

Circle No. 77 on Reader Service Page 15

SOLID-STATE POWER SUPPLY

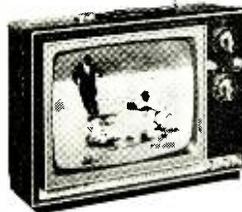
Round Hill Associates has announced a solid-state power supply, Model PS-200, for general-purpose use. The PS-200 employs zener-referenced voltage regulation and delivers 9 volts d.c. at loads up to 200 mA with complete dead short protection. A locking screwdriver-adjusted programming potentiometer permits the output voltage to be adjusted over a 1-volt range. Weighing 44 ounces, the PS-200 measures 9" x 2 3/4" x 3 1/4", and comes in a brown enameled steel case.



Circle No. 78 on Reader Service Page 15

PORTABLE "IC" TV KIT

A first in integrated circuit kits! *Heath's* GR-104 12" black-and-white TV kit incorporates an IC the size of a small transistor which contains 39 parts—and replaces the sound i.f. detector and preamp. Result: reduced heat, less power consumption, and easier kit assembly. Designed to operate on any 117-volt a.c. or 12-volt d.c. source, the GR-104 can be assembled in about 10 hours. An optional rechargeable battery pack is available (also in kit form) which makes it possible to use the set anywhere. The kit includes a built-in telescopic whip for VHF, plus an 8" UHF loop that attaches in seconds to the back panel. And there are inputs for 300-ohm balanced and 75-ohm coax fixed antennas.



Circle No. 79 on Reader Service Page 15

MOBILE CB ANTENNAS

Ever hear of a printed circuit being used for an antenna? *Antenna Specialists'* new "MACH III" CB mobile antennas feature a spiral-shaped printed circuit coil, water-proofed and shock-suspended inside a wing-shaped "futuristic" base. Molded from tough cycco-lac plastic of the type used in auto racing

CIRCLE NO. 17 ON READER SERVICE PAGE—>

LAFAYETTE HB-525 Solid State Mobile 2-Way Radio

All Crystals Supplied!



• Size: 2 $\frac{3}{8}$ " by 6 $\frac{1}{4}$ " 99-3076WX*

All **23** CB Channels
Crystal Controlled

Plus 2 Reserve Channels

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NO MONEY DOWN

- 19 Transistors, 7 Diodes, Thermistor
- Dual Conversion Receiver for Extra Selectivity and Sensitivity
- Full 5-Watt Input
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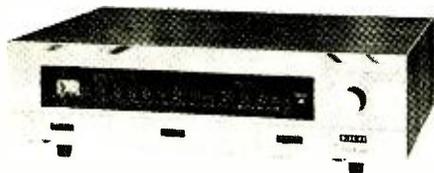
PRODUCTS (Continued from page 22)

bodies, the base is jet black with a smooth satin finish, trimmed in silver. All quarter-wave "MACH III" antennas are d.c.-grounded, and are reported to have an excellent VSWR, essentially flat at center frequency and 1.3-1 across the band. The 32" whip is made of stainless steel which can be bent in a full circle without "setting."

Circle No. 80 on Reader Service Page 15

STEREO TUNER AND AMPLIFIER

Near-perfect stereo at moderate cost is offered in *EICO's* new solid-state "Cortina" line—the Model 3200 FM/MPX automatic stereo tuner and the Model 3070 70-watt stereo amplifier—available both as kits and factory-wired. The five tuned circuits in the front end of the Model 3200 tuner (see photo) contain two r.f. stages, all coupled to a four-stage double-tuned i.f. circuit. Sensitivity is 2.4 μ V for 30 dB quieting—IHF standard. Channel separation is 40 dB at 1 kHz, harmonic dis-



ortion less than 0.75%. Specifications for the Model 3070 amplifier include: 70 watts total music power into a 4-ohm load, 50 watts into an 8-ohm load; a frequency response of 5 Hz to 100 kHz, ± 1.5 dB, and 8 Hz to 60 kHz, ± 0.5 dB; and harmonic distortion of less than 0.8%.

Circle No. 81 on Reader Service Page 15

TAPE RECORDING AIDS

Three new accessories for Kodak sound recording tape have been announced by *Eastman Kodak*—an "easier-to-use" splicing tape, a tough leader and timing tape, and a tape timing guide. The $\frac{1}{4}$ " Presstapes are precut splices of the same width as the recording tape; they come in packets of 40 with complete instructions for use. The leader and timing tape has a matte, opaque surface on $\frac{1}{2}$ -mil polyester base, enabling write-on identification and damage-free threading; it is supplied in 150' lengths on a 3" tape reel in a dispenser box. Measuring 5" x $1\frac{3}{4}$ ", the tape timing guide permits the number of minutes of playing time remaining on a reel to be read off on the proper scale of the guide; each package contains two guides, one for use at a tape speed of $7\frac{1}{2}$ in/s, the other for 3 $\frac{3}{4}$ in/s.

Circle No. 82 on Reader Service Page 15

MOBILE P.A. AMPLIFIER

Called the "Tiny Mite" (it measures only $1\frac{3}{8}$ " x $3\frac{5}{16}$ " x $5\frac{7}{8}$ "), the imported solid-state

public address amplifier introduced by *Lafayette Radio Electronics* features 16 watts of output power for mobile applications. It can be used with dynamic, crystal, or magnetic microphones; tape recorder; phono pickup or AM radio. Output impedance is 8 or 16 ohms. Current consumption: a maximum of 1.8 am-



peres from the vehicle's battery. Fused for overload protection, the "Tiny Mite" comes complete with microphone plug, battery and speaker cables, and underdash mounting bracket.

Circle No. 83 on Reader Service Page 15

CONVERTER/CHARGER PLUG AND CORD SET

"Safe-T-Plug Mark II," announced by *Dynamic Instrument Corp.*, is a completely sealed converter/charger plug and cord set that converts ordinary a.c. household current to the low d.c. voltage required by transistorized products and small motor-driven appliances. In addition, it recharges nickel-cadmium batteries used in cordless rechargeable appliances; the recharging ability also applies to the commonly available carbon-zinc batteries. No Underwriters' Laboratories listing is necessary for a product to which the plug is attached, since the Safe-T-Plug Mark II itself is UL-listed.

Circle No. 84 on Reader Service Page 15

FM STEREO TABLE RADIO KIT

All-transistorized, the new GR-36 FM stereo table radio kit available from the *Heath Company* features the same tuner and i.f. circuit used in deluxe Heathkit stereo components. Other features include automatic switching to stereo with an automatic stereo



indicator that lights up whenever stereo is being received; an adjustable phase control for optimum station separation and best stereo; fixed automatic frequency control for drift-free stereo; built-in automatic gain control to minimize blasting or fading; and a new clutch-release volume control for independent or simultaneous adjustment of both channels. The "front-end" is factory-assembled and aligned to insure peak performance.

Circle No. 85 on Reader Service Page 15

FINCO

"has 'em both"



MODEL #65-1 \$2995 list



MODEL #65-2 \$3995 list

BOOSTER COUPLERS IN 300 OR 75 OHM For Deluxe Home & Commercial Use

Finco's famous 2-tube, 4-set VHF-TV OR FM Distribution Amplifier is now available for 75 OHM CO-AX or 300 OHM operation.

Price? You can't beat it! Rugged quality? Finco's got it! Performance? Finco challenges 'em all!

Equip either model with Finco low-loss splitters (#3001 or #3003) and you can drive up to 16 sets in a master antenna system!

FINCO MODEL #65-1 \$29.95 list

Outstanding Features:

- 350,000 microvolts maximum input with ± 8 dB to each output • Maximum signal output of .85 volts in each of 4 outputs • Low noise 6HA5 premium tubes • One 300 ohm input — 4 300 ohm outputs • Silicone diode rectifier for dependability • Flat response — $\pm 1/4$ db per 6 mc channel • Ventilated perforated steel cabinet $6\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2}$ " • Metal enclosed to eliminate shock hazard — easy access for servicing • Easy mounting and connecting • All fittings & brackets supplied • UL listed AC cord — 117 volts, 60 cycles • 100% test for all electrical characteristics

FINCO MODEL #65-2 \$39.95 list

Outstanding Features:

- 400,000 microvolts maximum input with ± 6 dB to each output • 200,000 microvolt input — 1 volt output per band • Low noise 6HA5 premium tubes • One 75 ohm input — 4 75 ohm outputs • Most compatible "F" type input and output fixtures • Ultra-flat frequency response and complete RF isolation • Ventilated perforated steel cabinet $6\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{2}$ " • Metal enclosed to eliminate shock hazard — easy access for servicing • Easy mounting and connecting • All fittings & brackets supplied • UL listed AC cord — 117 volts, 60 cycles • 100% test for all electrical characteristics



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THE FINNEY COMPANY

34 West Interstate Street, Bedford, Ohio 44014

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.

The latest edition of *AmpereX Electronic Corporation's* "Condensed Electron Tube Catalog" is now available. Containing descriptions of and basic specifications for the full line of AmpereX tubes, this 27-page catalog serves as a quick reference guide for designers of new equipment as well as for replacement tube buyers. A special insert covers microwave tubes and components.

Circle No. 86 on Reader Service Page 15

Over 250 easy-to-build electronic kits are illustrated in the 108-page 1967 catalog put out by the *Heath Company*. Kits new this year include a transistor guitar amplifier; electric guitars; SSB receiver and matching transmitter; 2-way, 2-speaker system with acoustic suspension design; stereo tape recorder; signal monitor; 4-speed transistor portable pho-

nograph; and a 2-watt silicon transistor walkie-talkie.

Circle No. 87 on Reader Service Page 15

New and interesting among the 4000-plus items in *Edmund Scientific Company's* 148-page 1967 catalog are: a plastic fiber optics kit; an intriguing computer game called "Dr. Nim"; special bargains on magnets; laser-produced holograms, a new technique in 3-D pictures; and a low-cost solid-state thermo-electric cooling system.

Circle No. 88 on Reader Service Page 15

Turner Microphone Company's 12-page booklet entitled "Connecting the +2 to Your CB Set" describes the proper connections between the Turner "+2" microphone and more than 100 different CB sets. It also offers helpful hints for getting the best performance out of particular models when using the "+2".

Circle No. 89 on Reader Service Page 15

A full-color, 20-page 1967 brochure from *H. H. Scott, Inc.*, entitled "At Home With Stereo," features the greatly expanded line of Scott stereo consoles in an exclusive collection of decorator-styled room settings. Included is a complete explanation, in non-technical terms, of the more technical aspects of stereo consoles.

Circle No. 90 on Reader Service Page 15

What's the best antenna heading to hear a 6WB?
 What time is it in Zanzibar?
 How many IRC's for a letter from a ZP?
 Are the Dodecanese in Asia?
 Is a ZE in DX Zone 38?
 What's the address of the
 Venezuela QSL Bureau?

Find all the
 answers fast
 with the
BRAND-NEW
4TH EDITION
OF W9IOP'S
SECOND OP
\$1.00



Put vital world-wide DX data at your fingertips with this 10½" circular calculator. Shows beam headings, time differences, postal rates, DX zones, QSL bureaus, many more DX facts... at a glance! The fully-revised 4th Edition is now at your nearby E-V ham microphone headquarters, or send \$1.00 to:

ELECTRO-VOICE, INC.,
 Dept. 173P, 630 Cecil Street,
 Buchanan, Michigan 49107



CIRCLE NO. 9 ON READER SERVICE PAGE

Regardless Of What You Pay For A Color TV...

It Can't Perform As Well As This New Heathkit® "180" For Only \$379⁹⁵*



Here's Why!

Exclusive Features That Can't Be Bought In Ready-Made Sets At Any Price! All color TV sets require periodic convergence and color purity adjustments. This new Heathkit GR-180 has *exclusive* built-in servicing aids so you can perform these adjustments anytime . . . *without* any special skills or knowledge. Simple-to-follow instructions and detailed color photos in the GR-180 manual show you exactly what to look for, what to do and how to do it. Results? Beautifully clean and sharp color pictures day in and day out . . . and up to \$200 savings in service calls during the life of your set!

Exclusive Heath Magna-Shield . . . surrounds the entire tube to keep out stray magnetic fields and improve color purity. In addition, *Automatic De-gaussing* demagnetizes and "cleans" the picture everytime you turn the set on from a "cold" start.

Choice Of Installation . . . Another Exclusive! The GR-180 is designed for mounting in a wall or your own custom cabinet. Or you can install it in either optional Heath factory-built Contemporary or Early American styled cabinets.

From Parts To Programs In Just 25 Hours. All critical circuits are preassembled, aligned and tested at the factory. The GR-180 manual guides you the

rest of the way with simple, non-technical instructions and giant pictorials. You can't miss!

Plus A Host Of Advanced Features . . . like the hi-fi 180 sq. inch rectangular tube with "rare earth phosphors", smaller dot size and 24,000 volt picture power for brighter, livelier colors and sharper definition . . . *Automatic Color Control* and gated *Automatic Gain Control* to reduce color fading and insure jitter-free pictures at all times . . . deluxe *VHF Turret Tuner* with "memory" fine tuning . . . *2-Speed Transistor UHF Tuner* . . . *Two Hi-Fi Sound Outputs* for play through your hi-fi system or connection to the GR-180's 4" x 6" speaker . . . *Two VHF Antenna Inputs* — a 300 ohm balanced and a 75 ohm coax . . . *1-Year Warranty* on the picture tube, 90 days on other parts. For full details mail coupon on the following page. Better yet, use it to order the best 19" Color TV buy . . . it's available now in limited quantities.

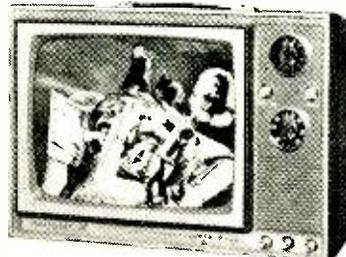
***Kit GR-180**, everything except cabinet, 102 lbs. **\$379.95**

GRA-180-1, walnut cabinet (shown above), 30 lbs. . . 18 1/4" D x 28 1/4" W x 29" H **\$49.95**

GRA-180-2, Early American cabinet, 37 lbs. . . 18 1/4" D x 28 1/4" W x 31 1/4" H Available February **\$75.00**

NEW 12" Transistor Portable TV — First Kit With Integrated Circuit

Unusually sensitive performance. Plays anywhere . . . runs on household 117 v. AC, any 12 v. battery, or optional rechargeable battery pack (\$39.95); receives all channels; new integrated sound circuit replaces 39 components; preassembled, prealigned tuners; high gain IF strip; Gated AGC for steady, jitter-free pictures; front-panel mounted speaker; assembles in only 10 hours. Rugged high impact plastic cabinet measures a compact 11 1/2" H x 15 3/4" W x 9 3/8" D. 27 lbs.



Kit GR-104
\$119⁹⁵

Turn Page For More New Kits From HEATH

CIRCLE NO. 12 ON READER SERVICE PAGE

How To Have Fun While You Save . . .

Harmony-by-Heathkit® Electric Guitars & Heathkit Guitar Amplifier



A **\$129⁹⁵**
Kit TA-16

A NEW Heathkit Transistor Guitar Amplifier

60 watts peak power; two channels — one for accompaniment, accordian, organ, or mike, — the other for special effects . . . with both variable reverb and tremolo; 2 inputs each channel; two foot switches for reverb & tremolo; two 12" heavy-duty speakers; line bypass reversing switch for hum reduction; one easy-to-build circuit board with 13 transistors, 6 diodes; 28" W. x 9" D. x 19" H. leather-textured black vinyl cabinet of 3/4" stock; 120 v. or 240 v. AC operation; extruded aluminum front panel. 52 lbs.

American Made Harmony-By-Heathkit Guitars

All wood parts factory assembled, finished and polished . . . you just mount the trim, pickups and controls in predrilled holes and install the strings . . . finish in one evening.

These Valuable Accessories
Included With
Every Guitar Kit



Each guitar includes vinylized chipboard carrying case, cushioned red leather neck strap, connecting cord, Vu-Tuner® visual tuning aid, tuning record, instruction book and pick . . . worth \$19.50 to \$31.50 depending on model.

B Deluxe Guitar . . . 3 Pickups . . . Hollow Body

Double-cutaway for easy fingering of 16 frets; ultra-slim fingerboard — 24 1/4" scale; ultra-slim "uniform feel" neck with adjustable Torque-Lok

B
Kit TG-46
\$219⁹⁵
(save \$111.55)



C
Kit TG-26
\$99⁹⁵
(save \$47)



D
Kit TG-36
\$119⁹⁵
(save \$40.55)



reinforcing rod; 3 pickups with individually adjustable pole-pieces under each string for emphasis and balance; 3 silent switches select 7 pickup combinations; 6 controls for pickup tone and volume; professional Bigsby vibrato tail-piece; curly maple arched body — 2" rim — shaded cherry red. 17 lbs.

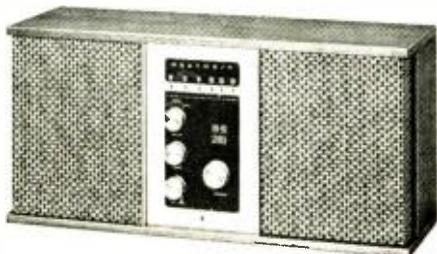
C Silhouette Solid-Body Guitar . . . 2 Pickups

Modified double cutaway leaves 15 frets clear of body; ultra-slim fingerboard — 24 1/4" scale; ultra-slim neck for "uniform feel"; Torque-Lok adjustable reinforcing rod; 2 pickups with individually adjustable pole-pieces under each string; 4 controls for tone and volume; Harmony type 'W' vibrato tail-piece; hardwood solid body, 1 1/2" rim, shaded cherry red. 13 lbs.

D "Rocket" Guitar . . . 2 Pickups . . . Hollow Body

Single cutaway style; ultra-slim fingerboard; ultra-slim neck, steel rod reinforced; 2 pickups with individually adjustable pole-pieces for each string; silent switch selects 3 combinations of pickups; 4 controls for tone and volume; Harmony type 'W' vibrato tailpiece; laminated maple arched body, 2" rim; shaded cherry red. 17 lbs.

NEW! Deluxe Solid-State FM /FM Stereo Table Radio



Kit GR-36
\$69⁹⁵

Tuner and IF section same as used in deluxe Heathkit transistor stereo components. Other features include automatic switching to stereo; fixed AFC; adjustable phase for best stereo; two 5 1/4" PM speakers; clutched volume control for individual channel adjustment; compact 19" W x 6 1/2" D x 9 1/4" H size; preassembled, prealigned "front-end"; walnut cabinet; simple 10-hour assembly. 17 lbs.

Build Your Own Heathkit® Electronics

NEW Heathkit® /Magnecord® 1020 4-Track Stereo Recorder Kit



Kit AD-16
\$399⁵⁰
 (less cabinet)

Save \$170 by doing the easy assembly yourself. Features solid-state circuitry; 4-track stereo or mono playback and record at 7½ & 3¾ ips; sound-on-sound, sound-with-sound and echo capabilities; 3 separate motors; solenoid operation; die-cast top-plate, flywheel and capstan shaft housing; all push-button controls; automatic shut-off; plus a host of other professional features. 45 lbs. Optional walnut base \$19.95, adapter ring \$4.75.

New! SB-101 80-10 Meter SSB Transceiver — Now With Improved CW Transceive Capability



Kit SB-101
\$360⁰⁰
 (less speaker)

Now features capability for front panel switch selection of either the USB/LSB standard 2.1 kHz SSB filter or the optional SBA-301-2 400 Hz CW filter . . . plus simplified assembly at no increase in price over the already famous Heathkit SB-100. Also boasts 180-watt P.E.P. input, 170 watts input CW, PTT & VOX, CW sidetone, Heath LMO for truly linear tuning and 1 kHz dial calibrations. 23 lbs. SBA-301-2, 400 Hz CW filter . . . \$20.95. Kit HP-13, mobile power supply . . . \$59.95. Kit HP-23, fixed station supply . . . \$39.95

2-Watt Walkie-Talkie



Assembled
 GRS-65A
\$99⁹⁵

New . . . Factory Assembled. Up to 6 mile range; rechargeable battery; 9 silicon transistors, 2 diodes; superhet receiver; squelch; ANL; aluminum case. 3 lbs. 117 v. AC battery charger & cigarette lighter charging cord \$9.95. Crystals \$1.99 ea.

NEW Portable Phonograph Kit

Kit GD-16
\$39⁹⁵



All Transistor. Assembles in 1 to 2 hours. Preassembled 4-speed automatic mono changer; 4" x 6" speaker; dual Sapphire styli; 45 rpm adaptor; olive & beige preassembled cabinet; 117 v. AC. 23 lbs.



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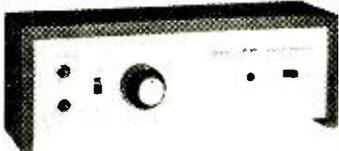
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HAM HOBBY CLEARINGHOUSE

If you have a hobby or interest in addition to amateur radio and would like to talk about it on the air, you can contact other hams with the same hobby through this column. To be listed here, just send a legibly printed postcard to Ham Hobby Clearinghouse, POPULAR ELECTRONICS, One Park Ave., New York, N.Y. 10016, including on it your call letters, other hobbies, the frequencies you use, mode of operation, when you operate, and your name and address.

CE5CN—Stamp collecting, chess, electronic experimenting; usually 7020 KHz. (Roberto Ibieta B., Freire 357, Concepcion, Chile)

DU1-FP—Experimenting, building projects, correspondence; 40 to 10 meters; 0800 to 1700 GMT. (Frederico C. Po, 77 Mayon St., Quezon City, Philippines)

WB2PAG—Ham radio, industrial and commercial photography, English sports cars, coins, industrial electronics; 7.015 MHz, CW, and 7.248 MHz, AM. (John A. Lupinski, 130 Elm St., Kearny, N.J.)

WB2TFN—Science fiction discussions; 80, 40 and sometimes 20 meters, CW; 0700 to 1100 GMT weekends. (Richard L. Gale, 365 W. 28 St., New York, N.Y. 10001)

WN2VGN—Astronomy, chess, coin collecting; 3730 KHz, CW; evenings, Saturdays and Sundays. (Peter Sockockki, 45 Park Ave., Latham, N.Y.)

WN2WSV—Biology, hi-fi, jazz, classical music, sports cars, stamps, books, writing; 40 meters, 7191 KHz, CW; Fridays and weekends. (Eric Levin, 5 Cheshire Terr., West Orange, N.J. 07052)

WB4CQJ—Skindiving, surfing; 80 to 10 meters, CW and AM; daily and nightly. (Ken Stuber, 200 NW 40 Ct., Pompano Beach, Fla. 33064)

WH6FQW/KH6PE3W—Hunting, fishing, hiking, camping, science; 40 meters; 0800 to 1100 GMT daily. (Guy K. Sueoka, 3328 Makini St., Honolulu, Hawaii 96215)

WABESV—Stock market, mutual funds, camping, hypnotism, parapsychology, medicine, travel, fishing, photography, salesmanship, public speaking, sciences; 6 and 2 meters; 1900 to 2200 week-nights. (E. S. Faith, 20584 E. Wood Ave., Cleveland, Ohio 44126)

K8QAT—Chess, radio construction, hunting, fishing, antennas; 80 to 10 meters; 0900 to 1200 weekdays and all day Saturday. (Joe Navotnik, 940 S. Hazelwood, Youngstown, Ohio)

WN9RMO—Coin collecting, camping, fishing, SWL'ing; 3731, 7182 KHz and 21.219 MHz, CW; evenings and weekends. (Ralph Alderson, 1456 N. Eagle St., Naperville, Ill. 60540)

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From December 1965 POPULAR ELECTRONICS:

"Well, at long last! A major kit manufacturer has produced a police/fire receiver . . . Allied Radio's KG-221 can be wired from scratch in less than 8 hours . . . It's a real bargain."

From May-June 1966 ELEMENTARY ELECTRONICS:

"Perhaps the best buy we've seen yet in a VHF FM receiver . . . covering the 152 to 174 megacycle band. A companion receiver, the KG-220 covers 30 to 50 megacycles. Building the kit is about a one evening project—even for beginners . . . You'd have to spend a lot more before you'd get a significant improvement in performance."

From July 1966 CB MAGAZINE:

"After two evenings of fun, the receiver was completed . . . Sensitivity was excellent . . . Frequency readout was good . . . Bandwidth checked out right on specs . . . an excellent buy for the money."

KG-221A. 152 to 174 Mc FM Monitor Kit is an easy-to-assemble receiver that lets you monitor police, fire, civil defense, U.S. weather bureau, forestry, conservation, and many other broadcasts. Two IF amplification stages and RF stage give top-notch sensitivity. Complete with all parts, wire, and easy-to-follow instructions. **\$44⁹⁵**

KG-220. 30 to 50 Mc Monitor Kit is same as above without RF stage and covers lower band. Monitors same type of services, except U.S. weather bureau forecasts, railroads, taxis. Complete kit. **\$39⁹⁵**

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Unique double conversion design and Frequency Synthesis Circuitry delivers outstanding performance.

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CIRCLE NO. 34 ON READER SERVICE PAGE



OPERATION ASSIST

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

Superior Instruments Model 710 multimeter. Wiring diagram needed. (David C. Moore, 114 S. 17 Ave., Phoenix, Ariz. 85007)

J. P. Seeburg Model MA1-L6 amplifier, ser. 14421; has 6 tubes. Schematic, operating manual, and source for parts needed. (Mark T. Starr, 3915 Orioff Ave., Bronx, N.Y. 10463)

Philco Model 38-4 receiver, code 121; tunes BC and s.w.; has 5 tubes. Schematic needed. (Alfred Charles Damm, Rt. 1, Box 158, Stetsonville, Wis. 54480)

Browning Model P4 synchroscope; has 14 tubes. Operating manual and information on Richardson T46543 transformer needed. (Sumner Eagerman, 39 Tennis Rd., Mattapan, Mass. 02126)

Zenith Model 1204 receiver, circa 1938. Schematic and source for 5Y4G and 6L7G tubes needed. (Bernard Guerin, 242 South St., Biddeford, Me. 04005)

CG 46115 receiver made by GE, circa 1942; tunes 0.2 to 1.5 MHz on 3 bands. Schematic, operating manual, and source for parts needed. (Leonard H. Kelley, 3074 N. Alvernon, Tucson, Ariz. 85716)

Lysco "Transmaster" 10-160 transmitter; has 8 tubes. Schematic and parts list needed. (Brian N. Hedland, 410 E. 9 St., Blue Earth, Minn. 56013)

Halicrafters "Super Sky rider" receiver, ser. H50297; tunes 550 kHz to 61 MHz; has 11 tubes. Schematic or tube chart needed. **Fada** receiver, ser. 2039, circa 1920; tunes BC; has 5 tubes. Schematic needed. (Brian Padgett, 432 W. 14 St., N. Vancouver, B.C. Canada)

Marconi Model 121 receiver, circa 1934; tunes on 3 bands; has 7 tubes. Schematic and source for parts needed. (Norman Emmons, Rt. #1, Chemoimus, British Columbia, Canada)

Philco Model 38-12 receiver. Schematic needed. (Thomas R. Belew, Jr., Rt. #1, Lexington, Ala. 35648)

CW-52063A transmitter, surplus, part of Model GF-12 set. Schematic, operating manual, and voltage, power ratings needed. (Michael Lavelle, 450 Oradell Ave., Oradell, N.J. 07649)

Triumph Model 841 oscillograph; has 6 tubes plus CRT. Schematic needed. (Bill Hliwa, 4212 Harvey Ave., Western Springs, Ill. 60558)

Zenith Model 1004 "Long Distance" receiver, ser. N476912; tunes S.W. on 4 bands; has 12 tubes. Schematic needed. (Wayne Earthman, 1427 Spruce St., Livermore, Calif. 94550)

National Model FSR-2 receiver; has 10 tubes. Source for coil and crystals needed. **ABK-4** transceiver made by (Continued on page 34)

new

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Short-Wave Listener's Guide. 2nd Ed. Gives listings for over 300 short-wave stations by country, call letters, frequency, power, and broadcast time. Invaluable for the short-wave fan. SLG-2 \$1.75

99 Ways to Improve Your CB Radio. Provides invaluable tips on how to operate, service, and maintain CB radio equipment to achieve optimum performance. ICB-1 \$2.50

How to Build Speaker Enclosures. Provides a wealth of both practical and theoretical information for constructing high-performance speaker enclosures for music systems. SEB-1 \$3.25

Understanding Telemetry Circuits. Clearly explains the four basic telemetry systems in current use. Explains how they are used in space and research to monitor and record remote conditions. UTL-1 \$3.25

101 Questions & Answers About Transistors. Provides through pertinent questions and answers, a basic understanding of transistor theory and applications. QTS-1 \$2.50

Electronics in Oceanography. A full description of modern electronic systems and the basic instrumentation used for gathering, measuring, and interpreting oceanographic data. EOL-1 \$4.95

101 Ways to Use Your Color-TV Test Equipment. 2nd Ed. Explains practical application of test equipment to diagnose color-TV troubles. Describes setup, proper test procedures, how to evaluate results. TEM-9A \$2.95

101 Ways to Use Your Oscilloscope. 2nd Ed. Provides latest information on the proper use of the oscilloscope for faster and better electronics servicing. TEM-2A \$2.95

PHOTOFACT® Guide to TV Troubles. 2nd Ed. Photos of actual TV picture defects indicate where to find the trouble source in minutes. PFG-2 \$3.95

Tube Substitution Handbook. 9th Ed. Includes hundreds of new substitutions; lists over 11,500 direct substitutions. Includes substitutions for receiving, picture tube, subminiature, industrial, and communications types. TUB-9 \$1.50

Color TV Servicing Made Easy. Full explanation of color principles, circuitry, setup adjustments, and servicing of color TV sets. Takes the mystery out of servicing color TV. CSL-1 \$3.25

Tape Recorders—How They Work. New 2nd edition. Fully explains principles of magnetic recording, various types of recorders, mechanisms and components, testing procedures, etc. Best reference on the subject. TRW-2 \$3.95

How to Read Schematic Diagrams. Not only shows you how to read and interpret diagrams, but analyzes each component, its construction, and its circuit purpose and use. RSD-1 \$2.25

Second-Class Radiotelephone License Handbook. New 3rd edition; complete study course for elements I, II and III of the latest FCC exams. Helps you earn the license you need for two-way radio work. QAN-2 \$4.75

Color TV Training Manual. 2nd Ed. Best guide for technicians preparing to service color TV. Detailed explanation of color principles, circuits, setup procedures, alignment, and troubleshooting; full-color illustrations. TVC-2 \$5.95

101 Ways to Use Your VOM & VTVM. Shows you how to get the most from these popular instruments, how to make required connections, how to test properly, how to evaluate results. TEM-3A \$2.95

Citizens Band Radio Handbook. New enlarged edition. Covers latest CB equipment and circuits, antenna systems, fixed and mobile installations, maintenance and repairs, FCC rules, etc. CBH-2 \$3.50



Computer Dictionary. Defines over 5000 terms and concepts. Valuable appendices include information on computer systems, applications, COBOL, FORTRAN, ALGOL, QUIKTRAN, etc. CDS-1 (softbound) \$4.95
CDH-1 (hardbound) \$6.95

Color TV Trouble Clues. Vol. 2. Field-tested guide to procedures for fast color TV receiver repair. Describes symptoms, troubleshooting techniques, proper use of test instruments. COL-2 \$1.95

ABC's of Lasers and Masers. 2nd Ed. Clearly explains the operation and applications of the laser, the amazing device which produces light radiations capable of performing astounding feats. LAL-2 \$2.25

Handbook of Electronic Tables & Formulas. New enlarged 2nd edition. Complete reference for all charts, math tables, formulas and laws, symbols, constants, and standards. Special color insert shows latest FCC frequency spectrum assignments. HTF-2 \$3.95

ABC's of Computers. Explains in simple terms how computers work and what they do. Covers analog and digital types; describes circuitry, memory devices, programming, etc. ABC-2 \$2.50

Transistor Radio Servicing Made Easy. 2nd Ed. The authoritative book on fast, accurate repair of transistor radios. Includes new FM models. TRE-2 \$2.95

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CIRCLE NO. 21 ON READER SERVICE PAGE



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gift
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Troubador model TSW-8S by

Argos
PRODUCTS COMPANY

Dept. C, 600 Sycamore St., Genoa, Illinois 60135

CIRCLE NO. 3 ON READER SERVICE PAGE

ASSIST

(Continued from page 32)

Zenith for U.S.N.; has 10 tubes. Schematic and operating manual needed. (Arch. Bursley, Middle Arm, Green Bay, Newfoundland, Canada)

Magnavox Model 148B receiver, ser. 219691, style C101-694; tunes on 2 bands; has 10 tubes. Schematic and operating manual needed. (Howard Silverstein, 6720 Calvert St., Philadelphia, Pa. 19149)

Philco Model 221 "Cathedral" receiver, ser. 960743, circa 1930; tunes BC on 1 band; has 7 tubes. Schematic, component values, and source for chokes needed. (B. F. Weed, Rt. #3, Winooski, Vt. 05101)

Radiomarine Corp. of America Model DEA direction finder; tunes 210 to 3000 kHz on 3 bands; has 8 tubes. Schematic and operating manual needed. (Robert Butler, Franklinville Rd., Swedesboro, N.J.)

RCA Model 211-B receiver; tunes from 150 kHz to 20 MHz on 5 bands. Schematic and operating manual needed. (Scott David, 3228 E. 160 St., Cleveland, Ohio)

AN/PRS-3A1 detector set, made by G.E., circa 1941; has 8 tubes. Operating manual needed. (Douglas Walters, 437 S. Lahoma, Norman, Okla. 73069)

RCA Model M1-10206 color TV monitor. Schematic and operating manual needed. (John Martin, 111 Bancroft Dr., Rochester, N. Y. 11616)

Hallcrafters Model S 201 "Sky Champion" receiver; tunes 550 kHz to 50 MHz on 1 band; has 9 tubes. Schematic, alignment data, parts list, and operating manual needed. (Michael Sherrett, 1818 Yorba Dr., Pomona, Calif. 91767)

Silvertone Model 1610 receiver, ser. 200957, chassis #101.476; tunes BC and s.w. on 3 bands; has 6 tubes, 1H1G and 136G tubes needed. (Orven F. Swenson, Star Rt. #1, Lemmon, S.D. 57638)

Automatic Sound Systems Model 29 power amplifier, ser. 15445; has 6 tubes. Schematic and operating manual needed. (R.L. Jaegly, 7606 Teal Dr., Huntsville, Ala. 35802)

GE Model A65 receiver, ser. 913669, circa 1935; tunes on 2 bands; has 6 tubes. Schematic needed. (W. E. Whittenburg, Rt. #1, Box 2, Wilmington, Ohio 45175)

Northern Electric Model 19 Mk II transceiver, controls marked in Russian and English, circa 1942. Schematic needed. (Chris Cunningham, 128 Maurice Dr., Oakville, Ontario, Canada)

Knight Model KG-636 DC-15 MC oscilloscope and dual-trace plug-in preamp. Construction manuals needed. (Charles Ball, Jr., Box 156, Rocky Mount, Va. 24151)

Jackson Model 120 oscillator, ser. 16609. Schematic, parts list, and operating manual needed. (Robert A. Davis, 605 36 St., Sioux City, Iowa 51101)

Airline receiver, circa 1925. Schematic needed. (Jim Rhodes, 12312 W. 51 St., Shawnee, Kan.)

Electronics Lab, Inc. Model 619 power supply, vibrator type LSB-1057. Tube numbers and location of tubes on chassis needed. (David A. Quick, Rt. #2, Box 25, Kingston, N.Y. 12101)

Hallcrafters Model S-28A receiver; tunes from 550 kHz to 50 MHz on 3 bands; has 5 tubes. Schematic and operating manual needed. (SP 1 John A. Dalla Valle, 55817613, USA STRATCOM, Facility Asmara, Box 86, AP0, New York 09843)

Master Vibrator Model EV-1 generator, ser. PL 8772, style 11156; 36 volts, 9.3 amps, 1800 r.p.m. Wiring diagram and maintenance information needed. (John T. Mullane, Hughes Research Labs., 3011 Malibu Canyon Rd., Malibu, Calif. 90265)

Heath Model DSB-100 transmitter. **Hallcrafters Model S-77A receiver**; tunes 550 kHz to 17 MHz. Schematics and operating manuals needed. (Thomas Ziegler, 118 Collins Ave., Williston Park, L.I., N.Y. 11596)

Philco Model 27-116 receiver; tunes 550 kHz to 20 MHz. Schematic, operating manual, and source for 6B1 tube needed. (Gary Mann, 2150 Pass, Topeka, Kan. 66611)

Zenith Model 6-S-229 receiver; tunes 1.6 to 18 MHz; has 5 tubes. Schematic needed. (John Kensta, 15 Edgehill Rd., Braintree, Mass. 02184)

Philco Model 40-155 receiver, circa 1910; tunes BC and s.w. Schematic needed. (Richard Roth, 2548 24 Ave., San Francisco, Calif. 94116)

Lear Model RM102C receiver, circa 1948; tunes on 3 bands. Schematic needed. (J. M. Young, 510 Hickory St., Algonquin, Ill. 60102)

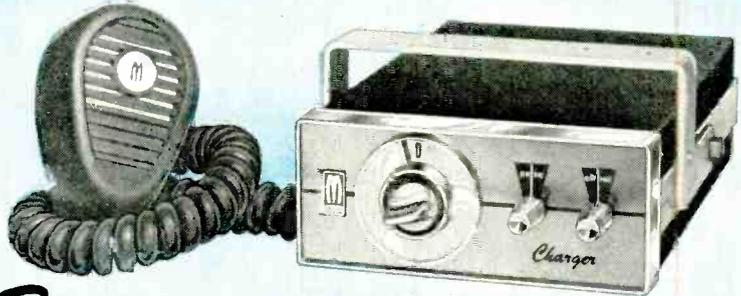
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2. Then get a job in a two-way radio service shop and "learn the ropes" of the business.
3. As soon as you've earned a reputation as an expert, there are several ways you can go. You can move *out* and start signing up and servicing your own customers. You might become a franchised service representative of a big manufacturer and then start getting into two-way radio sales, where one sales contract might net you \$5,000. Or you may even be invited to move *up* into a high-prestige



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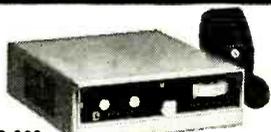
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THERE ARE TWO kinds of metal locators available: those that penetrate deep underground to detect large objects; and those that work on very small objects but do not go much more than a few inches below the surface. You can't have both—the math and the physical laws involved just won't let you. Presented here is a high-performance, deep-

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You'll find the IC-67 one of the newest and hottest receiver-transmitter type locators to hit the beach. It is not an experimenter's toy; it is a precision instrument with circuitry as good or better than anything now on the market. You can use it for any large metal object detection problem. It easily and strongly spots pipes, cables, and irriga-

**COVER
STORY**

January, 1967



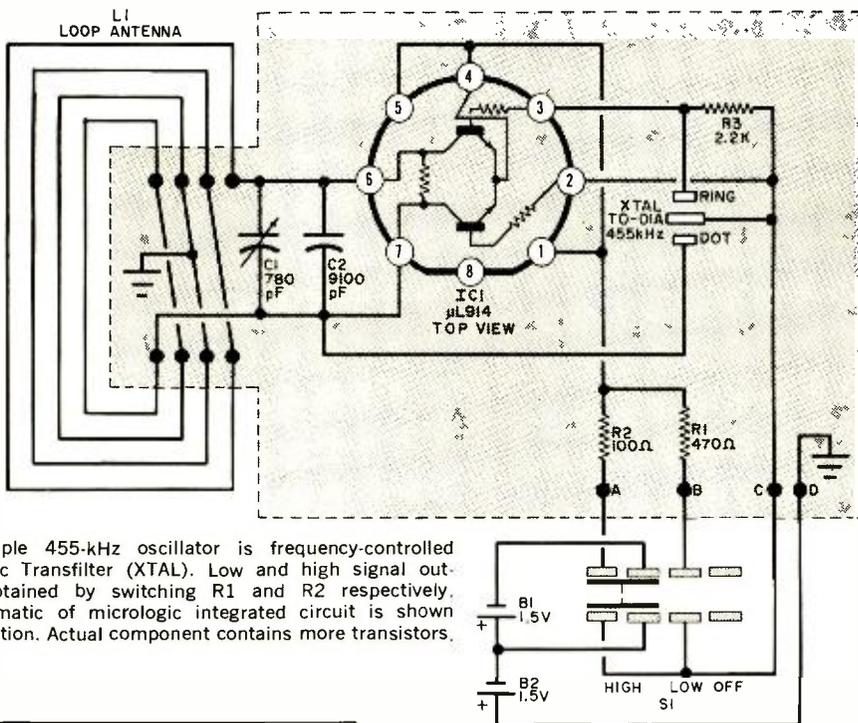


Fig. 1. Simple 455-kHz oscillator is frequency-controlled by a ceramic Transfilter (XTAL). Low and high signal outputs are obtained by switching R1 and R2 respectively. Partial schematic of micrologic integrated circuit is shown for simplification. Actual component contains more transistors.

TRANSMITTER PARTS LIST

- B1, B2—AA 1.5-volt penlight cell, (2 required)
 C1—170-780 pF trimmer capacitor
 C2—9100-pF polystyrene capacitor (Mallory type SX, $\pm 5\%$; do not substitute)
 IC1— μ L914 epoxy dual gate (Fairchild)
 L1—9" x 11" loop (1-turn four-conductor flat cable, 16 AWG, (formed from 37" of Belden 8476 or similar)
 R1—470-ohm, $\frac{1}{4}$ -watt carbon resistor
 R2—100-ohm, $\frac{1}{4}$ -watt carbon resistor
 R3—2200-ohm, $\frac{1}{4}$ -watt carbon resistor
 S1—D.p.3-t. slide switch (Wirt G-128 or similar)
 XTAL—TO-01 A Transfilter (Clevite)
 1— $1\frac{1}{4}$ " x $2\frac{1}{2}$ " printed circuit board**
 1—4" x $2\frac{7}{8}$ " x $1\frac{9}{16}$ " plastic case and cover (Harry Davies #220 or similar)
 1—Battery holder (Lajayette 99R6331 or similar)
 Misc.—Dialplate*, hardware, PC terminals (12), staples, wire, solder, etc.

Note: IC1 and XTAL are available from Semiconductor Specialists, 5700 W. North Ave., Chicago, Ill. 60639.

*,**See Receiver Parts List

tion valves buried as deep as seven feet, making it a top instrument for construction or landscape work. As a treasure finder, a silver dollar *in air* can produce a noticeable output, but when it comes down to the practical matter of reliably finding buried objects, a coffee can is

probably the best you'll be able to do.

Integrated circuits and low battery voltages as well as low power drain go hand in hand; only six penlight cells are used. A fully automatic zero-cost battery-tester feature is included. No headphones or dangling cords are required; a small sonic module easily provides a loud audio output from a very high gain receiver. A "crystal" stabilized transmitter in a CW broadcast system is used. An output meter and a choice of two transmitter power levels help locate the "treasure." Four controls run the instrument, and the entire project weighs in at only five pounds.

Most important, you get some features not found on commercial units. A signal expander circuit lets you reject all the background noise and signal variations to permit you to concentrate on what you're looking for. At the same time, the signal from deep targets is sharpened to enable you to precisely pinpoint deeply buried objects.

Total semiconductor cost is \$4.50, but the final bill will probably amount to about \$40—split \$35 for components and \$5 for lumber. This is about one-quar-

ter to one-ninth the cost of comparable commercial instruments.

While not intended as a beginner's project, the circuit is not too difficult to build and the parts are easy to get. Pay particular attention to the parts list and construction details; certain changes could cause trouble. A parts kit is available (see Receiver Parts List) or you can assemble your own parts.

How It Works. Essentially this instrument is nothing more than a receiver and a transmitter equipped with loop antennas. Loop antennas are very directional—two of them at right angles to each other provide practically zero signal coupling. But a metal object in the vicinity of the two antennas will upset a null condition and give you an output signal. Energy transmitted from the vertical rear transmitter loop is "reflected" by the object to the horizontal front receiver loop. Both loops must be rigidly connected and at least one of them precisely adjustable to null the no-target coupling.

The *transmitter* (Fig. 1) consists of a loop antenna driven by a 455-kHz oscillator. A dual micrologic integrated circuit (*IC1*) forms a push-pull CW oscillator when feedback is cross-coupled by a ceramic Transfilter (*XTAL*). As output power depends in part upon emitter current, a high or a low output level can be obtained simply by switching *R1* or *R2* into the circuit.

The *receiver* is a three-stage TRF type, followed by a detector, a signal expander, a meter, and sounder device. The receiving loop resonates at 455 kHz, picks up the signal from the transmitter and drives the r.f. amplifier (*IC1*). Transformer *T1* also resonates at 455 kHz, and couples the amplified signal to *IC2* for further amplification; *T2* similarly provides coupling to *IC3*. (See Fig. 2.)

The amplified output of *IC3* is transformer-coupled by *T3* to a conventional diode detector (*D1*). A d.c. voltage appears across *R4* and *C10* which is a function of the signal strength. To obtain signal expansion, the output voltage across *R4* and *C10* is added to the voltage across *R9* and part of the *Expansion* control *R7*, and applied to the base of a special, high gain transistor (*Q1*) to increase current flow through

the meter and the sounder, which serve as visual and audible indicators.

If the expansion voltage is large, *Q1* operates as an ordinary linear amplifier, and all target and clutter signals are equally amplified. On the other hand, if the expansion voltage is very small, *Q1* stays "off" unless a very strong signal is received. In this mode, only the peaks of the strongest signals reach the output, which "sharpens" target positioning and rejects background noise and clutter.

For intermediate settings of the *Expansion* control, the nonlinear operation of *Q1* amplifies the *stronger* signals more than the *weaker* ones, and "expands" the target signals at the expense of the clutter. Simply adjust the *Expansion* control to optimize results for each location.

Total receiver r.f. gain is on the order of 30,000, which is considerably more than the gain of an average AM radio. The gain of *IC1* and *IC2*, and hence overall gain, is controlled by *Gain* control *R6*.

Construction. No metal locator will work properly with a sloppy, loose or out-of-square frame. For topnotch operation, the frame *must* be absolutely rigid; the loop assemblies must be precisely at right angles; and there must be a means for smoothly adjusting the null between the two loops. Otherwise, "straight-through" transmitter energy will come booming through the receiver and completely "swamp" any target signals. Extra time spent on the frame will be more than made up by improved performance.

The main frame should be made from a quality piece of ¾" kiln dried maple, or plywood, as shown in Fig. 3. A ¼" dado blade, if available, makes child's play out of the rear slot; otherwise, just use repeated cuts and fence settings on a table saw to get the same result. Do not drill the ¾" pivot hole just yet.

Flush-mount three #10 Teenuts (washer-shaped metal fastener about ¾" in diameter, with three large fangs on outside and 10-32 threads on the inside) on the frame as shown. Put a dab of glue under each Teenut. The pilot hole for the Teenut on the rear end of the frame should go all the way through, into the

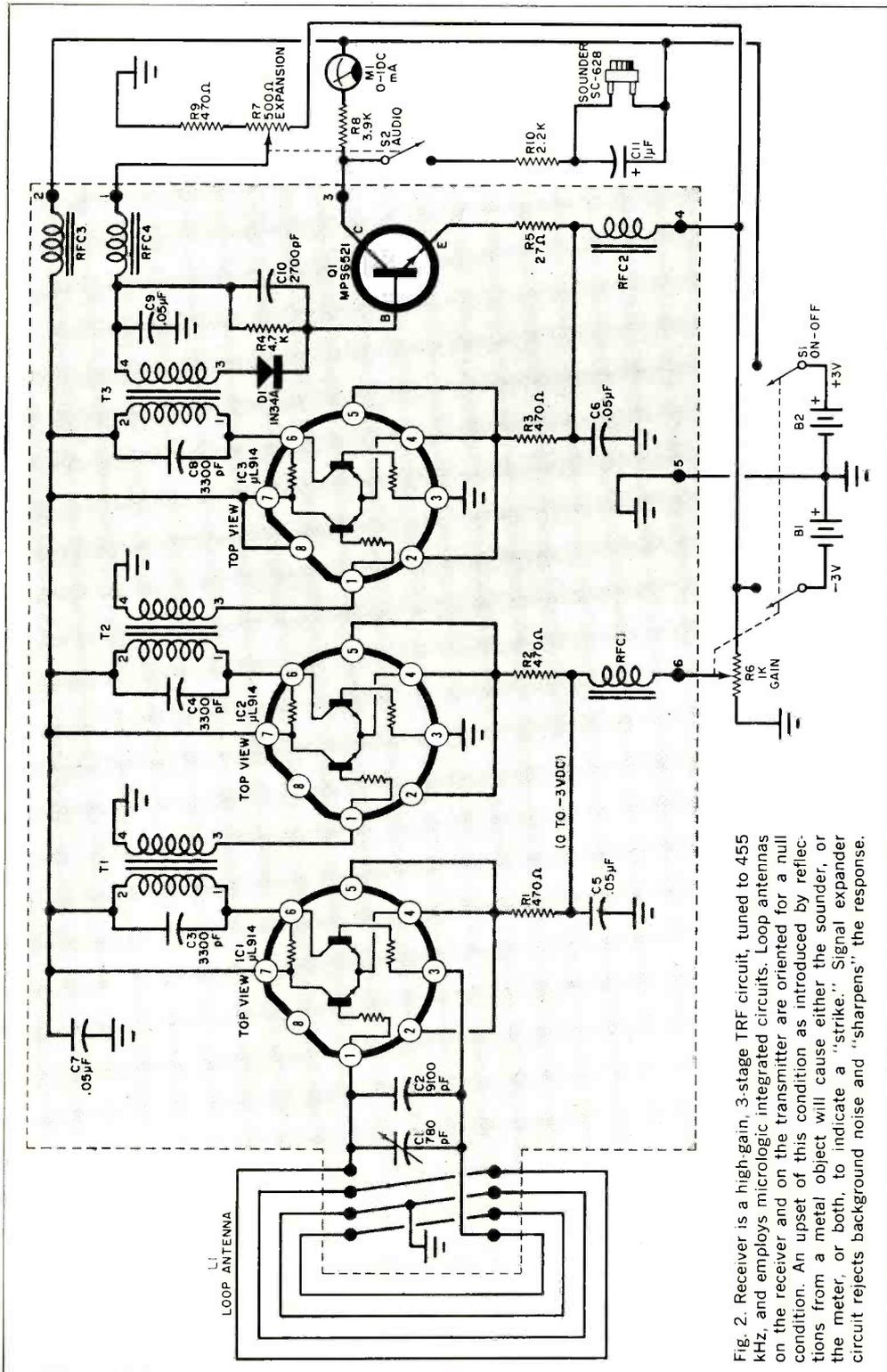


Fig. 2. Receiver is a high-gain, 3-stage TRF circuit, tuned to 455 kHz, and employs micrologic integrated circuits. Loop antennas on the receiver and on the transmitter are oriented for a null condition. An upset of this condition as introduced by reflections from a metal object will cause either the sounder, or the meter, or both, to indicate a "strike." Signal expander circuit rejects background noise and "sharpens" the response.

RECEIVER PARTS LIST

B1, B2—AA 1.5-volt penlight cells (4 required)
 C1—170-780 pF trimmer capacitor
 C2—9100-pF polystyrene capacitor (Mallory type SX, $\pm 5\%$; do not substitute)
 C3, C4, C8—3300-pF ceramic capacitor, 10% tolerance (Vitraron VK33; do not substitute)
 C5, C6, C7, C9—0.05- μ F miniature Mylar capacitor, or paper
 C10—2700-pF ceramic capacitor
 C11—1- μ F, 6-volt electrolytic capacitor
 D1—1N34A diode
 IC1, IC2, IC3— μ L914 epoxy dual gate (Fairchild)
 L1—9" x 11" loop (1-turn, four-conductor flat cable, 16 AWG, formed from 37" of Belden 8476 or similar)
 M1—0-1 d.c. milliammeter (Emico Model 13, edge-wise-type, or similar)
 Q1—MPS6521 transistor (Motorola; do not substitute)
 R1, R2, R3, R9—470-ohm, $\frac{1}{4}$ -watt carbon resistor
 R4—4700-ohm, $\frac{1}{4}$ -watt carbon resistor
 R5—27-ohm, $\frac{1}{4}$ -watt carbon resistor
 R6—1000-ohm linear carbon potentiometer with d.p.s.t. switch S1
 R7—500-ohm linear carbon potentiometer, with push-pull s.p.s.t. switch S2
 R8—3900-ohm, $\frac{1}{2}$ -watt carbon resistor
 R10—2200-ohm, $\frac{1}{2}$ -watt carbon resistor
 RFC1, RFC2, RFC3, RFC4—10 turns 34-AWG enameled magnet wire on Ferroxcube K5-001-

00/3B shielding bead; do not substitute***
 S1—D.p.s.t. switch on R6
 S2—S.p.s.t. push-pull switch on R7
 Sounder—6-28 volt d.c. audio sonic alarm module (Mallory or Sonalert SC628)
 T1, T2, T3—36 turns 34-AWG enameled magnet wire on Indiana General "Q-1" CF101 core, bifilar-wound; do not substitute***
 1—3 $\frac{3}{8}$ " x 2 $\frac{3}{8}$ " printed circuit board**
 1—6 $\frac{1}{4}$ " x 3 $\frac{3}{4}$ " x 1 $\frac{1}{8}$ " plastic case and cover (Harry Davies #240 or similar)
 1—Battery holder (Lafayette 99R6331 or similar)
 Misc.—Knobs (2), PC terminals (14), staples, dialplate*, hardware, wire, solder, etc.

*Metalphoto dialplate set (1 for receiver and 1 for transmitter); both available for \$1.50 from Reill's Photo Finishing, 4627 N. 11 St., Phoenix, Ariz. 85014, postpaid in USA.

The following parts are available from DEMCO, Box 16297, San Antonio, Tex. 78216:

**Etched and drilled circuit boards (1 for receiver and 1 for transmitter) both for \$3.50

***RCF and transformer kit consisting of 4 beads and 3 toroid cores with necessary lengths of magnet wire. \$2.50

Complete kit of parts, including Teenuts, less lumber, dialplates, and batteries. \$35.00. All prices postpaid in USA.

slot. The boards to hold the transmitter and receiver, also shown in Fig. 3, can be cut from $\frac{1}{4}$ -inch plywood.

Cut two flanges and the pivot from a small piece of $\frac{7}{16}$ " maple as shown in Fig. 4. Flush-mount four Teenuts on each flange. Glue the front flange into the 3" notch in the front of the main frame. The Teenuts on the flange should be on the bottom side. Be certain the flange is centered and square. Use clamps for the glue job. Insert and glue the pivot into the rear flange.

The pivot and flange assembly should be sanded to a smooth fit in the slot on the main frame. There should be no wobble or side play. After careful alignment, drill the $\frac{3}{4}$ " hole through the pivot and frame at the same time. Cut and insert a $\frac{3}{4}$ " length of $\frac{3}{4}$ " dowel. Secure with a dab of glue at one end only. Be sure that no glue gets into the pivot assembly to restrict movement.

Steel-wool all the woodwork and apply a coat or two of clear varnish. Keep the slot clear of varnish. After the final coat is thoroughly dry, assemble the microbalance as shown in Figs. 5 and 6.

Use a 3"-long 10-32 machine screw, a compression spring, and protecting washers. You may have to try several springs

to get just the right length and tension. You can redrill and tap a knob equipped with a setscrew for a $\frac{1}{8}$ " shaft to go over the top end of the long screw, and secure it in place with the setscrew. Rotating the knob rotates the pivot, which in turn rotates the transmitter board with respect to the receiver board. Each full turn of the knob represents 0.8 degree of transmitter tilt.

Fasten the transmitter and receiver boards to the main frame with four 10-32 $\frac{3}{8}$ "-long machine screws. If you use knurled head or thumbscrews for this purpose, you will be able to remove the boards to facilitate carting and storage. Certain special jobs of tracking pipes, or triangulating for depth measurements, can be more readily accomplished with this disassembly feature.

Metal cases should not be used to house the transmitter or the receiver on this type of metal locator as they would cause field-pattern distortion. Low-cost plastic instrument cases are suitable. Be sure to have all the electronic parts on hand and plan their layout before actual assembly is begun. External component dimensions may vary and you may have to make some allowances.

Drill the cases as shown in Figs. 7 and

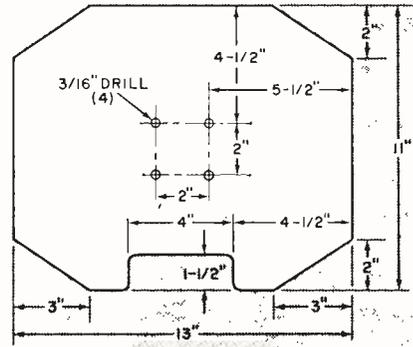
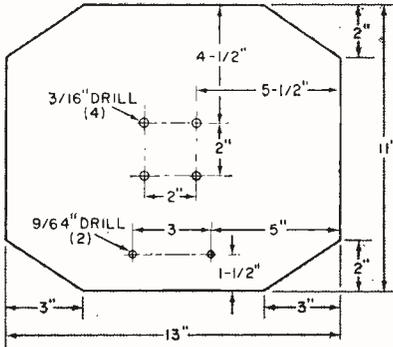
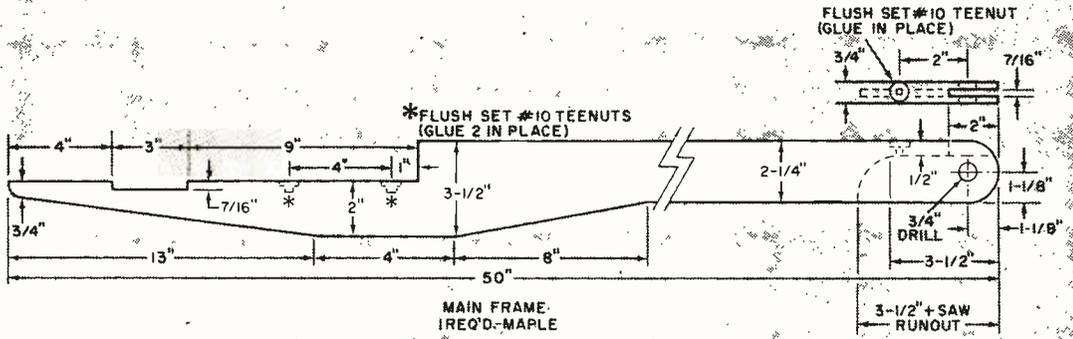


Fig. 3

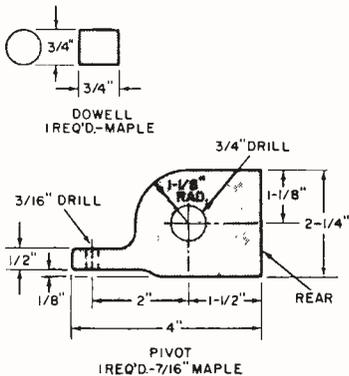
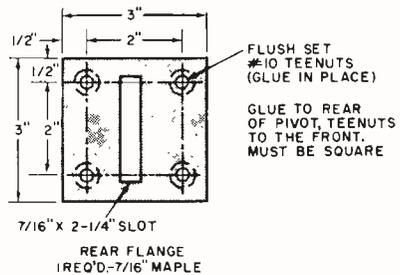
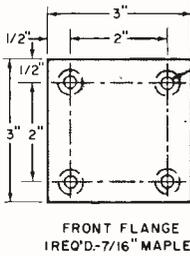
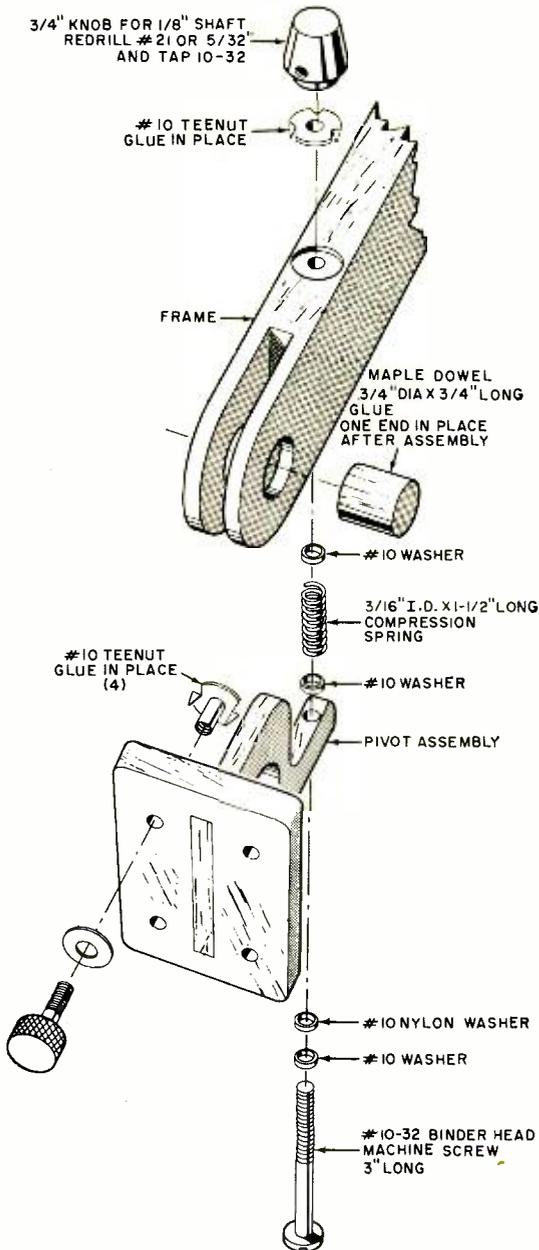


Fig. 4

Fig. 3. As in any precision instrument, all parts must be made to fit squarely and securely. Exact contour of frame and boards is not critical, but do maintain relative positions and distance between boards. The less metal hardware, the better. Use maple or other hard, high-quality wood for frame.

Fig. 4. Insert and glue the pivot into slot on the rear flange. Rear of pivot should be flush with back side of flange as shown in Fig. 5. The 3/4 inch hole should be drilled through the frame and pivot assembly at the same time. Position the pivot assembly as accurately as possible before drilling.



8, but do this carefully to avoid damage. A rotary file will save you time on the two big holes in the receiver. Glue nylon nuts over the holes in the case, as indicated, and keep the threads and the hole clear. Insert a metal screw while the gluing job is in progress, and then

FRAME PARTS LIST

- 1—Beam: 50" x 3 1/2" x 3/4" maple
- 2—Antenna boards: 13" x 11" x 1/4" plywood
- 1—Pivot: 4" x 2 3/4" x 7/16" maple
- 2—Flanges: 3" x 3" x 7/16" maple
- 1—Dowel: 3/4"-diameter x 3/4"-long maple
- 11—Teenuts: 10-32 x 3/4" diameter
- 1—Machine screw: 10-32 x 3" long, binder head
- 1—Knob: 3/4" diameter for 1/8" shaft, with set-screw
- 1—Spring, compression: 3/16" i.d. x 1 1/2" long, 6 turns
- 4—Thumb screws: 10-32 x 3/4"
- 3—Washers: #10 metal
- 5—Washers: #10 nylon
- 4—Machine screws: 10-32 x 3/4"
- Misc.—Glue, varnish, steel wool, etc.

Fig. 5. The microbalance assembly (left) should work freely, but not sloppily. One complete turn of the knob is equal to 0.8 degree of transmitter tilt.

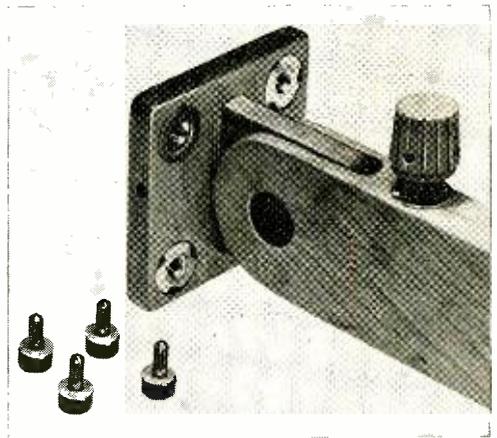


Fig. 6. Use of knurled-head bolts or thumb screws facilitates the removal of the transmitter board for storage, and to solve certain locating problems.

remove the screw before the glue sets. Metal nuts can be used if you have difficulty locating the nylon nut.

Two plastic battery holders for four AA cells are also cemented in place—one in the receiver, and one in the transmitter. Solder a lead to an appropriate eyelet or conductor on the receiver's battery holder to provide a "center tap," to give you a center-tapped 6-volt supply. On the transmitter's battery holder, connect the two bottom conductors together and a lead for a center tap, to provide a center-tapped 3-volt supply. Only two cells are used for the transmitter. You could use a 2-cell battery holder for this purpose, but the 4-cell holder permits easier access.

If the cases come through without

covers, use any suitable insulated material. A piece of $\frac{1}{16}$ " fiberglass is suitable. Add a dialplate to obtain a finished appearance, and to identify the controls.

Electronic Package Construction. Note: Due to the exceptionally high receiver gain, it is important that an exact duplicate of the prototype PC board be used, and that the exact core materials and winding instructions are followed for the transformers and r.f. chokes. Failure to do so will almost certainly result in receiver instability and bandwidth problems.

The r.f. chokes are wound on ferrite beads. Start with about 12" of 34-AWG

enameled magnet wire, and wind 10 turns equally spaced toroidal-fashion around the bead. Keep the wire tight and the turns neat. Do not nick the wire on the turns edge. After winding, cut each end to $\frac{1}{4}$ " length and strip the enamel back $\frac{3}{16}$ ". Sand your way down to shiny bare copper, and tin the leads.

The transformers are only slightly more difficult. Start with 10 feet of 34 AWG enameled magnet wire. (Do not substitute.) Fold the wire in half and twist it until you get about 12 turns per inch. Guard against kinks, nicks, and abraided insulation. Now, using this bifilar wire, wind *exactly* 36 turns on a
(Continued on page 94)

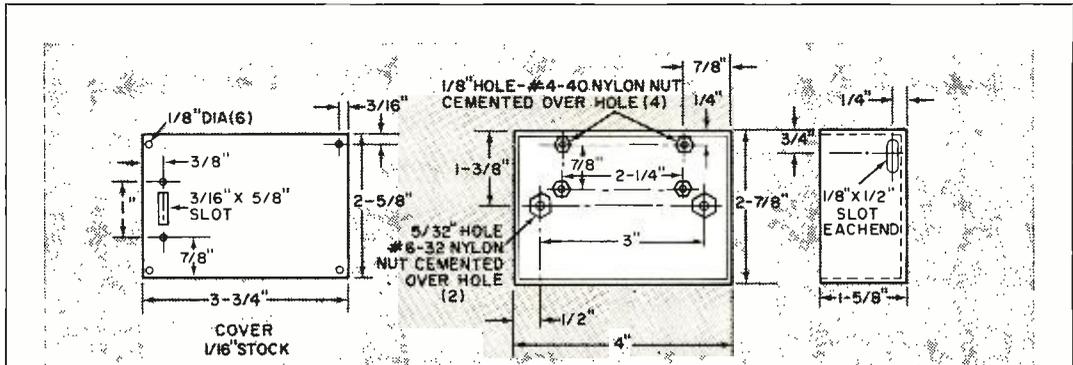


Fig. 7. Use a small plastic box to house the transmitter. Do not employ any more metal hardware than is absolutely necessary. A metal case will distort field pattern uniformity.

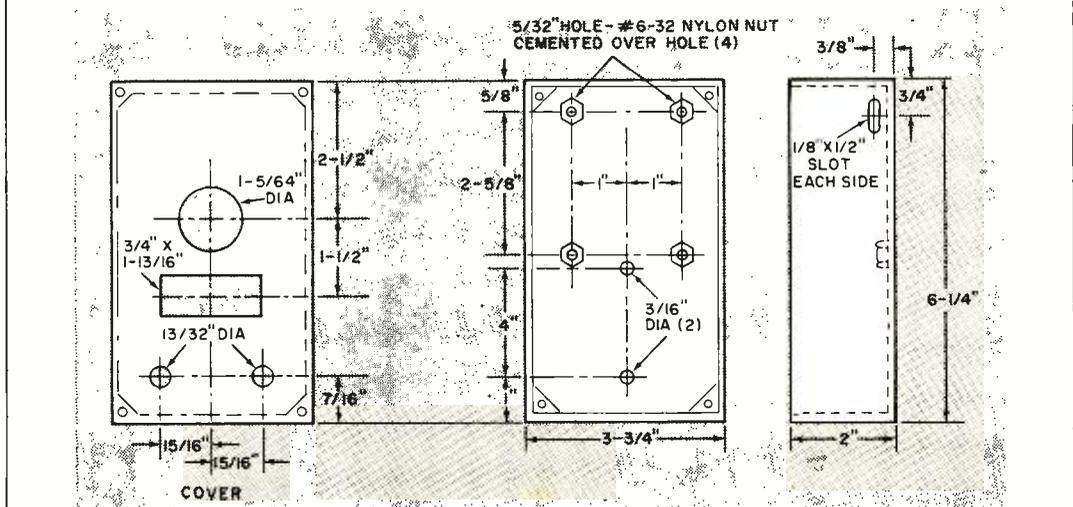


Fig. 8. Receiver housing is also made of plastic; work slowly and carefully when drilling or cutting. Slots in side of box should be large enough to accept antenna without bending or bunching conductors.

COMMUNICATIONS MYSTIQUE

By
WALT MILLER



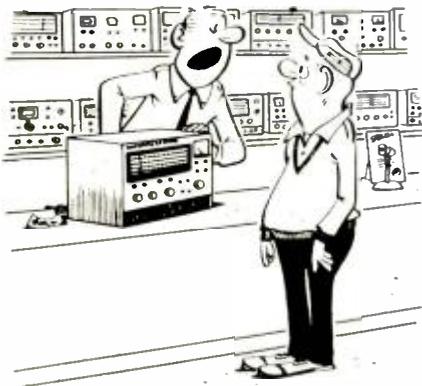
"The CIA wants us to QSL!"



"Look, Ethel, a QSL from the jungles of Brazil."



"But, Helen, do you know what it will mean if the electric company shuts off the power?"

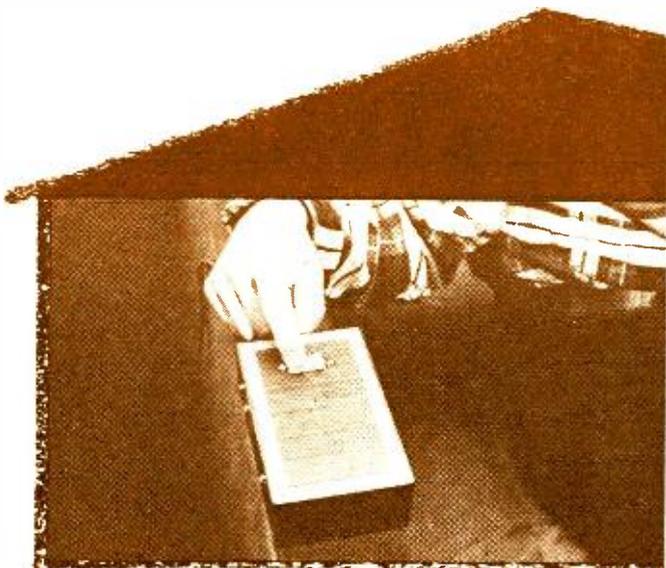


"...and replacement parts are no problem. Just pick up your phone and ask the operator for Hong Kong."



"For a minute I was worried—thought this was from the Internal Revenue about my tax return—but it's only an FCC 'pink ticket'."

BUILD A Carrier-Current Remote-Control System



By R. ZARR

PUT A
RADIO-FREQUENCY SIGNAL
ON YOUR
117-VOLT A.C. LINE
TO CONTROL
ELECTRICAL DEVICES
FROM A
DISTANT LOCATION

HOW LAZY CAN YOU GET? Now you can turn electrically operated devices on and off without getting out of your favorite chair—or off that couch! Two small easy-to-build units, one a transmitter and the other a receiver, are all that are needed.

Both units are plugged into any a.c. outlet, in the same room or in different rooms. Signals from the transmitter pass through the house wiring and are picked up by the receiver, which is equipped with a sensitive relay. Press the button on the transmitter and any light or electrical device plugged into

the receiver goes on. You need only press the button again to shut things down. The signal frequency is about 120 kHz; actual frequency is not critical, but it is important that the transmitter and the receiver be tuned to the same frequency.

There's nothing to prevent you from building more than one receiver and using a few of them—all controlled by one transmitter—to operate more devices in more than one location.

How It Works. The transmitter is a Colpitts oscillator as shown in Fig. 1. The oscillator frequency is determined by capacitors C_4 , C_5 and the setting of coil L_1 . Resistors R_1 , R_2 and R_3 establish the bias for Q_1 . The signal developed across R_3 is coupled to the a.c. line by C_1 and C_2 . Transformer T_1 steps down the line voltage to about 12 volts; diode D_1 rectifies and C_3 filters this voltage to power the transmitter. Capacitor C_6 serves as a d.c. blocker and a.c. coupler.

Switch S_1 turns on the transmitter and acts as the control switch for the entire system—when the transmitter is on, the receiver is on. Indicator lamp I_1 is optional.

The signal on the power line is picked



up by tuned circuit *C7*, *C8*, *L2* in the receiver (Fig. 2). The signal from the tuned circuit is rectified and used to "turn on" *Q2*. When *Q2* conducts sufficiently, relay *K1* energizes and connects whatever is plugged into *SO1* directly to the 117-volt a.c. power line. However, *S2* must be on for all this to happen.

The stronger the signal, the greater the current flow through *K1*. The voltage across the relay winding is a relative indication of the signal strength on the line. Without a signal, you should get about 0.2 to 0.6 volt d.c., depending upon the amount of transistor leakage current. A strong signal, such as you get when the transmitter and receiver are plugged into the same outlet, will produce more than 5 volts. When the units are separated by about 50 feet, about 3 volts will appear across the relay.

Do not exceed the current rating of the relay contacts. If you want to control a larger load, use a power relay and hook it up as shown in Fig. 3. If you duplicate this power relay, no modification of the receiver is necessary.

Transformer *T2* puts out about 6.3 volts a.c. (almost any inexpensive filament-type transformer will do); *D2* and *C9* rectify and filter, respectively, this

voltage to power the circuit. Indicator lamp *I2* is optional. To de-energize the relay, either *S1* in the transmitter or *S2* in the receiver should be shut off.

Construction. Parts layout is not critical. You can arrange the components in any convenient manner, but be on the alert to prevent short circuits.

Molded Bakelite boxes are best to use for the remote control units because these boxes are nonconductive and easy to work with. If you decide to use metal boxes, do not ground or otherwise connect the components to the boxes. Should any of the capacitors (*C1*, *C2*, *C7* or *C8*) break down, the entire circuit could be at 117-volt a.c. line potential. A case-grounded circuit could also put the case at line potential.

A see-saw switch with a built-in indicator lamp can be used to eliminate the need for mounting a separate lamp assembly in the transmitter unit, and it gives the unit a clean, attractive appearance.

You can wire in the parts in "breadboard" fashion as shown in Figs. 4 and 5. Cut two pieces of perforated board to size, one for the receiver and the other for the transmitter. Screw four 1/2"-long metal or plastic spacers onto each of

Fig. 1. The Colpitts oscillator circuit in the transmitter (right) develops a high-frequency control signal which is fed into the a.c. line through C1 and C2. Operating frequency is determined by C4 and C5 and the setting of L1.

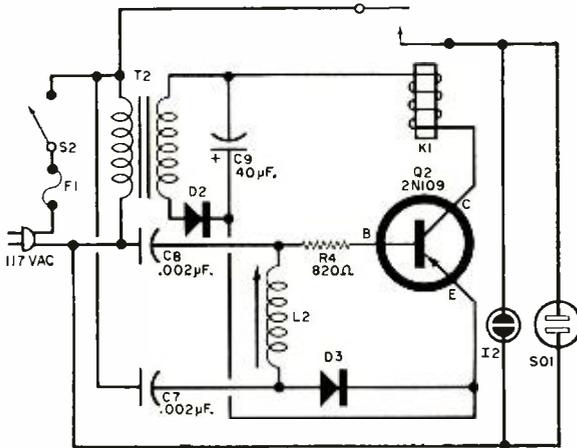
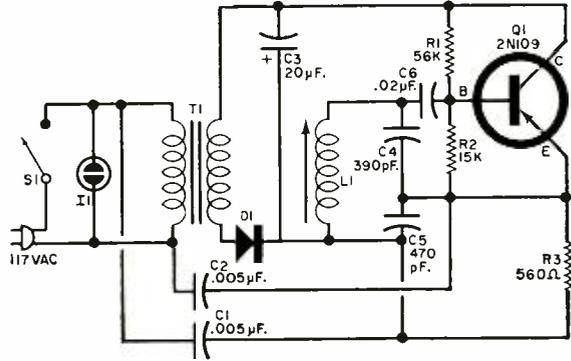


Fig. 2. When tuned circuit C7, C8 and L2 in the receiver unit (left) picks up the control signal on the a.c. line, Q2 conducts to energize K1. When K1 energizes, full line power is applied to any appliance plugged into S01.

PARTS LIST

- C1, C2—0.005-µF, 1000-volt disc capacitor
- C3—20-µF, 50-volt electrolytic capacitor
- C4—390-pF mica capacitor
- C5—470-pF mica capacitor
- C6—0.02-µF disc capacitor
- C7, C8—0.002-µF, 1000-volt disc capacitor
- C9—40-µF, 25-volt electrolytic capacitor
- D1, D2—DD-117 diode (International Rectifier)
- D3—1N48 diode
- I1—See S1
- I2—Indicator lamp (Allied Radio 8 U 698 or similar)
- K1—Miniature relay (Lafayette 99 C 6091 or similar)
- L1, L2—1.3 to 2.1-mH coil (Miller No. 4414)
- Q1, Q2—2N109 transistor
- R1—56,000-ohm, 1/2-watt resistor
- R2—15,000-ohm, 1/2-watt resistor
- R3—560-ohm, 1/2-watt resistor
- R4—820-ohm, 1/2-watt resistor
- S1—S.p.s.t. switch with built-in indicator lamp (Lafayette 99 C 6259 or similar); or use separate switch and indicator lamp
- S2—S.p.s.t. switch
- S01, S02—Chassis-mounting receptacle
- T1—12-volt, 1.0-ampere filament-type transformer
- T2—6.3-volt, 1.0-ampere filament-type transformer
- Misc.—Bakelite boxes (2), a.c. line cords (4), perforated board, terminals, spacers, etc.

the boards to obtain adequate clearance between the board and the case. And drill a small access hole in each case to line up with the tuning coils, so you can get to the tuning slug.

Tuning. Turn the transmitter and receiver on. If the relay does not pull in

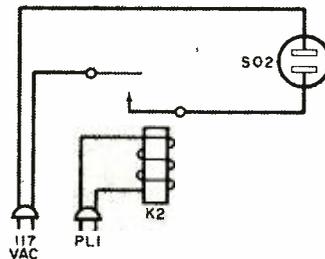


Fig. 3. To control high power equipment, a power relay must be used between the receiver and the equipment to prevent damage to relay in receiver.

immediately, adjust *L1* and *L2* until it does. Use a voltmeter to tune the units for a peak voltage indication across the relay winding. Center the slug in both coils before you start adjusting.

If you do not peak the adjustment with a voltmeter, you can put some dis-

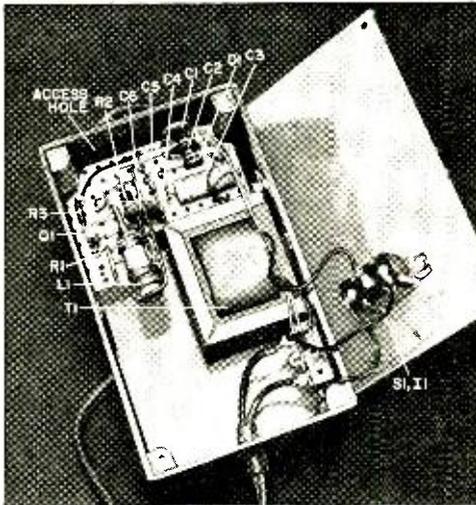


Fig. 4. Transmitter parts layout is not critical, but avoid excessive component lead length to prevent shorts between the a.c. and d.c. voltage sections.

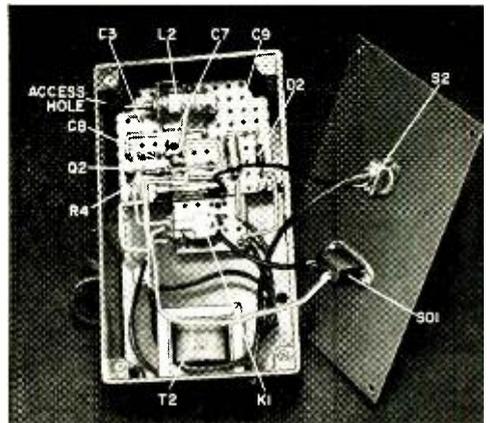


Fig. 5. Breadboard-type layout in receiver is easy to follow and greatly simplifies construction. However, almost any other type of chassis construction can be used. Drill access hole directly in line with tuning screw of coil *L2* to tune the unit.

tance between the transmitter and receiver and optimize the adjustment. The greater the distance, the more critical the tuning.

If you encounter a situation where the relay will not pull in, try connecting another 0.002- μ F capacitor in series with *C7*.

-30-

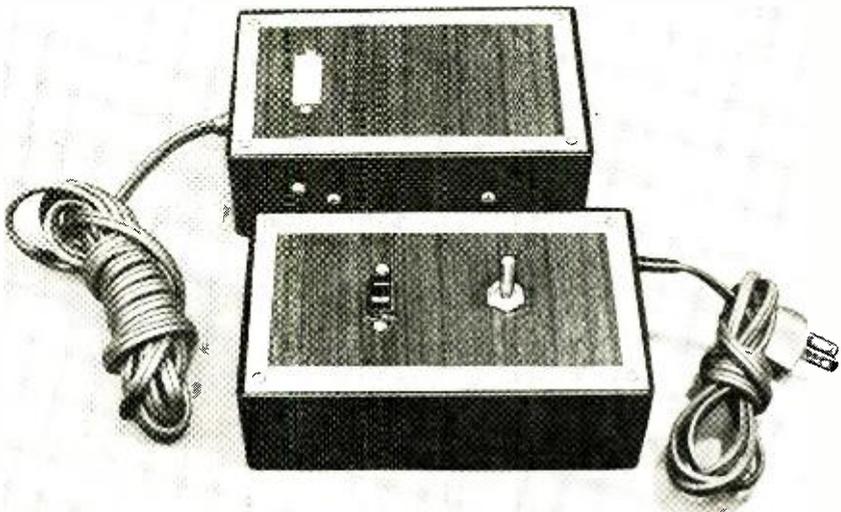
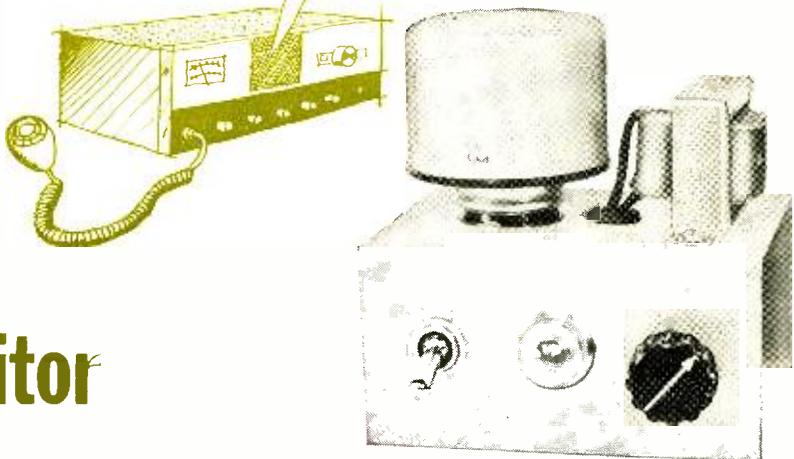


Fig. 6. Matching transmitter (top) and receiver units can add a distinctive touch to your room furnishings if you cover their lids with simulated wood or leather grain adhesive-backed vinyl. Leave about $\frac{1}{2}$ " of the metal cover showing or cover the entire lid, whichever blends with your room decor and suits your taste.



BUILD:

CB Radio Call Monitor

By RICHARD C. PETERSON

NOW YOU CAN ENJOY the convenience of selective calling and remote receiver monitoring from a simple radio call monitor you can build and install in an evening or two. Employing a frequency-selective circuit, the call monitor continuously listens in on the channel you select for the designated call signal, ignoring voice communication and noise peaks outside the selected frequency range.

When the call monitor is in operation, a tone signal from the calling station activates a control relay which turns on a visual or audible indicator at any desired monitoring area to alert the operator that he is being called. It works in conjunction with a transmitting station equipped with a tone-generating device—such as an ordinary code practice oscillator or audio signal generator.

How It Works. The call monitor is shown schematically in Fig. 1. Its LC tuned circuit consists of the secondary of transformer *T1* and resonating capacitor *Cx*. With coil inductance varying somewhat from transformer to transformer, the resonant frequency of the circuit is determined essentially by the value chosen for capacitor *Cx*, as shown

by the graph of Fig. 2. In general, for this application, a capacitor value of 0.0001 μF to 1.0 μF provides a tuning range of 50 Hz to 2 kHz.

The circuit also includes current limiting resistors *R2* and *R3*, tuning sensitivity potentiometer *R1*, neon glow lamp *I1*, relay *K1* shunted by filter capacitor *C1*, and battery *B1* controlled by *S1*. Capacitor *C1* eliminates relay chatter by filtering out the a.c. components from the relay coil circuit.

With no input signal applied, and with the correct battery voltage, *I1* is biased just below its firing point. With a signal present, the bias threshold is exceeded and lamp *I1* conducts, pulling in the relay to activate the alarm.

Construction. Start construction by laying out the chassis and drilling the mounting holes along the lines of Fig. 3. Then mount the relay socket and transformer in place on the chassis, running the transformer leads through the $\frac{3}{8}$ " rubber grommet. The transformer black leads are the signal input terminals.

The battery cutoff switch, neon glow lamp, and sensitivity control are mounted on the front panel. The resistors and capacitors are mounted under the chas-



THIS SIMPLE DEVICE
STAYS "GLUED"
TO YOUR RECEIVER
AND ALERTS YOU
WHEN THERE'S A CALL

sis, and a barrier strip on the rear of the unit facilitates input and output circuit connections.

While a couple of 90-volt dry cell batteries can be hooked up to provide the correct bias voltage for *B1* (exact battery voltage to be determined by test), it is usually more feasible to obtain this voltage from a tap on the transceiver's B+ circuit through an appropriate dropping resistor, except when working with transistorized equipment. If you must use batteries, they can be mounted externally, or under the call monitor's chassis, if there is space.

Checkout and Installation. With the battery switch off, set the potentiometer

for maximum resistance and connect an audio signal generator, tuned to the frequency you're interested in, across input terminals 1 and 2 (see Fig. 1). Connect the leads of an a.c. VTVM between points 2 and 3. Then adjust the signal generator output for a reading of approximately 10 volts on the VTVM. If this reading cannot be attained, reduce the setting on *R1* as necessary.

From Fig. 2, select an appropriate capacitor for the desired frequency, and temporarily connect it between points 2 and 3 (across the VTVM). The VTVM

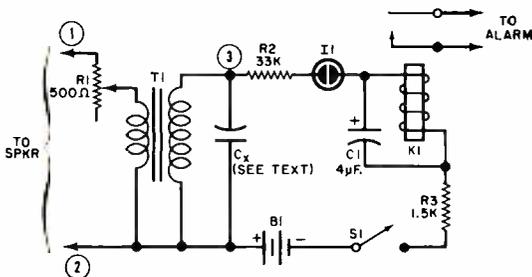


Fig. 1. With *S1* closed, the voltage across *I1* is maintained below its firing point. An input signal causes the lamp to fire and relay *K1* pulls in.

PARTS LIST

- B1*—90-volt dry cell battery (2 required—see text)
- C1*—4- μ F, 25-volt electrolytic capacitor
- Cx*—Resonating capacitor—see text
- I1*—NE-51 neon glow lamp
- K1*—Sigma 4F-2500S-S1L relay, or similar
- R1*—500-ohm potentiometer
- R2*—33,000-ohm, 1/2-watt resistor
- R3*—1500-ohm, 1-watt resistor
- S1*—S.p.s.t. toggle or slide switch
- T1*—Stancor A-3327 audio output transformer, or similar
- 1—3"-deep x 4"-wide x 2"-high open-end chassis
- Misc.—Neon lamp holder, 3/8"-i.d. rubber grommet, control knob, 5-terminal barrier strip, 5-pin relay socket (similar to Amphenol 78-RS5), wire, solder, mounting hardware

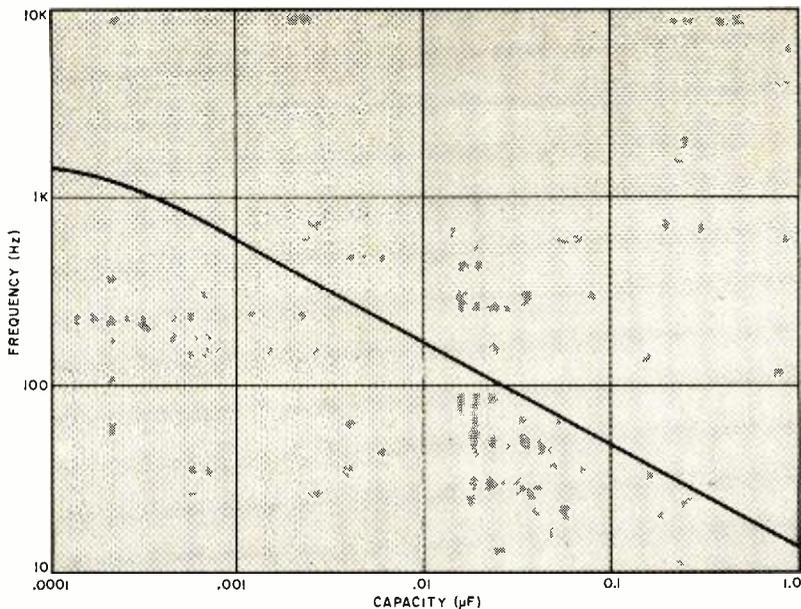


Fig. 2. With the transformer specified, the value of resonating capacitor C_x can be quickly determined from the coordinates of this FREQUENCY vs. CAPACITY chart.

reading should increase appreciably, making it necessary to turn down the generator output to maintain the 10-volt reading. Alternately interchange capacitor C_x for one of a higher and lower capacity rating—the capacitor produc-

ing the highest voltage reading should be installed permanently in the circuit.

Disconnect the signal generator and connect points 1 and 2 of the call monitor across the receiver's voice coil. Then call up the other station and ask that the tone signal be transmitted. Adjust your receiver volume control for normal listening, and readjust $R1$, if necessary, for an indication of approximately 10 volts, as was done previously.

Disconnect the VTVM and set the battery switch to *on*. Using a voltage divider in the battery or $B+$ circuit, as the case may be, adjust the voltage until the neon lamp just fires, pulling in the relay contacts. Then hook up your alarm circuit to the relay contacts. The call monitor is turned *on* or *off* by operating the battery switch.

If you want the call monitor to be tripped by any incoming signal—voice, noise, etc.—simply remove the resonating capacitor (C_x) from the circuit and set $R1$ to zero resistance. Or, you can remove $R1$ entirely. By adjusting the battery voltage to a value just below the lamp extinction voltage, the relay will pull in on any incoming signal and drop out when the signal is removed. —30—

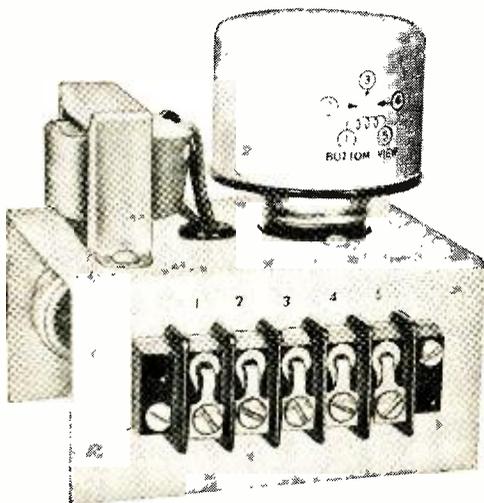


Fig. 3. This rear-view photo of the call monitor shows major components mounted on an open-end chassis. The operating controls are on front panel.



BUILD THE "TRANS-VOX"

TRANSISTORIZED, SUPERSENSITIVE,
VOICE-OPERATED RELAY
TURNS TRANSMITTERS,
TAPE RECORDERS,
AND OTHER EQUIPMENT
ON AND OFF

By **CHARLES CARINGELLA**, W6NJV

THE "Trans-Vox" will let you enjoy voice-controlled "hands-free" operation of your CB or amateur radio transmitter, your tape recorder, or other electronic or electrical equipment. When the "Trans-Vox" is used with a tape recorder, there is no wasted tape. Airport controllers, detectives, and other monitors depend upon this type of tape-saving feature to record what's going on over a long time period.

For most applications, this gadget can be used without modifying your equipment. You simply plug your microphone

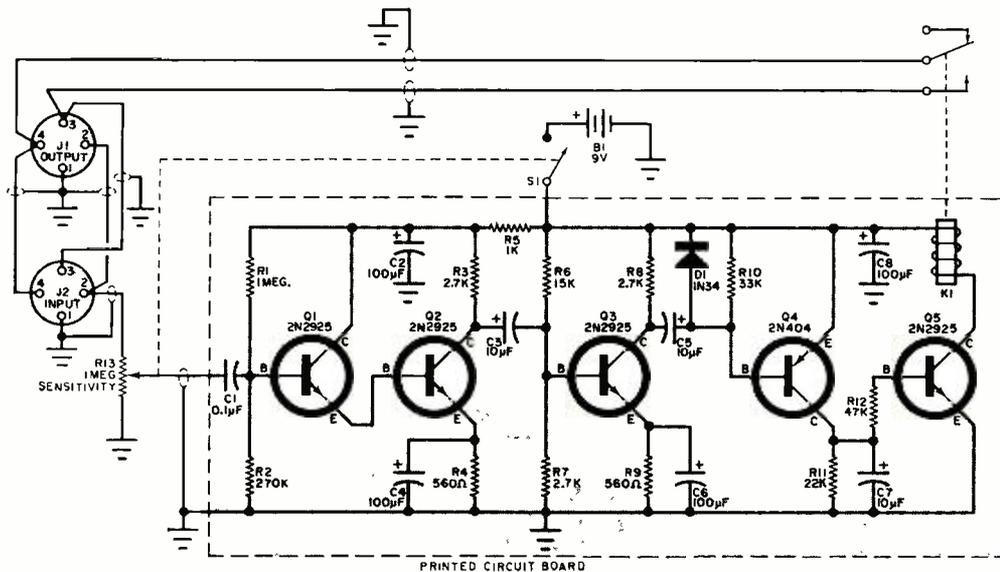


Fig. 1. The high-gain amplifier circuit converts sound to signal voltage sufficient to trigger the relay. Sensitivity can be varied to work distances up to 30 feet at normal voice levels. Unit is completely self-contained, and is plugged into the microphone input of a tape recorder, or a transmitter. No modifications of equipment are necessary. Push-to-talk as well as voice control can be obtained at the flip of switch S1. It's on for VOX.



into the Trans-Vox, and plug the Trans-Vox into your rig. All it takes to actuate the device is the sound of your voice. The circuit is extremely sensitive; normal conversation from as far away as thirty feet from the microphone will trip the works.

New low-cost plastic-encapsulated transistors are mounted on a printed circuit board (see Parts List), which greatly simplifies construction. An ordinary 9-volt transistor radio battery powers the unit.

How It Works. Transistor *Q1* (Fig. 1) serves as an emitter follower and provides a high input impedance to better match the output impedance of a ceramic or crystal microphone which is plugged into the unit at *J1* or *J2*. A portion of the sound picked up by the microphone is passed on to *Q1* through sensitivity control *R13*. The signal from *Q1* is direct-coupled to *Q2*. Both of these transistors (*Q1* and *Q2*) are cascaded

in a unique manner—the combination of the voltage divider action of *R1* and *R2*, as well as *R4*, stabilizes both transistors.

Transistors *Q2* and *Q3* work as high-gain RC-coupled audio amplifiers and pass the signal on to *Q4*. But before the signal gets to *Q4*, it is negatively clamped by diode *D1* to place all of the signal below a certain d.c. (9 volts) reference level. A negative voltage is needed on the base of *Q4*, with respect to its emitter, and the clamping action places all of the signal in a better position to turn *Q4* "on and off."

When *Q4* conducts, it drives *Q5* into conduction and energizes relay *K1*. Capacitor *C7* takes on a charge while *Q4* is conducting, and discharges when *Q4* is quiescent. The length of time it takes *C7* to discharge, below the point where *Q5* is conducting sufficiently to hold in *K1*, determines the Trans-Vox's hold-in time.

The pull-in time (sometimes called attack time) of the circuit is just a fraction of a second. It is determined mostly by the travel time of the relay armature. When the Trans-Vox is used in

PARTS LIST

B1—9-volt battery
C1—0.1- μ F, miniature ceramic capacitor
C2, C4, C6, C8—100- μ F, 12-VVDC miniature electrolytic capacitor
C3, C5, C7—10- μ F, 12-VVDC miniature electrolytic capacitor
D1—1N34 germanium diode or similar
J1, J2—Shielded 4-pin miniature chassis connector (Amphenol 78-PCG4 or similar)
K1—Relay, with pull-in current of 7.0 mA d.c. (Sigma 11F-1000-G/SIL or similar)
P1, P2—Shielded 4-pin miniature male cable connector (Amphenol 91-MPA14L or similar, to match *J1* and *J2*)
Q1, Q2, Q3, Q5—2N2925 npn transistor, or similar
Q4—2N404 pnp transistor, or similar
R1—1 megohms
R2—270,000 ohms
R3, R7, R8—2700 ohms
R4, R9—560 ohms
R5—1000 ohms
R6—15,000 ohms
R10—33,000 ohms
R11—22,000 ohms
R12—47,000 ohms
R13—1-megohm potentiometer, with switch *S1*
1—Printed circuit board, as shown
1—3 $\frac{3}{4}$ " x 3" x 2 $\frac{1}{8}$ " metal chassis box
Misc.—Metal spacers, $\frac{1}{2}$ " long x $\frac{1}{4}$ " O.D., tapped for 4-40 screw (4); knob; shielded cable; solder lugs; battery clip; etc.

An etched and drilled circuit board, complete with all mounting hardware, is available for \$2.50, postpaid. A complete kit of parts, which includes the above circuit board as well as a pre-punched and painted chassis box, is also available for \$18.50 postpaid. Order from Caringella Electronics Inc., Box 327, Upland, Calif. 91786.

conjunction with a transmitter for voice-controlled operation, a negligible portion of the first word spoken will be clipped; with a tape recorder, you'll find this clipping effect slightly intensified, because of the time it takes for the tape transport motor to reach operating speed.

Hold-in time is approximately one-half second when *C7* has a value of 10 μ F. If you find that the relay drops out too quickly to suit your purposes, increase the capacitance. Conversely, you can shorten the hold-in time by decreasing the capacitance. For most purposes, the value of 10 μ F provides enough hold-in time for short pauses between words and sentences, yet the relay drops out quickly enough when the talking has stopped.

The input and output connectors, *J1* and *J2*, are wired in parallel and can be used interchangeably.

If your microphone is equipped with

a push-to-talk switch, wire the switch in parallel with the relay contacts (pins 3 and 4 on *P2*) as shown in Fig. 2, to obtain either push-to-talk or voice-controlled operation. For voice-controlled operation, you simply turn *S1* on, and talk into the mike; you don't have to touch the push-to-talk switch. For push-to-talk operation, turn *S1* off, and use the push-to-talk switch on the microphone in the usual manner. No other connections or disconnections need be made to switch from one mode of operation to another.

Construction. All of the components shown within the dotted line in Fig. 1 are mounted on a printed circuit board, as shown in Figs. 3 and 4. If you choose not to use a circuit board, then follow the layout of the illustrated unit as closely as possible. Consideration should be given to proper lead dress in order to prevent feedback loops and parasitic oscillations which are inherently possible in high-gain amplifier circuits, such as this one.

Mount the resistors and the diode vertically to conserve space. Exercise

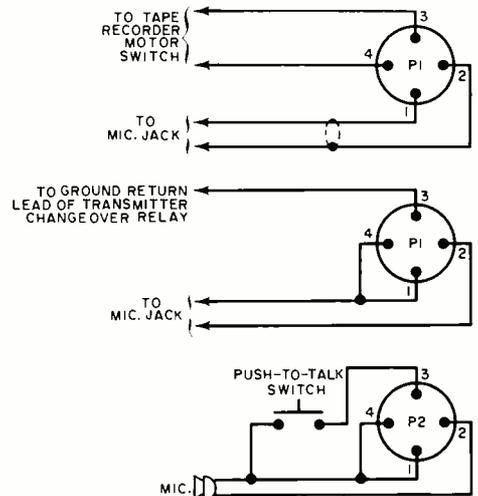


Fig. 2. Inputs *J1* and *J2* are in parallel, and can be used interchangeably, but the plugs must be wired in accordance with their specific function. Plug *P1*, top, serves as an output connector from the Trans-Vox, and is designed for a tape recorder. Plug *P1*, center, is for connection to a transmitter. Input plug *P2* can be wired as shown; if your microphone does not have a push-to-talk switch on it, simply omit the connections to pins 3 and 4 on *P2*.

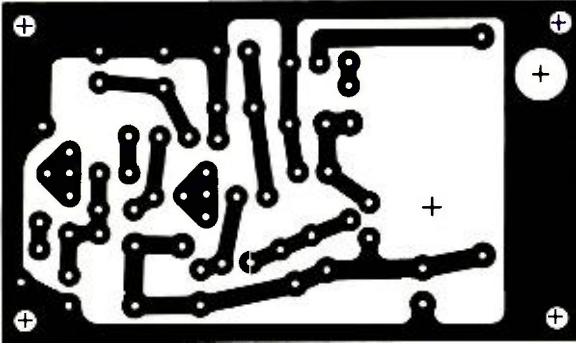


Fig. 3. Actual size of printed circuit board is shown to help you make your own. However, almost any type of wiring can be employed, but attention must be paid to proper lead dress to reduce inter-stage coupling in order to prevent parasitics.

Fig. 4. Component side of board. Relay frame must clear the foil on the other side of the board. Observe polarity of the capacitors, diode, and proper transistor connections when installing components.

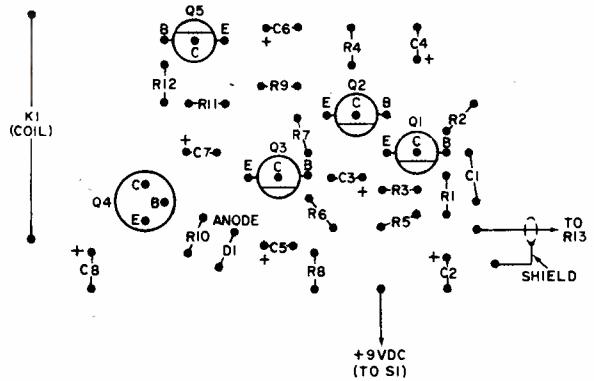


Fig. 5. Completed board assembly. Note use of shielded cable for input and output connections. Stand-offs are used to mount the board in the cabinet and to provide clearance. Components are stood on end.

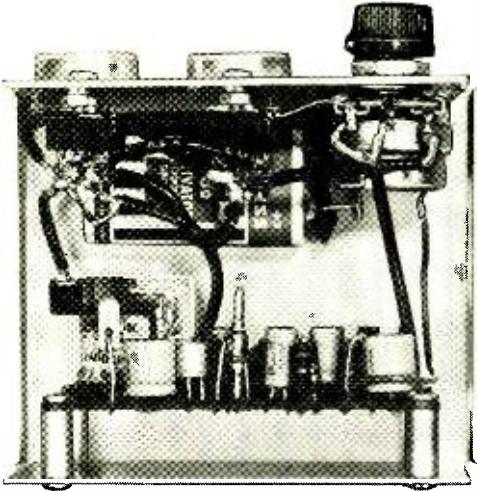


Fig. 6. Half the battle in stabilizing a sensitive high-gain amplifier circuit is neat construction and layout. Cable shields are connected on one end only to avoid setting up hum producing ground loops.

care, so as not to inadvertently connect the relay frame to the copper foil on the board. The relay frame on most relays is electrically connected to the armature. Shielded cable should be used as indicated in Fig. 1, and shown in Figs. 5 and 6. Connect the shield to the ground circuit only at one end, and trim the ends neatly to avoid short circuits. Probably the most difficult part of the project is to trim the shielded cables.

The completed circuit board assembly is housed in a small metal box. Mount the assembly on $\frac{1}{2}$ " spacers, and with suitable 4-40 hardware.

Operation. Once you have completed the unit, it is easy to check its operation. Relay idling current (when the relay is not energized) should be about 3 mA; pull-in current (depending upon the relay) is about 12 mA.

Watch out for stray noise and acoustical feedback; if you place the microphone too close to the Trans-Vox unit especially when the sensitivity control is turned up, the mike could pick up the clicking sound of the relay and cause continual "chattering." To eliminate this condition, turn the sensitivity control down or get more distance between the mike and the noise source.

If you find the normal clicking noise

of the relay contacts objectionable, you can cement a lining of foam rubber, or other sound absorbing material, under the circuit board and along the inside walls of the box, to kill some of the sound.

Many tape recorders have a separate jack (or one or two leads in the mike cable) for external control of the tape-drive motor. If your tape recorder doesn't have a provision for remote control, you can install a jack and wire it in series with one of the motor leads. You will then be able to plug in the control to turn the motor on and off.

Tape recorders that are not internally operated by one or more relays require manual manipulation of a button or a control to engage the tape transport drive mechanisms. These driving elements are usually rubber-clad, and if allowed to retain contact under pressure while the motor is off, will develop flat spots sufficient to cause a thumping mechanical sound and irregular tape transport. Therefore, when you are through with your recording session, be sure to return all switches and controls on the tape recorder to their normally-off position.

Practically all CB and ham transmitters are wired for a push-to-talk switch

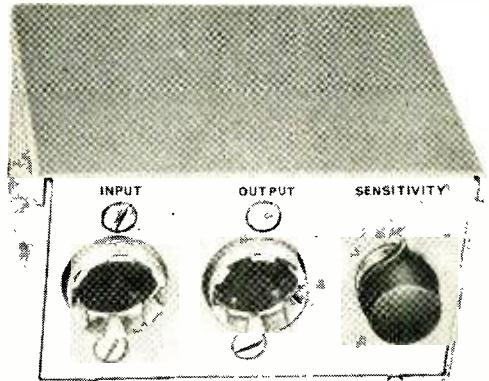


Fig. 7. Mounting of the on-off switch on the sensitivity control results in a simple, easy-to-operate, one-knob controlled unit. Input and output jacks and plugs can be of any design, but must be matching.

on the microphone. This switch simply grounds the ground-return lead of the transmitter's transmit-receive change-over relay. Select matching plugs and jacks to enable you to interconnect the control with your equipment. -50-

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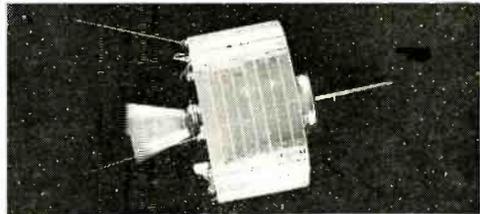
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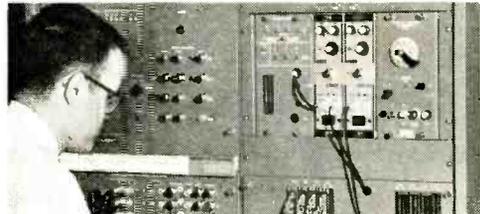
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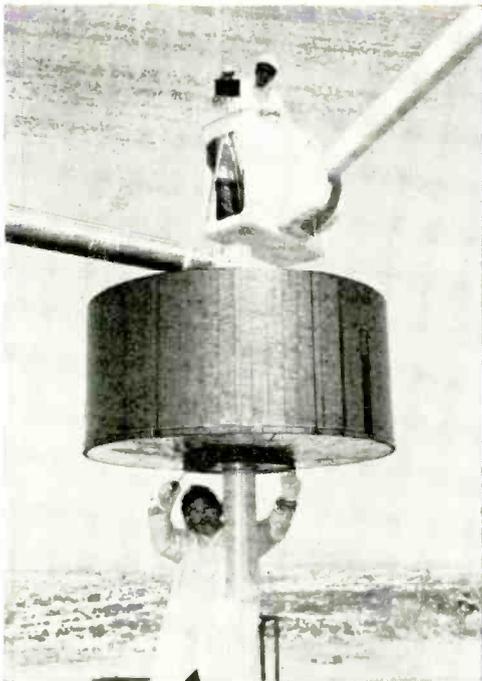


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ZERO-BEATING THE NEWS



TWO TO GO—Each of four new Hughes Aircraft Company satellites is capable of twice Early Bird's power. Two will be launched into orbit over the Atlantic and Pacific (two in reserve) for COMSAT's world-wide communications network.

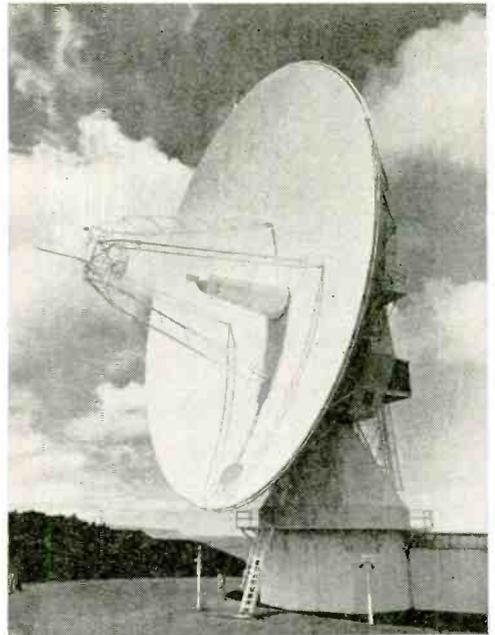


WHO GOES THERE?—The AN/PPS-6 one-man portable radar set built by the General Instrument Corp. detects a moving vehicle at distances up to 2 miles, a walking man up to 1 mile in pitch darkness.

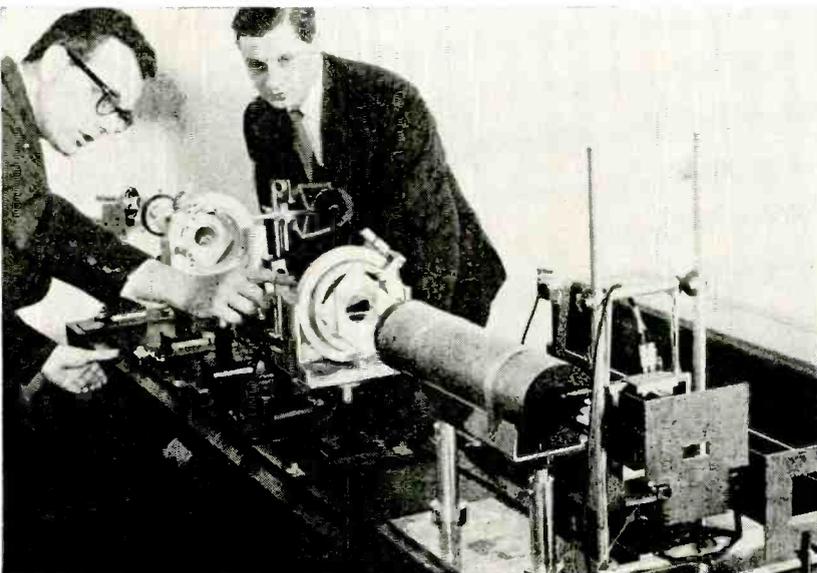
NOSY AIRCRAFT—Eight Air Force EC-135N aircraft are being modified by the Douglas Aircraft Company to provide better communications coverage for Apollo. Added to the Apollo Range Instrumented Aircraft (A/RIA) as shown below is a 10' long bulbous nose, housing a 7' parabolic antenna that will scan for a spacecraft, lock onto it, and transmit and receive voice and telemetry communications.



THEY GET SMALLER AND SMALLER—The NDC-1051, a 1/2-cubic-foot airborne computer developed by Nortronics Division of Northrop Corp., has the processing ability of much larger units, yet can be produced at much lower cost due to miniaturization and advanced packaging techniques. The glass master (below) is used to photographically transfer an etched circuit pattern to the 29-pound computer's two logic circuit boards.



TALLER THAN A TEN-STORY BUILDING—Six foot saucer-shaped antennas will be used to align two huge 85'-diameter antennas with sharpshooter precision at "boresight" test ranges being readied in Washington and Hawaii by General Telephone and Electronics Corp. The 135-ton antennas will be used for satellite communications.

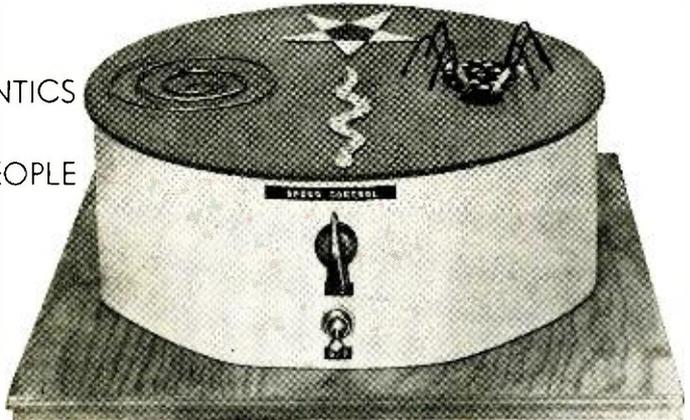


RED AND BLACK TV—An ultrasonic diffraction cell that directs acoustic waves of varying frequency to deflect a laser beam across a screen has been developed by Zenith Radio Corp. Other cells provide intensity modulation and vertical deflection, performing the same jobs as picture tubes and deflection yokes in conventional TV sets. Because the helium-neon laser emits a red light beam, the picture on the screen is red and black in this experimental television picture display system.

BUILD A "MAGIC" MOTOR

ROTATING MAGNET
CREATES INTRIGUING ANTICS
THAT CAN ASTOUND
AND ATTRACT PEOPLE

By **WALTER B. FORD**



MEEET THE "MAGIC" MOTOR. It can rotate odd-shaped figures without gears or belts, and will keep both youngsters and oldsters occupied for hours. You can use it to attract people, conduct a contest to see who can describe how it works, or dream up your own special applications. The gadget consists of a small battery-operated motor and a small but powerful cylindrical magnet mounted on the motor's shaft.

When a metal object, such as one of those shown above, is placed in contact with the magnet and the motor is turned on, the object will "slither" its full circumference and will appear to be traveling back and forth, or in a circle, or in random fashion, depending upon its shape. The secret is in the magnetic clutch action between the magnet and a metallic object. The magnetic force holds the object against the magnet; and as the magnet rotates, it drags the object along.

Imagination is really what makes this gadget a winner. Gaily painted and grotesque figures like giant insects, reptiles, and monsters—or even a practical display such as merchandise for sale—can be set up to attract attention.

Construction. Center and draw a $9\frac{1}{4}$ "-diameter circle on a piece of $\frac{3}{8}$ " x 12"

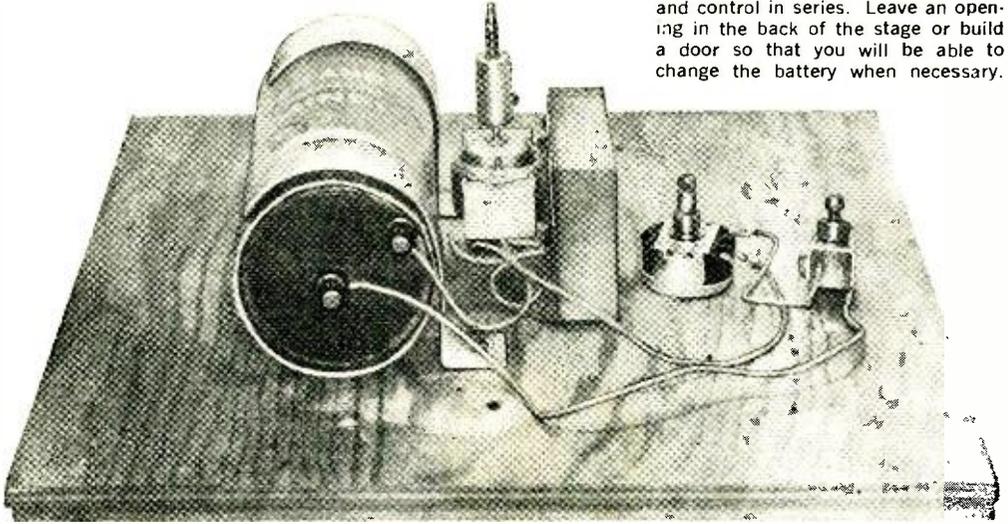
x 12" piece of plywood or other suitable board, and mark off eight equally spaced divisions on the circle. Then cut a $\frac{1}{2}$ "-thick piece of plywood or other suitable board to 10" in diameter, and drill a $\frac{1}{2}$ "-diameter hole in its center. The first piece of wood is the base; the second is the stage for the project. Smoothly sand one side (top) of the stage.

Mount the battery on the base in any suitable manner—you can shape a metal strap to hold it down. The motor can be mounted on a block of wood, or on a metal bracket. Position the motor so that the shaft is directly over the center of the circle drawn on the base. Use wood screws to hold the motor in place.

Another metal bracket is needed to support the speed control and the switch. Mount the bracket on the underside of the stage, close to the edge, so that the control and switch will project out of a "curtain" which you will wrap around the stage to hide the inner works.

Cut and mount eight $\frac{1}{2}$ "-diameter by $6\frac{1}{2}$ "-long wood dowels over the divider markings on the circle drawn on the base, to support the stage.

A coupler to mount the magnet on the motor's shaft can be made from $\frac{1}{2}$ "-diameter x 1"-long aluminum or brass rod. Drill a $\frac{1}{4}$ " hole, about $\frac{1}{2}$ " deep, in one end of the rod to accommodate the



Connect the battery, motor, switch, and control in series. Leave an opening in the back of the stage or build a door so that you will be able to change the battery when necessary.

BILL OF MATERIALS

1—Battery-operated motor*
 1—Dry cell battery, No. 6
 1—25-ohm rheostat
 1—S.p.s.t. toggle switch
 1— $\frac{1}{4}$ "-diameter x $1\frac{1}{2}$ "-long magnet*
 1— $\frac{1}{2}$ "-diameter x 1"-long piece of brass or aluminum rod
 1—12" x 12" sheet of $\frac{3}{8}$ " plywood
 1—10" x 10" sheet of $\frac{1}{2}$ " plywood
 6— $\frac{1}{2}$ "-diameter x $6\frac{1}{2}$ "-long wood dowels
 1— $6\frac{1}{2}$ " x 36" cardboard—see text
 Misc.—Hookup wire, wood screws, solder, cement, brackets, etc.

*Battery-operated motor and magnet can be obtained from Edmund Scientific Co., Barrington, N.J. (Motor: Catalog No. 30,305, 70 cents; magnets. Catalog No. P-40,418. \$1.05 for two; minimum order must be \$2.00)

magnet. Determine the diameter of the motor shaft and drill a $\frac{3}{8}$ "-deep hole in the other end of the rod to fit over the shaft. These holes must be centered or you will run into some pretty wild action when you turn the motor on. Excessive off-centering may cause you more trouble than you bargained for, but if you slow down the motor enough, you may wind up with a usable and possibly more interesting effect.

You can cement the coupler in place or do a little more machine work and install setscrews. Do not finalize the position of the coupler until the stage is

set, as you may find that you'll have to raise or lower the magnet.

Finishing Touches. Set the stage on the upright dowels and check to see if the magnet is centered in the stage's opening. If necessary, you can shift the position of the motor, but if you followed instructions, things will fit right from the start. Adjust the height of the magnet to about $\frac{1}{4}$ " above the top of the stage. Now connect the switch, control, motor and battery in series, using ordinary hookup wire. Turn on the motor and check the action; if you are satisfied, glue the stage in place.

The curtain comes next. Cut a strip of heavy but flexible cardboard about 30" long by $6\frac{1}{2}$ " wide. Cut two holes in the curtain to fit over the switch and the control. Drape and cement the curtain in place around the stage.

You can fashion your reptiles, insects, monsters, and other geometric figures from just about any thin piece of metal that has magnetic properties. A coiled snake (as shown) can be made from a length of iron wire, with a piece of sheet metal for a head. Avoid shapes or angles that will trap your figure so that it can't move. The movement of your figure can be lazy or aggressive, depending on the rotating speed of the motor. —50—

BUILD THE VOM RANGE SPLITTER

DOUBLE THE NUMBER OF VOLTAGE RANGES
ON YOUR MULTIMETER FOR GREATER
VERSATILITY AND UTILITY

By JULIAN ROSSNICK

FOR REASONS OF economy or size limitation, some multimeters do not have a sufficient number of voltage ranges for the test work on hand. While the four to six ranges available on most meters are sufficient for most jobs, there are times when additional or intermediate ranges are more convenient and more accurate.

When a voltage just about swings the

meter's pointer beyond the maximum point on the scale on a given range, you must use the next higher range, and wind up in the lower portion of the dial. When the pointer falls in the lower third of the meter's scale, a greater amount of meter error is likely to be encountered. An "in-between" voltage range could overcome this problem.

Practical in-between ranges can be obtained with the Voltage Range Splitter (VRS), and without any internal changes of the meter.

How It's Done. The project is as simple as it is practical, requiring only one additional resistor for each range you want to add. All you need to know to determine the value of each resistor is the meter sensitivity and the desired extension of an existing range. You multiply these two figures to get the value needed.

For example, suppose you want to read up to 12 volts on an existing 6-volt range, and the meter sensitivity is 20,000 ohms/volt. The resistor value needed is 120,000 ohms ($6 \times 20,000$). Notice that the input resistance to the meter for the new 12-volt range is doubled (from 120,000 ohms to 240,000 ohms), and a significant benefit can be derived by the use of the higher range, even to read as little as 4 or 5 volts, especially if this voltage is across a high impedance.

Plan your new ranges, if possible, so that they are compatible with the meter dial markings. If your meter has the same scales as the meter shown in Fig. 1, the 6-volt range can be extended to 12 volts, and the 120-volt scale markings

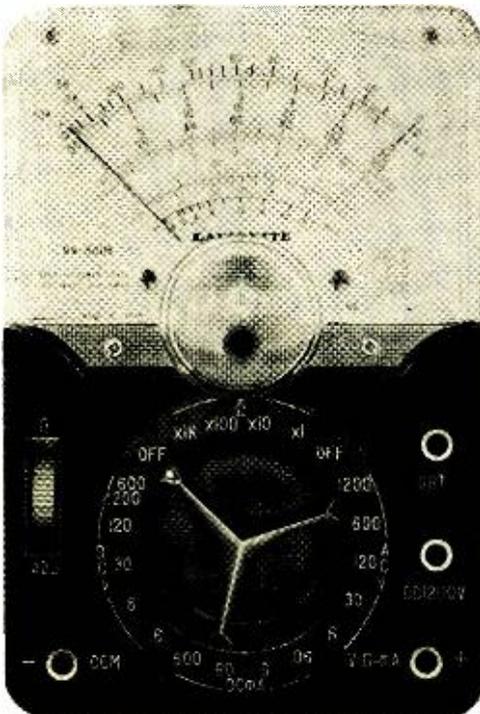


Fig. 1. Little variation exists among average VOM's as to number of voltage ranges available, but you can add in-between ranges when needed with VRS.

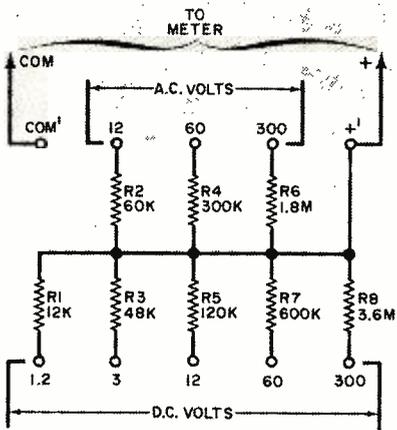


Fig. 2. Values shown are for meter sensitivity ratings of 10,000 ohms/volt on a.c. and 20,000 ohms/volt on d.c. For other meter ratings, see text.

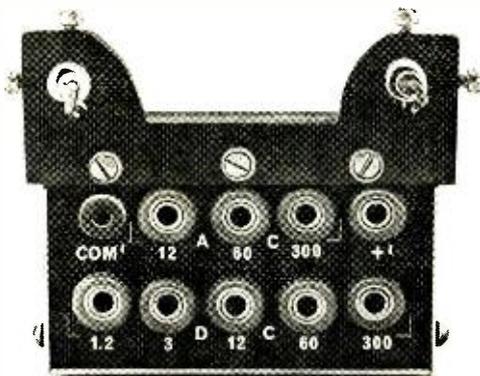


Fig. 3. Mount the jacks for d.c. voltage in lower portion of a piece of Bakelite; jacks for COM', + and a.c. voltage can be mounted in upper portion.

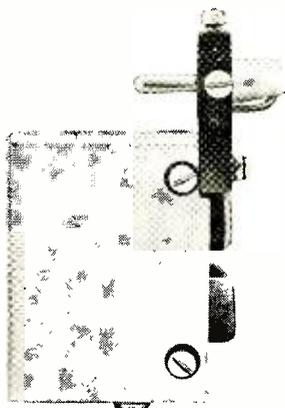


Fig. 4. The two plugs going directly to the meter are held in place by machine screws. Drill and tap the screw holes at right angles to each other.

PARTS LIST

R1—12,000 ohms
R2—60,000 ohms
R3—48,000 ohms
R4—300,000 ohms
R5—120,000 ohms
R6—1.8 megohms
R7—600,000 ohms
R8—3.6 megohms

All resistors 1/2-watt

Misc.—Five-way binding posts or jacks (10); test lead plugs, compatible with meter jacks (2); 5-lug terminal strips (2); small metal box

used to read out the 12-volt scale; just drop the zero. Similarly, the 30-volt range can be extended to 60 volts and the 6-volt scale read; this time, add a zero.

Construction. In order not to compromise the portability feature of your meter, build the VRS in a small metal box. The size of the box depends on the dimensions of your meter—or it can be quite a bit larger if you don't want to mount the VRS directly on your meter. In either case, the jacks or binding posts should be mounted on a piece of Bakelite or fiberboard or other insulating material.

Drill two holes large enough to pass the plugs on the back end of a pair of test leads to connect the VRS to the meter. Then drill and tap two machine screw holes at right angles to hold the plugs in place.

Mount the resistors between two terminal strips, in accordance with the schematic. Since no part of the metal case should come in contact with any part of the circuit, the terminal strips' mounting lugs should not be connected to any of the terminals. Notice that one end of each resistor is connected to a common bus, which is connected to the + terminal. Now plug the VRS into the meter.

Operation. The resistor values shown in Fig. 2 are for a VOM rated at 20,000 ohms/volt for d.c., and 10,000 ohms/volt for a.c. meter functions. With the VRS plugged into the multimeter and the test leads plugged into the appropriate COM' and + terminals on the VRS, you can use the meter to measure a.c. or d.c. voltages in the normal manner.

(Continued on page 100)

Heterodyne Vegetation Meter

ELECTRONIC DEVICE
MEASURES THE VOLUME
OF PLANT GROWTH

By WILLIAM B. MORSE



Donald Neal, co-inventor of HVM, demonstrates its portability. (Photo courtesy U.S. Forest Service)

RANGE SCIENTIST Donald L. Neal and electronics technician Lee R. Neal decided to tackle the job of providing the U.S. Forest Service Pacific Southwest Forest and Range Experiment Station with a time-saving method for determining the volume of plant growth. Out of their efforts was born the "Heterodyne Vegetation Meter" (HVM), a device that uses the capacitance principle for moisture measurement right in the field. The time formerly required to cut, dry and weigh plants in a laboratory can almost be eliminated with the HVM, which measures a sample in a mere ten seconds.

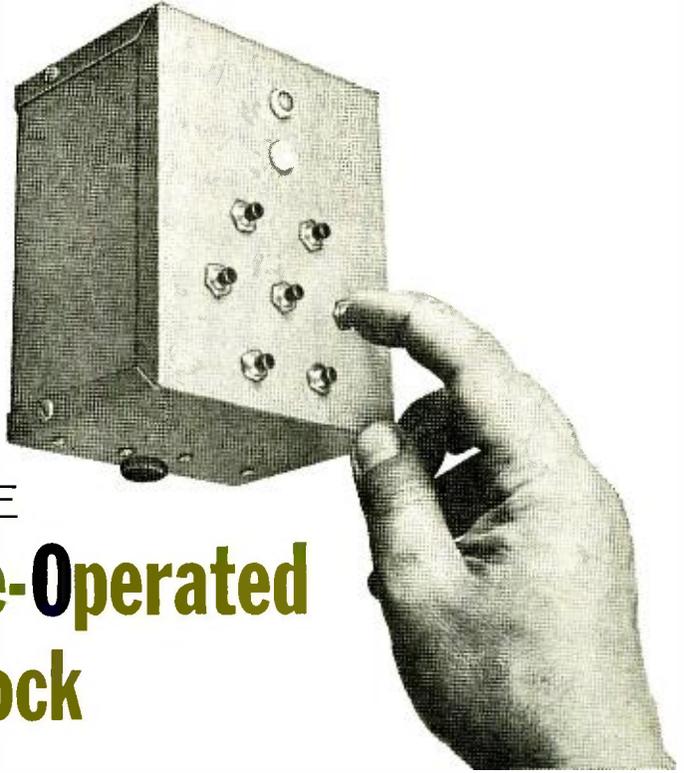
Two separate units make up the HVM, one a high-frequency-oscillator transmitter and the other a heterodyne receiver. Fifteen 18"-long insulated metal rods or probes, set in a grid pattern, are connected to the transmitter to approximate the plates of a huge capacitor in the oscillator circuit. The plant growth under test acts as the dielectric.

Before measurements—to determine the best method of forest resource management—are made, the receiver's heterodyne oscillator must zero-beat with the transmitter signal to calibrate the receiver. During calibration, the transmitter is kept far enough off the ground so that the probes are in the air. Then the probes are set into the vegetation to measure its growth.

Since the vegetation acts as the dielectric between the capacitor plates formed by the probes, it has a direct effect on the probe's capacitance. As the capacitance changes, the frequency of the transmitter's oscillator also changes. The new signal transmitted to the receiver causes the meter pointer on the receiver to deflect because the new signal doesn't zero-beat with the receiver's initial setting.

When the pointer deflects, the receiver's heterodyne oscillator is returned for zero-beat with the new transmitter frequency. The difference between the new and original zero-beat settings on the receiver's vernier dial is an indication of the volume of water trapped inside the plant. The amount of water in the plant is related to plant growth.

In order to prevent the body capaci-
(Continued on page 102)



BUILD
THE
**Sequence-Operated
Lock**



SILENT SENTRY FOILS LOCK PICKERS

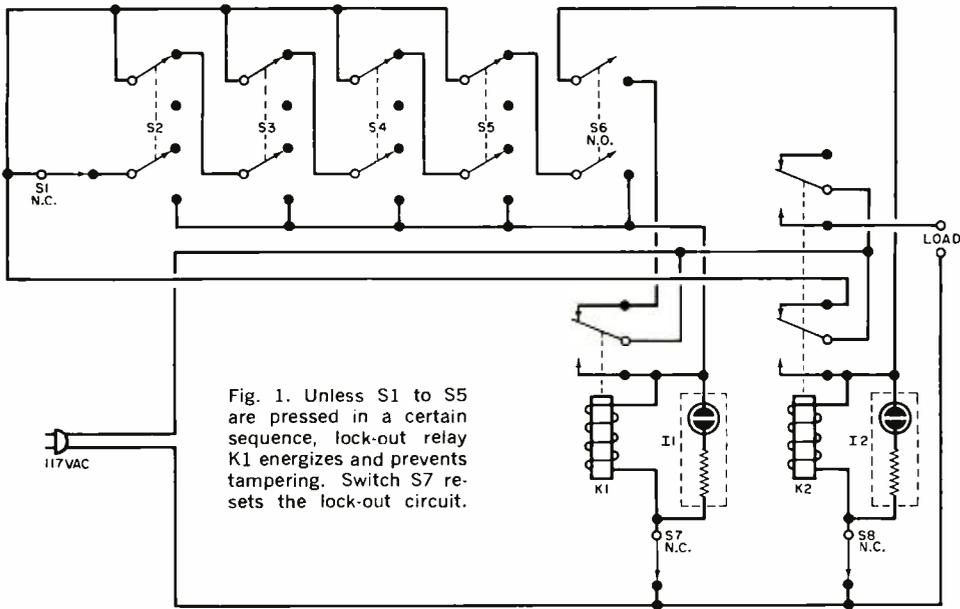
By **GORDON L. ANDERSON**

SECURITY against would-be lock pickers gaining entry into your home is one of the benefits you get with the "Sequence Operated Lock" (SOL). Also, the device can lock up almost any electrical tool in your workshop to eliminate the danger of injury to the children when you're not around to supervise them. These are just two of SOL's applications—to give you an idea of what the gadget can do.

When connected to a mechanical lock, SOL becomes an electric combination lock that combines many tamper-proof

features. Six push-button switches, wired into the circuit in a special manner, are used to select the combination. The chances of breaking the combination on the first try are pretty slim, and one chance is all an intruder would get. If the wrong push button is depressed, a lock-out circuit comes into play, blocking any further tampering. At the same time, an accusing red light shows that the lock has been tampered with.

Only you and those you trust with the combination know from the start that once a push button is pressed it must re-



main depressed until the entire six-switch sequence is complete. A lock picker would naturally assume that all he has to do is press a button, release it, and go on to press another. Not so. If he presses any of the remaining five buttons without holding the first one down, the lock-out circuit will come into play as if he had selected the wrong one on the first try—even if the second push

button happened to be the correct one in the sequence.

How It Works. Of the eight push-button switches shown in Fig. 1, five of them (S1 to S5) are pressed in a certain specific sequence to disarm the lock-out circuit. One switch (S6) actually energizes the relay that opens the lock, and
(Continued on page 100)

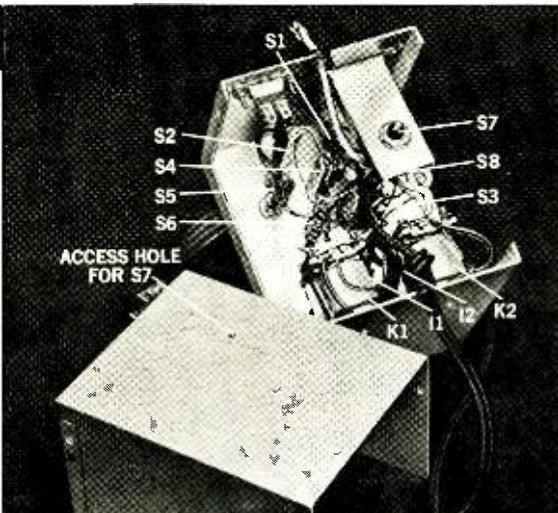


Fig. 2. To change the combination, positions of S1 through S6 are shifted. Access to lock-out circuit reset switch S7 is through a hole in the case.

PARTS LIST

- I1, I2—Neon lamp (Ticon indicator light, standard bezel, red and amber lens, or similar)
- K1—S.p.d.t. relay (coil voltage and contact ratings depend on use—see text)
- K2—D.p.d.t. relay (coil voltage and contact ratings depend on use—see text)
- S1, S8—S.p.s.t. normally closed momentary-action push-button switch (Switchcraft No. 1002, or similar)
- S2, S3, S4, S5—D.p.d.t. momentary-action push-button switch (Switchcraft No. 1006, or similar)
- S6—D.p.s.t. normally open momentary-action push-button switch (Switchcraft No. 1004, or similar)
- S7—S.p.s.t. normally closed momentary-action push-button switch (Switchcraft No. 202, or similar), or normally closed key-in-lock switch—see text
- Misc.—Stranded hookup wire, small box, metal bracket, line cord, solder, etc.



BUILD
THE

“Multi-Master”

By GARRY BOROSS

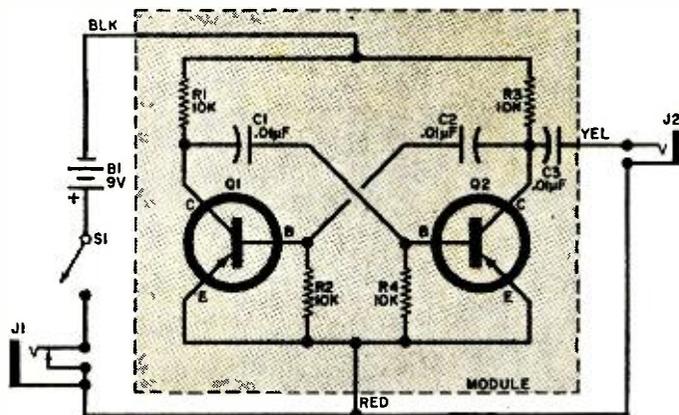
SOLID-STATE MULTIVIBRATOR MODULE
MAKES MANY-PURPOSE TESTER

THE “MULTI-MASTER” generates a 1000-Hz tone and, because it is richly endowed with harmonics, can be used to troubleshoot a.f., i.f., and r.f. circuits in much the same way as a regular servicing-type signal generator—yet it weighs only a few ounces and needs no external power source. It can also be used as a code practice oscillator and to check continuity of components and circuits.

Low cost (less than \$5) and short construction time (about an hour) are possible because all you need to do is connect a few easily obtained parts to a preassembled module. Current drain is only about 2 milliamps from a 9-volt source, which makes the “Multi-Master” as portable as a small transistor radio.

How It Works. The preassembled module consists of a free-running multivibrator and an output coupling capacitor, as shown inside the dotted lines on the schematic diagram. When *S1* is closed, power is applied to the multivibrator from *B1*. Transistors *Q1* and *Q2* fire alternately, setting up a symmetrical square-wave signal. The time constants of *C1*, *R4* and *C2*, *R2*, as well as the applied battery voltage, determine the frequency of operation. The signal across *R3* is coupled to jack *J2* through *C3*.

Construction. You do not have to use a commercial module for this project; just about any pair of *pnp* transistors can be used to build your own. If you would rather work with *nnp* transistors, you can; simply reverse the battery leads. But you may find it more convenient to use the preassembled module. Choose any metal or plastic box large



Parts inside the preassembled module are arranged to form a multivibrator oscillator circuit. Oscillator frequency is determined by C1, C2, R2 and R4.

PARTS LIST

B1—9-volt battery

C1, C2, C3—0.01- μ F disc capacitor*

J1—Closed-circuit phone jack, miniature-type

J2—Open-circuit phone jack, miniature-type

Q1, Q2—See text*

R1, R2, R3, R4—10,000-ohm, $\frac{1}{2}$ -watt resistor*

S1—S.p.s.t. switch

Misc.—High-impedance headphones, with miniature phone plug; test leads, with miniature phone plug; battery clip; solder; etc.

*Parts preassembled on module. (Module is available under different trade names and model numbers, such as: Electronic Wholesalers' HSI, Lafayette's 19C0124, Olson's TR-96, and Hytron's HSI)

enough to hold the small 9-volt battery and the module. You can mount the module on the outside of the box, and connect its three color-coded leads as shown in the schematic.

A pair of regular test leads can be terminated in a single miniature plug to fit J1 or J2. The cord from a pair of headphones can also be terminated in a similar plug to go into J2.

Operation. To use the Multi-Master as a signal injector, turn it on, and plug the test leads into J2. Connect the leads to appropriate check points on the equipment to be tested, and listen. Proceed in the same way as you would with a full-fledged service-type signal generator to find your trouble.

For checking continuity of components, remove the test cable from J2 and plug it into J1, and plug your head-

phones into J2. Momentarily touch the test leads' alligator clips together; you should hear a clear tone in the headphones. Separate the clips, and connect them across the circuit or component under test. If there is continuity, you will hear the tone. If there is resistance, there will be a change in the tone's pitch—the higher the resistance, the higher the pitch. Resistors up to 10,000 ohms can be checked for "continuity" in this manner.

Capacitors can be checked in this way, too; but it takes a little experience to recognize normal and abnormal conditions. Depending on the value of the capacitor, you should hear silence for small values—or a click, or chirp which soon disappears in a rising tone for larger values. A steady low-pitch tone usually indicates a shorted capacitor.

Checking diodes and transistors is simply a matter of testing for "front-to-back" tones. As you reverse the leads, you should hear one tone one time, and a different tone another time. If you don't hear a tone when the leads are in one of the two positions, it can be a normal indication; but if no tone is heard in either direction, the component is open.

To use the Multi-Master as a code practice oscillator, connect a telegraph key to the test cable and plug the cable into J1, then plug the headphones into J2. If you prefer to listen to your code practice without headphones, simply plug a loopstick antenna into J2, and tune an AM radio to a blank spot on the band and adjust the volume. —30—



SOLID STATE

By LOU GARNER, Semiconductor Editor

ONCE AGAIN it is time for us to unveil our crystal ball for a peek into the mercurial future of the consumer electronics industry. But before getting carried away, let's see how well we fared with our predictions for 1966.

● *Production of transistorized color TV receivers.* Seems like a strikeout. As far as we've been able to determine, no one is currently marketing a transistorized color TV set.

● *Introduction of a transistorized black-and-white TV receiver for under \$100 retail.* Score a home run—Sears, Roebuck and Company is featuring a 9-inch transistorized TV receiver in its 1966 Christmas catalog for only \$94.95. Also, some large discount houses are offering standard brands at a cut rate—under \$100.00.

● *Use of integrated circuits (IC's) in automobile electronic systems.* We are not sure whether we struck out or not. For a while some local auto dealers were claiming the use of IC's in several of their 1967 model cars, but we've not been able to verify just where the IC's are used. Could it be a secret?

● *Use of monolithic integrated circuits (IC's) in television r.t., i.t. and video amplifier circuits.* Score a hit—RCA was the first major manufacturer to incorporate an IC in its production-line TV receivers. Since then, others have followed suit, and at least one major kit producer (Heath Company) is now offering, in kit form, a TV receiver incorporating an integrated circuit.

● *Development of SHF transistors to compete with klystrons and other "exotic" tubes.* Score a hit—Texas Instruments has developed an experimental transistor capable of a gain of up to 10 dB at 6.0 GHz. And other firms are offering "off-the-shelf" production transistors capable of operation in the GHz range. RCA's 2N4012, for example, can deliver up to 2.5 watts output operating as a tripler at 1 GHz, and Fairchild's MT1060/61 can be used as an oscillator at frequencies of up to 2 GHz. International Semiconductors (Newburyport, Mass.) is producing a unit (the ISX-3400) that will deliver up to 70 mW at 3 GHz, and TRW Semiconductors (Lawndale,

Calif.) offers a broad line of UHF and SHF transistors. At least one major equipment manufacturer, Trak Microwave (Tampa, Fla.), offers a line of solid-state microwave energy sources capable of outputs of up to 4.2 GHz, in direct competition with tube-powered sources.

● *Expanded use of SCR's and related solid-state devices in consumer products other than receivers and amplifiers.* Score a home run—space limitations prohibit a full listing, but Rival, Ronson, Westinghouse and Waring, among others, are offering SCR-controlled food blenders; Hotpoint and Montgomery Ward are among the firms producing solid-state controlled automatic washers; Sears offers a gas range featuring an SCR ignitor in place of conventional pilot lights; and Black & Decker is only one of the firms manufacturing SCR-controlled hand drills and other power tools for home use. SCR's are also being used in floor polishers, light fixtures, sanders, furnace and air-conditioner controls and, of course, in wall-plate light dimmer switches.

● *Relatively inexpensive thermoelectric (TE) modules for hobbyist and experimenter applications.* Another home run—several firms are offering multi-couple modules for under \$25.00. For example, Cambion's No. 3950-1 module is priced at only \$21, while the Model FH12 12-couple Frigistor lists at only \$24.80. Individual couples suitable for experimental tests are available at even lower prices.

● *An appreciable drop in the prices of solid-state light emitters or semiconductor lasers.* Home run—Allied Radio's catalog No. 670 offers a GE type LED 9 light emitting diode for only \$12, while the H1D1 laser diode is priced at \$95.00. At these prices, a serious experimenter can assemble a complete solid-state laser system at a cost comparable to that of a medium-quality oscilloscope.

We didn't bat 1000, but in a mercurial electronics industry such as ours, we did do pretty well.

Things To Come. At this point, we are seriously tempted to rest on our laurels—that is, if we could do so without being deluged by protest mail from our many loyal

readers. So here we go again with our predictions of things to come in 1967: production of a transistorized color TV set in the "under \$200" price range; widespread use of IC's in automobiles, especially in voltage regulators, automatic speed controls, radio receivers and stereo tape players; the use of Triacs in place of SCR's in consumer products; the production of a radically new semiconductor device; the introduction of receivers featuring electronic tuning other than the use of variable capacitors or inductors; the development of a new type of solid-state electronic musical instrument; the production of large-screen solid-state TV receivers (only small-screen solid-state sets are in current production); the introduction of an "Experimenter's Integrated Circuit" kit; the development—though not production—of a solid-state automobile "safety-check" system capable of checking, automatically, the engine and electrical systems, and then warning the driver of danger conditions where they exist.

Reader's Circuit. For maximum effectiveness, a burglar alarm system, once tripped, should remain *on* until reset by the police, tenant, or property owner. Several devices, including electromagnetic or mechanical latching relays, electronic switches such as SCR's, and special bistable circuit designs can be employed to achieve this feature. While any of these methods may prove effective, experimenters are always looking around for new and simpler ways.

Reader Eugene Richardson (Alexandria, Va.) felt that "there must be a simpler way" in this case and set out to find it. The circuit he came up with is illustrated in Fig. 1.

Eugene's circuit achieves the desired "lock-on" action *without* the use of latching relays, SCR's, or complicated circuitry. Instead, he has relied on an inherent characteristic of all electromagnetic relays for his solution, which is that more current is required to pull in a relay than is necessary to keep it actuated.

The circuit consists of alarm relay *K1* controlled by transistor *Q1*, which is biased by photocell *PC1* through sensitivity control *R1*. A higher bias voltage can be applied across *R2* by pressing momentary contact switch *S1*. Operating power is provided by battery *B1*.

With *S1* open, a light source is focused on *PC1* from across the protected entrance (such as a door, window, or hallway). When the light beam focused on *PC1* is interrupted, as by an intruder, *Q1*'s base bias drops, its collector current is reduced, and the relay (*K1*) drops out, closing the alarm circuit. Thereafter, the alarm stays

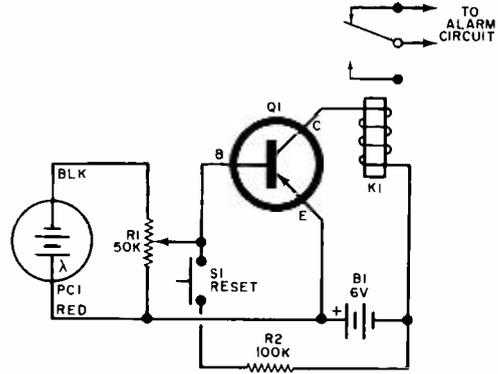


Fig. 1. In this intruder alarm circuit submitted by reader Eugene Richardson, relay *K1* is released to activate the alarm when an intruder interrupts the light beam focused on *PC1*. The alarm stays on until reset switch *S1* is pressed to turn it off.

on, even if the light beam is restored, until the reset switch, *S1*, is operated to increase the bias on the transistor, causing it to conduct sufficiently to open the relay contacts and deactivate the alarm.

Readily available components are used in the circuit. Photocell *PC1* is an International Rectifier S3M unit and *Q1* can be any general-purpose medium-to-high-gain *pnp* transistor, such as a 2N186. Sensitivity control *R1* is a conventional potentiometer, *R2* a half-watt resistor, and *S1* a s.p.s.t., momentary-contact, normally open push-button switch. For best results, a fairly sensitive relay should be used—typically, a Sigma 4F-1000-S/SIL. A 6-volt lantern battery is suitable for *B1*, although a 6-volt d.c. converter (such as an EicoCraft EC-900 or International Rectifier K-206) can be used as a substitute where line power is preferred.

The circuit can be built using an etched circuit board, a perforated phenolic board, or a conventional metal chassis, as preferred. The completed assembly can be mounted in a wooden box, or a plastic case, and installed in a small opening made in the door jamb, depending on individual needs.

You mount the assembled circuit on one side of the door or window to be protected, and install a suitable light source on the opposite side of the opening, adjusting the light beam so that it focuses on the photocell. Connect the relay's contacts to the alarm device and power source. Depending on *R1*'s adjustment, the alarm may sound, but in any case, turn this control fully down to sound the alarm.

Next, adjust *R1* until *K1* pulls in, silencing the alarm. Then back off slightly on the adjustment. Momentarily interrupt the

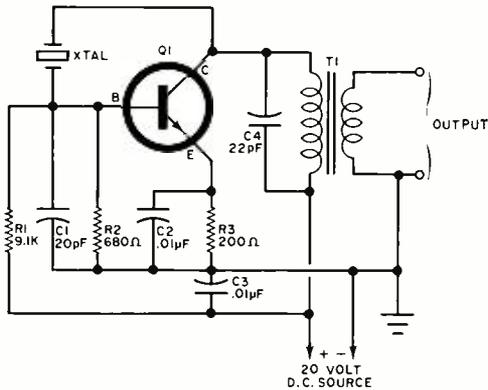


Fig. 2. This multi-purpose crystal-controlled oscillator is typical of the scores of useful circuits that are described in the new RCA Transistor Manual SC-12. The oscillator can furnish up to 50 milliwatts of power into a 50-ohm load.

light beam and observe that *K1* drops out, sounding the alarm. If the alarm sounds when the light beam is broken, and stops when the beam is restored, readjust *R1* until the desired operation is achieved. Thereafter, the system is reset by depressing *S1*.

Manufacturer's Circuit. Furnishing up to 4 milliwatts into a 50-ohm load, the crystal-controlled oscillator circuit illustrated in Fig. 2 can be used in a variety of applications. Typically, it can serve as the first stage of a transmitter, as a signal calibrator, or as a demonstration r.f. source for school experiments. The design is one of some 43 practical circuits described in the latest edition of RCA's Transistor Manual SC-12.

Transistor *Q1* is used in the common-emitter configuration with stabilized base bias established by voltage divider *R1-R2* in conjunction with emitter resistor *R3*, bypassed by *C2*. Capacitor *C3* acts as an r.f. bypass for the power supply. Transformer *T1*'s primary winding is tuned by *C4* and serves as *Q1*'s collector load; the step-down secondary winding matches the oscillator to a low impedance (50-100 ohm) load. The positive collector-to-base feedback needed to start and sustain oscillation is furnished through a capacitive voltage-divider made up of the crystal's (*Xtal*) interelectrode capacity and *C1*.

Transistor *Q1* is an RCA 2N1491 unit, the capacitors are 25-volt-rated disc ceramic types, and the resistors are all half-watters. The primary of *T1* consists of 15 close-wound turns of #22 enameled wire, while the secondary consists of two turns of #18 enameled wire wound over the "cold" end of the primary coil. The trans-

former is hand-wound on a Cambridge Thermionic Corporation (CTC) LS5 form equipped with a powdered iron slug. A 27-MHz crystal is used, and only 7 mA are drawn from the 20-volt power supply.

Although layout and lead dress are not overly critical, good wiring practice should be observed when assembling the device. All signal leads should be kept short and direct, and all ground and r.f. bypass connections should be made to a common point. Final assembly can be on a circuit board or conventional metal chassis, as preferred.

New Developments. High-voltage megohmmeters are used extensively throughout industry as insulation testers. Affectionately called "Meggers," most of these instruments require special high-voltage batteries or employ hand-crank-operated high-voltage generators. A new insulation tester recently introduced by a British firm, Edgcombe Peebles Ltd. (Surrey, England), features a transistorized high-voltage converter and requires only a 9-volt battery. Dubbed Metrohm (Fig. 3), the instrument measures 5" x 3 1/4" x 2" overall, and weighs only 22 ounces. In addition to its primary function as an insulation tester, it can also

(Continued on page 103)



Fig. 3. Newly developed, this transistorized insulation tester by Edgcombe Peebles Ltd. (Surrey, England), can also double as a low-resistance continuity tester, or as a general-purpose voltmeter.

ENGLISH-LANGUAGE BROADCASTS TO NORTH AMERICA

FOR THE MONTH OF JANUARY

Prepared by **ROBERT LEGGE**

TO EASTERN AND CENTRAL NORTH AMERICA

TIME—EST	TIME—GMT	STATION AND LOCATION	FREQUENCIES (MHz)
7 a.m.	1200	Copenhagen, Denmark	15.165
7:15 a.m.	1215	Helsinki, Finland	15.185 (Tues., Sat.)
		Melbourne, Australia	9.58 or 11.71
6 p.m.	2300	London, England	6.195, 7.13, 9.51
		Moscow, U.S.S.R.	7.15, 7.205, 9.665, 9.685
6:45 p.m.	2345	Tokyo, Japan	11.78, 15.135
7 p.m.	0000	London, England	6.195, 7.13, 9.51
		Moscow, U.S.S.R.	7.15, 7.205, 9.665, 9.685
		Peking, China	15.06, 17.68
		Sofia, Bulgaria	6.07
		Tirana, Albania	7.265
7:30 p.m.	0030	Budapest, Hungary	6.235, 9.833
		Johannesburg, So. Africa	9.675, 11.90
		Kiev, U.S.S.R.	7.11, 7.31, 9.645 (Mon./Thurs./Fri.)
7:50 p.m.	0050	Vatican	5.985, 7.25, 9.645
8 p.m.	0100	Berlin, Germany	5.96, 6.16
		Havana, Cuba	6.17, 11.76
		London, England	6.195, 7.13, 9.51
		Madrid, Spain	6.13, 9.76
		Moscow, U.S.S.R.	7.15, 7.205, 7.31, 9.665
		Prague, Czechoslovakia	5.93, 7.115, 7.345, 9.72
		Rome, Italy	6.01, 9.63
8:15 p.m.	0115	Berne, Switzerland	6.12, 9.535, 11.715
8:30 p.m.	0130	Bucharest, Rumania	5.99, 9.57
		Cairo, U.A.R.	9.475
		Cologne, Germany	6.075, 9.64
		Hilversum, Holland	9.59
8:45 p.m.	0145	Stockholm, Sweden	5.99
9 p.m.	0200	Lisbon, Portugal	6.025, 6.185
		London, England	6.195, 7.13, 9.51
		Moscow, U.S.S.R.	7.15, 7.205, 9.665
10 p.m.	0300	Bucharest, Rumania	5.99, 9.57
		Budapest, Hungary	6.235, 9.833
		Buenos Aires, Argentina	9.69 (Mon.-Fri.)
		Havana, Cuba	6.135, 6.17
10:30 p.m.	0330	Accra, Ghana	6.11
		Prague, Czechoslovakia	6.095, 7.115, 7.345, 9.72

TO WESTERN NORTH AMERICA

TIME—PST	TIME—GMT	STATION AND LOCATION	FREQUENCIES (MHz)
6 p.m.	0200	Melbourne, Australia	15.22, 17.84
		Tokyo, Japan	15.135, 15.235, 17.825
6:50 p.m.	0250	Taipei, China	11.825, 11.86, 15.345
7 p.m.	0300	Moscow, U.S.S.R.	
		(via Khabarovsk)	9.54, 11.755, 15.14
		Peking, China	9.457, 11.82, 15.095
8 p.m.	0400	Sofia, Bulgaria	6.07
8:30 p.m.	0430	Budapest, Hungary	6.235, 9.833
9 p.m.	0500	Berne, Switzerland	5.965
		Cologne, Germany	6.145, 9.735
		Moscow, U.S.S.R.	
		(via Khabarovsk)	9.54, 9.64, 11.755



SHORT-WAVE LISTENING

By HANK BENNETT, W2PNA/WPE2FT
Short-Wave Editor

INTERNATIONAL TELECOMMUNICATIONS UNION LOGS

PERHAPS the most complete set of reference logs that a DX'er can own is that published by the International Telecommunications Union in Geneva, Switzerland. The I.T.U. *International Frequency List* is a publication of massive size, totaling eight volumes and listing stations operating from 10 kHz to 50,000 kHz. The first three volumes are of greatest interest to most DX'ers because they cover frequencies up to 28,000 kHz.

These three volumes alone run to more than 3200 pages. In addition, supplements are issued periodically to keep each volume up to date. Information provided includes the broadcasting station name, country, call letters, date station was placed in service, geographic coordinates of the transmitter, area or areas of intended reception, class of station and nature of service, power, the operating administration or authority, and a good many more facts.

Literally worth their weight in gold, these three logs plus a prefix list (an important

accessory) cost a little over \$60. Of course, many types of stations besides short-wave broadcast stations are listed.

Another useful and considerably less expensive I.T.U. publication is the *Tentative High Frequency Broadcast Schedule* which covers short-wave transmissions from 5955 kHz up. It lists broadcasting stations, transmission times and frequencies, power, antenna gain, areas of intended reception, and stations most likely to cause interference. This schedule is published four times a year—in March, May, September, and November—and costs \$4 per issue.

DX'ers interested in obtaining more data on these and other I.T.U. publications should write to the General Secretary, International Telecommunications Union, Geneva, Switzerland. Six to eight weeks should be allowed for delivery of an order.

New Countries Awards. Several recipients of the WPE 150 Countries Award have inquired as to whether we intend to issue any award seals for those who have over 150 countries verified. At present there are not enough eligible DX'ers who would qualify for such awards to make it economically feasible to have the additional seals printed. However, we are most willing to issue "Letters of Certification" to those who have verified more than 150 countries, in steps of 10 (160 Countries Verified, 170, and on up).

To receive a "Letter of Certification," you must meet the same requirements as when applying for any of the award seals. Be sure to list *all* of the countries verified and not merely those you have verified since receiving your last award. The fee of 50 cents (60 cents outside of the U.S.) will still apply. Eventually, if a sufficient number of DX'ers qualify, seals will be printed and distributed—at no additional charge—to everyone who has received an interim Letter of Certification.

In the near future, we plan to publish a Monitor Award Honor Roll listing the top DX'ers based on the awards presented. It would be most satisfying if such an

(Continued on page 113)



John Sgrulletta, WPE2MXF, Bedford Hills, N.Y., uses a Hammarlund HQ-100AC receiver and a Norelco two-band transistor set. He has logged 93 countries (75 verified) and 41 states (34 verified).

BROADCASTS FROM ASIA AND OCEANIA

Prepared by **BILL LEGGE** and **BOB HILL**

Based on past experience, plus currently available schedules, here are some "best bets" for hearing stations broadcasting from the countries of Asia and Oceania during the winter DX season. In general, reception of signals from those areas will most likely be from around early morning to just after sunrise, your local time. Bear in mind that the times listed are approximate and not necessarily all-inclusive. Also, many of these stations are low-powered and—especially for DX'ers in Eastern North America—difficult to hear, so don't expect to log them all.

COUNTRY	LOCATION	TIME—GMT		FREQUENCIES (MHz)	LANGUAGES
		EASTERN N.A.	WESTERN N.A.		
AUSTRALIA	Brisbane	0900-1300	0700-1400	4.90	English
	Perth	1030-1400	1030-1500	9.61	English
BRUNEI	Brunei Town	1000-1230	0900-1430	4.863	English, Malay
BURMA	Rangoon	1100-1230	1100-1430	5.041	Burmese, English
CAMBODIA	Phnom Penh	1315-1345	1315-1545	9.70	Cambodian, English
CEYLON	Colombo	1230-1400	1230-1645	9.67	English
CHINA	Peking	1200-1400	1200-1400	9.48	English
CHINA	Taipei	1130-1200	1130-1200	7.13, 9.685	English
COOK ISLANDS	Rarotonga	0700-0730	0600-0730	5.045	English, Maori
FIJI ISLANDS	Suva	0900-1030	0600-1030	3.23	English
GILBERT & ELLICE ISLANDS	Tarawa (Thurs.)	0930-1030	0730-1030	4.912	English
HONG KONG	Hong Kong	.....	1400-1600	3.94	Chinese
INDIA	New Delhi	1330-1500	1330-1500	11.81, 15.23	English
INDONESIA	Djakarta	1100-1200	1430-1530	9.867	English
JAPAN	Tokyo	1200-1230	1400-1500	9.505, 9.605	English
KAZAKH S.S.R.	Alma Ata	0000-0200	1300-1500	10.53	Russian, Kazakh
KIRGHIZ S.S.R.	Frunze	1100-1200	1300-1500	4.01	Russian, Kirghiz
KOREA, NORTH	Pyongyang	1100-1200	1400-1500	6.65, 7.575	English
KOREA, SOUTH	Seoul	1030-1100	1030-1100	9.64	English
LAOS	Vientiane	1000-1200	1000-1400	6.115	Laotian, English
MALAYSIA, EAST	Kuching, Sarawak	1100-1200	1200-1400	4.95	English, Chinese
MALAYSIA, WEST	Kuala Lumpur	1115-1215	1115-1215	6.175, 9.75	English
MONGOLIA	Ulan Bator	1000-1100	1100-1300	4.165	Mongolian
NEPAL	Katmandu	.....	1320-1520	7.10	Nepali
NEW CALEDONIA	Noumea	1000-1100	0800-1100	3.355	French
NEW GUINEA	Wewak	1000-1230	0700-1230	3.335	English, Pidgin
NEW HEBRIDES	Port Vila	.....	0615-0715	3.905	French
NEW ZEALAND	Wellington	0800-1145	0600-1145	9.62, 11.82	English
PAKISTAN, EAST	Dacca	1345-1430	1345-1630	11.615	English, Urdu
PAKISTAN, WEST	Karachi	1335-1350	1335-1350	11.875, 15.09	English
PAPUA	Port Moresby	0900-1300	0730-1400	4.89	English
PHILIPPINES	Manila	1245-1330	1245-1400	9.505, 15.23	English
RYUKYU ISLANDS	Okinawa	1000-1200	1300-1600	7.165, 9.74	English
SINGAPORE	Singapore	1030-1200	1300-1630	5.052, 11.94	English
SOLOMON ISLANDS	Honiara	0930-1030	0800-1130	3.995, 7.115	English
TADZHIK S.S.R.	Dushanbe	0000-0200	1200-1500	4.635	Tadzhik, Russian
TAHITI	Papeete	0300-0500	0300-0800	11.825	French
THAILAND	Bangkok	1000-1300	1300-1430	11.91	English, Thai
TIMOR, PORTUGUESE	Dili	.....	1000-1430	3.268	Portuguese, Chinese
U.S.S.R. (Asiatic)	Khabarovsk	1000-1300	1200-1600	6.035	Russian
UZBEK S.S.R.	Tashkent	1200-1230	1400-1430	9.60, 11.925	English
VIETNAM, NORTH	Hanoi	1300-1330	1300-1330	9.76, 11.76	English
VIETNAM, SOUTH	Saigon	1200-1300	1200-1300	9.755	English



ON THE CITIZENS BAND

By **MATT P. SPINELLO**, KHC2060, CB Editor

AMONG the normal operational and interference problems tackled by CB'ers is the challenge of the thousands of walkie-talkies in the hands of would-be astronauts, junior G-men, and combat foot-soldiers, to mention a few. CB'ers throughout the United States and Canada have become aware of the acute dilemma which has been created by legalized interference. CB'ers are also aware that the unlicensed 100-milliwatt rigs and their enthusiastic users cannot be merely wished away, and that some sort of plan must be put into effect immediately to combat the situation.

THE WALKIE- TALKIE DILEMMA

When the GRS/CB channels in the London, Ontario, portion of Canada became jammed with walkie-talkies, the South Western General Radio Association sponsored a course to explain their proper use. Club officials were pleased at the turnout of eager youngsters, and with the intelligent questions asked by them about the GRS. Other branches of the SWGRA held similar meetings in St. Thomas, Windsor, and Woodstock, Ontario, following the suc-

cess of the London meeting. The meeting in Windsor drew 42 youngsters who were introduced to a plan to issue each of them a walkie-talkie call-sign with a prefix of WTO.

The prefix idea was generated by *SCOPE*, the General Radio Service Journal which is distributed throughout Canada free to all GRS clubs and individuals. Although GRS users realize the call-signs will not have any effect on curbing interference, the talkies will at least be identifiable, and GRS licensees will be able to recognize immediately whether incoming calls are for their stations or instead walkie-talkie war patrols being ordered into battle.

South of the border, U. S. CB'ers are following pretty much the same course of action on a local basis as groups of walkie-talkie users appear to be taking over the airwaves. Your CB Editor has received

The youngsters shown below are Canadian walkie-talkie users being instructed on proper operating procedures by members of the South Western General Radio Association. Lessons were started last year after thousands of walkie-talkies were presented to the kids as Christmas gifts—and verbal shenanigans began to jam up the 27-MHz air waves.

Photo courtesy of *SCOPE*





Your CB Editor was welcomed aboard International Crystal's "Flying Showroom '66" near Chicago, Ill., by engineer Royland Freeland, Jr. Roy is also the son of International Crystal's president, and in addition to performing public relations duties, he acted as co-pilot on the plane's journey around the United States. Below is Susan Susemihl (daughter of Royland Freeland), inside the flying showroom, giving us a close-up view of the latest CB gear.



several reports on meetings and classes held similar to the Canadian meets (for example, the story of how the walkie-talkie situation was handled in Pecatonica, Ill., as told in our May, 1966, column) and has held discussions with CB operators from New York to California about the problem.

During an interesting chat with Chuck and Bev Sisson, KHA3794, your reporter learned that CB'ers in the Sterling, Illinois, area have their regulatory system for the younger (unlicensed) set. Although Sterling area CB'ers allow their offspring to properly execute walkie-talkie transmissions, they limit 5-watt operation with a stringent set of rules. Many youngsters are not allowed to transmit at *any* time, while others are allowed *occasional necessary* transmissions.

Twelve-year-old Mike Sisson has a definite interest in electronics and is allowed to complete a call (when necessary) to a relative. The rest of the time Mike is more of an SWL monitoring the band. The Sissons feel that Mike will get both sides of the picture by acting as a monitor. How to (and how *not to*) operate a CB transceiver should be pretty obvious to Mike by the time he's of an age to be licensed.

The efforts of CB'ers and GRS users to enlighten, train, and use walkie-talkie teams during emergency operations in 1966 proved worthwhile on several occasions, and the trend should continue in 1967. As for the small fry, we can only hope that they will be governed by parents who realize that *they* are responsible for false emergency calls placed on the air, *on any frequency*.

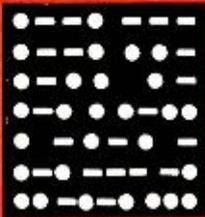
Perhaps the FCC will take a step to alleviate the walkie-talkie situation in 1967. Since walkie-talkie users are not required to obey Part 95 of the Rules and Regulations, it would seem a logical requirement to have manufacturers of 100-milliwatt units print a standardized warning in the carton that would: (1) warn users that—having an unlicensed unit operating on

the 27-MHz band—they are required to cease transmitting whenever legalized call-signs are heard making necessary transmissions; (2) spell out the fine and imprisonment clause about false emergency signals and profanity; and (3) indicate the probable range in which a low-powered unit may be received by licensed users.

Flying Showroom '66. We can say without reservation that at least one CB manufacturer literally took to the air in 1966. The International Crystal Manufacturing Company, Oklahoma City, Okla., decked out a Martin "202" in full communications regalia with a space-age electronics display. The display, which was flown to cities in 22 states, was designed to showcase International Crystal products to radio equipment dealers, commercial 2-way radio users, manufacturers, amateur radio operators, CB'ers, radio experimenters and hobbyists. Hundreds of electronic items on display included a full line of CB transceivers, frequency meters, alignment oscillators, multivibrators, sideband filters, modulators, converters, and amplifiers.

Prior to the flying showroom's arrival in a particular area, International Crystal posted ads in local newspapers to alert residents of the date of arrival and the location at which the display could be seen. The airborne tour proceeded from Oklahoma City to Jacksonville, Florida; north to New York; west to Seattle, Washington and Portland, Oregon; and south to the San Francisco and Los Angeles areas. The last stop before the plane headed home to Oklahoma was Salt Lake City, Utah.

(Continued on page 110)



AMATEUR RADIO

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

TRANSMITTER POWER VS. COMMUNICATIONS RANGE

A PERENNIAL POINT of discussion among radio amateurs is the importance of transmitter power. Good results obtained by Novices prove that high power is not necessary. Nevertheless, high power is helpful, especially when conditions are poor.

For example, when signals are down around the noise level, doubling power, which adds only 3 dB (half an "S" unit) to signal strength, can make the difference between no contact and a successful contact. But when signals are strong, a power increase of as much as ten times (10 dB) is of no practical importance on a clear channel. When there is competition on the channel, however, a difference of one "S" unit usually means the difference between making or missing the contact.

The fact is that transmitter power, receiver, antenna, location, mode of operation, and other factors all affect results. On the MF and HF bands it is pretty much of a guessing game deciding how important each factor is. On the VHF and UHF bands (line-of-sight propagation), it is relatively easy to predict the results of increasing power, raising your antenna, etc.,

TYPE OF ANTENNA	HEIGHT (feet)	BAND (MHz)	INPUT (watts)	RANGE (miles)	
				AM	CW
Dipole, halo, etc.	25	50	5	25	50
	"	"	15	35	60
	"	"	150	50	85
	"	144	5	22	45
	"	"	15	25	55
	"	"	150	38	75
	50	50	5	30	56
	"	"	15	37	68
	"	"	150	70	90
	"	144	5	27	48
Beam (10-dB gain), 5- or 6-element Yagi*	"	"	15	29	60
	"	"	150	43	85
	25	50	150	60	220
	"	144	"	55	140
5- or 6-element Yagi*	50	50	"	60	250
	"	144	"	60	220

*Figures for 5 watts and 15 watts into a beam antenna are essentially the same as for 15 watts and 150 watts into a dipole.

by using methods described by **K2LMG** in *QST* (November, 1961) and printed in the *ARRL's Radio Amateur's VHF Handbook*.

The distance figures for fairly level terrain shown in the accompanying table are
(Continued on page 111)

John Talipsky, W4GXW/K3LSX, has two amateur stations. At Louisville, Ky., where he is a Senior E.E. student at the University, he uses a Knight-Kit T-150 transmitter and a Lafayette HA-230 receiver. His home station in Bristol, Pa., pictured here, features a National NCX-5 transceiver, another T-150, and a Drake 2-B receiver. John will receive a one-year subscription for submitting the winner for January in our Amateur Station of the Month photo contest. To enter the contest, send us a clear photo of your station showing you at the controls, and some details on your ham career and the equipment you use. Mail your entry to: Amateur Photo Contest, c/o Herb S. Brier, Amateur Radio Editor, P.O. Box 678, Gary, Ind. 46401.

AMATEUR STATION OF THE MONTH

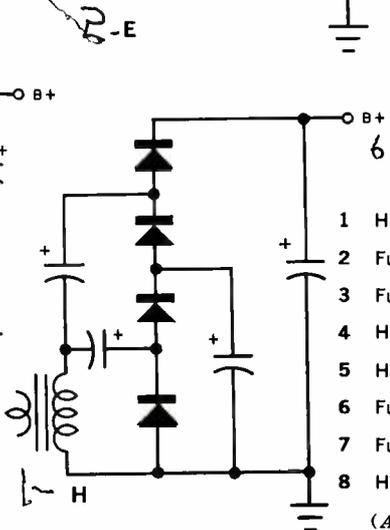
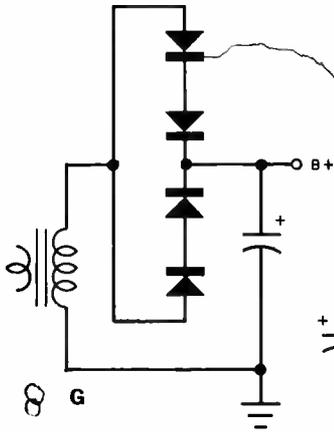
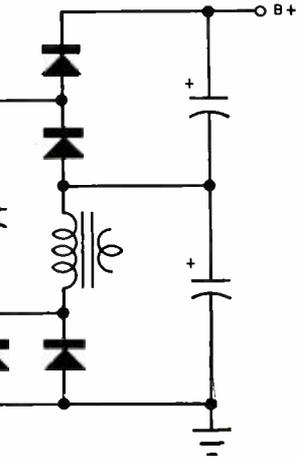
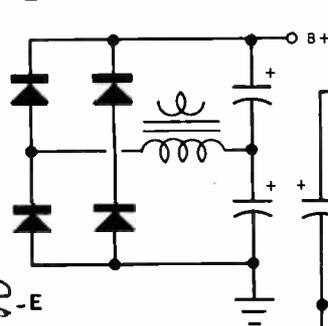
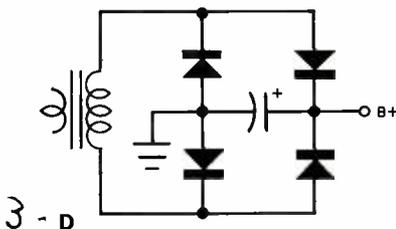
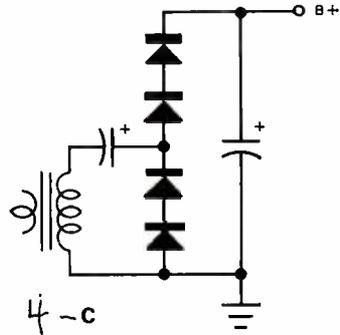
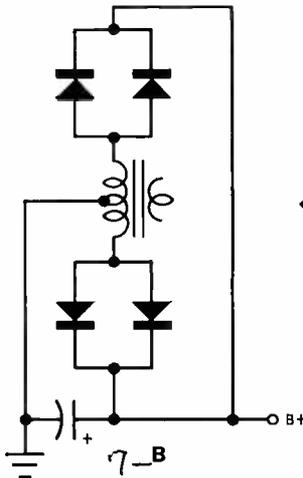
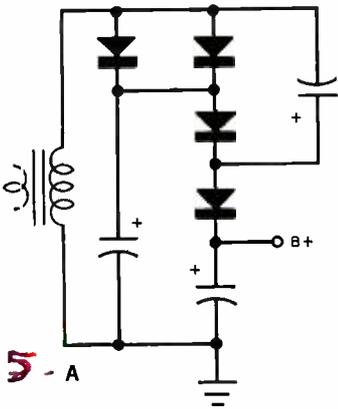


POWER SUPPLY IDENTIFICATION QUIZ

JAMES A. ATKINSON, Director, A. T. E. S. Technical School

P 104

The electronic draftsman lays out his circuit to achieve good balance and simplicity within established industry guide lines. Thus, most standard circuits can be readily identified by the electronic technician. When circuits are drawn without regard to standardization, they are sometimes difficult to identify. For example, various types of power supplies, each employing four diodes, are presented below. In some cases, all of the diodes are essential to the circuit; in others, some diodes are wired merely to boost the voltage or current rating of the power supply—and to keep you from identifying the circuit by diode count. See how many of these circuits (A-H) you can identify from the list (1-8).



- 1 Half-wave quadrupler
- 2 Full-wave doubler
- 3 Full-wave bridge
- 4 Half-wave doubler
- 5 Half-wave tripler
- 6 Full-wave tripler
- 7 Full-wave rectifier
- 8 Half-wave rectifier

H
E
C
D
B
G

(Answers appear on page 104)



BUILD
A
**“FUZZBOX” FOR
UNDER \$3**

DEFINITELY **NOT** RECOMMENDED FOR USE
BY MUSICAL PURISTS, THE FUZZBOX IS
INTENDED TO GIVE ROCK-'N'-ROLL
MUSIC THAT BIG, BRASSY SOUND

By **CRAIG ANDERTON**, WB2JQC

AS YOU LISTEN to rock-'n'-roll by the big-time performers, do you often wonder how they can get that fuzzy, raspy, piercing sound from an electric guitar while nonprofessional groups sound distinctively small-time? The answer lies in the use of an electronic gadget called a “Fuzzbox”—and you can build one for about \$3 in a matter of minutes!

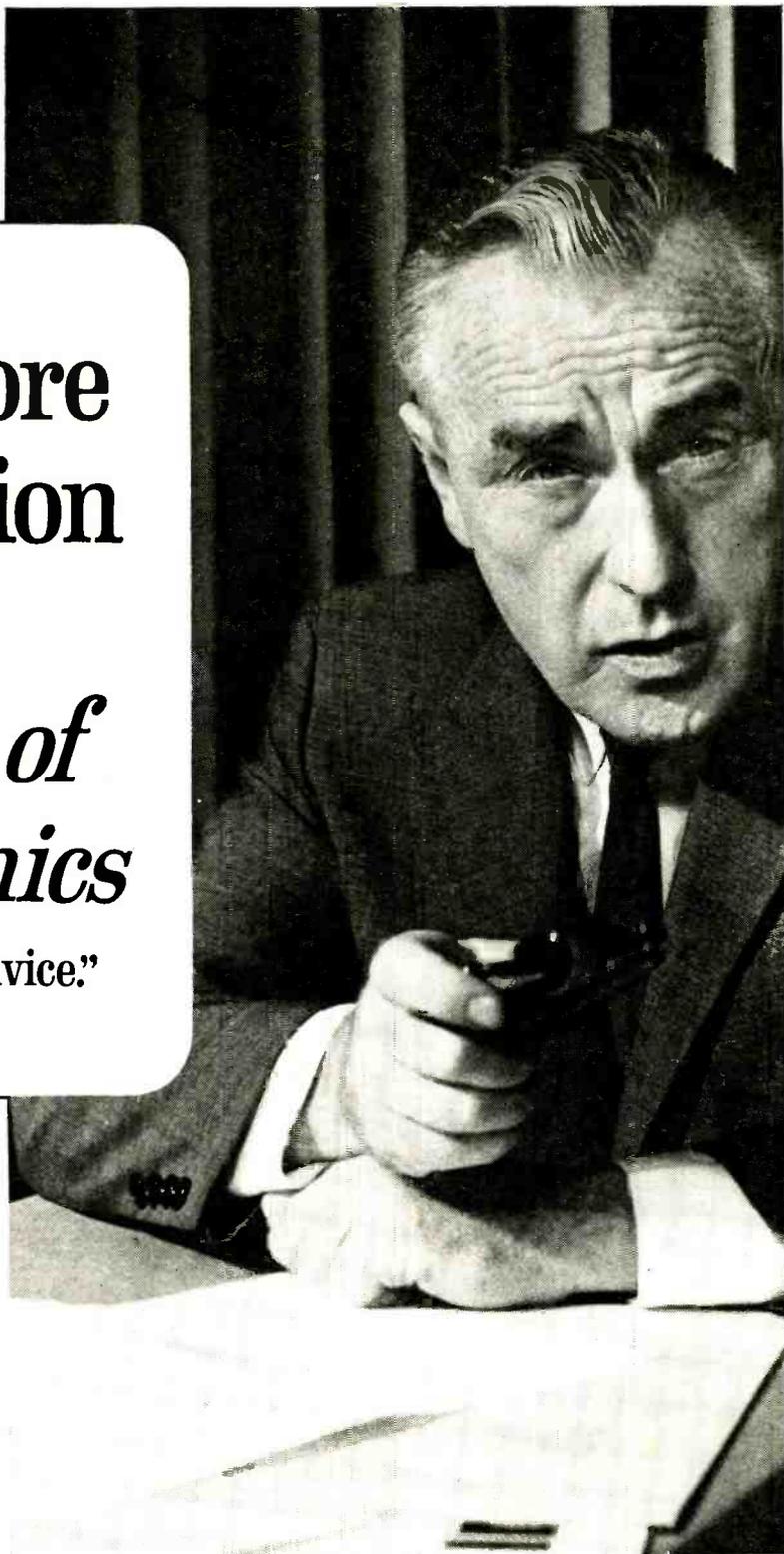
Most commercial “fuzz”-producing de-

vices are transistorized and must be powered by a battery or external line power. But this *batteryless* Fuzzbox gives the same nerve-shattering sound produced by transistorized commercial units selling for \$25 and up.

How It Works. The utter simplicity of the Fuzzbox is shown in Fig. 1. Its only parts are a s.p.d.t. momentary-
(Continued on page 92)

**“Get more
education
or
*get out of
electronics***

...that's my advice.”



Ask any man who really knows the electronics industry. Opportunities are few for men without advanced technical education. If you stay on that level, you'll never make much money. And you'll be among the first to go in a layoff.

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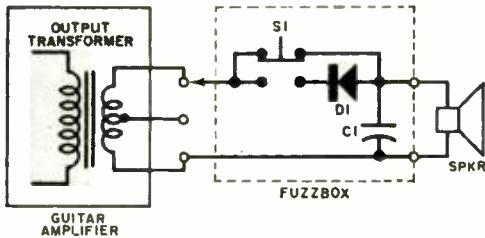


Fig. 1. The Fuzzbox goes between the amplifier's speaker taps and the speaker voice coil terminals.

contact push-button switch (*S1*), a power diode such as a GE 1N91 (*D1*), and a 0.05- μ F, 50-volt ceramic disc capacitor (*C1*). In operation, the unit is connected between the output of the guitar amplifier and the speaker, and the combination diode-capacitor acts as a simple wave-forming circuit.

The normal waveform produced by a guitar is relatively free of harmonic content. When the switch is pressed, the diode clips alternate peaks of the applied signal, and the signal is further shaped by the capacitor to produce a sawtooth-like waveform rich in harmonics. This enables the Fuzzbox to pro-

duce overtones which sound as if they were tearing your speaker to shreds, while actually reducing, slightly, the amplifier output power.

Construction. For professional appearance, the Fuzzbox should be mounted in a small presentable enclosure—a 4" \times 2" \times 1½" aluminum box of the gray hammertone type will do nicely. The push-button switch can be mounted on the top of the box for easy access, and the other two components connected via a terminal strip as shown in Fig. 2. A barrier strip can be mounted through a cutout on the chassis for easy connection to external circuits.

An alternate construction method is to use a footswitch with the few components mounted inside the switch. Also, the diode and the capacitor can be included in the guitar amplifier and controlled from a switch located outside the amplifier.

No shielding is required as the circuit is not susceptible to hum pickup, and no special precautions need be taken. But you must use a power diode for *D1*, since miniature low-power diodes cannot take the high power levels produced by most guitar amplifiers. Incidentally, slightly different sounds are produced by different types of diodes, and you may wish to experiment with some of the power types for the best sound. However, the author has found the GE 1N91 to be quite satisfactory.

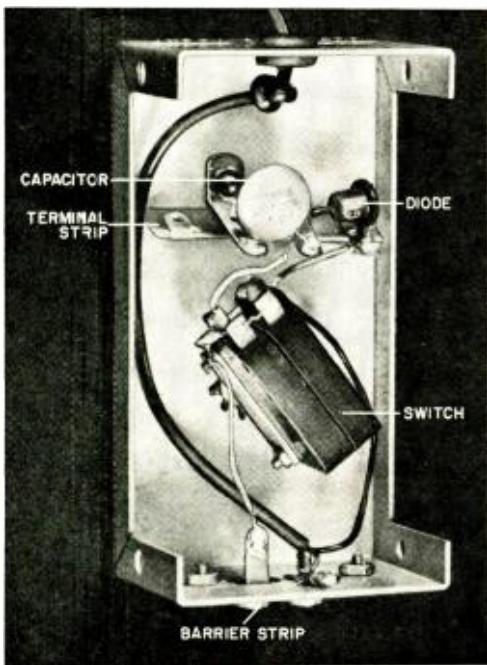


Fig. 2. For easy access, the push button is mounted on top of the box, while the diode and capacitor are wired on a terminal strip below the deck.

Installation and Use. The Fuzzbox is connected between the amplifier speaker taps and the speaker voice coil, with the switch wired in the "hot" or ungrounded lead. Also, be sure to make connections to the proper speaker impedance taps to prevent excessive power losses.

In addition to its "fuzz"-producing function, the Fuzzbox can be used as an aid in tuning a 12-string guitar. For if a pair of strings is not tuned an octave apart, as they should be, you will hear a distinct beat that can be overcome only by properly tuning the instrument.

And remember, the Fuzzbox is designed for single-string application, and will not reproduce chords satisfactorily. Have mercy on your audience by using the Fuzzbox as it should be used. —30—

Some plain talk from Kodak about tape:



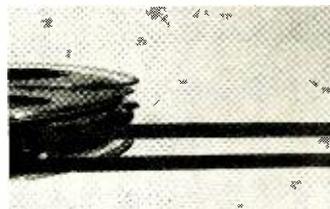
The big squeeze—Multitrack Stereo

Remember the college fad a few years back—how many brawny brutes could be squeezed into a little car built for plain folks? For a while, it looked like a somewhat similar situation was about to take place in the tape-recording field—first monaural, then 2-track, then 4-track, and now even 8-track recording. Even though these developments continue at a fast clip, 4-track stereo is still the name of the game as far as high-fidelity applications are concerned. And very nice it sounds, too, thanks to the precision built

Thus, to make the most of what you can record, you need a tape with a high-powered oxide layer—one that's going to give you a high output with a good signal-to-noise ratio.

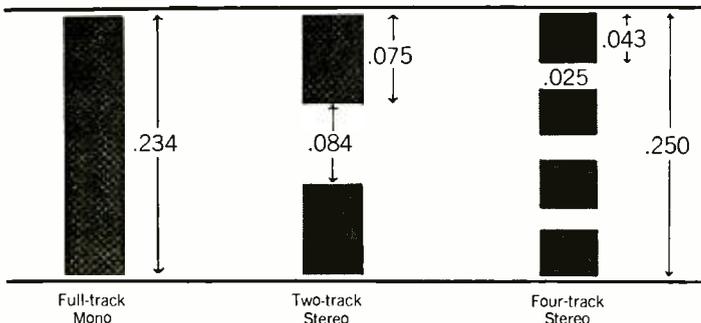
KODAK Sound Recording Tape, Type 34A, fills the bill—gives you 125% more undistorted output than conventional general-purpose tapes. You get practically the same per-channel output on 4-track stereo with Type 34A that the other tapes would give you on 2-track! But there's more to recommend Kodak tape.

signals completely, even pick up the signals on the tracks going the other way. Horrors! Lucky for you, you have nothing to worry about with Kodak tapes. We keep our tolerance to .001 inches. That's twice as close as industry standards. To make your life even easier, we also backprint all our tapes so you can always tell whether a reel has been wound "head" or "tail" first. Just note



which comes first off the supply reel, the "E" of "EASTMAN" or the "O" of "CO"... and note it on the reel.

Kodak tapes—on DUROL and Polyester Bases—are available at most electronic, camera, and department stores. To get the most out of your system, send for free, 24-page "Plain Talk" booklet which covers the major aspects of tape performance.



into modern heads. But you do have to watch yourself. Having double the information on a given length of tape means everything has to be just so—including the tape you use.

4-track star. The first thing to worry about in considering a tape for 4-track stereo is output. As you see in the chart above, adequate separation must be maintained between each track to prevent cross-talk. And as the actual width of the recorded tracks drops down, the output per channel on the tape drops in proportion.

Staying on the right track.

Because everything gets smaller in proportion when you go to 4-track, dimensional precision becomes that much more important. Take a tape that suffers from a case of drunken slitting. (That's when the edges of the tape snake back and forth even though the width is constant.) It's not hard to see how this tape isn't going to "track" straight past the head. A slight case of this and you get alternating fluctuations in output on both channels. If the condition is bad enough, a poorly slit tape can cause your heads to drop out the

EASTMAN KODAK COMPANY, Rochester, N.Y.

CIRCLE NO. 32 ON READER SERVICE PAGE

IC-67 METAL LOCATOR

(Continued from page 48)

CF101 core. Work your way evenly around the core until you near the end of the first layer. Leave a small gap on the core, with no wire in it. Then begin a second layer, working your way back to the beginning, and so forth. Keep

your turns neat, tight, and sequential.

After counting out the 36 turns, cut the leads to $\frac{1}{4}$ " and strip and tin to $\frac{3}{16}$ ", just as you did on the r.f. chokes. There should be four leads. Use an ohmmeter to identify each pair of wires. Also check for shorts between windings and the core.

Circuit boards are available, but if you want to make your own, follow the actual size layouts shown in Figs. 9 and

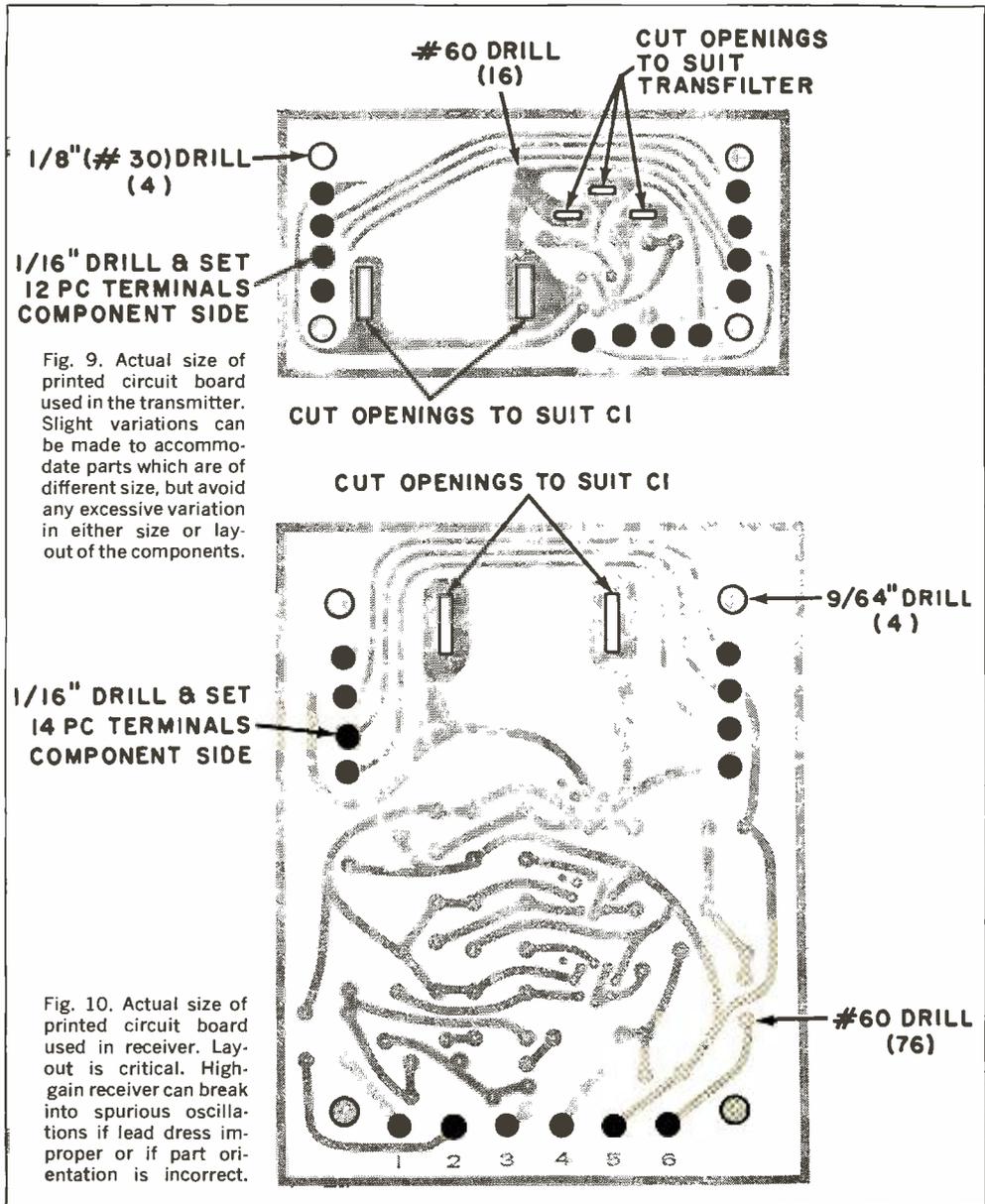


Fig. 9. Actual size of printed circuit board used in the transmitter. Slight variations can be made to accommodate parts which are of different size, but avoid any excessive variation in either size or layout of the components.

Fig. 10. Actual size of printed circuit board used in receiver. Layout is critical. High-gain receiver can break into spurious oscillations if lead dress improper or if part orientation is incorrect.

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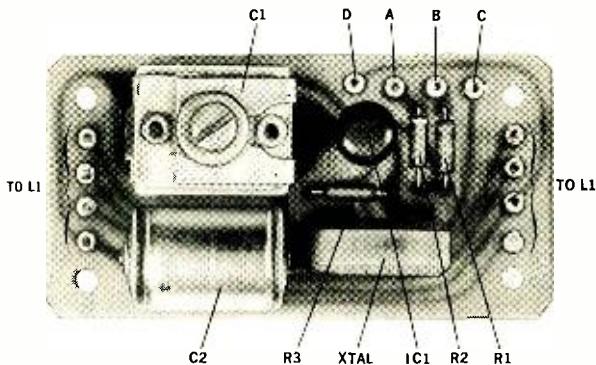
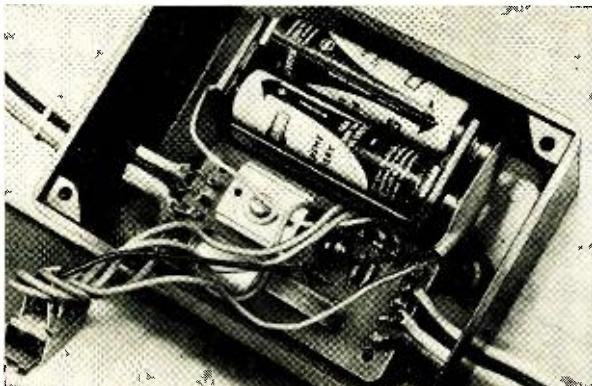


Fig. 11. Components are mounted on transmitter board. Note that pin numbers on IC1 run counterclockwise when you're looking at the top of the component.



10. Mount the components as shown in Figs. 11 and 13. Do not substitute capacitors; those called for have the proper "Q" and tolerance. The transformers and chokes are held in place by their leads. After the initial checkout, you can further secure them with a dab of coil dope.

Controls with switches mounted on them are used to simplify operation of the receiver. The *Gain* control carries on/off switch *S1*, and the *Expansion* control has a push-pull s.p.s.t. switch (*S2*) mounted on its back, as shown in Fig. 14.

Wiring should present no serious problems. Use several colors of wire and double-check all connections. Route all six receiver leads through a single piece of $\frac{3}{8}$ " sleeving to keep the receiver orderly and prevent spurious oscillation.

The two loop antennas are identical and are made out of a 37-inch length of four-conductor 16-AWG flat cable, and shaped into a 9" x 11" rectangle. It is important that both loops be exactly the same (in size and shape).

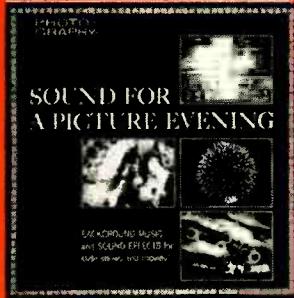
It is not possible to simply bend the cable—you'll have to gradually work or

mold it into shape with your hands. The cable must lie flat on the board, so work the cable by alternately bending and flattening as you go. You can best do this on a flat table. Temporarily add a bit of tape in the center of the cable, to mark the center, and work your way towards each end from the middle.

Staple the loops to their respective boards. Remove just enough excess cable (the same amount from each loop) to accommodate the receiver and transmitter terminal spacing. The loop ends are stripped and soldered into place. The loop leads must go to the antenna terminals in sequential order. They will do this naturally if your cable lies flat.

Initial Checkout. Insert the receiver batteries and turn both the *Gain* and *Expansion* controls all the way down. Pull out the *Pull Audio* switch. Bring up the *Expansion* control until the meter reads 0.4 mA. The audio should cut in initially around 0.3 mA. Now bring the gain up. The meter reading should increase only slightly. If it jumps up, you have

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oscillation problems, which can usually be cured by more careful lead dress. If necessary, try rotating the transformers slightly.

Set the transmitter a few feet away from the receiver, and switch it to *Low*. The receiver should immediately swing off scale and the audio volume should increase. Decrease the *Gain* control on the receiver to obtain a meter reading of 0.7 mA, and adjust the trimmer capacitor in the receiver and in the transmitter to peak the response.

To be sure that your metal locator is at optimum sensitivity, perform these three tests. First, have someone hold the receiver while you hold the trans-

mitter (antenna loops) *parallel* to the receiver, and walk away slowly. Key the transmitter on and off with the switch, as you walk. In the *High* position, there should still be a discernable receiver output beyond 50 feet; in the *Low* position, you should easily get a range of about 25 feet.

Second, assemble the locator, hold the beam sideways (receiver loop facing the horizon), turn the *Gain* up, and adjust the microbalance for a null reading (minimum). Approach a chain-link fence, a truck, or other large metallic body; the meter should show an output when you get within nine feet of the object, and should swing off-scale at seven feet.

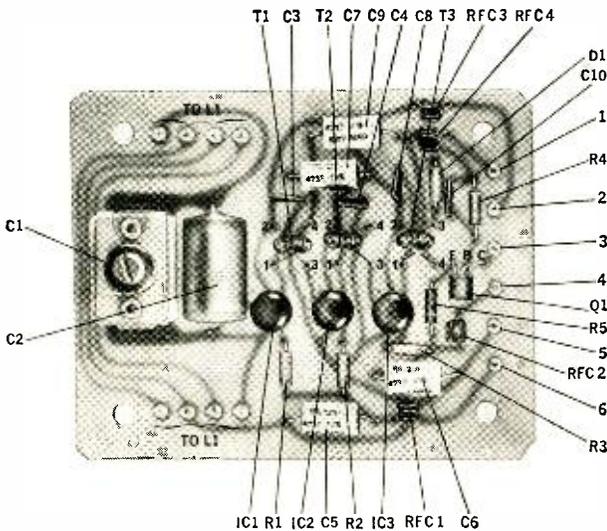


Fig. 12. Component layout in the receiver is critical. You may have to slightly rotate or bend the transformers towards or away from the board to prevent unwanted oscillations. Reverse leads on T3's secondary when connecting it to the board as shown.

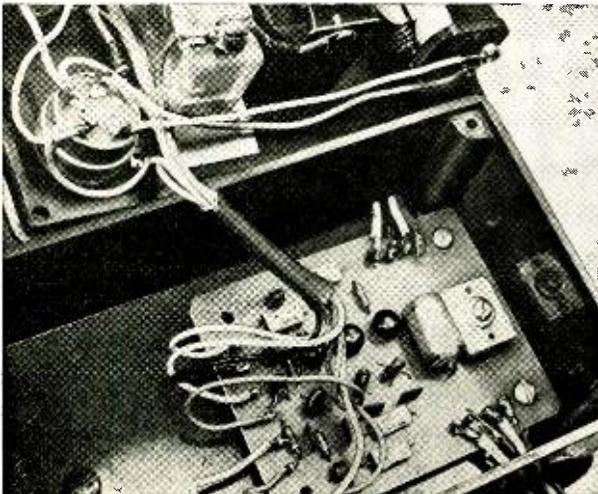


Fig. 13. All r.f. stages in receiver resonate at 455 kHz. Trimmer capacitor tunes the antenna. This is one project where you must stick as close as possible to instructions and not make parts substitutions or compromises.

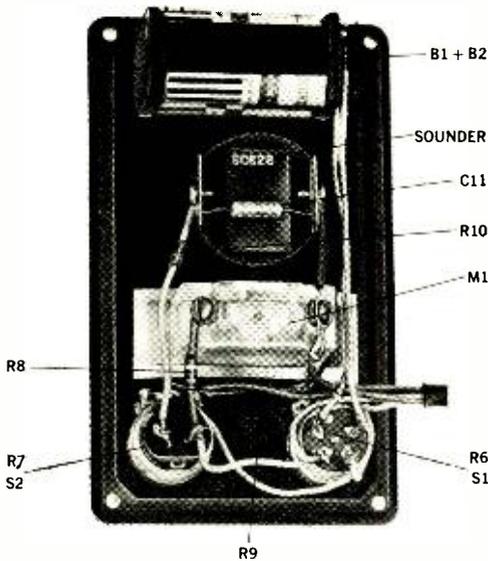


Fig. 14. Sounder, meter controls, and batteries are all mounted on cover of receiver. While most of the space is accounted for, layout is not cluttered.

Third, set the locator on a wooden stool (outdoors) and adjust the microbalance slightly off the null position with the *Gain* control at maximum. Hold a silver dollar or similar-sized piece of metal 4" above and centered on the receiver loop. As you rotate the coin slowly, it should produce at least one division of meter variation.

If any of these tests fail, you'll have to "ring" out the circuit with a good oscilloscope and an r.f. signal generator to find the stage or stages which are either off resonance or malfunctioning. All stages should peak at 455 kHz. You can check the receiver response independent of the receiving loop simply by

shunting the loop with a 10-ohm resistor and injecting a signal.

Operating Hints. Become familiar with your instrument and its behavior with known objects before attempting any treasure hunts. Try some sample targets—cookie sheets, pots, coffee cans, water pipes, etc.

You'll find that the microbalance control is best set at *one-half turn clockwise* from the null position to give you maximum sensitivity to changes in field pattern. Any time you change the operating height, you'll have to readjust this control. Normally, you can carry the instrument at arm's length, but for deepest penetration, you should hold it closer to the ground. Once you have located a target, keep backing down the *Expansion* control until your target is just barely detectable—to obtain the sharpest possible "outline."

To find the exact position of a target, approach it from several directions and average out the results. With proper use of the *Expansion* control, you should be able to pinpoint a target to within a few inches. When tracing pipe, always cross the pipe at right angles to get a distinct response. For unknown targets, cover an area first East-West, then North-South, traveling slowly and steadily, and repeating the "dosage" at two-foot intervals.

To test your batteries, turn the *Expansion* control all the way up. The receiver batteries are good if the meter reads at least 0.8 mA. Replace the transmitter batteries if the signal "drops out" in the *Low* position at any time.

Happy hunting.

-30-

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VOM RANGE SPLITTER

(Continued from page 71)

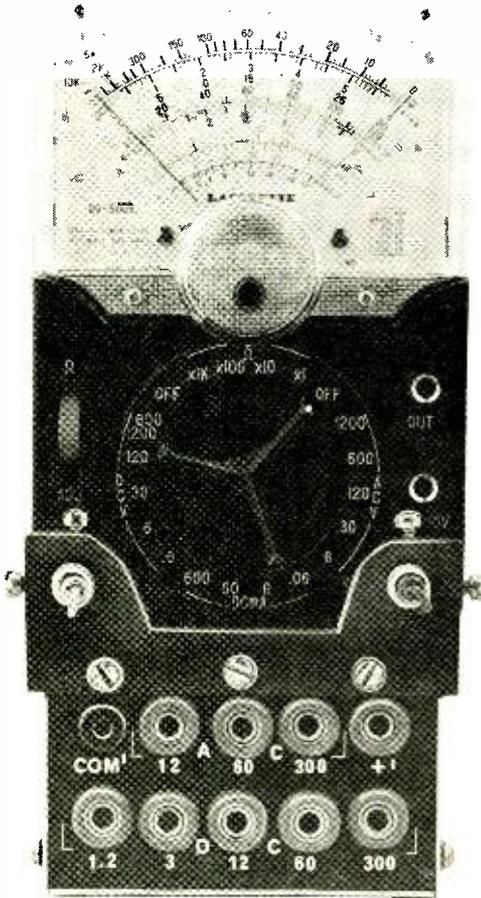


Fig. 5. The VRS adapter can be quickly plugged into the meter. It does not affect normal meter functions and increases number of voltage ranges.

To double the meter's range, say from 30 volts to 60 volts d.c., be sure to set the meter range selector switch to the correct position and plug the test leads into the correct jacks on the VRS as well as to observe proper polarity for d.c. measurements, thus preventing damage to the meter.

The VRS does not in any way permanently modify your VOM. It is an auxiliary device for adding in-between ranges when the occasion demands it, and you can use your meter in the regular way at any time. -30-

SEQUENCE-OPERATED LOCK

(Continued from page 74)

the two remaining switches (*S7* and *S8*) are used to reset the circuit.

Switches *S1* to *S5* must be depressed in proper sequence, starting with *S1* and continuing to *S5*. (You can locate the switches in any random pattern on your lock to confuse would-be lock pickers.) Notice that as each switch is depressed, it "disarms" the lower contacts on the next switch. These lower contacts on *S2*, *S3*, *S4*, *S5* and *S6*, in their down positions, complete the circuit to lock-out relay *K1*.

If these switches are depressed in incorrect order, they will cause the lock-out relay to energize and light *I1*. When *K1* energizes, it latches closed because of the way the lower contacts on the relay are wired. The relay will remain closed until *S7* is momentarily thrown to open the circuit.

After *S1* through *S5* are depressed in their proper sequence, it is necessary to also push *S6* to energize *K2*, which latches closed, lights *I2*, and applies power to a load which can be anything from a solenoid to a TV set.

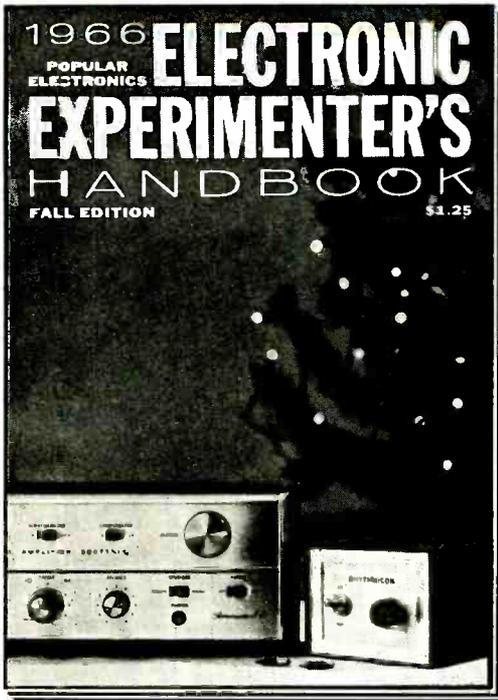
Once *K2* is latched, the push buttons can be released. *SOL* remains open until *S8*, the lock reset, is momentarily opened and returns the lock to its originally closed condition.

Construction. Point-to-point wiring between the switches and relays makes construction a snap. Parts layout isn't critical, but take care in wiring and do not use the metal box for a common ground.

Since the easiest way to change combinations is to juggle the positions of the switches, you should use a liberal amount of hookup wire. If you plan to change the combination frequently, you can employ stranded hookup wire to prevent breakage when switch positions are changed.

Reset switch *S7* should be concealed or designed so as to prevent unauthorized use of the lock. You can drill a small hole in the panel to provide a secret opening to reach *S7*, which is then mounted behind the panel directly

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in line with the hole. If you want SOL to lock your door, it is better to use a normally-closed key-in-lock switch for S7.

When you select your relays, make sure that the relay frames are not connected to the relay coils. Should you want to operate the lock with batteries or another voltage source, simply select appropriately rated relays. Of course, K2's contacts must be able to handle the current drawn by the controlled device. Contacts on K1 handle current through the coils on K1 and K2 only, and need not be as heavily rated as the contacts on K2, especially if K2 is selected to swing a big load.

Mount the switches in any configuration to suit your needs; in-line, circular, random, etc. It might take a little practice to operate your SOL efficiently in the beginning, but so does typing and piano playing. Once you get the hang of it, it comes naturally.

If you want to simplify the manipulation of SOL, you can eliminate one or more of the switches from S2 to S5. (If you had more than two hands, you could add more switches.) But don't forget the combination, or you might have to climb through a window. -30-

VEGETATION METER

(Continued from page 72)

tance of the operator from interfering with the test, the transmitter and receiver are built as separate units to let the operator step back out of the probes' range; distance is dependent on transmitter power.

Because different plants at various stages of their growth store different quantities of water, some sampling must still be done by the old method to check the accuracy and calibration of the HVM.

The HVM is still undergoing tests to determine what effects nearby shrubs have on readings. But, so far, the preliminary tests show that the HVM is a potentially valuable tool for management of both natural and domestic plant life. -30-

SOLID STATE

(Continued from page 79)

be used as a low-resistance continuity tester or as a general-purpose voltmeter.

Working under an AEC contract, RCA has developed a new radioisotope-powered thermoelectric generator. Weighing a little over 26 pounds, the experimental model has operated successfully for over two months, furnishing 12.6 watts continuously. A modified version of the test model will furnish over 28 watts. Future versions of the device may be used in our space exploration program and as a power source for remote installations of radar and communications equipment.

Two new VHF/UHF FET's are being offered by the Union Carbide Corporation (365 Middlefield Rd., Mountain View, Calif. 94041). Both units, types 2N4416 and 2N4417, are essentially similar except for differences in their interelectrode capacities, and can be used as amplifiers at frequencies above 400 MHz, furnishing up to a 12-dB gain.

Transitips. A diagram for a general-purpose lamp flasher appeared recently in a well-known engineering journal. The circuit used a UJT relaxation oscillator driving a two-transistor flip-flop, a pair of emitter followers, and two power transistors, plus several coupling diodes. Altogether, 10 semiconductor devices were employed, plus some 30 to 40 resistors and capacitors; yet the overall performance, according to the related article, was no better than can be obtained with a simple two-transistor multivibrator using cheap power transistors and lamps as collector loads, and only slightly more efficient than a simple, inexpensive thermostatic flasher.

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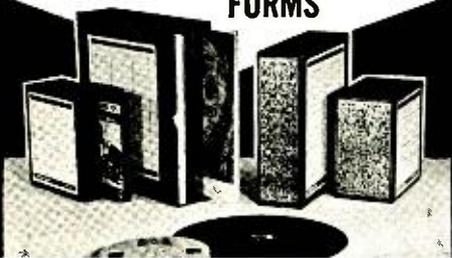
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In another instance, an engineer-designer in need of a line-powered 60-Hz low-voltage signal source devised an instrument which included a crystal-controlled oscillator, a six-stage frequency divider, a buffer amplifier, a twin T-filter, an emitter follower, and a regulated d.c. power supply. The output signal was quite stable—almost as stable, in fact, as the 60-Hz signal that can be obtained directly from the power line through a step-down transformer!

These two examples are typical of many that could be cited to show overdesigned equipment. Each circuit represented clever engineering, and demonstrated the skill and ability of the designer. Yet the desired results could have been obtained in much less time at considerably less cost by using a different approach. The moral of the story is, **THINK SIMPLE.**

This doesn't mean, of course, that one must be "simple-minded." On the contrary, it often takes a lot more effort to devise a simple circuit than a complex one—at least as far as creativity is concerned. But the same approach can be extended to other day-to-day problems. For example, if you are testing a breadboarded circuit and are not sure about the correct bias resistor value, the *simple* approach is to determine this value by experiment. Often, this may require only a few minutes—in contrast to the hours which might be required to look up characteristic curves, draw load lines, and then calculate the necessary value.

By the same token, if you need a power amplifier and if efficiency is *not* a factor, you'll find that a Class A stage is less critical insofar as component values are concerned—and, in general, is more stable than a Class B circuit.

So, **THINK SIMPLE** and save time, money, and parts. Until next month. . .

—Lou

QUIZ ANSWERS

(Quiz appears on page 86)

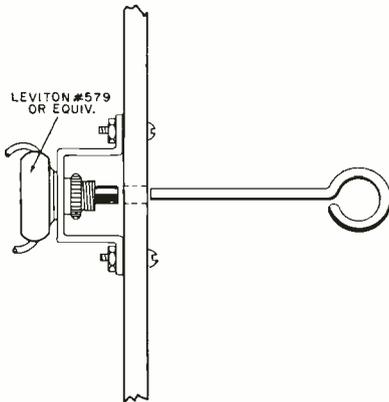
- 1 — H Half-wave quadrupler
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- 3 — D Full-wave bridge
- 4 — C Half-wave doubler
- 5 — A Half-wave tripler
- 6 — F Full-wave tripler
- 7 — B Full-wave rectifier
- 8 — G Half-wave rectifier

TIPS

(Continued from page 14)

SECRET SWITCH SAFEGUARDS YOUR EQUIPMENT

When you're not around, a hidden switch can stop inquisitive people from playing with your radio, TV, etc. Drill a hole in the front panel of the unit you want safeguarded. Mount a push-type switch on a U-bracket, and screw the bracket to the rear of the panel so that the switch is in line with the hole. Then connect the switch to one side of the power cord (leave the regular on-off switch in the circuit). When you want to dis-



connect the power, insert a metal or plastic rod in the hole and press. To restore the power, press again. The rod is the key to your lock, so bend one end of it into a closed loop and carry it around on your key chain.

—Carl Dunant

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—David Collins

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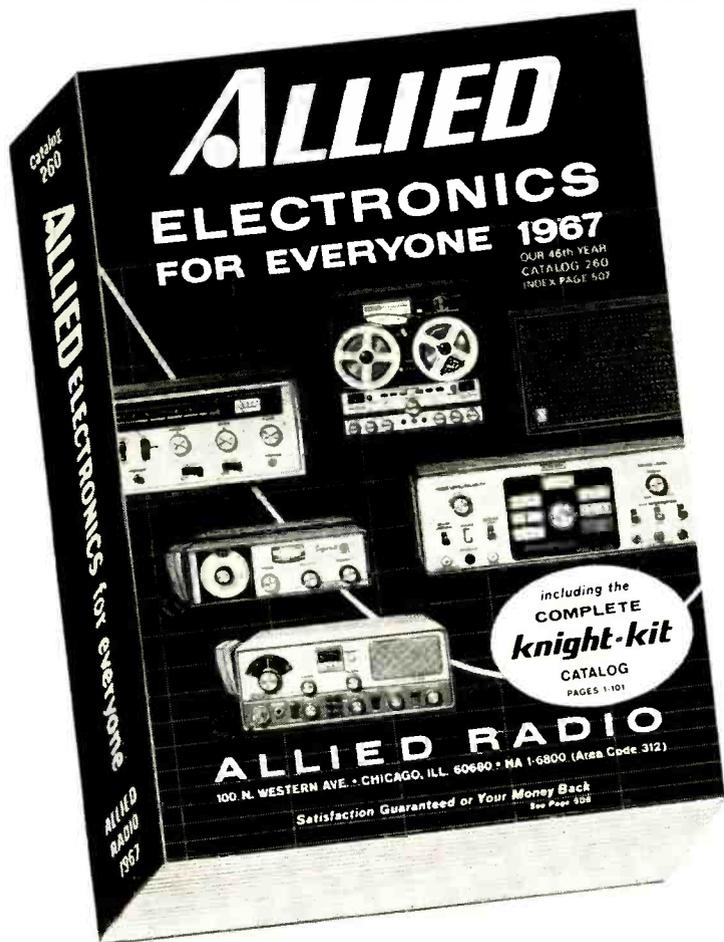
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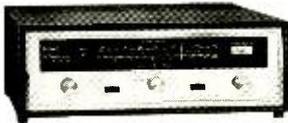
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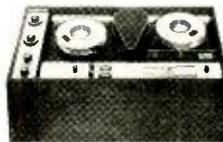
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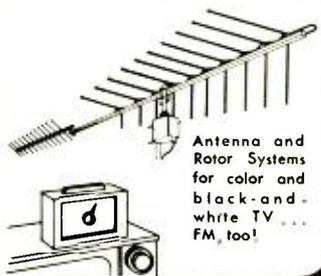
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3. Frequency of issue: Monthly.
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	Average No. Copies Each Issue During Preceding 12 Months	Single Issue Nearest To Filing Date
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A. Total No. copies printed (Net Press Run)	506,650	500,155
B. Paid circulation		
1. Sales through dealers and carriers, street vendors and counter sales	95,904	85,100
2. Mail subscriptions	300,981	307,000
C. Total paid circulation	396,885	392,100
D. Free distribution (including samples) by mail, carrier or other means	4,045	3,907
E. Total distribution (Sum of C and D)	400,930	396,007
F. Office use, left-over, unaccounted, spoiled after printing	105,720	104,148
G. Total (Sum of E and F— should equal net press run shown in A)	506,650	500,155

I certify that the statements made by me above are correct and complete.

PHILIP SINE, Treasurer

ON THE CITIZENS BAND

(Continued from page 83)

1967 OTCB CLUB ROSTER

In order to keep our roster of active clubs current, all CB clubs, rescue teams, and special police groups who have not reported to us in the last 12 months should do so now. Include your current membership totals, officers, club activities, copy of bylaws and constitution, and sample decal and membership card, if available. All groups are urged to enclose photographs of activities, emergency teams, and any unusual application that would interest other CB users. And be sure to send us your club newspaper or bulletin on a monthly basis. Forward this material to Matt P. Spinello, CB Editor, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016.

Tampa, Florida—*Tampa CB Radio Club*. Membership: 180, and on the increase. Officers: Grady Lowe, KKP0915, president; Chuck Howard, KDH-1018, vice president; Don Shaffer, treasurer; and Linda Kickliter, secretary.

Detroit, Michigan—*Radio Emergency Team, Inc.* Organized in 1963, this group monitors and travels Detroit freeways and surface streets to aid motorists; also aids local police agencies at accident scenes. Officers: Ken Miller, KNM2889, president; Harvey Slutsky, KPM6945, vice president; Gary



Brand, KLN6181, secretary; Ella Lettau, KLN-2005, treasurer; and Bob Baker, KPM4682, road patrol captain. R.E.T. urges all interested CB'ers in the area to write to P.O. Box 5056, Detroit, Mich.

Louisville, Kentucky—*Iroquois Gentlemen*. Current officers: Harold Schumacher, KLL0320, president; Jerry Brown, KPJ0011, vice president; Jerry Sacksteder, KNK2880, treasurer; James Coyle, KLJ6891, recording secretary; Al McPherson, KPJ3296, corresponding secretary.

Spokane, Washington—*CB 7/11 Radio Association*. This club maintains a women's auxiliary, interference committee, and an interesting monthly newspaper edited by Don C. McGowan. Current officers are: Larry Proless, KLD0752, president; Jerry Woodland, KFJ2384, vice president; Al Chafee, KLD1434, secretary; Lee Stone, LKD2415, treasurer; and five trustees.

Scarborough, Ontario, Canada—*Scarborough Emergency Communications Team*. This is a non-profit organization employing the GRS to aid in emergencies. Membership is made up of experienced radio operators. Constitution includes a code of ethics which enforces proper radio communications in accord with DOT regulations. Equipment must be kept in peak operating condition with the operator prepared to render assistance at all times. Member stations are required to stand by to be of community or national service at any time.

I'll CB'ing you.

—Matt, KHC2060

AMATEUR RADIO

(Continued from page 85)

based on the use of properly adjusted transmitters and receivers. Receivers must be fairly good and able to handle weak but readable signals. The antenna feed line is assumed to be a 50' length of RG-58/U; substituting RG-8/U will increase range approximately 5%.

Range on SSB is approximately midway between the AM and CW range. Similar tables can be prepared for higher power, bigger antennas, and the like, and for the higher frequency bands. Other things being equal, range drops off approximately 10% each time you move up one band.

If your reliable 50- or 144-MHz coverage does not at least approximate the figures shown, your setup could probably stand some improvement. But if you insist on "armchair" copy, cut the figures at least in half. Multiply them by 10 or more under various types of "skip" conditions.

QSO Party. The Second Annual Louisiana QSO Party will be held from 1800 GMT, January 28, to 2200 GMT, January 29, 1967. To participate, you work as many different Louisiana stations as possible. Suggested frequencies to use are 3.6, 3.91, 7.1, 7.23, 14.1, 14.3, 21.1, 21.4, 28.1, and 28.7 MHz. Multiply the number of different Louisiana stations worked per band and mode by the total number of Louisiana parishes worked for your score. Then mail your score with full log data to the Lafayette Amateur Radio Club, 612 Harding St., Lafayette, La. 70501, before February 28. Certificates will go to high scorers.



Steve Buerg, WN6THT, Daly City, Calif., made 458 contacts in 46 states and five continents in two months. How's that for a record? A Hallcrafters HT-40 transmitter and SX-101 receiver and a Hy-Gain 14-AVS vertical antenna are his tools.

January, 1967

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CIRCLE NO. 19 ON READER SERVICE PAGE



Tom Fowler, WB4CMU, Myrtle Beach, S.C., can work 80, 40, and 15 meters with his Heathkit HX-11 transmitter and Lafayette HA-230 receiver. But he prefers rag-chewing on 80 meters—and is currently putting together a Heathkit HW-12 transceiver.

phia to take his General exam. With a 20-wpm code certificate on the shack wall, he is not much worried about the code. . . Frank Crabtree, WA8PRA, 2813 Silvercliff Dr., Dayton, Ohio, didn't waste a minute of his Novice career. In a year, he worked the 50 states, but he still awaits a promised card from Alaska. His DX log shows 11 countries on four continents. All this was done with a Knight-Kit T-60 transmitter running 60 watts while exciting a Hy-Gain 14-AVQ vertical antenna mounted on the ground. A Drake 2-B handles the receiving chores. Frank has passed his General exam and has a Johnson "Ranger" with a built-in VFO waiting for the license to arrive.

Why not let us read your "News and Views," and see your picture. The first step is up to you. Write that letter and tell us about your successes—and disappointments, too. Thanks for keeping your club bulletins coming. And let us know about over-the-air code classes as far in advance as possible. The address is: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P. O. Box 678, Gary, Indiana 46401.

73, Herb, W9EGQ

SHORT-WAVE LISTENING

(Continued from page 81)

Honor Roll were to include at least one DX'er who had gone over the 190 countries mark.

Incidentally, we are seriously considering issuing a new 125 Countries Award seal, as complaints have been received to the effect that the step from 100 to 150 countries is too great.

BBC Ascension Island Relay. Many readers have asked how they can be sure that they have logged the British Broadcasting Company's new Ascension Island relay station, since the station does not specifically announce as being the Ascension Island relay.

We can only suggest that you tune to 15,350 kHz and listen for the usual station

January, 1967

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CIRCLE NO. 26 ON READER SERVICE PAGE

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identification. The announcer will list the regular frequencies and then add ". . . and for our African listeners on 15,350 kHz . . ." Tune for the station at the listed 0400-0800 or 0900-2245 transmission times, during which it will relay the World Service.

Those of you who can tune as high as 10 meters, might look for the second harmonic of the 15,350-kHz outlet. It has been reported around 2030 on 30,700 kHz. Conditions must be favorable, however.

CURRENT STATION REPORTS

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

Afghanistan—R. Kabul, 11,865 kHz, signs on in German at 1830 and in Eng. at 1900, with news and music to 1930. This channel provides very rough reception and the dual 15,225-kHz outlet is no better. The Eng. ID is "This is Radio Afghanistan."

Algeria—R. Algiers is good in Arabic to North and Central Africa at 1630-1730 on 11,810 kHz with Arabic music and chanting; news is given at 1715. Another xmsn in the same language was noted on 7172 kHz to 2230 s/off.

Angola—Station CR6RZ, R. Angola, Luanda, is heard fairly well on 3375 kHz around 2200, all-Portuguese.

Bechuanaland—The BBC Central African Relay at Francistown is fair on 4845 kHz from 0400 with time pips and BBC news, commentary at 0409, and an ID at 0414 including frequency annit for BBC African Service and a local time check. Heavy QRM is provided by R. Congo on 4843 kHz.

Bolivia—R. Universo La Paz, La Paz, 5015 kHz, was heard plainly with complete ID at 1020. R. Amoro, Station Cruz de la Sierra, is back on the air, and was heard around 4898 kHz (drifting) with Latin American music and a few voice annits until 0230, with best reception generally prior to 0100.

Brazil—Station PRC23, R. TV Gaucha, Porto Alegre, is definitely on the air—it was noted on 11,910 kHz from 2325 to past 0005. Three deep gongs are sounded during station breaks; news in Portuguese is given at 0002. R. Clube Paranaense, Curitiba, is now active on 11,935 kHz. R. Cultura da Bahia, Salvador, is on the air on 9595 and 15,225 kHz. Other miscellaneous loggings include: ZYT44, R. Guaruja, Santa Caterina, 5977 kHz, at 2130-2230, all-Portuguese; ZYF24, R. Maranhao, wandering around but located lately on 4725 kHz at 0330-0430 with Portuguese music; PSF, Agencia Nacional, in Portuguese from 1230 to 1300 on 14,690 kHz; PRN9, R. Difusora Departamento Seguranca, A Voz de Policia, Rio de Janeiro, 9295 kHz, at 1210 and 0120 with talks in Portuguese. A QSL in from R. Gazeta de Suo Paulo, 9685 kHz, states that they have moved their offices; reports

SHORT-WAVE ABBREVIATIONS

- | | |
|---------------------------------------|--------------------------|
| anmt—Announcement | kW—Kilowatt |
| BBC—British Broadcasting Corporation | N.A.—North America |
| CBC—Canadian Broadcasting Corporation | QRM—Station interference |
| Eng.—English | R.—Radio |
| ID—Identification | s/off—Sign-off |
| kHz—Kilohertz | s/on—Sign-on |
| | xmsn—Transmission |
| | xmtr—Transmitter |

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All certificates are filled in and lettered before mailing; they are mailed flat and unfolded. If you want to register and receive your WPE identification sign, fill in the application blank below. Mail with 50 cents in coin (or stamps) to: MONITOR, P.O. Box 333, Cherry Hill, N.J. 08034. (Personal checks will not be acceptable). Canadians should use their own currency, and other applicants not in the U.S.A. should use 10 International Postal Reply Coupons. Allow 4-6 weeks for processing.

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should now go to *Radio Gazeta*, Avenida Paulista 900, 4° andar, Sao Paulo, S. P., Brazil.

Canada—Forget about last month's listing of 11,760 kHz to the Caribbean and Latin American areas at 2258-0046. The CBC has gone back to 11,725 kHz for this xmsn, dual to 9625 and 5990 kHz.

Numerous DX'ers report hearing CFVP, *Voice of the Prairies*, Calgary, on 6030 kHz, which would seem to indicate a possible increase in power. But George Merchant of the CFCN Engineering Department (operators of CFVP) informs us that "the output is 100 watts and has not been increased at all."

Ceylon—*R. Ceylon* has been heard on 6075 kHz in the Asian Service at 1320 with Hindi music; it operates dual to 11,800 kHz. The 5075-kHz outlet is poor to fair at 1005 with Oriental music.

Chad—Fort Lamy, 4905 kHz, runs to 2300 on Saturdays, not 2200 as listed by some sources. It's audible at 2145 with Congo-type music and the language is French.

Colombia—Station HJDD, *R. Valledupar*, 4815 kHz, and HJDE, *R. Villavicencio*, 4935 kHz, have been heard in a network program at 0300-0330 with Latin American music. *R. Nacional*, Bogota, 9635 kHz, has news in Spanish at 1200-1217, then a rebroadcast of the BEC "English by Radio" program, and classical music at 0030-0055.

Costa Rica—Station TIRHB2, *R. Popular*, San Costa, is drifting: it was logged last on 4756.5 kHz at 0120. The ID's are given clearly and distinctly in Spanish.

Cuba—*R. Havana* has this new schedule: Eng. at 0100-0600 on 6170 and 11,760 kHz, at 0330-0600 on 6135 kHz, and at 0630-0800 on 6100 kHz; French at 0730-0930 on 9525 and 11,735 kHz, and at 1700-1810 and 2110-2140 on 11,735 and 17,855 kHz. The third harmonic of 9655 kHz is being reported at 2200 on 28,965 kHz.

Dominican Republic—A possible new style of call-signs for this country is indicated by the call-sign HIB1E now being used by *R. Mil*, Santo Domingo, 4940 kHz. The station was noted at 0255-0505 with music, no ads, but frequent time checks and ID's.

India—*All India Radio*, New Delhi, is good to excellent but with heavy teletype QRM on 9915 kHz at 2030-2230; Eng. news, Indian music, and other usual features were heard. The broadcast in English to S. E. Asia at 1330-1500 on 11,810 and 15,225 kHz is also good.

Malaysia (East)—Station 9WD215, Sabah, 4970 kHz, has been noted with local news at 1330 in Eng., with light music at 1345, and with *R. Malaysia* news at 1400. The ID is *Inilah Radio Malaysia*, Sabah.

Mali—*R. Mali*, Bamako, 4835 and 9745 kHz, was noted at 0600-0620 with African music, to 0636 with native-language talks, to 0700 with music, and to 0702 with news in French. Both channels are weak but clear; 9745 kHz was QRM'ed out at 0700 by HCJB, Quito, Ecuador.

Mexico—Definitely reactivated is XEBR, *El Heraldo de Sonora*, Hermosillo; it was noted on 11,820 kHz at 1730 relaying XEBH, Station XEJG, *La Casa de la Cultura*, Guadaluajara, the Jalisco state station on 4820 kHz, is now being heard best from 0400 to 0500 after the HRVC, Honduras, s/off. The programming is mostly classical music with few anmts.

Monaco—*Trans World Radio*, Monte Carlo, was reported on 11,845 kHz (replacing 7260 kHz) on a Sunday with a religious program in Eng. to past 1245; and on 9630 kHz in Eng. at 1030 with a test xmsn (asking for reports).

Mozambique—*R. Pax*, Beira, 7205 kHz, was noted—but was only barely audible—at 0430 with news in Portuguese.

Netherlands—*R. Nederland* is preparing a course on short-wave propagation and disturbances which will be on the air from April to September, 1967. Printed material can be obtained on request; write to *R. Nederland*, Propagation Course, P. O. Box 222, Hilversum, Holland.

New Guinea—Station VL9CH, Mt. Hagen, 2450 kHz, was noted on the East Coast in Eng., with music at 1030.

Peru—Station OBZ40, *R. Union*, Lima, 6115 kHz, is strong at 0100-0530 with Latin American music and many annmts in Spanish.

Station OAX5C, *R. Ica*, Ica, 9587 kHz, is audible when the Brazilian on 9585 kHz is off the air and before the *R. Nederland* s/on at 0125 on 9590 kHz. Reports from the South also indicate reception of music around 1145, an ID at 1200, time check, and commercials.

Saudi Arabia—Djeddah can be heard plainly at strong level as late as 2235, at which time a clear ID was picked up. This station has been airing programs of popular piano selections on the new frequency of 15.10 kHz.

Solomon Islands—Station VQ07, Honaira, is a new outlet operating on 7115 kHz with 500 watts, dual to 3995 kHz, at 0725-1130 in Eng. and pidgin-English.

South Africa—Numerous conflicting reports have been received on *R. South Africa's* new xmns to to N.A., but evidently they are as follows as of press time (subject to change): to East and Central N.A. at 0025-0125, to Central & Mountain zones at 0126-0225, and to Mountain & Pacific zones at 0226-0325, all on 9675 and 11,900 kHz. A cable from the station gives the United Kingdom and Europe schedule as 2100-2255 on 15,205 kHz (replacing 15,220 kHz) and 2200-2225 on 15,205, 11,785 (replacing 11,900), and 9720 (replacing 9690) kHz. They state that the present antenna situation is temporary; better signals are to be expected when the new antenna is completed. Reports go to P. O. Box 8606, Johannesburg. Listen for the call of the Bokmarierie, a South African bird, with guitar strumming in the background.

Spanish Guinea—Santa Isabel, Fernando Poo, is excellent from 2145 to 2300 s/off with talks in Spanish and variety music, including U. S. pop tunes, on 6250 kHz. The ID is *Radio Santa Isabel* and the s/off march is "Los Voluntarios." English is scheduled at 1830-1900.

Tanzania—According to information received, the xmns supplied by Red China are almost ready for operation. Tests have been noted on 9560 kHz on Sunday at 1000-1300 and on 21,600 kHz at 1700 with ID and dialect news from the National Program. The new xmns are rated at 240 kW.

Turkey—*The Voice of Turkey*, Ankara, now has Eng. to S. and S. E. Asia at 1415-1445 on TAV, 17,820 kHz, and to Western Europe, United King-



This is a photo of the new newsroom at Radio New York Worldwide, otherwise known as WNYW. Shown are acting news director Mark Bench (left) and newsman John Bradford. WNYW is the only international commercial station in the United States.

January, 1967

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POPULAR ELECTRONICS

JANUARY 1967

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dom, and the U. S. A. at 2200-2230 on TAU, 15,160 kHz. A mailbox program is aired on Tuesdays, and the popular music program "Evening Star" is broadcast on Saturdays.

The Istanbul-Kandilli Observatory is broadcasting test xmsns at 0825-0835 and 1425-1435 on 7615 kHz.

Turks & Caicos Islands—Station VSI35, Grand Turk Island, operates on 8000 kHz at 1830 for about 10 minutes with local news about schools, weather, shipping, and other items. Also announced as being in use, but not heard, is a 0000 xmsn for hurricane reports on 2590 and 3995 kHz.

Venezuela—Station YVNW, *R. Bolivar*, Ciudad Bolivar, 4770 kHz, is often good at 0000-0125 with time checks, Latin American music, and many Pepsi commercials. A late check indicates that YVOA, *La Voz del Tachira*, San Cristobal, has moved from 4830 kHz to 4837.5 kHz where it is heard at 0045. Station YVPM, *R. Tovar*, Tovar Merida, now operates on a new frequency of 9650 kHz, dual to 3365 kHz, and is good on both channels around 0030 with Latin American music and ads. Station YVOT, *R. Junin*, San Cristobal, is again active and provides good reception on 4930 kHz around 0025-0033 with a religious service, ID, and then light music. All of the above xmsns are in Spanish.

Windward Islands—Windward Islands Broadcasting Service, St. Georges, Grenada, is now on 11,970 kHz (replacing 15.105 kHz) at 0005-0215 with an unstable signal.

Clandestine—The Greek-speaking *I Fonti Tis Athinas* ("The Voice of Truth") was heard on 6216 kHz at 0515 through facsimile QRM; an ID was given at 0525. The excellent modulation quality would seem to indicate that the xmsn emanates from a government-controlled East European station. -50-

SHORT-WAVE CONTRIBUTORS

Ted Greisger (*WPE1FXL*), Danbury, Conn.
 Roger Camure (*WPE1GK*), Manchester, N. H.
 Harry Dube (*WPE1GVW*), Nashua, N. H.
 Eric Lebowitz (*WPE2JYY*), Jackson Heights, N. Y.
 Kenneth Coyne (*WPE2LSJ*), Long Beach, N. Y.
 Anke Garcia (*WPE2LXA*), APO, Thailand
 C. N. Coombe (*WPE2MOB*), Trenton, N. J.
 Bill Parkinson (*WPE2NAM*), Northport, N. Y.
 Bill Hafner (*WPE2OJJ*), West Islip, N. Y.
 Bruno Colapietro (*WPE2OWO*), Endwell, N. Y.
 Ed Kowalski (*WPE3AK*), Philadelphia, Pa.
 Bob Huber (*WPE3GUN*), Wilmington, Del.
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 David Meisel (*WPE4RS*), Charlottesville, Va.
 Wayne Day (*WPE4JA*), Murfreesboro, Tenn.
 Jim Cumbie (*WPE5AC*), Waco, Texas
 Jack Stephenson (*WPE5XX*), Oklahoma City, Okla.
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 Robert Palmer (*WPE7BB*), Spokane, Wash.
 David Borino (*WPE7EZ*), Cheyenne, Wyo.
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 George Merchant, Calgary, Alta., Canada
 Alan Raney, Memphis, Tenn.
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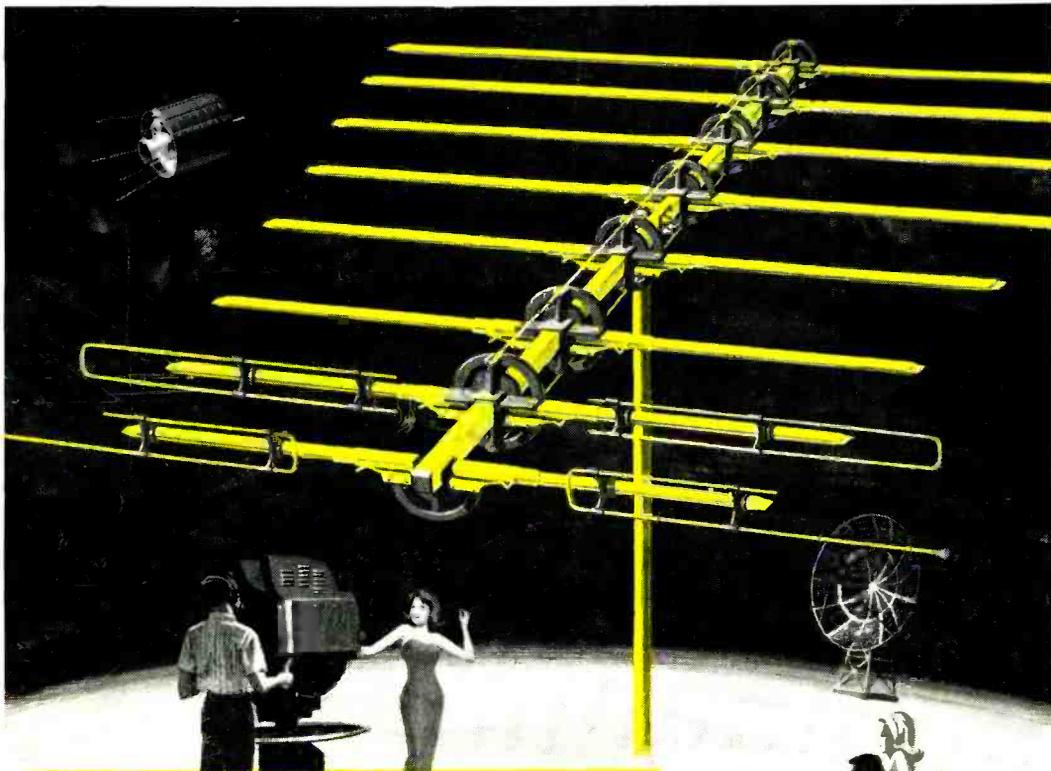
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