

TAPE CASSETTES—FACTS & FANCIES

POPULAR ELECTRONICS

JUNE
1969

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CENTS



BUILD OUTSIDE LIGHT GREETER

HOW TO TEST A UNIJUNCTION

CARL KOHLER GOES LOOT HAPPY

“EYEBALLer” MONITORS CB RIG

**BUILD
WIRED WIRELESS
REMOTE CONTROL**



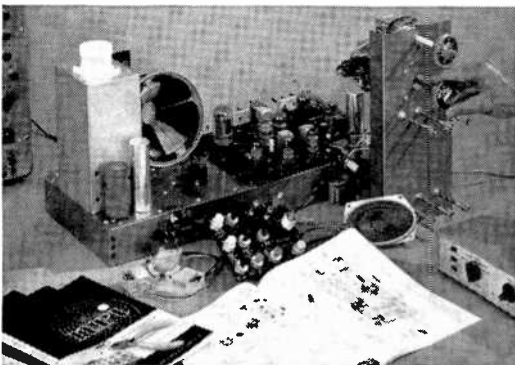
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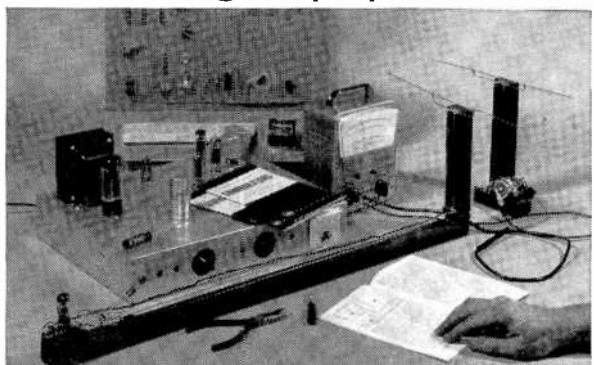
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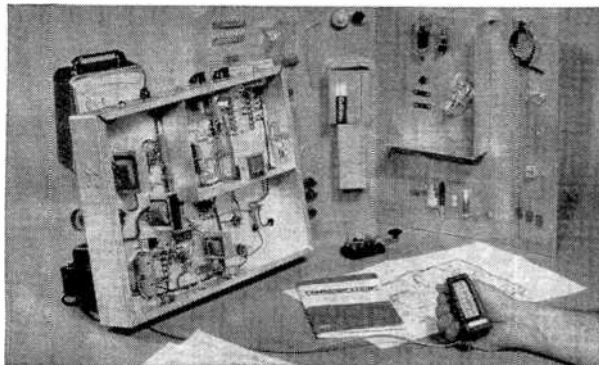
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POPULAR ELECTRONICS

VOLUME 30 NUMBER 6

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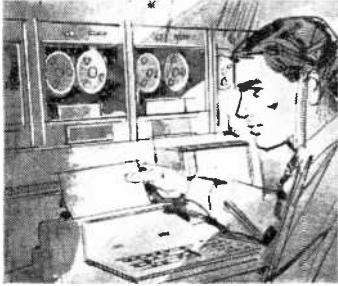
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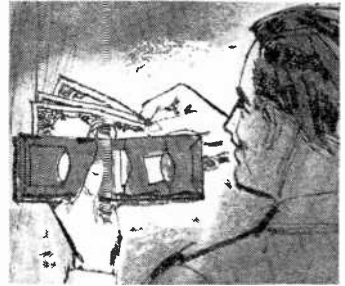
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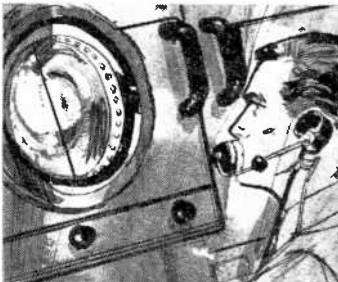
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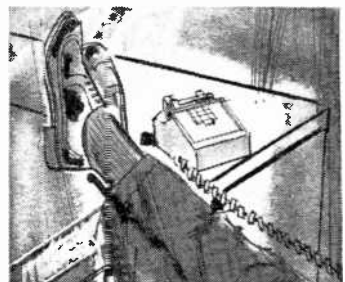
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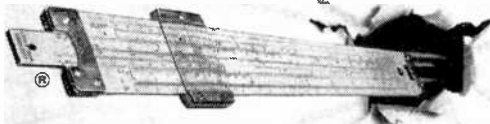
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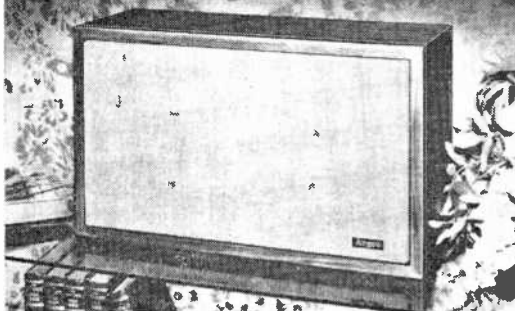
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Products Company

Genoa, Illinois 60135

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CIRCLE NO. 14 ON READER SERVICE PAGE

letters

FROM OUR READERS

HAM SPEAKS OUT

While reading through "The Hatfield Hams and the CB McCoys" (February, 1969), I found some very debatable points. I'll start by stating that I have had my ham ticket since January, 1958, and worked the old 11-meter ham band before it was turned over to the CB'ers. I don't miss the band now, and I don't regret that the FCC took it away. Nor am I against CB radio the way it was originally set up. However, I have only contempt for the majority—and I mean *majority*—of CB'ers who insist on rag chewing, signal reporting, and operating with illegal linear amplifiers. These CB operators have really fooled themselves into believing they are hams.

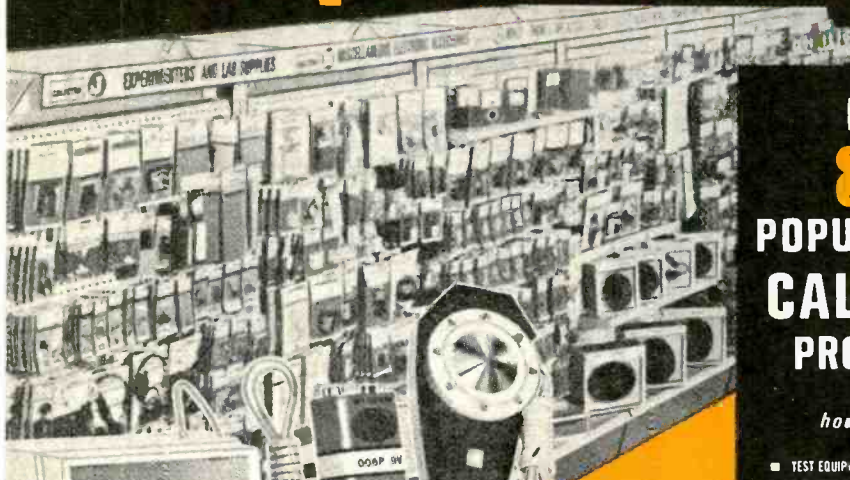
To cite an example, about two years ago an emergency arose in our city of 10,000 inhabitants, and the CB operators were on hand to assist; well and good. But a spokesman for the CB group told the local newspaper they were ham operators; not so good—in fact, a black eye for the hams. Imagine CB'ers passing themselves off as hams!

The POPULAR ELECTRONICS article implies that rag-chewing CB'ers used to exist. The



fact is, however, that this type of operator is the only kind of CB'er on the air—and the clan is growing. Furthermore, I can show you antennas all over the countryside where the CB'ers don't even pretend to comply with height regulations. Some CB operators here even use linear amplifiers with more than 100 watts plate power input. (A supposedly reputable TV sales and service shop here sells linear amplifiers to go with their

Talk about electronic supermarkets



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LETTERS (Continued from page 8)

CB rigs, and not under-the-counter, either. They're right there on the shelf, complete with price tag.)

I played dumb about radio with the salesman in the TV shop. I asked him a few questions about CB and just let him talk, but until he thought I was really interested in buying a linear, he referred to his linears as battery chargers! Then I asked for the names of some satisfied CB'ers, and he obliged. Why, I could have been an FCC inspector for all he knew.

One more point: some manufacturers make linears to cover the 25-50 MHz "business" band, but state in their advertising that the linears are "not for CB use." They might as well state "for 27-MHz band, not for CB use" if they were really looking to drum up business. The obvious reason for mentioning CB at all in the advertising is that CB'ers are prime sales targets.

The FCC has recently tightened up on hams with incentive licensing. Now I feel it is time to tighten up on CB operations by encouraging the FCC to acquire more mobile monitoring trucks to visit these small towns. Also, handing out more citations to rule breakers would help clear up the mess and give the good name back to ham radio and CB as well.

JEFF LUTHER, K4TRY
Union City, Tenn.

NYSTAGMIC vs SACCADIC EYE MOVEMENTS

The part of "The Dizzy Machine" article (April 1969) that deals with nystagmus and dizziness is accurate, but the rest of the article leaves much to be desired. Electro-nystagmography is only one phase of a general technique called electro-oculography (EOG), the study of eye movements by means of changes in electrical potentials produced in the surrounding skin. Some of these movements, which have a sawtooth pattern and are of low amplitude and relatively high frequency, are nystagmic. However, they are *not* associated with dreaming; the movements associated with dreaming produce much higher amplitude, fairly short rise time, lower frequency patterns. These are saccadic or rapid eye movements.

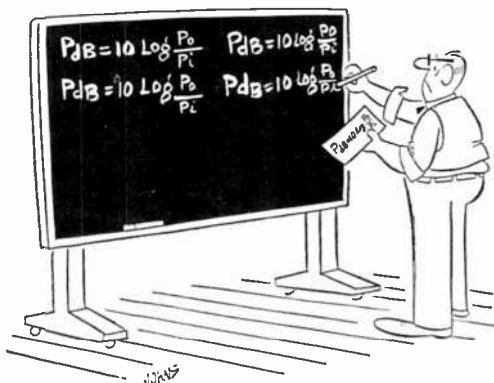
The movements studied in reading are of still another kind, more closely related to saccadic than to nystagmic movements. In fact, the use of the ENG or even EOG in speech pathology is neither widely used nor accepted.

Finally, while some psychologists make wide use of EOG (including ENG) in a variety of ways, few of us are concerned with ESP. In any case, it is not nystagmus but lesser frequency REM which is probably used as an index in dreaming in ESP studies.

ANDRE M. WEITZENHOFER, Ph.D.
Chief Research Clinical Psychologist
Veteran's Administration Hospital
Oklahoma City, Okla.

IN FAVOR OF MORE MATH FOR TECHNICIANS

If the unit of power gain in the sample equation in "Math, Doorway to Higher Pay"



(March, 1969, page 69) is decibels, the constant should be "10 log" instead of "20 log" as shown. However, this small error is overshadowed by the material in the article. Considering the fact that the average "technician" lacks a solid foundation, this was a most welcome article. As for the need for radio-TV repairmen to acquire some knowledge of algebra and trigonometry (and certainly physics), I could not agree more with you—but the State Board of Examiners here in Connecticut does not share my opinion.

WILLIAM B. HOYER, JR.
Danbury, Conn.

We caught that error—just a little too late to prevent it from getting into print. So, as punishment, we're going to write the entire correct equation 100 times. As for your State Board of Examiners, give them a little time; they'll come around as other states enact technician certification laws.

OUT OF TUNE

Build "Op-Tach" (March 1969). The value of R_9 shown in Fig. 1 and specified in Parts List, both on page 28, should be 6800 ohms—not 680 ohms.

"Sound-With-Sound Mixer" (March 1969). Change type number of Q_4 in the "Parts List" (page 60) to read 2N2925; correct type number is shown in Fig. 1.

"Popular Electronics Universal Frequency Counter, Part 2" (April 1969). In Fig. 17, the right-hand side of RESET switch S_4 should be connected to +3.6 instead of +6.

June, 1969

Compact sets

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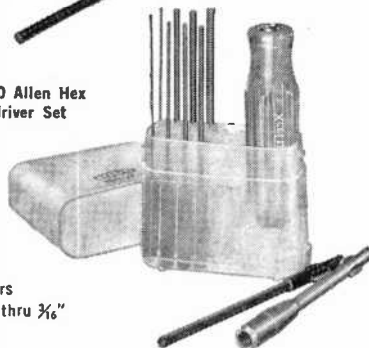
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10 Exciting New Kits



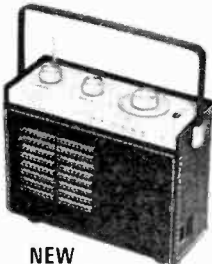
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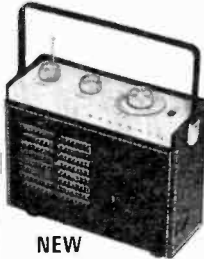
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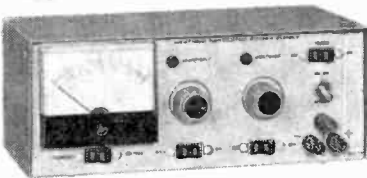
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NEW
Kit GR-98



NEW
Kit GD-69
\$19.95*



NEW
Kit IP-28
\$47.50*

NEW Heathkit Solid-State Auto Tune-Up Meter . . . Measures Dwell, RPM And DC Voltage

The new Heathkit ID-29 is most versatile . . . really three automotive test instruments in one . . . and its low price makes it even a better value. Measures Dwell on all 4-cycle 3, 4, 6, or 8 cylinder engines . . . measures RPM in two ranges 0-1500 and 0-4500 . . . measures DC voltage from 0 to 15 volts. And no batteries are needed . . . running engine provides both signal and power. Easy to use . . . on both 6 and 12 volt system without changing leads. It's lightweight, easy to carry . . . comes equipped with black polypropylene case that has a built-in lead storage compartment and is resistant to virtually everything. Fast, simple assembly . . . takes just one evening. The perfect accessory for the handyman who wants to do his own car tune-up, emergency road service personnel, or shop mechanics . . . order your ID-29 now. 4 lbs.

NEW Heathkit GD-48 Solid-State Metal Locator

A low cost, versatile, professional metal detector at one-third the cost of comparable detectors. Packed with features for long life, rugged reliability, and dozens of uses. Completely portable, battery operated and weighs only 3 lbs. The GD-48 is highly sensitive, probes to 7 feet, and has an adjustable sensitivity control. Its built-in speaker signals presence of metal: front panel meter gives visual indication. Other features include built-in headphone jack, telescoping shaft for height adjustment, weather protected and splash proof, smartly styled and smartly designed for easy in-hand use and easy assembly. Whether you're an amateur weekend hobbyist or a professional treasure hunter the GD-48 is for you . . . also a great help to contractors, surveyors. Gas, Electric, Telephone and other public Utility Companies. 4 lbs.
GD-396, Headphones, 2000 ohm (Superex) \$3.50*

NEW Heathkit Electronic Metronome

The new Heathkit TD-17 is a low cost, precise performing electronic Metronome . . . a handy helper for any music student. Battery operated . . . no springs to wind . . . accurate, steady calibration is always maintained . . . from 40 to 210 beats per minute. Instruction label on bottom gives conversion from time signature and tempo to beats per minute. Stylish fruit wood finished cabinet. Easy solid state circuit board construction . . . assembles and calibrates in only 2-3 hours. The new Heathkit TD-17 Electronic Metronome is so low in cost every music student can afford one . . . order yours now. 1 lb.

NEW Heathkit GR-88 Solid-State Portable VHF-FM Monitor Receiver

Tunes both narrow and wide band signals between 154-174 MHz . . . for police, fire, most any emergency service. Exceptional sensitivity and selectivity, will outperform other portable receivers. Features smart compact styling . . . with durable brown leatherette case, fixed station capability with accessory AC power supply, variable tuning or single channel crystal control, collapsible whip antenna, adjustable squelch control and easy circuit board construction. The new GR-88 receiver is an added safety precaution every family should have . . . order yours today. 5 lbs.

NEW Heathkit GR-98 Solid-State Portable Aircraft Monitor Receiver

Tunes 108 through 136 MHz for monitoring commercial and private aircraft broadcasts, airport control towers, and many other aircraft related signals. Has all the same exceptional, high performance features as the GR-88 above. The perfect receiver for aviation enthusiasts . . . or anyone who wants to hear the whole exciting panorama of America in flight. 5 lbs. GRA-88-1, AC Power Supply \$7.95

NEW Heathkit GD-69 "Thumb Tach" . . . An Accurate, Low Cost Tachometer To Measure RPM's On Any Model Engine

The new Heathkit GD-69 "Thumb Tach" Tachometer is an accessory every R/C modeler should have. An accurate, inexpensive and easy way to make sure your model engine is giving maximum performance (also suitable for measuring RPM's of any rotating shaft). Features all solid-state design and battery operation for long life reliability. Simple to use . . . set the slide switch to the meter scale you want to use, aim the lens at the propeller or flywheel. The meter reads directly in RPM from reflected light for precise, accurate measurements . . . doesn't load engine. Easy 2 or 3 hour assembly. Raise your engine performance standards now . . . with the new Heathkit GD-69. 1 lb.

NEW Heathkit 1-30 VDC Solid-State Regulated Power Supply

The new modestly priced IP-28 is an excellent power supply for anyone working with transistors whether it be in a laboratory or in a home workshop . . . and its low price makes it the ideal power supply for classroom use. Compact brown and beige. Heathkit instrument styling with large easy-to-read meter . . . with two voltage ranges 10 v. and 30 v. . . and two current ranges 100 mA, 1 A. External sensing permits regulation of load voltage rather than terminal voltage. Adjustable current limiting prevents supply overloads and excessive load current. Convenient standby switch. Fast, easy assembly with one circuit board and wiring harness. Order yours today. 9 lbs.

From The Leader



NEW Heathkit Ultra-Deluxe "681" Color TV With AFT ... Power Channel Selection & Built-In Cable-Type Remote Control

The new Heathkit GR-681 is the world's most advanced color TV with more built-in features than any other set on the market. Automatic Fine Tuning on all 83 channels ... eliminates touchy fine tuning forever, power push button VHF channel selection, built-in cable-type remote control ... or you can add the optional GRA-681-6 Wireless Remote Control any time you wish ... plus the built-in self-servicing aids that are standard on all Heathkit color TV's but can't be bought on any other set at any price. Other features include a bridge-type low voltage power supply for superior regulation; high & low AC taps to insure that the picture transmitted exactly fits the "681" screen. Automatic degaussing, 2-speed transistor UHF tuner, hi-fi sound output, two VHF antenna inputs, top quality American brand color tube with 2-year warranty.

GRA-295-4, Mediterranean Cabinet shown ... \$119.50*

Heathkit "295" Color TV

Big, Bold, Beautiful ... with the same high performance features and built-in servicing facilities as the GR-681 above ... but less the Automatic Fine Tuning, push button VHF power tuning and built-in cable-type remote control. You can add the optional GRA-295-6 Wireless Remote Control at any time.

GRA-295-1, Contemporary Walnut Cabinet shown ... \$62.95*

Both the GR-681 and GR-295 fit into the same Heath factory assembled cabinets; not shown, Early American style at \$99.95.*

NEW Deluxe Heathkit "581" Color TV With AFT

The new Heathkit GR-581 will add a new dimension to your TV viewing. Brings you color pictures so beautiful, so natural, so real ... puts professional motion picture quality right into your living room. Has the same high performance features and exclusive self-servicing facilities as the GR-681, except with 227 sq. inch viewing area, and without power VHF tuning or built-in cable-type remote control. The optional GRA-227-6 Wireless Remote Control can be added any time you wish. And like all Heathkit Color TV's you have a choice of different installations ... mount it in a wall, your own custom cabinet, your favorite B&W TV cabinet, or any one of the Heath factory assembled cabinets. **GRA-227-2, Mediterranean Oak Cabinet shown ... \$99.50***

Heathkit "227" Color TV

Same as the GR-581 above, but without Automatic Fine Tuning ... same superlative performance, same remarkable color picture quality, same built-in servicing aids. Like all Heathkit Color TV's you can add optional Wireless Remote Control at any time (GRA-227-6). And the new Table Model TV Cabinet and roll around Cart is an economical way to house your "227" ... just roll it anywhere, its rich appearance will enhance any room decor.

GRS-227-6, New Cart and Cabinet combo shown ... \$49.95*

Both the GR-581 and GR-227 fit into the same Heath factory assembled cabinets; not shown, Contemporary cabinet \$59.95.*

NEW Heathkit Deluxe "481" Color TV With AFT

The new Heathkit GR-481 has all the same high performance features and exclusive self-servicing aids as the new GR-581, but with a smaller tube size ... 180 sq. inches. And like all Heathkit Color TV's it's easy to assemble ... no experience needed. The famous Heathkit Color TV Manual guides you every step of the way with simple to understand instructions, giant fold-out pictorials ... even lets you do your own servicing for savings of over \$200 throughout the life of your set. If you want a deluxe color TV at a budget price the new Heathkit GR-481 is for you.

GRA-180-1, Contemporary Walnut Cabinet shown ... \$49.95*

Heathkit "180" Color TV

Feature for feature the Heathkit "180" is your best buy in color TV viewing ... has all the superlative performance characteristics of the GR-481, but less Automatic Fine Tuning. For extra savings, extra beauty and convenience, add the table model cabinet and mobile cart. Get the value-packed GR-180 today.

GRS-180-5, Table Model Cabinet & Cart combo ... \$39.95*

Both the GR-481 and GR-180 fit the same Heath factory assembled cabinets; GRA-180-2, Early American Cabinet \$75.00.*

Add the Comfort And Convenience Of Full Color Wireless Remote Control To Any Rectangular Tube Heathkit Color TV ... New Or Old!

Kit GRA-681-6, for Heathkit GR-681 Color TV's ... \$59.95*

Kit GRA-295-6, for Heathkit GR-295 & GR-25 TV's ... \$69.95*

Kit GRA-227-6, for Heathkit GR-581; GR-481 & GR-180

Color TV's ... \$69.95*

Now There Are 6 Heathkit® Color TV's To Choose From

2 Models In 295 Sq. Inch Size

NEW
Kit GR-681
With AFT
\$499.95*
(less cabinet)



Kit GR-295
\$449.95*
(less cabinet)

2 Models In 227 Sq. Inch Size

NEW
Kit GR-581
with AFT
\$419.95*
(less cabinet)



Kit GR-227
NOW ONLY
\$379.95*
(less cabinet & cart)

2 Models In 180 Sq. Inch Size

NEW
Kit GR-481
with AFT
\$359.95*
(less cabinet)



Kit GR-180
NOW ONLY
\$329.95*
(less cabinet & cart)



NEW

FREE 1969 CATALOG!

Now with more kits, more color. Fully describes these along with over 300 kits for stereo/hi-fi, color TV, electronic organs, electric guitar & amplifier, amateur radio, marine, educational, CB, home & hobby. Mail coupon or write Heath Company, Benton Harbor, Michigan 49022.

HEATH COMPANY, Dept. 10-6
Benton Harbor, Michigan 49022

Enclosed is \$ _____, plus shipping. *a Schlumberger company*

Please send model(s)

Please send FREE Heathkit Catalog. Please send Credit Application.

Name _____

Address _____

City _____ State _____ Zip _____

*Mail order prices; F.O.B. factory. Prices & specifications subject to change without notice. CL-358

CIRCLE NO. 13 ON READER SERVICE PAGE

TAKE ONE



new literature

To obtain a copy of any of the catalogs or leaflets described below, simply fill in and mail the coupon on page 15 or 95.

For good color TV, UHF TV, and mono/stereo FM reception, a good antenna is a must. In the *Finney Company's* "Finco Color Spectrum Antennas" brochure (Form No. 20-413), you will discover why best reception is obtained when a frequency-dependent antenna is selected. The brochure explains why a frequency-dependent antenna is so superior to frequency-independent antennas, combining text and diagrams to present the whole picture. In addition, the brochure lists Finney's complete line of discrete and integrated Color Spectrum antennas for UHF, VHF, and FM. The listing supplies all the pertinent data needed for antenna selection—including recommended signal area usage, element

breakdown, and basic antenna and antenna system price breakdown.

Circle No. 75 on Reader Service Page 15 or 95

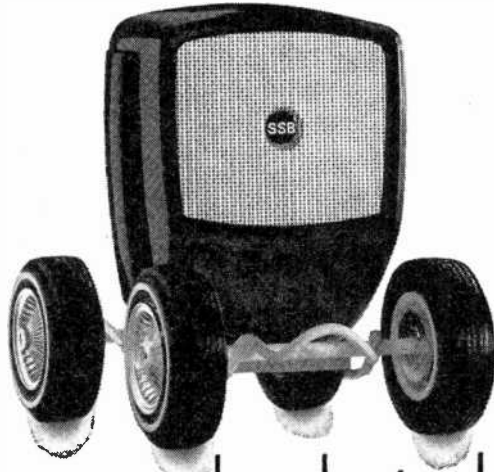
A new 24-page, fully illustrated catalog listing hard-to-find tools with detailed descriptions of each tool and its application has been issued by *Brookstone Company*. Almost all of the tools listed in the catalog are rarely—if at all—available from industrial suppliers and retail stores. Among the many tools listed are pliers and other tools for electronics—including unusual soldering tools and soldering jigs—woodworking tools, jewelers' tools, sensitive drillers, precision tools, flexible-shaft machines, screw and nut starters, etc.

Circle No. 76 on Reader Service Page 15 or 95

Once again, the *Sears, Roebuck and Company* "Home Entertainment Electronics Catalog" (No. 39A 7166) features a really impressive lineup of brand-name hi-fi equipment, color TV receivers, musical instruments, and accessory equipment. Included among the brand names in the catalog are Ampex, Fisher, Harman-Kardon, Electro-Voice, E. F. Johnson, and Sears' own "Silvertone" brand. Items listed include system and component hi-fi, cassette and reel-to-reel tape recorders, hi-fi furniture, color and monochrome TV sets, CB transceivers, reed and electronic organs, and other musical instruments.

Circle No. 77 on Reader Service Page 15 or 95

The 1969 Turner 360.



See it at your dealer's showroom.

The 360. A lightweight sporty compact from Turner. Reduced in size and weight (12 oz.), this custom styled mike is made to order for mobile units. Standard equipment on the 360 almost sounds optional: dash mounting knob and hardware, five foot extended coiled cord, beautiful black cyclac finish. Get in the driver's seat with a 360. It's got the smoothest transmission on wheels. □ The TURNER Co., Inc., A subsidiary of Conrac Corporation, 909 17th Street N.E., Cedar Rapids, Iowa. 52402, (319) 365-0421.

CIRCLE NO. 26 ON READER SERVICE PAGE

POPULAR ELECTRONICS READER SERVICE PAGE

free information service:

Here's an easy and convenient way for you to get additional information about products advertised or mentioned editorially (if it has a "Reader Service Number") in this issue. Just follow the directions below... and the material will be sent to you promptly and free of charge.

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2. Cut out the coupon and mail it to the address indicated below.

3. This address is for our product "Free Information Service" only. Editorial inquiries should be directed to POPULAR ELECTRONICS, One Park Avenue, New York 10016; circulation inquiries to Portland Place, Boulder, Colorado 80302.

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ELECTRONICS library

QUIET

THE AMATEUR RADIO DX HANDBOOK

By Don Miller, W9WNV

It would be unfair to any radio amateur chasing DX to tell him not to buy Don Miller's DX HANDBOOK. It's a good investment. The book is so jam-packed with vital information, miscellanea, and trivia that there is something for almost everyone. The list of contents includes just about every conceivable DX'ing situation and happenstance. However, if you're looking for more dirt about the Miller vs ARRL controversy, you will be wasting time and money—it isn't here. In fact, Miller goes out of his way to thank W1LVQ and W2NSD for "their inspiration and generous contribution of material."

Published by Cowan Publishing Corp., 14 Vanderventer Ave., Port Washington, N.Y. 11050. Soft cover. 200 pages. \$5.00.

ADVANCED TECHNIQUES FOR TROUBLE-SHOOTING WITH THE OSCILLOSCOPE

by Robert L. Goodman

This book describes several reasonably priced triggered sweep oscilloscopes—now considered a must in every TV repair shop. It explains how these scopes work and how they can be used to cut down on trouble-shooting time. Through more than 100 photos, the book further shows how to interpret waveform patterns and how to employ single and dual-trace triggered-sweep scopes in tube-type and solid-state circuits. While emphasis is placed on the triggered sweep scope, most of the troubleshooting procedures described can be performed with a general-purpose scope. Practical applications covered in the book include FM multiplex tests and alignment, stereo troubleshooting procedures, solid-state servicing including pulse and square-wave tests for transistors and IC's, circuit-by-circuit troubleshooting and alignment of TV receivers and more.

Published by Tab Books, Blue Ridge Summit, Pa. 17214. 256 pages. \$7.95 hard, \$4.95 soft cover.

DIGITAL PRINCIPLES AND APPLICATIONS

by Albert Paul Malvino and Donald P. Leach

Coming on the heels of the most up-to-date area of electronics technology—digital techniques—this is a really informative source book for the principles and applications in-



East Coast to West Coast Cobra leads the way in CB Communication

CB has been an integral part of communications for many years. Hobbyists, Government, Business, and Industry have found it to be an invaluable means of exchanging information and ideas.

Today, however, the fast pace of technology has demanded change and originality in all areas of electronics. CB 2-Way Radio Communication has been no exception.

To keep abreast of these changes, DYNASCAN developed the Cobras . . . CB Transceivers that strike out at maximum range and reliability. Advanced-design circuits, higher "Cobrapower" input for max-

imum range, and a full 23-channel operation make the Cobras the finest professional-quality CB units available. They devour competition in performance and dependability!

Drop in to your nearest Cobra distributor today. He'll be glad to show you the complete Cobra line. If you prefer, write to DYNASCAN direct; and we'll send you any and all information you desire.

Cobra Product of DYNASCAN CORPORATION
1801 W. Belle Plaine • Chicago, Illinois 60613
Where electronic innovation is a way of life.



COBRA V.
NET, \$99.95.



COBRA 27.
NET, \$179.95.



COBRA CAM-88.
NET, \$219.95.



COBRA 98.
NET, \$239.95.

CIRCLE NO. 4 ON READER SERVICE PAGE

volved. It covers all the necessary fundamental concepts offered in a first course in digital systems. Furthermore, the material is presented with emphasis on the practical application of fundamental ideas, basic digital circuits, and basic digital systems. The text does not waste time on describing any digital system specifically. Rather, the material presented emphasizes the basics common to any digital system. Modern and widely used IC circuits are shown in examples and explanations, and both wave-forms and truth tables are referred to throughout the text in describing circuit and system operation.

Published by McGraw-Hill Book Co., 330 West 42 St., New York, N.Y. 10036. Hard cover. 433 pages. \$8.95.

FUN WITH TAPE

by Joachim G. Staab

Packed with new ideas and practical advice for getting the most out of your tape recorder, this complete authoritative guide is guaranteed to provide hours of pleasure for audio buffs. It explains what different types of tape recorders can and cannot do, how they are put together, and how to use them most effectively. The book covers such activities as music recording, conducting interviews, building a library of natural and special-effect sounds on tape, and taping the proceedings at parties and other social events. In addition, the book answers almost any question you might have about conventional and special recording techniques and accessory equipment. The text is lively, often witty, and decidedly chatty—making it a pleasure to read—whether you own a tape recorder already or are planning to get one soon.

Published by A.S. Barnes and Co., Inc, Box 421, Cranbury, N.J. 08512. Hard cover. 248 pages. \$5.95.

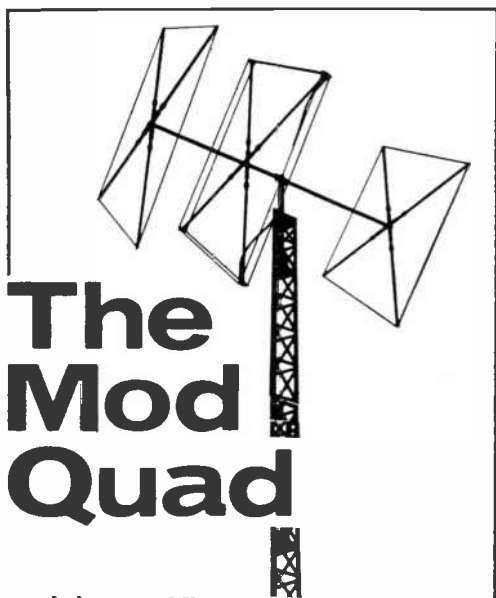
HOW TO SELECT AND INSTALL ANTENNAS

by Lon Cantor

This practical guide covers both the mechanical and electrical sides of antenna selection and installation. It offers reliable and up-to-date information on color and monochrome TV and stereo FM antennas as well as complete home master antenna systems. Covering 82-channel installations (UHF/VHF/FM), it concentrates on what is actually practiced in the field today. The book includes enough theory to enable the reader to solve virtually any reception problem he is likely to encounter. The book opens with a discussion of the latest advances in antenna technology, moves through step-by-step instructions for installation of individual antennas and complete systems, and gives tips on how to select the right materials. Special consideration of local, fringe, and near-fringe reception problems are included.

Published by Hayden Book Co., Inc., 116 West 14 St., New York, N.Y. 10011. Soft cover. 112 pages. \$3.95.

June, 1969



The Mod Quad

Model MCQ-27VH

Get the edge on crowded CB channels by switching polarization with the Mod Quad from Mosley. When the channels are too noisy in the vertical plane of polarization, flip the switch to horizontal: you can chop off interfering signals as much as 23 db. Then talk and make yourself heard. You can contact base stations in the horizontal plane as well as mobile units in the vertical.

You expect a lot from a quad and the Mod Quad's got it. With a 14 ft. boom supporting three diamond-shaped elements including a double radiator, it's a lot of antenna for the money. See for yourself that Model MCQ-27VH is all you want in a base station antenna. Ask for it at your nearest Mosley dealer. Write factory direct for brochure, including detailed specifications and performance data.

Mosley Electronics Inc. 4610 N. Lindbergh Blvd.,
Bridgeton Missouri 63042

Please send me FREE detailed information on
the Mosley MOD QUAD Dept. 186

Name _____

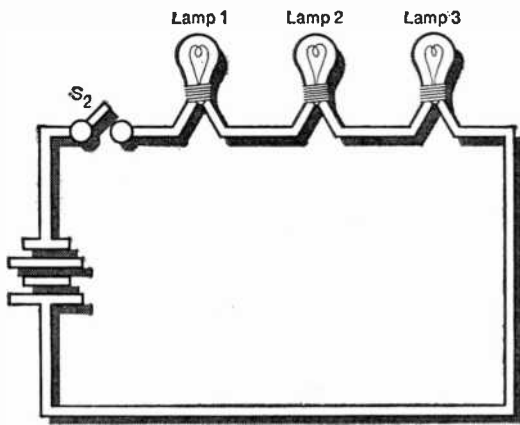
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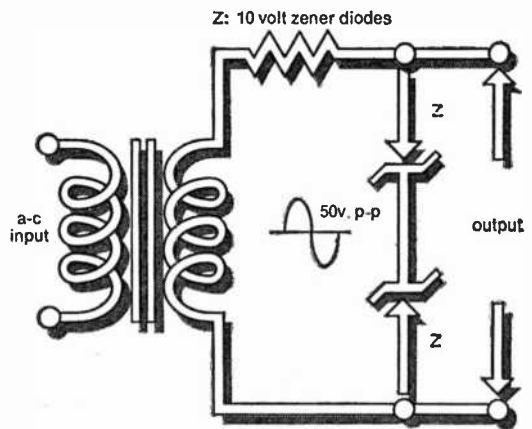
Can you solve these two basic problems in electronics?



This one is relatively simple:

When Switch S_2 is closed, which lamp bulbs light up?

Note: If you had completed only the first lesson of any of the RCA Institutes Home Study programs, you could have solved this problem.



This one's a little more difficult:

What is the output voltage (p-p)?

Note: If you had completed the first lesson in the new courses in Solid State Electronics, you could have easily solved this problem.

These new courses include the latest findings and techniques in this field. *Information you must have if you are to service today's expanding multitude of solid state instruments and devices used in Television, Digital, and Communications Equipment.*

If you had completed an entire RCA Institutes Home Study Course in Semiconductor Electronics, Digital Electronics, or Solid State Electronics, you should now be qualified for a good paying position in the field you choose. Send for complete information. Take that first essential step now by mailing the attached card.

ANSWERS: Problem 1—they all light up
Problem 2—20 Volts (p-p)

RCA Institutes Autotext learning method makes problem-solving easier... gets you started faster towards a good-paying career in electronics

Are you just a beginner with an interest in electronics? Or, are you already making a living in electronics, and want to brush-up or expand your knowledge? In either case, RCA has the training you need. And Autotext, RCA Institutes' own method of Home Training will help you learn more quickly and with less effort.

Wide Range of Courses

Select from a wide range of courses. Pick the one that suits you best and check it off on the attached card. Courses are available for beginners and advanced technicians.

- Electronics Fundamentals
- Black & White Television Servicing (Transistorized TV Kit Available)
- Color Television Servicing (Color TV Kit Available)
- FCC License Preparation
- Automatic Controls
- Automation Electronics
- Industrial Electronics
- Nuclear Instrumentation
- Electronics Drafting
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Plus these new up-to-the-minute courses

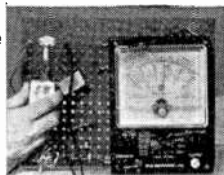
- Semiconductor Electronics
- Digital Electronics
- Solid State Electronics
- Communications Electronics

Prepare for good paying positions in fields like these

- Television Servicing
- Telecommunications
- Mobile Communications
- CATV
- Broadcasting
- Marine Communications
- Nuclear Instrumentation
- Industrial Electronics
- Automation
- Computer Programming
- Solid State
- Electronics Drafting



Build and keep this valuable oscilloscope.



In the new program on Solid State Electronics you will study the effects of temperature and leakage characteristics of transistors.



Valuable Equipment—Yours To Keep

A variety of RCA Institutes engineered kits are included in your program of study. Each kit is yours to keep when you've completed the course. Among the kits you construct and keep is a working signal generator, a multimeter, a fully transistorized breadboard superheterodyne AM receiver, and the all-important oscilloscope. These kits are at no extra cost. Compare this selection with other home study schools.

Convenient Payment Plans

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RCA Institutes operates one of the largest technical schools of its kind. Day and evening classes. No previous training is required. Preparatory courses are available. Classes start four times a year.

Job Placement Service, Too!

Companies like Bell Telephone Labs, GE, Honeywell, IBM, RCA, Westinghouse, Xerox, and major radio and TV networks have regularly employed graduates through RCA Institutes' own placement service.

All RCA Institutes courses and programs are approved for veterans under the new G.I. Bill.

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Please send me FREE illustrated career catalog.

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Address _____

City _____ State _____ Zip _____



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 or 95.

23-CHANNEL CB "WALKIE-TALKIE"

A hand-held, 23-channel CB transceiver, designated the "Clipper 23," has recently been introduced by *Courier Communications, Inc.* The trim Clipper "walkie-talkie" is capable of transmitting and receiving on all 23 CB channels (all crystals included), breaking through the old barrier of only six-channel operation for hand-held transceivers. A full five-watt power input assures an effective inland range of 10 miles, depending on the terrain; substantially more over water. For maximum signal fidelity, the Clipper 23 is equipped with a variable squelch, built-in range expander, and automatic noise limiter. A full complement of jacks for public address systems, external earphone/speaker, antenna, microphone, and power connections is provided. Technical Specifications: full 5-watt at 100% modulation power input; 0.25- μ V receiver sensitivity.



Circle No. 78 on Reader Service Page 15 or 95

AUDIO CONNECTOR/ADAPTER KIT

Switchcraft's No. K130 Music Adapter Kit makes it possible for the musician and professional audio man to interconnect a wide variety of guitars, electronic organs, microphones, amplifiers, etc. The kit contains 17 different pieces, including the most popular and some not-so-popular connectors and adapters. Unique in the kit are adapters for universal three-pin microphone connectors and for converting the three-pin connector for use with the standard two-conductor phone plug. Other pieces include Y adapters and Q-G connectors. Adapters and connectors are designed to help solve any number of tricky mating problems. For example, there are adapters that fill the requirements for male-to-male and female-to-female connections. Each assortment of parts is pack-



aged in a reusable, compartmentalized plastic box.

Circle No. 79 on Reader Service Page 15 or 95

MASTER CONTROL AMPLIFIER

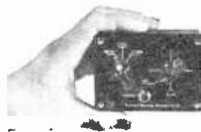
Debuting in the less-than-\$150 consumer price category, *Fisher Radio Corporation's* Model TX-50 Master Control Amplifier has features normally associated with much more expensive equipment. Included are a full complement of controls and switches, all-silicon complementary-symmetry power amplifier for the widest possible power bandwidth and lowest distortion, and Fisher's exclusive "Transisto-O-Gard" overload protection circuit. Technical Specifications: 65 watts \pm 1 dB at 8 ohms IHF music power (20 watts/channel r.m.s. power), both referenced at 1000 Hz; 0.5% harmonic distortion; 1% IM distortion; 25-25,000 Hz power bandwidth; 2.5, 7.5, and 250 mV input sensitivities; better than 55 dB hum and noise below rated output; 30-15,000 Hz \pm 2 dB phono low, 20-20,000 Hz \pm 2 dB auxiliary frequency response; greater than 10 at 8 ohms damping factor; 40-mV recorder output; better than 45-dB separation.



Circle No. 80 on Reader Service Page 15 or 95

MINI-SIZE AUDIO GENERATOR

Said to be the industry's first pocket-size audio generator, the Model 4110 "MINIGEN" being marketed by *Century General Corp.* makes available three stable audio signals for maximum versatility. The tone frequencies include 400 Hz, 1000 Hz, and 10,000 Hz, but a slight internal modification of the MINIGEN allows conversion of the 10,000-Hz tone to one of only 5000 Hz. The output of the tiny generator is continuously variable up to 2.5 volts. Supplied complete with probe and 9-volt transistor battery, the MINIGEN weighs only 7 1/2 ounces and measures 4" x 2 3/4" x 1 1/8".



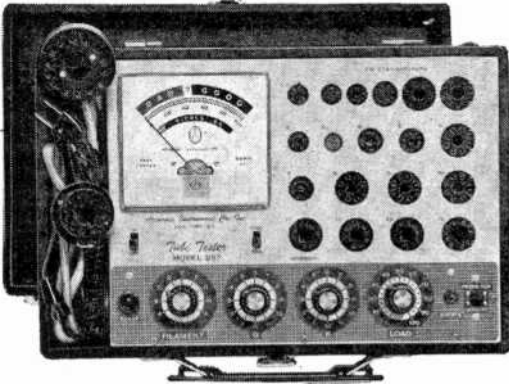
Circle No. 81 on Reader Service Page 15 or 95

AM/FM RADIO/CASSETTE RECORDER SYSTEM

A quality portable AM/FM radio is mated with a precision cassette recorder to make up *Lafayette Radio Electronics' Model RK-150* radio/recorder system. The system records "live" through a microphone, direct from phono, from other tape recorders for tape duplication, or direct from its built-in AM/FM radio. Playback and record time is up to two hours on a single tape cassette cartridge. Technical Specifications: switch-



The New 1969 Improved Model 257 **A REVOLUTIONARY NEW TUBE TESTING OUTFIT**



COMPLETE WITH ALL ADAPTERS AND ACCESSORIES, NO "EXTRAS"

STANDARD TUBES:

- ✓ Tests the new Novars, Nuvisitors, 10 Pins, Magnovals, Compactrons and Decals.
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- ✓ Tests each section of multi-section tubes individually for shorts, leakage and Cathode emission.
- ✓ Ultra sensitive circuit will indicate leakage up to 5 Megohms.
- ✓ Employs new improved 4 1/2" dual scale meter with a unique sealed damping chamber to assure accurate, vibration-less readings.
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BLACK AND WHITE PICTURE TUBES:

- ✓ Single cable used for testing all Black and White Picture Tubes with deflection angles 50 to 114 degrees.
- ✓ The Model 257 tests all Black and White Picture Tubes for emission, inter-element shorts and leakage.

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CIRCLE NO. 1 ON READER SERVICE PAGE

PRODUCTS (Continued from page 22)

able on/off a.f.c. for FM; dual-function battery condition/record level meter; a.c. bias and erase system; AM/FM slide-rule tuning dial; tone control; push-button controls for cassette functions; safety interlock to prevent accidental erase; built-in telescoping FM and ferrite core AM antennas; external earphone/speaker jack; tape monitor switch; auxiliary input jack.

Circle No. 82 on Reader Service Page 15 or 95

COMBINATION STEREO FM/PHONO COMPACTS

Eleven different models of compact stereo systems—one for every budget range—have been introduced by *H.H. Scott, Inc.* The basic system (Model 2505-16) consists of a three-speed automatic turntable, FM stereo tuner, basic audio amplifier with controls, and a matched speaker system. Other features include a magnetic cartridge with diamond stylus; FET FM front end and tone control circuits; IC i.f. strip and preamplifier; direct-coupled all-silicon output circuit; and com-



plete component control complement. Additional capabilities are available through a wide variety of speaker systems and a choice of an optional AM tuner and top-quality turntable. The top-of-the-line Model 2513-15 AM/FM stereo system in the Scott line-up incorporates all of the extras—including a Dual Model 1009F turntable and Scott's own Model S-15 three-way speaker systems.

Circle No. 83 on Reader Service Page 15 or 95

ALL-CHANNEL TV/FM ANTENNAS

A new series of antennas designed to provide improved color and monochrome reception on all VHF and UHF TV channels and strong, clear reception on the FM broadcast band are now being made by *Jerrold Electronics Corp.* Designated the "VUfinder Plus" line, the new antennas feature improved design for better pictures on the most significant UHF and VHF bands. Clean, streamlined design, coupled with rugged construction, provides the VUfinder Plus antennas with a built-in ability to withstand gale-force winds

under extreme icing conditions. The five antenna models in the series, available for direct 300-ohm installation (instantly convertible to 75-ohm operation by means of snap-on transformers), are for areas classified from "local" to "deep fringe."

Circle No. 84 on Reader Service Page 15 or 95

LOW-COST CARDIOID MICROPHONE

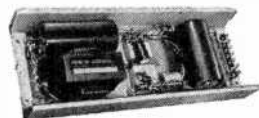
A miniature dynamic cardioid microphone, the Model 2850, designed for public address, paging, and recording applications, has been released by the *Turner Company*. The microphone can be hand held, stand mounted, or used as a lavalier (with cord and clip supplied with the microphone). The 2850's highly directional cardioid pick-up pattern effectively cancels sound arriving from the rear and provides smooth, peak-free response to sounds arriving from the front. Technical Specifications: 70-12,000 Hz frequency range; -60 dB at high impedance, -62 dB at 150-ohm impedance output level. The Model 2850 microphone includes an on/off shorting switch, lavalier assembly, and a 12'-long cable.



Circle No. 85 on Reader Service Page 15 or 95

IC AUDIO POWER AMPLIFIER

Currently being marketed by *Round Hill Associates, Inc.*, is the company's Model AA-800 12-watt integrated circuit audio power amplifier. The entire Model AA-800 is built around thick-film solid-state devices. The amplifier has its own built-in power supply suitable for line operation. Technical Specifications: 12-watt steady-state power output for 300-mV input; 20-20,000 Hz ± 1 dB at 12 watts frequency response; less than 1% for 1000 Hz at 12 watts harmonic distortion; 18,000 ohms nominal input, 4-16 ohms output (transformerless) impedances; 60-watt, 117-volt a.c. input.



Circle No. 86 on Reader Service Page 15 or 95

IMPROVED MOBILE CB ANTENNA

Greatly improved energy transfer is now available with the new *Hy-Gain Electronics Corp.* Model DX-CAT mobile CB antenna with the radiation characteristics of a 102" whip. The improved power transfer to the antenna is due mainly to a perfect 52-ohm match to the feed line, and any length of coaxial cable will work with no special matching devices needed. The DX-CAT utilizes a lightweight precision-wound high-Q coil encased in an epoxy-fiberglass sleeve. The coil is fitted with an adjustable tip rod for precise tuning. A fold-over, turn-over mast mounts on deck or bumper.

Circle No. 87 on Reader Service Page 15 or 95

NOW YOU CAN EASILY ADD SOUND TO YOUR SLIDE OR FILM SHOWS

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"SOUND FOR A PICTURE EVENING" RECORD ALBUMS

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"Sound For a Picture Evening," Vols. I & II, consist of selections from the music masters of the Capitol Records Hollywood Library. High Fidelity 12-inch vinyl albums—33½ RPM.

Expressly Created For Film and Slide Shows. No matter how good your film and slide shows are, sound will make them better . . . more entertaining and certainly more professional. But, it has to be the right kind of sound. Although any musical record can be used as a background for your film and slide shows, few, if any, can match the variety of actions, situations, and scenes inherent in most shows. That's why Popular Photography created these albums. They're ideal for almost every mood captured by your camera. Whether your show is simple, elaborate or somewhere in-between—"SOUND FOR A PICTURE EVENING" provides a final, professional touch to make it a complete success.



Selections of sparkling, mood-setting off-beat music and hard-to-find, sound effects. For use "as is" by playing the appropriate tracks as your slide or movie show proceeds or for editing your selections and recording them on tape. "Sound For a Picture Evening" adds another dimension to your photography—high fidelity sound.

A POPULAR PHOTOGRAPHY EXCLUSIVE

The "Sound For a Picture Evening" albums have been produced by the editors of Popular Photography exclusively for our readers and are prepared by the Custom Services Division of Capitol Records. They cannot be purchased in any store and are available by mail only to the readers of Popular Photography and other Ziff-Davis magazines.

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17 SPECIFIC MOOD MUSIC BACKGROUNDS • 8 TRACKS FOR SPECIAL SOUND EFFECTS—3 FILM OPENINGS: Grandiose • Sweet and Gentle and Dramatic • 3 FILM CLOSINGS: Epic Finale, Hollywood Style and Gentle • 11 THEMES: Happy-Go-Lucky • Gay Party • Vacation Tempo • Traveling • Happy Birthday Party • Pomp of a Parade • Sound of a Carousel • Circus Time • Sentimental Moments • Children's Playtime • Christmas Time • SOUND EFFECTS: Ocean Waves • Train • Jet Planes • Baby Crying • Crowd In Stadium • Traffic • Dog Barking • Thunder And Rain.

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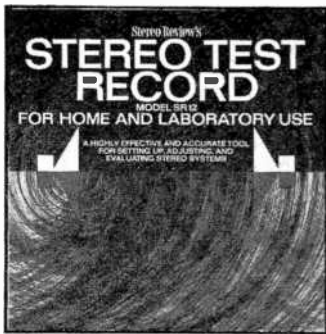
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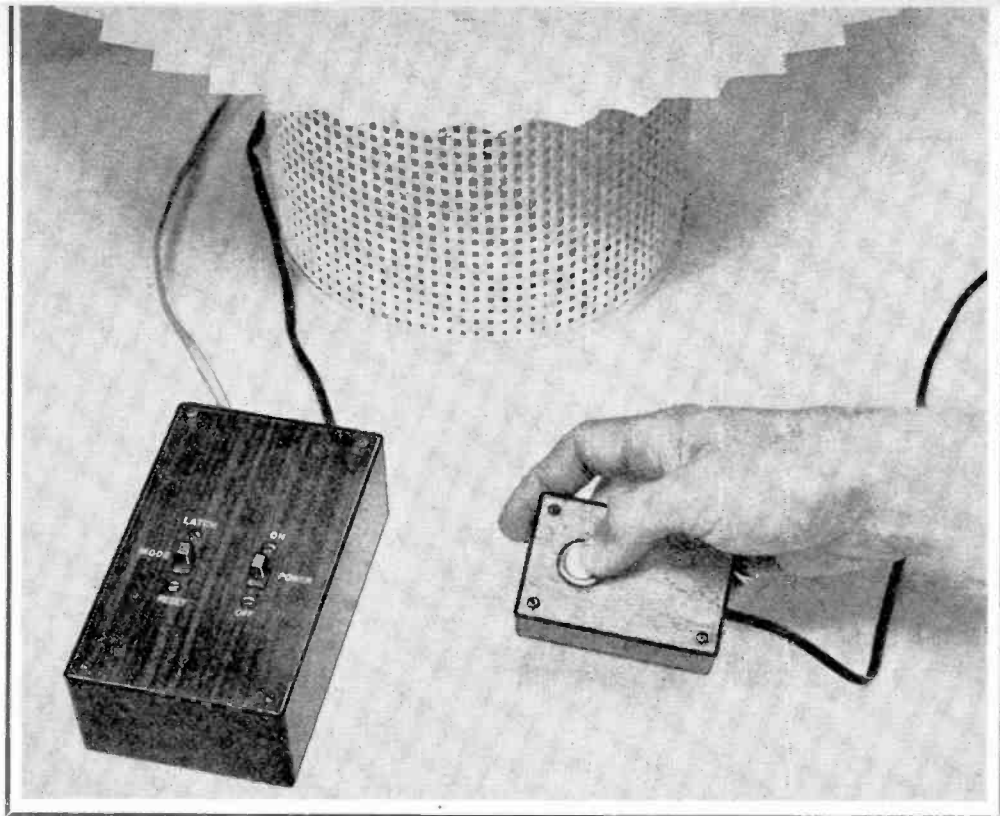
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BUILD **WWRC**

SUPER-SENSITIVE "WIRED WIRELESS REMOTE CONTROL"
IS ALL SOLID STATE

BY JOHN S. SIMONTON, JR.

HOW DO YOU install a burglar alarm when the area to be protected (garage, storage building, etc.) is at some distance from where the alarm is to be located? The obvious answer is to install wiring between the two points. That's fine, as long as you can do it. Sometimes, however, it is a physical impossibility or is not permitted by regulations or laws.

The Wired Wireless is a communications system which takes advantage of the fact that in the majority of cases, good, concealed wiring does in fact exist between any two points in a building complex. These are the commercial power lines used to carry electricity. Although these lines are designed for 60-Hz power, it is possible to pass somewhat higher

frequencies through them for a reasonable distance. (Note that the Wired Wireless cannot be used between two points if there is a transformer anywhere in the power line between them.)

There are two sections to the Wired Wireless. One is a small, self-powered transmitter which is coupled to the power line. When it is turned on by a triggering signal, it generates another signal which activates a remote receiver also coupled to the same power line. The second section is the receiver. When it gets the signal from the transmitter, an internal relay is energized. The action of the relay can be used to set off an alarm or any other type of signal device.

The Wired Wireless can also be used

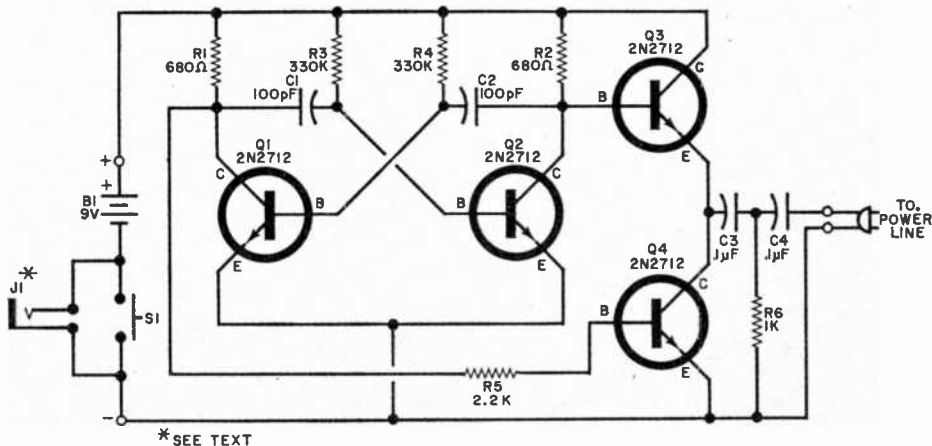


Fig. 1. Power is applied only when S1 (or J1) is closed. The multivibrator then generates a high-frequency audio signal which is passed down the power line to the receiver.

PARTS LIST

- B1—9-volt battery
- C1,C2—100-pF disc capacitor
- C3,C4—0.1-μF disc capacitor
- J1—Open-circuit miniature jack (optional)
- Q1-Q4—2N2712 transistor
- R1,R2—680-ohm, ¼-watt resistor
- R3,R4—330,000-ohm, ¼-watt resistor
- R5—2200-ohm, ¼-watt resistor
- R6—1000-ohm, ¼-watt resistor
- S1—Normally open pushbutton switch

Misc.—Plastic case approximately 3" x 2" x 1", case cover, battery clip and leads, line cord with plug, wood-grain contact paper (optional), mounting plastic, cement, etc.

Note—An etched and drilled PC board for \$5¢ or a complete kit of parts including circuit board and case and either jack input (WW-210) or pushbutton input (WWT-2S) for \$5.95 is available from PAIA Electronics, P.O. Box 14359, Oklahoma City, Okla. 73114. Postpaid in continental U.S. Oklahoma residents add 3% sales tax.

for non-alarm purposes to turn on appliances or lights from remote locations or as a signalling device such as those used by a sick person confined to bed.

Transmitter Construction. The circuit for the transmitter is shown in Fig. 1. The components are small in size and number and are best assembled on a printed circuit board. A foil pattern for such a board is shown in Fig. 2. Note

that, because of their small size, ¼-watt resistors are used rather than the more common ½-watt units, though the latter may be used if desired. Component mounting is shown in Fig. 3. Because of the small size of the assembly, be careful not to damage the components with heat when soldering.

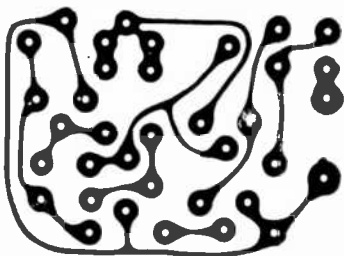


Fig. 2. Actual-size printed circuit foil pattern used for the receiver.

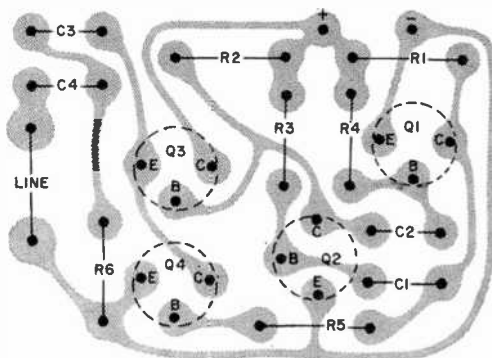
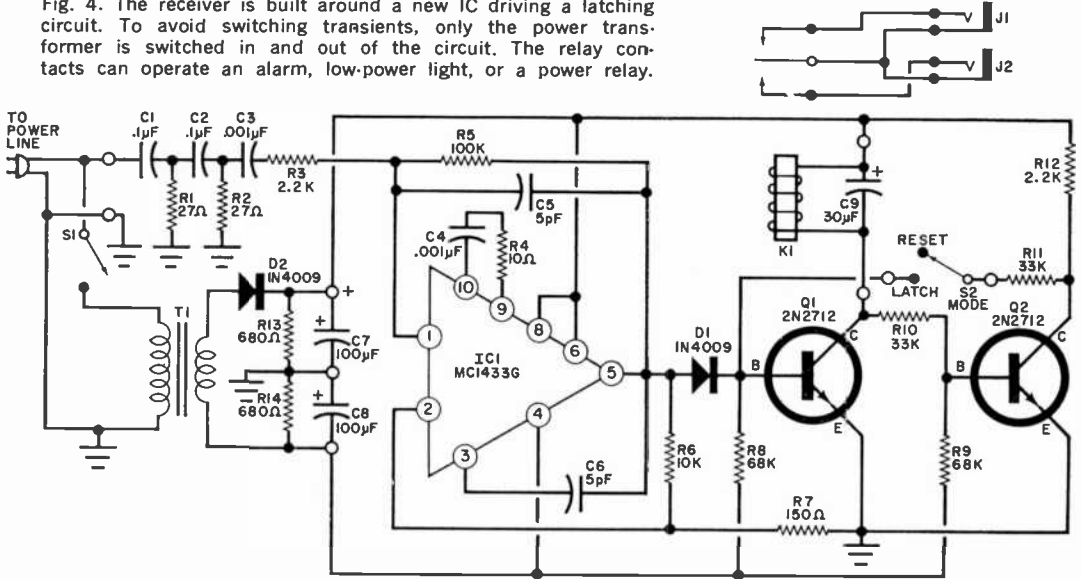


Fig. 3. Install components as shown here. The use of miniature parts helps make for a small package.

Fig. 4. The receiver is built around a new IC driving a latching circuit. To avoid switching transients, only the power transformer is switched in and out of the circuit. The relay contacts can operate an alarm, low-power light, or a power relay.



In the author's prototype, the PC board was glued to a thin piece of plastic foam material which, in turn, was glued into a small plastic case. Use either a silicon rubber cement or epoxy rather than a plastic cement as the latter may damage the plastic foam. Make sure that you leave enough room for the battery and its connector and for pushbutton switch *S1*. Carefully drill a small hole in one end of the case to pass the line cord through. Mount the pushbutton switch in the cover and, if you desire, use a wood-grain contact paper to trim the cover. For some applications an optional open-circuit jack can be installed across *S1*.

To test the transmitter, connect an os-

HOW IT WORKS TRANSMITTER

There are actually three sections in the transmitter. The first is an astable multivibrator, consisting of *Q1* and *Q2*, which generates a signal of approximately 500 kHz. The second section (*Q3* and *Q4*) is a buffer stage that matches the output of the multivibrator to the low impedance of the power-line output. Section three is a high-pass filter composed of *C3*, *R6* and *C4*, which prevents the output transistors from being affected by the 60-Hz power-line frequency but allows the high-frequency signal from the multivibrator to pass.

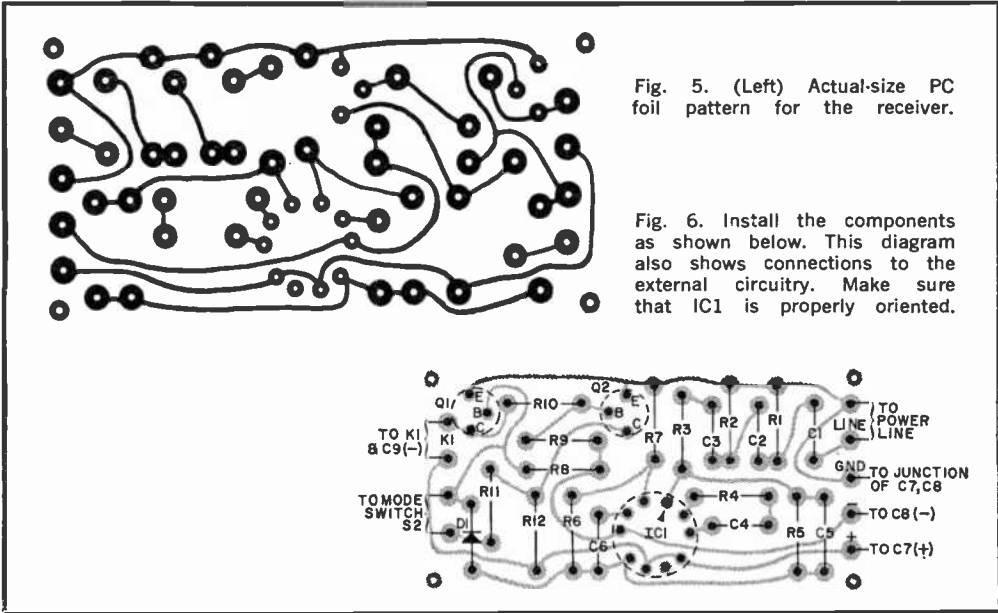
The transmitter is powered by an internal battery controlled by normally open pushbutton *S1*. When the pushbutton is depressed, a burst of 500 kHz is passed into the power line; when the pushbutton is released, the output ceases.

PARTS LIST

- C1, C2*—0.1- μ F disc capacitor
 - C3, C4*—0.001- μ F disc capacitor
 - C5, C6*—5-pF disc capacitor
 - C7, C8*—100- μ F, 10-volt electrolytic capacitor
 - C9*—30- μ F 25-volt electrolytic capacitor
 - D1, D2*—1N4009 diode
 - IC1*—Operational amplifier (Motorola MC-1433G)
 - J1, J2*—Miniature open-circuit phone jacks
 - K1*—Relay, 1750-ohm coil (Sigma 65F1A-12DC or similar)
 - Q1, Q2*—2N2712 transistor
 - R1, R2*—27-ohm
 - R3, R12*—2200-ohm
 - R4*—10-ohm
 - R5*—100,000-ohm
 - R6*—10,000-ohm
 - R7*—150-ohm
 - R8, R9*—68,000-ohm
 - R10, R11*—33,000-ohm
 - R13, R14*—680-ohm
- All resistors
1/4-watt
- S1, S2*—S.p.s.t. switch
 - T1*—Filament transformer, secondary 12.6 volts, 300 mA.
- Misc.—Plastic case approximately 6" x 3 1/2" x 2" with cover, line cord, wood-grain contact paper (optional), terminal strips, mounting hardware, etc.
- Note—An etched and drilled PC board for \$1.75 or a complete kit of parts for \$15.95 is available from PAIA Electronics, P.O. Box 14359, Oklahoma City, Okla. 73114. Postpaid in continental U.S. Oklahoma residents add 3% tax.

cilloscope to the prongs of the power-line cord (either side ground) and depress the pushbutton, *S1*. A burst of high-frequency square waves will be seen as long as the switch is depressed.

Receiver Construction. Construction of the receiver is straightforward (see Fig.



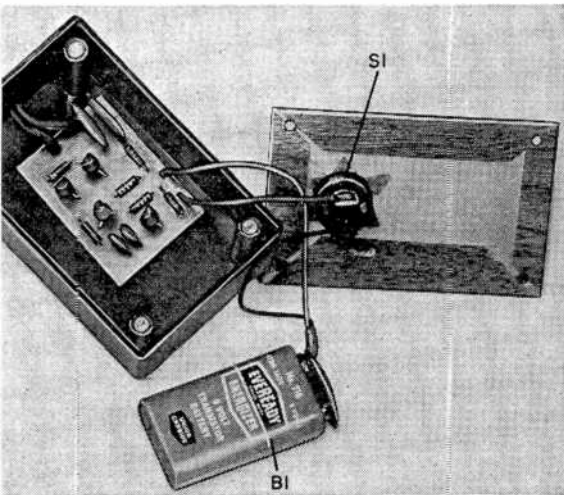
4). However, the use of a printed circuit board is highly recommended since the circuit uses an IC—also because the circuit has a tendency to oscillate if proper component layout is not followed. A foil pattern for the board is shown in Fig. 5 and component mounting in Fig. 6. Be sure the IC is properly oriented before installing it.

Physical placement of the PC board in the case, with relation to the other circuit components, is not critical. In the au-

thor's prototype, shown in the photo, the relay, with C9 attached, is at one end and the power supply components are at the other end with the PC board in the middle. Both the POWER switch, S1, and the MODE switch, S2, are mounted on the cover with 6" to 8" leads connected to them.

Drill a small hole at one end of the case for the power-line cord. Also mount J1 and J2 on the end. These two jacks are used to connect external circuits and devices to the relay contacts.

The receiver fits very nicely in the



By using this method of packaging, the transmitter, battery B1, and switch S1 can fit in a small box.

HOW IT WORKS RECEIVER

The heart of the receiver is an operational amplifier in an integrated circuit, IC1. Because of the high-pass filter between the amplifier input and the power-line connection (C1, R1, C2, R2, C3, and R3) and the negative feedback around the amplifier (C5 and R5), the IC amplifies over a very narrow frequency range, which is chosen to match that of the transmitter.

The circuit gain is increased by positive feedback from R6 and R7. Capacitor C6 and the combination of C4 and R4 are used for frequency compensation and to prevent undesirable circuit oscillation.

After it is amplified by IC1, the signal is detected by Q1, which also acts as a relay driver. When S2 is in the LATCH position, the output of Q1 drives Q2, forming a bistable flip-flop. When a signal is received, the flip-flop changes state to keep the relay energized even if the input signal is removed. Diode D1 isolates the relay driver circuit from the IC circuit.

specified plastic case. As with the transmitter, you can cover the top of the receiver with wood-grain contact paper.

The power transformer is fastened down to the case and the remainder of the power supply components are wired point-to-point on a pair of terminal strips suitably located near the transformer. When wiring to the terminal strips, make sure that you do not use the lugs connected to the mounting strap (the ground lug) as this might make the mounting screw on the underside of the case "hot" to ground and cause a shock.

To prevent voltage surges across the amplifier input each time line power is applied, *S1* is arranged so that it turns on the power supply without changing the amplifier input circuit.

To check the receiver operation, connect it and the transmitter to the same a.c. power circuit. Turn the receiver on, place the MODE switch on LATCH, and depress the transmitter pushbutton. The receiver relay should pick up. Turn the MODE switch to RESET. The relay should drop out when the transmitter pushbutton is released. Once the relay is picked up and the MODE switch is on LATCH, the relay should not drop out when the pushbutton is released.

Applications. The list of uses for the Wired Wireless is practically endless. Signalling systems represent probably the simplest application. In most systems of this type, you will want to use the normally open contacts of the receiver

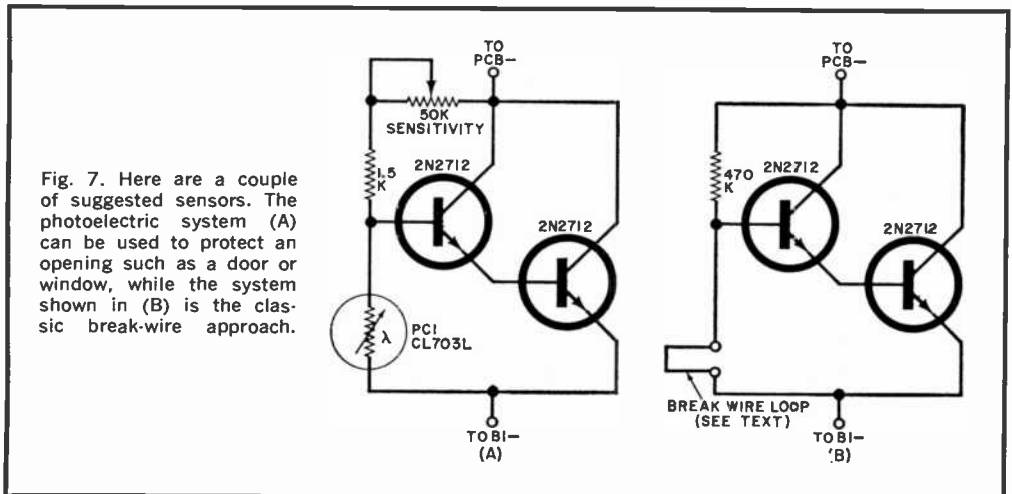
relay to activate a bell, buzzer or electronic alarm such as a Mallory "Son-alert." Power for an alarm with a current drain of 20 mA or less may be tapped from the receiver's internal 18-volt power supply but for devices requiring more current you will need an external power source.

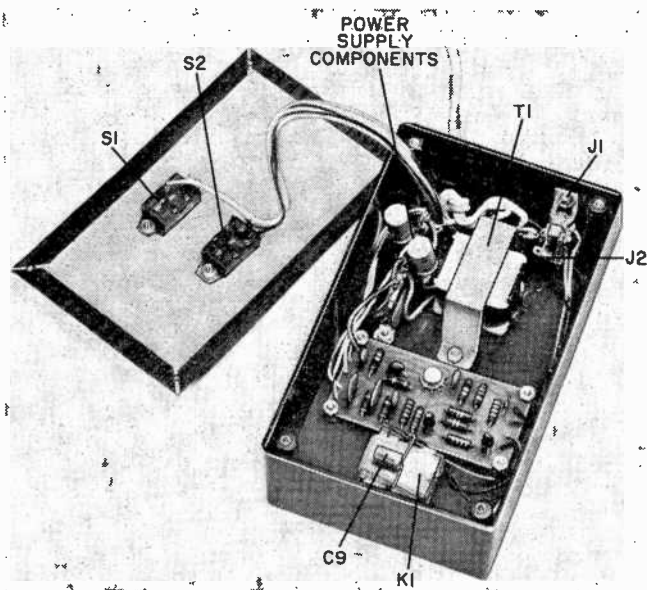
The receiver can be used in the latch mode if the external circuit is to operate continuously once a signal is received. If the receiver is to operate only when the transmitter is activated, use the reset mode. If you are sure that only the reset mode is desired, you can eliminate *S2*, *R9*, *R10*, *R11*, *R12*, and *Q2* from the receiver circuit. With this modification, the latch mode is entirely eliminated.

The Wired Wireless also makes an ideal general-purpose remote control unit for house or farm. A coffee pot in the kitchen or lights and machinery in an outbuilding may be controlled by a suitable power relay energized through the receiver's relay contacts. If you want a push-on/push-off type of operation, the receiver may be used in the reset mode with *K1*'s contacts activating an impulse relay. For sequencing operations, a stepping relay can be controlled.

Because of the low cost of the transmitter and the elimination of connecting wires, the Wired Wireless is perfect for burglar or fire alarm applications when it is desired to have a number of sensors in different locations.

Sensors. A wide variety of sensors—





The receiver is larger than the transmitter and contains a power supply. The relay outputs are terminated by J1 and J2 at rear.

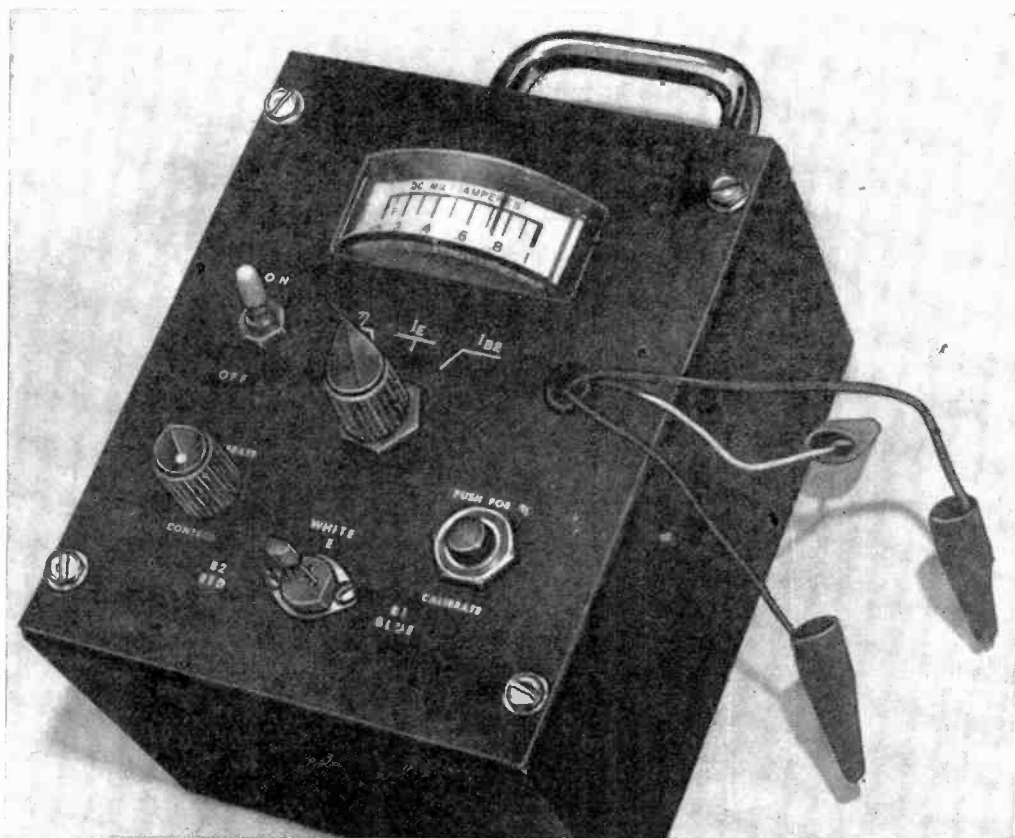
other than the simple pushbutton—may be used to trigger the transmitter. For instance, for a burglar alarm, a normally closed pressure-sensitive switch can be placed so that its contacts are held open by the pressure of a door or window. Then, when the door is opened, the switch closes and turns on the transmitter. You will want to use an input jack on the transmitter (in parallel with S1) so that the switch can be plugged in. Since the door may be closed again after entry, the latch mode of operation is the logical choice for the receiver. Additional switches may be wired in parallel to guard more than one door or window and additional transmitters may be placed in other rooms or buildings.

If you want to guard an entry that has no door, you can use a photoelectric sensor such as that shown in Fig. 7A. Place a light source so that it shines on the photocell and so that the beam is broken by an intruder. Enclose the photocell in a 5-dram pill bottle which has been painted flat black on the inside to protect it from ambient light.

To adjust this type of system, block the light from the photocell and place the sensitivity control at its high-resistance end. Then slowly decrease the resistance until the alarm sounds. To increase bat-

tery life, use the brightest light source practical and the highest setting of the sensitivity potentiometer that will give proper operation. Red filters may be used with the light source if desired. Since the photosensor will cause the transmitter to send a signal only while the light beam is actually interrupted, the latch mode of receiver operation should be used.

It is difficult to set up a light beam to cover a large area such as a field or an oddly shaped room. For this purpose, a break-wire type of sensor can often be used to advantage. A simple sensor of this type which may be built into the transmitter or plugged into it through an optional jack is shown in Fig. 7B. The breakable loop may be a piece of thin wire (#30 or smaller) suspended a few inches above the ground or it can consist of conducting foil on a window pane. Large pieces of electronic or similar equipment may be protected using this scheme if the wire loop is replaced by a shorting bar on the bottom of the equipment. The bar completes a circuit between two contacts on the workbench. As soon as the equipment is moved, the circuit is broken and the alarm is activated. Any number of loops may be used but make sure that they are all in series with one another.



Build the UJT TESTER

MAKES IT EASY TO CHECK OUT UNIUNCTION TRANSISTORS

BY J. W. CUCCIA

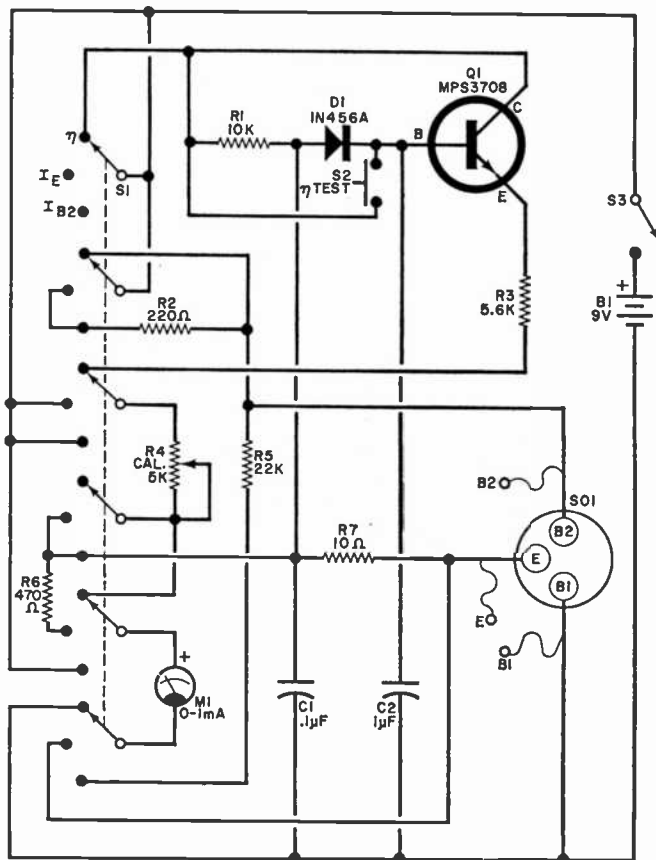
A CONVENTIONAL transistor tester cannot be used to check a unijunction transistor (UJT). However, these important semiconductors are becoming increasingly popular and you are probably using—or planning to use—one in an upcoming project or experiment. If so, you'll want to have one of these UJT Testers to help you in your work.

A unijunction transistor is basically a small length of silicon with electrical connections (called base-1 and base-2) at each end. The resistance between the connections is usually 5000 ohms or more. In normal operation, base-1 is grounded and a positive potential (V_{bb}) is applied

to base-2. At a certain point between the two bases, a diode junction is diffused into the silicon. This junction is called the emitter. A fraction of V_{bb} appears at the emitter—the exact amount being determined by the voltage-divider network formed by the resistance of the silicon. The resistance ratio is designated η (*eta*, or intrinsic standoff ratio).

Now consider what happens when a voltage V_E is applied to the emitter. If V_E is less than ηV_{bb} , the emitter is reverse biased and only a small leakage current flows. If V_E is greater than ηV_{bb} , the emitter is forward biased and emitter current flows. The result is a decrease

Fig. 1. UJT being tested is heart of a relaxation oscillator circuit. Parameters of the circuit are changed by switch S1 for making the various tests. Leads for testing transistors that don't fit SO1 are soldered to socket and brought out through a grommet in the front panel.



PARTS LIST

- B1—9-volt battery (Burgess 2N6 or similar)
 - C1—0.1- μ F, 25-volt capacitor
 - C2—1- μ F, 25-volt, non-polarized capacitor
 - D1—1N456A silicon diode (or similar)
 - M1—0-1-mA meter (Emico 52F6023 or similar)
 - Q1—MPS 3708 transistor
 - R1—10,000-ohm
 - R2—220-ohm
 - R3—5600-ohm
 - R5—22,000-ohm
 - R6—470-ohm
 - R7—10-ohm
 - R4—5000-ohm potentiometer
 - S1—6-pole, 3-position, non-shorting rotary switch (Mallory 3263J or similar)
 - S2—Single-pole pushbutton switch, normally open (Switchcraft 101 or similar)
 - S3—S.p.s.t. switch
- Misc.—Cabinet (Bud CU728B or similar), battery clip, battery holder, color-coded test leads with attached insulated small alligator clips, mounting hardware, handle (optional), etc.
- All resistors
1/2-watt

in the resistance between the emitter and base-1 so that, as the emitter current increases, the emitter voltage decreases and a negative-resistance characteristic is obtained. When the emitter voltage drops below ηV_{bb} , the current flow stops. Thus, a UJT can be thought of as a voltage-sensitive switch, unlike the linear amplification function of a conventional junction transistor.

The UJT Tester measures the two important characteristics of a UJT: η and the inter-base modulated current, I_{B1} . The latter is a measure of the effective gain between base-2 and the emitter.

Construction. The circuit for the UJT Tester is shown in Fig. 1. Choose a suitable mounting cabinet and mount all of the operating controls, including the meter and transistor socket on the front panel. The author's layout is shown in the

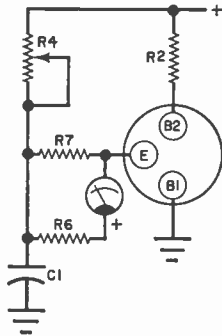
photos. The battery can be mounted on the rear of the cabinet with a battery clip.

Wire the circuit point-to-point between the components. A small hole, protected

HOW IT WORKS

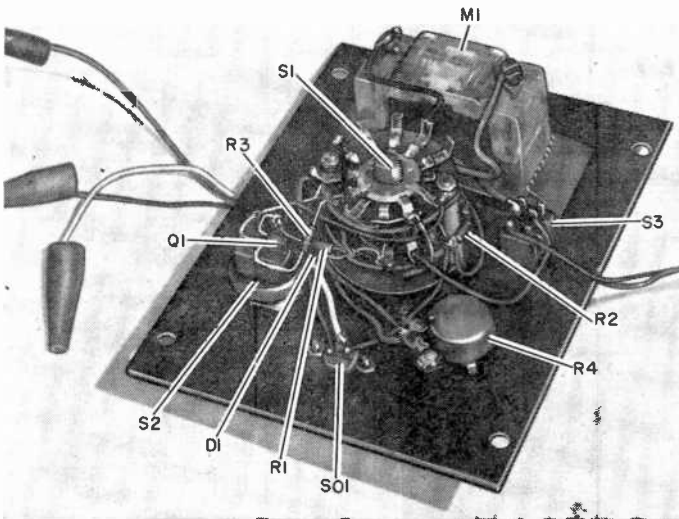
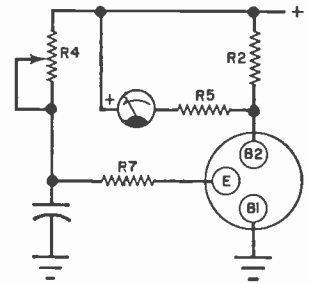
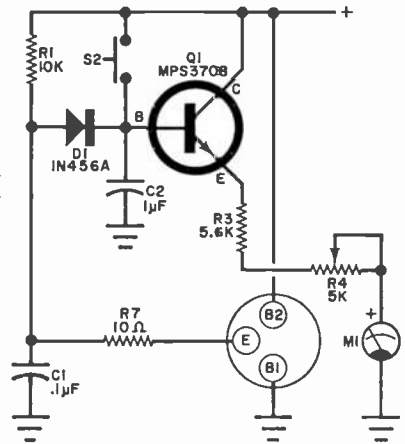
Schematics of the three modes of operation of the UJT Tester are shown here. In each case, the UJT is used as a relaxation oscillator and the circuit parameters and meter location are changed by *S1* to measure the different characteristics.

With *S1* in the η position, the frequency of the oscillator is determined by *R1* and *C1*. The intrinsic standoff ratio (η) is then measured with a peak voltage detector made up of *D1*, *Q1* and the meter circuit. Transistor *Q1* is an emitter follower used to keep the meter from loading the diode. Resistor *R3* and potentiometer *R4* are used to calibrate the meter.



The emitter current, I_E , is adjusted by altering the relaxation oscillator so that resistor *R2* is in series with base-2 and the meter is in the emitter circuit of the UJT. The resistance of *R4* is then varied to give a meter reading of 50 mA for I_E .

To measure I_{B2} the meter is placed in the base-2 circuit. In this arrangement, the meter has a full-scale value of 100 mA.



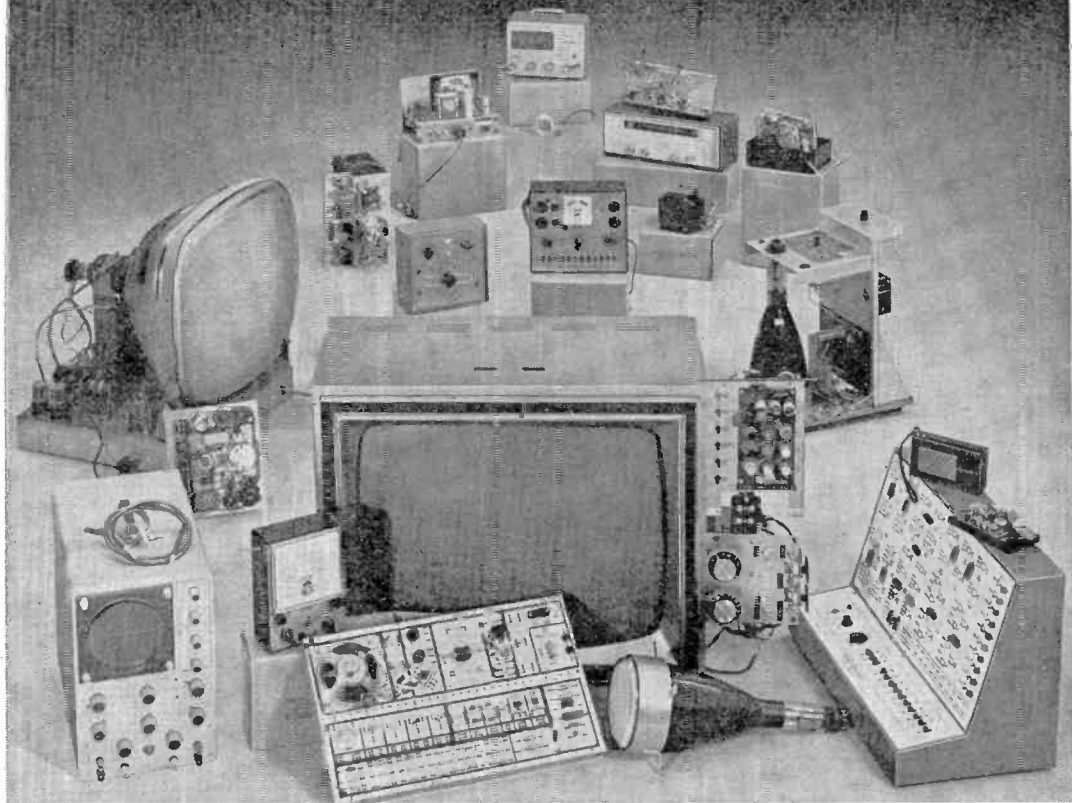
Rear view of front panel shows how all components are mounted and wired from point to point. Battery, mounted on rear panel, is connected to leads at right.

by a rubber grommet, is used for the three test leads designated *E*, *B1*, and *B2* in the schematic. These leads are used to test a transistor that won't fit in the socket. Color code the leads for identification. (The author used red for *B2*,

white for *E*, and blue for *B1*.) When the wiring is complete, check it carefully, connect the battery and close the case.

Operation. The on-off switch (*S2*) must
(Continued on page 92)

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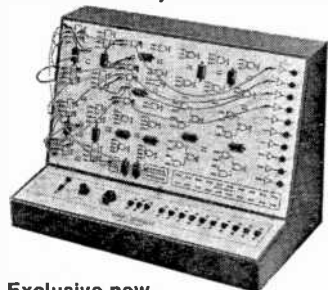
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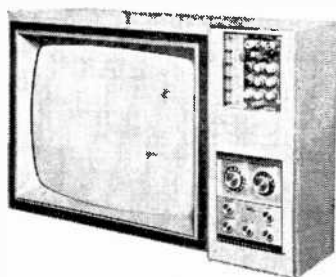


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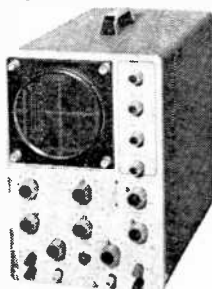
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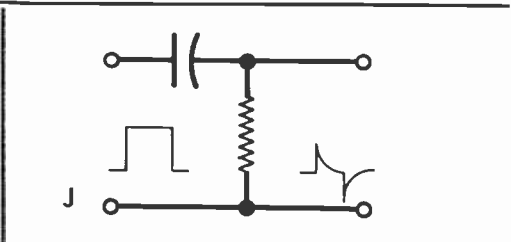
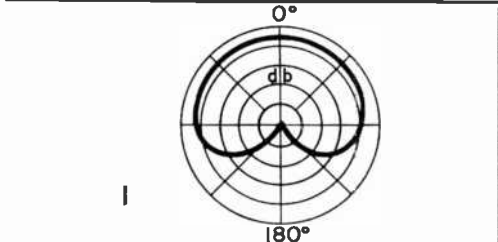
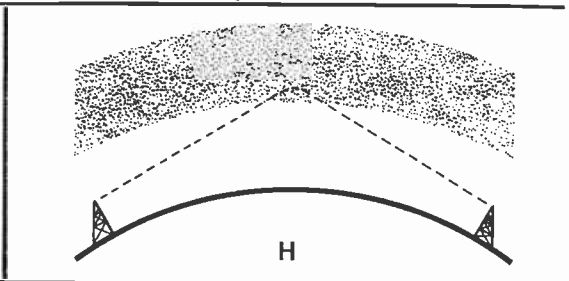
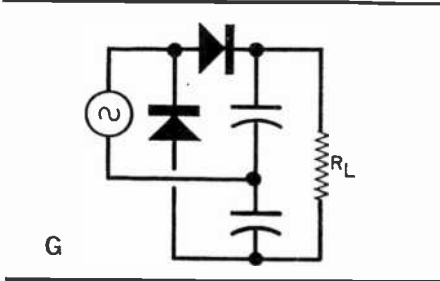
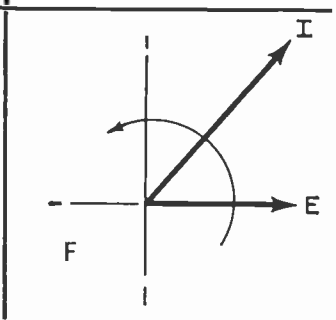
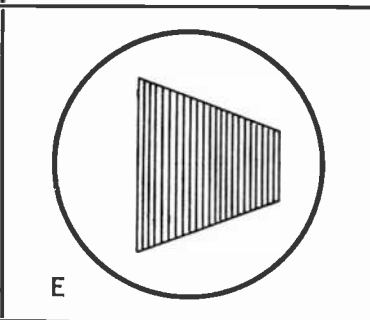
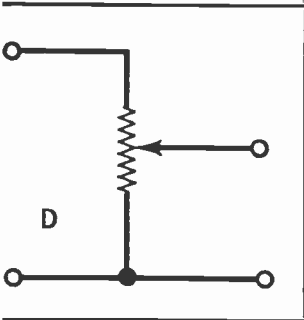
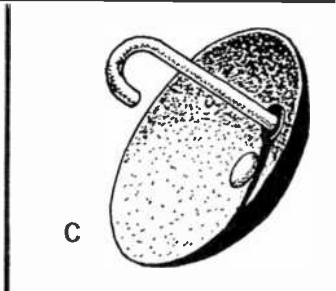
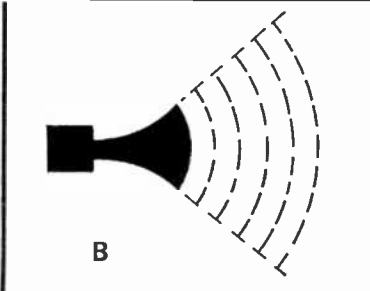
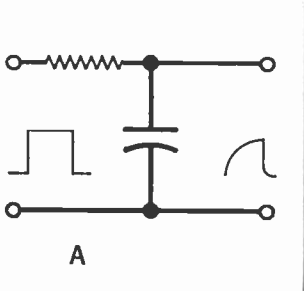
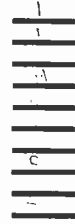
Electronics Mathematics Quiz

(Answers on page 100)

BY ROBERT P. BALIN

Many electronic circuits perform mathematical operations that are arithmetic; electronic components and their characteristic curves are often described in terms of the geometric forms they resemble; and electronic technicians use angular measurements to specify signal paths and coverage, as well as the phase relationship of a.c. voltages and currents. Test your knowledge of how mathematics is utilized in electronics by matching mathematical terms (1-10) to the sketches (A-J) of electronic applications.

1. Cardioid
2. Critical angle
3. Differentiator
4. Dispersion angle
5. Divider
6. Doubler
7. Integrator
8. Paraboloid
9. Phase angle
10. Trapezoid



BY JIM WHITE, W5LET

Build the EYEBALLER

SIGNAL MONITORING
FOR THE CB'ER,
HAM, AND
AUDIOPHILE



When you want to measure certain voltages within a circuit, the first thing that comes to mind is, quite naturally, a meter. Unfortunately, meters cost money; and if more than one signal is to be measured or monitored at the same time, total meter cost is prohibitive.

In those cases where exact voltage levels are not required and relative measurements will suffice, there is a low-cost way to do the job—and you just might have the parts to do it in your junk box. We call the device an "Eyeballer." The essential ingredient is the so-called "magic eye" indicator tube. Magic eyes come in a variety of shapes and types, and the indications they provide range from a simple "V" pattern to an exclamation point. The one used in the Eyeballer is the 6AL7GT. It has two vertical indicating bars—the tops are controlled by two separate signals and the common bottom edges are controlled by a third signal.

The Eyeballer can be used in many applications. One of the most obvious and practical is in CB equipment, where

it can monitor the r.f. output and modulation of the transmitter during the transmit mode and the level of the received signal during the receive mode. The ham operator can use it as a substitute for relatively expensive grid meters and monitor the drive to three stages in his transmitter. An audio enthusiast can use it to balance the outputs of stereo equipment. And, in a pinch, the device can be used as a low-cost, though uncalibrated, low-voltage d.c. voltmeter for rough testing.

You can build the Eyeballer in about three hours at a cost of about \$15—even if you don't have any of the parts available in your junk box.

Construction. The circuit of the Eyeballer is shown in Fig. 1. Its physical layout is optional and any type of housing can be used. It can be assembled within an existing piece of equipment if desired.

The author assembled his unit in a 5" × 4" × 3" metal enclosure as shown in the photos. The important thing is to

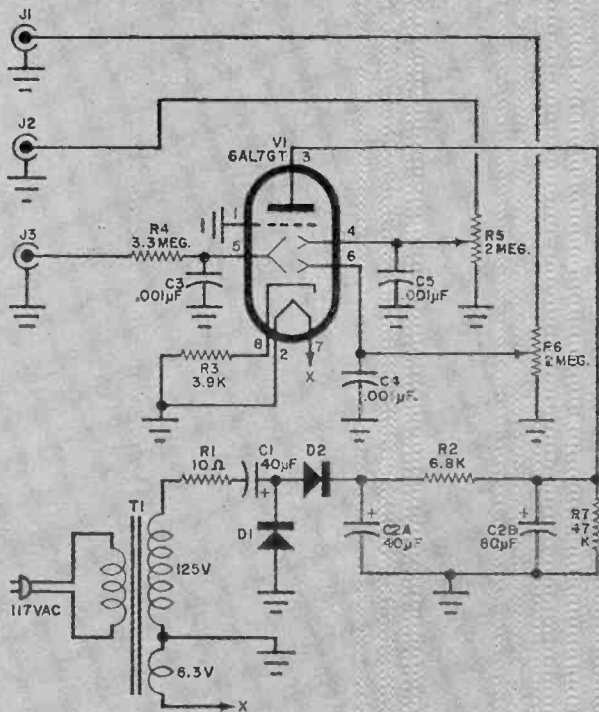


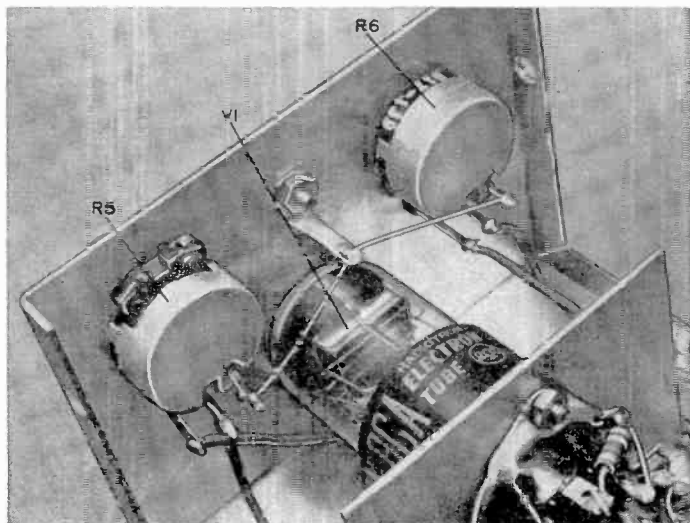
Fig. 1. Once the three circuits to be monitored are connected to the pertinent input jacks, use the associated potentiometers to set pattern size. Note that J3 requires an external control as explained in text.

PARTS LIST

C1—40- μ F, 150-volt electrolytic capacitor
 C2—2-section electrolytic capacitor, 40 and 80 μ F, 350 volts per section
 C3, C4, C5—0.001- μ F, 500-volt disc capacitor
 D1, D2—600-PIV, 750-mA silicon rectifier
 J1, J2, J3—Phono jacks (optional, see text)
 R1—10-ohm, 1-watt resistor
 R2—6800-ohm, 1-watt resistor

R3—3900-ohm, $\frac{1}{2}$ -watt resistor
 R4—3.3 megohm, $\frac{1}{2}$ -watt resistor
 R5, R6—2 megohm, linear taper potentiometer
 R7—47,000-ohm, 2-watt resistor
 T1—Power transformer; secondaries: 125 V, 15 mA and 6.3 V, 0.6 A.
 V1—6AL7GT electron-ray indicator tube
 Misc.—Metal enclosure 5" x 4" x 3", octal socket, line card, knobs (2), multi-lug terminal strip, rubber grommet, hardware, etc.

This is the author's internal arrangement of the two potentiometers and V1. Any other layout will suffice.



be sure that the 1" hole for the indicator tube and the octal tube socket are aligned so that the tube is not tilted when it is installed. Fasten the tube socket so that pin 8 is at the bottom to insure that the two fluorescent rectangles are vertical.

The components for the Eyeballer can be mounted in any way that is convenient. Mount capacitors $C3$, $C4$, and $C5$ directly between the appropriate terminals on the tube socket and ground pins 1 and 2. Cathode resistor $R3$ can also be installed directly at the socket.

If you do not use phono jacks for the three inputs, they can be wired directly to the circuits to be monitored. Mount potentiometers $R5$ (control for top portion of right-hand segment) and $R6$ (for top portion of left-hand segment) in a convenient location. Note that there is no control for the common bottoms of the segments.

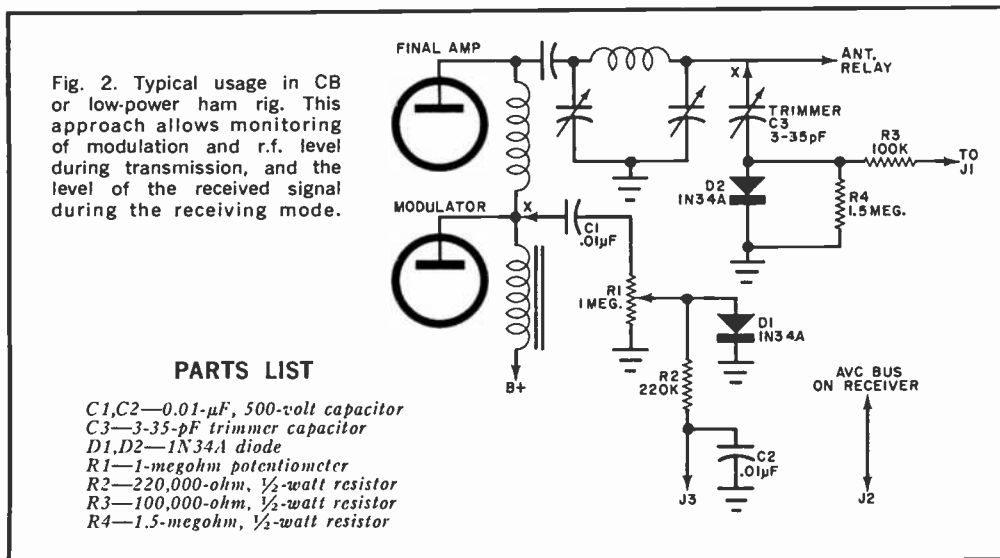
Testing. After making sure that the circuit is wired properly, turn on the power to the Eyeballer. When the tube has warmed up, a dual green pattern will be visible on the viewing face of the tube. With the positive terminal of a 9-volt battery grounded, connect the negative side to each of the input terminals in turn. For inputs $J1$ and $J2$, the amount of deflection can be varied by $R6$ and $R5$ respectively. For input on $J3$, the

amount of deflection must be varied by an external control.

Note that the circuit does not have its own power on/off switch. The input is connected to the circuit being monitored so that power is automatically applied to the Eyeballer when the equipment is turned on.

Typical Uses. The circuit shown in Fig. 2 can be used to connect the Eyeballer to a low-power AM transceiver such as a CB rig. Connections to the Eyeballer are at jacks $J1$, $J2$ and $J3$; connections to internal circuit of the transceiver are at the points labeled "X." Using this circuit, the top left-hand segment of the Eyeballer indicates the r.f. level of the transmitter, the top right-hand segment indicates the level of the received signal, and transmitter modulation is indicated by the movement of the common bottom portions. All indications are relative and depend on the settings of the various controls, including the r.f. trimmer capacitor in the $J1$ circuit.

Grid drive to three stages of a ham transmitter can be monitored by connecting one input to each control grid (of the three stages) through a 2.2-megohm. $\frac{1}{2}$ -watt, isolating resistor. A shunt resistor, connected between $J3$ and ground is used to preset the bottom indication. The value of this resistor must be determined

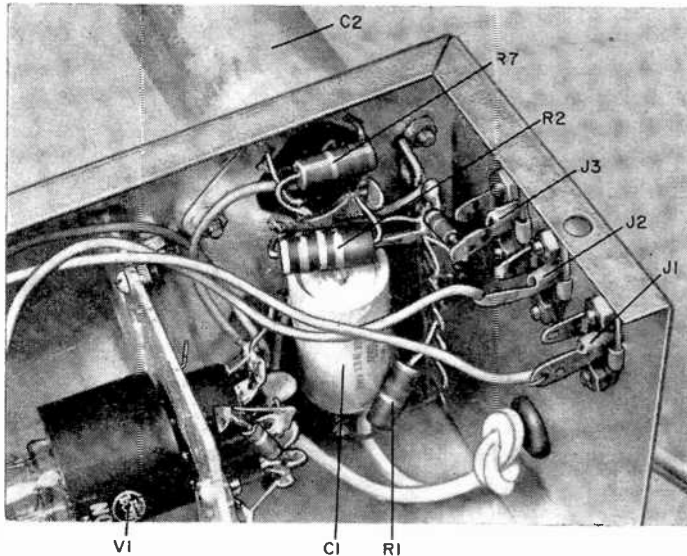


HOW IT WORKS

The circuit of the Eyeballer is designed around a 6AL7 electron-ray indicator tube (often called a "magic eye" tube). The tube is designed to indicate visually, by means of a fluorescent target, the effects of changes in applied control voltages. The target element (pin 3), which looks like the plate in the schematic symbol, is operated at a positive voltage to attract electrons from the cathode. When the electrons strike the target, they produce a greenish glow on its fluorescent coating. When a control electrode is mounted between the cathode and the target and the voltage on this element is made negative, the flow of electrons to the target is diverted and the pattern on the target is reduced in size.

The 6AL7 tube differs from the more conventional "V" image electron ray indicator tube in that there are three control elements instead of only one. The glow on the target is divided into two side-by-side rectangular segments. The top of the left segment is controlled by the voltage applied to pin 6; the top of the right segment is controlled by the voltage applied to pin 4; and the bottom portions of both segments are controlled by the voltage applied to pin 5.

By applying three independent control voltages to these pins, three separate circuits can be monitored. Segment movement is approximately 1 millimeter per volt with -7 volts required for fluorescence cutoff.



Wiring is point-to-point between components mounted on the chassis, a multi-lug terminal strip, and tube socket mounted on a small metal bracket. The parts layout is not critical so any arrangement will do.

experimentally to obtain the desired amount of deflection. As the three stages are tuned, the generated grid voltage causes the pattern to change; and if there is any change during transmitter operation, the Eyeballer calls attention to it. In this way, the Eyeballer takes the place of three, far more expensive, grid current meters.

To use the Eyeballer in balancing a stereo amplifier system, first ground the input at *J3*. Then apply the two ampli-

fier outputs to *J1* and *J2*. With the same input to both channels of the amplifier and with *R5* and *R6* set to the same value, adjust the amplifier channel balance to obtain equal amplitude pattern indications.

The Eyeballer can be used as an uncalibrated indicator of voltages simply by connecting any voltage (up to -7) to any input. The indicating pattern for that input will be smaller by an amount proportional to the voltage. -30-

BY CARL KOHLER

LIVE WIRE WITH A LOOT LOCATOR

*Return of the
Irrepressible
Experimenter*

BYOND an open window of the new workshack, the Gulf of Mexico murmured frothily upon a promising beach. Intently completing the electronic project at hand, I didn't hear Friend Wife approaching until she was already past the door I had unwittingly left unlocked and ajar.

Normally I might've fended her off with evasive tact or sickening diplomacy. Failing that, I have a grouch act calculated to strike terror in the heart of man or beast, child or distant relative. It works keen on the lady, too.

But she was shrewd enough to have brought with her the price of admission to my intellectual's sanctuary: the steaming pot of fresh coffee smelled wonder-



*"... the lady of the house is a
militant homemaker
whose dwelling sparkles ..."*

ful and my defenses suddenly suffered undeniable voltage droop. Here, then, was my lovely, illogical bride—the lady who only last year saw fit to have my 3-element beam strung with Christmas lights, and then had the gall to feign hurt dismay at my resultant rage. Oh, I've been

on to her for years. It's staying ahead of her that keeps me sleepless and tossing fretfully some nights. The communications gap in the same generation is called Marriage.

"What'cha building *this* time that ain't gonna work?" she demanded, her eyes boldly narrowing at the sight of the excitingly designed, home-crafted instrument before me. "Hey, that gismo looks awful *familiar*, Buster!"

Smoothly sipping the delicious brew, I shifted position casually in a sly effort to block her view of the nearly finished electronic metal detector. "Don't let me keep you," I hinted delicately. "I know you must have many little tasks awaiting your skill and diligence, dear."

"What tasks?"

"Surely you want the neighbors, here, to know that the lady of the house is a militant homemaker whose dwelling sparkles with—"

She stepped forward, peering harshly over me at the detector. "I *loathe* housework and I don't care who knows it! Hey, I remember that screwy thing! It was supposed to find gold or uranium—or something! And all it ever found was a buncha lousy bones!" She chuckled meanly, grinning down at me with the expression of a woman who has just found an open wound to salt. "Yeah, that was really the craziest flop you ever butchered the budget to put together! *Remember?*"

I stared into the distance with dignity. She had me. It was true. I *had* built a rare earth detector. The same one, in fact, that now lay—considerably modified and improved—before her jeering eyes. Due to a cruel quirk of a heartless fate, I'd made a small miscalculation—substituting animal horn for bakelite in the search coil—which had caused the detector to respond only to bone, improbable as it still seemed these many years later.

"You have a fantastic memory," I said coldly.

"Sure have!" She sounded proud.

"Then, surely you must recall that memorable day when you brightly informed me that it took *two* coats of paint to cover all my QSL Cards." I smiled thinly up at her. "If we're going to relive old errors, let's be *impartial*, eh?"

"You had to *mention* it, didn't you?"

I shrugged. "No, I didn't have to. I could just as easily have recalled the time I caught you using my stock of expensive tantalum capacitors for hair-rollers or that shattering instance when you——"

"Never mind all *that*," she chattered hastily, pointing to the instrument atop the workbench. "What I wanna hear is what *this* piece of fancy junk is supposed to *be*, anyway."

Standing tall, I drew myself to my full height, assuming the patient mien of a man—a superbly gifted, saintly modest, highly intelligent and utterly articulate man—who is about to attempt the heart-breaking chore of explaining quantum theory to an aborigine in small, easily understood words (if not a language so explicit that it teeters on the borderline of basic babytalk). She stiffened just as she always does when she senses I'm going to talk down to her.

"This ultra-sensitive and rather sophisticated instrument is the *Kohler Loot Locator*," I informed her with a kindly smile. "It's modified and brought sternly up-to-date. Comprised of all manner of truly efficient components, including silicon transistors, a 9-volt alkaline battery, a varactor tuning-control, a Faraday shielded search coil, a Sonalert and a——"

"What's it *do*?" she whined impatiently.

"—very stable circuit of original design that is charmingly representative of every advance made in the art and science of solid-state technology, this stunningly effective prototype will operate most beneficently in our behalf."

"Doing *what*?" The doll was maddeningly single-minded. "What's it gonna *accomplish*, big shot?"

"In two words: locate loot."

"Locate *whaat*?" She wore a bewildered expression.

"Loot . . . swag . . . booty . . . treasure," I chanted, knowing a dreamy film of greed was glazing my eyes. "That beach out there is jam-packed with ancient pirate treasure—and the *Kohler Loot Locator* is going to find it!"

She hooted raucously, like a banshee trying to win a hollering contest. I've heard that damning laughter many times before during the years of our relationship. It generally indicates that she is of

the opinion that I've lost my mind. I suffered the derisive snorting with a face carved from the granite of total resistance to ridicule.

"*Pirate treasure!* Oh, *wow!*" She wiped tears of merriment from her eyes with the back of her hand. Very lady-like, very graceful. "Man, you're too much! *Swag! Beautiful!*" She dissolved into another spasm of mirth, shrilling hysterically.

Restraint cracked. I spat cold coffee back into the cup, gesturing abruptly toward the door. "All right, laughing-girl, now you know what I'm preparing to do. Your morbid, unsympathetic curiosity has been satisfied. Kindly trudge back to your house and break a few dishes or burn some food."

A hand gently touched my arm.

"Aw, I didn't mean to hurt your feelings! Honest. I just lost my head when you were putting me on about looking for *loot* with—her mouth quivered with more laughter but she fought it back—that thing!"

"So who's putting you on?" I arched an eyebrow at her, questioningly. "I'm perfectly serious."

"You're perfectly nuts," she declared, all sham humility vanishing, "if you actually think you're going to find any—any swag or treasure with that bone-picking thingamajig!"

"It's been modified. And I have complete assurance from the oldest, most trustworthy residents of this area that there is indeed bona fide pirate loot stashed in those bleached sands." I clutched the light, mobile Locator protectively to my chest. "You'll change your tune when I prove there *were* pirates here!"

"Oh, I know there were pirates here. In fact, there still are!"

"I beg your pardon?"

"One of them sold me some bait, yesterday, when I went fishing!"

I glared at her in silence.

"Tell me," she said, softening her expression and voice. "Why didn't you try to find pirate treasure with this what-chamacallit when we were living on the California coast?"

"Simple. There never *has* been any pirate loot buried out there, no matter *what* the Los Angeles Chamber of Commerce may insist to the contrary."

"How do you know?"

I bent a pitying smirk of undisguised superiority upon her. "Sheer logic and a rudimentary understanding of human psychology would help you to recognize instantly the validity of my theory. Too bad, being female, you're naturally exempt from these necessary mental qualities, sister!"

"So?"

"So what self-determined pirate was likely to step ashore—much less be there long enough to bury his treasure—with all those *missions* along the coast. Why, there were probably even *more* of them during the pirating days."

"What's *that* got to do with it?"

"Just the risk of being apprehended and sent to church against their will, that's all." I grinned triumphantly. "Elementary logic. I can well imagine how your alleged mind balks at it."

"It doesn't even figure."

"It doesn't, eh?"

"Heck, no!"

I handed her the cup of cold coffee. "When was the last time you ever heard of a bunch of bank bandits burying *their* loot in a churchyard?"

She marched off to the house without another word of comment or argument. I sighed, returning to my work on the Loot Locator. She always loses. What stings, is, she refuses to *realize* it.

A week later I stopped walking along the pale sand to rest, momentarily letting the Locator lay at my feet. Mopping my sweating brow, I gave some dismally realistic thought to what the Locator had located in the past two days. Exactly 176 soda pop cans, 816 beer cans, 11 car bodies, 26 stoves and a couple of refrigerators—all of them in advanced stages of rusty disintegration. Regarding the compact trench-spade with distaste, I glanced at the beachcombing couple nearby, diligently peering at the sand as they strolled along the water's edge.

The sound of a car behind me diverted my attention. It was Friend Wife. Bringing me coffee and cruel amusement as usual. Having trailed me into this folly, she wasn't about to keep her distance and allow me to fail graciously. No, she wanted to be there for the kill—that moment of truth when I admitted I was finding nothing resembling pirate loot,

and possibly even confessing that my Locator was a proven flop. I suspected she would settle for nothing less than the joy of hearing me voice my laboriously developed suspicions that no freebooters had ever stepped ashore here, either.

"How's it going, treasure hunter?" she jeered, handing hot coffee to me. "Need any help getting the troves of swag back to the house?"

"Uh . . . well, I'm working my way through quite a bit of trash that must be gotten past in order to reach the lower levels of deposit where anciently placed items—such as doubloons, pieces of eight and chests brimming with loot—were originally buried," I stalled lamely, trying for a nicely detached expression. "I expect to stumble upon a treasure cache anytime now."

"Hogwash!"

"How can you say that?"

"It's easy. *Hogwash!*"

Suddenly, in staring mutely at my feet, my eyes swept past the Locator, tilted so the search plate was partially exposed—and I saw a large, gleaming ring clinging to the magnetic plate. Swiftly I bent and picked it up, holding it before her face.

"Just a piece of hogwash, dear!"



"Wh-What's that?" she stammered.

"Just a little piece of *hogwash*, dear! Just a small sample of what the magnificent Kohler Loot Locator is *doing* while the world snickers and smirks." I polished the ring on my damp shirt. Made of thick gold, it was studded with diamonds glittering in the sunlight. Visions of

wealth beyond mine or the IRS's wildest dreams romped briefly through my head. I trembled with excitement, spilling hot coffee all over myself. "Now are you convinced that—"

"Podden me, buddy," said a booming voice just behind my right shoulder, "but that's my wife's ring you got there?"

I turned. He was King Kong in bermuda shorts and a gaudy shirt splashed with tropical fish on a background of garish crimson. The same guy I'd seen studying the water's edge a few moments earlier. He also looked tough enough to chew nails without his store-teeth and spit out their heads without bruising his gums. I smiled *intensely* up at him.

"Y-Your wife's r-ring, sir?" I chirped.

"Yeah, dat's right! She losted it out here a coupla days ago. We been looking fer it ever since, see?" He plucked the gem-encrusted ring from my fingers just as deftly as I could have taken candy from a baby. Now I knew how babies feel when somebody puts the snatch on their goodies. "Sure was nice of you to find it for us!"

"M-My pleasure," I lied manfully.

"Don't suppose you'd take a modest reward for finding a ring that means quite a bunch to my little woman, would'ja, buddy?"

"Of course not!" Mouthy chimed nobly from the car. "My husband wouldn't *dream* of accepting money for having accidentally found your wife's lovely piece of jewelry!"

For a tenth of a second I think I understood why some husbands are entirely capable of sending their wives to a better world slightly ahead of divine schedule. I nodded, my face probably a mixture of emotions—greed—disappointment—false cheer—anguish. The works, simultaneously.

"N-No reward, th-thanks," I croaked.

"Hey, that's a purty tricky little chunka stuff you got there!" King Kong squatted, running a hairy hand admiringly over the Locator. "Does it *work*?"

"Does a chicken have lips?" I said bitterly.

"Huh?"

"It found your wife's ring, didn't it?"

"Hey, *yeah!* Dat's right, it *did!*" He pondered the truth of this fact for a few seconds. Then, rising to his full eight feet of towering flab once more, he jerked

a beefy thumb at the Locator. "I wanny *buy* it, buddy. How much ya want fer it?"

I hesitated, waiting for Mouthy to assure this character that I was also morally above business transactions but she remained silent. He misinterpreted by pause.

"Bet ya made the thingie yourself, huh?"

"Right!" I bit the word out, holding my chin high.

He named a sum that would comfortably purchase a *Heathkit* Color TV, a middling heap of Hewlett-Packard test equipment and still leave enough to take a mouthy wife to dinner at the best restaurant. Furthermore, he reeled it over in cash and I took it like a man getting rich in a dream.

"You sure this thingie works good?" he asked, turning to leave. "We lose a lotta stuff in the sand, going around the world and seeing all them beaches, ya know!"

My fist tightened about the sheaf of bills it held. There're only two things I love better than electronics. One of them

was keeping her yap shut. I was holding the other.

"That precision handcrafted instrument you just bought, sir," I assured him in a confident tone common to solvent men, "is so sensitive that it'll detect a germ with iron-rich blood!"

He departed, happy.

I got into the car, counting the bills with a reverence bordering on an ill-concealed mania. "Did that little old Locator ever find the loot or did it ever find the loot?" I babbled. "I no longer hear you chuckling with glee, kid."

"Y-you *pirate*!" she accused.

"The gentleman set the price."

"Talk about *piracy*!"

"Listen, sister," I said tartly. "Have you ever heard of pioneering?"

"Sure I have. Why?"

"Well, what you've just witnessed was a tidy example of another somewhat romantic endeavor along the same line as pioneering."

"What's that?"

"*Buck-aneering*, baby!"

And this time I dissolved into merry laughter.

-50-

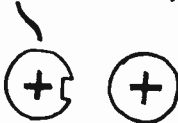


"Bet ya made the thingie yourself, huh?"

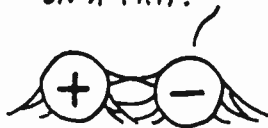


BY NICK ROBERTS

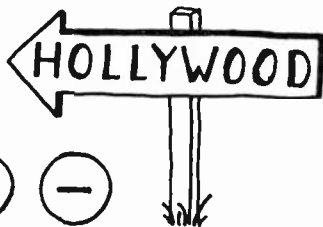
YES, MY CAR DOES HAVE SEAT BELTS. WHY?



AND THAT'S THE LAST TIME WE GIVE THE KIDS TAFFY ON A TRIP.



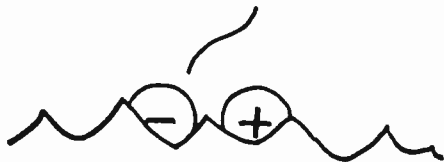
OH LOOK, MABEL! ISN'T THAT TINY TIM?



WELCOME TO THE SUNNYVALE NUDDIST RANCH.



WHEN THAT FARMER SAID TO "FOLLOW THE CREEK", I THINK HE MEANT THE ROAD NEAR THE CREEK.



SURE I HEARD THEY CAME DOWN HERE, BUT I NEVER EXPECTED TO SEE ONE.



ARE THESE REST AREAS ALWAYS THIS CROWDED?



NR

your own private OWL



AUTOMATIC "OUTSIDE WELCOME LIGHT"
TO GREET YOU AND YOUR FRIENDS

BY JAMES A. ARCHER

PUT AN OWL in your driveway! Not an owl that goes "who" at you but an OWL (Outside Welcome Light) that turns on the front- or back-porch light when you pull the car into the driveway and turns it off again after you're safely in the house. That way you don't have to stumble over the kid's toys on the porch steps or fumble for your keys in the dark.

The OWL will also greet a visitor when he turns his car into your driveway and the system can even be hooked up to your front doorbell to turn on the light when the bell is pushed.

The system is activated when the photocell, mounted near the driveway is momentarily illuminated by the headlights of a car. It is designed to respond only to a sudden increase in light—and is not activated by daylight.

The principal components in the OWL are a resistor photocell, an SCR, two relays and a unijunction timing circuit. The device is relatively easy to construct and should cost no more than \$25.

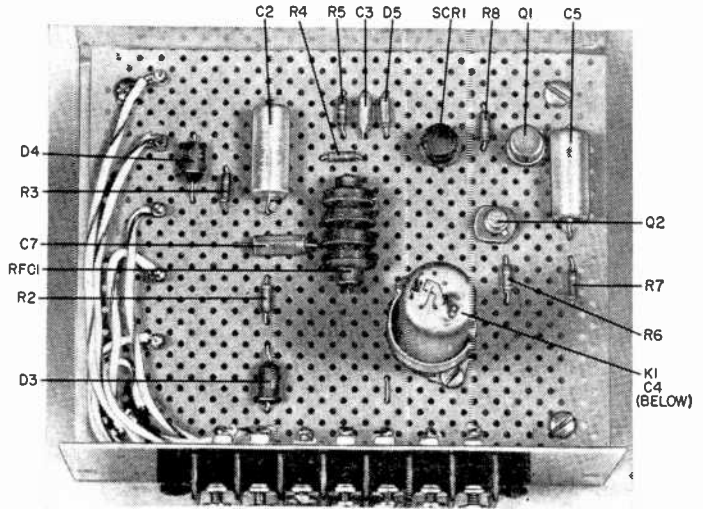
Construction. The system is in two major sections: a control circuit and a power supply. Each is housed in a 3" × 4" × 5" metal enclosure, although any other method of packaging can be used

(both circuits can be placed in one large package, for instance). The control circuit is shown in Fig. 1. When wired point-to-point on a perf board, it is as shown in Fig. 2. Resistor R_4 determines the sensitivity of the overall system, and its value is selected to suit the particular installation. A good value to start with is 10,000 ohms. Once the circuit has been wired and checked for possible wiring errors, the perf board is mounted in its chassis with spacers at each corner. A seven-terminal barrier strip can be used to make connections to the external circuits.

Power relay K_2 is usually mounted close to the point where the power is actually to be switched. Put it in a small metal enclosure and connect its coil to the control circuit as shown in Fig. 1.

The schematic of the power-supply circuit is shown in Fig. 3. Also shown are the optional circuit for the doorchime system and its associated components. The outputs of the power supply are 20 and 15 volts d.c. The former is used by the control circuit; the latter by the chime coils. If you are not using the doorchime arrangement, do not use D_3 , D_4 , R_1 , and C_2 in the power supply. Diode D_3 can also be eliminated from the

Fig. 2. Though the author used perf-board construction with layout shown, most any construction technique is sufficient.



or) to reduce light pickup from the sides. If the cell must be highly directional, the mold can be mounted at the end of an open length of pipe or tubing so that the pipe can be aimed in the desired direction. Be sure the potting compound covers an inch or two of the cable to make a good weatherproof seal.

When the entire system has been checked out for possible wiring errors, connect it together as shown in Fig. 5. This diagram also shows two ways of connecting *K2* to existing wiring for the outside light. All external electrical wiring must conform to your local electrical codes.

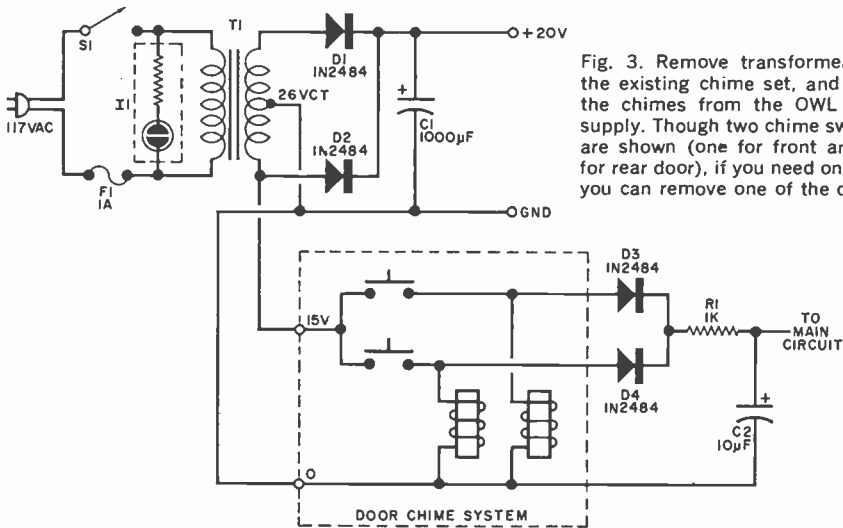


Fig. 3. Remove transformer from the existing chime set, and power the chimes from the OWL power supply. Though two chime switches are shown (one for front and one for rear door), if you need only one, you can remove one of the diodes.

PARTS LIST

C1—1000- μ F, 25-volt electrolytic capacitor
C2—10- μ F, 25-volt electrolytic capacitor
D1-D4—1N2484 diode
F1—1-ampere fuse and holder
I1—117-volt neon lamp assembly (optional)

R1—1000-ohm, $\frac{1}{2}$ -watt resistor
S1—S.p.s.t. switch
T1—Power transformer, 26.8-volt, 1-ampere secondary (Triad F-40X or similar)
Misc.—Doorchime assembly (internal low voltage transformer removed, see text); suitable metal enclosure for power supply; mounting hardware; 4-terminal barrier strip; etc.

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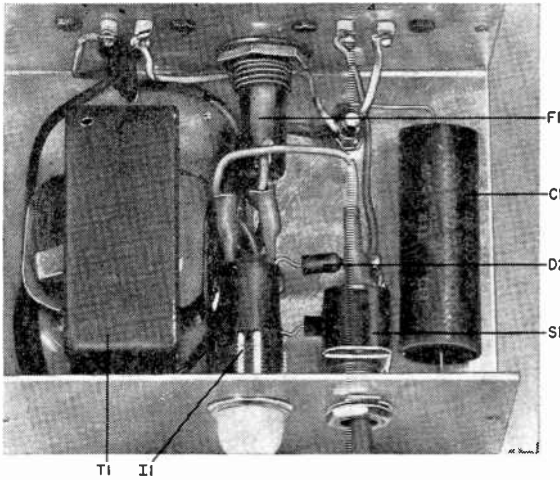


Fig. 4. The power supply can be built in one end of the chassis and made compact.

Testing and Use. Before making any tests, it is suggested that $R7$ (2.2 megohms) of the control circuit be shunted by a 22,000-ohm resistor to speed up the response time of the system. This temporary modification reduces the normal 5-minute response time to a few seconds.

With the system hooked up and connected to a power source, connect a conventional lighting fixture to the contacts of $K2$ as shown in Fig. 5. The light should be off. Place the palm of your

hand over the sensitive surface of the photocell and aim the photocell toward a source of light. When you remove your hand, the relay should be energized and the light should come on. The light should remain on for a few seconds and then automatically turn off, even if the photocell is still exposed to the ambient light. If the circuit works properly under these conditions, remove the temporary resistor across $R7$ to restore the 5-minute delay.

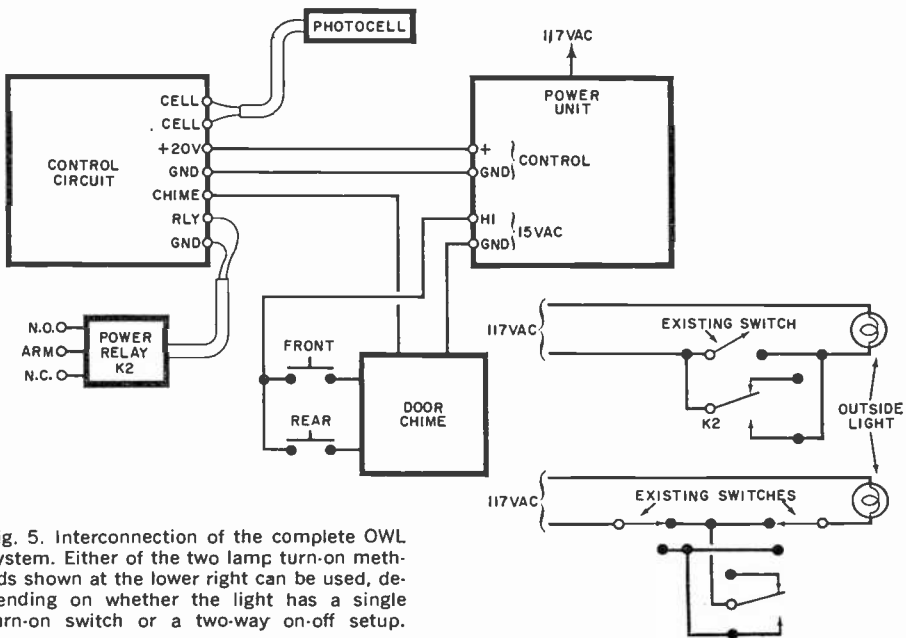


Fig. 5. Interconnection of the complete OWL system. Either of the two lamp turn-on methods shown at the lower right can be used, depending on whether the light has a single turn-on switch or a two-way on-off setup.

HOW IT WORKS

Photocell *PC1* and resistor *R2* are connected together to form a voltage divider. The photocell is a light-sensitive variable resistor whose resistance changes from about 15 megohms when it is in total darkness to less than 1000 ohms when it is exposed to a bright light. As a result, the voltage applied to *C2* ranges from 1.5 volts when *PC1* is in darkness to about 22 volts when *PC1* is in bright light. Capacitor *C2* blocks the steady-state d.c. from the rest of the circuit so that, under normal conditions, there is no gate signal on *SCR1*.

When *PC1* is abruptly illuminated, the voltage on *C2* rises sharply and is applied to the gate of *SCR1* as a positive going pulse. The SCR is turned on by the pulse and relay *K1* is energized. When *K1* is energized, power is supplied to energize *K2*, whose contacts can carry the current required by the outside light, and to the timing

circuit consisting of *Q1* and *Q2*. The emitter circuit of *Q2*, a unijunction transistor, takes about five minutes to charge up to the point where *Q2* fires. Once *Q2* fires, the drop across *R5* turns on *Q1*. With *Q1* conducting, the drop across the SCR is lowered and the SCR is turned off and relay *K1* is de-energized.

Diode *D1*, resistor *R2*, and capacitor *C1* form a decoupling network to prevent accidental triggering from power line transients. R.f. choke *RFC1* and capacitor *C3* prevent false triggering by r.f. interference. Diode *D5* shunts negative-going pulses, while *R3* and *R4* determine circuit sensitivity.

Activation of the doorchime system is essentially similar, in that a voltage pulse is applied to *C2* from the chime circuit rather than from the photocell circuit. When the doorchime circuit is activated during the daytime, the voltage at *C2* is already high due to the low resistance of the photocell so no voltage pulse can occur and the system remains off.

Retest the system. Now the light should remain on for five minutes or so before switching off.

Install the photocell where it can "see" an automobile headlight as the car comes up your driveway. Make sure that it cannot see any random headlights due to traffic in the street. Install the electronics

in a protected area where they won't get wet and connect the photo cell to the circuit using the weatherproof cable.

If you find that the system needs more sensitivity (depending on your car's headlights and the location) increase the value of *R4* in the control circuit. If the system is too sensitive, decrease *R4*. —~~30~~—

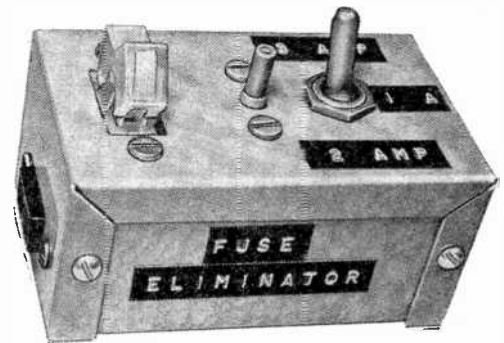
NO MORE FUSES

BY NEIL JOHNSON

ONE CIRCUIT BREAKER,
THREE CURRENT RANGES

TO SAVE TIME and trouble, most electronics experimenters are turning to circuit breakers as substitutes for fuses. When a fuse blows, you have to hunt around for the correct replacement—it's easy to make a mistake, too, since different current ratings come in the same physical size. With a circuit breaker, all you have to do is push the reset button when the cause of trouble has been eliminated.

Circuit breakers do have one drawback. When you install one in your bench wir-



ing, it has one definite current rating. In working with instruments and equipment of different wattage ratings, you may be too far over or under the breaker rating. By adding a couple of lowcost resistors and a switch, you can now make a multi-current circuit breaker that can be preset for several ratings.

Construction. The heart of the circuit, as shown in Fig. 1, is the breaker, in this case a conventional 1-ampere thermal type used in many TV sets. The resis-

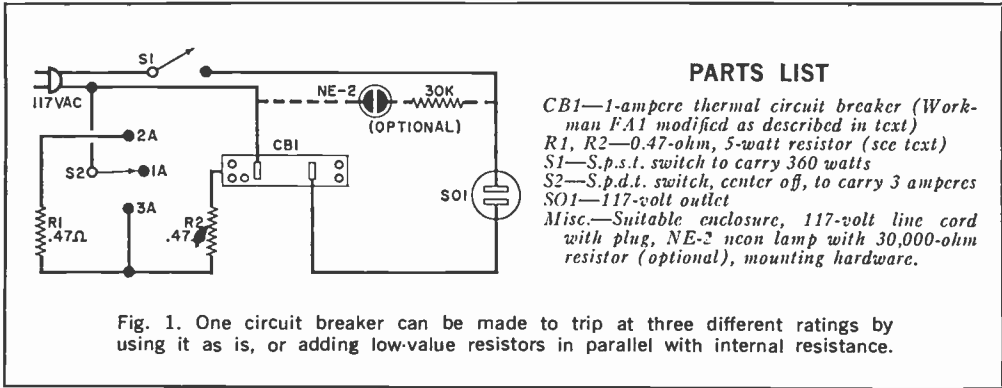


Fig. 1. One circuit breaker can be made to trip at three different ratings by using it as is, or adding low-value resistors in parallel with internal resistance.

tance of the thermal portion of the breaker is 0.96 ohm. To increase its current carrying capability, a one-ohm resistor can be connected across the resistor part of the breaker. To increase the current rating even farther, a ½-ohm resistor can be connected across this portion.

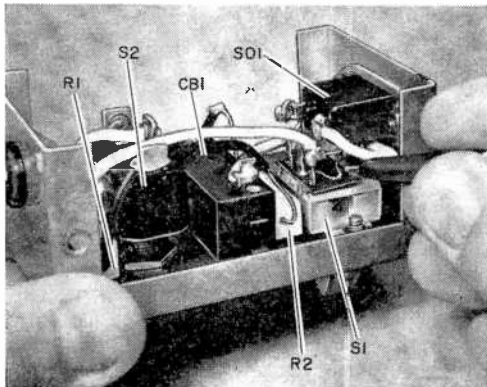
To make the necessary modifications to the circuit breaker, observe that on its back side, one end has two rivets and a soldering lug while the other end has only one rivet and a soldering lug. The modification is made at the end with two rivets. Looking at the end of the breaker adjacent to the two rivets, you will see a U-shaped cutout in the plastic. At the top of this channel is the end of a piece of metal (not to be confused with the metal front cover).

Using a large needle or the end of a small scribe, carefully clean the surface of this metal. Then tilt this end of the breaker down and tin the clean metal

area, being careful not to overheat the breaker (use a 40- to 60-watt iron or gun). Prepare a small piece of wire by stripping off ¼" of insulation and tinning the exposed wire. Form the tinned end of the wire into a small loop and sweat solder it to the previously prepared metal piece on the breaker. Do not apply too much solder to this joint since it could act as a thermal sink.

As shown in the photographs, the author mounted the circuit breaker in a small metal enclosure, though any other mounting method can be used. Mount the on-off switch *S1*, circuit breaker *CB1*, current-selector switch *S2*, and power outlet socket *SO1* as desired. If you want a "power on" indicator, connect an NE-2 neon lamp and a 30,000-ohm resistor in series across the terminals of *SO1*.

The author used a pair of Workman model WT47 current limiting resistors for *R1* and *R2*. However, a pair of 1-ohm, 2-watt conventional resistors in parallel can be substituted for either one. Leave at least a ¼" space around the resistors to avoid heat transfer to the breaker.



Inside view of the author's prototype. Make sure air can circulate between the power resistors (*R1* and *R2*) and heat-sensitive thermal circuit breaker.

Operation. In use, the modified breaker will open at either 1, 2, or 3 amperes, depending on the setting of the selector switch. These current ratings are roughly equivalent to 120, 240 and 360 watts, respectively and are suitable for most applications. The "carrying" capacity is approximately 65% of the break rating—or 75, 150, and 225 watts, respectively, on 117 volts a.c. If reactive loads are applied, don't be surprised if the breaker opens sooner than expected. This is due to high instantaneous currents—which, incidentally, will cause a fuse of the same rating to blow.

BY RONALD L. IVES

Finding Parallel Resistances

USE KIRCHHOFF'S LAW
TO SOLVE
YOUR PROBLEMS

ONE OF THE QUESTIONS most commonly failed on employment examinations for electronics technicians deals with three or four unequal resistors in parallel. Although problems of this type can be solved directly by the use of Kirchhoff's Law, to which most, if not all, of the applicants have been exposed, there seems to be a big gap between what they learned and what they can do with it.

It appears that most technicians memorize one or more formulas for parallel resistance circuits but are not sure of their derivation. Consequently, they are stumped by any problem that doesn't fit the memorized formulas. In addition, most people are woefully inept at simple algebraic processes.

Since a clear, thorough derivation of formulas for computing the effective resistance of a parallel system is not always readily available from a textbook, it is no wonder that many people cannot work these problems. Apparently, a review is in order.

KIRCHHOFF'S LAW

Kirchhoff's Law is generally given in the form of two statements relating to electric networks carrying steady currents.

The first states that, when conductors forming part of a network meet at one point, the sum of the currents flowing into the point is equal to the sum of the currents flowing out of it.

The second states that, starting at any such junction in a network and following any succession of the conductors (in either direction) which form a closed path, the algebraic sum of the products formed by multiplying the resistance of each conductor by the current through it is equal to the algebraic sum of the electromotive forces (voltage sources) encountered in the circuit.

Equations (1) and (2) in this article can be derived directly from these two statements, keeping in mind also the linear relationship between voltage, current, and resistance as stated in Ohm's Law: $E = IR$.

Fundamental Relations. When a number of conductors (resistances) are connected in parallel, the conductance of the system is the sum of the conductances of the individual elements. This statement is not only logically correct, it can be readily verified by experiment.

Thus, if the conductance of a system (in mhos) is G and the conductances of the individual elements are $G_1, G_2, G_3, \dots G_n$, then

$$G = G_1 + G_2 + G_3 \dots + G_n \quad (1)$$

the equation being extendable to any finite number of parallel conductors.

Since it is customary to compute circuit characteristics in terms of resistance rather than conductance, it is desirable to convert Eq (1) to resistance terms, which are the inverse of conductance terms. Thus

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \dots + \frac{1}{R_n} \quad (2)$$

Algebraic Simplification. Equation (2) can be derived directly from Kirchoff's Law and it is the basic starting place for any resistance calculations. Of course, it is not easy to use in its present form—adding fractions is one of the first pitfalls in simple mathematics.

To use Eq (2), then, we must perform some algebraic simplifications. First, we replace $R_1, R_2, R_3, \dots R_n$ with $a, b, c, \dots n$. Then

$$\frac{1}{R} = \frac{1}{a} + \frac{1}{b} + \frac{1}{c} \dots + \frac{1}{n} \quad (3)$$

Second, to reduce the problem to an example rather than considering the general case, we will limit our considerations to a system containing only five components (a, b, c, d , and e).

Normally, the final answer desired is R not $1/R$ so it is necessary to clear the fractions in Eq (3). This is done by multiplying each term by the same factor—the factor being the product of all of the denominators in the equation: $Rabcde$. Multiplying Eq (3) by this factor,

$$\frac{Rabcde}{R} = \frac{Rabcde}{a} + \frac{Rabcde}{b} + \frac{Rabcde}{c} + \frac{Rabcde}{d} + \frac{Rabcde}{e} \quad (4)$$

This can be simplified immediately by

cancelling like terms in the numerators and denominators.

$$abcde = Rbcde + Racde + Rabde + Rabce + Rabcd \quad (5)$$

Since each term on the right side of Eq (5) contains R , it can be factored out to give

$$abcde = R(bcde + acde + abde + abce + abcd) \quad (6)$$

Finally, by dividing both sides of Eq (6) by the terms in parentheses and transposing, we have

$$R = abcde / (bcde + acde + abde + abce + abcd) \quad (7)$$

This is the working equation for a system of five parallel resistive components. By using the same procedure, we can determine equivalent equations for systems with four, three, and two parallel elements.

$$R = abcd / (bcd + acd + abd + abc) \quad (8)$$

$$R = abc / (bc + ac + ab) \quad (9)$$

$$R = ab / (a + b) \quad (10)$$

Equation (10) is the familiar "handbook" formula for two resistors in parallel.

Identical Resistors. When all resistors are equal, the formula for n equal resistors in parallel (n being any finite number) is

$$R = a^n / na^{n-1} = a/n \quad (11)$$

where a is the resistance of a single element and n is the number of elements.

The Shunt Problem. Another variation of the parallel resistance problem is that in which a shunt resistance is to be found. Needed is a resistance of value R . Available is a larger resistor of value a . What is the value of the shunt b to be placed across a to give R ?

First multiply both sides of Eq (10) by $a + b$.

$$Ra + Rb = ab \quad (12)$$

Subtract Rb from both sides

$$Ra = ab - Rb \quad (13)$$


Factor the right side of the equation.

$$Ra = b(a - R) \quad (14)$$

Divide both sides by $a - R$ and transpose.

$$b = Ra / (a - R) \quad (15)$$

Equations (10), (11) and (15) are used frequently in shop and laboratory practice. All of them are derived by simple algebraic manipulation from the basic relationships set forth in Kirchoff's Law.



PRINTED CIRCUITS

PATH OF LEAST RESISTANCE)

SOMETIMES THE SIMPLEST AND MOST DIRECT APPROACH
IS THE BEST

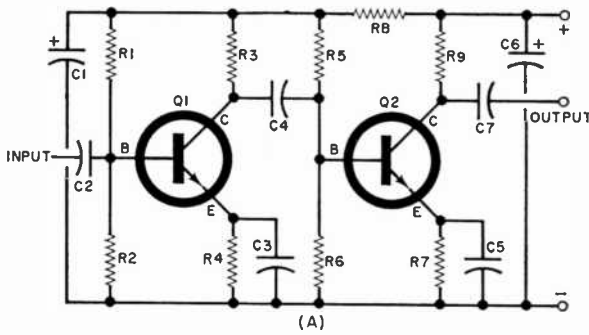
B* ROY HARTKOPF

IF YOU WANT to make your own printed circuit board, you can follow one of two procedures: (1) photocopy the foil pattern from an exact printed reproduction, or (2) create your own foil pattern following a schematic diagram. The first method is usually the more reliable (see "Making PC Boards from the Printed Page," POPULAR ELECTRONICS, October 1968), but the second is the more popular. The reasons for this paradox are that many are frightened off by the quasi-photographic techniques involved in copying somebody else's pattern and many like the idea of laying out their own patterns—thus strengthening the feeling of achievement. Unfortunately, most homemade patterns wind up hopelessly complicated and the troubles encountered in getting a satisfactory result are countless.

It can be done, however, and, if you want to make your own patterns, here are some useful hints and directions that will cut your problems in half and may insure a more accurate, useful board.

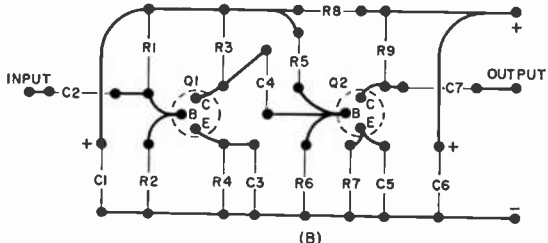
Making the Template. Having decided on the circuit you want to build, gather all of the components that are to be mounted on the printed circuit board. Lay the components, one at a time, on a clear, stiff plastic sheet and mark on the sheet the locations of the leads and, if necessary, mounting holes. Drill the required holes through the plastic. Then insert the components just as you would on a PC board. Use some form of marking pen to outline the area around and between the holes occupied by the components. Identify the components with their circuit designations (C1, R1, etc.). You can also identify them by type ($\frac{1}{2}$ -watt resistor, disc capacitor, etc.) for future use. Once this template has been fabricated, lay it to one side.

Circuit Arrangement. You have probably noticed that most schematic diagrams have some sort of order to their arrangement. That is, in most cases, inputs are on the left, outputs on the right, d.c. supply voltage at the top, and ground at



(A)

Fig. 1. Taking a close look at layout of a well-drawn schematic (A) will, in many cases, show the easiest way to create a printed circuit pattern (B). Note how some components (C1 and C6 here) can be "juggled" to fit without interference. Though the example is simple, the same reasoning can be applied to more complex circuits.



(B)

the bottom. Thus, a well planned schematic can, in nine times out of ten, serve as the actual basis for the foil pattern. The schematic and preliminary foil pattern in Fig. 1 show the direct correlation between the two.

Start your component layout on a clean sheet of paper, using the schematic for approximate location and the plastic template to get the correct component sizes. The template shows how much room is required for each component and where the lead holes have to be. To make the final PC board as compact as possible, keep the components as close together as possible without letting them actually touch. Once the location of a component has been decided, use a sharp pencil to mark the lead holes through the holes in the plastic template. Then outline the component perimeter lightly.

When most of the components have been laid out, remove the plastic template and join the marks for the lead holes together in accordance with the schematic. The lines you draw will eventually form the copper foil pattern. By careful planning, you will find that most odd leads can be routed between other component lead holes. Remember that

the components will be on the opposite side of the board from the foil so you have more room than is apparent.

In the event that it is impossible to route a foil lead from one point to another, terminate the two ends at convenient points and run an insulated jumper wire on the component side to make the complete connection. Do not run jumpers under components and remember that you can move the jumper holes around to make things as convenient as possible. Sometimes, you may have to juggle the components around a little, but with practice, you'll find that it is really easy to lay out a foil pattern.

Transferring the Pattern. Cut a piece of copper-coated board to the required physical size, leaving a border for mounting purposes. Clean the copper surface thoroughly using kitchen cleanser and a little water. Rinse and dry the board, using a lint-free cloth. After cleaning, always handle the board by the edges to avoid the collection of normal hand oils that may interfere with the etching process.

Place the paper layout over the board,
(Continued on page 96)

The Stereo Scene

by Charles Lincoln

CASSETTES: NOT EITHER/OR, BUT AND!

THE PEOPLE who promote tape recording as a home-entertainment medium have never been satisfied with the dent in the marketplace that tape has made since it was introduced about 20 years ago. Tape gave the recording and film industries a newfound freedom. And the ordinary mortal such as you or I could record and edit material in his own home without learning the skills of a machinist.

But that wasn't enough. Starting in the mid-1950's, tape has tried to compete with disc records as "the" medium for commercially packaged music. The battle was an uneven one from the start and the odds are still weighted in favor of discs. For packaged music, tape has a few serious disadvantages that overshadow its advantages. Notably, tape costs more than a disc for the same program length; and finding a particular selection among the half a dozen or so on one track is more difficult than locating a selected band on a disc. The tape user also has "fumbling" problems and, to some extent, open-reel tape is best suited for use by people with nimble fingers.

In addition, there are technical problems involved in the quantity duplication of tapes, resulting in poorer audio quality than the best available from discs. Last, but not least, a boxed 7" reel of tape is heavier and somewhat bulkier than a 12" long-playing record in its jacket. (For the same content, a tape measures roughly 25 cu in. and weighs almost a pound, while the disc is less than 20 cu in. and about 8 ounces.)

With all that against it, what is the appeal of tape? The principal one is that reel-to-reel commercially recorded tapes are not as vulnerable as discs are to dust, dirt, and scratches. There is less trouble with pops, clicks and crackle. The playing life of a tape, with minimum care in handling and occasional demagnetization of the tape heads, is indefinitely long. *But* the playing

life of a disc, kept clean and played with a good stylus and cartridge with a 2-gram (or lower) tracking force is also extremely long. In fact, you will probably get tired of the record before it wears out.

Enter the Cassette. In 1964, Phillips, the Netherlands-based electronics firm, introduced a tape recording and playback system that overcame many of the disadvantages of tape. The tape was contained in a small functional package called a *cassette*, measuring 4" x 2" x 3/8". Tape, cassette and all, simply snapped into the record/playback machine. The tape was 0.150" wide (a little more than 1/8") and moved at 1 7/8 in./s.

At first, because of the limited audio quality, the cassette system was recommended for dictation and similar applications where fidelity was not the main objective. The machines were designed for two-track mon-



The Bell & Howell 337 cassette tape changer is a stereo system which stores and plays six cassettes automatically. The price complete is only \$269.95.

aural operation, and one could (and still can) get up to 2 hours of recording time (1 hour per track).

The cassette is a superbly ingenious piece of engineering. With improved tape-head design, it became possible to record four tracks instead of two; and so the stereo cassette evolved, still offering the same program length as the mono cassette. The stereo cassette occupies only about 7 cu in. and weighs only a few ounces, thus virtually eliminating the user's size and weight objections to tape.

What About Fidelity? Well, that's still the limitation. Even with the finest playback heads and the best duplicating techniques, the upper frequency limit at the tape speed of $1\frac{7}{8}$ in./s is between 10,000 and 12,000 Hz, compared to 15,000 to 20,000 Hz for many discs and the best open-reel tapes. Signal-to-noise ratio is limited to about 45 dB, which is comparable to good AM radio reception, but far short of good FM (65 dB). Distortion tends to run somewhat higher than on the other media, especially at high frequencies.

Still, except in direct A/B comparison with discs or top-quality open-reel tapes, the stereo cassettes sound remarkably good, and their convenience and compactness make them very attractive.

Stereo cassettes are, in general, still about 25% more expensive than discs with comparable program material and playing time, and the variety of music available is sorely limited. So far, only certain cassette models include a means of locating a particular selection. Without this feature the cassette is less convenient than even an open-reel tape machine.

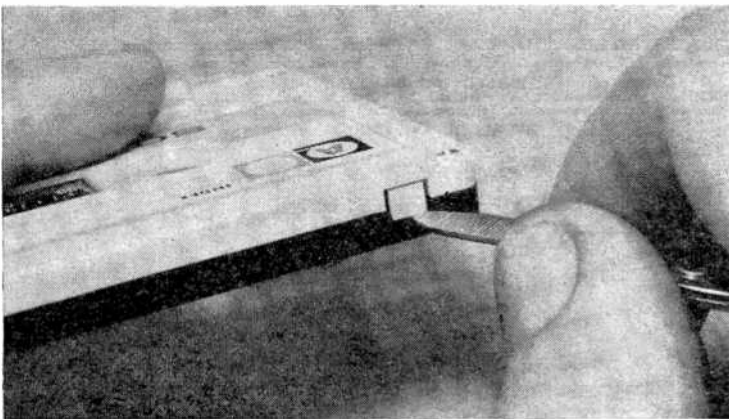


Priced at \$139.50, the TEAC A-20 cassette deck has wow and flutter less than 0.2%, frequency range of 60 to 1,000 Hz, and signal-to-noise ratio of 45 dB.

Cassettes in Proper Perspective. Each of the various sound-recording and reproducing media has its own peculiar advantages and drawbacks. It's a curious characteristic of American culture that, when something new comes along, it is expected to conquer and replace all that went before. We tend to see competition in terms of a struggle for absolute supremacy.

"Is tape better than a disc?" "Is a stereo receiver better than individual units?" "Is a ceramic cartridge better than a magnetic unit?" These are silly questions. There is no reason why two or more ways of doing something can't exist peaceably side-by-side forever. Sometimes a new development does deservedly supersede an older technique. For example, there is no good reason for designing new audio equipment with tubes. Transistors are simply superior in every way. But this is the exception, not the rule.

Tape has unquestioned advantages over discs *in certain areas*, which accounts for its complete acceptance for all original record-



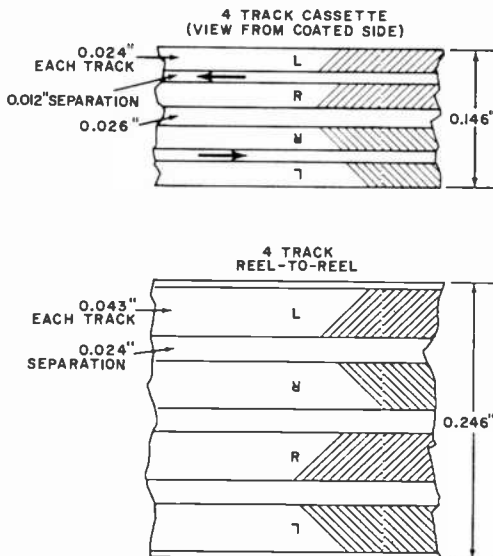
At the rear of each blank tape cassette is a plastic tab. When the tab is in place, the erase-record function of the cassette recorder cannot be operated. Snapping out the tab will disable the interlock. If you should change your mind about this feature, you can cover the hole with a small piece of masking tape.



Cassettes are smaller than cartridges and easier to store. Most of the experts are of the opinion that the cassette has a brighter future than cartridge and reels.

ing, whether the final form of the recording is disc, tape, or a film soundtrack. Its mechanical convenience, the ease with which synchronized multiple tracks can be recorded, the fact that it can be erased and re-used, and, most of all, the simplicity of editing by physically cutting and splicing have put tape in a place all its own. For

someone who wants to do original recording, especially if he wants to edit his material, there is nothing like the open-reel tape. But for someone who wants to purchase commercially recorded material in the widest possible variety with the best available fidelity and at the lowest cost, the disc record is still unsurpassed—and probably will remain so for a good many years. The universality of record-playing equipment assures that—if nothing else.



Magnetic tape used in cassettes is substantially narrower than tape in cartridges or on reels. Note the track arrangement. In the cassette, the left and right tracks are side by side, but in a cartridge, they are separated by a reverse track. This means that a cassette with a stereo recording can be played back in mono on a 2-track cassette player. A 4- or 8-track cartridge cannot be played on a 2- or 4-track player without hopelessly mixing signals. Purists downgrade the cassette because narrow tracks raise signal-to-noise ratio.

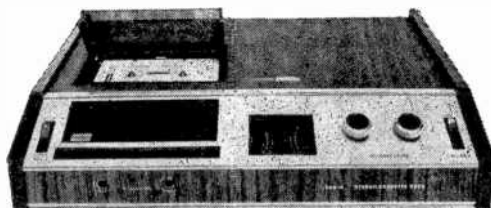
The cassette falls somewhere in between. There are areas where it is better than anything else around: providing background music while you walk or drive and recording interviews, conferences, speeches or other spoken material with good fidelity, marvelous convenience and notable economy—are two examples. Several radio stations and broadcast program services use cassette recorders extensively for on-the-spot coverage of news events or spur-of-the-moment interviews when it isn't practical to lure the subject into a recording studio. The raw material on cassettes is then dubbed off onto conventional $\frac{1}{4}$ " tape for editing and the cassettes are erased and re-used.

It is not practical to edit cassette tape directly. Many cassettes cannot even be opened without damage, but even when they can, the tape is thin and narrow and difficult to handle. The spools inside the cassette have no flanges, and once the halves of the cassette are separated, the tape can too easily spiral off one of the spools until you have a hopeless tangle. Also, the $1\frac{1}{8}$ in./s speed makes any but the simplest editing difficult because the "sounds" are crammed tightly together. If you want to edit what you record, do it on conventional open-reel $\frac{1}{4}$ " tape, preferably at $7\frac{1}{2}$ in./s.

Besides the battery-powered mono cassette recorders, there are now quite a few

machines that record four-track stereo cassettes. Many "compact" audio systems include cassette facilities. This partly solves the problem of a limited variety of commercially packaged music. If you have a stereo cassette player in your car, you can record any disc or radio program on a cassette at home and then listen to it while you travel. Cassettes, incidentally, can be bulk-erased as easily as open-reel magnetic tape.

One inherent limitation in the cassette system is that it must use a combination record-playback head. (The degree of miniaturization of the design simply does not permit enough space for separate heads.) This not only limits top-end frequency response and signal-to-noise ratio, but also makes it impossible to monitor from the



Harman-Kardon's CAD-4 cassette deck with preamplifier records and plays back with a frequency response of ± 2 dB from 50 to 12,000 Hz. High-level sensitivity is 200 mA; low-level, 0.2 mV. Output is 0.8 V r.m.s. With 2 VU meters. Price is \$179.50.

playback head while recording or to produce echo effects. For these reasons, cassettes will not supplant open-reel tape for serious recording.

There is no question that the cassette system is a brilliant contribution to the audio scene, but it must be considered on its merits, taking account of its own advantages and disadvantages. It *supplements* discs and open-reel tapes, but it won't replace them.

You may be wondering why we have said nothing about any of the "cartridge" tape systems. There is one good reason for this—cartridge systems are, at the moment, inferior to cassettes, discs and open-reel tape when all the factors of price, convenience, reliability and variety are considered.

So the word is: if you feel you can use cassettes to good advantage, by all means equip yourself to play them—and preferably to record them as well—but don't sell your turntable and/or tape recorder. Cassettes are good, but they won't make the other major media obsolete. -50-

CASSETTE RECORDERS

AIWA TP 728, MP	\$ 69.95
Allied 1150, MP	89.95
Ampex Micro 50, SD	139.00
Ampex Micro 88, SPY	199.00
Bell & Howell 295, MP	99.95
Bell & Howell 326, SD	139.95
Bell & Howell 337, SY	269.95
Blaupunkt 100, MP	110.50
Concertone 200S, SY	179.95
Concord F-50, MP	59.95
Concord F-98, MP	119.95
Concord F-400, SP	179.95
Craig 2603, MP	59.95
Craig 2703, SY	189.95
Crowncorder CTR 9450S, MP	69.95
Crowncorder CTR 9650S, MP	119.95
Fisher RC-70, SD	149.95
Grundig C-200, MP	99.95
Harman-Kardon CAD-4, SD	179.50
JVC Nivico 1600, MP	59.50
JVC Nivico 1700, MP	99.95
Lafayette RK-550, SD	119.95
Mercury 4450, SD	114.95
Mercury TR8700, PSY	159.95
Norelco 150, MP	64.95
Norelco 450, SY	199.95
Norelco 2401, SY	249.95
Panasonic RQ-204S, MP	49.95
Sony/Superscope TC-50, MP	125.00
Sony/Superscope TC-100, MP	99.50
Sony/Superscope 125, SD	129.50
Sony/Superscope 130, SY	229.50
TEAC A-20, SD	139.50
Telefunken 4001, MP	69.95
Wollensak 4200, SD	69.95

Bold-face letters after model number indicate significant features: **M**—mono, **S**—stereo, **D**—deck only, **P**—portable, **Y**—system (with amplifiers and speakers), **B**—playback only.

Circle No. 88 on Reader Service Page 15 or 95



The Fisher RC-70 cassette tape deck records and plays back with a frequency range of 30 to 12,000 Hz. It has separate VU meters for each channel and a digital counter with pushbutton reset for locating selections on the tape. Its price is \$149.50.

Calculating Input and Output Impedances

SIMPLE METHOD GIVES
ANSWERS WITHOUT
COMPLICATED MATHEMATICS

WHEN YOU buy or build an audio amplifier, you are given values for most of the important characteristics. Unfortunately, input and output impedances are not usually included. To get the most out of any amplifier, you need to know its input impedance so that you can match it to the output impedance of the signal generating device (preamp, mike, tuner, etc.). Similarly, the amplifier's output impedance should match the input impedance of the load (loudspeaker, power amplifier, etc.).

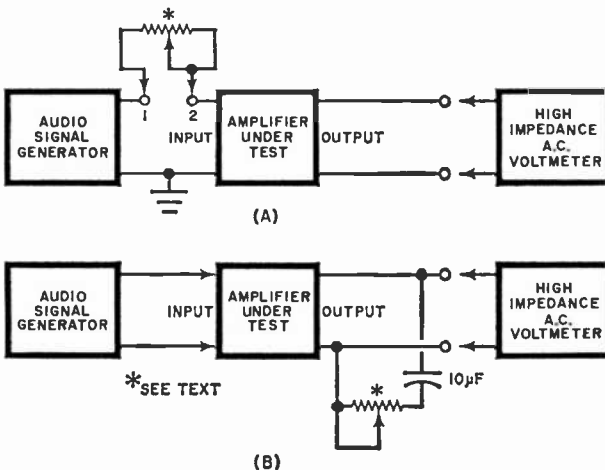
Means of determining input and output impedances are omitted in most cases because they involve complicated mathematics and sophisticated measurement techniques. Here is an impedance measuring technique which is simple and easy to perform. Mathematics have been reduced to the bare essentials and the re-

sults, although not exact, are close enough for use by most electronics experimenters. The measurements can be made on either transistor or vacuum-tube amplifiers and they require the use of only an audio signal generator, a high-impedance a.c. voltmeter (VTVM or TVM), a potentiometer, and perhaps a capacitor.

Input Impedance. To measure input impedance, use the circuit shown at (A). The output level of the signal generator should be equivalent to the normal input of the amplifier and it should be set for a frequency of 1 kHz. The potentiometer should have a resistance of 10,000 to 25,000 ohms for a conventional bipolar transistor input and several megohms for a field-effect transistor or vacuum-tube input.

First, short out the potentiometer (terminals 1 and 2 in the diagram). Apply the recommended input to the amplifier from the signal generator and read the output on the voltmeter as closely as possible. Without disturbing the controls of the generator or the amplifier, remove the short from across the potentiometer. (Note that one end of the potentiometer is connected to the rotor.) Adjust the potentiometer until the voltmeter indicates exactly half the previous reading. Without disturbing the setting of the potentiometer, remove it from the circuit and measure its resistance from the open end to the rotor. This value very closely approximates the input im-

(Continued on page 94)

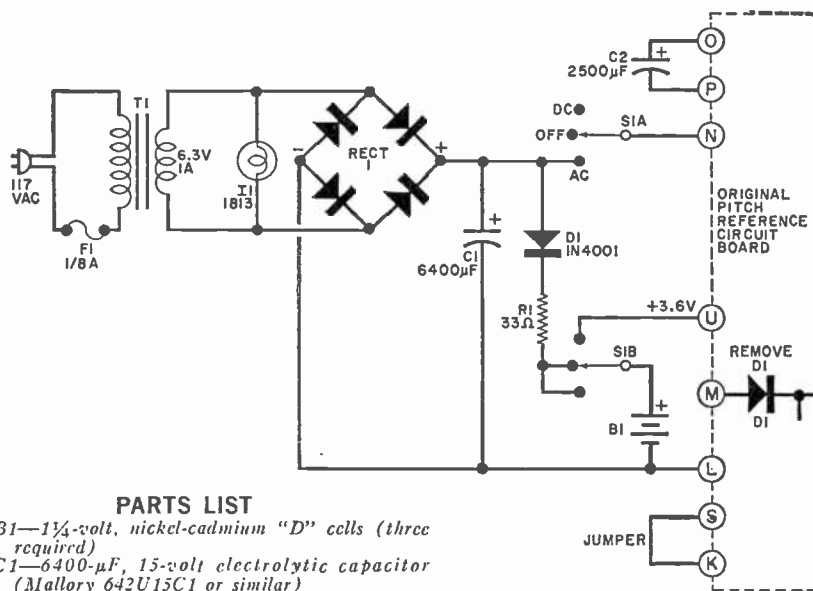


The upper circuit (A) is used to determine input impedance, while the lower circuit (B) is used for output impedance measurements. Although not exactly "on the head", system is accurate enough for most experimenters.

Second-Guessing the "PITCH REFERENCE"

PORTABILITY MAKES IT
EVEN MORE VERSATILE

BY EMERSON M. HOYT



PARTS LIST

- B1—1½-volt, nickel-cadmium "D" cells (three required)
- C1—6400-μF, 15-volt electrolytic capacitor (Mallory 642U15C1 or similar)
- C2—2500-μF, 15-volt electrolytic capacitor (Mallory 252U15A1 or similar)
- D1—1N4001 diode (can be D1 of original Pitch Reference)
- F1—⅛-A, 3 AG, slow-blow fuse
- I1—14-volt, 100-mA pilot light (GE 1813 or similar)
- R1—33-ohm, 1-watt resistor
- RECT1—Rectifier, four 1N4001, 1N2069, or similar
- S1—Single-pole, three-position switch
- T1—6.3-volt filament transformer

Fig. 1. The rectifier keeps the battery charged when the system is operating from commercial power line. Battery keeps the system operating when Pitch Reference is to be used remote from any 117-volt power source.

THE "Musical Pitch Reference" described in the September 1968 issue of POPULAR ELECTRONICS has proved to be quite effective in tuning most pianos and organs. However, this versatile instrument can be made more useful by the addition of a

self-contained, rechargeable battery so that it can be used in areas where commercial a.c. power is not available. A built-in charging circuit keeps the battery charged when the instrument is plugged into the a.c. line.

The battery and charger circuit is shown in Fig. 1. It includes the transformer, *T1*, that was in the original Pitch Reference, plus a pilot lamp to indicate when a.c. power is on (*I1*), a bridge rectifier (*RECT1*) that replaces the original single-diode rectifier, a filter capacitor

in series using short leads soldered to each cell. A new filter capacitor (*C1*) with a 15-volt rating is connected directly to the bridge rectifier output and a 2500- μ F, 15-volt electrolytic capacitor is connected between the O and P terminals of the PC board (positive side to O).

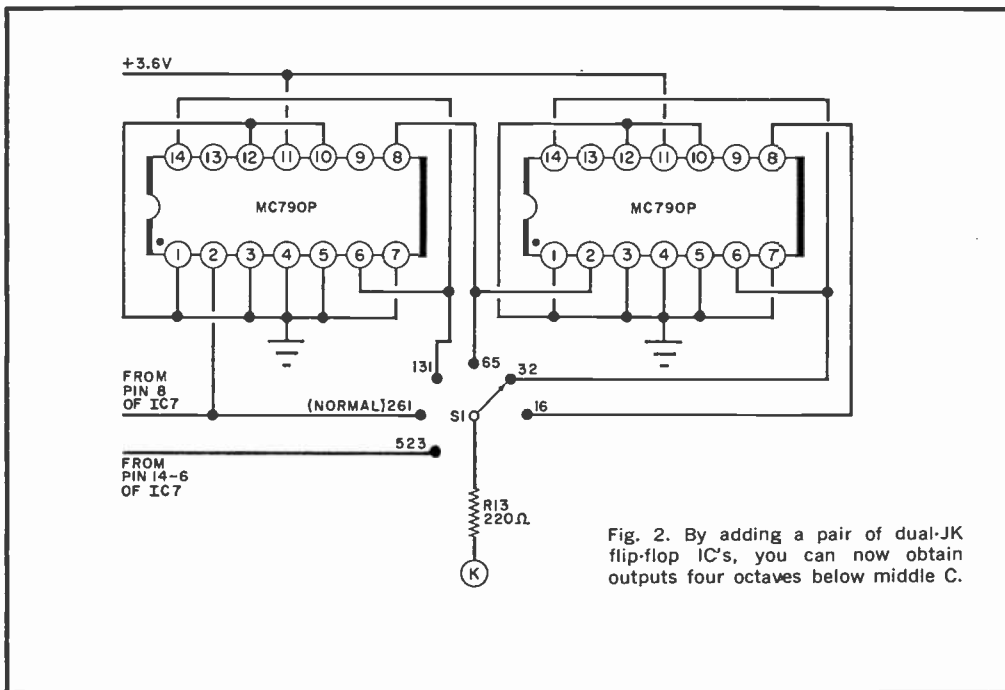


Fig. 2. By adding a pair of dual-JK flip-flop IC's, you can now obtain outputs four octaves below middle C.

(*C1*), a battery-charging diode (*D1*) with a current-limiting resistor (*R1*), a set of three 1¼-volt nickel-cadmium cells (*B1*) connected in series, and a three-position mode-selector switch (*S1*).

In the original equipment, it is necessary to remove *D1*, which can be reused as *D1* in the charging circuit, and capacitors *C3* and *C4*. Then remove the volume control (*R14*) and the power on/off switch *S2*. Connect a jumper between terminals S and K on the PC board. The volume control is removed to prevent accidental use of the battery with the volume turned way down. The power switch is unnecessary and the unit can be left turned on (AC position of *S1*) to keep the battery charged.

The new components can be installed within the original chassis and wired in accordance with Fig. 1. The three nickel-cadmium cells (*B1*) are connected

Once the batteries have been charged, keep *S1* off. When operation with a.c. power is required, place *S1* in the AC position. This also keeps the batteries charged up. The three 1¼-volt batteries will deliver between 3.6 and 3.75 volts and can operate the Pitch Reference for 3 to 4 hours before recharging is required.

Octave Selection. As another "extra" for the Pitch Reference, it is possible to add a pair of MC790P dual-JK flip-flops (the same as those used in the original) and, with slight circuit modifications and a six-position switch, divide the output frequency by 2, 4, 8, or 16. This permits you to obtain a pitch reference for the four octaves below middle C. In addition, as shown in the circuit in Fig. 2, 523 Hz is taken from the original circuit to provide for the second octave above middle C.



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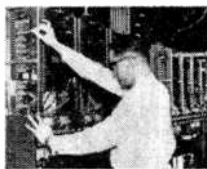
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the product gallery

REVIEWS AND COMMENTARY ON ELECTRONIC GEAR AND COMPONENTS

STEREO FM COMPACT
(Heathkit Model AD-27)



THERE are many reasons why a hi-fi buff might prefer a stereo compact to individual components. In the first place, the compact is particularly appealing where space is at a premium; all of the equipment needed for sound reproduction (and usually stereo FM reception), except speakers, take up little more than the area occupied by a modern FM receiver. Next, the individual components in the compact system are performance coordinated to assure the best possible quality in sound reproduction. Also, you usually get appreciable cost reductions, easy operation, and full versatility.

Dollar for dollar and feature for feature, your reviewer feels that the Heathkit Model AD-27 solid-state stereo FM compact (available at \$179.95 from Heath Company, Benton Harbor, Mich. 49022) ranks as a "best buy" in compacts. After having built and used a wide variety of Heathkits over the years, this came as no great surprise. To illustrate, here is how the AD-27 stacks up.

The system employs a BSR McDonald four-speed automatic record changer that incorporates all of the most wanted features. For example, the tone arm is of low-mass tubular aluminum construction, counter-balanced both horizontally and vertically for optimum tracking. There are also a variable dynamic anti-skate control, a cueing and pause control, and a built-in adjustable micrometer-type gauge/control for stylus pressure. Three interchangeable spindles—for automatic long-play, automatic 45 r/min, and manual play—are provided with the kit, not as extras.

Next, the record changer is coupled to

Heathkit's own specially modified Model AR-14 30-watt stereo FM receiver. There is no need to describe the receiver since the impressive list of technical specifications given on the following page tells the whole story.

Finally, the record changer and receiver are housed in a handsome oiled walnut cabinet with tambour (roll-top) door. This really attractive cabinet will make a piece of furniture that you will be proud to display. With the door rolled back, you have easy access to all controls. When the system is not in use, simply close the door, and the system stores safely out of sight.

Assembling any Heathkit is easy if you carefully follow the instructions given in the well-written and lavishly illustrated manuals, but putting together the AD-27 is a breeze. Virtually all point-to-point wiring has been eliminated; even the components in the power supply mount directly on a printed circuit board. In fact the only components that have to be chassis mounted are three rocker switches, three pilot lamps, input and output connectors, and the power transformer and filter capacitor in the power supply. Interconnections among the printed circuit boards are accomplished by soldering into place two ready-made wiring harnesses.

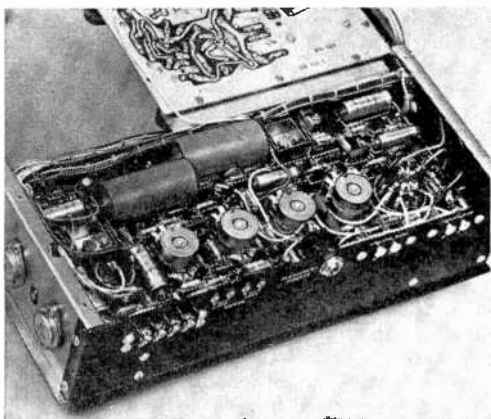
The strong chassis consists of seven heavy-gauge metal parts. These go together with self-tapping sheet metal screws, eliminating the frustrations involved with machine screws and nuts.

Once the chassis is assembled and all sub-assemblies are mounted in place and wired together, the whole thing slips into the cabinet as a unit. Then the record changer drops

into its cutout, and the front plate and knobs are fixed to the control shafts. The whole job requires about fifteen hours from start to finish—including the recommended coil and transformer outlined in the manual.

Performance-wise the AD-27's sound reproduction is crisp and clean. Even high-frequency musical passages and transients come through effortlessly and without coloration, while bass tones sound smooth and natural. And FM reception in both the mono and stereo modes is strong and clear with no detectable drifting.

Circle No. 89 on Reader Service Page 15 or 95



Audio amplifier/control center and associated inputs and outputs are conveniently grouped at one end of chassis. This bottom view of circuit board shows roomy layout and board-mounting controls.

TECHNICAL SPECIFICATIONS Heathkit AD-27

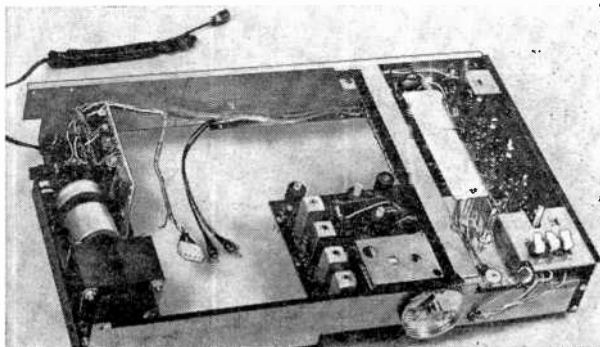
FM Section:

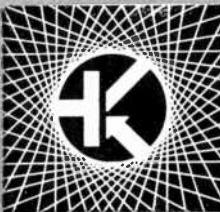
Tuning Range—88-108 MHz
Antenna input—balanced 300 ohms
Sensitivity—5 μ V (IHF)
Hum and noise—45 dB down at 1 watt reference
Mono audio frequency response—20-15,000 Hz, 0 to -3 dB
Harmonic distortion—1% or less (IHF)
Image rejection—45 dB down (IHF)
Capture ratio—4 dB (IHF)
A.f.c. correction—150 kHz/volt
AM suppression—35 dB down (IHF)
I.f. rejection—80 dB down (IHF)
Separation—27 dB at 1000 Hz

Amplifier Section:

Continuous power output/channel—10 Watts
Music power output/channel—15 watts (IHF)
Tape output—0.5 volt
Speaker output impedance—4 to 16 ohms
Tape output impedance—3500 ohms
Damping factor—50 or higher
Hum and noise—Phono at 10 mV: -60 dB without phono cartridge; -47 dB with phono cartridge; -60 dB overall for auxiliary input
Frequency response—12-60,000 Hz \pm 1 dB; 6-100,000 Hz \pm 3 dB
Power response—5-90,000 Hz
Input sensitivity—phono: 4.5 mV; aux.: 300 mV
Input impedance—phono: 47,000; aux.: 180,000 ohms
Channel separation—45 dB or better at 1000 Hz
Total harmonic distortion—less than 1% from 12 to 60,000 Hz at full output
I.m. distortion—less than 1% (60 and 6000 Hz mixed 4:1) at full output
Phono equalization—RIAA
Bass—16-dB cut, 15-dB boost at 20 Hz
Treble—13-dB cut, 15-dB boost at 20 kHz

Stereo compact consists of three discrete subchassis. Left to right are power supply; FM tuner, i.f. strip, multiplex; and amplifier/control center subchassis. Power supply cable harness is shown along rear apron of chassis. Large open space at center is for automatic record changer.





SOLID STATE

By LOU GARNER, Semiconductor Editor

PEOPLE POWER—electrical, not political—can knock out a transformer radio as effectively as a hammer can. The level of people power (the static electricity charge built up through friction) can reach 25,000 volts under the right circumstances. Most of us have felt the tingle we get after walking across a carpeted floor and then touching a grounded doorknob. The tingle is slight, even with a voltage as high as 25,000, because the amount of current involved is only a few millionths of an ampere. However, this voltage is sufficient to destroy the junction in even the hardest of transistors if the voltage is placed directly across the device. And that's what happens in a radio where the first transistor stage is directly coupled to the external antenna connection.

According to Signalite Inc. (1933 Heck Ave., Neptune, N. J. 07753), which receives much correspondence about this transistor-radio phenomenon from many parts of the world, popping the first transistor is easier than you think. For example, touching the antenna of your car radio after sliding across the seat on a dry day can do it.

One strange case was recently uncovered in England where brand-new, factory-inspected portables were delivered to dealers with the first-stage transistors blown out. In each case, the damage was traced to the use of a plastic packaging material. A static charge was built up between the inside wall of the plastic bag and the receiver. Eventually, this voltage discharged into the set through the antenna connection.

In Brazil, the cause of some failures was traced to static electricity in the air built up by charged clouds and thunderstorm activity in the area. Still another cause of failure was traced to discharges occurring in certain atmospheric conditions when a car passed under high-power grid lines.

What can be done about this gremlin? According to Signalite, all you have to do is install an inexpensive neon lamp (dark-compensated LT-2-24) between the antenna terminal and the set's ground. The neon lamp fires when any high voltage is impressed across it and effectively shunts the potentially damaging voltage to ground. At other times, the neon lamp is simply a high im-

pedance and has no effect on the set's operation. A British car manufacturer reports that 63% of all transistor radios returned for service had their first stages blown out by high-voltage transients. After using neon lamps in later models, the sets returned for service dropped to 3%.

Some people, aware that the antenna may be a problem, are connecting ordinary diodes between the antenna and ground, the theory being that the diode will conduct at about a half a volt or so and thus protect the set. This does work; however, in strong signal areas, it can produce a lot of cross modulation with accompanying distortion and strange signals.

Radiation and IC's. Perhaps the toughest problem the semiconductor design engineer has had to face in recent years has been to come up with integrated circuits that will continue to function when exposed to the types of radiation encountered in satellites and space vehicles. Even moderate radiation levels can cause built-in IC resistors to increase in value, diode-type capacitors to lose capacitance, and transistor leakage currents to increase while current gains drop.

Simple shielding, as used in a nuclear power plant, for example, has not been a satisfactory answer because the necessary shields are too heavy and bulky for all but a few applications. The designer's solution, found after extensive research and experimentation, has been to develop "hardened" circuits, capable of satisfactory performance even when directly exposed to moderate radiation levels.

The first commercially available line of radiation-hardened IC's was introduced at the annual IEEE Show and Convention last March by Radiation, Inc. (Melbourne, Florida 32901), a division of the Harris-Inter-type Corporation. The new line includes a family of logic circuits, an operational amplifier, a dual level shifter, and a dual 4-input line driver.

In pioneering the production of hardened IC's, the manufacturer combined sophisticated circuit design methods with a number of unique processing steps to achieve radiation resistances two orders of magnitude

greater than those of conventional *pn*-junction integrated circuits. Among the new techniques are the use of dielectric isolation, thin-film resistors over oxide instead of sensitive semiconductor tapes, small active device geometries, shallow diffusions and ultrasonic aluminum contact wire bonding. The new premium-priced devices are packaged in standard TO-86, 1/4" square flat packs.

Reader's Circuit. A high-school sophomore, Tim Wallace (29242 Ashwood Dr., Wickliffe, Ohio 44092), submitted the line-powered interval timer circuit shown in Fig. 1. Tim writes that he developed the circuit after he became frustrated with the breakdown of costly mechanical timers. The project uses non-critical components, may be used in a variety of applications, and can be assembled quite easily by the average hobbyist in one or two evenings.

As shown in the diagram, Tim has used a pair of *npn* transistors, *Q1* and *Q2*, as d.c. amplifiers in the high-gain Darlington configuration. Circuit power is obtained from a conventional d.c. power supply made up of half-wave rectifier *D1*, ripple filter capacitor *C1*, and neon-type pilot lamp assembly, *I1*. Series current-limiting resistor *R3* and shunt resistor *R6* protect *Q1* and *Q2* from excessive currents and collector voltages, while relay *K1* is used as the output device.

In operation, d.p.d.t. switch *S2* serves as the recycling control. With *S2A* closed and *S2B* open, timing capacitor *C2* is charged slowly through *R1*. This capacitor serves as the base bias source for the Darlington amplifier, with the actual bias determined by

the voltage divider made up of *R2*, *R4*, and *R5*. The setting of *R5* determines the point on *C2*'s charging curve at which bias is applied to *Q1* and *Q2*. When the bias is sufficient, the transistors conduct current and *K1* is energized. The relay remains closed until the timing cycle is restarted by a momentary actuation of *S2*. This opens the power supply and discharges *C2*.

Conventional parts are used in the timer. The relay is a Price Electric type 5509-24HS with a 5000-ohm coil, and *I1* may be any commercial 125-volt neon pilot lamp assembly (Leecraft type 36EN2111, for example).

Point-to-point, perf board, or etched wiring may be used since neither parts arrangement nor wiring dress is critical. Jack or screw-type terminals should be provided for the external relay contact connections. The completed circuit, after checkout and test, can be housed in a suitable metal or plastic enclosure.

Parts substitutions may be made in some cases. If preferred, equivalent *pnp* transistors may be used instead of the specified *npn* types, provided polarities are reversed on *D1*, *C1*, and *C2*. The pilot lamp assembly is optional and may be omitted. A larger- or smaller-value capacitor may be used for *C2*, with a corresponding change in the basic timing range. According to Tim, the values given provide timing intervals of 1 to 10 minutes, depending on the setting of *R5*.

In practice, the relay's contacts are used to switch an external circuit after a preset time interval. The external equipment may be turned on or off; and it is possible to arrange the external circuit so that one piece

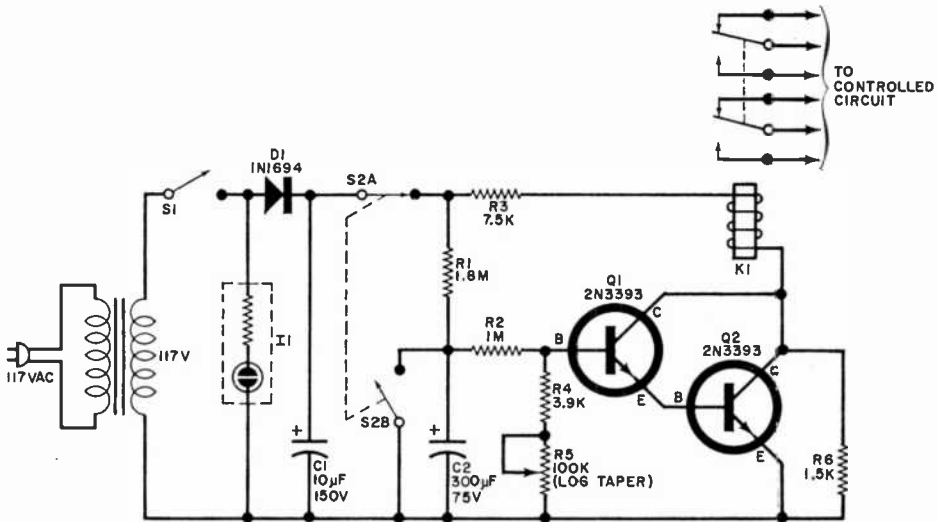


Fig. 1. In this interval timing circuit, the values of *C2* and *R1* determine the length of time before the relay closes. It can be anywhere between 1 and 10 min.

of equipment is turned on while another is turned off.

Manufacturer's Circuit. Although originally designed for use in a transformerless, transistorized TV set, the audio amplifier shown in Fig. 2 may be used for a variety of other applications—such as a simple p.a. or intercom system or an inexpensive phonograph. It is one of eleven related circuits described in an RCA booklet entitled "Power Transistors—Typical Audio Amplifier Circuits." According to the manufacturer, this line-powered circuit is capable of delivering 4.5 watts (r.m.s.) when driven by a 70-mV signal and has a frequency response flat (within 3 dB) from 18 Hz to 18 kHz.

With *npn* transistors throughout, the circuit uses a common-emitter drive, *Q1*, direct-coupled to a class A push-pull power amplifier, *Q2-Q3*. Inverse feedback is applied to *Q1*'s emitter through *R6*, while compensated and stabilized d.c. base bias for *Q1* is obtained from the output stage's emitter circuit through voltage-divider *R2-R5*, bypassed by *C2*. The power amplifier is unique in that the out-of-phase drive signal for *Q3* is obtained from the emitter circuit of *Q2* (*R7* and *R8*), which eliminates the need for a separate phase inverter or a center-tapped driver transformer. Transformer *T1* matches the output of the push-pull transistor stage

to the loudspeaker coil. A conventional half-wave d.c. power supply is used, consisting of rectifier *D1* and a filter composed of *C6*, *C7* and *R11*. Resistor *R10* and capacitor *C3* form an isolation filter for the driver. Fuse resistor *R12* provides overall circuit protection.

Conventional construction techniques may be used for circuit assembly, but good audio wiring practice should be followed, with all signal leads kept short and direct. Adequate isolation should be provided between input and output circuits. Both *Q2* and *Q3* should have heat sinks and, of course, all component polarities must be observed.

Although component values need not be adjusted after assembly and check-out, it may be necessary to reverse the connections to the secondary of *T1* to insure correct feedback phasing (through *R6*) for minimum distortion and maximum stability.

The completed amplifier has an input impedance of 5000 ohms and is designed for use with an RCA type CA3013 integrated-circuit sound i.f. amplifier. If used with another signal source, such as a simple pre-amp, circuit impedances must be matched for optimum performance.

Device News. The unique plastic-encapsulated phototransistors illustrated in Fig. 3
(Continued on page 93)

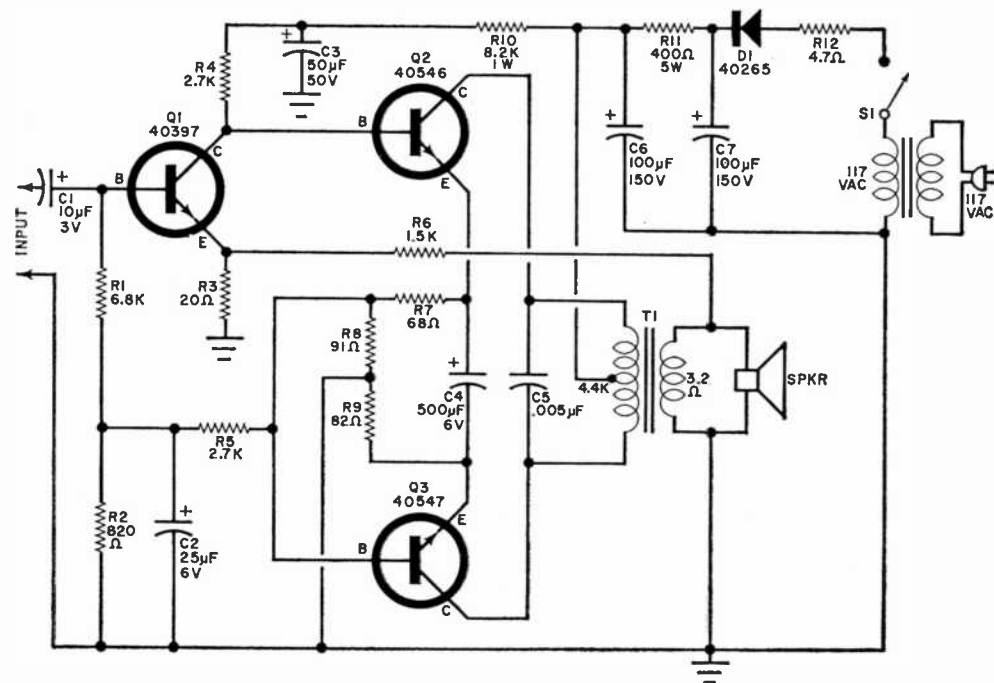


Fig. 2. Versatile audio amplifier can be used in a variety of applications. Output is 4.5 watts from a 70-mV signal and frequency range is from 18 to 18,000 Hz.



SHORT-WAVE LISTENING

By **HANK BENNETT**, W2PNA/WPE2FT
Short-Wave Editor

U. S. PIRATE STATION LOCATED

WHILE TUNING the 2400-2500-kHz marine band in search of some of the low-power tropical broadcasters, your columnist stumbled onto a station that was broadcasting in English! Over a three-week period, this 2400-kHz station gave several different ID's, including KCBY (or KCDY), WXMZ, and *King Kong Radio*. It also used the phrase "operating at 1200 on your radio dial." There were no locations given and no commercials; there were many periods of pop music and small talk. One monitoring session revealed a recording supposedly made by a well-known night-club entertainer. This particular program can be classified only as obscene.

All periods of monitoring were between 2300 and 0200; at other times, the station was not heard. It was inaudible on its primary frequency of 1200 kHz although a check with Gordon Nelson of the National Radio Club informed us that the station had been heard on 1203 kHz at his eastern Massachusetts home. During the monitoring period only one announcement was made that gave any clue as to the possible location of the station. This had to do with the closing of a school due to weather conditions.

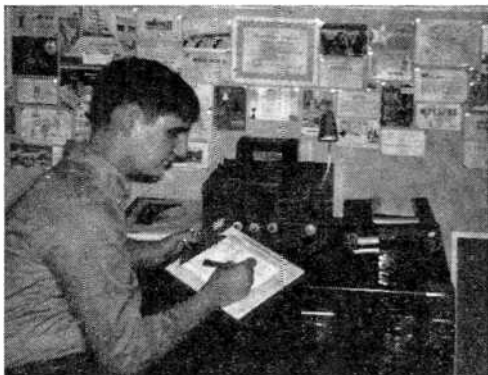
Because of the broadcast containing the night-club recording, a letter was sent to the Federal Communications Commission. One week later, another letter was sent to the FCC with more details. Neither report was acknowledged.

A check with Miss May Bennett, a school administrator in the Cape Cod area (and my sister) showed that there is a regional high school in Massachusetts bearing the name of the school mentioned in the school-closing report. A letter was sent to the principal of the school explaining the situation with regard to operating a broadcasting station without a license and the penalties that might be incurred if the FCC caught the operators.

Shortly thereafter a letter was received from the principal thanking me for my information and stating that he had located the guilty parties, had called them into his office, explained FCC rules to them and had them read my letter in his presence. The boys were not aware that they were operating in an

illegal manner and promised to cease operations at once.

Sweden Calling DX'ers. The very popular mimeographed bulletin that has been issued weekly for 20 years by *R. Sweden* has been discontinued. This bulletin, with a free distribution in excess of 1200, was a favorite of DX editors, clubs, and individuals. A reduction in the budget was given as the reason.



A Hallicrafters S-72 receiver is the chief piece of equipment used by Ed Tufexis, WPE3HTJ, Pittsburgh, Pa., to bring in DX. To date he has 37 countries and 24 states logged; 16 of each verified. He's a member of "R. Canada" Short-Wave Club.

CURRENT STATION REPORTS

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

Albania—*R. Tirana* was noted in English on 6200 kHz from 0233-0257 s/off, on 5948 kHz from 0559 s/on, and on 7124 kHz rebroadcasting Peking at 0110.

Australia—Darwin's new 250 kW outlets have been tuned on 9595 kHz at 1110 in Indonesian and on 9610 kHz at 1315 in Vietnamese. Other new channels in use by *R. Australia* include 7205 kHz at 1135-1200 with Keith Glover and 15,355 kHz, dual

DX STATES AWARDS PRESENTED

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

20 STATES VERIFIED

Richard Williams (WPE3FYG), Lebanon, Pa.
 Dan Biederman (WPE2QHO), Scarsdale, N. Y.
 Anthony Macone (WPE1HHE), Somerville, Mass.
 Bruce Slykhouse (WPE8JXB), Dearborn, Mich.
 Howard Kreutzberg (WPE1HDO), Mystic, Conn.
 Duane Hayes (WPEØFGM), Denver, Colo.
 Arvidas Jarasius (WPE9JFS), Lansing, Ill.
 Stephen Anthony (WPE1HIE), Lincoln, R. I.
 Larry Douglas (WPE6HDM), Burbank, Calif.
 John McGing (WPE9JFC), Chicago, Ill.
 Ronald Del Buono (WPE2PYJ), Union City, N. J.
 Ron Budziak (WPE9JHK), Cicero, Ill.
 Charles Brooks (WPEØEXW), Mitchell, S. D.
 Stephen Ruggles (WPE1HCH), Lunenburg, Mass.
 Dean Hanson (WPE6MF), Redwood City, Calif.
 Alan Carpenter (WPE8JXS), Fairmont, W. Va.
 David Peters (WPE6HDM), Modesto, Calif.
 John Norton (WPE2PXT), Orange, N. J.
 Thomas Lamphere (WPE2QDB), Johnson City, N. Y.
 Stephen Adamus (WPE2PCP), Livingston, N. J.
 Michael Razor (WPE9GOJ), Burlington, Wisc.
 Joel Dennis (WPE3HJJ), Shickshinny, Pa.
 James Daley, Jr. (WPE4JUR), Atlanta, Ga.
 Ron Wicks (VE5PE6B), Cut Knife, Sask.
 Steve Sprague (WPEØEVU), Coffeerville, Kansas
 James Blumenfeld (WPE2QGD), Monticello, N. Y.
 James Bochantin (WPE9JDA), Du Bois, Ill.
 Steven Jacobs (WPE9IMQ), Chicago, Ill.
 Marshall Brooks (WPE2POW), Rochester, N. Y.
 Laurie Coghlin (VE4PE7N), Winnipeg, Man.
 Elliott Moscot (WPE2QER), Brooklyn, N. Y.
 Robert Hayes (WPE6HEH), Los Angeles, Calif.
 Jay Ayers (WPE2PMV), Endicott, N. Y.
 Robert Asbury (WPE2PYT), Williston Park, N. Y.
 Steven Schwartz (WPE2QLN), Brooklyn, N. Y.
 Wayne Howell (WPE8JYM), Livonia, Mich.
 Lee Kovel (WPE8JOB), Shaker Heights, Ohio
 Bradford Wall (WPE6GCJ), San Bernardino, Calif.
 Moshe Shatkai (4X4PE1L), Jerusalem, Israel
 Martin Miron (WPE8JTN), Warren, Mich.
 Edward Stone (WPE3HQN), Silver Spring, Md.
 Ori Siegel (WPE2QIX), Toronto, Ont.
 Vincent Geraci (WPE1HMP), Shelton, Conn.
 Richard Miller (WPE4JRN), Richmond, Va.
 Mitchell Stern (WPE2QIA), Brooklyn, N. Y.
 Richard Davis (WPEØAKR), Denver, Colo.
 Glen Whitney (WPE6GQY), Canoga Park, Calif.
 John Berszoner (WPE9IZE), Lemont, Ill.
 John Nickele (WPE9JIK), Chicago, Ill.

Jonathan Tara (WPE8KBT), Detroit, Mich.
 Rick Schiffer (WPE3HLL), Franklin, Pa.
 Frank O'Donnell (WPE6HFD), La Habra, Calif.
 Redd Swindells (WPE2PXK), Oswego, N. Y.

30 STATES VERIFIED

Don Zimmerman (WPEØFDR), Madison, S. D.
 Mark Halliday (WPE3HKR), Doylestown, Pa.
 Alan Harris (WPE8JQY), Oak Park, Mich.
 Eugen Floda (WPE2OFH), Fort Hood, Texas
 Frank Hames (WPE3CDM), Silver Spring, Md.
 Dave Gellerman (WPE9JBC), Wisconsin Rapids, Wisc.
 Roger Cox (WPE4JOX), Fort Lauderdale, Fla.
 Jimmy Chocklett (WPE4IDH), Wilson, N. C.
 Steve Johnson (WPE5EWF), Tulsa, Okla.
 Jeff Blumenfeld (WPE2KKM), Monticello, N. Y.
 Jon Pearkiss, Jr. (VE7PE1CQ), Burnaby, B. C.
 Gerald Larocque (WPE1GED), Greenfield, Mass.
 Gary McNelly (WPE9IRG), Cahokia, Ill.
 Dave de Manigold (WPE8JUT), Detroit, Mich.
 Robert Levin (WPEØFBN), Minneapolis, Minn.
 Walter Kakareka (WPE3GFx), Moscow, Pa.

40 STATES VERIFIED

David Condor (WPE9IHV), Centralia, Ill.
 Gary Ligon (WPE4JAX), Cliffside, N. C.
 Bruce Kirkpatrick (WPEØDZY), Topeka, Kansas
 Robert Gage (WPE9IXZ), Lafayette, Ind.
 Thomas Gracie, Jr. (WPE2FXL), Collingswood, N. J.
 Timothy Armstrong (WPE6GGJ), Suisun, Calif.
 Robert Buckner (WPE2NMO), Rush, N. Y.
 Viktor Decyk (WPE1FCJ), Colrain, Mass.
 Gregory Jones (WPE6FCK), Pacific Palisades, Calif.
 Ron Miller (WPE6GLB), Santa Ana, Calif.
 Sam Chmell (WPE9ITW), Elmwood Park, Ill.
 Christopher Lucas (WPE1FNN), Fairfield, Conn.
 Andrew Cooper (WPE8JNC), Westland, Mich.
 Roy Carroll (WPE2QAA), Neptune, N. J.

50 STATES VERIFIED

Robert Downey (WPE4INN), Newport News, Va.
 Robert Baker (WPE2PFM), Pitman, N. J.
 William Via (WPE3FHB), Baltimore, Md.
 Charles Harris (WPE2OGK), Rochester, N. Y.
 Leo Fleury (WPE2KUR), New York, N. Y.
 Mike Hogan (WPEØEPI), St. Louis, Mo.

to 15.320 kHz. at 0925 with English pop music. Many reports have been received concerning *R. Australia's* unexpected appearance on 3280 kHz with play-by-play cricket matches. These cricket matches were played in Australia and the ABC used the facilities of the Windward Islands Broadcasting Corp., St. Georges, Grenada.

Bahrain—An overseas report tells that *R. Bahrain*, P. O. Box 253, Manama, has been heard testing in English at 0745 in the 16-meter band.

Biafra—After an absence of several months, *Voice of Biafra*, Enugu, has returned to the air on 6145 kHz where it operates 0500-0200. It has been heard 0630-0645 with news in English. Also at 2200-2245. A European report lists a mobile station being used by *Voice of Biafra* on 6100 kHz with English at 2230-2350.

Bolivia—CP18. *R. El Condor*, Oruro, 6070 kHz, is heard around 0159 with commercials, time checks and ID's.

Canada—*R. Canada's* service to N.A. and the Antilles is now at 0717-0813 in English on 11.720 and 9625 kHz. and at 0815-0843 in French on 11.720 kHz. The Northern Service was logged on 9625 kHz at 2215-2235 in English with music, news, and sports items. The proposal to suspend the International Service has itself been killed. New plans call for installing five new 250-kW xmtrs to supplement the three existing 50-kW xmtrs which have been in use since 1945; later to replace the 50-kW units with two additional 250-kW xmtrs. The first item of business is the relocation of medium wave CBA (1070 kHz) to provide additional antenna space.

Ceylon—*R. Ceylon*, Colombo, is fair in English to S.E. Asia at 1130 on 17,830 kHz. Also widely reported on 15,230 kHz at 0130 s/on. *BBC* news at 0200 and with music to 0245.

China—*R. Peking* is noted on 7315 kHz in Portuguese to South America at 2250 and on 7120 kHz in English with news at 0300. A regional station in Urumchi on 10,245 kHz, is audible at times around 1330-1345 with Oriental music and talks in Chinese. Again we remind our readers who wish to send reception reports to *R. Peking* that you must address your letters to "People's Republic of China" to avoid having your mail returned. This is a directive of the U. S. Post Office Department.

Ecuador—During 1969, HCJB, Quito, is offering six new QSL cards. Half are of a technical nature, the rest will feature Inca art designs. HCJB has replaced 17,890 kHz with 17,860 kHz in English at 2330-0000 and are requesting reports. . . . The item last month on *Emisora Luz y Vida*, Loja, should have given 4712 kHz, not 4812 kHz. This one is noted around 0200.



One of our newer monitors is B. Hanetta Clark, of Inglewood, Calif. The receiver shown here is a Grundig Satellite 5000, with which she has logged and confirmed 50 countries. Recently, however, she has added a new Galaxy R-530 and a Mosley SWL-7 antenna. Her card from "R. Denmark" is her prize QSL since it is not easy to get on the West Coast.

Egypt—New channels in use by Cairo include the following: 7234 kHz from 0300 s/on in Arabic, 9850 kHz with Arabic news at 2345-2351 s/off, 11,785 kHz to 2313 s/off, 15,260 kHz with chanting at 1830-1845, then clock chimes and news, 15,300 kHz with IS and s/on at 0300, 17,725 kHz with English to W. Africa with news at 2115 and s/off at 2200, and 17,840 kHz at 2230 with Arabic music. Other channels reported include 9475 kHz at 0218 with English news and weather, and 12,005 kHz with English at 2145.

England—*BBC*, London, has this World Service schedule to N.A.: 2115-2315 on 15,140 kHz, 2115-0330 on 11,780 kHz, 2245-0330 on 9580 kHz and 2200-0415 on 6110 kHz.

Greenland—A recent QSL reveals the information that *Gronlands Radio*, sometime during 1969, will increase its output from 1 kW to 10 kW. An overseas report indicates good reception on both 5960 and 5980 kHz.

Haiti—What is thought to be *R. Capois la Mort*, Port-De-Paix, has been heard on 5040 kHz at 0140-0201 with pop records, French anmts and poor modulation.

Holland—A new frequency for *R. Nederland*, Hilversum, is 9615 kHz, found at 2100 with their weekly "Juke Box" program, each week prepared by a different DX'er; this runs to 2150 and has good DX tips.

SHORT-WAVE CONTRIBUTORS

Stephen Goldstein (*WPEIHNM*), Providence, R. I.
 James Podolski (*WPEIHOV*), Mousup, Conn.
 John Kiernan (*WPE2EMN*), New York, N. Y.
 John Banta (*WPE2PHU*), Bay Shore, N. Y.
 Roy Alson (*WPE2PMG*), East Meadow, N. Y.
 Richard Wells (*WPE2QHY*), Wayne, N. J.
 Tom Shultz (*WPE2QJ*), Cherry Hill, N. J.
 John Mac Donald (*WPE2QOV*), East Orange, N. J.
 Michael King (*WPE3GPI*), Rockville, Md.
 Tim Ohrmann (*WPE3HHA*), Monroeville, Pa.
 Peter Romeika (*WPE3HMV*), Rosemont, Pa.
 Ed Tufexis (*WPE3HTI*), Pittsburgh, Pa.
 John Wilson (*WPE3NB*), Wilmington, Del.
 Dan Ferguson (*WPE4AUL*), Coral Gables, Fla.
 Grady Ferguson (*WPE4BC*), Charlotte, N. C.
 John Rich (*WPE4CZH*), Columbia, S. C.
 Visco Jones (*WPE4DSM*), FPO, Vietnam
 Ralph Roberts (*WPE4HPT*), APO, Vietnam
 David Potter (*WPE4XO*), Key West, Fla.
 David Weronka (*WPE4KBE*), Durham, N. C.
 Richard Fortson (*WPE5EFA*), Edinburg, Texas
 Charles Bennett (*WPE5SW*), Sumrall, Miss.
 Dan Seibel (*WPE6HCU*), San Leandro, Calif.
 Darrell Neft (*WPE6HDI*), Costa Mesa, Calif.
 Jeff Uter (*WPE6HDI*), Carlsbad, Calif.
 Andy Lisowski (*WPE6HET*), Los Angeles, Calif.
 Chuck Sadoian (*WPE6HHG*), Dinuba, Calif.
 Herman Herbig (*WPE7CVL*), Gardnerville, Nev.
 Steve Frantz (*WPE7CWC*), Auburn, Wash.
 Jonathan Tara (*WPE8KBT*), Detroit, Mich.
 Gary Steele (*WPE8KEQ*), Benton Harbor, Mich.
 Gerry Dexter (*WPE9HDB*), Lake Geneva, Wisc.
 Richard Pistek (*WPE9HOA*), Chicago, Ill.
 Pat Griffith (*WPE9HVV*), Rockford, Ill.
 Jack Widner (*WPE9JDT*), Indianapolis, Ind.
 David Lubar (*WPE9JFD*), Elmwood, Ill.
 Charles Rann (*WPE9JFQ*), Wheaton, Ill.
 John Nickele (*WPE9JIK*), Chicago, Ill.
 Steve Jacobsmeyer (*WPE9JMJ*), Mt. Prospect, Ill.
 A. R. Niblack (*WPE9KM*), Vincennes, Ind.
 John Beaver (*WPE9AE*), Pueblo, Colo.
 Mike Martin (*WPE9BTP*), Manassas, Va.
 C. Vernon Hyson (*WPE9CVF*), Somerville, N. J.
 Clarence Wahl (*WPE9FQI*), Wichita, Kansas
 Marty Eggers (*WPE9FCA*), Avoca, Iowa
 Jack Perolo (*PY2PE1C*), Sao Paulo, Brazil
 Werner Breitkopf (*VE2PE1A*), Montreal, Que.
 Samson Voron (*VK4PE2R*), Coosque, N.S.W., Australia
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 Pat Briggs, La Canada, Calif.
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 Mike Caditz, Los Angeles, Calif.
 Mike Davis, Moberly, Mo.
 Thomas Fuhrman, Dumont, N. J.
 Jeff Golden, Westfield, N. J.
 Thomas Gongaware, Latrobe, Pa.
 Jerry Lenamon, Waco, Texas
 Mrs. Sue Medley, Waco, Texas
 Maik Nodine, Salem, Ore.
 Tom Palmer, Detroit, Mich.
 Steve Phelps, West Lafayette, Ind.
 Rick Straube, Hawthorne, Calif.
 Mike Taylor, Oklahoma City, Okla.
 Dan Tschopp, Humble, Texas
 R. Canada, Montreal, Que.
 Sweden Calling *DX'ers* Bulletin, Stockholm, Sweden

Iran—The first two 250-kW xmtrs for *R. Iran's* short-wave centre at Kamalabad have been ordered. Also, a 2000-kW xmtr is under construction for medium-wave service.

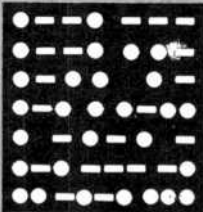
Israel—*Kol Israel* and *Kol Zion Lagola* is scheduled daily to Europe on 3009 kHz (50 kW), 9625 kHz (20 kW) and 9725 kHz (100 kW) at 1530-2000 in Yiddish, Persian, Hungarian, Rumanian, Ladin, Hebrew and Moroccan Arabic. English to Africa is given at 2015-2030 on 9009 kHz; French at 2045-2115 and English at 2115-2130 to Europe on all three channels, and in Eastern European languages at 2145-2200 on 9009 and 9725 kHz. Other tunings include the new experimental English service to N.A. at 0400-0415 on 9009 kHz, a language xmsn at 0430-0445 s/off on 9009 kHz, English at 0615 and French at 0630 on 9625 kHz.

(Continued on page 91)

ENGLISH LANGUAGE BROADCASTS FOR THE MONTH OF JUNE

Prepared by **ROGER LEGGE**

TO EASTERN AND CENTRAL NORTH AMERICA			TO WESTERN NORTH AMERICA		
TIME—EDT	STATION AND LOCATION	FREQUENCIES (MHZ)	TIME—PDT	STATION AND LOCATION	FREQUENCIES (MHZ)
7:00 a.m.	Stockholm, Sweden	15.315	8:00 a.m.	Tokyo, Japan	9.505
7:15 a.m.	Melbourne, Australia	9.58, 11.71	9:00 a.m.	Stockholm, Sweden	15.31
7:45 a.m.	Copenhagen, Denmark	15.165	7:00 p.m.	Melbourne, Australia	15.32, 17.84, 21.74
8:15 a.m.	Montreal, Canada	9.625, 11.72, 15.325		Tokyo, Japan	15.235, 17.825, 21.64
12 Noon	London, England	21.61	7:30 p.m.	Bonaire, Neth. Antilles	9.695
7:00 p.m.	Montreal, Canada	9.625, 15.19, 17.72		Johannesburg, South Africa	5.98, 6.075, 9.705
8:00 p.m.	London, England	6.11, 9.58, 11.78, 15.14	8:00 p.m.	London, England	9.58, 11.78, 15.26
	Moscow, U.S.S.R.	11.87, 15.15, 17.745		Madrid, Spain	6.13, 9.76, 11.815
	Peking, China	17.673, 17.855		Moscow, U.S.S.R.	9.70, 11.96, 15.15
	Sofia, Bulgaria	9.70		Peking, China	15.095, 17.673, 17.795
8:30 p.m.	Johannesburg, South Africa	5.98, 6.075, 9.705		Prague, Czechoslovakia	7.345, 9.63, 11.99, 15.37
	Stockholm, Sweden	11.805		Seoul, Korea	15.43
8:50 p.m.	Brussels, Belgium	6.125, 9.615	8:20 p.m.	Taipei, Taiwan	15.125, 15.345, 17.89
	Vatican City	9.695, 11.785, 15.285		Yerevan, USSR (via Khabarovsk)	15.18, 17.79, 17.88
9:00 p.m.	Berlin, Germany	9.73, 11.89	8:30 p.m.	Berlin, Germany	9.73, 11.825, 15.17
	Budapest, Hungary	9.833, 11.91, 15.16		Stockholm, Sweden	11.705
	Havana, Cuba	9.655, 15.30		Tirana, Albania	6.21, 7.30
	Prague, Czechoslovakia	7.345, 9.63, 11.99, 15.37	9:00 p.m.	Budapest, Hungary	9.833, 11.91, 15.16
9:30 p.m.	Rome, Italy	11.81, 15.41		Havana, Cuba	9.655, 15.30
	Berne, Switzerland	9.535, 11.715, 15.305		Lisbon, Portugal	6.025, 11.935, 15.125
	Bucharest, Rumania	11.94, 15.25		Moscow, USSR (via Khabarovsk)	15.18, 17.79, 17.88
	Cologne, Germany	6.185, 9.735, 11.925		Peking, China	15.095, 17.673, 17.795
	Hilversum, Holland (via Bonaire)	9.59, 11.73	9:45 p.m.	Sofia, Bulgaria	9.70
	Copenhagen, Denmark	9.52		Bucharest, Rumania	11.94, 15.25
9:45 p.m.	Cairo, Egypt	9.475	9:30 p.m.	Kiev, USSR (Mon., Thu., Sat.)	11.96, 15.21
10:00 p.m.	Lisbon, Portugal	6.025, 11.935, 15.125		Berne, Switzerland	9.72, 11.715
	Moscow, U.S.S.R.	9.70, 11.87, 15.15	9:45 p.m.	Cologne, Germany	6.145, 9.545, 11.945
	Peking, China	15.06, 17.673		Havana, Cuba	9.655, 11.76
	Quito, Ecuador	9.745, 11.765, 15.115	10:00 p.m.	Quito, Ecuador	11.765
	Beirut, Lebanon	15.285		Tokyo, Japan	17.785
10:30 p.m.			11:00 p.m.	Moscow, USSR (via Khabarovsk)	15.18, 17.79, 17.88
			11:30 p.m.	Havana, Cuba	11.93



AMATEUR RADIO

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

AMATEUR RADIO PROGRAM BEGINS 10th TV SEASON

The program "Ham Operators Club" first appeared on the Alabama Educational Television Network in June 1959 and has been a regular summer feature of the network ever since. Frank Martin, producer of "Ham Operators Club," claims that the original idea for the 12-week series had a selfish motivation. He reasoned that, with it, he could study for his own amateur license and produce an interesting program at the same time. The theme of the program is to have fun while learning about Amateur Radio. The 12-week course is divided into 36 lessons that take the student from a "no-technical-knowledge" state to about where he can pass his Novice examination and operate his amateur station efficiently. Many students have gone far beyond these goals. Frank Martin's "selfish" aim in starting the program paid off. He is W4YMW and his wife, Doris, is W4YMX.

Selton Campbell, K4COY, the club's first theory instructor, stayed with the program until 1967. Herb Coleman, W4AVX, is the present instructor. Code instruction has been handled by James Foley, K4UQR; Jim Brinson, K4WOP; and Earl Brinson, K4BSK.

Stations in the Alabama Educational Television Network are WAIQ, Montgomery; WBIQ, Birmingham; WCIQ, Cheaha; WDIQ, Dozier; WEIQ, Mobile; and WHIQ, Huntsville. Further information may be obtained from Frank Martin, Asst. Studio Director, Producer "Ham Operators," Birmingham Area Educational Television, 2316 7th Ave., Birmingham, Ala. 35203. Television station KETC, St. Louis, Mo., also aired the program last summer.

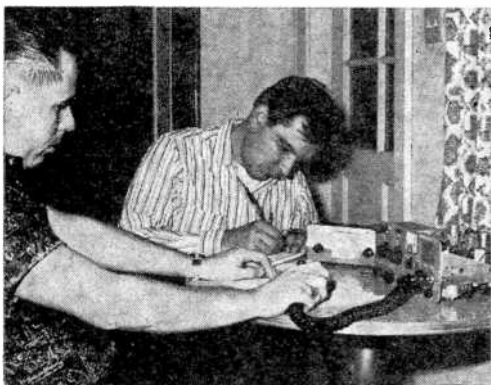
Items from Here and There. In a recent speech in New York City, Chester L. Bu-



AMATEUR
STATION
OF
THE
MONTH

Father Alan Malone, W7KBN, 8620 North 7th St., Phoenix, Ariz. 85030, needs Wyoming and Vermont for his Worked All States certificate. His Heathkit DX-60 transmitter, Hallicrafters SX-111 receiver, and Hy-Gain 14-AVQ vertical antenna have also worked South America, Japan, Guam, Puerto Rico, and many Canadian stations. We are sending W7KBN a 1-year subscription for winning this month's Amateur Station Photo Contest. You can enter the contest by sending a clear photo (preferably black and white) of you at the controls of your station and details about your amateur career to Amateur Station Photo Contest, Herb S. Brier, Amateur Radio Editor, POPULAR ELECTRONICS, Box 678, Gary, Ind. 46401.

chanan, head of the Ocean Engineering Branch, Ocean Technology Division, Naval Research Laboratories, Washington, D.C., a leader in the searches for the lost submarines "Thresher" and "Scorpion," praised the performance of electronic components in the ocean depths. He reported, however, that a 25-pound case is often required to protect an electronic device weighing only a few ounces from the tremendous deep-sea pressures. Many amateurs will recognize Buchanan as "Chet," W3DZZ. Chet's development, twenty years ago, of the process of inserting lumped resonant circuits ("traps") at predetermined positions in a 1/2-wave dipole produced a practical, shortened, multi-frequency, matched-impedance antenna. The thousands of multi-band verticals, dipoles, and beam antennas now using W3DZZ's idea attest to the soundness of his designs.



Phil Zobel, WA9RMT, and Ed Martin, K9ULU, handling messages over W9LJ during the Lake County (Indiana) Amateur Radio Club's public demonstration.

Japanese Amateur and SWL Awards.

Through the cooperation of Heinz, K7KHA, we are able to provide a list of the requirements for the amateur and SWL awards offered by the Japan Amateur Radio League, P.O. Box 377, Tokyo, Japan. To be eligible for an award, the applicant must submit QSL's (written confirmations) fulfilling the conditions of the award. Include a list of the stations worked (or heard) with dates and times, frequency and type of emission used, signal report, and location of the stations. All work must have taken place on or after July 30, 1952. All applications should be sent to Awards Manager, JARL and must be accompanied by the specified number of International Reply Coupons.

AJD and AJD/SWL: One QSL from each of the 10 JA/JH call areas, 1 through Ø. 10 IRC's.

WAJA and WAJA/SWL: QSL's from the 46 Japanese prefectures. 10 IRC's. The prefectures are: JA1—Tokyo, Kanagawa, Chiba,

Saitama, Ibaraki, Tochigi, Gumma, Yamana-shi. JA2—Shizuoka, Gifu, Aichi, Mie. JA3—Kyoto, Shiga, Nara, Osaka, Wakayama, Hyogo. JA4—Okayama, Shimane, Yamaguchi, Tottori, Hiroshima. JA5—Kagawa, Tokushima, Ehime, Kochi. JA6—Fukuoka, Saga, Nagasaki, Kumamoto, Oita, Miyazaki, Kagoshima. JA7—Aomori, Iwate, Akita, Yamagata, Miyagi, Fukushima. JA8—Hokkaido. JA9—Toyama, Fukui, Ishikawa. JAØ—Niigata, Nagano.

JCC and JCC/SWL: 100 QSL's from JA's/JH's in specified cities. JCC-200, -300, etc., also available. Send three IRC's for list of cities involved. 10 IRC's.

HAC: SWL reports from amateurs in the six continents. 5 IRC's.

Field Day, June 28-29. The annual American Radio Relay League "Field Day" is probably the most important amateur operating activity of the year. It demonstrates—to the public—amateur radio's ability to provide emergency communications. During Field Day, individual amateurs and club groups set up portable radio stations, operating from power sources independent of the regular power mains, in order to work as many other amateur stations as possible. Full details appear in the May issue of *QST*.

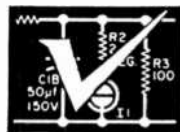
Rather than take the space to extol the Field Day, we simply report that 3117 stations and 12,200 individuals participated in last year's event.

First QSL Card: According to *Short Wave Magazine* (London), W. E. F. Corshan, G2UV, was the first to think of sending a postcard to confirm a radio contact. This was over 40 years ago; Mr. Corshan is still active on the air—still sending QSL cards.

(Continued on page 89)



Jerry Felts, WN5FTU, Henryetta, Okla., just passed his General class exam. As a Novice, he worked 46 states and 13 countries with his Heathkit DX-60B transmitter, Heathkit Twoer and Hallicrafters SX-140.



OPERATION ASSIST

Through this column we try to make it possible for readers needing information on outdated, obscure, and unusual radio-electronics gear to get help from other P.E. readers. Here's how it works: Check the list below. If you can help anyone with a schematic or other information, write him directly—he'll appreciate it. If you need help, send a postcard to Operation Assist, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016. Give maker's name and model number of the unit. If you don't know both the maker's name and the model number, give year of manufacture, bands covered, tubes used, etc. State specifically what you want, i.e., schematic, source for parts, etc. Be sure to print or type everything legibly, including your name and address. Do not send an individual postcard for each request; list all requests on one postcard. 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.

Dumont Labs type 154 oscillograph. Schematic, parts list, and manual needed. (George Havriliak, 58-43 77 Place, Elmhurst, NY 11373)

Hallicrafters Model SX-110 receiver. **Gonset** mobile 2 meter converter. **Knight** Model T-150A transmitter. Schematics and operating manuals needed. (Doug Grant, 23 Birchcroft Rd., Canton, MA 02021)

Hallicrafters Model S-120. Schematic needed. (Dale R. Trotman, 1083 Warnock Ave., Daytona Beach, FL 32014)

Electrovoice EV-6 speaker system. Buy new or used. (Les Borean, Box 156, Richmond, CA 94807)

Supreme Model 561 signal generator. Manual and schematic needed. (John Skurla, 2910 W. 35 Ave., Spenard, AK 99503)

Crosley Model 52 receiver. circa 1923. Schematic, parts placement diagram, and manual needed. (Robert Runnels, RR #1, Box 115, Wilmington, OH 45177)

Webster-Chicago wire recorder. Record/playback head needed or will buy/rent operating wire recorder. (Arnold Knutsen, 11 Alabama Ave., Merritt Is., Fla.)

Hallicrafters Model S-40 short-wave receiver. Schematic and operating manual needed. (William G. Philie, P.O. Box 945, Scottsbluff, NE 69361)

Ellis Associates Model BAM-1 bridge amplifier meter. Schematic and/or manual needed. (Alvin Marshall, Box 412, Pocomoke, MD 21851)

RCA Model 240-147 superheterodyne radio, circa late 1930's. Coils and L42C-54 ballast tube needed. (Daniel Oocsta, 45-25 48 St., Flushing, NY 11377)

RCA Rider Chanalyst. **Supreme** Model 576 signal generator. Operating manuals and schematics needed. (Arnold E. Smith, 9362 Gwendolyn Dr., OH 43065)

Knight Model KG-625 RF sweep generator. Assembly manual and schematic needed. (Ron Gillen, 1746-A N. Warren Ave., Milwaukee, WI 53202)

Knight-Kit 23B8187-E space-spanner receiver. Schematic, manual and parts list needed. (Max Churui, 1600 Louisiana, Houston, TX 77002)

E.H. Scott all-band receiver; serial number TT-342. Schematic, manual, and any information needed. (Robert H. Gleason, Grover Hill, OH 45849)

Hallicrafters Model S-38 receiver, 1946. Schematic needed. (Robert Antrim, 2513 Grant Rd., Broomall, PA 19008)

Hallicrafters Model S-40B receiver. Operating manual needed. (Dutee R. Yaghjian, 30 Mason St., Swansea, MA 02777)

RCA Model 20 Radiola. Schematic and source of tubes needed. **Atwater Kent** Models 20 and 40. Want to purchase speakers for same. (Norman W. Halverson, 1903 Hillcrest, Grand Haven, MI 49417)

Philco Model 7001 VTVM. Schematic and source of parts needed. (Dave Trimble, 2900 Wyoming Ave., Burbank, CA 91505)

Transis-Tronic Model S 15 stereo amplifier. Number P-43-ATC 133-A output transformer needed. (S. Gay-lardo, 128 Clinton Ave., Brooklyn, NY 11205)

Webster-Chicago Model 210 tape recorder needed plus Webster tape and reels. (LaMar C. Mertz, Jr., 2141 Grove Rd., Bethlehem, PA 18018)

Readrite Model 430 tube tester. Operating instructions needed. **Hallicrafters** Model S-38E receiver. Servicing manual needed. (R. Paskevitz, 37 Greeley St., South-Side, Pittsburgh, PA 15203)

RCA Model III-A Radiola, early 1920's. WD-11 tubes needed; can use UV or UX 199's. (O.B. Toole, 133 W. 3rd St., Uhrichsville, OH 44683)

Heathkit Model TC-2 tube tester. Assembly instructions needed. (Robert F. Selden, Susan, VA 23163)

Graybar Model 550 BC receiver. Schematic and power transformer type GW250 ER needed. **Philco** Model 18 receiver, code 121. Schematic and alignment data needed. (William Petrowsky, 335 Vaughn St., Johnstown, PA 15906)

Lumatron Electronics Model 112A-3589 sampling oscilloscope. Schematic needed. (William D. Tuttle, Jr., Dependent Mail Section, APO San Francisco 96301)

Concord stereophonic Model 440 tape recorder. Operating manual needed. (F. J. Estvan, Jr., 2346 Geneva Terr., Chicago, IL 60614)

Philco Model 40-180 receiver. Schematic needed. (David Turkel, 36 Menzel Ave., Maplewood, NJ 07040)

Electronic Measurements Model 200 transconductance tube tester, circa 1954. Schematic, specs, and/or operating manual needed. (Arman Dolikian, 18162 San Rosa, Lathrup Village, WA 98075)

McMurdo Silver R9 antenna tuner. Operating instructions needed. (Donn Miller, 2353 San Juan Ave., Walnut Creek, CA 94596)

Zenith Model 7G605 portable radio. Schematic and source for parts needed. (Grover Carson, 66-34 60th Pl., Ridgewood, NY 11227)

Supreme Instruments Model 563 audio oscillator. Schematic, tube layout diagram, or tube complement list needed. (Marvin R. Weinstein, 3232 E. Stanford Dr., Paradise Valley, AZ 85251)

National Model NC 60 Special. Schematic, operating manual, and tuning procedure needed. (Justin E. DeVault, Jr., 610 Foxx St., Johnson City, TN 37601)

Heathkit Model CB-1 transceiver. Assembly and instruction manual needed. (Bill Swafford, Banner Elk, NC 28604)

Heathkit Model XR-1, P or L. Source for parts needed. (George E. Raymer, 28 Ash St., Galeton, PA 16922)

Crosley Model 817 BCB and SV radio. Schematic and parts list needed. (Lowell Kursinsky, 2927 Ridley Rd., Palms, MI 48465)

Channel Master Model 6512 superhet. Schematic and tuning capacitor needed. (Norman Tyson, Jr. RD 1, Box 240, Laurel, MD 20810)

GE Model T1225 A radio. Schematic and wiring diagram needed. (Don Hofer, 1402 Mimosa Lane, Silver Spring, MD 20904)

EICO Model 221 VTVM. Instruction and maintenance manual needed. (H. C. Cain, Box 66, Coal Hill, AK 72832)

Olson Model RA 717 CB radio. Schematic and tube
(Continued on page 88)

ASSIST

(Continued from page 87)

placement chart needed. (John Spina, 8915 Major Ave., Morton Grove, IL 60053)

Hallicrafters Model SX-28. Source for parts needed. (E. A. Sjolander, Jr., 119 7th St. W., Ashland, WI 54806)

Philco Model 7109 oscilloscope. Schematic and specs needed. (E. Ganger, 516 Kirkwood Ln., Virginia Beach, VA 23452)

Dumont Type 208-B oscillograph. Manual and schematic needed. (Kirk Dahl, 5111 Aldrich Ave. South, Minneapolis, MN 55419)

National Model SCR3 XTAL controlled receiver, circa 1945. Source of coils and Xtals needed. (Mark L. Du-bay, 500 S. Gilbert, Fullerton, CA 92633)

Colonial Radio Model 158 radio. Schematic needed. (Everardo Flotte, P.O. Box 1242, Presidio, TX 79845)

Raytheon Model UM30-1 high-band transceiver. Schematic, operating and/or tuning instructions needed. (Reeve Fritchman, Lehigh Radio Network, Bethlehem, PA 18015)

AMI Model AA audio frequency amplifier. Schematic and any information needed. (Dennis Adams, 1040 Tu-lane Ave., San Leandro, CA 94579)

Dumont Model 304H cathode ray oscillograph. Operating manual and schematic needed. (R. W. Merdler, 3254 Flamingo Dr., Saginaw, MI 48601)

Hoffman Model 769 FM/AM portable car radio. Schematic needed. (Chris Holmes, 1725 Orchard, Fresno, CA 93703)

Hallicrafters Model S-38D SW receiver. Schematic, alignment information, and operating manual needed. (Steven Solomon, 582 Larch Ave., Saddle Brook, NJ 07862)

Galaxy Model R-530 receiver. Operating manual and any information needed. (James Dalterio, 356 High St., Webster, MA 01570)

RCA Model 7T, circa 1935. Schematic, operating manual, parts list, and source for parts needed. (Michael Krausnick, 1902 3rd Ave., Scottsbluff, NE 69361)

Majestic Model 90-B. Schematic and parts needed. (R. Vaux, 6159 King Ave., Maywood, CA 90270)

Polyphase Instrument Model TA-1A transistor analyzer. Operating manual and schematic needed. (John Jenkins, 1219 College St., Milton Freewater, OR 97862)

Hallicrafters Model S-38E receiver. **Sparton Model 69 "Equasone"** BCB receiver, circa 1928-30. Schematics and alignment data needed. (Reid C. Wheeler, 702 1/2 Pleasant, Walla Walla, WA 99362)

RCA Model 6t2. Schematic and source for parts needed. (Herbert Crosby, 2729 Millard, Shreveport, LA 71108)

Heathkit Model OM-3 oscilloscope. Schematic or construction manual needed. (E. C. Galland, William H. Carr Jr. High School, 157th St. & 17th Ave., Whitestone, NY 11357)

Philmore Model 700 ICR SW/AM. Schematic and instruction manual needed. (Bobby Richey, Rte. 1, Noble, LA 71462)

Meissner analyst, circa 1948-50. Schematic, operating instructions, and source for parts needed. (N. B. Adams, 1902 Dahlia Cir., Nashville, TN 37210)

Korting Model 158 S tape recorder. Schematic needed. (Russell Pastuch, 472 Locksley Bay, E. Iklidonan 15, Manitoba, Canada)

Superior Instruments Model TV-50 generator. **Superior Model 76 C. R. bridge and signal tracer.** Schematics and operating instructions needed. (Clifford J. Fink, 71 S. Linwood Ave., Norwalk, OH 44857)

Echophone Commercial, circa 1945; has 6 tubes; covers .54-30 kHz. Schematic and/or manual needed. (Tom Smith, 7808 E. 108 Terr., Kansas City, MO 64134)

Heathkit Model ES-400 modular analog computer. Assembly manuals needed. (Tim M. Sharon, 1206 N. Fair-lawn, Santa Ana, CA 92703)

Stromberg-Carlson serial no. 880912274 stereo 8 amplifier. Operating instructions needed. (David M. Kingsley, 511 Mapleview Rd., Cheektowaga, NY 14225)

RCA Model 7-BX-10 radio. Substitute tube (50A1) and wiring diagram needed. (Jennings Parrott, 3936 Ventura Canyon, Sherman Oaks, CA 91403)

Atwater Kent Model 145 receiver. Schematic, source of parts, and operating manual needed. (Brian L. Mack, Rte. 1, Piedmont, KS 67122)

Solar Model CF Exam-Eter. capacitor analyzer. Manual and schematic needed. (James Hamilton, 1894 Mendota, Detroit, MI 48221)

Hallicrafters Model SX-28 "Super Skyrider" receiver. Schematic and servicing manual needed. (Gavino B. Bautista, LUSAT Amateur Radio Club, La Union School of Arts and Trades, San Fernando, La Union B-515, Philippines)

Hallicrafters Model S-41W "Skyrider Jr." SW receiver. Main tuning capacitor, 048-000-144, and parts list needed. (Eric Franks, RFD #5, Findlay, Ohio)

RCA Radiola 17 and 18. Wood cabinet needed. **Atwater Kent Model 55.** Metal cabinet needed. (W. D. Huney-cutt, Box 535, Norwood, NC 28128)

Superior Instruments Model 50 A geneometer. Instruction manual and schematic needed. (Arvin Richardson, Box 389, Ashley, OH 43003)

Hallicrafters Model S-40A receiver. Schematic needed. (Thomas P. Kelfer, 101 Long Lake Blvd., Akron, OH 44319)

Philips Industries Model CM23L receiver. Schematic and operating manual needed. (Daniel Crampton, 62b Chesterton Dr., Ottawa 5, Ont., Canada)

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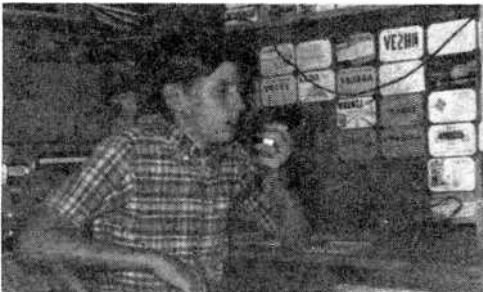
AMATEUR RADIO

(Continued from page 86)

NEWS AND VIEWS

Collector and Emitter, the bulletin of the Aeronautical Center Amateur Radio Club, Oklahoma City, reports that **Fred M. Conover, W7QPK**, Great Falls, Montana, dropped in at the Los Angeles office of the FCC (with his Conditional class license in hand) and took all the amateur examinations the FCC would give him. He passed the 13-wpm General code test, the General and Advanced class written exams, the Extra class 20-wpm code test, and the Extra class written exam. The entire ordeal took approximately three and a half hours.

G. W. Powell, WN5WLI, P.O. Box 662, Jonesboro, Ark. 72401, got his Novice license two months after first getting interested in amateur radio. Three months later, he passed his General test—but the ticket has not arrived. Before you read this, he plans on taking the Advanced class exam! In three months he has worked 30 states, using a Heathkit TX-1 transmitter and Heathkit RX-1 (Mohawk) receiver in conjunction with dipole antennas. He keys with a homebrew electronic keyer and has a Heathkit SB-10 SSB adapter standing by. . . . As many prospective amateurs, **Wayne Anreychik, WN2IIZ**, P.O. Box 731, Manville, N.J., stalled around for a couple of years before buckling down to learning the code. But once the decision was made, it didn't take long. In three weeks as a Novice, Wayne has worked 33 states, Canada, England, and Germany. A Knight-Kit T-60 transmitter, Hammarlund HQ-110 receiver, and a 40-meter dipole contributed to the record.



Greg Ginn, WB6ZNM, Hermosa Beach, Calif., worked 95 countries running 100 watts to a GSB-100 transmitter. He plans on a new 1000-watt amplifier soon!

Bruce Fingerhood, WB6UOH, 18420 Los Alimos St., Northridge, Calif. 91234, has been licensed for two years and will be trying for his Advanced ticket about the time you read this. Bruce uses an EICO 753 transceiver on 80-, 40-, and 20-meter SSB and a Heathkit DX-100 on 160, 15, and 10 meters. Although he has a 3-element, 20-meter beam, Bruce's favorite bands are 40 meters (SSB and CW) and 15 meters (CW) using a homebrew vertical antenna. WB6UOH has worked all states and all continents, as well as 35 countries. Oh yes, an ancient Hammarlund HQ-120X receiver is used in conjunction with the DX-100. . . . **Lee L. Gamble, WN6PAQ**, 750A Colorado, Chula Vista, Calif. 92010, works 80 and 40 meters but makes the 15-meter scene at times. His Knight-Kit T-60 transmitter feeds either a Hy-Gain 18-AVQ vertical antenna or a 15-meter rotary beam. A Heathkit SB-301 does the receiving. A Heathkit SE-101 transmitter and SB-200 linear amplifier await the day Lee gets

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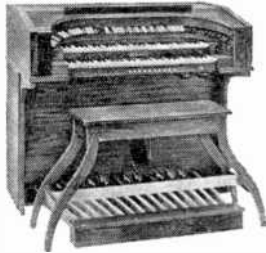
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his General ticket. Another "rag-chewer," Lee much prefers long chats to "hello-goodbye" contacts; so he has only 11 states and one foreign country confirmed. . . . Paul W. Olin, WA1FXD, 382 Linden St., Boyleston, Mass. 01505, started his Novice career with a Johnson Ranger transmitter and an inexpensive receiver without too much success until his neighbor, KIERT, told Paul that there were stations answering his CQ's! Paul's new (slightly used) Drake 2B receiver made a dramatic improvement in his results. Then, over a period of two years, he acquired General, Advanced, and Extra class licenses (he thinks he passed that last one), a Mosley TA-33-Jr, triband beam on a 70-foot tower, and a Johnson Valiant transmitter. Some SSB equipment is next on his "must-have" list.



Herb Coleman, W4AVX, teaches amateur radio on the 12-week "Ham Operators Club" aired over the Alabama Educational Television Network. The Collins 32V-2 transmitter, the modern Galaxy-V transceiver, and the electronic components on the studio wall are used to illustrate points in the televised lessons.

Bill Santee, WN9ZMF, 70 S. Lake St., Mundelein, Ill. 60060, had a real thrill when his first transmission on 15 meters was answered by a PY5 (Brazil)! So far, his Heathkit HW-16 CW transceiver, homebrew transmitter, and Hallicrafters SX-130 receiver have worked 31 states and three countries. A Hy-Gain 14-AVQ vertical antenna and a dipole do the radiating. A trip to the FCC office in Chicago is scheduled soon for license re-reading. . . . Doing it the hard way! Stewart S. Perry, W1BB, 36 Pleasant St., Winthrop, Mass. 02152, heard HKØTU, Malpelo Island, apparently answering his call for post-war country 100 and DXCC on 160 meters when everything went "dead." There was a short in the 235 feet of coaxial cable to the antenna. Climbing the antenna tower at midnight with the temperature at 33 degrees and the wind blowing at 25 MPH, Stew found a shorted, water-logged coax connector. Driving one and a half miles, Stew picked up an "emergency" piece of coax, returned, climbed the tower again and spliced in the new cable. Down the tower again and into the shack to connect the new cable to the antenna relay. Eureka! HKØTU was still there and answered W1BB's second call to make the 100th 160-meter country contact complete and official. The whole episode took just 30 minutes. As Stew leaned back to take a breath, he suddenly realized that he had forgotten to wear his safety belt when he climbed the tower. Excited?

Even if you didn't climb your tower at midnight, your friends would like to read about your exploits in "News and Views" and see your picture. Also, I appreciate being put or kept on the mailing list to receive your club paper. Address all mail to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P.O. Box 678, Gary, Ind. 46401.

73, Herb, W9EGQ

POPULAR ELECTRONICS

SHORT-WAVE LISTENING

(Continued from page 83)

Italy—Rome noted s/on at 0415 in Italian on 6095 kHz, a new frequency. Also good is the N.A. xmsn at 0105 in English and 0120 in French on 9575 kHz.

Kuwait—R. Kuwait was noted at 1415 with Arabic music on 17,795 kHz, apparently a new channel for the Home Service repl. 17,810 kHz. A tentative logging of the station is on 17,750 kHz at 1805 in Arabic.

Lebanon—Beirut opens in Arabic and English to Africa at 1830 on 15,350 kHz, another new frequency.

Liberia—ELWA, Monrovia, noted in vernacular on 15,170 kHz, up from their usual 15,155 kHz, at 1930; this was followed by religious programming. . . . The VOA relay in Monrovia was found at 6035 kHz at 2230 with clear ID.

Mauretania—Nouakchott, 4850 kHz, has an extended schedule on Sundays with native chanting until past their normal 2145 s/off.

Mozambique—R. Paz, Beira, is again audible at times on 7205 kHz from 0357 s/on and into Portuguese. . . . R. Clube Mozambique has a schedule different than that appearing in some publications. "A" Program in Portuguese is at 1630-2100 on 4925 kHz, 0430-1800 on 6115 kHz, 0430-2100 on 11,820 kHz and 0600-2100 on 15,295 kHz. All 25 kW except 6115 kHz which is 10 kW. The "B" Program in English and Afrikaans is at 1815-0345 on 3218 kHz (10 kW), 0300-0700 and 1500-2200 on 4855 kHz (20 kW), 0415-1745 on 6050 kHz (25 kW), 0630-1400 on 9620 kHz (10 kW) and 0300-1845 on 11,780 kHz (7.5 kW). "A Voz do Mocambique" in various African languages is aired at 0930-1200 and 1530-1930 on 11,845 kHz (100 kW).

Nicaragua—As reported last month, Radiodifusora Nacional Nicaragua Managua continues to be well heard on 5935 kHz from 2300-0400 s/off and now on the new frequency of 11,875 kHz at 1455-2130 with L.A. music, instrumental music, numerous ID's and requests for reports.

Norway—R. Norway, Oslo, is operating to the Pacific, West Indies and South America at 2000 on 11,735, 17,825, 21,655, 21,730 and 25,730 kHz and to West Indies, Central and South America and East Coast N.A. at 2200 on 15,125, 15,345, 17,825 and 21,655 kHz.

Peru—OAX5U, R. La Voz de Huamanga, Huamanga, listed for 4815 kHz, is actually on 6201 kHz where it is heard after 0200 with lengthy listener request periods, frequent ID's and time checks. OAX7K, R. Puno, Puno, 5925 kHz, is very weak with RTTY QRM after 0200 with light music, many ads and very few ID's.

Qatar—Qatar Radio, Doha, has this schedule: daily 0300-0535 (Friday to 0735) and 1300-1835 on 9570 kHz. Available frequencies include 6135, 7150, 9550, 11,710 and 11,900 kHz.

Reunion—According to a letter from the station, Saint Denis now uses 4 kW on 2446 and 4807 kHz at 0230-1800. Other short-wave channels appear to have been deleted.

Rhodesia—Gwelo noted at s/on at 0355 after an IS and into English on the new frequency of 5012 kHz.

Sudan—R. Omdurman observed around 0400 in Arabic on 7200 kHz although QRM from VOA generally prevents a positive ID.

Tanzania—R. Tanzania, Dar-es-Salaam, 15,435 kHz, generally poor at 1805-1835 with native music and commentary. R. Tanzania, Zanzibar, 9550 kHz, in Swahili home service noted at 1315 with African music and a few anmts.

Tunisia—R. Tunis, 15,215 kHz, is noted around 2315-2330 with a short anmt and anthem just prior to s/off; this may be a rough channel to tune in

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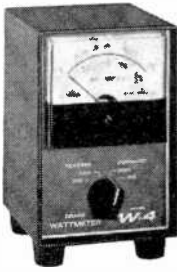
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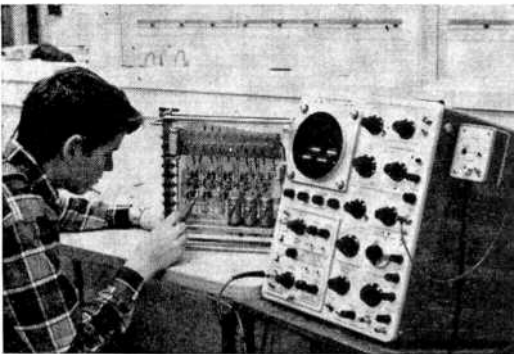
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although reports from Southern states indicate good reception.

Turkey—R. Ankara apparently has deleted its German and French xmsn at 1830-1930 on 9515 kHz in favor of all Turkish; however, German is aired at 2100-2130 on 15,160 kHz. English is still heard at 1415-1445 on 17,817 kHz and 2200-2230 on 15,160 kHz.

Uruguay—CXA3, R. Ariel, Montevideo, was logged with a period of commercials in Spanish followed by a short newscast at 2300 on 6075 kHz.

USA—Students of Oklahoma City University please note: we've received a report that your Electronics Division has received permission from the FCC to operate a 50-watt station on 6106 kHz from 0200-0300 with the call sign WACW. Can anyone definitely confirm the existence of this station and, especially, the "W" call sign in "K" territory?

Venezuela—YVQN, Ondas Portenas, Puerto La Cruz, 4790 kHz, has a weekly broadcast to listeners who have sent in reception reports. Tune for it on Saturdays at 0500. . . . YVMG, Maracaibo, 4810 kHz, was noted with an English ID at 0105 on a Monday; the ID included the medium-wave outlet. The musical program that followed had commercials in English.

Vietnam (North)—Voice of Vietnam, Hanoi, broadcasts to American GI's daily on 11,950 kHz at 1130 with war protest songs, statements by US prisoners of war and a daily listing of servicemen of the US who have been killed.

Unidentified—What appears to be a Russian regional station is being heard from 0215-0500 s/off at 7097-7100 kHz. They relay R. Moscow at 0300-0500. This station has never been heard to use an IS nor is the closing anthem that of the Soviet Union.

UJT TESTER

(Continued from page 35)

always be in the OFF position when you are not making tests. Plug the UJT into the test socket or connect it to the test leads, being sure that you have the correct connections.

Place S1 in the η position and turn on the power. The meter should indicate slightly up-scale, if the UJT is good. If the meter shows no indication, either the UJT is bad or the leads have not been correctly attached. To measure η , depress the CALIBRATE switch (S2) and adjust R4 (CALIBRATE CONTROL) until the meter indicates full scale. Release S2 and read the value of η on the meter (full scale = 1).

To measure I_{B2} , set S1 on I_E and adjust R4 until the meter indicates mid-scale, which is 50 mA. Now place S1 in the I_{B2} position and read the base-2 current on the meter scale (full scale = 100 mA). Do not operate the UJT under these conditions for extended periods of time since it can be damaged with this amount of current.

—30—

SOLID STATE

(Continued from page 80)

are the latest members of Motorola's (P.O. Box 955, Phoenix, Ariz. 85001) growing line of opto-electronic devices. One type, the MRD450, is assembled in a two-lead package with an integral lens for highest sensitivity and definition. Types MRD100 and MRD150 are in subminiature packages for high-density applications. With minimum sensitivities ranging from 0.04 mA/mW/cm² to 0.2 mA/mW/cm², the new units are relatively inexpensive and suited for high-volume commercial and consumer applications. The new devices may be used in applications such as security alarms, home lighting controls, toys, auto-light switches and sensors, test equipment, and automatic reading or identification instruments.

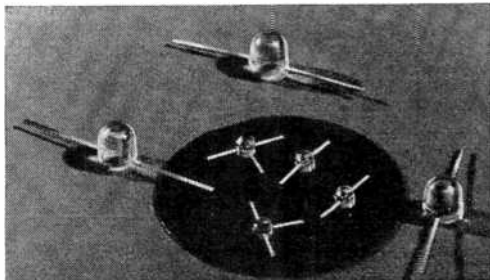


Fig. 3. Motorola's new molded-plastic phototransistors for alarms, toys, controls. A 1"-diameter silicon wafer contains 1200 phototransistor dice.

Motorola has also announced a new monolithic voltage regulator (Fig. 4) which has an output impedance of only 20 milliohms and a regulation of 0.002% at outputs up to 500 mA. The regulator is available in two packages: MC1560R is in a 9-pin variation of the TO-66 transistor case and can dissipate up to 10 watts with a 500-mA load; MC1560G, in a 10-pin TO-5 case, can

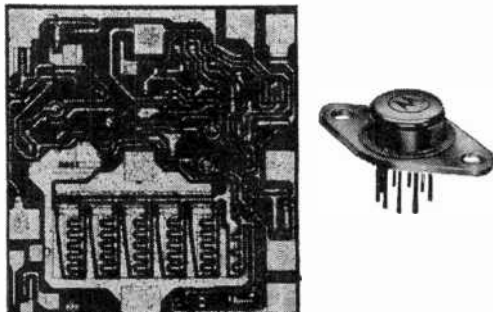


Fig. 4. Geometry (left) and case version of Motorola's new integrated circuit voltage regulators.

June, 1969

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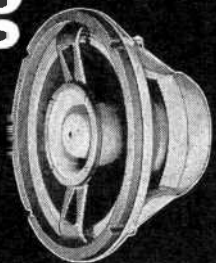
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dissipate 1.8 watts and regulate 200 mA. Less expensive versions (narrower temperature ranges and slightly relaxed specifications) are available as types MC1460R and MC1460G.

Color-Coded Transistors? General Electric's Semiconductor Products people (Syracuse, N. Y.) are now packaging their popular low-cost D27 "Power Tab" transistors in colored silicone plastic. The D27C *npn* power transistor is red, while its complementary *pnp* cousin, the D27D, sports a beautiful shade of green. Both units are rated at 3 amperes continuous, 5 amperes peak collector current.

Japan's Sony Corporation has developed a monolithic integrated circuit audio amplifier that can deliver up to 18 watts continuous r.m.s! With a maximum current rating of 4 amperes at 40 volts, the new device contains two power transistors, four small signal transistors, a diode, and six resistors on a chip measuring only 1.5 by 1.75 mm. It is assembled in a strap-style, heat-sinked flat package. Chances are this new device will show up first in the U. S. later this year in Sony's own line of stereo units, radios, and other consumer products.

Transitips. One of our neighbors recently complained that he had spent a lot of money having his small transistorized receiver repaired in an attempt to correct a comparatively simple "defect"—the set continued to play for a couple of seconds *after* it had been switched off. Thus far, he said, the set's power switch had been replaced three times with no success. We have heard this complaint several times before from readers. The fact is that such operation may not indicate a defect at all. It may actually be normal, if not typical, of some types of transistorized equipment.

Quite often, the manufacturer "floats" a large value electrolytic capacitor across the equipment's power source. This capacitor, which may be used in battery-operated as well as a.c. line-powered equipment, serves to reduce the power source's effective a.c. impedance and thus minimize interstage coupling through the power supply. Its use may help increase effective battery life. Once charged, however, the capacitor acts as a power reservoir operating the equipment for a short time after the power switch is opened. The period of time during which operation continues depends on the equipment's power requirements and the value of the capacitor.

Speaking of transistorized equipment and batteries, it's time to check the batteries for your portable equipment—summer, with picnics, beach parties, and vacations, is on its way.

—Lou

IMPEDANCES

(Continued from page 69)

pedance (at 1 kHz) of the amplifier under test. The input impedance at any other audio frequency can be measured similarly.

Output Impedance. In the circuit shown at (B), the output of the signal generator is coupled directly to the input of the amplifier and the voltmeter is used to measure the amplifier output across a variable load. The resistance of the potentiometer should be up to 50 ohms for a loudspeaker load, up to 25,000 ohms if the load is a transistor power amplifier, and up to 1 or 2 megohms if the load is a tube circuit. If the amplifier does not have a capacitor-coupled output, the variable load resistor should be connected to the output through a large-value capacitor whose reactance is low at the testing frequency.

Set the load potentiometer close to its maximum resistance and apply a signal to the amplifier. Record the voltmeter reading as $V1$. Reduce the value of the load resistor until the voltmeter reads about 10% less than before. Record this voltage as $V2$. Without disturbing the setting of the potentiometer, remove it from the circuit and measure the resistance between the free end and the rotor. Record this value as $R1$.

The output resistance can then be calculated from $Z=R1/V2(V1-V2)$. For example, if $R1$ is 3000 ohms, $V1$ is 3 volts and $V2$ is 2.5 volts, the output impedance of the amplifier is $3000/2.5(0.5)=2400$ ohms.

—50—

CITIZENS BAND JAMBOREE CALENDAR

June 14, Volunteer State CB Radio Club, Chattanooga, Tenn., 6th Annual Bar-B-Que at Hamilton County Park, Lake Chickamauga. Proceeds are for Rescue Squads as part of the Chattanooga, Hamilton County Civil Defense.

June 28, Cumberland Valley CB Radio Club, Nashville, Tenn., Jamboree at National Guard Armory, Sidco Dr., Nashville. Contact: P.O. Box 7285, Nashville 37210.

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CIRCLE NO. 10 ON READER SERVICE PAGE

PRINTED CIRCUITS

(Continued from page 64)

copper side up, and tape them together to the top of a table so that they will not separate during the subsequent operations.

Using a sharp scriber or similar hand tool, prick through the paper at each point where a component lead (or jumper) hole is to be. The sharp tool will make distinct impressions in the soft copper foil. Do not use a nail punch or other tool that requires a heavy hand since they may damage the relatively brittle PC board.

Once all holes have been marked, remove the paper pattern. Use liquid resist and a fine pen or brush to draw in the previously laid-out foil pattern. Take care not to touch the boards with the fingers. If you accidentally make a mistake, let the resist dry and use a hard ink eraser or the edge of a sharp knife blade to remove the unwanted resist. After making a correction in this way, be sure to brush removed pieces of resist from the board. Use a soft, dry brush. When the pattern has dried thoroughly, use the sharp edge of a knife blade to clean up the pattern. Make sure that there is enough room between the adjacent foil leads to prevent a solder bridge from forming when the components are installed.

The last step is to recheck the foil pattern against the original schematic. Make sure that all required holes have distinct impressions and that there are no resist spots on the shiny board.

Etch the board following the instructions supplied with the etchant you are using. After the pattern has been etched, rinse the board in cold running water and use steel wool to remove the resist. Use a bit of the proper size to drill the necessary holes.

-30-

Coming Up in August.....

ANNUAL DIRECTORY OF CB EQUIPMENT

Details on all the new models
with complete specs, prices, etc.

tips & techniques

COAX CONNECTOR WRENCH

The last time you soldered a BNC coaxial connector to the end of a cable, did you have a tough job trying to assemble the connector

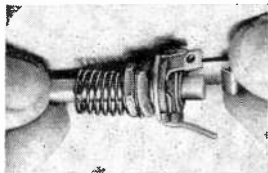


because you didn't have a wrench that would fit? Well, you may not have realized it, but if you have a Weller soldering gun, the tip-changing wrench that came with it is perfect for the job of assembling BNC connectors. Not only is the box cutout just right, the thickness of the wrench could leave nothing more to be desired.

—R.L. Mucha

EMERGENCY PUSHBUTTON SWITCH

According to the laws of chance, if something is to go wrong, it will do so at the worst possible time and under the worst possible conditions. So, the next time you need a momentary-action pushbutton switch in a hurry



and all the stores are closed, try this simple trick. Locate about a 2" length of 1/4"-diameter metal rod (cut possibly from the extension shaft of a potentiometer), a

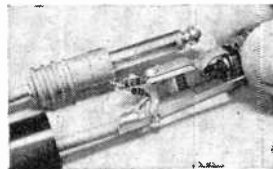
phone jack, and a compression spring. Slip the rod into the jack until it touches the iso-

lated contact of the jack. Now, determine the length of spring needed to return the jack/rod switch to the "open" condition. Remove the rod from the jack, drill a hole through the rod, and fasten the spring to the shaft via the hole. Reassemble the switch, and that's it (see photo). The jury-rigged switch will serve until you can get to the store and buy a regular switch.

—Dean Becker

REDUCE STEREO HEADPHONE SENSITIVITY

A few stereo headphones are just too sensitive to be used with some hi-fi amplifiers. You can reduce the sensitivity of your phones if you have a pair of 100-ohm, 1/4-watt resistors



and a Switchcraft Type 267 stereo plug. Connect the resistors in series with the signal leads from the phones and the respective connections on the phone plug as shown in the photo. The resistors are small enough in size to fit neatly inside the plug's plastic handle, so you will not have an unsightly mess dangling from the end of the headphone cable.

—Donald R. Hicke

MARK SCREWDRIVER HANDLE

A mark on the end of your screwdriver handle, showing the orientation of the blade flats



(a cross for Phillip's screwdrivers), can come in handy when you have to work in a blind area. For flat-blade screwdrivers, another mark near the blade shank will tell you by feel the blade's orientation. These marks

can be made with a medium three-corner file and filled in with paint.

—S. Clark



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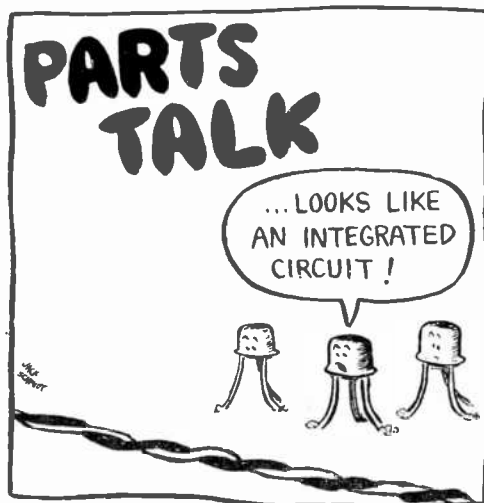
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ELECTRONICS MATHEMATICS QUIZ ANSWERS

(Quiz is on page 40)

- 1-I A cardioid geometric curve is used to display graphically the typical directional characteristics of a certain type of microphone.
- 2-H The critical angle of a transmitted signal is the minimum angle which a wavefront entering the ionosphere can make with a line extending to the center of the earth, and still be reflected back to the earth.
- 3-J A differentiator circuit produces an output whose instantaneous values are proportional to the rate of change of the input voltage waveform.
- 4-B The dispersion angle of a speaker outlines the limits of sound radiation possible from a given cone design.
- 5-D A voltage divider provides an output which is the same proportion of the applied voltage as the divider resistance is of the total resistance.
- 6-G A voltage doubler produces a d.c. output which is approximately equal to twice the r.m.s. value of the a.c. input voltage.
- 7-A An integrator circuit provides an output voltage which is proportional to the area under the curve representing the input signal voltage waveform.
- 8-C A paraboloid is the geometric surface used for microwave transmitting and receiving signal-focusing reflectors.
- 9-F The phase angle of an electric current is a measure of the relative time by which it leads or lags the voltage applied to a circuit.
- 10-E A trapezoid can be created on an oscilloscope screen to determine the percent modulation of a carrier signal.

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