SPECIAL: COMPLETE CB EQUIPMENT CATALOG

POPULAR ELECTRONICS

AUGUST 1970

50 CENTS

A ZIFF-DAVIS PUBLICATION

BUILD 7-SEGMENT READOUT

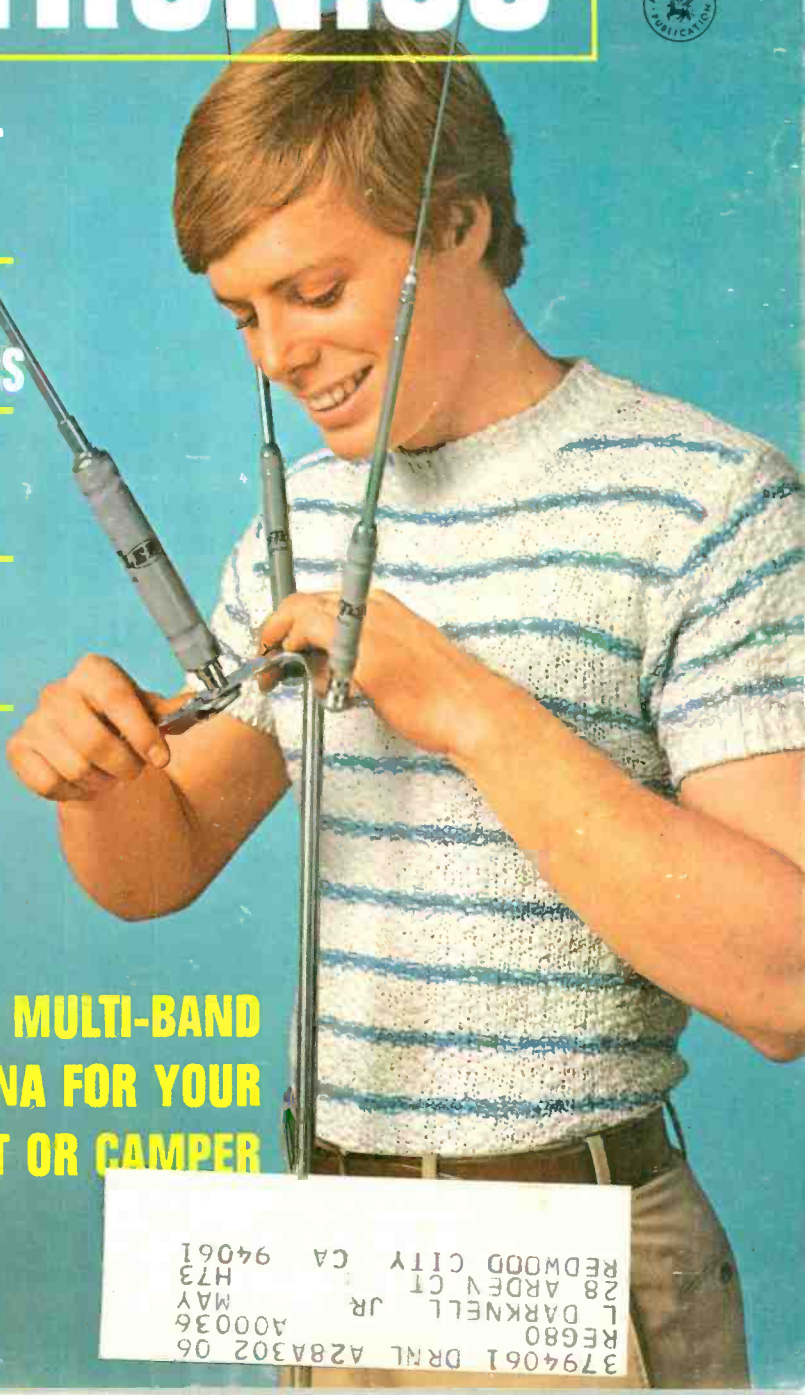
ASSEMBLING COAX CONNECTORS

WHAT'S NEW IN HAM GEAR

BUILD RIAA/NAB EQUALIZER

DESIGNS FOR STAGE LIGHTING

MULTI-BAND HAM ANTENNA FOR YOUR APARTMENT OR CAMPER



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POPULAR ELECTRONICS

VOLUME 33 NUMBER 2 **AUGUST 1970**

WORLD'S LARGEST-SELLING ELECTRONICS MAGAZINE

SPECIAL FEATURES

FEATURE ARTICLES

DEPARTMENTS

POPULAR ELECTRONICS is indexed in the Readers' Guide to Periodical Literature

This month's cover photo by Justin Kerr

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Bearcat 23 has more features than any other standard CB radio on the market. Regardless of price.

Yet the cost of this precision built mobile and base station unit is only $199.95.*

Check out the list of features below.

Then compare it to any other radio, feature for feature.

Compare performance; the clear reception, the unequaled sensitivity.

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You will find radios that cost up to $500.00.

But you will not find a better radio.

Bearcat 23.$199.95*

Bearcat 23 features: Large illuminated combination RF/S Meter. Large illuminated SWR-forward meter (no switching required). Large illuminated SWR-reflected meter (no switching required). Digital clock that automatically turns set on at preselected time. Automatic Noise Limiter and true RF Noise Blanker with Manual Override Switch. Three position Delta Tuner. Slide controls. 23 channels with all crystals included. Integrated circuits. Field Effect Transistor. Public Address system. Headset jack. External speaker jack. Plug-in dynamic mike. "On the Air" light. Modulation light. Combination 12 VDC and 115 VAC power supply for base or mobile use. Separate power on/off switch. All solid state circuitry. Upward-tilt pedestals. Brushed aluminum finish. Built by Pearce-Simpson, finest name in marine radios, CB's antennas, electronic communications equipment. Pearce-Simpson: one of the many fine divisions of the Gladding Corporation, first in outdoor recreation since 1816. Write: Pearce-Simpson, P.O, Box 800, Biscayne Annex, Miami, Florida 33152.

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Forms 3579 and all subscriptions correspondence should be addressed to POPULAR ELECTRONICS, Circulation Department, P.O. Box 1096, Flushing, N.Y. 11352. Please allow at least six weeks for change of address. Include your old address, as well as new—enclosing if possible an address label from a recent issue.

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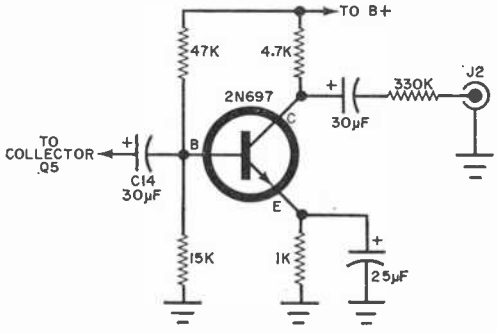
letters

FROM OUR READERS

SCA ADAPTER MODIFICATION

I was quite pleased with the "Simple SCA Adapter" (June 1970). However, after testing it in the lab, I found that several changes



would sufficiently improve rejection of the regular stereo signals at my home.

First, in areas where transmission towers are located nearby, a higher degree of rejection can be achieved by changing capacitor C2 from 0.0022 μF to 0.05 μF. Then, to obtain a lower output between selections, another stage can be added to the adapter as shown in the schematic diagram.

P. J. SUSSMAN
Electro Communications
Dayton, Ohio

PATENT ON BURGLAR ALARM

In my recent article "Automatic Vehicle Burglar Alarm," which appeared in your April 1970 issue, you omitted the fact that the concept and circuits are patent pending and that Metrotec Industries, 1405 Old Northern Blvd., Roslyn, NY 11576, reserves all rights. Thank you.

GEORGE M. MEYERLE

SWL HAM BAND REPORTS

These comments have all been made before, but after completing a 3½ year period as KX6FJ, Marshall Is., I feel that a few pertinent remarks about SWL reports should be aired.

From the viewpoint of the ham operating overseas using big antennas and the full legal limit power, the average SWL report is of no value. During those 3½ years I

6 good reasons why the revolutionary Avanti Astro Plane is the best omni-directional C.B. antenna you can buy.

1. It has top radiation which means that your signal gets out from the highest part of your antenna. This is especially important where antenna height is limited because your signal radiates about 15 feet higher than other antennas which radiate near the bottom. This 15 feet means you get increased range and fewer dead spots.

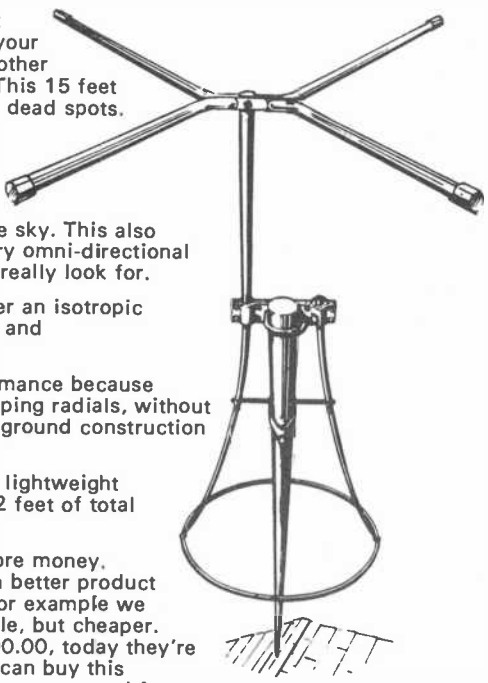
2. The ASTRO PLANE has a lower angle of radiation which makes more efficient use of the radiated signal by allowing it to hug the curvature of the earth instead of shooting your power up into the sky. This also gives you greater distance than an ordinary omni-directional antenna, one thing the professional users really look for.

3. The ASTRO PLANE has 4.46 db gain (over an isotropic source) which gives you a stronger signal and better, clearer reception.

4. You'll get long lasting, trouble free performance because it is compact in design—without long drooping radials, without coils to burn or short out, and with direct ground construction to dissipate static charges and lightning.

5. You'll find it easy to install because of its lightweight construction (less than 5 lbs.) and only 12 feet of total height and 30 inches in diameter.

6. All of these features need not cost you more money. Part of good engineering is how to make a better product for less money—by eliminating the coils for example we not only make the Astro Plane more reliable, but cheaper. Just like a radio back in the 30's cost $100.00, today they're even better for $20.00 or $30.00! So you can buy this advanced antenna for only $29.95 and it is guaranteed for one full year against mechanical or electrical defects.



If your local C.B. Dealer does not have an ASTRO PLANE in stock, have him order you one or write direct to AVANTI.

avanti

33-35 WEST FULLERTON AVENUE,
ADDISON, ILLINOIS 60101

AVANTI RESEARCH & DEVELOPMENT, INC.

THE PACESETTER IN HIGH PERFORMANCE ANTENNAS

CIRCLE NO. 5 ON READER SERVICE PAGE

LETTERS (*Continued from page 8*)

failed to receive a single report indicating that I had been heard in an unexpected place.

Many reports are incomplete and inaccurate. Time is rarely converted to GMT and the station being worked is often not indicated, or the frequency omitted.

Lastly, many reports are received without return postage. My postage bill just for ham activities is big enough and I cannot afford replying to SWL reports that are of little value under the best of conditions.

I strongly urge that SWL's improve the accuracy of their ham-band reports, and enclose an envelope and postage if they want a direct reply.

S. A. FIERSTON, KX6FJ/W1BRJ
Lynn, Mass.

WATCH THAT OZONE

My experience with a device similar to the Transcipitor described in the article in your June 1970 issue showed that it generated quantities of ozone. The breathing of ozone (once thought to be beneficial) is now regarded as a serious health hazard. Users of the device should be warned against breathing too much of the air from the device if they detect the smell of ozone.

LYMAN E. GREENLEE

LOADED DICE PAID OFF

I have built "A Pair of Loaded Dice," POPULAR ELECTRONICS, January 1970, and am very pleased with the sound quality that they deliver. My total cost, including wood cut to size from a cabinet maker, was $14. They are well worth the money spent.

MERRILL C. PATTEN, JR.
Andrews University
Berrien Springs, Mich.

LEAVE THE POWER ON—OR NOT?

During a visit to NASA Space Center in Houston, I was shown the main communications room and was told that the electronic equipment there is never turned off to make it last longer. Is it advisable for me to do the same with my solid-state stereo amplifier?

DAN WERNING
Concordia Teachers' College
Seward, Neb.

The gear at NASA is left on because the internal heat generated maintains a relatively constant temperature, thus reducing drifting and avoiding adjustments when turned on cold. In addition, the heat reduces moisture accumulation and thus prevents contact corrosion. You can leave your solid-state equipment on if you don't mind the extra electric bill. It is not advisable if the gear generates too much heat—which might conceivably shorten the life of some commercial components.

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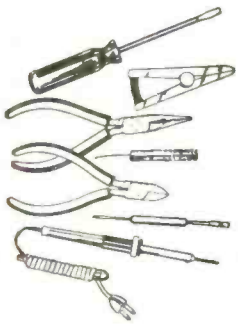
VARIABLE BALANCE STEREO HEAD PHONE

Unique "Sound Level" control on each earpiece permits adjustment. Frequency range: 20 to 20,000 + cps. 6½' cord with stereo plug. Impedance 4 to 16 ohms.
Cat. No. Q4-132 $17.95 Net



HOBBYIST'S SOLDERING AND TOOL KIT

Diagonals, long nose pliers, soldering iron and solder, solder aid tool, heat-sink, and screwdriver. An ideal gift item.
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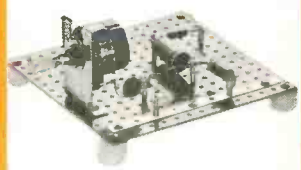

EXPERIMENTER'S CIRCUIT BOARD KIT

Contains a 3¾" x 4" perforated board, 15 terminals (No. J4-636) and 4 mounting feet w/screws. Build small circuits, hobby and science projects, etc.
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Cat. No. Q4-288 $.99 Net

TWO STATION WIRELESS INTERCOM

Just plug into any electrical outlet. Completely portable. Expand system anytime with additional units. Two unit system complete in display pack.
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Type PR2 • 2.5 volt • 0.50 amp •
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Attractively packaged 2 per pack, showing values, color codes and formulas.

STANDARD 1000 VOLT CAPACITOR

High quality, compact and reliable.

THE "GC CALECTRO HOBBYIST HANDBOOK"

The "GC Calectro Hobbyist Handbook" is available at your nearest Calectro Electronic Supermarket. One is located near you. WRITE TODAY and we'll rush you the name and address of your nearest Calectro Supermarket.

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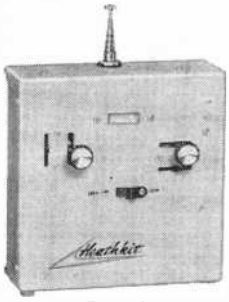
8 New Action-Packed Kits From Heath—

Heathkit GD-101
$49.95*

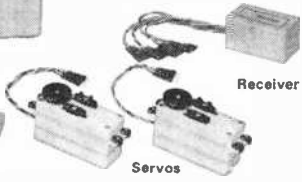


Heathkit GD-57
$129.95*

Transmitter

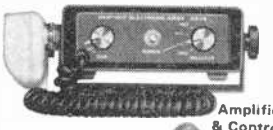
Receiver

Battery Pack

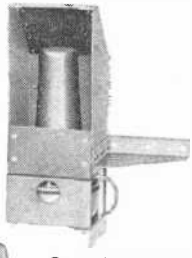


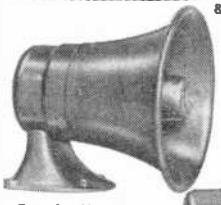
Servos

Heathkit Siren & Speaker
$99.95*



Amplifier & Controls





Exterior Horn

Concealed Horn

Heathkit MI-29
$84.95*

NEW Heathkit "Spectre" 1/8 Scale R/C Car
Join The Most Exciting New Hobby In America...

building and racing radio-controlled Grand Prix cars up to scale speeds of 200 mph. The Heathkit "Spectre" R/C car reaches that speed and has already proven itself a winner. And no wonder; its design is unique. It has a chrome plated steel chassis, adjustable caster and toe-in, specially formulated rubber tires that lock onto the cast nylon wheels, independent front suspension for excellent cornering and a 5.5:1 gear ratio for maximum torque at all speeds. The snap on, 1/8 scale car body (length: 19¾") is of high impact plastic — almost indestructable. Suspension is by real coil springs. The radio equipment compartment is dirt and oil proof. The Heathkit "Spectre" is the only complete car kit available. You get the body, chassis, wheels & tires, 4 oz. fuel tank & tubing, equipment case & protective foam, centrifugal clutch & gears, axles, servo linkages & mounting tape, all hardware, decals, numbers and a comprehensive manual. The "Spectre" accepts any .15 to .23 cubic inch R/C engine and any proportional R/C electronics system. It requires only two servos to operate the steering, brake and throttle. Get in on all the thrills of R/C car racing at the lowest possible price ... order a Heathkit "Spectre".

Kit GD-101, R/C car only, 8 lbs.....$49.95*
Assembled GDA-101-1, Veco .19 R/C engine, 1 lb.....$19.95*

NEW Heathkit 3-Channel Digital Proportional R/C System
For Planes, Gliders, Cars And Boats

Ideal for use with the new Heathkit "Spectre" R/C car to give you total control ... ease of handling. Here's what the Heathkit GD-57 R/C system includes: Transmitter with assembled, factory aligned RF circuitry; new 2 oz. miniature receiver that needs no IF alignment, in a tough nylon case; you also get two servos; all plugs; connectors; cables; charging cord; new flat-pack rechargeable nickel-cadmium transmitter and receiver batteries ... and a special soldering iron. You can have your choice of five operating frequencies in each of three bands ... 27, 53 or 72 MHz. This is the most value ever offered in a 3-channel rig.

Kit GD-57, transmitter, receiver, 2 servos, batteries, charging cord, switches and soldering iron, (specify freq. desired), 11 lbs.....$129.95*
Kit GDA-57-1, transmitter, battery, charging cord, (specify freq. desired), 5 lbs.....$54.95*
Kit GDA-57-2, receiver only, (specify freq.), 1 lb.....$34.95*

NEW Heathkit Siren/PA
For Licensed Emergency Vehicle Only

Hey Chief! Save up to 60% on a new electronic siren/PA system by ordering the low cost Heathkit GD-18. The siren gives both "wail" and "yelp" warnings at 55 watts output power, and you can adjust the pitch. As a public address it will amplify your voice with a full 20 watts of power, and it's practically immune to acoustical feedback. (Either PA or siren can be interrupted to use the other.) Incoming radio calls can be channeled through the GD-18 so you can hear them when away from your vehicle. Use it on any 12-volt auto electrical system with either positive or negative frame ground. It will operate from -20° to 150° F conditions. Control panel is lighted. Comes with gimbal bracket mounting. Take your choice of speakers ... concealed or exposed.

Kit GD-18, Siren/PA Amplifier, 7 lbs.....$54.95*
Assembled GDA-18-1, Exterior Horn, 9 lbs.....$49.95*
Assembled GDA-18-2, Concealed Horn, 4½ x 4½ x 13", 9 lbs.....$49.95*
System GD-18A, (includes GD-18 plus exterior horn), 16 lbs.....$99.95*
System GD-18B, (includes GD-18 plus concealed horn), 16 lbs.....$99.95*

NEW Heathkit Solid-State Portable Fish Spotter

Costs half as much as comparable performers. Probes to 200 ft. Doubles as depth sounder. Transducer mounts anywhere on suction cup bracket. Adjustable Sensitivity Control. Exclusive Noise-Rejection Control stops ignition noise. Runs for 80 hrs. on two 6 VDC lantern batteries (not included). Manual explains typical dial readings. Get set for next season; order your Heathkit MI-29 today.

Kit MI-29, 9 lbs.....$84.95*

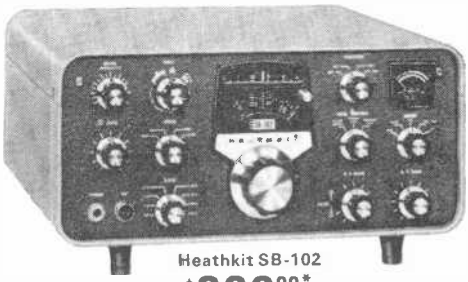
The Value Leader

HEATHKIT®

NEW Heathkit 5-Band SSB Amateur Transceiver

The new Heathkit SB-102 . . . proud successor to the famous "100" & "101". You can expect top performance and value from this rig . . . and you get it. An all solid-state Linear Master Oscillator delivers faster warmup, greater stability and better tracking . . . new receiver circuitry gives better than 0.35 uV sensitivity for real performance under bad band conditions. Plus all the features that made the SB-101 the world's most famous, most popular transceiver . . . 180 watts PEP SSB input . . . 170 watts CW input . . . 80 through 10 meter coverage . . . USB, LSB or CW modes . . . built-in VOX or PTT operation . . . built-in CW sidetone . . . built-in 100 kHz crystal calibrator . . . Triple Action Level Control for reduced clipping & distortion . . . fast, easy bandswitching and tune-up . . . rugged, inexpensive 6146 finals . . . separate headphone level control & front panel jack . . . simple assembly with circuit board-wiring harness construction . . . sharp Heathkit SB-Series styling plus many more features. Order yours now.

Kit SB-102, 23 lbs.....$380.00*
Kit SBA-100-1, mobile mt., 6 lbs.....$14.95*

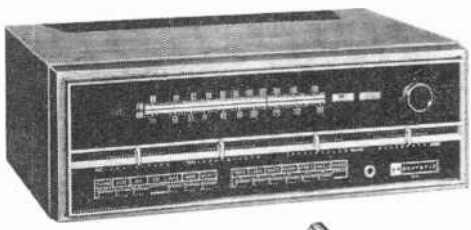


Heathkit SB-102
$380.00*

NEW Heathkit 60-Watt AM-FM-FM Stereo Receiver

Superb stereo performance at budget price, that's the new Heathkit AR-19. A giant, electronically regulated power supply provides 60 watts IHF music power (ideal for all modular and high efficiency speaker systems) . . . frequency response is -1 dB from 6 Hz to 35,000 Hz . . . and Harmonic & IM distortion are less than 0.25% at *any* output. This advanced performance assures you of crisp, clean highs without ringing or breakup . . . solid, clean-cut lows without distortion — just pure, uncolored sound reproduction at all frequencies and power levels. The FM Stereo circuitry is unequalled by any receiver in this price class . . . a factory assembled & aligned FET FM tuners . . . superior overload characteristics & 2.0 uV sensitivity . . . a factory assembled & aligned FM IF circuit board with 4 IC's for superior AM rejection, hard limiting, greater stability and 35 dB selectivity . . . a precision ball-bearing inertia flywheel for smooth, precise tuning . . . two front panel tuning meters for exact station selection. Other features include modular snap-out circuit boards, built-in self-servicing capability, hi-fi AM reception and much more. Make the AR-19 the heart of your stereo system now.

Kit AR-19, 29 lbs.....$225.00*
Assembled AE-19, oiled pecan cabinet, 10 lbs.....$19.95*



Heathkit AR-19
$225.00*

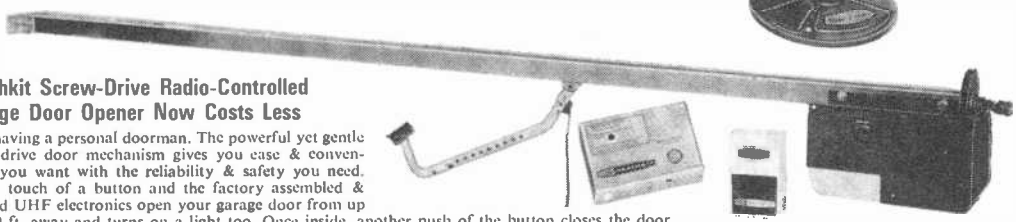
Heathkit Solid-State Metal Locator

Here's versatile, professional performance in a metal locator at lowest cost. The all solid-state GD-48 uses a unique induction balance detection system that doesn't produce a tone until metal enters the search field . . . eliminates having to listen for a change in tone. The built-in Sensitivity control allows adjustment to detect varying size objects down to 6 feet. A built-in speaker audibly signals presence of metal . . . for higher sensitivity use the accurate front-panel meter. And the front-panel headphone jack lets you use headphones to screen out annoying background noise. Look no further for an excellent metal locator . . . order the GD-48 now.

Kit GD-48, 4 lbs.....$59.95*
GDA-48-1, 9 V battery, 1 lb.....$1.30*

Heathkit GD-48
$59.95*

Heathkit Screw-Drive Radio-Controlled Garage Door Opener Now Costs Less



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ELECTRONICS library

QUIET

THE RADIO AMATEUR'S HANDBOOK, 47th Edition

Edited by the ARRL Headquarters Staff

Although the latest edition of "the" Handbook looks remarkably like the 1969 edition (even to the helical antenna photo on the cover), the theory and construction chapters have been updated or revised. Certain chapters have been almost completely rewritten and new illustrations added. Various new construction projects are in the new edition including: a new power supply, VHF/UHF converters and a solid-state transmitter. As usual, the Handbook shows tube base diagrams and specs for a variety of ham-style vacuum tubes. The semiconductor listing has been doubled, but it is still meager considering the state-of-the-art. Also new, a black-stripe page tabbing method allows the user to spot chapter "starts" with greater ease. All-in-all, a Handbook a year is a dirt cheap investment—for hams, communications technicians, and others.

Published by the American Radio Relay League, Inc., Newington, Conn. 06111. Soft cover. 610 pages + appendix. $4.50.

ANTENNAS AND WAVES: A MODERN APPROACH

by R.W.P. King & C.W. Harrison, Jr.

The authors have prepared an up-to-date source of information on published work in the field over the past fifteen years. New material on ionized and dissipative media is included and is of particular interest because of recent developments in satellite and military programs. Chapters on pulse or transient response will interest those involved in the area of wideband systems.

Published by the MIT Press, 50 Ames St., Cambridge, MA 02142. Hard cover. 778 pages. $15.

ESSENTIALS OF ELECTRONICS

by F. H. Mitchell and F. H. Mitchell, Jr.

The field of electronics is constantly growing in complexity and sophistication as new electronic devices are developed. In turn, the

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LIBRARY (*Continued from page* 14)

need for improved instrumentation stimulates the development of new devices. Consequently, courses in electronics have become increasingly valuable in the applied science curriculum. This book furnishes an introduction to the fundamental physical principles upon which electronic devices are based and provides applications for these devices. Intended as a first-semester textbook, the text makes no pretense at completeness. In a one-semester course, it is possible to select only some of the more important phenomena and to treat a few arbitrarily chosen illustrations of their applications.

Published by Addison Wesley Publishing Co., Inc., Reading, MA 01867. Hard cover. 272 pages. $10.50.

RADIOTELEGRAPH OPERATOR'S LICENSE Q&A MANUAL

by Milton Kaufman

Just off the press, this book provides all the necessary study material, arranged by Elements, for successful completion of the FCC exams for any of the three classes of Radiotelegraph Operator's license as well as for endorsements for ship radar and aircraft radiotelegraph operation. Following the FCC Study Guide faithfully, the book presents the essentials clearly and logically. Each Element contains a series of pertinent questions and concise answers. Most of the answers are followed by more detailed explanations in discussion sections, which contribute considerably to the reader's comprehension as well as further clarify specific questions.

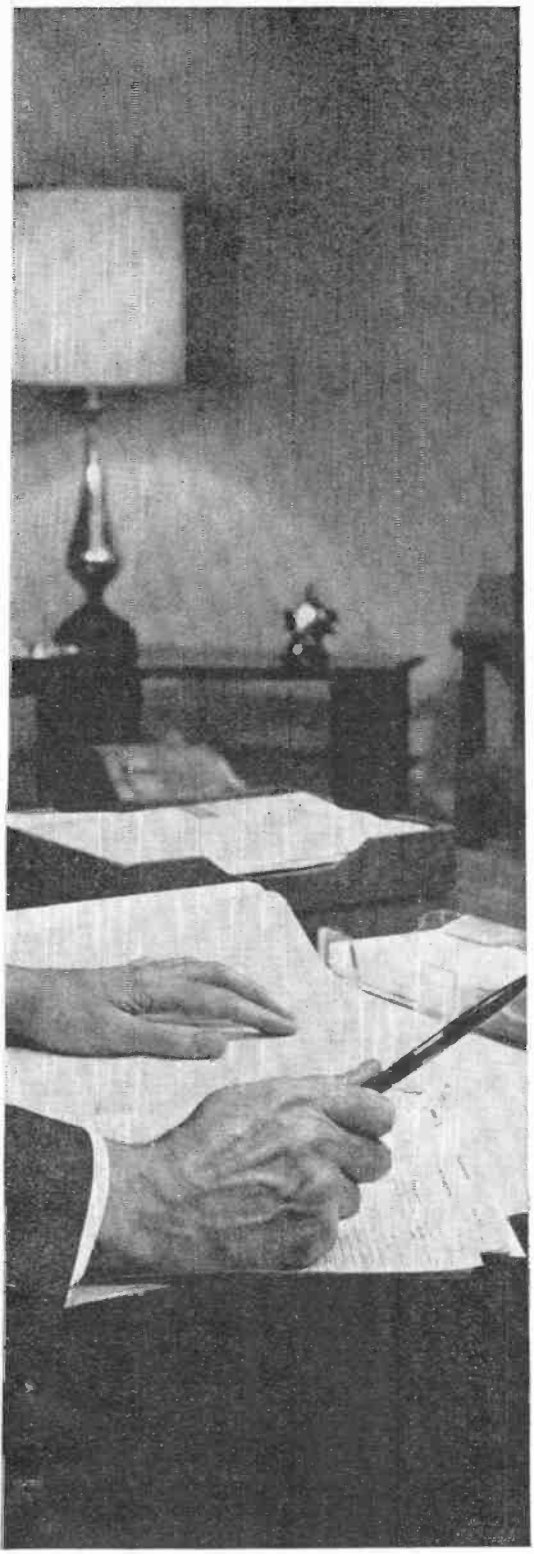
Published by Hayden Book Co., 116 West 14 St., New York, NY 10011. Hard cover. 400 pages. $11.95.

73 DIPOLE AND LONG-WIRE ANTENNAS and SWL ANTENNA CONSTRUCTION PROJECTS

by Edward M. Knoll, W3FQJ

An author occasionally comes up with an idea that lends itself to substantial exploitation. Ed Knoll has encountered that idea in these two books embracing about 100 slightly different antennas. The "SWL" book is particularly noteworthy in its attempt to introduce truly resonant beam antennas to the listener tuning 31, 25, 19, 16, and 13 meters. Ed has also brought back to life the triangle antenna—a device completely unknown to SWL's—but, whether it works or not is open to some question. However, since this is one of two currently available books on SWL antennas, it's worth buying. Ed's second book, "73 DIPOLES," concentrates on V's and rhombics, but leaves the reader guessing about construction of the mysterious 4-to-1 balun that is used with numerous antennas. Obviously, the essential differences between antennas (to make the 73 total) are subtle.

(*Continued on page* 102)



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NEW PRODUCTS

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

NOISE REDUCTION SYSTEM

The *Advent Corp.* Model 100 Noise Reduction Unit represents the first direct adaptation of the Dolby Audio Noise Reduction System for use as a separate component with any home-type high-quality recorder. The unit dramatically reduces hiss and other noise inherent in the tape recording process without affecting the musical integrity of the recorded signal. The model 100 is a simultaneous record/playback control center, incorporating the Dolby System. The B-Type Dolby circuits used in the Model 100 are designed to reduce the most annoying noise inherent in tape recording, "tape hiss." It achieves a 3-dB improvement in signal-to-noise ratio at 600 Hz, 10 dB at 4000 Hz and above.

Circle No. 79 on Reader Service Page 15 or 95

PLUG-IN REMOTE CONTROL RELAY

The Model FRE-103 plug-in "remote control" relay made by *Alcoswitch* readily adapts to a standard a.c. outlet for experimental or quickly assembled remote-control circuit applications. It controls circuits isolated from power lines and operates apparatus and equipment at low voltages, such as those obtained from a battery. Inside the plastic case is a s.p.d.t. relay with a two-coil (primary and secondary) laminated core construction. The case holds the core inside and also contains a patented three-way receptacle that allows selection of normally open or normally closed circuit, while a jack on the case side serves as a plug-in for a remote switch or sensor.

Circle No. 80 on Reader Service Page 15 or 95

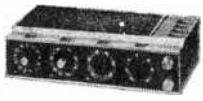
ULTRASONIC INTRUDER/FIRE ALARM

The Model U-15 Ultrasonic Intruder/Fire Alarm made by *Comdial Corp.* is designed and priced to enable the homeowner and traveler to beat the statistics of the rising crime rate. The U-15 contains its own power supply and is completely portable. It can be installed by anyone. A remote buzzer, located at bedside, and an R-40 relay switch to activate outside bells, automatic telephone dialing systems, flashing lights, etc., make this an alarm of a thousand applications.

Circle No. 81 on Reader Service Page 15 or 95

RECEIVER DESIGNED FOR THE BLIND

An FM/AM receiver that also tunes in the sound portions of VHF and UHF television channels has been designed for the blind and other handicapped persons by *RCA Consumer Electronics.* Braille characters on the operating controls of the "Audio Center" receiver facilitate tuning by the sightless person. And a specially prepared instruction booklet, printed in large type size and also in Braille, is included with the receiver. The Audio Center is also attractive to housewives who are content with just listening to TV programs while doing household chores. The Audio Center has automatic frequency control for drift-free FM reception; bass and treble tone controls; rocker-type switches; built-in antenna systems; and a.c. operation.



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QUARTER-TRACK TAPE RECORDER

Now available from *Martel Electronics* is the Uher "Varicord 263" quarter-track stereo tape recorder that has been engineered with the user in mind. The Varicord 263 can be equipped with an optional two-track head assembly which can be installed in moments without tools, and when in use with the four-track head, provides sound-with-sound performance. Perfect recording level is attained with the Uher Sigma Level Control that allows one knob and one VU meter to establish recording level on both stereo tracks simultaneously. The 263 is prewired to accommodate an optional automatic level control. Technical specifications: 7½, 3¾, and 1⅞ in./sec tape speeds; 30-20,000 Hz at 7½ in./sec, 30-17,000 Hz at 3¾ in./sec, and 30-7000 Hz at 1⅞ in./sec frequency ranges; 0.2% maximum wow and flutter; 53-dB four-track/55-dB two-track signal-to-noise ratio.

Circle No. 83 on Reader Service Page 15 or 95

VHF MARINE ANTENNAS

A new line of VHF Marine ship-to-shore communications antennas is available from *Hy-Gain Electronics Corp.* The line includes four shipboard and three shore station antennas. All shipboard models are made of marine

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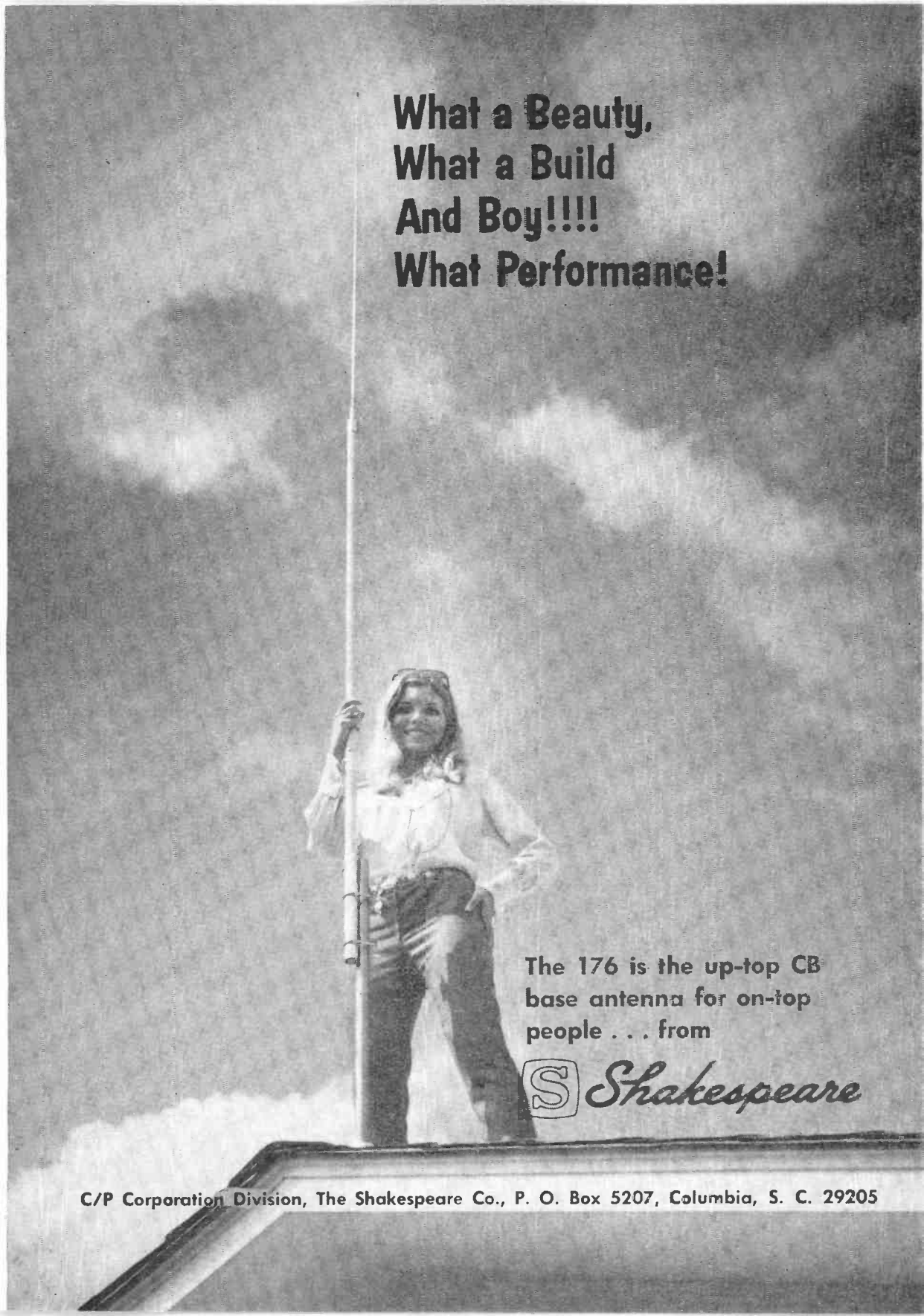
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The 176 is the up-top CB base antenna for on-top people . . . from
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PRODUCTS (*Continued from page* 22)

fiberglass and chrome-plated brass fittings. The entire line covers the VHF frequencies from 156 through 163 MHz. The Model 768 provides 3 dB of gain and is only 54" long; Model 769 has 6 dB gain and is 9' overall in length; Model 770 provides 9 dB of gain and is 21' long, the ultimate in shipboard antennas, consisting of stacked dipoles in a fiberglass radome; Model 771, sailboat antenna, provides 3 dB gain and is designed for mounting atop ships' masts; and the Model 714, shore station antenna, with 9 dB gain. The remaining two antennas in the line are the Models 731 and 758, which provide 3.4 dB and unity gain, respectively.

Circle No. 84 on Reader Service Page 15 or 95

SOLID-STATE OSCILLOSCOPE

A new high-performance, all solid-state oscilloscope, containing many new features especially desirable in industrial and servicing use, was announced recently by *RCA Electronic Components*. The 5" scope, Type WO-505A, offers all the rugged, high-performance of its predecessors, plus such other features as a flat-face CRT, return-trace blanking circuits, illuminated graticule screen, and camera mounting studs. The gain of the WO-505A is 15 mV peak-to-peak/in. on the high-sensitivity range of the vertical amplifier, with a frequency response of ± 1 dB from d.c. to 5 MHz (usable up to 8 MHz). Horizontal sweep frequency is adjustable up to 1 MHz in six ranges, permitting lock-in of signals up to 10 MHz. The vertical input attenuator and illuminated graph screen are calibrated directly in volts so that the scope can be used as a voltmeter.

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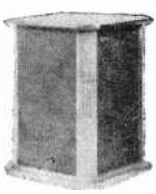
DELUXE "QUADRANT" SPEAKER SYSTEM

The Quadrant Model Q-101 is a deluxe version of the *H.H. Scott, Inc.*, recently introduced Quadrant design which produces a full-frequency three-dimensional stereo effect throughout a room, rather than in a limited area. The Quadrant design, with two woofers, four midrange drivers, and four tweeters placed around the enclosure's four sides, projects the full-frequency sound in all directions. Sound is both reflected off the walls and projected directly from the speakers toward the listener, eliminating the "hole-in-the-middle" effect. Technical specifications: 35-20,000 Hz frequency range; 8 ohms impedance; 100 watts continuous power handling capacity; 10-12 watts minimum power required; air suspension enclosure; three-position midrange/tweeter switch.



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VHF/UHF MONITOR RECEIVER

Midland International has added to their electronics line the Model 13-920 full three-band (including 450-470 MHz coverage) VHF/UHF monitor receiver. The receiver employs 32 solid-state devices and can be powered from any standard 110-120-volt a.c. or 12-volt d.c. mobile source. The 13-920's features include a crystal/manual switch, lighted dial, and slide-rule tuning. A professional serious communications receiver, the 13-920 monitors police, fire, emergency, industrial, and weather broadcasts, as well as the newly assigned high-frequency and special services broadcasts. The receiver comes with a 12-volt d.c. cable, accessory jacks, and mobile mounting hardware.

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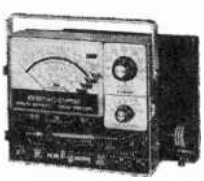
LOW-COST STEREO HEADPHONES

The *Weltron Company* has made available new stereo headphones, complete with individual tweeter controls and adjustable headband, in the $20 price range. The earpieces of the Model 37-003 headphones are lightweight foamplastic for listening ease and comfort. Each earcup contains a miniature high-fidelity speaker with separate controls to assure perfect listening balance. The headphones have a frequency range of 30-25,000 Hz and an impedance of 8-16 ohms. The 37-003 is supplied with a connecting cable and three-conductor phone plug.

Circle No. 88 on Reader Service Page 15 or 95

HI-LO MULTIMETER

A new concept in multimeters, called the Hi-Lo meter, is currently being made by *Sencore*. The new Model FE20 meter powers the ohms section with a conventional C cell for conductivity in transistors, diodes, and rectifiers, enabling the user to check front-to-back ratios. With the flip of a switch, to the Lo ohms position, the ohms section is powered with less than 0.1 volt, which is less than the conductivity point of solid-state devices. Resistances can then be measured in-circuit for true values without solid-state device conductivity causing erroneous indications. Both Hi and Lo ohms are read on the same scale to avoid



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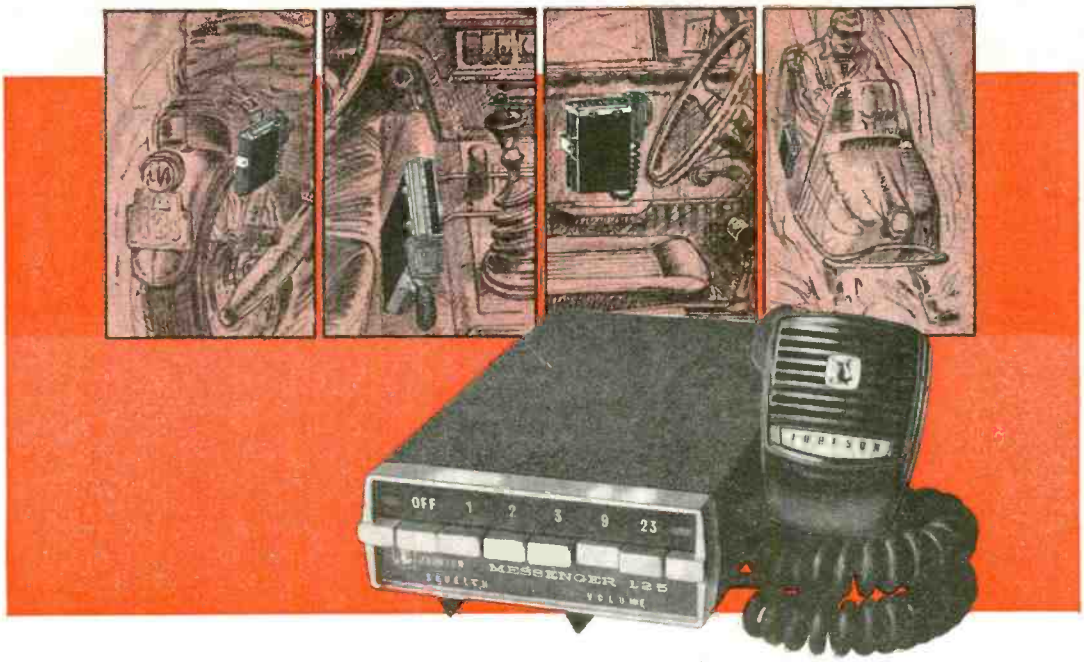
Try these installations with any other five watt unit!



At $99.95 the Messenger 125 fits anywhere ...including your budget.

Best of all, even with its mini-size and price, the Messenger 125 is *big* on performance. Its 5-watt transmitter, with high level class B modulation and speech compression, gives it all the "talk power" you'd expect from a full-size radio. Half-a-microvolt receiver sensitivity pulls in the weak ones. Automatic threshold noise limiting, IF clipping, and special AGC circuitry means less noise—better quieting. Full 2-watt audio lets you hear even in noisy vehicles. And the Messenger 125 looks great, too. Not a single knob—push-buttons select up to 5 channels, slide-levers adjust squelch and volume. Installs between bucket seats, in door pockets, on trail bikes—or over your shoulder with its optional rechargeable battery pack.

Dimensions: 1 3/16" High x 4 19/32" Wide x 7" Deep • 4-watts output at 13.8 VDC • FCC type accepted, DOC approved • All solid state—draws just 0.2 amperes on squelched stand-by • Optional portable pack available with rechargeable battery, charger, antenna, and leather carrying case

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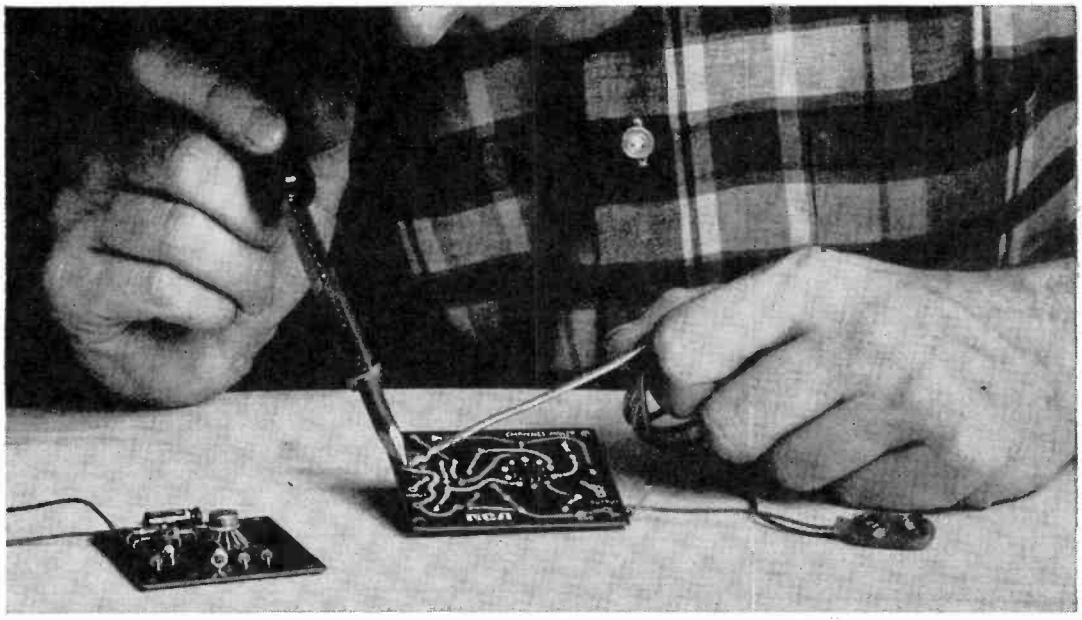


For use at home, on hobby bench, or in classroom

Assemble these new RCA IC Experimenter's Kits quickly and easily.
All the active and passive components, the pre-drilled printed circuit boards, and full clear instructions are included.
(8-ohm speakers for KC4005 and KC4006, and batteries not included.)

KC4000: Microphone Preamplifier IC Kit—a high-gain, low-noise, wideband preamplifier that accommodates both low- and high-impedance microphones.

KC4001: 2-Channel Mixer IC Kit—combines any two audio inputs, such as microphone, radio, phono, or oscillator, into a single output.

7 NEW IC KITS FROM RCA

KC4002: Audio Oscillator IC Kit—for testing audio, hi-fi equipment, and amateur radio transmitters—also for code practice.

KC4003: Amplifier/Oscillator IC Kit—a 500 mW audio amplifier or a variable tone audio oscillator.

KC4004: 9-V Regulated Power Supply IC Kit—supplies 9 volts DC output with voltage regulation of less than 3% at a maximum current of 250 mA.

KC4005: Intruder Alarm IC Kit—a circuit that develops a "whooping" signal as a warning.

KC4006: Fire Alarm IC Kit—a heat-sensing wire sets off a warning circuit.

KC4500: IC Kit Enclosure and Hardware Pack—optional for KC4000, KC4001, and KC4002—a handsome, sturdy, prepunched case with input and output jacks, switch, and other hardware.

Buy these kits from your RCA Distributor. For information, write: RCA Electronic Components, Commercial Engineering, Section F-133SD/S30R, Harrison, N.J. 07029

(STARTING AT UNDER $5.00*) * Optional distributor resale price

RCA

CIRCLE NO. 26 ON READER SERVICE PAGE

1-2-3-4 ON A MAST

MINIMUM SPACE, MULTI-BAND HAM ANTENNA

BY RUSS ALEXANDER, W6IEL

GETTING ON THE AIR can at times be downright frustrating. Many landlords oppose the erection of any beam or dipole antenna, feeling that it detracts from the esthetic appeal of their apartment buildings. And, as a corollary, where does one find space for a good antenna system when living in a house trailer or other mobile-type home?

So, without an effective sky wire, you can't get on the air, right? Wrong! With a little effort and a relatively small investment, you can put together the "1-2-3-4 On A Mast" multi-band antenna system, described in the following pages, that will be more appealing and require less space than a conventional array used for TV reception. The minimum-space antenna system takes advantage of easily available "Hustler" items made

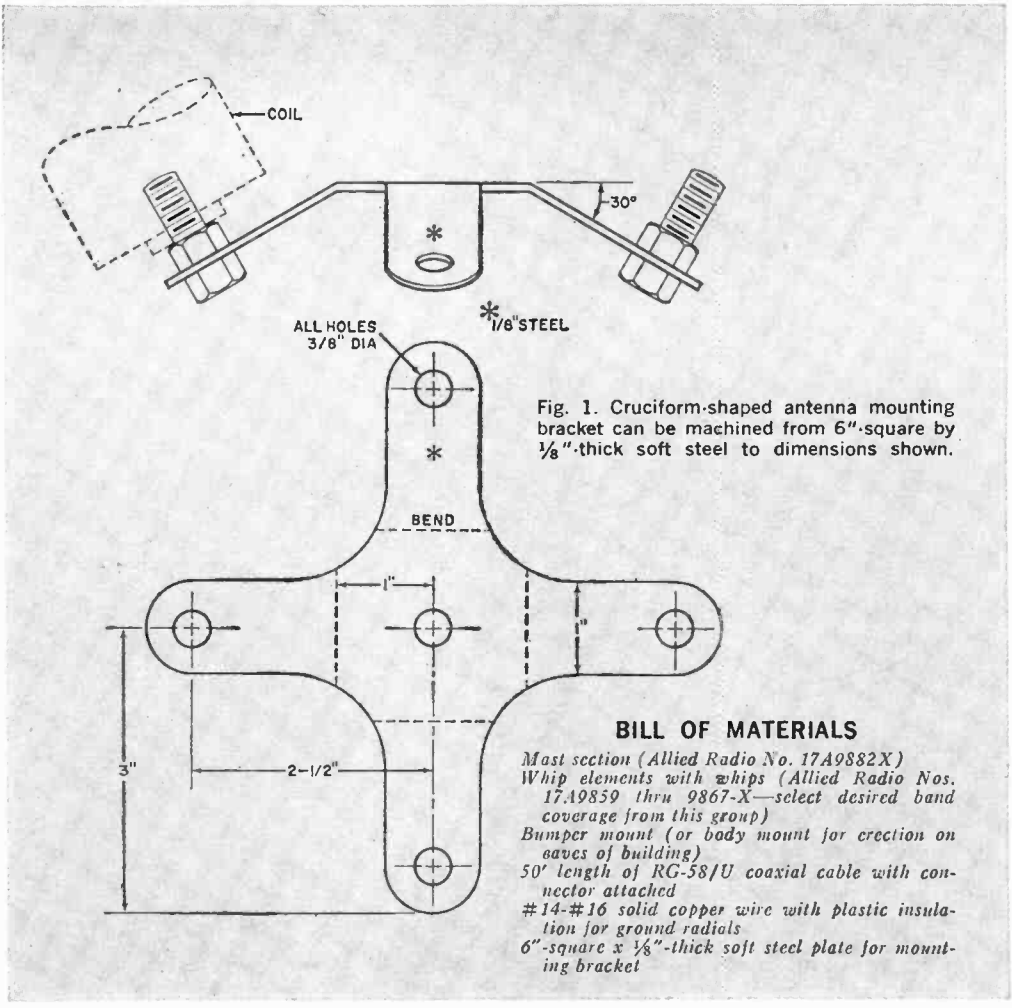


Fig. 1. Cruciform-shaped antenna mounting bracket can be machined from 6"-square by 1/8"-thick soft steel to dimensions shown.

BILL OF MATERIALS

Mast section (Allied Radio No. 17A9882X)
Whip elements with whips (Allied Radio Nos. 17A9859 thru 9867-X—select desired band coverage from this group)
Bumper mount (or body mount for erection on eaves of building)
50' length of RG-58/U coaxial cable with connector attached
#14-#16 solid copper wire with plastic insulation for ground radials
6"-square x 1/8"-thick soft steel plate for mounting bracket

by New-Tronics Corp. And, best of all, you have to fabricate only one small part.

How It Works. If a number of different resonant circuits are properly connected together and fed signals of varying frequencies, each circuit will pass only one narrow band of frequencies and reject all others. And, since each circuit is different from the others, only one band of frequencies will pass through the system of circuits at any one time.

This is basically what happens in the 1-2-3-4 On A Mast. Since the system contains up to four different band antenna elements, each loaded for a different band of frequencies, they can be hooked up to a band-switching transmitter with a common feed line. Because all of the antenna elements share a common feed point, you can switch bands at the transmitter and only the proper antenna will accept power and radiate a signal at the selected frequency carrier.

Fortunately, this theory is easy to put into practice. Small but excellent antennas designed for the different ham bands for mobile use are available in the Hustler line. The proper grouping and mounting of these antennas will allow practical multi-band operation.

Assembling The System. Before getting started, decide on how many and on which bands you plan to operate. Then buy a mobile mast section (preferably one hinged near the base), the coil-whip

combinations for the bands of your choice, and a mount. (Get the bumper mount if you plan to set up your antenna system on a porch railing; the body type if the setup is to be on the eaves of a roof or other similar surface.)

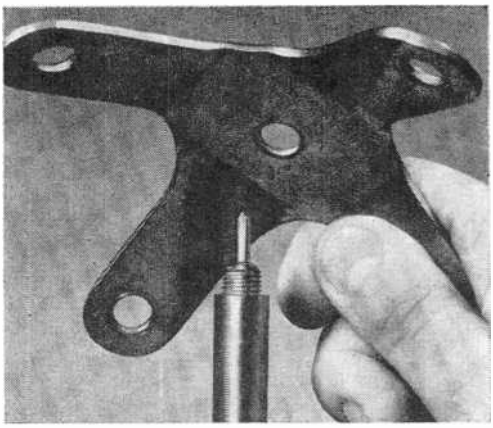
As mentioned earlier, there is only one part you have to fabricate. This is the mounting bracket that will accommodate the antenna elements and fasten them to the mast section. For the four-antenna capability, the bracket will be made in the cruciform shape as shown in Fig. 1.

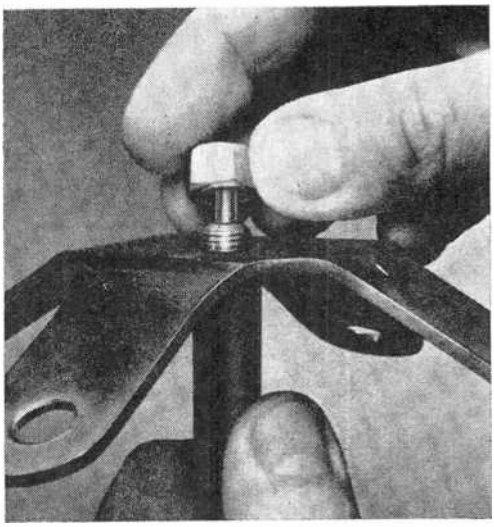
The bracket should be made from ⅛"-thick soft stock steel; a 6"-square piece will do. You can cut the bracket to shape yourself. However, if you are not particularly handy with power tools, you can have the bracket fabricated by a machine shop. In either case, machine it as shown and bend the extremities all in the same direction at 30° angles.

If you want to be extra fancy and protect the bracket from the elements, it is a good idea to have it copper and then cadmium plated. The finished bracket will look like a commercially marketed item.

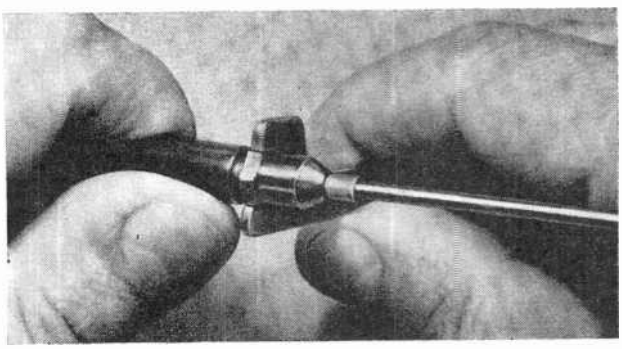
Next, using 1" × ⅜-24 cap screws, attach the outer coils to the mount (see Fig. 2). Then fasten the mast section to the center of the mounting bracket.

Attach the bumper mount to the porch railing, the roof eaves, or wherever you have decided to erect the antenna system, keeping the elements as high and





Once machined and plated, mounting bracket slips over end of mast section (top) and is anchored in place with hex nut (left). When working with hardware on whip elements, use proper size tools to prevent damage to hardware threads (see below).



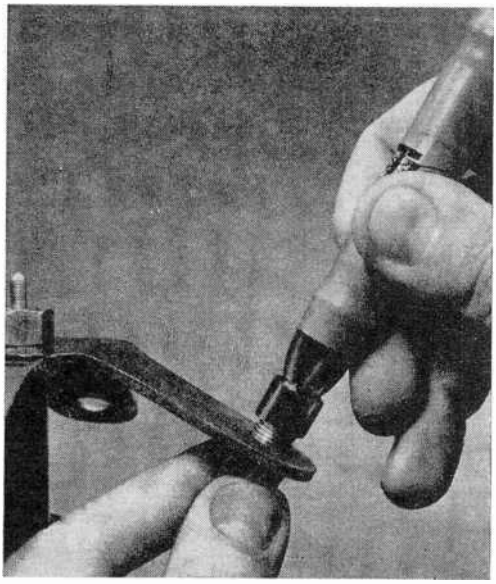


Fig. 2. Whip elements attach to mounting bracket via predrilled holes with 1" x ⅜-24 cap screws.

clear of other objects and surfaces as possible. Run the coax feedline from the antenna mount to the transmitter, connecting the inner conductor of the coax to the mount. The shielded braid at the antenna base goes to a *near* ground (metallic railing, water pipe, rain gutter or the like). A good ground connection is essential. If the antenna system is to be used on a mobile home, connect the outer braid to the metallic trailer body, adjacent to the antenna base.

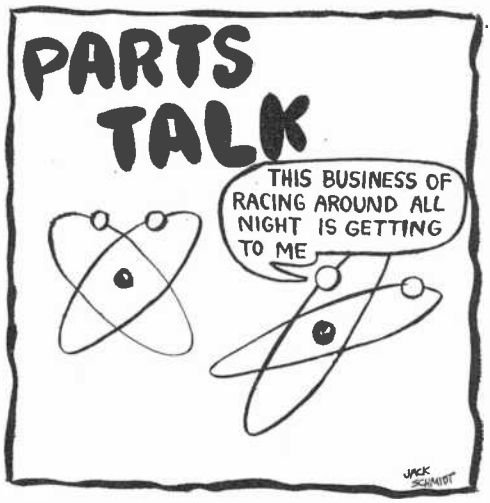
Where a good ground is not available, one must be supplied. This is best accomplished by making radials from #14 or #16 insulated solid wire cut to the dimensions listed in the table for the given band. Where space does not permit placing the wires to radiate straight out from the mast, they can be installed in an L fashion or even zig-zagged. Installation is not critical, and radials for different bands can be run parallel to each other with a minimum of 6" spacing. Best performance will be obtained with two or more radials running in opposite directions for each band.

BAND	RADIAL LENGTH
10 Meters	8'4"
15 Meters	11'4"
20 Meters	16'4"
40 Meters	32'4"
80 Meters	64'4"

Tuning The System. Connect the coax line to your transmitter. Then set up for the highest band of your antenna system. Optimum bandwidth and best SWR will be obtained when the ground system is effective and will result in superior transmitting and receiving capability. To obtain this, the system must be tuned with a SWR bridge.

Standing wave ratio readings of 1.2:1 or better at the resonant frequency of the antenna normally indicate an effective ground. Where readings exceed 1.5:1 at resonance, some experimentation might be necessary to obtain another ground source or a shorter ground lead. Apartment dwellers need not feel handicapped since several possibilities for good grounds are available from heating systems, plumbing systems, metal porch railings, or even the ground side of a built-in coaxial TV antenna system. Phenomenal results have been obtained from locations that appeared to have totally unfavorable surroundings.

Once the antenna system is "tuned" for the highest frequency band, the other bands will also be set up. All you have to do thereafter is to switch from band to band at your transceiver and let the antenna system take care of itself. Incidentally, the 1-2-3-4 On A Mast should also work well for SWL'ing the ham bands on receive only. -30-



ANNUAL CATALOG OF 5-WATT CB EQUIPMENT

PREPARED BY THE STAFF OF POPULAR ELECTRONICS

THE PAST 12 MONTHS—since our last report on CB equipment (August 1969)—have been of great significance to the CB'er. First, the Federal Communications Commission approved the use of channel 9 for emergency two-way communications involving the immediate safety of life, protection of property, and assistance to motorists. This important change in the CB Rules was long overdue and was finally brought about by the insistance of REACT (and a few others) that CB was not being given a fair shake for emergency communications.

Secondly, single-sideband transmitting and receiving techniques were given a new lease on life by the sudden and unexpected entry of SBE Linear Systems, Inc. into the CB marketplace. Single-sideband is the preferred method for voice communications by the military services and ham radio operators. CB is the last stronghold of straight amplitude modulation (AM) with its waste of power and signal intelligibility. Of course, SSB equipment is more complex and costs more, but its use can double the number of CB channels from 23 to 46 by simply placing two separate signals (one to each side-band) on each assigned channel. SBE Linear Systems has been very active in the ham radio field and is among the top 3 or 4 manufacturers of SSB equipment. Their expertise in SSB should —at long last—get the SSB ball rolling in CB.

And, while SBE was making its unheralded entry into CB, two of the earliest CB equipment manufacturers—Browning and Tram—were quietly perfecting their own SSB gear. Add to this list Mark Products and Midland, who also offer 46-channel SSB equipment, plus some of the specialized receiving equipment (such as Regency), and the picture for a real surge forward in SSB in the next year has enormous potential.

(*Continued on page* 45)

START OF SOMETHING NEW?

The assignment of CB channel 9 to emergency communications traffic will have many resounding effects. Not the least of these is likely to be the development of new specialized transceivers. First in the marketplace is the modified E. F. Johnson Messenger 124 base station.

The 124 can almost be considered to be two receivers in one. As the CB'er works on his routine channel, the appearance of a signal on channel 9 "overrides" and switches the transceiver communications channel to 9, thus offering the possibility of monitoring channel 9 while working on any one of the other 22 channels. A separate squelch and volume adjust for only channel 9 help keep interference to a reasonable level. Otherwise the 124 is as described in the Equipment Catalog.

Manufacturer	Model	Type of Signal	No. of Transmit Channels	No. of Receive Channels	Is Receiver Tunable?	Power Supply (Volts)	Type of Receiver	Circuits Use	Notes	Price
Allied Radio Corp. 100 N. Western Ave. Chicago, IL 60680	A-2561	AM	23	23	no	12	dual superhet	solid-state	1,2,3,7,8,12,22	$ 99.95
	A-2564	AM	23	23	no	12	dual superhet	solid-state	1,2,3,7,8,12,22	$149.95
	A-2567	AM	23	23	yes	117 & 12	dual superhet	tubes	1,2,3,7,8	$179.95
	A-2568	AM	23	23	no	117 & 12	dual superhet	solid-state	1,2,3,7,8,12,22	$199.95
Browning Labs, Inc. 1269 Union Ave. Laconia, NH 03246	Golden Eagle Mark II	AM	23	23	yes	117	dual superhet	tubes	2,3,4,6,7,8,9, 13,15,16,21	$495.00
	Eaglette	AM	23	23	no	12	dual superhet	solid-state	1,2,3,6,7,12, 15,23	$204.50
	Golden Eagle SSB-15	SSB	46	45	yes	117	dual superhet	tubes	2,3,4,7,8,9,10, 15,16,20,21	$595.00
Command Electronics 4309 Cassopolis St., Elkhart, IN 46514	Chalet	AM	6	6	no	12	superhet	solid-state	1,7,8,12,23	$189.95
	Ravelle Plus 23	AM	23	23	yes	117 & 12	superhet	tubes	1,3,7,12	$249.50
	Super Satelite	AM	23	23	yes	117	dual superhet	tubes	1,2,7,8,9,10,13	$450.00
Courier Communications, Inc. 100 Hoffman Pl. Hillside, NJ 07205	Citation 23	AM	23	23	yes	117	dual superhet	solid-state	1,2,3,7,8,10, 12,22	$229.95
	Courier 23 Plus	AM	23	23	yes	117 & 12	dual superhet	tubes	1,3,7,8,9,12	$239.00
	Courier Clipper 23	AM	23	23	no	12	dual superhet	solid-state	1,2,3,8,10,12, 18,23	$149.95
	Courier Classic	AM	23	23	yes	12	dual superhet	solid-state	1,3,7,12,23	$169.00
	Courier Classic II	AM	23	23	yes	117 & 12	dual superhet	solid-state	1,2,3,6,7,10,12,22	$199.00

	Courier Royale	AM	23	23	yes	117 & 12	dual superhet	tubes	1,2,3,7,8,9,12,15	$279.00
	Courier TR5	AM	5	5	no	12	superhet	solid-state	5,10,11,12,22,23	$ 99.00
	Courier Traveller	AM	23	23	yes	12	superhet	solid-state	1,2,7,22,23	$139.95
	CWT-50	AM	6	6	no	—	superhet	solid-state	2,3,11,18,23	$ 99.95
	Ranger 23	AM	23	23	yes	117 & 12	dual superhet	tubes	1,3,7,8,12	$199.00
Communications Division Dynascan Corp. 1801 W. Belle Plaine Chicago, IL 60613	Cobra-V	AM	5	5	no	12	superhet	solid-state	2,11,23	$ 99.95
	Cobra-27	AM	23	23	no	12	superhet	solid-state	1,2,7,8,23	$179.95
	Cobra-24	AM	23	23	yes	12	dual superhet	solid-state	1,2,3,7,8,12,23	$169.95
	Cobra-88	AM	23	23	yes	117 & 12	dual superhet	tubes	1,2,3,7,8,12	$219.95
	Cobra-98	AM	23	23	yes	117 & 12	dual superhet	tubes	1,2,3,7,8,12	$239.95
Fanon Electronic Industries 100 Hoffman Place Hillside, NJ 07205	Fanfare 23	AM	23	23	no	12	dual superhet	solid-state	1,2,3,8,10,12,18,23	$159.95
	SFT-400	AM	23	23	no	117 & 12	dual superhet	solid-state	1,2,3,7,8,12	$169.95
	SFT-500	AM	23	23	no	117 & 12	dual superhet	solid-state	1,2,3,7,8,12,17	$189.95
	SFT-600	AM	12	12	no	117 & 12	dual superhet	solid-state	3,7,8,11,12	$109.95
	SFT-800	AM	23	23	yes	12	dual superhet	solid-state	1,2,7,22,23	$119.95

NOTES
1—Has frequency synthesis circuit
2—Transmitter circuitry includes a system of speech clipping or modulation percentage boosting
3—Modulator can be switched to "Public Address" from front panel
4—Unit has a "Spotting" switch on front panel
5—Unit has a transmit crystal socket on front panel
6—Transceiver has socket connections to use manufacturer's selective calling system
7—Meter on front panel reads "S-units"
8—Meter on front panel reads approximate or relative power output
9—Receiver features low-noise Nuvistor r.f. stage
10—This description fits basic unit—see manufacturer's catalog for optional accessories
11—Transceiver requires 2 crystals per channel
12—Rear skirt provision for remote speaker (paging)
13—Transceiver features dual antenna (switched) input/output connections
14—Transceiver has power switching to reduce transmitter input to 100 milliwatts
15—Receiver features front panel r.f. sensitivity switch or control
16—Transceiver may be tuned to either sideband for SSB mode of operation
17—Console arrangement with built-in clock
18—Walkie-talkie
19—Transceiver feeds received signal to car radio; no complete receiver in this package
20—Requires only 1 crystal per controlled channel
21—BFO in receiver for SSB reception
22—Receiver features i.f. noise blanking
23—A.C. power pack available
24—Canadian D.O.C. Approved

Manufacturer	Model	Type of Signal	No. of Transmit Channels	No. of Receive Channels	Is Receiver Tunable?	Power Supply (Volts)	Type of Receiver	Circuits Use	Notes	Price
Heath Company Benton Harbor, MI 49023	GW-14	AM	23	23	no	12	superhet	solid-state	7,8,10,11,24	$ 76.95 (K) $109.95 (W)
E. F. Johnson Company Waseca, MI 56093	Messenger I	AM	5	5	no	117 & 12	superhet	tubes	10,11,24	$124.95
	Messenger III	AM	12	12	no	12	dual superhet	solid-state	2,3,6,10,11,23, 24	$149.95
	Messenger 100	AM	6	6	no	12	superhet	solid-state	2,3,6,10,11,23, 24	$129.95
	Messenger 110	AM	5	5	no	12	superhet	solid-state	2,10,11,23,24	$109.95
	Messenger 123	AM	23	23	no	12	superhet	solid-state	1,2,7,10,23,24	$179.95
	Messenger 124	AM	23	23	no	117 & 12	dual superhet	solid-state	1,2,3,7,8,10,24	$289.95
	Messenger 125	AM	5	5	no	12	superhet	solid-state	2,10,11,24	$ 99.95
	Messenger 223	AM	23	23	no	117	dual superhet	tubes	1,2,7,8,10,24	$224.95
	Messenger 320	AM	23	23	no	12	dual superhet	solid-state	1,2,7,8,10,23,24	$199.95
	Messenger 323	AM	23	23	no	12	dual superhet	solid-state	1,2,3,6,7,8, 10,23,24	$239.95
Kalimar 2644 Michigan Ave., St. Louis, MO 63118	Kali-Com 23	AM	23	23	no	12	dual superhet	solid-state	1,3,6,7, 8,10,23	$190.00
Lafayette Radio Electronics Corp. 111 Jericho Turnpike Syosset, NY 11791	Dyna-Com 5A	AM	3	3	no	—	superhet	solid-state	2,8,10,11,13,18, 24	$ 79.95
	Dyna-Com 12	AM	12	12	no	—	superhet	solid-state	2,8,10,11,13,18,	$ 99.95

	HB-525D	AM	23	23	yes	12	dual superhet	solid-state	1,2,3,6,7,10,12 23,24	$149.95
	HB-625	AM	23	23	yes	12	dual superhet	solid-state	1,2,3,6,7,10,12, 22,23	$189.95
	Comstat-19	AM	9	9	yes	117	superhet	tubes	10,11,14	$ 59.95
	Comstat-23-VI	AM	23	23	no	117	dual superhet	tubes	2,3,6,7,8,10	$109.95
	Comstat 25B	AM	23	23	yes	117 & 12	dual superhet	tubes	1,2,3,6,7,8,	$149.95
	HB-23	AM	23	23	no	12	dual superhet	state solid-	1,6,7,10,12, 20,23	$ 99.95
	HB-600	AM	23	23	yes	117 & 12	dual superhet	solid-state	1,2,3,6,7,10, 12,22,24	$219.95
	HE-20T	AM	12	12	yes	117 & 12	superhet	solid-state	3,6,7,8,11	$ 89.95
	Micro 12	AM	12	12	no	12	superhet	solid-state	2,6,10,11, 22,23	$ 79.95
	Telsat 23	AM	23	23	no	117 & 12	dual superhet	solid-state	1,2,3,6,7,8	$152.95
	Telsat 50	AM	23	23	yes	12	superhet	solid-state	1,6,12,22,23	$199.95
	Telsat 150	AM	23	23	yes	117 & 12	dual superhet	solid-state	1,6,12,13,22,23	$199.95
Mark Products Co. 5439 West Fargo Ave. Skokie, IL 60076	Invader 2305	AM	23	23	no	12	dual superhet	solid-state	1,3,7,8,12	$169.95
	Lancer-23	AM	23	23	no	12	dual superhet	solid-state	1,7,8	$139.95

NOTES

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2—Transmitter circuitry includes a system of speech clipping or modulation percentage boosting
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5—Unit has a transmit crystal socket on front panel
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22—Receiver features i.f. noise blanking
23—A.C. power pack available
24—Canadian D.O.C. Approved

How to get into

One of the hottest money-making fields in electronics today– servicing two-way radios!

HE'S FLYING HIGH. Before he got his CIE training and FCC License, Ed Dulaney's only professional skill was as a commercial pilot engaged in crop dusting. Today he has his own two-way radio company, with seven full-time employees. "I am much better off financially, and really enjoy my work," he says. Read here how you can break into this profitable field.

More than 5 million two-way transmitters have skyrocketed the demand for service men and field, system, and R&D engineers. Topnotch licensed experts can earn $12,000 a year or more. You can be your own boss, build your own company. And you don't need a college education to break in.

HOW WOULD YOU LIKE to start collecting your share of the big money being made in electronics today? To start earning $5 to $7 an hour... $200 to $300 a week... $10,000 to $15,000 a year?

Your best bet today, especially if you don't have a college education, is probably in the field of two-way radio.

Two-way radio is booming. Today there are more than *five million* two-way transmitters for police cars, fire department vehicles, taxis, trucks, boats, planes, etc. and Citizen's Band uses—and the number is still growing at the rate of 80,000 new transmitters per month.

This wildfire boom presents a solid gold opportunity for trained two-way radio service experts. Many of them are earning $5,000 to $10,000 a year *more* than the average radio-TV repair man.

Why You'll Earn Top Pay

One reason is that the United States Government doesn't permit anyone to service two-way radio systems unless he is *licensed* by the Federal Communications Commission. And there simply aren't enough licensed electronics experts to go around.

Another reason two-way radio men earn so much more than radio-TV service men is that they are needed more often and more desperately. A home radio or television set may need repair only once every year or two, and there's no real emergency when it does. But a two-way radio user must keep those transmitters operating at all times, and *must* have their frequency modulation and plate power input checked at regular intervals by licensed personnel to meet FCC requirements.

This means that the available licensed experts can "write their own ticket" when it comes to earnings. Some work by the hour and usually charge at least $5.00 per hour, $7.50 on evenings and Sundays, plus travel expenses. A more common arrangement is to be paid a monthly retainer fee by each customer. Although rates vary widely, this fixed charge might be $20 a month for the base station and $7.50 for each mobile station. A survey showed that one man can easily maintain at least 100 stations, averaging 15 base stations and 85 mobiles. This would add up to at least $12,000 a year.

Be Your Own Boss

There are other advantages too. You can become your own boss—work entirely by yourself or gradually build your own fully staffed service company. Instead of being chained to a workbench, machine, or desk all day, you'll move around, see lots of action, rub shoulders with important police and fire officials and business executives who depend on two-way radio for their daily operations. You may even be tapped for a big job working for one of the two-way radio manufacturers in field service, factory quality control, or laboratory research and development.

How To Get Started

How do you break into the ranks of the big-money earners in two-way radio? This is probably the best way:

1. Without quitting your present job, learn enough about electronics fundamentals to pass the Government FCC Exam and get your Commercial FCC License.
2. Then get a job in a two-way radio service shop and "learn the ropes" of the business.
3. As soon as you've earned a reputation as an expert, there are several ways you can go. You can move *out* and start signing up and servicing your own customers. You might become a franchised service representative of a big manufacturer and then start getting into two-way radio sales, where one sales contract might net you $5,000. Or you may even be invited to move *up* into a high-prestige salaried job with one of the major manufacturers either in the plant or out in the field.

The first step—mastering the fundamentals of Electronics in your spare time and getting your FCC License—can be easier than you think.

Cleveland Institute of Electronics has been successfully teaching electronics by mail for over thirty years. Right at home, in your spare time, you learn electronics step by step. Our AUTO-PROGRAMMED® lessons and coaching by expert instructors make everything clear and easy, even for men who thought they were "poor learners." You'll learn not only the fundamentals that apply to all electronics design and servicing, but also the specific procedures for installing, troubleshooting, and maintaining two-way mobile equipment.

Get Your FCC License... or Your Money Back!

By the time you've finished your CIE course, you'll be able to pass the FCC License Exam with ease. Better than nine out of ten CIE-trained men pass the FCC Exam the first time they try, even though two out of three non-CIE men fail. This startling record of achievement makes possible the famous CIE warranty: you'll pass the FCC Exam upon completion of your course or your tuition will be refunded in full.

Ed Dulaney is an outstanding example of the success possible through CIE training. Before he studied with CIE, Dulaney was a crop duster. Today he owns the Dulaney Communications Service, with seven people working for him repairing and manufacturing two-way equipment. Says Dulaney: "I found the CIE training thorough and the lessons easy to understand. No question about it—the CIE course was the best investment I ever made."

Find out more about how to get ahead in all fields of electronics, including two-way radio. Mail the bound-in postpaid reply card for two FREE books, "How To Get A Commercial FCC License" and "How To Succeed In Electronics." If card has been removed, just mail the coupon below.

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Your book on "How To Get A Commercial FCC License."

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☐ Broadcast Engineering ☐ Industrial Electronics
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CIRCLE NO. 9 ON READER SERVICE PAGE

Manufacturer	Model	Type of Signal	No. of Transmit Channels	No. of Receive Channels	Is Receiver Tunable?	Power Power (Volts)	Type of Receiver	Circuits Use	Notes	Price
Mark Products Co. (see preceding page)	Sidewinder 46	AM/SSB	46	46	yes	117	superhet	solid-state	1,2,7,8,15,16,22	$495.00
Midland International Corp. 1909 Vernon Street North Kansas City, MO 64116	13-770	AM	6	6	no	12	superhet	solid-state	3, 7, 8, 11, 12, 18, 23	$ 89.95
	13-772	AM	12	12	no	12	superhet	solid-state	3, 7, 8, 11, 12, 18, 23	$ 99.95
	13-775B	AM	6	6	no	12	superhet	solid-state	2,3,7,8,11,12,18, 23	$110.00
	13-778	AM/SSB	3	3	yes	12	dual superhet	solid-state	16,18,22,23	$219.95
	13-790	AM	23	23	no	12	dual superhet	solid-state	1,2,3,7,8,12, 18,23	$165.00
	13-855	AM	6	6	no	12	superhet	solid-state	11,23	$ 79.95
	13-868	AM	23	23	yes	12	dual superhet	solid-state	1,7,8,12,23	$179.95
	13-870C	AM	23	23	no	12	dual superhet	solid-state	1,2,3,7,8,12,23	$159.95
	13-872	AM	23	23	yes	12	dual superhet	solid-state	1,2,3,7,8,12,23	$189.95
	13-873	AM/SSB	46	46	yes	12	dual superhet	solid-state	1,2,3,7,8,12,16	$359.95
	13-874	AM	8	8	no	117	superhet	solid-state	3,7,8,11,12	$ 89.95
	13-876	AM	23	23	yes	117 & 12	dual superhet	solid-state	1,2,3,7,8,12	$199.95
	13-877	AM	23	23	yes	117 & 12	dual superhet	solid-state	1,2,3,7,8,12,17	$219.95
	13-880	AM/SSB	46	46	yes	117 & 12	dual superhet	solid-state	1,2,3,7,8,12, 15,16,17,22	$369.95

Multi-Elmac Company 21470 Coolidge Highway Oak Park, MI 48237	Citifone 19	AM	23	23	no	12	dual superhet	solid-state	1,2,3	$159.95
Olson Electronics, Inc. 260 S. Forge St. Akron, OH 44308	CB-94	AM	5	5	no	—	superhet	solid-state	3,11,18	$ 79.99
Pace Communications Corp. 24049 S. Frampton Ave. Harbor City, CA 90710	Pace 100	AM	6	6	no	12	dual superhet	solid-state	6,7,10,11	$129.95
	Pace 2300	AM	23	23	no	12	dual superhet	solid-state	3,6,7,8,10,11,12	$200.00
	2376	AM	23	23	no	117	dual superhet	solid-state	1,22	$149.95
	Base Station	AM	23	23	no	117	dual superhet	solid-state	1,7,8,12,15	$330.00
Pearce-Simpson, Inc. DIU Gladding Corp. Box 800, Biscayne Annex Miami, FL 33152	Bearcat 23	AM	23	23	no	117 & 12	dual superhet	solid-state	1,3,7,8,9,11,17,22	$199.95
	Bobcat 23	AM	23	23	no	12	dual superhet	solid-state	1,3,7,8,11	$149.95
	Companion II	AM	5	5	yes	117 & 12	superhet	tubes	5,11,12	$159.90
	Companion IV	AM	10	10	no	12	superhet	solid-state	3,11,12,23	$139.90
	Director 23	AM	23	23	no	12	dual superhet	solid-state	1,7,12,23	$269.90
	Guardian 23B	AM	23	23	no	117 & 12	dual superhet	tubes	1,7,8,9,12,15	$269.90
	Panther	AM	5	5	no	12	superhet	solid-state	11,23	$ 99.90
	Tiger 23	AM	23	23	yes	12	dual superhet	solid-state	1,3,7,8,11	$149.95
	Wildcat	AM	6	6	no	12	superhet	solid-state	11,23	$ 69.95

NOTES

1—Has frequency synthesis circuit
2—Transmitter circuitry includes a system of speech clipping or modulation percentage boosting
3—Modulator can be switched to "Public Address" from front panel
4—Unit has a "Spotting" switch on front panel
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8—Meter on front panel reads approximate or relative power output
9—Receiver features low-noise Nuvistor r.f. stage
10—This description fits basic unit—see manufacturer's catalog for optional accessories
11—Transceiver requires 2 crystals per channel
12—Rear skirt provision for remote speaker (paging)
13—Transceiver features dual antenna (switched) input/output connections
14—Transceiver has power switching to reduce transmitter input to 100 milliwatts
15—Receiver features front panel r.f. sensitivity switch or control
16—Transceiver may be tuned to either sideband for SSB mode of operation
17—Console arrangement with built-in clock
18—Walkie-talkie
19—Transceiver feeds received signal to car radio; no complete receiver in this package
20—Requires only 1 crystal per controlled channel
21—BFO in receiver for SSB reception
22—Receiver features i.f. noise blanking
23—A.C. power pack available
24—Canadian D.O.C. Approved

Manufacturer	Model	Type of Signal	No. of Transmit Channels	No. of Receive Channels	Is Receiver Tunable?	Power Supply (Volts)	Type of Receiver	Circuits Use	Notes	Price
J. C. Penney Co., Inc. 1301 Avenue of the Americas New York, NY 10019	Golden Pinto	AM	23	23	yes	12	dual superhet	solid-state	1,2,7,8,22,23	$159.00
	Pinto Jr.	AM	6	6	no	12	superhet	solid-state	10,11,23	$ 59.00
	Pinto-23	AM	23	23	no	12	dual superhet	solid-state	1,3,7,23	$129.00
	Pinto-23B	AM	23	23	yes	117 & 12	dual superhet	solid-state	1,2,3,7,8,12	$159.00
Radio Shack Corp. 730 Commonwealth Ave. Boston, MA 02215	Navaho	AM	23	23	no	117 & 12	dual superhet	solid-state	1,7,8	$119.95
	TRC-10	AM	6	6	no	12	dual superhet	solid-state	10,11,23	$ 69.95
	TRC-24	AM	23	23	no	12	dual superhet	solid-state	1,3,7,8,12,23	$139.95
	TRC-29	AM	23	23	yes	117 & 12	dual superhet	solid-state	1,2,3,7,8,12,23	$169.95
Regency Electronics, Inc. 7900 Pendleton Pike Indianapolis, IN 46226	Imperial II	AM/SSB	23	46	yes	117 & 12	dual superhet	tubes	7,8,12,16,24	$369.00
	Sprint	AM	23	23	no	12	dual superhet	solid-state	1,7,8,12,23,24	$129.95
	500	AM	12	12	no	12	superhet	solid-state	3,11,12,23	$ 99.95
	GT-523	AM	23	23	yes	12	dual superhet	solid-state	1,3,7,8,12,23	$189.00
	Formula 12	AM	12	12	no	117	superhet	solid-state	3,7,8,11,12	$ 99.95
	Formula 23	AM	23	23	no	117	dual superhet	solid-state	1,3,7,8,11,12	$189.00
Robyn International, Inc. P.O. Box 478 Rockford, MI 49341	GT-146	AM/SSB	46	45	yes	12	dual superhet	solid-state	1,3,7,8,10,12,15,16,21,23	$279.95
	J-123	AM	23	23	no	12	dual superhet	solid-state	1,3,12,15,23	$109.95
	T-123	AM	23	23	yes	117 & 12	dual superhet	tubes	1,2,3,7,8	$179.95

	TR-123	AM	23	23	no	12	dual superhet	solid-state	1,2,3,7,8,10,12,23	$159.95
SBE Linear Systems, Inc. 220 Airport Blvd. Watsonville, CA 95076	Capri	AM	5	5	no	12	superhet	solid-state	2,11,23	$ 79.95
	Cascade	AM	6	6	no	12	superhet	solid-state	3,8,11,18	$ 89.95
	Coronado	AM	23	23	no	12	dual superhet	solid-state	1,2,3,7,8,23	$159.95
	Sidebander	AM/SSB	46	46	yes	12	dual superhet	solid-state	1,3,10,12,16,23	$339.95
	Sidebander Console	AM/SSB	46	46	yes	117	dual superhet	solid-state	1,3,7,8,10,12,15, 16,17	$395.00
	Sierra	AM	23	23	yes	117 & 12	dual superhet	solid-state	1,2,3,7,8,10,12, 15,17	$219.00
Sears, Roebuck and Company 3245 W. Arthington Chicago, IL 60607	6556	AM	5	5	no	12	superhet	solid-state	2,10,11,24	$ 99.95
	6562	AM	23	23	yes	12	dual superhet	solid-state	1,2,3,6,7,8, 10,12,23,24	$199.95
	7531	AM	23	23	no	12	superhet	solid-state	1,2,24	$159.95
	7535	AM	23	23	no	117	dual superhet	solid-state	1,2,7,8,24	$209.95

NOTES
1—Has frequency synthesis circuit
2—Transmitter circuitry includes a system of speech clipping or modulation percentage boosting
3—Modulator can be switched to "Public Address" from front panel
4—Unit has a "Spotting" switch on front panel
5—Unit has a transmit crystal socket on front panel
6—Transceiver has socket connections to use manufacturer's selective calling system
7—Meter on front panel reads "S-units"
8—Meter on front panel reads approximate or relative power output
9—Receiver features low-noise Nuvistor r.f. stage
10—This description fits basic unit—see manufacturer's catalog for optional accessories
11—Transceiver requires 2 crystals per channel
12—Rear skirt provision for remote speaker (paging)
13—Transceiver features dual antenna (switched) input/output connections
14—Transceiver has power switching to reduce transmitter input to 100 milliwatts
15—Receiver features front panel r.f. sensitivity switch or control
16—Transceiver may be tuned to either sideband for SSB mode of operation
17—Console arrangement with built-in clock
18—Walkie-talkie
19—Transceiver feeds received signal to car radio; no complete receiver in this package
20—Requires only 1 crystal per controlled channel
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Manufacturer	Model	Type of Signal	No. of Transmit Channels	No. of Receive Channels	Is Receiver Tunable?	Power Supply (Volts)	Type of Receiver	Circuits Use	Notes	Price
Sonar Radio Corp. 73 Wortman Ave. Brooklyn, NY 11207	FS-23	AM	23	23	yes	117 & 12	dual superhet	tubes	1,6,7,8,9,10, 11,12,24	$299.95
	J-23	AM	23	23	no	12	dual superhet	solid-state	1,3,6,10,12, 23,24	$239.95
	T-6	AM	6	6	no	—	superhet	solid-state	3,8,11,12,18,23	$139.95
Teaberry Electronics Corp. 3401 N. Shadeland Ave. Indianapolis, IN 46226	Five by Five	AM	23	23	no	12	dual superhet	solid-state	1,2,3,7,8,12,23	$149.95
Tram Corporation Lower Bay Rd. Box 187 Winnisquam, NH 03289	Corsair	AM/DSB	23	46	yes	12	dual superhet	solid-state	2,3,7,12,16,20, 22,23	$415.00
	Titan I	AM	23	23	yes	117	dual superhet	tubes	2,4,7,8,12, 15,24	$410.00
	Titan II	AM/DSB	23	46	yes	117	dual superhet	tubes	2,4,8,12,15, 16,24	$482.00
	Titan III	SSB/AM	46	46	yes	117	dual superhet	solid-state	2,4,7,8,12,15,16, 17,21	$598.00
Utica Electronics, Inc. 2917 W. Irving Park Rd. Chicago, IL 60618	RME Six-Sixty		6	6	no	117 & 12	dual superhet	tubes	7,8,11	$79.95
	RME Six-Eighty		6	6	no	117 & 12	dual superhet	tubes	2,7,8,11	$114.95

NOTES
1—Has frequency synthesis circuit
2—Transmitter circuitry includes a system of speech clipping or modulation percentage boosting
3—Modulator can be switched to "Public Address" from front panel
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5—Unit has a transmit crystal socket on front panel
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Browning has retained its individual unit styling introduced in the very early days of CB. The "Golden Eagle" (above) has the transmitter to the left and receiver to the right. They are SSB/AM units with 46-channel capability. The Allied Radio A-2561 (to the left) is an under $100 23-channel mobile transceiver.

INTERPRETING THE CATALOG

Type of Signal: There are three modulation methods currently in use by CB'ers. Most transceivers broadcast amplitude modulation (AM) signals. Several models broadcast a somewhat similar signal, but with reduced carrier and enhanced sideband modulation. This type of signal is referred to as double-sideband (DSB). Many new transceivers are being manufactured to transmit and receive signal-sideband (SSB) signals. Specialized circuits are required for SSB, a method of virtually eliminating the carrier and transmitting on only one of the two AM sidebands.

No. of Transmit Channels. Any one of 23 channels may be used by a CB'er; however, channel 9 is reserved for emergency communications. Channels 10 through 15, plus channel 23, are available for purposeful communications between stations operated by different licensees. Channels 1 through 8 and 16 through 22 are to be used by the CB'er only for intracommunications between his own base and mobile stations. In this Catalog, a transceiver capable of transmitting and receiving SSB signals on all 23 channels is considered capable of operating on 46 separate channels.

No. of Xtal Receive Channels: Though

A "SCANNER" FOR CB

Apparently POPULAR ELECTRONICS jumped the gun last year in announcing that Commander Electronics (133 N. Jefferson St., Chicago, IL 60606) would "soon" introduce its model 778 Scanalyzer. This new product has just made its initial appearance and is now known as the Model 779 or Scanalyzer 23.

The Scanalyzer 23 automatically scans a special group of CB channels, or all 23 of them, in very rapid rotation. A "Visual Monitor" board with 23 indicator lamps shows which channels are occupied and which are either silent or occupied by stations below a predetermined input field strength. Thus the model 779 can be used to determine roughly signal strengths so that an operator knows whether the signals are from close-in stations or stations far enough away not to be bothered by your carrier. And, if you're forgetful, it has a "memory" switch to give you a second look at the activity within your receiving range. It's all visual—no speaker.

You can couple the Scanalyzer to your present antenna or a separate antenna.

Circle No. 97 on Reader Service Page 15 or 95

most transceivers receive and transmit on the same number of channels, modern techniques permit the CB'er to receive on split channels (such as used by SSB stations), increasing the number of receive channels over those used for transmitting.

Tunable Receiver: In this Catalog, any receiving convenience which permits the CB'er to shift the received frequency above or below the assigned channel frequency is considered to make the receiver tunable. Also included in this category are the few receivers with fully continuous tuning.

Power Supply: For the purposes of this Catalog, the household a.c. line voltage has been "standardized" at 117 volts. About four out of every five CB transceivers can also be powered from 12-volt automobile batteries, and a few can operate off 6-volt batteries. In the Catalog, the word "and" means the transceiver contains a universal power supply permitting operation from any of the input voltages indicated. The word "or" means that the transceiver contains one power supply which must be physically changed to switch from one input voltage to another.

Receiver: There are only two types of receiver circuits used in CB transceivers: straight superheterodynes or dual-conversion superheterodynes. The latter circuit is usually considered much more selective, although the buyer should look for the possibility that the straight superheterodyne includes some sort of crystal or mechanical filtering to provide channel selectivity comparable to that of a dual-conversion superheterodyne.

Circuit: CB transceivers may use all tubes, some tubes and some transistors (hybrid) or circuits with nothing but solid-state devices. It should be noted that every CB transceiver listed has two features that are not itemized—a variable squelch control and a built-in noise limiter.

Notes: A detailed breakdown of notes appears on each odd-numbered page. The notes describe special features that are not common to all CB transceivers.

Canadians should look for note 24, which indicates D.O.C. approval.

Price: This Catalog shows prices set by the manufacturers or distributors as reported to us at press time. Readers are advised that all prices are subject to change without notice. No distinction has been made between the "list" and "net" prices. We are not in a position to judge the exact nature of any manufacturer's pricing structure and depend upon the prices furnished as being those in effect during the preparation of the Catalog. -30-

SBE "Console" (top, below) is an under $400 SSB/AM unit for base station operation. Radio Shack TRC-23B "Navaho" (center) claims superior sensitivity and selectivity. Operates from 117-volts a.c. or 12 volts d.c. Courier "Classic II" is a handsome unit using slide switches and controls.

CARE AND HANDLING OF COAXIAL CONNECTORS THE QUICK, FOOLPROOF WAY

BY WILLIAM I. ORR, W6SAI

MANY of the so-called UHF connectors were developed during World War II for use with medium size coaxial r.f. cables (such as RG-8/U and RG-11/U). Now generally supplanted by the newer Series N connectors in commercial equipment, these inexpensive and readily available UHF connectors are still widely used on amateur, CB, and SWL equipment. The most common members of this family are the male plugs (PL-259, PL-259A, and UG-295/U) and the female receptacles (SO-239, UG-296/U).

The male plug, a beguilingly simple affair, has a non-constant impedance, is a non-waterproof device and (to many exasperated amateurs and CB'ers) is an invention of the devil. A look at the PL-259 plug shows instantly how it *should* fit on the end of a piece of coax cable; the installation is self-evident! But, alas, getting the plug properly astride the cable end and soldered firmly in place is a frustrating and time-consuming task. In too many instances, the user simply gives up the battle, jams the connector on the end of the cable, and solders what he can, leaving whiskers of copper braid ready to short out the plug.

True, the plug manufacturers provide nifty little drawings showing how the plug should be placed on the cable; but these pieces of advertising art merely make the frustrating experience seem more bitter, since sooner or later most amateurs come to the reluctant conclusion that the PL-259 plug was *never intended* to be placed on a coaxial cable by the hand of man!

I have battled the PL-259 plug problem for longer than I care to admit and I finally solved the dilemma by switching to the newer and better *type N* coaxial fittings, which were seemingly designed by a sane mind. However, time does not march on, and a large amount of gear in the W6SAI station is equipped with the PL-259's matching partner, the ubiquitous SO-239.

Finally, with the assistance of W6CYL, who had made his peace with the coaxial plug problem, it was decided to try a system approach that would solve the PL-259 question once and for all. Here is the solution.

Coaxial Connector Assembly. The mating cable must be properly prepared if the connector is expected to operate to its fullest capability. With a little care and some inexpensive tools, a well-engineered assembly may be made in a few minutes. In addition to a soldering iron or gun, you will need: a ruler, a sharp knife (the Stanley 99A Shop Knife is

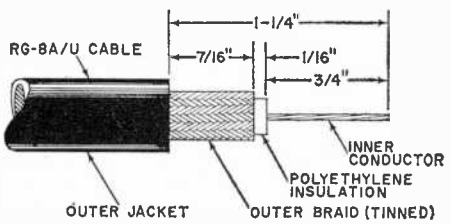
recommended), and a tubing cutter (the General Hardware #123 Midget Tubing Cutter is recommended). Oh yes, you'll need a pair of wire cutters to snip the cable to proper length, also.

Follow this procedure carefully:

Step 1. Slide the coupling ring of the PL-259 over the coaxial line. Next, take the shop knife and circumscribe a cut in the outer, black jacket of the cable about 1½" back from the end. Make the cut at right angles to the cable so that the end of the vinyl jacket will be square and ship-shape. Slit the free end of the jacket with the knife and peel it off.

Step 2. You now have part of the outer braided shield exposed. Using a hot soldering iron or gun, *quickly* and *smoothly* tin the braid, making the shield a solid entity. Do this quickly so as not to unduly overheat the inner polyethylene insulation of the cable. If you take too long, the inner insulation will melt and "squirt" out between the interstices of the braid. Don't worry; you'll obtain expertise in soldering the braid once you set your hand to it. Clean the left-over flux from the braid with paint thinner after the solder cools.

Step 3. Next, cut the soldered braid with the tubing cutter. You'll want to cut it so that 7/16" is left exposed. Using a soft pencil, make a mark on the braid exactly 7/16" out from the black jacket. Place the tubing cutter over the braid so that the cutter wheel falls on the pencil mark. Tighten the cutter a bit and slowly revolve it about the cable. Tighten the cutter wheel once or twice again and continue to revolve the cutter. Four or five revolutions, and the tubing cutter will neatly slice the solid braid. The unwanted braid end may be easily pulled off, using the wire cutters as snips.



By the time you have finished step 4, the end of your RG-8A/U cable should look like this.

UHF CONNECTORS
For RG-8A/U and RG-58/U Cable

Plugs: PL-259, PL-259A, UG-295/U
Adapters for RG-58/U: UG-175/U, UG-410/U
Right-angle adapter: UG-297/U, UG-646/U, M-359
Adapter, straight (female-female): PL-258, UG-360/U, UG-299/U
Receptacle: SO-239, UG-296/U
Adapter, straight (male-male): Dow-Key F-2
Hybrid adapters:
- UHF (female) to BNC (male): UG-255/U
- UHF (male) to BNC (female): UG-273/U
- UHF (female) to N (male): UG-146A/U
- UHF (male) to N (female): UG-83B/U
- UHF (female) to male phono connector: Dow-Key A-210
- UHF (male) to male phono connector: Dow-Key A-211
- UHF plug (solderless): Amphenol 83-851 (for RG-8A/U)

Step 4. Trim the inner polyethylene insulation of the cable. It should be cut cleanly (using the utility knife) so that a collar about 1/16" wide is left at the end of the outer braid which was just trimmed. Go slowly, so that you do not nick the inner conductor. Once the slug of insulation is free, it may be removed from the cable by grasping it with your fingers and slowly but firmly pulling and rotating it at the same time. When the slug is off, tin the inner conductor.

Step 5. You have now come to the moment of truth. The cable is ready for the PL-259 shell. It should be pushed on the cable end and rotated with the fingers so that the internal threads of the shell are screwed onto the outer vinyl jacket of the cable. As the plug is screwed onto the cable, you should see the tinned outer jacket appear through the four solder holes of the plug. Continue twisting the plug onto the cable until the braid is completely visible through all holes.

Step 6. The last step is to solder the braid through the solder holes of the plug and solder the center conductor to the center terminal of the plug. Use an iron or gun with a small point and make neat connections to the braid, taking care that the solder does not run over the outer threads of the plug. With a little care, you'll have a work of art. When the joints cool, examine your masterpiece and then slide the coupling ring down over the plug.

Sealing for Outdoor Use. The PL-259 is not waterproof and must be protected against moisture by an additional covering. If water does get into the plug, it can be very quickly sucked down the coaxial cable by capillary action. Soon the entire outer braid becomes corroded and line loss rises rapidly.

To seal the plug and line properly, the mating surface between the plug and the matching SO-239 receptacle should be packed with silicone grease. The connectors are then mated and the excess grease is forced out of the joint and wiped off. The next step is to wrap the coaxial joint thoroughly with pressure sensitive vinyl electrical tape. Several layers of tape should be used; and the wrappings should extend beyond each connector a minimum of four inches, making the total wrap about ten inches long. The tape should be put on under tension, with one layer overlapping the one beneath. As a final precaution, the cable run should be dressed so that water cannot run to a joint and stand there.

Use With Small Cables. The popular PL-259 UHF plug may be used with small-diameter coaxial cables (such as RG-58/U and RG-59/U) by adding a reduction adapter. For example, RG-58/U (52-ohm cable) requires a UG-175/U adapter and RG-59/U (72-ohm cable) requires a UG-176/U adapter. Follow much the same procedure detailed above with the exceptions noted below.

Step 1. Insert the cable end through the coupling ring *and the adapter*. Note that the knurled end of the ring and the narrow end of the adapter face the open end of the cable. Cut the end off ¾" of the cable jacket with the utility knife.

Step 2. Fan the braid out slightly and fold it back over the outer jacket.

Step 3. Push the adapter forward under the braid and trim the braid with small, sharp scissors to a length of ⅜". Next, using the utility knife, remove ⅝" of the insulation from the center conductor. Be careful not to nick the conductor. Tin the exposed conductor quickly with a small soldering iron.

Step 4. Carefully screw the plug assembly onto the adapter. The center conductor will pass through the center pin and the braid should appear through the side holes of the plug assembly. Using an iron

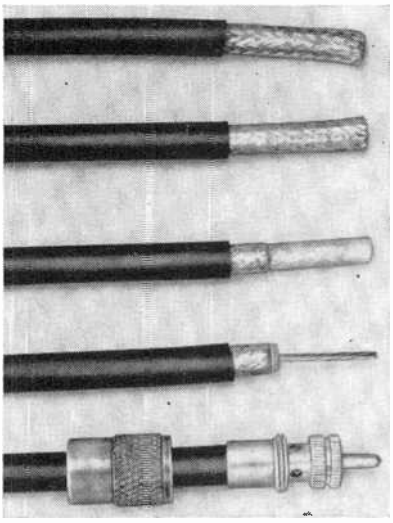


Photo shows, from top to bottom, the results of steps in preparing the cable.

with a small soldering tip, solder the braid through the plug assembly holes. Use just enough heat to bond the braid to the shell. After these have cooled, solder the center connector to the tip of the plug. Finally, screw the coupling ring on the assembly.

Waterproofing and sealing are even more important when using either the RG-58/U or RG-59/U cable. -30-

MAKE YOUR VTVM A MEGGER TOO

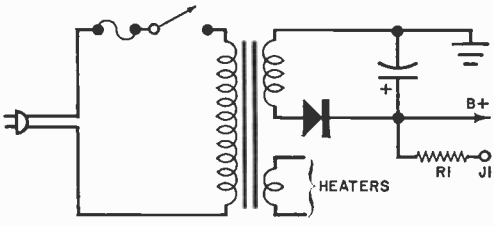
MEASURE UP TO 50,000 MEGOHMS

BY JAMES CHILDS AND JOHN ESKRIDGE

BUILT RIGHT into your VTVM is a megger that can measure extremely high resistances (to 50,000 megohms). To make use of this megger function, all you have to do to the basic meter is add a resistor and a pin or banana jack. The modification simply provides a convenient voltage source for measuring very high resistances; it does not interfere with the normal operation of your meter.

The megger modification comes in handy for all sorts of jobs. It greatly simplifies the detection of leakage in non-electrolytic capacitors, between coil and transformer windings, and between conductors of transmission lines.

The filtered d.c. for the megger is obtained from the positive side of the filter capacitor, through load resistor *R1* which is also used as a current limiter, in your VTVM as shown in the schematic diagram. Load resistor *R1* is the megger modification resistor that must be added to the VTVM's circuit. Its value must be calculated on the basis that it will pass no more than 1 mA if the ground lead of the meter is accidentally shorted to *J1* (the pin or banana jack that is used in the modification). This value is usually between 50,000 and 75,000 ohms, depending on the amplitude of the B+ voltage in your particular meter and derived by Ohm's Law ($R1 = B+/0.001$).



Two small parts, R1 and J1, are all that have to be added to basic VTVM to provide megger function.

The first step in measuring an unknown resistance is to measure the source voltage at *J1* with the positive d.c. probe of the meter. Then unknown resistor *Rx* is placed between *J1* and the probe to provide a circuit from B+ through *Rx* and into the input of the meter. At this point, the meter is measuring the voltage drop across input impedance *Rm* of the meter, which is typically 11 megohms.

If *Rm* and its voltage drop *Em* are known, you can calculate total current *It*. The voltage drop across *Rx* can be calculated by subtracting meter voltage *Em* from source voltage *Es* to obtain *Ex*, the voltage dropped across the resistance being measured.

With total current through and the voltage drop across *Rx* known, calculate the value of *Rx* by using Ohm's Law ($Rx = Ex/Ix$), or from the equation: $Rx = [Rm\ (Es - Em)]/Em$.

Most VTVM's have unregulated power supplies, but since the resistances being measured are very high, the loading effect on the power supplies will be negligible. Also, since current through *Rx* is very low, the voltage drop across the current-limiting resistor, *R1*, can be ignored

-30-

amateur radio equipment 1970-1971

BY HERB S. BRIER, W9EGQ

Review & Preview

EVER SINCE the transistor emerged from the laboratory, design engineers have encouraged its use in amateur transmitting equipment. Simultaneously, designers were trying to cram more and more transmitting power into smaller and smaller packages. The short duty cycle of single sideband and CW signals made it possible to put lots of power into small tubes. When it comes to r.f. transistors, however, low power and low voltage are essential. As a result, high power in a transmitter or transceiver can still be achieved only with hybrid (tube-plus-transistor) circuits.

Unfortunately, designing a transceiver that used transistors (and/or IC's) in all of its low-power circuits—not in just a few carefully selected places—and one that could compete with tube models in performance and price proved to be extremely difficult. So difficult, in fact, that several wellknown manufacturers quietly gave up the fight when their hybrid transceivers failed in field tests. But the specifications of several units announced for 1970-71 indicate that the engineers have finally succeeded in producing efficient hybrid transceivers at competitive prices.

Some Definitions. Before examining the evidence, let's define a few terms. A transceiver combines transmitting and receiving functions in a single physical package and uses many of the same components in both modes. Its advantages are compactness, economy, and ease of operation. An SSB transceiver usually transmits and receives on the same frequency, but some incorporate clarifiers, delta tuning, or receiver incremental tuning to touch up receiver tuning slightly without affecting the transmitted frequency.

It is also sometimes desirable to transmit and receive on widely separated frequencies. This is normally achieved with an external variable frequency oscillator (VFO) to control the transmit function while the regular VFO controls the receive function (or vice versa). Some transceivers switch automatically from receive to transmit when the operator talks into the microphone (VOX) or presses the key—otherwise they require manual switching. Unless specifically mentioned in the individual descriptions below, you may asume that VOX operation is not available. (Not all operators like VOX, anyway.)

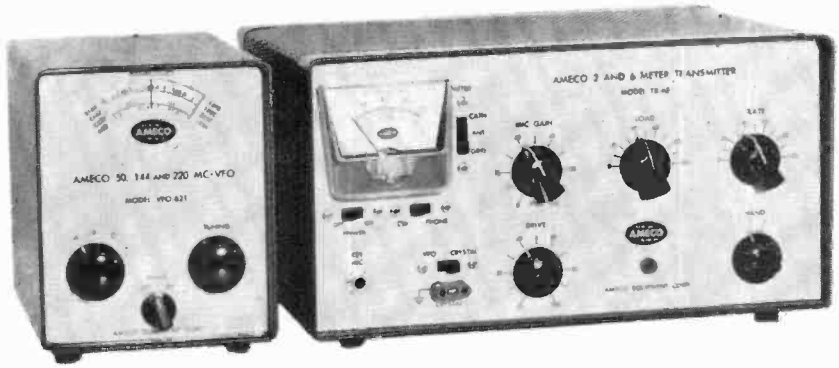
Transceivers. One hybrid transceiver for 1970-71 is the brand-new, **SBE-Linear Sys-**

tems Inc. SB-35. It employs 30 bi-polar transistors, eight FET's, several different diodes, and a pair of audio hi-fi 8417 tubes to develope a 260-watt SSB/CW signal on the amateur bands between 3.5 and 29.7 MHz. The self-contained package includes a 117-volt, a.c./12-volt, d.c., power supply and a loudspeaker. The SB-35 has a 2.1-kHz bandwidth, choice of sidebands, high receiver sensitivity, S-meter, and delta tuning. Price of the SB-35 is $549. Options include: VOX ($29.95), 25-kHz crystal calibrator ($24.95), and external VFO ($89.95). . . . **National Radio Company, Inc.,** compresses a lot of power into its new NCX-1000, 100-watt (PEP) hybrid transceiver. Its built-in power supply delivers 2750 volts to the 8122 output tube. A built-in i.f. clipper, bracketed front and back by crystal lattice filters, doubles effective SSB power without splatter. Bandwidth is 2.7 kHz, and receiver sensitivity is 0.5 μV. Price of the NCX-1000 is $995. Optional 100-kHz crystal calibrator and CW sidetone modules are available.

Allied Radio's entry in the SSB/CW transceiver race is the A-2517. Its transmitter power input is 160 watts up to 21.5 MHz and 120 watts on 29 MHz to Japanese S-2001 tubes (replaceable by 6146's). The A-2517 uses a solid-state VFO, selectable sidebands, 2.4- or 0.5-kHz bandwidth, VOX, 25-kHz crystal calibrator, and delta tuning. Price with power supply/speaker console is $450, or $500 with the external VFO.

The big plus in **R.L. Drake's** new TR-4, 300-watt SSB/CW/AM transceiver is in its i.f. noise blanker. (The 17-transistor noise blanker may be factory installed in older TR-3's and TR-4's for $129.) The features of last year's TR-4, such as VOX, crystal calibrator, CW audio sidetone oscillator, and solid-state VFO, are retained. The TR-4 is priced at $822, including power supply/speaker console. The external VFO is $110, and the model L-4B matching 2-kW PEP linear amplifier is $825 . . . For the operator who wants high-grade equipment in kit form, **Heath** has put a pre-built, solid-state linear master oscillator (LMO) in its deluxe SB-102, 180-watt transceiver. The new LMO stabilizes in half the time required by the previous tube model, and minor circuit changes have increased receiver sensitivity to 0.35 μV. Being crystal-controlled, the SB-102 has built-in VOX, a sidetone CW oscillator, and 100-kHz crystal calibrator as standard equipment. You can sharpen up CW selectivity by adding a 400-Hz filter to the standard built-in 2.1-kHz filter. The **Heathkit** SB-102 kit sells for $380, plus $52 for the a.c. supply, $80 for the 12-volt, d.c., supply, and $19.95 for the matching speaker. (The power supplies and speaker match all Heath transceivers, by the way.) External LMO, $100; 1200-watt amplifier $220; 2000-watt amplifier, $350. For $250, the **Heathkit** HW-100 has all the basic features of the SB-102, including VOX, but without the frills. The HW-12 (3.8-4 MHz) $100; the HW-22 (7.15-7.3 MHz) $105; and the HW-32 (14.15-14.35 kHz) $105, give similar singleband SSB performance (no CW).

Galaxy Electronics concentrates its amateur transceiver efforts on the GT-550, 550-watt, SSB/CW transceiver. Galaxy has earned the reputation of especially good receiving performance in its transceivers, and the GT-550 does not hurt that reputation. It has solid-state VFO, 2-1-kHz bandwidth. The GT-550 lists at $550, plus $100 for the a.c. power supply and $29.95 for the speaker. Options include plug-in VOX, $30; 25-kHz crystal calibrator, $25; 300-Hz CW filter, $37.50; external VFO, $95 . . . From Japan, **Spectronics** imports the Yaesu FTdx-560, hybrid, 560-watt, SSB/CW transceiver. It features built-in power supply, 2.3-kHz bandwidth, VOX, 25-100-kHz crystal calibrator, sideband selector switch, and clarifier. The FTdx-560 lists at $450, plus $20 for the matching speaker. The external VFO is $100, and two 1200-watt linear amplifiers are available at $230 or $300, depending on the tubes used . . . High on the watts-per-dollar curve is **World Radio's** Duo-Bander II. Designed for 80- and 40-meter operation, the unit lacks a few of the refinements of more costly transceivers. Nevertheless, its hybrid circuit generates a clean 400-watt sideband signal on transmit and its excellent receive sensitivity and 2.7-kHz bandwidth concede little to any other transceiver. The Duo-Bander lists for $170, plus $90 for the husky, 400-watt, 117/235



The low-power Model TX-62 transmitter made by Ameco can be operated crystal-controlled or driven by outboard model VFO-621. The complete package sells for under $250.

Solid-state Varitonics/Inoue IC-2F has a FET front end and IC's in the audio if stages. The output is 10 watts of crystal-controlled narrow-band FM.

New SBE Linear Model SB-35 is claimed to be 9.6% solid-state. It has a rating of 260 watts p.e.p., and covers five bands: both phone and CW.

Top-value linear amplifier is this new item from Heathkit—Model SB-220. With a 2-kW p.e.p. SSB and 1-kW CW/RTTY rating, it sells for about $350. The SB-220 also has A.L.C. and a drive requirement of 100 watts for full rated input/output.

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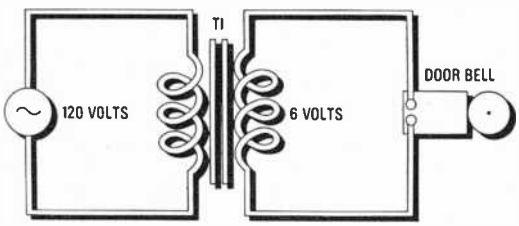
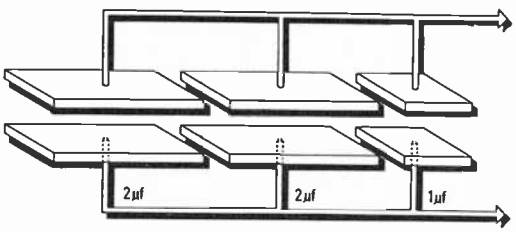


In this door bell circuit, which kind of transformer is T_1 — step-up or step-down?

Note: if you had completed only the first lesson of *any* of the RCA Institutes Home Study programs, you'd easily solve this problem.

This one is more advanced.



What is the total capacitance in the above circuit?

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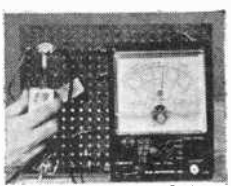

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volt a.c., supply or $150 for a 300-watt 117/12-volt supply.

Swan Electronics, a division of the Cubic Corp., has upgraded its top SSB/CW/AM transceiver, the Swan 500CX. The process has increased transmitter power to 550 watts on SSB, improved AGC action, increased audio gain and decreased distortion, and improved the crystal calibrator, and the balanced modulator circuit. The price remains the same, $565, plus $105 for the 117-volt power supply/speaker console. Options include VOX, $35; 800 Hz, CW filter, $28; deluxe external VFO, $145, and 2-kW amplifier, $660. Swan also offers its budget-priced Cygnet in two models. Both are self-contained, 260-watt, SSB/CW transceivers with dual 117-volt, a.c./12-volt, d.c. power supply and loud speaker. The basic Cygnet 260 lists at $435, but for $90 more, the 270 has more sideband suppression, selectable sidebands, AGC/ALC, more-versatile metering facilities, and a built-in 100-kHz crystal calibrator. The 270 also has facilities for a plug-in VOX unit.

Leaping upward $1100 in price, **Hallicrafters** division of Northrop continues to offer the only full-power amateur SSB/CW transceiver on the market. Besides its maximum power rating, the SR-2000 "Hurricane" features 2.1-kHz bandwidth, 0.35 μV receiver sensitivity, noise blanker, crystal calibrator, and receiver incremental tuning. It lists at $1620 with power supply. And do not overlook the Hallicrafters SR-400 "Cyclone II." It offers all the features of the SR-2000 at the 400-watt level and has a couple of extra features of its own, such as a built-in 200-Hz CW filter and a variable notch filter for eliminating heterodyne interference. The SR-400 and its matching power supply and speaker console lists at $1025. The HA-20, remote VFO, SWR bridge, control console matches either unit; it lists at $200.

Staying in the deluxe price bracket, **Collins Radio** continues to offer its KWM-2, 175-watt SSB/CW transceiver at a price of $1150, plus $153 for the a.c. power supply console. At these prices you naturally expect such features as 2.1-kHz bandwidth, superb stability, 1-kHz dial readout, VOX, and built-in crystal calibrator. The KWM-2 options include expanded frequency coverage outside the amateur bands, an r.f. type noise blanker, $133; asorted filters, and a control console containing an external VFO and a reflected power bridge for $350. Also available are 1200-watt and 2000-watt linear amplifiers priced at $520 and $2200, respectively. A 1-year guarantee covers all Collins gear, by the way.

Is the **Signal/One** division of ECI (a subsidiary of NCR) exaggerating when it claims that its hybrid CX-7, 300-watt transceiver equals or outperforms any other amateur equipment available today? The CX-7 covers all amateur frequencies from 1.8 to 30 MHz, and it will cover three additional 1000-kHz bands up to 15 MHz. Two 8-pole, cascaded crystal filters provide 2-kHz bandwidth, and there is provision for plugging in an additional filter for bandwidths between 200 Hz and 6 kHz. Other features include a noise blanker, r.f. envelope clipper, two VFO's, and a built-in electronic keyer. The CX-7 employs 100 silicon transistors and one 8072 tube, and the power supply is built in. All this for a mere $1750!

SSB above 50 MHz. If 50 MHz is your bag, one of these transceivers may put a gleam in your eyes: the **R. L. Drake** TR-6 duplicates TR-4 performance on 50 MHz for $760 with power supply. **Heathkit's** SB-110A parlays SB-102 performance to the band for $351 including the power supply kit. **Swan's** 250C is the 50-MHz *alter ego* of the Swan 500CX at the 300-watt level. Its price tag is $555 with power supply. Finally, **Gonset** offers its model 910C GSB-6 20-watt, hybrid, AM/SSB/CW, 50-MHz transceiver for $395 including power supply. And so new that the paint is hardly dry is **E. T. Clegg Associates'** Comet for 144 MHz. The comet is a hybrid, 125-watt AM/SSB transceiver that brings traditional Clegg performance to the 144-MHz SSB operator. Its tentative price is $350 with power supply.

Another approach to VHF SSB for operators with lower-frequency SSB gear is the VHF transverter. **R. L. Drake's** TC-6 transverter, for example, converts a 14-MHz SSB transmitter signal to 50 MHz, 300 watts output, and the TC-2 works with 14- or 50-MHz gear to produce 144-MHz, 180

The Clegg Associates 22'er Mk II is a complete 2-meter transceiver with enough outside-of-the-band coverage to embrace the MARS, CAP, and Coast Guard Auxiliary channels. It has a rating of 20 watts AM output.

Renowned Japanese Trio components are featured by Allied Radio in this 3-part station package. At left is the solid-state VFO, in the center is the 160-watt input transceiver, and to the right is the 117-volt a.c. power supply and oversize PM speaker.

This R.L. Drake T-4XB transmitter may be operated VFO or crystal-controlled. Also has controlled carrier modulation to make it compatible with SSB linear amplifier. The input rating is 200 watts p.e.p.

The low-cost Duo-Bander II is from World Radio Labs and operates up to 400 watts p.e.p. on 40 and 75. Power supplies for mobile or fixed station use are also available at modest prices.

watts output. They are priced at $250 and $300, respectively. Drake converters work in conjunction with the transverters to do the receiving. The **Yaesu** FTV-650 transverter works with 14-MHz units to produce 50 watts input on 50 MHz. The FTV-650 also functions as a 50-MHz receiving converter. It is priced at $140.

Heathkit's SB-500, 144-MHz transverter transmits and receives in conjunction with a 28-MHz SSB transceiver. Its transmitter input is 130 watts, PEP, and it lists for $180. The **Swan** TV-2B is another 144-MHz receiving/transmitting converter. Rated at 300 watts on transmit, the TV-2B will work with 14, 28, and 50-MHz transceivers as specified. Price is $250.

Separate Receivers and Transmitters. Although the advantages of transceivers are well known, separate receivers and transmitters usually outperform them somewhat, because the latter do not incorporate compromises required for bilateral operation. But matched transmitters and receivers will transceive or operate independently at the snap of a switch. Three such pairs are the **Collins** 75S-3 receiver, $795, and the 32S-3 transmitter, $865; the **Drake** R-4B receiver, $475, and T-4XB transmitter, $495; and the **Heathkit** SB-301 receiver, $290, and SB-401 transmitter, $295.

Of course, there is no reason why you cannot use a separate receiver with a transceiver or use brand "X" receiver with brand "Y" transmitter, if you wish. Data on a few receivers suitable for the purpose follow.

Receivers. The **Hammarlund** HQ-110-AC/VHF amateur receiver tunes all amateur bands between 1.8 and 148 MHz! It uses built-in converters for the 50- and 144-MHz bands, and it lists at $360. The HQ-200 is a typical general-coverage receiver in the Hammarlund line that includes receivers at prices up to and beyond $2000. The HQ-200 tunes between 0.54 MHz and 30 MHz with expanded, calibrated "band spread" tuning of 3.5, 7, 14, 21, and 28 MHz. The HQ-200 lists at $250. In the low-price bracket, the **Heathkit** HR-10B offers good amateur-band performance—after you put it together, of course.

Another receiver kit is **Allied Radio's** Knight-Kit solid-state R-195. It tunes from 125 kHz to 30 MHz with good sensivity and stability and 4.5-kHz bandwidth. The kit with built-in power supply and speaker lists at $90. Also solid state, Allied's A-2515 receiver tunes 125 kHz to 30 MHz and has 1.5-kHz SSB selectivity. Its ready-to-operate price is $110 with matching speaker. Allied's A-2516 amateur receiver covers the 3.5- through 28-MHz amateur bands. It uses a crystal-controlled front end and a solid-state VFO for direct frequency readout and has 1.5-kHz selectivity. Price $190 with speaker.

Lafayette Radio Electronics' solid-state HA-800 covers the six amateur bands between 3.5 and 54 MHz. It has 2-kHz selectivity, excellent stability, and good sensitivity. It also contains a built-in 100-kHz crystal calibrator that can be put into service by plugging in the proper crystal (available from LRE for $4.) The cost of the HA-800 with matching speaker is $159. Also from Lafayette, the HA-600T receiver tunes from 125 kHz to 30 MHz. It, too, has 2-kHz selectivity. The HA-600T and speaker go for $109.

Galaxy Electronics' R-530 receiver is also solid state, but that is about its only similarity to the last few receivers mentioned. It tunes from 500 kHz to 30 MHz in 500-kHz "bites" with a phase-locked oscillator. The R-530 has a built-in noise blanker and 2.1-kHz selectivity with the standard filter supplied. However, there are sockets for plugging in two additional filters for selectivities between 500 Hz and 6 kHz. Its price is $875 with speaker. If all these prices turn you off, **Conar's** 500UK, 80, 40, and 15-meter amateur receiver at $45 in kit form and $75 wired does a good job for its cost.

CW Equipment. Because Novices are limited to code operation, some inexperienced people downgrade code (CW) as a beginner's game. In spite of their snobbery, CW remains the easiest way to work the world with low power. All of the transmitters and most of the transceivers described above work on CW. They can also be cranked down to the 75-watt Novice power limit, and crys-

(*Continued on page* 97)

BUILD A RIAA/NAB PREAMPLIFIER

IC OP AMP SIMPLIFIES CONSTRUCTION— GIVES IDEAL CHARACTERISTICS

BY NORMAN P. HUFFNAGEL

BECAUSE OF ITS UNIQUE properties, the integrated circuit operational amplifier (op amp) is ideal for use as a preamplifier stage for a hi-fi system. And the Fairchild μA739C IC, containing two high-quality op amps that share a common power supply and package, is an excellent choice for a really simple project. Even though its two op amps are in close proximity to each other, interchannel separation is quite good, and there is roughly 94 dB of separation.

The μA739C IC is the heart of the "RIAA/NAB Preamplifier" project described here. Aside from the project's value as a preamp, it also enables you to become acquainted with the ability of the operational amplifier to be completely controlled by the circuit in which it is used: an "ideal" amplifier.

About The Circuit. Shown in Fig. 1 is the schematic diagram of the preamplifier. Switch *S1* is in the phono mode (RIAA) position. In this position, *S1* selects the roll-off characteristic impedance to match either phono cartridge or magnetic tape head inputs; input impedance is 47,000 ohms to match it to most cartridges currently on the market. Output impedance of the preamp is 10,000 ohms. Resistors *R7-R10* and capacitors *C9* and *C10* supply d.c. bias to the negative inputs of the op amps.

Since the two op amps are identical, discussion of the operation of only one op amp applies equally to both. In channel A, *C1* and *R1* form the input network. The circuit made up of *C5*, *C7*, and *R5* form the RIAA feedback gain network and establish the roll-off curve. In the NAB mode (*S1* set to the alternate position), *C3* and *R3* perform the roll-off function. Capacitor *C11* is a high frequency oscillation limiter, and *C13* is the output coupling capacitor for channel A.

The open circuit gain of the μA739C IC (*IC1*) is on the order of 20,000, or 86 dBV. Since most preamplifiers achieve a gain of only 1000 (60 dBV), the μA739C can be treated as though it has infinite gain.

Construction. The original prototype of the RIAA/NAB Preamplifier (shown in the photos) employed a perforated board and push-in solder terminals. However, because of the close proximity of the

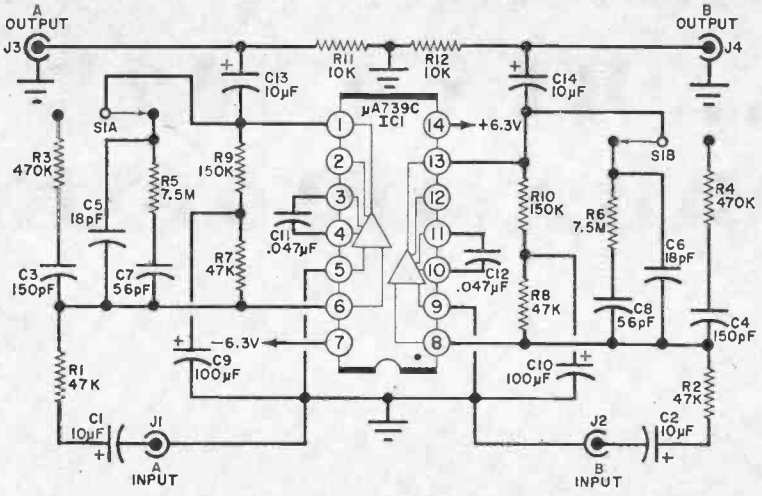


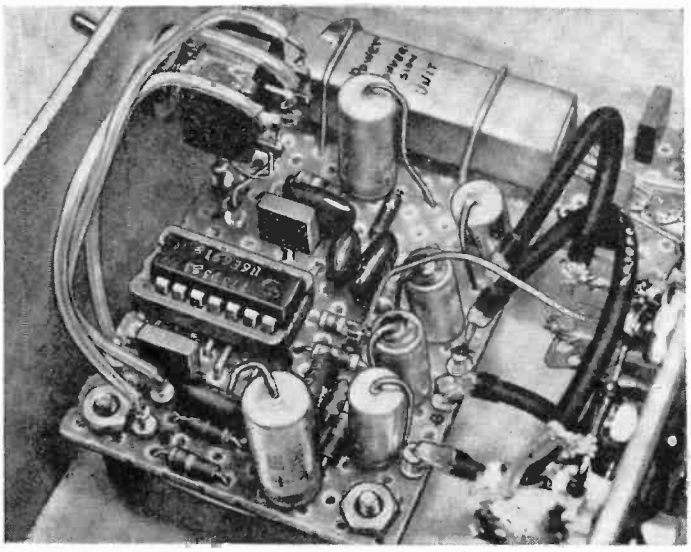
Fig. 1. Identical op amps in IC1 have same outboard circuitry. Note that positive and negative d.c. power is needed for proper circuit operation.

PARTS LIST

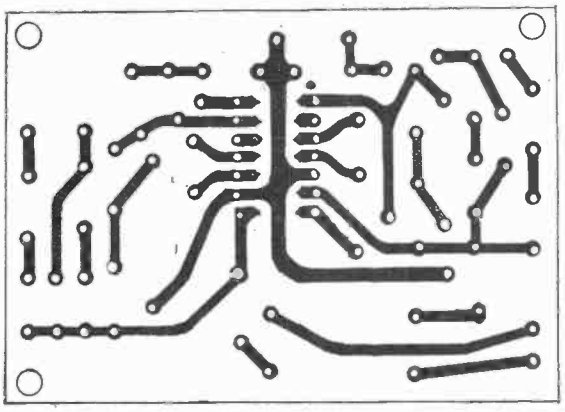
C1,C2,C13,C14—10μF, 15-volt electrolytic capacitor
C3,C4—150-pF disc capacitor (see text)
C5,C6—18-pF disc capacitor
C7,C8—56-pF disc capacitor
C9,C10—100-μF, 3-volt electrolytic capacitor
C11,C12—0.047-μF disc capacitor
IC1—Integrated circuit operational amplifier (Fairchild μA739C, Motorola MC1303L, or Signetics E5003A)
J1-J4—Phono jack
R1,R2,R7,R8—47,000-ohm
R3,R4—470,000-ohm (see text)
R5,R6—7.5-megohm
R9,R10—150,000-ohm
R11,R12—10,000-ohm
All resistors ½-watt
S1—D.p.d.t. slide or toggle switch
Misc.—Perforated board and push-in solder terminals (or optional printed circuit board); two contact screw-type barrier block; #6 solder lug; spacers (4); metal utility box; #6 machine hardware; hookup wire; solder; etc.

pins on *IC1*, it is suggested that you use a printed circuit board for assembly. An actual-size etching guide and a parts location drawing are given in Fig. 2.

If you use the printed circuit board for assembly, you should encounter no crosstalk problems. However, if you use any other type of assembly technique,



Original prototype was wired on perforated board and incorporated IC socket. Oblong box (at top) housed a power pack.



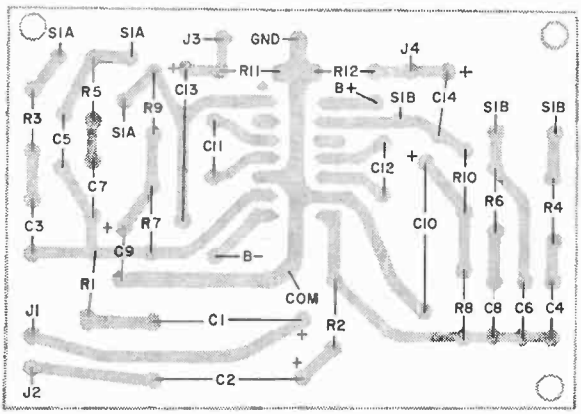


Fig. 2. An actual size printed circuit etching guide is shown above; at left is guide to component placement and orientation as viewed from the top of the board. Note: align pin 1 of integrated circuit with hole located directly below R11.

you will have to locate and orient the components to insure good isolation between the channels. When laying out the components, make sure to observe the indexing guide for *IC1* and the polarities of the electrolytic capacitors.

The integrated circuit requires both positive and negative supply voltages, each referenced to ground, for proper operation. Hence, it is a good idea to incorporate into your project the optional power pack shown in schematic diagram form in Fig. 3. Note that the power pack will accept a.c. potentials between 6.3 and 12.6 volts and d.c. potentials between 12 and 20 volts. For the a.c. source any filament transformer rated at about 0.5 ampere will suffice, while any good d.c. supply—including batteries—will work well for the d.c. source.

The preamp circuit is best housed inside a metal utility box to minimize the possibility of induced hum and/or noise. Neither the preamp circuit nor the power pack generate much heat; so a small box can be employed.

In Use. If while using the RIAA/NAB Preamplifier you notice that insufficient gain is available in the tape (NAB) position, you can substitute 100-pF capacitors for *C3* and *C4* or 500,000-ohm resistors for *R3* and *R4*; don't change both resistors and capacitors. Either substitution will alter the roll-off curve, raising it everywhere, but the slope will remain unchanged.

A second problem you might encounter is increasing gain at frequencies below 20 Hz. To rectify this situation, you can

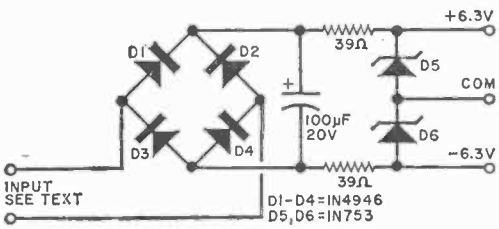
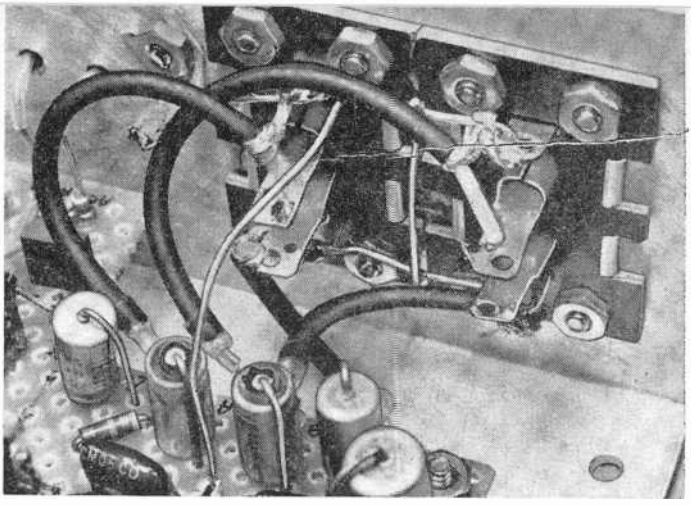
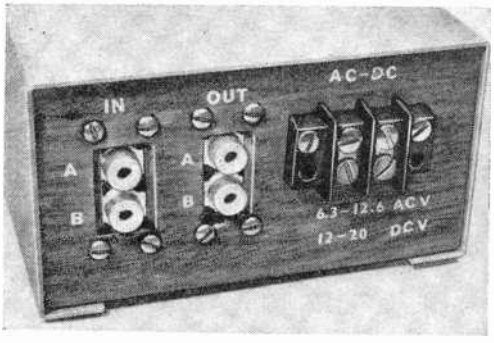


Fig. 3. Optional power pack to provide positive and negative voltages can be wired point-to-point.

Use shielded cable to interconnect the circuit board with the input and output jacks as shown in photograph at right.



Connectors for input and output signals and power should be located on the rear apron of the metal cabinet as shown below.



parallel *C3* and *C4* with 5.6-megohm resistors. Gain will be limited to about 61.5 dB, but roll-off will be unaffected.

If at all possible, it is recommended that you use a tone control circuit (using FET circuitry) between the preamp and input of the amplifier. This serves to isolate the preamp from the amplifier and eliminate objectionable feedback oscillations that may occur in the power amplifier that has local feedback. -30-

HIRSCH-HOUCK LABORATORIES

Project Evaluation

The equalization provided by the preamplifier for both RIAA and NAB characteristics is quite good from 60 to 20,000 Hz, coming within ±3 dB of the ideal. It appears, however, that the feedback drops off at the lower frequencies so that the gain rises to about +11 dB at 20 Hz, relative to 1000 Hz. This is undesirable for phono use, since it can be expected to amplify greatly any rumble.

The gain of the preamp is not particularly high, requiring 9.7 mV at 1000 Hz for a 1-volt output for phono; the output clips at 2.5 volts, corresponding to an input of less than 25mV. This latter is not really a bad situation, since most amplifiers can be driven well with less than 200 mV on their auxiliary (AUX) inputs. So, the dynamic range of the preamp is okay for use with all but high-output cartridges—greater than 7mV.

For some reason, a lower gain was chosen for tape than phono, with 38 mV needed at 1000 Hz input for a 1-volt output on NAB. With tape head outputs normally being in the low millivolt range, it is difficult to understand how the preamp can be used with a tape deck. However, we did use it as a phono preamp, and it sounded fine with a Shure V-15 Type II cartridge. The noise output of the preamp is about 53-54 dB below 1 volt and is normally subsonic. Crosstalk is about 55 dB down at 1000 Hz, and harmonic distortion is less than 0.1% up to the 1-mV output and did not increase significantly up to 2 volts.

Operating the preamp from an EICO Model 1020 d.c. power supply at 12 volts, the minimum rated operating potential, a current drain of only 5 mA was noted. The zener diodes in the optional power pack drew rapidly increasing current above 12 volts so that the drain increased to 33 mA at 15 volts. Obviously, when operating the preamp from a battery supply, a 12-volt battery would be most economical and should provide long life even if the preamp is inadvertently left on continuously.

In listening tests, we found, not unexpectedly, that it is not possible to use amplifier bass boost without inducing acoustic feedback. With proper equalization, in the amplifier itself, there was no such difficulty.

STAGE LIGHTING CONTROL SYSTEM

CONVENTIONAL COMPONENTS ACHIEVE PROFESSIONAL EFFECTS

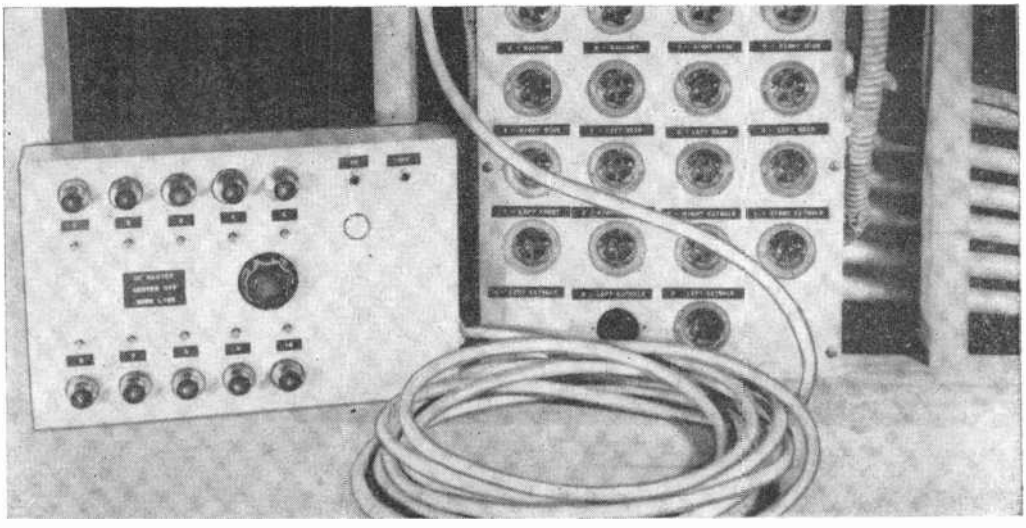
BY GERALD THUROW

LITTLE THEATRE groups and other "amateur" production organizations are notoriously short on funds and one thing they usually need but can't afford is a good stage lighting system. If you are reasonably good at electrical construction projects, you can be a real hero coming to the rescue by building them a solid-state light control system. If you use silicon controlled rectifiers (SCR's) the job is easy and the cost is low.

The dimmer system shown in the photos in this article is built around ten General Electric Triac units. It is a 120-volt, 15,000-watt system consisting of ten individual 1500-watt units. It has a portable control console which can be used in the front of the house, while the dimmers are mounted backstage. The Triacs are pre-assembled SCR variable-voltage circuits with complete linear dimming ranges, zero sets, RFI suppression and isolated heat sinks.

Of course, any type of Triac or SCR dimmer, whose output is varied with a control potentiometer, may be used. Some of these dimmers may be purchased at your local hardware or electri-

Take a group of commercially available light dimmers, make only a small circuit change, package them neatly, and you have a professional looking control system that can make the lighting on any stage similar to that in big-time theatres.



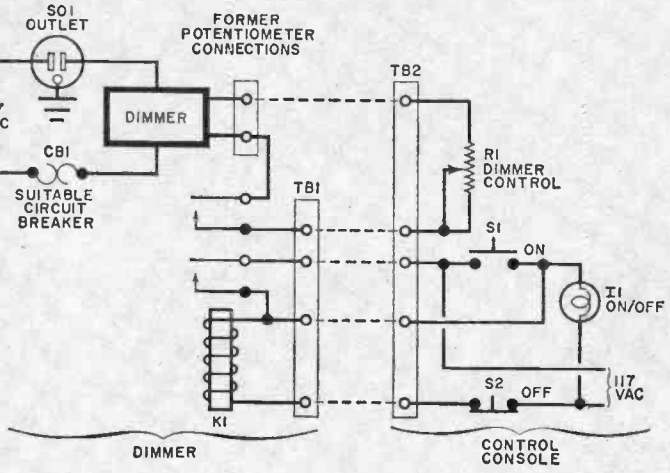
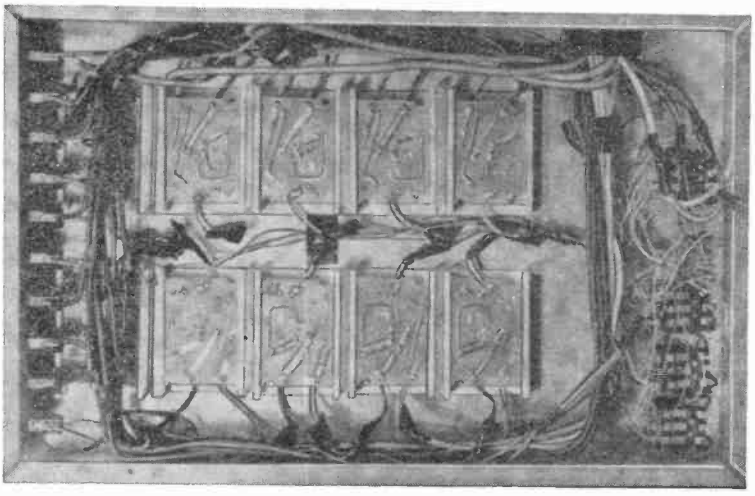


Fig. 1. Each dimmer stage is coupled to the remote control console via a multi-lead cable—preferably shielded to reduce electrical noise. Almost any number of dimmers may be used, all to one console.

PARTS LIST

CB1—Suitable circuit breaker
Dimmer—Wattage as required, modified per text
I1—Indicator lamp with holder
K1—Relay to suit power source
R1—Potentiometer removed from dimmer
S1—Normally open s.p.s.t. pushbutton switch
S2—Normally closed s.p.s.t. pushbutton switch
SO1—Three-pin electrical outlet
TB1, TB2—Multiterminal barrier strip (or similar)
Misc.—Interconnecting power cable, shielded pair cable, chassis for dimmer and relay, chassis for control console, knobs, press-type lettering, etc.



When mounting a number of dimmers in one chassis, make sure that sufficient heat sink area is provided to enable each to operate at a safe temperature.

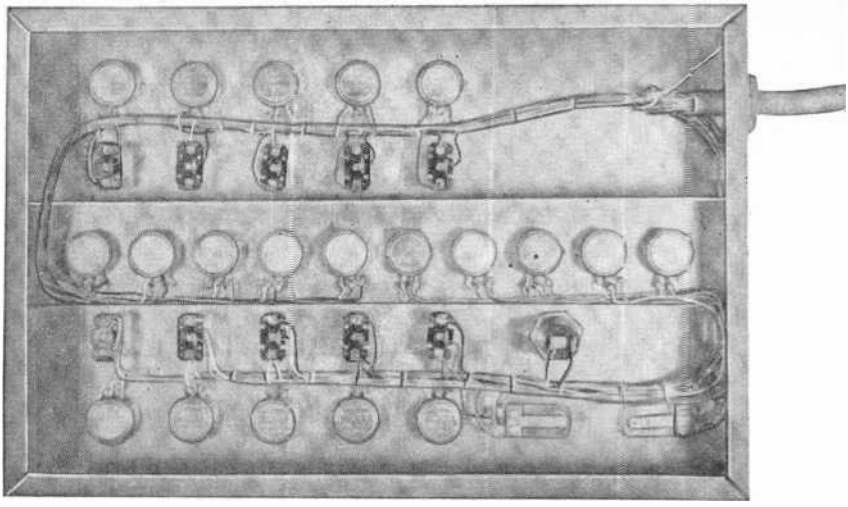


Fig. 2. Example of a typical control console showing dimmer potentiometers and on-off switches. Each control covers different lighting function.

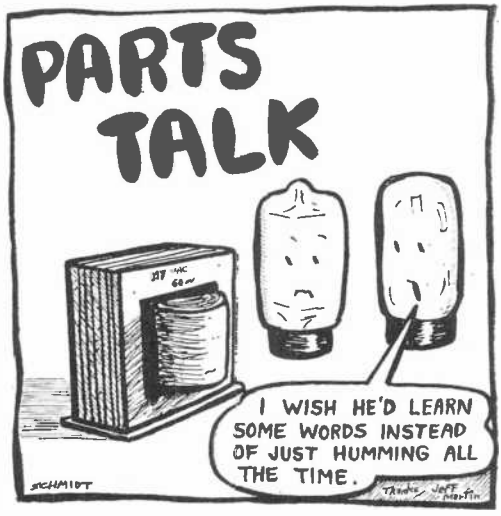
cal store. Others are available through catalogs. Select the dimmers that will handle the contemplated load. The total cost of the system will depend on the type and number of dimmer units you have to buy. The 15,000-watt system shown here is about $200.

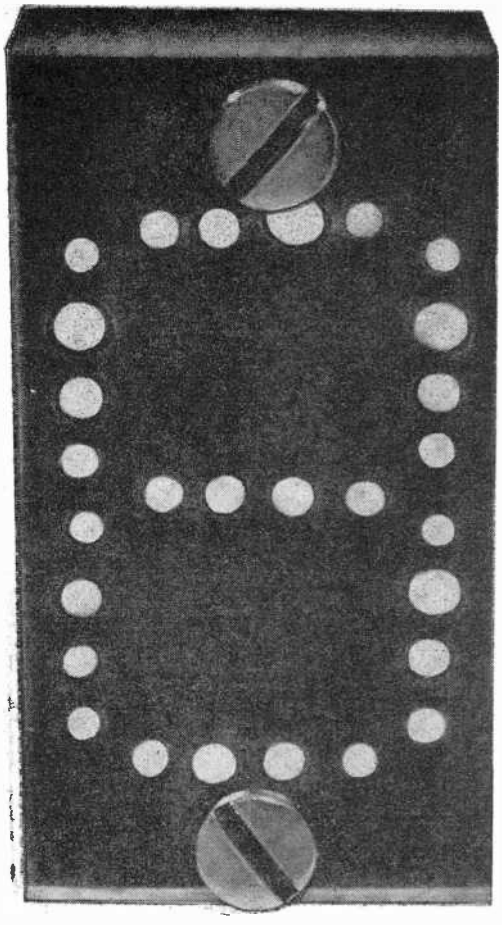
Typical Circuit. Since the variations and complexity of the systems that can be built are practically endless, we will describe in detail only the basic one-dimmer, one-control circuit. The first step in constructing such a system is to locate the dimming control potentiometer on the unit you are using. Remove the potentiometer from the circuit and wire the two leads that formerly went to the potentiometer to two terminals of a barrier (or similar) strip. If you want remote turn-on/turn-off control, obtain a 117-volt d.p.s.t. a.c. relay to be mounted in the cabinet backstage with the dimmer. Wire the system as shown in Fig. 1. External connections to the relay are made to other terminals on the barrier strip.

The dimmer control and on-off controls (with a pilot light indicator) are mounted in the control console as shown in Fig. 2. The control potentiometer is connected to the remote dimmer through a shielded pair, while the other wiring can be made with conventional multilead power cable. Just make sure that the wire is large enough to handle the relay coil current. Of course, if you have some low-voltage d.c. relays and a suitable power supply, these can be used instead of the 117-volt a.c. relay.

Obviously tandem potentiometers can be used to control two or more dimmers simultaneously or individually and more relay contacts can be used to switch more than one dimmer.

Connections between the control console and the dimmer must follow local electrical codes for safety. Mark the outlet of each dimmer with the maximum load it can tolerate. This will prevent damage through accidental overload. -30-





BY DAVID C. KROOP

MAKE YOUR OWN Seven Segment Readout

EASY TO CONSTRUCT AND THEY LOOK GREAT

DIGITAL READOUT devices are becoming ever more popular and everybody has his own idea of what is the best type of readout device—incandescent lamps, Nixie® tubes, Numitrons, 7-segment displays, and so on. The basic simplicity and low cost of the 7-segment display make it particularly popular (see "Third-Generation DCU," POPULAR ELECTRONICS, February 1969) and many experimenters have designed and made their own display units. One such unit is described here. It is easy to construct and, when properly finished off, gives a very professional appearance to your digital readout. All you need is a block of some opaque material, a couple of drill bits, a piece of translucent plastic sheet for the faceplate, and a little time. You can make a single or multiple display.

Construction. If you intend to make more than one readout stage, it is suggested that you make a drilling guide with a hole arrangement like that shown in Fig. 1A. You can use heavy card stock, sheet plastic, or even thin metal for the guide. When making the guide try to keep the hole centers on straight lines and spaced about ⅛" apart to produce a neat, symmetrical layout. Note also that hole centers for the optional circuit board and translucent faceplate mounting screws should be shown.

The opaque material can be either Bakelite or aluminum stock (unless you have access to a drill press with a 200 r/min speed, avoid using plastic). Although the Bakelite or aluminum can consist of a solid block, it is better if you use two separate pieces, one measuring 2½" × 1" × ⅜" for the light guides

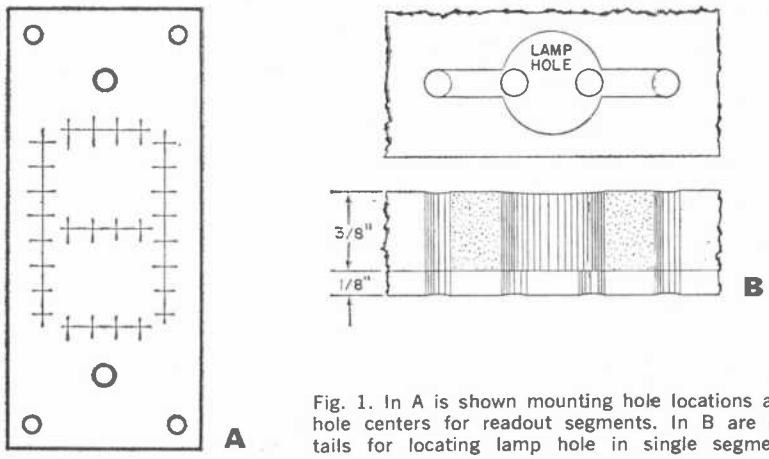


Fig. 1. In A is shown mounting hole locations and hole centers for readout segments. In B are details for locating lamp hole in single segment.

and another measuring 2½" × 1" × ⅛" for the numeral mask. If more than one readout stage is required, multiply in both cases the 1" dimension by the number of stages desired.

Now, place the two pieces of opaque material squarely together and clamp them solidly in a vise to prevent them from shifting position with respect to each other. Use a file to groove one end of the blocks to serve as guides during assembly.

Working carefully with your drilling guide and a sharp center punch, mark the hole centers for each stage. The 28 holes that make up the seven segments of each readout and the four circuit board mounting holes should be drilled all the way through both blocks. Use a 1/16" drill for the segment holes and a ⅛" drill for the mounting holes. Keep all holes as close as possible to right angles to the surface. Countersink the mounting holes.

Loosen the vise and remove the thinner block and temporarily set it aside. Retighten the vise on the thicker block. Use an appropriate size drill to bore the lamp holes through the block (back up the exit hole side of the block with wood to prevent chipping and flaking). There should be exactly seven of these new

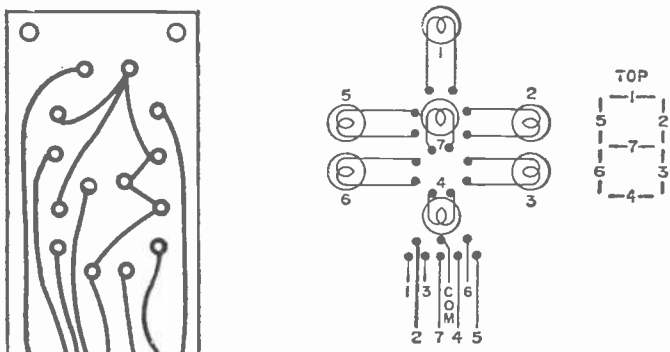
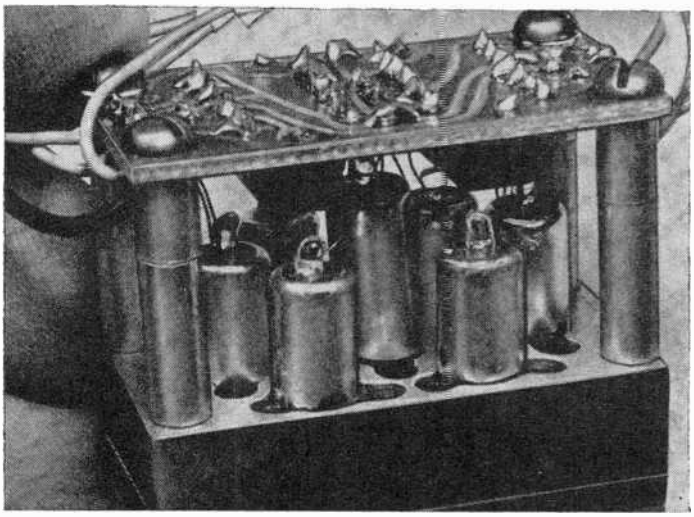


Fig. 2. An actual size printed circuit board etching guide is shown at the left. Drawings above show lamp connections for each segment.



Assembled seven-segment module is shown at right. Note use of metal spacers to support circuit board away from the lamps.

holes per decade, and each should be centered in a grouping of four 1/16" holes (see Fig. 1B).

Next, remove the solid material between the unconnected holes. This is best accomplished with the aid of a "saw-type" drill bit or a hacksaw equipped with a tungsten carbide blade.

If you used Bakelite for the blocks, spray a coat or two of metallic aluminum or white paint into the holes of both blocks and the inner surface of the thinner block. If aluminum was used, just spray a coat of velvet black paint on the front surface of the 1/8"-thick block. In both cases, when the paint dries, carefully remove any that obstructs the passage of light through the segment holes.

Wiring. To simplify the wiring process, make the optional printed circuit board, using the actual-size etching guide at the left in Fig. 2. The center drawing shows how to wire the lamps to the circuit board and the board to the DCU, while the final drawing shows the numeral segment/lamp layout.

Now, mate the two blocks together, carefully observing your register marks. Then use flat-head machine hardware and spacers of appropriate length to bolt together the blocks and circuit board/lamp assembly.

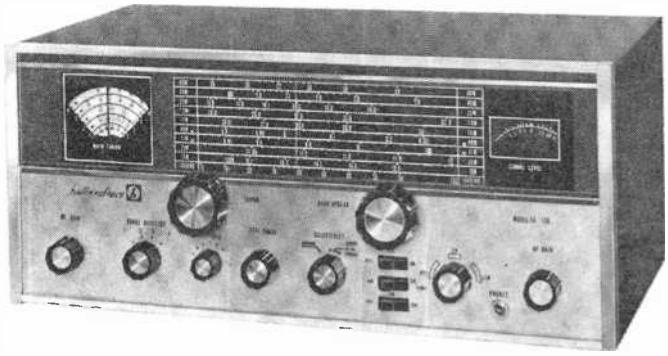
Mount the translucent faceplate to the front of the assembly. (This faceplate can be homemade from 1/16"-1/8"-thick transparent plexiglass—any color will do, including clear. To make it translucent, rub one surface with No. 00 emery cloth and fine-grade steel wool. This will produce a velvety-smooth finish.) When you mount the faceplate, place the dull side against the numeral mask. -30-

the product gallery

REVIEWS AND COMMENTARY ON ELECTRONIC GEAR AND COMPONENTS

HAM/SWL COMMUNICATIONS RECEIVER

(Hallicrafters Model SX-133)



A UNIQUE compromise approach to "band-spreading" is now available in a new communications-type receiver manufactuerd by Hallicrafters. Called the Model SX-133 ($249.95), this 4-band all-wave receiver tunes from 535-1610 kHz, skips to 1725 kHz, and then tunes continuously to 31.5 MHz. The skipped portion outside of the high end of the AM broadcast band is the guard channel around the 1650-kHz i.f.

Dominating the face of the SX-133 is a slide-rule bandspread dial calibrated for the usual five ham radio bands—plus four international broadcasting bands (49, 31, 25 and 19 meters). The main tuning and bandspread dials are visually correlated by a color code system for ease in setting up on the 4 shortwave broadcasting scales.

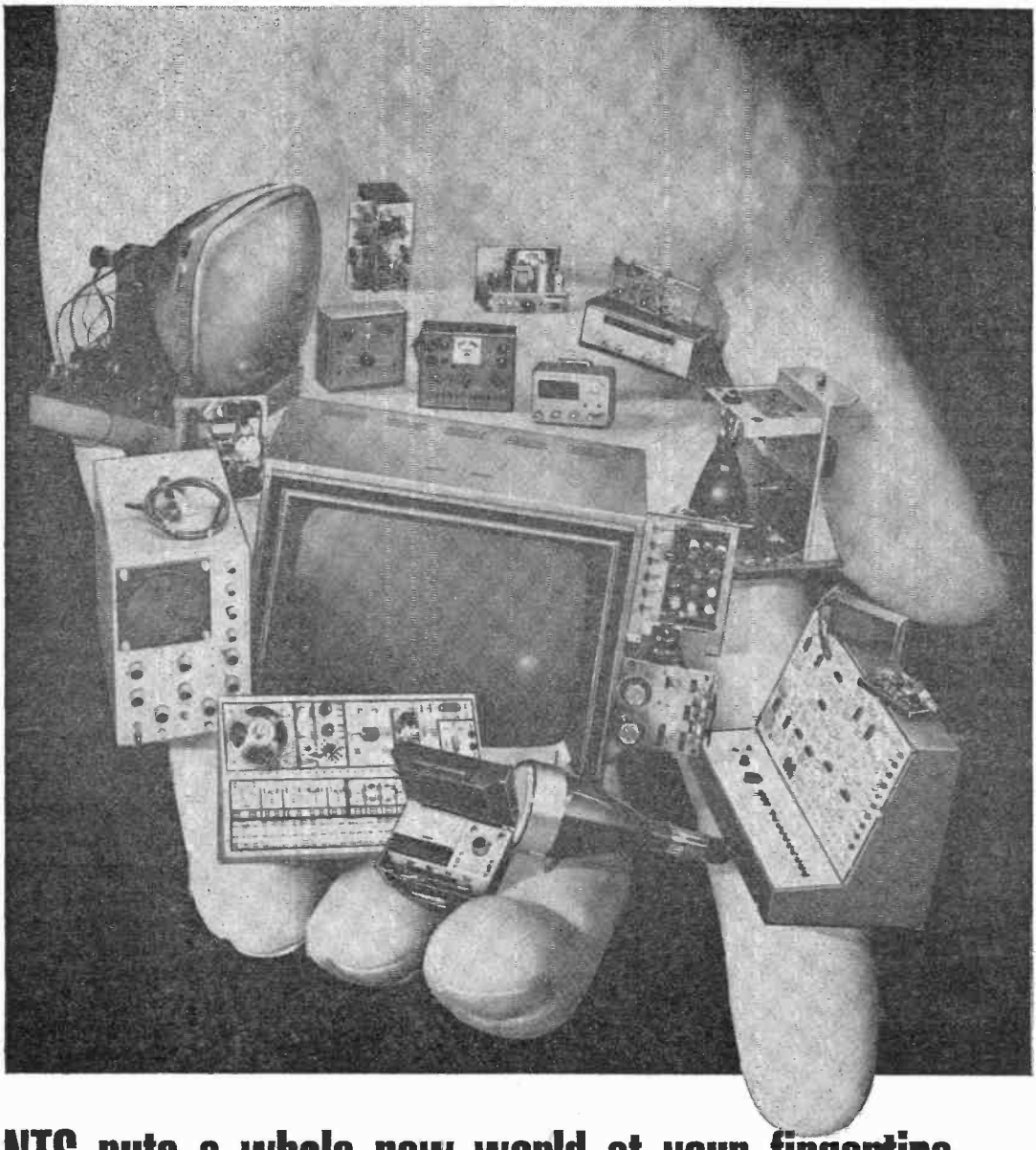
The SX-133 uses only tubes (except for a half-wave diode rectifier) and has a tuned r.f. stage plus two i.f. stages. Good CW/SSB reception is insured by a BFO/product detector while a crystal filter sharpens selectivity and permits "phasing out" of annoying heterodynes. The product detector is slug-tuned from the front panel to either the upper or lower sideband. An r.f. gain control varies the bias on the tuned r.f. and second i.f. stage. An accessory plug-in socket for a 100-kHz crystal calibrator (Model HA-19, $29.95, optional extra) is conveniently available on an accessible part of the chassis. A panel switch to activate the calibrator is built into the SX-133 as part of the original equipment. The r.f. stage has a panel "trimmer" for better antenna-to-receiver impedance matching. There is no built-in speaker.

On the Air Tests. As received from the manufacturer our test model was slightly out of "Main Tuning" calibration. It was immediately obvious that the same angular degrees of misalignment of the rotary scale applied to all four bands and a mechanical adjustment consisting of slipping the main tuning dial scale (after removing the chassis cover) about 4-5° put calibration pretty much on the nose.

The bandspread calibration was checked on the 40-meter ham band and the 19-meter broadcast band—these being representative of special segments from Bands 3 and 4. When the bandspread dial was set to 7.00 MHz, a reading of 7.1 MHz was actually 2-3 kHz high. With the bandspread dial set at 7.2 MHz the receiver was tuned to 7.194 MHz. At 7.3 MHz the receiver was actually tuned to 7.289 MHz, and at 7.4 MHz the receiver was tuned to 7.382 MHz.

On the 19-meter broadcast band the receiver was spotted at 15.00 MHz and a 15.1 MHz reading on the bandspread dial was 2-3 kHz high. Moving the bandspread dial to 15.2 MHz and 15.3 MHz we found they were literally "right on the money." Tuning the bandspread dial to 15.4 MHz showed that the receiver was now about 5 kHz low and at 15.5 MHz the receiver was tuned to a spot 10 kHz low.

As should be expected from tube-type receivers—even of the very best design—there is some cold-start warm-up drift. It amounts



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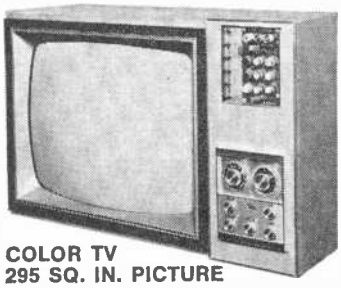

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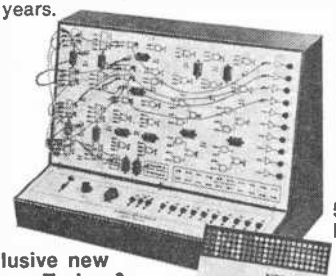

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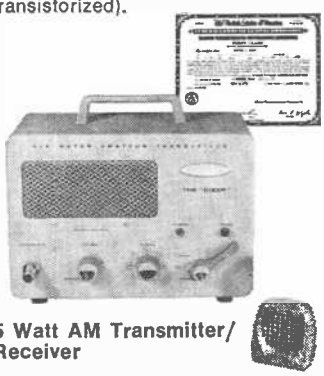

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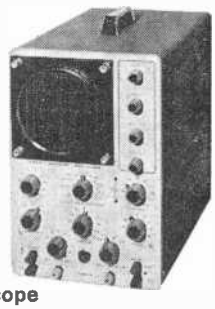

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to 8-10 kHz and on our test model it drifted 8 kHz from 15.00 MHz during the first thirty minutes. The drift was to a lower frequency.

Sensitivity of the SX-133 appears to be adequate on all four tuning ranges, and after warm-up the receiver is reasonably stable. Selectivity in the "Normal" position is good, but lacks the steep skirts possible with an i.f. on the other side of the broadcast band (or at 50 kHz as in the Hallicrafters SX-122A). Most hams and SWL's will soon find that they do practically all of their tuning with the selectivity control in the "Broad Xtal" position.

The Main Tuning control is too "cramped" for our personal use in casual tuning—amounting to 2.0-2.7 MHz per knob revolution on Band 4 and 900-1100 kHz per revolution on Band 3.

Closing. The SX-133 is a very definite step in the right direction in providing the earnest SWL with a pre-calibrated receiver. The use of logging scales on both the Main Tuning and Bandspread dial enhances this unique accomplishment and is especially valuable when used in conjunction with the 100-kHz calibrator. Unfortunately, there is some backlash in the Bandspread control that SWL's and hams may find mildly annoying. And, reducing the r.f. gain control while tuning SSB will "pull" the signal 300-400 Hz and must be compensated for by the USB-CW-LSB control.

Regardless of its minor faults, the SX-133 is a good intermediate receiver that very comfortably fits the nitch in price category between the $125 and $400 brackets. It is in that area that each dollar means more in flexibility, ease of resetting the dial, selectivity, etc.

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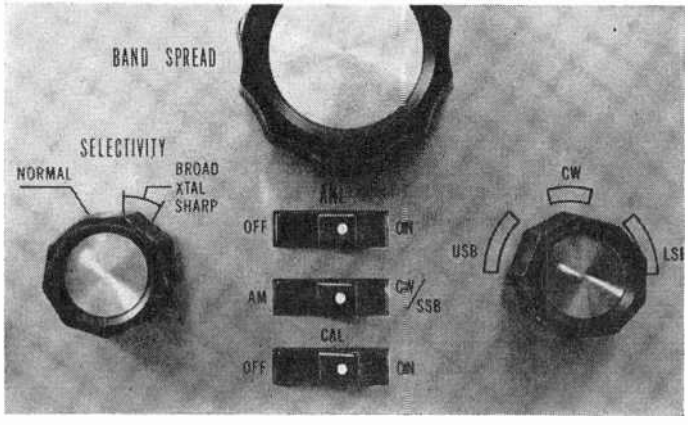
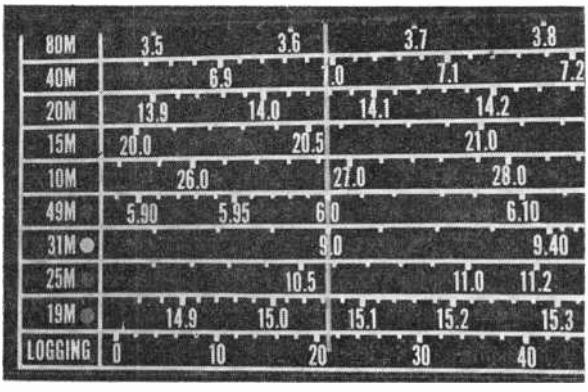
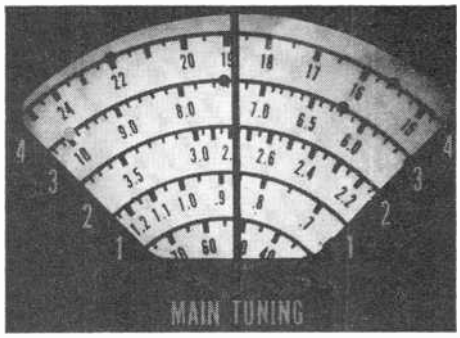


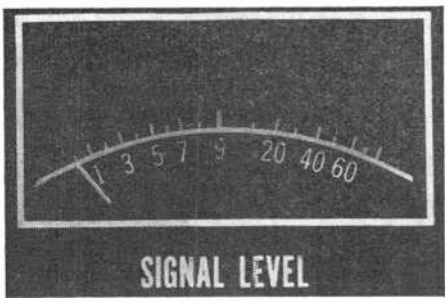
Switch and knob arrangement on the Hallicrafters SX-133 is orderly and convenient. Rocker arm switch (bottom center) is used to turn on optional 100-kHz crystal calibrator, available for $29.95. The Normal selectivity position proved to be a little too broad for option DX'ing and the Broad xtal position was used for tuning.



Bandspread dial dominates panel of the SX-133 receiver. Note spreading of the 5 ham bands, plus the 4 most important international short-wave broadcasting bands. Color-coded dots identify the band settings on the main tuning dial.



Dots—some color-coded, some black—indicate cursor setting of "Main Tuning" dial for bandspreading the 5 ham and 4 broadcast bands (see photo on facing page). Your reviewer recommends purchase of the 100-kHz calibrator for maximum dial accuracy.



The "Signal Level" S-meter on SX-133 is heir to our same complaint as voiced about the Hallicrafters SX-122A—who but an experienced listener would understand the 1,3,5,7,9,20,40, and 60 relationship. Why all the unnecessary guesswork?

THOR-GO CD IGNITION SYSTEM
(Alpha Lunco Corporation)

ALTHOUGH there are some opinions to the contrary, the capacitive discharge (CD) ignition system does offer some advantages over the tried-and-proven Kettering "brute force" ignition system comprising breaker points, 80:1 ignition coil, and arc-suppressing 0.1-μf capacitor (automotively—a "condenser"). In a new well-tuned car these advantages are not as immediately obvious as advertising copywriters would like the consumer to believe. However, advantages are present and there is an undeniable extension of breaker point life (due to an 80% reduction in current handling), easier cold-weather starting (due to a 90% decrease in firing current demand), and improved high-speed performance (due to sustained high-voltage output from the ignition coil—amounting to as much as 10,000 volts at speeds in excess of 70 miles per hour).

One new system (patent pending) is the "Thor-Go" ($59.95) manufactured by the Alpha-Lunco Corporation. This is a completely encapsulated system with the power inverter transistors heat sinked to the heavy aluminum mounting bracket.

The Circuit. Capacitive discharge ignition circuits have not changed to any great extent since their introduction to the driving public in 1964. Examination of the Thor-Go circuit shows the usual 2-transistor inverter and 4-diode bridge rectifier applying about 350-400 volts to a storage capacitor which is discharged by SCR action (breaker points control) into the "original equipment" ignition coil. About the only new item in the Thor-Go circuit is a varistor shunted across the SCR as a protective device.

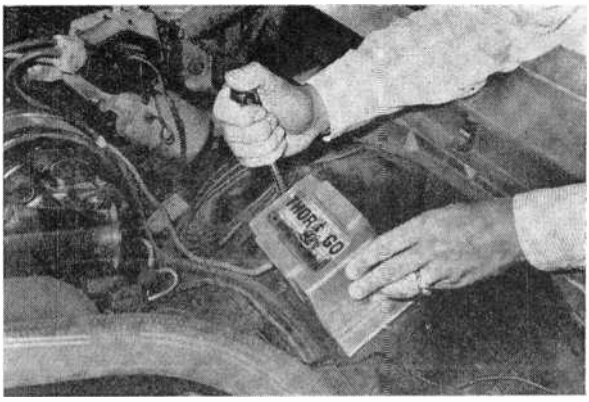
Road Test. Last spring your reviewer had the opportunity to submit this new ignition system to an extended life test which it passed with flying colors. Wired into a 1969 Pontiac Catalina Station Wagon (curb weight 4900 lb), we were surprised to see nearly a full second cut off our 0-60 mi/hr. time—9.6 seconds versus 10.5 seconds with the original equipment. Although part of the secret of this unusual performance was in the steel-studded snow tires, it was also an indication that, at high engine revolutions, the CD system has that important extra "punch."

Shortly after removing the snow tires and replacing them with fiberglass belted tires, the station wagon was driven 6100 miles from New York to New Orleans, San Antonio, Carlsbad, Albuquerque, Colorado Springs, and home. The estimated loaded weight of the station wagon was 5800 lbs. The average miles-per-gallon for the entire trip was 15.6. Since much of this driving was done at speeds in excess of 70 mi/hr., this "per gallon" figure is remarkable and compares favorably with our usual 15.0 miles-per-gallon for 30-40 miles speed limit driving around northern New Jersey. It is also worthy of mention that about 1500 miles of this trip was at an altitude over 5000 feet above sea level—where engine efficiency is expected to decline as much as 15-20%.

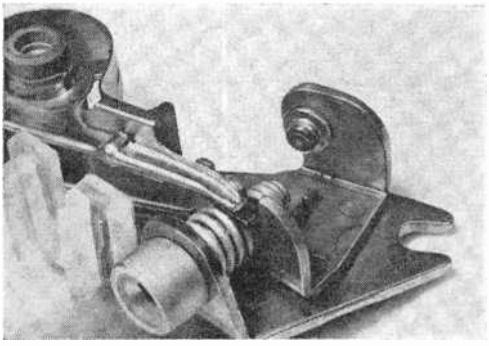
The Thor-Go CD ignition system has passed its 10,000-mile point and continues to function as smoothly as you might expect from a well-designed package.

Circle No. 95 on Reader Service Page 15 or 95

(Photos overleaf)



The Thor-Go is completely encapsulated and easily mounted on left front fender housing, using only two short, but large-diameter, sheet-metal screws. Four-wire cable is brought to ignition coil where easy connect/disconnect terminals cut installation time to about 15 minutes.



Close-up photo of the "grounded" breaker point after 7000 miles with the Thor-Go ignition system. Both points show no discoloration or pitting. The slight burnishing is normal and is the result of high-speed driving. Points could have been used 3 or 4 times the trial mileage before replacement.

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

THE ORIGINAL Radio Shack DX-150 was reviewed on these pages in December 1967. As the first Japanese import offering reasonable sensitivity and flexibility for good dollar value, we applauded its entry into the SWL market place. The DX-150A ($119.95) is externally almost identical to the earlier version of this receiver and the differences that exist are mostly in circuitry where a conscious effort has been made to improve selectivity and eliminate a serious defect that our initial test had not uncovered—cross-modulation.

Circuit. A major portion of the new DX-150A circuit has been revamped to permit use of 4 FET's in the first r.f. stage, the oscillator, and the mixer. A new i.f. filter improves the shape factor of the bandpass. The S-meter is now part of the second detector having been moved from the a.g.c. amplifier circuit in the DX-150. The diode ring demodulator for CW/SSB reception has been retained and all bipolar transistors in the i.f. amplifier, BFO, and audio stages are *npn* types as opposed to the "mix" of *pnp* and *npn* types in the DX-150.

The use of FET's appears to have overcome the problem not experienced in our first test and report on the DX-150—severe cross-modulation if the receiver is operated in the immediate vicinity of a powerful AM broadcasting station. This effect, although not too prevalent, is experienced in all bipolar transistor shortwave receivers. Although a portion of the r.f. gain control in the DX-150A has been shunted across the antenna input, back-to-back germanium diodes are wired to the input circuit to virtually eliminate the possibility of diode clipping and the production of vigorous harmonics from strong AM broadcast band carriers.

On-the-Air Tests. The DX-150A retains the cold-start stability of the earlier model. At 15 MHz the cold-start-to-30-minute warm-up drift was less than 1 kHz. At 600 kHz the same time period resulted in a drift of about 500 Hz.

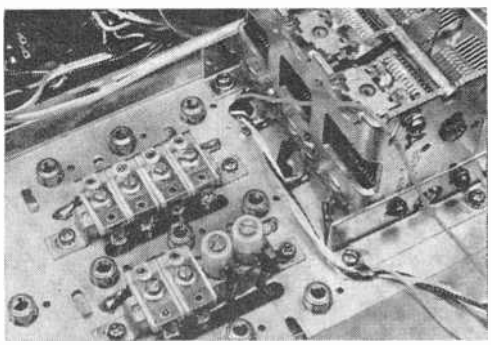
For a "production model" (assuming this was not a "pre-selected" model), the main tuning dial calibration was fairly accurate. However, on the AM broadcast band the maximum error was 20 kHz at 1600 kHz. Below 1.0 MHz the dial read 5 kHz high. On Band B, a dial reading of 3.0 MHz was

measured to be 3021 kHz, and 4.5 MHz was 4490 kHz. On Band C, 5.0 MHz was actually 5,015 kHz, 10.0 MHz was 10,105 kHz and 13.0 MHz was 13,060 kHz. On Band D, 15.0 MHz was 15,045 kHz and 19.0 MHz was 19,050 kHz.

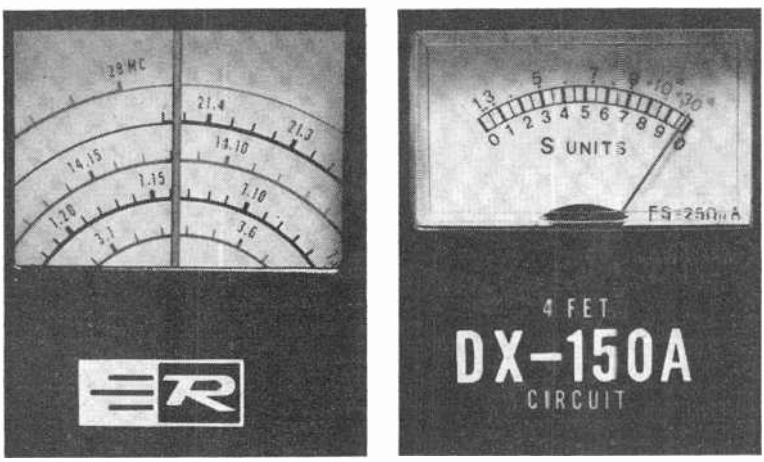
As with its predecessor, the DX-150A is quiet, sensitive and now has somewhat improved selectivity—although not as sharp as some Japanese imports employing "mechanical" i.f. filters. Our principal objection to the DX-150A are in the areas of audio feedback (when using the built-in speaker), and "crowding" on bands C and D. A single knob rotation on Band C covers 700 kHz and on Band D it is in excess of 1350 kHz. This makes casual tuning of the shortwave bands very difficult. Use of the bandspread tuning control would improve matters, but the bandspread dial is calibrated only for the ham bands and has no "logging" scale—another minor objection to the DX-150A.

Circle No. 96 on Reader Service Page 15 or 95

RADIO SHACK
DX-150A



Inside view of the DX-150A shows clean construction and availability of all preset tuning adjustments that might need touching up. Although not visible here, the uncushioned mounting of the built-in speaker results in audio feedback howl when volume is turned up above soft-spoken level.



Bandspread dial (left) of the DX-150A is calibrated for only the five shortwave ham bands. There is no logging scale—an inconvenience to the SWL. Note that this dial reads backwards with increasing frequency counter-clockwise. The very "energetic" S-meter (right) reads against the pin on almost all signals. Most receivers are set for an S9 reading at 50 mV antenna input. This one reads S9 at only 12 mV and, at 100 mV input, the meter needle pins to maximum.

AN IMPROVED FOUR-WAY FLASHER

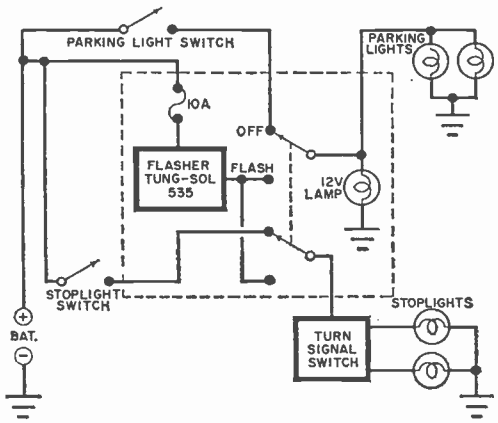
AVOID THE PITFALLS OF MOST COMMERCIAL UNITS

BY DONALD R. HICKE

NOW THAT ALL NEW CARS are required to have emergency flashing-light systems, owners of older cars will want to add similar systems to their cars. There is a wide variety of do-it-yourself kits available for the purpose. Some are better than others, but nearly all of them have operational quirks that, for one reason or another, make them less than ideal.

For instance, one cheap kit consists of nothing more than a switch which is installed so that, when it is on, all four turn-signal lights flash in unison when the turn lever is moved to either position. This arrangement has two serious faults. First, the flasher mechanism in the car was designed to handle only two lamps, and the additional load imposed by the added pair shortens its life. This could eventually leave the driver with no flashing lights at all. Secondly, and more important, flashing stops if the brakes are applied. This could have serious consequences during those first critical moments when the car is being positioned at the side of the road.

The better commercial kits are called "emergency flashers" and they contain a fuse, a heavy-duty flasher, and an indicator light. The flasher output is connected to all four turn-signal lamps to flash them together. The main disadvantage to this unit is that it also is inoperative when the brakes are applied. In another kit the indicator lamp is connected to one of the rear turn-signal lamps, which of course doubles as a brake light, and the "emergency" indicator comes on whenever the brakes are applied. This is very annoying for night driving.



The components to be added to the standard automotive circuit are shown inside the dashed-line box.

An improved four-way flasher system is shown in the schematic. The main difference is in the manner of connecting the FLASH-OFF switch and indicator lamp. The switch connects the flasher to the stop light and to the front parking lights for emergency flashing. It also opens the normal circuits to these lights so that applying the brakes or turning on the parking lights does not stop the flashing. The indicator lamp monitors the parking lights instead of the brake lights and serves as a warning signal in case the parking lights are inadvertently left on.

The improved four-way flasher may be constructed in a small metal box and fastened under the dash. A much neater arrangement, however, is to mount the switch and indicator lamp right on the dash and locate the flasher and fuse out of sight. To avoid confusion with other indicator lights on the dashboard, be sure to use a different colored lens over the flasher indicator. -30-

SOLID STATE

By LOU GARNER, Semiconductor Editor

NEW TECHNIQUE LOWERS COST

EMPLOYING PRINCIPLES never before used in semiconductor technology, scientists at the Bell Telephone Laboratories have created a new class of low-cost, reliable electronic devices suitable for use in logic, imaging, and memory applications. Dubbed Charge Coupled Devices (CCD's), the new units perform many of the functions of more complex integrated circuits, yet are simple and easily fabricated.

As illustrated in Fig. 1, a typical CCD structure consists of three layers: metal conductors, an insulating layer of silicon dioxide, and a base of homogeneous silicon semiconductor material. The basic technology is applicable to a wide range of semiconductor-insulator systems, however, and is not restricted just to those materials in which it is possible to form *p-n* junctions.

A CCD creates and stores minority carriers (electrons or holes) in spatially defined depletion regions called "potential wells" near the surface of the semiconductor. In Fig. 1 an *n*-type semiconductor is used and the minority carriers are holes at the semiconductor-insulator interface.

In operation, the potential wells are produced and moved by an array of metallic

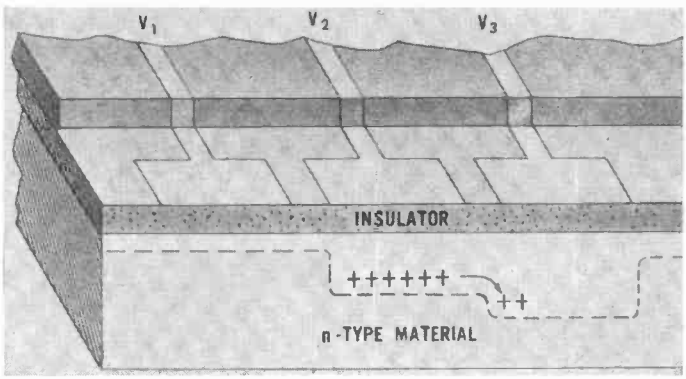


Fig. 1. A CCD structure consists of three layers: metal conductors (V1-V3), insulating layer of silicon dioxide, and base of homogeneous silicon semiconductor material.

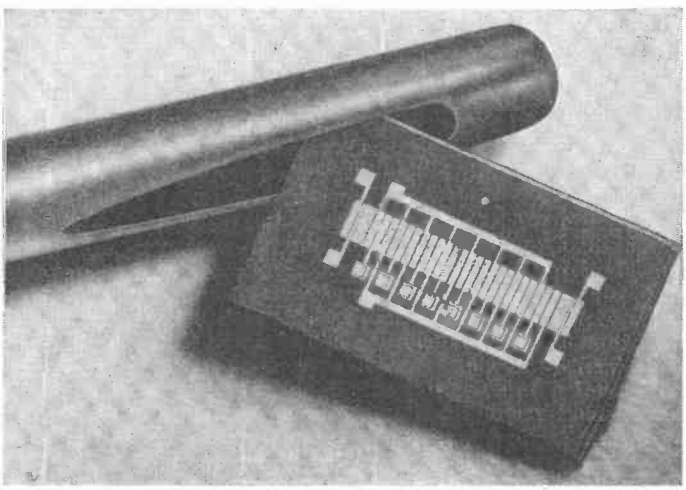


Fig. 2. Experimental CCD 8-bit shift register shown in photo is so small, it can be passed through eye of needle.

electrodes. The electrodes normally are made negative with respect to the semiconductor base. When voltage is first applied, there are no holes at the interface and the potential is divided between the semiconductor and insulator. Holes introduced in the depletion region by avalanche multiplication, or other means, collect at the interface causing the potential to become more positive. The minority carriers forming the potential wells may be moved from under one electrode to an adjacent electrode on the same substrate by applying a more negative voltage to the adjacent electrode. The sequence may be repeated, as needed, to move the carriers (and wells) in any desired direction. When required, the resulting charge pattern can be detected and measured by other electrodes.

Although still in its developmental stage, the CCD technology already has been used to fabricate a number of useful devices, including the experimental 8-bit shift register illustrated in Fig. 2. Future units may include other logic and switching devices as well as CCD image sensors, in which potential well patterns would be created through photoelectric action by light images focused on the back side of the semiconductor substrate, then read out using the metal electrodes.

Reader's Circuit. The sequential lamp control circuit of Fig. 3 was submitted by reader Paul Schultz (6208 Templeton Drive, Carmichael, CA 95608). If coupled to a conventional electromechanical or thermal flasher switch, it can be used as an automotive sequential-type directional turn signal. In addition, the basic circuit can be employed in moving-light advertising displays, in warning systems, and in other similar applications.

In operation, lamp *I1* lights as soon as power is applied. Meanwhile, *C1* is charged slowly through *R1* and *R2*, eventually firing *Q1* and developing a voltage pulse across load resistor *R4*, which triggers *SCR1* on, lighting lamp *I2*. With *SCR1* on, *C2* is charged through *R3* and *R4*, firing *Q2*, which triggers *SCR2*, lighting lamp *I3*. The three lamps remain lit until circuit power is interrupted and restored by the external flasher switch, at which time the cycle repeats. The lamps are ordinary 12-volt automotive bulbs.

With neither layout nor lead dress critical, the builder can duplicate the project using any construction technique. Although not essential in most applications, heat sinks can be provided for the two SCR's as a precaution against over-heating.

Two complete units are required, of course, for automotive turn-signal applications. Usually, the controls can be mounted in the car's luggage compartment. After installation, sequence timing resistors *R2* and *R4* must be adjusted for optimum performance in conjunction with the car's regular flashing switch (that is, so that the full sequence is completed during each flashing interval). If the control unit is used in non-automotive service, these timing controls are adjusted to achieve the preferred display effect.

Device Developments. Four new types have been added to Motorola's exclusive line of silicon *pnp* r.f. power transistors. Identified as types MM4020 through MM-4023, the new devices offer output power ratings ranging from 3.5 to 40.0 watts, with gains from 11.5 to 4.5 dB. Designed for 12.5-volt VHF large-signal amplifier applications at frequencies up to 20 MHz, the new transistors feature balanced emitter construction in which thin-film nichrome resis-

(*Continued on page* 88)

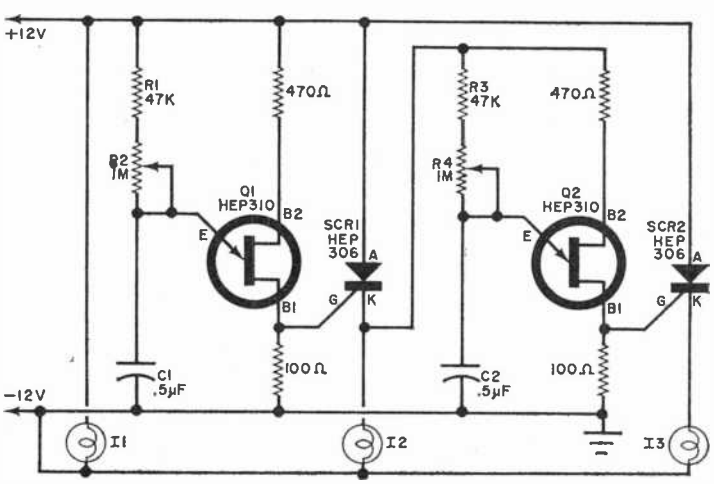


Fig. 3. If coupled to conventional electromechanical or thermal flasher switch, circuit shown can be used as auto sequential-type turn signal.

AMATEUR RADIO

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

CLEOPATRA WAS AN AMATEUR

FIFTEEN YEARS AGO—in August 1955—I began my first amateur radio column in POPULAR ELECTRONICS: "Shakespeare defined Cleopatra's fascination as follows: 'Age cannot wither her, nor custom stale her infinite variety.' By a similar definition, amateur radio is the Cleopatra of all hobbies. It thrils the newest beginner and continues to fascinate men and women who have been radio amateurs 40 years and more."

That first column contained the information that there were then 130,000 amateur radio operators in the United States and another 65,000 in the rest of the world. The column was reprinted in a general reference encyclopedia as its chapter on amateur radio. However, except for the statement that amateur radio thrills beginners and fascinates old timers, scarcely anything else in that column is true today.

It was just shortly before that that Novices had been operating on the 27-MHz band. (Yes, 27 MHz was then assigned to amateurs.) Then Novices were moved to 21 MHz—possibly the first step in transferring 27 MHz to the Citizen's Radio Service. While there is some question as to whether the latter move was the smartest thing that the Federal Communications Commisison ever did, certainly the 21-MHz band opened the door to international DX for the Novices.

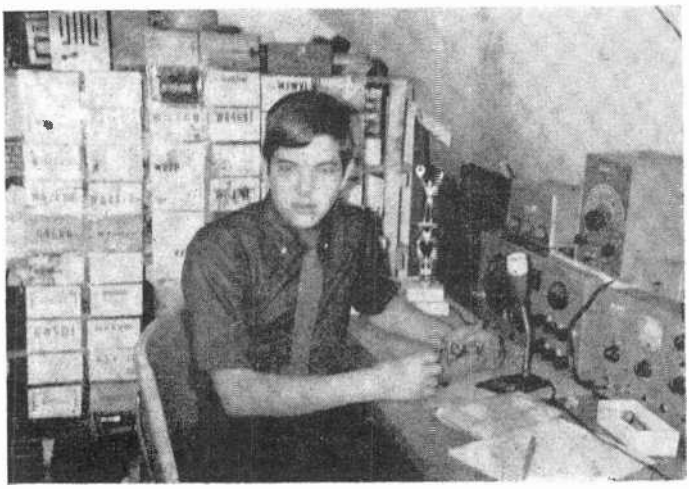
Those were the halcyon days of amateur radio. Within a few years, the amateur population doubled—to a quarter of a million in the United States and 150,000 in the rest of the world. The Novice written examination was ridiculously simple, and Novice licenses were being issued at a rate close to 20,000 a year. The Novices were all newcomers because the license was issued only to applicants who had never held a U.S. amateur radio license of any kind. Furthermore, the license was good only for one year and could not be renewed.

With this large influx of newcomers to amateur radio, our column concentrated on items of special interest to Novices. Manufacturers were selling Novice ham equipment, but not many people seemed concerned that a large percentage of Novices faded out of the picture when their 1-year tickets expired. After all, there seemed to be an endless string of replacements for them and the new ones bought more equipment.

But changes were on the way. After a slow start, the Citizen's Radio Service and its no-test license suddenly took off in a manner

AMATEUR STATION OF THE MONTH

Mark F. Mokris, WB8AGA, 21741 Robinhood Ave., Fairview Park, OH 44126, spends most of his time on 80-meter CW but tries 40 meters at times. His Knight-Kit T-50 transmitter and Hallicrafters SX-43 receiver with a long-wire antenna and 40-meter vertical have worked just 23 states. WB8AGA gets a one-year subscription free for winning this month's photo contest.



ENGLISH LANGUAGE NEWS BROADCASTS FOR THE MONTH OF AUGUST

Prepared by ROGER LEGGE

TO EASTERN AND CENTRAL NORTH AMERICA

TIME-EDT	STATION AND LOCATION	FREQUENCIES (MHz)
7:00 a.m.	Stockholm, Sweden	15.315
7:30 a.m.	Melbourne, Australia	9.58, 11.71
8:00 a.m.	Peking, China	11.685, 15.095
8:15 a.m.	Montreal, Canada	9.625, 11.72
12 Noon	London, England	21.61
5:30 p.m.	Hilversum, Holland	11.73, 15.425
6:00 p.m.	Ankara, Turkey	15.16
7:00 p.m.	Helsinki, Finland	15.185
	Montreal, Canada	9.625, 15.19
7:45 p.m.	Tokyo, Japan	15.235, 17.825
8:00 p.m.	London, England	6.11, 9.58, 11.78, 15.14
	Moscow, U.S.S.R.	11.87, 11.90, 15.15
	Sofia, Bulgaria	9.70
8:30 p.m.	Johannesburg, South Africa	5.98, 9.695, 9.705
	Stockholm, Sweden	11.825
8:50 p.m.	Brussels, Belgium	15.335, 17.715
	Vatican City	9.615, 11.725, 15.285
9:00 p.m.	Berlin, Germany	9.73, 11.89
	Budapest, Hungary	9.833, 11.91, 15.16
	Havana, Cuba	9.525
	Madrid, Spain	6.14, 9.76
	Peking, China	7.125, 9.78, 15.05, 17.715
	Prague, Czechoslovakia	7.345, 9.63, 11.99, 15.36
	Rome, Italy	11.81, 15.41
9:30 p.m.	Berne, Switzerland	9.535, 11.715, 15.305
	Cologne, Germany	9.735, 11.925
	Melbourne, Australia	15.32, 17.84, 21.74
	Tirana, Albania	6.20, 7.30
10:00 p.m.	Cairo, U.A.R.	9.475, 12.005
	Hilversum, Holland (via Bonaire)	11.73
	Lisbon, Portugal	6.025, 11.935, 15.125
	London, England	6.11, 9.58, 11.78

TO WESTERN NORTH AMERICA

TIME-PDT	STATION AND LOCATION	FREQUENCIES (MHz)
8:00 a.m.	Tokyo, Japan	9.505
6:30 p.m.	Melbourne, Australia	15.32, 17.84, 21.74
	Tokyo, Japan	15.235, 17.825, 21.64
7:00 p.m.	Oslo, Norway (Sun.)	11.86
7:30 p.m.	Johannesburg, South Africa	5.98, 9.695, 9.705
8:00 p.m.	Madrid, Spain	6.14, 9.76
	Moscow, U.S.S.R.	9.685, 9.70, 11.90
	Peking, China	15.095, 17.675, 21.735
	Prague, Czechoslovakia	5.93, 7.345, 9.63, 11.99
	Seoul, Korea	15.43
	Tokyo, Japan	17.785
8:30 p.m.	Berlin, Germany	9.56, 9.65
	Stockholm, Sweden	11.705
	Tirana, Albania	6.20, 7.30
9:00 p.m.	Budapest, Hungary	9.833, 11.91, 15.16
	Havana, Cuba	9.525, 11.76
	Lisbon, Portugal	6.025, 11.935, 15.125
	London, England	6.11, 9.58, 11.78
	Moscow, USSR (via Khabarovsk)	15.14, 17.865
	Sofia, Bulgaria	9.70
	Tokyo, Japan	17.785
9:30 p.m.	Kiev, USSR (Mon., Thu., Sat.)	11.90, 11.96
9:45 p.m.	Berne, Switzerland	11.715, 15.305
	Cologne, Germany	9.545, 11.945
10:00 p.m.	Havana, Cuba	11.76
	Hilversum, Holland (via Bonaire)	9.715, 11.73
11:00 p.m.	Moscow, USSR (via Khabarovsk)	15.14, 17.865
	Tokyo, Japan	15.105
11:30 p.m.	Havana, Cuba	9.55

SHORT-WAVE LISTENING

By HANK BENNETT, W2PNA/WPE2FT
Short-Wave Editor

SWL THROUGH THE YEARS

IN A RECENT issue of the Newark News Radio Club bulletin, there was a reference to SWL club editors who grind out column after column and bulletin after bulletin as though it were part of their life. To a degree, this is pretty much the truth. This sort of work gets to you after you have done it for a while. But it is something that you realize has to be done; and for most of us, it is something that we like to do. Speaking for myself, I feel that I've been providing a service that may help another SWL in the hobby of short-wave listening. The NNRC article went on to list editors and the number of years they have been preparing their columns; some were fairly recent additions to the roster while others, like Hank Bennett, "have been around longer than anyone can remember."

When I was invited to join the staff of POPULAR ELECTRONICS, the magazine was very young. That was nearly 15 years ago and, in the interim, I've had the pleasure of working with a number of people, processing reports of thousands of listeners—and enjoying every minute of it.

POPULAR ELECTRONICS has grown by leaps and bounds in the past 15 years and today it is the first and foremost magazine of its type in the world. Back in 1955, when I prepared my first column, the information was based on listings supplied me by members of the Newark News Radio Club. As can well be imagined, with no previous professional writing experience, I fully expected to have my column returned with all kinds of rejection slips attached. Instead, I received a warm and friendly letter from Miss Margaret Magna, who handled the proofreading chores at that time. "Maggie" gave me invaluable assistance, hints, tips, and suggestions on how to write a column. She continued to do so until her untimely death a few years later. I shall always be grateful to Miss Magna for her untiring efforts on my behalf.

Through the years, this SWL column has locked horns with various SWL'ers and radio clubs. Most of these arguments stemmed from what seemed to be inaccurate information in my column. Probably the thing that stirred up the most interest was a couple of loggings in North America of a station in the Falkland Islands on 3958 kHz. The critics said that this simply was not possible. The DX'er in Colorado, nonetheless, sent a detailed reception report and promptly received a verification. We wrote to the station to confirm the verification and received a prompt reply that the original reception report was unquestioned—it contained information on the broadcast in question that had never been published (local spot announcements, for example). Yes, the logging was good, the report was valid, and the confirmation was genuine. Studies at Stanford Research Institute have subsequently proved that reception of the Falkland Islands on 3958 kHz was, indeed, entirely possible in a relatively small area in the Southwest U.S.A.

Another topic that used a lot of editorial space was the existence of the semi-clandes-

Hank Bennett is well-known to SWL'ers throughout the world, having edited this column for 15 years.

tine *Radio Swan*—later renamed *Radio Americas*. Our initial claim that *Radio Swan* was on Swan Island has never been conclusively proved incorrect.

Members of the SWL hobby have always done a good job of helping to keep the airwaves clear of clandestine stations—at least here in the United States. Most of the pirate stations have been operated by teen-agers who have the urge to "make like" a broadcast station—without harmful intent. In fact, during one blizzard a couple of years ago, one of these young chaps provided a "service" of sorts by keeping his immediate listening area aware of school closings. With mixed emotions, we located this fellow and persuaded him, through his school officials, to leave the air before Federal authorities caught up with him. Hopefully, he has since continued in the hobby; we felt that his experience would enable him to put his broadcasting knowledge to good use in years to come.

We could continue to tell stories such as these, but space does not permit. It's time that we start to close shop. Before doing so, however, we would like to invite all of our devoted readers—as well as the casual reader and any newcomers—to continue to write to us at P.O. Box 333, Cherry Hill, New Jersey 08034. I am not leaving the DX hobby. We wholeheartedly suggest that those of you who intend to continue SWL, make plans to join one or more of the many excellent radio clubs that provide monthly (or oftener) bulletins for your enjoyment. Our Leaflet H (Clubs and Publications) lists these clubs and you may have a copy of it at no charge other than return postage.

In our monthly columns, we have always had a list of those who have provided information for the column. Now, here is our own "List of Credits." In addition to Miss Magna, whom I mentioned earlier, my thanks to Oliver "Perry" Ferrell, Editor of POPULAR ELECTRONICS and to various other editors with whom I have had the pleasure of working. Thanks also to the clubs and various short-wave organizations for their cooperation and to the many stations for providing me with schedules. Special thanks also to the group of always dependable reporters who helped me when I had to "holler" for help—and those who assisted me in the preparation of articles for the COMMUNICATIONS HANDBOOK.

Finally, my warmest thanks to those immediately around: my Mom and Dad, for their continuing inspiration; Aunt Butch; my sister, May; Jim Drake and Bruce McAllister, for good, but tiring, jobs of proofreading; my son, James, who made literally thousands of trips to the post office for me; my daughter, Marion, for help with filing, sorting, and typing. Sincere thanks also to my spiritual adviser, Msgr. Bernard Hewitt, for his aid when I needed it and for the use of his church hall for meetings of SWL groups. Last, but by no means least, special thanks to my ever-patient wife, Mea, for having put up with me during these 15 years of meeting deadlines, helping to keep material in order, typing up thousands of Monitor Registration Certificates, and taking countless hundreds of telephoned reports when I was not at home.

Regretfully, this is my last column for POPULAR ELECTRONICS. Important news concerning short-wave listening will be handled in future issues in a special "Communications" section. As mentioned above, I have enjoyed everything and, if I have missed anyone in my "acknowledgements," the oversight was not intentional.

Thank you, again, and 73.

Hank, W2PNA/WPE2FT

AMATEUR RADIO

(*Continued from page* 83)

never anticipated by the FCC. CB was designed for brief, necessary, local communications, using 5-watt equipment; but many CB operators appropriated 27 MHz as their own ham band, ignoring FCC rules.

As the number of CB'ers increased, the number of Novice hams began to decrease. It is easy but incorrect to blame CB for this decrease. Many people forget that some years ago, the FCC quietly changed the Novice written examination from little more than a questionnaire to a genuine theory test that requires approximately 10 hours of study in order to be passed.

This test screens out would-be Novices with no real interest in electronics. Undoubtedly, some of them switch to CB, but most would probably have shown up in the CB camp when the old test was in effect—it would just have been a year later when their Novice lincenses expired. Tightening up the rules for obtaining a Conditional class license by mail may also have shunted a few prospective amateurs to CB.

Another reason given for the slowdown in the issuance of new amateur licenses is the license fee—even though there is no fee for a Novice license and the fee for a CB license is quite high. Still another is the amateur "Incentive Licensing" program. Undoubtedly, all of these factors have affected amateur radio; but the slowdown in the issuance of new licenses started before they entered the picture.

The real reason may be what Joe Levine, the movie producer, calls "the devil"—TV. After all, Television is blamed for ruining the movie business and minor-league baseball (among other things) so why not blame it for the slowdown in amateur radio?

Ed Sayre, WNØLV, Kansas City, Kans., and his EICO 720 worked 24 states and 6 countries in 2 months.

How bad the slowdown is depends on one's point of view. To large manufacturers who need mass sales to make a profit, it was nothing but bad news. Nevertheless, since the implementation of "Operation Retread," which increased the term of the Novice license to two years and makes any applicant who has not held any U.S. amateur license within a year eligible for a Novice license, the number of Novices has increased significantly. Furthermore, the total number of amateur licenses issued has been increasing slowly over the past few years.

In our opinion, the future growth of amateur radio depends largely on how fast already licensed amateurs want it to grow. Almost without exception, wherever amateurs or amateur clubs lend a helping hand either individually or through well-prepared courses, many new or upgraded amateur licenses are produced. A current example of this system at work is the amateur course sponsored jointly by the Oklahoma City VHF Amateur Radio Club and the Aeronautical Center Amateur Radio Club. The course has an enrollment of 95.

The annual POPULAR ELECTRONICS amateur equipment review that appears elsewhere in this issue points up the fact that many companies are producing amateur equipment of all degrees of sophistication. As further indication of the continued high interest in amateur radio, there are now four major magazines devoted exclusively to amateur

radio. In the recent past, there were only two.

Of course, the circulation of POPULAR ELECTRONICS exceeds the combined circulation of all the amateur radio magazines, and reader surveys indicate that more people read this column than the total circulation of the largest amateur magazine. It is true, however, that many of the column readers are interested in amateur radio as spectators, rather than as active participants.

Farewell. For the past two years the editors of POPULAR ELECTRONICS have been studying the readership of this magazine and have come to the conclusion that much of the editorial content must be revised, and the editorial outlook directed toward a more specific—as opposed to a general—audience. This is the last of my columns in POPULAR ELECTRONICS. It certainly does not mean that POPULAR ELECTRONICS is deserting ham radio. News items and feature stories pertaining to ham radio will continue to appear in a new broad-based "Communications" column. However, the Amateur Radio column, as a separate entity, will be discontinued.

You will continue to see my name and call letters in POPULAR ELECTRONICS and in other magazines. I hope that I will continue to hear from my friends and readers through my home address, Herb S. Brier, W9EGQ, P.O. Box 678, Gary, IN 46401.

Thank you one and all for the wonderful support that readers and editors alike have given me in the preparation of the material for this column for the past 15 years.

73, Herb, W9EGQ

SOLID STATE

(*Continued from page* 82)

tors are in series with each of the multiple emitters to distribute power evenly throughout the chip. This technique prevents "hot emitters" and results in rugged devices which stand up under the high voltage standing-wave-ratio conditions sometimes occurring in mistuned r.f. systems. All four devices are supplied in strip-line packages with minimum series lead inductances. For complete specifications, contact the Technical Information Center, Motorola Semiconductor Products, Inc., Box 20924, Phoenix, AZ 85036.

Motorola also has introduced a new series of silicon power Darlington devices. In a monolithic construction, both transistors and their compensating emitter resistors make up the configuration on a single chip. The new units offer minimum d.c. betas of

1,000 at V_{CEO} ratings of 60 and 80 volts. Type numbers are MJ900 and MJ901 for the *pnp* units and MJ1000 and MJ1001 for *npn*.

A new crystal-controlled microcircuit oscillator has been announced by TRW Semiconductors (14520 Aviation Blvd., Lawndale, CA 90260). The new unit model, MCOF, operates in the 5-MHz to 25-MHz frequency range, offering a frequency stability of 0.003% from −55°C. to 125°C. Contained in a 4-lead TO-5 package, the device uses thin-film capacitors and resistors on a single substrate and is designed specifically for applications as the local oscillator for the second mixer in dual conversion receivers. Operating voltage is 1.8 to 5.0 volts, while the output ranges from 0.35 to 3.0 volts r.m.s. into a 1,000-ohm load.

Practical Publications. A cross reference guide of IR universal replacement transistors and rectifiers is now available from International Rectifier's Semiconductor Division. Folding to a handy 3″ × 5½″ size, small enough to fit a shirt pocket, the booklet lists IR types corresponding to devices offered by Motorola, GE, RCA, Sylvania, Delco and Tungsol, covering the most popular transistors and rectifiers used in professional servicing, hobby projects, and technical experiments. In addition, transistor and rectifier specifications for all the IR devices listed are presented in easy-to-use tabular form. For your copy of this informative guide, write to International Rectifier, Semiconductor Division, Dept. 781, 233 Kansas Street, El Segundo, CA 90245.

Texas Instruments, Inc. (P. O. Box 5012, Dallas, TX 75222) has recently published an extremely useful 8-page booklet entitled the *Design Assistance Directory,* Bulletin CM-102C. Listing a wide range of literature resources covering solid-state circuit applications and design techniques, the publication includes abstracts describing textbooks, brochures, catalogs, and application reports.

Transitips. A common problem facing the serious hobbyist is that of improving or modifying the performance of an existing circuit design. While space limitations prohibit an exhaustive discussion of all available techniques, we'll try to cover various aspects of the problem from time to time—starting, this month, with a look at the techniques for extending the low frequency response of an R-C coupled amplifier.

Consider, first, the basic two-stage amplifier circuit illustrated in Fig. 4A. Here, voltage-dividers *R1-R2* and *R4-R5* establish base biases for *Q1* and *Q2,* respectively, while *R3* and *R6* serve as corresponding collector loads. Capacitor *C1* provides interstage coupling.

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The important factors affecting the circuit's low-frequency response are the size of the coupling capacitor (*C1*) and the input impedance of the following stage. In practice, the coupling device and the input impedance form a frequency-sensitive voltage divider.

One technique for extending the low-frequency response is simply to use a larger-valued coupling capacitor—either substituting another unit, or connecting a second capacitor in parallel with the first, as *C2* in Fig. 4B.

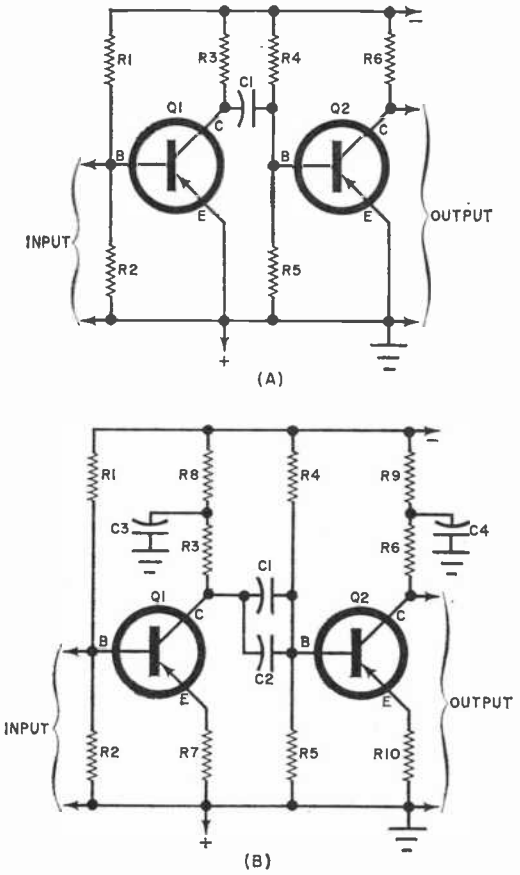
Another technique is to raise the effective input impedance of each stage. This can be accomplished at a loss in overall gain by adding unbypassed emitter resistances, as *R7* and *R10* in Fig. 4B. The value of the resistors used will vary considerably from one circuit to another but, in general, will range from a few ohms in the case of power transistors (or even a fraction of an ohm for multi-watt stages) to as high as several hundred ohms where low-signal levels are involved.

A final technique, commonly used in oscilloscopes and some instrument amplifiers, is the use of a low-frequency "boost" network. In general, this takes the form of a simple L-type circuit, as illustrated by C3-R8 and C4-R9 in Fig. 4B. At the same time, somewhat smaller main load resistors (*R3* and *R6*) are used. The net effect is to establish a frequency-sensitive load which raises the stage's effective gain at low frequencies.

In the first stage (*Q1*), for example, *R3* serves as the prime collector load at mid-range and high frequencies, because *C3* acts as an effective mid-to-high frequency bypass device. As lower frequencies are approached, *C3*'s impedance increases and *R8* becomes a part of the collector load. The lower the frequency, the higher the load impedance and the greater the stage's gain.

The component values needed will vary considerably with the specific circuit parameters. Generally speaking, however, the prime load resistor (*R3*) might be reduced to two-thirds or one-half of its original value, with the secondary load (*R8*) making up the difference. The boost capacitor (*C3*) may range in value from one to as high as 20 μF depending on the amount of boost needed.

That's it for August—until next month, keep boosting! —*Lou.*



Low-frequency response of amplifier shown at (A) can be improved by changes shown in (B) circuit.

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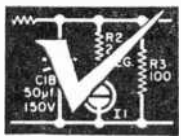

OPERATION ASSIST

Through this column we try to make it possible for readers needing information on outdated, obscure, and unusual radio-electronics gear to get help from other P.E. readers. Here's how it works: Check the list below. If you can help anyone with a schematic or other information, write him directly—he'll appreciate it. If you need help, send a postcard to Operation Assist, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016. Give maker's name 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.

Supreme Model 589A tube tester. Operators manual needed.

Multiphone (1908) 24-cylinder phonograph. Source for parts needed. (John Boyd, 7434 15th Ave., Barnaby 3, B.C., Canada)

Bludworth Marine "Port Pilot" Model DF 30A Serial #381 direction finder. Information on power supply voltages and schematic needed. (Neil Davidson, 29 Hidden Brook Dr., Stamford, CT 06907)

Hallicrafters Model SR 75 novice transceiver. Schematic and alignment information needed. (T. Gosman, 143 Roxton Rd., Plainview, NY 11803)

Brunelli Jones Model V receiver. Any information needed. (Gary R. Oaks, Rt. 2, Box 147, Burlington, WI 53105)

Masterwork Model M-808 stereophonic recorder. Schematic and operating manual needed. (Eugene Lapierre, 73 Bevier St., Springfield, MA 01107)

Zenith Model 3 receiver. Pointer type knob for filament rheostat and horn type loud speaker needed. (Walter Hall, RD #2, Box 13, Altoona, PA 16601)

General Electric Model 260 radio. Source for supplies needed. (Anthony Marks, P.O. Box 521, La Grande, OR 97850)

Heathkit Model DX-20 transmitter. Operating manual and schematic needed. (Jerry Wagoner, 912 Golden Ave., South Bend, IN 46616)

Metrodyne single dial BC receiver with 7 OIA's. Schematic and photo needed. (Michael Eck, Hillcrest Rd., Martinsville, NJ 08836)

Atwater Kent Model 33. Front face, knobs, parts needed. **Atwater Kent** Model 511 (or 409). Tune-o-matic mechanism, motor, parts, clock motor needed. **Superior** Model TV-11 tube tester. Tube chart needed. **Knight** KG-652 sweep generator. Metal cover, instructions and schematic needed. (W.D. Huneycutt, Box 535, Norwood, NC 28128)

Dynoptimum Model 322 tube tester. Operating manual and schematic needed. **McMurdo Silver** "Vomax" Model 900. Operating manual and schematic needed. (Vincent Acanfora, 4246 Rudisill, Montclair, CA 91763)

Phanstiehl Model 7. Schematic and layout of battery connections and voltages needed. (Lonny Simonian, 6222 E. Townsend, Fresno, CA 93727)

National Model NC 240C receiver. Schematic and owner's manual needed. (Edwin Chrt, 1419 Wisconsin Ave., Berwyn, IL 60402)

Fada "Special" Model "A", 265-A or RP-65 receiver. Schematic and operating manual needed. (Louis Yurek, 50 Darien Rd., Lakewood, NJ 08701)

Firestone Model R-3148-A receiver. Schematic needed.

Truetone shortwave and standard receiver with 6 tubes and motor drive. Schematic needed. (Greg Anderson, 314 3rd St. E., Fort Frances, Ont., Canada)

McMurdo Silver Masterpiece 5. Schematic and parts list needed. (Wm. Lee, 1980 Clinton Ave., Oroville, CA 95965)

Hallicrafters Model SX-99 receiver. Operating manual needed. **Eico** Model 772 CB transceiver. Schematic and operating manual needed. **Truetone** Model D-930 broadcast, aircraft and shortwave band receiver. Schematic needed. (Richard Friend, 756 S. Main St., Athens, PA 18810)

Dumont Model 224A three-inch scope. Schematic and instruction manual needed. (R. Roth, 13617 Bell Rd., Caledonia, WI 53108)

Atwater Kent Model 44. Schematic and any information needed. (Peter Byfield, Columbus High School, Columbus, WI 53925)

Hallicrafters Model SW-500 receiver. Schematic, parts list and alignment information needed. (John Jamack, 2803 Jackson St., Phila., PA 19145)

Hallicrafters Model S20R Sky Champion receiver. Schematic and parts list needed. **RCA Victor** Model 5-C-599 radio. Schematic and parts list needed. **Magnavox** Models CR199J and CR702AA radios. Schematic and parts list needed. (M. Costello, 86 Willow Dr., Briarcliff Mnr., NY 10510)

Hallicrafters Model SX-28 Super-Skyrider receiver. Instruction manual and schematic needed. (E.R. Joynes, P.O. Box 125, Glen Ellen, CA 95442)

RCA Model DZ-2 aircraft radio direction finder. Source of parts and schematic needed. (S.L. Sargent, RFD #5, Box 517, Laconia, NH 03246)

Kuba Model 5713 AM/FM shortwave receiver. Schematic and instruction manual needed. **Laja** Model 114247 tape recorder. Schematic and instruction manual needed. (Dennis Bagley, 17 Pinewood Dr., Framingham, MA 01701)

Wilcox-Gay Model 3A10 tape recorder and **Zenith** Model H-500 transoceanic. Schematics and owner's manual needed. (David Thompson, 361 College Ave., Staten Island, NY 10314)

Zenith Model 12H696 three-band receiver. Schematic and operating manual needed. (Jeff Angwin, 3709 Palo Alto, CA 94306)

Osborne Model 300. Power supply needed. (John Young, 323 Peach Dr., Exeter, CA 93221)

Philco radio receiver. Chassis number Y39736. Covers 540 kHz to 23 MHz. Eleven tubes. Tube diagram, model number and schematic needed (Dan Johnson, 412 N. Taft, Humboldt, IA 50548)

Atwater Kent Model 36 six-tube receiver. CX-326 and UX-226 tubes and schematic and operating manual needed. (Michael Boes, 338 Hedges St., Tiffin, OH 44883)

Montgomery Ward amplifier made in 1947, catalog number 74HA-8200-A. Schematic and service manual needed. (D. Peck, 185 Brookdale Ave., Newark, NJ 07106)

Drexel Model SF-4801 four-band radio. Schematic and service manual needed. **Mercury** all-transistor 9U portable record player, type AG4126W/54. Schematic, parts list and service manual needed. (SSG James Walker, C. "C" USAMMCS, Redstone Arsenal, AL 35809)

Sears Silvertone chassis number 101-826. Schematic, AM/FM alignment data and source for transformers R-60734 to R-60736 needed. (Rick Quillen, 106 Jefferson Davis Ave., Biloxi, MS 39530)

Deterola Model 571 AM radio and **Emerson** Model T-1840 TV. Schematics and parts lists needed. (Lowell Kurinsky, 2927 Ridley Rd., Palms, MI 48465)

Revere Model T-100 tape recorder. Schematic and manual needed. (Paul Tran, 1126 Miles Ave., Pacific Grove, CA 93950)

Hallicrafters Model S-120. Schematic and installation instructions for S-meter needed. (Joe Gutman, 30 Mell Dr., North Babylon, NY 11703)

OUT OF TUNE

"Modify Your Electronic Guitar Sound" (June 1970). In the schematic on page 58, the polarities of *C3*, *C15*, and *C16* should be reversed.

AMATEUR RADIO EQUIPMENT

(*Continued from page* 60)

tal control adapters are available for use with most transceivers that do not incorporate built-in optional crystal control operation. On the other hand, straight CW equipment is far less costly than SSB/CW gear.

For example, the **Heathkit** HW-16, CW transceiver incorporates a 75-100 watt crys-

tal-controlled transmitter and a sensitive, selective receiver for $110, less crystal and accessories. And the 5-band Heathkit DX-60B 75-90 watt transmitter kit sells for $82. Of minor importance in this day of SSB, the DX-60B functions on AM phone as well as on CW. Incidently, both the HW-16 and the DX-60B and the Drake 2-NT described next can be controlled by the Heathkit HG-10B VFO. Its kit price is $45.

The **Drake** 2-NT almost classes as a "deluxe" 100-watt CW transmitter. It contains a built-in audio oscillator for monitoring one's sending, an antenna changeover relay, and a low-pass filter for TVI elimination. It sells for $164. At the other end of CW transmitter price range, the **Ameco** 1-tube (plus rectifier) 80 and 40 meter AC-1T 15-watt CW transmitter kit sells for $25. Add $1.10 for the second coil. **Conar's** 400UK CW transmitter is a 25 watter for 80, 40, and 15 meters. It sells for $40 as a kit and for $56 wired.

Ten Tec's new solid-state power mite CW transceivers are for the low-power buffs. The 2-watt PM-1 covers 80 and 40 meters with a transmitter that may be crystal controlled or controlled by the receiver oscillator. The 5-watt 40/20 meter PM-3 is a straight transceiver. Both have autodyne receivers with 2-kHz bandwidth and operate into high-impedance phone. The PM-1 lists at $50, and the PM-3 at $70. Individual Ten Tec modules are priced from $6 to $15.

Today, most large population centers have 50- or 144-MHz FM repeater stations and FM nets. Supplementing the surplus commercial FM gear previously used by amateur FM users, several sources of VHF equipment specifically designed for amateur use are now available. **Galaxy Electronics's** solid-state FM-210, 144-MHz FM transmitter/receiver has a 5-watt capability when operated from a 12-volt battery and 10 watts when used with the 117-volt/12-volt power booster. Frequency deviation is normally 15 kHz and receiver sensitivity is 1 μV for 20 dB of quieting. The FM-210 lists at $200 and the power booster at $40 . . . The **Inoue** HT-2, 3-pound, 3-watt, solid-state handi-talkie will talk to a repeater over surprising distances. It comes complete with rechargable nickelcadmium batteries, battery charger, and two sets of transmit-receive crystals for $270 . . . **Varitronics,** who imports the HT-2, also imports the 20-watt IC-6F 50-MHz FM transceiver and its IC-2F, 144-MHz twin. Both units operate on 12 volts, d.c., or from a separate 117-volt, a.c., power supply. IC-6F, $330; IC-2F, $350. Both prices include two sets of crystals. An a.c. power supply is $50.

Miscellaneous. The demand for low-frequency AM equipment is virtually non-existent, but there is still a need for AM on the 50- and 144-MHz bands. Check with **Ameco, Clegg, Gonset, Heath,** and **Lafayette Radio** for information on their AM gear, ranging from low-power handi-talkies to medium power AM transmitters. **Ameco, Clegg, Drake, Heath,** and **Vanguard** also offer solidstate and tube-type converters to extend the frequency range of lower-frequency amateur receivers to the amateur bands above 50 MHz. Also add **Allied Radio, BTI Industries, Gonset, Hammarlund,** and

Henry, to the names of the companies already mentioned that offer transmitter amplifiers for the amateur frequencies up to 148 MHz.

Any of the companies mentioned in this review will supply additional information on their amateur equipment, including items that space limitations prevented us from covering. Their addresses are given below.

ADDRESSES OF MANUFACTURERS

(Manufacturers will be pleased to send you more information. Mention that you saw the product discussed by Herb S. Brier, W9EGQ, in the August POPULAR ELECTRONICS.)

Allied Radio Corporation
100 N. Western Ave., Chicago, IL 60680
Ameco Div., Aerotron, Inc.
P.O. Box 6527, Raleigh, NC 27608
BTI Amateur Div., Hafstrom Technical Products
4616 Santa Fe, San Diego, CA 92109
E. T. Clegg Associates, Inc.
Littel Rd., East Hanover, NJ 07936
Collins Radio Co.
Cedar Rapids, IA 52406
Conar Div., National Radio Institute
Washington, DC 20016
R. L. Drake Co.
540 Richard St., Miamisburg, OH 45342
Galaxy Electronics
10 S. 34 St., Council Bluffs, IA 51501
Gonset Div., Aerotron, Inc.
P.O. Box 6527, Raleigh, NC 27608
Hallicrafters Co., Subs. of Northrop Corp.
600 Hicks Rd., Rolling Meadows, IL 60008
Hammarlund Mfg. Co., Subs. of Electronic Assistance Corp.
20 Bridge St., Red Bank, NJ 07701
Heath Co.
Benton Harbor, MI 49023
Henry Radio
11240 W. Olympic Blvd., Los Angeles, CA 92801
Lafayette Radio Electronics, Inc.
111 Jericho Turnpike, Syosset, NY 11791
Linear Systems, Inc.
2200 Anvil St. No., St. Petersburg, FL 33710
National Radio Co., Inc.,
111 Washington St., Melrose, MA 02176
Signal/One, Div. of ECI
2200 Anvil St., No. St. Petersburg, FL 33710
Spectronics West
Box 338, Lakewood, CA 90714
Spectronics East
Box 1457, Stow, OH 44224
Swan Electronics, Div. of Cubic Corp.
305 Airport Rd., Oceanside, CA 92054
Ten Tec, Inc.
Highway 411 East, Seiverville, TN 37862
Vanguard Labs.
196-23 Jamaica Ave., Hollis, NY 11423
Varitronics Inc.
2321 E. University Dr., Phoenix, AZ 85034
World Radio Labs.
3415 W. Broadway, Council Bluffs, IA 51501

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.

Pioneer Electronics U.S.A. Corp. has just issued its new Stereo Components catalog. Published in color, this convenient reference source lists Pioneer's receivers, AM/stereo FM tuners, stereo amplifiers, stereo preamplifiers, reverberation amplifiers, equalizer preamplifier, speaker systems, turntables and stereo tape decks, and stereo headphones. The electronic and mechanical specifications of each component are outlined, with illustrations and prices. Hence, the hi-fi buff can easily use the catalog to create a complete stereo system, knowing its total cost, weight, space requirements, and all important electronic features.

Circle No. 75 on Reader Service Page 15 or 95

A comprehensive two-color catalog, No. D-70, featuring standard and special panel meters is being offered by *Triplett Corp.* Punched for ring-binder reference use, the 20-page catalog contains detailed electrical and mechanical specifications and dimensional and mounting drawings. User net prices are given for all panel meters listed. Among the instruments described are a new line of pyrometers with thermocouples, "G"-type meters for space-saving instrumentation requirements, and null meters. Also featured in the catalog is a complete listing of sales and service modification centers, plus Triplett's sales representative organizations.

Circle No. 76 on Reader Service Page 15 or 95

Catalog J, available from *Hy-Gain Electronics Corp.*, describes the company's complete line of fiberglass VHF marine antennas, shore station antennas, and mounts. The catalog comes with a separate ring-binder perforated price list.

Circle No. 77 on Reader Service Page 15 or 95

Available from *University Sound* is the company's 1970 comprehensive catalog that lists the technical data on the latest commercial public address products. Information on all University Sound products from power-line amplifiers to portable "Powrpage" systems is included in this new catalog.

Circle No. 78 on Reader Service Page 15 or 95

NEW PRODUCTS

(*Continued from page 24*)

confusion. Other features include 0.1-volt full scale for more accurate measurements of transistor biases and a high-voltage probe to extend voltage-measuring to 30,000 volts at no extra cost. The meter also measures d.c. and a.c. voltages and currents.

Circle No. 89 on Reader Service Page 15 or 95

ELECTRONIC BONGO KIT

A new solid-state electronic bongo kit, the Knight-Kit Model KG-391, that sounds like real bongo drums when played through an amplifier is being marketed by *Allied Radio Corp.* The compact unit has a high and a low bongo head, each with its own sustain control for varying the tone and producing realistic sounds; volume control; and on/off slide switch. The KG-391 bongos are designed to operate from a single 9-volt transistor battery. Step-by-step assembly instructions and a wood base are provided with the kit.

Circle No. 90 on Reader Service Page 15 or 95

HARMAN-KARDON REVIVES CITATION LINE

Harman-Kardon, Inc., has just re-introduced its famous Citation line of components with the release of the Citation Twelve stereo amplifier with performance and specifications said to be second to none. The Citation Twelve's components are assembled on a single heavy-duty etched circuit board which plugs into special non-corrosive-type connectors. Two separate power supplies, each with its own transformer and electrolytic capacitors, drive the channels independently, providing flawless performance even under musical stress conditions. Technical specifications: less than 1 to beyond 100,000 Hz frequency response at normal listening level; 5-35,000 Hz power bandwidth; virtually unmeasurable distortion from 20-20,000 Hz at full rated power; unconditional stability with all types of speakers.

Circle No. 91 on Reader Service Page 15 or 95

THREE-ELEMENT CB BEAM ANTENNA

The newest high-performance CB antenna in *Avanti Research & Development, Inc.* lineup is the "Astro Beam," said to have more forward gain than a typical three-element beam and a front-to-back ratio not found in any antenna currently made for the CB market. The 40-dB rejection makes it possible to cut out noises and unwanted signals in an almost unbelievable fashion. The Astro Beam combines Avanti's famous "Astro Plane" omnidirectional antenna as the center element with a reflector and a director to achieve the three-element beam configuration. Optimum spaced beam design plus direct ground construction provide lightning protection and static dissipation. Technical specifications: 11-dB forward gain; 40-dB front-to-back ratio; 50 ohms impedance; 1.3:1 VSWR; 80 mi/hr wind survival.

Circle No. 92 on Reader Service Page 15 or 95

EIGHT-TRACK AM/STEREO FM SYSTEM

A new item in the *Mercury Electronics* line is the Model 8000 eight-track AM/stereo FM home entertainment system. The system boasts 100 watts of power through four air-suspension speakers. The eight-track stereo cartridge player has a preamplifier which can be used in conjunction with a magnetic-cartridge record player and is housed in a modern cabinet that matches the speaker enclosures.

Circle No. 93 on Reader Service Page 15 or 95

LIBRARY

(*Continued from page* 16)

However, as an idea book, the text of this book has some merit for the all-band ham (160 through 10 meters).

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, IN 46268. 73 Dipoles: soft cover; 160 pages; $4.50. SWL Antennas: *soft cover; 128 pages; $2.95.*

INFORMATION TRANSMISSION, MODULATION, AND NOISE, Second Edition

by Mischa Schwartz

A comparison with the first edition of this book will show that, except for the first two chapters, the book has undergone extensive revisions. Although the first edition contained much material on digital systems and the statistical analysis of communications systems, there is much more emphasis placed on both of these modern trends in the new edition. The book, a text for working and student engineers, is in two parts. Chapters 1-4 constitute a comprehensive introduction to modern communications systems and modulation theory. Chapters 5-8 are a self-contained introduction to modern statistical communication theory.

Published by McGraw-Hill Book Co., 330 West 42 St., New York, NY 10036. Hard cover. 672 pages. $14.50.

SOLID-STATE CIRCUIT DESIGN & OPERATION

by Stanton Rust Prentiss

Here is a unique and informative guide to semiconductor circuit analysis and design that should prove of value to technicians and engineers. From diodes to integrated circuits, from FET's and MOSFET's to operational amplifiers, coverage is evidently complete, backed up by numerous illustrations. Chapter headings include: Semiconductor Devices & How They Work; Semiconductor Biasing Techniques; AC Circuits & Amplifiers; Pulse & Switching Techniques; Logic & Digital IC's; Operational Amplifiers; and Arithmetic of Electronics.

Published by TAB Books, Blue Ridge Summit, PA 17214. Hard cover. 288 pages. $9.95.

COMPUTERS AND ARTIFICIAL INTELLIGENCE

by Robert G. Middleton

This is a useful introduction to the computer, not as a technology, but as a means of communication. The chapter titles are: Introduction to Computers; Digital Computer Principles; Information Theory and Cybernetics; Fundamentals of Deductive Logic; Fundamentals of Inductive Logic; and The Case For Artificial Intelligence.

Published by Howard W. Sams & Co., Inc., West 62 St., Indianapolis, IN 46268. Soft cover. 126 pages. $3.95.

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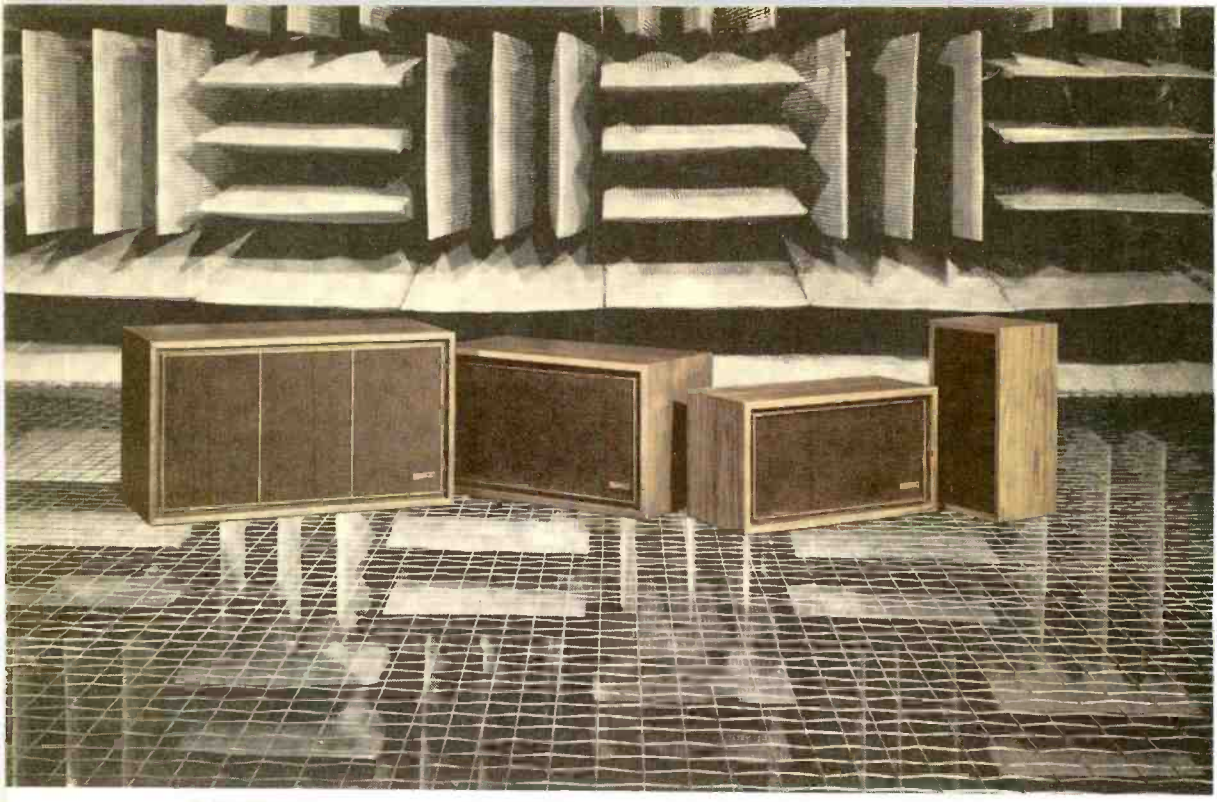

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