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VOLUME 31 NUMBER 3 SEPTEMBER, 1969

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letters FROM OUR READERS

CB BACKLASH

In response to the letters by J. Hanley and Jeff Luther ("Letters From Our Readers," May and June 1969), I would like to make myself heard on the subject of CB radio. Two or three years ago, I thought I might be interested in qualifying for a ham license; so I bought a short-wave receiver and listened in on the ham bands for a few weeks. In a very short time, it became clear to me that the only operators active on the ham bands were the type that have been condemned as CB'ers. For several nights there was continuous controversy between two groups over the use of a specific frequency. A group of about 15 or 20 operators claimed "squatters rights" and violently objected to another group attempting to operate within a few kilohertz of the squatters. I quickly came to the conclusion that if this is amateur radio, it was properly named, and I wanted no part of it.

Both letter writers take issue with the manner in which CB'ers operate and apparently feel that it is all the fault of the CB'er. But I say let's put the blame squarely where it belongs—in the lap of the FCC. Imagine the chaos that would result if the Federal Road Commission attempted to influence the operation of the Interstate Road System to give unlimited preference to "hot rodders" and other "good-time-Charlies" but prohibited the general public from using the roads except under the most stringent and restrictive conditions. This is just the kind of attitude the FCC is taking with respect to the various radio services.

The current situation is not hopeless nor irreversible. What we need most is a slate of FCC Commissioners who will fully discharge their responsibilities to the people they are supposed to serve. A change to sensible rules would have a virtual immediate effect for the better. In the meantime, I intend to use CB radio in the spirit and intent for which the service was authorized. And I will continue to work for the public interest with members of any local groups, including radio amateurs who express a real desire to serve the community.

R.M. Lewis, KKD7237
Huntsville, Ala.

I am in agreement with Jeff Luther on such things as operators on 11 meters running power and constructing antennas that are way above the legal limit set by the FCC. I must disagree, however, with his statement that all CB'ers rag-chew. There are many of us on 11 meters who do our best to operate

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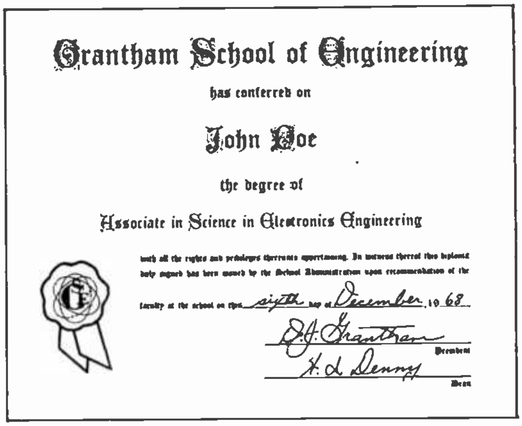

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LETTERS

(Continued from page 8)

according to the restrictions set forth in Part 95 of the Rules and Regulations. Our equipment is well maintained and strictly legal.

There are many of us on 11 meters who would like to see the FCC get tough and help clear up the so-called mess. We would like to see a testing procedure initiated for licensing an applicant.

There are many things wrong with CB radio, and the serious CB'er is the first to admit it. However, CB has many good points which are too often overlooked.

KEN MOSES, KPD3705
El Monte, Calif.

TAPES-VERSUS-DISCS READER FEEDBACK

With reference to "The Stereo Scene" (June 1969), I'm afraid that Charles Lincoln has fed us a long list of fallacies concerning magnetic recording tapes. As evidenced by the statements made in the article, I can only conclude that Mr. Lincoln is not an expert on tapes and discs.

First, tapes cost less—not more—than discs for the same program length. The open-reel tape man who records material from borrowed discs and off the air can get four $5 disc albums on a single $3 tape, doubling the program length for a small added investment by switching over to 2400′ tapes. And a boxed 7″ reel of tape is not heavier or bulkier than four record albums as opposed to what the article would have us believe.

Next, it is at least as easy to place a reel of self-threading tape onto a machine and let the machine go to work as it is to stack four or five discs onto a record player. You even have access to both sides of an album simultaneously.

Finally, Mr. Lincoln can't even get the advantages of tapes to us intact. True, tapes last longer and require less care than discs, but the really unique advantage of tape is that it can be used where you wouldn't dare use records, such as in a car.

I can see that Mr. Lincoln is sold on cassettes, and I must give him credit for this. But in looking back, I can see a few errors in that section of the column as well. I am really sorry for the person who decides against open reel tapes because of this article.

TODD BOYLE, WA7DGZ
Phoenix, Ariz.

Authors of featured columns in POPULAR ELECTRONICS *must be experts in their subject areas and Charles Lincoln is definitely an expert in hi-fi. What you failed to note is that the article deals with prerecorded tapes which contain only one album each and on the average cost more than their disc counterparts. Consequently, you would need at least as many boxed tapes as you would albums for the same program length. Also, each open-reel tape would have to be threaded onto a playback machine individually. The key phrase is "same program length."*

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Published by Hayden Book Co., Inc., 116 West 14 St., New York, N.Y. 10011. Soft cover. 111 pages. $2.95.

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by Albert C. W. Saunders

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(*Continued on page* 118)

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new literature

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The entire line of Endeco desoldering/resoldering irons, tips, and kits is illustrated and described in Bulletin No. 69 just published by *Enterprise Development Corp.* Among the items listed are the Model 100A iron with temperature control for continuous heavy-duty and industrial service and pencil-style Model 400 iron for removing and replacing miniature components. Thirteen replaceable tips (with a run-down of their inside and outside dimensions) and desoldering kits that include everything needed to handle any soldering job are also listed.

Circle No. 75 on Reader Service Page 15 or 115

"Every tape recorder owner ought to have his head examined!"—tape head, that is. This is the theme of pamphlet No. 7260 available from *Nortronics Company, Inc.* The pamphlet outlines the three-step procedure for checking tape head wear—look, touch, and listen.

Circle No. 76 on Reader Service Page 15 or 115

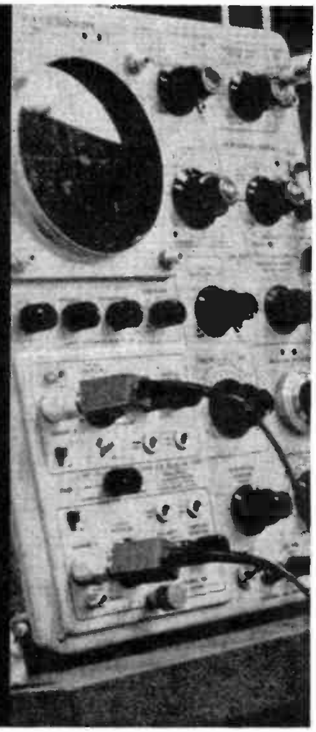
Catalog No. 695 available from the *Edmund Scientific Co.* is a treasure-trove of interesting and exciting items for the fun-seeker, experimenter, and serious amateur astronomer. Listed and described are thousands of items, such as "MusicVision," Edmund's own line of electronically driven colored-light displays; a dry copier; fiber optics, diffraction gratings, and thermoplastic sheets designed to produce moire patterns; photography accessories; etc. The line of toys and educational toys has been greatly expanded, and there is even a line of laser and laser kits for the really technically minded experimenter.

Circle No. 77 on Reader Service Page 15 or 115

J.W. Miller Co. has just published Catalog 170, containing 196 pages of coil replacement guide information. The 120-page cross-reference section is the most comprehensive and authoritative coil replacement guide for color and monochrome TV receivers and home and car radio receivers. More than 35,000 replacement listings are included. The catalog gives specifications and prices for more than 3400 coils and components.

Circle No. 78 on Reader Service Page 15 or 115

How to become a "Non-Degree Engineer"



In today's electronics boom the demand for men with technical education is far greater than the supply of graduate engineers. Thousands of real engineering jobs are being filled by men without engineering degrees—provided they are thoroughly trained in basic electronic theory and modern application. The pay is good, the future is bright... and the training can now be acquired at home—on your own time.

THE ELECTRONICS BOOM has created a new breed of professional man—the non-degree engineer. Depending on the branch of electronics he's in, he may "ride herd" over a flock of computers, run a powerful TV transmitter, supervise a service or maintenance department, or work side by side with distinguished scientists on a new discovery.

But you do need to know more than soldering connections, testing circuits an replacing components. You need to reall know the fundamentals of electronics.

How can you pick up this necessa knowledge? Many of today's non-de engineers learned their electroni home. In fact, some authorities fe a home study course is the *best* wa *ular Electronics* said:

"By its very nature, home study ops your ability to analyze and extr formation as well as to strengthe sense of responsibility and initiativ

Cleveland Method Makes It Ea

If you do decide to advance your ca through home study, it's best to pic school that *specializes* in the home stu method. Electronics is complicat enough without trying to learn it fro texts and lessons that were designed the classroom instead of the home.

Cleveland Institute of Electronics co centrates on home study exclusively. Ove the last 30 years it has developed tech-

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 115.

COLOR BAR/PATTERN GENERATOR

"Up-to-the-minute" is the most appropriate description for the new *Heathkit* Model IG-28 solid-state color bar/pattern generator for color TV receiver servicing. The IG-28 employs 15 J-K flip-flops that count down from a crystal-controlled master oscillator to eliminate flicker, bounce, and jitter in the display. The divider chain *never* needs adjusting. All six standard patterns are available from the IG-28—dots, cross hatch, shading bars, color bars, vertical lines, and horizontal lines—in both nine-by-nine and three-by-three displays. A clear raster is also available for adjusting purity without disturbing the receiver a.g.c. Featured are front-panel tuning for TV channels 2-6, variable positive and negative video output, sync output, two a.c. convenience outlets, built-in gun-shorting circuits and grid jacks, vectorscope capability, switchable crystal-controlled sound carrier, and regulated power supply.

Circle No. 79 on Reader Service Page 15 or 115

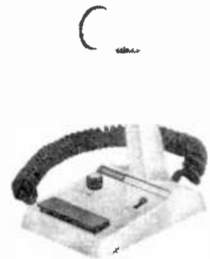
8-TRACK CARTRIDGE TAPE CHANGER

The world's first automatic changer for 8-track stereo tape cartridges is now available in both home and mobile models from *Qatron Corp.* Both changers, commonly designated the Models 48H, accept up to 12 standard tape cartridges and will play in three different selectable sequences. Individual cartridges can be "dialed in" manually, and any cartridge can be rejected or repeated at will. The Qatron 48H is designed around a removable circular magazine (similar in principle to those used on many modern slide projectors). Additional magazines for storage of large tape collections are also available. Technical specifications: frequency response—50-15,000 Hz ±3 dB; output power—24 watts peak (12 watts/channel); total harmonic distortion—less than 1% at 5 watts; signal-to-noise ratio —50 dB; flutter—less than 0.25%; cartridge change cycle—2 seconds nominal (to adjacent cartridge).

Circle No. 80 on Reader Service Page 15 or 115

SOLID-STATE CB MICROPHONE

A modern-styled base station microphone with built-in preamplifier and compression amplifier (to prevent over-modulation) is being introduced as the Model "Plus Three" by the *Turner Company.* The new mike allows the user to set volume level with a ten-position control for any desired modulation level. The compression amplifier circuit then allows the user to talk close to, or far from, the mike without varying the output signal or transmitter modulation. Frequency range of the Plus Three is 300-3000 Hz, tailored for best voice-signal transmission. A touch-to-talk switch and lock-lever are built into the base. The Plus Three is wired to function with both relay-operated and electronic switching sets (a booklet included with the mike provides installation instructions for more than 100 popular transceiver models). The preamplifier circuit provides up to 35 dB of gain.



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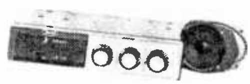
REVERB SYSTEM FOR AUTOMOBILES

Allied Radio Corporation's Deluxe Solid-State Stereo Reverberation System adds a new dimension in sound to any mobile stereo tape player or stereo FM receiver. It even creates a pleasing stereo-like effect from mono broadcasts. The reverb system mixes the sound from each stereo channel and delays it through the rear speaker to fill the "hole in the middle" with full reverberating sound. Controls are provided on the front panel for volume level, balance, and degree of reverberation, and pilot lamps indicate "on" and "stereo" mode. Measuring 8" × 5¾" × 1¾", the reverb system easily mounts under the dash of most cars. A 6" round speaker mounted on a 6" × 9" adapter board with chrome grille is supplied for rear mounting.



Circle No. 82 on Reader Service Page 15 or 115

CB BASE STATION ANTENNA

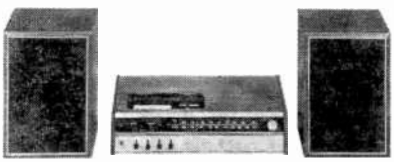
The *Avanti Research & Development, Inc.,* "Moonraker" is a new CB base station antenna designed along the lines of antennas used to pinpoint signals on "moon bounce." The new antenna combines half-wave cross-dipole elements with a reflector. A switch box (in-

cluded) permits operation in either the horizontal or the vertical polar mode. Moonraker employs only a 15' boom thus eliminating the efficiency loss inherent in multiple in-line quad setups with longer lengths. The shorter boom length also helps to keep weight and turning radius to a minimum, allowing the use of an ordinary TV-type antenna rotation system. Technical specifications: gain—14.5 dB; SWR—1.20:1; impedance—50 ohms; power handling capability—1000 watts; front-to-back separation—38 dB; vertical-to-horizontal separation—25 dB; wind survival—90 mi/hr.

Circle No. 83 on Reader Service Page 15 or 115

COMPACT HOME STEREO MUSIC SYSTEM

Concord Electronics Corp. has just introduced its Model HES-35 Stereo Home Music System for AM/FM/stereo FM listening, recording and playing. Included in the system are a powerful AM/stereo FM receiver, built-in Concord cassette tape deck, and a pair of matching bookshelf speaker systems. The 35-watt receiver has a FET front end for

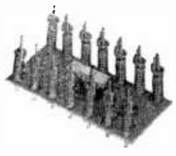


increased sensitivity; automatic muting on stereo FM; separate tone and volume controls for each channel; a.f.c. for locked-in tuning; and built-in AM and FM antennas. Frequency range of the receiver is 20-25,000 Hz and stereo reception is better than 65 dB at 1.9 kHz. The frequency range of the cassette tape deck is 50-12,000 Hz, with wow and flutter less than 0.2% and signal-to-noise ratio better than 45 dB. A full complement of stereo inputs allows the user to record off-the-air, from a microphone, or from a modern record player.

Circle No. 84 on Reader Service Page 15 or 115

IC BREADBOARD SOCKET

A new device for breadboarding 14-pin dual-in-line integrated circuits is now available from *Vector Electronics Company, Inc.* The No. 507G breadboard IC socket consists of a 2.63" X 1.33" epoxy-glass PC-type board on which is mounted a standard IC socket. The tabs of the socket are soldered to two adjacent rows of solderless Springclip terminals, each of which are numbered to correspond to the numbered socket contacts. Two pins mounted on the bottom of the board permit the 507G to be plugged into the holes of standard Vector "AA" perforated board. Breadboarding is easy with the 507G; as many as four solderless connections can be made to any terminal pin with ordinary hookup wire. And for discrete components, the adjacent perforated board can serve as a regular breadboard.



Circle No. 85 on Reader Service Page 15 or 115

TWELVE-CHANNEL MONITOR RADIO

Regency Electronics has developed a new 12-channel, all solid-state monitor radio that is designed to be operated from either a.c. or d.c. sources for base and mobile applications. The compact Model TMR-12 receiver is capable of monitoring any of 12 channels within an 8-MHz range within the entire 152-174 MHz band. Plug-in crystals are available for easy frequency change. The TMR-12 is sold with a.c. and d.c. power cords, a mobile mounting bracket, removable telescoping antenna, built-in 4" speaker, external antenna jack, and remote speaker terminals. Technical specifications: 1.5μV sensitivity; 50 dB at 15 kHz selectivity; 3 watts of audio output power; one ampere required for full audio power from 12-volt input, 9 watts required from 117-volt a.c.

Circle No. 86 on Reader Service Page 15 or 115

PUSHBUTTON MULTIMETER

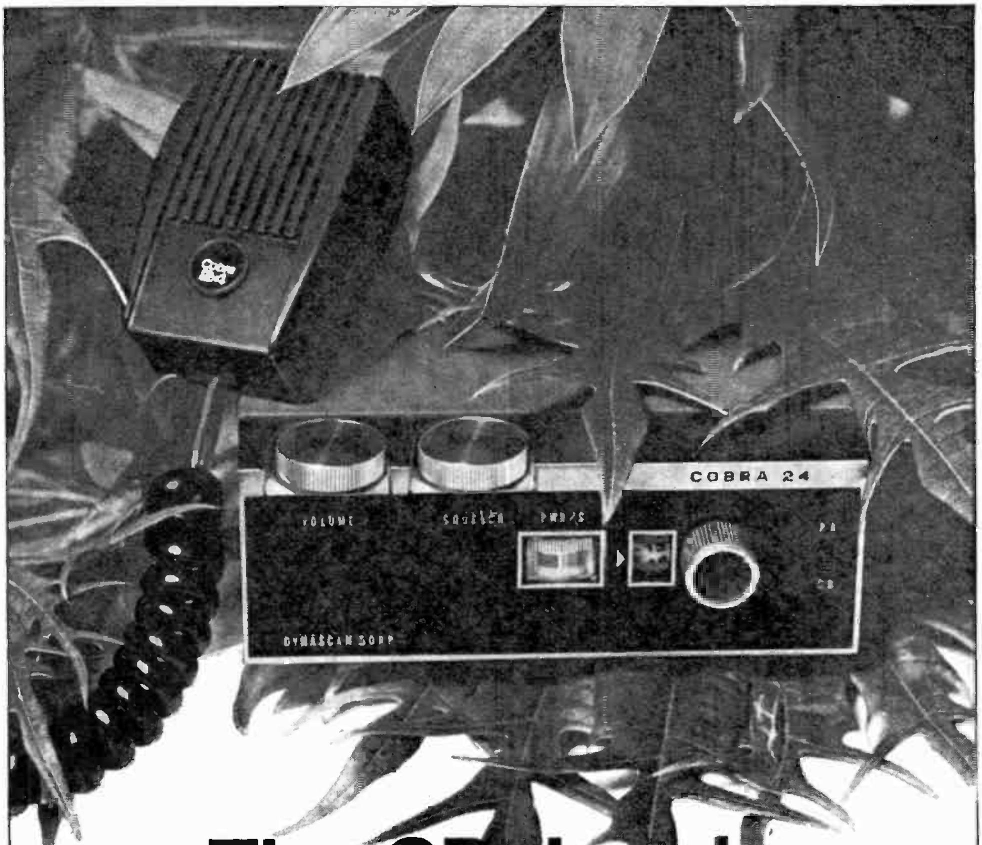
Pushbutton range and function switches and a taut-band meter movement that assures greater accuracy and extended meter life are features of the new *Olson Electronics Inc.* Model TE-235 multimeter. In addition, the expanded-scale meter has a built-in mirror for parallax. Technical specifications: sensitivity—30,000 ohms/volt; d.c. ranges—0 to 1, 2.5, 10, 50, 250, 1000 volts and 0-50 μA, 100 mA, 250 mA, 500 mA, 10A; a.c. ranges—0 to 2.5, 10, 50, 250 volts and −10 to +36 dB; resistance ranges—0 to 5 K, 50 K, 500 K, 5 megohms; size—8½" × 5⅛" × 2¹³⁄₁₆". The meter is supplied complete with batteries and test leads.

Circle No. 87 on Reader Service Page 15 or 115

CO-PHASER BOOSTS ANTENNA EFFICIENCY

A complete coaxial harness system designed to co-phase two mobile antennas for an efficiency increase of 25% is now available from *Avanti Research and Development, Inc.* By mounting two mobile antennas on opposite sides of any land vehicle, a much wider aper-

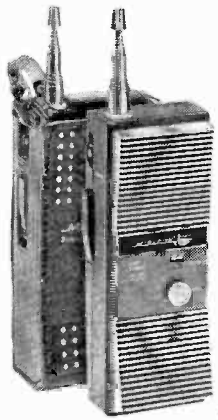
(Continued on page 116)


COBRA 24

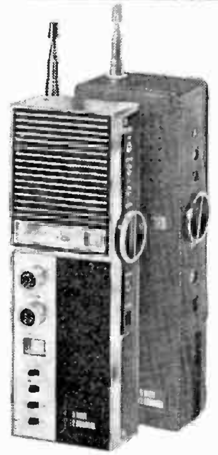
Midland transceivers go the distance for you

...with solid state dependability, extra power, warranted service!

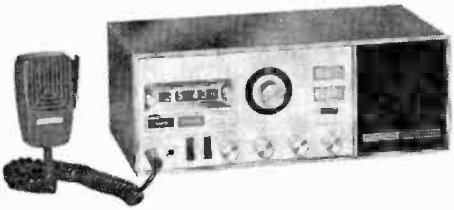
3-Channel, 100 mw. Solid state. Call Signal®, AC adaptor jack. Channel 11 crystals, earphone and battery included. Model 13-428 **$16.95 ea.**



2 Watts, 3 Channels. Integrated circuit, separate speaker/mike, Call Signal®, squelch. Charger and AC adaptor jacks. Model 13-724 **$44.95 ea.**



5 Watts, 12 Channels. Integrated circuit, 3-way meter, Call Signal®, battery saver. Jacks for PA, antenna, AC. Model 13-772 **$79.95 ea.**



AC/DC 23-Channel, 5-Watt CB. Built-in digital clock. 4 solid state integrated circuits, F.E.T. front end RF amplifier. Delta tuning, SWR meter with forward/reverse switch. Model 13-877 **$189.95**

23-Channel, 5-Watt Base/Mobile CB. Instant all-channel operation. Integrated circuit. Dual conversion receiver with filter. RF/signal meter, PA switch, squelch. Model 13-870C **$139.95**

Prices shown are suggested retail

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CIRCLE NO. 20 ON READER SERVICE PAGE

COVER STORY

PSYCHEDELIA 1

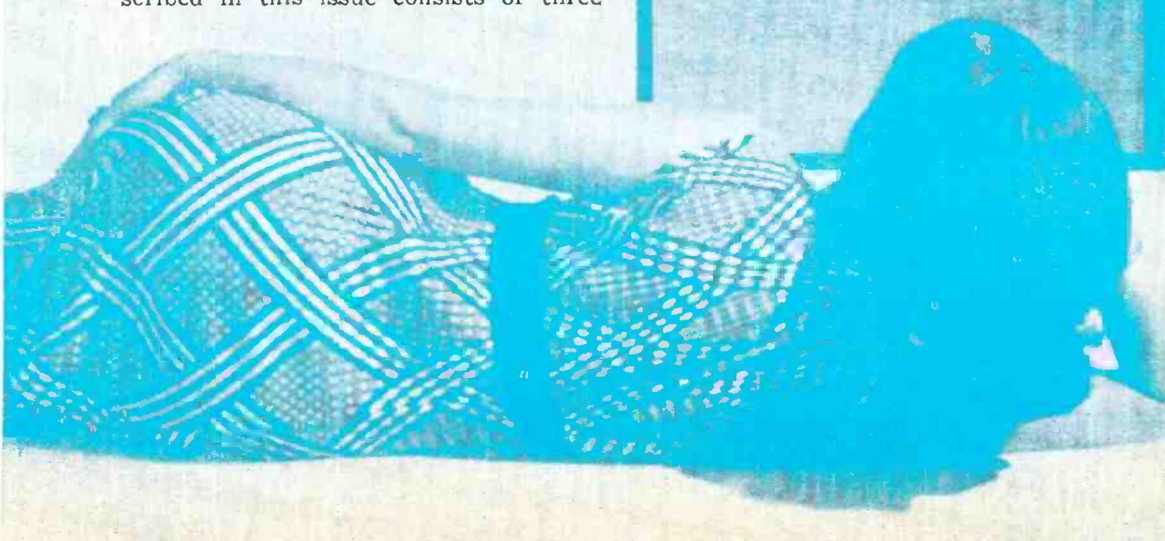
Color Organ Designed for the 70's Opens New Vistas in Display of Sound

BY DON LANCASTER

THIS IS the day of the color organ. By combining the visual stimuli of multicolor lighting with the aural stimuli of hi-fi sound you can make your living room or den into a psychedelic showcase. Of course, you can now buy a color organ (some even physically looking pretty much like the one described here) but for a modest investment you can build a more versatile color organ with greater sensitivity and power handling capacity.

By employing new design techniques, the latest semiconductors, and computer-derived audio filtering—the ultimate in color organs has been designed. It's called Psychedelia 1 and can control up to 600 watts of vari-colored light per channel. The input signal to the Psychedelia 1 can be a hi-fi system loudspeaker output, a contact microphone, tape recorder output, or just about any audio source. The Psychedelia 1 will add no distortion. The visual display of Psychedelia 1 is distinctive and eye-catching—(see cover photo).

The basic 600-watt Psychedelia 1 described in this issue consists of three



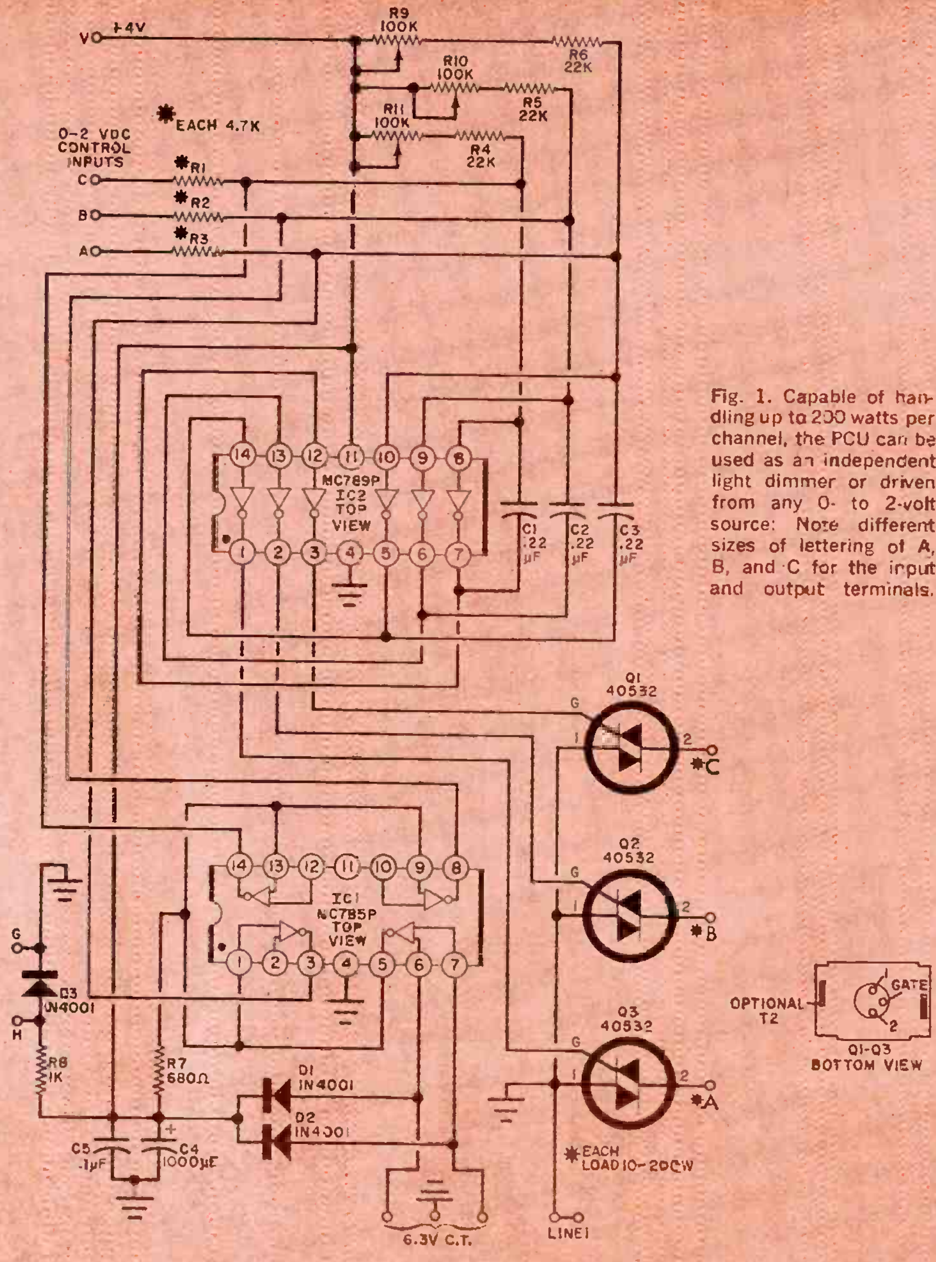


Fig. 1. Capable of handling up to 200 watts per channel, the PCU can be used as an independent light dimmer or driven from any 0- to 2-volt source. Note different sizes of lettering of A, B, and C for the input and output terminals.

PARTS LIST
POWER CONTROL UNIT

C1-C3—0.22-µF, 50-volt Mylar capacitor (see text)
C4—1000-µF, 5-volt electrolytic capacitor
C5—0.1-µF, disc ceramic capacitor
D1-D3—50-volt, 500-mA silicon power diode (1N4001 or similar)
IC1—MRTL quad two-input expander (Motorola MC785P)
IC2—MRTL hex inverter (Motorola MC789P)
Q1-Q3—Triac (RCA 40532, no substitute)
R1-R3—4700-ohm, ½-watt resistor
R4-R6—22,000-ohm, ½-watt resistor
R7—680-ohm, ½-watt resistor
R8—1000-ohm, ½-watt resistor
R9-R11—100,000-ohm trimmer potentiometer (CTS U-201 or similar)
Misc.—Male quick-disconnect PC terminals (Keystone #1256 or #1257 or similar, 3 required); mounting hardware; solder; etc.
Note—The following are available from Southwest Technical Products, Box 16297, San Antonio, Texas, 78216: etched and drilled PC board, #501, $2.80; complete kit of all parts, #501-K, $15.20, postpaid in U.S.A. Individual parts and assembled and tested units are also available.

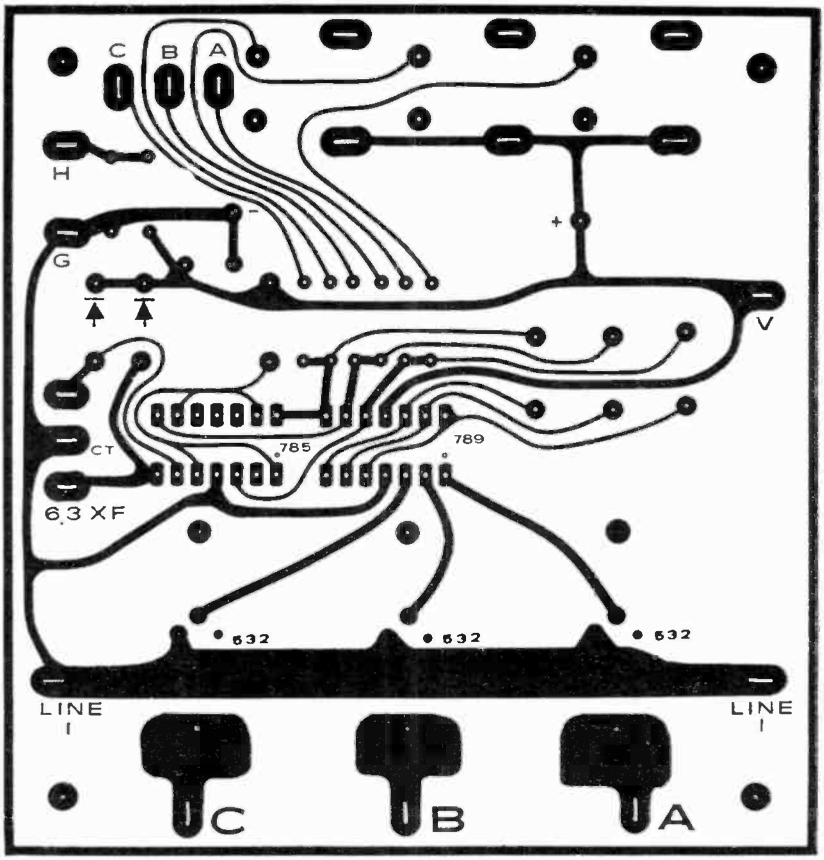
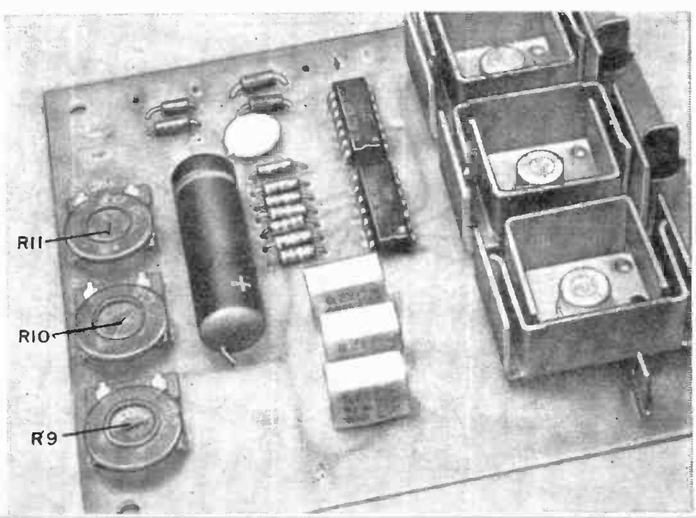


Fig. 2. This foil pattern for the PCU PC board is actual-size and can be reproduced.

elements: a power control unit (PCU), a quality filter unit (QFU), and a holographic bookshelf display. This is all you need for a "starter" system.

Power Control Unit. This is a three-channel (200 watt per channel) full-wave proportional (or strobe) a.c. power controller. It uses three triacs and two IC's in a unique (patent pending) circuit. It has continuous gate drive for the triacs, eliminating channel-to-channel interaction; it is very sensitive and requires only 0-2 volts d.c. for operation; and it is mechanically simple. The triacs have their own built-in heat sinks and require no insulation or mounting hardware. Three background control po-



The three background controls can either be finger or screwdriver adjusted. They are physically isolated from the power line for maximum safety in adjustments. The three triac heat sinks may be "hot" to ground, depending on polarity of line.

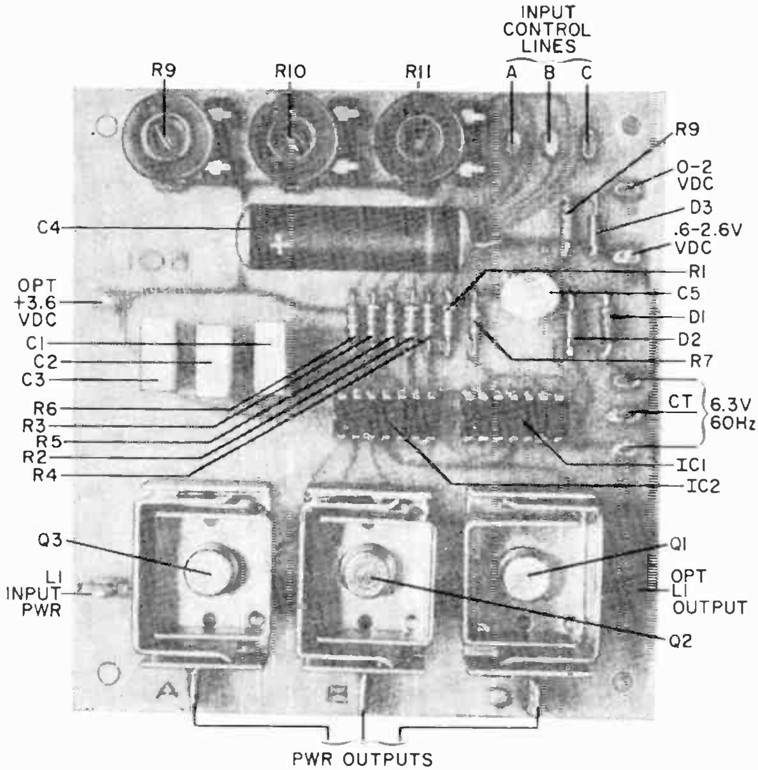


Fig. 3. To install the components, follow the arrangement shown here. Soldered-in, slip-on power terminals are to be used for the output.

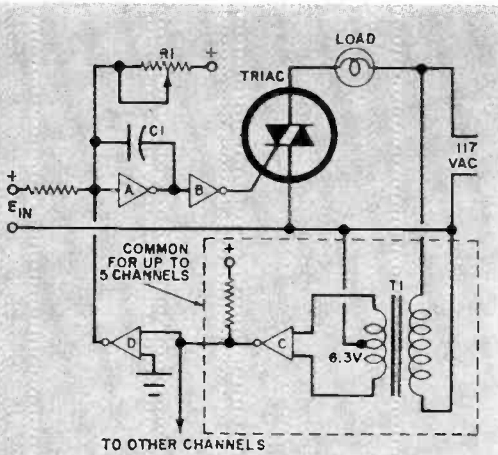
HOW IT WORKS
POWER CONTROL UNIT

As shown in the simplified schematic, in the Power Control Unit. Inverter A is a single *npn* gain stage which, with capacitor *C1* forms a ramp generator. The amplitude of the ramp is at a maximum each time the reference or a.c. line voltage passes through zero. The build-up and decay of the ramp are determined, as we shall see, by other elements in the circuit.

Inverter B operates whenever the ramp voltage drops below 0.6 volt. Above 0.6 volt, the inverter holds the triac in the nonconducting state and below 0.6 volt, the triac is conducting. In this way, the triac gate is either clamped to ground or to a positive voltage so that the possibility of gate interactions is eliminated. Inverter B also isolates the loading effect of the triac from the ramp generator.

The triac acts as a series switch between the supply and the load, automatically turning off when the a.c. line passes through zero. Once it is off, the triac stays off until the ramp voltage drops below 0.6 and the inverter supplies a gate signal. The decay time of the ramp voltage is determined by the size of the input control voltage E_{in} and the resultant input current. The higher the input, the faster the ramp decays and the sooner the triac turns on during each cycle. Thus more power is supplied to the load and the light is brighter.

The ramp generator is reset each time the supply goes through zero by a synchronizing signal provided by transformer *T1* and gate expander *C*. Each time the supply passes through



zero, a 0.5-millisecond positive pulse drives expander D to recharge capacitor *C1* and return the ramp to its initial positive value. Only one synchronizer circuit is required for 5 or less channels.

Background control is obtained by applying a constant d.c. level in parallel with the input through potentiometer *R1*.

Strobe or on-off operation of the Psychedelia 1 can be obtained by decreasing the background control to a minimum. This produces an abrupt switching action. The switching action can be made even faster by eliminating capacitor *C1*.

tentiometers permit the user to preset the "off" level of the display lamps.

The schematic of the PCU is shown in Fig. 1. The unit is assembled on a fiberglass PC board using the foil pattern shown actual-size in Fig. 2. Once the board has been made or purchased, mount the components as shown in Fig. 3. Observe the notch, dot, and lead code on the semiconductors and polarity markings on the electrolytic capacitors. The case lead (*T2*) on each triac may be cut short since the *T2* connection is made when the heat sink is soldered in place on the board. The triacs come with an integral heat sink and require no insulation from the board. Install quick-disconnect male terminals at the triac outputs, which are marked **A, B,** and **C** beside each heat sink.

Quality Filter Unit (QFU). This circuit takes a relatively low-level audio input, divides it into three isolated frequency bands, and provides three proportional control voltages for the PCU. The QFU is considerably more complex than most color organ filters, but it gives the finest filtering ever offered for a lighting display. Usual filter problems involving display washout, multiple-channel tracking, input loading, distortion, requirements for high input levels, nonlinearity and limited dynamic range have been eliminated.

Among the unique features of the QFU are active filters with very steep slopes and narrow guard bands between channels, and the use of an averaging detector.

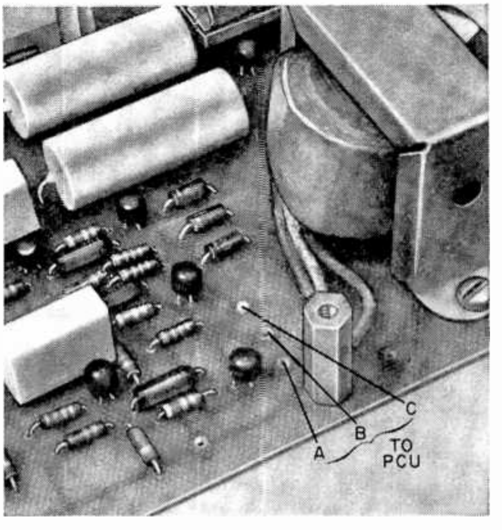
An averaging detector responds to the average value of a signal for a few milliseconds instead of instantaneous peak values. This makes the display less susceptible to radical input variations and eliminates threshold nonlinearity.

The filters are a combination of transistors and passive components called a "two-pole Tschebyscheff." They would require two high-Q, load-isolated inductors per channel if conventional parts were used.

Guard bands are "holes" between the filter responses. These no-response areas between the channels eliminate multiple-channel tracking on a single loud passage or a dominant instrument. Because of the high harmonic content of most music, the guard bands lose very little of the music. Usually there is *too much* "information" in most music for a psychedelic light display to handle. If a little of the music information is thrown away, the display action is much livelier and is without washout or multiple tracking.

Since transistors are used for the filters in the QFU, they also provide gain. The result is excellent sensitivity, no noticeable loading of the input circuit, and no noticeable distortion since the input impedance is resistive at all frequencies of interest.

Resistor *R44* (see Fig. 4) provides input protection and also serves as a sensitivity adjustment. For normal audio listening levels with a 5- to 20-watt amplifier, use the 47-ohm resistor specified. For lower power levels, *R44* can be reduced to 12 ohms, 1 watt. For high-power systems, increase *R44* to at least 100 ohms, 10 watts. The resistor should be the largest ohmic value that still gives acceptable sensitivity to minimum-volume passages.



Holes marked A, B, and C on QFU provide outputs to PCU. The single spacer shown here is one of four used to attach PCU and QFU boards together.

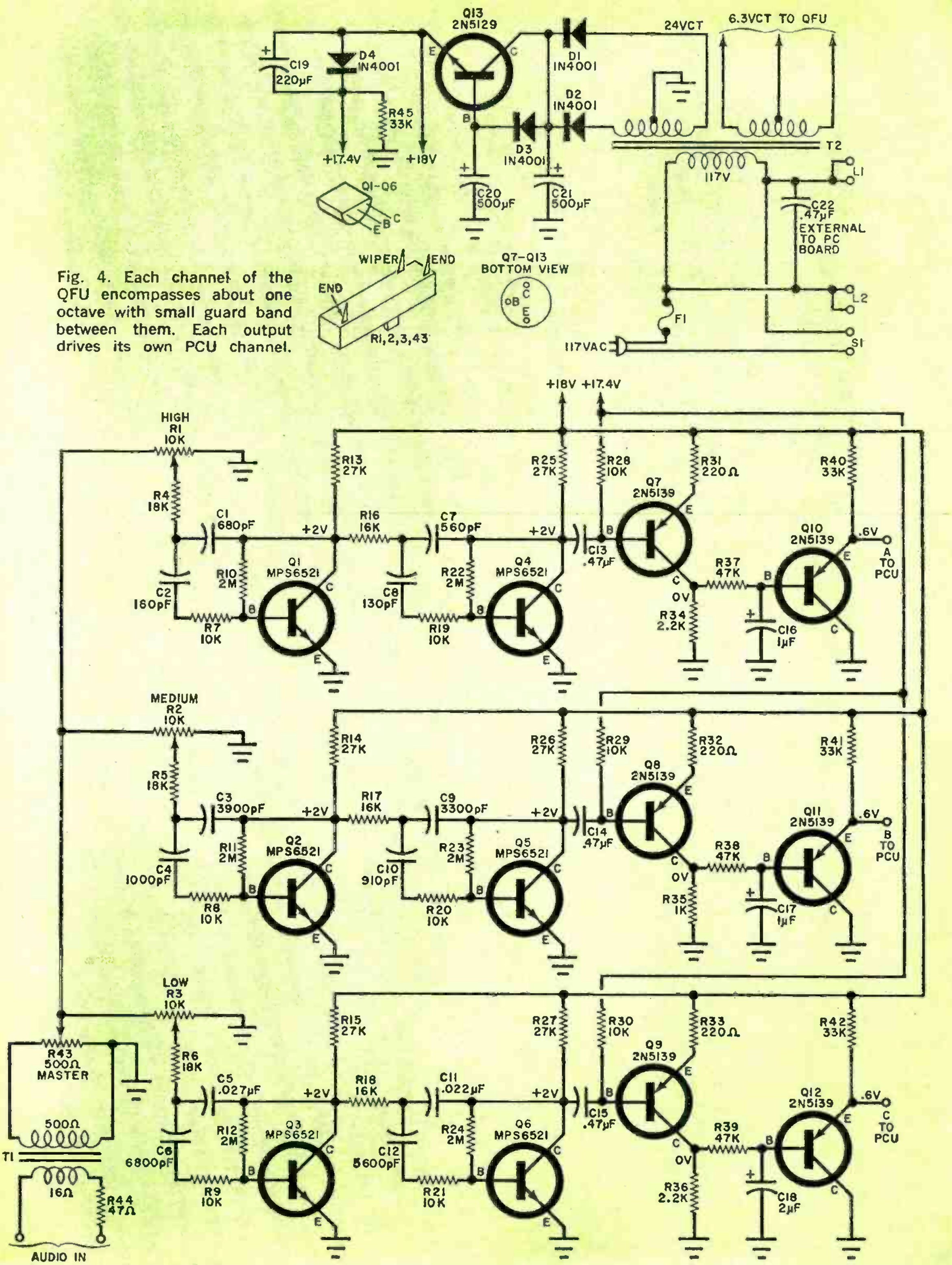
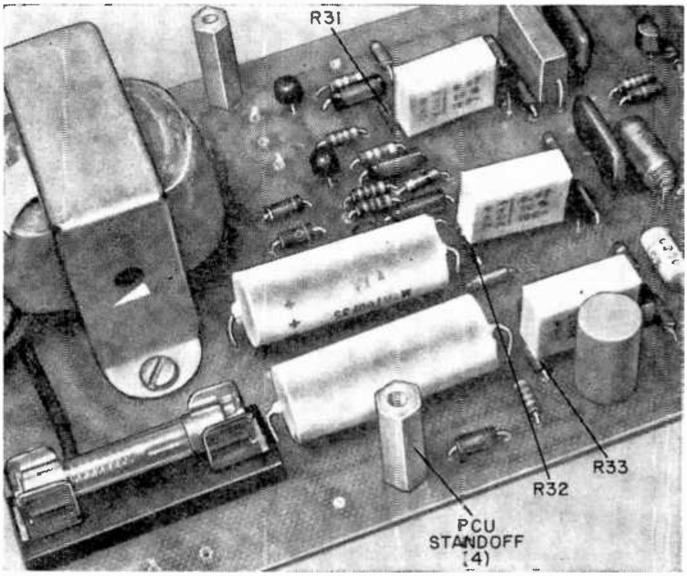


Fig. 4. Each channel of the QFU encompasses about one octave with small guard band between them. Each output drives its own PCU channel.

PARTS LIST
QUALITY FILTER UNIT (QFU)

C1—680-pF, 5% mica or polystyrene capacitor
C2—160-pF, 5% mica or Mylar capacitor
C3—3900-pF, 5% Mylar or polystyrene capacitor
C4—1000-pF, 5% Mylar or polystyrene capacitor
C5—0.027-μF, 5% Mylar or polystyrene capacitor
C6—6800-pF, 5% Mylar or polystyrene capacitor
C7—560-pF, 5% Mylar or polystyrene capacitor
C8—130-pF, 5% Mylar or polystyrene capacitor
C9—3300-pF, 5% Mylar or polystyrene capacitor
C10—910-pF, 5% mica or polystyrene capacitor
C11—0.022-μF, 5% Mylar or polystyrene capacitor
C12—5600-pF, 5% Mylar or polystyrene capacitor
C13-C15—0.47-μF Mylar capacitor (do not substitute an electrolytic)
C16,C17—1-μF, 6-volt tantalum or electrolytic capacitor
C18—2-μF, 6-volt tantalum or electrolytic capacitor
C19—220-μF, 6-volt electrolytic capacitor
C20,C21—500-μF, 20-volt electrolytic capacitor
C22—.47-μF, 600-volt high-quality Mylar capacitor
D1-D4—1-ampere, 50-PIV silicon power diode (1N4001 or similar)
F1—Fuse to suit load, clip mounted to board
Q1-Q6—Transistor (Motorola MPS6521, no substitute)
Q7-Q12—Transistor (National 2N5130)
Q13—Transistor (National 2N5129)
R1-R3—10,000-ohm, color-coded slide potentiometer, one each red, blue, and green (Southwest Technical #S-10K-R, S-10K-B and S-10K-G or similar rotary equivalent or stackpole slide-trol)
R4-R6—18,000-ohm, 5%
R7-R9,R19-R21—10,000-ohm, 5%
R10-R12,R22-R24—2-megohm
R13-R15,R25-R27—27,000-ohm
R16-R18—16,000-ohm
R28-R30—10,000-ohm
R31-R33—220-ohm
R34,R36—2200-ohm
R35—1000-ohm
R37-R39—47,000-ohm
R40-R42,R45—33,000-ohm
(All resistors ¼-watt)
R43—500-ohm, white-coded slide potentiometer (Southwest Technical S-500-W or similar rotary equivalent or stackpole slide-trol)
R44—47-ohm, 2-watt resistor
S1—S.p.s.t. switch
T1—Input transformer: 8- or 16-ohm primary, 500-ohm secondary, 5 watts, 500-volt winding-to-winding insulation. (Knight 54F1423, Southwest Technical PSY-T1 or similar)
T2—Power transformer: secondaries, 24 VCT at 100 mA and 6.3 VCT at 100 mA (Southwest Technical PSY-T2 or two separate filament transformers such as Knight 54F1416 (6.3 VCT) and 54F710 (24 VCT) or similar)
Misc.—Fuse mount; male quick-disconnect terminals (15); transformer rivets or hardware; mounting hardware; spacers for PCU; clamp for C22; solder; etc.
Note—The following are available from Southwest Technical Products, Box 16297, San Antonio, Texas 78216: etched and drilled PC board, #502, $5.50; complete kit of all parts, #502-K, $29.50; postpaid in U.S.A. Individual parts and assembled and tested units are also available.



The three resistors called out here cannot be seen in the top view as they are hidden by the three capacitors. Also shown are two of the four spacers that join the PCU to the QFU.

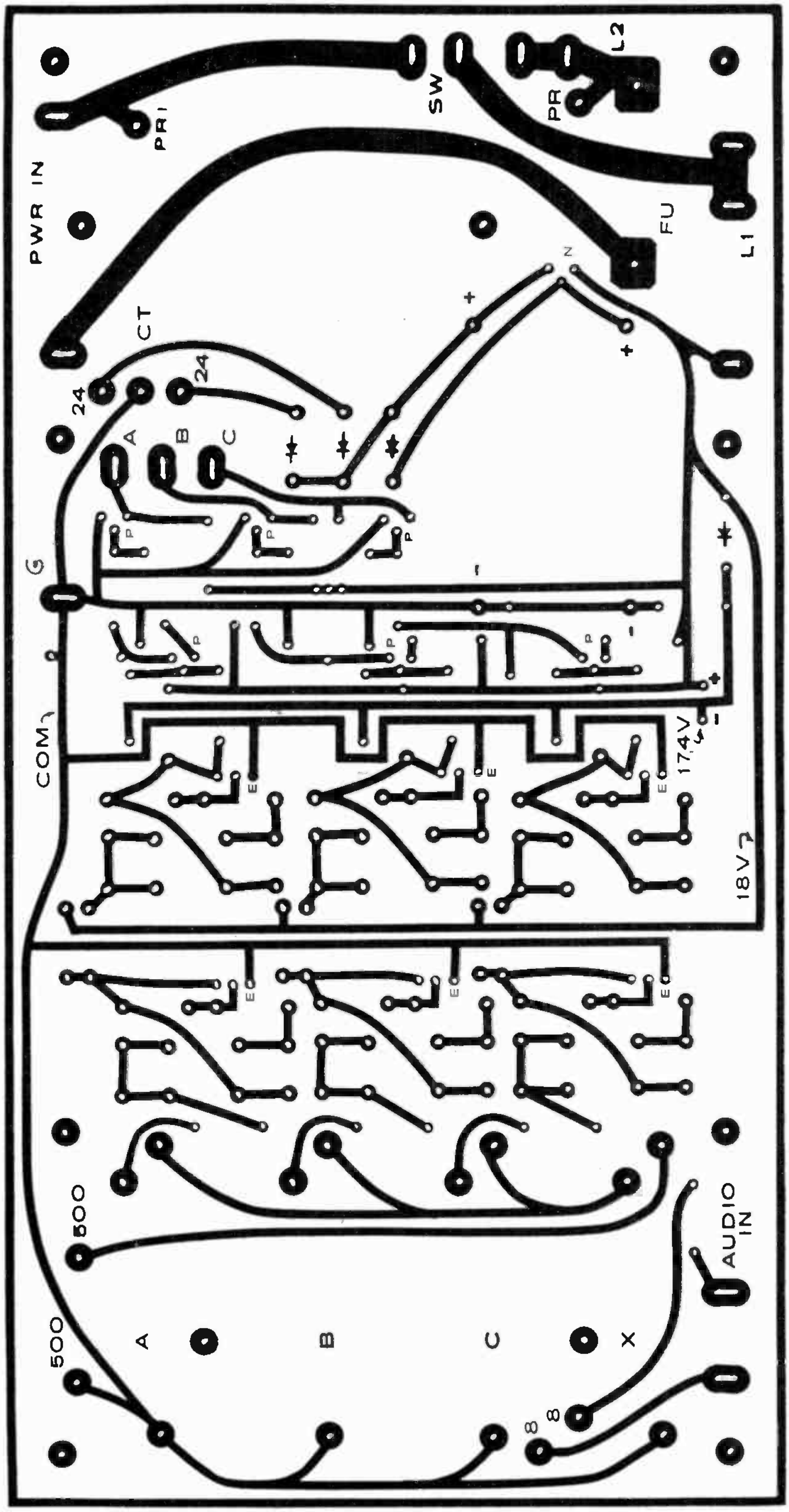


Fig. 5. You can copy this actual-size foil pattern for the QFU PC board or buy the board readymade.

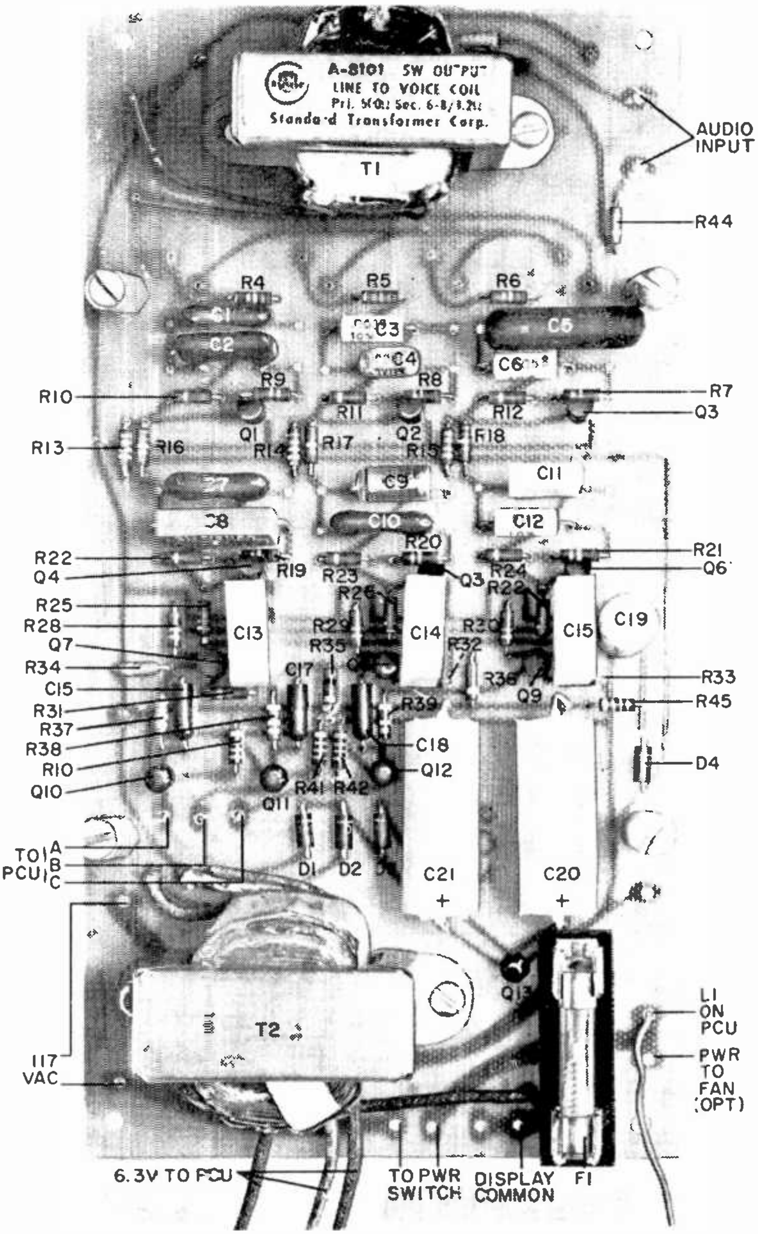
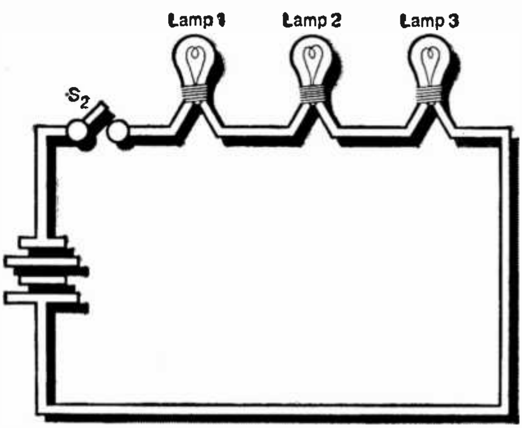


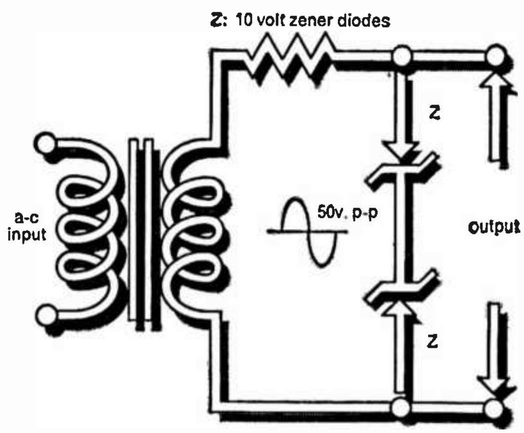
Fig. 6. Component installation on QFU PC board. Also shown are connections made to the board.

Construction of the QFU. The schematic of the QFU is shown in Fig. 4 and an actual-size foil pattern for the PC board is in Fig. 5. Components are installed on both sides of the PC board. The units on the foil side are shown in Fig. 6. Install the four slide potentiometers with the blue at *R1*, green at *R2*, red at *R3*, and white at *R43*. The components on the other side of the board are shown in Fig. 7. Transformers *T1* and *T2* are pop-riveted or bolted in place on the component side of the board. Except for the three leads to the 6.3-volt winding of *T2*, all transformer leads terminate on the *PC* board.

Do not be disturbed by what appear to be extra holes near the active filter capacitors. These holes permit the use of capacitors of different physical sizes at each stage. Use the holes that fit the capacitors you have. If you alter the PC

Can you solve these two basic problems in electronics?





This one is relatively simple:

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

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

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

This one's a little more difficult:

What is the output voltage (p–p)?

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

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

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

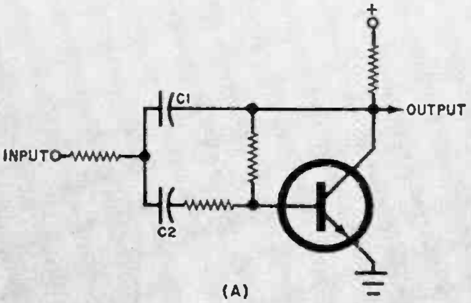
HOW IT WORKS
QUALITY FILTER UNIT

The heart of the QFU is an active filter with the basic configuration shown in the schematic. The transistor must have a very high gain for best operation. This circuit produces a single resonant peak such as that shown at B. Two of the filter stages are cascaded for each channel and the responses are slightly staggered to produce a steep-skirted, flat-topped, octave-wide response such as that at C.

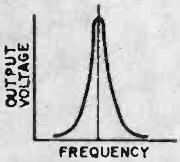
The values of capacitors *C1* and*C2* determine both the Q of the circuit and the center frequency. The capacitors used in the Psychedelia 1 were selected to produce the response shown at D. To experiment or add more channels, divide each capacitor value by the ratio of old to new center frequencies. For example, the low channel shown covers 50 to 100 Hz. To change it to cover 100 to 200 Hz, each capacitor value would be divided by 2. Do not change the ratios between capacitor values or the Q and bandpass values will be changed.

The output of each cascaded filter is applied to a detector transistor biased so that it is almost, but not quite, conducting. A negative-going audio signal turns the detector on, and vice versa. This type of detector produces some gain with a very low threshold offset. The detected signal is smoothed by an RC filter and coupled to the PCU through an emitter follower. The medium-frequency channel detector has half the gain of the others (*R35* is lower in value than either *R34* or *R36*). This compensates for the greater amount of medium frequencies than either high or low in most music.

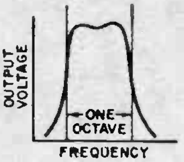
D.c. supply is obtained from a regulated supply powered by transformer *T2*. Dynamic regulator *Q13* insures excellent low-frequency bypassing. Transformer *T2* also provides 6.3 volts, center-tapped for the PCU. To prevent coupling hum in the low channel, *T1* and *T2* must be located at least 5½" apart.



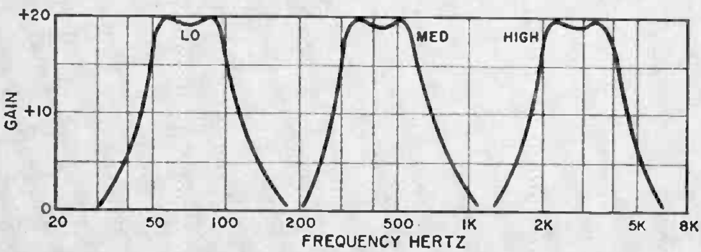
(A)



(B)



(C)

(D)


board layout, be sure that *T1* and *T2* are at least 5½" apart and that *T1* is at least 10" away from any other source of a.c. hum (motors, power transformers, etc.). Do not substitute for transistors *Q1* through *Q6* and use only polystyrene, Mylar, or mica capacitors for the filter elements. Above all, do not delete *T1* since it provides power-line isolation as well as impedance matching for the audio input.

Capacitor *C22* is a noise reducing filter and can be mounted wherever convenient off the PC board. It must be a high-quality, 600-volt Mylar type.

Assembly. The PCU board can be mounted directly above the QFU board to form a control console. Use 1" spacers at each of the four corners of the PCU and mount the PCU on the four holes of the larger QFU board as shown in Fig. 8. Note how the two boards are aligned—component side of the QFU facing the foil side of the PCU with the triacs adjacent to *T1*. Short spacers can be used to mount the combined board on the front panel of the console you select. Only the four level potentiometers are exposed.

Make the board-to-board connections as shown in Fig. 9. For testing, connect three 25- to 40-watt lamps to the system as shown in Fig. 9. These are not the lamps used in the final display. They are for testing only.

Caution is advised from here on since portions of the PCU are referenced to ground and severe shock can be experienced if you touch certain leads.

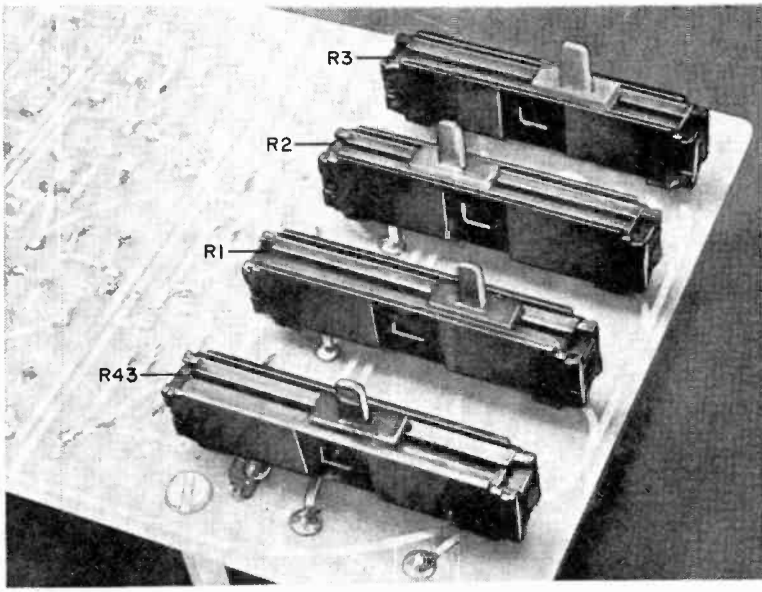


Fig. 7. The three color-level and the master-level slide potentiometers are mounted on the foil side of the QFU PC board.

With the primary a.c. power turned on but no audio applied, the three lamps may or may not glow. Adjustment of the three background controls on the bottom of the PCU (*R9*, *R10*, and *R11*) should cause the respective lamps to vary in brightness from out to almost fully lit. Set the three controls so that the lamps barely glow.

With the audio input coupled to the speaker leads of a radio or other power amplifier, turn up the volume to the source. Slide control *R43* is the master gain control and can be set at about ¾ of the way up. Adjustment of each of the channel slide potentiometers will cause the respective lights to glow in proportion to the amount of power in that frequency range. Each control must be checked for smooth operation.

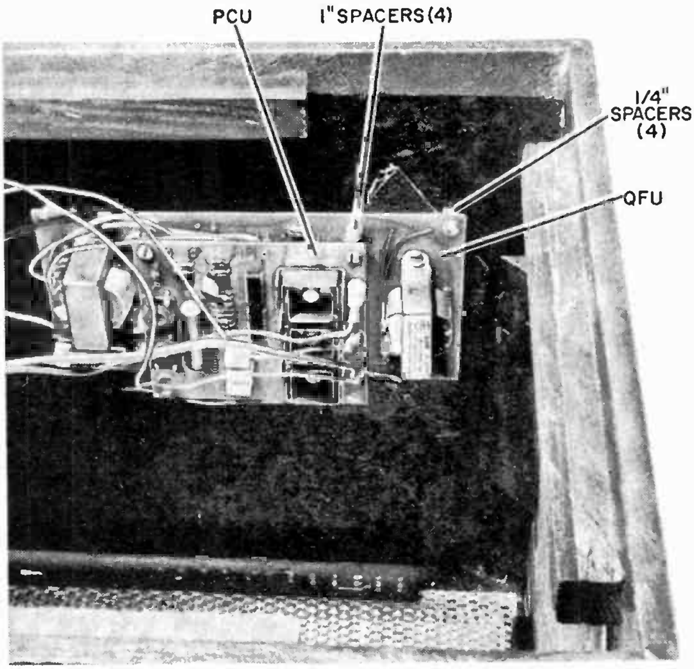


Fig. 8. Four 1" spacers are used to assemble the PCU and QFU boards together. Then use smaller spacers to mount the two of them on the top of the cabinet with the four sliders accessible through a cut slot.

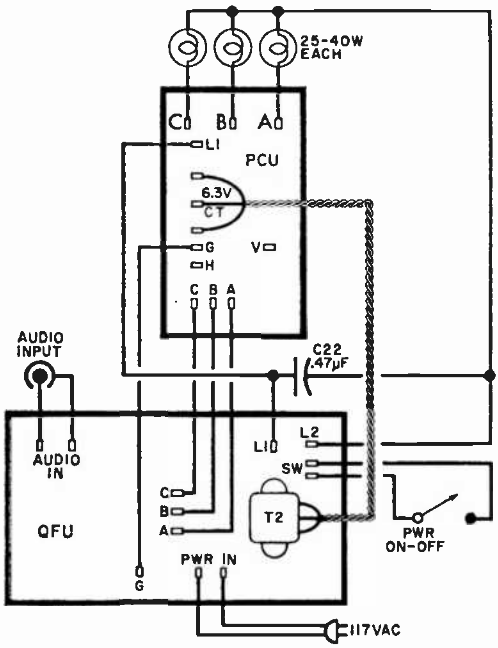


Fig. 9. Interconnection of the complete system. Capacitor C22 is added to reduce switching noise in a radio if that is the source of the signal.

If noise is created in the audio system, install capacitor *C22* as shown in Fig. 9. Some localized interference may be heard on the AM broadcast band, particularly if long display cables are used.

Holographic Bookshelf Display (HBD). A suggested display unit for the Psychedelia 1 is shown in the photos. It is 15″ × 16″ × 24″ with a durable vinyl covering and an attractive holographic imaging system. The HBD can be built as an integral unit with internal QFU and PCU units or it can be built separately for remote control. A maximum of four HBD's can be powered by one QFU/PCU combination.

Keys to successful display in the HBD are the holographic imaging panel and the lamp placement. The imaging panel is a rigid transparent plastic sheet with hexagonal lenses made up of individual wedge-shaped elements. If you look at a single colored lamp through the panel you see a six-petaled flower. The bulb diameter and the spacing of the bulb from the plastic sheet govern the size, shape, and petal details of the flowers.

Constructing the Display. The imaging panel is a light diffuser for fluorescent lighting usually suspended from the ceiling ("T-Bar" or "Grid Lume"). You can buy it at your local hardware or building supplier in an 18″ × 24″ sheet.

The HBD case is a box made of 4 particle board panels ½″ thick. You can buy the panels already prepared as mentioned in the Parts List or you can buy the material and have it cut (or cut it yourself) according to the details given in Fig. 10. Cleats are added to the panels to strengthen the corners and provide a means of attaching the rear panel. The panels are assembled around the imaging panel using nails and glue.

The interior of the cabinet may be painted all flat black, black on the sides and white on the rear panel, or all gloss white. A solid black background accentuates the flower pattern produced by the lamps; while a completely white interior increases the overall brightness and mutes the flower pattern. Painting the rear panel gloss white increases the light output slightly but does not mute or blend the patterns. The cover photo was taken with a white interior.

SIX- OR TWELVE-CHANNEL OPERATION. You can operate the six lamps in the Psychedelia 1 individually by using two PCU units and two QFU's. However, the capacitors in the QFU must be changed to the values given below.

	QFU #1	QFU #2
C1	1200 pF	470 pF
C2	270 pF	110 pF
C3	5600 pF	2200 pF
C4	1500 pF	620 pF
C5	0.047 µF	0.015 µF
C6	0.012 µF	4200 pF
C7	910 pF	390 pF
C8	220 pF	62 pF
C9	4700 pF	2000 pF
C10	1300 pF	560 pF
C11	0.039µF	0.012 µF
C12	0.01 µF	3300 pF

All capacitors are 5% mica, Mylar or polystyrene types.

You can use only one bulb per channel in one display unit or you can use two units side-by-side with three channels in each. For a super-duper 12-channel stereo display, use 4 PCU's and 4 QFU's.

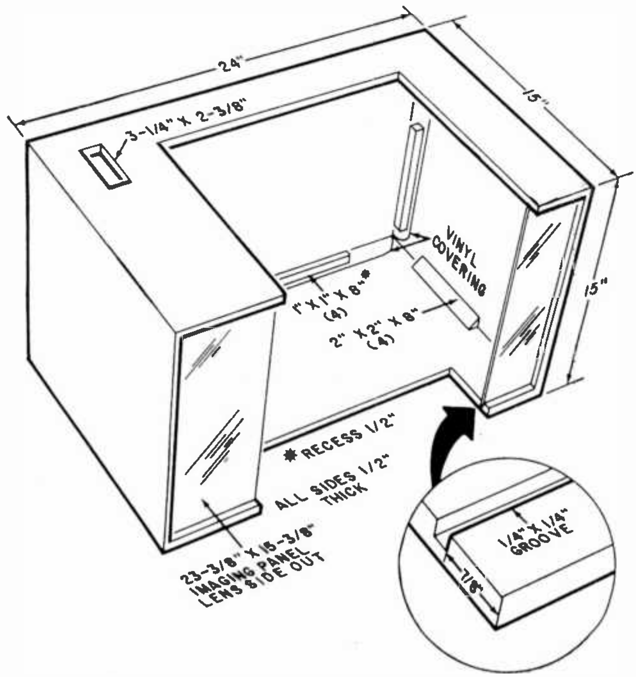


Fig. 10. General construction details of a display cabinet. Any other dimensions can be used. The controls are accessible through a small cutout in the top of the cabinet. Display can be viewed either horizontally or vertically.

If a built-in PCU and QFU are used, a suitable access hole should be added to one side. The rear panel supports the lamps and optional fan, and is shown in photos. The five 2″ × 3″ posts on the inside of the rear panel range in height from ¾″ to 8½″. They support the sockets for the lamps and should be spaced in a random manner to give the most pleasing pattern.

The Edison lamp sockets are mounted with wood screws on the posts with a sixth socket attached to the rear panel itself. The higher wattage bulbs go to the rear. The prototype uses 7½- and 25-watt red bulbs for the low frequencies, two 25-watt green bulbs for the medium frequencies, and 7½- and 40-watt blue bulbs for the highs. You can experiment to obtain what you think are the most dramatic effects.

Wiring. Using 16- or 18-gauge wire, parallel the two similarly colored lamps for each channel. Connect one side of each pair to each other and then to ter-

CABINET BILL OF MATERIALS

Lumber
2—24″ x 15″ pieces of ½″ particle board
2—15″ x 15″ pieces of ½″ particle board
1—22⅞″ x 14⅞″ piece of ½″ particle board
4—2″ x 2″ x 8″ triangular pine molding
4—1″ x 1″ x 8″ pine
1—4″ x 3″ x ¾″ pine
1—¾″, 1—3½″, 1—4½″, 1—7½″, 1—8½″ — 3″ x 2″ pine

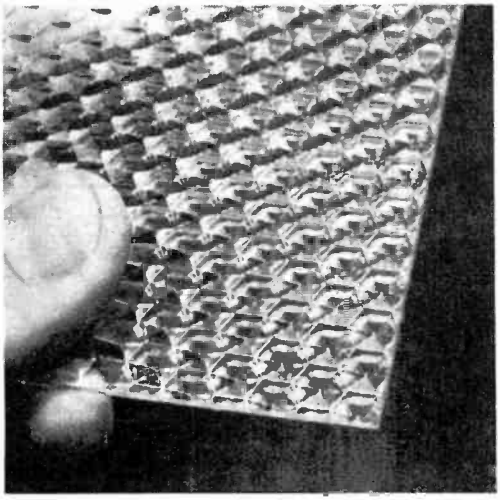
Electrical
6—Edison cleat sockets for 117-volt lamps
2—40-watt, 117-volt lamps, one red, one blue
2—25-watt, 117-volt lamps, both green
2—7½-watt, 117-volt lamps, one red, one blue
1—Cooling fan, whisper type, 55 CFM (optional)
1—6-pin female chassis mounting socket, polarized (Cinch-Jones S-306-AB or similar)
1—6-pin male plug, polarized (Cinch-Jones P-306-AB or similar)
3—Quick disconnect female terminals

Integral Master Unit
1—Line cord and strain relief
1—Phono jack
1—Rocker switch (6 amperes, 117-volts)

Slave Unit
1—6-pin female chassis mounting socket, polarized (Cinch-Jones S-306-AB or similar)

Misc.—23⅜″ x 15⅜″ panel of "T-Bar" or "Grid Lume" (for imaging panel); cloth-back upholstery vinyl 21″ x 84″; vinyl glue; wood glue; nails; no-skid feet (4); paint; wood screws.

Note—An assembled cabinet, less lamps and not wired, is available from Southwest Technical Products, Box 16297, San Antonio, Texas 78216 for $26.50. Item is shipped express or truck, collect only. Specify type of shipment desired.

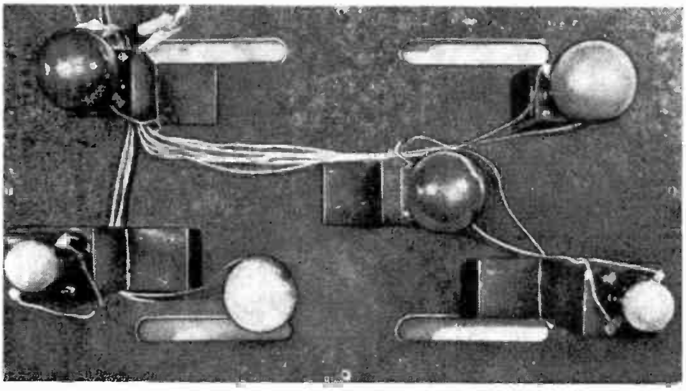


The imaging panel is made up of hexagonal lenses that make each lamp appear as a flower.

minate *L2* on the QFU board. Connect the other sides of the pairs to female quick-disconnect terminals to mate with the male terminals at **A**, **B**, and **C** on the PCU board.

The colors that you put on the respective channels is up to you. Once the system is operating, you can change the colors by switching the quick-disconnect terminals around. Be sure that primary power is turned off before touching these terminals. The system doesn't require any warm-up time, so there is no need to rush.

Connect a suitable length of shielded audio cable between the input bracket audio jack and the QFU board. Connect capacitor *C22* (Fig. 9) between the *L1* and *L2* terminals of the QFU boards to reduce switching noise.



The lamps are arranged in any random pattern around the rear panel. Secure wiring to hold it in place and avoid shorts.

Three different lamp heights are used as shown here. The stands are made from wood.

Final Assembly. When the wiring is completed and checked, mount the electronics assembly to the cutout on the inside of the display cabinet so that the slide potentiometers are accessible from the outside. Use spacers at the four holes on the corners of the QFU board to support the assembly. The power on-off switch can be mounted anywhere that is convenient.

Connect the audio input cable and turn on the power. Set the amplifier to a reasonable listening level. (Make sure that *R44* has been selected to match the audio system as explained previously.) The white slide potentiometer controls the master level, while the three colored slide potentiometers can be adjusted to obtain the desired interplay of colors. The display is best viewed directly from the front. The cabinet can be mounted either horizontally or vertically. —30—

MINI-SIX ADD-ON

Try new dispersion technique for better stereo

BY DAVID B. WEEMS

SINCE high fidelity first came on the scene, some critical listeners have complained that most music systems produce sound that appears to come through a hole in the wall. The advent of stereo gave us two openings for music and added the phrase "hole in the middle" to the hi-fi vocabulary.

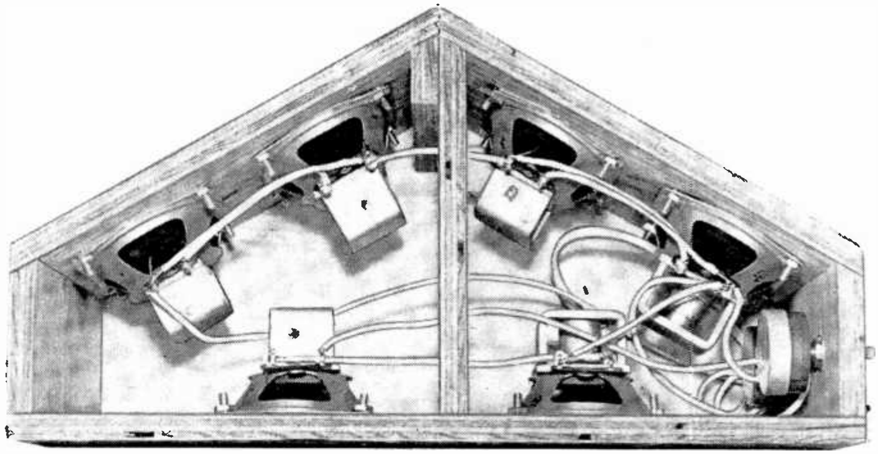
As good as they are, loudspeakers still sound more like loudspeakers than musical instruments. One reason for this is that the sound reaching the listener at a live performance is rich in both direct and reflected sound waves. But in the optimum listening position for most stereo systems, the predominant effect is produced by direct sound waves.

The directivity of loudspeakers gives a satisfactory left-to-right perspective in locating individual voices or musical instruments. However, there is a tendency to aim the sound in only one direction—particularly the high frequencies—often in stereo compressing the sources into two separate "points."

Dealing With The Problem. Several approaches have been tried to eliminate the "point source." Some of the earlier ones were: adding a center channel to stereo systems; removing the back of the speaker enclosure to gain reflections

The Author

While Dave Weems was getting his Bachelor of Science degree at the University of California at Los Angeles, he worked as research assistant in a physics laboratory which was next door to an acoustics lab. That was when he started building amplifiers and speaker systems. He has taught mathematics, physics, and chemistry and is now a free-lance consultant and writer on the design of speaker systems.



Four speakers (top) are mounted on angled baffles facing back. The other two speakers face the front. Individual L-pad controls for two sets of speakers are mounted on side.

from the rear; using speaker columns to produce a line source for wider horizontal distributions and reflections; and developing nondirectional tweeters.

A new approach, described by some enthusiasts as "revolutionary" is offered by the Bose Model 901 speaker system. This system contains nine 4″ loud speakers—eight of them located on baffles that are mounted on angles at the rear of the small enclosure. A single speaker faces forward. The purpose of this rather unorthodox arrangement is to produce 89% reflected and 11% direct sound waves. The Bose Corporation claims that this is the optimum ratio for the reproduction of recorded sound.

Each of the nine speakers in the Bose system handles the full range of frequencies without crossover networks. A solid-state "active equalizer" is used to tailor the response to that preferred by the listener as well as to compensate for the inherent base rolloff caused by the small enclosure.

Even if you are a critical listener, you will notice that the "character" of the sound produced by the Bose system does not change as much as you might expect it to as you move about the listening room. And the feeling of spaciousness adds a depth of sound not evident with conventional speaker systems.

A minor drawback of this unique speaker system is the necessity of locating the Model 901 about 12″ away from the wall to obtain the proper reflection pattern. There is also the question of the reflecting surface itself. If it is smooth you can confidently expect the reflected sound content to approach the optimum of 89% . But a rough surface or the presence of even a small amount of drapery or other sound absorbing material could alter this ratio. The exact percentage of reflected sound might not be critical, but listening rooms present a wide variety of acoustical environments.

Taking the above into consideration, it is desirable to provide a means for varying the direct/reflected sound ratio produced by the speaker system. This would allow the listener to optimize the ratio to his particular listening room and personal tastes.

The "Mini-Six," the add-on speaker system described here, is designed to be adjusted to the environment. Utilizing the reflected sound principle employed in the Bose 901, it permits the listener to vary the ratio of direct/indirect sound to match his room acoustics.

The Mini-Six, unlike the Bose system, is not a full-range speaker system; rather, it is an add-on for existing hi-fi speaker systems, the latter being used only to reproduce the bass range. This strategem minimizes material cost and satisfies limited space requirements.

The add-on consists of 3″ × 5″ replacement-type 8-ohm oval speakers selling for about a dollar apiece. Each has a magnet weight of 1.47 ounces. Four of the speakers are mounted on angled boards facing the rear of the enclosure, and two face the front.

The rear speakers are connected in series-parallel to maintain a normal 8-ohm impedence, while the front speakers are wired in series to provide a 16-ohm impedence. The two sets of speakers are then wired in parallel to provide a total impedence between 5 and 6 ohms.

The front speakers would normally dissipate 33% of the power with this hookup. However, a 16-ohm L-pad controls the output to any desired level up to about 33% of the total sound.

While the low-frequency response of the replacement-type speakers is limited by their small size and high cone resonance (over 200 Hz), their performance in the high-frequency range is fairly good. When used as designed to reproduce the midrange and high-frequencies from 300 Hz up, the sound reproduction does not betray the low cost of the speakers.

A simple home-made crossover network permits you to utilize your present speaker system as a woofer. Because the crossover point is at 300 Hz, the position of the big speaker system is not critical. And the addition of an 8-ohm L-pad allows you to match the output of the Mini-Six to that of your woofer.

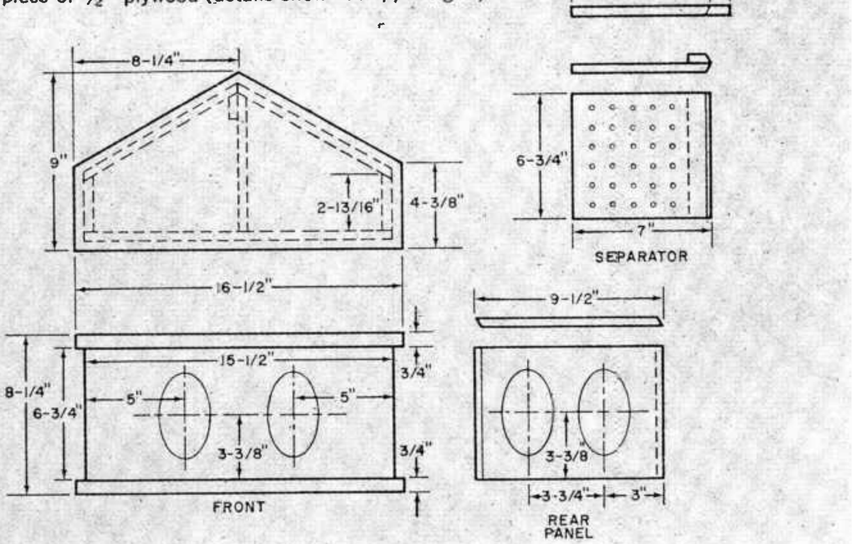
Construction. Although building the Mini-Six (Fig. 1) appears to be an exercise in making 60° miter cuts, construction is quite simple. A table saw or an adjustable portable rotary saw, set for 30°, will do the job easily. If you elect to use a sabre saw for the cutting operations, be very careful to keep the cuts straight and go very slowly. Always make a few practice passes at the cutting angle through some scrap ½"-thick plywood.

Now, referring to Fig. 1, prepare each of the eight major pieces that make up the enclosure according to the dimensions provided. The center panel that separates the two interior chambers of the enclosure (see drawing at upper right) should be cut from a 6¾" × 8" piece of ½" plywood. The excess strip (illustrated) can then be reversed and secured to the center panel with glue and screws, forming a double angled surface to accommodate the rear panels. Then drill about 30 ¼"-diameter holes on 1" center-to-center squares through the panel.

Rub chalk around the gasket of one speaker. Then firmly press the speaker onto a piece of heavy cardboard to obtain a pattern for the speaker cutouts. Cut the cardboard along the *inner* outline. Then punch a small hole through the center of the pattern.

Place the pattern over each of the

Fig. 1. Prepare compartment separator from single piece of ½" plywood (details shown at upper right.)



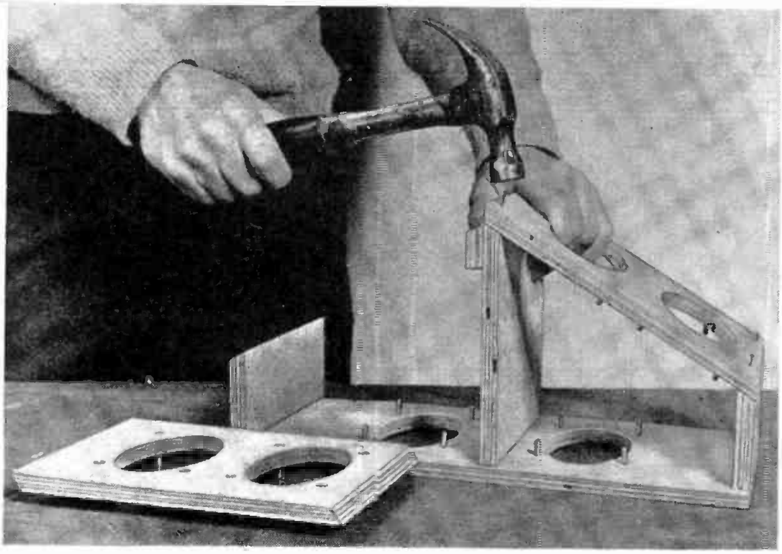


Fig. 2. Except for top plate, all parts should be joined using wood glue and finish nails.

speaker locations on the front and rear panels of the enclosure to make the outlines for the speaker cutouts. Then cut the outline holes. Set a speaker over each cutout and mark the positions of the speaker mounting holes. Now drill a 3/16" hole through the front and rear enclosure panels at each marked location. Mount the bolts, and check the speakers for proper fit.

Anchor the sides and center panel to the enclosure front plate with glue and screws. Then attach the rear panels with glue and finishing nails as shown in Fig. 2. Apply a coat or two of flat black paint to all exterior surfaces and the insides of the speaker cutouts. Allow the paint to dry.

Next, invert the enclosure shell onto the inverted top panel. Carefully center the shell; then mark the outline of the interior shell surfaces on the top panel (see Fig. 3). Again, carefully center the bottom panel over the enclosure shell, and glue and nail the bottom panel to the shell.

Prepare 3/4" × 3/4" pine cleats to fit the *inside* of the shell outline on the top panel at the front and rear, and glue and screw together as in Fig. 4. Locate and drill holes through the front and two rear panels to permit screws to be driven through the shell and into the cleats to hold down the top panel. Stain and finish the top and bottom panels.

The screw-type terminal strip mounts on the bottom of the enclosure, centered near the side on which you plan to install

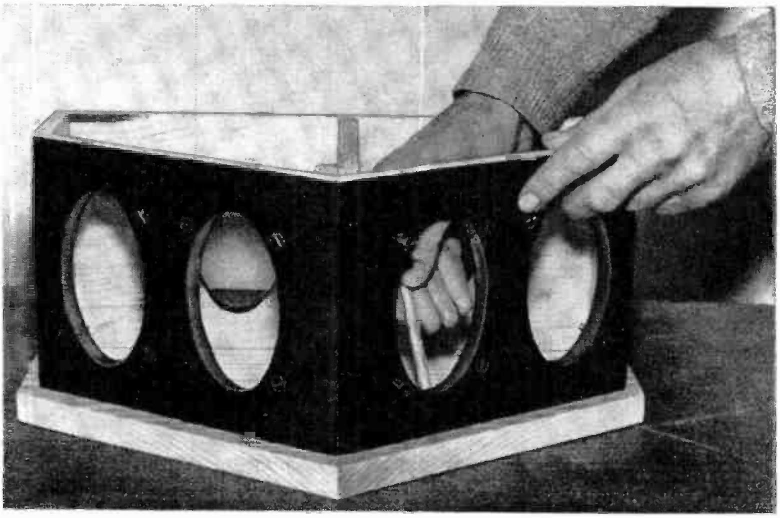


Fig. 3. To locate positions of top cleats, invert top plate, center enclosure shell on it, and strike pencil lines along edges of inner walls of shell.

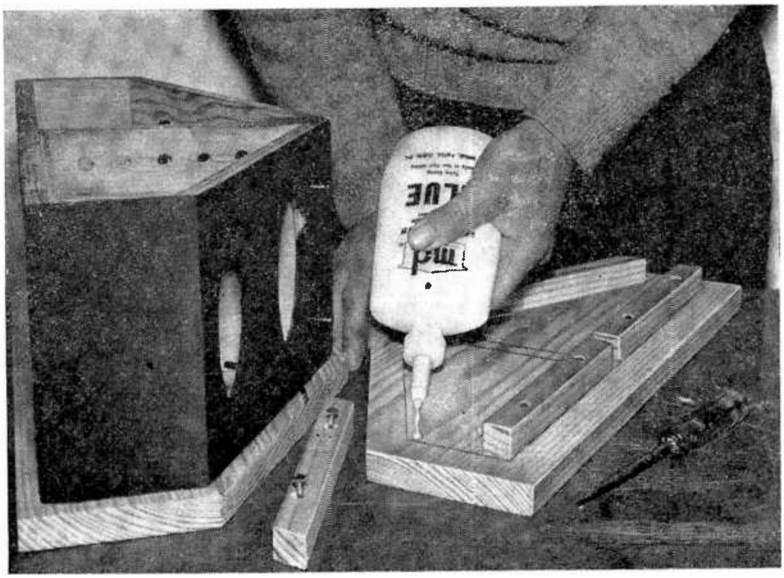


Fig. 4. Fasten cleats along only front and rear locator lines on top plate. Leave appropriate breaks in cleat to accommodate the chamber vertical separator.

the L-pads. First, drill two ¼″ holes through the enclosure bottom panel, removing enough wood to accommodate both the solder lugs and screw ends of the terminal strip. Next, solder one conductor of a 15″ length of zip cord to each solder lug on the terminal strip. Then mount the terminal strip on the outside surface of the bottom panel with glue and screws.

Invert the enclosure and attach to the bottom panel three rubber bumpers. These bumpers should be large enough to provide adequate clearance for the speaker wires and screw connections at the terminal strip when the Mini-Six is placed on a flat surface right side up.

Wiring and Testing. Set the LP8 L-pad down with the shaft pointing away from you and the solder lugs pointing downward. The lugs in this orientation are numbered 1, 2, and 3, left to right. (This same orientation and numbering procedure also applies to the LP-16 control.)

Solder a 10″ wire and one of the terminal strip conductors to lug 1; a 16″ and a 7″ wire to lug 2; and the remaining terminal strip conductor to lug 3.

Now place before you the LP16 control. Connect and solder a 5″ wire to lug 1 and an 11″ wire to lug 2.

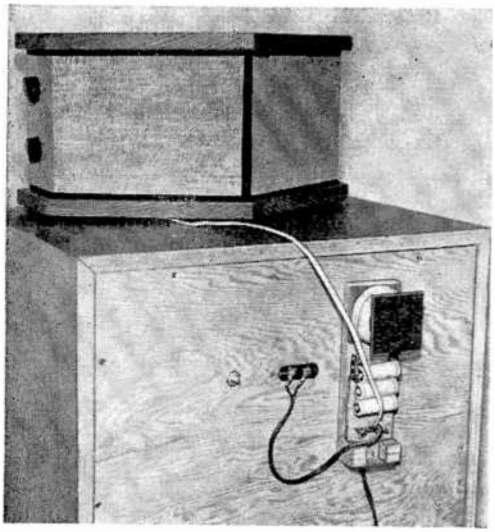
Drill the holes for and mount the two controls, locating the LP16 at the top. Connect and solder the loose end of the 7″ wire from lug 2 of the LP8 pad to lug 3 of the LP16 control. The remaining loose wire ends will be connected later, after the speakers are mounted inside the enclosure.

Carefully unpack the speakers and determine the voice coil polarity of each with a 1.5-volt battery. To determine the polarity, momentarily touch the contacts of the battery across each pair of speaker terminals, and observe the direction of cone movement at the moment of contact. If the cone moves outward, mark the terminal adjacent to the positive pole of the battery with a permanent identifying mark (red dot or scribed plus sign). Inward movement of the cone indicates that the terminal adjacent to the negative pole of the battery should be marked.

Now install the speakers on the front and rear mounting boards, pointing the solder terminals on the speakers toward the top of the enclosure. (If all speakers are the same brand name and model number, all identifying marks will likely be either on the left or the right, greatly simplifying wiring.) Note that you will have to remove the four mounting bolts nearest the chamber separator panel before mounting the speakers on the rear panels of the enclosure.

When you tighten the mounting hardware, do not apply excessive force or you will deform the speaker baskets.

Finish wiring the Mini-Six according to Fig. 5. After wiring is completed,



System crossover network mounts on rear of woofer enclosure; connecting wires are routed as desired.

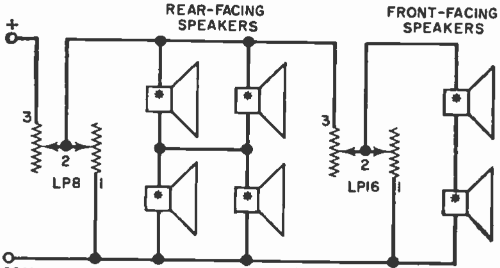


Fig. 5. Combination series-parallel hookup is used to obtain a system impedance between 4 and 8 ohms.

BILL OF MATERIALS

6—5" x 3" replacement-type 8-ohm speakers
1—8-ohm L-pad (Calrad LP8, or similar)
1—16-ohm L-pad (Calrad LP16, or similar)
1—100-µF nonpolarized capacitor (see text)
1—1-lb spool #18 magnet wire
1—Two-terminal screw-type terminal strip
1—15½" x 6¾" piece of ½" plywood for front panel
2—9½" x 6¾" pieces of ½" plywood, edges cut at 60° angle, for sides
2—6¾" x 2 13/16" pieces of ½" plywood, one edge cut at 60° angle, for compartment separator panel
1—6¾" x 1¼" piece of ½" plywood for separator panel (see text)
2—16½" x 9" pieces of ¾" clear pine shelving for top and bottom
1—36" length of ¾"-square pine for cleats
8—1¼" x #8 flathead wood screws to anchor cleats to top of enclosure
2 doz—1" x #8 flathead wood screws
2 doz—1" x 3/16" flathead stove bolts for speaker mounting
Misc.—Grille cloth; three-penny finishing nails; wood glue; nuts for stove bolts; wire; solder; etc.

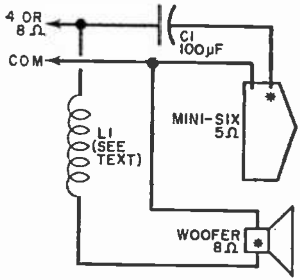
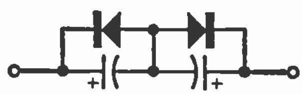


Fig. 6. Homemade crossover network must be connected between Mini-Six and woofer as shown.

DIODES "DE-POLARIZE" POLARIZED CAPACITORS

A low-cost method of obtaining the equivalent of a high-capacity non-polarized capacitor was recently suggested by Don Purland in a recent issue of "Electronic Design" magazine. As shown in the diagram, two polarized capacitors, each twice the desired value and connected back-to-back, cancel out the polarizing effect. But to prevent an undesirable reverse voltage appearing across either capacitor (even though each is "protected" by the other), connect a silicon diode in reverse polarity across each capacitor.



The capacitors in this arrangement will never "see" the reversed voltage since the diode shorts out the capacitor that is connected into the circuit backwards.

Although untested at this writing, the suggestion seemingly has great merit since it permits the use of cheaper capacitors of more common values.

check the polarity of the system by the same method used for the individual speakers, and identify the positive screw terminal with a permanent mark. Check that all cones move in a common direction.

Connect the Mini-Six to the 4- or 8-ohm output of your amplifier to check for "buzzes" and "rattles." A sweep-frequency test record is ideal here, but you can substitute a variety of music programs in a pinch. If you detect a buzz or rattle, locate the speaker causing it and loosen or tighten the mounting hardware until the problem clears up.

Now check the LP8 and LP16 controls

(*Continued on page* 117)

BY LYMAN E. GREENLEE

BUILD A

Blinky Blinker

EMERGENCY FLASHING LAMP FOR YOUR CAR

MOST ACCIDENTS are preventable, and the best way to prevent one is to display a warning signal whenever and wherever a hazardous condition exists. The best warning device you can use is the universally accepted flashing red emergency light which most people associate with the message: "Danger. Proceed with caution."

With the incidence of preventable accidents on the rise, it pays every motorist and home owner to have an emergency light. It could save his life some night when changing a tire at the side of the road or it could prevent a costly law suit when a sidewalk is broken or blocked. In fact, there are dozens of uses for the emergency light, including a few that are just utilitarian—such as guiding you back to your campsite at night or locating your car in a crowded parking lot.

The emergency lights available at auto supply and marine stores are generally very simple devices, consisting essentially of a battery, switch, and thermal flasher lamp in series. With such systems, battery life is short because the flasher lamp is almost constantly connected to the battery (off time of the lamp is very short). The "Blinky Blinker" emergency flasher light, on the other

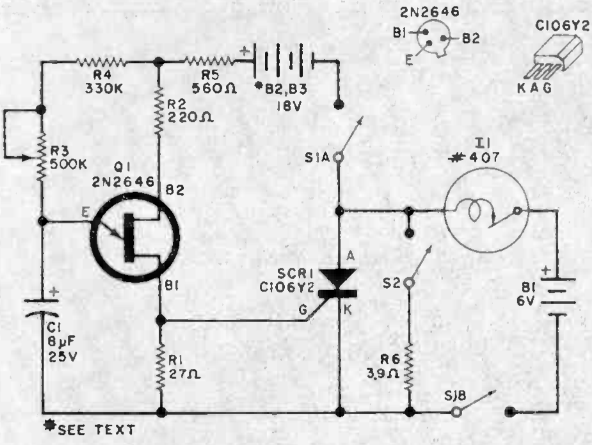


Fig. 1. The 18-volt source for Q1 circuit consists of two 9-volt transistor batteries connected in series. Power for I1 is supplied by independent long-life 6-volt lantern-type battery.

PARTS LIST

B1—6-volt lantern battery
B2, B3—9-volt transistor battery
C1—8-µF, 25-volt electrolytic capacitor
*I1—Flasher lamp (GE #407)**
*Q1—2N2646 unijunction transistor**
R1—27-ohm resistor
R2—220-ohm resistor
R4—330,000-ohm resistor
R5—560-ohm resistor
R6—3.9-ohm resistor
(*All resistor ½-watt*)
*R3—500,000-ohm potentiometer (Mallory #MTC-55L1)**
S1—D.p.s.t. slide or toggle switch
S2—S.p.s.t. slide or toggle switch
*SCR1—Silicon controlled rectifier (GE #C106Y2)**
1—5" X 4" X 3" aluminum utility box
Misc.—Red trailer clearance lamp assembly; lamp socket to fit #407 lamp; 2" X 2½" X 3/16" linen Bakelite or perforated phenolic board (or substitute printed circuit board—see text); "flea" clips (omit if PC board is used); rubber feet; ½" rubber grommet; 1"-wide X 22-gauge soft aluminum strip for battery holders; 9-volt battery clips; #6 hardware; ½" metal spacers (2); hookup wire; solder; etc.*
**These parts available postpaid for $3.50 from Lyman E. Greenlee, PO Box 1036, Anderson, Ind. 46015.*

hand, employs an electronic triggering/switching circuit that extends the off time of the lamp up to 12 seconds.

The extended off time of the lamp in the Blinky Blinker eliminates the costly objection of short battery life. In addition, the flasher has two repetition speeds—one variable between 6 and 12 seconds between flashes; the other flashing about once a second. Consequently battery life should average about 2000 hours on the slow flash and about 200 hours on the fast flash. Compare these figures to those you can expect from other emergency flasher lights, and you can readily see that the extended battery life more than makes up for the difference in cost.

How It Works. As shown in Fig 1, the circuit of the Blinky Blinker consists of a unijunction transistor oscillator (*Q1*) that drives a silicon-controlled-rectifier power switching stage (*SCR1*). Triggering *SCR1* into conduction applies independent power source *B1* across special flasher lamp *I1*.

With *S1* set to ON and *S2* set to FAST, the blinker circuit is contained within the series loop consisting of *R6*, *B1*, and *I1*. As soon as *S2* is closed (set to FAST), power from *B1* lights *I1*. Thereafter, *I1* flashes on and off at a rate determined by its built-in bimetallic strip. Resistor *R6* limits the current flowing through the series loop and drops the source voltage from 6 volts to the 4.9-volt level required for operation of *I1*.

Leaving *S1* in the ON position and moving *S2* to the SLOW position transfers control over the flash repetition rate

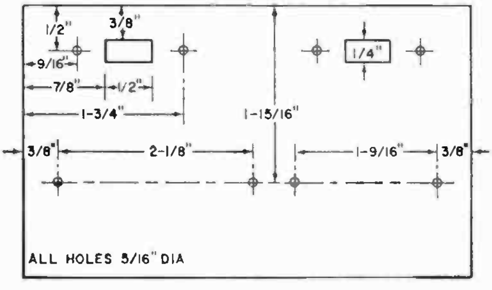


Fig. 2. Cutouts in front of box. If toggle switches are used, substitute round holes for rectangular.

to the *Q1* oscillator circuit. At the instant *S2* is switched to SLOW, the oscillator charging circuit is completed, allowing *C1* to charge up at a rate determined by the series resistances, *R3*, *R4*, and *R5*. At some point during the charge cycle, the voltage level across *C1* becomes great enough to cause *Q1* to fire, discharging the capacitor through the E-B1 junction of *Q1* and *R1* to the common negative buss.

The sudden firing and discharge action of the oscillator circuit produces a sharp pulse at the B1 terminal of the UJT. This pulse, coupled to the gate of *SCR1*, triggers the SCR into conduction, placing the power from *B1* across *I1* and lighting the lamp. From here, the bimetallic strip in the lamp takes over, opening the lamp circuit and interrupting the power through *SCR1*, preparing the circuit for a repeat cycle.

Meanwhile, as the lamp circuit is being operated, the charge cycle of the oscillator is repeating. The entire series—charge, discharge, SCR firing—repeats indefinitely as long as power is applied. With the component values given in Fig. 1 and specified in the Parts List, the SLOW repetition rate of the blink cycle can be varied between 6 and 12 seconds simply by changing the setting of *R3*. The on time of the lamp remains strictly a function of the characteristics of the lamp's bimetallic strip.

Construction. Begin fabricating the Blinky Blinker by modifying an ordinary trailer clearance lamp assembly as follows. First remove the lens and remove and discard the lamp that comes with the assembly. Then pry away the lamp socket with pliers, leaving only the base of the assembly shell.

Next, drill a ½" hole through the center of the base of the shell and through the center of the top of the utility box. Drill two more smaller holes through the base of the assembly shell, spacing them equidistant from—and on opposite sides of—the large center hole. Set the assembly base over the hole in the utility box, mark the locations of the smaller holes, and drill the same size holes through the box top at the marked positions.

Now mount the base of the shell in place, fastening it down with #6 hardware. Place a ½" rubber grommet in the center hole, and force a lamp socket (compatible with the base of the #407 flasher lamp) through the rubber grommet from the inside of the box. Screw in the new lamp and replace the lens.

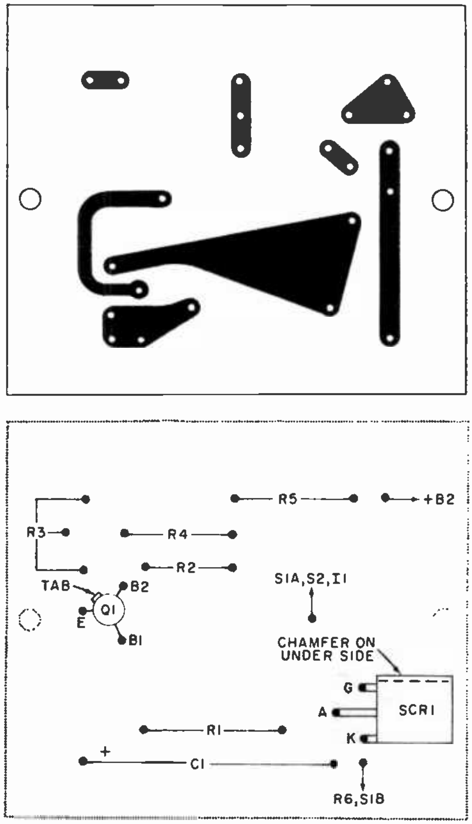
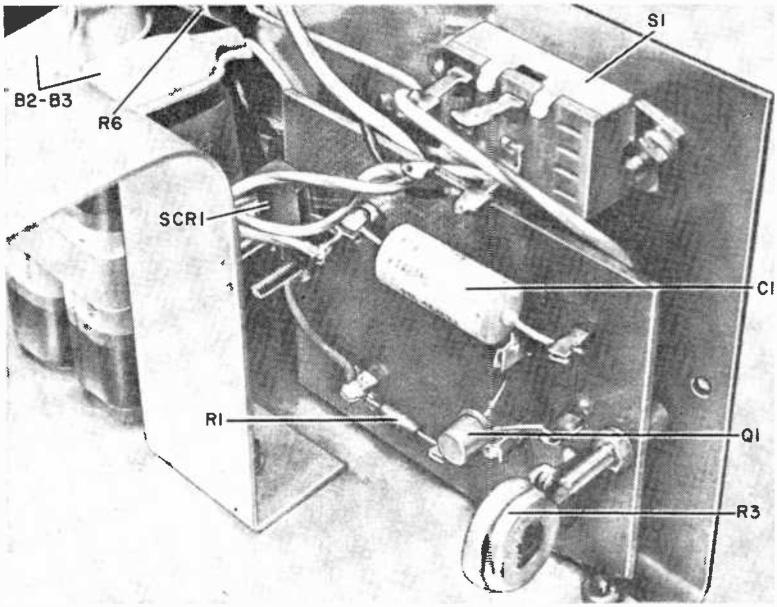


Fig. 3. Upper drawing is actual-size etching guide for PC board; lower drawing shows parts placement.

Referring to Fig. 2, machine the front of the utility box as shown. The rectangular switch cutouts and mounting holes are symmetrically located on each side near the top of the box half section. (Note: if you prefer, you can substitute toggle switches. In this event, only two holes are required, their centers spaced 1⅛" in from the sides and ½" down from the top.) Mount the switches in their respective holes.

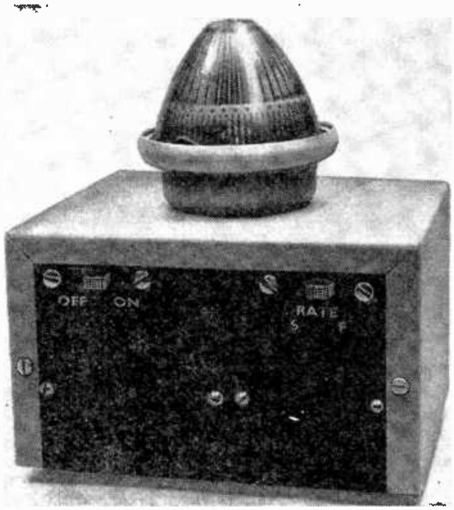
Component placement inside the utility box is not critical. Consequently, you can use any method of wiring that best suits your needs. If you plan to board-mount the components, an etching guide and component placement diagram are provided in Fig. 3. (The author cut to



Mount circuit board on utility box with 1/2"-long spacers. Metal U bracket (at the left) is for B1.

size and drilled a piece of linen Bakelite for his prototype, locating components on the top and bottom of the board. If you prefer this method, drill lead holes for the components in approximately the same locations shown for the PC board layout.)

Wire the components together as illustrated. Then double check the connections of *C1* for polarity and *Q1* and *SCR1* for proper orientation. The component layout diagram in Fig. 3 shows the proper orientation of the transistor tab and SCR chamfer for the PC board wiring.



After assembling project, label S1 and S2 as shown.

Bend strips of aluminum around the lantern battery and the sandwiched-together 9-volt batteries to form mounting brackets. Leave about 3/4" of excess metal on both ends of each bracket, bending the excess to form mounting tabs. Now drill holes through the tabs of the small mounting bracket and through the tabs of the large mounting bracket and the bottom and rear of the utility box. Set the batteries in place (also place a piece of corrugated cardboard between the 9-volt batteries and front of the box), slip on the mounting brackets, and fasten them down with #6 hardware.

Now interconnect the batteries, lamp, switches, and circuit board. Then mount the circuit board to the front of the box with 1/2" metal spacers and #6 hardware.

To test the circuit, set *S2* to FAST and *S1* to ON. The lamp should flash on and off at a regular, fairly rapid rate. Now set *S2* to SLOW. This time the lamp should remain extinguished for between 6 and 12 seconds, flash on for a short time, and extinguish for another 6-12 seconds before repeating the cycle. If the SLOW off time is too fast or too slow for your needs, simply adjust the setting of *R3* as desired. Finally, assemble the utility box. —30—

A LOOK AT THE HQ-200 & SX-122A

RESULTS OF OUR COMMUNICATIONS-RECEIVER FIELD TRIAL

BY OLIVER P. FERRELL

TO MANUFACTURERS, most side-by-side comparisons of their products are odious. However, to the potential buyer, such comparisons provide valuable insight that is not otherwise obtainable. This story reports how two recently "up-graded" communications receivers were operated side-by-side for several weeks. The receivers are similar only in tuning range, looks, and popularity. Otherwise, they are as alike as an orange and a pineapple. Readers of this article—it is assumed—will be intrigued by subtle differences between the Hallicrafters SX-122A and Hammarlund HQ-200 receivers, as reflected in the $145 price differential.

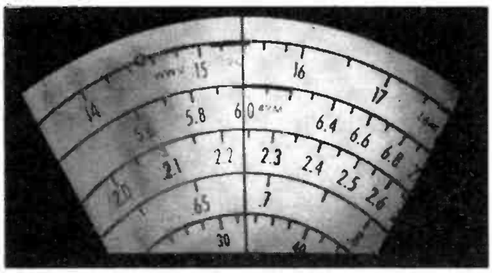
"A" Is to "200." The up-graded SX-122A is only slightly different from the SX-122—which it now replaces. To all intents and purposes the comments here apply to the older model as well as the "A". The HQ-200 is an improved HQ-100, a receiver that has been with us for quite a few years (see POPULAR ELECTRONICS, February 1957). It has been improved and repackaged and labeled HQ-200.

Hard-Core Differences. In the photos and captions of this story are some of the more obvious differences between these two receivers. However, there are

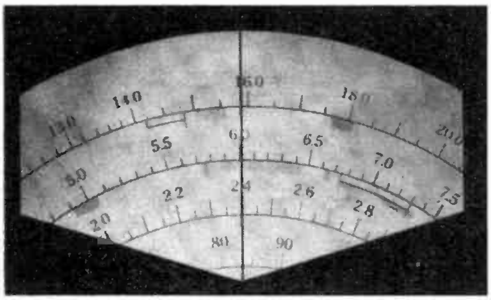
CAPSULE CIRCUIT INFORMATION

Hallicrafters SX-122A: A dual-conversion superhet (all tubes) with 4 nearly continuous tuning ranges (0.54-34.0 MHz) with bandswitching at 1.6, 4.9, and 12.6 MHz. There is no coverage between 1.6 and 1.75 MHz due to the first i.f. channel. The second i.f. is at 50 kHz and is R/C decoupled to permit bandwidth options (panel selected) at 5.0, 2.5, and 0.5 kHz. There is calibrated electrical bandspread on 5 ham bands. Built-in 100-kHz crystal calibrator is an optional extra. Tunable BFO and product detector for CW/SSB reception. Built-in series-type noise limiter. Price $395.00 (without speaker).

Hammarlund HQ-200: A single conversion superhet (all tubes) with 4 continuous tuning ranges (0.54-30.0 MHz) with band switching at 1.8, 4.0, and 10.0 MHz. A Q multiplier affords continuously adjustable selectivity and is tunable across i.f. channel. Calibrated electrical bandspread on 5 ham bands. Tunable BFO and product detector for CW/SSB reception. Built-in shunt-type noise limiter. Price $259.50 (without speaker).



Main Tuning. The Hammarlund HQ-200 (below) tunes 550 kHz to exactly 30.0 MHz in four ranges. The Hallicrafters SX-122A (above) tunes 540 kHz to 34.0 MHz. Single rotation of main turning knob on SX-122A tunes about 600 kHz at 10.0 MHz and 270 kHz at 4.0 MHz. A knob rotation of the HQ-200 tunes 1100 kHz at 10.0 MHz and 450 kHz at 4.0 MHz. The least number of kHz tuned per knob rotation favors ease of difficult DX'ing for the SWL.

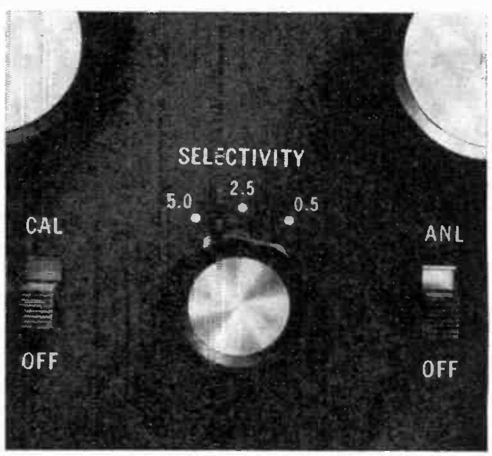


three characteristics that deserve editorial comment: image rejection, sensitivity, and selectivity.

In regard to image rejection—which neither manufacturer rates in his literature—the SX-122A walks off with all honors. Image rejection is the ability of the receiver to suppress the image of a desired signal that is removed from the signal by twice the i.f. The HQ-200 being a single-conversion receiver does have images—they are quite tolerable, but they do exist. The SX-122A being a dual-conversion receiver has none that are detectable. Presumably they do exist, but if so, they are too weak to possibly interfere with short-wave reception.

The sensitivity of these two receivers for straight AM reception is approximately the same and both should be able to dig weak signals out of the background atmospheric noise. In view of the extreme crowding in the various radio bands it is the question of selectivity rather than sensitivity that should be of greatest importance to the SWL.

Selectivity. The HQ-200 (above) and SX-122A (below) offer two different answers to the problem of achieving good selectivity—Q-multiplication in the HQ-200 and a unique R/C network in the SX-122A. Selectivity on the HQ-200 is continuously adjustable from the receiver normal bandwidth of about 7 kHz (at −6 dB) to 400 Hz. The Hallicrafters SX-122A model has 3 preset switched positions.



A NICE RECEIVER, BUT—

For the past few years POPULAR ELECTRONICS has been intrigued by the absence from the American marketplace of the British communications receivers manufactured by Eddystone. After establishing that there was no importer for the Eddystone SWL and ham receivers, we purchased a popular Model EC-10 from the factory and subjected it to a battery of tests—lab and field trials.

The EC-10 is an all-solid-state 5-band receiver with self-contained loudspeaker and battery pack (6 D cells). It has continuous coverage from 0.55 to 30.0 MHz with band switching at 1.5, 3.5, 8.4, and 18.0 MHz. There is no S-Meter, noise limiter, "antenna" tuning, electrical bandspread (see below), or selectivity adjustment. Special features include an a.f. filter for CW operation and the renowned Eddystone slow-motion dial which is flywheel-loaded, gear-trained, and operates at a reduction of 110 to 1.

In tests, the Model EC-10 was slightly less sensitive than we had expected. Since sensitivity appeared to vary from excellent to fair throughout the tuning ranges, we are left to assume that this may be due to the lack of a tuning adjustment (usually referred to as "antenna") in the first r.f. stage. Selectivity was only fair and measured at 8.0 kHz at −6 dB and somewhat wider than 25 kHz at −40 dB. Image rejection was fair to good and disconcerting above 18.0 MHz.

On the plus side, POPULAR ELECTRONICS was impressed by the clean, sturdy craftsmanship in the EC-10 construction. As expected, the Eddystone mechanical bandspread proved to be somewhat less versatile than electrical bandspread (as in the Hq-200 and SX-122A), but nevertheless fairly free of backlash and with a high order of "resetability." Although not as "pretty" as comparably priced transistorized consumer portables with multiple bands, the EC-10 looks and feels professional. The EC-10 is a superb CW receiver—due primarily to the stability of solid-state and the a.f. filter. Although the EC-10 lacks a product detector, we had no difficulty with SSB signals.

The suggested American retail price for the EC-10 will be about $180.00. Although no importer had been appointed at this writing, POPULAR ELECTRONICS is assured that valid inquiries will be answered through our Reader Service.

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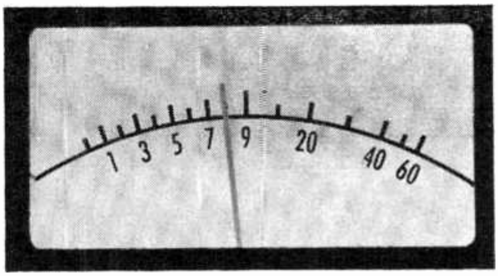
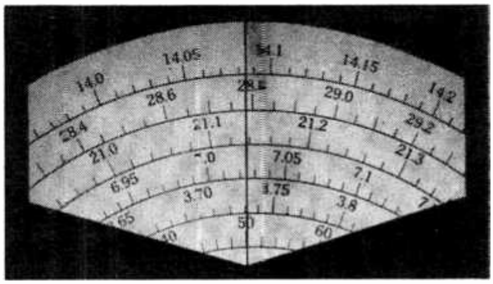
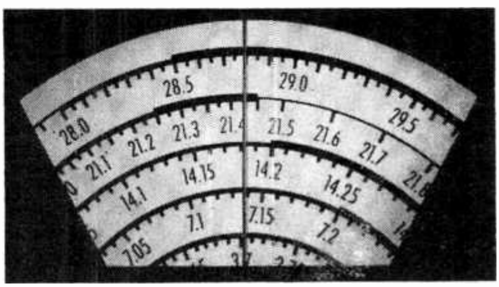


Tuning Meter. The S-meter on the SX-122A is clean, well-illuminated and accurately calibrated at 50 μV input to read (S)9. If you didn't know what the meter indicated, could you make sense out of a 1,3, 5,7,9, etc. scale without your electronic expertise?

A true communications-type receiver must feature excellent selectivity—preferably adjustable. The HQ-200 and SX-122A offer two different approaches—Q multiplication in the HQ-200 and a very low i.f. with high-Q transformers in the SX-122A. The width of the nose of

(*Continued on page* 112)





Bandspread. Each receiver has reasonably accurate bandspread dial calibration for the 10, 15, 20, 40, and 75/80 meter ham bands. The HQ-200 (above) has a special logging scale to assist SWL's tuning the international broadcast bands. Single rotation of the bandspread knob of SX-122A tunes 400 kHz on 10 meters; 50 kHz on 20 meters; and 40 kHz on 40 meters. The HQ-200 single rotation is 400 kHz on 10; 120 kHz on 20; and 105 kHz on 40 meters.

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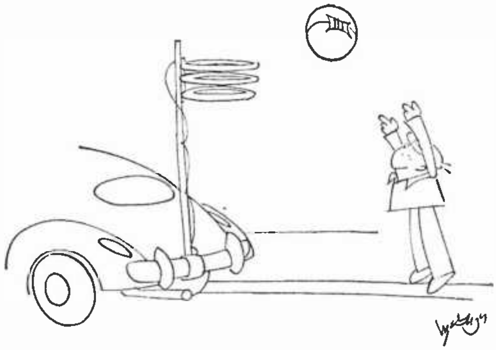
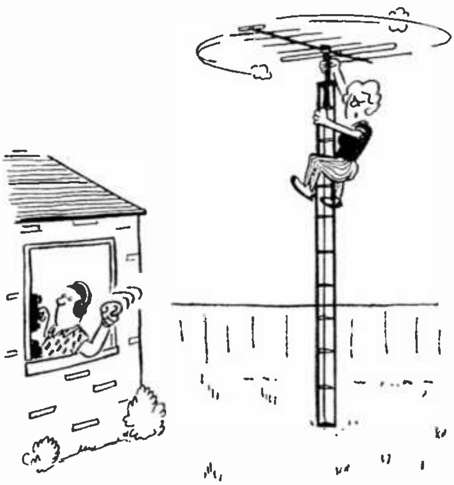
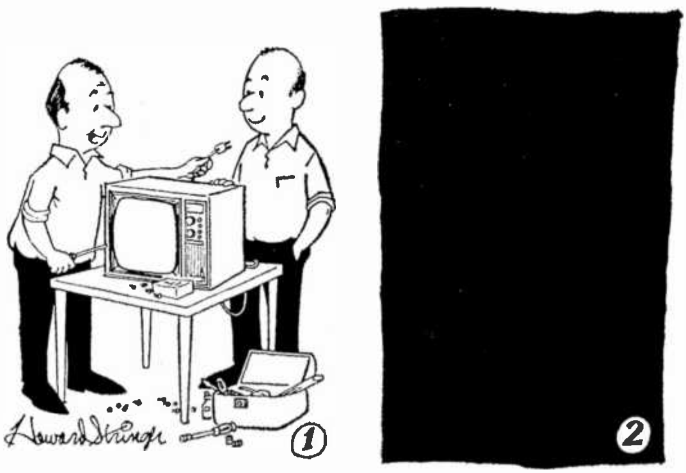


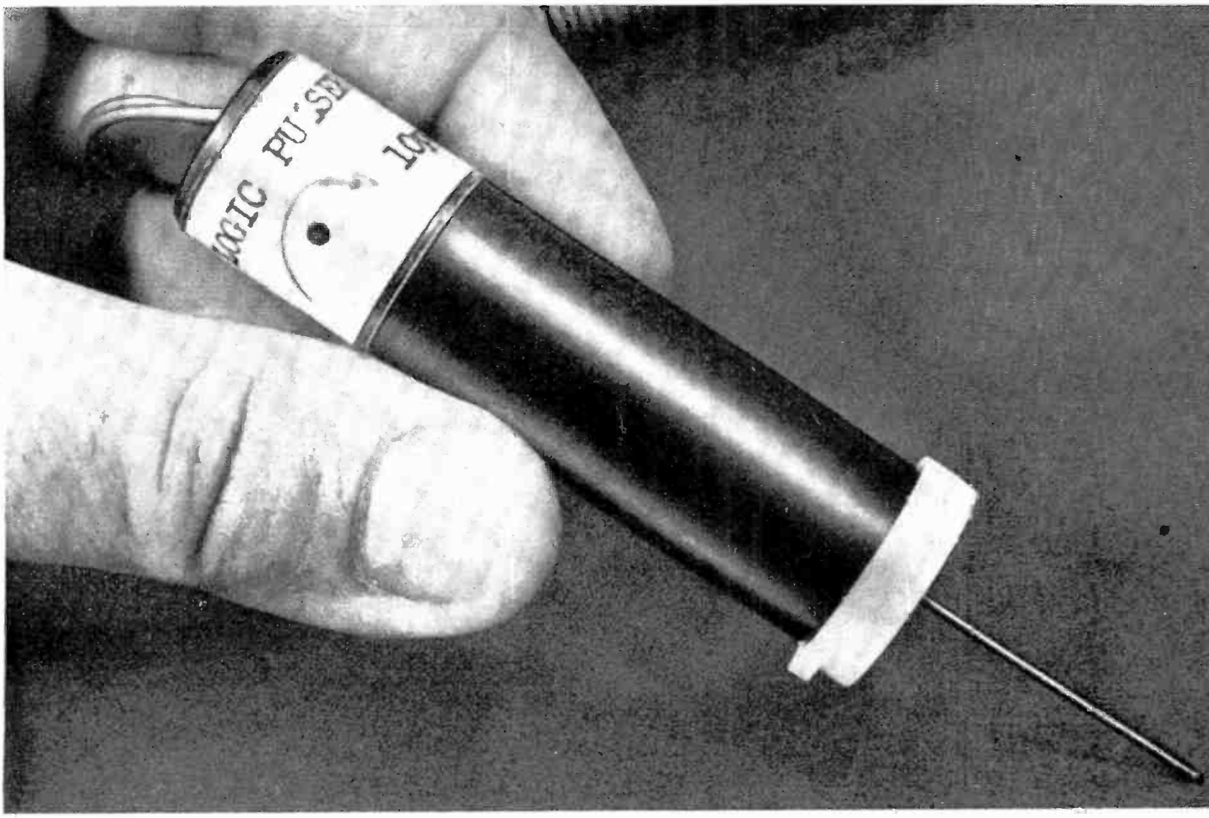


Speed it up Marconi,
I have to get supper ready.

It's a QSL card—they got
our message in the bottle.



There, finished. Plug it in,
and we'll see what happens.



POLA-Testers

SURPLUS CONTAINERS MAKE HANDY PROBES

BY E. B. BEACH

ONE OF the more vexing problems facing the electronics experimenter is finding a way to house small, odd-sized projects. The author, for example, designed a series of very useful, low-cost test instruments that occupy very little space and must be held in the hand during use. The novel packaging scheme he devised can be seen in the photographs. All three of the devices shown are packaged in discarded Polaroid® print coat containers. The containers are of generous proportions and fit well in the hand when used as probes. If you don't happen to have a Polaroid camera, you certainly know someone who would save you a couple of the containers since they are normally discarded. If that source is dry, you can use any small plastic container of the type used for pills.

If you are using the coater containers, remove and discard the used spreader and leave the cap off the container for a few days to allow the chemical to dry thoroughly. If this is not done, the chemicals in the coating compound will corrode soldered connections and leads, which may eventually lead to trouble.

After the container and cap have dried out, scrape the dried material from inside the container and the lip of the cap. Make sure that both are clean, inside and out.

The three test instruments which employ this unique packaging scheme are used with the many RTL digital IC projects recently published in this magazine. Several other, non-digital instruments are presently being designed and will appear in future issues. To use these instruments, connect the +3.6-volt lead to the power supply of the circuit being tested and the ground lead to the board ground.

Logic Probe

Connect the power leads to the respective terminals on the digital board being tested, then follow digital signal around the board, observing the lamp. Each time trace signal goes positive, the small lamp glows.

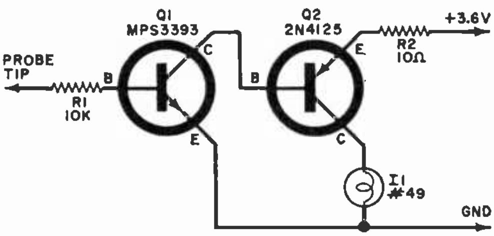


Fig. 1. In this simple electronic switch, resistor R1 isolates the probe from the circuit under test.

Logic Probe. The purpose of a logic probe is to detect the presence of the discrete voltage outputs (1 and 0) in a digital circuit without having to disassemble the device. Place the tip of the logic probe on the proper point in the circuit and, when the voltage switches up and down according to the logic, a small lamp within the probe will blink on and off. A positive voltage lights the lamp.

The circuit for this simple probe is shown in Fig. 1. Any low-cost *npn* silicon transistor can be used for *Q1*, while any low-cost *pnp* transistor can be used for *Q2*. Using the specified value for *R1*

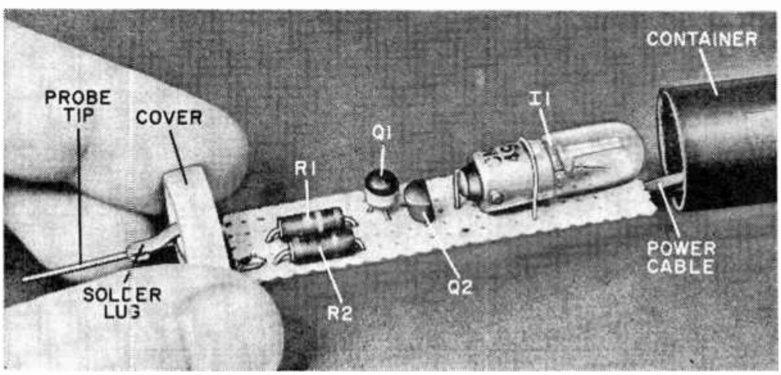


Fig. 2. Lamp is strapped down with a small piece of wire while other components are lead mounted.

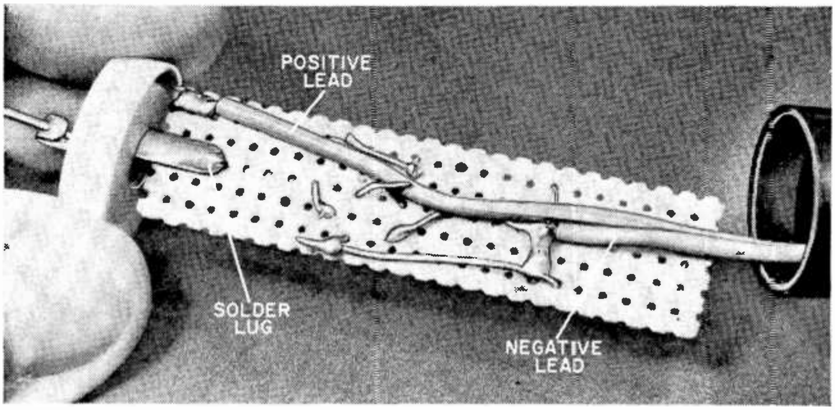


Fig. 3. The underside of the probe board showing the two power connections, and the solder lug that connects to the probe through cover mounted hardware.

gives an input sensitivity of about 0.8 volt. Resistor *R2* limits the current flow and gives degenerative stability to the circuit.

The circuit is assembled on a 2⅜" × 9/16" piece of perforated phenolic board having a 0.1" grid of 0.042" holes. The lamp is strapped down at one end using a small piece of bare wire. The other components are installed as shown in Fig. 2. Connections are made using component leads protruding through the board. The underside of the board is shown in Fig. 3. Two small holes must be made in the closed end of the plastic case—one for the two color-coded power leads and one through which the lamp can be easily seen.

The probe tip is made from a piece of a paper clip soldered to a lug which is secured to the cap with a 4-40 screw and nut. A second solder lug on the inside of the cap is connected to *R1*. The board assembly is rotated and slipped into the plastic case so that the lamp is opposite its viewing hole. The cap then fits snugly on the container.

As a finishing touch, make up a typewritten label describing the device, identifying the color code on the power leads, and telling what the lamp does. Attach the label to the container with transparent tape.

Logic Pulser

Logic Pulser. This is an astable multivibrator made from a dual-buffer IC which is adjustable from about one pulse per second to about 10 pulses per second. It is capable of driving as many as 80 milliwatt RTL gates or 26 medium-power IC gates for testing purposes. It receives its primary power from the circuit being tested.

The circuit for the pulser is shown in Fig. 4. It is also built on a 2⅜" × 9/16" piece of perforated phenolic board having a 0.1" grid of 0.042" holes. The integrated circuit (*IC1*) fits directly into

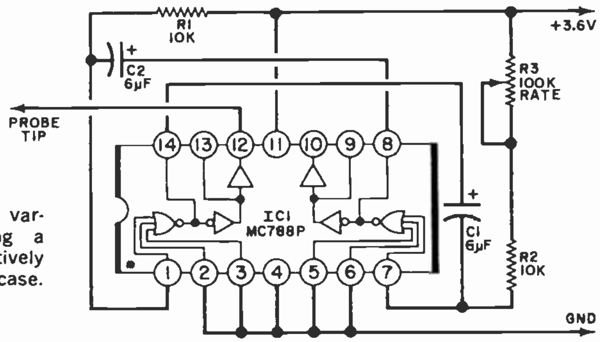
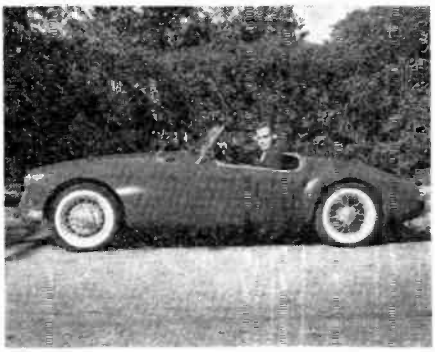


Fig. 4. IC1 is coupled up as a variable-frequency oscillator having a buffer output. Even this relatively complex circuit fits the small case.

6 good reasons to get into electronics:

1



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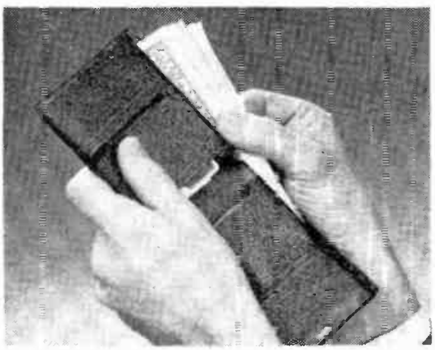

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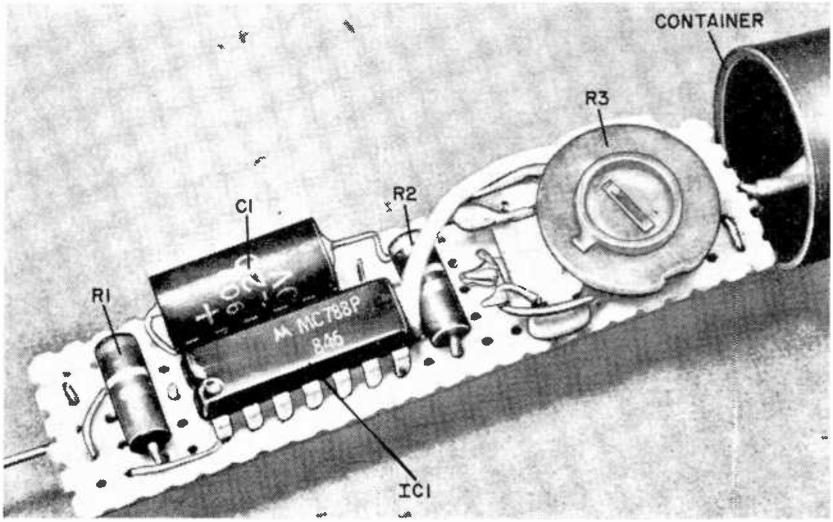
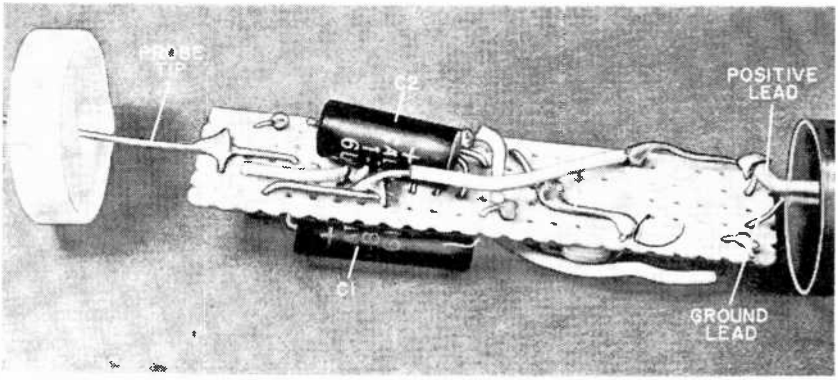


Fig. 5. The parts fit the small board easily if you follow the layout shown here. Make sure you have a small hole in the container to make screwdriver adjustments of R3 as required during operation.

the board holes and is positioned as shown in Fig. 5. Bend a couple of leads over to keep the IC in place while assembling the other components. Mount *C1* beside the IC and mount *C2* on the other side of the board as shown in Fig. 6. Be sure that these two capacitors are not larger than 5⁄16″ in diameter or the completed circuit will not fit into the container. Potentiometer *R3* is held on the board by the wiring to its three terminals.

The probe tip for this instrument is made from a length of paper clip. Make a hook in one end of the probe to fit through a hole in the board. A small piece of bare wire soldered to the hook of the paper clip will hold the probe in place while it is connected to pin 12 of *IC1*. Make a small hole in the center of the plastic cap for the probe tip to pass through. Make one small hole in the end of the container for the power leads and another small hole in such a position that *R3* can be adjusted with a screwdriver when the circuit is mounted.

Fig. 6. Underside view showing placement of C2. When selecting both C1 and C2, make sure that they are no larger than 5⁄16″ diameter so that they will fit the container. Note how the probe is supported.



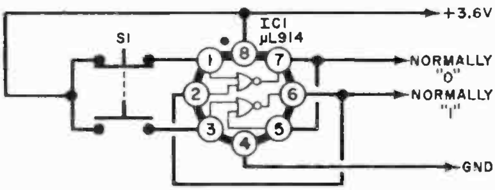


Fig. 7. The circuit is a basic "bounceless switch" made up of one small IC. It produces a clean pulse.

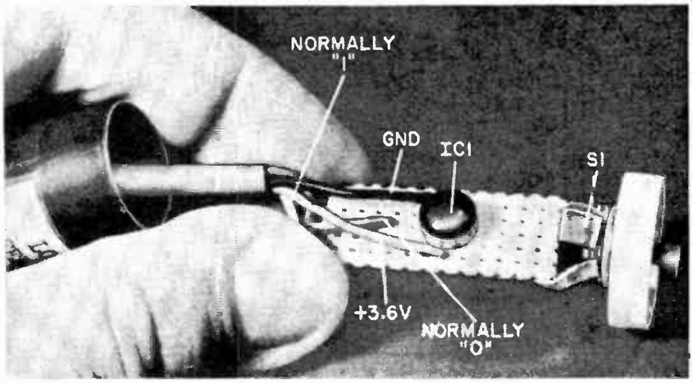
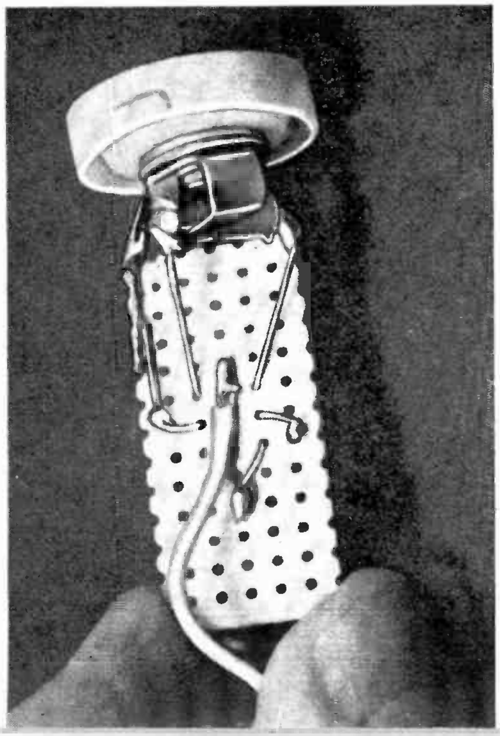


Fig. 8. All that's in the circuit is the IC and a switch. Four-lead flexible cable couples to board.

The pushbutton switch fits in a hole drilled in container cover. Like other testers, a typewritten label identifies leads and explains operation.

Fig. 9. Underside of the board showing method of mounting the switch using its circuit connections.



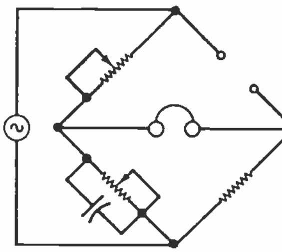
Logic Switch. One difficulty encountered in triggering an RTL circuit with low noise immunity is the erratic count that occurs when a conventional noisy mechanical switch generates the trigger. This noise can be eliminated by using a mechanical single-pole double-throw pushbutton switch to operate a set-reset flip-flop. This insures that a clean, noise-free, single pulse is generated each time the pushbutton is operated.

The circuit for the logic switch is shown in Fig. 7. It is built on a 1¼" × 5/16" piece of perforated phenolic board. Mount the s.p.d.t. pushbutton switch in a hole centered in the plastic cover. Drill a hole in the closed end of the container for a four-wire cable. The circuit is wired (Fig. 8) so that it holds the switch at the end of the board. Another view is shown in Fig. 9. -30-

Bridge Function Quiz

BY ROBERT P. BALIN

Many electronic components—vacuum tubes, transistors, diodes, thermistors, etc.—are often connected in the form of a bridge, which can make a particular circuit more sensitive and efficient. With the bridge balanced, one gets a zero-current-consuming indication of relationships between components in the circuit. To test your knowledge of bridge circuits, match the functions (1-10) to the proper diagrams (A-J).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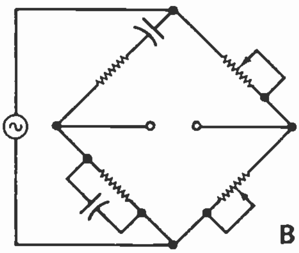
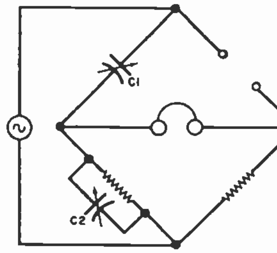

B

1. Amplifier ___
2. Band-pass filter ___
3. Band-suppression filter ___
4. Capacitance measurement ___
5. Frequency measurement ___
6. Inductance measurement ___
7. Modulator ___
8. Oscillator ___
9. Rectifier ___
10. Resistance measurement ___

(Answers on page 114)



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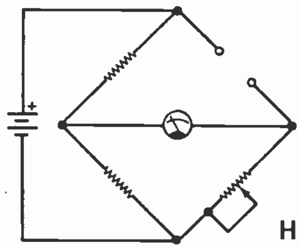
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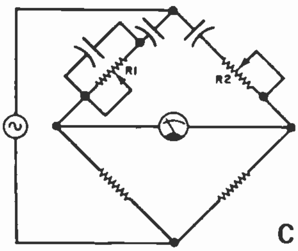

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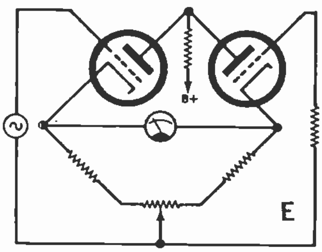

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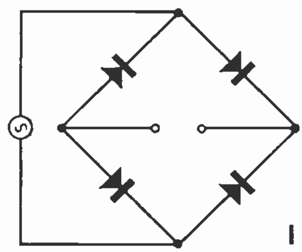
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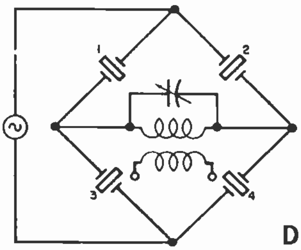

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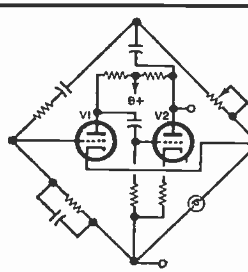

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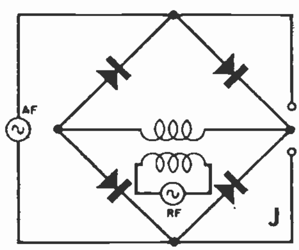

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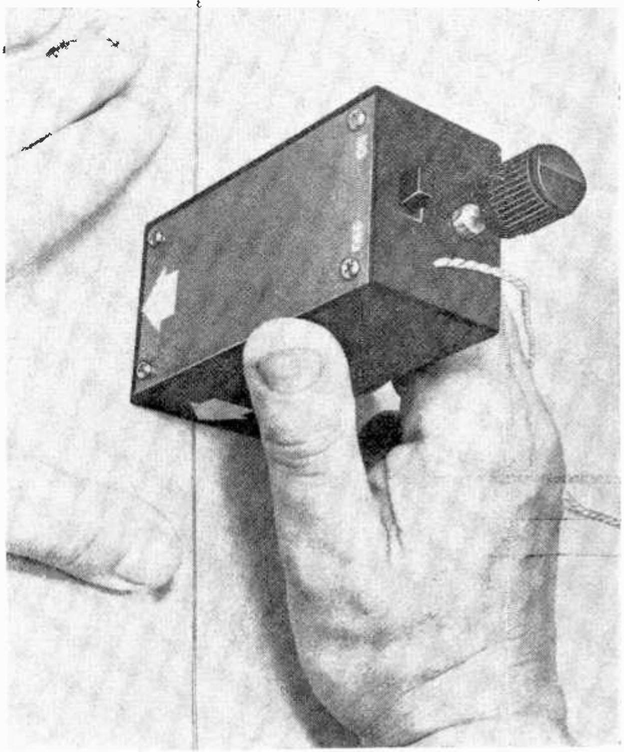


Carpenter's Mate

TINY METAL LOCATOR FOR TINY METAL

BY JOHN S. SIMONTON, JR.

THOSE LITTLE magnetic gadgets that carpenters use to locate studs work fine if you're looking for ferrous nails. They won't do the job, though, for a boat owner trying to avoid sanding and sawing the brass hardware used on his craft.

If you have this problem, you can save some of the time you're spending developing a sailor's vocabulary and some of the money you use replacing chewed up saw blades by building the "Carpenter's Mate." It locates ferrous or non-ferrous metals quickly and easily.

The Carpenter's Mate, not much bigger than a pack of cigarettes, works just the same as larger types of metal locators except that it has a very restricted range and better resolution (pin-point accuracy). By using a small search coil (mounted inside the plastic case) maximum range has been reduced to about 2 inches while resolution is increased so that even a small wire brad—detected head on—can be spotted. The Carpenter's Mate slips easily into your shirt pocket and can be put into operation as fast as you can turn it on.

Construction. The circuit of the Carpenter's Mate is shown in Fig. 1. Layout is critical and since radio frequencies are involved, good wiring practice should be followed and all leads should be as short as possible. A circuit board simplifies the construction. You can make your own using Fig. 2 as a guide or you can buy one.

Parts placement on the board is shown in Fig. 3. The leads of *Q1* and *Q2* are bent so that the flat sides of their bodies can be placed adjacent to one another and glued together. This helps to maintain the two transistors at the same temperature to stabilize the relative frequencies of the two oscillators.

The sensing coil, *L1*, is made by modifying a standard J.W. Miller #6300 or equivalent High-Q variable inductor. Make the modification by removing the tuning slug and carefully cutting the threaded brass tuning screw off flush with the ferrite core material. Then carefully unsolder the lead wires from the terminals on the side of the coil and use a sharp knife to cut the form so that the coil winding is centered between the ends

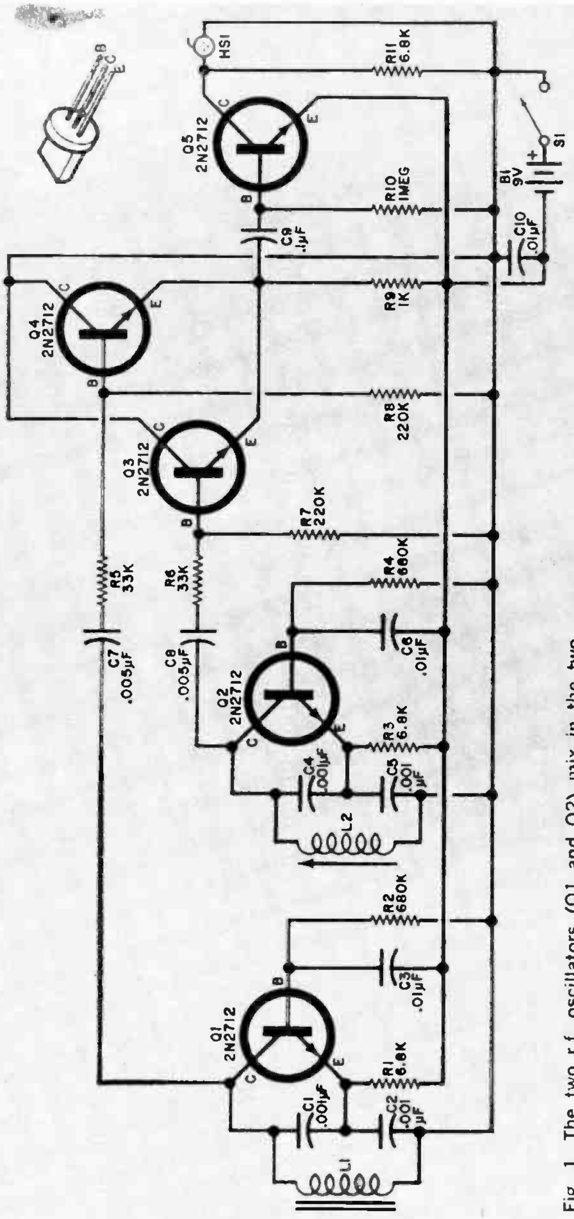


Fig. 1. The two r.f. oscillators (Q1 and Q2) mix in the two emitter followers (Q3 and Q4) and produce an audible sound that is a function of their frequency difference. This difference occurs when L1 is brought close to a piece of metal.

PARTS LIST

B1—9-volt transistor battery
C1,C2,C4,C5—0.001-µF ceramic disc capacitor
C3,C6,C10—0.01-µF capacitor
C7,C8—0.005-µF capacitor
C9—0.1-µF capacitor
HS1—High-impedance earphone
L1, L2—High-Q Ferrite Antenna Coil (J.W. Miller #6300 or similar)
Q1-Q5—2N2712 transistor
R1,R3,R11—6800-ohm
R2,R4—680,000-ohm
R5,R6—33,000-ohm
R7,R8—220,000-ohm
R9—1000-ohm
R10—1-megohm
All resistors ½-watt
Misc.—Plastic case 1⅝" x 4" x 2⅛" with metal cover, battery connector, battery clip, wire, solder, epoxy cement.
Note—The following are available from PAIA Electronics, P.O. Box 14350, Oklahoma City, Okla. 73114: etched and drilled PC board, $2.00; complete kit of parts including cement, $9.95; postpaid in continental U.S.A. Okla. residents, add 3% sales tax.

of the form. Slide the ferrite slug back into the coil and center it before securing it in place with a dab of cement.

The completed unit is housed in a 1⅝" × 4" × 2⅛" plastic utility box (see Fig. 4). To prevent tone changes associated with touching exposed metal hardware, all internal components, including *L1*, *S1*, and the PC board are glued in place with epoxy cement. Clean all mating surfaces thoroughly with steel wool before gluing. Blow away all steel-wool debris to avoid shorts. Drill a hole for *S1* at one end of the box and glue it in place. Then drill a hole on the same end for the mounting clip of *L2* and snap it into place. Drill a small hole near these two to pass the earphone cord. Make a knot at the inside end of the cord to prevent it from being pulled through.

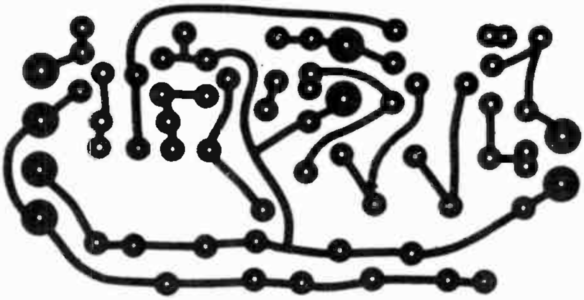


Fig. 2. Actual-size foil pattern to be used in making the PC board.

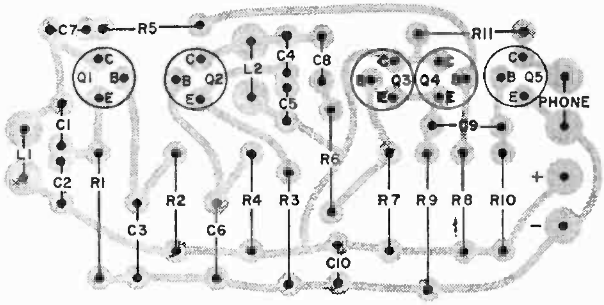
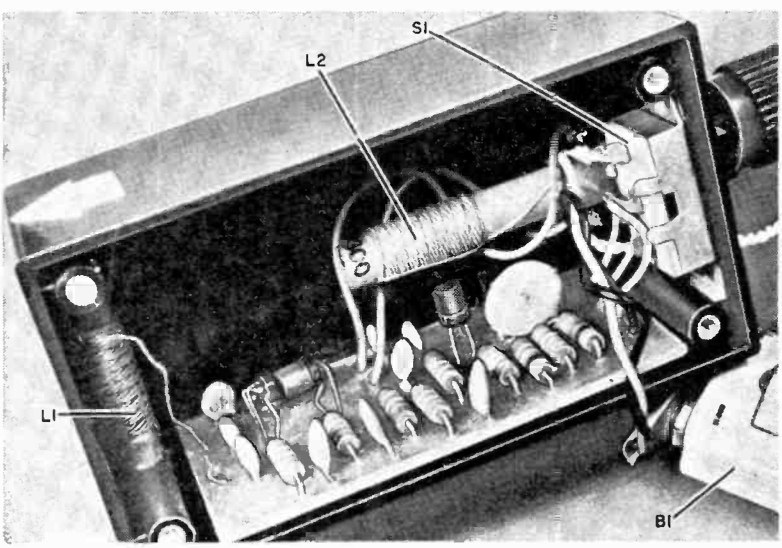


Fig. 3. Other than transistors, component polarities are not critical.

Mount *L1* at the center of the undrilled end of the box, using epoxy cement. Before mounting, make sure that the leads are long enough to reach the terminals on the PC board. If they are not, either unwind a little wire from the coil or solder on short extensions. Before mounting the PC board, connect up the circuit and put a small knob on the protruding shaft of *L2*. Turn on the power and adjust *L2* until a whistle is heard in the earphone. Once you hear this whistle,

Fig. 4. The entire instrument is easily mounted in a small plastic box. Place arrowheads to indicate the center of the search coil. All parts mount with epoxy.



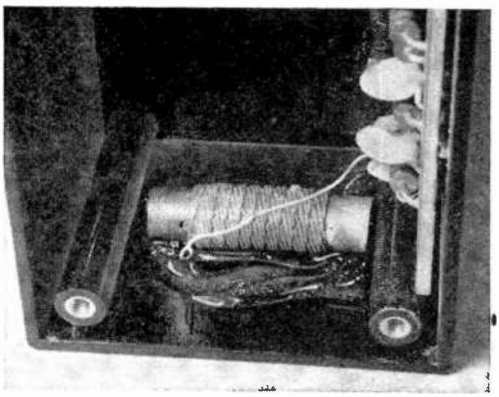
you know that the circuit is operating. Turn off the power and cement the board in place using a drop of cement at each corner.

When attaching the battery clip to the cover, place it slightly off center to keep it from interfering with the circuit board components when the cover is in place.

Operation. Hold the unit clear of any metal, turn it on, and insert the earphone in your ear. Withdraw the core from *L2* by turning its adjusting screw knob counterclockwise. As the slug passes through the coil, you will hear a rising and falling tone. While any position of the slug which produces a tone may be used as an operating point, the most desirable setting can be found in the following manner. Start with the slug screwed out about an inch. At approximately this point, a tone considerably louder than the others will be heard. Continue to withdraw the core until a null is reached. Slightly before this null point is the best position for locating non-ferrous metals. In this case, the presence of a non-ferrous metal causes a slight increase in the oscillator frequency, causing the signal to go toward the null point. For detection of ferrous materials, withdraw the slug so that the tone is slightly beyond the null point. The presence of a ferrous object then decreases the oscillator frequency, again bringing the tone down to the null. By positioning the slug on either side of the null, it is possible to identify either ferrous or non-ferrous materials. If you leave the slug so that a relatively low audio frequency is head, the frequency will go up or down depending on the metal detected.

To get some practice using the Carpenter's Mate, use a test surface which you know contains a piece of brass hardware. With the case held so that the side adjacent to the sensing coil is pressed lightly against the test surface, move the device over the area. The tone will decrease noticeably when the sensing coil is directly over the brass. With the proper adjustment of *L2*, the null point will be reached when the metal is detected.

Four clearly visible arrows can be drawn or pasted on the sides of the box at the *L1* end so that scribe marks can be made on the test surface to locate the detected metal under the center of the coil. If the coil is exactly centered in the end of the box, the arrows should be centered on the sides. It is possible to orient *L1* so that it butts against the end of the box. In this case, the sensitive area is greatly reduced permitting more accuracy in location. However, with this arrangement there is always the chance that the coil will be dislodged when the instrument is moved about. —30—



Coil L1 should be mounted with epoxy cement on the blank end of the box in exact orientation shown.

HOW IT WORKS

Transistors *Q1* and *Q2* and their associated components form two independent Colpitts oscillators. The outputs of these oscillators are combined in the mixer composed of *Q3* and *Q4* and the resulting signal appears across the common load resistor *R9*. Since the mixer is nonlinear, the output signal contains the two original frequencies and also the sum and difference of the two. However, only the difference signal is within the range of human hearing. This signal is amplified by *Q5* and used to drive the high-impedance crystal earphone.

When a metallic object (either ferrous or nonferrous) comes close enough to *L1* to intercept and distort the magnetic field surrounding the coil, there is a change in the effective inductance of the coil. This causes a change in the frequency of the "sense" oscillator *(Q1)*. This relatively small change in the frequency of the oscillator can be heard as a significant change in the tone in the earphone.

To minimize "pulling" of the oscillators and the tendency of the two to lock on to the same frequency, the "local" oscillator *(Q2)* is adjusted to run at about twice the frequency of the "sense" oscillator.

MAYBE FREEDOM OF SPEECH SHOULD END AT OUR BORDER

BY THOMAS J. R. KENT

RED LION, Pennsylvania, is a small, quiet town not far from Harrisburg. Few of its five thousand citizens, many of whom work at nearby furniture and cigar factories give any thought to WINB, the short-wave broadcasting station on the edge of town. Perhaps they should know it better. The programming and policies of WINB have brought Red Lion international attention.

WINB, *World International Broadcasters*, is the smallest of America's three privately-owned international stations.[1] Through complex corporate arrangements, WINB is one of three radio stations associated with Dr. Carl McIntire, an ex-Presbyterian minister who has been accused of right-wing and anti-minority group views. A number of civic organizations, including the Pennsylvania AFL-CIO, the Catholic Community Relations Council, and the Anti-Defamation League of B'nai B'rith charges that McIntire is using some of these stations to air his own personal stands on major political issues without acknowledging or representing the opposite side. The FCC has been petitioned to cancel the stations' licenses.

The Presbyterian Office of Information says that Carl J. McIntire was "deposed" (about 1936—Editor) and has made a career of maligning the leadership and programs of major church bodies in this country and abroad. Evangelist Billy Graham has been a target of abuse.

In 1945, his tabloid newspaper, the *Christian Beacon,* carried the statement that "one would be better off in a Communistic society than in a Roman Catholic fascist set-up," but his friends say the remark was "taken out of context" and does not represent any anti-Catholic viewpoint. McIntire denies being anti-Semitic, but his comments about Jews have been found offensive by Jewish organizations. According to the Presbyterian Office of Information, he has attacked Negroes, UNICEF, John F. Kennedy, Lyndon Johnson, the United Nations, Post Office Department, the Internal Revenue Service, and Billy Graham in the past few years alone.

1. *Oddly enough, all three are owned and operated by religious organizations. WNYW is reportedly financed by the Mormon Church and KGEI by the Far East Broadcasting Corporation, a Baptist Church affiliate.*

McIntire promotes his ideas through his private broadcasting empire, a growing operation headquartered in Collingswood, N.J. His own radio program, the *Twentieth-Century Reformation Hour*, is heard over 500-600 AM stations. He apparently also indirectly controls three radio stations, WXUR in Media, Pa. and WGCB in Red Lion, plus short-wave station WINB. Because of the international audience WINB gains for Dr. McIntire, it has received special attention from his many critics.

What does WINB broadcast? Although the station is on the air daily to southern Europe, the Mediterranean, the Middle East, and North Africa, areas where English is not commonly spoken, less than 4 hours of foreign language programming is broadcast per week. The majority of WINB broadcasts are in English, most of them prepared in advance by organizations which presumably pay WINB for their transmission. Many of the broadcasts are religious, either Christian evangelical programs or ones that mix religion with politics. Typical of the latter group are McIntire's *Reformation Hour* and the *Christian Crusade*, "the world's largest Christian anti-Communist movement." Virtually all political programs take a right-wing, strongly anti-communist attitude, and some of them indicate that the United States is already in the grip of a sinister Communist conspiracy. *Lifeline* and *The Manion Forum,* two programs with reputations for far-right views, are also heard throughout the shortwave target area.

The fact that such fare is broadcast overseas should be disturbing to many Americans. The FCC requires that private international stations "reflect the culture of this country and promote international goodwill, understanding, and cooperation." WINB's attacks against the U.S. government hardly comply with this regulation, and must confuse foreigners used to government-controlled shortwave stations.

Also, federal law states that programs designed specifically for American audiences are not acceptable as programming for international stations.[2] Programs such as *Lifeline* and the *Twentieth Century Reformation Hour* are, it seems, in this category; the requests that listeners write their Congressmen or attend rallies in major U.S. cities would indicate that the programs are not produced with the foreign listener in mind.

In the past few years, the activities of Dr. McIntire and the stations said to be associated with him have brought protests from many of his listeners. In a petition currently before the FCC, nineteen civic groups, led by the Greater Philadelphia Council of Churches, claim that WXUR, the Media, Pa. fundamentalist right-wing station, presents a one-sided view of major issues, violating FCC fairness doctrine requirements. WXUR officials, however, insist that they do offer equal time to groups with differing views, but that the groups have refused the opportunities to use WXUR facilities.[3]

Radio-Minister Dr. McIntire's critics feel that he has abused his right to free speech and should be either taken off the air or forced to comply with FCC fairness requirements. The FCC is wary of such action, however, because censorship is a controversial subject and the Commission does want to protect its licensee's constitutional rights. According to the FCC, the entire matter of international broadcasting is under review, and new requirements for private shortwave stations may be forthcoming. In the meantime, however, Carl McIntire, his associated stations, and his international network continue on the air.

The size of WINB's overseas audience is hard to estimate, but the 50-kW signal is heard well in Europe and WINB personnel report receiving "thousands" of listeners' letters per year. The station solicits reception reports and verifies by QSL card but, due to a limited staff, reports may not be answered for a long time. Transmissions are from 1700-2000 GMT on 17,720 kHz and from 2000-2200 GMT on 11,795 kHz. The 2000 GMT program may often begin as late as 2004 or 2005 GMT because of time needed for transmitter bandswitching.

2. *However, this "rule" is probably also violated by WNYW.*

3. *Apparently WXUR was able to convince retired Hearing Examiner H. Gifford Irion that they had been "extremely circumspect" and license renewal was recommended by Examiner Irion in late 1968. This immediately brought forward a blast from the FCC's own Broadcast Bureau who characterized Irion's actions as "an attempt to write the great American broadcasting novel."*

Getting to Know THE SCS

MYRIAD OF USES FOR THE SILICON CONTROLLED SWITCH

BY FRANK H. TOOKER

ONE OF THE MOST useful semiconductor devices on the market today is neglected by the majority of experimenters and circuit designers. That device is the SCS—silicon controlled switch. The neglect is not due to cost since at least one SCS (the 3N84) has a catalog price of only $1.98. More likely, it is due to a lack of understanding of what the SCS is, how it works, and what it can do.

The SCS, shown schematically at (A) in Fig. 1, is actually a simple device. It has a *pnpn* structure, as shown at (B) in Fig. 1, and thus resembles the SCR—with one important difference. It has a fourth connection, called the anode gate, brought out from the third layer of the "sandwich." The more conventional SCR has only a cathode gate. The anode gate gives the SCS a versatility which the SCR does not possess. (For some applications, this fourth lead can be overlooked and then, in fact, the SCS becomes a miniature SCR. In this case, the 3N84, for example, can handle 175 mA with a maximum anode-to-cathode d.c. potential of 40 volts.)

A Convenient Assumed Circuit. Probably the easiest way to understand the SCS is to think of it as an integrated circuit composed of two transistors—one *npn* and one *pnp*—with the circuit configuration shown in Fig. 2. The SCS is not really made this way; but in many cases, it behaves as if it were. Note that the cathode of the SCS is now the *npn* emitter, the cathode gate is the *npn* base and *pnp* collector, the anode gate is the *npn* collector and *pnp* base, and the anode is the *pnp* emitter.

To become acquainted with the SCS, construct the circuits shown in Fig. 3. Before applying power to either circuit, set the potentiometer to maximum resistance. Then with power applied, adjust the potentiometer to produce a gate current reading of 2 mA on the 5-mA meter. In each case note the base (cathode gate) and collector (anode gate) currents. You will find the *npn* has a d.c.

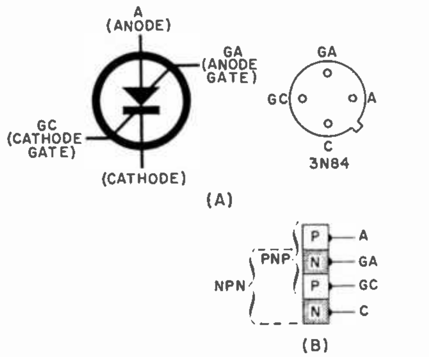


Fig. 1. Lead identification of the SCS including bottom view of the base. Unlike its SCR cousin, the SCS has an anode gate.

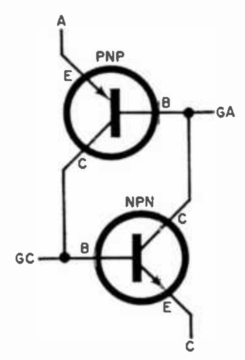


Fig. 2. Equivalent circuit of the SCS shows it to appear to be two conventional bipolar transistors tied in a regenerative-type circuit.

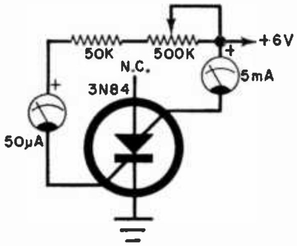
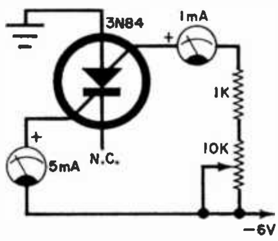


Fig. 3. In (A) above, the pnp section is inoperative. In (B) below, npn section is inoperative. In both circuits, set the pot to full maximum before turning on the power.



current gain of about 40, while that of the *pnp* is only about 1.5 or 2. These experiments will give you a "feel" for what goes on inside the SCS, enabling you to employ it more skillfully in circuits of your own design.

Regenerative Turn-On. The turn-on characteristics of the SCS are highly sensitive because of regenerative action. If you study the circuit of Fig. 2 for a moment, you'll see that the two transistors are connected so that there is a closely-coupled positive feedback. The output at the collector of the *npn* feeds into the base of the *pnp,* while the output at the collector of the *pnp* completes the circle by feeding into the base of the *npn.*

Obviously, if such a circuit is connected to a d.c. power supply and a signal of proper polarity is introduced, a "whirlwind" of amplification and reamplification (regeneration) takes place, ending in a very short time with the circuit locked up in a state of maximum conduction.

This is exactly what happens when the SCS turns on. It goes from what is essentially a no-conduction state between anode and cathode to a maximum-conduction state. In other words, it behaves like a switch, except that the action is electronic not mechanical.

In this respect, there is one important point which should always be kept in mind when experimenting with or using an SCS: be sure there is sufficient resistance in series with either the anode or the cathode to limit current flow to a safe value when the SCS turns on. If this is not done, the SCS, acting as a switch, will tend to short-circuit the power supply; and one or the other, or both, will either overheat or burn out.

Controlled Regeneration. Thanks to the availability of the anode-gate connection, it is possible to control positive feedback in the SCS. To study how this works, build the circuit in Fig. 4. It uses the *npn* portion of the SCS as an amplifier with the emitter current of the *pnp* portion controlled by potentiometer *R2.* This resistance introduces negative feedback which acts to offset the positive feedback previously described.

With potentiometers *R1* and *R2* both set at maximum resistance, connect the 9-volt power supply, being careful to observe the indicated polarity. Advance *R1* to obtain a reading of 1 mA on meter *M1.*

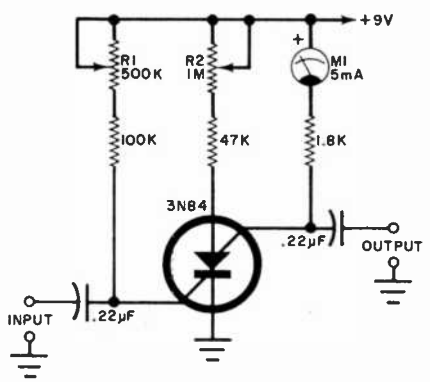


Fig. 4. By adjusting the potentiometers, you can make the SCS act like a conventional variable-beta, bipolar npn transistor.

With potentiometer *R2* set at maximum resistance, the circuit operates as an *npn* transistor amplifier. With *R2* set on minimum resistance, the circuit is simply a turned-on SCS. In between these extremes, the circuit is regenerative, with its gain increasing as the value of *R2* is made smaller.

With *R2* set at maximum resistance and *R1* set for an anode-gate current of 1 mA, advance *R2* and note that, as the setting approaches minimum-resistance in the circuit, anode-gate current rises rapidly to between 4 and 5 mA.

What we have here now is actually a variable-β *npn* transistor amplifier. To see how it works, connect an audio signal generator to the input terminals and an audio VTVM to the output terminals. Set *R1* for a reading of 1 mA on *M1* and set *R2* at maximum resistance. Set the VTVM on its 1-volt range and feed a 50-mV signal at 1000 Hz into the circuit. The reading of the audio VTVM should be somewhere around 0.25 volts, indicating that the circuit has a signal-voltage gain of about 50.

Now slowly advance the setting of *R2*, observing the VTVM. The meter reading should increase, indicating increasing voltage gain in the amplifier. With care, it should be possible to set *R2* for a full-scale (1-volt) reading on the audio VTVM. With a 50-mV input, the gain of the circuit is now 200! This fourfold increase in gain is due to regeneration provided by positive feedback through the *pnp* section of the SCS.

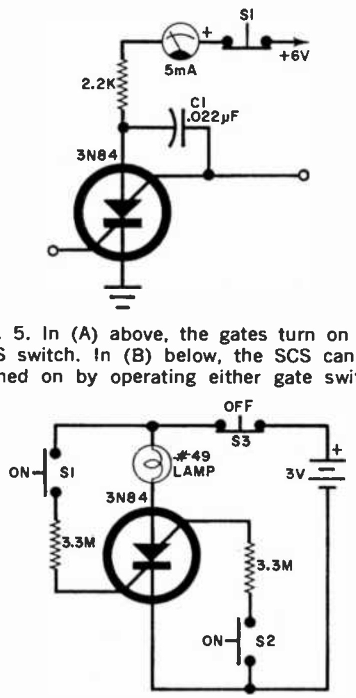


Fig. 5. In (A) above, the gates turn on the SCS switch. In (B) below, the SCS can be turned on by operating either gate switch.

Simple Switching. Now that we have a good concept of what is inside an SCS and how it works regeneratively, let's study its switching properties. To see how sensitive the SCS is to turn-on at its cathode gate, build the circuit shown at (A) in Fig. 5. With the 6-volt supply switched on, note that the meter reads zero. The SCS is in its off state. Actually, a small current does flow in this condition, but it is only a few microamperes and does not indicate on the meter. For most practical purposes, we can assume that the off current of the SCS is zero.

With your eye on the meter, touch your fingertip to the cathode-gate terminal. Immediately, the meter needle swings up to about mid-scale, indicating a current flow of about 2.5 mA. The SCS is now switched on, and it took no more than the touch of your finger to do it.

Now remove your finger from the terminal and you will note that the reading on the meter does not change. The SCS stays on. To turn it off, momentarily disconnect the power supply by opening switch *S1* (which should be a normally closed pushbutton switch).

To demonstrate turn-on with the anode gate, hold one finger of one hand on any grounded part of the circuit and touch a finger of the other hand to the anode-gate terminal of the SCS. Turn-off is again accomplished by momentarily opening *S1*. In either of these experiments, turn-off may also be accomplished by momentarily shorting the cathode gate to the cathode or the anode gate to the anode.

So sensitive is the SCS to turn-on that even a mild switching transient can accomplish it. In the circuit of Fig. 5(A), the transient response is subdued by capacitor *C1*. To prove this, with the power supply on but with the SCS in its off state, press and release *S1* several times and note that the meter needle remains at zero. Now do the same with capacitor *C1* removed from the circuit. Note that the meter needle promptly swings up to about mid-scale, indicating that even the transient produced by switching the power supply off and on is sufficient to turn on the SCS. The only way to keep it off is to open the switch.

and leave it open. The moment it is closed, the SCS will turn on. Capacitor *C1* prevents this by applying the same potential to the anode and the anode gate simultaneously during the brief interval when the power supply is switched on.

An SCS is always easy to turn on; and as long as it is conducting only a milliampere or two, turn-off is not too difficult. As higher currents are drawn, however, turn-off becomes more of a problem. In the circuit of Fig. 5(B), for example, where about 40 mA is pulled through the 3N84, shorting the cathode gate to the cathode or the anode gate to the anode will not turn it off. On the other hand, opening the power supply circuit is always effective.

The circuit of Fig. 5(B) can be turned on by closing either *S1* or *S2* momentarily. Very little gate current (only a

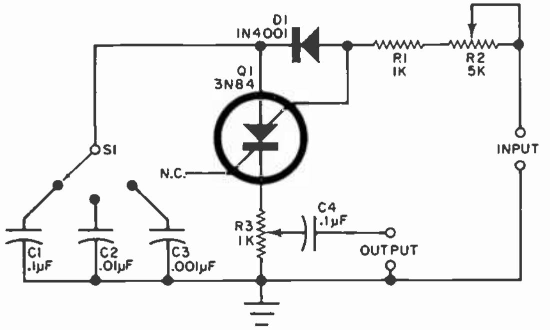
(*Continued on page* 110)

A SELF-POWERED PULSE GENERATOR

HERE IS a spike-pulse generator using an SCS and operating directly from the output terminals of a sine-wave audio signal generator—and it requires no other source of power! It has a range of 100 to 10,000 pps (pulses per second), producing one positive-going pulse for each cycle of the input signal. The sine-wave input-signal level may be anywhere between 1 and 4 volts r.m.s. You'll find it particularly useful for triggering digital logic circuits.

How It Works. While the sine-wave input signal is going through its positive alternation, diode *D1* conducts and charges up one of three capacitors, *C1*, *C2*, or *C3*, depending on the setting of switch *S1*. Simultaneously, the anode gate of *Q1* is made positive by the input so that the SCS is kept turned off.

When the input signal goes negative, diode *D1* is back-biased and ceases to conduct. At the same time, the anode gate is made negative with respect to the cathode. The SCS is thus turned on and the capacitor (*C1, C2,* or *C3*) discharges through potentiometer *R3*. When the sine-wave input signal goes positive again, the cycle repeats.



This simple self-powered pulse generator can be built directly into an existing audio sine-wave generator. The output pulses can be used to trigger experimental digital circuits or, if accurately calibrated, scope trace times.

How to Use. Connect the output of an audio signal generator to the input of the pulse generator. Connect the output of the pulse generator to the vertical input terminals of an oscilloscope. Set the pulse generator's output level control, *R3*, for maximum output (toward the cathode of *Q1*). Set potentiometer *R2* at about midposition.

Set the signal generator at any frequency between 100 and 10,000 Hz and run its output up to about 2.5 volts r.m.s. Observing the trace on the oscilloscope, set switch *S1* to the position which provides the best spike waveform. Then adjust potentiometer *R2* to improve it, if necessary. The largest value of capacitance (*C1*) is best for the lowest frequencies, and vice versa.

If the output pulse is broad, set *S1* at a smaller value of capacitance. If multiple pulses appear, set *S1* to a large capacitance. With each change in the setting of *S1*, adjust *R2* to get the best obtainable waveform. —30—

The Stereo Scene

by Charles Lincoln

USUALLY, every technology, as it grows, moves from the clumsy, lumbering approach to the lithe and elegant. Often this refinement in techniques and materials is accompanied by a marked improvement in performance, reliability and versatility. So has it been with high-fidelity sound.

The earliest radios and phonographs in which designers paid any attention to sound quality were large, cumbersome, noisy and power-hungry. Compare that with a typical "compact" system of today: reception of FM and stereo-FM broadcasts, either of which have considerably greater information-carrying capacity than standard medium-wave AM, and hence greater fidelity; perhaps AM thrown in as an extra; 3- or 4-speed record changer with fidelity comparable to the best FM broadcasts (typical playing times 25 minutes per side); tape playback and sometimes recording, usually in the form of cassettes which store up to 2 hours of material in two sets of two independent stereo tracks, with bandwidth and noise comparable to much of today's average-quality broadcasting and recording.

The invention of FM radio, multiplexing, tape recording and the transistor are the major innovations around which the high-fidelity recording, reproduction and broadcasting of sound are centered. As for the rest, a steady procession of relatively minor refinements adds up to a significant overall improvement in quality.

A Logical Evolution. It is interesting, and very much to the point, to examine the history of hi-fi and discover that the *compact* system of today is not a throwback to a more primitive stage of sound technology inherently inferior to the separate-component system. The compact from a technical as well as merchandising standpoint, represents perfectly logical evolution. The separate-component system is not the final answer to good sound quality, but in a transitional stage, just as the discrete transistor is rapidly being superseded by the integrated circuit—a functional "black box" that does a desired job without the need for laborious interconnection of elements.

In both cases, the transitional stage was a necessary part of the evolutionary process, of finding out how the components work, how to improve them, and how to relate them to one another.

Various engineers and experimenters in the 1940's discovered that one of the most easily improvable elements in the sound-reproducing chain was the amplifier, and so we saw the introduction of negative feedback and various interesting wide-band, low-distortion circuit designs like the Williamson and the McIntosh Unity-Coupled amplifiers. In the 1930's Armstrong was at work on VHF wide-band FM, which, besides its wider frequency response, was much less sensitive to natural and man-made interference than AM.

The introduction of the long-playing fine-groove 33⅓-rpm record in 1948, with significantly less background noise and much longer playing time than the 78-rpm disc was another transition. The better records demanded more precise pickups with lighter stylus forces and lower moving masses. Speakers also got their share of attention. In the 1950's, the refinement of the Helmholtz resonator type of enclosure, and especially the introduction of the acoustic-suspension principle, rapidly demolished the notion that good bass could come only from huge speaker systems.

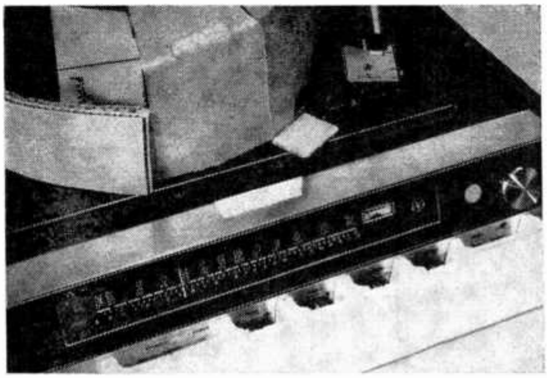
Components Made Their Mark. Each part of the sound system was more or less separately improved. It was quite natural that the record lover who wanted the best system the state of the art had to offer purchased the best amplifier, best speaker, best tuner, best pickup and so forth, very likely each the product of a different manufacturer. He did so because he had no choice, not because there was any particular magic in having separate components. There were (and still are) those who delight in owning a complex array of hardware, and it is partly through them that the mystique of the all-separate components hi-fi system arose. Still, components did once represent the best available, and, with the help of the advertiser's magic brush, the word "components" took up a lofty semantic perch, seeming to distinguish between the true believers and the mere dabblers in home music systems.

But the components created a new problem. Manufacturers naturally sought wider markets for their products, since it was, after all, a business and not a hobby for them. There was obviously a rising interest in hi-fi recorded sound, but many potential customers were discouraged by the apparent complexity of selecting and assembling components for a sound system.

Bit by bit the separately improved components were re-integrated. First came the all-in-one consoles, generally far superior to the department-store radio-phonograph, and usually made by a manufacturer who had a good reputation in home sound. Various combinations of components began to reappear: the tuner plus preamp/control center, the preamp/control center plus power amplifier (the integrated amplifier), and of course the receiver—a tuner with complete audio control and switching facilities plus a power amplifier.

Many such combinations, especially when

ASSAYING A STEREO COMPACT



Packaging. Typical stereo compact is delivered to purchaser in carefully designed, fully protective cardboard or styrofoam cocoon. This Scott Model 2505 also has plastic protective screen over dial.

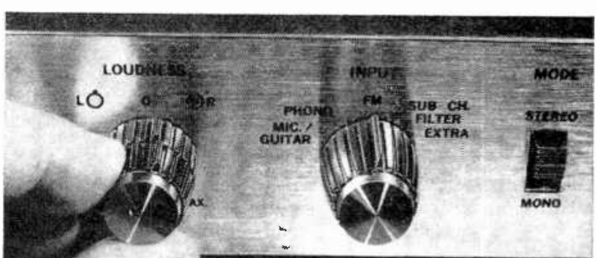
Set and Forget. Two important, but rarely used controls are under the Scott 2505. Three-position "Balance" switch enables listener to compensate for the acoustic differences in room that might interfere with output of speakers. Thumb wheel miniature potentiometer is for setting "Meter Zero" of the tuning meter.

made by the lesser-rank manufacturers, were simplified, somewhat downgraded devices, intended to reach a public that was deemed not to be as critical as the component-type hi-fi buyer. But as the technology continued to improve, as the market expanded and hi-fi became a major industry, it became possible to buy integrated stereo receivers that were the equal of separate-component systems in the same price range. They occupied less space, they were preassembled, and were a little less formidable to operate than comparable separate units.

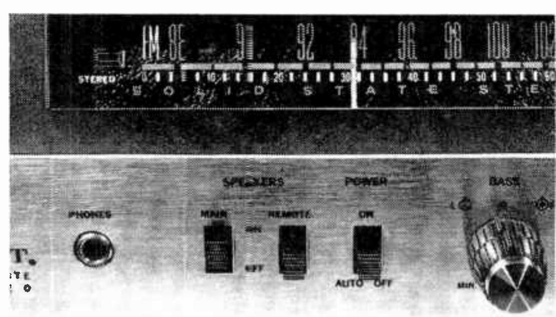
Transistors Make the Difference. The development of transistor technology pushed the process along. Using transistors, it was possible to build high-power amplifiers in much less space than earlier tube designs—partly because of the elimination of the large and heavy output transformer, and partly because transistors, besides being inherently smaller than the tubes required to do the same job, threw off a lot less heat and needed less ventilation. Other circuit elements were made smaller and it was soon possible to crowd more parts into the same space. Complete stereo receivers, with FM, AM and multiplex circuits and two independent amplifier channels are now smaller than monaural FM/AM receivers of 10 years ago.

The mid-1960's saw the introduction of the tabletop unit that included a record changer and a complete receiver (and now also, frequently, a cassette tape unit) in a space not much greater than that occupied formerly by a turntable or changer alone. The audio quality of the better tabletop units is at least as good as the best equip-

Turntable Holddown. Auto turntable is restrained from bouncing and possibility of motor damage by two "transit screws." The screws may seem to be in backwards—counterclockwise turn to restrain, clockwise to release. Turntable is Garrard 2025TC.



Signal Sources. A variety of inputs is possible with typical stereo compact. Besides FM and phono, the user has an extra input for tape and separate microphone/guitar inputs. A special position of input control switches in FM sub-carrier filter. Loudness dual controls for individual channels are clutch-type and, once set, turn in unison.



Sound Distribution. Two pairs of speakers may be fed from the 2505, controlled by rocker switches on front panel. Options include main speakers only, remote speakers only, or both sets simultaneously.

ment available 10 years ago, and compares very favorably with today's middle-bracket component systems. Only the speakers remain separate. The minimum spacing necessary for good stereo effect, about 4 feet or so, is too great to allow the speakers to be built into a single unit. That would defeat the purpose of a tabletop compact. Also, acceptable bass reproduction still requires an enclosed volume of at least a cubic foot or thereabouts, which would again produce an uncomfortably large unit.

The arrangement makes sense from another point of view. Together in the tabletop unit are all the components that require control or manipulation. The speakers, which have no controls, are off at some acoustically and/or esthetically suitable places, which may be inconvenient otherwise.

To Compensate or Not. Another interesting feature of some compacts is the "systems" approach used in their design. One school of sound-system design has held that it is legitimate to compensate for deficiencies in the frequency response of one element in a system with reciprocal equalization in another element. This approach appalled some purists, who felt that this is "cheating" and that every element of a system should be "perfect" by itself. Yet every amplifier for home sound systems has sound controls and we all tinker with the frequency response of the sound channel—as do the engineers who make the records and tapes we buy. (Although a friend of mine once remarked that you can always tell an audio purist by the fact that his amplifier's tone controls are set precisely at their "flat" positions!)

Several manufacturers, notably KLH, have produced remarkably fine sound from very small speaker systems by incorporating a carefully controlled amount of fixed bass boost in the amplifier circuit. Needless to say, this works properly only if the speaker's characteristics are accurately known and consistent, which is true only when the speakers are supplied as part of the system and designed into it. The compensated amplifier would probably sound terrible with a different speaker system. But, does that make it bad, or do we have to establish new criteria for judging the quality of whole systems?

It seems clear to me that we do. The individual specifications of components that are wedded together in a compact have relatively little meaning. The essential judgment on the quality of a sound system must be *how it sounds*. The variety of numbers we use to describe the performance of a sound system—frequency response, distortion, power bandwidth, etc.—are only guides. They are attempts to measure aspects of performance and describe them in definite, repeatable, consistent and comparable ways. But one can fake with numbers—one can play games, create hoaxes, even outright lies, just as easily with numbers and mathematics as with words.

Numbers Don't Count. In addition, there are two other difficulties with numbers. First, the numbers may be very accurate and used in good faith, yet still not mean much. For example, "1% total harmonic distortion at 1 kHz and 50 watts output" is necessarily incomplete, because just how noticeable that 1% distortion is depends on how much of it is second, or third, or fifth, or thirteenth harmonic, the kind of program material, the hearing acuteness of the listener, the loudness level of the program, and the system frequency response. Second, it takes a good deal of knowledge and insight to understand what the numbers purport to describe. How many people can intelligently judge an amplifier's quality by reading its published specifications? Can *you?*

So the advent of the compact system cuts two ways. It may bring to more people than ever before a higher grade of audio quality in a simple, relatively inexpensive package, while it frees them from the confusion generated by a kaleidoscopic variety of separate components, each with its own set of specifications to be read and digested. At the same time, the consumer audio industry is at a crossroads. Having struggled for 20 years to validate the name and concept of high fidelity and differentiate it from mere "radio" or "record-playing", and having built up a huge market demand for products that call themselves hi-fi, the industry could well begin to abuse its hard-won good will. Let us hope that profits will not mean emphasizing compacts more and more—compacts which are sold as complete systems, and about which, little can be said that is meaningful about the individual components in them.

As the market grows, the temptation to exploit it unfairly grows also. It is well to remember that the hi-fi industry is a business just like any other, and its principle motivation is profit.

There is only one immediate answer, and that is for you, the potential buyer of audio equipment, to learn to be intelligently critical of what you buy. If indeed the trend is toward the *compact* with decreasing emphasis on individual components with measured and published specifications, you will have to learn to depend on your ears to tell you what is acceptable to *you* and what is not. But that's another subject.

the product gallery

REVIEWS AND COMMENTARY ON ELECTRONIC GEAR AND COMPONENTS

IN/OUT-OF-CIRCUIT TRANSISTOR TESTER (Heathkit Model IT-18)

The experimenter who works with transistor circuits labors at a disadvantage without the aid of a transistor tester. Most reliable transistor testers are designed for bench use and have laboratory-equipment price tags to match. Not so with the Heathkit (Heath Company, Benton Harbor, Mich. 49022) Model IT-18 In-Circuit/Out-of-Circuit Transistor tester. Feature for feature, the IT-18 is as good a field/bench transistor tester as you are likely to find at twice its kit price of only $24.95.

The IT-18 features Heath's "new" look in test equipment. Built into a rugged one-piece plastic case, the instrument will bear up to the abuse of field use. Open the snap-handle case, and you have access to all controls, transistor sockets, and auxiliary leads for in-circuit tests. The large 4½" meter makes meter reading a cinch.

Inside, the circuit of the IT-18 employs precision components, including 1% tolerance resistors and a ten-turn BETA CALIBRATE control potentiometer. Wiring is point-to-point. But considering the simplicity of the circuit, total construction time should not exceed 3 hours for even the most inexperienced kit builder.

Electronicly, the performance of the IT-18 matches that of good bench-type transistor testers. It measures d.c. *beta* both in and out-of-circuit, collector-to-emitter and collector-to-base leakage out-of-circuit, and diode condition. In addition, it also identifies transistors according to type, and is even self-calibrating.

Circle No. 95 on Reader Service Page 15 or 95

TECHNICAL SPECIFICATIONS

D.c. beta—X1 range: 2-100; X10 range: 20-1000
Accuracy—Out-of-circuit: ±5%; in-circuit: indicates good or bad
Collector-to-emitter and collector-to-base leakage (out-of-circuit only)—0-5 mA (midscale 1000 μA)
Diode testing—In-/out-of-circuit tests indicate whether good, shorted, or open
Power—1½-volt, size D cell

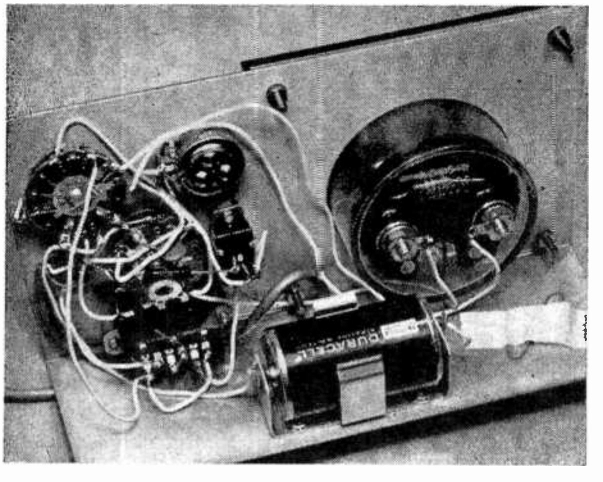


Chart in top of transistor tester case provides guide to case sizes and pin arrangements. In photo at right, a resistor for use in set calibration is shown under the piece of white tape.

(More Product Gallery overleaf)

tpg

CONTINUED

LEVERAGE TOOLS "LEVERWRENCH" (Model #6)

THIS EQUIPMENT reviewer is an admirer of ingenious tool manufacturing. This is coupled with a belief that too many hobbyists fail to realize the advantages of using the right tool at the right time. Who knows how many otherwise attractive construction projects have been scarred by makeshift tools.

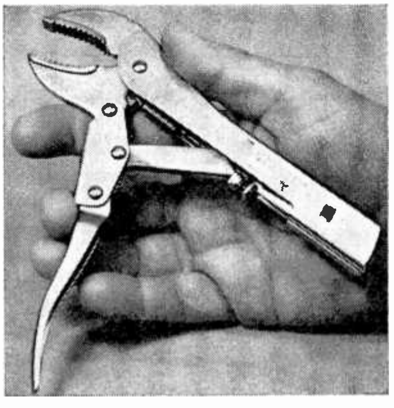
One particular tool that too few hobbyists have at their fingertips is a pair of clamping or grasping pliers—pliers that can be locked. It was with great interest that this reviewer tried out something new in jaw-locking pliers—the LeverWrench automatic model #6 ($3.95).

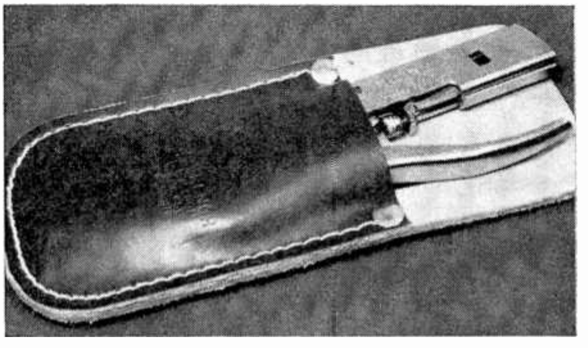
Locking pliers have been around for a few years, but they have a built-in deficiency—you must reset the jaws for varying thicknesses and pressure application. Too light a pressure and your work slips, too tight and the work is scarred or fractured.

The LeverWrench surmounts the varying thickness problem with a special patented "sensing plate" and automatically grasps anything from shim stock to ⅞" (or 1⅜" in the larger Model #10). If you have any doubts about the pressure, you need only adjust a knurled nut about ⅛ turn!

This is a tool that belongs on every workbench or in every tool box. If you want to rigidly hold something in place and you might otherwise *try* to hold it in gas pliers, the LeverWrench is your answer.

Circle No. 96 on Reader Service Page 15 or 115





Smaller size LeverWrench will grip anything from thin shim stock to ⅞" in diameter. Lower handle flips down and away for quick release. Closing the handle applies pressure automatically to any object held in jaws. Each LeverWrench is supplied in sturdy cowhide leather pouch (see above). Tab on pouch is split for carrying it on your work belt.

SOLDERLESS COAX CONNECTORS (NT-T No. 6-80-58 and 6-80-2)

If you want to escape the somewhat hazardous task of soldering coax braid to a PL-259 plug, try the new National Tel-Tronics connectors. The connectors are designed to enable completely solderless splicing and termination of either RG-58 or RG-59 coax cables.

To use them, simply strip off ½" of the black vinyl jacket and ¼" of the braid and inner insulation. Fan out the braid and insert a special Delrin insulator over the inner insulator to compress the braid. Lastly, twist the center wire into a miniature pigtail and screw in the Delrin-insulated plug. Tighten the plug and your connector is finished without soldering. The splicer works in the same fashion.

The connectors are designed so that wire impedance is maintained. They are made of silver plated brass.

Three connectors are available. No. 6-80-2 is a splicer for RG-58 cable. No. 6-80-8 is a plug for RG-58 cable. No. 6-80-8 is a plug for RG-8 cable.

Circle No. 97 on Reader Service Page 15 or 115

COLOR BAR GENERATOR
(Eico Model 385)

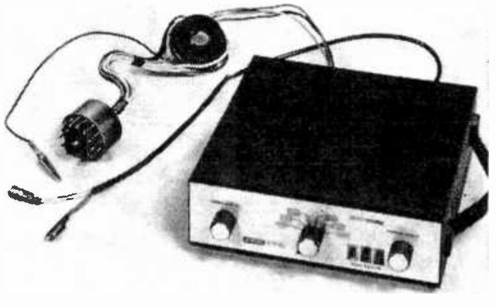
Every so often, a manufacturer of test equipment announces a "new" color bar generator for color TV receiver servicing. Needless to say, not all such instruments are novel; in fact, the great majority are based on a tried and true design principle. Following this line of reasoning (keyed rainbow) is the Eico Model 385 "Color Mate" generator selling for $79.95 as a kit or $109.95 factory wired.

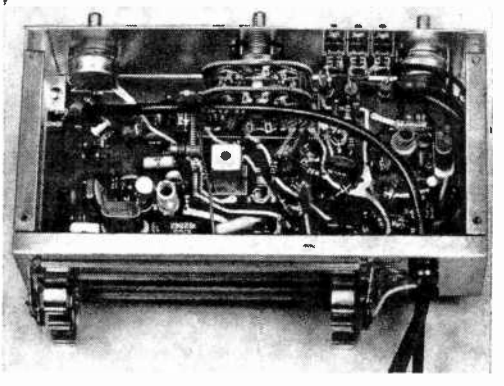
The Model 385 is a rugged instrument, housed in a heavy-duty metal case that has ample storage room for the gun-killer and r.f. cable assemblies. Electronically, the Model 385 generates an r.f. signal on TV channel 3. The patterns that can be impressed on this r.f. signal include individual horizontal and vertical lines; crosshatch lines; dots; and ten-bar keyed rainbow. Each pattern is clear and well-defined, although the very dark portions of the picture-tube display do not fade to the blackest of black.

Checking inside the 385, you will find a large, roomy printed circuit board and printed switch that speed construction time and practically eliminate the possibility of wiring errors. The battery holders for the six C cells that power the circuit are arranged on the rear apron of the enclosure. Once the instrument is assembled, however, it is difficult to insert or remove the batteries without removing the case.

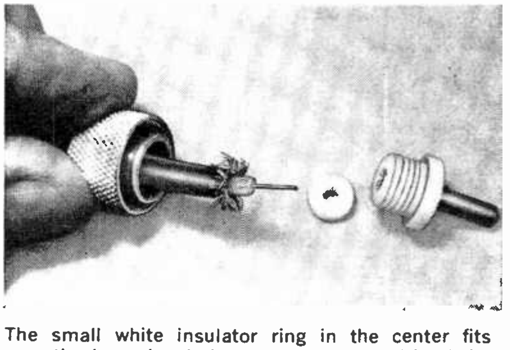
The function switch and gun-killer switches are conventional. We feel there should have been r.f. gain control and video output. Also, the plug and socket supplied with the gun-killer cable assembly are not for the "now" standard wire-pin CRT bases.

All-in-all, the 385 is a sturdy color bar generator servicing kit that will take a lot of wear and tear.

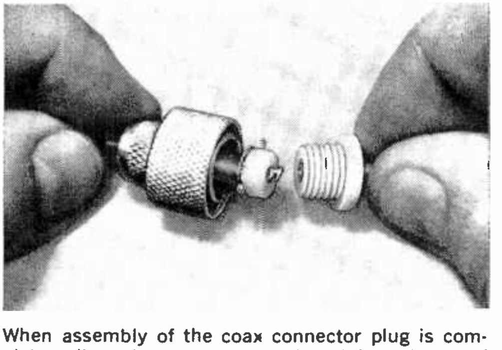




In the view of the Color Bar chassis, above right, the printed circuit selector switch is at the top of the photo while battery clamps on back of chassis are at bottom.



The small white insulator ring in the center fits over the inner insulation to compress and hold the braid when the plug (right) is screwed into holder.



When assembly of the coax connector plug is complete, all contacts are assured and impedance of the cable is maintained at its specified value.

ENGLISH LANGUAGE NEWS BROADCASTS FOR THE MONTH OF SEPTEMBER

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
7:15 a.m.	Melbourne, Australia	9.58, 11.71
7:45 a.m.	Copenhagen, Denmark	15.165
8:15 a.m.	Montreal, Canada	9.625, 11.72, 15.325
7:00 p.m.	Montreal, Canada	9.625, 11.945, 15.19
	Moscow, U.S.S.R.	9.685, 11.87, 11.96
7:30 p.m.	Johannesburg, South Africa	5.98, 9.705, 11.875
8:00 p.m.	London, England	6.11, 9.58, 11.78, 15.14
	Peking, China	15.06, 17.673
	Sofia, Bulgaria	9.70
8:30 p.m.	Kiev, USSR (Mon., Thu., Sat.)	9.685, 11.735
	Stockholm, Sweden	11.915
8:50 p.m.	Brussels, Belgium	6.125
	Vatican City	9.615, 11.785, 15.285
9:00 p.m.	Berlin, Germany	9.73, 11.89
	Budapest, Hungary	9.833, 11.91
	Havana, Cuba	9.525, 15.285
	Madrid, Spain	6.14, 9.76
	Prague, Czechoslovakia	5.93, 7.345, 9.54, 11.99
	Rome, Italy	9.575, 11.81
9:30 p.m.	Berne, Switzerland	6.12, 9.535, 11.715
	Cologne, Germany	6.075, 9.735
	Tirana, Albania	6.20, 7.30, 9.50
9:45 p.m.	Copenhagen, Denmark	9.52
10:00 p.m.	Hilversum, Holland (via Bonaire)	11.73
	Lisbon, Portugal	6.025, 11.935, 15.125
	London, England	6.11, 9.58, 11.78
	Moscow, U.S.S.R.	9.685, 11.735, 11.87
	Peking, China	15.06, 17.673
10:30 p.m.	Beirut, Lebanon	11.785

TO WESTERN NORTH AMERICA

TIME-PDT	STATION AND LOCATION	FREQUENCIES (MHz)
7:00 a.m.	Tokyo, Japan	9.505
9:00 a.m.	Stockholm, Sweden	15.315
6:30 p.m.	Tokyo, Japan	15.195, 17.925, 21.64
7:00 p.m.	Melbourne, Australia	15.32, 17.84, 21.74
7:30 p.m.	Bonaire, Neth. Antilles	15.345
	Johannesburg, South Africa	5.98, 9.705, 11.875
8:00 p.m.	London, England	6.11, 9.58, 15.26
	Madrid, Spain	6.14, 9.76
	Peking, China	15.095, 17.673, 21.735
	Prague, Czechoslovakia	5.93, 7.345, 9.54, 11.99
	Seoul, Korea	15.43
	Taipei, Taiwan	15.125, 15.345, 17.89
8:30 p.m.	Berlin, Germany	9.73, 11.825
	Stockholm, Sweden	11.705
	Tirana, Albania	6.20, 7.30
9:00 p.m.	Budapest, Hungary	9.833, 11.91
	Havana, Cuba	9.525, 11.76
	Lisbon, Portugal	6.025, 11.935, 15.125
	Moscow, USSR (via Khabarovsk)	15.18, 17.865, 17.88
	Peking, China	15.095, 17.673, 21.735
	Sofia, Bulgaria	9.70
9:30 p.m.	Kiev, USSR (Mon., Thu., Sat.)	9.665, 11.735, 11.96
9:45 p.m.	Berne, Switzerland	9.72, 11.715
	Cologne, Germany	6.145, 9.545
10:00 p.m.	Havana, Cuba	9.525
	Hilversum, Holland (via Bonaire)	9.715, 11.73
	Quito, Ecuador	15.255
	Tokyo, Japan	15.105
11:00 p.m.	Moscow, USSR (via Khabarovsk)	15.18, 17.865, 17.88
11:30 p.m.	Havana, Cuba	11.93

AMATEUR RADIO

By HERB S. BRIER, W9EGQ
Amateur Radio Editor

THE NEW RADIO SEASON

JUST AS January 1 starts the calendar year, September 1 traditionally starts a new radio year. As the sun moves back toward the south after spending the summer up north, static levels go down, daytime maximum usable frequencies (MUF) increase, and nighttime frequencies decrease. There may be two peaks in the current sunspot cycle and DX conditions on the amateur 21-MHz band should be as good or better than they were last year (when they were very good). Conditions on the 28-MHz band should be just about as good as they were last year. Both bands, however, will probably open for DX a little later in the morning and close a little earlier in the afternoon or evening than they did during the 1968-1969 season.

The slightly lower level of sunspot activity means that the chances for 50-MHz trans-Atlantic or trans-Pacific DX this season are virtually nil, but there probably will be a number of 50-MHz openings between the United States and Central and South America before next spring. On lower frequencies, conditions on 14-MHz should be little different from last season but nighttime conditions on the 7-, 3.5-, and 1.8-MHz bands should improve a little. All in all, many DXCC certificates will be filed by amateurs working 100 or more countries on each of five amateur bands.

W6MLZ and the International Handicappers Honored. Harold Russell, Chairman of the President's Committee on Employment of the Handicapped, has appointed Ray Meyers, W6MLZ, a member of the committee. Russell also named the International Handicappers an organizational committee in recognition of the net's "brilliant record of Public Service." Ray, the only American holder of the International Columbus Gold Medal Award for Humanitarian Service, organized the International Handicappers ten years ago and has since issued several thousand membership certificates. The Handicapper Net operates daily on 7280 and 14287 kHz and cooperates with other public service nets.

W6MLZ is Civil Defense director for San Gabriel, California, and writes a weekly "Ham on the Air" column for the Los Angeles *Herald Examiner*. Incidently, "Hire

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AMATEUR STATION OF THE MONTH

Noah L. Cottfried, WA2URS, 955 Franklin Lakes Rd., Franklin Lakes N.J. 07417, went from Novice to Advanced in six weeks, working 32 states and eight countries in the meantime. Having to attend school (8th grade) slowed him down a little. Noah has a Heathkit DX-60B transmitter and Realistic DX-150 receiver. A Hy-Gain 18-V vertical antenna, 30' high, handles the outside work. We are sending WA2URS a 1-year subscription to POPULAR ELECTRONICS for winning our Amateur Station Photo Contest this month. You can enter the contest by sending us a clear photo (black and white preferred) of you at the controls of your station. Include some details of your radio career and send to Amateur Station Photo Contest, c/o Herb S. Brier, Post Office Box 678, Gary, Ind. 46401.

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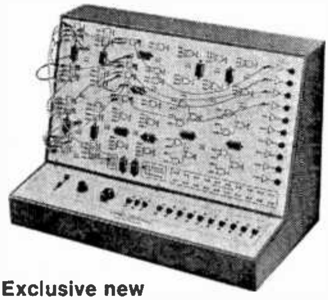

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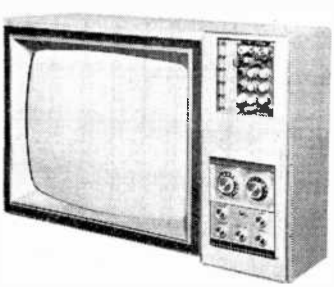

COLOR TV 295 SQ. IN. PICTURE

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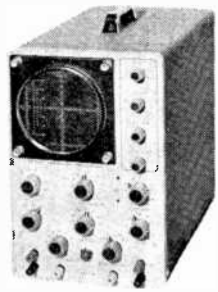

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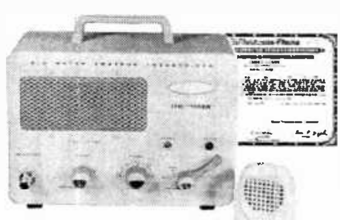

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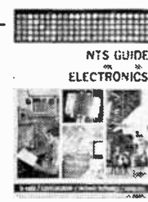

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the Handicapped Week" is October 1 through 7.

FCC and ARRL Actions. Last spring, the Federal Communications Commission scheduled public hearings on the proposal to modify the amateur regulations to allow: radioteletype operation in the 28-28.5-MHz segment of the 28-29.7-MHz band; to shift the 2-meter CW band from 147.9-148 MHz to 144-144.1 MHz; and to permit U.S. amateurs to operate maritime-mobile on the high seas in the 7-7.1 MHz segment of the 40-meter band—the only portion of the band assigned to the worldwide amateur service. Unless unexpected opposition to these proposals is developed, the changes should go into effect shortly.

The reason for moving the 2-meter CW sub-band to the low-frequency edge of the band is that virtually all international 2-meter communications via the moon, satellites, meteor showers, etc., are on code; and in many parts of the world, the only amateur 2-meter assignment is 144 to 146 MHz.

At the recent board meeting of the American Radio Relay League, Inc. (ARRL), it was voted to ask the FCC to open the entire 144-MHz band to Technician class operators and authorize Technicians to operate between 29.5 and 29.7 MHz. The board also recommended that the FCC reduce from two years to one year the period that an amateur must hold a license of a grade higher than Technician before he is eligible to apply for an Extra class license.

W9EGQ personally favors the three ARRL proposals, but we suspect that the FCC will reject the proposal to permit Technician operation in the 10-meter band, as it has rejected several similar proposals in recent years. In any event, the red tape involved will probably delay any ruling on these matters for some months.

On the operating front, the ARRL board authorized its headquarters station, W1AW, to transmit code practice on the usual W1AW frequencies in the mornings for a 6-month trial period to determine whether or not there is any demand for code practice transmissions at this time of day. It also authorized a new 5-band WAS (Worked All States) award to parallel the 5-band DXCC award authorized last year.

Items From Here and There. Although Great Britain has 50 per cent more amateurs than any other European country, one of amateur radio's mysteries is why G's, GM's, GW's, etc., are so scarce on the bands when other Europeans are coming through. The G's themselves blame TV Channel One on 42 MHz. They say this channel, being so close to the 28-29.7 MHz amateur band and being in the second and third harmonic shadows of the 21- and 14-MHz amateur bands, creates a difficult TVI (television interference) problem.

Well, things are looking up for the G's. Starting in mid-November, all English VHF TV programs will be duplicated on the UHF channels. Later, the VHF channels will be phased out of service. The change is expected to be 75 to 80 per cent complete in the large population centers by the early 1970's. There will be some educational TV programs on the VHF's until the early 1980's.

Is the world's oldest licensed amateur an Englishman? *Radio Communications* (London) reports that over 72 years ago, Will Badman, G2ZG, then 18 years old, charged the batteries that Marconi used in his successful 1897 experiments to transmit wireless signals across the Bristol Channel. Now 91 years old, G2ZG can truly say that he has been associated with wireless or radio from its earliest days.

Ray Meyers, W6MLZ, was also intimately associated with an early radio pioneer. In 1914, Ray—then a young Navy sailor—climbed some 600-foot towers to string up

(*Continued on page* 100)

This is where Explorer Post V of the Boy Scouts meets in Oklahoma City through the courtesy of Clyde Johnson, WA5VIL. The Collins KWM-2 transceiver is fitted with a crystal adapter for Novice operation. A Hallicrafters TR-46 and a complete Drake KW SSB/CW are also available for Scouts to use.

TWO WAY REACTIONS

BY G. H. REESE, KCN6990

ESTABLISHED by Hallicrafters in 1963 as a community program to provide organized Citizens Two-Way Radio communications in local emergencies, REACT is now sponsored as a public service by General Motors Research Laboratories. With almost 1500 locally organized teams in all 50 states and over 40,000 members, we receive considerable information about the entire field of Citizens Radio. We will attempt to bring to this column news of all activities of CB clubs, government, and news events that have a bearing on those using this means of communication. In all of this, we will emphasize the positive public-service aspects.

> **NOTE**
>
> This is the first of a series of monthly columns devoted to news and developments in Citizens Two-Way Radio. POPULAR ELECTRONICS is pleased that REACT National Headquarters will be able to prepare these columns. News of Citizens Two-Way Radio appearing in this column will not be confined to REACT activities, but will encompass the gamut of the largest radio communications service in the world.
>
> Editor, POPULAR ELECTRONICS

Citizens Two-Way Radio is growing in popularity. Latest statistics show that about three million radios are in use with 15,000 to 20,000 new licenses granted each month. Approximately 100,000 new licenses were granted during the first half of 1969. Licensees operate at least two and sometimes three transceivers. It is estimated that one car out of 60 is now equipped with Citizens Two-Way Radio. In 1968, REACT teams alone reported to authorities over 1,200,000 automotive emergencies, 27% of which were accidents.

New Booklet. A very informative booklet has been published by the Citizens Two-Way Radio Section of the Electronic Industries Association. We recommend it to those who wish to learn more about this communications medium. It is ideal for use by the active enthusiast in explaining the service to others. REACT National Headquarters has a limited supply and will be happy to send one without charge to anyone forwarding a stamped, self-addressed envelope (#10 size for business letters) to: E.I.A. Booklet, c/o REACT National Headquarters, 205 West Wacker Drive, Chicago, Ill. 60606.

Highway Safety. With the overall objective of improving highway safety, General Motors Research Laboratories has been ex-

The Ozark REACT team is justly proud of its emergency truck. It provides a mobile base for operations—especially valuable in search and rescue work.

This typical REACT base station is that of the Honolulu team. Monitor radio, rosters, and emergency telephone numbers are all within easy arm's reach.

ploring the problem of two-way communication from automobiles for over ten years. During this time, they have tested the practicality of Citizens Two-Way Radio. The medium has been incorporated into several experimental designs for highway guidance systems. In an extensive operational test, an emergency network was established in 1966 to monitor the John C. Lodge Freeway in Detroit. This service proved so valuable on the twelve miles of freeway that the system was expanded under the control of the Detroit Department of Streets and Traffic to cover the entire city of Detroit in April 1968.

Today, the Detroit CB Radio Aid Network handles as many as 1000 calls per month. This includes reports of traffic accidents, requests for road conditions and routing information.

Through all of this, the significant result has been the unquestioned value of Citizens Two-Way Radio for improved communications and greater safety on the highway. Now, with the sponsorship of REACT, GMRL has expanded its research in this communications area to the entire country.

REACT introduces one additional element to the past experiments—*volunteer service*. REACT teams aim to monitor the Citizens Radio Channel 9, 24 hours per day. They operate on a strictly voluntary basis. Cooperating with local authorities, they are prepared to provide emergency communication in disasters such as floods, tornadoes, fires, etc. In addition, they assist in communications for special events such as parades, fairs, rodeos, etc.

Arthur Underwood, KNM1243, who is Manager of GM Research Laboratories, states the sponsor's attitude toward REACT: "While REACT has built an amazing record of usefulness in its relatively brief history, it has the potential for still further growth. We at GM Research, as a public service, are going to help REACT realize that potential. No matter how far science and technology take us in our ability to cope with highway problems, there will al-

(*Continued on page* 105)


Members of the Ozark REACT team contributed considerable amounts of own time, money and effort to purchase and equip their emergency truck.

SHORT-WAVE LISTENING

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

ECUADOR, SANTO DOMINGO, BRAZIL, AND BONAIRE

HCJB Increases Service. The number of daily broadcast hours of HCJB has been increased to 50. Two additional hours have been assigned to Spanish; four additional hours to English. Russian, Rumanian and Japanese programming hours have been increased.

A new program "Northwest Alert" begins at 0500 and joins the "Southern Cross Salute" until 0800. The target areas are Canada and Alaska. The frequency for this service is 15,255 kHz. The second new program is "Calling India" and is beamed to India and Southeast Asia from 0000-0130 on 11,765 kHz and from 0130 on 11,795 kHz. "Carribean Call" now begins at 2200 using 11,765 kHz until 2330, then adding frequencies in th 16- and 19-meter bands.

More on HISD. A letter has been received from Lawrence Brandon, Universal Broadcasting Corporation, 310 Madison Avenue, New York, 10017, in which he states that his organization has been operating HISD, Santo Domingo, Dominican Republic, since February 25, 1968. The schedule that Mr. Brandon sent shows English in use from "11:00 a.m. to 11:00 p.m." (presumably this is EST; the GMT equivalent is 1600-0400) daily on 9505 kHz (50 kW), 6090 kHz (20 kW) and 3215 kHz (7.5 kW). Mr. Brandon says that the station would like to receive reports from as many countries as possible and that "anyone correctly identifying one of the programs will receive a card of acknowledgement". However, *send all reception reports to the New York address,* not to Santo Domingo.

Once in a Lifetime. One of our Detroit monitors told us that he logged *Trans World Radio,* Bonaire, Netherland Antilles, the other evening. This in itself would not seem to be a news item because many DX'ers can easily tune this 800-kHz medium-wave outlet. However, this particular reporter lives almost in the shadow of the antenna of CKLW, Windsor, Ontario. This station also operates on 800 kHz with 50 kW power. Fortunately, CKLW was off the air with antenna trouble between 0230-0400, thus affording those in Michigan, Ontario, Ohio, and surrounding areas an unusual opportunity to log Bonaire.

ZYK-33 Wants Reports. Snr. A.S. Miranda of station ZYK-33, Recife, Brazil, has requested reception reports. Snr. Miranda is the technician in charge of this station. He lists daily transmissions at 1200-0030 on 15,145 kHz with programming in Portuguese. All correct reports will be verified if send directly to Snr. A.S. Miranda, ZYK-33, P.O. Box 1332, Recife, PE., Brazil. He requests a self-addressed envelope and one IRC.

CURRENT STATION REPORTS

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

Afghanistan—"That is the end of the news from

Danny Hubert, way up in La Tuque, Quebec, uses a Trio 9R-59 for tuning the ham bands, a Hallicrafters S-200 for general short-wave listening, and a Hitachi TH-812 for the medium waves. Danny, his family, and most of the neighbors are also CB operators—there's a mobile unit on the dog sled.

Radio Afghanistan" is the ID noted at 1805 at the close of English news on 15,264 kHz. This new frequency then goes into music. S/off time is currently 1830.

Algeria—A recent schedule from *Radiodiffusion Television Algerienne,* Algiers, reads: Arabic on 11,810 kHz at 0600-0900 and 1100-0000; Kabyl on 9685 kHz at 0600-0800 and 1200-2230 (Sunday 0600-2230), 11,835 kHz at 0600-0800, 1200-1400 and 1700-0000 (Sunday 0600-0000) and on 9510 kHz at 0600-0800 and 1200-0000 (Sunday 0600-0000); French on 6080 kHz at 0600-0800 (Sunday until 0900) and 1700-0000 and on 15,200 kHz at 1200-1700 (Sunday 0900-1700).

Angola—*R. Clube da Huila,* CR6RH, Sa da Bandeira, 5024 kHz, has been logged with lengthy classical music periods and few anmt's around 2130 in Portuguese.

Bolivia—*R. El Condor, La Voz del Ferroviario,* Oruro, 6070 kHz, features L.A. pop tunes and the usual Bolivian format until 0330 (varies) s/off.

Bulgaria—*R. Sofia* noted on 17,830 kHz with IS at 2104; ID in Bulgarian and English and news followed. This was dual to 15,310 kHz.

Burma—*R. Rangoon,* 4725 kHz, has been noted often on the West Coast from 1223-1327 but only in Burmese and with no music.

Cameroon—A good catch in the middle of the 75-meter ham band, if you can log it, is *R. Buea,* Buea, 3971 kHz. It has been noted before its listed s/on time at 0500; there is an English newscast at 0515. Otherwise programs are in mixed vernaculars and French.

Canada—Canadian Broadcasting Corp xmsn's to Africa at 1832-1915 and 1915-1958 and to Europe at 2000-2044 and 2045-2152 have been moved from 15320 kHz to 15,325 kHz. Other xmsns noted: 11,765 kHz in French at 0624, dual to 9625 kHz, and 17,720 kHz at 2300 in English news.

Cuba—Havana has English for the Americas at 2050-2150 on 15,285 and 17,715 kHz, 0100-0450 on 9525 kHz, 0100-0600 on 15,285 kHz, 0330-0600 on 11,760 kHz and 0630-0800 on 11,930 kHz. Reports to P. C. Peraza, Apartado 6240, Havana. The *Voice of Vietnam* program in English can be heard on 11,760 kHz at 0400-0600 and there is a newscast at 0500. French at 1755 and Spanish news at 1913 is the result of our tuning on 15,195 kHz.

Denmark—Copenhagen operates to N.A. at 1145-1215 on 15,165 kHz and at 0145-0215 on 9520 kHz. "DX Window" is heard on Mondays.

UTILITY STATIONS

Dean Frey, VE6PE7N of Fort Saskatchewan, Alberta, sends this list of recently copied Morse stations:

Ethiopia—NKA, U. S. Naval Station, Asmara, has a CW tape on 17,510 kHz at 1700. Power is 10 kW.

Japan—JCU/JCT and JCS, Choshi, verifies by card. The station operates on 17 frequencies, including 13,105, 12,878 and 12,826.5 kHz.

Poland—SPA4, Gdynia, has a CQ tape of 8482 kHz around 0630. The transmitter is 20 kW and the antenna vertical and non-directional.

Sao Tome—CQK55 is a CW station on 17,455 kHz. Verification is by letter and is signed by the postmaster general. The power is 5 kW and best listening time is at about 1900.

Dean would also like assistance in obtaining city locations for the following: CCS on 6980 kHz at 0745 (probably Chile), TGA on 5788 kHz at 0500 (Guatemala), BBE3 on 18,400 kHz at 2300, YVG on 17,460 kHz at 2100 (Venezuela) and UKD on 11,887 kHz at 0030 (Russian).

Ecuador—New frequencies in use by HCJB, Quito, include 9710 kHz with an English ID and time pips at 0600, then into German with religious music; 11,795 kHz at 0700 in English with a religious story and drama; and 15,255 kHz with religious music at 0707, dual to 11,755 kHz.

Egypt—Cairo, too, has several new channels in service. English with pop music is noted at 2225 on 9778 kHz. Arabic news after a clock strike for 1 a.m. was heard at 2200 on 11,908 kHz. An all-Arabic xmsn to the Middle East, N. Africa and W. Europe at 2200-2300 is broadcast on 15,090 kHz. This latter xmsn includes chanting, orchestral Arabic music and some brief anmts.

England—The World Service from London is on two new frequencies: 15,140 kHz, dual to 11,780 kHz and the Ascension Island relay on 9510 kHz, and all to N.A. at 2300-0000; news at 2300, "Jazz Time" to 2344 and "Letter From America" to 2359; and on 15,290 kHz, dual to 21,550 kHz, to the West Indies, Central and South America at 2200-2300; news at 2200, talks and folk music to 2245 and sports news to 2259.

Ethiopia—*R. Voice of the Gospel,* Addis Ababa, has this current English schedule: (Xmtr 1) 0530-0555 to W. Africa on 11,890 kHz, 1330-1345 to India on 15,315 kHz, 1655-1710 to Ethiopia on 6065 kHz, 1930-1945 and 1945-2015 to W. Africa on 11,910 kHz. (Xmtr 2) 0400-0425 to E. Africa on 9680 kHz, 1330-1345 and 1345-1400 to India on 15,150 kHz, 1700-1715 to E. Africa on 9695 kHz, 1800-1815 and 1815-1855 to S. Africa on 9705. kHz.

France—*Ici Paris,* 15,135 kHz, noted with this ID at 0000; news followed and this was dual to 15,120 kHz.

Germany (East)—*R. Berlin International* ,has changed its schedule to N.A. Broadcasts to the East Coast are at 0100 and 0230 on 9730 and 11,890 kHz and to the West Coast at 0330 on 11,840, 11,970 and 15,450 kHz.

Guinea—*R. Conakry* was heard on 7125 kHz at 2330-0000 s/off in French; they repeat *La Voix de la Revolution* several times at s/off. The same frequency, dual to 15,310 kHz at 0711 and 0823 in French and/or African languages.

Holland—The former English xmsn to N.A. at 2055-2150 is now aired at 2125-2250 daily except Sunday on 15,425 kHz, dual to 11,730 kHz. The always popular "Happy Station Program" with Eddie Startz has been drastically moved, time-wise; the N.A. version is now aired via Bonaire Mondays at 0155-0320 on 11,730 kHz; the West Coast program is also Mondays 0455-0620 on 11,730 and 9715 kHz. Your Editor opposes the change from the previous long-time schedule: the new program hasn't been heard at our listening post for over a month!

India—*All India Radio,* Delhi, was noted with English to Europe at 1945 on 11,620 kHz.

Italy—At press time, Rome has English news and music to N.A. at 0100-0120 on 11,810 and 9575 kHz.

Kuwait—*R. Kuwait* has been found at 1600 with an IS, a clock strike for 7 p.m., an English ID and into pop music on a new frequency of 15,405 kHz.

Lebanon—Beirut was monitored on 17,815 kHz at 0037-0100 with anmt's, talks and music, in Spanish; on 15,285 kHz to N.A. at 0130 in French and 0230 in English; and on 11,825 kHz in English to Europe and N.A. with news to 0230 and "Spotlight" following.

New Zealand—*R. New Zealand,* Wellington, has replaced 11,705 kHz with 6080 kHz to Australia from 0900-1145. English news was tuned at 1000 on 6080 and 9520 kHz.

Pakistan—Karachi has been heard on 15,405 kHz at 2015 when ending English news, and on 15,265 kHz with IS and an ID in Turkish at 1845, an anthem and anmt's, and into Indian music.

Panama—Currently the best time to log HOU31, *La Voz del Baru,* David, 6045 kHz, is around 1030 when it has frequent ID's in Spanish and native music.

(Continued on page 102)

SOLID STATE

By LOU GARNER, Semiconductor Editor

SOLID-STATE electronics has played a significant role in establishing America's commanding lead in the space race. Without the reduced bulk, weight and power requirements of communications gear, telemetry equipment, space vehicle computers, and control systems made possible by semiconductor circuits, our astronauts might have waited for years for the development of more powerful rocket propulsion systems to take them to the moon.

Past achievements, no matter how spectacular, are but stepping stones to greater goals. Even today, scientists and engineers are busy developing new electronic equipment which may be needed by future space technicians.

An experimental version of one suggested control unit, developed by RCA's Advanced Technology Laboratories, Camden, NJ, was displayed at the 23rd Annual Convention of the Armed Forces Communications Electronics Association (AFCEA) held last June in Washington, D.C.

So advanced that it might have been a science-fiction creation, the new control system was designed to enable a future astronaut to move about in space *merely by speaking* directional commands, thus freeing his hands for other tasks. Operating on voice recognition patterns, the demonstration model weighed approximately 25 pounds and required a container about the size of an average suitcase. RCA's engineers are confident, however, that a production model can be developed which will weigh less than 5 pounds (on Earth, naturally) and occupy only 100 cubic inches.

Farewell to Tubes. Although at least one major manufacturer (Motorola) has a broad line of fully transistorized TV receivers and a number of others produce partially transistorized designs, only about 5% of the circuits used in the millions of sets produced in the U.S. during 1968 employed transistors. However, 1969 may be the year of the big swing to solid state, according to Texas Instruments' Director of Applications, Howard Bonner. He predicts that there will be a substantial increase in the number of semiconductor units used in TV sets during 1969-70, with IC's, transistors, and related devices gradually edging vacuum tubes out of the television receiver market. As many as 70% of all U.S. produced circuits may be fully transistorized (or "IC'ed") by 1971.

Until recently, most manufacturers have balked at the higher prices of suitable semiconductor devices as compared to vacuum tubes, as well as the major engineering costs that would be incurred by a switch to solid-state designs. However, transistor and IC prices have continued to drop while tube prices have remained static, with the result that transistor costs, in general, have dropped far below those of tubes. Today, then, circuit redesign is not only feasible, but almost mandatory from an economic viewpoint, to compete with the rising tide of low-cost imported sets, most of which are solid state.

Inventor's Corner. A lot of guys get good ideas for circuits or mechanisms that they feel are really worthwhile. Unfortunately, they feel that, until they get a patent, they

Caught in a moment of high spirits, Lou Garner (on the left) presents an award to Frank Reel, Vice President of Metromedia Producers Corp. Award was made during the Conference of the Society of Technical Writers and Publishers. Metromedia won for TV's "The Undersea World of Jacques Cousteau".

can't talk about anything for fear of having the idea stolen. Now, a new service, provided for inventors by the U.S. Patent Office, provides for the acceptance and preservation for a limited time of "Disclosure Documents" as evidence of the dates of conception of inventions.

Under the new "Disclosure Document Program", a paper disclosing the invention and signed by the inventor may be forwarded to the Patent Office where it will be retained for two years and then destroyed unless it is referred to in related patent applications. This disclosure is not a patent application. When the inventor is ready to submit his patent application, he can refer to the disclosure document in his letter of transmittal.

Other details of the program are outlined in a brochure available from the U.S. Patent Office, Office of Information Service, Washington, D.C. 20231. Ask for "Disclosure Document Program."

Reader's Circuit. Widely used in switching, control and power-supply applications, the silicon controlled rectifier (SCR) is seldom encountered in other types of circuits, for its "all or nothing" conduction characteristic limits its use in oscillator and amplifier arrangements. Thus, the circuit shown in Fig. 1—a linear (sawtooth) sweep generator—is a somewhat unusual application for this device. Reader Nyle A. Steiner (K7NUH, 186 "S" Street, Salt Lake City, Utah 84103), who submitted the design, has achieved this unique mode of operation by combining the electrical characteristics of an SCR with those of a neon lamp. According to Nyle, the circuit will deliver a sawtooth signal of sufficient amplitude to provide direct horizontal drive for the typical cathode-

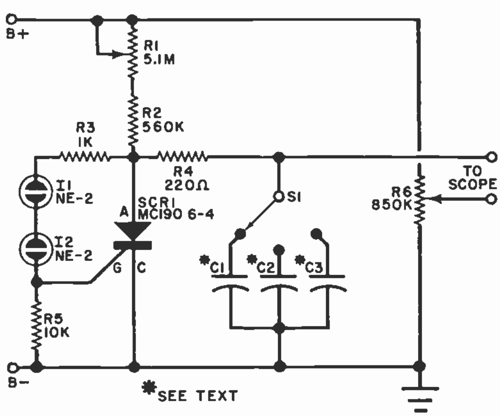


Fig. 1. An SCR is used in a rather unusual application in this linear (sawtooth) sweep generator.

ray tube used in most general-purpose oscilloscopes.

In common with most relaxation oscillators, Nyle's circuit utilizes the charge-discharge features of an *RC* network to form the familiar sawtooth waveform. Referring to Fig. 1, *SCR1* and neon lamps (*I1* and *I2*) are in a non-conducting (open) state when d.c. is first applied. A capacitor selected by *S1*, is charged slowly by the d.c. source through *R1*, *R2* and *R4* until its voltage equals the combined ionization voltages of the neon lamps. At this point, the neon lamps "fire," furnishing gate current to *SCR1* through current limiting resistor *R3*, switching the SCR to a conducting status. This discharges the capacitor through *R4*. With the capacitor discharged, *SCR1* reverts to its non-conducting status, the neon lamps are extinguished, and the cycle repeats.

Potentiometer *R6* is not a functioning part of a basic circuit. It is included to provide a d.c. reference for beam centering when the circuit is used to furnish direct drive to a CRT's plates.

The circuit's repetition rate (frequency) depends on the supply voltage, the neon lamps' combined ionization voltage and, of course, on the time constant of the *RC* network which includes *R1*, *R2*, *R4* and the selected capacitor. The value of *R4* is relatively small, and therefore, can be ignored. A variable resistor is used for *R1* to serve as a fine frequency control, while selector switch *S1* provides a choice of capacitors (*C1*, *C2*, or *C3*) and thus acts as a coarse control or range switch.

All the parts used are readily available. Resistors *R2*, *R3*, *R4* and *R5* are half-watt resistors; *I1* and *I2* are type NE-2 or NE-51 neon lamps; and *SCR1* is a Motorola type MCR1906-4 or equivalent with, at least, a 200-volt rating. The timing capacitors, *C1*, *C2* and *C3*, should be good quality 400-volt plastic film or paper tubulars, with their values determined experimentally to provide the desired range of operating frequencies; generally, values from 0.01 μF to 0.25 μF will be used.

Neither parts nor wiring arrangements are critical and the circuit can be assembled using any of a variety of construction methods. The neon lamps should be shielded to exclude light, for these devices may be photosensitive. Virtually any well-filtered d.c. source furnishing in excess of 200 volts may serve as a power supply, but Nyle suggests at least 350 volts be used to insure a linear output signal.

Manufacturer's Circuit. Originally designed for use as a video amplifier in a monochrome TV receiver, the circuit shown in Fig. 2 could serve either as an untuned r.f.

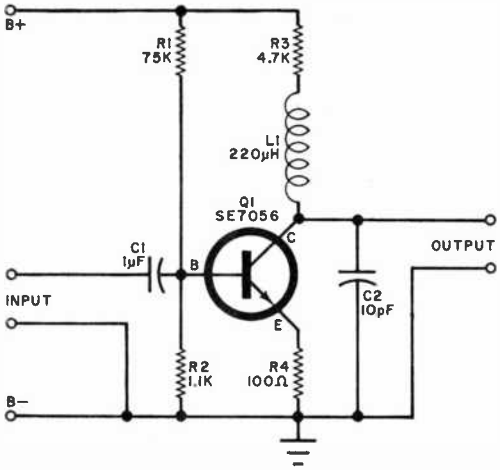


Fig. 2. This versatile amplifier, with its 3-dB point at 2.6 MHz, is described in the text below.

amplifier in a broadcast-band receiver or as a general-purpose wide-band amplifier in a transistorized cathode-ray oscilloscope, signal tracer, a.c. voltmeter, or similar test instrument. Abstracted from Fairchild Semiconductor's application manual for the TCSO123 series of high-voltage silicon planar transistors, its 3-dB point is 2.6 MHz, but this can be extended by modifying the peaking network.

A conventional common-emitter configuration, the circuit itself is not unusual, but it does illustrate what can be achieved by the application of professional engineering design techniques. In operation, *Q1*'s base bias is established by voltage-divider *R1-R2* in conjunction with emitter resistor *R4*. Resistor *R3* serves as the collector load, with the circuit's frequency response extended by peaking network *L1-C2*. A moderately large input coupling capacitor (*C1*) insures good low-frequency response.

The circuit may be assembled from conventional commercial components. Transistor *Q1* is a Fairchild SE7056 *npn* type. Composition resistors should be used throughout, with *R1* a 1-watt, *R3* a 2-watt, and both *R2* and *R4* half-watt units. Any commercial 220-µH peaking coil can be used for *L1*. Coupling capacitor *C1* is a 400-volt plastic film or tubular paper type and *C2* a 400-volt mica or ceramic capacitor.

Although either etched circuit or perf board may be used, layout and lead dress are reasonably critical and good wiring practice should be observed during assembly. Signal carrying leads should be kept short and direct to minimize both distributed capacitances and stray inductances. A low-ripple, 150-volt d.c. source should be used as the circuit's power supply.

New Devices. A new hybrid IC video amplifier has been developed by the Amperex Electronic Corporation (Cranston, Rhode Island). Intended for use in tape recorders, video circuits, comparators, broadband amplifiers, frequency selective instruments and active filters, the new unit, illustrated in Fig. 3, is designed around low-noise LID semiconductors and features a sputtered thin-film process. Designated type ATF-416, the device offers a gain of approximately 52 dB from d.c. to 10 MHz and has a common mode rejection of at least 40 dB. Its bandwidth with a 1000-ohm, 20-pF load is 8 MHz. The ATF-416's input section is a 3-stage d.c.-coupled differential amplifier, while its output is a 2-stage cascaded d.c. amplifier. This arrangement permits a designer to use the device either as a gain- or bandwidth-controlled unit, or as a straight broadband amplifier.

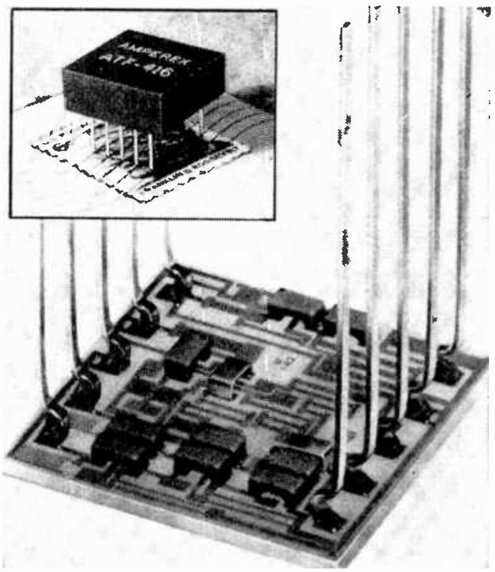


Fig. 3. Hybrid IC video amplifier features a gain of approximately 52 dB from d.c. to 10 megahertz.

Plastic 4-ampere SCR's that can operate at rated currents at case temperature as high as 97°C., and with current-stage ratings 50% higher than other competitive plastic devices are now available from Motorola Semiconductor Products, Inc. (P.O. Box 20912, Phoenix, Arizona 85036). The high-temperature specifications of these new units, designated the MCR406 series, reduce the need for costly heat sinking, while the 50% higher current-surge capability improves operating reliability in critical applications (such as motor starting and in-rush lamp turn-on). The complete series

(*Continued on page* 111)

AMATEUR RADI

(*Continued from pag*

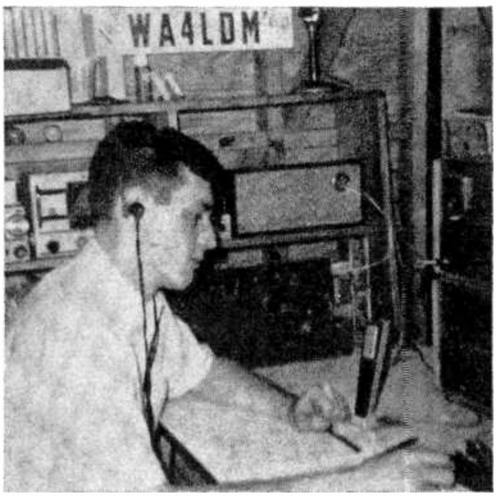
an antenna for Dr. Lee De Fo inven- tor of the triode tube. The s were needed to demonstrate some equip- ment to the Navy. Ray was 1 $25.00 when De Forest got some m mething he never seemed to have.

Bob Collom, WNØTWL, 2600 9th St., Boulder, Colo., has a Drake T-4 transmitter/R-4 receiver combination and teaches his son in Vietnam code by tape recorder so they can have a father/son station.

NEWS AND VIEWS

Ken Martin, WA7KJV, 225 Hardy Ave., Eugene, Ore. 97402, kept his Novice transmitter—a Knight-Kit T-150—as a standby rig when he got his General ticket. His new big gun is a Galaxy-5 SSB/CW transceiver running 300 watts to dipoles on 40 and 20 meters plus a 2-element beam or a dipole on 15 meters. Ken sticks to SSB on 40 and 15 but uses both SSB and CW on 20 meters. He just completed working all states and is gunning for Europe and Africa for a Worked All Continents certificate. He plans to have his Advanced ticket when you read this. . . . **Ronald Tomo, WA2COL**, 82 Burtis Ave., Rockville Center, N.Y. 11570, especially enjoys ragchewing and running overseas "phone patches" for our military personnel overseas. Ron has worked the U.S. Carriers, *Yorktown*, *Forrestal*, and *New Jersey*, as well as the Hospital Ship *Hope* in a harbor in Ceylon. Running a Drake T-4XB transmitter, 2C receiver, and an MN-4 antenna coupler in conjunction with a 2-element, 15-meter beam and a Hy-Gain 14-AVQ vertical antenna 50 feet high, Ron has worked all continents and all states, and holds a 20-WPM code certificate. . . . **Richard Henderson, WN1JLK**, 112 Arch Parkway, Meriden, Conn. 06450, hit the 80-, 40-, and 15-meter Novice bands hard when his ticket arrived. In six weeks, he worked 35 states (31 confirmed) and nine countries. He has a Drake 2-NT transmitter, backed up by an old Johnson Adventurer, Hammarlund HQ-145 receiver, 15-meter dipole, and 80/40 meter vertical antenna. Check with Dick, if you need a Connecticut QSL card; he QSL's 100 per cent.

Steve Barrymore, WN5YBX, 4760 NW 24 Apt. 124, Oklahoma City, Okla. 73127, calls both W5CML and W5OTZ "uncle." He has parlayed a Johnson Ranger transmitter, Hallicrafters SX-111 receiver, 80/40 meter "trap" dipole and a 15-meter dipole into 28 states in seven weeks on the air. Twenty-seven of them were worked on 40 meters. Steve figures that after getting WAS on 40 meters, he'll do the job again on the other bands—ARRL's new 5-band WAS may have been designed with Steve in mind. . . . **Scott Marzolf, WN2IZF,** 903 Coach Road, Blackwood, N.J. 08012, doesn't rate his "all-band" vertical as much of an antenna. Nevertheless, his Heathkit DX-60 transmitter and Lafayette HA-700 receiver have racked up seven states in three weeks. A better antenna is in the planning stage; besides, a friend up the street says that he can come over and use his Mosley tribander beam and 80/40 meter dipole—both 90 feet high—when he wishes. We bet, though, that Scott will discover there is more thrill working a new state on your own equipment than working around the world on another ham's station. . . . **Doug Goodman, WN9AVY,** 1324 S. Main St. Lombard, Ill. 60148, had just passed his General test and is speculating if his new call letters will be WB9AVY. As a Novice, Doug's Knight-Kit T-60 transmitter and Sky Roamer receiver fed a dipole antenna to work 23 states and two Canadian provinces—mostly on 80 meters.



Jack Jackson, WA4LDM, Florence, S.C., works unusual DX but with low power. See story below.

If you think that it takes high power, extra-fancy equipment and high-gain beam antennas on 20, 15, and 10 meters to work a lot of DX, you will never believe the record of **Jack Jackson,** WA4LDM, 1402 Azalea Drive, Florence, S. C. 29501. For openers, he has worked 15 countries (six on AM phone) and 47 states on 160 meters, running 50 watts. He has 49 states and 25 countries worked on 80 meters, and has worked all states and continents—119 countries, total—on both AM and CW on 40, 20, 15, and 10 meters, always using a power under 100 watts. Jack's main equipment includes a Knight-Kit T-150A transmitter and a Knight-Kit R-100A receiver, plus the usual array of surplus and homebrew accessories. Antennas include inverted-V's for 160 and 80 meters, verticals for the other bands, and a homebrew 2-element beam on 28 MHz. Of course, Jack holds many DX certificates and is gunning for the "big one" now—an Extra class ticket. With a 30-WPM code certificate on the wall, he is not much worried about the code test. . . . If you haunt the 80-meter Novice band early Saturday mornings, check 3740 kHz at 1100 GMT (6:00 a.m., EST) for the Early-Bird Net sponsored by WN3KHG, WN4KSG, and WN3LTB. . . . **Ron Marra, WB8BTU,** 24963 S. Sylbert Ct., Detroit, Mich. 48239, kept the electrons hopping during his Novice career. In four months, he worked 47 states and 41 countries! The band was 15 meters; the equipment was a Heathkit DX-60B transmitter, a Heathkit HR-10B receiver, and a dipole antenna.

Daniel A. Johnson, WA9YOH, P.O. Box 443, Marion, Ind. 46952, works SSB with Galaxy 300 transceiver and CW with an Elmac AF-67 transmitter and a Mosley CM-1 receiver, for 45 states, 7 countries.

We invite your "News and Views" and pictures (black and white, please) for *your* column, and we thank you who have continued mailing your club papers and bulletins to us and would appreciate being put on the mailing list, if we are not already on yours. The address is: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P. O. Box 678, Gary, Ind. 46401.

73, Herb, W9EGQ.

SHORT-WAVE LISTENING

(Continued from page 96)

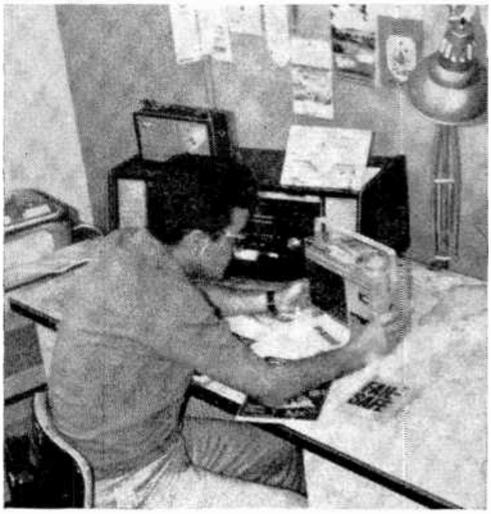
Peru—OAZ4L, *R. Del Pacifico*, Lima, is a new logging on 9675 kHz, heard at 0115-0135 and around 0220 with religious programming and a singing ID by a chorus of girls' voices. OAX7T, *R. Sicuani*, Sicuani, 4967 kHz, has moved from 4837 kHz and is heard at times around 0200. Do not confuse with a Colombian on 4965 kHz or *R. San Juan*, Piura, Peru, on 4967 kHz. OAZ4C, *R. Andina*, Huancayo, has moved from 6244 kHz to 4995 kHz and is irregularly noted to past 0000 with listener requests and very few ID's. Do not confuse with *R. Abancay*, Peru, on 4997 kHz. OBX7H, *Ondas del Titicaca*, Puno, 4921 kHz, was heard with Andean music during a listener request program that ran to past 0300.

Poland—Warsaw has been found on 11,815 kHz at 0040-0100 with American pop music and in language.

South Africa—*R. RSA*, Johannesburg, has English to N.A. at 2330, 0030, 0130 and 0230 on 9705, 6075 and 5980 kHz. Other English xmsns: 0415-0427 to Kenya, Uganda, Tanzania, Ethiopia and Sudan on 9525 and 7270 kHz; 0430-0442 to the Middle East on 15,220 and 11,900 kHz; 0500-0512 to Rhodesia, Zambia and Malawi on 5980 and 4895 kHz; 0515-0527 to Middle East on 17,805 and 15,220 kHz; 0645-0657 to Nigeria and Ghana on 15,220 and 11,900 kHz; 1100-1450 to Africa (English and Afrikaans) on 21,535, 17,805, 15,220 and 11,900 kHz; 1600-1650 to Rhodesia, Zambia and Malawi on 9525 and 7270 kHz; 1700-1750 to Middle East, Kenya, Uganda, Tanzania, Ethiopia and Sudan on 21,535 and 15.220 kHz; 2100-2150 to Ghana and Nigeria on 15,360 and 11,900 kHz; 1800-1850 to United Kingdom and Ireland on 21,500 and 17,795 kHz: 0800-0850 to New Zealand on 21,535 and 17,825 kHz; and 1000-1050 to Australia on 21,535, 17,825 and 15.220 kHz.

Sudan—*R. Omdurman* has a 100-kW xmtr on 11,835 kHz for testing but Algeria on the same channel makes for heavy QRM.

Sweden—*R. Sweden*, Stockholm, has this schedule in effect: (English only) to Europe at 1100-



Raul Menchaca Falcon, XE1PE1K, Mexico City, Mexico uses a Philips Vivaldi and Blaupunkt Deluxe 40175. He has 19 countries that are verified.

1130 on 9625 kHz and 2045-2115 on 6065 kHz. To the Middle East at 1600-1630 on 21,585 kHz and 1900-1930 on 11,860 kHz. To the Far East at 1230-1300 on 15,105 kHz, 2045-2115 on 11,705 kHz and 0745-0815 on 15,155 kHz. To Africa at 1230-1300 on 21,690 kHz and 1900-1930 on 15,240 kHz. To Asia at 1400-1430 on 21,585 kHz and 0515-0545 on 17,840 kHz. To South America at 2245-2315 on 11,705 kHz. To Eastern N.A. at 1100-1130 and 1400-1430 on 15.315 kHz and 0030-0100 and 0200-0230 on 11,950 kHz. To Western N.A. at 1600-1630 on 15,315 kHz and 0330-0400 on 11.705 kHz.

SHORT-WAVE ABBREVIATIONS

anmt—Announcement	kHz—Kilohertz
BBC—British Broadcasting Corp.	kW—Kilowatts
CBC—Canadian Broadcasting Corp.	L.A.—Latin America
CW—Morse Code	N.A.—North America
GMT—Greenwich Mean Time	QRM—Station Interference
ID—Identification	R—Radio
IS—Interval Signal	s/off—Sign-off
	s/on—Sign-on
	xmtr—Transmitter

Switzerland—Berne presents this English schedule: to Australia and New Zealand at 0700, 0800 and 0830 on 9590 and 11.775 kHz. To Africa at 1000 and 1100 on 15,305, 17,795 and 21,520 kHz and at 1815 and 1915 on 15.180 and 17,795 kHz. To N.A. at 0130, 0230 and 0300 on 9535, 11,715 and 15,305 kHz and at 0445, 0545 and 0615 on 9720 and 11,715 kHz. To United Kingdom and Ireland at 1130, 1230, 1300, 1930 and 2030 on 9665 and 11,865 kHz. To Far East, India, Pakistan, Japan and China at 1315, 1415 and 1445 on 15,135, 17,845 and 21,520 kHz. To Near and Middle East at 1500, 1600 and 1630 on 15,305 and

17,830 kHz. Omnidirectional xmsns are at 0700, 0800 and 0830 on 6165 and 9535 kHz.

Turkey—Ankara is often good on 15,160 kHz in French at 2130-2200 and in English from 2200-2230.

USSR—*R. Kiev* lists a new schedule calling for English to N.A. at 0030 on 17,900, 17,760, 15,260 and 11,700 and at 0430 on 12,010, 11,960, 11,730 and 9600 kHz. English to Western Europe is listed at 1930 on 15,170, 15,160 and 11,700 kHz.

Vatican City—Two more new frequencies for *Vatican Radio* include 17,810 kHz from 0000 s/on in Spanish, and 11,745 kHz from 2200 s/on in English.

Venezuela—A new logging is that of *Vallos del Tuy*, location not yet determined, on 6129 kHz. It's been noted with native music and ads for General Electric, in Spanish, with a most abrupt s/off at 0045 or shortly thereafter. There are frequent ID's but QRM is heavy. *R. Barquisimeto* is often good on 4990 kHz until 0400 s/off with L.A. and N.A. music and in Spanish.

Vietnam (North)—Hanoi is still wandering from 15,010 to 15,020 kHz and noted at 1545-1550 in language, 1834 to 2000 in language and from 2000 to at least 2021 in English with news and commentaries.

Vietnam (South)—A new frequency for Saigon is 7175 kHz, found fair to weak in language at 1100 but with heavy ham radio QRM.

SHORT-WAVE CONTRIBUTORS

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Gert Schultz, Goteborg, Sweden
Fred Schulz, La Mesa, Calif.
Russ Stafford, Newark, Del.
Charles Webking, St. Louis, Mo.
Radio Voice of the Gospel, Addis Ababa, Ethiopia
Radio Sweden, Stockholm, Sweden
Swiss Broadcasting Corp., Berne, Switzerland
Radio RSA, Johannesburg, South Africa

TWO-WAY REACTIONS

(*Continued from page* 94)

ways be a need for vigilant, life-saving REACT teams. We are sometimes asked why GM should sponsor REACT. The answer is that GM is in the transportation business and is interested in any program that can improve motoring safety and traffic flow. REACT fulfills a great need in highway communications."

CURRENT NEWS

Since the change in sponsorship of REACT in March of 1969, a concerted effort has been made to improve substantially the support that local REACT teams receive from REACT National Headquarters. Managing Director Gerald (Jerry) H. Reese, KCN6990, has been added to direct the day-to-day organizational activities. National Director, Henry B. (Pete) Kreer, KPK1386, is still at his old post.

More frequent and direct communication with the FCC and other agencies whose activities affect the Citizens Radio user are now possible through the strengthening of REACT National Headquarters.

New procedures have been introduced so that all Headquarters' services to member teams are handled more efficiently. The first issue of the National REACTer published since October 1967 was sent out free to all teams for distribution to their members. This is the official news publication of REACT National Headquarters. It is now bigger and better than ever and has received many favorable comments from REACT teams everywhere. Another issue is about ready to be mailed and issues will be published on a regular quarterly basis.

Denver, Colo.—Members of the Denver Metro REACT Team recently cooperated with the Jefferson County sheriff's office in apprehending three people who were charged with theft of clothing and household items deposited in collection boxes for donation to Goodwill Industries. One Sunday night, 22 team members in 12 cars kept the home of the suspects and 10 collection booths under surveillance, reporting the movements of the suspects as they traveled in their pickup truck to and from seven booth locations. The monitoring log showed the team sighting the truck at 6:39 p.m. and the sheriff's deputies making the arrests at 8:27 p.m.

New Miami, Ohio—Unusual atmospheric conditions affecting radio transmissions caused the REACT monitor here to receive an emergency call recently from a motorist who was reporting a two-car collision 15 miles south of Cheyenne, Wyoming. The New Miami monitor called the local sheriff's office and the Ohio State Highway Patrol. They could not help. Finally, a long-distance call was placed to the Wyoming State Police. By this time they had been informed and help was on the way. When you ask for help on Channel 9 in southern Ohio, you get it.

Festus, Mo.—Members of the Ozark Citizens Band Radio Club, a REACT team, have been very active in this community. Monitoring Channel 9 for emergencies, a frequent report is that livestock is on the highway. It may be funny to city slickers, but it's not funny when you collide with a cow or a horse at highway speeds! In addition to handling the usual traffic calls, the club's emergency truck is used under the supervision of the county conservation commissioner to patrol the area during the deer hunting season on the lookout for unlawful night hunting.

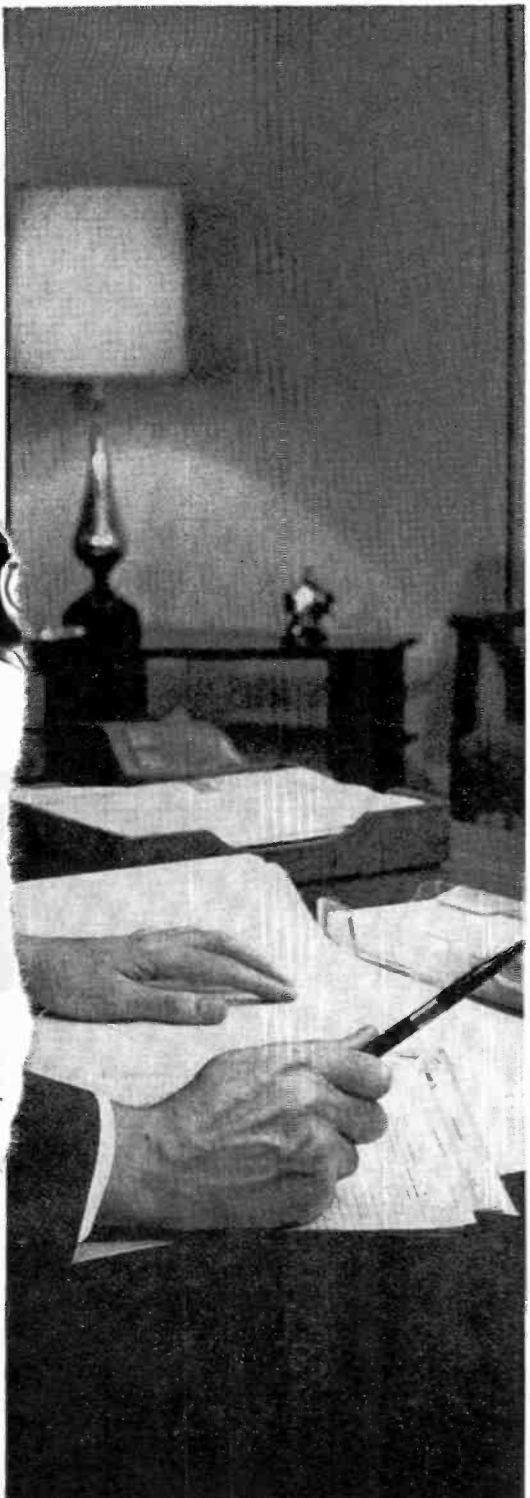
We Need Your Help—There is a definite meaning to the title of this column—"Two-Way REACTions." It does, of course, refer to Citizens Two-Way Radio and to REACT. It also means that we are interested in your reactions to this column and, even more important, in your contributions. News of all phases of Citizens Two-Way Radio is welcome. Send us information, photos, and anything you would like to see in print. REACT is operated on the basis of organized team membership. If your group is interested in learning how you can become an active REACT team, we will be happy to send you the information.

All correspondence should be sent to: Editor, Two-Way REACTions, c/o REACT National Headquarters, 205 West Wacker Drive, Chicago, Ill. 60606.

CITIZENS RADIO JAMBOREE CALENDAR

September 13 and 14, Emergency Citizens Band Monitors, Huntsville, Ala. Fall Festival at Madison County Coliseum. Contact: Emergency Citizens Band Monitors, PO Box 1542, Huntsville, Alabama 35807.

September 27 and 28, West Virginia Citizens Band Radio Association. First State Jamboree, Beckley Radio Club Grounds, Crow, W. Virginia. Contact: Ted England, KPN8419. PO Box 628, Beckley, W. Virginia.



KNOW THE SCS

(Continued from page 78)

microampere) is required for turn-on. If desired, a 100-pF capacitor can be substituted for the 3.3-megohm resistor in either gate circuit. This is a useful substitution when d.c. isolation is required.

Turning an SCS off by opening the power-supply circuit requires a switch in a position to break the full load current

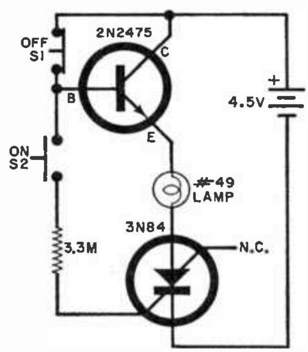


Fig. 6. A conventional npn transistor can be used in place of a power switch to turn the SCS on and off. Any type of mechanical contacts can be used for switches S1 and S2.

flowing through the SCS. This is not always practical if you want to use a very small switch. For such applications, it is better to use a transistor to switch the load current with a small mechanical switch to turn the transistor off and on.

Now to Work. The SCS is such a versatile device that its applications are limited only by your imagination. One typical application is described on page 78. —30—

OUT OF TUNE

"Build the POPULAR ELECTRONICS Universal Frequency Counter" (March 1969). Capacitor *C5*, in Fig. 13, page 45, is connected backwards. The negative side should be connected to the junction of D3 and D4, the positive side to ground.

SOLID STATE

(*Continued from page* 99)

consists of eight devices, with peak forward blocking-voltage ratings from 30 to 200 volts. All are sensitive-gate devices which permit direct triggering without additional stages of signal amplification, thus making them suitable for use with low-level signal sensors such as thermistors and photocells.

RCA Electronic Components (Harrison, NJ 07029) has introduced a new IC amplifier array consisting of four independent a.c. amplifiers on a single monolithic silicon substrate. Designated type CA3052, the array can be used as a stereo tape head or full-function stereo preamp. With internal and external feedback features to facilitate equalization and tone control, each of the four amplifiers has an equivalent input noise voltage of only 4 microvolts, a voltage gain of 58 dB, an input resistance of 90 kilohms, an output resistance of 1.000 ohms, and an open-loop bandwidth of 300 kHz. They can deliver an undistorted output signal of 2.4 volts r.m.s.

Transitips. We've received a number of letters from readers asking why low-cost, pocket-size transistorized receivers generally feature push-pull audio amplifiers, while moderately priced auto sets more often employ simpler single-ended output stages. At first glance, the design differences are rather surprising, for automobile receivers may cost from ten to twenty times more than a pocket set, and, as a general rule, one expects a more expensive product to use a more complex circuit. But there are valid engineering as well as economic reasons for the differences.

First, there is the matter of efficiency. A single-ended stage must be operated as a class-A amplifier. While delivering an exceptionally "clean" (distortion-free) signal, a class-A stage is notoriously inefficient. A 1-watt class-A amplifier, for example, requires *two watts* from its power source . . . with the power drain *remaining unchanged* whether or not it is delivering an output (audio) signal. With a 12-volt power supply, a 1-watt class-A amplifier would require a steady current of approximately 166 mA while, with a 9-volt source, it would require about 222 mA.

A class-AB or class-B amplifier, on the other hand, is much more efficient and has the added advantage that its power supply requirements are very small when the stage is operating with zero signal—a fraction of its peak requirements. A class AB or B amplifier however must be operated as a push-pull stage to keep distortion levels within acceptable limits.

With the small batteries used in pocket-sized sets unable to supply large currents on a continuous basis, the use of an efficient class-AB or class-B stage is mandatory.

Second, how about cost? A class-A single-ended amplifier draws a relatively large steady d.c. Its output transformer must have a fairly large iron core to resist saturation. A class-B push-pull stage, on the other hand, will operate efficiently with a much smaller output transformer, even when delivering substantial audio power.

In practice, then, a 1-watt class-A output transformer, alone, may be more costly than a complete 1-watt class-B stage, including both transistors and a small drive transformer.

Since a car battery/generator can deliver relatively large currents with little effort, as opposed to those available from a miniature 9-volt battery, there is no real need to seek the higher efficiency of a class-AB or class-B push-pull amplifier. In addition, a cost-conscious manufacturer is more interested in total component costs than circuit complexity, and, therefore, prefers to use the least costly approach . . . that is, a class-B push-pull stage. —*Lou*

HQ-200 & SX-122A

(Continued from page 57)

the selectivity curve of the HQ-200 is continuously variable from a width of 7-8 kHz (at 6 dB down) to a claimed 400 Hz, or less. The SX-122A has three switched selectivity options; 5.0 kHz, 2.5 kHz, and 0.5 kHz (also at 6 dB down).

Of more importance in dealing with selectivity is the shape of the curve (flat-top or like a church steeple) and width of the curve 40, 50, or 60 dB down. Technically this is the "shape factor", or to put it into SWL'ing terms, the ability to separate two very strong stations only 10 kHz apart.

In this category, the SX-122A is very selective and the i.f. bandpass (switch at 5.0 kHz) is only 12 kHz wide at −40 dB and 14.5 kHz wide at −60 dB. Without Q multiplication the HQ-200 is 12 kHz wide at −20 dB and 8 kHz with the Q multiplier switched on. This can be reduced (at −20 dB) to about 2 kHz, however if the signals are strong, the selectivity curve on the HQ-200 at −40 dB is starting to widen rapidly.

In field trials, the HQ-200 demonstrated its ability to separate two S5 to S9 signals, but when one signal was S5 and the other 20 dB over S9 only the SX-122A could make the weaker 100% readable.

Conclusions. Space does not permit a more exhaustive or critical appraisal of these two different—but same—receivers. The sameness is in the frequency coverage and flexibility, the differences are numerous and important. Probably this can be best summarized by pointing out that the extra cost of the SX-122A is reflected in refinements. The HQ-200 is an excellent basic receiver for the beginning SWL or Novice ham. The SX-122A is cut for the discriminating SWL or ham. Both represent good dollar value. —30—

For Hallicrafters SX-122A:
Circle No. 92 on Reader Service Page 15 or 115
For Hammarlund HQ-200:
Circle No. 93 on Reader Service Page 15 or 115

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.*

Pentron Model PT-1 stereo recorder. Instructions, schematic, and source for parts needed. (Larry Berk, 2576 Ashurst Rd., University Hgts., OH 44118)

Collins Type 180 K loading coil Series 705. Schematic and instructions needed. (Paul Bilodeau, Box 635, Friendswood, TX 77546)

Webster-Chicago Model 181. Parts, schematic and owners manual needed. (William Bonn, 42 Clover Ln., Bloomfield, NJ 07003)

Clough-Brengle Model CRA oscilloscope. Schematic, specs and source for parts needed. (Walter Yates, Virginia Polytechnic Institute, Ambler Johnston, Box 5006, Blacksburg, VA 24061)

Madison Fielding Series 440 stereo receiver and amp. Schematic and owner's manual needed. (Alan Boritz, 80 Cheshire Rd., Bethpage, NY 11714)

DuMont Model 5108C 12" rack mount TV monitor and Model 5110A power supply. Service manual, parts list, schematic and additional information needed. (S. Thomas Dorey, 708 Henderson Rd., King of Prussia, PA 19406)

Hoffman Mark V black and white TV with color converter and phono inputs. Schematic, tube layout and type CX-299 or UX-199 tube needed. (Steve Swift, 6211 Gladiator Dr., Olympia, WA 98501)

Heath Model V4A vacuum tube voltmeter. **Johnson** Viking Adventurer transmitter. Construction manual needed for both. (Tom Dornback, 19W167 21st Pl., Lombard, IL 60148)

Kellogg radio; 1927. Tubes type 401 and 403 needed. (C. E. Miller, R=3, Box 209B, Platteville, WI 53818)

Lumatron Model 220 sampling converter. Manual needed. (R. Zahorcak, 29 Parker Ave., Passaic, NJ 07055)

RCA Model 86E receiver. **Gonset** G-11 communicator. Schematics needed. (Gordon Betts, Bald Cove, Winterport, ME 04496)

Bell Model 2145 amp. Schematic needed. (Arthur H. Baily, 805 Castle Pt. Terrace, Hoboken, NJ 07030)

GC Model 36-600A tube tester. Schematic needed. (George A. Kee, 32 Constitution Blvd., New Castle, DE 19720)

BRIDGE FUNCTION QUIZ ANSWERS

(*Quiz is on page* 68)

1-E. A half-bridge amplifier circuit is used in vacuum-tube voltmeters to provide high sensitivity and high input impedance. A "zero set" potentiometer balances no-signal tube currents.

2-D. This quartz-crystal full bridge is a band-pass filter employed in SSB transmitters to obtain the narrow bandwidth required. Within the passband, the impedances of the two pairs of crystals, 1-4 and 2-3, differ widely due to their different resonant frequencies, thus causing the bridge to be unbalanced and permit a large signal output.

3-B. A Wien-bridge band-suppression filter employs series and parallel RC circuits to keep the bridge unbalanced outside the rejection band. Within the band, the impedances of the RC circuits change in opposite directions to balance the bridge and attenuate the output.

4-G. This capacitance measurement circuit is a Schering bridge using standard capacitors to determine the unknown capacitance. Capacitor C1 balances out the resistance of the unknown while C2 is calibrated to indicate the unknown capacitance when the bridge is balanced.

5-C. A Wien-bridge frequency measurement circuit employs two calibrated potentiometers, R1 and R2, varied simultaneously in equal increments to indicate the unknown frequency when the bridge is balanced.

6-A. An inductance measurement circuit is a Maxwell bridge for measuring the inductance of low-Q coils (10 or less) by balancing the reactance of a fixed standard capacitor against that of the coil.

7-J. A modulator circuit using a shunt-type full bridge balances out the r.f. input so that the r.f. carrier is always suppressed and only the upper and lower sidebands are present in the output signals.

8-F. A Wien-bridge RC oscillator circuit for frequency stabilization employs one tube, V1, as an oscillator and a second, V2, to provide a frequency-selective, 180-degree feedback signal.

9-1. A full-bridge rectifier is employed to obtain full-wave rectification of an a.c. signal.

10-H. A resistance measurement circuit in the form of a Wheatstone bridge employs a calibrated potentiometer to indicate the value of an unknown high resistance when the bridge is balanced.

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9 b

NEW PRODUCTS

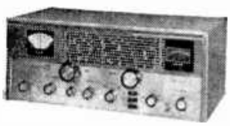
(*Continued from page 24*)

ture is obtained, resulting in a boost in antenna efficiency. The complete co-phasing kit includes a precision-cut cable and coaxial connectors.

Circle No. 88 on Reader Service Page 15 or 115

HAM/SWL COMMUNICATIONS RECEIVER

Wrapping up the best in both hamming and SWL'ing is the new *Hallicrafters* Model SX-133 communications receiver. For example, the SX-133 has calibrated bandspreading on the four most important SWL bands (49, 31, 25, and 19 meters). Also included in the basic receiver is a two-position crystal-select switch, S-meter, product detector for CW/SSB, noise limiter, etc. A crystal calibrator for checking band edges is an optional extra.

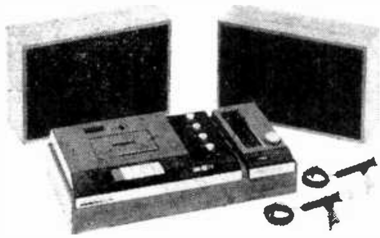


Overall tuning range of the SX-133 is 535-1610 kHz and 1825-31,500 kHz. Mounted on the front panel is a convenient headphone jack. An external speaker is required. This tube-type 117-volt a.c. communications receiver requires only 48 watts input.

Circle No. 89 on Reader Service Page 15 or 115

HOME AND MOBILE CASSETTE PLAYERS

A mini-compact stereo cassette system and a mobile cassette player have been introduced by *Crown-Industrial Suppliers Co.* The a.c./d.c. Model SHC-44 cassette component ensemble for the home consists of a recorder deck, AM/stereo FM tuner, and a pair of speaker systems—all housed in matching teak cabinets. The deck features piano-key-type function controls, cassette eject button, digital tape counter, record-level/battery-condi-

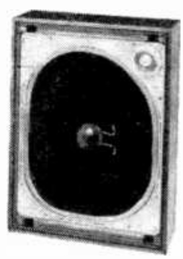


tion indicator, and volume, tone, and selector controls. Frequency range is 100-10,000 Hz; speaker systems each handle up to 5 watts of power. The mobile cassette Model CSC-1000 "Musicruiser" player has a peak power output rating of 20 watts and features easy loading and operation. Other features of the CSC-1000 include a play indicator lamp, balance control, two-step stop and ejection key, etc.

Circle No. 90 on Reader Service Page 15 or 115

"NATURAL SOUND" SPEAKER SYSTEMS

Yamaha International Corp. recently announced the addition of two new models to their "Natural Sound" hi-fi speaker system lineup. Designated the Models NS-15 and NS-10, these new systems are enclosed in walnut cabinets and are designed to fit into corners or on bookshelves. Unlike conventional cone-type loudspeakers, the Natural Sound speakers are based on the same principle as used in a piano sounding board; they are irregularly shaped and flat instead of deep. The edge of the speaker cone is locked into an aluminum casting which enables the cone to develop various full-range vibrations through bending motions. Sound reproduction is said to be extremely clear and mellow, with the richness and timbre of a fine musical instrument.



Circle No. 91 on Reader Service Page 15 or 115

MINI-SIX

(*Continued from page* 50)

for proper operation. Rotating the LP8 clockwise should increase the total volume of sound; clockwise rotation of the LP16 should increase the sound level coming from the two front speakers only.

Final Assembly. Disconnect the amplifier, and fill the enclosure with small cut-up pieces of fiberglass batting. Then cement felt or weather stripping to the top edges of the shell to provide a proper sealing gasket for the enclosure. Set the top panel in place and screw it down.

Starting and ending at the apex of the rear panels, wrap the sides of the enclosure with grille cloth. Cover the exposed edges with ¼″-wide velvet ribbon or other finishing material.

If you do not have a suitable crossover network, a simple coil-capacitor arrangement as shown in Fig. 6 will suffice. Capacitor *C1* is a 100-μF *non*polarized type (if you cannot obtain this value, parallel-connect three 33-μF, 25-volt nonpolarized capacitors). The coil, *L1*, is homemade, consisting of 1 pound of #18 magnet wire (about 500 turns) wound on a 1″-diameter by 1½″-long coilform made of wood doweling and Masonite. When connecting the Mini-Six to your present speaker system, disconnect the LC network in the system.

When using the Mini-Six, place it so that the apex of the enclosure is about 12″ from the reflecting surface. Now, set the LP8 control so that a proper balance is obtained between the bass speaker and the Mini-Six. Then have someone adjust the setting of the LP16 as you move about the room. This control is properly set when a minimum change in the high-frequency response of the system can be detected as you cross the listening area. (For the stereo version, set each Mini-Six system independently.)

As you listen to the composite speaker system in different locations in your listening room, you will come to realize that your favorite listening chair is not so special any more. The big change you will notice is that the Mini-Six adds a feeling of depth and spaciousness that was missing before. —30—

LIBRARY

(Continued from page 14)

starts the ball rolling by covering the basics of semiconductor devices, starting with the simple PN junction. It then proceeds through progressively more complex circuit explanations, concluding with a thorough discussion of logic-circuit counting and binary arithmetic. Some of the semiconductor devices dealt with in the text include conventional rectifiers, bipolar transistors, field effect transistors, unijunction transistors, tunnel diodes, and silicon controlled rectifiers.

Published by Tab Books, Blue Ridge Summit, Pa. 17214. 224 pages. $7.95 hard cover; $4.95 soft cover.

CONDENSED COMPUTER ENCYCLOPEDIA

by Philip B. Jordain

It begins with the phrase, "abnormal statement," and ends with "zone punch," but in the intervening 571 pages, it presents an almost totally new language. This remarkable encyclopedia (it's too detailed to be a dictionary) is everyman's guide to an understanding of what computer programmers and technicians talk about. The author has an unusual grasp of computer technology and has produced a standard reference for anyone working with, in, or around computers—business or scientific.

Published by McGraw-Hill Book Co., 330 West 42 St., New York, N.Y. 10036. Hard cover. 580 pages. $14.50.

THE RADIO COMMUNICATION HANDBOOK Fourth Edition

Although the two American ham radio handbooks are very popular in Great Britain and the Continent, few hams on this side of the pond realize that the Radio Society of Great Britain (RSGB) publishes an electronics handbook that is no slouch. This Handbook is about twice as wordy and thorough (in the same subject areas) as the ARRL Handbook. This is not to say that the British are long-winded—only that the concepts and circuits are discussed with greater thoroughness. If you have misgivings about the language and terms—don't. A few minutes and a little common sense will make you conversant in British as well as American electronic terminology.

Vacuum tubes play a big part in this Handbook, but solid-state devices are given plenty of recognition. The flow of subject material is smooth and natural and there are approximately 1000 circuit diagrams with parts values. If you use ham radio handbooks as reference material, you shouldn't be without this one.

Published by Radio Society of Great Britain. Available from Comtec, Box 592, Amherst, New Hampshire 03031. Hard cover. 832 pages. $11.95.

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