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POPULAR ELECTRONICS

JANUARY 1969

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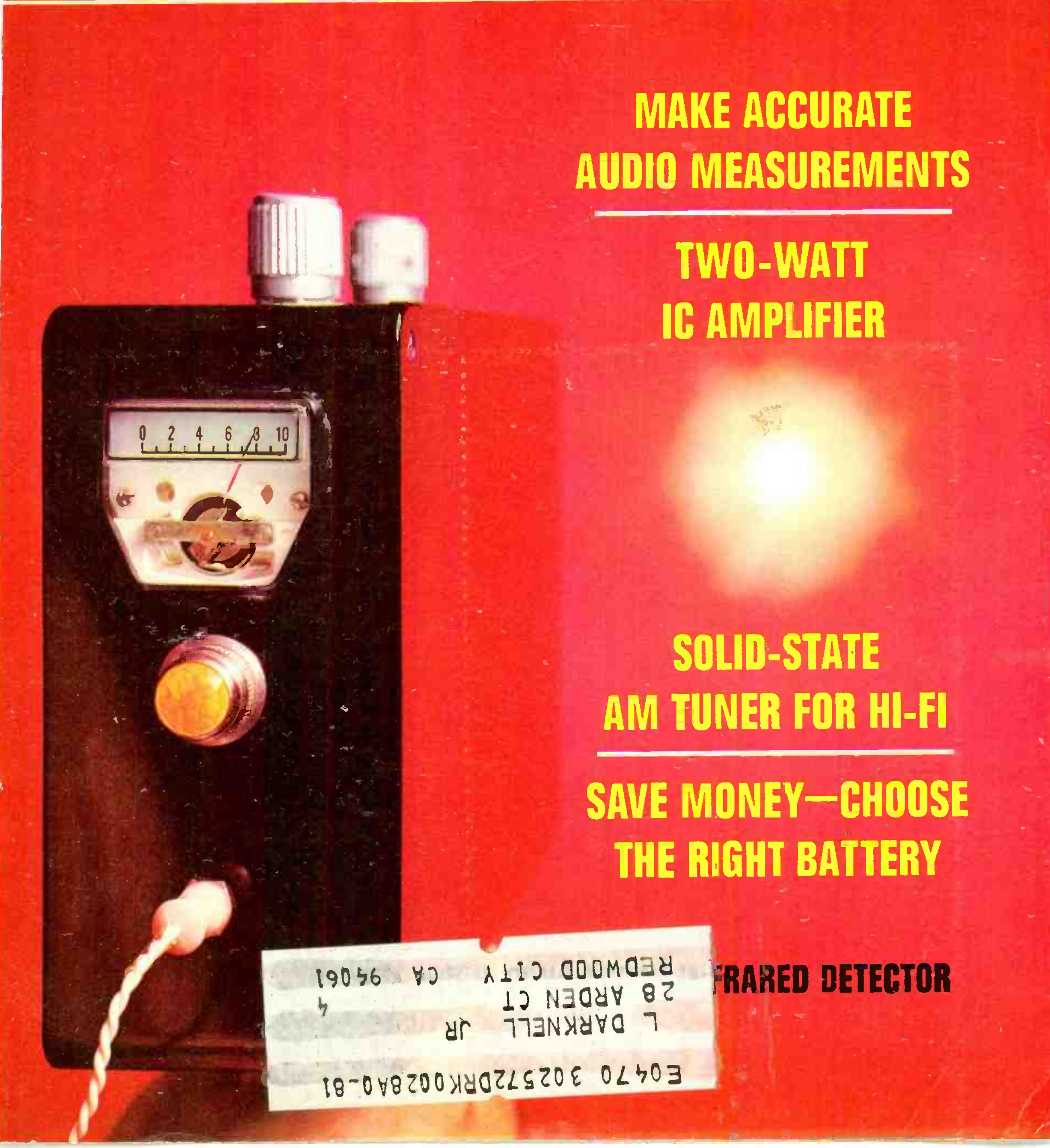

MAKE ACCURATE AUDIO MEASUREMENTS

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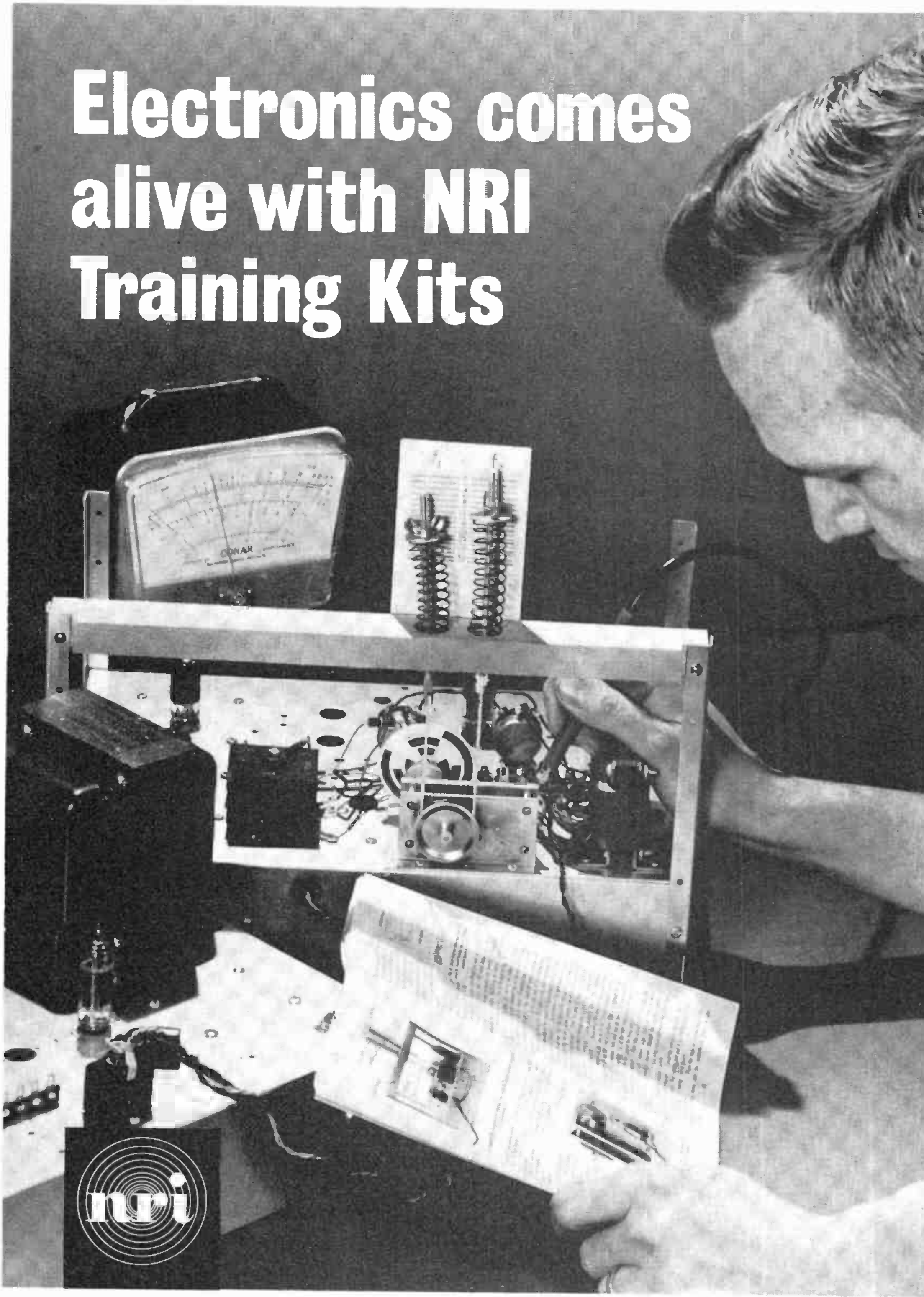
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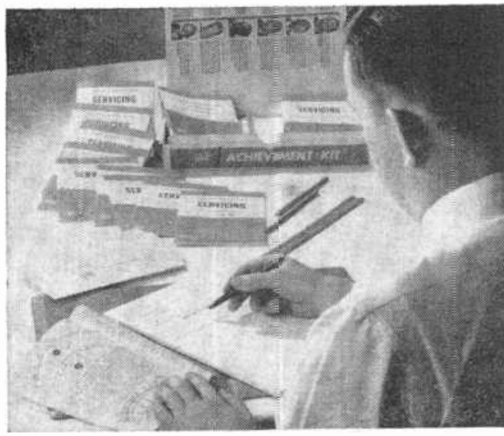

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POPULAR ELECTRONICS

VOLUME 30 NUMBER 1

JANUARY, 1969

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letters FROM OUR READERS

SPEED THINGS UP

In reference to "Color TV That Isn't" (October, 1968), shouldn't the second paragraph under the heading "TV Applications" on page 75 read: "The Butterfield disc is rotated at 5 rev/s" instead of "5 rev/m"?

S. J. Maggio
Bayside, N.Y.

It certainly should!

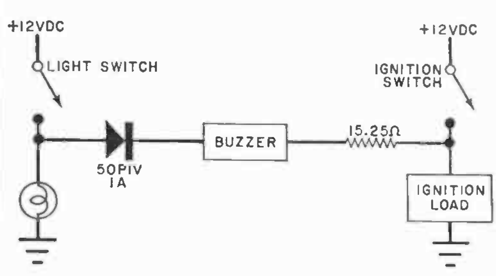
THERE ARE SIMPLER WAYS

The story "Who Left the Car Lights On?" (August, 1968) proposes some overly complicated solutions for a very simple problem. An approach similar to that shown in Fig. 1 of the article is used by Lafayette Radio Electronics in their "Lite Buzzer." The buzzer consists of two coil windings, one of which is fed through an interrupter from the light switch; the other operates directly from the ignition switch and holds the interrupter closed while the ignition is on.

Incidentally, the best place to connect the "lights" wire is at the panel light fuse. This way, the buzzer sounds off if either the parking or the the headlights are left on. If you want to operate the headlights on purpose, just dim the panel lights until the buzzer quits.

Fred Moore
Rockville, Md.

I'm becoming tired of reading articles devoted to automobile "lights-on" alarm systems that are written around "relatively" bulky, expensive components and complex circuits. The best designs are the simplest and usually most reliable. Therefore, I submit that the best "auto lights-on" alarm is composed of a diode, buzzer, and limiting resistor as shown in the schematic diagram. The



They hide under dashboards and bite way out with striking power. The CB solid-state Cobras.

Coiled up under your dash ready to strike. Mysteriously attractive, but all business. Their bite radiates a long way. Penetrates through layers of interference.

When a Cobra bites, you'll be surprised at all the people who know about it.

Because tucked away in the Cobra's throat is the exclusive Dyna-Boost circuit that fills out the sidebands to give you a lot more talking range. Full 5 watts input. 100% modulation.

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Cobras are also very sensitive and receptive to the human voice. Very selective, too, when it comes to rejecting adjacent channel interference. And a Cobra will give you a sharper bite, because all channels are crystal controlled.

If you go solid state, get the bite of the Cobra. For base station as well as mobile applications. (Ask your distributor for the snake or write us for detailed information.)

Cobra **27,** 23-channel CB transceiver, complete with all necessary crystals ready for immediate operation on all 23 channels. **$179.95**

Cobra **V,** 5-channel CB transceiver. (Channel 11 crystal supplied) **$99.95**

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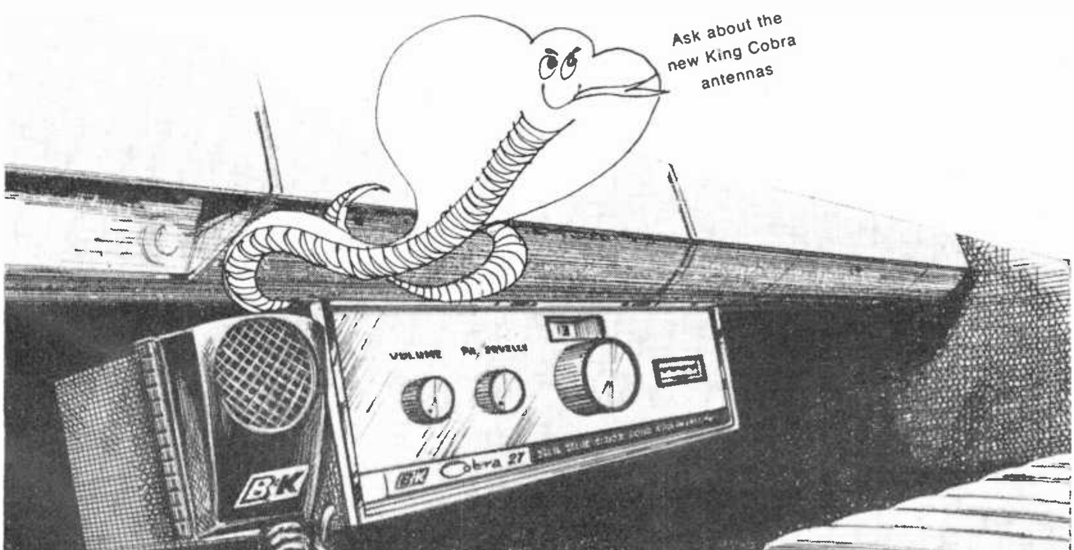

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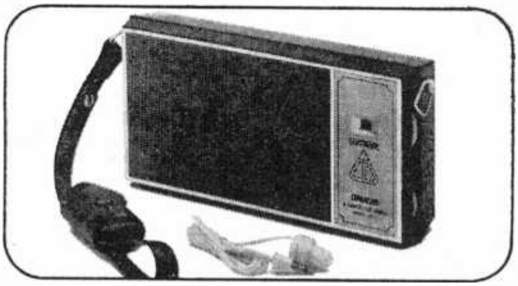
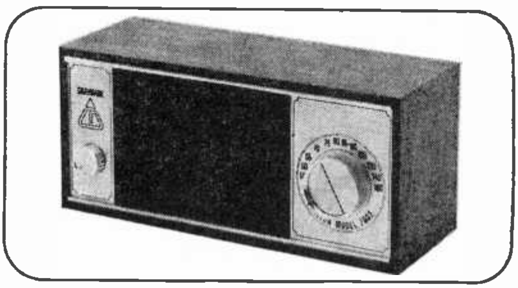




diode serves as a switch which allows the buzzer to sound off only when the light switch is closed and the ignition is turned off. The components can usually be mounted inside the buzzer's housing, and the buzzer can be affixed to the steering column.

LEONARD H. ZANDEL
Los Angeles, Calif.

Both suggestions show sound reasoning, and both should work at least as well as the authors claim.

BINARY ADDER IS FIRST-PRIZE WINNER

I built the "Binary Adder" ("Demonstrating Binary Computation With the Binary Adder," April, 1968) and entered it in a science fair. I won first prize—a $200 set of encyclopedia. I am now building another computer but have been unable to locate a power transformer with secondary windings capable of delivering 125 volts at 25 mA and 6.3 volts at 1 ampere. Could you please tell me where I can obtain this transformer?

TOM KOZICKI
Wheeling, W. Va.

We can't locate a power transformer with your exact specifications, but a good substitute is the 125-volt, 50-mA and 6.3-volt, 2-ampere (stock number 54 E 1411) power transformer available from Allied Electronics, 100 N. Western Ave., Chicago, Ill. 60680. The price is $3.88 each.

COSTLY SIDE EFFECT

Working with Neil Johnson's "A.C. Amp-Watt Adaptor" (January, 1968), I have encountered a costly side effect. The instantaneous high current of a load and the power surge in the transformer have destroyed the FET in my transistor voltmeter and the rectifier in my VOM. I've found that the safest way to use this adaptor is to first turn on the appliance, then connect the meter. This hint may just save some readers a costly repair bill.

BILL ZUCKER
Westbury, N.Y.

It well might if you're using a TVM without adequate overload protection. But even if your TVM does have adequate protection, it's always good practice to connect a voltmeter to a circuit after power is applied.

SIMPLE DIODE POLARITY RULE

The "Noise Blanker" ("Build Noise Blanker," October, 1968) is just what the doctor ordered to clear up my problem. Being a ham and living right off one of the busiest thoroughfares in New York, I am constantly plagued by electrical noise from passing vehicles. So, I built the "Noise Blanker," but I destroyed five diodes before I realized that someone goofed—the polarities of the bat-

(*Continued on page 117*)

"Performance-Plus" Kits For Home And

NEW
kit AD-27
169^{95}

NEW
kit AD-17
109^{95}

HEATHKIT AD-27 FM Stereo Compact

The new Heathkit "27" Component Compact was designed to change your mind about stereo compact performance. How? By sounding as if it were made of top quality stereo components . . . which in fact it is. Heath engineers took their highly rated AR-14 solid-state Stereo Receiver, modified it physically to fit the cabinet, and matched it with the precision BSR McDonald 500A Automatic Turntable. Performance? Here's the AD-27 in detail. The amplifier delivers 30 watts music power . . . 15 honest watts per channel — enough to drive any reasonably efficient speaker system. Response is virtually flat from 12 Hz to 60 kHz, and Harmonic & IM distortion are both less than 1% at full output. Tandem Volume, Balance, Bass & Treble controls give you full range command of all the sound. Select the FM stereo mode with a flick of the rocker-type switch and tune smoothly across the dial, thanks to inertia flywheel tuning. You'll hear stations you didn't know existed in your area, and the clarity and separation of the sound will amaze you. The adjustable phasing control insures best stereo separation at all times. And the automatic stereo indicator light tells you if the program is in stereo. AFC puts an end to drift too. The BSR Automatic Turntable has features normally found only in very expensive units, like cueing and pause control, variable anti-skating device, stylus pressure adjustment and automatic system power too. Comes complete with a famous Shure diamond stylus magnetic cartridge. The handsome walnut cabinet with sliding tambour door will look sharp in any surroundings, and the AD-27 performs as well as it looks. For the finest stereo compact you can buy, order your "27" Component Compact now. 41 lbs.

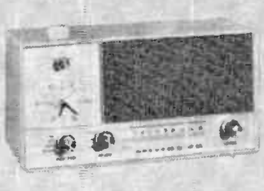
HEATHKIT AD-17 Stereo Compact

Using the component approach of the AD-27, Heath engineers took the solid-state stereo amplifier section of the AD-27, matched it with the high quality BSR-400 Automatic Turntable and put both of these fine components in a handsomely styled walnut finish cabinet. The result is the "17" — featuring 30 watts music power, 12 Hz to 60 kHz response, auxiliary & tuner inputs, less than 1% Harmonic & IM distortion, adjustable stylus pressure & anti-skate control and much more. Order your "17" now. 27 lbs.

NEW
kit TA-38
225^{00}

HEATHKIT TA-38 Solid-State Bass Amplifier

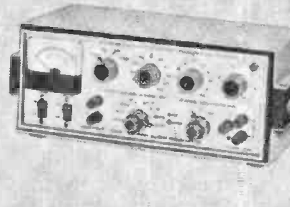
The new Heathkit TA-38 is the hottest performing bass amp on the market, for quite a few reasons. First, there's all solid-state circuitry for reliability. Then there's the tremendous power — the TA-38 puts out 120 watts of EIA music power, 240 watts peak, or 100 watts continuous. Extremely low harmonic & IM distortion too. Many amps suffer from "blow-out" problems, but not the new TA-38 — *YOU CAN'T BLOW IT* . . . it boasts two 12" heavy duty special design speakers with giant 3 pound 6 ounce magnet assemblies mounted in a completely sealed, heavily damped ¾" pressed wood cabinet — those speakers will take every watt the amp will put out, and still not blow. Sound? The TA-38 is tailored to reproduce the full range of bass frequencies delivered by bass guitars and its sound with combo organs and other instruments is remarkable. Easy 15 hour assembly to the wildest bass amp on the market. Order one now and surprise the guys with the high-priced gear. 130 lbs.



NEW
kit GR-58
47^{95}

HEATHKIT GR-58 Solid-State AM/FM Clock Radio

The easy way to get up in the morning. Choose the morning news & weather on AM or the bright sound of FM music. AFC makes FM tuning easy. The "Auto" position on the Telechron® clock turns only the radio on, or use the "Alarm" setting for both the radio and the alarm. You can even enjoy fresh coffee when you awake in the morning, thanks to the clock-controlled accessory AC socket on the back of the new GR-58. The handy "snooze" alarm feature lets you wake up gradually for ten minutes to the sound of the radio, then the alarm goes on . . . push the "snooze" button to silence the alarm for ten minutes more of music or news — the alarm sounds automatically every ten minutes and the "snooze" button turns it off, cycling continuously until the selector switch is moved to another position. Fast, easy circuit board construction, smart blue hi-impact plastic cabinet and top reliability make this GR-58 the clock radio for you. 8 lbs.



NEW
kit IG-18
67^{50}

Wired IGW-18
99^{50}

HEATHKIT IG-18 Solid-State Sine-Square Wave Generator

A precision source of sine or square waves at a low kit price . . . that's the new solid-state IG-18 from Heath. Delivers 5% accuracy thru the wide range of 1 Hz to 100 kHz. The sine wave section features less than 0.1% distortion thru the audio range, 8 output voltage ranges from 0.003 to 10V, switch-selected internal 600 ohm load or external load and metered output of both voltage & dB. The square wave section has a 50 nS rise time and three output voltage ranges from 0.1 to 10 V P-P. Both sine & square waves are available simultaneously and the frequency is switch-selected for constant repeatability and fast operation. Circuit board construction makes the new IG-18 easy to build . . . new Heathkit styling and engineering excellence make it easy to use. Put the new IG-18 on your bench now. 10 lbs.

ELECTRONICS library

QUIET

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More than 2.4 million words, 125,000 definitions, 16,500 separate articles, and 2000 photos and diagrams make this Scientific Encyclopedia as unique and valuable a reference source as you can find. In its fourth edition, this one-volume reference work has been completely revised and enlarged into a format to accommodate the wealth of material in science and technology. It is so complete and accurate that it not only provides the information needed by the professional, its simple format can be used and understood by virtually any reader. The volume contains a survey of mathematics, the physical and biological sciences, all phases of engineering (including electronics), and medical technology. It appears that every effort has been made by the authors, who are specialists in their fields, to update the information on new scientific developments.

Published by D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N.J. 08540. Hard cover. 2008 pages. $42.75.

UNDERSTANDING ELECTRONIC ORGANS

by Thomas Jaski

Many books have been written about the various home organs that are currently available and popular. However, most of these books are specifically applicable to particular instruments—many of which may soon be obsolete. This book takes a general approach, providing a basic understanding of the complex circuits used in electronic organs and explaining why the circuits are used as they are. This approach should help the reader become familiar with new organs as they are introduced. The book is full of useful information, including a review of what sound is and a discussion of organ pipes and how electronic circuits attempt to reproduce the sounds of pipes. It also explains how to perform minor repairs without the tools and instruments used by the professional organ technician.

Published by Hayden Book Co., 116 West 14 St., New York, N.Y. 10011. Soft cover, 224 pages. $4.95.

RADIO AND ELECTRONIC HANDBOOK

by G. R. Wilding

This one-source reference work is the technician-level counterpart of conventional en-

(*Continued on page* 116)

POPULAR ELECTRONICS READER SERVICE PAGE

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new literature

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Circle No. 75 on Reader Service Page 15 or 115

A 16-page Fall, 1968 catalog available from *Tab Books*, publishers of the Gernsback Library books, describes over 100 current and forthcoming books. The subject areas of these books cover broadcasting, basic technology, CATV, electric motors, electronic engineering, test instruments, transistors, etc.

Circle No. 76 on Reader Service Page 15 or 115

Allied Radio Corporation recently issued its 536-page catalog number 280 for 1969. The catalog lists the latest in major brands of hi-fi components and tape recorders; video tape recorders, monitors, and cameras; transistorized FM-AM and SW receivers; TV portables in various screen sizes; and specialized equipment for the ham, CB'er, experimenter, and hobbyist. Specialty lines included in the catalog illustrate hobby and craft kits, electric guitars, music instrument amplifiers, movie and 35-mm cameras, binoculars, adjustable lamps and fluorescent fixtures, weather instruments, and an electronic organ.

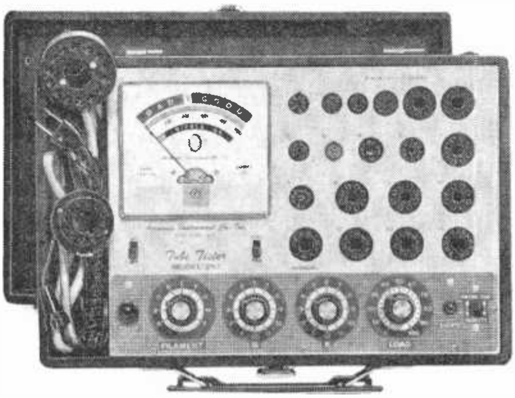
Circle No. 77 on Reader Service Page 15 or 115

More than three hundred electronic kits for every interest and budget are featured in the *Heath Company*'s 1969 catalog. Stereo/hi-fi components; ham radio equipment;

(*Continued on page* 113)

The New 1969 Improved Model 257 **A REVOLUTIONARY NEW**

TUBE TESTING OUTFIT



COMPLETE WITH ALL ADAPTERS AND ACCESSORIES, NO "EXTRAS"

- Tests all modern tubes including Novars, Nuvistors, Compactrons and Decals.
- All Picture Tubes, Black and White and Color

ANNOUNCING...for the first time

A complete TV Tube Testing Outfit designed specifically to test all TV tubes, color as well as standard. Don't confuse the Model 257 picture tube accessory components with mass produced "picture tube adapters" designed to work in conjunction with all competitive tube testers. The basic Model 257 circuit was modified to work **compatibly** with our picture tube accessories and those components are not sold by us to be used with other competitive tube testers or even tube testers previously produced by us. They were custom designed and produced to work specifically in conjunction with the Model 257.

STANDARD TUBES:

- ✔ Tests the new Novars, Nuvistors, 10 Pins, Magnovals, Compactrons and Decals.
- ✔ More than 2,500 tube listings.
- ✔ Tests each section of multi-section tubes individually for shorts, leakage and Cathode emission.
- ✔ Ultra sensitive circuit will indicate leakage up to 5 Megohms.
- ✔ Employs new improved 4½" dual scale meter with a unique sealed damping chamber to assure accurate, vibration-less readings.
- ✔ Complete set of tube straighteners mounted on front panel.

BLACK AND WHITE PICTURE TUBES:

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

COLOR PICTURE TUBES:

- ✔ The Red, Green and Blue Color guns are tested individually for cathode emission quality, and each gun is tested separately for shorts or leakage between control grid, cathode and heater. Employment of a newly perfected dual socket cable enables accomplishments of all tests in the shortest possible time.

The Model 257 is housed in a handsome, sturdy, portable case. Comes complete with all adapters and accessories, ready to plug in and use. No "extras" to buy. Only **$47.50**

NOTICE We have been producing radio, TV and electronic test equipment since 1935, which means we were making Tube Testers at a time when there were relatively few tubes on the market, 'way before the advent of TV. The model 257 employs every design improvement and every technique we have learned over an uninterrupted production period of 32 years.
Accurate Instrument Co., Inc.

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CIRCLE NO. 1 ON READER SERVICE PAGE

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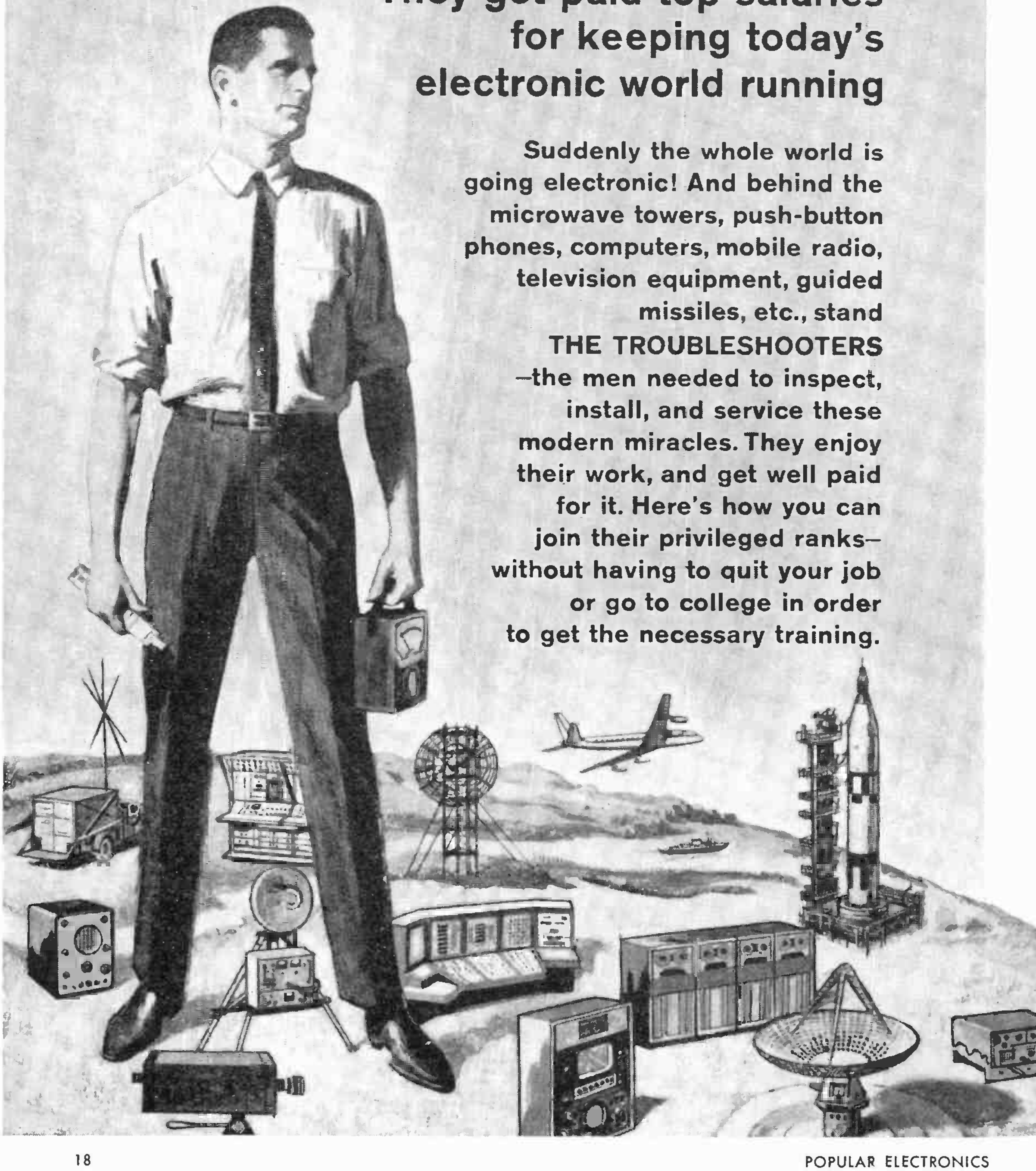

JUST THINK how much in demand you would be if you could prevent a TV station from going off the air by repairing a transmitter...keep a whole assembly line moving by fixing automated production controls...prevent a bank, an airline, or your government from making serious mistakes by servicing a computer.

Today, whole industries depend on Electronics. When breakdowns or emergencies occur, someone has got to move in, take over, and keep things running. That calls for one of a new breed of technicians—The Troubleshooters.

Because they prevent expensive mistakes or delays, they get top pay—and a title to match. At Xerox and Philco, they're called Technical Representatives. At IBM they're Customer Engineers. In radio or TV, they're the Broadcast Engineers.

What do you need to break into the ranks of The Troubleshooters? You might think you need a college degree, but you don't. What you need is know-how—the kind a good TV service technician has—only lots more.

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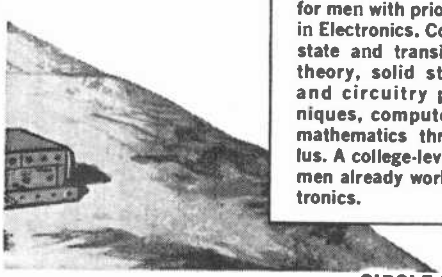

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CIRCLE NO. 8 ON READER SERVICE PAGE

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.

SOLID-STATE STEREO RECEIVER

Two hundred watts output is a big boast for any stereo receiver, but the Model TK-140x AM/FM receiver from *Kenwood Electronics, Inc.*, has just that. The front end of the receiver employs a four-gang tuning capacitor, three FET's, and four IC's (in the i.f. strip). Sensitivity is down to a low 1.7 μV, so a mere 1-dB difference in signals on the same frequency will allow the TK-140x to capture one station and reject the other. Also, FM image rejection, cross modulation, and i.f. rejection are all better than 100 dB, while alternate channel selectivity is 45 dB and harmonic distortion is less than 0.5% at 400 Hz, 100% modulated signal. Included are two sets of output taps, convenient two-channel preamplifier outputs, and main amplifier inputs.

Circle No. 78 on Reader Service Page 15 or 115

CB TV INTERFERENCE FILTER

The CB'er can now eliminate TV interference caused by his transceiver with a TVI filter being offered by *Gold Line Connector, Inc.* The TVI filter features a tuning control to facilitate adjustment for maximum television interference rejection, guaranteed 40 dB or better. When he transmits, the CB'er simply adjusts the control knob on the filter until the TVI is corrected.

Circle No. 79 on Reader Service Page 15 or 115

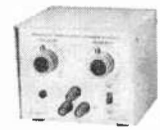
ELECTRIC GUITAR BROADCASTER

A wireless electric quitar broadcaster that plugs into the output jack of any electric-guitar has been introduced by *Saxton Products, Inc.* The broadcaster converts guitar sound into FM radio signals that can be picked up by any FM radio within a 50-foot radius. Miniature antenna, tuning control to insure extended quality reception, and phone plug are included. Tuning range is from 88 to 94 MHz; frequency response is 20-15,000 Hz; and input power to the antenna is 6 mW. For best results, a Saxton B-101 battery is recommended as the power source.

Circle No. 80 on Reader Service Page 15 or 115

LOW-COST, LOW-VOLTAGE POWER SUPPLY

An inexpensive 1-15-volt d.c. power supply, Model IP-18, is available from *Heath Company*. This all-silicon-transistor supply features voltage regulation within 40 mV from no load to full load and less than 0.5% change in output voltage with input variations from 105 to 125 volts a.c. The IP-18 also features current limiting, continuously variable between 10 and 500 mA. Ripple and noise are maintained at less than 0.1 mV, and transient response is 25 μsec. Output impedance is 0.5 ohms or less up to 100 kHz.



Circle No. 81 on Reader Service Page 15 or 115

INDUCTION-BALANCE METAL DETECTOR

Designed to locate buried metal objects to depths of five feet, the Model 70 "Metalert" metal detector by *Fisher Research Laboratory* can be used practically anywhere—even in shallow water. The Model 70 is so finely balanced and lightweight that the user can hold and tune it simultaneously with the same hand. Featured are high sensitivity, a waterproof loop mounted on an adjustable shaft, 9-volt battery operation, built-in battery condition tester, and a cushioned headset. Accessories such as a plug-in speaker/amplifier and carrying case are available separately.

Circle No. 82 on Reader Service Page 15 or 115

HIGH-QUALITY HI-FI SPEAKER SYSTEMS

The "Imperial I" and "Imperial II" speaker systems available from *Marantz Company, Inc.*, feature three-way, five-speaker design. The Imperial I system has a walnut enclosure with a hand-rubbed French lacquer finish and a selection of decorator-design grille fabrics. The Imperial II is hand-crafted from selected hardwoods with antique finish and hand-carved wood grille. Technical specifications: 40-20,000 Hz frequency response (crossovers at 700 and 6000 Hz); 40-watt power-handling capability; and 8-ohm impedance. Both speaker systems feature built-in acoustical balancing controls.

Circle No. 83 on Reader Service Page 15 or 115

MOBILE CB ANTENNA

The "Avanti One" available from *Avanti Research and Development, Inc.*, incorporates rugged, durable fiberglass with an exclusive tuning device for precisely adjusting SWR to 1:1. The fiberglass shaft of the antenna is capped with a unique stainless steel adjust-

PRODUCTS (*Continued from page 22*)

able tip. Tuning is accomplished by a simple adjustment of the tip length, after which the tip is locked in position, providing maximum power transfer to the antenna. Available in two models (4' and 6'), the Avanti One is designed to fit rooftop, trunk, cowl, bumper, or marine mounts. A chrome-plated brass ferrule permits easy installation on standard brackets.

Circle No. 84 on Reader Service Page 15 or 115

COLOR-BAR PATTERN GENERATOR

The Model LCG-389 color-bar pattern generator, used extensively for production testing and field service, is now available from *Leader Instruments Corp.* This ultra-compact, all-solid-state instrument, designed for convergence and synchronization adjustments of color and monochrome TV receivers, features five basic patterns—among

them, gated rainbow color bars; vertical and horizontal lines; crosshatch; small, well-defined dots. Gun killers are provided for convergence adjustments. Technical specifications: channels 5 and 6 selectable r.f. output; 10 gated rainbow color bars; 21 vertical and 15 horizontal lines for vertical and horizontal lines and crosshatch patterns; continuously adjustable 0-200% chroma level; 105-125 volts, 50-60 Hz operation.

Circle No. 85 on Reader Service Page 15 or 115

MARINE AUDIO SYSTEM

The "Sound Center" audio system, available from *Simpson Electronics, Inc.*, is designed to provide maximum clarity and range in voice projection and sound pickup for marine use. The new multi-purpose system includes a manual and automatic fog horn, intercom, an alarm that can warn of fire, bilge leaks, or break-ins, and a high-quality carbon microphone with a press-to-talk switch. Also included is a fully adjustable weather-

resistant speaker horn made by Electro-Voice. Construction of the "Sound Center" is all solid state, including integrated circuits. The system operates on 12 volts d.c.

Circle No. 86 on Reader Service Page 15 or 115

LISTENING ACCESSORIES FOR STEREO

Stereo-Magic has developed two new adapters for stereo headphones. The Model HAD-1 adapter allows the user to add a plug-in jack to any stereo receiver, phonograph, or tape player. The second adapter lets the user change the volume of any stereo headphone set to adjust for hearing differences from one ear to the other. Also available is a set of matching headphones with foam rubber lined ear cups in a lightweight frame for maximum comfort. Frequency range is 30-20,000 Hz.

Circle No. 87 on Reader Service Page 15 or 115

CARTRIDGE FM TUNER

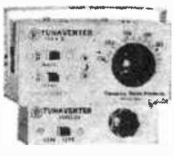
Capable of plugging into all 4- and 8-track cartridge tape players, *Eastern Specialties Corporation*'s "Stereo-Magic" universal FM tuner adds a new dimension to the ordinary tape player. The shape and size of an ordinary tape cartridge, Stereo-Magic plugs in like one. Technical specifications: 88-108-MHz tuning range; 10.7-MHz i.f.; power consumption, 6 mA at 9 volts; "C" type rod antenna and built-in antenna connector; 10

μV/meter at 0.1 volt output coil sensitivity; and 23 dB at 0.1 volt signal-to-noise ratio. This all solid-state tuner employs eight transistors and three diodes.

Circle No. 88 on Reader Service Page 15 or 115

SQUELCH FOR R.F. CONVERTER

The first squelch control for noise-free monitoring on HF and VHF "Tunaverters," making it possible to have receiver squelch performance with economical converter usage, was recently introduced by *Tompkins Radio Products.* The new squelch attachment requires only a single coaxial cable hookup to the converter. It has complete electronic control without relays, fully adjustable squelch setting,



power switch, and 9- or 12-volt operation. The squelch attachment is available in two models: Model ST fastens to the bottom of the Tunaverter; Model SU has its own mounting bracket.

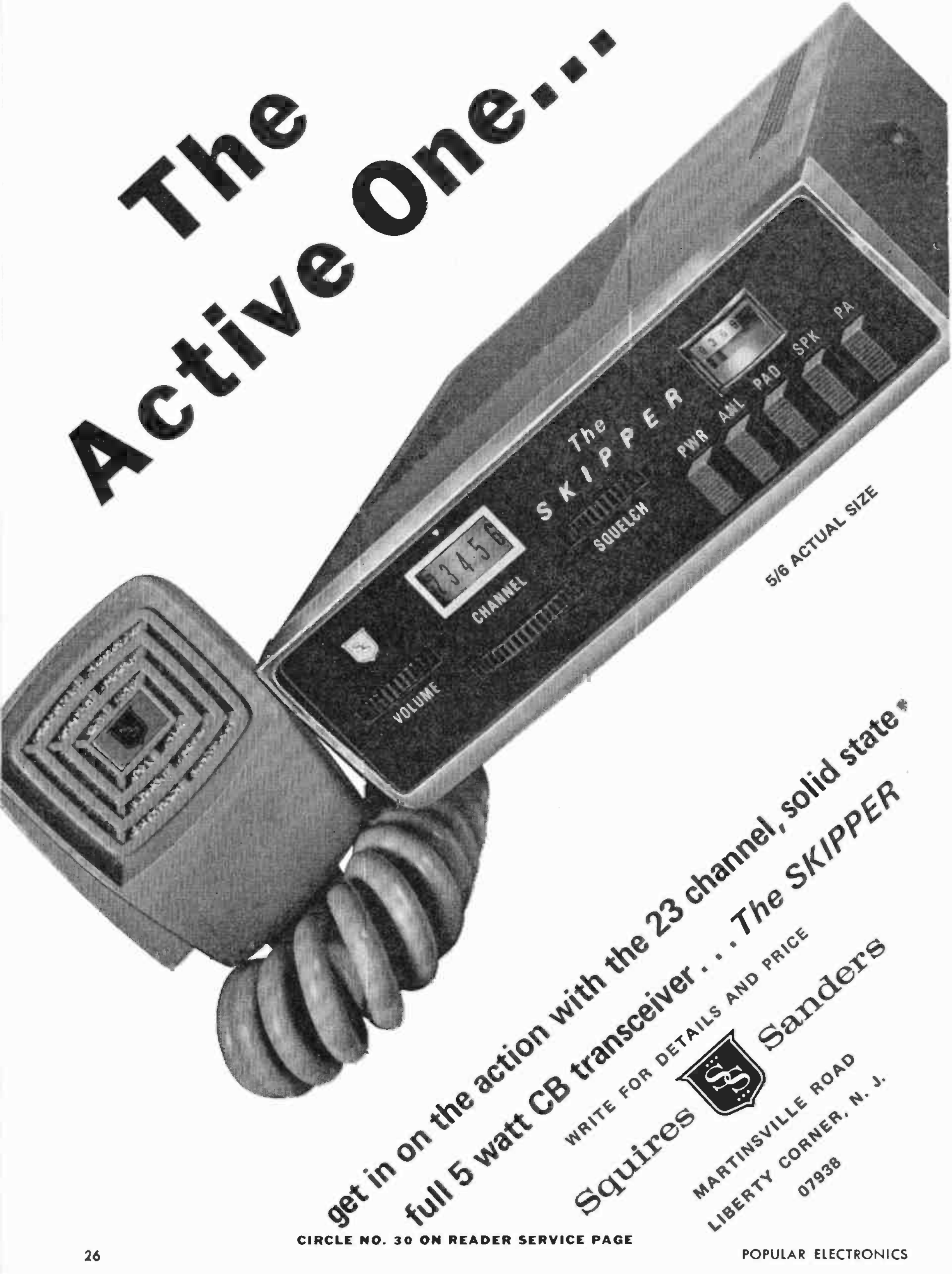
Circle No. 89 on Reader Service Page 15 or 115

100-WATT AM/FM STEREO RECEIVER

Two separate methods of tuning the FM band are featured in *Fisher Radio*'s model 250-T all-transistor stereo receiver. In addition to conventional flywheel tuning, the 250-T employs Fisher's "Tune-O-Matic" push-button tuning of five FM stations. The FM section has a.f.c. for center-of-channel accuracy, FET front end, IC i.f. amplifier, and a Stereo Beacon. Technical specifications:

amplifier section—100 watts ±1 dB music (30 watts/channel r.m.s.) power at 8 ohms; 0.5% harmonic distortion; 1% at 30 watts IM distortion; hum and noise 90 dB below rated output. AM tuner section—10-μV/m usable sensitivity; 50-dB selectivity; 80-dB image rejection; 85-dB i.f. rejection. FM tuner section—2-μV usable sensitivity; 65-dB signal-

(*Continued on page* 114)



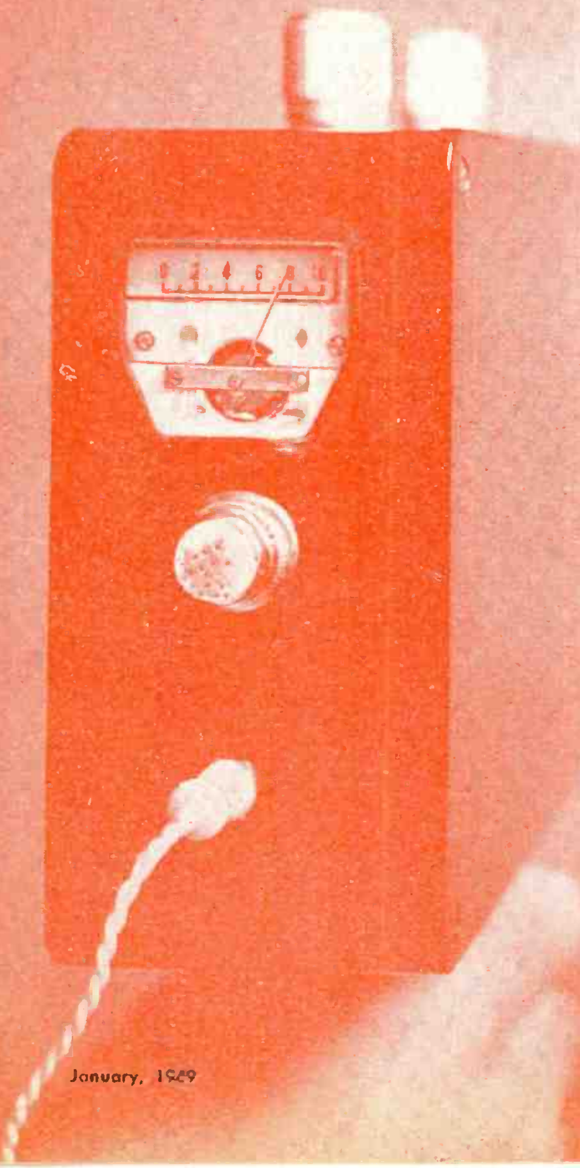
CIRCLE NO. 30 ON READER SERVICE PAGE

COVER STORY

BY JAMES G. SLOAT
Texas Instruments, Inc.

Build Infrared Sensor

IR "HOTBOX DETECTOR" HAS FANTASTIC SENSITIVITY



HAVING a fire alarm in a house or office is a good idea—sometimes, it's a life saver. However, most commercial alarms use sensors that only operate at some critical temperature before they actuate the alarm. Under these conditions, if a fire starts some distance from the sensor, a lot of building can burn away before an alarm is given. What is needed is a device that can detect the infrared (IR) radiation from a smoldering or unusually hot object. This radiation can be sensed from a distance.

In the realm of burglar alarms, most low-cost units use either a frangible trip wire or a light beam to detect intruders. Trip wires, in many cases, can be seen and light beams can either be seen directly or can be detected by the dust motes in the air. This, or course, nullifies the alarm. What is needed here is an invisible beam of IR and a detector

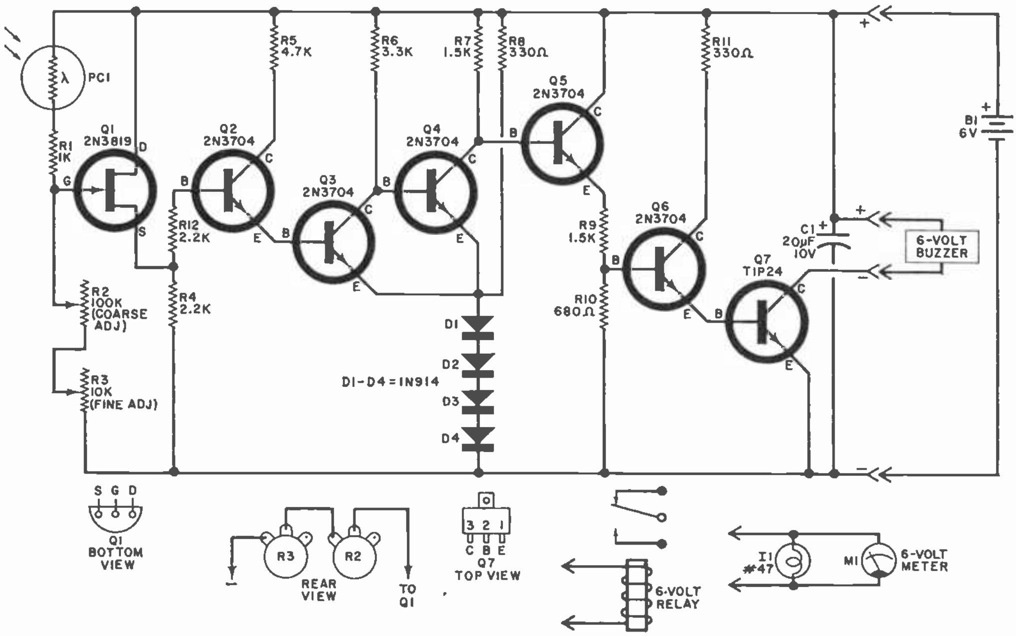


Fig. 1. No power is applied to output indicator until PC1 "sees" a predetermined level of infrared.

that resonds only to IR and not to visible ligh .

Incidentally, the infrared portion of the electromagnetic spectrum lies between the highest radio frequencies and visible light. Because all material emits IR radiation if its temperature is above absolute zero, the amount of IR radiated is a measure of heat (not necessarily actual flames).

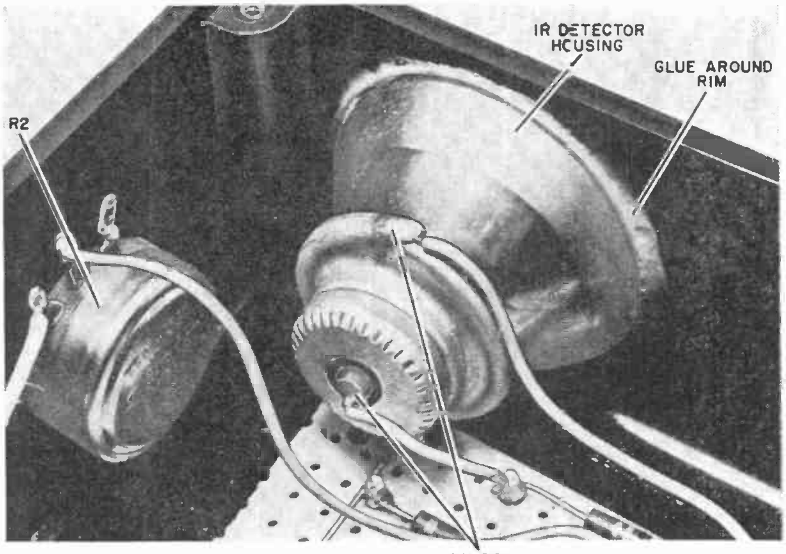
The "Hotbox" IR detector described here not only makes an ideal fire or burglar alarm, but has many other uses. For example. it can check for over-heating conditions in electrical and mechanical equipment or detect the difference between a cloudy and a clear sky. When not serving some truly practical purpose, it can tell you when your soldering iron is up to temperature, turn on your hi-fi or TV when you light a cigarette, or provide a low-cost test instrument for studying the IR properties of various materials.

Because the Hotbox is, by necessity, a low-cost device, its IR range is limited. It responds only to objects that are at least 75°C hotter than the ambient temperature of the detector. Therefore it does not respond to the warmth of a human body. Commercial IR detectors are submerged in cryogenic (extremely low temperature) chambers making the detector sensitive not only to humans, but also to very low levels of IR.

Similar to visible light, IR can be reflected around corners by shiny sheets of metal or conventional mirrors, thus enabling the device to "see" around cor-

PARTS LIST

B1—6-volt lantern battery
C1—20-μF, 10-volt electrolytic capacitor
D1-D4—1N914 diode
PC1—Infrared detector kit, including reflector and filter (Radio Shack #276-035 or similar)
Q1—2N3819 field-effect transistor (see text)
Q2-Q6—2N3704 transistor (see text)
Q7—Power transistor (Texas Instruments TIP24 or similar, see text)
R1—1000-ohm
R4, R12—2200-ohm
R5—4700-ohm
R6—3300-ohm
R7—1500-ohm
R8, R11—330-ohm
R9—1500-ohm
R10—680-ohm
(All resistors ½-watt)
R2—100,000-ohm potentiometer
R3—10,000-ohm potentiometer
I1—#47 indicator lamp and holder
M1—6-volt meter movement
Misc.—Plastic case and cover (Harry Davis type 260 or similar), 6-volt d.c. buzzer (optional), 6-volt d.c. relay (optional), miniature jack and plug with earphone-type lead, perf or PC board, camera pistol grip (optional), knobs (2), cement or epoxy, mounting hardware wire, etc.
Note—An etched and drilled PC board may be purchased from Excello Circuits Co., 847 W. 23 St., Houston, Texas 77008, for $3.95.



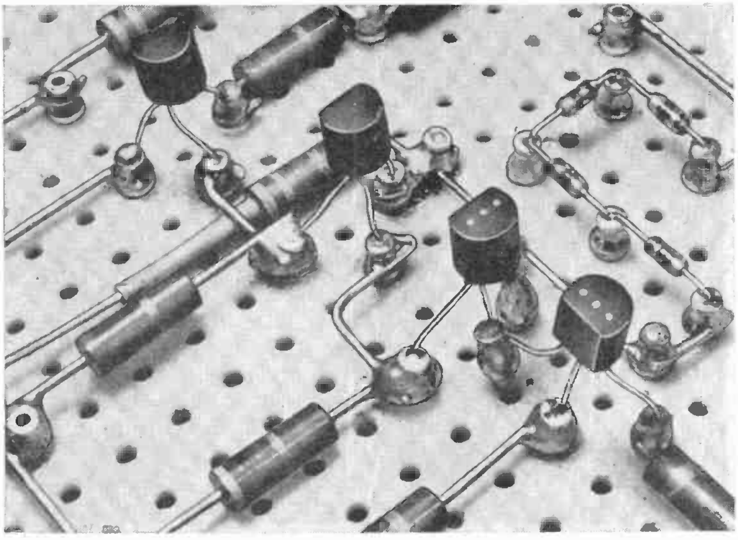
When soldering the lead to the IR detector housing, work fast so that you do not overheat the IR element within the reflector. Other connection is made to bulb tip.

ners if desired. The reflector unit specified in the Parts List for Fig. 1 is as directional as a flashlight, so that the device can be pointed very precisely at the IR source.

Construction. Putting the Hotbox together is simple and straightforward. Lead dress is not critical and the circuit (shown in Fig. 1) is very flexible with regard to resistor values and transistor parameters. In fact, almost any silicon *npn* transistors can be used for *Q2* through *Q6*. Most *n*-channel FET's will work for *Q1*, while almost any *npn* power transistor can be used for *Q7*.

The author used perf-board construction (see photos), although a printed-

This is what good perf-board construction looks like. Note the clean, almost polished look of the solder connections and the neat arrangement of parts.



HOW IT WORKS

The heart of the circuit is a threshold detector composed of transistors *Q2*, *Q3*, and *Q4* and their associated components. Each of silicon diodes *D1* through *D4* has a constant 0.6-volt drop when forward biased with a few milliamperes. Under all conditions, current flows through *R8* and forward biases the four series-connected diodes so that the voltage at the emitters of *Q3* and *Q4* is fixed at 2.4 volts. This fixed voltage establishes the operating point for the circuit.

If the detector, *PC1*, is shielded from IR radiation, *Q2* and *Q3* are turned off, and current flows through *R6* into the base of *Q4*. Thus *Q4* is turned on and appears as a short circuit between its collector and emitter. The collector voltage of *Q4* is therefore close to 2.4 volts.

Emitter follower *Q5* acts as a buffer between the threshold detector and the output stage. Because its base-emitter junction behaves like a forward-biased diode, the emitter of *Q5*, under all circuit conditions, is about 0.6 volt below the collector of *Q4*. When *Q4* is conducting, the emitter of *Q5* is at about 1.8 volts. Voltage divider *R9* and *R10* presents slightly less than one third of *Q5*'s emitter voltage to the base of *Q6*. With 1.8 volts on the emitter of *Q5*, the voltage at the base of *Q6* is about 0.55 volt, which is not enough to turn on *Q6*. Since no current flows through *Q6*, *Q7* does not receive base drive and is turned off. If an indicator is connected in series with the collector of *Q7*, it is not energized as long as *Q7* is in the off state.

Assume now that the voltage at the base of *Q2* increases. This transistor must be conducting in order for *Q3* to conduct. However, this requires a bias of at least 3.6 volts on the base of *Q2* to overcome the emitter bias on *Q3*. When this condition is satisfied, *Q2* and *Q3* both turn on, and the base-emitter junction of *Q4* is bypassed. This turns *Q4* off and its collector voltage jumps from 2.4 volts to about 5.5 volts. The emitter voltage of *Q5* jumps correspondingly from 1.8 to about 4.9 volts. Under this condition, voltage divider *R9* and *R10* provides a forward bias for *Q6*, causing it to conduct. This turns *Q7* on and the output indicator is energized.

Field-effect transistor *Q1* is connected as a source follower with the detector *PC1* and a pair of trimming potentiometers, *R2* and *R3*, determining its gate voltage. The sensitive area of the detector is lead sulphide whose resistance decreases when exposed to infrared radiation. If the detector is shielded from IR and the trimmer potentiometers are adjusted for a *Q1* gate level of 3 volts, then, when *PC1* is exposed to IR, the voltage at the gate of *Q1* goes above 3.6 volts. The remainder of the circuit is then triggered on. Adjustment of the coarse and fine potentiometers determines at what IR level the Hotbox produces an output signal.

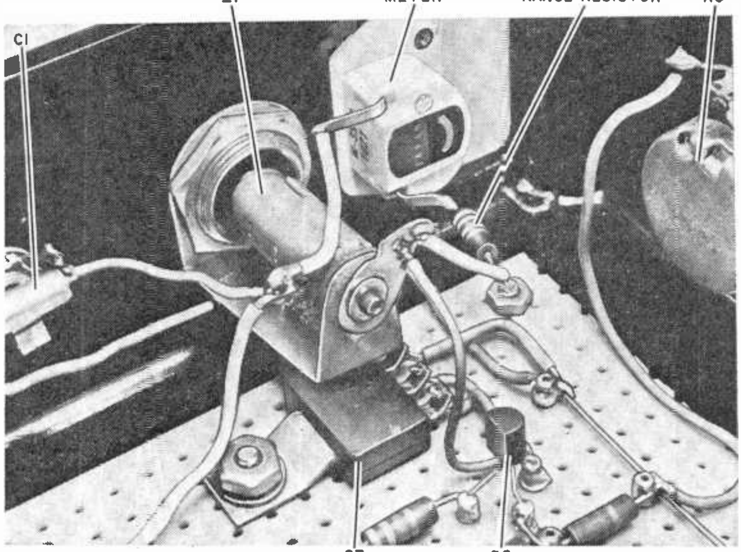
circuit board is available. The components layout for the perf board is shown in Fig. 2.

To prepare the case, use a circle cutter or fine saw to cut a hole in one end of the case slightly smaller than the rim diameter of the IR detector reflector. Secure the reflector to the case using high-quality cement or epoxy. The filter provided with the IR detector must be cut to size, with the protective paper left on it during the cutting process. Cut the filter slightly larger than the diameter of the reflector hole. When you are ready to affix the filter, remove the paper from both sides and glue the filter into place, covering the reflector.

At the top of the case, drill holes for the two potentiometers, *R2* and *R3*. In the end opposite the IR reflector, drill appropriate holes for indicator lamp *I1* and a miniature phone jack for the battery power leads. The author used the type of phone jack and earphone cable and plug usually furnished with imported transistor radios. The battery is carried on the waist belt. If desired, a hole can be cut out for an optional 6-volt meter. This meter is used for daylight indications when the glow of the lamp may be obscured by bright light.

Once the case has been prepared, mount the perf board (or PC board) in the case, using a standoff at each corner. Connect the circuit board to the other components according to Fig. 1. The schematic also shows the correct way to wire potentiometers *R2* and *R3*. One of the connections to the IR detector must be made to the reflector. Use a small file to clean away the protective coating. Tin this area soon after filing, avoiding excessive heating of the detector. If you want to use the Hotbox to trigger an external relay, mount a pair of binding posts near the power input jack. Connect the binding posts in parallel with the indicator lamp.

Checkout. Check all wiring for circuit errors, wrong component installation. and faulty soldering. Assuming that all is well, connect the 6-volt battery to the circuit being careful to get the polarity correct. Aim the IR detector end of the Hotbox so that it does not "see" any incandescent lamp, hot soldering iron, or other source of IR energy. With both *R2* and *R3* completely counterclockwise, the indicator light should be off (and the optional meter should indicate zero). Slowly rotate *R2* clockwise. At some point, the indicator light will come on. Once it is on, back off on *R2* until the light

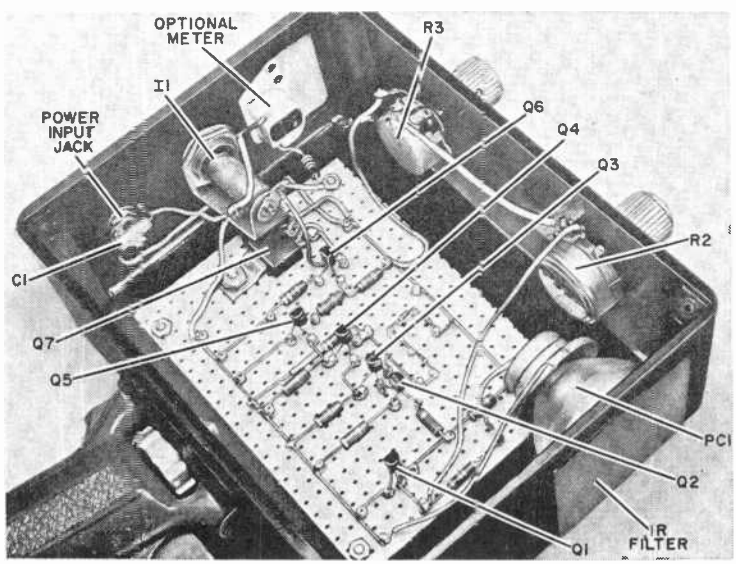


The optional meter range resistor converts the low-current meter into a 6-volt full-scale indicator. The resistor value depends on the type of meter. The meter reads the voltage drop across I1.

goes off. Now turn *R3* clockwise until the light comes on again. Then rotate *R3* slowly counterclockwise until the light just goes off. The detector is now set for maximum sensitivity. Potentiometer *R2* is used as the coarse control while *R3* is the fine adjustment. The settings of these controls determine at what level the Hotbox responds. If a particular device normally runs hot, set the controls

(*Continued on page* 110)

Fig. 2. Internal arrangement of the detector. The optional camera pistol grip is secured with its own screw and makes portable use very convenient. With it, you can aim the detector where desired.

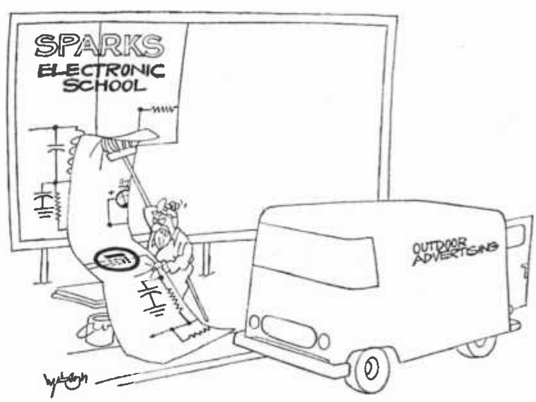


Popular EleComics

I understand you have a hi-fi bug in your house.

Think of it—in three days you'll no longer be a single sidebander.

Here's a nifty little job, owned by an old guy who never called more than 2 miles.



BUILD
The Big Six

THE SPEAKER SYSTEM THAT'S BIG— AND PROUD OF IT

BY DAVID B. WEEMS

THERE IS more to some large speaker systems than impressive size—namely, quality. Some compact speaker systems have an amazingly low resonance and use long-throw woofer design to reduce distortion. But think of the results you could get by using a woofer whose resonance is already at the low end of the audio spectrum and putting it in an enclosure designed to maintain the speaker's resonance below that of any available compact. The enclosure might be much larger than any compact, but the system would be capable of producing deeper, smoother bass response right down to the bottom of the music spectrum.

The "Big Six" speaker system described here uses this approach and also provides room for another feature you're not likely to find in any compact system—a column of four midrange speakers. Add a super tweeter and a crossover network, and you have a speaker system that doesn't have to apologize for its large size. The performance of the Big Six speaks for itself.

Overall System. The Big Six speaker system is built around a low-resonance Jensen Model W12NF "Flexaire" woofer, mounted inside a modified labyrinth. The 20-Hz characteristic resonance of the woofer is raised somewhat by the enclosure, partly because the labyrinth is shorter than the optimum quarter-wave length. (Fourteen feet, after all, would be a bit large for the average-size listening room.) The cross-section area of the labyrinth is greater than the theoretical maximum because experiments indicate that the larger "tube" produces deep, unrestricted bass.

Four economy priced Cinaudagraph 6½" midrange speakers are arranged in a sealed column to prevent interaction with the woofer. As a result, they provide an extremely wide frequency response and upgrade the overall quality of the Big Six.

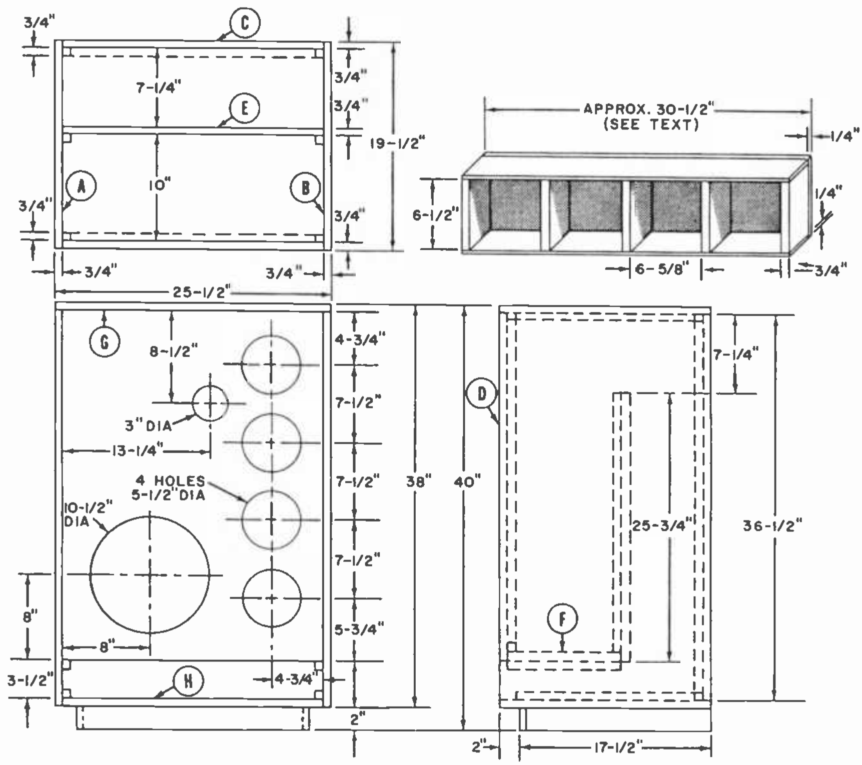


Fig. 1. To avoid confusion, all plates in basic enclosure are identified by letter symbols A through H. Cleats and corner blocks are referred to by lengths as they are used in text.

To round out the speaker system, a University Model T-202 "Sphericon" super tweeter is used because of its superior high-frequency dispersion characteristics. However, if you wish to economize, you can substitute a less expensive tweeter with dispersion characteristics similar to those of the Sphericon's. Further economizing can be accomplished by substituting less expensive fixed crossover networks for the more versatile ones specified in the Bill of Materials. Do not, however, substitute the "Flexaire" woofer or you will degrade system performance.

Construction. To avoid confusion during construction, the eight major parts of the enclosure are identified by letters A through H in the text, Bill of Materials, and dimensioned drawings of Fig. 1. Instructions for fastening parts together (with the exceptions of speaker mounting board D, rear enclosure wall C, and the rear wall of the midrange speaker column) mean "glue and screw."

Start construction by attaching the 16½" cleats ¾" in from the side edges and 1½" in from the front and rear edges of plates G and H. Then attach the 30¾" cleats to the front and the 25" cleats at the center of side plates A and B. Make sure the front cleats are flush with the top edges and recessed ¾" in from the front edges of the side plates, and that the center cleats are 7¼" from the top and 10" from the front edges. The rear cleats for plates A and B will be attached later.

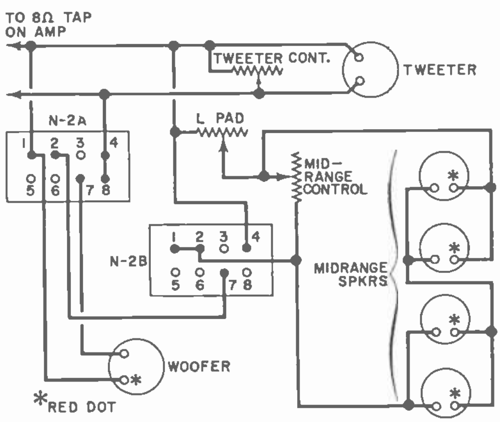


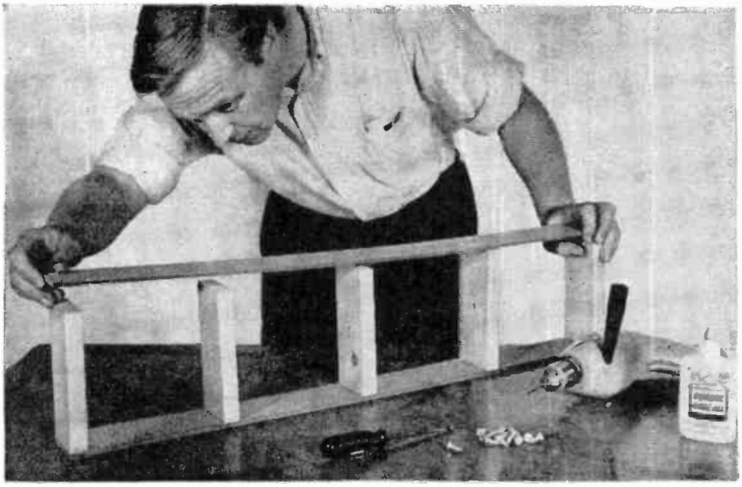
Fig. 2. To obtain proper phasing, be sure to wire all speakers together as shown here. Terminal numbers are stamped right on crossover networks.

BILL OF MATERIALS

1—Jensen Model W12NF "Flexaire" woofer
1—University Model T-202 "Sphericon" tweeter
4—Cinaudagraph 6½" midrange speakers (stock no. 6-½"-MR from McGee Radio, 1901 McGee St., Kansas City, Mo.)
1—University Model N-2A crossover network
1—University Model N-2B crossover network
1—University Model AP-8 L-pad for midrange control
2—37½" × 19½" pieces of ¾" plywood (parts A and B)
1—36½" × 24" piece of ¾" plywood (part C)
1—33" × 24" piece of ¾" plywood (part D)
1—25¾" × 24" piece of ¾" plywood (part E)
1—24" × 10" piece of ¾" plywood (part F)
1—25½" × 19½" piece of ¾" plywood (part G)
1—24" × 19½" piece of ¾" plywood (part H)
5—6½" × 2⅝" pieces of ¾" white pine for ends and partition separators of midrange column
2—30¼" × 2⅝" pieces of ¼" Masonite for sides of midrange column (see text)
1—30¼" × 7" piece of ¼" Masonite for rear of midrange column (see text)
2—35¾" pieces of ¾" × ¾" pine (rear cleats for parts A and B)
4—24" pieces of ¾" × ¾" pine (top and bottom cleats at rear, top cleat for part D, and front cleat for part F)
4—16½" pieces of ¾" × ¾" pine (top and bottom side cleats)
2—25" pieces of ¾" × ¾" pine (side cleats for part E)
2—30¾" pieces of ¾" × ¾" pine (front side cleats)
2—10" pieces of ¾" × ¾" pine (side cleats for part F)
1—21½" piece of 2" × ¾" pine (front of footing)
2—16¼" pieces of 2" × ¾" pine (sides of footing)
30—¾" × #10 flathead wood screws for Masonite parts in midrange column
120—1¼" × #8 flathead wood screws
4—1¼" × #12 panhead sheet metal screws for woofer
28—¾" × #10 panhead sheet metal screws for midrange speakers, tweeters, and crossover networks
4—³⁄₁₆" × 1" bolts for conductors
25'—2" × 24" fiberglass house insulation (see text)
Misc.—Pine for front trim; grille cloth; stain; paint, hookup wire; spade and ring lugs; solder; aluminized "duct" tape, etc.

Invert top plate G onto a clean, flat surface, and secure the side plates in place. Now do the same for plate H. During construction make frequent reference to the dimensioned drawings in Fig. 1 to insure that each part of the enclosure is properly fitted into place.

To complete assembly of the enclosure shell, anchor the footing pieces to the bottom of plate H by driving the screws down through the bottom plate and into the footing. Set the enclosure shell aside temporarily.



Start construction of midrange speaker enclosure by assembling sides, ends, and compartment separators. Use glue and screws to anchor the members together.

Attach 10″ cleats to the bottom side edges of plate F and the 24″ cleat to the front top edge. Anchor plates E and F together by letting E overlap F at the rear (see side view drawing in Fig. 1 for details).

Coat with glue the interior surfaces that will make final contact with plates E and F. Slide the E-F assembly into place and anchor it with wood screws along both cleats at the sides. Attach the 30¾″ cleats at the front and the 35¾″ cleats at the rear of plates A and B. (Note, the front and rear cleats will be recessed ¾″ in from the front edges of the side plates.)

Prepare back plate C by drilling the guide holes for the anchoring screws and two 11/64″ holes to accommodate the bolts for electrical hookup. Finally, drill two ⅜″ holes near the top of this plate to accommodate the midrange and tweeter controls.

Referring to the front view drawing, carefully prepare speaker mounting board D. Now you can begin assembling the midrange speaker column.

First, drill ½″ holes through the centers of the three compartment separators to facilitate routing of the wiring. Temporarily set the partition separators, sides, and ends of the column over the speaker cutouts, and check for the proper locations of each part. (Because of the possibility of slight variations in the locations of the speaker cutouts, the length dimension given in the top right drawing in Fig. 1 is only approximate.)

If necessary, trim either the column or the cleats to insure that the column fits properly between the top and bottom cleats on the speaker mounting board when all parts are in place. When satisfied with the fit, assemble the column enclosure (except rear wall) with glue and screws, and set it temporarily in place on plate D. Scribe with a pencil the outline of the column and partitions. Remove the column from the speaker mounting board, and drill countersunk guide holes through plate D, two for each partition and end. Locate these holes 1″ in from both ends of the individual partitions and ends. Attach the column.

When properly mounted, the crossover networks should be located between woofer and tweeter.

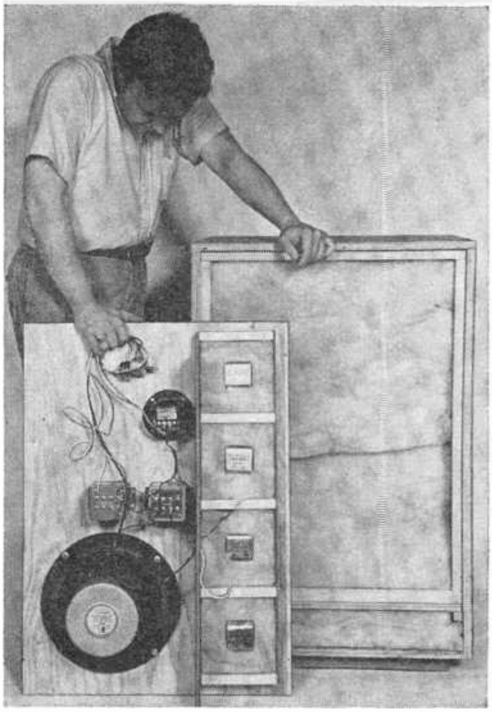


Fig. 3. For proper damping, loosely folded fiberglass wool should fill entire enclosure volume.

Fill the enclosure with fiberglass wool. (Because of the amount of fiberglass wool needed, about 25′ × 24″ × 2″, it is suggested that you use house insulation fiberglass to effect savings. The cost of a 50′ length of this material is generally less than $5, and you will have enough to fill two enclosures.) First strip the fiberglass wool of its aluminum foil backing. Cut a 3′ length, fold it in half, and place it on the floor of the enclosure. Triple fold another 8′ to 9′ length, and place it in the well immediately behind the speaker mounting board, arranging a hole for the woofer. Finally, fill the rear well of the enclosure with folded fiberglass wool.

Install the midrange speakers in the column, and wire them according to Fig. 2. One of the terminals on each of these speakers is color coded with a red dot; so be sure to use these dots as guides during wiring. Then terminate the wires in conducting bolts (which you can mount on the rear wall of the column's enclosure). Code the bolt that connects to the terminals with the red dots.

Now, cut four squares of fiberglass wool to a size just large enough to fit into the speaker compartments, and remove the centers to make room for the magnet assemblies (see Fig. 3). Set the squares over the speakers, and screw the Masonite rear panel in place, using two screws for each partition and end and placing the screws one inch in from the sides of the enclosure. Test the midrange column with a battery (all speaker cones move in the same direction when the terminals of the battery are momentarily touched against the conducting bolts.) Then tape the rear corners of the column with aluminized cloth "duct" tape to seal the column against air leaks.

(Continued on page 111)

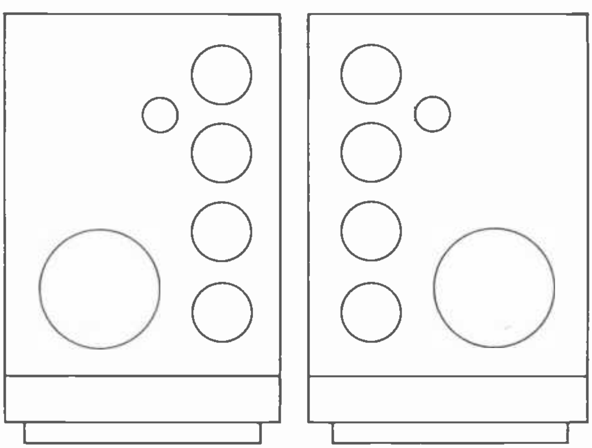
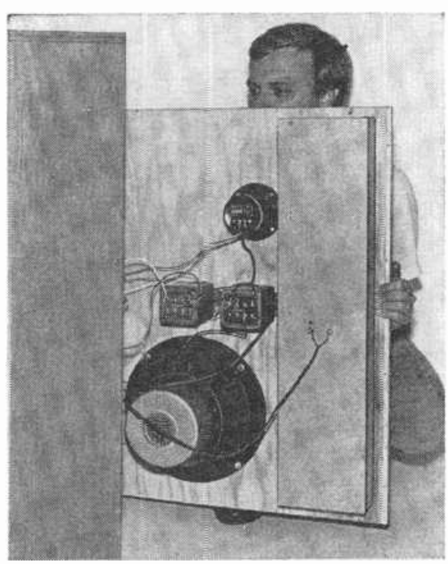


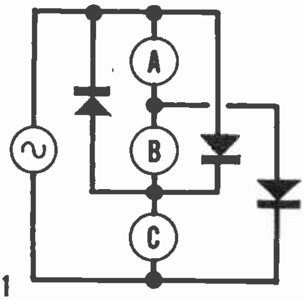
Fig. 4. Speaker mounting boards must be mirror images of each other for proper balancing of stereo.



Assembled and wired speaker board is anchored to enclosure front with flathead wood screws.

Lamp Brightness Quiz

BY ROBERT P. BALIN



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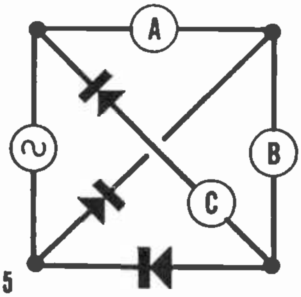

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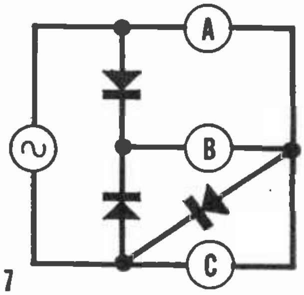

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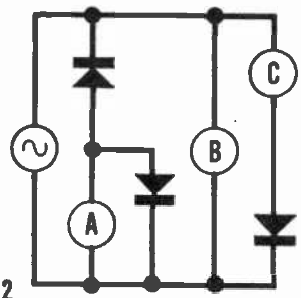
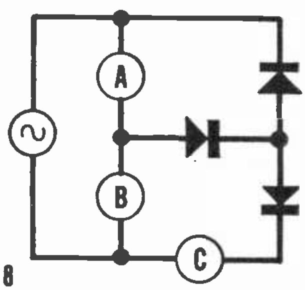


2

The brightness of a lamp operated on a.c. depends on the average current through its filament during each cycle. A rectifier connected in series or parallel with a lamp can be used to control the current on alternate half cycles. In lamp circuits, current paths and individual lamp brightness may be considerably altered, and some interesting effects produced. To test your ability to analyze lamp and rectifier circuits, try to determine which lamp is the brightest in each of the ten circuits shown here. Assume that the diodes have zero forward resistance and infinite back resistance and that all lamps and supplies are identical. Answers are on page 101.



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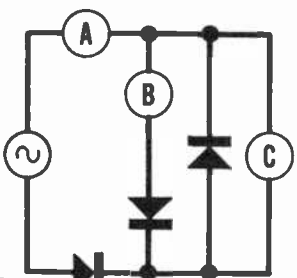

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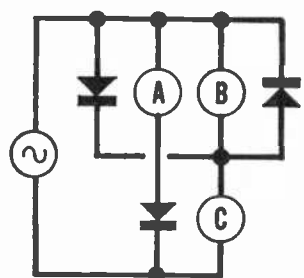

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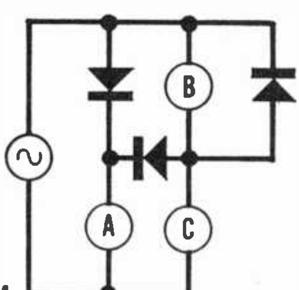

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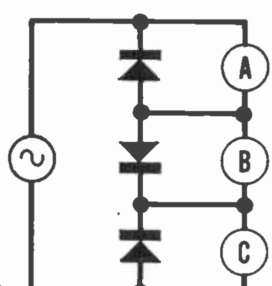

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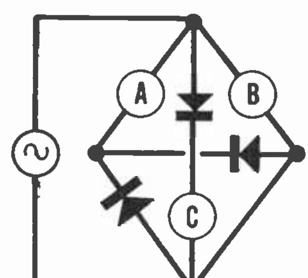

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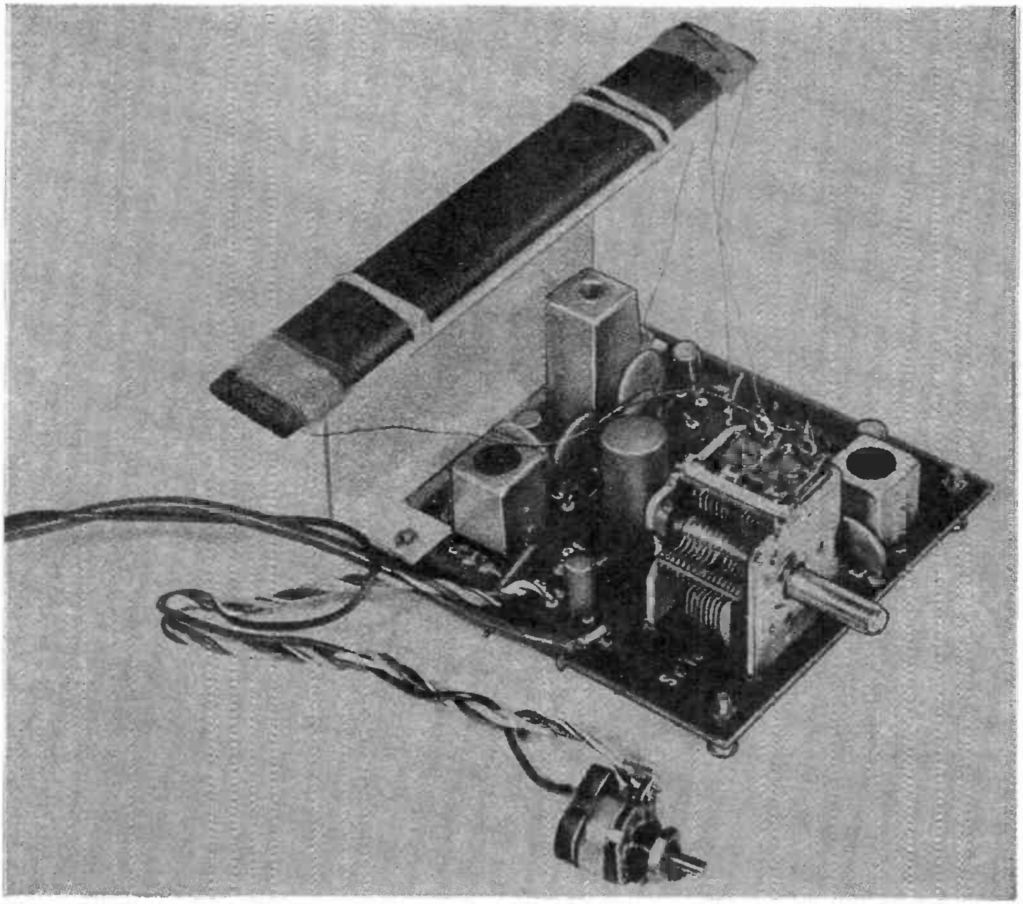


Top-Rated AM Tuner

SOLID-STATE BROADCAST-BAND TUNER FOR HI-FI RIGS

BY JIM CUCCIA

HIGH-QUALITY broadcast-band AM tuners are scarce. Most hi-fi enthusiasts either pay extra for the addition of AM to their FM receivers or tuners, or they use makeshift improvisations for reception of the AM broadcast band.

With the introduction of a new line of high-performance, yet low-cost transistors, it is now practical to build a high-quality AM tuner at low cost, with performance rivaling that of many commercial units.

The excellent performance is achieved through careful circuit design (see Fig. 1) and the use of a separate mixer-local-oscillator combination and a.g.c. in both the mixer and i.f. stages. As for the technical details: frequency tuning range is 550 to 1600 kHz; (S + N)/N is 20 dB; a.g.c. figure of merit, 30 dB; image rejection, 48 dB; and adjacent channel attenuation, 26 dB.

Construction. To avoid circuit wiring errors and keep the tuner as small as possible, the use of a printed board, such as that shown actual size in Fig. 2, is recommended. All components, with the exception of the volume control (*R11*) and the ferrite antenna (*L1*) are mount-

PARTS LIST

C1, C2—Variable capacitor. C1A—5.3-190 pF, C1B—12 pF, C2A—5-77pF, C2B—12 pF (Southwest Technical Products C-190 or similar)
C3, C6, C9, C11, C12—0.05-µF disc capacitor
C4—390-pF, 150-volts polystyrene capacitor
C5—100-µF, 25-volt electrolytic capacitor
C7—0.001-µF, disc capacitor
C8—0.005-µF, 50-volt disc capacitor
C10—10-µF, 15-volt electrolytic capacitor
C13—4.7-pF capacitor
C14—0.02-µF capacitor
C15—10-µF, 25-volt electrolytic capacitor
D1—1N34 or similar germanium diode
L1—Ferrite BCB antenna with low-impedance secondary winding
Q1—Transistor (RCA 40487)
Q2—Transistor (RCA 40488)
Q3—Transistor (RCA 40489)
R1,R2—6800-ohm
R3—22,000-ohm
R4—270,000-ohm
R5—820-ohm
R6—2200-ohm
R7—82,000-ohm
R8—680-ohm
R9—18,000-ohm
R10—1000-ohm
(R1–R10: *All resistors ½-watt*)
R11—5000-ohm potentiometer
T1—Local oscillator transformer (Southwest Technical Products 7E-050-1A)
T2—First i.f. transformer (Southwest Technical Products 7E-505-2)
T3—Second i.f. transformer (Southwest Technical Products 7E-050-3)
Misc.—Non-conducting support for ferrite antenna, dial mechanism to suit builder, knobs for tuning and volume control, cabinet, solder, etc.
Note—A complete kit of parts listed above, including the PC board, is available from Southwest Technical Products Corp., 219 W. Rhapsody, San Antonio, Texas 78216, for $10.00 plus $0.30 postage.

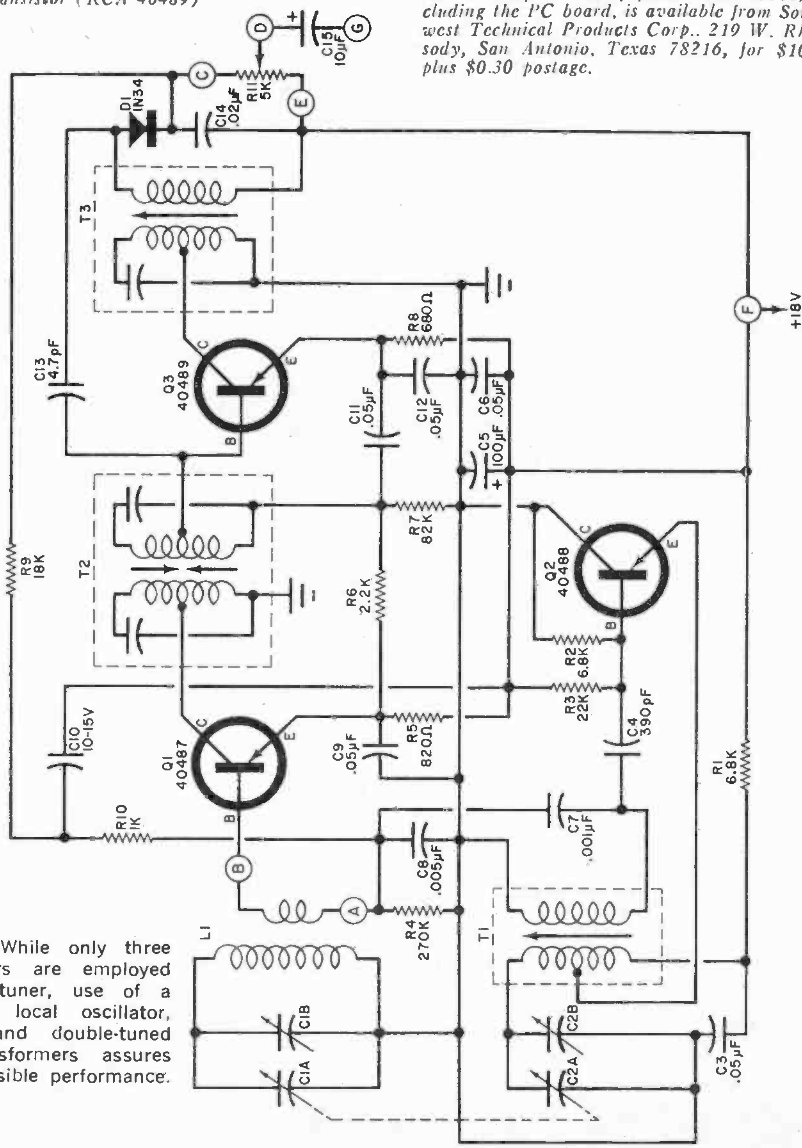


Fig. 1. While only three transistors are employed in the tuner, use of a separate local oscillator, a.g.c., and double-tuned i.f. transformers assures best possible performance.

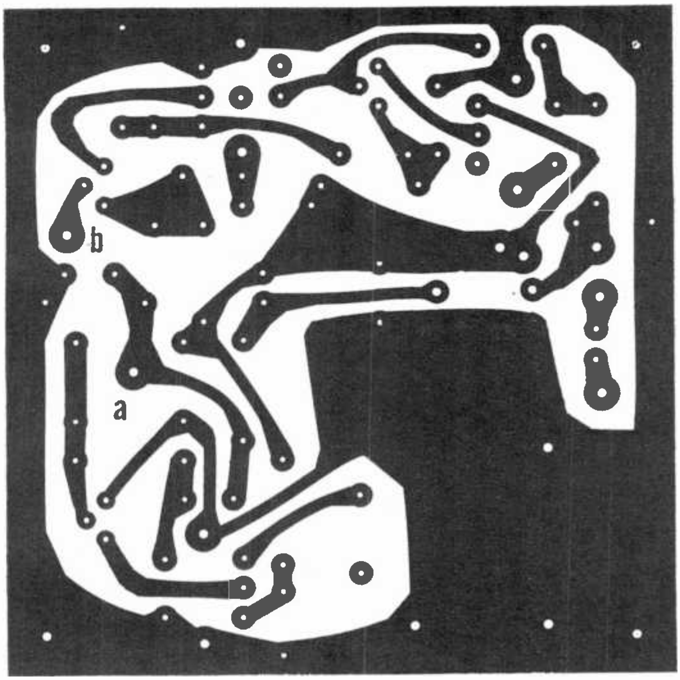


Fig. 2. If you make your own printed circuit board, carefully copy this actual-size etching and drilling guide.

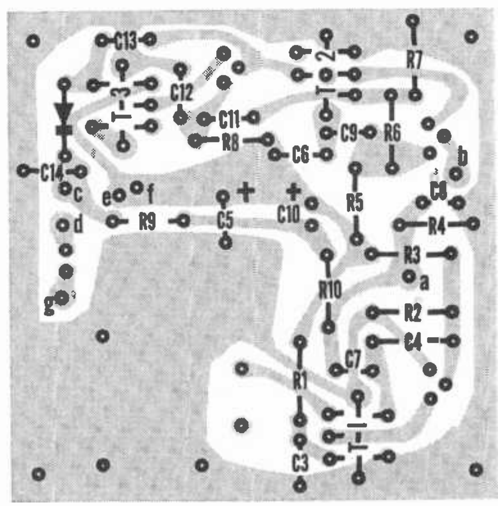


Fig. 3. Transistors are located on circuit board as follows: Q1—to right of R6; Q2—directly above C4; Q3—directly above C11. When mounting transistors, match widely-spaced leads to widely spaced holes in board.

ed on this board as shown in Fig. 3. When installing the components, be careful to observe the polarities of the semiconductors, the electrolytic capacitors, and the diode. If you use the printed circuit board shown and the parts called for in Fig. 1, oscillator transformer *T1* as well as the second i.f. transformer *T3* can only be installed one way. However, the first i.f. transformer *T2* can be inserted two ways. To avoid this, cut off pin 1 of this transformer (see Fig. 4) before installation.

Mounting of the ferrite antenna is not critical as long as it is kept away from large metallic masses. Cement the antenna to a piece of cardboard or other non-conducting material which is then attached to the rear of the circuit board. Use caution in working with the antenna as the ferrite core is fragile and cracks easily.

Volume control *R11* can be located wherever it is most convenient. The arrangement of the tuning dial is also optional and can be designed to match other components in a system or to match the cabinet. Any convenient cabinet can be used.

Any 18-volt power supply can be used with the tuner, or power can be taken

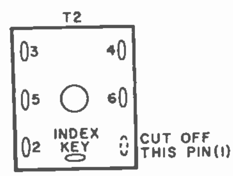


Fig. 4. Before you mount i.f. transformer T2 on the board, cut off pin 1 as shown.

HOW IT WORKS

This tuner uses a separate mixer and local-oscillator combination (*Q1* and *Q2* respectively in Fig. 1) with a.g.c. fed to the mixer through a divider consisting of *R4*, *R9*, and *R10*. The mixer stage operates with collector currents of 20 microamperes (maximum a.g.c.) to 1.6 milliamperes (minimum a.g.c.).

The received signal is applied to the base of the mixer along with the local-oscillator signal, which has been reduced to an optimum level by a divider formed by *C7* and *C8*. This configuration of mixer/local oscillator produces very low noise and results in excellent overload performance without the need for an overload diode. At the same time, the grounded-collector local oscillator provides excellent frequency stability with varying load and varying supply voltage.

The resultant i.f. (455 kHz) is fed to a double-tuned i.f. transformer (*T2*) to provide good selectivity. If a single-tuned transformer were used, two stages of i.f. and three transformers would be required to obtain the same selectivity. The i.f. signal is amplified by *Q3* acting as a high-gain neutralized amplifier. Power gain of this stage is in excess of 40 dB and neutralization is provided by capacitor *C13*. Biasing of *Q3* is such that it has large signal-handling capability and partial gain control when receiving strong signals. Base bias is provided by *R5*, *R6*, and *R7*, with *R5* being the emitter resistor of *Q1*. This network produces partial a.g.c. for the i.f. amplifier.

Transformer *T3* is a single-tuned unit that, in conjunction with *T2*, provides more than adequate selectivity. Diode *D1* acts both as the signal detector and as a source for the a.g.c. voltage. Capacitor *C14* is used for r.f. bypassing and potentiometer *R11* is the volume control. The basic design of the tuner is sound and substitution of transistors offers no real problem.

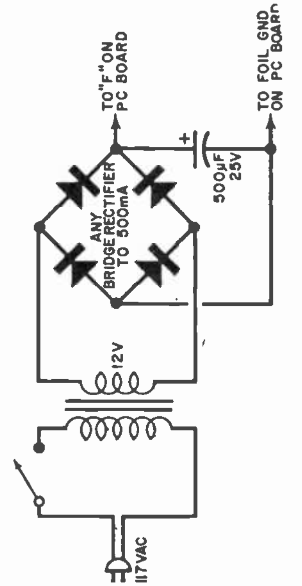
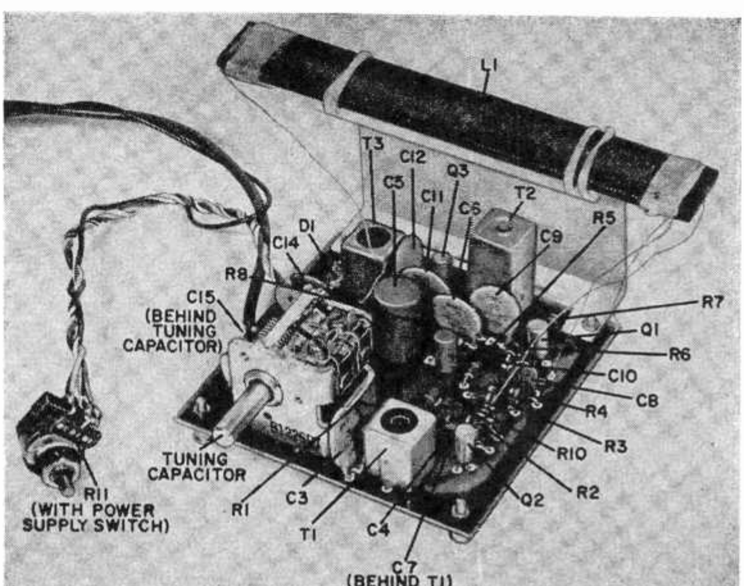


Fig. 5. Any 18-volt power supply, such as that shown here, can be used with the tuner. Use either a packaged bridge or four individual diodes.

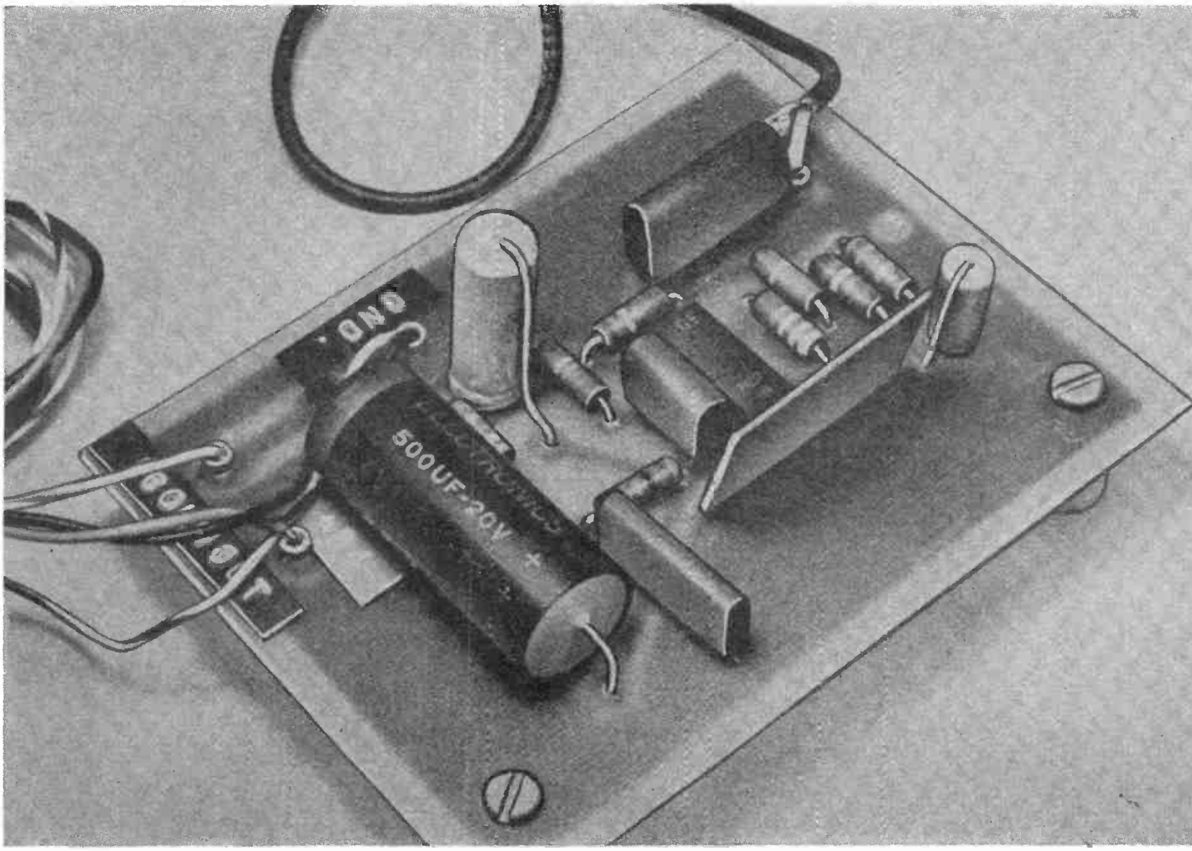
from the audio system with which it is being used. A typical power supply circuit is shown in Fig. 5.

Alignment. After construction, examine the circuit board carefully for wiring or placement errors. Also look for solder

(*Continued on page* 112)



Once completed, the AM tuner can be mounted in any type of cabinet as only the tuning capacitor shaft is fixed. Any dial mechanism can be used, depending on installation. Volume control (with attached power switch) can be mounted remote from the tuner. Be sure the ferrite antenna is clear of metal objects for best results.



Mini-Watt IC Amp

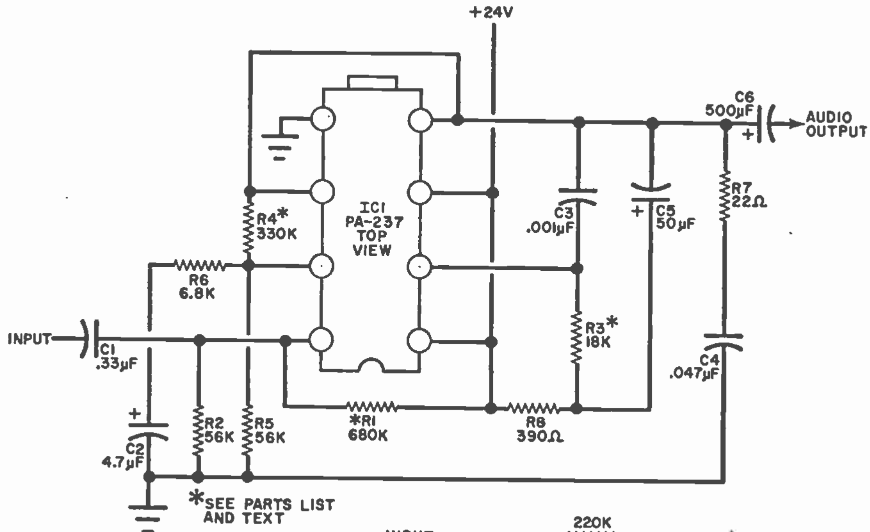
SINGLE IC HAS 2-WATT OUTPUT

BY WILLIAM KIRES
General Electric Company

WHEN YOU ARE building or experimenting with a tuner or an audio-signal generator, one thing you need is an amplifier to bring the signal up to an audible level. You can use an amplifier from another system; but it's a real convenience to have a small, simple amplifier designed especially for the purpose.

The amplifier described here can be built to provide either 1 or 2 watts output (with some minor circuit differences). For the 2-watt unit, you'll need a 24-volt power supply, which is also described. The 1-watt unit can be operated from a 12-volt battery such as that used in your car or boat. (This makes it good for use with a portable phono on picnics or outings.)

The secret of this low-cost, compact amplifier is an integrated circuit designed for audio circuits. The IC is rated for a 24-volt input with a 2-watt output, but with a 12-volt input it will still deliver 1 watt, which may be just what you need.



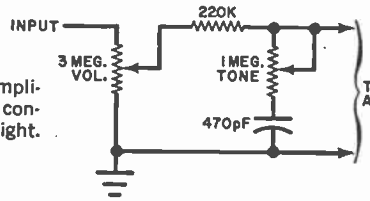


Fig. 1. The IC is a seven-transistor power amplifier requiring 8mV to deliver 2 watts audio control. Tone and volume control circuits at right.

PARTS LIST

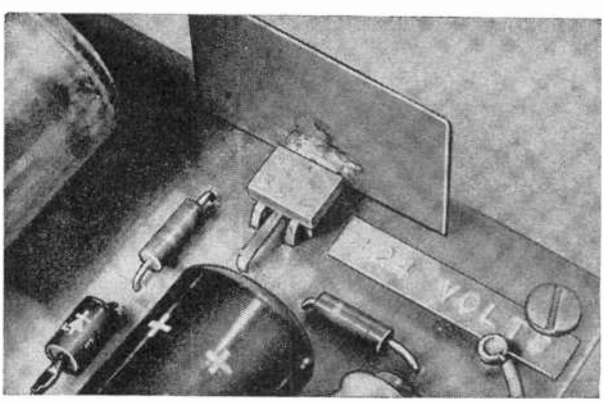
C1—0.33-µF capacitor
C2—4.7-µF, 15-volt electrolytic capacitor
C3—0.001-µF capacitor
C4—0.047-µF capacitor
C5—50-µF, 25-volt electrolytic capacitor
C6—500-µF, 20-volt electrolytic capacitor
IC1—Integrated circuit (General Electric PA-237)
*R1—680,000-ohm**
R2,R5—56,000-ohm
*R3—18,000-ohm**
*R4—330,000-ohm**
R6—6800-ohm
R7—22-ohm
R8—390-ohm
All resistors ½-watt

Misc.—1" x 1" x $\frac{1}{32}$" copper sheet heat sink, printed circuit board, insulated standoffs (optional, 4 if used)
**For a 1-watt amplifier, with 12-volt supply, use R1—390,000 ohms, R3—12,000 ohms, R4—180,000 ohms, all ½ watt.*

Note: An etched and drilled printed circuit board #158B is available from Southwest Technical Products Corp., 219 W. Rhapsody, San Antonio, Texas 78216, for $2.00, postpaid. A kit, #158CP, containing the PC board and all parts to be mounted on it, including the PA-237 is also available from the same source for $7.50, postpaid.

Construction. The circuit for the 2-watt amplifier is shown in Fig. 1. It is assembled on a printed circuit board such as the one shown actual size in Fig. 2. When you have completed the board, mount all of the components, except *IC1*, as shown in Fig. 3. To prepare the IC for mounting, use a pair of long-nose pliers to bend its leads, including the large heat-sink tab, so that they are at right angles to the body of the IC. Be sure that the IC is properly positioned before mounting it on the board; a small notch at one end of the IC must be oriented as shown in Fig. 3.

After bending the leads, insert the IC pins and the heat-sink tab into the board and solder them to the foil. Use no more



In the power supply, the copper heat sink is soldered to both transistor tab and PC board foil.

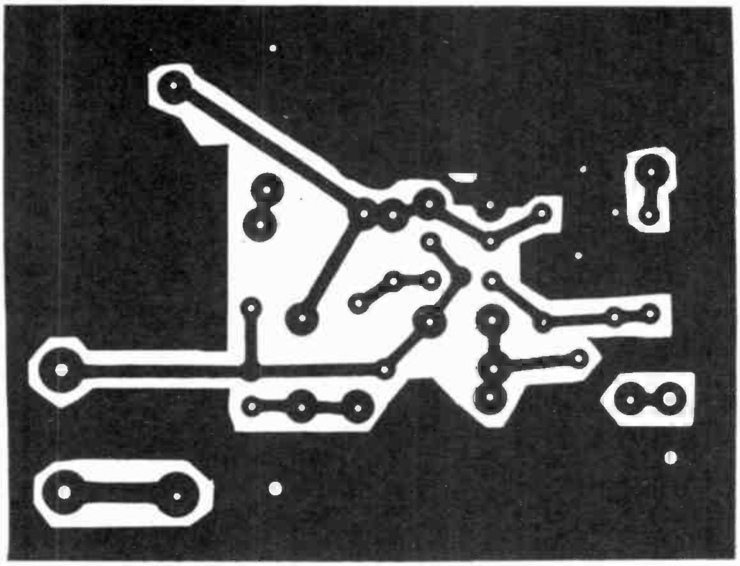


Fig. 2. Use this actual size layout for the PC board for the amplifier. Large amount of foil left on the board acts as an extra heat sink for IC1.

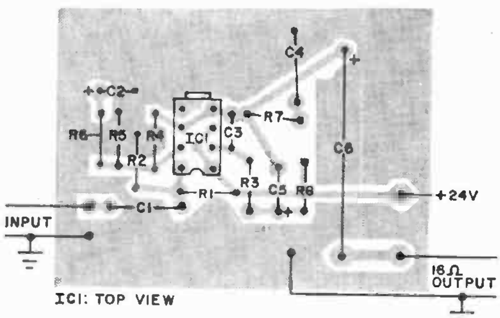
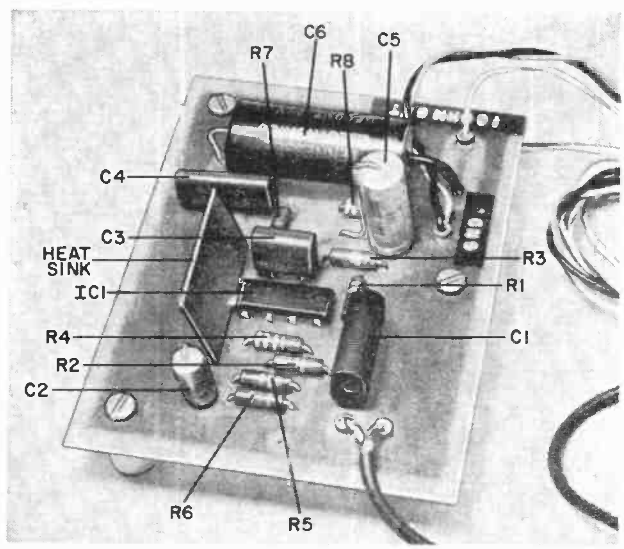


Fig. 3. Install the components as shown here. If you don't have a 16-ohm speaker, use two 8-ohm units in series. Be sure they are phased right.

heat than is necessary to get a good solder joint.

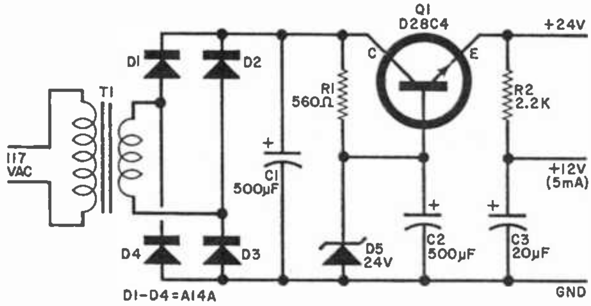
To make a heat sink for the IC, cut out a 1″-square piece of heavy-gauge copper (at least 1/32″ thick). Tin the center of one edge of the copper and tin the piece of the IC heat-sink tab that is on the component side of the board. Solder the heat sink to the tab of the IC so that the heat sink is vertical to the board. This completes the 2-watt amplifier.

To use this design for a 1-watt amplifier with a 12-volt supply, use the same printed circuit board but make the fol-



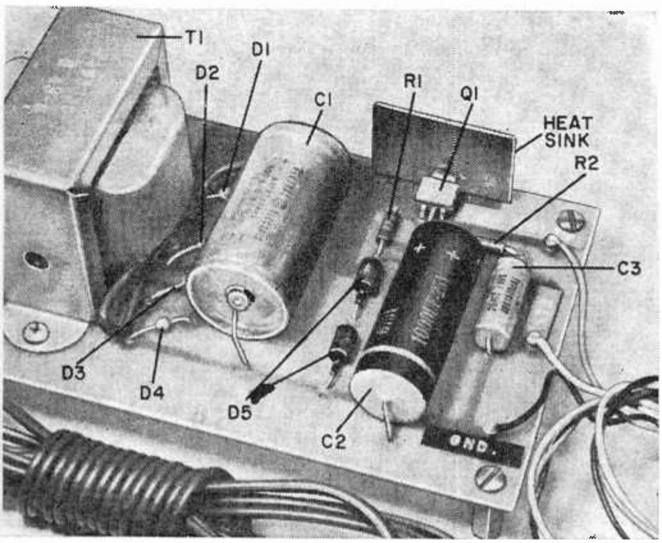
Although not required, you can mount the finished amplifier on four standoffs, as shown. In attaching the heat sink to the IC and PC board, do not apply too much heat to the IC tab while soldering since heat can damage the IC. Tin both connections before joining and flow solder in.

Fig. 4. Besides the 24 volts required by the 2-watt amplifier, the power supply has a 12-volt, 5-mA output for use with a preamplifier.



PARTS LIST

C1, C2—500-μF, 50-volt electrolytic capacitor
C3—20-μF, 25-volt electrolytic capacitor
D1-D4—1-ampere, 100-volt rectifier diode (GE A14A or similar)
D5—24-volt, 1-watt zener diode
Q1—Power transistor, npn (GE D28C4 or similar)
R1—560-ohm, ½-watt resistor
R2—2200-ohm, ½-watt resistor
T1—Power transformer, secondary—24 volts, 1.2 amperes.
Misc.—1" x 1" x 1/32" copper sheet heat sink, printed circuit board, line cord, insulated standoffs (optional, 4 if used)



If you do not have a 24-volt zener, use a pair of 12-volt units in series as shown here. You must break the foil that shorts one diode connection.

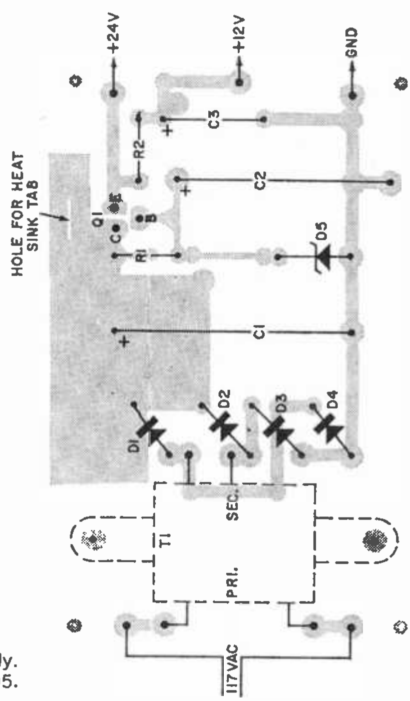


Fig. 6. Component installation for power supply. Only one zener diode is shown here for 24-volt D5.

lowing component changes: for R1 use 390,000 ohms, for R3, 12,000 ohms, and for R4, 180,000 ohms.

Power Supply. The schematic of a 24-volt d.c. regulated supply for the 2-watt amplifier is shown in Fig. 4. The circuit also has a 12-volt, 5-mA output for a preamplifier. This power supply can be constructed on a printed circuit board, if desired, using the actual-size foil layout shown in Fig. 5. When the board is finished, install the components as shown in Fig. 6.

To make a heat sink for the transistor, cut out a 1" square of heavy-gauge cop-

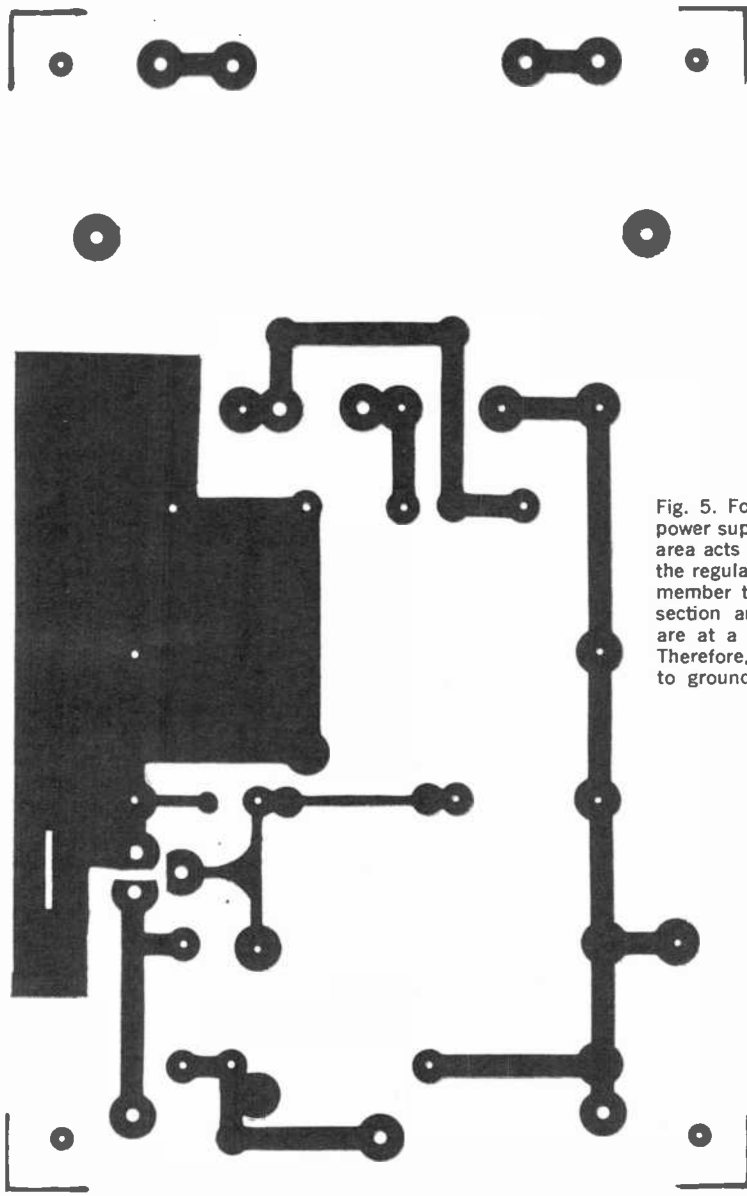
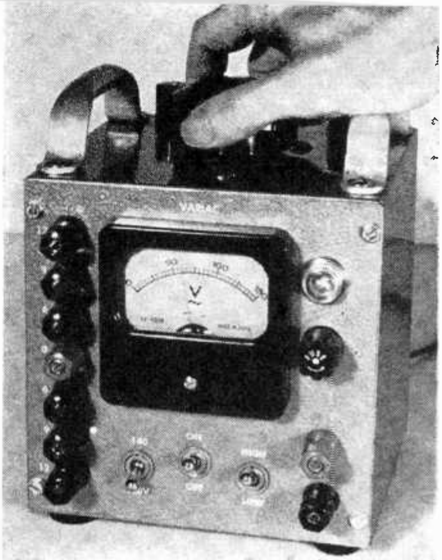


Fig. 5. Foil pattern for the power supply. The large foil area acts as a heat sink for the regulator transistor. Remember that both this foil section and the heat sink are at a full 24-volt level. Therefore, don't short them to ground for any reason.

per (at least 1/32" thick) with a 3/16" wide by 1/8" long tab at the center of one edge of the square. This tab is to be inserted through the PC board for mounting the heat sink. Solder the heat sink to the heat-sink tab on the transistor and to the foil on the bottom of the board. On this transistor, the heat-sink tab is actually connected to the collector and is at a potential of 24 volts so be sure that neither the tab nor the heat sink is shorted to ground. Position the copper heat sink so that it is vertical to the board.

Volume and Tone Controls. If volume and tone controls are desired for the amplifier, insert a circuit such as that shown in the inset in Fig. 1 at the input to the amplifier. The tone control is of the "losser" type so that, as the rotor of the tone-control potentiometer approaches the capacitor end, the high frequencies are attenuated. —30—



Setting Up Your A.C. Bench Supply

THOUGHTS ON MAKING A VARIAC MORE VERSATILE

BY B. W. BLACHFORD

One of the most versatile and necessary pieces of equipment on the test bench of many an engineer, technician, experimenter, or hobbyist is the variable-voltage transformer. Although it is a relatively uncomplicated, usually dependable device, there are several points you should keep in mind when setting up your transformer to obtain a good, versatile supply.

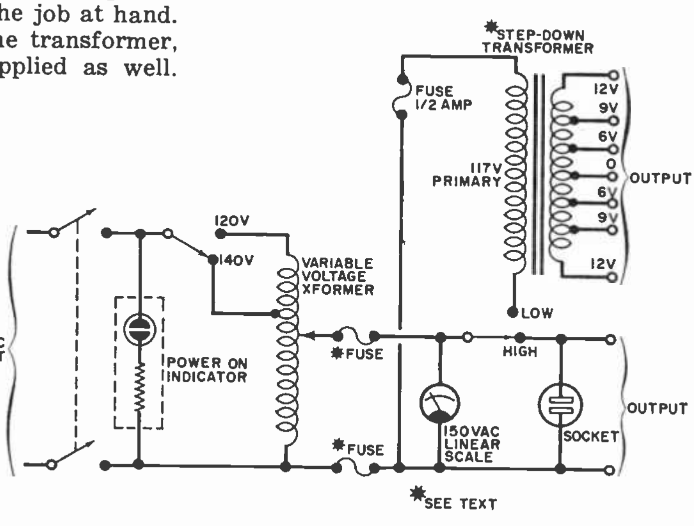
Protection. Fuses on the input (primary) side of a variable-voltage transformer do not give good protection against overloads. Fuses should be in the output (secondary) side. Also, since the device is an autotransformer, protection from burnout due to grounding can be obtained only by fusing both sides of the secondary circuit.

Use fuses with current ratings no larger than required by the job at hand. This protects not only the transformer, but the circuit being supplied as well. Under no circumstances should the fuse ratings be larger than the maximum rated output current of the transformer.

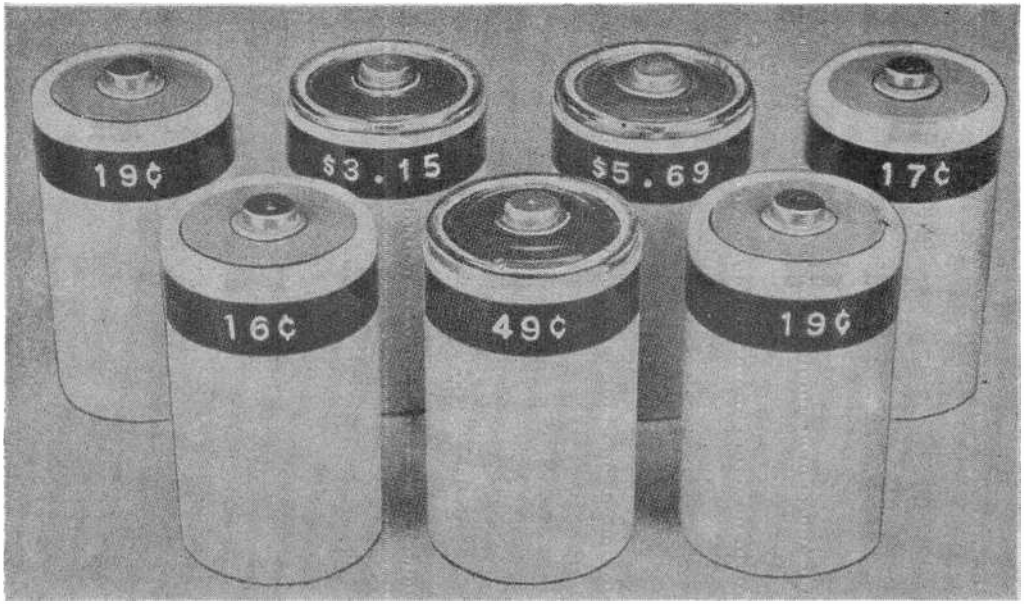
Controls and Meter. The ON-OFF switch in the line side of the transformer should be a double-pole switch with one pole in each side of the line. A single-pole switch should only be used on ordinary fixed-ratio transformers where the primary and secondary windings are insulated from each other.

Many variable-voltage transformers have a tap on the winding, usually at a point about 20 volts below the upper terminal of the full winding. To achieve versatility in your supply, it is advantageous to include a s.p.d.t. switch to permit connecting the incoming line ei-

(*Continued on page* 66)



Circuit diagram shows how protective devices and controls are connected to Variac to give ease and variety to use.



Choosing the RIGHT Battery

ACCELERATED LIFE TESTS DEMONSTRATE BIG DIFFERENCES IN PER-HOUR COSTS

BY _EWIS A. HARLOW

WHEN IT COMES to calling out the battery, the usual parts-list instruction is: Use an ordinary transistor radio battery. Of course, the voltage required is given—1.5, 3.0, 4.5, or 9.0 volts—but there are literally scores of batteries of all different sizes, shapes, and prices that fill this requirement. And, strangely enough, there appears to be no fixed set of rules for selecting the "right" battery. Even if you are replacing a battery in a portable radio receiver or transceiver, you must still choose between two or three different types of batteries—regardless of the physical volume and shape limitation!

To add insult to injury, there are identical batteries—in terms of external appearance—that have vastly different current-output ratings and life cycles. There is no perfect answer to the problem of battery selection, but there are important guidelines, some new, some old, but all worth reviewing.

First Things First. If the physical size of the battery is not a hindrance, the one basic specification that you must know is how much current is going to be drawn from the battery. If you have designed your own circuit, you can estimate the current drain the hard way, or you can measure the drain from your low-voltage bench power supply from a temporary battery hookup. The answer should be in the range of 1 to 20 milliamperes—rarely more.

A current drain measurement should also be made on commercial gear; however, in this instance, try to use a fresh battery of a type similar to that recommended by the manufacturer. The answer you get is very helpful in making the right battery selection.

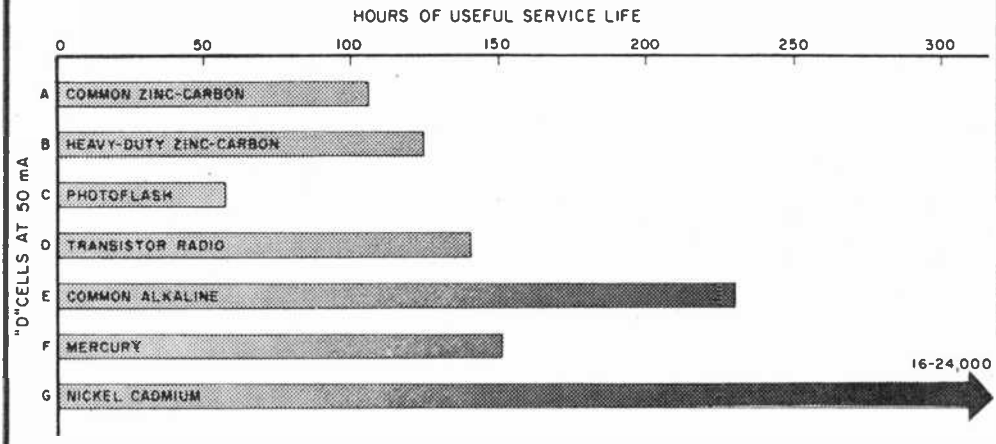


Fig. 1. Results of life tests on seven different types of D cells used in most solid-state circuits. Figures for hours of useful service should be used for comparison only.

Physical Size. A primary principle of battery engineering is that batteries of the same chemical composition have a service life directly related to the weight of the battery. A good, big battery has a longer service life than a good, small battery of the same chemical makeup.

You can prove this to your own satisfaction by testing the three different sizes of the common 1.5-volt battery—the D cell, the C cell and the AA cell. The author tested three typical cells on the basis of four hours of service per day at a drain of 15 mA. The test was halted when the cell output under load dropped to 1.0 volt. The results were:

D cell—service life, 360 hours
C cell—service life, 180 hours
AA cell—service life, 38 hours

From this information we can safely assume that the D cell has approximately twice the service life of the C cell and almost nine times that of the AA cell. Since all three have essentially identical chemical compositions, service life is directly proportional to the physical size of the cell.

Impedance. This may seem to be a strange term to find in an article on battery selection, but the impedance of a dry cell is important in all solid-state applications. You want as little internal battery impedance as possible. Impedance and the voltage/current output of the battery are, of course, related; the greater the internal impedance, the greater the internal voltage drop under load. When the internal impedance of the battery is too high it may become a source of audio-signal distortion or r.f. oscillator instability.

The internal impedance of a fresh zinc-carbon D cell at normal room temperature is 0.277 ohms. This figure rises sharply as the cell discharges. The internal impedance of a fresh alkaline D cell is 0.15 ohms and it remains fairly constant throughout the life of the battery. The impedances of mercury and nickel-cadmium cells are said to be even less than that of an alkaline cell.

Shelf Life and Voltage Droop. Although in many solid-state applications the shelf life of a battery is not an important problem, most battery users neglect to include in overall life expectancy the periods when the equipment in which the battery is installed is not in use. No battery lasts indefinitely, and the life of any battery is shortened by high temperatures—and, conversely, somewhat lengthened by low temperatures. Roughly speaking, an AA cell stored for 24 months at 70°F retains only 50% of its initial capacity. A mercury cell, on the other hand, retains nearly 90% of its initial capacity. Alkaline cells have shelf and storage lives similar to mercury cells, but a nickel-cadmium cell generally loses more than 10% of its charge in one month and about 60% in one year.

Comparative Service Life. The author subjected seven different D cells—commonly used in solid-state projects—to identical service-life tests. A current-drain of 50 mA was chosen for this test. Admittedly, this is a high load level, but it is the lowest that includes the ratings of all seven D-cell types.

The bar chart in Fig. 1 shows the result of the author's tests. The figures for "hours of useful service life" should be used only for comparative purposes. All of the batteries used in the D-cell test (and in the 9-volt representative test) are identified in the interchangeability table.

The service lives of four zinc-carbon D cells are shown by bars A, B, C, and D in Fig. 1. In the accelerated test, the "usual" zinc-carbon D cell that had a service life at 15-mA load of 360 hours only survived 102 hours with a load of 50 mA. This is the 15-16¢ battery commonly seen in hardware stores, drug stores, etc. For only one or two cents more you can buy the so-called "heavy duty" D cell that had an accelerated service life represented by bar B. This is the D cell used by night watchmen and in the flashlights of gas, water and electric meter readers.

The surprisingly low service life of the battery represented by bar C is due to the fact that this battery was never destined to be used in solid-state circuits. Its chemical composition is adjusted to favor brief surges of maximum current. Consequently the battery is of greatest use to the photographer. It is listed here only because you may happen to wonder if this particular battery has any magic properties.

The last zinc-carbon D cell, the so-called "transistor radio" cell, is represented by bar D. In this instance, the chemical composition has been adjusted to favor long service at a reasonably low current drain, and in this respect it is the exact opposite of the photoflash D cell (bar C). The service life of this battery under the loads it is designed to handle is approximately 700 hours at 10 mA, 510 hours at 15 mA, and 300 hours at 25 mA.

The Non-Zinc-Carbon D Cells. Bar E in Fig. 1 represents the accelerated test for a common 50¢ alkaline D cell. Even with the accelerated drain of 50 mA the battery performed excellently for approximately 230 hours. The alkaline D cell has a low internal impedance and the output voltage remains reasonably stable throughout its life. The impedance and voltage stability minimize audio distortion and help stabilize oscillator performance in portable receivers. The service life at very low drains is almost astronomical. All things considered, the alkaline D cell is probably the best buy for solid-state projects.

Where it is necessary to obtain a battery with a very low internal impedance and superb voltage stability, the mercury D cell is the obvious choice. The accelerated service life of a mercury D cell is shown in bar F. The figures are not too impressive—indicating 150 hours at 50 mA. The price of a mercury D cell exceeds $3 and it is obvious that the real value of the mercury-type battery is not found in the D-cell size. However, mercury battery construction lends itself to miniaturization and miniature mercury batteries are the best choice for stable low-drain voltage requirements over very long periods of time.

It is difficult to approximate the "life" of a rechargeable nickel-cadmium D cell, which is represented by bar G in Fig. 1. A typical battery (costing about $5.50) had a service life at 50 mA of only 80 hours. However, this life value must be multiplied by the 200 to 300 times that this type of battery can be recharged. On the other hand, recharging a nickel-cadmium cell is a critical operation and the charge rate is determined by the ca-

BATTERY INTERCHANGEABILITY LIST

	Burgess	Everready	RCA	Mallory	Ray-O-Vac	NEDA
A*	2	950	VS036	M13F	2D, 2LP	813, 13F
B	210	1150	—	M13X	3LP, 3D	13C
C	220	850	VS736	M13P	210LP	13P
D	230	1050	VS336	M13R	13	13
E	AL2	E95	VS1336	MN1300	—	813, 13A
F	Hg42R	E42N	—	RM42R	—	—
G	CD10	CH4	—	—	—	—
H	2U6	216	VS323	M1604	1604	1604
I	2MN6	222	—	—	M1604	1604D
J	Hg136R	E136N	—	TR136R	—	—
K	2N6	246	VS305	M1602	1602	1602
L	M6	266	VS322	M1605	1605	1605

**Letters correspond to bars in Figs. 1 and 2.*

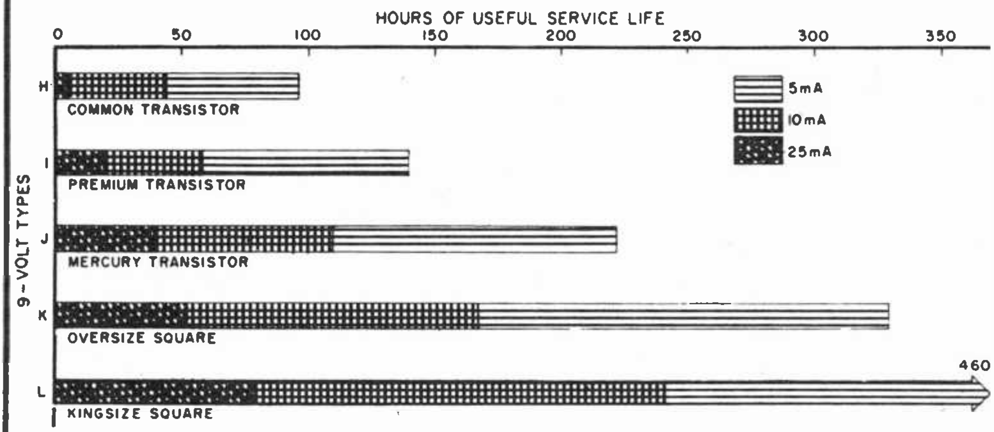


Fig. 2. Three samples each of five types of nine-volt batteries were given life tests with current loads of 4, 10, and 25 milliamperes. Types H, I, and J are interchangeable in size.

pacity of the cell. Commercially available chargers are generally tailored to the needs of a specific size of battery cell and are therefore difficult to adapt to any other type of battery charging. This has resulted in the phenomenon of the cordless razor and cordless carving knife that are always sold with a "charging stand."

If you are not scared away by the complications of recharging, the nickel-cadmium battery is a very good buy for solid-state service. Internal impedance is low and stable. The battery holds its rated voltage output throughout most of the life of the charge. In the long term, the cost-per-hour of use of the nickel-cadmium battery is surprisingly low.

The Nine-Volt Batteries. The other standard of battery-powered solid-state equipment—one that is sold by the millions of units—is the 9-volt battery. There are not too many 9-volt batteries to test, but accelerated life tests of several different examples are represented by the bars in Fig. 2.

Bar H is the common low-cost 9-volt "transistor radio battery." Bar I is the better grade of the common zinc-carbon 9-volt battery. Although this premium battery is an exact physical replacement, it has a somewhat different internal structure. Equated at list prices the premium battery saves you only 0.04¢ an hour at the 5-mA rate.

Bar J represents the expected life of a mercury 8.1-volt battery replacement for the common "transistor radio battery." This battery offers the real advantage of very low internal impedance and excellent voltage stability. Don't be disturbed by the 8.1-volt rating of the mercury battery. The zinc-carbon 9-volt batteries drop to this voltage level as soon as they are put in operation, whereas the mercury battery delivers close to its full voltage rating throughout most of its life.

The batteries represented by bars H, I and J are all interchangeable, but if you have the physical room, the following larger 9-volt zinc-carbon batteries should be considered. In bar K we see the expected life of a square-type battery that costs about twice as much as the common "transistor radio battery." In bar L is another square-top zinc-carbon battery of somewhat greater physical dimensions. The cost between the batteries shown in bars K and L is only a matter of a few pennies.

We have shown what you can expect from 12 different types of 1.5- and 9-volt batteries. Since all batteries were purchased and tested as being "fresh" and given the same accelerated life test, the comparisons are felt by the author to be perfectly legitimate. Using the information here, however, you will know what to do when a schematic calls for a "1.5- or 9-volt battery." —30—

Advanced Ham Frequency Calibrator

COMPLY WITH NEW RULES—CHECK YOUR OPERATING FREQUENCY TO 25 KHZ

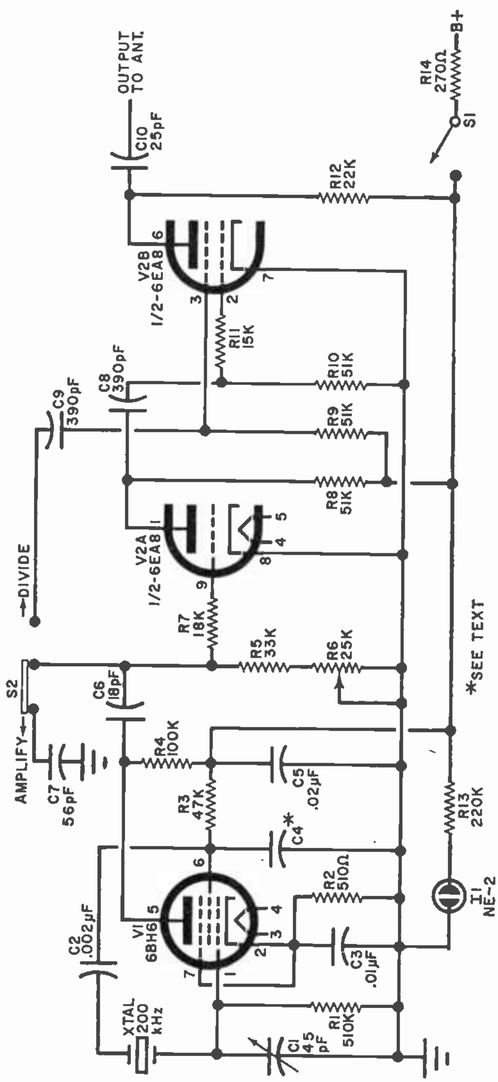
BY NEIL JOHNSON, W2OLU

THE MAJORITY of American hams has been content to comply with FCC rules for checking operating frequency by using a 100-kHz crystal-controlled frequency standard. Under the latest FCC regulation, however, Advanced and Extra class licensees are required to check their operating frequencies to make certain that they fall within certain 25-kHz sub-bands in the conventional ham bands. At present, there is no low-cost commercial unit available for this purpose. The crystal-controlled calibrator described here fills the need.

It would be natural to assume that such a device would incorporate the latest in semiconductor devices. However, a casual survey of hams in the N.Y. metropolitan area showed that over 95% of them are still using vacuum-tube receivers. This being the case, the frequency calibrator was designed to work in conjunction with this type of receiver.

Because power can be obtained from the receiver, the frequency calibrator can be built directly into the receiver cabinet, with only a couple of front-panel switches to control operation. Power requirements are low for a vacuum-tube unit: 600 mA for filaments and 10 mA or less for the plates. One switch determines whether the frequency output is at 200-kHz or 25-kHz intervals and the other turns the calibrator on and off.

Construction. The author elected to construct his calibrator on perf board, although point-to-point or printed-circuit board construction can be used. The use of good-quality components, especially in the crystal oscillator stage, is recommended. Silver mica, or zero-temperature-coefficient ceramic capacitors should be used. By-pass capacitors should be ceramic or Mylar, while tube sockets should be either ceramic or mica-filled. Do not use tube shields as they tend to attenuate the higher harmonics of the circuit. Use as short a lead as possible from the r.f. output of the calibrator to the receiver antenna terminals. Avoid the use of lengthy coaxial cable as this reduces the signals above 30 MHz. Neon lamp *I1* and its associated dropping resistor *R13* are optional. Between 150 and 200 volts d.c. is required by the plate circuits, and this can be obtained from the receiver power supply. If the available B+ is higher than 200 volts, a 2-watt dropping resistor can be inserted between *R14* and the B+, allowing 100 ohms for each volt to be dropped. For example, if the B+ is 250 volts, the resistor should be approximately 5000 ohms.



No tuned circuits are used, giving the crystal oscillator a harmonic-rich output. The second stage (V2) acts as a frequency divider controlled by R6.

Avoid the use of World War II surplus crystals. The best type is the HC6U, a source for which is given in the Parts List.

Note that no value is given for *C4*, the screen bypass capacitor for *V1*. Values will vary from 150 pF maximum to 50 pF minimum, depending on the crystal used. With the crystal specified in the Parts List and a 51-pF screen bypass capacitor, the crystal resonated with 15 MHz from WWV.

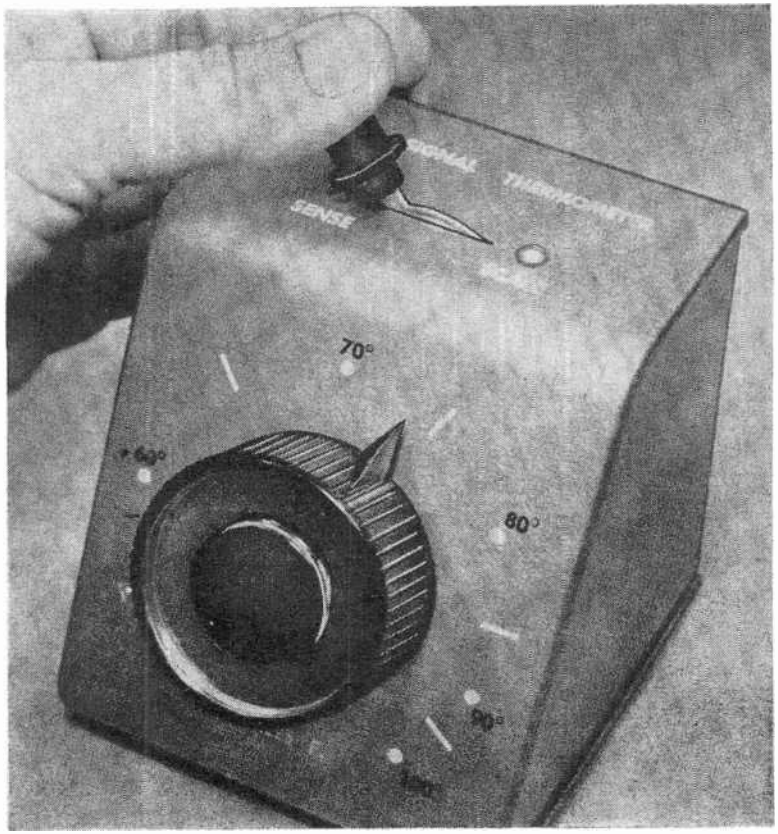
PARTS LIST

C1—3.2- to 50-pF trimmer capacitor (E.F. Johnson type S or similar)
C2—0.002-µF capacitor
C3—0.01-µF capacitor
C4—See text
C5—0.02-µF capacitor
C6—18-pF capacitor
C7—56-pF capacitor
C8, C9—390-pF capacitor
C10—25-pF capacitor
I1—NE-2 neon lamp (optional)
R1—510,000-ohm
R2—510-ohm
R3—47,000-ohm
R4—100,000-ohm
R5—33,000-ohm
R7—18,000-ohm
R8-R10—51,000-ohm
R11—15,000-ohm
R12—22,000-ohm
R13—220,000-ohm
R14—270-ohm
All resistors ½-watt
R6—25,000-ohm potentiometer
S1—S.p.s.t. switch
S2—S.p.d.t. switch
V1—6BH6 tube
V2—6EA8 tube
*XTAL—200.000-kHz HC6U**
Misc.—Perf board, ceramic tube sockets (one 7-pin, one 9-pin), ceramic crystal socket, mounting hardware, terminal strips, wire, etc.
**A 200.000-kHz HC6U crystal is available from JAN Crystals, 2400 Crystal Drive, Fort Myers, Florida 33901, for $2.30 ($2.50 with socket) postpaid.*

Operation. With power applied to the calibrator and the r.f. output connected to the antenna terminal of the receiver, turn on switch *S1*. The optional neon indicator lamp should come on. Place *S2* in the AMPLIFY position and, with the receiver BFO turned on, note that, as the receiver tuning is operated, a signal is heard at each 200-kHz interval along the dial. Turn off the calibrator and tune the receiver to any of the WWV standard frequency stations. Once you have accurately set a zero beat (using the receiver BFO) with WWV, turn the calibrator back on, turn off the receiver BFO, and adjust *C1* until the calibrator and WWV zero beat with each other. Use a drop of cement to lock *C1* in place.

Place *S2* in the DIVIDE position. Adjust frequency division potentiometer R6 until seven calibrator signals are heard between the 200-kHz intervals on the dial. In the author's prototype, this occurred with *R6* set at about 11,000 ohms. Flip *S2* back and forth between its two positions, making sure that the 25-kHz "birdies" return whenever *S2* is on DIVIDE. If not, a slight readjustment of *R6* is required. -30-

THERMISTOR-CONTROLLED TONE GENERATOR USED FOR AUDIBLE TEMPERATURE READINGS



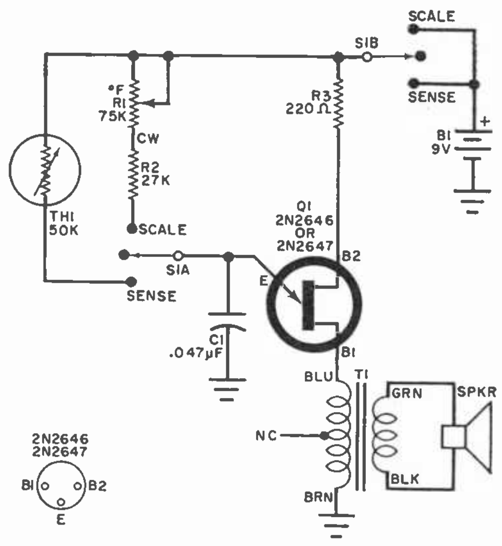
BUILD Sound-Signal THERMOMETER

BY FRANK H. TOOKER

AIR TEMPERATURE CAN be measured in many ways—with a conventional mercury thermometer, a bimetal strip turning a pointer on a dial, or a thermocouple operating a digital readout. However, all of these systems have one thing in common—you have to be able to see the indicating device to be able to determine the temperature.

Some of us have friends or relatives who have difficulty seeing and who would welcome a device or technique to help them in going about their daily tasks. The "Sound-Signal Thermometer" is an electronic device that any experimenter can build and that will enable even a sightless person to tell the temperature. By flicking a switch and making a dial adjustment, he can "read" the temperature by comparing two sound signals. The range of the electronic thermometer is from 55 to 100 degrees Fahrenheit.

Construction. The layout of the components is not critical so any assembly arranged for convenience can be used. The author's version (see photos) is assembled in a small, sloping-panel metal cabinet. Switch *S1* is mounted on the top, potentiometer *R1* is on the sloping front, and battery *B1* is clip-mounted to the



PARTS LIST

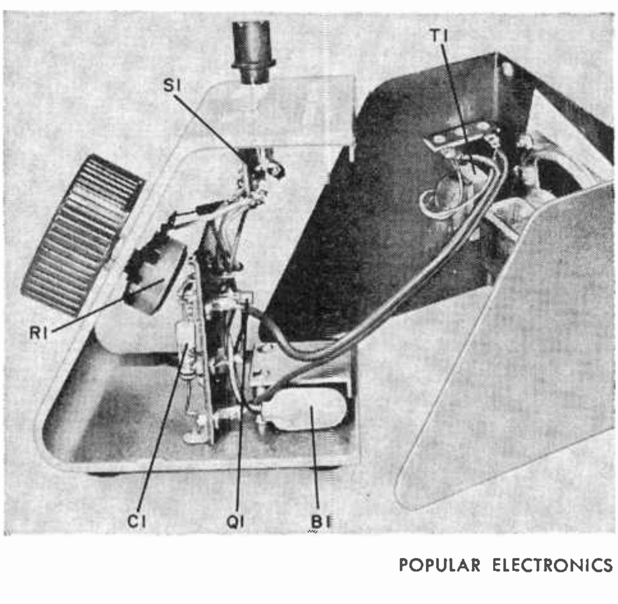
B1—9-volt transistor battery
C1—0.47-μF Mylar capacitor
Q1—2N2646 or 2N2647 unijunction transistor
R1—75,000-ohm potentiometer (Ohmite CU-7531, or similar)
R2—27,000-ohm, ½-watt resistor
R3—220-ohm, ½-watt resistor
S1—2-pole, 3-position lever switch with spring return from both sides to center (Centralab 1455, or similar)
SPKR—2½", 3.2-ohm speaker
T1—Transistor output transformer (Argonne AR-174, or similar)
TH1—Probe-type thermistor, 50,000 ohms at 25°C (Fenwal GA45P2, or similar)
Misc.—Sloping-panel cabinet 4" × 4" × 4¼" (Bud AC-1610-A, or similar), large-diameter pointer knob, 2½" × 2½" × 1/16" plastic mounting board, transistor socket, cambric tubing (to fit thermistor body), mounting hardware, wire, solder, etc.

The a.f. output of the UJT oscillator depends on emitter-circuit resistance—in SENSE mode, a function of the temperature acting on TH1.

bottom of the chassis. The output transformer *T1* and the loudspeaker are on the other half of the cabinet. The remainder of the components are assembled on a small piece of plastic mounted on L brackets within the cabinet. The dial knob used for *R1* should be large, with a distinct pointer, and the calibration marks can be either numerical (in degrees F) or in Braille.

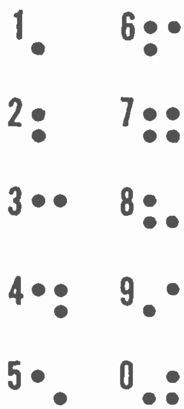
The most critical part of the assembly is the mounting and connecting of the thermistor. The probe-type component recommended for this unit is a small, very delicate device. It is easily damaged by both careless handling and excessive heat. The author found it expedient to mount the thermistor in a snug-fitting, short length of cambric spaghettic tubing, held in place on the plastic circuit board by a small metal clamp. Plastic insulation, slipped over the two thermistor leads, is cemented to the cambric tubing.

Keep the thermistor leads as long as practical in the assembly. Solder them



The entire electronic thermometer is contained within a small cabinet. The circuit is not critical, so any other mechanical arrangement can be used. If you wish to measure outside temperature, mount the thermistor out of a window in a weather-protected spot, and connect it to the thermometer via a twisted pair. This pair can enter the cabinet through a rubber grommet.

quickly, keeping the heat of the soldering iron well away from the thermistor at all times. Once overheated, a thermistor's characteristics may change and drift indefinitely. In this event, permanent accuracy of the instrument is impossible.



Braille numbers, in various combinations, can be embossed on front panel for use by a blind person.

Calibration. There are several ways of calibrating the thermometer, most of them are somewhat complex. However, there is one simple method that is accurate enough for almost all purposes.

Assemble the thermometer, except for the thermistor. Connect a pair of 15- to 20-inch leads between the thermistor and its terminals on the circuit board. Using a large container of water and an accurate mercury thermometer, adjust the water temperature consecutively (from 55 to 100 degrees F) to the various temperature values to be calibrated. With the thermistor placed two thirds of its length into the water, set *R1* until the frequency of the audible tone is the same in both the SENSE and SCALE positions of *S1*. Mark the *R1* dial in accordance with the thermometer readings. Calibration at 5° intervals is adequate. Do not allow the thermistor leads to get wet as this may produce inaccurate temperature indications.

When calibration is complete and has been checked, remove the auxiliary leads from the thermistor and reinstall it in the cabinet.

HOW IT WORKS

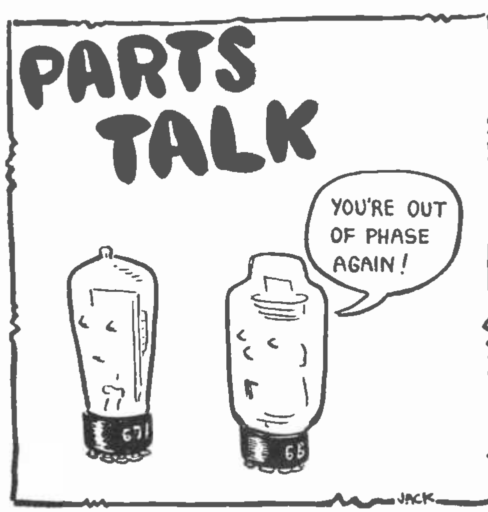
Unijunction transistor *Q1* is an oscillator whose frequency is determined by the combination of emitter capacitor *C1* and the resistance of either the thermistor *TH1* or calibration potentiometer *R1*. Audio output is obtained from B1 of *Q1* through transformer *T1*.

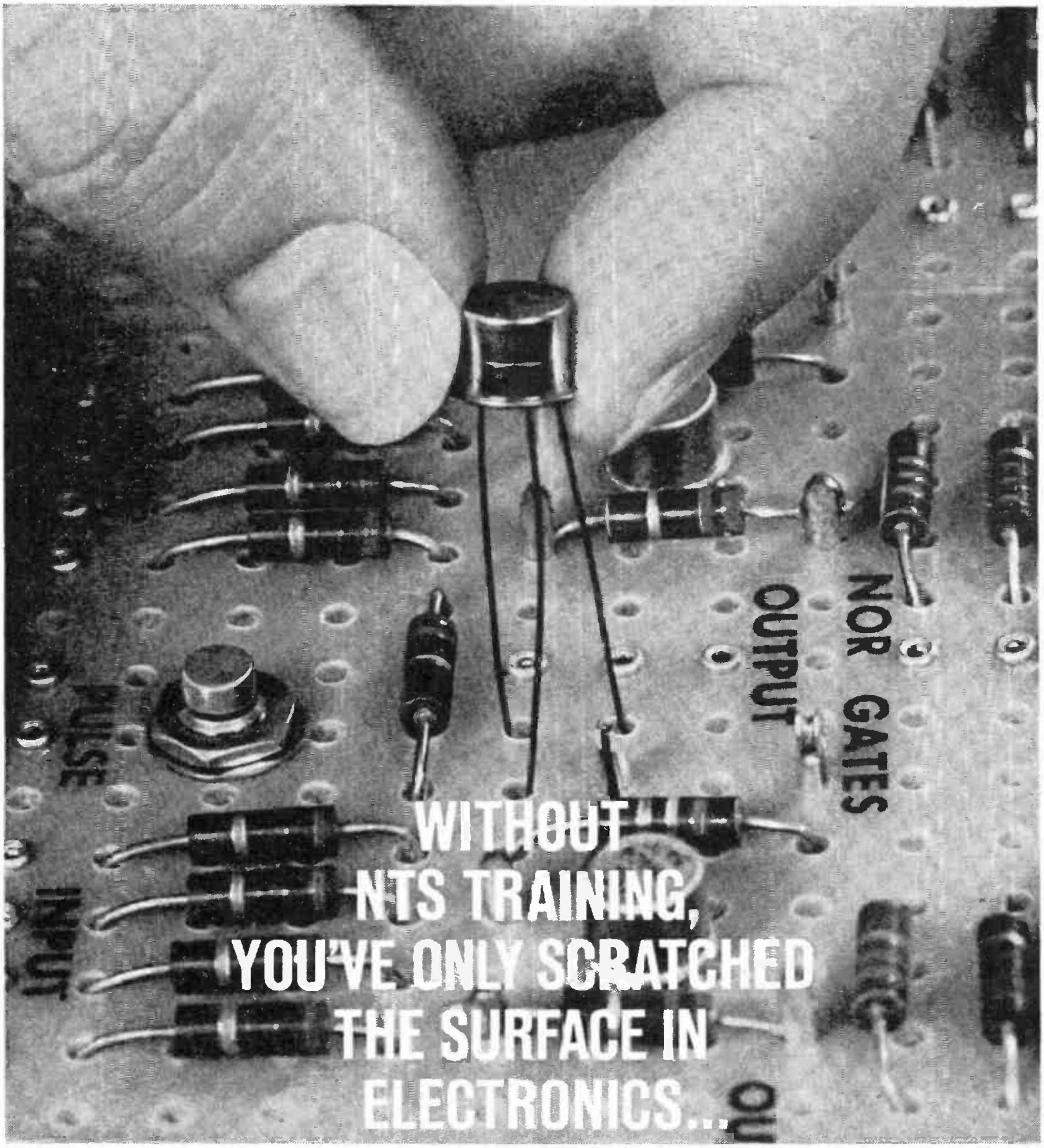
Switch *S1* is spring-loaded to return to its center position. If it is moved to either of its two other positions (SCALE or SENSE) and released, it will automatically return to the off position.

When *S1* is moved to SENSE, thermistor *TH1* supplies the resistance for the *RC* circuit which controls *Q1*. The transistor then oscillates at a frequency determined by capacitor *C1* and the resistance (at ambient temperature) of *TH1*. A thermistor is a semiconductor device whose resistance varies inversely with temperature; as the temperature goes up, the resistance goes down. Therefore, the audible output frequency is a function of thermistor resistance and, hence, the temperature.

The values of potentiometer *R1* and resistor *R2* have been selected so that, over the range of 55 to 100 degrees Fahrenheit, the resistance of *TH1* can be duplicated by adjustment of *R1*. Thus, when *S1* is in the SCALE position, *R1* can be adjusted to duplicate the tone generated by the thermistor.

Installation. The Sound-Signal Thermometer can be placed in any convenient place in the house and is always ready for immediate use. If desired, the thermistor can be mounted outside a window, with the cabinet on a window sill, ready to make outside temperature measurements within its range. When using external mounting, the thermistor leads must be waterproofed to prevent resistance changes caused by rain. –30–





Only NTS penetrates below the surface. Digs deeper. Example? Take the above close-up of the first transistorized digital computer trainer ever offered by a home study school.

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BENCH SUPPLY

(*Continued from page* 52)

ther to the full winding or to the tap. With the switch in the latter position, you can get an output approaching 140 volts.

It is also a good idea to have a means of obtaining very low voltages without depending on the setting of the variable transformer. For this purpose, use a HIGH-LOW switch which, in the LOW position, puts a step-down transformer across the output of the variable transformer. The author uses a multi-tap transformer here, but any step-down transformer with a 12-volt center-tapped secondary which is capable of carrying at least 1 ampere would be suitable.

Having a meter in the output of the supply is extremely convenient and timesaving. A meter with a 0-150 volt linear scale is best. Unfortunately, a number of inexpensive a.c. voltmeters have nonlinear scales. Although they serve perfectly well in other applications, such meters do not have a scale range that is sufficiently detailed to be of value when used with a variable-voltage transformer.

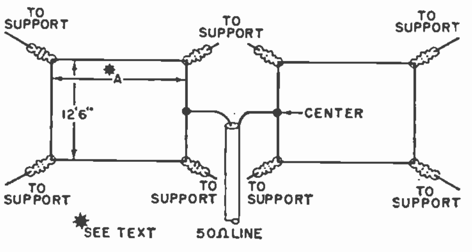
You can use the meter for the low-voltage output if you determine the voltage (turns) ratio of the step-down transformer accurately and apply this ratio to the meter reading.

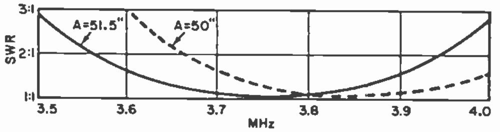
Packaging the Supply. The assembly shown in the photo uses a 2.4-ampere Variac mounted in a 6″ × 6″ × 6″ aluminum cabinet, with the knob for the Variac on the top. Two large handles also on the top can be used to carry the supply; they also protect the Variac knob so that it can't be accidentally moved and they provide a place to rest the palm of your hand while making a setting of the knob.

Although the schematic diagram shows only one 120-volt output receptacle, the author's setup has two wired in parallel for added convenience. They are located on the rear of the cabinet so that cords plugged into them are out of the way of the work area and the controls. -30-

Broadband Dipole For 75/80 Meters

BY BOB DAHLQUIST, WB6KGF





Length of side A depends on coverage desired and determines the standing wave ratio for the dipole.

THIS ANTENNA WILL ALLOW you to load your transmitter across the entire 500 kHz of the 75-80-meter band without using an antenna tuner, and with a SWR less than 3:1.

Construction is shown in the diagram. About 260 feet of antenna wire is required, as well as eight insulators, a conventional Hy-Gain center insulator (or substitute), and a length of 50-ohm transmission line long enough to go from the antenna to the transmitter. You will also need three antenna supports, masts or trees, between 20 and 30 feet high. Although these supports should be in a reasonably straight line, the antenna will work if it is folded up to 90°, making a horizontal Vee.

For coverage of the entire band, side A should be 51 feet, 6 inches. To cover just the phone portion of the band, side A is made 50 feet long. The resultant SWR is also shown in the diagram.

Because the SWR is affected by the height of the antenna and whether or not it is folded, you may have to shorten or lengthen side A to obtain the lowest SWR. -30-

build a cheapie metronome

USE OLD RADIO PARTS FOR A MUSICAL ACCESSORY

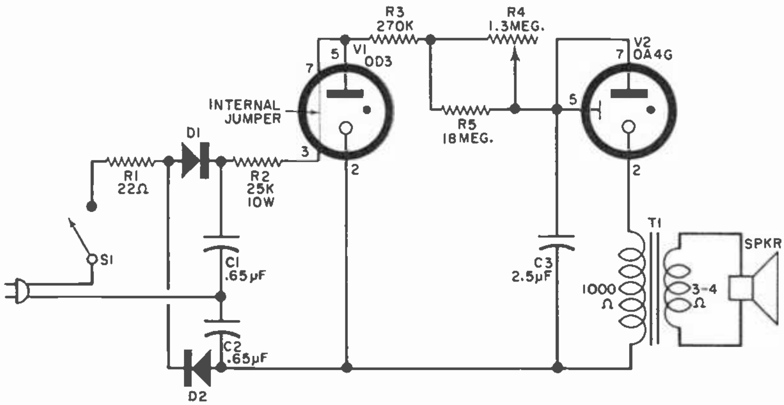
BY KARL GREIF

THERE ARE TIMES when a seemingly useless electronic device can find service in a capacity other than the purpose for which it was designed. This was the case when an old tube-type portable AM BCB radio I had kicking around my shop fell prey to an idea I had for building an electronic metronome.

Making the conversion wasn't difficult, and aside from providing me with several hours of good clean experimenting and fabrication time, it provided my musically inclined sister with a first-class metronome. The portable radio was a fairly common type, but you can use almost any other similar-size radio receiver to accomplish the same results. Most of the parts you probably have on hand from cannibalizing old radios, phonographs, or TV receivers, so cost-wise, this project is "dirt cheap."

About The Circuit. The schematic diagram of the "Electronic Metronome" is shown in Fig. 1. It is fairly simple, built around two gas-type tubes (*V1* and *V2*) and a transformerless voltage-doubler power supply.

With the power supply shown, a potential on the order of 200 to 300 volts ap-



PARTS LIST

C1, C2—0.5-μF (or higher), 400-volt capacitor
C3—2.5-μF, 200-volt bathtub capacitor (see text)
D1, D2—See text
R1—22-ohm, ½-watt resistor
R2—25,000-ohm, 10-watt resistor
R3—270,000-ohm, ½-watt resistor
R4—1.3-megohm potentiometer (see text)
R5—18-megohm, ½-watt resistor
S1—S.p.s.t. switch (salvaged from radio)
T1—1000-ohm primary/4-ohm secondary impedance-matching transformer
V1—VR150 or OD3 gas tube
V2—OA4G cylindrical plate gas tube
1—3-4 ohm speaker
1—Old tube-type radio or similar size utility box (see text)
Misc.—Dial cord and pulley (optional); wire; solder; etc.

Fig. 1. The voltage-doubler power supply's output is voltage regulated to provide a constant output, maintaining a uniform charge-discharge action from RC elements in oscillator V1.

pears across the *C1-C2* combination. This filtered potential is then regulated by *V1* and ballast resistor *R2* before being applied to the *V2* relaxation oscillator stage. The output of *V1* always remains constant at 150 volts regardless of line voltage—a very important feature if you want the beat rate of the metronome to remain stable.

The 150-volt output from *V1* is then applied to the *RC* network formed by *R3*, *R4-R5*, and *C3* with a conventional charge and discharge action through *V2*. Current flowing through the resistors charges *C3* at a rate determined by the total resistance presented in series with the capacitor and *V1*. The larger the resistance, the slower the charging rate, and vice versa.

As *C3* charges, the potential across it rises proportionally until it reaches the firing potential of *V2*. At this point, the gas in *V2* ionizes, effectively connecting *C3* to *T1*. As a result, *C3* rapidly discharges, producing a beat note in the speaker. Immediately upon discharge, *V2* de-ionizes and stops conducting, allowing *C3* to begin charging again. The rate at which the beats are produced can be varied by changing the setting of *R4* which is in parallel with *R5* and controls the charging path to *C3*.

Construction. Since this is essentially a "spare-parts" box project, it is best to breadboard the components you plan to use to make sure the circuit will operate as desired. Diodes *D1* and *D2*, for example could be any type of selenium rectifiers containing five or more plates each or a pair of 2-ampere 250-volt silicon diodes—whichever you have handy.

Select a potentiometer on the order of 2 megohms for *R4* if you use the 2.5-μF capacitor called out for *C3*. If you use a different value capacitor, make the proper adjustment in the potentiometer value. However, the capacitor chosen, being the heart of the circuit, is fairly critical; it must retain a stable capacitance value with respect to temperature, and it should have no (at least constant)

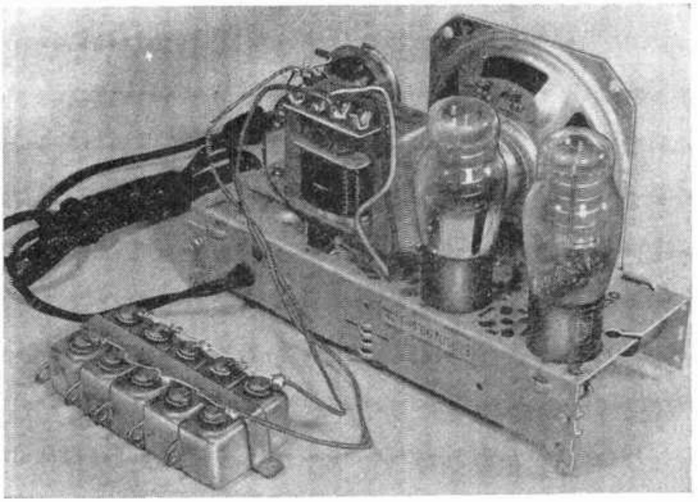


Fig. 2. Salvaged receiver chassis easily accommodates all of the metronome's parts. Bathtub capacitors (lower left) can be bolted to floor of receiver cabinet once chassis is in place.

leakage current. A bathtub type capacitor seems to have the best characteristics.

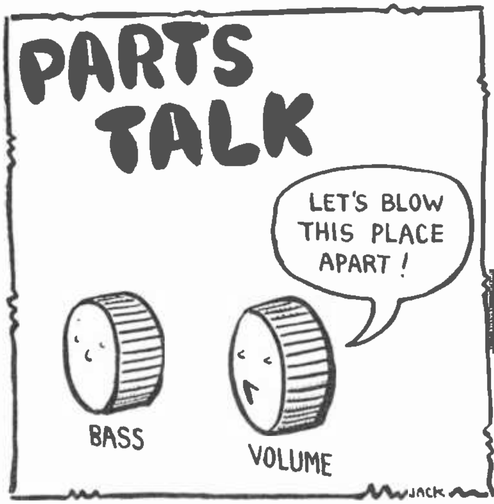
Once you have breadboarded the circuit and are satisfied it works (the beat rate range should be continuously variable at least between the limits of 40 and 208 beats/min on the upper and lower ends), you're ready to begin converting that old radio chassis and cabinet. The first step is to remove the innards of the radio.

Mount the metronome parts, and wire them together, using Figs. 1 and 2 as guides. Location of the parts is not critical, and if you use a different radio chassis—or even, as a last resort, build the circuit into a utility box—there is nothing to prevent you from exercising your own mechanical ingenuity. With the radio chassis and cabinet shown in the photo on the first page of this article, you can even calibrate and hand-letter a dialplate that will permanently locate the various beat-rate settings of *R4*.

To use the dialplate gimmick, you can fashion an L-bracket to hold the potentiometer fixed in a position where its shaft will accept a tuning dial pulley in line with the tuning dial control shaft. Then all you have to do is string the dial, making sure the pulley will allow a complete 280° revolution of the shaft on the potentiometer.

Finally, slide the chassis into the radio case, and it's ready to use. Plug the line cord into a convenient a.c. outlet, close *S1*, and allow about a minute of warm-up time. Now, calibrate the dial, using a stopwatch or a sweep second hand on a conventional time piece. The number of dial markings you select will depend on the taper of the potentiometer selected and the amount of space available for lettering.

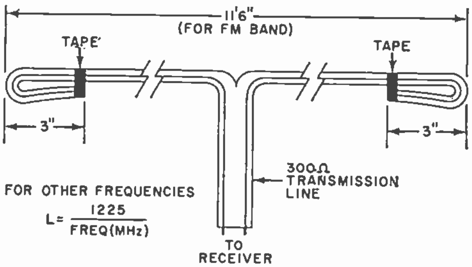
For large group practice sessions, the Metronome can be connected to a public address system by tapping the output from the speaker terminals. -30-



Extended Double Zepp Antenna

BY JOHN NELSON

ADD A FEW INCHES TO YOUR ANTENNA AND WATCH THE SIGNAL LEVEL IMPROVE



For 88-108-MHz FM band, the extended double Zepp is made of 11 feet 6 inches of split 300-ohm line.

MOST INDOOR antennas for FM or TV are conventional half-wave dipoles. Thousands of dipoles have been bought or made up by experimenters from a length of conventional 300-ohm transmission line. Usually the length of a dipole is restricted to half of the wavelength at the frequency of interest.

However, most experimenters don't realize that if they made the antennas slightly longer than half a wavelength, the gain would be increased noticeably. In fact, some AM BCB stations, in order to increase their coverage area without increasing transmitter power, use a ⅝-wavelength radiator. This improves the low-angle radiation and gives these broadcasters greater coverage than they can get with the usual half-wave antenna.

Hams who are familiar with this principle of extending the dipole, often use a center-fed antenna 1¼ wavelengths long. This gives a net gain of 3 dB. The same principle is used in the design of the "Extended Double Zepp" (EDZ) antenna described here.

The EDZ can be supported by string, rubber bands, or thumbtacks; it can be placed under a rug or hidden behind wall mouldings; it has no bulky or breakable insulators; and, if you should forget and leave it out in the woods on a camping trip, all you lose is about 50¢.

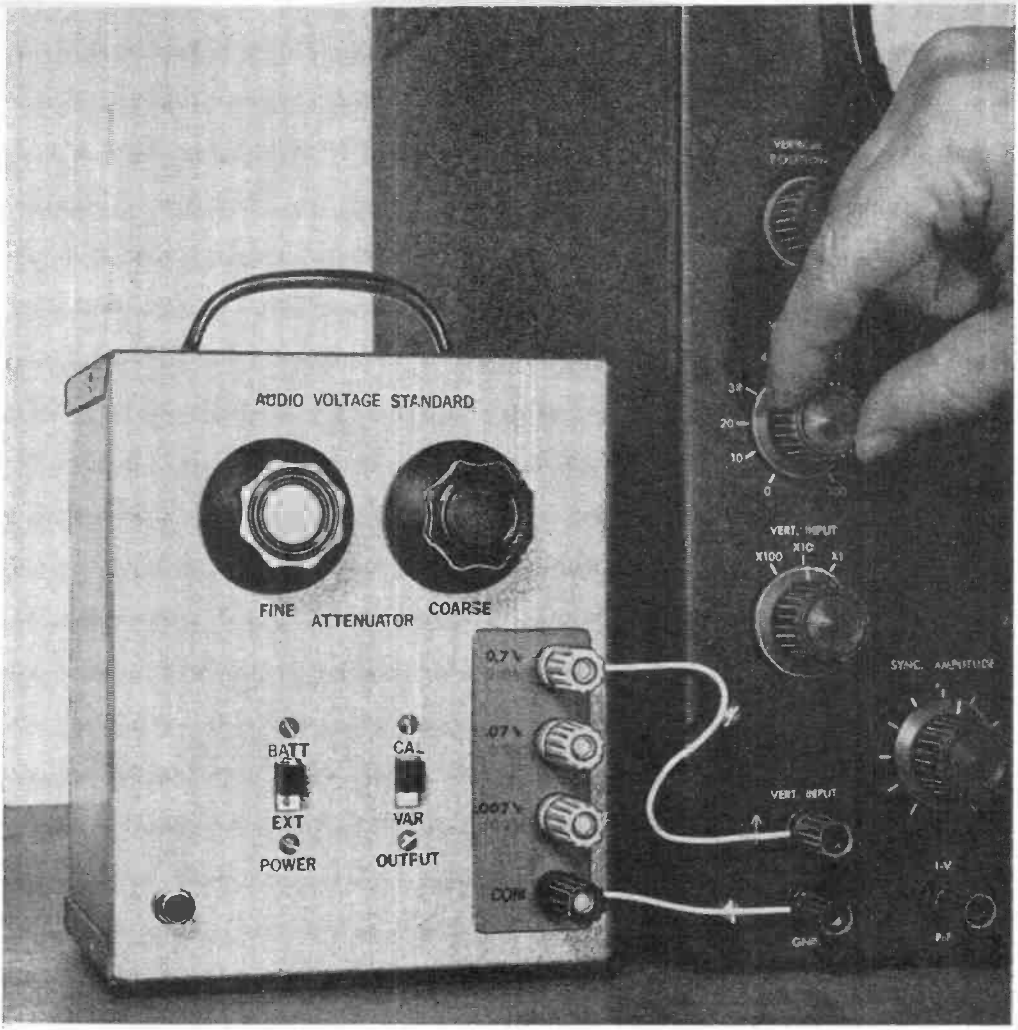
Fabrication. To make an EDZ antenna for the 88-108-MHz FM band, use the dimensions given in the illustration. Cut a piece of conventional twin-lead, 300-ohm TV line that is 6 feet long plus enough to go from the antenna to your receiver. Cut down the center of the twin lead for 6 feet. Make a knot (using the two loose ends) to keep the twin-lead from being further torn apart. At each of the two free ends, form a loop to permit the antenna to be hung. Use plastic tape to close the loops. This completes the antenna itself; the remainder of the uncut twin lead is used as the transmission line to the receiver. The latter should be only as long as necessary to keep signal loss to a minimum.

To construct an antenna for other than the FM band, calculate the length of the antenna portion by dividing 1225 by the frequency in megahertz. If you want to cover a relatively wide band, cut the antenna length for the highest frequency.

Using the Antenna. You can mount the antenna anywhere but remember that its directivity is rather sharp. It should be placed so that its length is broadside to the stations you want to hear.

Some further signal enhancement can be obtained by wrapping a 6-inch square of aluminum foil around the transmission line and sliding the foil up and down the line until the desired signal is maximized. Use a piece of plastic insulating tape to secure the foil to the line at the desired spot. -30-

What's a Zepp? In early short-wave radio, an antenna consisting of a half-wave dipole, end-fed through a quarter-wave transmission line was developed as an antenna system for the then popular Zeppelin airship. Because of the large metal base of the Zeppelin, the antenna system had to be designed so that only the antenna proper, and not the transmission line, radiated. This antenna later became popular with hams under the name "Zepp."



Precision Audio Voltage Standard

A LAB/WORKSHOP INSTRUMENT FOR ACCURATE MEASUREMENTS

BY TOM GILBERT

ELECTRONIC measuring instruments are so sophisticated—versatility combined with style and ease of use—that we often take the instrument's accuracy for granted. An audio VTVM, for example, may have a claimed accuracy of ±5% and we might assume that this means it is accurate to 5% at any time. However, the VTVM can have a *total variation* of 10% and still be within the manufacturer's specifications! In other words, unless the calibration is checked frequently, and readjusted as necessary, ±5% can easily be 0 and −10% or 0 and +10%.

Of course VTVM's can be calibrated using their internal calibration circuits, but age and temperature affect such circuits and the calibration is sometimes not as accurate as might be desired.

As another example, many oscilloscopes don't even have built-in calibrators; and, of those that do, the line voltage may be used as the calibration

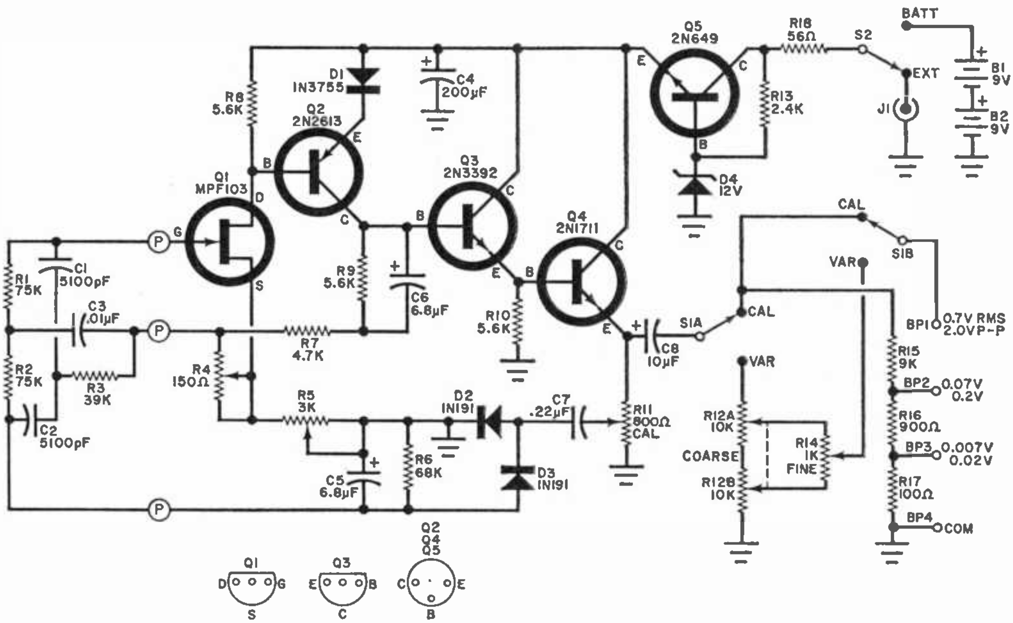


Fig. 1. The twin-T feedback oscillator incorporates both positive and negative feedback for stability and waveform purity. Frequency can be changed by replacing the twin-T filter.

PARTS LIST

B1, B2—9-volt alkaline transistor battery (Mallory MN1604B or similar)
BP1-BP3—5-way binding post, yellow (E. F. Johnson type 111-107 or similar)
BP4—5-way binding post, black (E. F. Johnson type 111-103 or similar)
C1, C2—5100-pF, 5%, polystyrene capacitor (Mallory type SX or similar)
C3—10,000-pF, 5%, polystyrene capacitor (Mallory type SX or similar)
C4—200-μF, 12-volt, miniature electrolytic capacitor
C5, C6—6.8-μF, 6-volt, polarized solid-tantalum capacitor (Sprague type 150D or similar)
C7—0.22-μF, 100-volt Mylar capacitor
C8—10-μF, 12-volt subminiature electrolytic capacitor
D1—1N3755 diode
D2, D3—1N191 diode
D4—12-volt, 1-watt zener diode
J1—RCA-type phono jack
Q1—MPF103 field-effect transistor
Q2—2N2613 transistor
Q3—2N3392 transistor
Q4—2N1711 transistor
Q5—2N649 transistor
*R1, R2—75,000-ohm**
*R3—39,000-ohm**
R4—150-ohm, miniature PC-type, wire-wound potentiometer (Clarostat type U-39 or similar)
R5—3000-ohm, miniature PC-type, wire-wound potentiometer (Mallory type MR3000P or similar)
*R6—68,000-ohm**
*R7—4700-ohm**
*R8-R10—5600-ohm**
R11—800-ohm, miniature PC-type, wire-wound potentiometer (Clarostat type U-39 or similar)
R12—Dual potentiometer, 10,000 ohms per section, molded composition, linear taper (Ohmite type CCU or similar)
*R13—2400-ohm**
R14—1000-ohm, molded-composition potentiometer, linear taper (Ohmite type CU or equal)
R15—9000-ohm, 1% precision resistor
R16—900-ohm, 1% precision resistor
R17—100-ohm, 1% precision resistor
R18—56-ohm, 10%, ½-watt resistor
S1—D.p.d.t. slide switch
S2—S.p.d.t. slide switch
1—6"x5"x4" aluminum cabinet
Misc.—Glass-epoxy PC board stock, L-brackets, ¼"-I.D. soft rubber grommets (3), short lengths of ¼"-diam. metal rod, dual battery clip, battery connectors (2), knobs, carrying handle, rubber feet (4), hardware, wire, solder, etc.
**These resistors are 2%, ½-watt (IRC Metal-Glaze type RG-20).*

source. At best, the accuracy of this type of calibration is no more dependable than the accuracy of the power-line potential. Even a zener-controlled calibrator can be in error by as much as 20%, depending on the tolerance of the diode.

Thus, to obtain reliable use from instruments such as the audio VTVM or the oscilloscope, you need an accurate audio voltage calibration standard. Using such a standard, it is possible to tell immediately whether the instrument is reading high or low—and by how much. The instrument calibration can then be

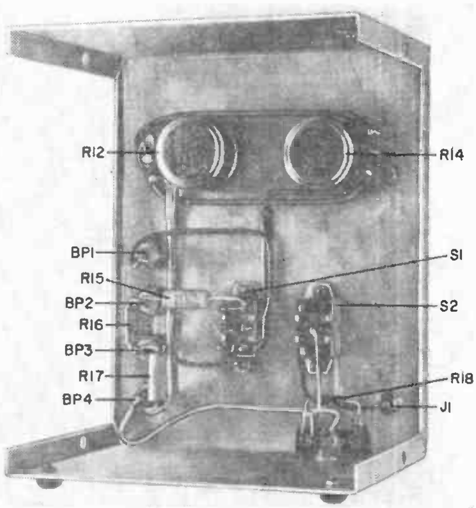


Fig. 2. Rear view of front panel showing component mounting. The four rubber feet are optional.

touched up to bring its accuracy up to that of the standard.

A commercial audio voltage standard can be quite expensive. The instrument described here, however, can be assembled for about $35.00. When properly calibrated, it has an accuracy of ±1% over a temperature range from 60° to 90°F. Negligible variation occurs in the output signal level when the supply voltage is varied between 12 and 20 volts d.c. Compensating for temperature and voltage variations accounts for much of the cost of commercial instruments.

Actually the standard shown in Fig. 1 can be used for three purposes. It is a precise audio voltage standard; it is a

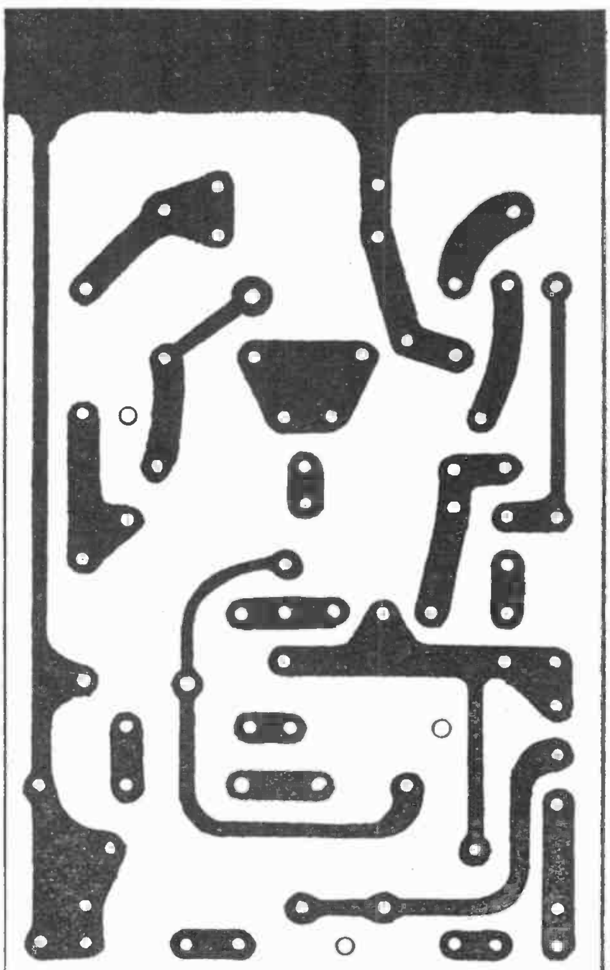


Fig. 3. Actual size foil pattern for the standard. Drill all holes including the three isolated plain circles.

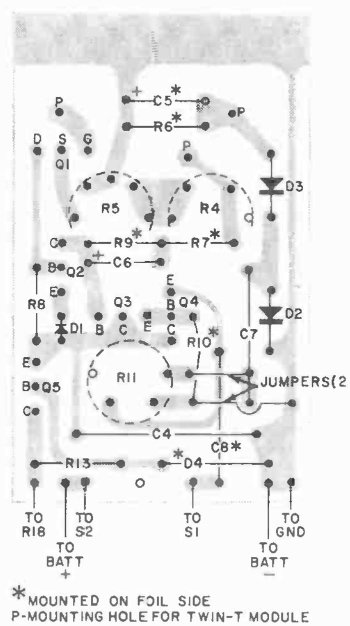


Fig. 4. Note that some of the components are mounted on the foil side of the board to ease construction.

calibrator with accurate output levels of 0.7, 0.07, and 0.007 volts r.m.s.; and it is a 400-Hz audio signal generator with a clean, highly stable, sine-wave output of zero to 0.7 volts r.m.s., which is continuously variable and controlled by a double attenuator to provide both fine and coarse adjustments.

The seemingly odd value of 0.7 volts output is no accidental or arbitrary selection. Actually the figure is 0.707, the reciprocal of the square root of 2. Thus 0.7 volts r.m.s. is 2 volts peak-to-peak. The r.m.s. value is used in calibrating a VTVM; 2 volts peak-to-peak is used to calibrate the vertical deflection of an oscilloscope. Both values are marked next to the output binding posts on the calibrator.

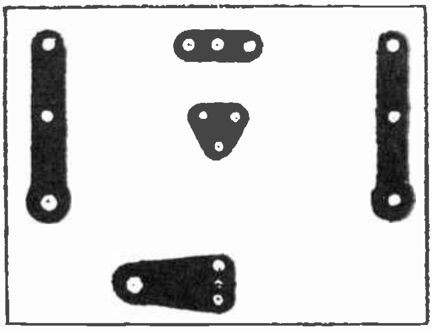


Fig. 5. Actual-size foil pattern for the twin-T PC board. A separate board is used so that, if it is desired to change frequency, you merely remove three screws and insert a new twin-T filter PC board.

Power consumption for the instrument, from two 9-volt alkaline batteries connected in series, is about 90 milliwatts.

Construction. The audio voltage standard is assembled in a 6″ × 5″ × 4″ metal enclosure, whose front-panel layout is shown in Fig. 2. The rest of the components are mounted on a pair of printed-circuit boards attached to the back of the front panel. Two circuit boards are used so that the twin-T frequency-determining network can be a separate, interchangeable unit. It is mounted on the main PC board using three ⅝″-high aluminum-alloy spacers and three 4-40 binder-head screws. Thus when it is desired to change the basic operating frequency of the standard, it is only necessary to replace the twin-T board.

The main PC board is prepared using the actual-size foil layout of Fig. 3. The preferred material for the board is glass epoxy. After the board has been fabricated, assemble the components as shown in Fig. 4. Note that *R6*, *R7*, *R9*, *R10*, *C5*, *C8*, and *D4* are mounted on the foil side.

The twin-T board can be prepared using the actual-size foil layout shown in Fig. 5. After etching, mount the components on the board (Fig. 6) noting that C3 is mounted on the foil side. When both boards are complete, attach the twin-T board to the main board. The assembled PC board should be mounted securely in the cabinet, but preferably *not rigidly*. In the prototype, a three-point flexible mounting was made by using soft rubber grommets, short length of ¼″-diameter rod (which fits the inner diameter of the rubber grommets snugly), flat washers, screws and nuts. Two of these assemblies were fitted to a 4¼″ L-bracket at the top of the cabinet, and one was centrally located attached to a 1⅛″ bracket at the bottom. (See Fig. 7.) The grommet hole in the lower bracket was elongated to permit a vertical play of about 1/16″. Details of the flexible board mount are shown in Fig. 8. The batteries are secured to the bottom of the chassis. The finished chassis is shown in Fig. 9.

Adjustment and Calibration. You will need a variable-voltage power supply capable of adjustment from zero (or near zero) to at least 18 volts d.c.; an oscilloscope; an accurate 400-Hz voltmeter standard; and a stable electronic audio voltmeter which can be calibrated against the voltmeter standard at 0.7 volt r.m.s. If you don't have a voltmeter standard, the audio voltage standard may be calibrated as accurately as available means

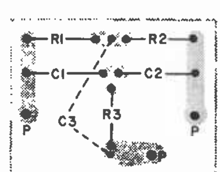


Fig. 6. Capacitor C3 is mounted on the foil side of the twin-T PC board. The three holes marked "P" mate with similar holes on the main circuit board.

HOW IT WORKS

The standard consists of an audio oscillator (*Q1* and *Q2*), a buffer current amplifier (*Q3*), and an output current amplifier (*Q4*). To control the operating level, a portion of the output signal is rectified in a voltage-doubler circuit (*D2* and *D3*), filtered, and applied as reverse bias to the gate of *Q1*. This type of circuit is similar to the a.v.c. used in a radio receiver and, in this case, will hold the output voltage level extremely close to its calibrated setting.

Operating frequency is determined by a twin-T network (*R1*, *R2*, *R3*, *C1*, *C2*, and *C3*). Both positive (through *R4*) and negative (through *R5*) feedback are used to obtain stability and waveform purity (minimum harmonic content). Although the twin-T network described is designed for 400 Hz, any other frequency may be used.

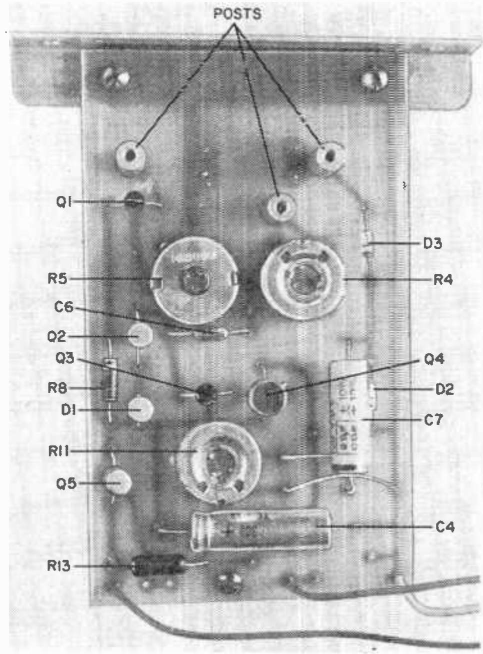
The frequency stability of the circuit is excellent—on the order of ±0.5% at 400 Hz. To make the circuit independent of power supply variations, a supply regulator is used. Because the circuit consumes only 90 milliwatts, internal batteries are used, but provisions have been made for the use of any external power supply that can deliver regulated 18-volt d.c.

permit and can be depended on to hold this calibration for reference and comparison, even though its output may not be precisely 0.7 volt r.m.s.

The first step is to set the negative feedback control *R5* so that oscillation begins when the d.c. power-supply level is at 10.5 volts. To do this, first set OUTPUT switch *S1* at CAL, and POWER switch *S2* at EXT. On the main PC board, set potentiometer *R4* at maximum resistance and potentiometers *R5* and *R11* at midposition.

Connect the oscilloscope to the 0.7 V and COM output binding posts. Connect the variable-voltage d.c. power supply to J1 (lower left corner of the front panel). Set the power supply for zero output voltage and turn it on.

Advance the output control of the d.c. power supply *slowly* while observing the oscilloscope screen. Stop as soon as oscillation shows on the oscilloscope and note the output level of the power supply. If it is below 10.5 volts, *R5* should be advanced slightly; if it is above 10.5 volts, *R5* should be set for lower resistance. Set the power supply back to zero output, adjust *R5* as necessary, and make the check over again. Continue this process until oscillation begins at exactly 10.5 volts of power supply. Once oscillation begins, it will continue until the power supply has been reduced to 8 volts or



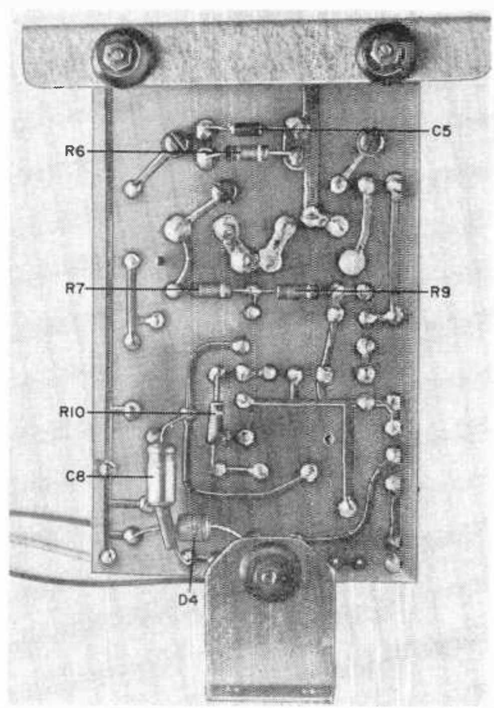


Fig. 7. Component location on the main PC board. The lower view also shows the method of installing the two flexible mountings. Use of these mountings reduces the possibility of instrument vibration which affects the stability of the oscillator.

less. Thus, $R5$ should not be adjusted while the oscillator is operating. Set the power supply back to zero each time, and wait a few moments for the electrolytic capacitors to discharge.

When $R5$ is properly adjusted, run the power supply up to about 18 volts d.c. Connect the electronic audio voltmeter across the oscilloscope connection and adjust potentiometer $R11$ to give an output signal level of 0.7 volt r.m.s. Observe the waveform on the oscilloscope screen. It should be a clean, highly stable sine wave with a frequency close to 400 Hz. If there is any distortion, it should be slight, and it should be on the negative-going excursions of the waveform. A small adjustment of the positive feedback potentiometer, $R4$, should clean up the distortion. If $R4$ is adjusted, $R11$ must be reset to bring the signal level back to a 0.7-volt output. It is desirable that both $R4$ and $R11$ be set as high as possible (consistent with an acceptably clean waveform) to maintain the accuracy of the output.

When the output is at precisely 0.7 volt r.m.s., the calibration is complete and the instrument is ready for use.

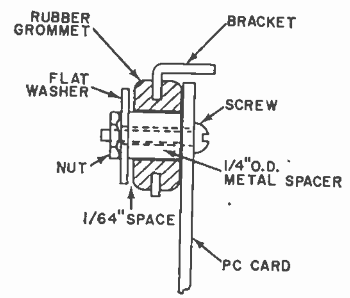


Fig. 8. Details of the flexible mounting. Rubber grommet is fitted in a hole in the L-bracket.

Use. To use the instrument as an audio voltage standard or r.m.s. calibrator, set switch $S1$ at CAL. Outputs of 0.7, 0.07, and 0.007 volt are then available between the respective binding posts and common. To use the instrument as a 400-Hz signal generator, set $S1$ at VAR. Continuously variable output between zero and 0.7 volt is then available at the 0.7 V binding post. With this setting of $S1$, the binding posts for 0.07 and 0.007 volt are dead. The FINE ATTENUATOR control, $R14$, permits a variation of about 60 millivolts at any setting of the COARSE ATTENUATOR control, $R12$.

Output Loading. In general, voltage standards such as that described here, are not intended to deliver power. Since the input impedance of the average audio VTVM or oscilloscope is on the order of a megohm or two, loading of the precision audio voltage standard in the course of calibration is of no consequence. However, should it be desired at any time to use the standard for some other purpose, a resistive load as low as 10,000 ohms connected between the 0.7 V and COM binding posts, with switch $S1$ in either CAL or VAR, produces negligible variation in accuracy. Heavier loading, however, will cause clipping of the negative excursions of the output waveform. –30–

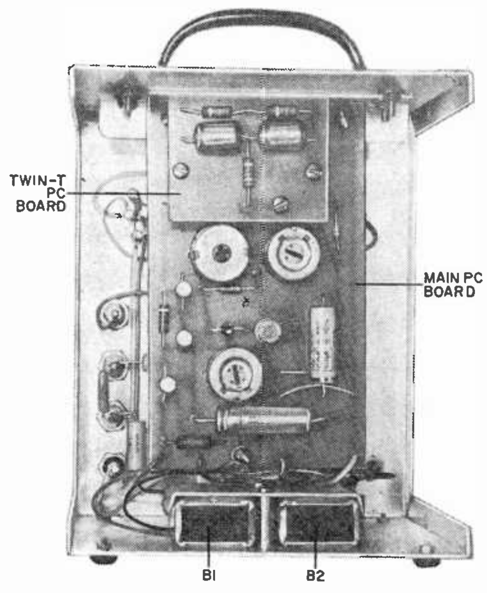
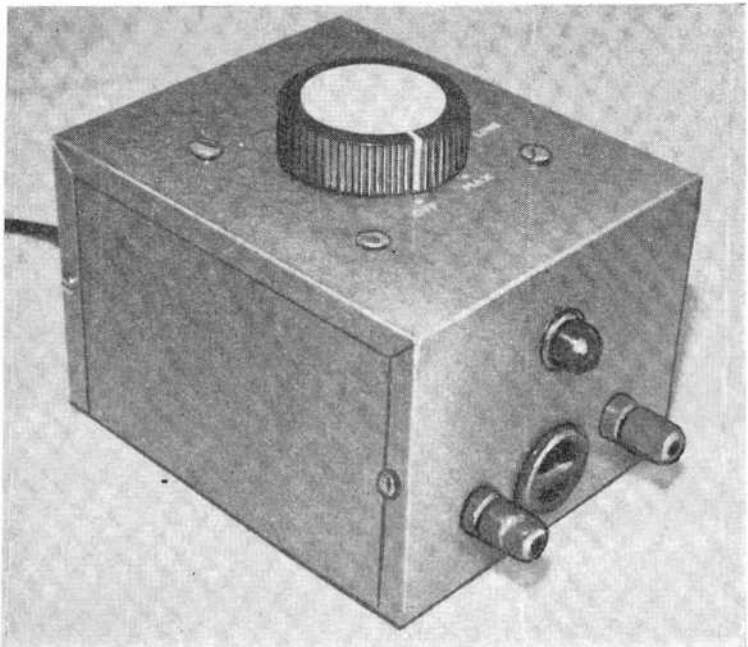


Fig. 9. Rear view of completed instrument. The two batteries are secured with an aluminum strip.



Build a VOLT BOX

Uses low-cost variable auto-transformer

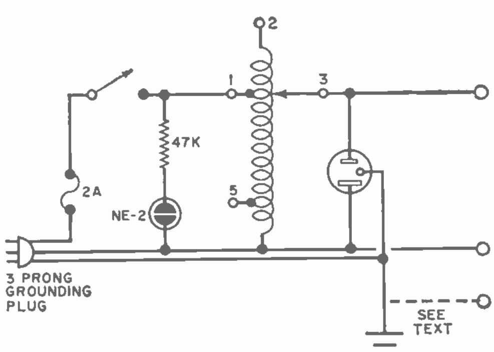
BY FREDERICK W. CHESSON

THE "VOLT BOX" was designed primarily to fill an important need for the experimenter. Power-supply output voltage adjustments, soldering iron temperature regulation, and tracking down intermittent circuit malfunctions all require the use of an adjustable a.c. power supply such as the Volt Box.

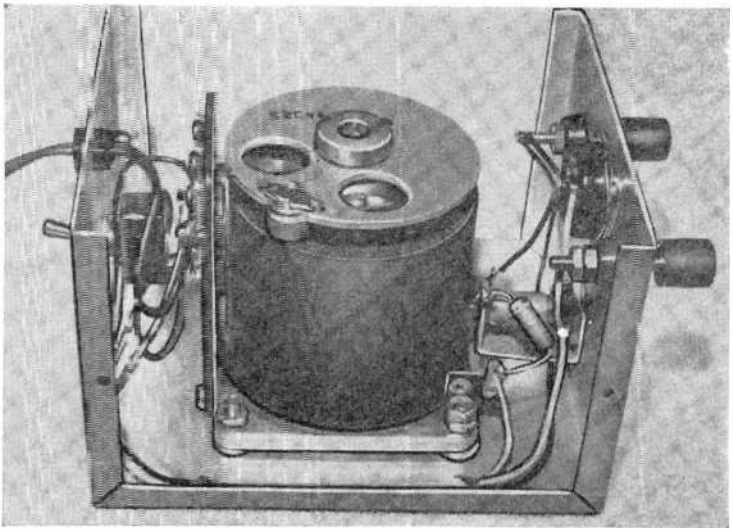
While variable a.c. supplies are commercially available, they are generally expensive—especially for the beginning experimenter. However, a General Radio type W-2, 2.4-ampere Variac can be obtained from Radio Shack for $7.95—specify number 273-043—which is a considerable saving.

Mount the Variac in the center of a 6″ × 5″ × 4″ utility box to provide space for mounting the power switch and line cord at one end, and the output receptacle, binding posts, and pilot lamp at the opposite end. If you cannot obtain a pilot lamp assembly with built-in resistor, be sure to use a dropping resistor (47,000 ohms) with the basic lamp. Mount a fuse holder in a convenient location, and wire the components together. (Note: the connections to the Variac shown in the schematic diagram will yield up to 140 volts a.c. output with a 117-volt a.c. input. If you prefer that the output voltage not exceed 117 volts, move the connection from terminal 1 to terminal 2.) The dashed line between chassis ground and the binding post indicates an optional grounding feature.

Additional uses for the Volt Box include regulation of high-intensity lamps, a.c. meter calibration, d.c. meter calibration when the power supply input is



With the variable transformer connected as shown, a maximum output of 240 volts a.c. can be obtained.

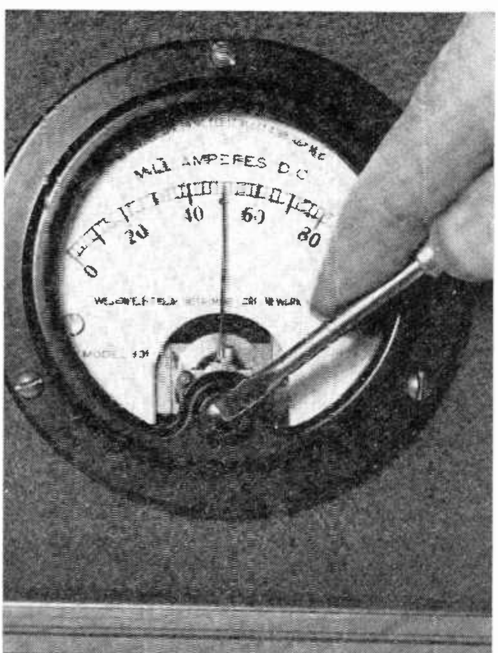


Note how the Variac is mounted in the center of the enclosure with input components on one end, output on the other. This is bottom view of chassis.

regulated, insulation testing, TV picture tube temporary brightener, and vacuum-tube "burn-in" procedures. In fact, in any application where an a.c. power supply up to the maximum voltage available is required, the Volt Box can be used. -30-

IMPROVING MILLIAMMETER ACCURACY

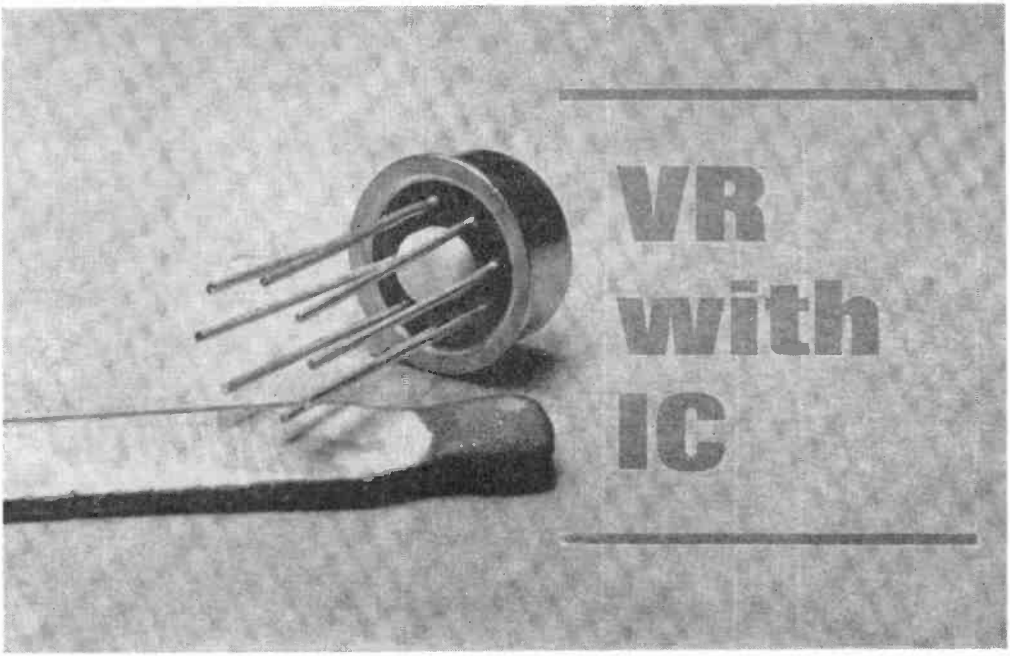
BY JACK SMALL



IN MANY CASES, a milliammeter is used in an application where only a small segment of its range is of importance. One such application is current monitoring in critical and semi-critical circuits. Here, only one specific reading is of any real importance; any deflection above or below that point indicates trouble.

The accuracy of the meter employed in such an application can usually be improved by comparing its reading in use against that of an instrument of known accuracy. If the two readings do not agree, simply adjust the milliammeter's mechanical zeroing screw (see photo) until both meters indicate the same value.

Of course, an adjustment of this kind generally makes the milliammeter even more inaccurate over other portions of its scale and will likely disturb its zero setting. But since only one deflection indication is of any real importance, no harm is done. -30-



PRECISE REGULATION IN A TO-5 PACKAGE

BY TOM THORKELSON

THE WIDESPREAD popularity of the integrated circuit has brought to light the urgent need for an inexpensive regulated d.c. power supply that can be safely used for IC experimentation. Working on the assumption that most experimenters already have an unregulated power supply on their benches, the problem was to design an inexpensive accessory that could upgrade the common power supply to provide lab features.

Now, for less than $5, such an accessory is obtainable in the form of the NJS300 voltage regulator available from New Jersey Semiconductor Products, Inc., Blue Star Shopping Center, U.S. Highway 22, Watchung, N.J. 07060.

This new voltage regulator IC employs 12 transistors, eight resistors, and three diodes—two of which are zeners—all contained in a compact TO-5 eight-lead package. The NJS300 accepts unregulated d.c. inputs ranging from +8 to +30 volts, and delivers any regulated d.c. output voltage between +2 and +20 volts.

When connected to the output of an unregulated power supply, voltage regulation is 0.5% for load changes and 0.1% for a 1-volt change in input. The input-output voltage differential ranges from 3 volts minimum to 20 volts maximum. Additionally, the voltage regulator gives short-circuit protection, fast action regulation, choice of output voltages, and low idle drain.

With the addition of external components, you can build a power supply to deliver almost any regulated current. The short circuit protection simply shuts down the power supply when the output terminals are shorted together; removing the short restores the voltage to its former value.

How to Use. The voltage regulator's pin designations are shown in Fig. 1. You can leave pin 1 unconnected for standard regulator operation, or connect a resistor between pins 1 and 8 to provide current limiting. The resistor value can be determined from the relationship $R = 0.350/I$, where I is the desired current limit in amperes. For example, if you want to limit the current to 10 mA

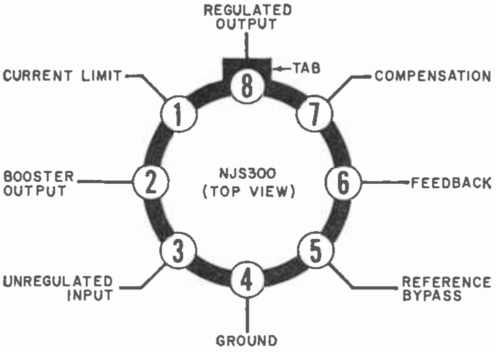


Fig. 1. Voltage-regulator pin arrangement. Components are added to provide for various load types.

(0.01 ampere) the resistance needed is 0.350/0.01 or 35 ohms.

If you want to use the regulator for output currents not in excess of 12 mA, connect pin 2 to pin 3. For output currents exceeding 12 mA, other external components (to be given later) are needed.

The unregulated input voltage is applied to pin 3 and must never exceed 30 volts. An input below 8 volts cannot be properly regulated, though it is possible to get a regulated 2-volt output with the unregulated 8-volt input. In any case, the unregulated input must be at least 3 volts greater than the desired output.

Pin 4 is normally connected to the circuit ground. Do not make any connection to pin 5.

A portion of the regulated output is applied to pin 6 as feedback. The amount of feedback used depends on the output desired. Two resistors are used as a voltage divider to obtain a portion of the output for the feedback. The ohmic values of these two resistors are determined from the curves in Fig. 2. For example, assume that a 4-volt regulated output is desired. The values of *R1* and *R2* (see How It Works) are found to be 5000 and 4000 ohms respectively.

A 47-pF capacitor should be connected between pins 6 and 7 for all applications to improve compensation response time.

Applications. Three different current-limiting circuits, suitable for a variety of

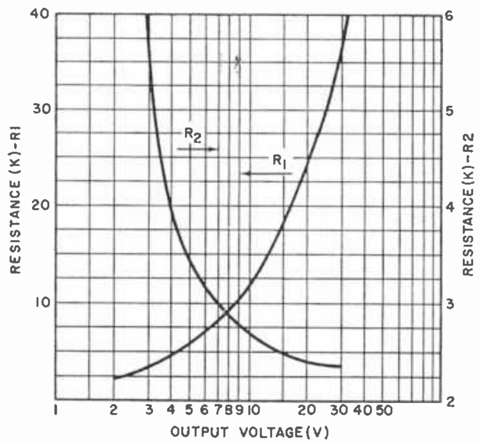
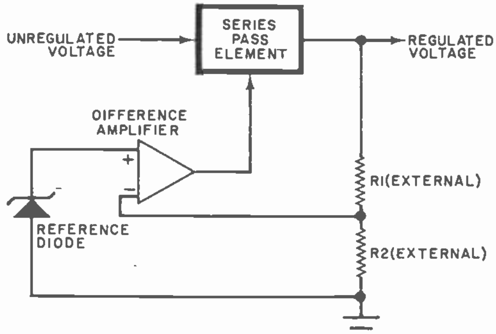


Fig. 2. Resistance values (in kilohms) for R1 and R2 in feedback circuit versus desired output volts.

HOW IT WORKS

The NJS300 voltage regulator consists of 12 transistors, 8 resistors, and 3 diodes, all deposited and interconnected on a single silicon chip $\frac{1}{16}$" square. These 23 elements make up a feedback control system as shown in the diagram.

The unregulated d.c. input is applied to a series-pass element that is controlled by an error voltage from a difference amplifier. The error is determined in the amplifier by comparing a portion of the regulated output voltage with the voltage across a precise voltage reference diode. (The sample of regulated output is taken from an external voltage divider consisting of resistors R1 and R2.) If the regulated output voltage is not correct, the error voltage developed by the difference amplifier causes the series-pass element to adjust the output until it returns to the predetermined value.



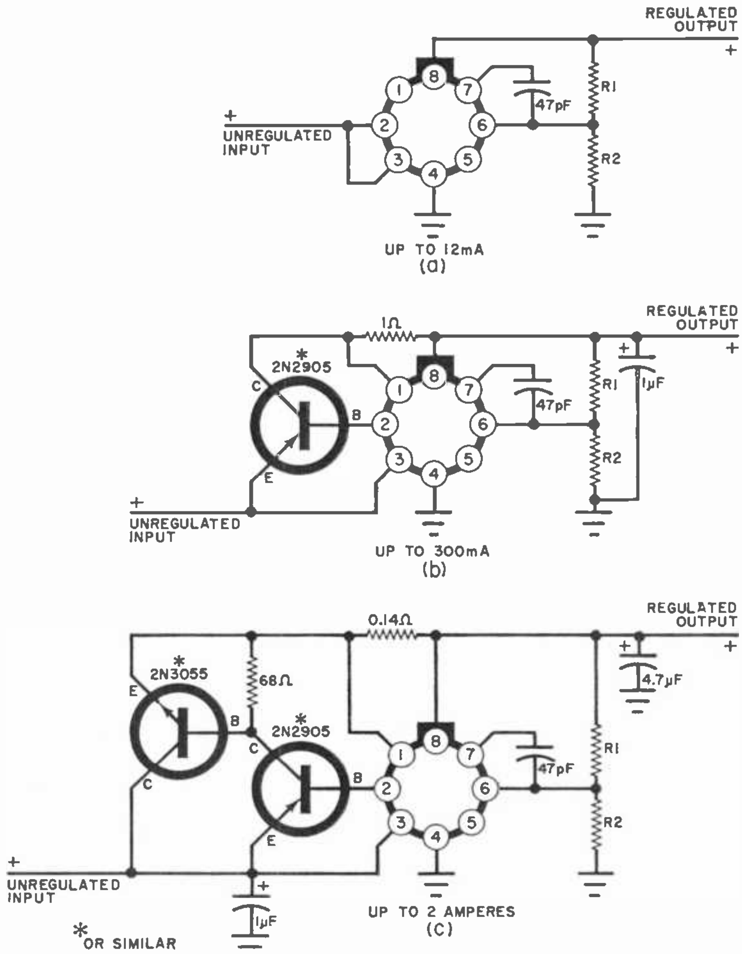
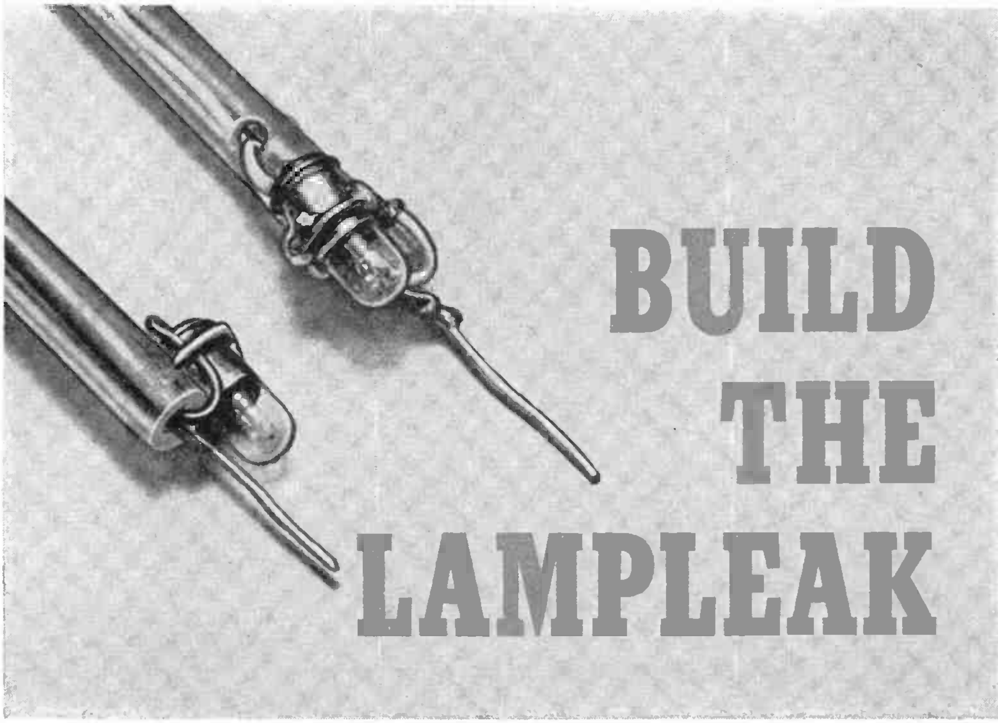


Fig. 3. Circuit at (a) provides a regulated output under 12 mA. Booster transistor is added in circuit (b) for output to 300 mA with smoothing capacitor. Second transistor (c) provides up to 2 A.

experimenters' power supplies are shown in Fig. 3. In Fig. 3(a), the current-limiting resistor between pins 1 and 8 is omitted because the current output demand should not exceed 12 mA. (A resistor could be added, of course, if a lower current limit is desired.) A transistor and resistor have been added in Fig. 3(b) to provide output current up to 300 mA. In Fig. 3(c), a pair of transistors is used to provide an output up to 2 amperes. In the second and third circuits, solid-tantalum filter capacitors have been added to improve smoothing. Also, in these two cases, the current-limiting resistors have been determined for the approximate maximum current value. If a lower current limit is required, the resistor value should be changed accordingly. -30-



BUILD THE LAMPLEAK

FOOLPROOF TESTER CHECKS TRANSISTORS AND DIODES

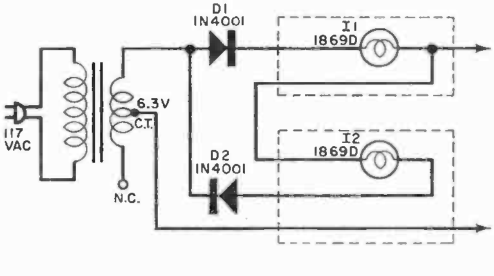
BY IMRE GORGENYI

When you want to test a semiconductor, in or out of a circuit, you usually have two options: use a semiconductor test set (which you probably don't have) or an ohmmeter. The trouble with using an ohmmeter is that you might "pop" the transistor due to excessive current flow through the junction. Besides, you can never remember which lead goes where in order to identify transistor types.

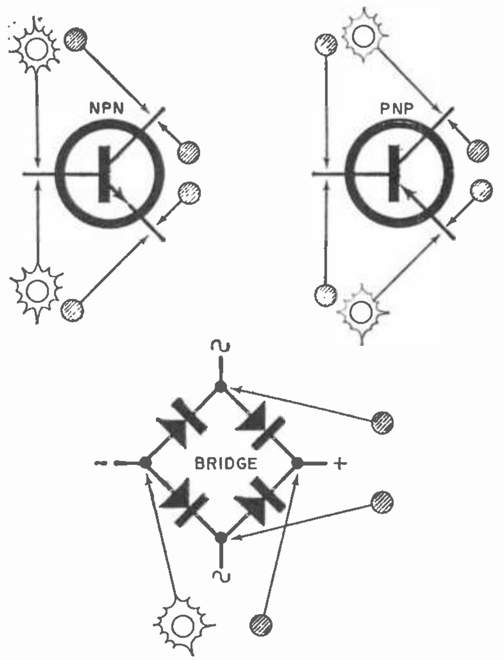
Now, at very low cost, you can build the "Lampleak", a perfectly safe semiconductor test set that can be used with any type of diode or transistor without fear of getting the polarities wrong, or destroying the device due to excessive current flow. This tester does not tell the "quality" of the semiconductor—only whether or not it works.

The circuit consists of half of the secondary of a 6.3-volt filament transformer connected in series (through the probe tips) with a parallel circuit of two low-current pilot lamps and two diodes. If the two probe tips are connected directly together, both lamps glow at a very low level, due to the low current flow through them. This current is not enough to damage any transistor or diode connected to the probes.

The circuit is arranged so that, if the probe tips are connected across a diode, regardless of which tip is connected to which end of the diode, only the lamp associated with the probe on the anode



The lamps are connected so that, with equal potential on both probes, both lamps glow very dimly.

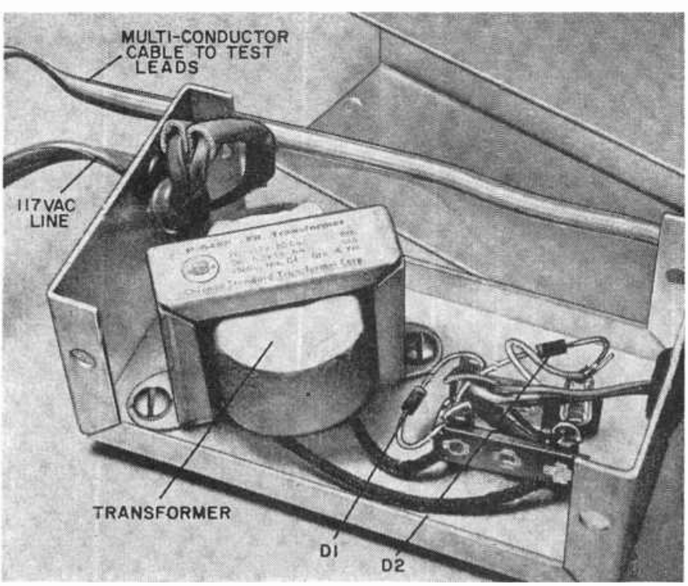


To check a transistor for type, connect probes as in two diagrams at top. If unit is npn, the lamp connected to the base will glow; if it is pnp, the lamp connected to either emitter or collector will glow. In a bridge rectifier, the lamp connected to the low side of d.c. glows.

glows, indicating a good diode. If neither lamp glows or if both lamps glow, the diode is bad.

Since transistors are similar to two back-to-back diodes, the sex of the unknown transistor can be determined easily. Merely connect one probe to the base lead, the other to either the emitter or collector. If the base lamp glows, the transistor is *npn*, if the lamp connected to the emitter or collector glows, the transistor is *pnp*. In a good transistor, of either type, connecting the probes between the emitter and collector should cause neither lamp to glow. If they do, leakage of less than 500 ohms is present. These tests, along with a test for a conventional bridge rectifier, are also shown in the illustration.

The author mounted the filament transformer and the two rectifier diodes in a small enclosure. The shells from a pair of ball-point pens were used as insulated probes. A hole, sufficient to accommodate the base of the pilot lamp, was drilled near the working end of each probe. The lamp wiring was fished through the probe and soldered directly to the bulb. Although the author used General Electric 1869D lamps, any similar type of low-current, 10-to-28-volt lamp can be used. The diodes can be any silicon rectifier type. —30—



The transformer is mounted directly on the chassis with its secondary connected to the diodes mounted on terminal strip.

27 ON THE CITIZENS BAND

By MATT P. SPINELLO, KHC2060, CB Editor

WHAT'S CB?

AFTER 48 out of 50 people, when asked what they know about CB, say they never heard of it, the questioner realizes that he really is a foreigner. That was the case when your CB Editor spent nearly a month visiting London and Reading, England; Paris and Versailles, France; Frankfort, Stuttgart, Boeblingen, and Fussen, Germany; portions of Austria; and Zurich, Switzerland.

Federal Communications Commission officials warned us before we left that, although getting a portable CB transceiver into Europe might present no problem, getting it back into the U.S. might be more difficult. So we left the rig at home (A wise move since we had plenty of trouble getting our battery-operated cassette recorder back in—the Customs officer could see plainly that it was "made in Austria"!)

Our main interest was to monitor the 11-meter band to determine the extent of skip conditions and to see how various Europeans might be using the band. The first thing we found out was that CB is against the law in most of Europe.

Sp/4 Paul Sojka, stationed in Europe, but by now on his way home to Perth Amboy, N.J., gave us a U.S. Army bulletin, issued April 15, 1968, entitled "Unauthorized Operation of Citizens Band (CB) Radio Equipment" in the European Command area. It states that the frequency band 26,960 kHz to 27,280 kHz is allocated by the countries concerned to uses in the areas of public safety, law and order, commerce, trades and sports clubs. "Use of the band for individual personal communications known as 'Citizens Band' operation is not authorized." The prohibition includes every type of radio equipment capable of radiating a radio signal in the band, regardless of power, including home installations, walkie-talkie type portables, and "toy" radios capable of emitting a signal.

Although operation of CB equipment is not authorized in the European theater, it is available for purchase in exchanges, audio clubs and other sales outlets. The operation of such equipment purchased must be deferred, however, until the purchaser returns to the U.S. Personnel operating CB gear within the Command obviously render themselves liable to prosecution by the civil authorities of the country concerned, including confiscation of the equipment, fines, and other punitive action.

Getting the Facts. In England, six electronics sales engineers pleaded guilty to having no prior knowledge of the CB concept; a seventh had a storehouse of knowledge about CB clubs, their functions, CB jamborees, and emergency team activities. He quoted many of the statistics from our U.S. Monitour—he is a POPULAR ELECTRONICS subscriber!

Ten German electronics engineers in Sindelfingen, Germany, shook their heads in unison when asked about personal communications: "no CB, no Citizens Radio, no Citizens Band." They had never heard of it! Walkie-talkies they had heard of, but the ones they knew were khaki in color and were used only by a helmeted soldier—like TV. "We are not allowed personal two-way radio," Hans Deiter Schmidt told us. "Those frequencies are reserved for governmental use!" He was right, at least in Germany.

Despite the laws, Rotterdam, Holland readers supplied us with a shocker when they told us that their CB club has had at least 300 contacts with U.S. CB'ers—all confirmed by QSL's. The club secretary admits that the members' callsigns (nearly 400) are made up by the club and that they also use "skip-names." The secretary's code name is "Batman."

The Holland CB Club sports its own newsletter and printed stationery, to boot. Members say they have recently contacted U.S. stations such as "Wild Cat," "Red Robin," "Dean Walker," and several untallied ones in Tennessee. We appreciate their choice of POPULAR ELECTRONICS as their "most popular paper outside Holland," but we frown on their admittedly illegal operating tactics—in which they are sticking out their necks farther than their antennas!

More Ports Abroad. Sp/4 Bill Wilhelm, currently serving a hitch in Vietnam, returns to the U.S. for a 30-day leave about the time this column goes to press. Formerly active as KBQ7415 in Tampa, Fla., Bill is interested in receiving word from other CB'ers active in the H.E.L.P. program. Parties interested in corresponding with him during his brief leave and again after another six-month hitch in Vietnam may contact him at 3210 W. Minnehaha, Tampa, Fla. 33614.

Murray Bott, 46 Arundel St., Hillsborough, Auckland 4, New Zealand, reports that he and several other New Zealanders are interested in learning more about the American Citizens Band operation.

Attention Fox-Charlie-Charlie. Trouble spots reporting illegal CB operation include *Norwalk, Conn.,* where unsolicited comments, some of them nasty and profane, are said to be cutting in on legal communications . . . *Metairie, La.,* linears in use; code names: "Gator," "Bones," "Slick Foot," "Louisiana Anna," and "Toad Frog." . . . *Pittsburgh, Penn.,* "The Crusher," reported to be a skinny beatnik, has everyone believing he is a tough guy; "The Whisper," who reportedly drives around in an expensive, beefed-up car, makes filthy remarks on the air; informants say "reliable source indicates violators are tipped off when FCC is coming to town, and lay low until the all-clear is sounded." . . . *Grand Rapids, Mich.,* short-wave listener suspects "bootlegged" transmitter operating far above 5 watts; on-air interchange exceeding 35 minutes; illegal operators using the names like "Tweety Bird," "Old Fox," "Redstick," "Flying Irishman"; skip from New Brunswick, Louisiana, Alabama, and North Carolina, working Michigan.

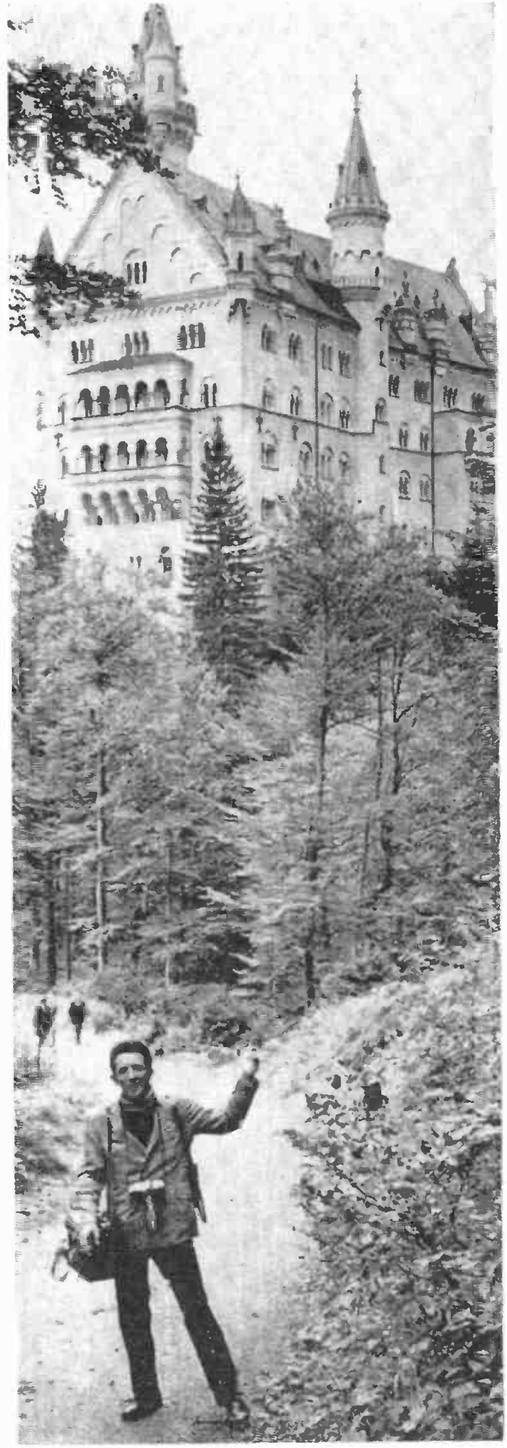
Our answer to the situations noted above can be summed up by the Electronics Industries Association, Citizens Radio Service Section, Washington, D.C., in its current message to Citizens Radio Operators:

"ANY NUT CAN BREAK THE LAW—but it takes a *man* to respect the rights of others. And in the citizens radio service, that's what 'the law' is all about, of course—simple, common-sense rules to help insure *the right of all to communicate.*

"Maybe most of the real problems are created by that small 'obnoxious minority,' but aren't all of us a little too windy at times? A little too quick to make that next call? A little too willing to work that beautiful skip signal 'just this once'?

"Let's *all* come out of our shells and

(*Continued on page* 116)



CB Editor Spinello, complete with tape recorder and cameras, stands near the back door to the Royal Castle, Neuschwanstein, in Fussen, Germany. The castle in Disneyland is said to be a model of it.

SOLID STATE

By LOU GARNER, Semiconductor Editor

EVERYONE HAS HIS "moment of truth"—ours comes in January when we examine our predictions for the previous year. Here were our predictions for 1968—and how we scored on them:

● *IC's and SCR's in toys.* Home run! Montgomery Ward introduced an IC project kit in the toy section of its 1968 Christmas catalog; REMCO, a major toy manufacturer, offered remote control toys using SCR circuits.

● *High-power FET's.* Home run! Although a majority of currently available FET's have maximum power dissipation ratings of only a few hundred milliwatts, the 2N3970-72, 2N4091-93, and 2N5018-19 types are all rated at 1.8 watts, while the CP600-603 series has ratings up to 9 watts, and the CP 650-653 series carries 8-watt ratings.

● *A portable solid-state color TV receiver.* Not a hit, but score a base on balls. While we find no listing of a fully transistorized portable color-TV set in available catalogs, a number of receivers employ hybrid (part tube, part transistor) circuitry. One semi-portable receiver, for example, has forty-six semiconductor devices and only eleven tubes.

● *Development of a new type of semiconductor transducer.* Home run! Refer to our mention of an infrared-to-visible-light converter in March, to our discussion of the *Pitran* pressure transducer in November, and, finally, to our description of a new ultraviolet sensor in December, 1968.

● *A solid-state video recorder at a price competitive with high-quality audio tape recorders.* Home run! A studio-quality tape recorder may sell for well over $1,000 while top-quality professional units, such as the Tandberg Model 64X, sell for over $500. In contrast, the Sony Model CT-2100 Videocorder is offered in Allied Radio's current catalog for only $795.

● *A.C. control devices with integral-triggering elements.* Home run! See our February, 1968 column for a practical circuit using RCA's model 40431 triac, a medium-power, bi-directional control device with an integral trigger component.

● *An inexpensive solid-state oscilloscope kit.* Strike-out! Optimistic, we felt sure someone (anyone?) would introduce such a kit, but apparently our enthusiasm wasn't shared by industry.

● *A drop in the cost of medium- to high-power high-frequency transistors, making them generally competitive with tubes for ham and communications applications.* Home run! Motorola's 2N3866, with 5 watts power dissipation and an f_T of 800 MHz, nets for less than $3 each in small quantities, while RCA's 2N2631, which can handle 7.5 watts at 50 MHz, now nets for under $4.

● *Introduction of project kits featuring IC's as their main circuit elements.* Home run! Lafayette Radio's latest catalog features several such kits, including RCA's popular KD-2112, described in "The Product Gallery" in our April, 1968 issue.

● *IC's featuring FET's.* Home run! As reported in our April, 1968 column, a major test instrument manufacturer, Tektronix, has been successful in combining 5 *p*-channel FET's and 30 *npn* bipolar transistors on a single IC chip.

● *Development of a radically new type of semiconductor manufacturing process.* Home run! Several new manufacturing methods were announced during 1968, including Bell Telephone Laboratories' new technique for producing ultra-dense IC's, as described in our September, 1968 column.

So, we scored 9 home runs, 1 base on balls, 1 strike-out in eleven times at bat.

Things to Come. Now—like a fool rushing in where angels fear to tread—here are our predictions for 1969. *Development of an r.f. power transistor capable of handling well over 100 watts* . . . a solid-state oscilloscope (either kit or factory-built) for approximately $100 . . . *IC's at over-the-counter prices of $1 (or less) each* . . . another major firm introducing a line of experimenter/hobbyist semiconductor devices . . . *expanded use of solid-state equipment in the war against crime, including the use of radios by foot patrol officers* . . . lower prices for semiconductor lasers, making them suitable for some experimenter applications . . . *higher manufacturing efficiencies, resulting in lower prices for FET's as well as high-*

voltage diodes and bipolar transistors . . . development of new microwave semiconductor devices which can challenge even the more exotic vacuum tubes.

Transitips. With literally thousands of transistor types now offered by semiconductor manufacturers, one is likely to forget that there are a number of basic characteristics which are common to each class of device, regardless of individual specifications. A bipolar transistor, for example, has a relatively low-to-moderate input impedance (in the common-base configuration) when compared to either vacuum tubes or field-effect transistors (FET's), no matter what its voltage rating, frequency response, gain, or power dissipation. Similarly, an insulated-gate FET (IGFET or MOSFET) has the highest input impedance of *any* amplifying device.

Intended as a general guide for students, hobbyists, experimenters, technicians, designers and practical engineers, the table below compares the characteristics of vacuum tubes, small-signal and high-power bipolar transistors, and junction and insulated-gate FET's. In each case, the characteristics listed are those encountered in the most common circuit configuration.

Reader's Circuit. In a broad sense, heat is the natural "enemy" of electronic components. Prolonged moderately high temperatures can cause electrolytics to dry out and lose capacitance (or even short), insulation to become brittle and break down, coil impregnants to melt, etc., etc. Excessively high temperatures, even for short periods, may cause permanent changes in semi-conductor device characteristics. Recognizing these facts, reader Bruce J. LaVaia (67-25 FT "A" School, SCC NTC, Bainbridge, Md. 21905) devised the solid-state temperature-sensing and control circuit illustrated in Fig. 1. Bruce writes that he has installed such a circuit in his personal hi-fi equipment and suggests its use not only in audio amplifiers, but in TV sets, communications receivers, medium-power transmitters, and other types of electronic equipment.

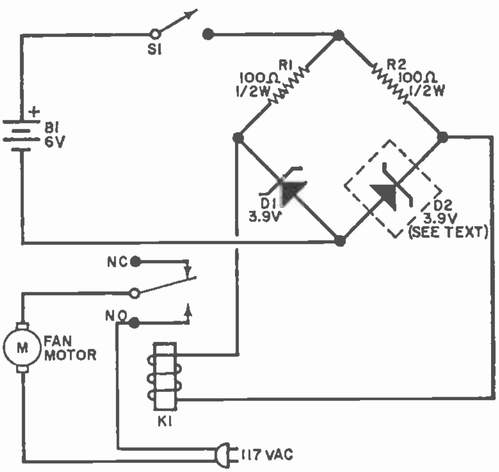


Fig. 1. Zener diode, D2, in electronic equipment, senses heat, unbalances bridge and turns on fan.

Referring to the schematic, fixed resistors *R1* and *R2* form a temperature-sensing bridge network in conjunction with zener diodes *Z1* and *Z2*, with the latter mounted within the critical (high-temperature) area. Bridge power is furnished by *B1*, controlled by *S1*. In operation, a rise in *Z2*'s temperature results in a corresponding shift of its conduction characteristics, unbalancing the bridge, and furnishing coil power to relay *K1*, which closes, operating a ventilation

(*Continued on page* 99)

COMPARATIVE CHARACTERISTICS OF ACTIVE DEVICES

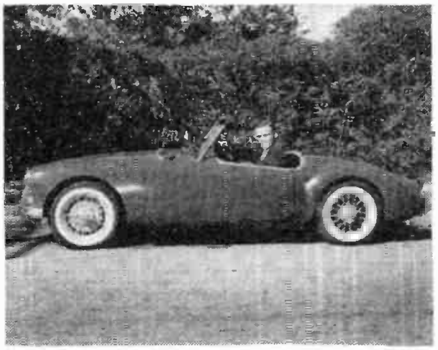
CHARACTERISTIC	VACUUM TUBE	SMALL-SIGNAL TRANSISTOR	HIGH-POWER TRANSISTOR	JUNCTION FET	MOSFET
Input impedance	High	*	Very low	High	Very high
Output impedance	High	*	Low/moderate	High	High
Noise	Low	Low	Moderate	Low	Unpredictable
Warm-up time	Long	Short	Short	Short	Short
Power consumption	Large	Small	Moderate	Very Small	Very small
Aging	Appreciable	Low	Low	Low	Moderate
Reliability	Poor	Excellent	Very good	Excellent	Very good
Overload sensitivity	Excellent	Good	Fair	Good	Poor
Size	Large	Small	Moderate	Small	Small

*Impedances depend on circuit arrangement:

	Input Impedance	Output impedance
For common base	Low (10's of ohms)	High (megohms)
For common emitter	Medium (kilohms)	Medium (10's of kilohms)
For common collector	High (100's of kilohms)	Low (100's of ohms)

6 good reasons to get into electronics:

1



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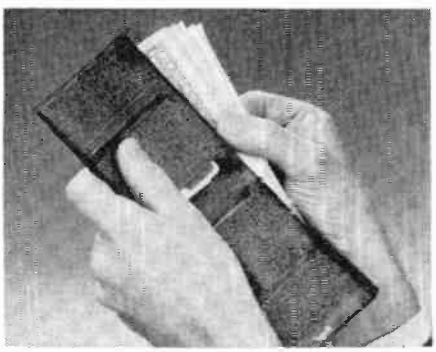

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ENGLISH-LANGUAGE BROADCASTS TO NORTH AMERICA FOR THE MONTH OF JANUARY

Prepared by ROGER LEGGE

TO EASTERN AND CENTRAL NORTH AMERICA

TIME—EST	STATION AND LOCATION	FREQUENCIES (MHz)
7:00 a.m.	Melbourne, Australia	9.58, 11.71
7:15 a.m.	Montreal, Canada	9.625, 11.72
7:45 a.m.	Copenhagen, Denmark	15.165
9:00 a.m.	Stockholm, Sweden	21.675
4:00 p.m.	Hilversum, Holland	9.715, 11.73
6:00 p.m.	Montreal, Canada	9.625, 11.725, 15.19
7:00 p.m.	Peking, China	17.675, 17.855
	Sofia, Bulgaria	9.70
7:30 p.m.	Budapest, Hungary	6.235, 9.833, 11.91
	Johannesburg, South Africa	9.705, 11.875, 15.22
	Stockholm, Sweden	5.99
7:50 p.m.	Brussels, Belgium	6.125
	Vatican City	6.145, 9.69, 11.895
8:00 p.m.	Berlin, Germany	9.50, 9.73
	London, England	6.11, 9.58
	Moscow, U.S.S.R.	7.15, 7.205, 9.685
	Prague, Czechoslovakia	5.93, 7.345, 9.63
	Rome, Italy	6.01, 9.575
8:30 p.m.	Berne, Switzerland	6.12, 9.535, 11.715
	Bucharest, Rumania	6.195, 9.51, 11.94
	Cologne, Germany	6.185, 9.64
	Hilversum, Holland	6.085, 9.59
	Tirana, Albania	6.20, 7.30, 9.50
9:00 p.m.	Havana, Cuba	9.525, 15.285
	Lisbon, Portugal	6.025, 9.68, 11.935
	Madrid, Spain	6.13, 9.76
	Peking, China	15.06, 17.715, 17.90
	Quito, Ecuador	9.745, 11.915, 15.115
9:30 p.m.	Bonaire, Neth. Antilles	9.695
	Johannesburg, South Africa	9.705, 11.875, 15.22
10:00 p.m.	Budapest, Hungary	6.235, 9.833, 11.91
	London, England	6.11, 9.58
	Moscow, U.S.S.R.	7.15, 9.665, 9.685
10:30 p.m.	Prague, Czechoslovakia	5.93, 7.345, 9.63

TO WESTERN NORTH AMERICA

TIME—PST	STATION AND LOCATION	FREQUENCIES (MHz)
8:00 a.m.	Oslo, Norway (Sun.)	17.825, 21.655
	Stockholm, Sweden	15.31
	Tokyo, Japan	9.505
5:00 p.m.	Melbourne, Australia	15.32, 17.84, 21.74
6:00 p.m.	Lisbon, Portugal	6.025, 9.68, 11.935
	Tokyo, Japan	15.235, 17.825, 21.74
6:30 p.m.	Johannesburg, South Africa	9.705, 11.875, 15.22
7:00 p.m.	Budapest, Hungary	6.235, 9.833, 11.91
	London, England	6.11, 9.58
	Madrid, Spain	6.13, 9.76
	Peking, China	15.095, 17.675, 17.795
	Quito, Ecuador	9.745, 11.915, 15.115
	Seoul, Korea	15.43
	Taipei, Taiwan	15.345, 17.72, 17.78
7:30 p.m.	Berlin, Germany	6.08, 9.65, 9.73
	Bonaire, Neth. Antilles	9.695
	Prague, Czechoslovakia	5.93, 7.345, 9.63
	Stockholm, Sweden	11.705
	Tirana, Albania	6.20, 7.30
8:00 p.m.	Havana, Cuba	9.525, 15.285
	Lisbon, Portugal	6.025, 9.68, 11.935
	Moscow, U.S.S.R. (via Khabarovsk)	9.54, 11.755, 15.18
	Peking, China	15.095, 17.675, 17.795
	Sofia, Bulgaria	9.70
	Tokyo, Japan	15.105
8:30 p.m.	Bucharest, Rumania	6.195, 9.51, 11.94
	Budapest, Hungary	6.235, 9.833, 11.91
8:45 p.m.	Berne, Switzerland	6.12, 9.72
	Cologne, Germany	6.145, 9.545
9:00 p.m.	Havana, Cuba	9.525, 11.76
10:00 p.m.	Moscow, U.S.S.R. (via Khabarovsk)	9.54, 9.735, 11.755
	Tokyo, Japan	9.505
10:30 p.m.	Havana, Cuba	9.655

SHORT-WAVE LISTENING

By HANK BENNETT, W2PNA/WPE2FT
Short-Wave Editor

THE POWER RACE CONTINUES

WITH THE PASSAGE of time, more and more short-wave stations (and medium-wave stations, too) are turning to transmitters of super power ratings to make themselves heard through the maze of same- and co-channel interference. Not too long ago a short-wave station with a power output of 50 kW was really something!

A good example of a really small station entering into the high-power race is *Radio Barlavento,* Cape Verde Islands. Currently operating on 3910 kHz with a mere 1000 watts, the station has ordered a new transmitter with a power rating of 100 kW!

The *Voice of America,* with super stations of 1000 kW (that's one million watts), located on Okinawa on 1178 kHz and in the Philippines on 1140 kHz, has added another unit with the same power rating at Bangkok, Thailand (1580 kHz). It's not positively confirmed, but *Radio Kuwait* is said to be using 750 kW on 539 kHz, Saudi Arabia has a huge station reportedly operating with 2000 kW on 647 kHz and the largest broadcaster may be in Urumchi, China, used by *Radio Peking* for Russian service to Europe on 1525 kHz. It is listed by some sources at no less than 8000 kW!

News Items. *Radio Nederland* has announced that it will repeat its two previous radio courses: Short-Wave Propagation and Transistors. You can still enroll in its All-Around DX'ers course also. Mail separate requests to (name of course), DX Juke Box, *Radio Nederland,* P.O. Box 222, Hilversum, Holland.

According to a statement made by Wieslaw Groszecki, new editor-in-chief of the German section of the Polish Radio, and which was published by Deutsch Volkdzeitung, the German broadcasts from Warsaw have been increased from two and one-half to four hours a day. A new pop show will be broadcast daily at 1900, and a new Polish-language course will be offered. Complete details and booklets may be obtained at no charge by writing to *Radio Warsaw,* Warsaw, Poland.

Operations in the 11-meter band continue in spite of slowly lowering sunspot activity. Monitors in the past month have logged the following: London on 25,650 kHz at 1447-1515 with "Radio Newsreel"; *Radio RSA,* Johannesburg, South Africa, 25,790 kHz, from 1745 with English news; Oslo, Norway, on 25,900 kHz at 1755-1826 and on 25,730 kHz from 1615-1631, both with Norwegian programming but an English ID on the hour or half-hour.

Radio Euzkadi, a clandestine Basque station, often rumored to be in various parts of Europe as well as in South America, has a mailing address (as we gave it last October) of B.P. 59, Poste Centrale, 75-Paris (16), France. This is correct. Thinking at that time was that the station was located near the west coast of Europe or near the Spanish-French border. For what it's worth, and this may be the missing clue, a recent QSL, received in three weeks, was postmarked from St. Jean de Luz in the French Basque province of Basses Pyrenees. This indicates that the station is using a high-powered fixed installation rather than a mobile unit.

Birthday greetings are in order, belatedly, to *Radio New Zealand,* which celebrated its

Javad Masbahi, of Shiraz, Iran, uses a Hammarlund HQ-150 receiver and has a Hallicrafters S-38 for a standby. As a licensed radio amateur, callsign EP2DM, he has worked in excess of 100 countries with his 50-watt transmitter and a dipole antenna.

20th anniversary in September, and to the International Short Wave Club of England on its 40th anniversary last October 4th. Little known among SWL's is the fact that the ISWC was founded in 1929 right here in the USA. We wish both many pleasant years of further activity.

Radio Zaracay, Santo Domingo de los Colorados, Ecuador, often good on 3390 kHz between 0400-0500 with musical programming, is having building fever. Currently underway are four transmitters, each 3500 watts (two for short-wave but no frequencies given), two emergency power plants, a four-story studio and office building, a 5000-seat auditorium, and a vacation villa at San Jacinto de Manabi Beach for the benefit of vacationing station personnel.

New newsroom of Radio New York Worldwide, Inc. at 485 Madison Ave., New York City, is large enough to accommodate 20 journalists and has five United Press lines, one Associated Press, Reuters and United Nations lines. The company operates WNYW, the only international commercial radio station in the United States, and FM stereo station WRFM-New York.

We urge all of our readers to check the newsstands for the new 1969 COMMUNICATIONS HANDBOOK. Among other features it contains a completely revised and updated combined country and zone listing to be used in conjunction with the new All Zones Awards. The ground rules for the new Zones Awards were given in our October column and may also be found in the new Handbook. Please note that the new Country-Zone listing will be the only official listing accepted for the POPULAR ELECTRONICS DX Award Program.

CURRENT STATION REPORTS

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

Albania—Tirana's latest English schedule calls for xmsns of one half-hour at 0030 and 0130 on 6200 and 7300 kHz and 0300 on 9510 kHz. The IS is 9 notes on two trumpets in a minor key. Other loggings include one in Albanian on 9665 kHz until 0230 s/off; in Spanish on 11,860 kHz at 1725 and in Portuguese on the same channel from 2130 s/on; on 7135 kHz in Arabic at 0330-0400 and from 0430; jamming noted before 0330 and from 0400-0430.

Austria—The latest schedule from *Austrian Radio* reads: to N. A. in English on even dates at 0000-0400 on 6155 kHz and 2300-0000 on 9770 kHz and on odd dates at the same times but with the frequencies reversed. Dates are based on GMT.

Belgium—"Belgium Speaking" in English is broadcast as a part of the xmsns for Belgians abroad in French and Flemish. These xmsns are scheduled at 2205-2215 on 6010, 9615 and 15,335 kHz and at 0050-0100 on 6010, 6125 and 11,885 kHz. A mailbag is aired Thursday. These English segments will be longer in the future.

Bolivia—*La Voz del Ferroviario,* Uyuni, 5990 kHz, verified an old report stating that they are off the air due to government intervention. No date for return. CP90, *R. Juan XXIII,* San Ignacio Velasco, 4951 kHz, verified after many attempts; it runs 1 kW with daily closing between 0300-0330.

British Honduras—*R. Belize,* Belize, 3300 kHz, continues to be widely reported from 0125-0435 s/off with mostly English programming. Your Editor often finds the medium-wave outlet on 834 kHz to have a better signal.

Congo (Dem. Rep.)—The frequency of 11,866 kHz is again in use with an English ID of "This is the Voice of the African Brotherhood" at 1900 and in French as "La Voix de la Fraternite Africaine". The ID is followed by pop music. Location is Lubumbashi.

Costa Rica—*R. Reloj,* San Jose, has effected another move as noted with an ID at 0210 in usual Spanish on 6067 kHz. American pop tunes follow. TIQ, *R. Casino,* Puerto Limon, 5954 kHz, has American gospel programs in English on Sunday at 0500-0600.

Czechoslovakia—Prague has English for 15 minutes after each hour during the 1800-2100 xmsn on 21,450, 11,990, 9600, 9505, 6055 and 5930 kHz. Other channels in use include 1286, 7345, 9575, 11,800, 15,310, 17,840, and 21,700 kHz for various xmsns in German, English, French and Italian. An unlisted channel in use at press time is 9762 kHz, noted at 2330-2358 s/off in Spanish to Latin America, as announced.

Ecuador—HCMP2, *La Voz de la Peninsula,* (location unknown) runs 350 watts on 4898 kHz but they expect to move "soon" to 3905 kHz. Best listening time is after 0300.

Ethiopia—ETLF, Addis Ababa, heard s/on at 0330 to E. Africa in Swahili on 9600 kHz and at 0430 s/on on 15,180 kHz. One veteran monitor claims that the xmsns around this time of night often provide far more consistent reception.

Formosa—The 0200 English release on 17,720 kHz is now beamed to Hong Kong, Macau, Australia and New Zealand, as well as to the US, Hawaii and Japan.

Gabon—*Radiodiffusion Gabonaise,* Libreville, was heard with native folk music and French anmts on a Saturday at 2235-2312 s/off on 4777 kHz.

Germany (East)—*R. Berlin International* is on 21,475 kHz with English until 1730 s/off and in French to Africa at 1815.

Guatemala—TGQB, *R. Nacional,* Quetzeltenango, has been found testing on 11,700 kHz around 2230 and earlier in English and Spanish and requesting reports on their new international service. TGCH, *R. Chortis,* Jocotan, 3380 kHz, is good as early as 0200 with US and Guatemalan music and commercials; news in Spanish at 0255-0300 s/off.

Holland—*R. Nederland,* Hilversum, has English to N.A. at 2055-2150 on 15,425 kHz (repl. 17,810

(Continued on page 104)

AMATEUR RADIO

By HERB S. BRIER, W9EGQ
Amateur Radio Editor

THE FCC WRITES LETTERS/TAKES ACTION

TO KEEP the record straight, our September, 1968 item that the FCC had decided that Technicians who had never held any other amateur licenses were eligible for Novice licenses was in accord with a Commission letter dated May 2, 1968. On September 20, 1968, Mr. James E. Barr, Chief, Safety and Special Services Bureau, informed your columnist that the May letter was in error; the Commission has never had any intention of issuing a Novice license to an already-licensed Technician.

As reported last month, the FCC has proposed that Section 97.9 (f) of the amateur regulations be modified to make any citizen who has not held an FCC-issued amateur license within the preceding 12 months eligible for a Novice license. However, paragraph 5 of this proposal (RM-1288) states: "No person would be permitted to hold Novice and Technician Class licenses concurrently."

In another letter (to Al Fisher, W6ZHH) printed in the *WCARSentinel*, Reno, Nevada, the FCC states that any amateur who originates or relays messages (including phone patches) into commercial establishments to buy, sell, or to enquire about prices or shipping information of radio gear either for himself or others is engaged in a prohibited remunerative operation and has a pecuniary interest in his license. The prohibition does not apply to an individual amateur who occasionally buys, sells, or swaps a piece of old radio equipment over the air, although the FCC does not encourage such transactions.

The FCC has recently taken action against several amateur operators for alleged violations of the Rules. Sam A. Johnson, Jr., WA4MVY, lost his Conditional class license for six months for malicious or willful interference with other amateurs. Five operators had their license suspended for six months or a year on various charges such as damaging the equipment of a licensed station, malicious or willful interference, and transmitting music: Joseph S. Renzi, WB6FNV; Brandon H. Sinay, WB6OFD; Michael S. Ingram, WB6RBR; Norman A. Scott, WB6TRQ; and William K. Ingram, WB6RBQ. Charges of willfully damaging

AMATEUR STATION OF THE MONTH

Proving that AM phone on low frequencies is not forgotten, Paul "Mike" Desharnais, WA1IPD, 22 Cote St., Somersworth, N. H. 03878, worked 28 states and 10 countries with his Johnson Valient transmitter and Hammarlund HQ-110C receiver—in six months on Sunday mornings! His antenna is a multi-bander fed with open-wire transmission line via a Johnson Match Box. As Amateur Station of the Month, WA1IPD gets a 1-year subscription to POPULAR ELECTRONICS. If you would like to enter this monthly contest, send a sharp, black-and-white photo of yourself at the controls of your station and details of your radio career to: Herb S. Brier, Amateur Radio Editor, POPULAR ELECTRONICS, P.O. Box 678, Gary, Ind. 46501.

the equipment of a licensed radio station brought against Damian A. Osterday, WB6RYE, have been withdrawn after he supplied evidence to prove that he was in the clear.

Incidently, from *Radio Communications* (London), we learn that half a dozen Englishmen were recently convicted of unlicensed amateur operation. They were assessed relatively heavy fines and court costs, and most of them had all or part of their equipment confiscated.

Tom Clancy, WA3GUI, Beltsville, Md., has worked all states and 64 countries. He has a Heathkit DX-60B transmitter, HR-10 receiver—aided by an AMECO preamp—and a trap dipole antenna. WA3GUI has an Advanced license and a 25-wpm certificate.

Eye-Bank Network in Operation. Via George, W6AEV, and the *WCARSentinel* comes the information that a 19-year-old "hippie" girl literally almost scratched her own eyes out while on a "pill trip." In an effort to save her sight, the Los Angeles Eye Bank initiated a request for fresh corneas for transplants to her eyes. The plea went out on the Eye Bank Network, which meets twice daily on 75-meter phone. The eye banks in New York, Baltimore, and Denver immediately air-shipped corneas to California for the transplant operations.

January Operating Events. January 4-5. ARRL VHF SS (Sweepstakes) Contest. Operate between 2:00 p.m., local time, Saturday, January 4, and midnight, January 5, on the amateur frequencies above 50 MHz. Work other amateurs in the different ARRL "sections," exchanging "message preambles" with each station worked. The same station may be worked once per band. Two points are earned for each complete contact; total score equals the sum of your contact points multiplied by the number of different sections worked. Rules and log sheets are available from: American Radio Relay League, Inc., 225 Main St., Newington, Conn. 06111.

Fourth Annual Louisiana QSO Party, 1800 GMT, Saturday, January 18, to 2200 GMT, Sunday, January 19. Suggested frequencies: 3.6, 3.91, 7.075, 7.26, 14.075, 14.3, 21. 075, 21.4, 28.1, and 28.7 MHz. Louisiana works the world, and the world works Louisiana. Each contact counts one point, and the same station may be worked on phone and CW segments of each band. Exchange contact numbers, signal reports, and names of state, province, country, and parish with each station worked. Louisiana stations multiply contact points by number of states, Canadian provinces, and other countries worked; outside stations multiply contact points by number of Louisiana parishes worked. The Louisiana winner will receive a trophy, and second and third placers will receive certificates. State, province, and country winners outside Louisiana will earn certificates. Send complete contest logs to Lafayette Amateur Radio Club, 123 Normandy Rd., Lafayette, La. 70501, before February 28. Include a stamped return envelope for a list of winners.

New Rules for Ragchewer's Club (RCC) Certificates. Any amateur who chats (rag chews) with a member of the RCC for a minimum of 30 minutes is eligible for membership in the RCC. Under previous rules, both the applicant and the RCC member sent the contact information to ARRL, who then issued the certificate. Under the new system, the RCC member sends his information to the RCC applicant who then forwards it with his request for membership in the Rag Chewers' Club to ARRL, 225 Main St., Newington, Conn. 06111.

Coil Winding Contest. *Break-In* (Christchurch, New Zealand) for August, 1968, re-

Using a Heathkit MS-301/SB-401 receiver/transmitter combination, Gary Buda, WAØNDN, Hopkins, Minn., works 10 to 80 meters with various antennas.

ports an interesting contest between members of Wellington branch of the NAZRT. Each member selected a coil form, length of wire, and a fixed capacitor of marked capacitance from boxes containing an assortment of these components and attempted to wind a coil that would resonate at 7000 kHz with the selected capacitor. The club supplied a 2-terminal oscillator (a grid-dip meter could also be used) and a calibrated receiver for measuring frequencies. The entry of ZL2WY resonated at 7100 kHz, and ZL2BD's at 7200 kHz; the remaining entries covered the spectrum from 1.5 to 13 MHz.

Twenty-five states have been worked by Bernard Skoch, WN5VPE, 1001 N. Gray St., Jacksonville, Ark. His equipment: a DX-20 transmitter, a Mosley GM-1 Receiver, and a Hy-Gain 18-V vertical antenna.

NEWS AND VIEWS

Bob Samson, WN7KOB, Rt. 2, Box 2314, Kennewick, Wash. 99336, learned about amateur radio through the POPULAR ELECTRONICS *Communications Handbook.* Using an EICO 720 transmitter and a borrowed ARC-5, war-surplus receiver on 40 meters, Bob has worked 13 states and three Canadian provinces. This record represents daytime effort because of receiver deficiencies. But Bob is saving his pennies for a receiver of his own so he can operate all bands when he obtains his General ticket—soon, he hopes . . . **Bill Corcoran, WA9UNR,** 4336 N. Mozart St., Chicago, Ill. 60618, went from Novice to Advanced in a year and says he can now copy code at 35 wpm. A Johnson Ranger transmitter, Knight-Kit T-50 transmitter, Heathkit Twoer transceiver, Hammarlund HQ-129X, and several pieces of homebrew gear are some of the equipment which Bill shares with his brother, Ray, WN9VVU. Aided by 40-, and 20-meter dipoles, Bill has worked 40 states and eight countries. He is a member of the QRP (low-power) club, the Rag Chewers' Club, ARRL "Intruder Watch," and the Chicago Amateur Radio Club. Contact him for details about the CARC's code and theory classes . . . Short and to the point, **David Axinn, WA3JAE,** 722 Wyndale Road, Jenkintown, Pa., would like to hear from anyone interested in forming a 75-meter teen-age net.

Steve Cabral, WN1JIE, 51 Brookings St., Medford, Mass. 02155, took two months after getting his license to get on the air. Then, using his EICO 720 transmitter, National NC-98 receiver, and Hy-Gain 18-V vertical antenna he quickly worked seven states, including Oregon and California. In the meantime, WN1JIE passed his General exam; at the time of writing, he was waiting for the new ticket to come. A new, homebrew, 10-meter beam and a new phone transmitter are ready and waiting for this happy event . . . **WN6ZXN** was the only Novice among the 457 making perfect copy of the 25-wpm Armed Forces Day (May 18) message from the Secretary of Defense. Five-hundred-sixty-seven perfect copies of the radioteletype version of the message were submitted, and 9048 "crossband" amateur-to-military contacts were made as part of the Armed Forces Day communications tests. If you worked WAR, NSS, NPG, or AIR during the test and did not receive a QSL card, you may request one from Armed Forces Day Contest, Room 5B960, The Pentagon, Washington, D.C. 20315. Include your call letters, the call of the military station worked, its frequency, and the time of the contact . . . **Bob Lauzon, WB2NSD,** 151 West Jefferson Rd., Pittsford, N.Y. 14534, our Amateur Station of the Month winner last March, verifies our statement that he was "studying like crazy" for his Extra class license by passing the exam in September.

All those QSL cards show the success of Mike Welch, WN1GTH, Williamstown, Mass., working DX with an EICO 720 transmitter and a Lafayette receiver.

Don Decaria, WA7GQD, 825 Adams St., Layton, Utah 84041, worked 35 states on 40 meters with a 15-watt transmitter as a Novice. As a General, using a Heathkit DX-100 running 100 watts to drive a vertical on 20 meters, Don worked 44 states and 20 countries. Just to keep his hand in, he passed the Advanced class exam and is waiting for two years to pass; so that he can take the Extra class exam. By the way, Don receives on a National NC-125 and will sked you on 20 meters, if you need Utah. Being Activities Manager for the Layton Amateur Radio Club, he can probably arrange a sked with another station, if you can't work "20." . . **Doug Pongrance, WA3JBN,** 316 Donnell Rd., Lower Burrell, Pa. 15068, closed out his Novice career with 40 states and six countries worked on the 80-, 40-, and 15-meter Novice bands. He used vertical antennas on 80 and 15 meters and a horizontal doublet on 40 meters, but a new Mosley TA-33, 10-, 15-, 20-meter beam awaits the arrival of his General ticket—he has already passed the test . . . Commenting on the efforts of various groups to simplify the U.S. Novice exam, **S. Erlichman,** Willowdale, Ontario, Canada, wishes that someone would simplify the Canadian amateur examinations. Their simplest exam includes a 10-WPM code test and a written/oral technical examination about equivalent to the U.S. General class written test. For what consolation it may be to Mr. Erlichman, neither the FCC nor the Canadian authorities seem disposed to simplify their amateur exams; but on a percentage basis, the number of Canadian amateurs is increasing slightly faster than the number of U.S. amateurs.

Will your "News and Views," picture, or comments appear in your column next month? Send your contributions, including club papers, to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P.O. Box 678, Gary, Ind. 46401.

73, Herb, W9EGQ.

SOLID STATE

(*Continued from page* 87)

fan. As *Z2* cools, bridge balance is restored, the relay opens, and the fan motor is turned off.

Bruce uses conventional components in his design; *R1* and *R2* are half-watt resistors, while *Z1* and *Z2* are low-to-medium wattage 3.9-volt zener diodes comparable to types 1N748 or 1N4730. The 6-volt relay is moderately sensitive, similar to P & B type RS5D. A special low-noise blower assembly is preferred for optimum performance (Model B-52HK, Alpha Components Corporation, 4087 Glencoe, Venice, Calif. 90291, for example).

With neither parts arrangement nor lead dress critical, the circuit may be assembled using any construction method—perf board, etched circuit, or point-to-point wiring. The basic circuit should be installed in an outboard case, but the temperature sensing zener (*Z2*) *must be mounted inside* the equipment that is to be protected, preferably near a "heat well" (a point at which heat tends to be high). The blower fan should be mounted on the equipment's cabinet or back cover and positioned so that its air stream is directed over the main heat producing components. Finally, relay sensitivity should be adjusted for best operation by *minor* adjustment of the armature spring.

Manufacturer's Circuit. With automobile thefts rising, the auto burglar alarm circuit in Fig. 2 should be of real interest to most car owners. Abstracted from "Economy Power Semiconductor Applications," a booklet published by GE's Semiconductor Products Department, the circuit is suitable for use in any car equipped with a standard 12-volt negative-ground electrical system.

In operation, the alarm circuit, once set, sounds the auto's horn continuously if the car door is opened by a potential thief. The car's owner (or regular driver), on the other

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION (Act of October 23, 1962: Section 4369, Title 39, United States Code).

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7. Owner: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual must be given.) Ziff-Davis Publishing Company, One Park Avenue, New York, New York; William B. Ziff, One Park Avenue, New York, New York; Priscilla R. Stafford, One Park Avenue, New York, New York.

8. Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities: None.

10. Extent and nature of circulation

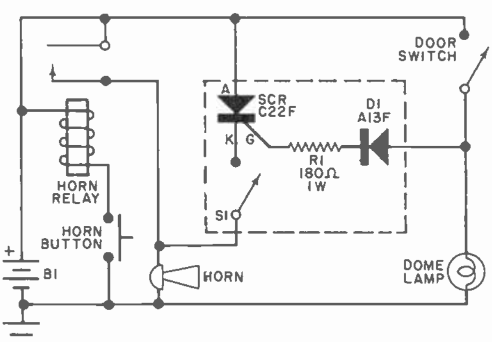
	Average No. Copies Each Issue During Preceding 12 Months	Actual Number of Copies of Single Issue Published Nearest to Filing Date
A. Total No. Copies printed (Net Press Run)	478,549	478,221
B. Paid circulation		
1. Sales through dealers and carriers, street vendors and counter sales	83,308	78,300
2. Mail subscriptions	305,818	308,435
C. Total paid circulation	389,126	386,735
D. Free distribution (including samples) by mail, carrier or other means	3,982	3,800
E. Total distribution (Sum of C and D)	393,108	390,535
F. Office use, left-over, unaccounted, spoiled after printing	85,441	87,686
G. Total (Sum of E and F—should equal net press run shown in A)	478,549	478,221

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

PHILIP SINE, Treasurer

hand, can disable the alarm in advance by operating a hidden switch.

An SCR supplies power to the horn when its gate is triggered by voltage from the door-switched dome light. The gate signal is applied through isolation diode *D1* and current-limiting resistor *R1*. Series switch *S1* serves as the system disabling switch and is left closed whenever the car is parked and locked; it is opened by the owner before the car door is opened or whenever it is necessary to reset the system. Once sounded, the alarm cannot be silenced except by operating *S1*, disconnecting the horn, or disconnecting the car's battery . . . and few thieves would take the time either to hunt for a switch or to work under the hood.



Alarm circuit uses an SCR to supply power to the car's horn if door is opened by potential thief.

Relatively simple, the circuit requires only four electrical components: a type C22F SCR, a type A13F diode (*D1*) a 180-ohm 1-watt resistor (*R1*), and a heavy-duty s.p.s.t. key, toggle or rotary switch (*S1*). Layout is not critical and the circuit may be assembled quite easily in a small outlet box or similar metal case.

As indicated on the schematic, only three lead connections are needed for installation. Physically, the basic control assembly should be mounted in an unobtrusive location away from the heat of the engine compartment, with *S1* in a hidden, but accessible, location outside the car's passenger space.

Industry Items. A rating of 325 volts—the highest of any EIA-registered germanium power type—is combined with low cost in a new transistor recently introduced by Motorola Semiconductor Products, Inc. (P.O. Box 955, Phoenix, Ariz. 85001). One of two new epitaxial-base types, the 2N5325, shown in Fig. 3, is ideal for power switching, inverters, TV deflection, switching regulators, amplifiers, and industrial power-supply applications. Its companion unit, the 2N5324, carries a 250-volt rating, and both are suitable for operation on line power supplies. The rated power dissipation for both types is 56 watts at 25°C.

New Motorola epitaxial-base power transistor has rating of 325 volts, highest of germanium types.

The National Semiconductor Corporation (2975 San Ysidro Way, Santa Clara, Calif. 95051) is now producing a new AM receiver i.f. subsystem integrated circuit. Identified as the type LM172/LM272 AM i.f. strip, the new IC includes 14 transistors, 9 diodes, 16 resistors, and 5 capacitors in its amplifier, second detector, and a.g.c. circuitry. It is designed for both i.f. and TRF applications over the range from 50 kHz to 2 MHz when used with appropriate external tuning elements. Suitable for operation on 6-to-15-volt d.c. supplies, the device has a 60-dB a.g.c. range, and can deliver as much as 0.8 volts peak-to-peak when driven with a 50-μV, 80% modulated signal.

That's our January story . . . until next month, keep your fingers crossed.

—Lou

LAMP BRIGHTNESS QUIZ ANSWERS

1-C	6-B
2-B	7-A
3-A	8-B
4-C	9-C
5-A	10-B

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OPERATION ASSIST

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

Philmore Model CPM-1. CB power supply needed for xmitter CT-1 and CC-1 converter. (Roger J. Dubay, 18501 Brohl, Roseville, Mich. 48066)

Hallicrafters Model S-22-R, circa 1946. Plug-in ballast tube (BK 29D) needed. (Kevin McGowan, 108 Darwin Ln., Oak Ridge, Tenn. 37830)

Hallicrafters Model S-36A receiver. Schematic and operating manual needed. (Danny Boyer, P.O. Box 556, Eldorado, Texas 76936)

Zenith Model 34P receiver. Schematic and source for no. 27 tubes needed. (David Roit, 70 Cranston St., Westfield, Mass. 01085)

Hallicrafters S-38B receiver. Schematic and operating manual needed. (Scott Daniels, 1749 Popham Ave., New York, N.Y. 10453)

Dumont type 292 cathode ray oscillograph. Power transformer and schematic needed. (Kent Leach, 5428 N. 83 St., Milwaukee, Wisc. 53218)

Simpson Model 305 tube tester. Schematic, supplements to manual, and data for adding different sockets needed. (John P. Chevalier, 25 Standard Ave., W. Warwick, R.I. 02893)

Clough-Brengle Model 185 unimeter. **Heathkit** Model A-5 amplifier. Schematics and instruction manuals needed. (Andrew Dickey, 80 Nordica Dr., Croton, N.Y. 10520)

Grundig TK 819-820 tape recorder. Motor with good bearings and capstan needed. (R.B. Reithel, 808 Georgia Ave., Pittsburgh, Pa. 15210)

Superior Model TV-50A Genometer. Schematic and operating manual needed. (C.J. Hershfield, 302 Texas NE, Albuquerque, N.M. 87108)

Heathkit Model 0-8 oscilloscope. Schematic and operating manual needed. (Reid Larson, 215 S. Grant, Westmont, Ill. 60559)

Radio City Products Model 668 electronic multi-tester VTVM. Schematic and operating manual needed. (J.F. Waynick, 1309 Ritcherson Dr., Reidsville, N.C. 27320)

Sylvania type 400 TV oscilloscope. Schematic and instruction manual needed. (Leonard S. Waller, 330 W. 28 St., New York, N.Y. 10001)

Premier Model 570 signal generator. Schematic, operating manual, and parts source needed. (Wallace F. Peterson, RR #1, Box 248, Thompson, Conn. 06277)

Atwater-Kent Model 41 receiver. Schematic, parts list, operating manual, and parts source needed. (John L. Timm, 78 Orchard St., Cos Cob, Conn. 06807)

Solar Model CE Capacitor Exam-eter. Power transformer designated CF-5 in operating manual needed (or source for same). (Virgil W. Treadwell, 915 S. 31 Ave., Yakima, Wn. 98902)

Harvey-Wells Models TBS-50 and TBS-50D. Schematics for both and operating manual for latter. Also schematic for APS-50. Stephen Sant Andrea, 490 Coolidge St., W. Hempstead, N.Y. 11552)

McMurdo Silver Masterpiece V all-wave receiver, circa 1936. Schematic needed. (David Baird, P.O. Box 3036, Cocoa, Fla. 32922)

Heathkit DX-35 transmitter. Assembly and operating manual needed. (Fred Elliott, 312 Church St., Dallas, Ore. 97338)

Westinghouse Model WR-306 receiver. Antenna coil assembly for broadcast band needed. (Part #RC 9577). Gregory Zabolocky, 2415 W. Becher St., Milwaukee, Wisc., 53215)

Atwater-Kent type F-4-A radio speaker. Information on type and amount of voltage needed to energize magnet coil; replacement speaker paper needed. (David Bandfield, 24 Circle Dr., Plandome Manor, N.Y. 11030)

Scott marine SLRM; has 11 tubes. Schematic and operating manual needed. (John Davies, 331 Alexander St., Memphis, Tenn. 38111)

Stromberg-Carlson Model 112146 TV. Tube chart needed. **Stewart-Warner** Model 01-6E receiver. Tube chart and schematic needed. (Mike Bialaski, 12850 Coyle St., Detroit, Mich. 48227)

Hammarlund Model HQ-140-X. Plastic main tuning dial and mounting needed. (Tom Rose, 1305 Rancho Rd., Roswell, N.M. 88201)

Precision Apparatus series 920 tube and set tester. Instruction manual and schematic needed. (Charles L. Bagley, Rte. 1, Box 601, Clearwater, Fla. 33516)

Heathkit Model AV-2. Manual needed. **RCA** Model 165A VoltOhmyst Jr. Schematic and manual needed. (A.D. Illein, 263 Pine Ave., Garwood, N.J. 07027)

Hickok Model 530 tube tester. Schematic and tube chart needed. (N. W. Zimmerman, 1904 W. 46 Ave., Anchorage, Ak. 99503)

Telephone Electronics Co. S/N 3901 CB transceiver. Schematic, tech manual, and any information needed. (Jim Maschmann, 3340 S. Eudora, Denver, Colo. 80222)

Harvey-Wells Bandmaster Senior, transmitter Model TBS-50C. Schematic and operating manual needed. (Henry C. Lambert, Box 604, W. Yarmouth, Mass. 02673)

Lafayette Model 60 radio, 1925. **Lowry** Organo, Model 5J serial 1123 manufactured by Central Commercial Industries. Schematics needed. (B. R. Meschke, 3824 Ridgeview Dr., Indianapolis, Ind. 46226)

Heath Model SB-10 SSB adapter. Schematic or operating manual needed. Also any information on converting the **Heath** DX-100 amateur transmitter to SSB operation. (Gerald I. Miles, RT Div., U.S.S. Belmont (AGTR-4), FPO New York 09501)

RCA Model AR-936 Radiola 18. Schematic and parts list needed. (Joseph Mazary, Jr., 136 Liberty Ave., New Kensington. Pa. 15068)

DeForest Model D-12 receiver. Schematic needed (Bob Knutson, 1000 23 Ave., S.W., Austin, Minn. 55912)

Dumont type 292, serial 6A57 oscilloscope. Operating manual or schematic needed. (Edward M. Arand, Jr., 5344 118 Pl., Inglewood, Calif. 90304)

Hallicrafters Model SX-71. Schematic and alignment data needed. (John W. McWhirter, 6250 Condon Ave., Los Angeles, Calif. 90056)

Majestic Model 20. Screen Grid Superheterodyne. **Stromberg-Carlson** self-contained house-current receiver; has 6 tubes, high/low voltage selector switch. **Silver-Marshall** Model 30 chassis broadcast band receiver. Schematics and tube location charts needed. (Dean R. Kazmierczak, 886 Eggert Dr., N. Tonawanda, N.Y. 14120)

Heathkit Model DX-100B. Schematic and operating instructions needed. (A. Barry, 135 N.W. Dr., Patrick AFB, Fla. 32925)

Philco Model 46-480 radio. Schematic needed. (Gary Rakes, 903 10th Ave., Nebraska City, Neb. 68410)

Philco Model 66 AM & SW receiver, 1935. Schematic and source for tubes needed. (J. A. Colombo, Totoket Rd., Northford, Conn. 06472)

Philco Model 050 tube tester. Tube charts and schematic needed. (Irvan Mitchell, 1509 Bashor Rd., Goshen, Ind. 46526)

Triumph Model 841 3" oscilloscope. Schematic and manual needed. (Ronald Burgess, 89 Clinton St., Portsmouth, N.H. 03801)

Texas Research & Electronics Model 190 CB transceiver. **Globe** Model CB-100 CB transceiver. Schematics needed. (John Davis, 132 Thackeray Dr., Millington, N.J. 07946)

Superior Instruments, Model 670A multimeter. Meter and other parts needed. (Allen H. Leonard, R.D. #2, Box 305-A, Ashland, Ohio 44805)

Sonar DF4X direction finder. Schematic, sense antenna, loop antenna, meter, operating manual, and information needed. (Robert Rioja, 166 Wright St., Staten Island, N.Y. 10304)

Crosley 6-tube BC receiver, 1925; has type D Musicone speaker. Tube layout and battery wiring diagram needed. (G.W. Craven, 11918 Price St., N.E., Alliance, Ohio 44601)

Atwater-Kent Models 35 and 20 radio receivers.. Operating manual and/or schematic needed. (Leroy Corbin, 32 Anderson Rd., Bernardsville, N.J. 07924)

Hammarlund Model HQ-140X. Audio gain switch needed. (N.D. Sheppard, Mountain Village, Ak. 99632)

Hallicrafters Model S-38-E. Schematic and instruction manual needed. (James Blumenfeld, Belmont Dr., Monticello, N.Y. 12701)

Bell Model 603 4-track tape recorder for RCA-type cartridge. Source for drive belt & capstan flywheel, and owners manual needed. (Richard McCreedy, 16554 Blackstone, Detroit, Mich. 48219)

Knight Model KN3203 32-watt amplifier. Assembly manual and schematic needed. (Jim Batug, 136 Mallard Dr., McKees Rocks. Pa. 15136)

SHORT-WAVE LISTENING

(*Continued from page 94*)

kHz) and 11,730 kHz with world and home news, commentary, music and some talks.

Iran—*R. Iran,* Teheran, 15.135 kHz (announces 15.105 kHz) monitored from 1548-2029; best signals noted during French xmsn at 1930-2000 and English segment with news, music and talks on Iran at 2000-2029.

Italy—"Nocturne From Italy", a daily program of pop songs, opera, dance music, symphony and jazz, with short news bulletin in four languages is aired at 2306-0459 from Rome 2, 845 kHz; Milan 1, 899 kHz; and the Caltanisetta, Sicily, outlets A. 6060 kHz, and B, 9515 kHz. This is a good chance for medium-wave DX'ers to look for Rome and Milan.

Ivory Coast—Abidjan has placed 7215 kHz into service, dual to 11,920 kHz, where it has a short newscast in French until 0000 closing.

Japan—Tokyo is good at times to Europe in German at 2000 and in English at 2030 on 11.965 and 9700 kHz.

Kuwait—We learn at press time that all test or experimental xmsns from Kuwait have been suspended but they may have been resumed by the time you read this. From monitoring, the apparent English xmsns seem to be scheduled for 0400-0600 and 1600-1900 on 1133 kHz (1 kW), 1345 kHz (200 kW), 4967.5 kHz (10 kW) and 9520 kHz (50 kW). The frequencies listed for experimental xmsns include 6055, 11,940, 15,150, 17,750 and 21,525 kHz, all 250 kW. Others may be used as well.

Lebanon—Beirut continues to wander around in the 19-meter band with Arabic news at 0325-0330 on 15.370 kHz and in Arabic and French at 0130 s/on on 15,440 kHz.

Martinique—Fort-de-France, 3315 kHz, can often be heard from 0210-0240 s/off with mostly classical music. This xmsn is in French.

Mexico—XETS, *R. Tapachula,* Tapachula, 6120 kHz, is extremely difficult to log. One West Coast expert lists it as being audible only around 1200 with "Amanecer Ranchero" (Mexican folklore music). Otherwise it cannot be heard.

Nigeria—Lagos noted on the new frequency of 9690 kHz in English to Europe at 2100-2205 with news, commentary, native Nigerian music, talks and pop music dedications.

Pakistan—R. Pakistan opens to S. E. Asia in English at 0030 on 15,358 kHz. The station also has English at 1500-1515 on the new frequencies of 15,190 and 17,855 kHz. Two new 100-kW short-wave xmtrs have been installed at Dacca and Islamabad to provide a radio link between East and West Pakistan. Three additional stations are to go into operation in 1970.

Peru—OBX1Q, *R. San Juan,* Piura, listed 4970 kHz but operating on 4967 kHz, noted in Spanish to 0300 closing with heavy QRM from a Colombian on 4965 kHz.

Poland—*R. Warsaw* has an English xmsn to Africa at 2200 on 17,800 kHz with generally fair to good signals.

South Africa—*R. RSA,* Johannesburg, tuned from 2200 s/on in Portuguese on a new frequency of 15.245 kHz.

Spanish Guinea—EAJ206, *R. Santa Isabel,* Fernando Po, was noted fading in at 2206 with classical piano music and anmts in Spanish. The s/off came at 2301 with an ID in Spanish and the anthem "Los Voluntarios." *R. Ecuatorial,* Bata, Rio Muni, was heard with good signals at 2156 fade-in with Spanish pop music; an ID is given at 2158. Pop and classical music followed until s/off at 2300 with an anthem.

Switzerland—Late schedule changes as given by Berne: Portuguese to Brazil at 2315 on 11.845 and

15,305 kHz (repl. 11,715 and 15,125 kHz); Portuguese to South America at 0030 on the same channels; English to N.A. at 0130 on 5985 kHz, repl. 15,305 kHz. Berne has also been noted on 11,880 kHz at 2005 with answers to radio questions of interest to DX'ers. This Monday program was heard until close at 2028.

Tunisia—We've made further checks here as indicated last month: the station on 11,900 and 5985 kHz is definitely *Huna Al-Idha-A Att-Tounoussia (R. Tunis)* as heard with good signals from 0430 s/on with Arabic chanting and anmts until 2358 s/off with ID and band music. It is *not* Saudi Arabia.

Turkey—Ankara, 15,160 kHz, was observed with IS at 0420, then s/on and into Turkish at strong level, covering Budapest on the same channel. This outlet is also noted from 2200 with English news, fading out by 2215 when the news ended.

USSR—*R. Alma Ata,* 10,530 kHz, is heard at 0120-0140 fade with dance lessons, a short commentary and Russian music. A letter from the station states flatly that they do not operate on 9380 kHz despite many loggings to the contrary.

Vatican City—A new frequency for *R. Vaticanna* is 9670 kHz, noted from 2205 s/on in English to Australia and New Zealand.

Unidentified—On 11,795 kHz, a station has been reported by several monitors as being on the air from 1830-2030 with light music but absolutely no ID's or announcements of any kind during the entire two-hour period. Some fading is noted but reports indicate that it is one of the strongest signals in the 25-meter band. An overseas bulletin reports the same—or similar—station on 6135 kHz with an identical format. It definitely is not an image or a local station harmonic. Can anone help?

73. Hank

SHORT-WAVE CONTRIBUTORS

Christopher Lobdell *(WPE1GCI)*, Reading, Mass.
Vincent Geraci *(WPE1HMP)*, Shelton, Conn.
Richard Pendleton *(WPE1HMV)*, East Braintree, Mass.
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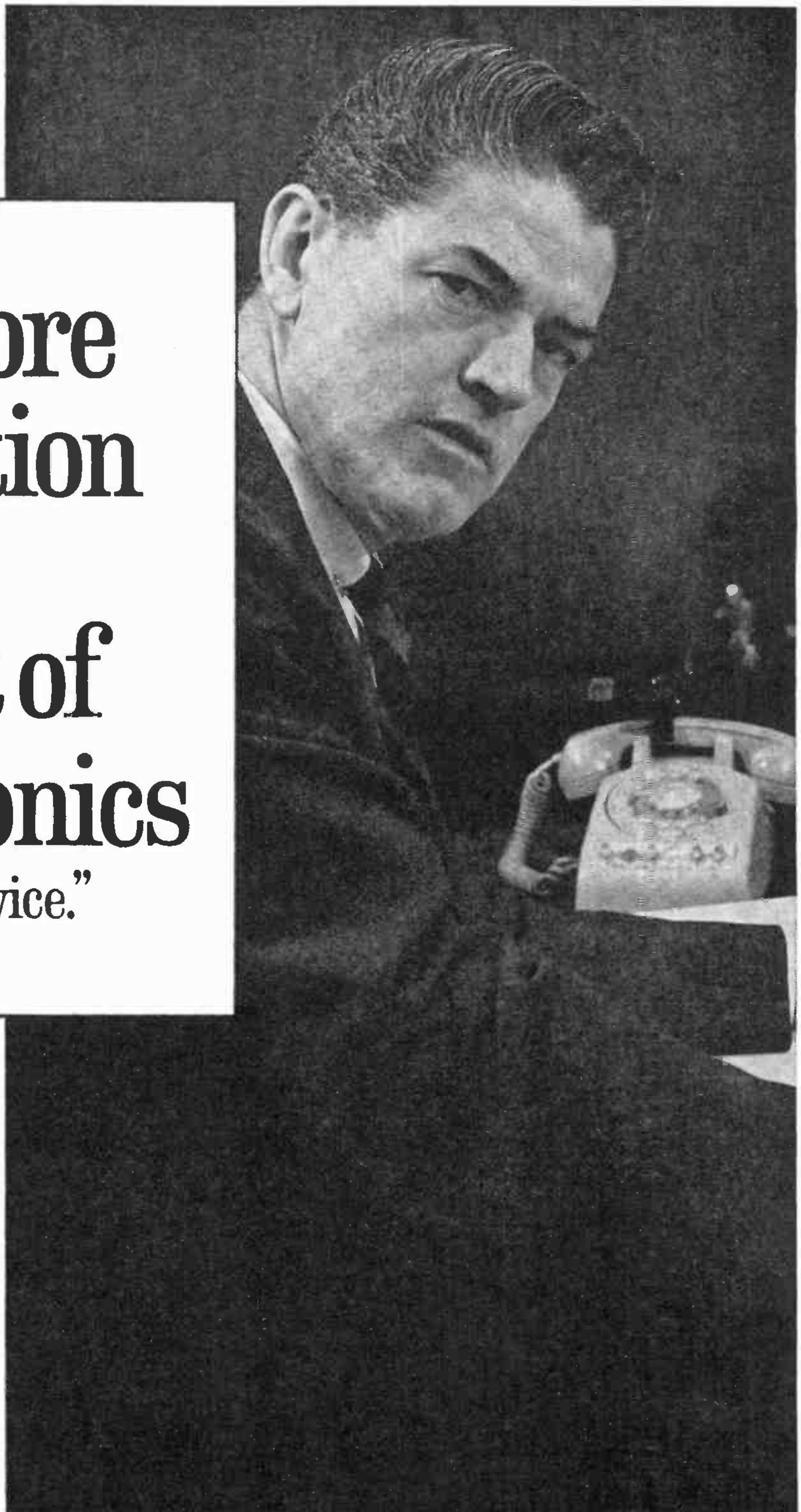
Dan Ferguson *(WPE4AUL)*, Coral Gables, Fla.
Grady Ferguson *(WPE4BC)*, Charlotte, N. C.
Bruce Tindall *(WPE4JQQ)*, Chapel Hill, N. C.
Steve Joiner *(WPE5EVP)*, Dallas, Texas
Charles Bennett *(WPE5SW)*, Sumrall, Miss.
Trevor Clegg *(WPE6FAF)*, Fresno, Calif.
Paul Farmanian *(WPE6GVG)*, Glendale, Calif.
Frank Hanley *(WPE6GWQ)*, Orangevale, Calif.
Arthur Bair *(WPE6GXV)*, San Francisco, Calif.
Walter Dick *(WPE6HAX)*, Santa Monica, Calif.
Jeff Utter *(WPE6HDJ)*, Carlsbad, Calif.
Robert French *(WPE8FGH)*, Bellaire, Ohio
Richard Pistek *(WPE9HOA)*, Chicago, Ill.
Craig Cook *(WPE9JBI)*, Milwaukee, Wisc.
A. R. Niblack *(WPE9KM)*, Vincennes, Ind.
John Beaver *(WPEØAE)*, Pueblo, Colo.
C. Vernon Hyson *(WPEØCNF)*, Somerville, N. J.
Philip Carney *(WPEØFCD)*, Minneapolis, Minn.
Jack Bacon, Jr. *(WPEØFDJ)*, Bloomington, Minn.
Michael Clow *(VE1PE1AM)*, Moncton, N. B.
Fred Baines *(VE1PE2C)*, New Glasgow, N. S.
Rejean Lavoie *(VE2PE1MT)*, Chomedey, Que.
Gerry Couture *(VE2PE1NB)*, Longueuil, Que.
Mike Wilson *(VE6PE4N)*, Calgary, Alta.
Jack Perolo *(PY2PE1C)*, Sao Paulo, Brazil
Charles Albertson, Scottsdale, Ariz.
Steve Briggs, La Canada, Calif.
Guy Cavallo, Arlington, Va.
Richard Daly, Bronx, N. Y.
Mike Davis, Moberly, Mo.
Bruce Frahm, Colby, Kansas
Andrew Galik, Jr., Clifton, N. J.
Michael Gessner, Lakeland, Fla.
Leonard Hyde, Jr., Lexington, N. C.
Warren Lauzon, APO (Philippines)
Mark Nodine, Salem, Ore.
Eugene Paradis, Fairfield, Maine
SP4 George Weir, APO (Qui Nhon, Vietnam)
Sweden Calling DX'ers Bulletin, Stockholm, Sweden



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IR DETECTOR

(Continued from page 31)

so that the Hotbox does not respond to this normal temperature but will respond to any higher temperature. Also remember that, although the Hotbox does not respond very readily to visible light, it does respond quite rapidly to the source of such light if it is hot—such as the filaments of incandescent or fluorescent bulbs, sunlight, etc. Keep this in mind when installing the Hotbox as a fire alarm.

Once the device is working properly, aim it at a source of IR energy—incandescent or fluorescent lamp filaments, lighted cigarette, hot soldering iron, etc. The indicator lamp should come on as the "beam" of the IR detector crosses the hot spot. You can determine the size of the detector's beam by placing the detector on one side of a pane of glass and moving a lit cigarette around the other side of the glass, marking the glass with a grease pencil where the detector goes on and off. You can make the calibration or measurement at various distances between the Hotbox and the glass pane.

For many applications, an external signal indication is desirable or necessary. In this case, a 6-volt d.c. relay coil can be substituted for the indicator lamp, with its contacts used to actuate a remote signalling system. A 6-volt d.c. buzzer can also be substituted for the relay for a local audible signal.

To use the detector as a burglar alarm, get a conventional IR lamp (heat lamp) from a drug or department store and position it so that the Hotbox can see it either directly or through a series of mirrors. Arrange the relay output so that, as long as the Hotbox sees the IR source, the external signalling device will not be actuated. If an intruder breaks the IR beam, the alarm should go off. This is a fail-safe system since, if the intruder sees the IR source and turns it off, the alarm will sound anyway.

If a high-power alarm system is to be used, a power relay whose contacts can carry the required current can be activated by contacts on the relatively low-current relay that is driven directly by the Hotbox. -30-

BIG SIX

(*Continued from page* 41)

Now, install the crossover networks, tweeter, and woofer on the speaker mounting board. Carefully observing polarity, complete speaker/crossover system wiring. If you plan to paint or stain the enclosure, now is the time to do so. And, while you're at it, apply a coat or two of flat black paint to the front of the speaker mounting board.

Set the speaker mounting board close to the enclosure, and thread the leads to the two L-pad controls and conducting bolts on the rear of the enclosure. Install the controls. The basic system is now ready for testing.

Temporarily set the speaker mounting board in place on the front of the enclosure, and hold it in place with four screws. Connect your amplifier, and start a record playing. Now, listening carefully, test the range of the controls. There should be more than enough range to allow adjustment of the sound reproduction to the acoustical environment of your listening room. When you are satisfied, turn off the power amplifier, and disconnect the feed cable.

Complete construction by installing the rest of the screws for the speaker mounting board and the grille cloth and trim.

Stereo Setup. If you build two Big Six speaker systems for stereo reproduction, make the speaker mounting boards mirror images of each other. In this way, the sound will be balanced. A diagram of a mirror-image stereo system is shown in Fig. 4.

Because the midrange speakers are mounted off center and the two speaker mounting boards are mirror images of each other, the two speaker systems can be reversed to alter the stereo effect.

What is the sound reproduction like from the Big Six speaker system? As mentioned earlier, the bass is deep and smooth, but not obtrusive. (So use a turntable with negligible rumble). The midrange is full and smooth, with the column adding to the effectiveness of the sound distribution. And the treble is expansive. —30—

AM TUNER

(Continued from page 46)

bridges between foil sections and make sure that all solder connections are good. Using a d.c. VTVM, measure the voltage from each transistor emitter to ground. It should be between 15 and 18 volts on the mixer and i.f. stages (*Q1* and *Q3*, respectively) and between 10 and 14 volts on the oscillator. Connect the output from terminal g on the PC board to an oscilloscope or a.c. VTVM in parallel with the input to the audio system.

The oscillator transformer (*T1*) slug should be set about 4 or 5 turns in from the top of the can and the top slug of *T2* should be in between 2 and 4 turns. Rotate the tuning capacitor through its range, listening for a station or watching for an indication on the test instrument.

Locate a known station near the low-frequency end of the dial (near 550 kHz) and adjust the slug of *T1* until the dial reads the known frequency of the station. Then tune to a station near the high-frequency end of the dial and adjust the trimmer capacitor on *C2* to locate that station where it belongs on the dial. Adjust the antenna trimmer *C1A* to maximize the high-frequency signal.

Adjust the slug in *T3* for maximum signal when the tuner is set at 950 kHz. Then adjust the bottom slug of *T2* to further increase the signal level. Once you hit the maximum signal with *T2*, back the bottom slug out about ¾ of a turn. You may have to repeat the i.f. transformer adjustment because of some slight interaction, but when complete, the tuner will be aligned.

If you have a 455-kHz signal generator, you can align the tuner by injecting a signal into the antenna (at 455 kHz) and adjusting the three i.f. transformer slugs for maximum response. Back off the bottom slug of *T2* about ¾ of a turn. Then inject a 550-kHz signal, set tuning capacitor *C1-C2* fully meshed and adjust the slug of *T1* for maximum response. A signal of 1600 kHz can be used, with the tuning capacitor fully open, to adjust oscillator trimmer *C2B* and antenna trimmer *C1B* for a maximum response. The tuner is now aligned. –30–

LITERATURE

(*Continued from page* 16)

test, service, and lab equipment; CB radio; and photographic aids are among the many general and special interest items illustrated, some in full color, in this 116-page catalog. Among the new items appearing for the first time are a 295 sq. in. color TV receiver featuring automatic fine tuning, remote control, power channel selector, and built-in servicing aids; the "Boonie Bike" high-powered trail and snow bike kit; and the Heath/Mitchell "Color Canoe" color processor.

Circle No. 90 on Reader Service Page 15 or 115

Four do-it-yourself illustrated instruction sheets for the electronics experimenter are offered by *DeVry Institute of Technology*. Step-by-step construction details are given for: a printed circuit, a radio-controlled model plane, a field-effect transistor timer circuit, and a motor speed control. The printed circuit, timer, and motor speed control can be used in dozens of different ways in the home workshop.

Circle No. 91 on Reader Service Page 15 or 115

"At Home with Stereo" is a well-illustrated, full-color, 20-page brochure from *H. H. Scott, Inc.* describing their 1969 line of stereo consoles in a collection of decorator-styled room settings. Included are many informative features on high fidelity, choosing the correct console to match individual room decor, and complete explanations, in nontechnical terms, of the more technical aspects of stereo consoles.

Circle No. 92 on Reader Service Page 15 or 115

Edmund Scientific Co.'s new Catalog 691 contains a complete selection of hard-to-find products for countless applications. Included are a compact (1/3 pint) ultra-sonic cleaner, which uses sound waves to scrub any kind of small machine parts; a line of MusicVision systems ranging from consoles to do-it-yourself kits, which can be attached to radio, record player, or hi-fi/stereo to provide colorful patterns in time with the music; a variety of special visual effects products, such as a polarized color projector, a kaleidoscope projector, strobe lights, etc.; a ceiling motor for use in rotating lights and displays; and a chromatology kit by which chemical analyses of soluble materials by means of color-band separations can be made.

Circle No. 93 on Reader Service Page 15 or 115

PRODUCTS

(*Continued from page* 24)

to-noise ratio; 45-dB selectivity; 70-dB i.f. rejection; 55-dB image rejection; 38-dB stereo separation; 0.5% harmonic distortion.

Circle No. 94 on Reader Service Page 15 or 115

230-CHANNEL INDUSTRIAL PAGER

Lafayette Radio Electronics Corp. recently announced the addition of the 230-channel "Priva Com 10" encoder/decoder industrial pager to their line of CB gear. (Also available is the "Priva Com 111A," with up to 23 paging channels.) The Priva Com 10 is designed to operate in conjunction with a Lafayette 27-MHz CB transceiver. Selection of the transceiver channel and Priva Com call button automatically breaks the individual-coded pager's silence and permits private one-way communications. A reset switch on the pocket-size pager quiets the unit at the completion of the call. The 18-transistor, five-diode superhet circuit features 0.7-μV sensitivity, a mechanical filter, dual-tone squelch, and an internal ferrite antenna.

Circle No. 95 on Reader Service Page 15 or 115

CUBICAL QUAD CB ANTENNA

The Model MCQ-27 cubical quad CB antenna, available from *Mosley Electronics, Inc.*, embodies the latest developments in CB base station antenna design. Featuring three widely spaced elements, the antenna's high signal directivity eliminates unwanted side and back signals, while its low radiation angle assures maximum distance transmission. An accessory allows the user, with the flip of a switch, to change from horizontal to vertical polarization. Technical specifications: forward gain, 9 dB over reference dipole, 11.1 dB over isotropic source; 25-dB or better front-to-back ratio; 1.5/1 or better SWR; gamma match with 52 ohms nominal feed impedance; unidirectional radiation; 23-channel operation; 3 elements; 7.55 sq ft wind surface; 151-lb wind load (80 mi/hr EIA Standard).

Circle No. 96 on Reader Service Page 15 or 115

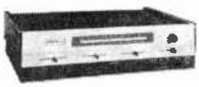
VOLT-OHM-MILLIAMMETER WITH FET

The *Mercury Electronics Corp.* Model 4000 transistorized volt-ohm-milliameter, employing a field-effect transistor input, combines the features of a VTVM and portability of a VOM in a single instrument. The Model 4000 can be operated from the a.c. power line or from its own batteries. Features include a full-view 6" (200 μA) meter movement, instant operation, and direct readout of battery condition on meter scale. Technical specifications: 0.5-volt low-d.c. range; 0-1, 3, 10, 100, 300, and 1000 volts d.c. and a.c. voltage ranges; 0.2-1000 megohm, with 10 ohms center scale, resistance measuring capapility in seven ranges; five d.c. current ranges from 0 to 1000 milliamperes.

Circle No. 97 on Reader Service Page 15 or 115

AM/FM STEREO RECEIVER

Integrated circuits, ceramic filters, and slide controls are featured in the Model DB250 solid-state stereo receiver available from *Bogen Communications Division.* The IC's provide better limiting, improved capture ratio, lower distortion, and greater reliability, while the ceramic filters provide more than ten times better selectivity than with conventional filter circuits. The AM portion of the receiver has a mechanical filter to improve selectivity and eliminate interstation heterodyning. Selectivity in the FM mode is rated at 60 dB, and a balanced bridge FM detector reduces distortion to 0.3%. A zero-center meter for FM switches automatically to a signal-strength meter for AM. Rated at 75 watts (IHF) output power, the audio section exhibits 0.8% harmonic distortion at full rated output.



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

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LIBRARY

(*Continued from page* 14)

gineering reference texts. It brings together in a single volume the important principles, applications, and formulas that would normally be spread out among many electronics textbooks. The book is divided into four sections—direct-current theory, alternating-current theory, valve (tube) theory and applications, and transistor theory and applications. Worked-out sample problems and schematic diagrams are employed to clarify important or difficult points in the text. The prerequisites for understanding and using this book are a working knowledge of elementary algebra and trigonometry.

Published by Iliffe Books Ltd., Dorset House, Stamford St., London, S.E. 1. Distributed by Gilfer Associates, PO Box 239, Park Ridge, N.J. 07656. Soft cover. 149 pages. $3.25.

FEEDBACK AMPLIFIERS AND OSCILLATORS

by Robert E. Sentz and Robert A. Bartkowiak

Written specifically for technical institutes and junior colleges, this book is also eminently suited for home study. An integrated transistor and vacuum-tube approach is employed in the discussions, but emphasis is on transistors. The book covers the entire field of oscillators and feedback amplifiers, from the fundamental types of feedback through UHF and microwave oscillators. Numerous worked-out problems are presented to illustrate various applications and formulas, and practice exercises conclude most chapters. In addition, selected transistor data is included in the appendix to aid the reader in understanding the points developed in the text.

Published by Holt, Reinhart and Winston, Inc., 383 Madison Ave., New York, N.Y. 10017. Soft cover. 218 pages. $3.95.

CITIZENS BAND

(*Continued from page* 85)

get cracking on the whole problem. Start by re-reading Part 95. Resist the temptation to stretch your nickels into dimes. Use your call numbers. And respect the 'unwritten law' of Channel 9 for emergencies.

"If we *really* discipline ourselves, the Federal Communications Commission will have plenty of time to crack down on the nuts."

Have a happy '69 and I'll CB'ing you!

Matt, KHC2060

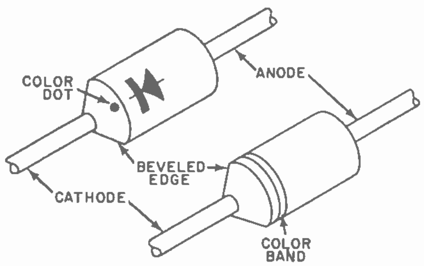
LETTERS

(Continued from page 10)

teries are reversed in the project! As a result, the excessive current flow through the diodes causes them to break down. After I replaced the diodes and reversed the battery connections, the "Noise Blanker" worked fine.

NAME WITHHELD
Forest Hills, N.Y.

Neither the batteries nor the diodes in the schematic diagram of the "Noise Blanker" article are reversed. The description of the "trouble" points up an important fact that has been brought to our attention several times in the past—some readers fail to identify properly the leads of the common diode.



In a schematic diagram, the arrow is the anode and the bar is the cathode. Physically, the cathode is identified by some type of mark or by the shape of the body of the diode. In a circuit where the diode is reverse biased, the positive voltage is connected to the cathode. Therefore, the diode does not conduct until the input level exceeds the total of the internal conduction requirements of the diode and the reverse bias.

RESISTANCE SOLDERING HANDPIECE

Where can I purchase the Redy handpiece shown in Melvin Whitmer's "Resistance Soldering" story (September, 1968) on page 82? Also, where can the different electrodes be obtained?

FRANK SAGNOG
Chicago, Ill.

The only thing we can suggest is that you write to Redy Company, Belleville, Kansas 66935 for this information concerning the resistance soldering handpiece. A similar handpiece is available from Newark Electronics Corporation, 500 North Pulaski Rd., Chicago, Ill. 60624. When ordering, specify catalog No. 34F712 and include payment of $10.50 plus postage. The electrodes are also available from Newark Electronics; for a package of six metal electrodes, specify catalog No. 34F708, and for the carbon electrodes, specify catalog No. 34F710. The prices of the electrode packets are 50¢ and $1.50, respectively.

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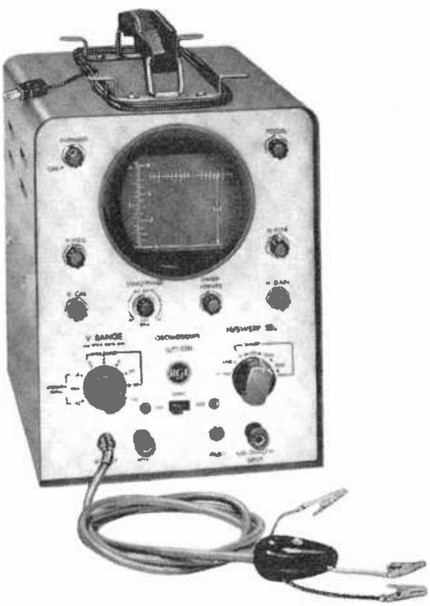

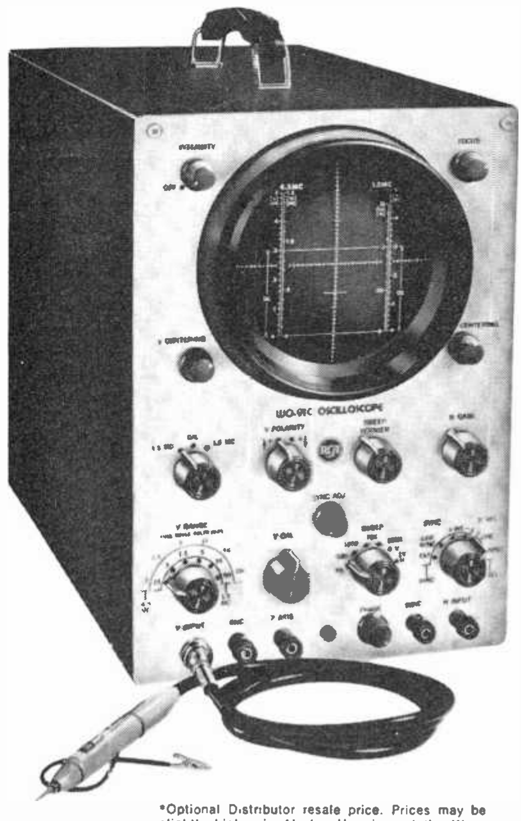

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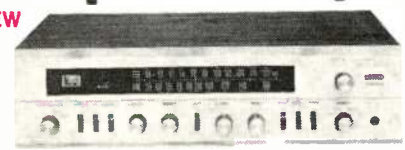

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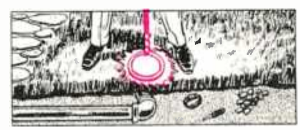

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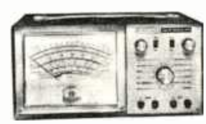

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