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PROJECTS**

101 ELECTRONIC PROJECTS

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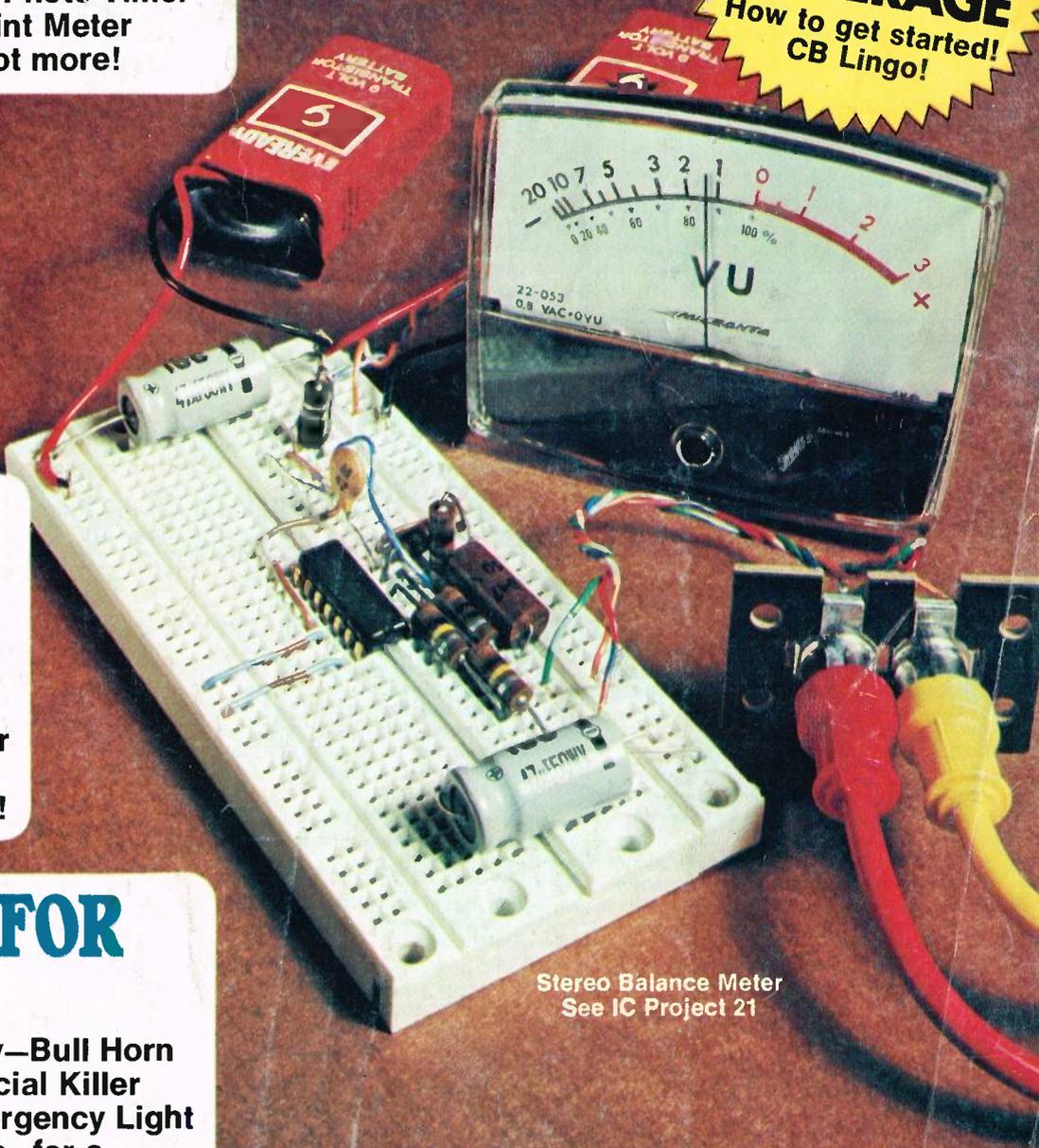
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CB Base Power Supply—Bull Horn
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SCA Adaptor—AC Emergency Light
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**SPECIAL
CB
COVERAGE**
How to get started!
CB Lingo!



Stereo Balance Meter
See IC Project 21

Which of these fascinating electronic gadgets would you like to build?

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Elementary Electronics features low-cost, practical projects like these in every issue!

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Yes, every issue of ELEMENTARY ELECTRONICS brings you step-by-step instructions, with photos and diagrams, for all kinds of devices you'll enjoy building—and be proud to own!

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Invaluable Basic Courses in electronic theory!

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Our readers tell us these Basic Courses are one of the magazine's most popular and valued features.

A magazine with a personality all its own!

You'll meet a lot of interesting people in the pages of ELEMENTARY ELECTRONICS. Like Hank Scott, our Workshop Editor. He conducts a regular letters-from-readers

A shortwave station finder/marker. Suppose you pick up an interesting but elusive station in Papeete, Kuwait or Kinshasa. This stable wide-band oscillator lets you relocate it any time you like—without hours of searching.

A nostalgic crystal radio set—just like the one your grandad had. You make it with a Quaker Oats box.

A futuristic pulse-width modulated mini-audio amplifier. It can boost the volume of a pocket radio to dancing level!

column called "Ask Hank, He Knows!" If you have any trouble on a project—or with anything electrical—just ask Hank. He knows!

And Kathi Martin, KGK3916, our Citizens Band Editor. She writes "Kathi's CB Carousel"—the most entertaining and informative CB feature you'll find anywhere!

Plus the people who contribute our columns on shortwave, antique radio, new products, electronics news tid-bits—and much, much more!

All our writers, editors and columnists know their stuff backwards and forwards. And they know how to make it interesting! With the same kind of straightforward language you use yourself when discussing electronics or radio.

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A solid-state wind-chill factor meter that can tell you instantaneously just how cold you feel!

A compact, portable gas alarm for home, trailer, car or boat. It detects many kinds of dangerous fumes—and could easily save your life!

CB MEETS SWL IN GOOF-PROOF PROJECT See page 47

Elementary Electronics TRANSFORMERS FOR BEGINNERS

FUTURISTIC Pulse-width modulated mini audio amplifier boosts pocket radio sound to dancing level.

NOWADAYS Buck stretcher clock gives time, date, and alarm, plus two options in simplest design yet!

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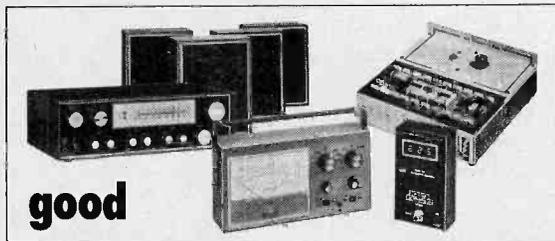
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ELECTRONIC PROJECTS FOR UNDER \$15

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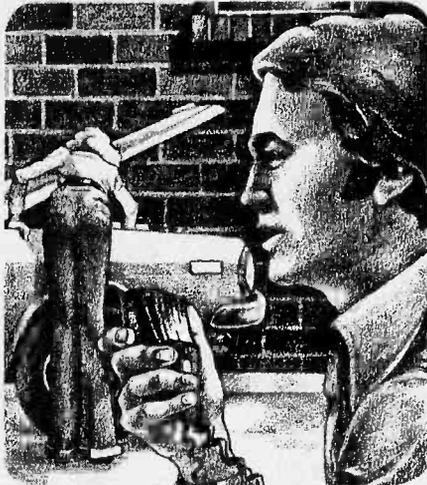
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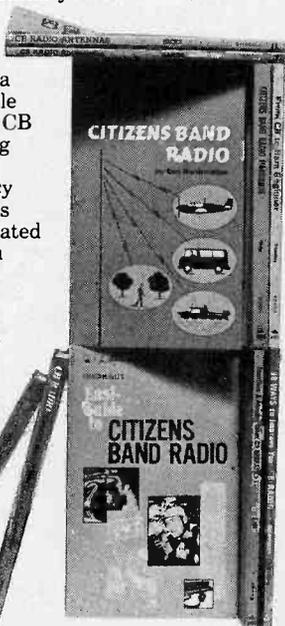
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New Products

Digital Multimeter

The economical, full-feature Model 334 Digital Multimeter from Hickok Electrical Instrument Company is designed for continuous operation in service, laboratory, and testing applications. It has 5 ranges of AC and DC voltage and current, and 6 resistance ranges. The Digital Multimeter features 3½-digit resolution, automatic decimal point, automatic polarity, and automatic overrange indication. The easy-reading, green fluorescent display minimizes eye fatigue over long periods of use. Automatic polarity eliminates the



CIRCLE 29 ON READER SERVICE COUPON

need to reverse leads if a DC voltage is negative, and the overrange indication is nondeceptive. If any input exceeds the maximum reading of 1999, the display shows two flashing bars and three zeros. Other features of the rugged, lab-quality Model 334 include 200-mV AC and DC ranges, fuseless protection on volts and ohms, and fast response (2.5 readings/second sampling rate). Power input is 105-125 VAC/210-250 VAC, 50-400 Hz. Price: \$229.00. For more information on the Model 334 Digital Multimeter, write to Hickok Electrical Instrument Company, 10514 Dupont Avenue, Cleveland, OH 44108.

Two-Band Bargain

Continuing to expand its line in police scanners, Electra announces its newest model—the Bearcat 6! This two-band (L/H), 6-channel model carries a low suggested retail price of only \$119.95. In addition to its low price, the Bearcat 6 offers additional innovations. The full-sized unit features a wooden cabinet, assuring nice appearance and also the sound that only wood enclosures can give. Electra has included many of the features exclusive to Bearcat. These include track tuning for full coverage of both the low (30MHz to 50MHz) and high (146MHz to 174MHz) bands; a single, electronically-tuned antenna; front-mounted speaker; and flashing LED's; and lock-out switches. Performance of the Bearcat 6 has not been com-

WHO'S WHO ON

101

ELECTRONIC PROJECTS FOR UNDER \$15

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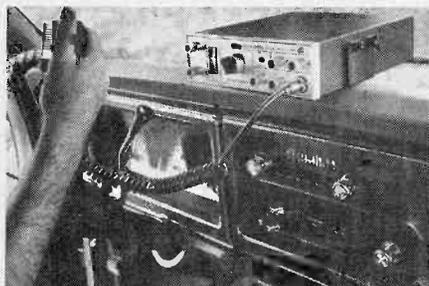


CIRCLE 39 ON READER SERVICE COUPON

promised: sensitivity is .6 μ V; selectivity is -50 db at \pm 25 kHz; audio output is 1.5 watts RMS; and scan rate is 20 cps. For more info on the Bearcat 6 and other Bearcat units, write to the Electra Company, 300 South on East County Line Road, Cumberland, IN 46229.

SSB CB with PA

A new, solid-state Citizens Band radio transceiver called the SSB-23A Albatross, has a public address capability built in as well as a noise blanker circuit. Fine tuning and a minimum of interference is another feature of the SSB-23A, which is made by Siltronix. Weighing only 5.5 pounds, it has a frequency range of 26.965 to 27.225 MHz. With overall di-



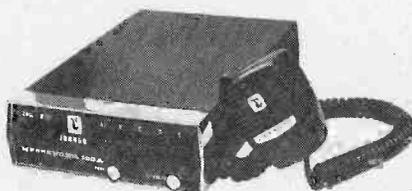
CIRCLE 27 ON READER SERVICE COUPON

mensions of 2.5 inches high by 8 inches wide by 11 inches deep, the SSB-23A has conventional AM and suppressed-carrier SSB modulation. The transceiver requires 1.2 amps of power to transmit and 250 milliamps to receive, while operating on 13.8 volts DC. Priced at \$359.95, the SSB-23A is available from Siltronix, 269 Airport Road, Oceanside, CA 92054. Write for full details.

Quiet CB Listening

The E. F. Johnson Company has introduced a new CB two-way radio, the Messenger 120A, with a selective calling feature that keeps it completely silent until called by another radio equipped with the correct code tone. The selective calling system, Tone Alert, is built-in the new Messenger 120A as a standard feature. With the Tone Alert system activated, the operator is not interrupted except by calls from his own system, even though others are sharing the channel. The Johnson Tone Alert system also helps prevent missed calls, since the operator does not have to listen to all

calls on the channel. When a call is made from another radio in the system, a tone sounds and a red "call" light illuminates to alert him to the call. Even if the driver has temporarily left his vehicle, he will be alerted when he returns because the "call" light stays illuminated. There are ten code tones available in the Johnson Tone Alert system, resulting in 220 available separate systems in any local area by utilizing the 22 CB channels available for everyday, non-emergency communications. Other features of the new Messenger 120A include easy pushbutton selection of up to five channels, new high torque rotary controls for volume and squelch, and built-in speech compression on transmit for longer range. The radio can operate with the Tone Alert system activated, or as a conventional CB radio receiving all calls.



CIRCLE 16 ON READER SERVICE COUPON

Suggested retail price of the radio is \$149.95. U.S.-made, it is covered by Johnson's one-year parts and labor warranty. Complete details on the new Messenger 120A are available. Contact your local Johnson CB dealer or drop a postcard to: E. F. Johnson Company, Waseca, MN 56093. Always mention 101 ELECTRONIC PROJECTS when you write.

Economy Tape Head Demagnetizer

A new economy model magnetic tape head demagnetizer has been introduced by Robins Industries. Measuring only 4½-inches long with a 1¼-inch tip and a 1¼-inch diameter, the new Model R25013 sells for about half the price of a comparable professional demagnetizer. The low price is made possible by mounting and connecting all the components onto one molded plastic piece.



CIRCLE 30 ON READER SERVICE COUPON

This holds the coil, the locating feet for the bobbin, the metal core and its plastic covering, the switch housing, strain relief for the line cord, and snap-lock assembling tabs. The unit should be used about every 20 hours to demagnetize the tape heads in reel-to-reel, cassette, or cartridge tape recorders and players. Without such demagnetization signal-damaging noise, hiss, high-frequency loss, and harmonic distortion are caused by unsymmetrical signal and noise peaks. The demagnetizer consists

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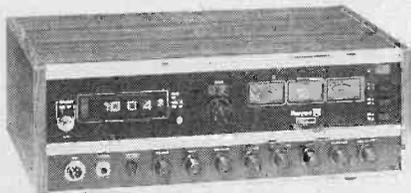
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of an AC-line-operated coil with a metal core that extends out of the plastic housing to form a tip. This tip is plastic-covered so that it will not damage tape heads. The plastic case is flame-retarding and impact-resistant. The demagnetizer draws only 3 watts from a 120-volt, 50 or 60-Hz AC line. The Model R25015, lists at \$8.50. A deluxe Model R25015, which includes an AC-line switch, lists at \$11. Get all the facts from Robins, 75 Austin Blvd., Commack, NY 11725.

SSB/AM CB Transceiver

The Royce Model 1-640 Single Sideband/AM CB Base Station features full metering, Warn-Tron protection circuit, a digital clock, and sophisticated styling. Three large separate meters monitor S-RF and SWR, which allow monitoring RF output and SWR simultaneously—without switching. The unique Warn-Tron protection circuit minimizes damage to RF output transistors by automatically removing power to the driver and final transistor if an open, short or excessive SWR occurs in the antenna. The large full-feature backlighted digital clock has buzz signal alarm. The Model 1-640 is encased in a modern, smoked plexiglas front panel, and has extruded brushed aluminum trimming and walnut-grained wood top and sides. While AM operation has

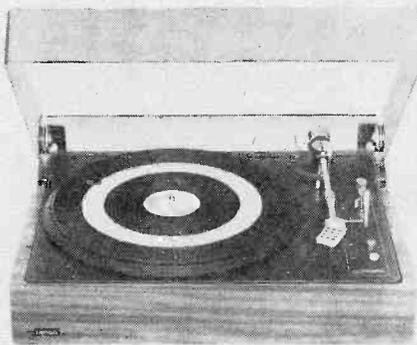


CIRCLE 38 ON READER SERVICE COUPON

an AGC circuit, the sideband mode has an amplified AGC circuit that expands the range of an ordinary AGC circuit by several times. Other features of the 1-640 include: fully variable tone control; clarifier control, which adjusts transmit and receive frequencies in SSB mode, and changes to delta tune in AM mode; variable RF gain control; push-button switches for power on-off, PA-CB, noise blanker and AGC; AC or DC power; positive and negative ground; built-in PA; full 12-watt P.E.P. SSB output power (25 watts P.E.P. input) plus 4-watt output on AM; headphone jack; fully variable squelch control; special jack for recording directly; choice of 46 Upper and Lower SSB plus 23 AM channels; dual detectors; 6-pole crystal lattice filter; new MOSFET RF stage; transmit light; push-pull audio; and mike pre-amp. Priced at \$479.95. For further information on the Royce Model 1-640 and other Royce products, write to Royce Electronics Corporation, 1746 Levee Road, North Kansas City, MO 64116.

Hi-Fi Turntable

The Swiss-made line of fine Lenco transcription turntables is now being distributed by Uher of America. At the top of the Lenco line is the L-851C belt-drive transcription turntable. Among the features of the L-851C are a 16-pole synchronous motor, illuminated stroboscope, viscously damped spring suspension, and anti-skating device. The unit is equipped with IC electronics to ensure that switch-off and lifting of the tonearm from the record will be trouble-free. Fine speed adjustment is also a feature of the unit.

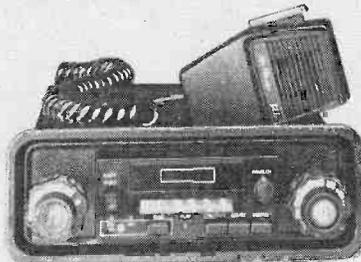


CIRCLE 17 ON READER SERVICE COUPON

Wow and flutter are ± 0.08 percent; weighted rumble is -63 dB. The two-speed ($33\frac{1}{3}$, 45 rpm) unit comes with base and dust cover and retails for \$299.50. As with all Lenco products, the L851C features quality handcrafted Swiss workmanship. For more information, write to Lenco/Uher of America, Inc., 621 S. Hindry Ave., Inglewood, CA 90301.

CB/Radio/Tape

Radio as you like it now comes compacted into one in-dash unit by J.I.L. The new 23-channel mobile transceiver with AM/FM-MPX radio and cassette player combination, Model 606CB, has been designed to fit into the dashboard of virtually all autos and recreational vehicles. Cutting into the dash is not necessary for installation. CB front panel



CIRCLE 37 ON READER SERVICE COUPON

controls include a variable *squelch* control to reduce noise and interference, a unique *stand-by* button, and a transmit/receive red and green indicator light. The 606CB offers a cassette tape player with

a number of convenience features, such as a running light that changes from red to green to white indicating tape play. When the tape ends, the light remains constant. A *fast forward/eject* button is also provided for easy operation. In addition to CB and cassette configurations, the 606CB offers the luxury of a dependable AM/FM-MPX radio. Its features include *stereo/mono* and *AM/FM* switches, as well as *volume*, *balance*, and *tone* controls. Price is \$419.95. For further information and complete specifications, write J.I.L. Corporation of America, 1000 East Del Amo Blvd., Carson, CA 90746.

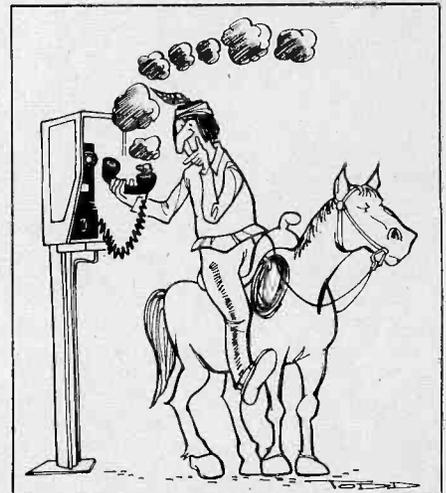
DC Regulated Power Supply Kit

All parts and materials necessary to construct a well regulated, stable, ripple-free power supply are included in the DC Regulated Power Supply Kit offered by GC Electronics' Calectro Division. The Power Supply Kit (Cat. No. G2-100) can be used in place of batteries in radios, tape recorders, and other electronic devices using from 2 to 25 volts, up to a current drain of 500 mA. Voltage output remains constant, even when output load varies from none to a full load. The Kit also includes an illustrated, step-by-step instruction booklet that contains helpful hints and construction techniques. Sells



CIRCLE 28 ON READER SERVICE COUPON

for \$32.50. GC Electronics offers other ready-to-assemble Calectro Kits that are fun, educational, and practical to build, including a Digital Clock, Motor Speed Control, Burglar Alarm, and TTL-5 Power Supply. Get all the facts by writing to GC Electronics, Division of Hydrometals, Inc., 400 South Wyman Street, Rockford, IL 61101.



LITERATURE LIBRARY

101. Get acquainted with the new *EICO* products, designed for the professional technician and electronics hobbyist. Included in brochure are 7 IC project kits, *EICO's* "Foneaids," security products and many varied kits.

102. *International Crystal* has a free catalog for experimenters (crystals, PC boards, transistor RF mixers & amps, and other comm. products).

103. See brochures on *Regency's* 1976 line-up of CB transceivers & scanner receivers (for police, fire, weather, & other public service emergency broadcasts).

104. *Dynascan's* new *B & K* catalog features test equipment for industrial labs, schools, and TV servicing.

105. Before you build from scratch, check the *Fair Radio Sales* latest catalog for surplus gear.

106. Get *Antenna Specialists'* catalog of latest mobile antennas, test equipment, wattmeters, accessories.

107. Want a deluxe CB base station? Then get the specs on *Tram's* super CB rigs.

108. Compact is the word for *Xcelite's* 9 different sets of midget screwdrivers and nutdrivers with "piggyback" handle to increase length and torque. A handy show case serves as a bench stand also.

110. *Turner* has two booklets on their Signal Kicker antennas. They give specifications and prices on their variety of CB base and mobile line. Construction details help in your choice.

111. *Midland Communications'* line of base, mobile and hand-held CB equipment, marine transceivers, scanning monitors, plus a sampling of accessories are covered in a colorful 18-page brochure.

112. The *EDI (Electronic Distributors, Inc.)* catalog is updated 5 times a year. It has an index of manufacturers literally from A to X (ADC to Xcelite). Whether you want to spend 29 cents for a pilot-light socket or \$699.95 for a stereo AM/FM receiver, you'll find it here.

113. Get all the facts on *Progressive Edu-Kits* Home Radio Course. Build 20 radios and electronic circuits; parts, tools, and instructions included.

115. *Trigger Electronics* has a complete catalog of equipment for those in electronics. Included are kits, parts, ham gear, CB, hi fi and recording equipment.

116. Get the *Hustler* brochure illustrating their complete line of CB and monitor radio antennas.

117. *Teaberry's* new 6-page folder presents their 6 models of CB transceivers (base and mobile): 1 transceiver for marine-use, and 2 scanner models (the innovative "Crime Fighter" receiver and a pocket-size scanner).

118. CBers, *GC Electronic's* 8-page catalog offers the latest in CB accessories. There are base and mobile mikes; phone plugs; adaptors and connectors; antenna switchers and matchers; TV1 filters; automotive noise suppressor kits; SWR Power and FS meters, etc.

119. *Browning's* mobiles and its famous Golden Eagle base station, are illustrated in detail in the new 1976 catalog. It has full-color photos and specification data on Golden Eagle, LTD and SST models, and on "Brownie," a dramatic new mini-mobile.

120. *Edmund Scientific's* new catalog contains over 4500 products that embrace many sciences and fields.

121. *Cornell Electronics'* "Imperial Thrift Tag Sale" Catalog features TV and radio tubes. You can also find almost anything in electronics.

122. *Radio Shack's* 1976 catalog colorfully illustrates their complete range of kit and wired products for electronics enthusiasts—CB, ham, SWL, hi-fi, experimenter kits, batteries, tools, tubes, wire, cable, etc.

123. Get *Lafayette Radio's* "new look" 1976 catalog with 260 pages of complete electronics equipment. It has larger pictures and easy-to-read type. Over 18,000 items cover hi-fi, CB, ham rigs, accessories, test equipment and tools.

127. There are *Avanti* antennas (mobile & base) for CB and scanner receivers, fully described and illustrated in a new 16-page full-color catalog.

128. A new free catalog is available from *McGee Radio*. It contains electronic product bargains.

129. Semiconductor Supermart is a new 1976 catalog listing project builders' parts, popular CB gear, and test equipment. It features semiconductors—all from *Circuit Specialists*.

130. There are over 350 kits described in *Heath's* new catalog. Virtually every do-it-yourself interest is included—TV, radios, stereo & 4-channel, hi-fi, etc.

131. *E. F. Johnson* offers their CB 2-way radio catalog to help you when you make the American vacation scene. A selection guide to the features of the various messenger models will aid you as you go through the book.

132. If you want courses in assembling your own TV kits, *National Schools* has 10 from which to choose. There is a plan for GIs.

133. Get the new free catalog from *Howard W. Sams*. It describes 100's of books for hobbyists and technicians—books on projects, basic electronics and related subjects.

134. *Sprague Products* has L.E.D. readouts for those who want to build electronic clocks, calculators, etc. Parts lists and helpful schematics are included.

135. The latest edition of *Tab Books'* catalog has an extensive listing of TV, radio and general servicing manuals.

137. *Pace communications* equipment covers 2-way radios for business, industrial and CB operations. Marine radiotelephones and scanning receivers are also in this 18-p. book.

138. *Shakespeare's* new pocket-size catalog lists and describes their full line of fiberglass CB antennas, mounts and accessories offered in 1976.

142. *Royce Electronics'* new full-color catalog updates information on their CB transceivers (base, mobile, handheld). It also describes new product lines—CB antennas and a VHF marine radiotelephone.

144. For a packetful of material, send for *SBE's* material on UHF and VHF scanners, CB mobile transceivers, walkie-talkies, slow-scan TV systems, marine-radios, two-way radios, and accessories.

145. For CBers from *Hy-Gain Electronics Corp.* there is a 50-page, 4-color catalog (base, mobile and marine transceivers, antennas, and accessories). Colorful literature illustrating two models of monitor-scanners is also available.

150. Send for the free *NRI/McGraw Hill* 100-page color catalog detailing over 15 electronics courses. Courses cover TV-audio servicing, industrial and digital computer electronics, CB communications servicing, among others. G.I. Bill approved, courses are sold by mail.

152. Send for the new, free descriptive bulletin from *Finney Co.* It features the Finco line of VOM multi-testers (and accessories) for electronics hobbyists and service technicians.

153. *MFJ* offers a free catalog of amateur radio equipment—CW and SSB audio filters, electronic components, etc. Other lit. is free.

154. A government FCC License can help you qualify for a career in electronics. Send for information from *Cleveland Institute of Electronics*.

155. New for CBers from *Anixter-Mark* is a colorful 4-page brochure detailing their line of base station and mobile antennas, including 6 models of the famous Mark Heliwhip.

156. Send for *Continental Specialties* new bread-boarding prototest devices. They vary in prices from a mini-budget kit at \$19.95. Featured is the new logic monitor, giving information on what it does, how it works, and how to use it.

157. *Dage Scientific Instruments* offers a 16-page booklet on how to build an electronic thermometer with control. Included is an introductory course on thermocouples, schematics and many applications.

101 ELECTRONIC PROJECTS
Box 1849, G.P.O.
New York, NY 10001

1976 Edition
Void after August 20, 1976

Please arrange to have the literature whose numbers I have circled below sent to me as soon as possible. I am enclosing 50¢ for each group of 5 to cover handling. (No stamps, please.) Allow 4-6 weeks for delivery.

101	102	103	104	105	106	107	108	110	111	112	113
115	116	117	118	119	120	121	122	123	127	128	129
130	131	132	133	134	135	137	138	142	144	145	150
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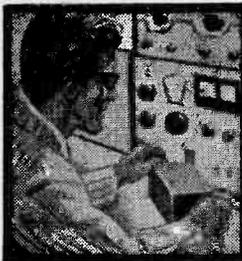
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**ASK HANK,
HE KNOWS!**

Got a question or a problem with a project—ask Hank! Please remember that Hank's column is limited to answering specific electronic project questions that you send to him. Personal replies cannot be made. Sorry, he isn't offering a circuit design service. Write to:

Hank Scott, Workshop Editor
101 ELECTRONIC PROJECTS
229 Park Avenue South
New York, NY 10003

Kids Go CB

Do you have to be 18 or older to operate a CB? I'm 15 years old now, do I have to wait three years?

—G. R., Marietta, OH

You cannot apply for a CB license until you are 18 years old, but your father or other member of your family can apply for a license. Once obtained, anyone in your household can operate CB.

Class A CB Rates an F

What is UHF-CB? A local oil company has a set-up and won't tell me anything.

—G. W., Reidsville, NC

UHF-CB is actually Class A CB. You can read about it in Part 95 of the CB Rules and Regulations. Class A CB is expensive and has difficult licensing conditions. If you want to hobby on UHF, go ham. If you want UHF for business, go business band.

Way Down Low

I want to build a simple tuner that will pick up the low-frequency Navy stations. What should I do?

—V. S., Atlanta, GA

What I would do is add about 20 percent more turns to the tuning coil on the RF section and 20 percent additional fixed capacitance to the tuning capacitor of an ordinary table radio. Do not touch the oscillator components. The receiver should go down to about 400 kHz, and you should be able to pull in several loud stations below the broadcast band.

The Earth Is Round

The indoor FM antenna which came with my Marantz Model 2015 receiver does not pull in distant stations. What type of antenna do I need in order to pick up FM stations 250 to 300 miles away?

—J. S., Mathis, TX

The same antenna will do the job if you string it from a Goodyear blimp. Or is it Goodrich? (Maybe they'll send a set of tires). Joking aside, 300 mile FM reception is out of the question. Maybe a tower will help, but before you send cash, find out if anyone has been successful receiving distant stations and copy their antenna setup.

It's a Lot of Noise

I would like to know if you could advise me on a filter for the reverb for my stereo system. As I increase reverberation, both distortion and hiss increase.

—J. P., West Allis, WI

Reverberation is distortion and the transducer that picks up the reverb introduces hiss. If you want reverb, then you'll have to live with the distortion. Reduce hiss by turning down the set's treble control.

Lay It On Me

Where can I get some of that nice lettering I see on the projects in ELEMENTARY ELECTRONICS?

—D. N., Harbor City, CA

An outfit under the name of Datak has press-on lettering sets for meter, dial and panel marking like the "pros" do. Several different kits are offered. If you can't find one locally, look in the Radio Shack and Lafayette Electronics catalogs. Datak is not alone, there are other suppliers. Commercial art supply stores carry different type styles but only the alphabet and numerals.

MD Hamfest

The Maryland Mobileers Amateur Radio Club would appreciate early publication notice of its Sixth Annual Hamfest to be held on Sunday, June 13, 1976 at Anne Arundel Community College, Arnold, Maryland. Gates open at 9 A.M. Registration: \$2.00. Tailgaters: \$3.00 plus registration fee. Drawings to be held at 3 P.M.: First prize—\$200 Savings Bond, Second prize—\$50 Savings Bond, Third prize—\$25 Savings Bond. Talk-ins on 146.10/70-146.52-146.16/76. Thanks!

—WA3WAN, Millersville, MD

You got it!

Can You Help Out?

△ Bruce Ritter has to do some extensive restoration work on a CMX 46159 radio that the previous owner modified. If you can help, write to Bruce at 22208 Ave. San Luis, Woodland Hills, CA 91364.

I wish to thank all those readers who lent a helping hand in the past. Your help made many people happy and made my work enjoyable. I do not have the space to publish thank you letters, but rest assured they come every week. Keep up the good work.

△ Michael Liben would like to build a phase shifter and other audio devices for use with the electronics used by the rock group he manages. If you can help, write to Mike in care of Charles Octet and Fire-dog, 8 Willis Lane, East Falmouth, MA 02536.

△ Walter S. Harley of 2436 Streetsboro Rd., Peninsula, OH 44264 needs circuit and specifications for the Triumph Model 840 oscillograph.

△ If you can, send to Allen Fryou, 3735 Fairmont Dr., New Orleans, LA 70122 schematic and wiring diagrams for Echo-phase (Echophone Commercial) 3-band radio.

△ Ric Keefee of 8402 John Dowel Rd. #14, Tacoma, WA 98499 needs the schematic diagram and instruction book for the Marka-Sweep Model 1-F made by Kay Electric Co. of Pine Brook, NJ.

△ Kirk Butler has a 1942 Philco Model 42-360 receiver that he wants to restore. He needs help. Write him at 57045 Mayflower Rd., Lot 96, South Bend, IN 46619.

△ Our good buddy, Kevin Kendell of 24 Smith St., Glen Head, NY 11545 would like the schematic diagram for his U.S.L. Contact 8 CB transceiver. Help him out, boys.

△ Jeff Lendaro of 25 Fanton Rd., Danbury, CT 06810 would like to buy or trade for a Radiola 28. Write to him.

△ Anyone have a schematic diagram of an old Tecraft, Model Falcon Mk IV CB transceiver? If yes, send it to Ron Eichel, P.O. Box 237, Rockaway, NJ 07866.

△ Jerry D. Pitcock of 607 Chickadee, Apt. 7, Little Rock, AR 72207 would like to obtain a Hammarlund SP400SX or equivalent receiver. Drop Jerry a line if you can help.

△ Dr. Frank Porth would like a schematic diagram of a Korting Studiotone, Trident T200 made by Schneider Sound Equipment, Ltd. of West Germany. The good doctor receives mail at Box 815, Fort Qu'Appelle, Saskatchewan, Canada S0G-1S0. ■

CALLING ALL ACE CB REPORTERS

□ CB is making news all over the country and we'd like to keep you up-to-the-minute on the latest developments. But we'll need your help. Got a funny story about an experience you've had with CB radio? How about an exciting or unusual experience? Send us short (400-500 words) personal accounts of your experiences with CB. Pictures can make or break a story, so whenever it's possible, include at least one black and white glossy photo of CB in action. If you're talking about a CB gathering, get pictures of the highlights. If you're talking about an emergency or a crisis where CB played a role, get pictures to go along with your account. Even if it's a funny story, if you can, get a funny photo to illustrate it.

We'll compile the best of what we receive and we'll publish it in ELEMENTARY ELECTRONICS in a regular column called *CB's Buzzin' Bee*. We'll pay up to \$25 for each item used. Submit your stories to *CB's Buzzin' Bee*, ELEMENTARY ELECTRONICS, 229 Park Avenue South, New York, NY 10003. Keep your eyes open, your pencils writin', your cameras shootin', and we'll get this column buzzin'—come on . . . ■

ELECTRONICS INFORMATION CENTER

FREE

TO ALL READERS OF 101 ELECTRONIC PROJECTS

At no cost to you the Editor will have information and literature about products and services advertised in this issue sent to you at no cost!

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- Tear out the coupon.
- Circle the number under the ad that interests you.
- Circle the number identifying products mentioned in columns and articles.
- If you wish, answer the simple questionnaire on the coupon.
- Print or type your name and address on the coupon.
- Mail to 101 ELECTRONIC PROJECTS before the expiration date.
- Please allow 4-6 weeks for delivery.

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101 ELECTRONIC PROJECTS wants you to get all the product information as soon as possible—but you have to get the ball rolling!

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41	42	43	44	45	46	47	48	49	50

We would like to know about you. Please help us by placing an "X" in the appropriate boxes. • Do you own a CB transceiver? ⁷⁶ Yes ⁷⁷ No • If your answer is Yes, please check appropriate boxes below if you have one or more of the types indicated. ⁷⁸ Base Station ⁷⁹ Mobile Unit ⁸⁰ Portable • Do you use CB in your work? ⁸¹ Yes ⁸² No.

Name (print clearly)

Address

City

State

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Address

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State

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CB LINGO



MERCY SAKES ALIVE, Good Buddys, let the hammer up on those doggone Papermates. Polish Ham ten-fours your bodacious requests. Here's a bundle of CB lingo you've been picking up on your ears like bugs on a bumper for sure. Brain bank 'em and you'll turn into a regular CB ratchet jaws. Four? Now, Good Buddys, keep the greasy side down and the shiny side up. Stack them eights. We gone.

—POLISH HAM, KGK 3915

Advertising—A marked police car that has its lights turned on.

Back door—Last vehicle (truck) in a string of three or more—all in contact with each other.

Bear—Policeman.

Bear Cave—Police station or post on

highway.

Beat the Bushes—"Front door" (lead vehicle) looks for Smokey by going fast enough to draw him out of hiding. See also "Shake the leaves."

Bodacious—Good signal; clear transmission.

Break One-Oh—Also "Break 10"—I want to talk (on Channel 10).

Bushes—One-half-ton; a 20-ton load would be 40 bushels.

Camera—Police radar unit.

Catch You on the Old Flip/Flop—Catch you on the radio on a return trip.

Check the Seatcovers—Watch for a female driver with her skirt pulled up.

Chicken Coop—Highway truck weigh station.

Clean—No Smokies around.

Comic Books—Truckdrivers' log sheets or log books.

Cotton Picker—Cotton picker (instead of four-mouty words on the air).

County Mouty—County sheriff or highway patrol.

Ears—Antennas or radios. (See also "Smokey with Ears.")

Eatum-Up—Roadside restaurant.

Eighteen Wheeler—Any semi-tractor truck with any number of wheels.

Fat Load—Overload, more weight than local state law allows.

Feed the Bears—Collect a ticket from Smokey.

Five-Five-55, the legal limit in most places.

Four—Abbreviation of "10-4," meaning "OK."

Four Ten—10-4, emphatically.

Four Wheeler—Passenger car.

Front Door—First vehicle (truck) in string of three or more trucks in radio contact.

Grass—Side of the road or median strip.

Green Stamps—Dollars.

Green Stamp Road—Tollway.

Hammer—Accelerator.

Hammer Down—Highballing; driving fast.

Handle—Slang names used by CBers.

In the Grass—Parked or pulled over on the median strip.

(Continued on page 77)

SCOPE DOOPE

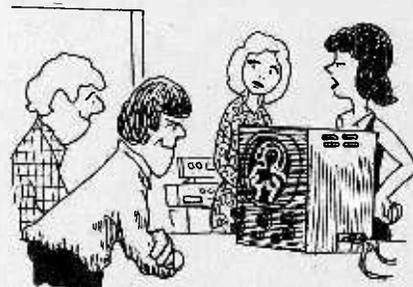
By Jack Schmidt



"... And he uses this one so he knows when to swear."



"Buy it today and we'll give you an extra pack of sine waves!"



"It's hard to believe, Alicè, that grown men would sit around for hours watching sine waves!"



"It looks like I'll have to take it into the shop, Lady!"



"I don't really know how to use it, but I stare at it intently when Martha wants something done."



"Harry, you'd better take a little time away from your hobby..."

101

ELECTRONIC PROJECTS FOR UNDER \$15—ALL EASY TO BUILD 1976 EDITION

EVEN a quick glance through this issue of 101 ELECTRONIC PROJECTS should tell you something is really different about this collection of experimenter projects. You haven't seen it? Okay, take another look at a handful of projects. Do you see any oddball or industrial-only solid-state devices? OEM (only electrical manufacturers) coils or capacitors? Specialty-shop or custom-fabrication components? Nope! You don't see any of these, nor do you see transistors that went out of stock six years ago, or solid-state devices from discontinued hobby/experimenter lines.

Fact is, every project in this book can be built with standard replacement-grade components available at local distributors; with solid-state devices available in the more or less universal Motorola HEP, Calectro, Radio Shack, and Lafayette lines; or with components generally stocked by at least three national "surplus" dealers.

Every project in this book has been checked and rechecked to be certain *you, the builder*, can get the parts. In most instances we have checked carefully to be certain we have used the most convenient or popular device. For example, at the time this book was prepared there were literally millions of 2N2222 transistors available on the surplus market, and they often cost something like 10-for-\$1. So we specified this transistor for several projects; but before we went ahead and suggested the 2N2222 we made certain at least

one national distributor had its direct equivalent in its line, in this instance the Radio Shack 276-2009. In this way, even if every one of the 2N2222s on the surplus market is sold, which is unlikely, you can be certain its direct replacement will be readily available through 1976.

Similarly, to insure you can get the parts needed we often specified HEP or RCA SK replacement types rather than a specific Motorola or RCA device, even though they are priced slightly higher (reflecting the peg-board packaging and replacement guidebook costs). The reason we recommend the higher-priced replacement-type devices is because we know the average builder hasn't one chance in a hundred of locating the lower-cost industrial versions; and even if you could locate the distributor he's probably got a \$25 minimum order.

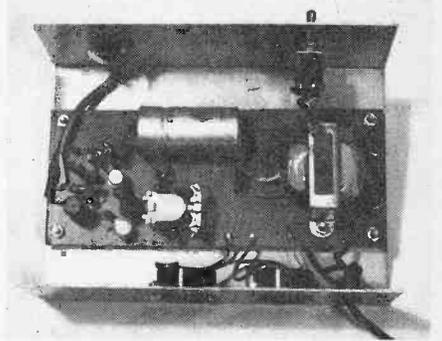
We have carried the idea of *general availability* to other components besides transistors. For example, the 1N914 diode is very popular and readily available from many surplus dealers. It is not readily available, however, from local distributors. In every instance where a diode is needed we have tried to use the general purpose 1N60 or 1N34 for small signal use, and have suggested the 1N914 only when its particular characteristics will make the project work better than with a general-purpose diode.

For silicon rectifiers with less than 1-

ampere ratings we have usually indicated only the needed characteristics because just about every dealer has a wide assortment of silicon rectifiers and you're certain to find what you need locally. Where there might be some confusion about values, or where we believe you can save a few cents because we know there's a good surplus stock around, we will specifically suggest a particular rectifier or its equivalent.

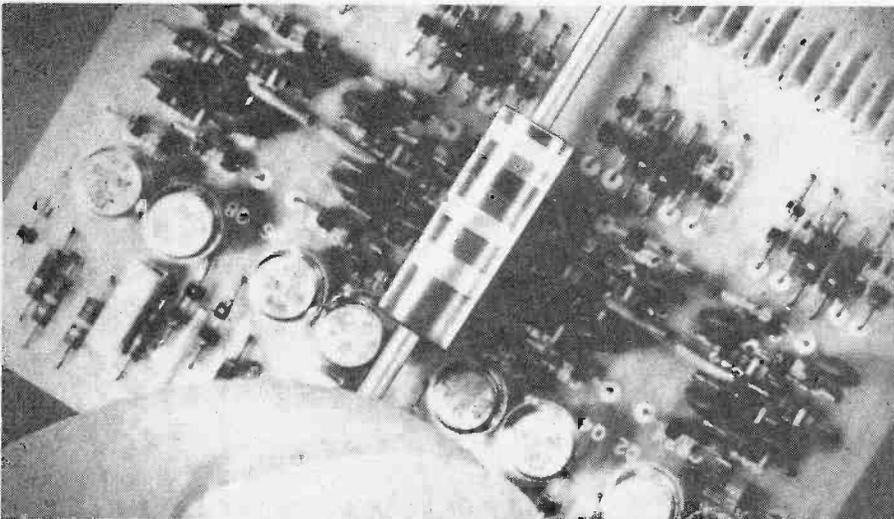
Where RF coils are needed we have tried to stick with the J. W. Miller brand because Miller coils are standard-stock at many local distributors and at the mail order houses such as Lafayette, Allied Radio and Burstein-Applebee (B-A). Should you want to make a coil using a toroid core don't waste your time looking locally or in any general parts catalogs; write directly to Amidon.

Old New Ideas. You are certain to



Those old projects are a gold mine. If you try to salvage every resistor and capacitor you'll probably get bored and scrap the whole bit. Go for the big, expensive hardware: AC sockets, transformer, relay, switch, and high- μ F capacitor. The rest is scrapped. Just these six items alone represent \$18.89 at current prices and going higher every day. Would you believe this entire project including cabinet cost under \$10 just a few years ago—using "all new" components?

Where did I find thee? "Why on an old printed circuit board along with eight 2N1305 transistors, 14 signal diodes, 14 disc capacitors and a bunch of other resistors like me in size but of different values," said the color-coded 5%-tolerance resistor. This surplus bargain was picked up locally by the author for only one dollar.



run across several projects that look familiar. They should be, because we haven't changed some well-proven projects simply to make them new or different. (Trying to conceal an old idea with new packaging often produces third-rate performance). For example, the basic amplified super-sensitive field strength meter (FSM) cannot be improved upon; radio amateurs and CBERs have been using the same general circuit for some 20 years. While it might look familiar to you, to the newcomer to ham radio or CB it's a brand new idea. Also, we have updated the project with a low-leakage silicon transistor because there's no way you'll get the germanium transistor originally used when the project was first introduced some 20 years ago.

There are a few of the most popular tried-and-true projects scattered throughout this book; in all instances they have been updated with modern, easy-to-get components.

Keeping Cost Down. In this period of rapid inflation a \$10 project can easily wind up costing some \$20 or \$30 if you buy precision quality parts. You can probably count on one hand the number of projects that require some-

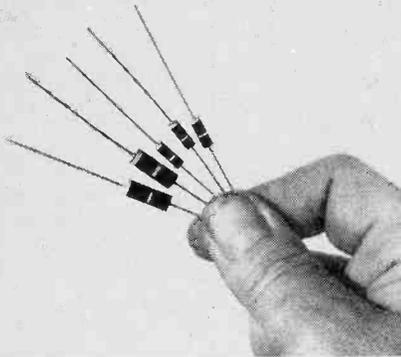
thing like a silver mica 2% tolerance capacitor, and even then the project will take only two or three of these higher-cost items. In every instance where a specific precision, or tolerance, or type is required for the project to work as described we have specified the exact tolerance or type needed. In all other instances you should use the lowest cost part you can get, because a higher grade component won't make one bit of difference in the final performance—it will only increase the overall cost.

For example, many projects use electrolytic capacitors. You can get *popular values* from "surplus" dealers for as little as 10 cents, or as high as 70 cents. Substitute tantalum type capacitors and you will pay as high as \$5 each, yet the project won't work any better. You get the same deal with resistors. You can purchase ordinary 1/2 watt 10% carbon resistors for as little as 3 cents each in 100-piece assortments. Unless otherwise specified all projects are designed to work well with this run-of-the-mill resistor. A 60-cent, or \$1 precision resistor won't work any better in the circuit. When a better resistor might help, in cases such as wanting to keep noise to a minimum in an audio pre-

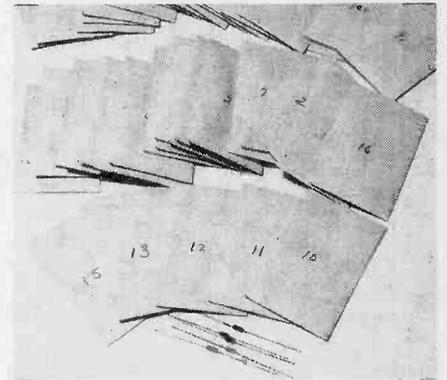
amplifier, we will specify "low-noise resistor"; but if we don't say anything about higher quality components don't waste your money.

Cabinet or Breadboard? In most instances a project will work if you just twist the leads together and keep them from shorting, for most projects aren't critical as to layout, assembly or cabinet material. Naturally, customary precautions such as using short leads for RF circuits should be followed. But where some special attention must be given to the layout or wiring we make specific recommendations. For example, if a project requires a metal cabinet it will be so stated. If a solid-state device requires a heat sink, again, such will be stated. When no recommendation is given as to cabinet type, use whatever you'd like; and if there's no specific recommendation for a heat sink, none is needed.

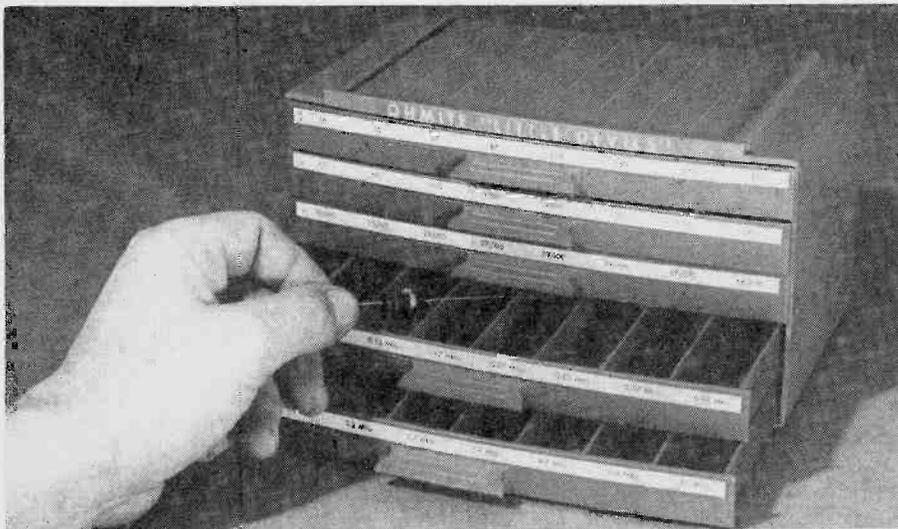
The only place where you should use a little extra care even if not spelled out in the project is with integrated circuits (ICs). Bypass capacitors, those connected from an IC terminal to ground, should be as close to the IC as is physically possible. If you decide to whip up a printed circuit (PC) board



If you don't mind separating the resistors yourself the small "100 for \$..." resistor kits are the best buy, and you might wind up with precision lo-noise type resistors; but in general you get standard resistors. As an example of what you get and save, the resistor on top is 10,000 ohms, 1/2 watt, 10% and cost 15¢ at the local "parts distributor." The resistor on bottom looks the same, and it is, but it cost only 3¢ in a "100 for \$3" kit. But make certain the kit has standard values in decent proportions. Too often, the "100 for..." kits have oddball values in quantity, like 30 pieces of 1 megohm, and 1 meg isn't too common in solid state projects.



Real savings and convenience come in a resistor "proto-kit." Averaging out to less than 4¢ apiece, this 1/4-watt, 5%-tolerance kit has ten resistors of every standard 5% value from 10 ohms to 1 megohm. Part of the cost goes into the packaging that separates each value in a small envelope that fits a standard kitchen drawer cutlery tray—making for convenient storage and value selection. Smaller kits are also available in standard 10%-tolerance values at proportional reduction in cost.



What do you do with salvaged and excess resistors? File them! Here, the author files resistors in a four-shelf bin he's used for years. If you can't find one, look in 5- & 10¢ stores for plastic bins used to file buttons and small parts. Surplus resistors are never used if you can find them quickly.



Never throw out a loudspeaker—they cost too much! Salvage from old radios and television sets, even old car radios and CB sets. True, they go bad with time and dampness, but if you have a supply, a few should be serviceable. Fix small punctures and tears in the paper cone with nail polish. Store with cardboard over the face of the cone to protect it from accidental damage.

for the project don't put the IC on one edge of the board and the power supply bypass capacitors on the opposite edge. Follow this rule even if it complicates the PC foil layout and perhaps requires a few extra jumpers to get the bypass capacitors near the IC.

Voltage Regulators. As a general rule, linear IC circuits such as amplifiers, and even oscillators, do not require regulated power supplies. As long as you use the voltage range indicated, or approximately the specified voltage when no range is given, you'll come out okay. If you're in doubt, try to stay under the specified voltage; the project will work if you're off by a volt or so. For example, if an op-amp project calls for ± 12 VDC and your power supply delivers ± 11 volts go ahead and use it—it's not all that critical.

On the other hand, TTL logic circuits require a regulated power supply of 5 to about 5.5 volts maximum. (Yes,

if it comes out 4.5 volts that's okay. It's 5.5 volts that's the safety limit.) Always use a regulated power source—either a commercial power supply or an on-card regulator using one of the popular 3-terminal regulators.

Use A Socket. Let's be honest. Not every solid state device sold by surplus dealers or name-brand packagers works. You can expect that somewhere in every few projects at least one—possibly more—brand new device will be defective. Now, it's very easy to pull out a three-lead transistor, or a two-lead rectifier. Even if you destroy the device in most instances all that's lost is a 15-cent-to-\$1 transistor or diode. But even though some ICs sell for as low as 15 cents (like the 7400), after you get finished trying to unsolder anywhere from eight to sixteen connections there's a good chance you have ruined a PC board and possibly a handful of components. As a general rule, we suggest that a socket be used for most ICs. This way, it's easy to troubleshoot by simply plugging in a new component. IC sockets save time, money, and in the end, your nerves.

Fudge Factors. In virtually no instance will you find any projects that call for "fudging" a parts value to get the project to work; none of the "Adjust potentiometer R3 until you hear clean sound" type of thing. Some projects do require "tweaking" of parts value because there's no other way to get around the problem without adding three to five extra stages for stabilization; but there's no reason why a one-, two-, or three-transistor project has to have fudged parts values to work, and you won't find that kind of thing in this book.

But the shoe fits the other way too. The projects will work only with the values indicated. If we call for a 1000 ohm resistor don't substitute 860 ohms or 1500 ohms; it probably won't work. Similarly, don't substitute completely different transistor types; if we call for a 2N2222 don't try to reverse battery polarity and get away with using a 2N217 you happen to have lying around.

About the only things you can do is substitute $\frac{1}{4}$ - or $\frac{1}{8}$ -watt resistors when $\frac{1}{2}$ -watt is specified, and raise the voltage rating for diodes and electrolytic capacitors. Most projects call for $\frac{1}{2}$ -watt resistors because they are the least expensive. If you feel like building a four-transistor amplifier into a sewing thimble by all means use miniature components. As for capacitors, we generally specify the lowest voltage rating which is safe to use, or the lowest-cost capacitor. But be careful, when you see



An example of surplus buying. Top axial lead capacitor costs 49¢ in a blister pack. Lower capacitor of same value with single-ended leads (printed circuit) was purchased from a surplus dealer for 5¢. Isn't it worth 42¢ just to re-arrange a couple of circuit leads?

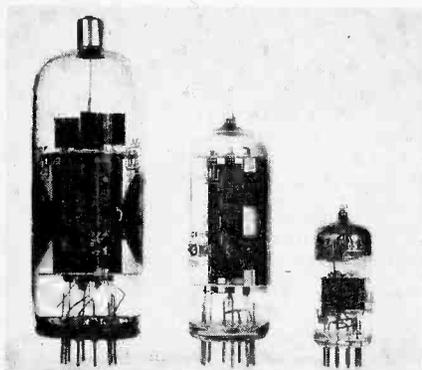
a 500-volt capacitor used in a circuit with an under 20-volt power supply—don't assume it's a mistake. There's some reason for the high voltage rating. Normally, the project requires the high voltage characteristics associated with the specified capacitor. The circuit's input, or output, DC blocking capacitor may also require high voltage rating because the project is expected to be used with associated equipment possibly having very high DC voltage.

The general rule for capacitors in our projects is: "Use the lowest cost type or style you can get unless otherwise specified in the parts list."

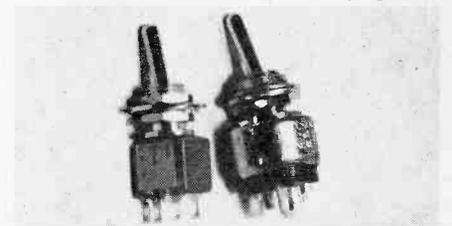
Save. Save. Save. Potentiometers are another place you can throw your money away by "buying the best." Nearly all the projects can get by with any potentiometer, with any taper—audio, linear, semi-log, etc. A "standard" potentiometer costs upwards of \$1; a surplus pot sells for well under \$1, and sometimes you can get up to five for that price. Unless we specify a particular type or taper use the lowest cost pot, they just are not critical.

One of your best sources for low cost components are the surplus dealers that advertise in this book and in our sister publication ELEMENTARY ELECTRONICS. These dealers often have "specials" on assortments like the previ-

(Continued on page 98)



Don't quit on vacuum tubes. There are many worthwhile projects you can build from old magazine articles (even some new ones) that use vacuum tubes. In many cases you can salvage vacuum tubes from old projects, radios, hi-fi equipment and television sets at no cost. Wipe them clean with a damp cloth. If you can't read the tube-type markings, breathe on the glass, it may bring up the lettering.



Thank heaven for surplus! The SPDT mini-switch at bottom came right off a peg-board rack for \$1.75. The SPDT mini-switch on top has the same contact ratings and was purchased new through a mail order surplus house at 10 for \$1, or 10¢ each. Maybe there would be a difference in performance on a NASA space shot, but not in a hobby project.

101

ELECTRONIC PROJECTS FOR UNDER \$15

1 CB Remote Volume Control



□ Your CB rig can do double duty by feeding signals around the house. But to avoid blasting the sound in one location while it's a pipsqueak somewhere else, connect an L pad at each speaker, then run the transceiver gain nearly wide open.

The L pad is a special impedance-matching volume control that lets you adjust the volume at each individual speaker from full off to full on, without affecting the volume at

**PARTS LIST FOR
CB REMOTE VOLUME CONTROL**

L1, L2—8-ohm L pad, Radio Shack 40-979 for stereo, Radio Shack 40-980 for mono
PL1—Plug to match your external speaker jack

CB
TRANSCEIVER
EXTERNAL
SPEAKER
JACK

the other speakers. Regardless of the impedance of the speakers you're

using, best results are obtained with 8 ohm L pads.

2 CB Modulation Monitor



□ You can measure CB audio modulation percentage with the accuracy of the local broadcast station—'cause you'll be using the same type system.

In building the circuit, keep R1, D1 and R2's leads as short as possible. Meter M1 must be a high-speed model, such as the Alco P-1000 series. Connect the meter across the transceiver's RF output with a coaxial T-connector in the transmission line. As you key the transmitter, set switch S1 to *calibrate* and adjust R2 for a full scale reading. Accuracy will be within 10%.

Better accuracy is assured if R2's adjustment and meter calibrating point is compared against a scope modulation pattern. Don't compare this meter against commercial CB modulation meters. On a tone signal, this one is less accurate, but on speech modulation, the commercial models are not as accurate as a circuit of this type.

**PARTS LIST FOR
CB MODULATION MONITOR**

<p>C1—500-pF, 100-VDC capacitor C2—10-uF, 10-VDC electrolytic capacitor C3—200-pF, 100-VDC capacitor C4—300pF, 100-VDC capacitor D1, D2, D3—1N60 germanium diode</p>	<p>M1—0-1 mA DC high-speed meter (Alco P-1000 or equiv.) R1, R4—1000-ohm, ½-watt resistor R2—1000-ohm pot R3—910-ohm, ½-watt resistor; 5% S1—Spdt spring-return switch</p>
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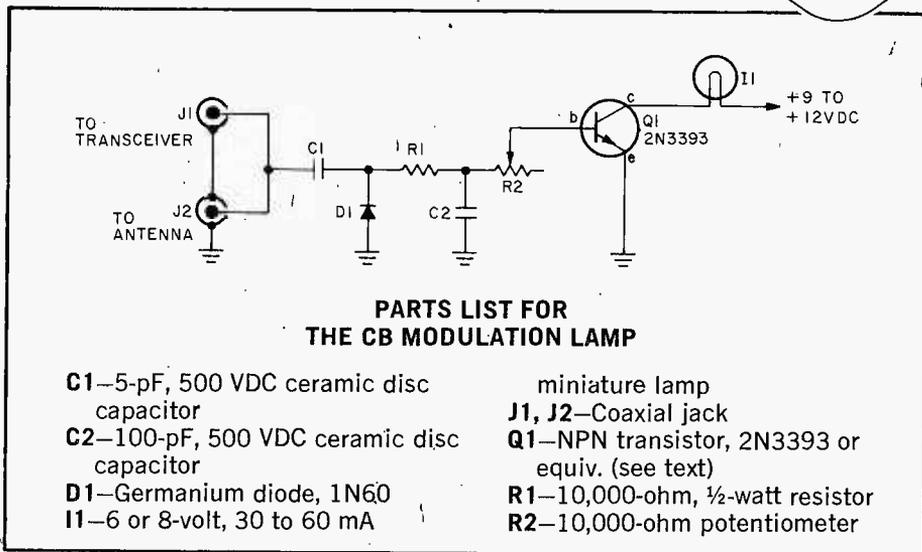
3

CB Modulation Lamp



□ Less than \$2 is all that's needed to be certain that what you put into the mike is really getting to your sky hook. Working directly from a minute sample of the transceiver's RF output, the Modulamp will glow only if there is a carrier output and modulation. So if no one replies to your call and the lamp glows in step with your modulation, you can at least be certain it's not the transceiver that's at fault.

If the unit is built into a small metal box, jacks J1 and J2 should match the existing transmission line connectors. If you build the Modulamp directly into your transceiver, simply connect capacitor C1 to the RF output jack (and forget about J1 and J2). To adjust, simply talk into the mike in your normal voice and



adjust trimmer potentiometer R2 until lamp I1 flashes in step with the modulation. If I1 will not flash re-

gardless of R2's adjustment, substitute a higher gain transistor for Q1 (try a 2N3392).

4

Scope Your CB Signal



□ Critical inspection of a transmitter signal and accurate measurement of modulation is possible only with an oscilloscope. Note that you must use your scope's vertical *plate* connection. The RF signal can't travel through the vertical amplifier unless your scope happens to cost a kilobuck or more. Unfortunately, a CB transmitter's RF output is so low the scope pattern is barely discernible—unless

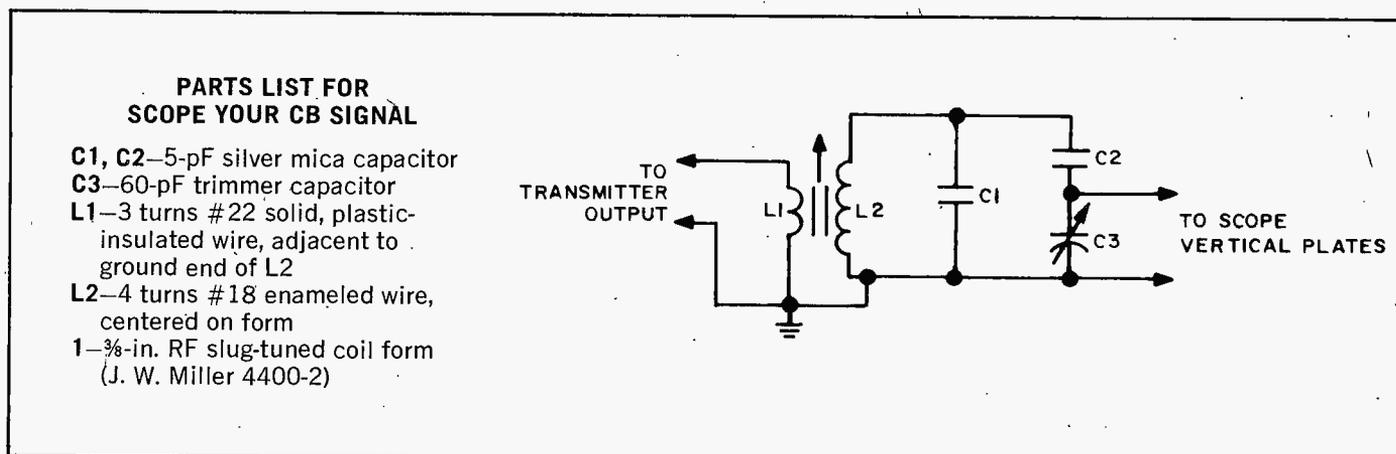
you use this booster.

Since a scope's vertical plate connections operate at a high input voltage, it requires that a CB transmitter's output be fed to a resonant circuit to step up to high RF voltage. The circuit shown will just about fill a 5-in. scope from edge to edge with virtually no loss at the transmitter.

First, wind L2 on the center of a ⅜-in. slug-tuned coil form

L1 adjacent to the ground end of L2. Connect L1 across the transmitter output with the CB antenna system also connected.

Adjust L1's slug for minimum standing-wave ratio (SWR). If the coil is correctly made, there should be no change in the antenna system's SWR. Adjust C3 for the desired scope trace height; it may be necessary to reset L1 each time C3 is adjusted.



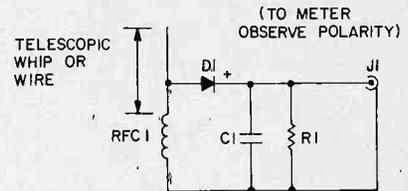
5 CB RF Detector For VOM/VTVM

□ Though CB field strength meters aren't too expensive, for many CBers there's often no real reason to have one, until the time comes when you need to check out your rig or antenna, and then it's too late. But if you have a VOM or VTVM and some spare parts around you can throw a CB RF detector together in a few minutes time. Fact is, you don't even have to solder the wires, just twist them together.

While RFC1 is shown as 1-mH or 2.5-mH, those are optimum values. Just about any RF choke can be used, including any choke salvaged from an old CB transceiver. Similarly, C1 can be 47-pF or any other higher value to 0.001-uF. And if R1

PARTS LIST FOR CB RF DETECTOR FOR VOM/VTVM

- RFC1—1- or 2.5-mH RF choke, see text
- R1—220,000-ohms resistor
- C1—47-pF, ceramic disc capacitor
- D1—Germanium diode, type 1N34/1N60 or equiv.
- J1—Phono jack



is anywhere near 220,000-ohms, that's okay too.

Simply connect the RF detector's output to your VOM or VTVM and select the meter range that gives a convenient scale indication. If your

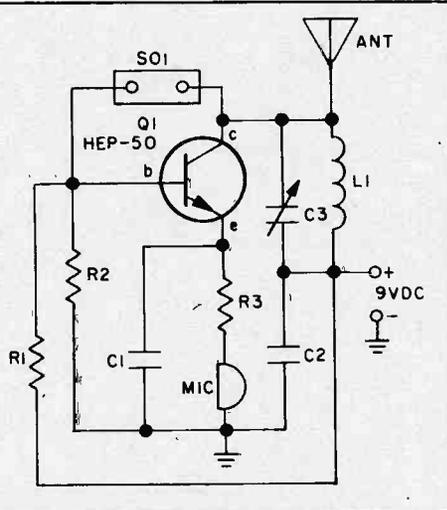
meter reads reverse off-scale, just switch the test lead connections. If you build the detector as a "permanent project" a phono jack output will insure proper meter polarity every time.

6 CB Pager

○ UPDATED ○

PARTS LIST FOR CB PAGER

- C1, C2—0.001-uF, 50-VDC disc capacitor
- C3—60-pF trimmer capacitor
- L1—10 turns #16 enameled wire wound on 3/8-in. form, spaced 1 in. end to end
- MIC—Carbon microphone element
- Q1—HEP-50 npn transistor
- R1—47,000-ohm, 1/2-watt resistor
- R2—10,000-ohm, 1/2-watt resistor
- R3—330-ohm, 1/2-watt resistor
- SO1—Crystal socket



□ Small enough to fit into a cigarette pack, this pocket pager produces a

low-output signal on the Citizen's Band (27 MHz) suitable for paging

inside a building. The signal is strong enough to be heard on a standard transceiver, but not enough to cause receiver overload.

If only one crystal frequency is needed, socket SO1 can be eliminated and an over-tone type crystal soldered directly into the circuit. Salvage crystals from junked units. The whip antenna is a standard walkie-talkie three-section replacement type. The carbon microphone can be a telephone transmitter.

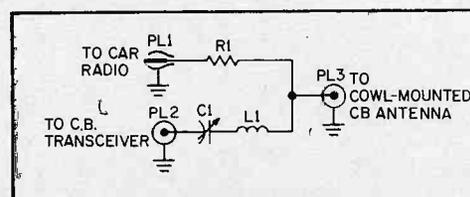
To tune, receive the signal on an S-meter-equipped receiver and adjust trimmer C3 for maximum output. Key the transmitter a few times to check crystal activity. If starting is intermittent, slightly alter C3's adjustment until operation is consistent.

The power supply can be a standard 9V (2U6) battery.

7 CB/AM Coupler

○ UPDATED ○

□ If you're tired of having your friendly new car dealer knock \$100 or so off the trade-in allowance because you drill holes in the body for CB antennas, simply replace the existing auto radio antenna with a cowl-mount CB whip, install the CB



GET BC FROM A CB ANTENNA

- C1—47-pF trimmer capacitor
- L1—RF choke, Ohmite Z-144 or equiv.
- R1—560-ohm, 1/2-watt resistor

coupler and no one will know you ever had a CB whip on the car.

Cowl-mounted CB whips generally are exact replacements for auto antennas. The coupler automatically connects the antenna to either the car radio or CB rig. When transmitting on CB the series tuned circuit of C1-L1 passes the RF along to the antenna, while R1 blocks the RF from

feeding through to the car radio. When receiving broadcast stations C1-L1 represents a high impedance, thereby blocking the signals from entering the CB rig where they would short-out. Instead, the broadcast signals pass through R1 to the car radio.

Build the coupler in a small metal enclosure. Plugs PL1, PL2 and

PL3 should match the existing jacks on the radio equipment, usually PL-259 for the CB set and a Motorola-type for the AM or AM/FM auto radio. To adjust C1, connect an SWR meter between PL2 and the transceiver and adjust C1 for minimum SWR.

8

Hi Z Earphone Booster

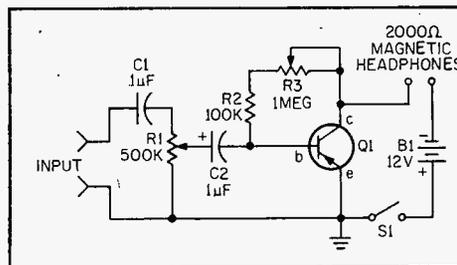


Quite often the audio output from small projects is just barely sufficient to produce a recognizable signal in standard experimenter magnetic earphones. Yet a handful of surplus components will provide enough gain to turn that whisper sound into a roar.

Specifically intended for use with magnetic earphones of from 1000 to 5000 ohms impedance, the Headphone Amplifier can do double-duty as an audio signal tracer. Transistor Q1 can be any PNP of the 2N2613 variety. Even the 10-for-a-buck kind will work. Volume control R1 should have an audio taper. Distortion control R3 can have any taper. Make

certain C2's polarity is correct; the positive terminal connects to volume control R1 (wiper terminal). Adjust distortion control R3 for best sound quality. If you use a jack and plug to connect your headphones to this amp, you can eliminate on-off switch S1 because power is removed

whenever the headphones are disconnected.

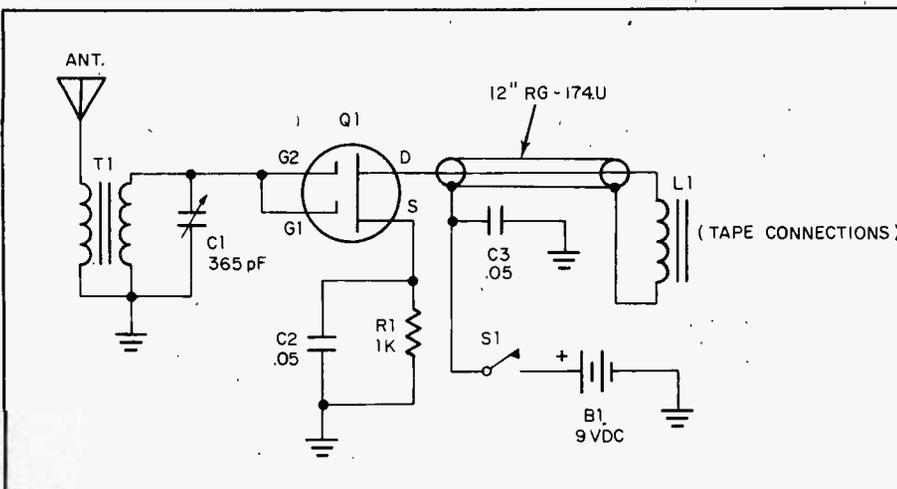


PARTS LIST FOR HI Z EARPHONE BOOSTER

- B1**—Battery, 12 volts (two RCA VSO68 in series or equiv.)
- C1**—0.1-µF capacitor, 15 VDC or better
- C2**—1-µF electrolytic capacitor, 15 VDC or better
- Q1**—PNP transistor, 2N2613 or equiv. (Radio Shack 276-2003)
- R1**—500,000-ohm audio taper potentiometer
- R2**—100,000-ohm, ½-watt resistor
- R3**—1-Megohm potentiometer, any taper

9

Wireless BC Booster



PARTS LIST FOR WIRELESS BC BOOSTER

- B1**—9-volt transistor battery
- C1**—365-pF tuning capacitor (Radio Shack 272-1341 or equiv.)
- C2, C3**—0.05-µF disc capacitor
- L1**—Loopstick coil (Radio Shack 270-1430)
- Q1**—FET, RCA 40822, 3N187, or equiv.
- R1**—1000-ohms, ½-watt resistor
- S1**—Spst slide or toggle switch
- T1**—J. W. Miller A-5495A antenna coil
- Misc.**—Co-axial cable, cabinet

Just about any standard radio can be turned into a DX hound with this easy-to-build wireless broadcast band booster. Transistor Q1 in conjunction

with antenna coil T1 provides from 10 to 20 dB extra gain to snare those weak BC stations. The project should be assembled in a metal cabinet as

“feedback” from coupling coil L1 to the input will cause oscillation.

Field effect transistor, (FET) Q1 is the type with built-in diode protec-

tion so you don't have to worry about strong signals or static discharges.

To use the booster, first set C1 to the approximate frequency of the desired station—C1 is supplied with a calibrated dial. Place coil L1 parallel to the rod antenna inside the radio.

L1 can be taped to the back of the radio. Turn the radio on and tune in the desired station; then peak the signal with C1. C1 can also be used to reject excessively strong signals which might be interfering with the desired station. You cannot, however, reject

a station close to, or on the same frequency as the desired station.

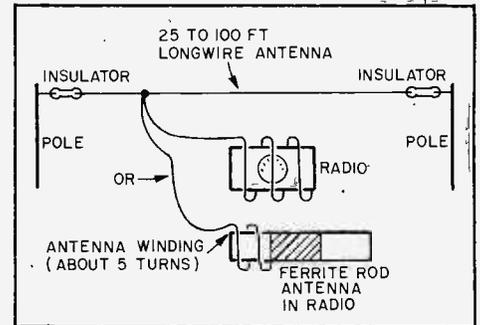
The antenna can be any length of wire from 3 feet or longer. If you use a metal cabinet connect the antenna into the circuit through an insulated binding post.

10 No Parts BC Booster

Just about any transistor radio can be made a "DX hound" with the No Parts BC Booster. Simply bring in the end of an outdoor "longwire" antenna and wrap the end around the radio about 5 times.

Even better reception is possible if

you open the radio and wrap about 5 turns around the rod antenna immediately adjacent to the antenna coil mounted on the rod. Make certain the ends of the antenna are insulated with glass or ceramic insulators.

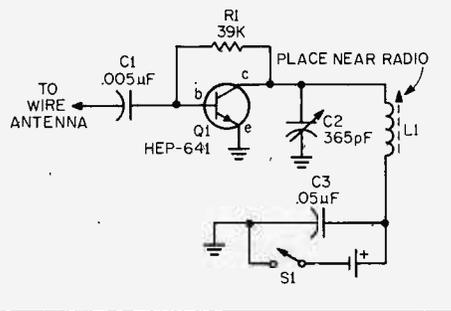


11 Pep Up a Pocket BCB



PARTS LIST FOR PEP UP A POCKET BCB

- B1—15-volt penlight AA battery
- C1—0.005- μ F disc capacitor, 25 VDC or better
- C2—365-pF miniature tuning capacitor with dial
- C3—0.05- μ F disc capacitor, 25 VDC or better
- L1—Loopstick for C2 (Radio Shack 270-1430)
- Q1—NPN transistor, HEP-641 (Radio Shack 276-2002)
- R1—39,000-ohm, $\frac{1}{2}$ -watt resistor
- S1—Spst switch (on-off)



Here's a low cost project that can pack a lot of extra sensitivity into an ordinary transistor pocket radio. You'll be able to do some extensive broadcast band DX'ing with that

pocket portable the bank gave you when you opened an account.

Assemble the unit in a small plastic cabinet with coil L1 cemented to the side or back of the cabinet; use an adhesive such as General Electric's RTV. Connect from 10 to 80 feet of antenna wire to the input, and position this pocket booster flat against the radio with L1 directly behind the loopstick antenna built into the radio. Tune capacitor C2 to the approximate frequency you want to receive, then turn on the radio and listen to the signals boom in. Keep in mind that the receiver's normal AVC action will mask any boost applied to strong signals.

12 Crystal-Transistor Radio

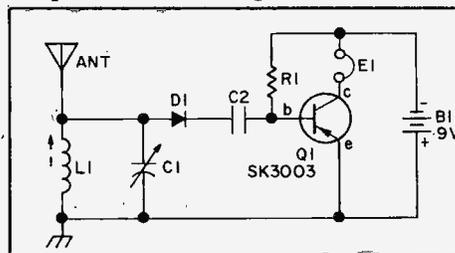


That old favorite, the crystal radio, becomes more than just a weak voice buried in the headphone when it's amplified with a "junk box" amplifier.

Transistor Q1 can be just about any general purpose pnp germanium type such as the 2N107, 2N109, etc. The SK3003 specified gives a little extra gain.

L1 is any ferrite antenna coil for

the broadcast band, while E1 must be a magnetic headset for maximum output level. To align the receiver,



PARTS LIST FOR CRYSTAL-TRANSISTOR RADIO

- B1—9-V battery
- C1—365-pF tuning capacitor
- C2—0.2- μ F, 10-VDC capacitor
- D1—1N60 diode
- E1—Hi-impedance magnetic earphone (Calectro J4-825)
- L1—Ferrite antenna coil (Radio Shack 270-1430)
- Q1—SK3003 (RCA)
- R1—100,000-ohm, $\frac{1}{2}$ -watt resistor

set C1's dial to the known frequency of a strong local station and adjust L1's slug until you hear the station in the phones.

For reception of weaker signals the receiver should be connected to an

earth ground such as the cold water pipe. The longer the antenna, the better the reception. Try 20 feet or more.

To feed the radio's output into an amplifier and speaker, replace the

headphone with a 1000-ohm, ½-watt resistor. Connect a .1 mfd, 25VDC capacitor from Q1's collector to the amplifier input. Then be sure to connect radio's ground to the amplifier ground.

13 Hi-to-Lo Z Mike Amp

PARTS LIST FOR HI-TO-LO Z MIKE AMP

B1—1.5-volt AA battery

C1—10-µF, 12 VDC electrolytic capacitor

Q1—Field effect transistor,

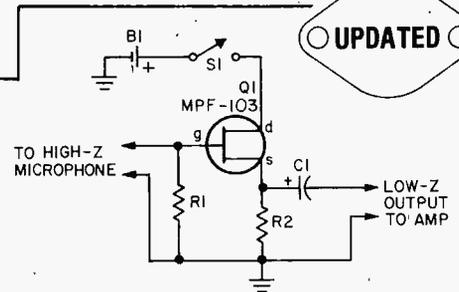
Motorola MPF-103

(Radio Shack 276-2028)

R1—2-megohm, ½-watt resistor

R2—150-ohm, ½-watt resistor

S1—Spst switch



UPDATED

Try to run a high impedance mike line for more than 25 feet and you're sure to get high frequency losses and hum pickup. But this simple junk-box project mounted in a small metal enclosure on the mike stand will con-

vert the mike's output to a low impedance that can run for hundreds of feet without hum pickup or losses.

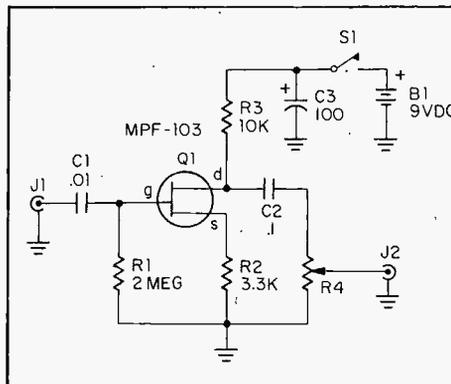
The output can be run into any microphone input-rated from 150-ohms up to high impedance. The cir-

cuit serves only to convert high to low impedance; it provides no amplification. A metal enclosure must be used. The Field Effect Transistor, Q1, can be just about any surplus N-channel type.

14 Talk Power Booster

If your CB or Ham rig is a little shy on talk power, this 10 dB talk power booster will give your signal that extra edge through the QRM. The input impedance is high enough to handle anything from a low impedance dynamic mike to a crystal or ceramic model. You can run the booster into just about any rig; chances are it will work. Since it's so easy and inexpensive to try out a breadboard model, don't bother worrying about the input impedance of your rig; it's faster to give it a try.

Potentiometer R4 serves as the volume control into your rig; it is adjusted for optimum modulation, as indicated on a modulation meter or other reliable device.



PARTS LIST FOR TALK POWER BOOSTER

B1—9-volt battery (Type 2U6 or equiv.)

C1—0.01-µF capacitor

C2—0.1-µF Mylar capacitor

C3—100-µF, 10 VDC capacitor

J1, J2—Jacks to match existing microphone equipment

Q1—FET, Motorola, MFP-103 (Radio Shack 276-2028)

R1—2-megohms, ½-watt resistor

R2—3300-ohms, ½-watt resistor

R3—10,000-ohms, ½-watt resistor

R4—50k or 100k audio-taper potentiometer.

S1—Spst switch

Jacks J1 and J2 match your existing microphone and transmitter connectors. Battery B1 can be the type used for small transistor radios as the current drain is but a few milliamperes. Capacitor C3 must be used regardless of what you use for a

power supply. A metal cabinet is suggested to keep hum and RF out of the microphone system.

15 Communications Rebroadcaster

One way to keep an ear on the Amateur or Citizens band while working around the house or searing steaks out on the patio, is to install

a lot of remote speakers. An easier way is to feed the audio signal from your CB or amateur receiver into a broadcast band Rebroadcaster and

radiate the signals throughout the house and yard. A small transistor pocket radio tuned to the rebroadcaster frequency will alert you in-

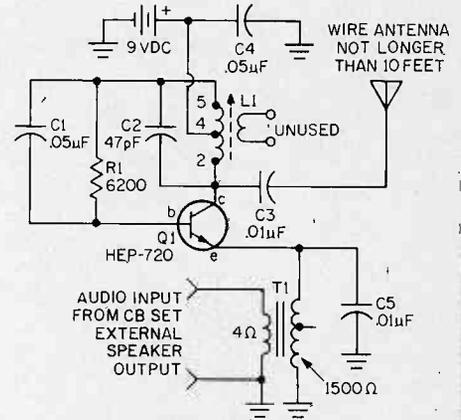
stantly if a call is received on your communications gear. Best of all, since the radio travels with you, you're never away from your receiver.

Build the rebroadcaster in a metal cabinet. The power supply can be a transistor radio type 9-volt battery, though a line supply is preferred for more dependable continuous operation. The unit draws about 10 mA. Power input and antenna length are limited by FCC regulations. If the input current exceeds 10 mA, increase the value of R1 in 20% increments until the current is below 10 mA. The antenna wire cannot exceed 10 feet. Adjust slug L1 so the rebroadcaster operates on an unused BC frequency. The audio input connects to the speaker or headphone output

PARTS LIST FOR COMMUNICATIONS REBROADCASTER



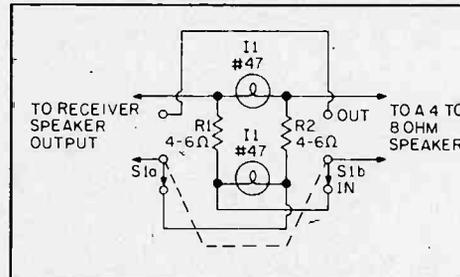
- C1, C4**—0.05- μ F disc capacitor, 50 VDC or better
- C2**—47-pF silver mica capacitor, 100 VDC or better, Allied Electronics 782-0860
- C3, C5**—0.01- μ F disc capacitor, 50 VDC or better
- L1**—Oscillator coil, Miller 2022 (Do not substitute)
- Q1**—NPN transistor, HEP-720
- R1**—6200-ohm, 1/2-watt resistor, see text
- T1**—Output transformer, 4 ohms to 1000 or 2500 ohms



of your communications equipment. Adjust the volume on the receiver for a high, undistorted transmission by the rebroadcaster.

16 SWL's Simple Squelch

It's almost a universal rule that two-way radios have a squelch control, a device that mutes the background noise until a station is received. Even public service radios now include a squelch, so why put up with ear-jarring noise when listening on your SWL receiver. Just a couple of #47 pilot lamps scrounged from old tube radios and two resistors are all that's needed to squelch your SW receiver. And if you can't scrounge the lamps, they're available at just about every radio parts distributor and service shop. Switch S1 is needed only to bypass the squelch for very



PARTS LIST FOR SWL'S SIMPLE SQUELCH

- I1, I2**—#47 pilot lamp
- R1, R2**—4 to 6-ohm resistor, 1-watt, 10 percent
- S1**—Dpdt switch

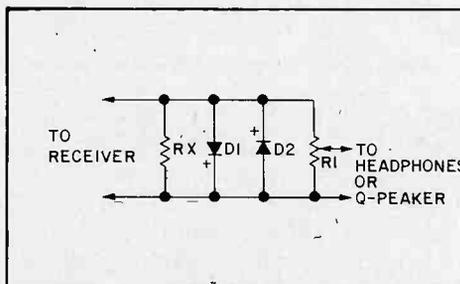
weak signals.

In many instances, the circuit will provide a basic attenuation of the noise background, not complete squelch. But it's a substantial squelch

considering the low cost and ease of construction. Just about any enclosure, plastic or metal, can be used. The components can even lie on the table.

17 Earphone Limiter for CW

Most receivers don't provide automatic volume control on code reception. Thus a CW signal that blows your headphones off one moment might lie buried on the threshold of hearing the next. The Headphone Limiter chops those S9-100 signals down to size until they equalize with weaker signals, giving relatively con-



PARTS LIST FOR EARPHONE LIMITER FOR CW

- D1, D2**—1N60 diode
- R1**—5000-ohm audio taper potentiometer
- Rx**—See text

stant headphone volume. Because the clipping action produces some distortion, the limiter should feed a head-

phone Q-peaker (described in another circuit).

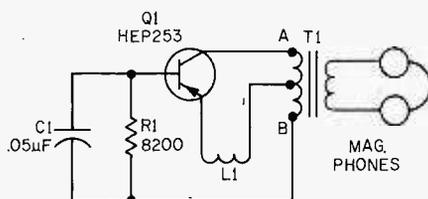
The value of Rx should match the

existing speaker impedance and power. In most cases this will be equal to 4 ohms at 2-5 watts.

18 Parasite CW Monitor

PARTS LIST FOR PARASITE CW MONITOR

- C1**—0.05- μ F disc capacitor, 50 VDC or better
- L1**—2 to 6 turns on $\frac{1}{2}$ -in. form, see text
- Q1**—PNP transistor, HEP-253 (Radio Shack 276-2004)
- R1**—8200-ohm, $\frac{1}{2}$ -watt resistor
- T1**—Miniature transistor transformer, 500 ohms center tapped to 500 ohms, Lafayette Radio Electronics 33 R 85531 (do not use secondary CT)



Here's a self-powered CW keying monitor that doesn't require a direct connection to the transmitter or transmission line. Position coil L1 near the transmitter output tank until you obtain a dependable key-down

tone. Then tape the coil in position.

While the signal is generally monitored with headphones, a small monitor amplifier can be used. Simply connect a 2000-ohm, $\frac{1}{2}$ -watt resistor in place of the phones, and connect the amplifier input across the resistor. Start with a 2-turn coil made of #16 enameled wire wound on a $\frac{1}{2}$ -inch form.

If the signal pickup is not sufficient to produce a steady tone, increase the coil one turn at a time until the tone is steady and reliable. If you cannot obtain any sort of tone with any coil, reverse the primary connections A and B.

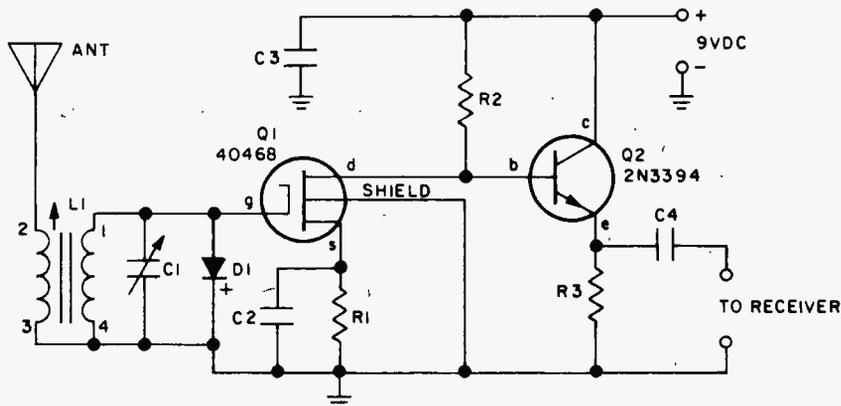
19 SWL's FET Booster

Super sensitivity is the feature of this two-transistor shortwave pre-selector. It provides overall gain as high as 40 dB from 3.5-30 MHz.

Diode D1 protects against excess gate voltage caused by nearby transmitters, while Q1 serves as an emitter follower to match the medium output impedance of the FET transistor to the low input impedance of the receiver.

Since Q1 is a MOSFET type with a gate that's very sensitive to static changes, Q1 must be handled with a short-circuit across all leads until just before power is applied. Also, a soldering iron must not be applied to Q1's leads unless they are shorted.

L1's connections are specified in the instructions supplied with the coil. An RG-174U coaxial cable should serve for the output.



PARTS LIST FOR SWL'S FET BOOSTER

- C1**—365-pF tuning capacitor
- C2, C3**—0.05- μ F, 25-VDC capacitor
- C4**—470-pF, 25-VDC capacitor
- D1**—1N914 diode
- L1**—Antenna coil: 1.7-5.5 KHz use Miller B-5495A, 5.5-15 MHz use

- Miller C-5495A, 12-36 MHz use Miller D-5495-A
- Q1**—RCA 40468 FET transistor (Do not substitute)
- Q2**—2N3394 npn transistor
- R1**—470-ohm, $\frac{1}{2}$ -watt resistor
- R2**—2400-ohm, $\frac{1}{2}$ -watt resistor
- R3**—4700-ohm, $\frac{1}{2}$ -watt resistor

20 Lights-On Alerter

UPDATED

No more dead batteries in the morning; the Headlight Minder lets you know, loud and clear, if your

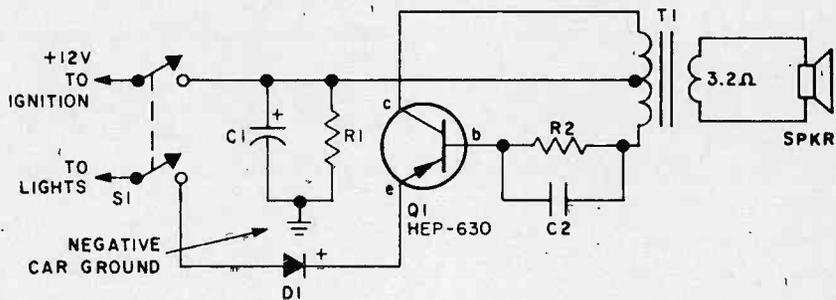
lights are on when the ignition is off.

When the ignition only is on, the tone circuit is off since there is no

complete power path for Q1. Diode D1 prevents positive battery voltage from flowing through Q1 to the

PARTS LIST FOR LIGHTS-ON ALERTER

- C1**—30- μ F, 25-VDC electrolytic capacitor
C2—0.25- μ F, Mylar capacitor
D1—1-A, 50-PIV rectifier
Q1—HEP-630 pnp transistor
R1—15,000-ohm, 1/2-watt resistor
R2—680-ohm, 1/2-watt resistor
S1—Dpst switch
Spkr—8-ohm speaker
T1—500-ohm CT pri. to 8-ohm sec. output transformer, Lafayette Radio Electronics 33 R 85572



lights. When lights and ignition are on, Q1's collector and emitter are positive and the tone generator remains off. When the lights are on and the ignition is off, Q1's (ground) ter-

minal through R1 and the generator sounds off. You'll know you left the lights switched on.

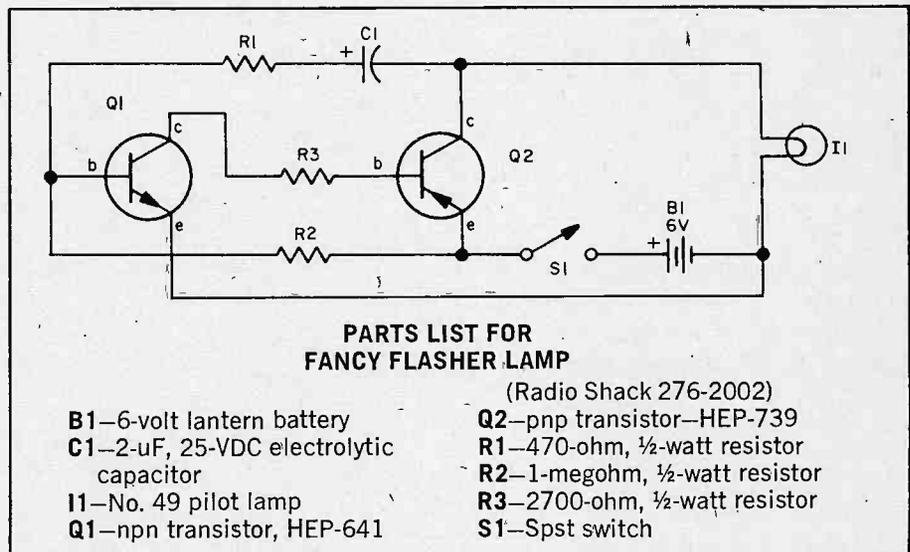
The unit can be built in a metal cabinet fastened to the car's dash-

board so R1 is connected through the cabinet to the car's chassis, thereby completing a negative battery connection.

21 Fancy Flasher Lamp

□ The ballgame is over and your car is buried in the parking lot along with two thousand other cars of the same color. Only yours isn't lost. Sticking above acres of metal is a little lamp going *blink-blink-blink*.

Mount the No. 49 lamp at the top of the antenna and run two wires down to the control unit inside the car. When switch S1 is turned on the multivibrator makes the lamp blink away. Changing the capacitor's value will vary the blink rate.



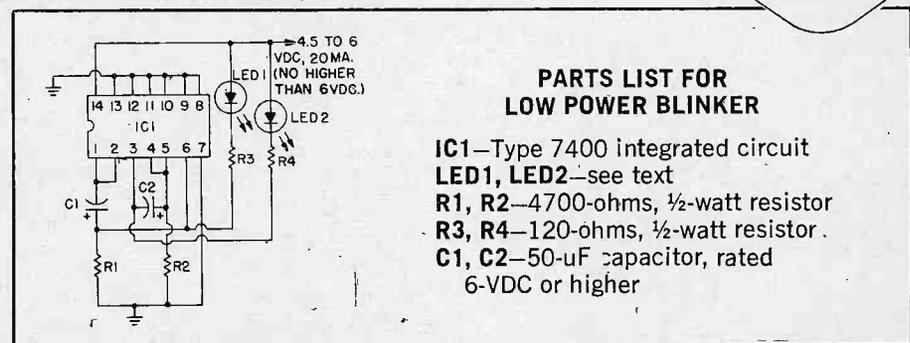
PARTS LIST FOR FANCY FLASHER LAMP

- (Radio Shack 276-2002)
B1—6-volt lantern battery
C1—2- μ F, 25-VDC electrolytic capacitor
I1—No. 49 pilot lamp
Q1—nnp transistor, HEP-641
Q2—pnp transistor—HEP-739
R1—470-ohm, 1/2-watt resistor
R2—1-megohm, 1/2-watt resistor
R3—2700-ohm, 1/2-watt resistor
S1—Spst switch

22 Low Power Blinker

NEW 1976

□ Sometimes things that start out as toys wind up as circuit hardware. This device started out as winking bow-tie lights, but its low current consumption of 20 mA or less makes it ideal as a power indicator for "dangerous" or portable equipment where something more is needed than a light that just glows. If you purchase the IC, LEDs and capaci-



PARTS LIST FOR LOW POWER BLINKER

- IC1**—Type 7400 integrated circuit
LED1, LED2—see text
R1, R2—4700-ohms, 1/2-watt resistor
R3, R4—120-ohms, 1/2-watt resistor.
C1, C2—50- μ F capacitor, rated 6-VDC or higher

tors from a "surplus" dealer the whole thing should cost less than \$2. The circuit uses a standard 7400 IC as a multivibrator, and the values shown cause the lamps to alternate at a rate of approximately once a second. The timing is determined by the values of R1, R2, C1 and C2,

but it's best not to make the resistance values higher than 4700 ohms. So if you want to change the timing rate you should change the values of C1 and C2. Increasing the capacitance slows down the rate of change.

Any LED indicator rated from 20 to 40 mA can be used. Use what-

ever is least expensive. Four penlight batteries (6-VDC) can be used as a portable power supply, but the circuit will work with only three penlights (4.5-VDC). If you use 4.5-volts try to use 20 mA LEDs for greatest brightness. Ground all unused IC terminals.

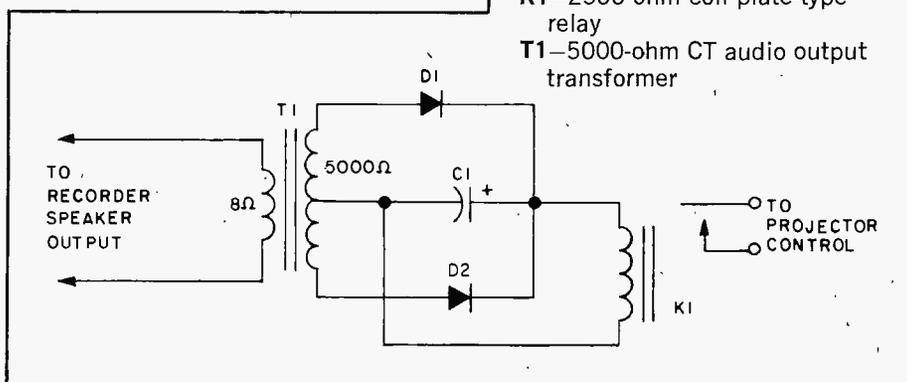
23 Slide Show Stopper

□ Soundless slide shows are dull, dull, dull! But a stereo recorder can automate the whole show so slides change automatically in step with the commentary.

Record your commentary on the left track. At the instant you want slides to change, record a one-second noise or tone burst on the right track. Connect the programmer between the recorder's right speaker output and the projector's remote control cable. Make a test run to determine the right-track volume setting to make noise or tone bursts activate relay K1. No fancy tone generators needed here. Just give a hearty Bronx cheer into the mike of the left channel only!

Then start the tape from the beginning. The audience will hear your

commentary or spectacular music-and-sound reproduction through a speaker connected to the recorder's left channel, while the signal on the right channel automatically changes the slides.



○ UPDATED ○

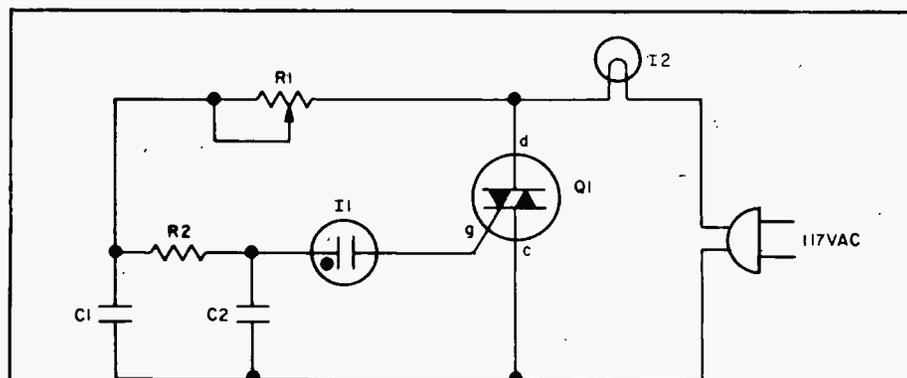
PARTS LIST FOR SLIDE SHOW STOPPER

- C1—25- μ F, 50-VDC electrolytic capacitor
- D1, D2—1-A/400-PIV silicon rectifier, Motorola 1N4004
- K1—2500-ohm coil plate-type relay
- T1—5000-ohm CT audio output transformer

24 Lo-Cost Lamp Dimmer

□ With miniature components and extreme care you can build a low power lamp dimmer right into a socket. Without a heat sink, Triac Q1 handles up to a 200-watt lamp. Instead of a relatively expensive trigger diode, an ordinary neon lamp of the NE-2 variety can be used.

Because the neon does not trip the gate until it conducts, the lamp turns on at medium brilliance. The lamp can then be backed off to a soft glow. Because the neon drops out when the applied voltage falls below the neon holding voltage of approximately 40V the lamp cannot adjust as low as it can with a diode trigger.



PARTS LIST FOR LO-COST LAMP DIMMER

- | | |
|--|---------------------------------------|
| C1, C2—0.068- μ F, 200-VDC capacitor | 400 watts |
| I1—NE-2 neon lamp (Calectro E2-480) | Q1—RCA SK3024 Triac |
| I2—External lamp not to exceed | R1—50,000-ohm, pot. (Calectro B1-685) |
| | R2—15,000-ohm, 1/2-watt resistor |

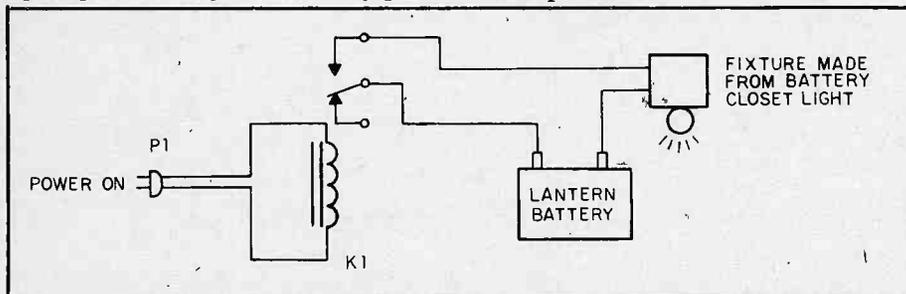
○ UPDATED ○

25 AC Emergency Light

□ Next time the power fails there's no need to stumble around in the dark looking for a flashlight, for this emergency light will automatically turn on a battery lamp as soon as the power fails. This same type of emergency lighting is now required in many pub-

lic buildings.

As long as there's AC on the powerline relay K1 contacts are held open breaking the battery-to-lamp circuit. When power fails the wiper on K1 springs back, closing the battery-to-lamp circuit.



The lamp is one of those inexpensive battery-operated closet lamps sold by mail order houses. They normally work off two C-cells (3 volts), so you'll have to replace the bulb with a 6-volt flashlight or high intensity bulb. Don't try to use the existing batteries and bulb; the C-cells won't run long enough. The lantern battery has a shelf life of about 2-years in standby service. To be sure of lighting when you need it, affix a label to the battery showing the date it should be replaced.

Relay K1 can be any *continuous duty* 117 VAC model with spdt contacts. Note the lighting circuit connects to the relay contacts that are *open* when K1 is energized.

26 Fire Up a Nixie



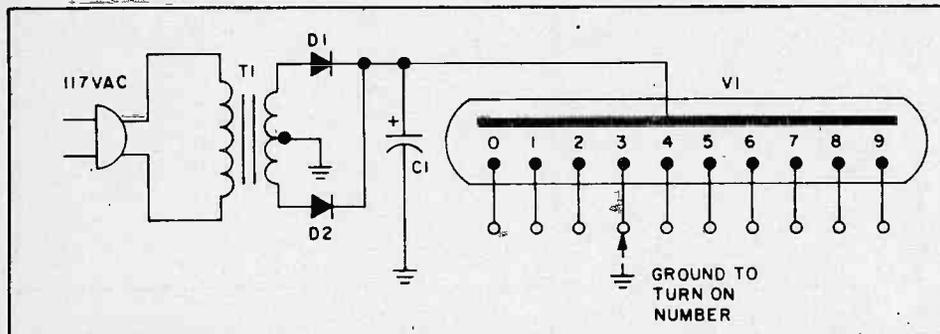
□ Using *Nixie* tubes you can transmit numerical signals or even ball scores over long distances.

The Nixie—actually a peanut-size tube—has 10 numerical-shaped neon lamps (0 through 9). By shorting the appropriate lead to ground, an internal neon lamp corresponding to that number is illuminated.

Transformer T1 is 250V center-tapped, providing an output voltage (peak DC) of approximately 200. Though current requirements are very low, D1 and D2 should be line-voltage type silicon rectifiers of 200 mA minimum.

The same power supply can be used for additional *Nixies*, each con-

necting to the top of C1. The neon numbers can be turned on either through an 11-position (one position for off) rotary switch or individual toggle switches.



PARTS LIST FOR FIRE UP A NIXIE

- C1—40- μ F, 250-VDC electrolytic capacitor
- D1, D2—1A, 400-PIV silicon rectifier
- T1—117-V primary, 250-V secondary, 25-mA center-tapped power transformer
- V1—Neon readout tube (National Electronics NL840 or any high voltage "Nixie" gas discharge-type tube)

27 Audio Distortion Meter

□ This 1-kHz distortion meter is extremely accurate and is handy for measuring the distortion of power amplifiers.

Resistor Rx is the load resistor for the amplifier; 4, 8 or 16 ohms at the

appropriate power rating. The AC meter can be an AC-VIVM or a 20,000 ohms/volt VOM. Adjust the amplifier for the desired power output, set switch S1 to the calibrate position and note the meter reading.

Set S1 to the THD (Total Harmonic Distortion) position and adjust both coil L and resistor R for the *minimum* meter reading.

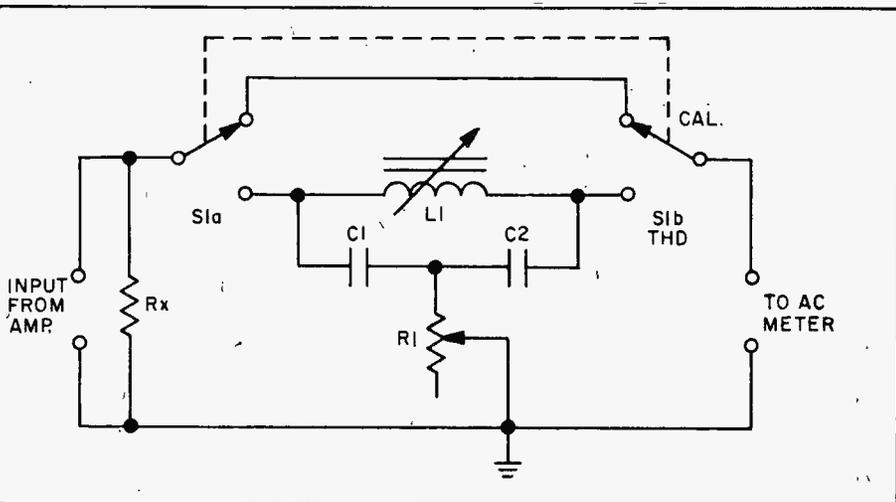
The percent harmonic distortion is equal to the *minimum* reading di-

vided by the *calibrate* reading $\times 100$.

The circuit works by filtering out the 1-kHz fundamental signal with the L1/C1/C2/R1 T-notch filter. What's left is the harmonic content.

PARTS LIST FOR AUDIO DISTORTION METER

- C1, C2—0.01- μ F, 100-VDC capacitor, 5%
- L1—UTC VC-15 variable inductor (Do not substitute)
- R1—500,000-ohm pot
- R_x—Amplifier load resistor (see text)
- S1—Dpdt switch



28 Audio Wattmeter

Here's an easy way to measure an amplifier's output power without trying to convert voltage to power measurements. Resistor R1 provides the load for your amplifier and should be rated at least twice the maximum amplifier power output; for example, if your amp puts out 25 watts, R1 should be rated at least 50 watts.

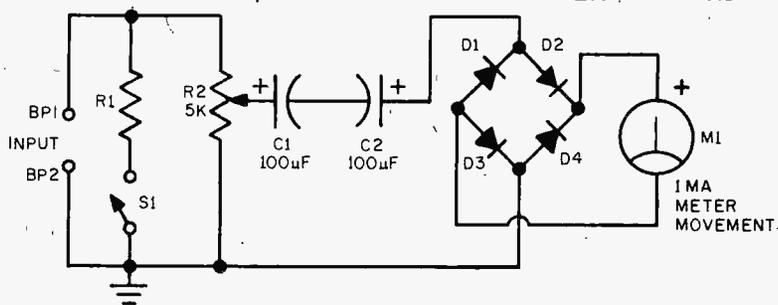
The meter scale must be hand calibrated, and will take some time and effort, but once done it's done for good. Remove the scale cover from meter M1 and borrow an AC variable autotransformer, or connect a 1000 Hz signal generator to the amplifier output. Connect the output of the autotransformer (or amplifier) to binding posts BP1 and BP2, and connect an AC voltmeter (VOM) across the binding posts. Set R2 to off—full counter-clockwise if correctly wired. Adjust the autotransformer (or amplifier) output until the AC meter indicates 20 V rms—the voltage for 50 watts across 8 ohms.

Adjust potentiometer R2 for a full

PARTS LIST FOR AN AUDIO WATTMETER

- BP1, BP2—Insulated binding posts
- C1, C2—100- μ F, 50 VDC capacitors
- D1, D2, D3, D4—1-A, 400-PIV diode
- M1—0-1 mA DC meter
- R1—8-ohm, 100-watt resistor, see text
- R2—5000-ohm linear taper potentiometer

Voltage	Watts at 8-ohms
20.0	50
17.9	40
15.5	30
14.1	25
12.6	20
11.0	15
9.0	10
6.3	5
2.8	1
2.0	0.5



scale indication on meter M1. Seal R2's shaft with a drop of Glyptol or nail polish. Reduce the voltage across

the binding posts in accordance with the table shown and mark the meter scale accordingly.

29 Active Square Shaper

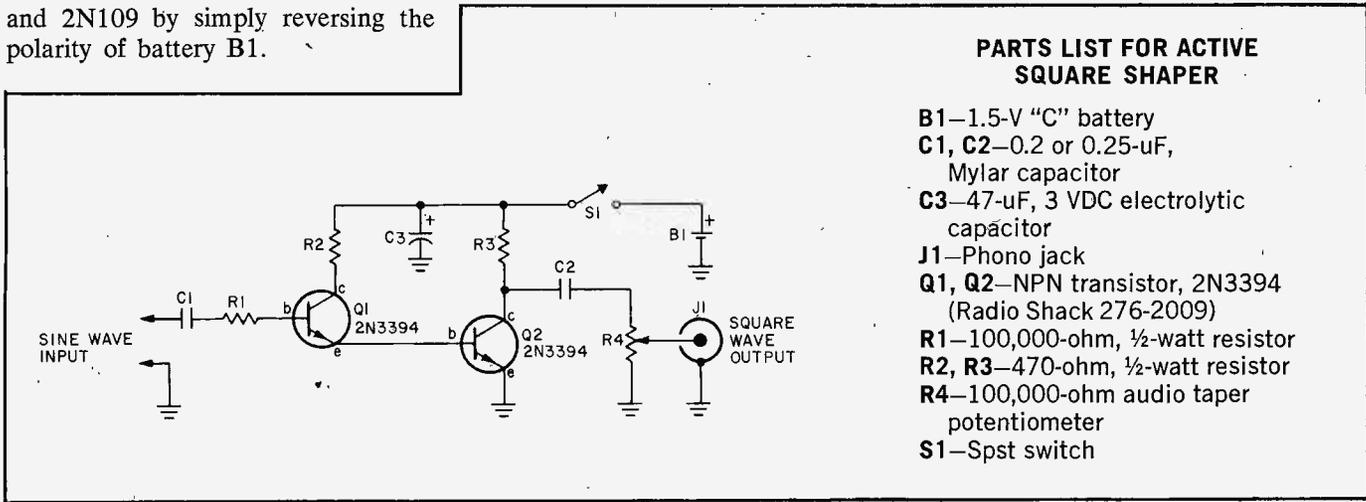
A quick-and-dirty square wave generator for audio amplifier tests can be fashioned from a standard signal generator and the Square Shaper. Simply drive the Square Shaper

with about 1 volt from the generator; the maximum output at jack J1 will be a square wave of about 1 volt peak-to-peak. Just about any general purpose small-signal transistor can be

used for Q1 and Q2, and any resistance value reasonably close to 470-ohms will be okay for R2 and R3. You can even substitute some surplus PNP transistors such as the 2N404



and 2N109 by simply reversing the polarity of battery B1.



PARTS LIST FOR ACTIVE SQUARE SHAPER

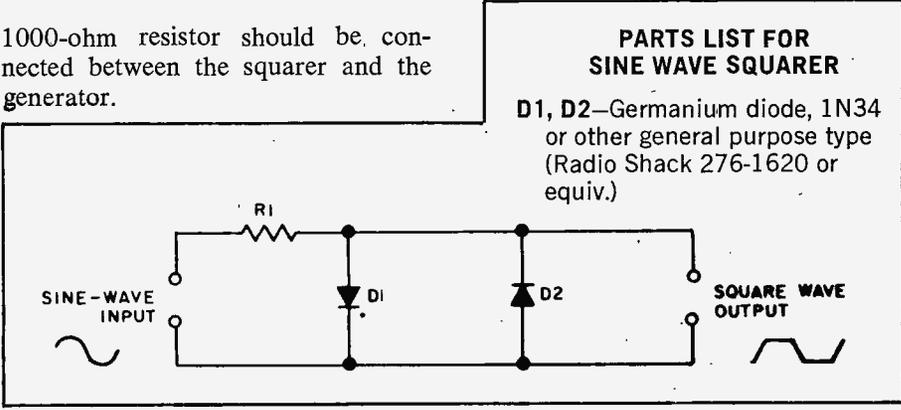
- B1—1.5-V "C" battery
- C1, C2—0.2 or 0.25-uF, Mylar capacitor
- C3—47-uF, 3 VDC electrolytic capacitor
- J1—Phono jack
- Q1, Q2—NPN transistor, 2N3394 (Radio Shack 276-2009)
- R1—100,000-ohm, 1/2-watt resistor
- R2, R3—470-ohm, 1/2-watt resistor
- R4—100,000-ohm audio taper potentiometer
- S1—Spst switch

30 Sine Wave Squarer

Two reverse-parallel diodes of the germanium type provide an emergency square wave generator. Since a germanium diode has an approximate 0.2 V breakover, any sine wave applied to the diodes will be clipped at 0.2 V. It provides a 0.4 peak-to-peak square wave. It's not perfect since the "rise" of the original sine-wave is still present, as shown in the waveform.

To prevent loading and possible distortion of the sine wave input a

1000-ohm resistor should be connected between the squarer and the generator.



PARTS LIST FOR SINE WAVE SQUARER

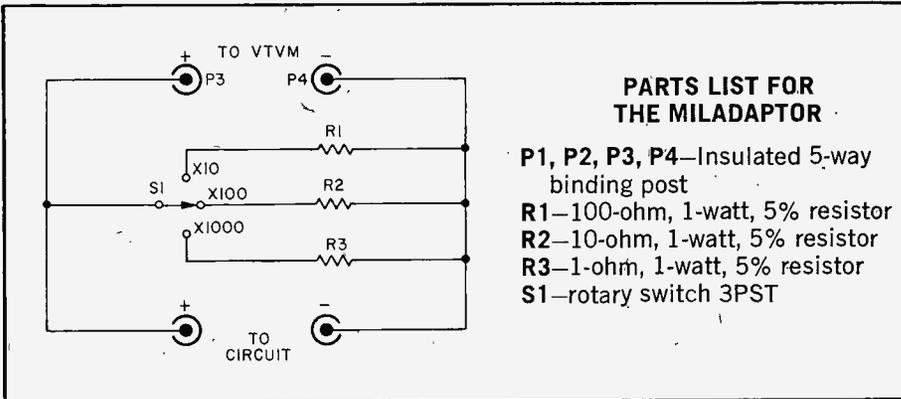
- D1, D2—Germanium diode, 1N34 or other general purpose type (Radio Shack 276-1620 or equiv.)

31 Miladaptor for VTVM



Less than \$2 worth of parts is all it takes to convert your VTVM into a DC millammeter. To use the Miladaptor you simply multiply the VTVM reading by X10, X100 or X1000 to obtain the DC current. For example, if the VTVM indicates 0.1 volt and S1 is set to X100, the current is 0.1 X100 or 10 milliamperes. If the VTVM indicates 0.25 volts and S1 is set to X1000, the current is 0.25 X 1000 or 250 milliamperes.

The circuit under test connects to binding posts P1 and P2; the VTVM connects to binding posts P3 and P4. Switch S1 must be the make-before-break type. To avoid damage

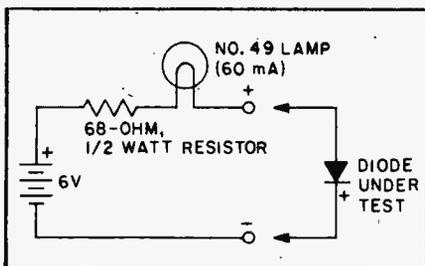


PARTS LIST FOR THE MILADAPTOR

- P1, P2, P3, P4—Insulated 5-way binding post
- R1—100-ohm, 1-watt, 5% resistor
- R2—10-ohm, 1-watt, 5% resistor
- R3—1-ohm, 1-watt, 5% resistor
- S1—rotary switch 3PST

always start with S1 in the X1000 position and downrange until the VTVM indicates a convenient reading.

32 Low Voltage Diode Tester



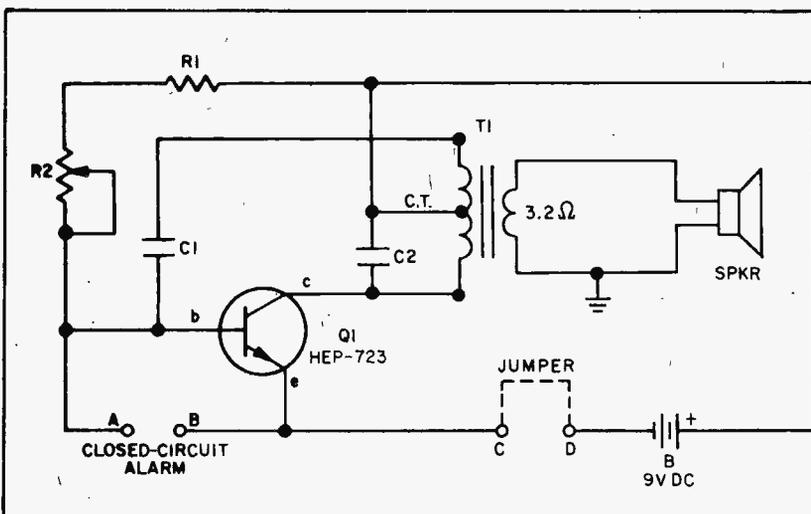
Low voltage signal diodes are easily tested with this "go/no-go" checker. The only restriction is that a diode under test be rated to handle at least 60 mA. Diodes such as the IN34 cannot be checked since test current is too high.

If the diode is good, the lamp will light in one direction, and remain

dark when the diode is reversed. If the lamp stays on when the diode is reversed, the diode is shorted. If the lamp stays dark when the diode is reversed, the diode is open.

To test diodes rated under 60 mA, a lower current lamp must be substituted in the checker.

33 Useful Tone Oscillator



PARTS LIST FOR USEFUL TONE OSCILLATOR

- B1—9-V battery
- C1, C2—0.02- μ F, 25-VDC capacitor
- Q1—npn transistor, HEP-723
(Do not substitute)
- R1—10,000-ohm, 1/2-watt resistor
- R2—500,000-ohm pot
(Calectro B1-666)
- Spkr—3.2-ohm speaker
- T1—Output transformer:
5000-ohm center-tapped
primary to 3.2-ohm secondary.

The circuit is a Hartley oscillator whose tone is determined by R2's value. Just about any wiring or layout will work, but transformer T1 must be the type used in table radios. A miniature transistor transformer might not oscillate, or if it does, will produce only "clean" high tones, with no raucous or low frequency tones.

For CPO operation connect a hand

key across points C and D. For a "make" intruder alarm, connect one or more normally open magnetic switches across points C and D. For a "break" intruder alarm connect a series wire circuit across A and B, which disables the oscillator though power is applied. An intruder breaking the series circuit, or a normally

closed magnetic switch, causes the alarm to sound off.

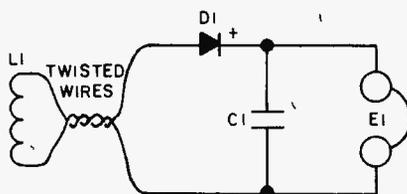
For use as a signal generator, connect C and D and attach a shielded test signal lead directly across the speaker terminals.

Service Note: If the unit fails to oscillate, generally due to transistor differences, change C2's value slightly.

34 Simple Mod. Monitor

PARTS LIST FOR SIMPLE MOD. MONITOR

- C1—100-pF disc capacitor
- D1—1N914 diode
- E1—Magnetic headphone, 2000 ohms or better
- L1—Coil, 3 turns on 1 1/2-in. dia. form, use any thin gauge wire



This simple modulation monitor for AM ham transmitters requires no connection to the transmitter. Just position the loop near the final tank or antenna matching coil until the signal is heard in the headphones.

35

455 kHz Alignment Osc.

Using a 455-kHz crystal, this generator provides a signal for testing and aligning radio IF circuits. The unit is built on a perfboard or some other rigid mounting to achieve good circuit stability. A metal cabinet reduces radiation so the signal fed to the receiver will be primarily determined by level control R2.

To align the completed circuit, adjust L1's slug for maximum S-meter reading in a receiver or connect R2 to an oscilloscope and adjust L1 for maximum output.

Turn the power supply on and off several times to make certain the oscillator starts consistently. If the os-

**PARTS LIST FOR
455 KHZ ALIGNMENT OSC.**

C1—0.05- μ F, 25-50 VDC capacitor
C2—47-pF silver mica capacitor
C3—15-pF silver mica capacitor
L1—3.4-5.8 mH RF coil
 (J. W. Miller 21A473RB1)
Q1—HEP 641 (Radio Shack 276-2002)
R1—330,000-ohm, 1/2-watt resistor
R2—5000-ohm pot
XTL—455-kHz crystal

illator fails to start every time, adjust L1's slug *slightly* until you obtain

immediate and consistent starting each time the power is applied.

36

Test Osc. for Crystals

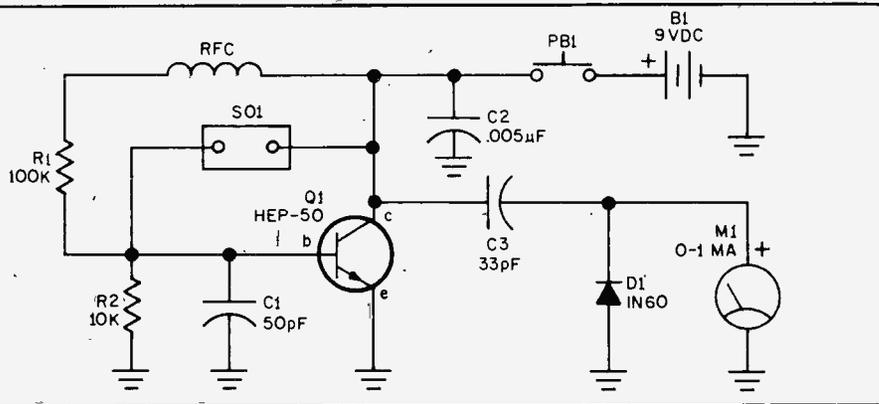


**PARTS LIST FOR
TEST OSC. FOR CRYSTALS**

B1—9-volt transistor radio battery
C1—50-pF disc capacitor, 100 VDC or better
C2—0.005- μ F disc capacitor, 25 VDC or better
C3—33-pF disc or mica capacitor, 100 VDC or better
D1—Diode, 1N60
M1—Meter, 0-1 mA DC
PB1—Normally open push button switch
Q1—NPN transistor, HEP-50 (Radio Shack 276-2009)
R1—100,000-ohm, 1/2-watt resistor
R2—10,000-ohm, 1/2-watt resistor
RFC—2.5-mH RF choke
SO1—Socket to match crystals, see text

A fast way to see if the crystal from your transmitter or receiver is properly "active" is to compare its output against that of a known good crystal. This crystal checker will handle both fundamental and overtone type crys-

tals. Socket SO1 should match the pins on your crystals. If you use more than one type of crystal, install two (or more) sockets in parallel. The unit can be assembled in any type of cabinet.



To test a crystal's activity, first plug in a known good crystal, depress push button switch PB1 and note the meter reading. Then install the questionable crystal, press PB1 and note

its meter reading; if it's good its output should approximate that of the reference crystal. Take care that you don't compare apples with oranges; the reference crystal should be the

exact same type as the crystal to be tested. If good crystals drive the meter off scale, install a 1000-ohm, 1/2-watt, 10 percent resistor in series with meter M1.

37

100 kHz Marker Oscillator



This 100-kHz marker oscillator provides output from 100 kHz to about 30 MHz, and can be built from salvaged components. Only the crystal is critical; it must be 100 kHz

and can be ordered from JAN Crystals, 2400 Crystal Drive, Ft. Myers, FL 33901. Send ten cents for their catalog.

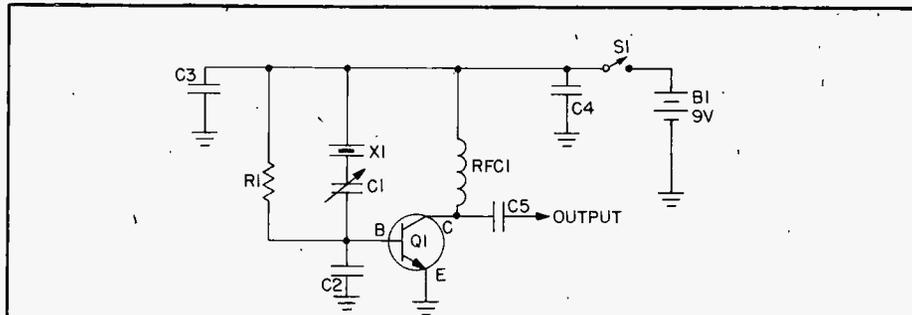
Trimmer capacitor C1 is used to

zero beat the marker's output to National Bureau of Standards station WWV at 2.5, 5, 10, 15, 20 or 25 MHz—whichever frequency you receive best. For maximum stability C2

should be a silver mica, but an ordinary dipped Mylar will work well; you simply might have to readjust C1 more often. Do not make C5 any larger than 25- or 27-pF.

Note that two bypass capacitors—C3 and C4—are required. C3 should be as close as possible to RFC1. C4 can be near the battery. If you have a 2.5-mH choke lying around you should try it out before buying a 1-mH choke for RFC1, because 2.5-mH will probably work in your circuit. Transistor Q1 can be any high frequency, silicon NPN of the 2N2222 type. Battery B1 is the 2U6 type such as used in small transistor radios.

To use the marker simply place the output wire (about 12 inches long) near the receiver's antenna input. If the markers aren't strong enough at the higher frequencies try clipping the wire to the antenna terminal.



**PARTS LIST FOR
100 KHZ MARKER OSCILLATOR**

- R1—470,000-ohms, ½-watt, 10%, resistor
- C1—5-to 50-pF trimmer capacitor, see text
- C2—390-pF silver mica capacitor, see text
- C3—100-pF ceramic disc capacitor
- C4—0.001-uF ceramic disc

- capacitor
- C5—25- or 27-pF ceramic disc capacitor
- RFC1—1-mH RF choke
- Q1—NPN transistor, 2N2222, (RS 276-2009 or equiv.) see text
- X1—100 kHz crystal, see text
- S1—Switch, SPST
- B1—Battery, 9-VDC, type 2U6 or equiv.

The unit can be assembled on an

open perfboard or in a plastic cabinet.

38

Super Sniffer



While a diode and a meter are often all that's required to build a field strength meter (FSM) for transmitters running greater than 1 watt RF output, when it comes to low power walkie-talkies and/or low power RF amplifiers the ordinary FSM won't even budge off its pin. But put a high impedance amplifier between the antenna and the meter and anything in the way of RF output will give you a usable meter reading. You can use a small replace-

ment-type telescopic whip as a "radiation probe" (you don't touch any part of the circuit being tested).

The unit can be assembled in any type of cabinet, though a metal cabinet is suggested to prevent readings from RF picked up by your body. Meter M1 can be any type rated 0-1 mA DC. Normally points A and B are connected together. But if you work with RF circuits of such intensity that the meter is always pinned even if you move the antenna away

from the equipment being tested, insert a 10,000-ohm potentiometer (wired as R1) between points A and B.

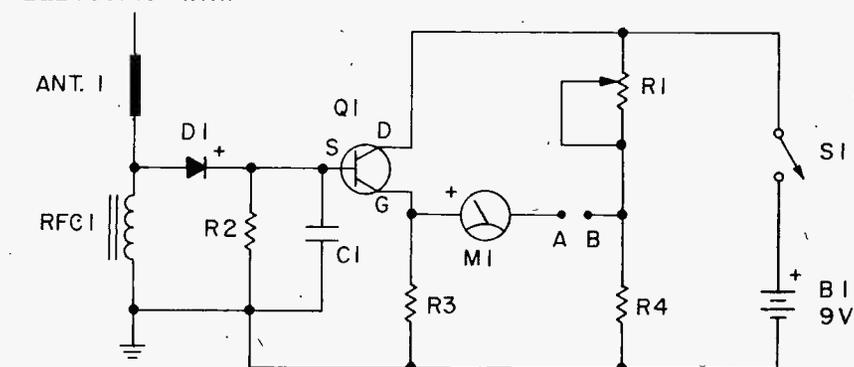
Diode D1 should be the lowest cost germanium type, such as the 1N34 or 1N60. Do not use a silicon diode.

The circuit is a bridge and must be balanced. After S1 is turned on adjust potentiometer R1 for a zero meter reading. The meter is then ready for use.

**PARTS LIST FOR
THE SUPER SNIFFER**

- Resistors ½-watt, 10%, unless otherwise specified
- R1—50,000-ohm linear potentiometer
- R2—1-megohm
- R3—10,000-ohms
- R4—1,000-ohms
- C1—100-pF ceramic disc capacitor
- Q1—FET, Radio Shack 271-2028
- RFC1—1-mH RF choke (for 3 to 30 MHz use)
- S1—Switch, SPST
- B1—Battery, 9 VDC, type 2U6 or equiv.
- M1—Meter, 0-1-mA DC

TELESCOPIC WHIP

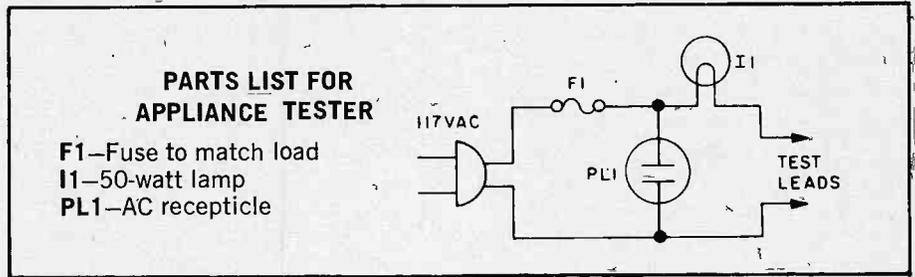


39 Appliance Tester

□ A simple circuit consisting of a 50-watt lamp, fuse and power outlet is all that's needed to check out appliances such as toasters and electric coffee pots.

To check for *opens*, first plug the tester into a live outlet. Next, connect the test leads to the appliance's power cord; if the lamp lights, the circuit is good (not open). Because the appliance is in series with the lamp, the lamp may not light to full brilliance. You are only interested in whether the lamp lights at all—not the level of brilliance.

If you suspect there is a short from



the appliance's motor or heating coil to the appliance frame which can cause a shock hazard, connect one test lead to the appliance frame and connect the other test lead first to one prong of the appliance's plug and then to the other prong. If the lamp lights with either connection there is a short

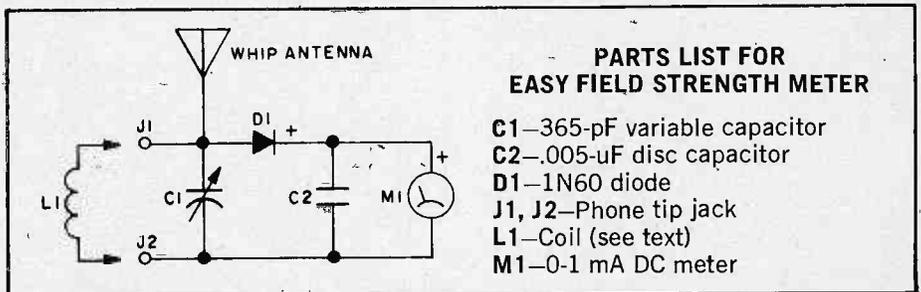
to the frame. If the lamp fails to light at all, the appliance frame is safe.

After the repair is made, try out the appliance by using the fused power outlet, PL1. This way, if the appliance is still defective it will blow fuse F1 rather than a fuse in the basement.

40 Easy Field Strength Meter

High sensitivity without amplification is obtained when a field strength meter (FSM) is tuned to its operating frequency. With a *poly*-type miniature capacitor for C1, the FSM can be built in a pocket-size cabinet.

Tuning range is from 1.5 to 144 MHz, depending on the choice of coil L1. The coil can use phone tip jacks for a plug-in connection for band changing. Consult any coil table for L1's winding data since coil construction depends on the type of



wire and frequency.

Even greater sensitivity is obtained if a more sensitive meter is used.

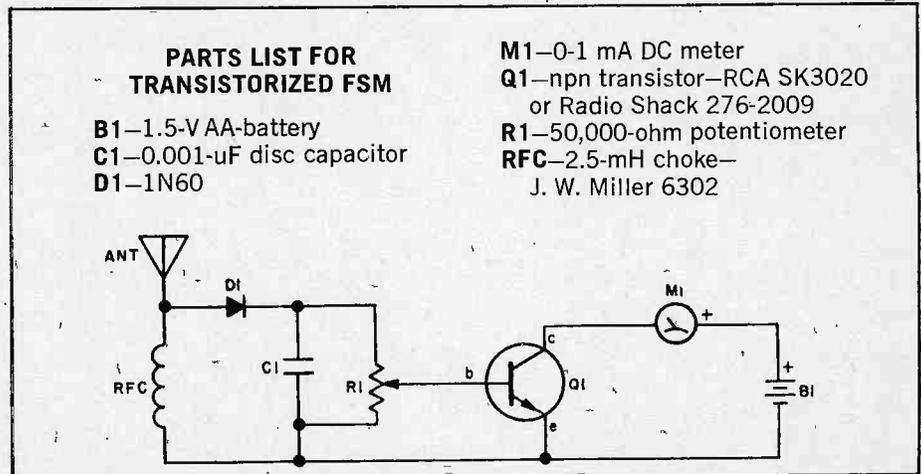
A 50- μ A meter, M1, provides maximum sensitivity combined with reasonably rugged construction.

41 Transistorized FSM



□ A kilowatt transmitter may pin the needle of regular FSMs (field strength meters), but you need high sensitivity to get readings from low-power oscillators, flea power transmitters and CB walkie-talkies. This simple, amplified FSM has a sensitivity of 150 to 300 times that of ordinary models. It indicates full scale when other meters can't budge off the pin.

Dependable frequency range is approximately 3 to 30 MHz. A metal enclosure is recommended, with a stiff wire antenna about 6 in. long. For compactness, RFC should be a



miniature 2.5-mH choke.

To operate the unit, sensitivity control R1 is adjusted for 1/3 to 3/4-scale reading. Avoid working too

close to the top of the scale, since it can saturate transistor Q1, producing full-scale readings at all times. Back off on R1 as you make transmitter

adjustments to keep the needle at approximately half scale. Any high-gain npn small-signal transistor can be substituted for Q1.

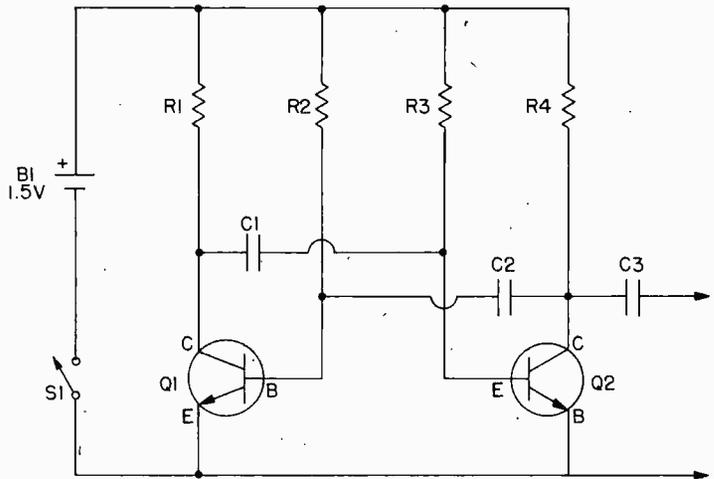
42

Signal Injector



PARTS LIST FOR SIGNAL INJECTOR

- Resistors 1/2- or 1/4-watt, 10%
- R1, R4—10,000-ohms
- R2, R3—100,000-ohms
- C1, C2—0.01- μ F, 6-VDC or higher
- C3—0.01- μ F, 500-VDC or higher (ceramic disc suggested)
- Q1, Q2—NPN transistor, 2N2222 (Radio Shack 276-2009 or equiv.)
- B1—1.5-volt battery
- S1—Switch SPST



The average service shop has so much sophisticated test equipment it's easy to get the impression nothing can be fixed without a bench full of test gear. Yet much sound equipment—amplifiers, radios, receivers—can be serviced with a two-dollar signal injector like this one. Using ordinary general purpose transistors in a multivibrator circuit this signal injector produces a square waveform

output of approximately 700 Hz. Since the output is a square waveform, harmonics of the fundamental frequency are produced well into the RF spectrum, actually higher than 28 MHz. If you touch the output lead to a receiver's antenna input, RF amplifier, IF amplifier or audio amplifier (the ground lead will be needed for audio injection) you'll hear the tone in the speaker. If you

work backwards from the speaker the trouble is in the circuit at the point where you lose the tone.

Just about any small-signal NPN transistor can be used for Q1 and Q2. The battery can be an AA penlight cell. For maximum convenience the entire project can be assembled in a Keystone probe, or a small plastic pill box.

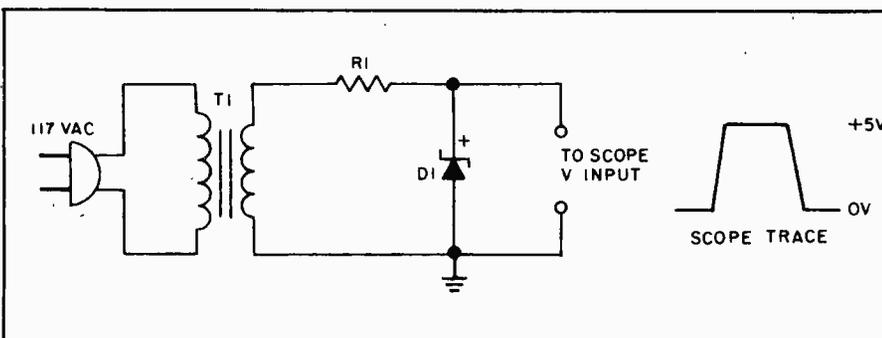
43

Budget Scope Calibrator

You can make accurate voltage measurements with your oscilloscope if you calibrate the vertical input with a Scope Calibrator.

When the top of zener diode D1 goes negative it conducts and voltage across the diode is essentially zero.

(Continued on page 38)



PARTS LIST FOR BUDGET SCOPE CALIBRATOR

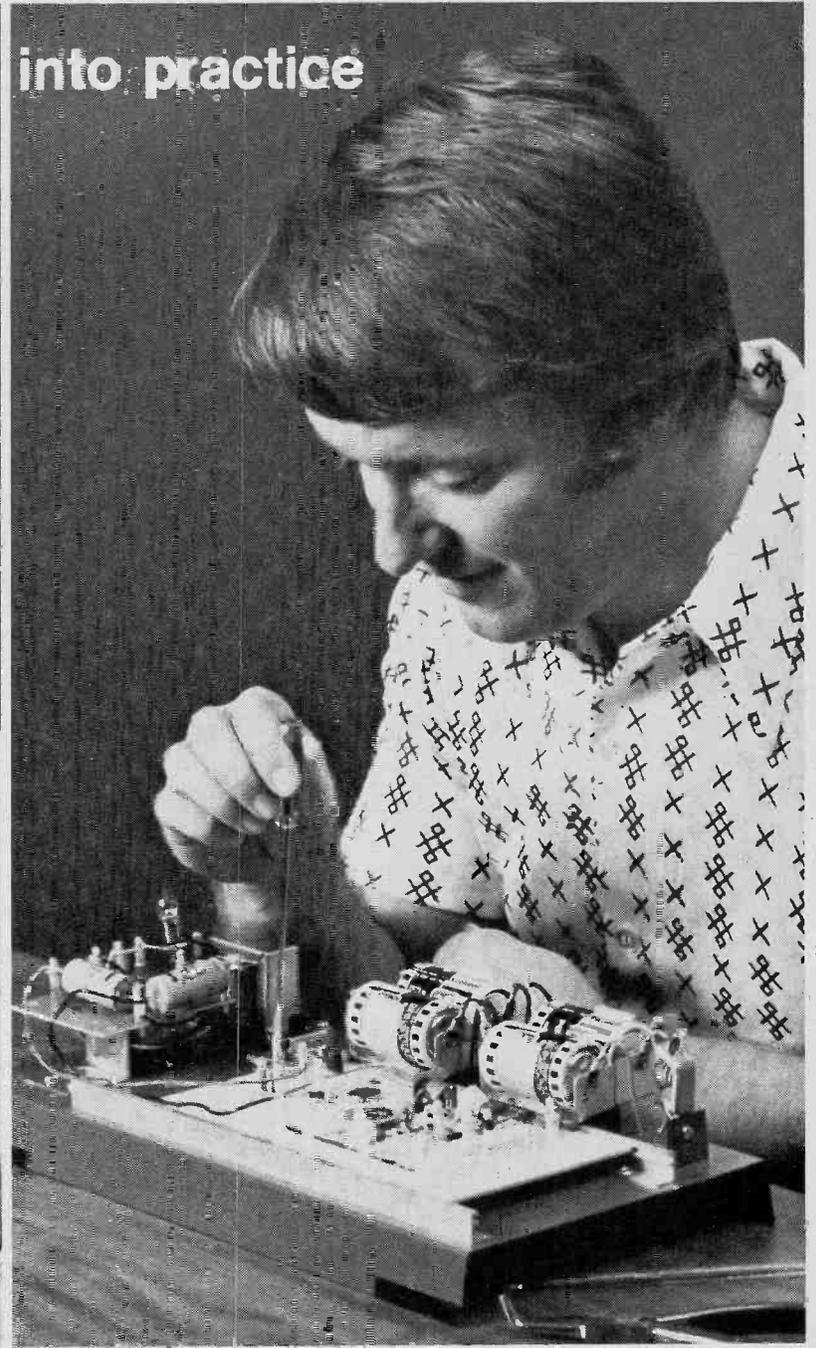
- D1—10V, 0.4-watt Zener diode—HEP-101
- R1—270-ohm, 1/2-watt resistor
- T1—117 to 12.6 VAC filament transformer
- C1, C3—0.01- μ F, 25-VDC capacitor
- C2—0.002- μ F, 25-VDC capacitor
- Q1—HEP-720 npn transistor (Radio Shack 276-2015)
- R1—100,000-ohm, 1/2-watt resistor
- R2—1000-ohm, 1/2-watt resistor
- Xtal—100-kHz crystal

From CIE — Cleveland Institute of Electronics

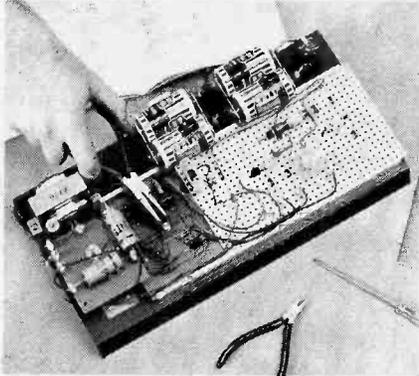
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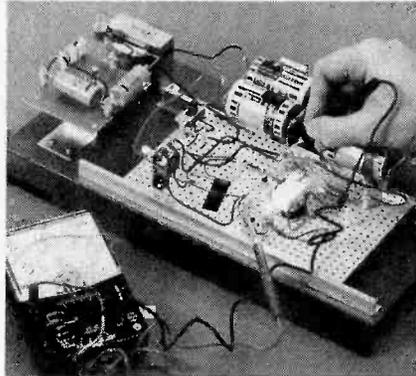
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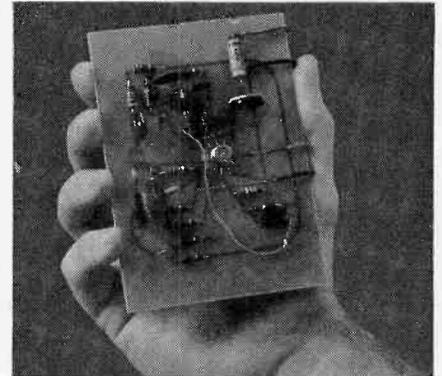
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OE-07

(continued from page 34)

When the voltage at the top of the zener goes positive, it builds until it reaches 10 V. At that point the diode conducts, dropping five volts across D1. The result is a square wave which

varies from zero to 10 V, as shown.

The scope's vertical input is connected across the diode and the vertical attenuator control is adjusted so the square wave exactly fills one vertical division. This provides a calibration of 10 V peak-to-peak per divi-

sion. The scope's vertical attenuator then provides multiples of the calibration such as 1 V/div., 10 V/div., etc. Since calibrator output varies from zero volts it may be necessary to adjust the vertical centering when the scope's DC input is used.

44 Better Scope Calibrator

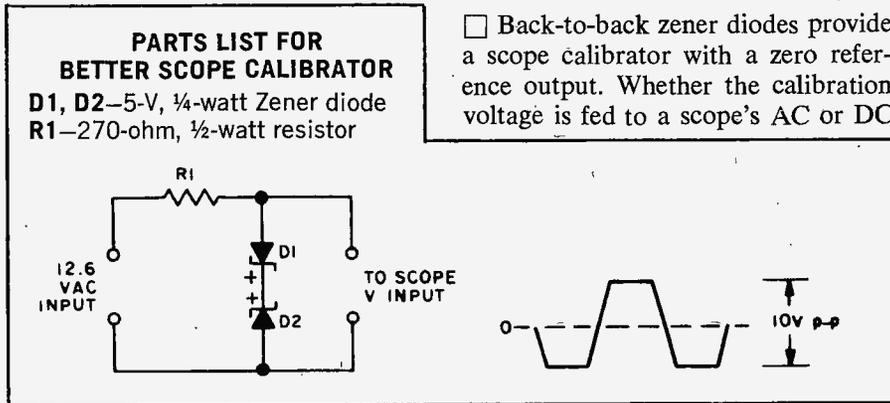
PARTS LIST FOR BETTER SCOPE CALIBRATOR

D1, D2—5-V, ¼-watt Zener diode
R1—270-ohm, ½-watt resistor

□ Back-to-back zener diodes provide a scope calibrator with a zero reference output. Whether the calibration voltage is fed to a scope's AC or DC

input, the baseline will not have to be readjusted.

When the top of D1 goes positive D1 conducts current through to the D2 cathode. The voltage across D2 builds until 5 V is reached and the output waveform is 5 V positive. The reverse action takes place when the top of D1 goes negative, providing an output waveform of 5 V negative. The total result is a 10 V peak-to-peak square wave to calibrate the scope face.



45 Audible Logic Probe

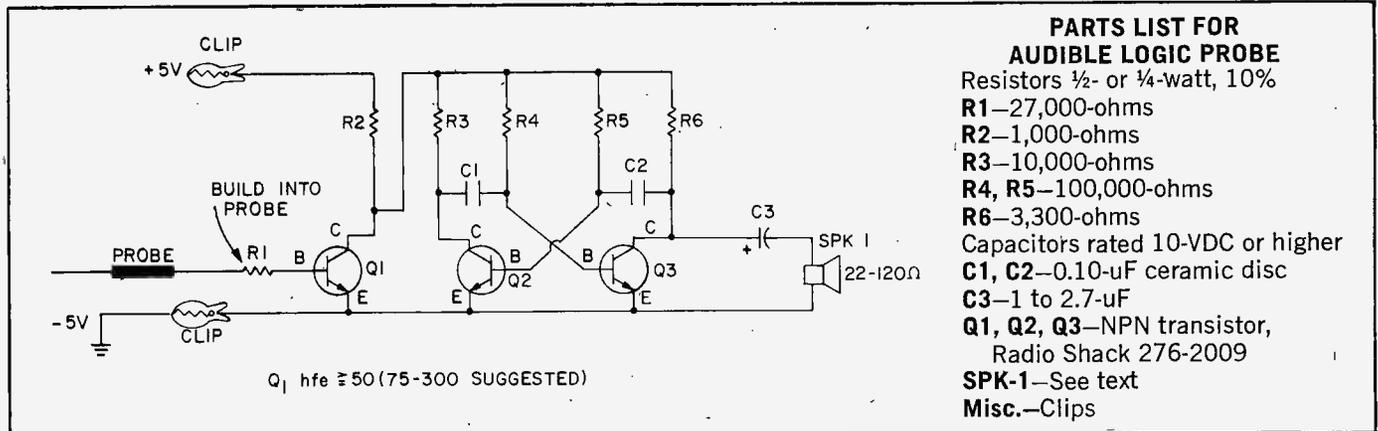
NEW 1976

□ One problem when servicing modern IC circuits is that everything is packed in so tight, and IC terminals are so close together, if your test

probe slips a fraction of an inch (or centimeter) it's ZAP!, another component bites the dust; and trouble is, solid state breakdowns usually take

out a whole string of components.

Logic probes used to trace digital circuits often lead the list in devices that ZAP ICs because you've got to



PARTS LIST FOR AUDIBLE LOGIC PROBE

Resistors ½- or ¼-watt, 10%
R1—27,000-ohms
R2—1,000-ohms
R3—10,000-ohms
R4, R5—100,000-ohms
R6—3,300-ohms
Capacitors rated 10-VDC or higher
C1, C2—0.10-µF ceramic disc
C3—1 to 2.7-µF
Q1, Q2, Q3—NPN transistor,
Radio Shack 276-2009
SPK-1—See text
Misc.—Clips

keep one eye on the probe indicator lamp and the other eye on the tip of the test probe. But all that's a thing of the past with this Audible Logic Probe because you can keep both eyes and your full attention on the tip of the test probe, and a tone indicates a logic low.

Normally, Q1 is cut off (no base input), and there is a small, insignificant

voltage drop across R2 so multivibrator Q2-Q3 receives operating voltage and produces an output in the speaker of approximately 700 Hz (at low but comfortable volume). When the probe is touched to a logic low (0) Q1 is still cut off so sound output indicates a low. When the probe is touched to a logic high (1) Q1 is driven to saturation and the

full supply voltage is dropped across R2, so the multivibrator and its output is cut off, indicating a logic high.

Alligator or crocodile clips are used to connect to the TTL equipment's + and - 5-volt terminals. Resistor R1 should be built directly into the test probe to provide good isolation between the TTL equipment and your test lead circuit. Speaker SPK-1

should be rated 20 to 120 ohms—the higher the impedance the greater the

volume. 20-, 32- or 45-ohm intercom speakers available on the surplus

market are good choices.

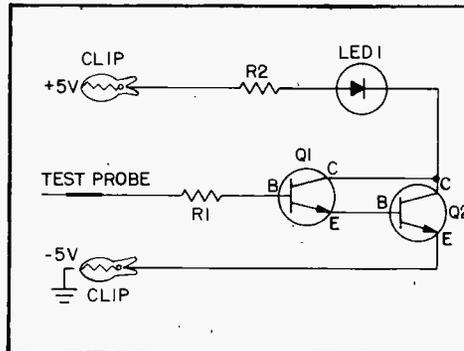
46 Logic Probe

NEW 1976

Most of the digital equipment used by the hobbyist is easily serviced with a logic probe, a device that shows when a digital input or output is at a logic low (0) or high (1). This probe, using an LED for an indicator, is more or less the standard test probe circuit—the type often sold for \$20 or more; yet you can build it for under \$7, with most of the cost representing the test probe assembly itself.

Transistors Q1 and Q2 can be just about any NPN silicon of the 2N2222 type. LED-1 should be one of the "surplus" LEDs rated for 20 to 40 mA, with 20 mA preferred.

Resistor R1 should be placed as close as possible to the test probe tip by wiring. Build it directly into the test probe itself, or build the whole thing into a Keystone test probe assembly, available from some



PARTS LIST FOR LOGIC PROBE

- R1—27,000-ohms, 1/2- or 1/4-watt, 10%, resistor
- R2—150-ohms, 1/2- or 1/4-watt, 10%, resistor
- LED-1—See text
- Q1, Q2—NPN transistor, 2N2222 (Radio Shack 276-2009 or equiv.)
- Misc.—Alligator clips and test probe or test probe assembly.

local radio parts distributors or from Custom Components, Box 153, Malverne, N.Y. 11565, \$5 prepaid. If you build the entire device in the Keystone probe mount all components should be secured firmly to the supplied perf-board strip and R1 mounted near the test tip.

The +5 volt alligator clip connects

to the TTL system's positive supply voltage. The -5 volt alligator clip connects to the -5 volt terminal or ground. The test probe connects to the various inputs and outputs. LED-1 will light when the test probe is touched to a logic high (1). It will remain out when the probe is touched to a logic low (0).

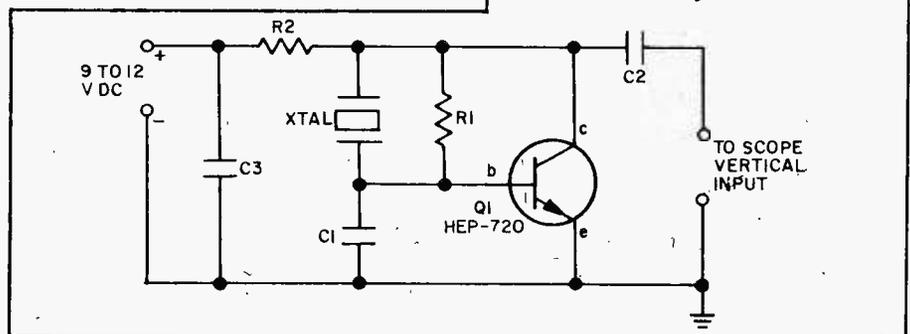
47 Time Base Reference

Operating on exactly 100 kHz, the Scope Calibrator provides a reference for calibrating the variable time base oscillator of general purpose scopes. If the scope is set, for example, so one cycle of the signal fills exactly 10 graticule divisions, each division represents 1 MHz, or 1 microsecond. If the scope is adjusted for 10 cycles on 10 graticule divisions, or 1 cycle per division, each division represents 100 kHz or 10 microseconds. Now if the scope's time base oscillator is sufficiently stable so

it doesn't drift to far off, you can make precise measurements of an unknown pulse width, length and frequency.

PARTS LIST FOR TIME BASE REFERENCE

- C1, C3—0.01-uF, 25-VDC capacitor
- C2—0.002-uF, 25-VDC capacitor
- Q1—HEP-720 npn transistor
- R1—100,000-ohm, 1/2-watt resistor
- R2—1000-ohm, 1/2-watt resistor
- Xtal—100-kHz crystal



48 Doorknob Security Alarm

UPDATED

Here's security for the traveler. Just connect this alarm to the doorknob of your motel room and a loud buzzer will sound if anyone touches

the doorknob.

Transistor circuit Q1 is an oscillator with a connection through binding post BP1 to the doorknob. As

long as Q1 oscillates, its rectified output is applied to Q2 which holds the SCR1 gate almost at ground potential. When someone touches the door-

knob, hand capacitance "kills" the oscillator, thereby removing that cut-off (holding) bias from the SCR1 gate; the SCR conducts and sounds alarm buzzer BU1. The alarm can

PARTS LIST FOR DOORKNOB SECURITY ALARM

B1—6-volt battery, Burgess Z4 or equiv.

BP1—Binding post

BU1—6-volt buzzer

C1, C2—0.05- μ F disc capacitor, 25 VDC or better

C3—47-pF silver mica capacitor (Allied Electronics 782-0860)

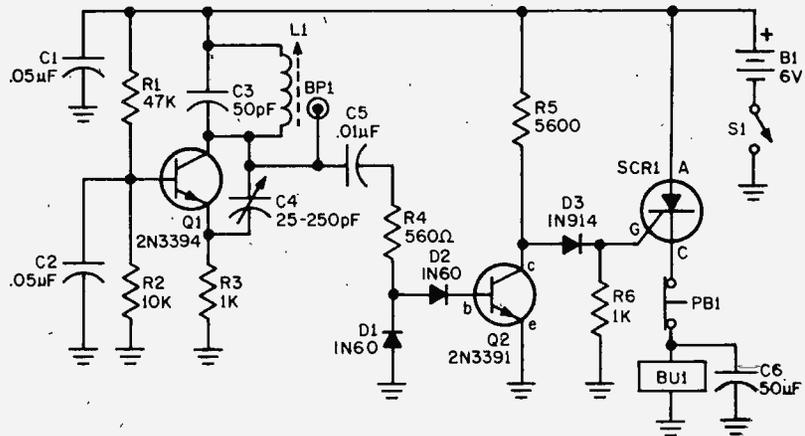
C4—300-pF trimmer capacitor

C5—0.05- μ F, 25 VDC capacitor

C6—50- μ F electrolytic capacitor, 25 VDC or better

D1, D2—Diode, 1N60

D3—Diode, 1N914



L1—15- μ H adjustable RF coil (Miller 4205, or equiv.)

PB1—Pushbutton switch (reset)

Q1—2N3394

Q2—2N3391

R1—47,000-ohm, 1/2-watt resistor

R2—10,000-ohm, 1/2-watt resistor

R3, R6—1000-ohm, 1/2-watt resistor

R4—560-ohm, 1/2-watt resistor

R5—5600-ohm, 1/2-watt resistor

S1—Switch, spst (on-off)

SCR1—800-mA/30-V silicon controlled rectifier, HEP R1001

only be turned off by opening reset switch PB1.

The alarm should be assembled in a small metal cabinet with insulated binding post BP1 at the top. A small

wire loop attached to BP1 secures the alarm to the doorknob—the alarm actually hangs on the knob. To adjust, carefully set C4 in small increments until touching your finger to BP1

causes the buzzer to sound. If C4 is overadjusted, hand capacitance will not "kill" the oscillator. Best operation is obtained if the door is made of wood.

49 Easy Auto Theft Alarm

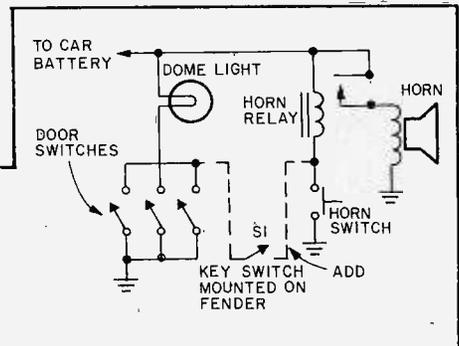
□ A single fender-mounted key switch is all that's needed to turn your car's horn and courtesy lights into a burglar or theft alarm! Simply install key switch S1 on the fender, connect one terminal to the horn relay and the other to the courtesy-light door-switch wiring, as shown by the dotted lines.

When S1 is on, anyone entering a car door equipped with a courtesy-light switch will automatically sound the car's horn. The sudden blast of the horn is usually enough to frighten

off a potential burglar. If all the car doors are not equipped with switches you can easily install them; switches are available from local auto supply stores.

PARTS LIST FOR EASY AUTO THEFT ALARM

S1—Fender-mounted key switch.



50 Power Failure Alarm



□ Never fear again that a power failure will knock out your electric alarm clock. The instant the juice fails, the Power Failure Alarm's raucous buzz let's you know about it, even in the wee hours of the morning.

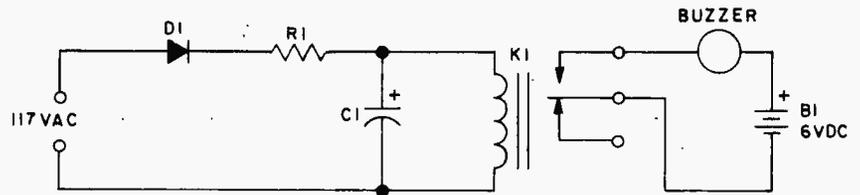
To keep current consumption (and operating costs) at rock bottom, a very sensitive relay is used for K1. As long as AC power is supplied, K1 is activated and the buzzer contacts are held open. When power fails, K1's

contact springs back, completing the battery connection to the buzzer.

K1 is a "model radio-control" type relay with a pull-in current of approx. 1.5 to 3 mA.

PARTS LIST FOR POWER FAILURE ALARM

- B1—6V dry-cell battery
- C1—20- μ F, 150-VDC capacitor (Calectro A1-179)
- D1—1-A/200-PIV silicon diode, Motorola 1N4003 or equiv.
- K1—3000-5000-ohm sensitive relay coil (Calectro D1-963 or equiv. See text)
- R1—10,000-ohm, $\frac{1}{2}$ -watt resistor
- 1—6-VDC commercial home buzzer



51 Auto Ignition Maze

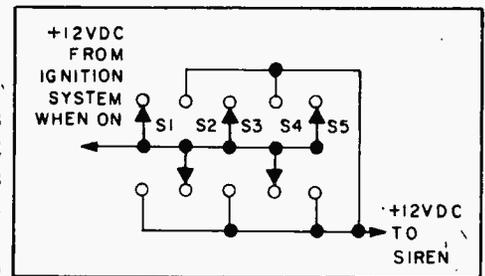
□ Install a combination lock on your car's dashboard and a thief would have a better chance playing Russian roulette.

Switches S1 through S5 are spdt rather than spst only to keep all external switch markings the same.

Tracing the circuit will show that only if switches S2 and S4 are down

is the siren disabled. The siren sounds if any other switch is down or if S2 or S4 is up when the ignition is turned on. A simple wiring change lets you set any combination.

The switches can be "sporty" auto accessory switches sold individually or in switch banks such as G.C. 35-916. Provide labels such as "Car-

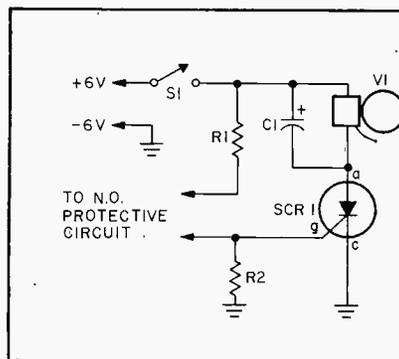


buretor Heater," "Window Washer," etc. and no one will know the car is wired for "sound."

52 Open Circuit Burglar Alarm



□ This simple electronic latch-up alarm circuit handles normally open protective devices such as concealed floor-mat switches. All protective devices are connected in parallel and the alarm is tripped as soon as any of the devices are closed. There is no standby current and a battery power source will last its shelf life. Either a line powered 6VDC supply or a 6V lantern battery is suggested. Once the alarm is tripped it can only be turned off by opening the master switch S1.



PARTS LIST

- C1—50- μ F, 12 VDC electrolytic capacitor
- R1—4700-ohm, $\frac{1}{2}$ -watt resistor
- R2—1000-ohm, $\frac{1}{2}$ -watt resistor
- S1—Spst switch
- SCR1—Silicon controlled rectifier, rated 12 PIV or higher (HEP R-1220 or equiv.)
- V1—6 VDC alarm bell (Audiotex 30-9100)

53 Foil-A-Burglar Alarm

□ This professional type burglar alarm can be used to protect windows or glass areas by using window foil that "breaks" a circuit as the glass is broken. It's an alarm that is triggered when the protective circuit is opened.

All protective door and window circuits must be normally closed and series connected so that an opening of any protective device will trigger the alarm. Once the alarm is triggered it can be turned off only by

opening master switch S1.

The recommended power supply is an AC powered 6 VDC source or a lantern battery; standby current is about 100 μ A. To adjust, connect a voltmeter (10 VDC range) across re-

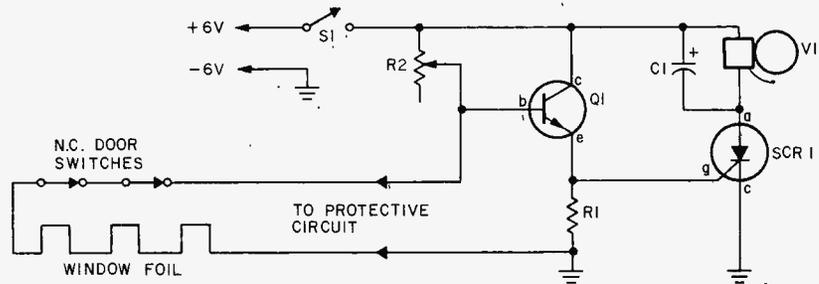
sistor R1, open the protective circuit and adjust potentiometer R2 so the meter indicates a voltage rising to-

wards 1 volt. The alarm bell should ring before 1 volt is reached on the meter. If it does not, there is a wiring

error. Finally, set R2 for the 1 volt meter reading, remove the meter and restore the protective circuit.

PARTS LIST FOR FOIL-A-BURGLAR ALARM

- C1**—47- μ F, 12-VDC electrolytic capacitor
- Q1**—NPN transistor, HEP 53 (Radio Shack 276-2009)
- R1**—1000-ohm, 1/2-watt resistor
- R2**—500,000-ohm, pot (Calectro B1-687)
- S1**—Spst switch
- SCR1**—Silicon controlled rectifier rated 12 PIV or higher HEP R-1101
- V1**—6 VDC alarm bell (Audiotex 30-9100)



54

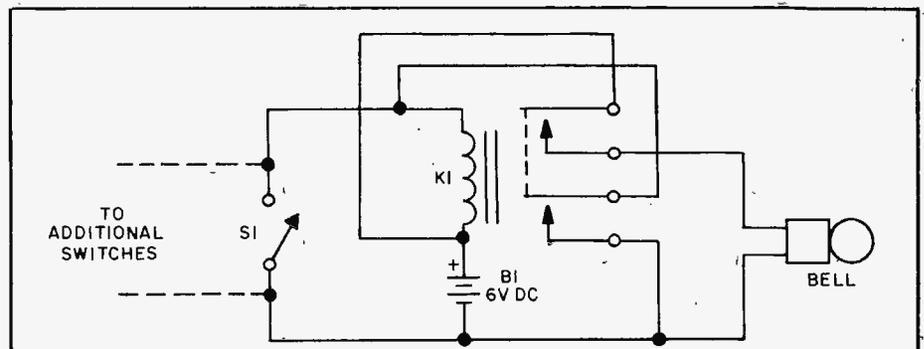
Latching Burglar Alarm



Open a fancy commercial burglar alarm and all you'll find inside is this ordinary relay latching circuit.

The input terminals are connected to parallel-wired normally open (N.O.) magnetic switches, or wire-type security switches stretched across a window that close a bell contact circuit when the wire is pushed or pulled.

When a security switch closes the series battery circuit, relay K1 pulls in. One set of contacts closes the alarm bell circuit, while the second set "latches" the battery circuit. Even if the security switches are opened, the alarm remains on. To disable the alarm, or for reset, install a concealed switch in series with one battery lead.



PARTS LIST FOR LATCHING BURGLAR ALARM

- B1**—6-V lantern battery
- K1**—6-VDC dpst relay
- BELL**—6-VDC alarm bell
- S1**—Spst n.o. switch

55

Speaker-A-Mike Preamp



A speaker can often serve as a microphone in intercoms, "one-way telephones" or as an emergency microphone. All the speaker needs is amplification to raise "voice power" output to normal mike level.

A small speaker-mike preamp can easily be thrown together with junk

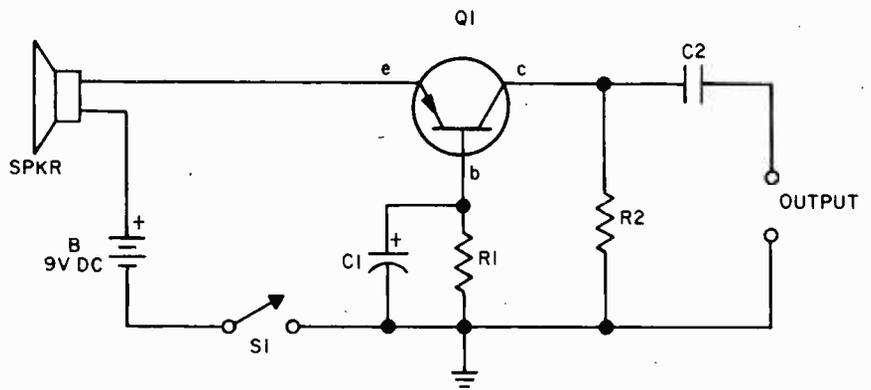
box parts and just about any general purpose transistor with a beta of 30 to about 150. While a pnp transistor is shown, an npn type can be substituted if the battery and C1's polarity are reversed. No other changes are needed.

Q1 is a common base amplifier

providing a low impedance input to match a low impedance speaker of 3.2, 4, 6-8, or 16 ohms. The collector output is medium impedance and the .47- μ F capacitor at C2 allows the preamp to work into loads of 7000 ohms or higher.

PARTS LIST FOR SPEAKER-A-MIKE PREAMP

- B1**—9-V battery
- C1**—4.7- μ F, 25-VDC electrolytic capacitor
- C2**—0.47- μ F, 10-VDC capacitor
- Q1**—RCA SK 3004 (Radio Shack 276-2005)
- R1**—270,000-ohm, $\frac{1}{2}$ -watt resistor
- R2**—27,000-ohm, $\frac{1}{2}$ -watt resistor
- S1**—Spst switch
- Spkr**—Any PM speaker, 4-10-ohms



56 Budget Mike Mixer

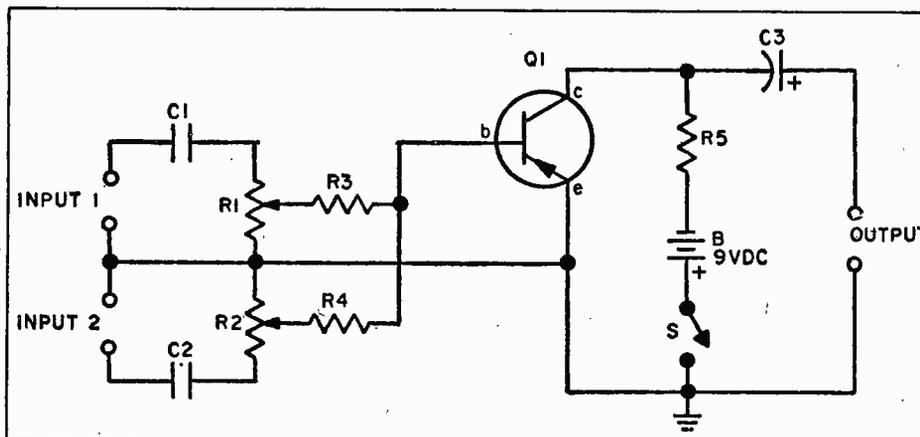


Using components often found in an experimenter's junk box, this two-channel mike mixer handles high impedance or dynamic microphones. Level controls R1 and R2 should not be run wide open with hi-Z mikes since the input impedance then becomes the value of R3 and R4, or

100,000 ohms. If a hi-Z mike is loaded by less than 1 megohm, the low frequency response of the mike is attenuated.

Transistor Q1 can be almost any general purpose type such as the 2N107 or 2N217. However, the better the transistor, the better the sig-

nal-to-noise ratio. Top quality high-gain transistors should not be used since relatively high leakage current of experimenter-grade transistors provides the base bias current. Transistors with low leakage might produce high distortion because of low "internal" base bias.



PARTS LIST FOR BUDGET MIKE MIXER

- B1**—9-V battery
- C1, C2**—0.1- μ F, 50-VDC capacitor
- C3**—10- μ F, 12-VDC electrolytic capacitor
- Q1**—Pnp general purpose transistor, (GE-2, Calectro K4-500, etc.)
- R1, R2**—2-megohm audio taper potentiometer
- R3, R4**—100,000-ohm, $\frac{1}{2}$ -watt resistor
- R5**—15,000-ohm, $\frac{1}{2}$ -watt resistor
- S1**—Spst switch

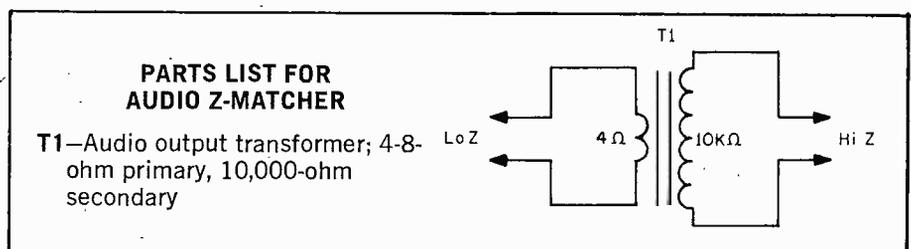
57 Audio Z-Matcher

Headphone outputs aren't standard. On some equipment the phone output might be low impedance such as for hi-fi type headphones; on other equipment the phone output might be "high Z" such as 1,000 or 10,000 ohms. Connect low-Z phones to a high-Z output and the volume level will fall to next-to-nothing, and distortion might soar to unpleasant values.

But use a Z-Matcher, actually a

low-to-high matching transformer, and you can use just about any phone on any circuit. Don't let the 4 and

10,000-ohm markings fool you. Any low-Z phone from 4 to 20 ohms connects to the 4-ohm transformer ter-



PARTS LIST FOR AUDIO Z-MATCHER

- T1**—Audio output transformer; 4-8-ohm primary, 10,000-ohm secondary

minals; any high-Z phone connects to the 10,000-ohm terminals. For example, if you are using 8-ohm hi-fi

phones and a recorder with a 5000-ohm phone output, connect the 8-ohm phones to the 4-ohm terminals and

the 10,000-ohm terminals to the recorder. An exact match isn't critical.

58 Audio Peak Limiter



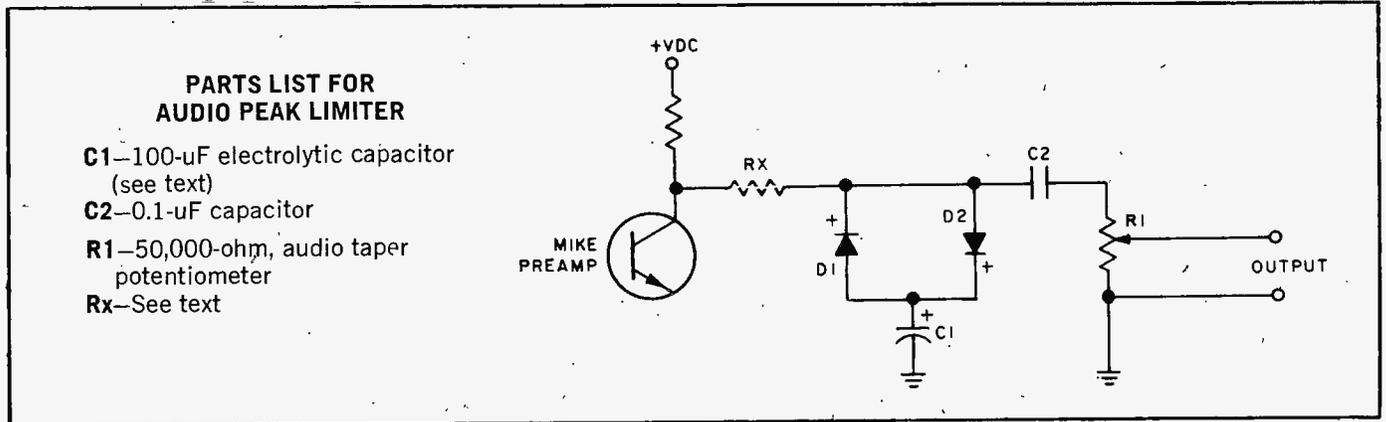
□ An effective speech clipper for transmitters and PA systems can be made from only two diodes and a capacitor.

Connect the diodes to the collector of the microphone preamplifier, the stage with at least a 1V peak-to-peak audio output voltage. The diodes clip

at approximately .2V, allowing overall amplifier gain to be increased without speech peaks producing over-modulation or excess peak power output.

Capacitor C1's voltage rating must be at least equal to the DC supply voltage at the preamp collector. If

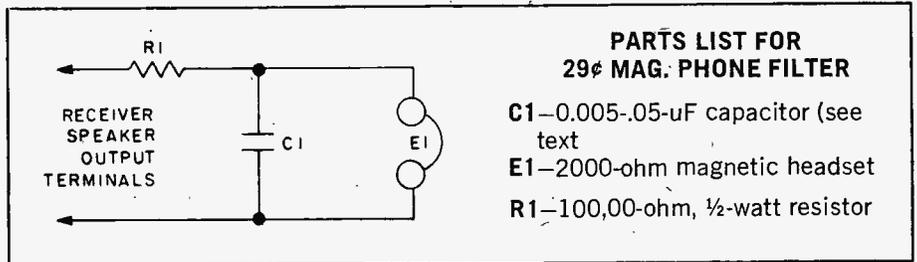
the preamp uses a negative supply, reverse C1's polarity. The output level to the rest of the amplifier is determined by R1. If the diodes cause distortion in the preamplifier, add resistor Rx, as shown. Use the necessary value between 1000 and 10,000 ohms.



59 29¢ Mag. Phone Filter

□ If you're tired of copying CW signals through the grind without a Q-multiplier on your receiver, the 29¢ Mag. Phone Filter is the next best answer. It's the cheapest route to greater selectivity.

Capacitor C1 plus the inductance of a magnetic headset form a parallel resonant circuit at approximately 1 kHz. All other signals are sharply attenuated so you hear mainly the signal you want. Resistor R1 isolates the resonant circuit to prevent a re-



ceiver's low output impedance from reducing the "Q" of the headset circuit.

The exact value of C1 depends on

the particular headset. Try different values in the range shown until the desired resonant frequency or peaking action is obtained.

60 Tape Dubbing Filter



□ Next time a friend asks you to dub his old 78 or worn 45 record collection on tape, don't start telling him how it will come out with more scratch and noise than music. No

need to apologize. Just pass his records through the Tape Dubbing Filter and he'll never know *wh' happen'* to the noise—it will all be gone.

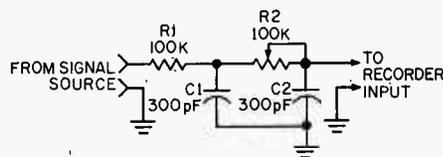
The filter connects between the sig-

nal source such as a record player and your tape recorder. Its cut-off frequency starts at about 5000 Hz, attenuation increasing at the higher noise producing frequencies. Control

R2 allows you to shift the "corner" frequency slightly up or down to obtain more or less high frequency attenuation as needed. For proper operation, the recorder input impedance should be at least 100,000 ohms. Some solid state recorders with input impedances less than 100,000 ohms will reduce the degree of high frequency noise filtering. This unit should be built in a metal enclosure.

PARTS LIST FOR THE TAPE DUBBING FILTER

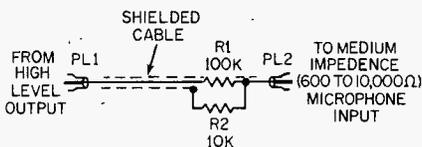
- C1, C2**—330-pF disc capacitor, 500 VDC or better
- R1**—100,00-ohms, ½-watt resistor
- R2**—100,000-ohm potentiometer, any taper



61 Tape Dubber's Pad

PARTS LIST FOR TAPE DUBBER'S PAD

- PL1, PL2**—Plugs to match existing tape equipment shielded cable
- R1**—100,00-ohm, ¼-watt resistor
- R2**—10,000-ohm, ¼-watt resistor



Many cassette recorders do not have a high level (aux) input; they are meant only for use with microphones. If you try to dub directly from another recorder's "line" output, the relatively high signal level overloads the microphone input, causing severe distortion.

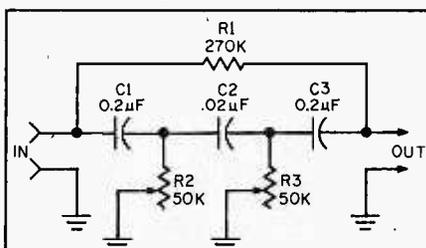
Good dubs can be obtained by attenuating the high level signal almost 50 dB, so the attenuated signal is essentially equal to microphone

level. This recorder bridging cord provides about 50 dB attenuation in a single, easy-to-handle assembly. Connect resistor R1 in series with the shielded cable hot lead. Connect the free end of R1 to recorder plug PL2 and one end of resistor R2. Fold R2 back adjacent to R1 and solder the free end to the cable shield. Loop a wire from the shield to the PL2 outside (sleeve) terminal. PL1 should match the output jack of the recorder you dub from.

62 78's Hiss Filter

Old 78-rpm collector's-item records cut back in the early days when performers sang in front of a large horn usually have a peak in the mid-band that drives the sound into your mind like a fingernail scratched across a blackboard. The overall sound quality is easily tamed, and made more natural and modern, by attenuating the shrill peaks with a Record Restorer, a device that suppresses, by hi-fi standards, the mid-band frequencies.

The Record Restorer should be assembled in a metal cabinet to prevent hum pickup. Connect the output of your phonograph to the restorer input. Connect the output of the restorer to your tape recorder. Set potentiometer R2 to maximum resistance and adjust potentiometer R3 for the most pleasing sound. If R3's adjustment is too little, or too much as evidenced by a "hole" in the sound quality, trim the restorer with R2 until you get the optimum equalization.



PARTS LIST FOR 78'S HISS FILTER

- C1, C3**—0.25-µF mylar capacitor
- C2**—0.02-µF mylar capacitor
- R1**—270,000-ohm, ½-watt resistor
- R2, R3**—50,000-ohm potentiometer, linear taper

63 Stereo Beat Filter

Many early stereo tuners, and quite a number of modern budget priced stereo tuners, have considerable output at 19 kHz and 38 kHz from the stereo pilot system. While these frequencies aren't heard, they can

raise havoc if they leak through to a Dolby noise reduction encoder, or if the frequencies beat with a tape recorder's bias frequency or its harmonics. Normally, Dolby-equipped units have a 19 kHz filter specifically

to avoid the problem of pilot leakage from the tuner, but often the pilot interference is so high it still gets through.

This filter, which can be powered by an ordinary transistor radio type

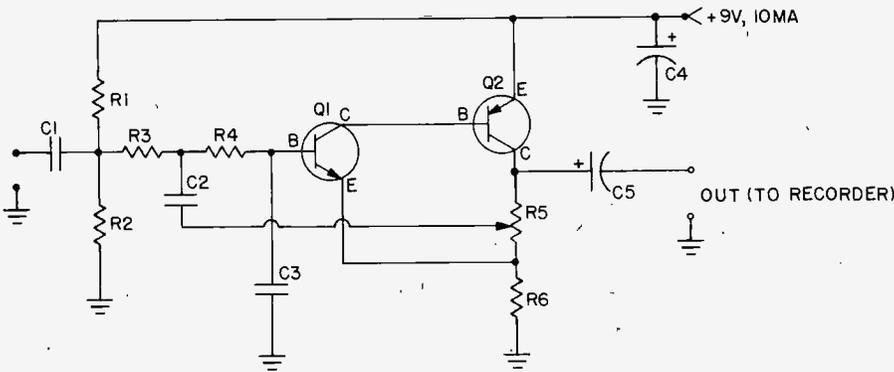
NEW 1976

battery, is connected to the output of the FM stereo tuner, and provides approximately 12 to 15 dB additional attenuation at 19 kHz and about 25 dB attenuation at 38 kHz. It has virtually no effect on the frequency response below 15 kHz, the upper limit of frequencies broadcast by FM sta-

tions.

The only really critical components are C1, C2 and R4, and no substitutions should be made.

A signal generator is required for alignment. Feed in a 1 kHz signal and note the output voltage. Then change the generator to 10 kHz and adjust



PARTS LIST FOR STEREO BEAT FILTER

Resistors 1/2-watt, 10%, unless otherwise specified

R1—470,000-ohms

R2—220,000-ohms

R3—33,000-ohms

R4—33,000-ohms, 5%

R5—5,000-ohm linear taper potentiometer

R6—3,300-ohms

Capacitors rated 10-VDC or higher

C1—0.047- μ F

C2, C3—220-pF, 2% silver mica or equiv.

C4—25- μ F

C5—1- μ F

Q1—Transistor, Radio Shack 276-2009

Q2—Transistor, Radio Shack 276-2021

R5 so the output level at 10 kHz is the same as for 1 kHz. You might have to check the measurements sev-

eral times to get R5 set correctly. When properly adjusted there will be perhaps 1 dB loss at 15 kHz.

The input signal should be in the range of 0.1 to 1 volt—typical level from a tuner's tape output jack.

64 FM Knockout Filter

A simple filter is all it takes to remove a strong, local FM signal that is blocking or cross modulating other FM stations. The filter connects in series with the FM antenna's downlead. Just be sure to use the shortest possible length between the filter's output and the receiver.

The filter *must* be assembled in a metal cabinet with 1/4-in. access holes so you can adjust the trimmer tuning capacitors. The metal cabinet is grounded to the receiver's chassis. Switch S1 by-passes the filter for normal operation. If your antenna's

downlead is coaxial cable, only one filter is installed—in series with the center (hot) conductor. To adjust,

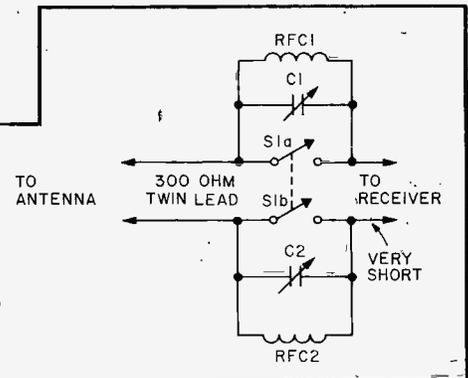
PARTS LIST FOR THE KNOCKOUT FILTER

C1, C2—40-pF trimmer capacitor

RFC1, RFC2—0.22- μ H RF choke, any type

S1—Dpst slide switch

Misc—300-ohm twinlead, metal cabinet



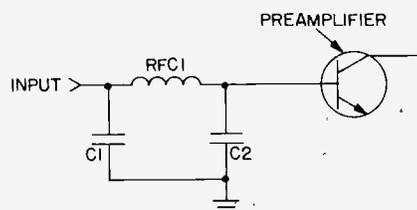
tune in the offending station and use an insulated alignment screwdriver to

adjust trimmer capacitors C1 and C2 for *minimum* signal strength.

65 Hi-Fi Interference Filter



It is not uncommon for nearby communications transmitters, and even AM and FM broadcast transmitters to be heard in hi-fi amplifiers that are switched to the phono input. The reason is that the input preamplifier in the hi-fi makes a dandy RF detector for any radio signal(s) picked up by the connecting lead from the turntable. After everything else,



PARTS LIST FOR HI-FI INTERFERENCE FILTER

C1, C2—240-pF dipped Mylar or silver mica capacitor

RFC1—10- μ H miniature RF choke, J. W. Miller 75F105AP or equiv.

such as grounding equipment and installing power line filters, fails to get rid of the interference, try installing this filter in series with the input lead to the preamplifier. Best results are attained if the filter is as close as possible to the transistor itself. But if it

means cutting into the printed circuit board's wiring, place the filter *at the input* to the PC board wiring—where the wire from the phono input jack connects to the copper foil terminal. Make certain C1 and C2 connect to the copper foil ground. The values of

the filter have no effect on audio frequencies.

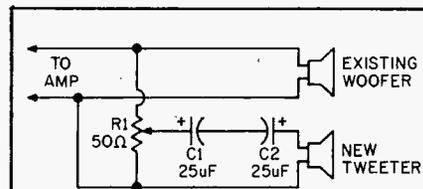
Keep in mind that the filter might also fail. Not every RF filter works the same way in every circuit. There are some RF interference problems that just won't go away.

66 Add-A-Tweeter

Any single-voice coil speaker is hard pressed to handle both low and high frequencies simultaneously—and it's the highs that suffer most. A much cleaner sound can usually be obtained from speakers 6 inches or larger if the highs are pumped through a tweeter. It can be any small speaker rated 4 to 6 ohms of approximately 2 to 3 inches in diameter.

The back-to-back capacitors, C1 and C2, permit only the highs from

about 1500 Hz up to pass into the tweeter. By keeping the lows out of the tweeter, the highs come out cleaner, and there's no chance of the greater low frequency power "blowing" the tweeter. Potentiometer R1 is used to match the tweeter's output level to that of the woofer—because small speakers are generally much more efficient than large speakers. If you eliminate R1, the highs will literally scream in your ears.

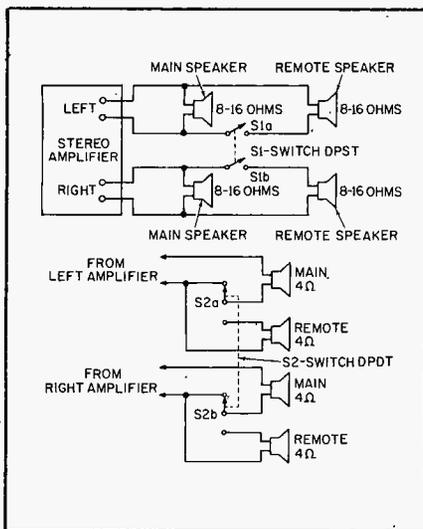


PARTS LIST FOR ADD-A-TWEETER

C1, C2—22- μ F electrolytic capacitor, 50 VDC
R1—50-ohm wirebound potentiometer, 1 or 2 watts.

Misc.—Cone type tweeters are suitable for use with this circuit.

67 Hook-up Remote Speakers



Even if your hi-fi amplifier does not have output terminals for remote speakers, it is easy enough to add them without complex switching equipment. With few exceptions, modern solid-state amplifiers have no output transformer and automatically match any speaker impedance between 4 and 16 ohms. The only important consideration is that the total impedance connected to the left and/or right speaker output is never less than 4 ohms, or the amplifier will attempt to deliver so much power output, the output transistors will self-destruct.

If your main speakers have an impedance of 8 or 16 ohms, simply add

remote speakers as shown; switch S1 turns the remote speakers on and off. Since transistor amplifiers usually put out more power at 4 ohms than at 8 or 16 ohms, adding the extra speakers does not substantially reduce the volume at the main speakers because the amplifier sees a lower impedance load and attempts to drive more power output into the combined speaker load.

If your speakers are 4 ohms, and you plan to use 4 ohm remote speakers use the circuit modification shown. Switching in the remote speaker will result in the main and remote speakers being series connected for a total load of 8 ohms.

68 Magnetizer-Demagnetizer



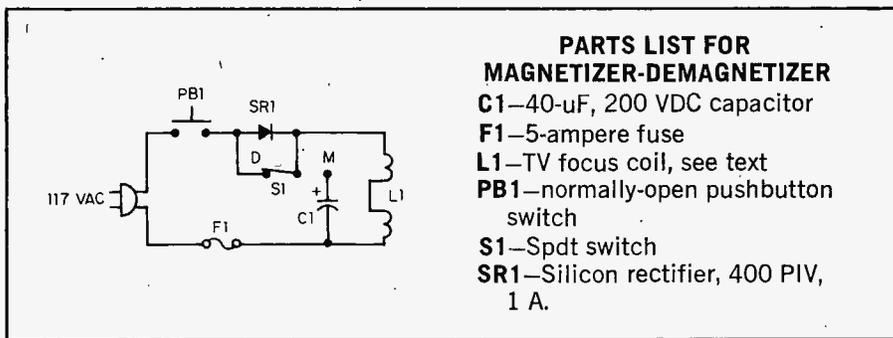
Quite often it's most handy to magnetize your tools to start a screw or nut into a blind spot. On the other hand, there are times when your tools must have absolutely no trace of magnetism, such as when adjusting a tape

recorder's heads. This easy device can flip your tools either way, at any time. All it takes is the press of a button.

Coil L1 is an ordinary TV focus coil. Using an ohmmeter, locate two pair of leads. Short one lead from

each pair together and connect the coil into the circuit as shown. Assemble the unit in a plastic (not metal) cabinet using zip, or lamp, wire about 12-in. long for L1's connections.

To magnetize a tool, place switch S1 in the M position, insert the tool into L1's opening and depress switch PB1 for about 1 second. Release PB1 and then withdraw the tool. To demagnetize, place the tool inside L1, set S1 to D and depress PB1. While holding PB1 down slowly withdraw the tool from L1. If the unit fails to magnetize reverse the connections of one pair of L1's leads.



PARTS LIST FOR MAGNETIZER-DEMAGNETIZER

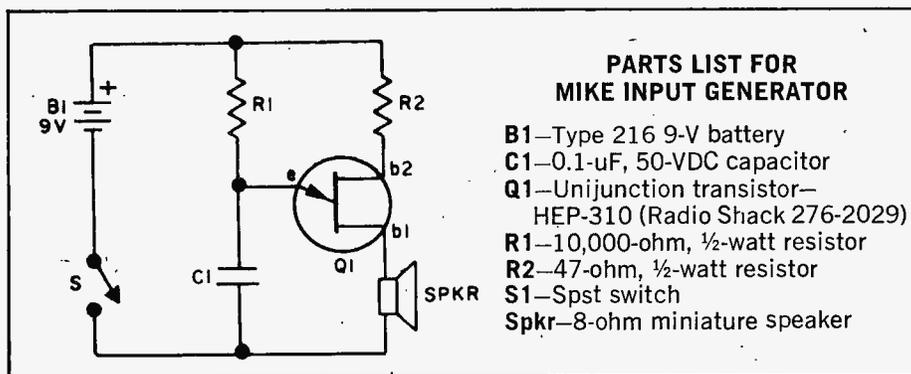
- C1—40-uF, 200 VDC capacitor
- F1—5-ampere fuse
- L1—TV focus coil, see text
- PB1—normally-open pushbutton switch
- S1—Spdt switch
- SR1—Silicon rectifier, 400 PIV, 1 A.

69 Mike Input Generator



□ You can always feed an audio generator into a mike input to check an AF system, but how do you check the mike? Saying "woof, woof, hello, test" gets mighty tiring. Instead, clamp the generator to the front of the mike with a rubber band and you'll send continuous tone *through the mike*. It lets you take your time checking the mike, connecting cable, jacks, amplifiers, etc.

The beeper can be built in a small plastic case—nothing is critical. The speaker may be any size from one to three inches.



PARTS LIST FOR MIKE INPUT GENERATOR

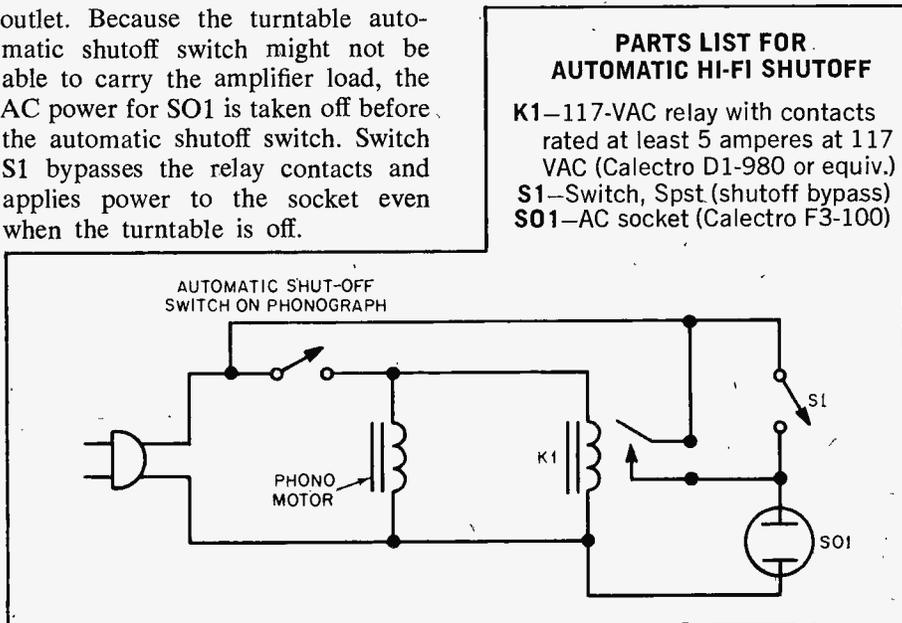
- B1—Type 216 9-V battery
- C1—0.1-uF, 50-VDC capacitor
- Q1—Unijunction transistor—HEP-310 (Radio Shack 276-2029)
- R1—10,000-ohm, 1/2-watt resistor
- R2—47-ohm, 1/2-watt resistor
- S1—Spst switch
- Spkr—8-ohm miniature speaker

70 Automatic Hi-Fi Shutoff

□ It happens to just about everyone. One minute you're listening to the hi-fi, the next you're called away to answer the doorbell or a phone call. You forget all about the music, the record plays through, the automatic turntable shuts off—but the amplifier stays on until you happen to pass by and notice the glow from the pilot lamps. Yet, this simple circuit, which you can throw together in less than an hour, will automatically turn off the amplifier when the turntable shuts off.

The relay coil voltage is taken from across the phono motor; when the turntable motor is on, relay K1 closes and applies power to AC socket SO1; when the turntable shuts off, removing voltage from the motor, K1 opens, disconnecting power from the

outlet. Because the turntable automatic shutoff switch might not be able to carry the amplifier load, the AC power for SO1 is taken off before the automatic shutoff switch. Switch S1 bypasses the relay contacts and applies power to the socket even when the turntable is off.



PARTS LIST FOR AUTOMATIC HI-FI SHUTOFF

- K1—117-VAC relay with contacts rated at least 5 amperes at 117 VAC (Calectro D1-980 or equiv.)
- S1—Switch, Spst (shutoff bypass)
- SO1—AC socket (Calectro F3-100)

71 Stereo Balancer

□ One sure way to be certain your stereo system is in perfect electrical balance is to use a power amplifier Stereo Balancer to substitute for guesswork.

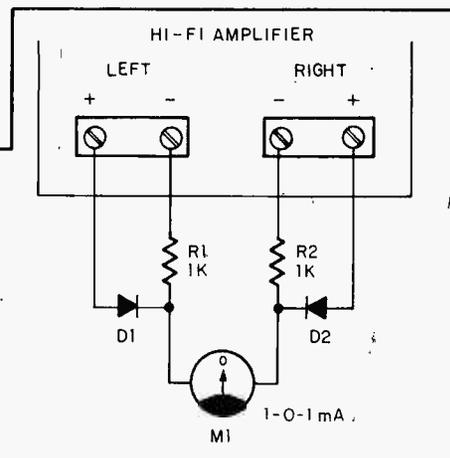
Meter M1 can be a zero-center DC milliammeter rated 1-0-1 mA or less. Alternately, you could use a standard meter but the pointer might be driven off-scale to the left while making adjustments, though the meter won't be damaged—it will just be an inconvenience.

Play any stereo disc or tape and then set the amplifier to *mono*. Adjust

the left and right channel balance until meter M1 indicates zero; meaning the left and right output level are identical—that's balance.

PARTS LIST FOR STEREO BALANCER

- D1, D2—Silicon rectifier rated 100 PIV at any low current
- M1—Zero-center DC mA meter (see text)
- R1, R2—1000-ohm, ½-watt resistor, 5% or 1%



72 Basic Color Organ

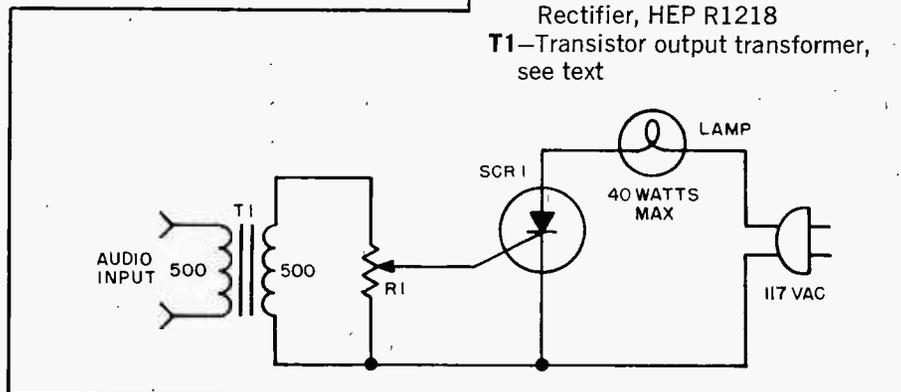
□ This simple color organ is certain to keep your party from becoming a drag. Connected to your hi-fi amplifier's speaker output (across the speaker terminals) it will throb in time to the music. Paint the bulb red or deep blue and your party room will take on the atmosphere of a rock club.

Transformer T1 can be any matching transistor type in the range of 500/500 to 2500/2500 ohms. Note that none of the connections from SCR1 or its components are connected to ground. For safety's sake, you must keep the 117-volt line voltage from the amplifier connections—that's the reason for T1. To adjust, set potentiometer R1 "off" and adjust the

amplifier volume control for a normal listening level. Then adjust R1 until lamp I1 starts to throb in step with the beat.

PARTS LIST FOR BASIC COLOR ORGAN

- I1—117V lamp, not to exceed 40 watts.
- R1—Potentiometer, 500 to 5000 ohms
- SCR1—Silicon Controlled Rectifier, HEP R1218
- T1—Transistor output transformer, see text



73 Bull Horn

□ The next time someone tries to shout you at a public meeting just reach for this Bull Horn and drown 'em out.

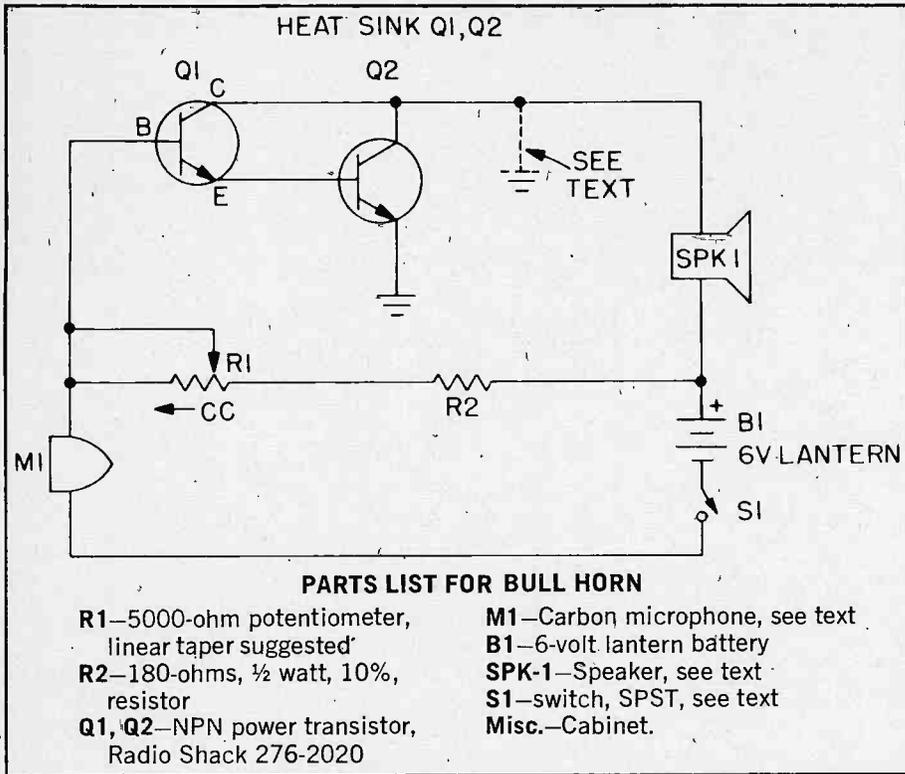
With a little ingenuity the circuit can be built into a small metal cabinet that secures directly to the 6-volt lantern battery power supply. Speaker SPK-1 can be anything from 4- to 8-ohms impedance, but a miniature PA horn or "trumpet" will give much greater volume with no increase in

battery drain since the horns are very efficient.

Note there is no main circuit ground. Transistors Q1 and Q2 must be heat sinked. Since Q1 and Q2's collectors are connected to the heat sink mounting tab you can secure the transistors directly to the cabinet if you use the ground indicated by the dashed lines. If you connect the battery's negative wire to the cabinet (ground) you must insulate Q1 and

Q2 from the cabinet with *insulated* power transistor mounting hardware.

Potentiometer R1 is used to compensate for different carbon microphone values, and for reduced battery voltage. Normally, a Bull Horn gets very distorted as the battery wears down. With this circuit, however, you can compensate somewhat for battery wear with R1, getting up to 25 percent extra use from the battery. Wire R1 so maximum resistance is in



the circuit when R1's shaft is full counterclockwise. A linear taper pot will give the easiest control.

M1 can be any carbon microphone; from a surplus telephone transmitter to the element from an old, scrapped CB rig's microphone. If you get one of the war surplus carbon mikes you can use the built in push-to-talk (PTT) switch for S1.

To use, set R1 full counter-clockwise and turn S1 on. As you speak into the mike adjust R1 very slowly for *cleanest* sound, or maximum understandable volume. This adjustment compensates the circuit for the microphone impedance and, once set, you can leave it alone. Later, to stretch the battery life, adjust R1 slightly clockwise as the distortion (caused by reduced battery voltage) increases. Do not use the Bull Horn when the distortion is very bad and R1 is full clockwise as this will damage the transistors: get a new battery.

74 Light Power Control

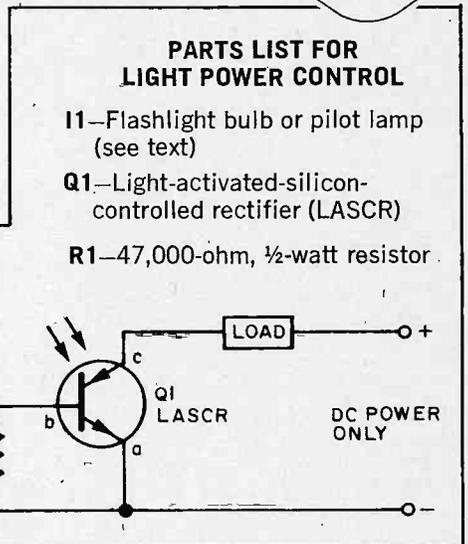


□ Heavy direct current or DC power is easily controlled without the use of massive power switches and wiring by using a LASCR (light activated silicon controlled rectifier) as an interface between the control and controlled circuits. The LASCR is similar to an SCR except that the gate is tripped by light rather than voltage/current.

The triplamp can be any ordinary flashlight bulb powered by two D cells. When the lamp is turned on the LASCR gate is closed, causing current to flow through the load and the LASCR anode (a) cathode (c) circuit.

A suitable LASCR is one from GE's L8B series. Use one with the

appropriate PIV rating. Inexpensive LASCRs are occasionally available from "surplus dealers", though you must make certain the "surplus" unit has the required PIV rating.



75 Yelp Oscillator



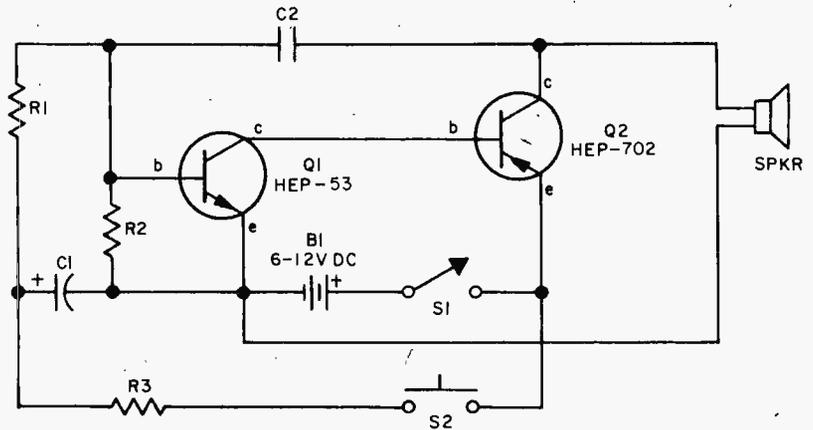
□ A real screamer! Use a public-address type amplifier and horn under the hood of your car and you'll punch a hole in the tightest traffic jam. (Be certain, of course, that you hold a position that entitles you to a siren.)

Build this yelper in a small box and hold the PA mike 2-3 inches from the 8-ohm speaker. Press push-button switch S2 and the siren starts up, shifting to a higher frequency. Release it and the tone slides down

until you press S2. Tone quality is adjusted by changing C2. If the siren pulsates before S1 is pressed, Q1 is too "leaky."

PARTS LIST FOR YELP OSCILLATOR

- B1**—6-V or 12-V battery
- C1**—30- μ F, 15-VDC electrolytic capacitor
- C2**—0.02- μ F, 75-VDC capacitor
- Q1**—Motorola HEP-53 npn transistor (Radio Shack 276-2009)
- Q2**—Motorola HEP-702 pnp transistor
- R1, R2**—56,000-ohm, $\frac{1}{2}$ -watt resistor
- R3**—27,000-ohm, $\frac{1}{2}$ -watt resistor
- S1**—Spst switch
- S2**—N.O. pushbutton switch (Calectro E2-142)
- SPKR**—8-ohm speaker or PA horn (Calectro S2-245/6 or equiv.)



76 Flash Tester



The way film and flashbulb prices are going these days, if your flash fails to fire you're stuck with almost half a buck in wasted polaroid film, and if you fire a flash to check the flashgun battery you've just burned up at least 25-cents worth of flash. But worse, if the flash fails to fire you might have missed the picture of a lifetime.

You can't check a flash battery with a voltmeter because the meter doesn't apply the heavy surge current needed by the flashbulb, and just about any fully dead battery that

isn't leaking acid will check okay when tested without load.

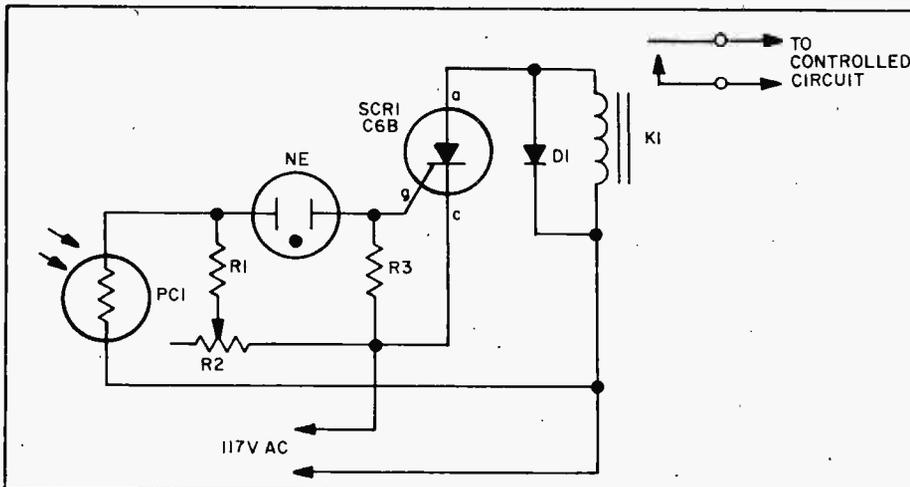
This little flash tester you can probably build from junk-box parts will give you a quick load-check on flashgun batteries. T1 can be any 6.3-volt filament transformer rated from 300-mA up. NL-1 is just about any neon lamp of the NE-2 or NE-86 variety. Solder T1's terminals to those of a used flashbulb or flashcube.

To check the battery, just plug in the flash tester and trip the camera shutter (cover the lens if the camera has film). Lamp NL-1 will flash if the

battery is okay (T1 requires a high inrush current, as does the flashbulb).

PARTS LIST FOR FLASH TESTER
T1—6.3-volt filament transformer
NL-1—Neon lamp, see text
Misc.—Used flashbulb base.

77 Commercial Killer



- PARTS LIST FOR COMMERCIAL KILLER**
- D1**—400-PIV silicon rectifier
 - K1**—117 VAC latching relay (Guardian IR-610L-A115 or equiv.)
 - NE**—NE-83 neon lamp
 - PC1**—Cláirex photo cell CL505 for high light level; CL704 or CL705 photocell for low light level
 - R1**—22,000-ohm, $\frac{1}{2}$ -watt resistor
 - R2**—1-megohm potentiometer
 - R3**—100-ohm, $\frac{1}{2}$ -watt resistor
 - SCR1**—HEP R1218, 200V, 4A, silicon-controlled rectifier

□ A flashlight beam stabs out—the irritating TV commercial for under-arm deodorant vanishes. Moments later, when the program returns, the flashlight beam stabs out again. The sound snaps back on. Between the flashlight and TV speaker circuit

is the light-controlled switch.

When a beam of light strikes the photocell, the voltage across neon lamp NE-1 rises sharply. When conduction voltage is reached NE-1 turns on and fires the SCR. K1 is an impulse relay whose contacts stay in

position even after coil current is removed. So the first impulse opens K1's contacts, the second impulse closes them, etc. To prevent ambient light from tripping the photocell, it should be recessed at least an inch inside a metal or cardboard tube.

78

Action Freeze Photo Trip



□ You, too, can take strobe-flash pictures the instant a pin pricks a balloon, a hammer breaks a lamp bulb or a bullet leaves a gun. You'll

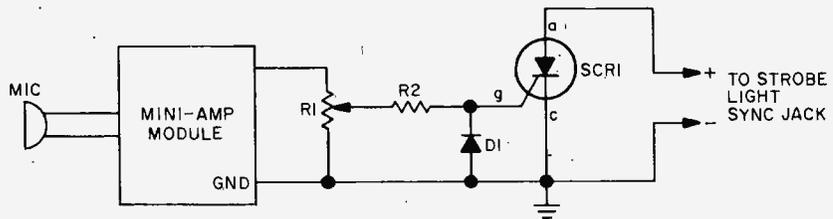
need a mini-amp—one of those transistor amplifier modules of 1-watt rating or less. *It must have an output transformer.* Don't use an "OTL" (no transformer) amplifier. The amplifier is terminated with a resistor on its highest output impedance, preferably 16 ohms. Make certain the connec-

tions to the strobe flash sync terminals are correctly polarized.

Darken the room lights, open the camera shutter and break a lamp bulb with a hammer. The sound of the hammer striking the lamp will trigger the flash, and the picture will have been taken at that instant.

PARTS LIST FOR ACTION FREEZE PHOTO TRIP

- D1—HEP-154 silicon rectifier
- R1—5000-ohm potentiometer
- R2—2700-ohm, ½-watt resistor
- SCR1—Calectro K4-584 silicon-controlled rectifier
- MIC.—Ceramic microphone



79

Remote Flash Trigger



□ Even if you spend \$18 or \$20 for a super-duper professional remote flash tripper, you'll get little more than this two-component circuit. Price is important if the results are equal.

Transistor Q1 is a light-activated silicon-controlled rectifier (LASCR). The gate is tripped by light entering a small lens built into the top cap.

To operate, provide a 6-in. length of stiff wire for the anode and cathode connections and terminate the wires in a polarized power plug that match-

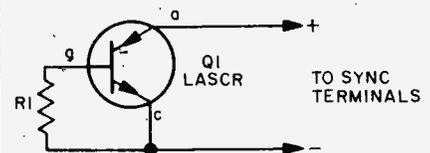
es the sync terminals on your electronic flashgun (strobelight). Make certain the anode lead connects to the *positive* sync terminal.

When using the device, bend the connecting wires so the LASCR lens faces the main flash. This will fire the remote unit.

No reset switch is needed. Voltage at the flash's sync terminals falls below the LASCR's holding voltage when the flash is fired, thereby turning off the LASCR.

PARTS LIST FOR REMOTE FLASH TRIGGER

- Q1—200-V light-activated silicon-controlled rectifier (LASCR)
- R1—47,000-ohm, ½-watt resistor



80

Variable Flood Lighting

□ All the flexibility of a professional photo studio's variable lighting can be yours with this 500-watt lamp dimmer.

Triac Q1 must be connected to a large heat sink. The entire unit is assembled in a metal cabinet with Q1

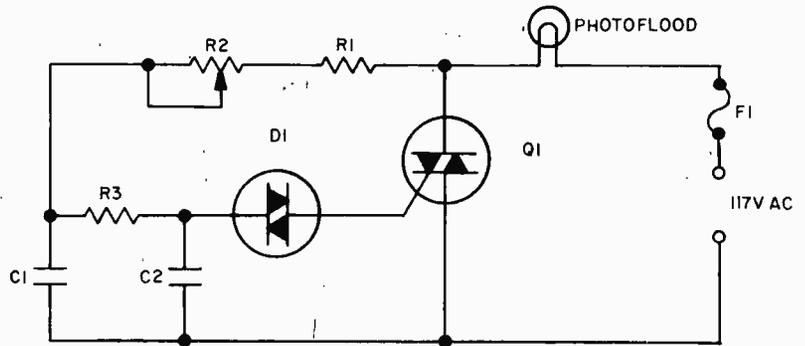
epoxy-cemented to the cabinet for heat dissipation.

Fusing must be employed. Otherwise, the surge current when 500-watt photo lamps burn out will instantly destroy Q1. Connect an 8AG (fast-action) 5-ampere fuse in series with

the lamp or any other fuse of equal action, or faster. In this circuit 3AG fuses cannot be used. Potentiometer R2 will adjust the lamp's intensity from full off to essentially 100% full on.

PARTS LIST FOR VARIABLE FLOOD LIGHTING

- C1, C2**—0.01- μ F, 300-VDC capacitor
- D1**—HEP-311 diode
- F1**—Fuse, type 8AG, 5A
- Q1**—Triac, HEP R1723, 8A/200V
- R1**—1000-ohm, $\frac{1}{2}$ -watt resistor
- R2**—100,000-ohm linear taper potentiometer
- R3**—15,000-ohm, $\frac{1}{2}$ -watt resistor



81 Photo Print Meter

○ UPDATED ○

□ Every print a good print! That's what you get with the photo print meter.

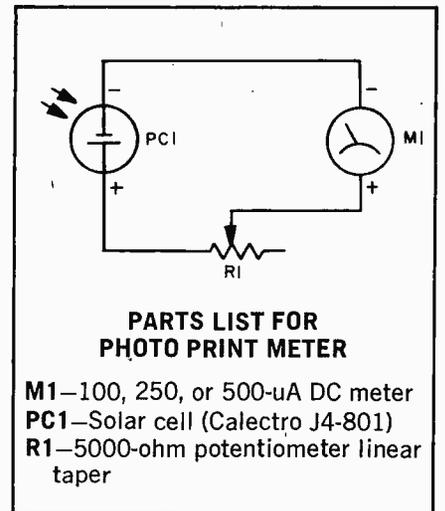
Meter M1 can be just about anything up to 0-1 DC mA. But if you prefer low light levels and long exposures, install a sensitive meter of 500 μ A or less.

When light from the enlarger falls on the solar cell (PC1), a voltage is generated that is in proportion to the amount of light. Sensitivity control R1 allows the user to set the meter indication to a convenient value.

To use the meter, first make a good normal print in your normal manner from a No. 2 or No. 3 nega-

tive. Then, do not disturb the enlarger setting, but integrate the light by placing a diffusing disc or opal glass under the lens. Place the solar cell on the easel and adjust R1 for a convenient meter reading, say, full scale. The meter is now calibrated.

When using it, focus the enlarger, use the diffuser, and adjust the lens diaphragm until you get the reference meter reading. Then use the exposure time previously found for the calibration print. Suggested reading: Ilford Manual of Photography, obtainable from any photo store. Also, check Kodak publications available at the same place.



PARTS LIST FOR PHOTO PRINT METER

- M1**—100, 250, or 500- μ A DC meter
- PC1**—Solar cell (Calectro J4-801)
- R1**—5000-ohm potentiometer linear taper

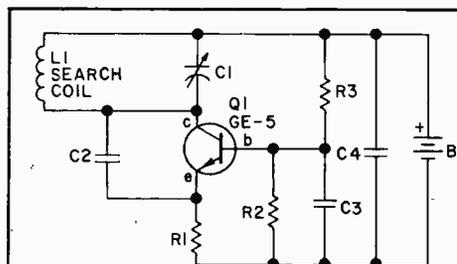
82 Lo-Parts Treasure Locator

○ UPDATED ○

□ You won't find Long John Silver's buried treasure but you will have lots of fun finding bottle caps and uneaten sandwiches at the beach; maybe even some quarters and dimes.

This treasure locator keeps costs down by using a transistor radio as the detector. The unit is assembled on a perf-board, with rigid component mounting a must. It is strapped to a broom handle close to the bottom where the search head is mounted. A transistor radio is mounted near the top of the handle.

With the radio tuned to a "weak station," Capacitor C1 is adjusted so the locator oscillator "beats" against



PARTS LIST FOR LO-PARTS TREASURE LOCATOR

- B1**—9-VDC transistor battery
- C1**—365-pF trimmer or variable capacitor

- C2**—100-pF, 100-V silver mica capacitor (Allied Electronics 782R0818)
- C3**—0.05- μ F, disc capacitor
- C4**—4.7- or 5- μ F, 12-V electrolytic capacitor
- L1**—Search coil consisting of 18 turns of #22 enamel wire scramble wound on 4-in. diameter form
- Q1**—RCA SK3011 npn transistor or equiv.
- R1**—680-ohm, $\frac{1}{2}$ -watt resistor
- R2**—10,000-ohm, $\frac{1}{2}$ -watt resistor
- R3**—47,000-ohm, $\frac{1}{2}$ -watt resistor

the received signal, producing a whistle in the receiver. When the search head passes over buried metal, the metal changes the inductance of L1, thereby changing the locator oscillator's frequency and changing the "beat tone" in the radio.

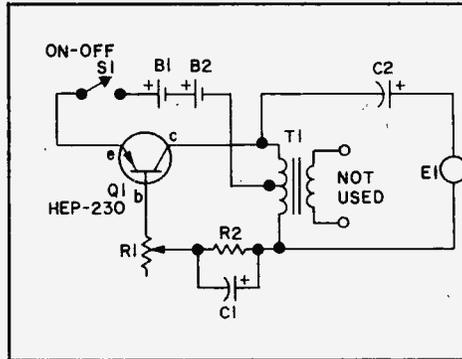
The search coil consists of 18 turns of #22 enameled wire *scramble wound* (which means don't be neat) on a 4-in. diameter form, which can be a cardboard tube or a wood puck or even plastic—anything but metal. After the coil is wound and checked

for proper operation, saturate the coil with *coil dope* or G.E.'s *RTV* adhesive. If a single loop of the coil is not firmly cemented the unit will be unstable.

83 Angler's Bite Booster

Click-click might not sound like much to you but to a fish it's the dinner bell. That's the lure of this electronic circuit. Shove the whole works in a watertight container, lower it over the side, and wait for the fish to hit the hooks.

For proper operation T1 must be subminiature type about half as large as your thumb. E1 must be a crystal headpiece.



PARTS LIST FOR ANGLER'S BITE BOOSTER

- B1, B2—1.5-V AAA battery
- C1, C2—50-uF, 12-VDC electrolytic capacitor
- E1—Crystal earphone
- Q1—Motorola HEP-230 pnp transistor
- R1—5000-ohm pot
- R2—27,000-ohm, ¼-watt resistor
- S1—Spst switch, part of R1
- T1—Subminiature transistor output transformer; 500-ohm center tapped primary to 8-ohm secondary

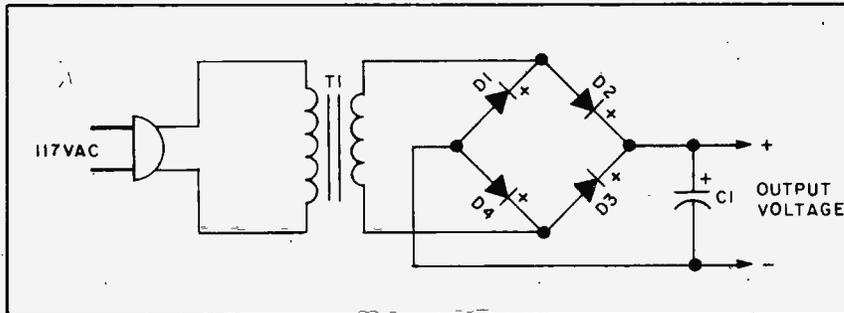
84 Basic Power Supply

Though the transformer isn't center-tapped in this circuit, the bridge rectifier provides full-wave rectification with an easy-to-filter DC output. It forms a handy supply for solid-state projects.

The output voltage is equal to the secondary voltage multiplied by 1.4. Or, working backwards, the secondary voltage must be 0.707 times the desired output voltage.

Silicon rectifiers D1 through D4

must have a PIV rating equal to at least the DC output voltage. Their current rating must at least equal the current requirements of the project being powered by the supply.



PARTS LIST FOR BASIC POWER SUPPLY

- C1—2500-uF electrolytic capacitor, voltage rating at least 1.5 times higher than output voltage
- D1, D2, D3, D4—1A, 400-PIV silicon rectifier
- T1—Transformer; 117-VAC primary, secondary voltage equal to desired output voltage x 0.707

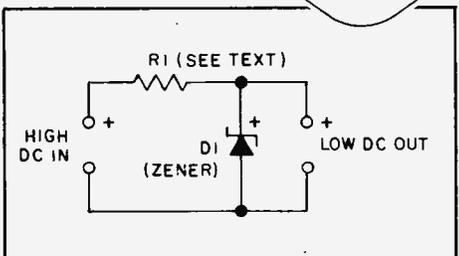
85 Zener Regulator

When the output from an AC power supply is too high for a solid-state project, chop it down to size with a zener diode voltage regulator and keep it on the button.

To calculate R, first add the load current and 1/20 of the load current for the zener's idling current. Then

use Ohm's Law ($R = E/I$) to calculate R. The resistor's power rating should be twice the calculated power

The power rating for the zener diode is determined by the voltage across the diode squared, divided by diode's nominal internal resistance. You can calculate the internal resis-



tance by working backwards from the zener's power rating. As an example:

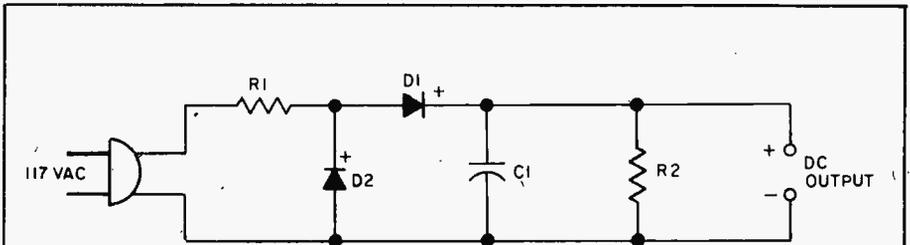
a 9-volt, 1-watt zener would have a nominal internal resistance of $R =$

E^2/W , 81/1, or 81 ohms. It's not precisely accurate, but close enough.

86 Lo-Hum Power Supply

Just a handful of components are needed for a line-powered low-voltage low-current supply for powering audio preamplifiers.

The values for different voltage and current outputs are given in the Parts List. Pick the set you need and wire up. D1 and D2 are silicon rectifiers rated at a minimum of 200 PIV at any current.



PARTS LIST FOR LO HUM POWER SUPPLY

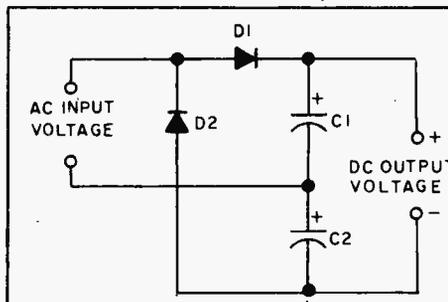
Output V	I max*	R1	C1	R2
12	1 mA	43,000-ohm, ½-watt	250-µF, 15-VDC	180,000-ohm, ½-watt
12	2 mA	22,000-ohm, ½-watt	250-µF, 15-VDC	100,000-ohm, ½-watt
25	2 mA	18,000-ohm, ½-watt	250-µF, 30-VDC	180,000-ohm, ½-watt

*For lower current, decrease value of R2

87 Make A Voltage Doubler

Found in many CB transceivers, the full-wave voltage doubler provides reasonably good regulation with DC output voltage twice the AC input. Capacitors C1 and C2 should be a minimum of 100-µF and rated at twice the DC output voltage. The larger the capacity, the greater will be the filtering.

On the positive half-cycle, C1 is charged through silicon diode D1. On



PARTS LIST FOR A VOLTAGE DOUBLER

C1, C2—100-µF electrolytic capacitor or larger, WVDC should be twice DC output voltage

D1, D2—500-milliampere (or larger) rectifying diode rated PIV at least twice DC output voltage

the negative half-cycle, C2 is charged through D2. The DC output voltage

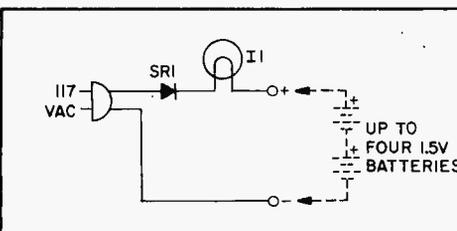
is the sum of the charge across C1 and C2.

88 Dry-Cell Charger

This circuit in a fancy commercial package will cost you about \$5. Build a lamp bulb charger yourself and 50¢ may just about do it.

The lamp maintains constant charging of approximately 20 mA through one to four 1.5-volt batteries. But you can go as high as 22.5 volts for either batteries in series or a single battery.

Give small penlight batteries about



PARTS LIST FOR DRY-CELL BATTERY CHARGER

I1—No. S-6, 6-watt candelabra lamp
SR1—400-PIV, 1A silicon rectifier (Lafayette Radio Electronics 32R08824 or equiv.)

10 hours charge; the C and D cells about 20 hours. Yes, you can recharge

NICads stamped with a charge rate of approximately 20 to 25 mA.



89

NiCad Battery Charger

□ Providing an adjustable output voltage up to 35 VDC and maximum output current of 500 mA, this battery charger handles just about any NiCad

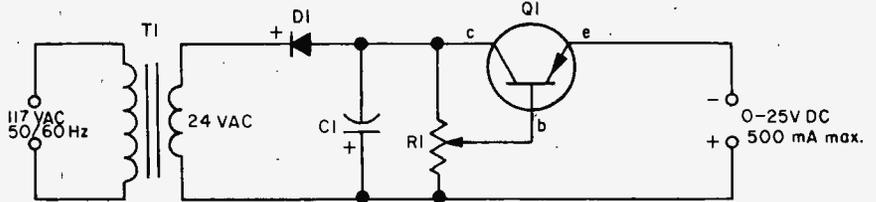
battery used by experimenters and consumer equipment.

Transistor Q1 must be mounted on a heat sink (which can be a metal

cabinet). Since Q1's case is also the collector connection it *must* be insulated from the cabinet.

PARTS LIST FOR NICAD BATTERY CHARGER

- C1—100- μ F, 50-V electrolytic capacitor
- D1—1-A, 400 PIV-silicon rectifier (Lafayette Radio Electronics 32R08824 or equiv.)
- Q1—40-W, pnp power transistor
- R1—2000-ohm potentiometer
- T1—24-VAC, 117-VAC primary filament transformer



90

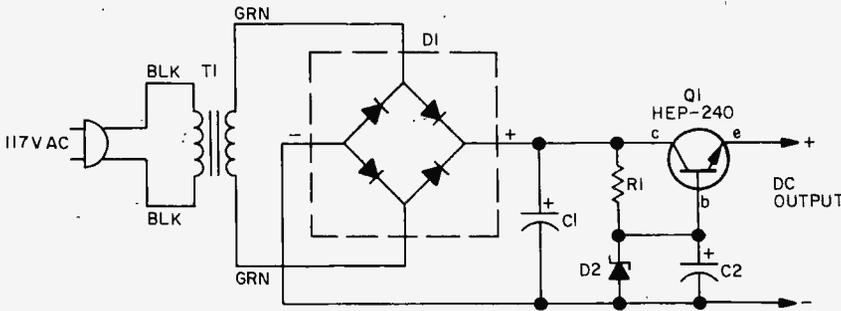
A Regulated Nine

□ Providing 9 volts at approximately 250 mA, this lab-type power supply will handle many experimenter projects. Actually, T1 can be a 6.3-V imported filament transformer since they usually give approximately 12 V

peak at less than 500 mA output. Change the Zener diode to 12 or 6 volts (and possibly the value of R1) and you get a regulated 12- or 6-volt supply.

For 12 volts you must use a 12-V

filament transformer. Filtering is very good since the *electrical* filter capacitor equals the value of C2 times the gain of Q1. It can add up to thousands of μ F.



PARTS LIST FOR A REGULATED NINE

- C1—470- μ F, 25-VDC electrolytic capacitor
- C2—100- μ F, 12-VDC electrolytic capacitor
- D1—Motorola HEP-175 50-PIV diode bridge rectifier
- D2—Motorola HEP-104, 9.1-V Zener diode
- Q1—Motorola HEP-240, 10-watt npn transistor
- R1—560-ohm, 1/2-watt resistor
- T1—12-V filament transformer (see text)

91

12 to 9 for Transistors

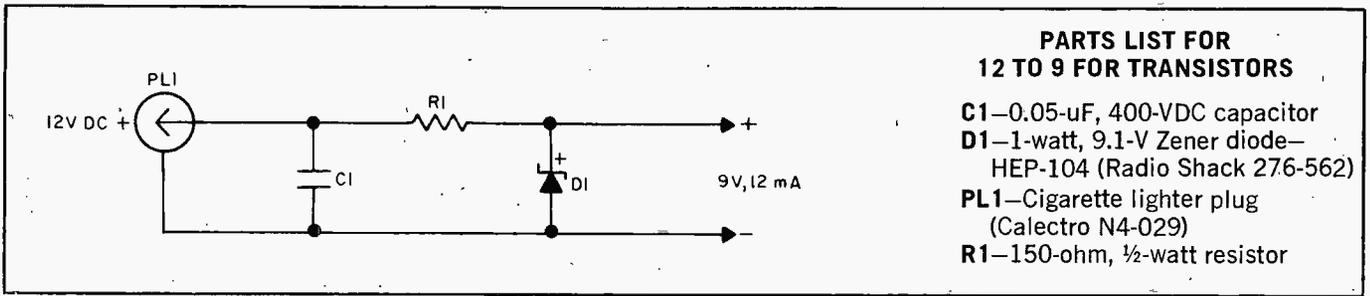
□ When your auto radio poops out, this regulated voltage adapter keeps you in music from a transistor portable until you're ready to climb under the dash to get at the trouble and fix it.

Power is taken from the 12-volt

auto battery through a cigar lighter plug. The zener diode can be anything with an approximate rating of 9 volts. For example, you can use a 9.1-volt unit (common in Zener kits), or even one rated at 8.6 volts. Make certain the Zener is correctly installed; the

end marked with a band is the cathode.

The adapter is rated for a current of 12 mA maximum. A good rule of thumb is that a radio powered by a Burgess type 2U6 battery can safely operate on the adapter.



**PARTS LIST FOR
12 TO 9 FOR TRANSISTORS**

- C1—0.05- μ F, 400-VDC capacitor
- D1—1-watt, 9.1-V Zener diode—HEP-104 (Radio Shack 276-562)
- PL1—Cigarette lighter plug (Calectro N4-029)
- R1—150-ohm, $\frac{1}{2}$ -watt resistor

92 AC Adapter

NEW 1976

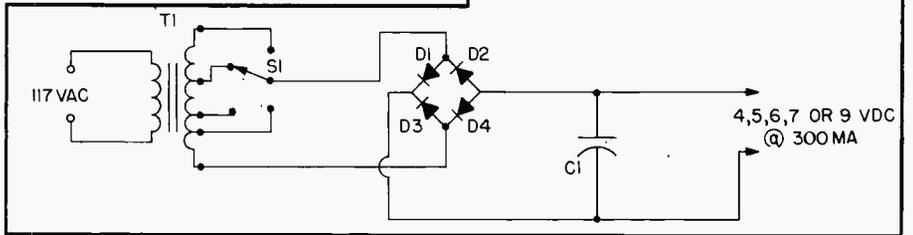
It seems that just about everything these days is battery powered, and when something goes bad and you're ready to check it out more than likely the size batteries needed are not in your stock, and it's two hours past store-closing time. But with this universal AC adaptor you can handle just about any battery powered repair job that gets on your test bench. Providing up to 300 mA, you can arrange the output leads of the adaptor to deliver the required polarity connections.

Keep in mind, however, that this AC adaptor is for radios, cassette recorders, and the like. *It is not for calculators.* Some calculators require

an adaptor with an AC output (the rectifier and filter are in the calculator) and this fact isn't indicated anywhere in the instruction manual or on the calculator. Connect an adaptor with a DC output to a calculator requiring an AC input and you probably will be buying a new calculator. So don't claim later you weren't warned.

PARTS LIST FOR AC ADAPTOR

- T1—Adaptor transformer, Calectro D1-743
- D1-D4—Any silicon rectifier rated at least 25 PIV at 0.5 A.
- C1—2000- μ F, 15 VDC capacitor
- S1—Any switch that can provide 4PST.

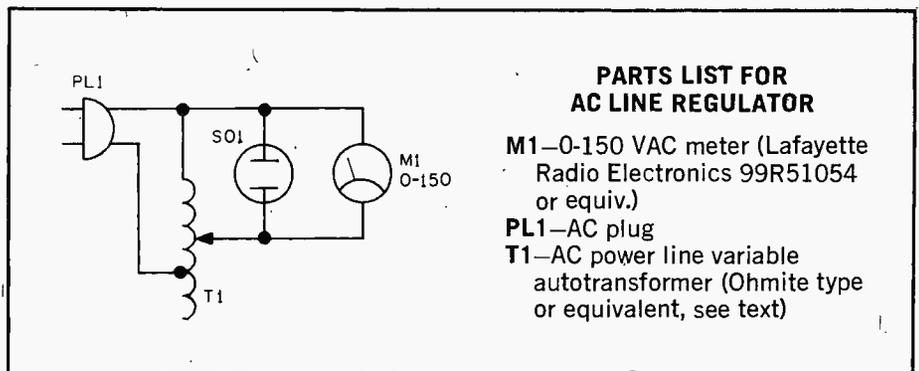


93 Line Regulator

UPDATED

Shrinking TV pictures, color shifts, hi-fi amplifiers that don't put out anywhere near their rated power, photographic enlargers requiring extra-long exposures. These are just a few of the symptoms associated with low line voltage. Maybe it's the local electric company "browning" you out because they can't meet the electric surge to power summer cooling (or winter heating), or perhaps your electric wiring capacity is just too low for all the appliances on your line. Whatever, that expensive modern equipment pooping out from low line voltage can be brought back to life with an AC variable transformer, often called a variable autotransformer.

The autotransformer normally has an operating output of from 0 to 150 VAC, so that's a reserve of at least



**PARTS LIST FOR
AC LINE REGULATOR**

- M1—0-150 VAC meter (Lafayette Radio Electronics 99R51054 or equiv.)
- PL1—AC plug
- T1—AC power line variable autotransformer (Ohm type or equivalent, see text)

30 volts. When the power line dips, simply crank up the autotransformer until the meter indicates between 115 and 120 VAC. The device works the same way if your line voltage runs too high; simply crank the transformer down to the desired voltage.

Autotransformers come in many wattage ratings; make certain the one you get can handle the load. As a safety feature, have at least 25 percent reserve capacity. If the load is 150 watts, use an autotransformer rated at least 200 watts.



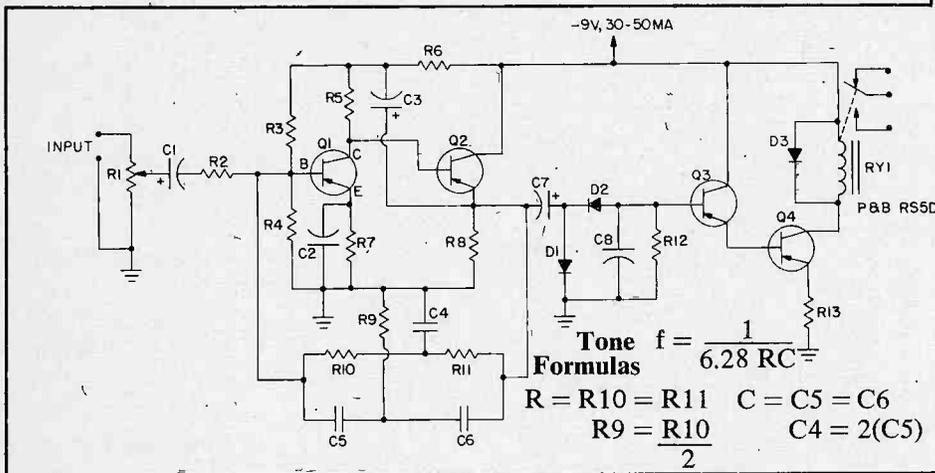
□ This tone controlled relay circuit is a lot more complex and more expensive than the usual tone control circuit but it's suggested for use when you need super-sensitivity and/or super-Q (the ability to respond only to the control frequency). Capacitor C8 provides a small delay of about 0.5 second so the unit can distinguish between the control input tone and random frequencies from sounds picked up by, say, a dynamic micro-

phone which can be connected to the input. In typical use potentiometer R1 is adjusted for the minimum input signal that provides reliable tripping of the relay.

The values shown provide an operating frequency of approximately 1500 Hz. The frequency is determined by R9, R10, R11, C4, C5 and C6. The relationship between these components is shown in the schematic. Frequency is calculated with

PARTS LIST FOR TONE CONTROLLED RELAY

- Resistors ½ watt, 10%, unless otherwise specified
- R1—25,000- to 50,000-ohm linear potentiometer
 - R2, R10, R11—4,700-ohms
 - R3—100,000-ohms
 - R4—10,000-ohms
 - R5—5,600-ohms
 - R6—2,200-ohms
 - R7—1,200-ohms
 - R8—3,300-ohms
 - R9—2,400-ohms
 - R12—47,000-ohms
 - R13—22-ohms
- Capacitors rated 10-VDC or higher
- C1, C2, C4—0.047-uF
 - C3—2-uF
 - C5, C6—0.022-uF
 - C7—15-uF
 - C8—50-uF
- Q1, Q2, Q3, Q4—2SB22, (Radio Shack 276-2003 or equiv.)
 - D1, D2—Germanium diode type 1N60 or equiv.
 - D3—Silicon rectifier type 1N4001 or equiv.
 - RY1—Relay, 200- to 400-ohm coil, 6-VDC, P&B RS5D-6 or equiv.



Tone Formulas

$$f = \frac{1}{6.28 RC}$$

$$R = R10 = R11 \quad C = C5 = C6$$

$$R9 = \frac{R10}{2} \quad C4 = 2(C5)$$

the formula $F = \frac{1}{2\pi RC}$. Use 4,700-ohm resistors for R10 and R11 even if it limits the range of frequencies

you can use. Virtually any general purpose PNP transistors of the type indicated in the parts list can be used. Diodes D1 and

D2 should be the germanium 1N34/1N60 type. Be very careful about all power supply and capacitor polarities.

Simple Signaller

□ Using diode switching, a single pair of wires controls two circuits that normally require four wires. Though illustrated here with lamps, the same idea can be used for telephone circuits.

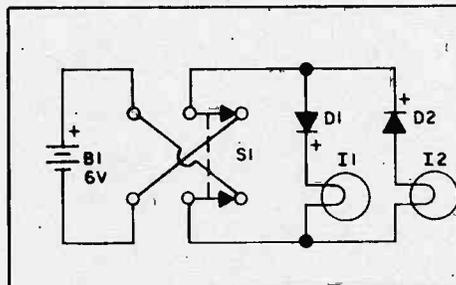
When polarity-reversing switch S1 is set so the positive battery terminal feeds the top wire, the D1/I1 circuit is operative and only lamp I1 lights up. Lamp I2 remains off because diode D2 blocks the flow of DC to the lamp.

When battery polarity is reversed,

so the top wire is negative, only D2 conducts, illuminating I2. D1 blocks the current flow and I1 is off.

If a carbon mike is connected in

series with the battery and the lamps are replaced with headphones, switch S1 determines which of two headphones receives the signal.



PARTS LIST FOR SIMPLE SIGNALLER

- B1—6-V battery, 4 D-cells in series
- D1, D2—50-PIV 1-A silicon diode (Lafayette Radio Electronics 33R08790 or equiv.)
- I1, I2—6.3-V, 0.15-A, #40 pilot lamp (Radio Shack 272-1128 or equiv.)
- S1—Dpdt toggle switch

96 Wide Range Funk Box

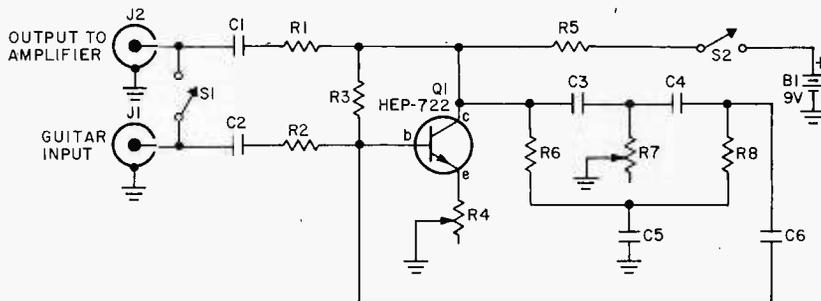
□ Fuzz, echo, reverb, big bass. They're all out! The new guitar sound is *funky*, and you'll get with it with the wide-range funk box. Just crank potentiometer R7 and you'll get an extra twang from way down low to

way up high. Just about any construction can be used. If you build it in a metal box, use a push switch for switch S1 and you'll be able to key the effect in and out with your foot. To adjust the Funk Box simply ad-

just potentiometer R4 until you hear a whistle (oscillation); then back off R4 until the oscillation just ceases. Connect your guitar to jack J1 and twang away. The effect can be varied from bass to treble by R7.

PARTS LIST FOR WIDE RANGE FUNK BOX

- B1—9V-type 2U6 battery
- C1, C2—.1-uF Mylar capacitor
- C3—.47-uF Mylar capacitor
- C4—.02-uF Mylar capacitor
- C5, C6—.01-uF Mylar capacitor
- J1, J2—Phono jack
- Q1—NPN transistor, HEP-722 or 723
- R1, R2—22,000-ohm, ½-watt resistor
- R3—470,000-ohm, ½-watt resistor
- R4—2000-ohm trimmer potentiometer



- R5, R6, R8—56,000-ohm, ½-watt resistor

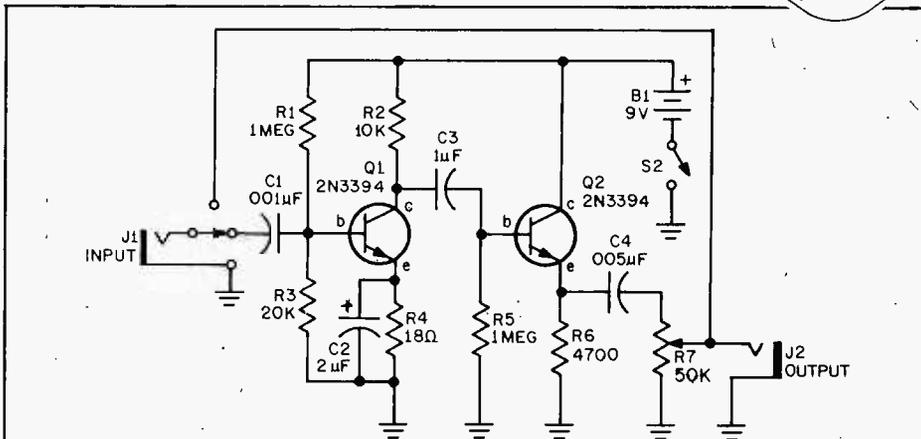
- R7—10,000-ohm potentiometer
- S1, S2—Spst switch

97 Twang-A-Matic



□ It seems no one cares for the sound of a plain, unadorned guitar. First they added fuzz, then big-boom bass, next it was reverberation and screaming highs. Now the in sound is *twang*, a guitar sound that more or less approximates a banjo or mandolin. A Twang-A-Matic produces these unusual sounds from an ordinary electric guitar by cutting the bass, severely distorting the midband and highs, and then amplifying the distortion. It might read "bad" to you, but it sure sounds good!

You can assemble the Twang-A-Matic in any type of cabinet. Switch S1 cuts the effect in and out while switch S2 turns the unit on and off. Output control R7 should be set so the Twang-A-Matic has the same volume level as the straight guitar feed-through. Various degrees of twang are obtained by varying the output so the guitar picks up with the level controls built into the guitar:



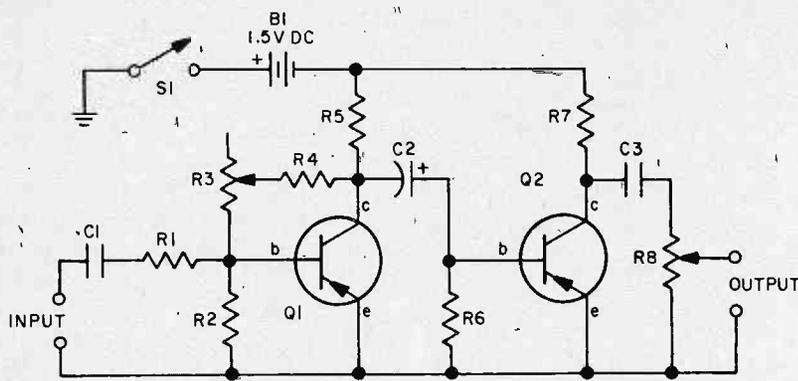
PARTS LIST FOR TWANG-A-MATIC

- B1—9-volt battery (Eveready 246 or equiv.)
- C1—0.001-uF disc capacitor 25 VDC or better
- C2—2-uF electrolytic capacitor, 15 VDC or better
- C3—1-uF electrolytic capacitor, 15 VDC or better.
- C4—0.005-uF disc capacitor, 15 VDC or better
- J1, J2—Phone jack

- Q1, Q2—NPN transistor, 2N3394
- R1, R5—1 megohm, ½-watt resistor
- R2—10,000, ½-watt resistor
- R3—20,000-ohm, ½-watt resistor, 5 percent
- R4—18-ohm, ½-watt resistor
- R6—4700-ohm, ½-watt resistor
- R7—50,000-ohm potentiometer
- S1—Switch, spdt (twang in-out)
- S2—Switch, spst (on-off)

98 Fancy Guitar Fuzzbox

PARTS LIST FOR FANCY GUITAR FUZZBOX



- B1**—1.5-V AA battery
- C1, C3**—0.1- μ F, 50-VDC capacitor
- C2**—4.7- μ F, 10-VDC electrolytic capacitor
- Q1, Q2**—pnp transistor—HEP-632
- R1, R6**—22,000-ohm, 1/2-watt resistor
- R2**—18,000-ohm, 1/2-watt resistor
- R3**—1-megohm pot
- R4**—100,000-ohm, 1/2-watt resistor
- R5, R7**—10,000-ohm, 1/2-watt resistor
- R8**—50,000-ohm pot
- S1**—Spst switch

□ Add that way-out fuzz sound to any electric guitar by connecting the Fuzzbox between your guitar and amplifier. Potentiometer R3 sets the degree of fuzz, R8 the output level.

Since the fuzz effect cannot be completely eliminated by R3, fuzz-free sound requires a bypass switch from the input to output terminals. The switch should completely discon-

nect the fuzzbox output; the input can remain in parallel with the bypass switch.

99 Vari-Rev Motor Control

□ Old universal appliance motors and shaded-pole induction motors salvaged from inexpensive turntables can be easily converted to slow-speed hobby drills, chemical stirrers, variable-speed turntables, movable display drives, etc. It's done with a full-wave Triac speed controller.

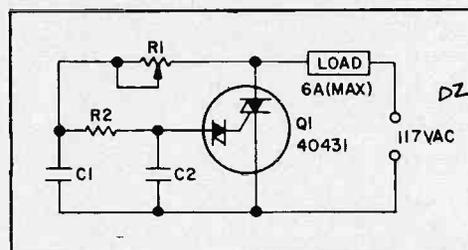
Unlike other speed controllers, which require an external trigger device, Q1 combines both the Triac and Diac trigger diodes in the same case.

The motor used for the load must be limited to 6 amperes maximum (or 740 watts). Triac Q1 must be

provided with a heat sink, which can be the metal cabinet. Build up a marblesize mound of epoxy on the cabinet and insert Q1's case into the epoxy. When the epoxy hardens the Triac's heat is dissipated to the cab-

inet. Make certain Q1's case is not shorted to the cabinet and is insulated by the epoxy.

With the component values shown on the parts list, the Triac controls motor speed from full off to full on.



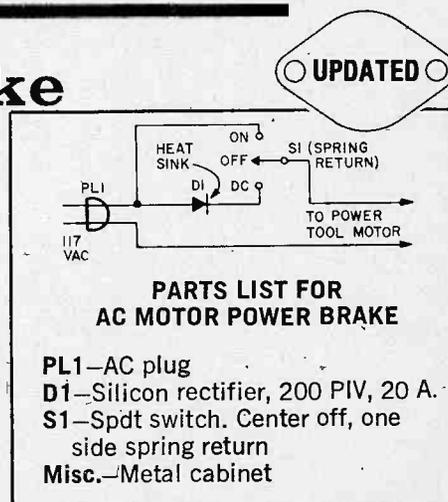
PARTS LIST FOR VARI-REV MOTOR CONTROL

- C1, C2**—0.1- μ F, 200-VDC capacitor
- Q1**—RCA 40431 Triac-Diac
- R1**—100,000-ohm linear taper potentiometer
- R2**—10,000-ohm, 1-watt resistor

100 AC Motor Power Brake

□ Give it a shot of direct current, and any AC power tool motor will instantly stop. No more free-running power saws or drills with the Power Brake. The unit must be assembled in a metal enclosure as the enclosure provides the heat sink for silicon rectifier D1. This diode has only one solder terminal, the case is the second terminal.

Place a single strip of plastic electrical tape on the bottom of SR1's case, thoroughly coat SR1's case with epoxy adhesive and cement SR1 to the enclosure (heat sink). When the adhesive is dry solder one connecting wire directly to SR1's case, the remaining wire connects to the terminal. Polarity is not important; any wire can go to any SR1 terminal.



PARTS LIST FOR AC MOTOR POWER BRAKE

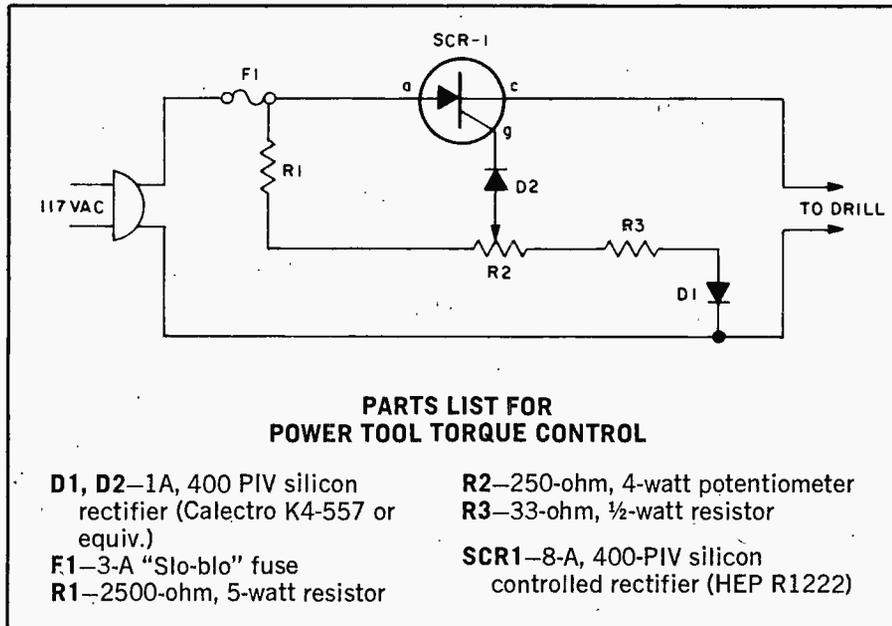
- PL1**—AC plug
- D1**—Silicon rectifier, 200 PIV, 20 A.
- S1**—Spdt switch. Center off, one side spring return
- Misc.**—Metal cabinet

Switch S1 is a center-off, one side spring return. With S1 *on*, AC will be fed to the motor and the motor will run. To brake the motor, simply

press S1 down and a quick shot of DC will instantly stop it. The switch returns to the center *off* position when released. This Power Brake can only

be used with AC motors; it will not brake universal (AC-DC) motors.

101 Power Tool Torque Control



□ As the speed of an electric drill is decreased by loading, its torque also drops. A compensating speed control like this one puts the oomph back into the motor.

When the drill slows down, a back voltage developed across the motor—in series with the SCR cathode and gate—decreases. The SCR gate voltage therefore increases relatively as the back voltage is reduced. The "extra" gate voltage causes the SCR to conduct over a larger angle and more current is driven into the drill, even as speed falls under load.

The only construction precaution is an extra-heavy heat sink for the SCR. The SCR should be mounted in a ¼-in. thick block of aluminum or copper at least 1-in. square; 2-in. if you drill for extended periods.

What's your favorite circuit?

If you have a small, simple circuit that you honestly believe should be in 101 ELECTRONIC PROJECTS magazine, please let us know about it. Just pencil in the schematic diagram complete with parts identification. Mail to the Editor, 101 ELECTRONIC PROJECTS, 229 Park Avenue South, New York, New York 10003. All submissions become the property of the magazine and cannot be returned.

30 INTEGRATED CIRCUIT PROJECTS

IC 1 CB Channel Puller

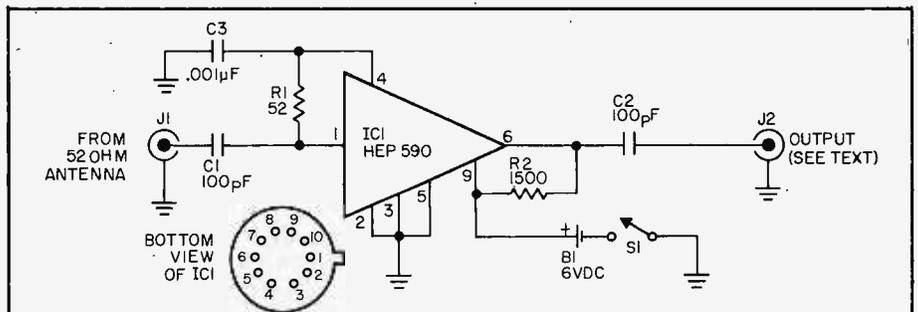
UPDATED

□ Connect the CB Channel Puller ahead of a low cost receiver, and you'll hear CB signals as if they were coming from your backyard. Using no tuned circuits, this CB signal booster delivers approximately 15dB overall gain—that's about 3 S-units! Only restriction is that this little rf amplifier be used with a communications-type receiver having an antenna trimmer. It cannot be used in front of a low-impedance-input type CB transceiver. Seems the low impedance antenna input common to CB units will sharply reduce the booster's gain.

Typical of all RF amplifiers, the booster requires very short connecting leads. In particular, solder capacitor C3 right at pin 4. Integrated

circuit IC1 can be soldered directly into the circuit or a socket can be

used. Battery B1 is a 6V Z4 type or larger.



PARTS LIST FOR CB CHANNEL PULLER

- | | |
|---------------------------------|--------------------------------|
| B1—6V battery | J1, J2—Phono or coaxial jack |
| C1, C2—100-pF, 15 VDC capacitor | R1—52-ohms, ½-watt resistor |
| C3—0.001-uF, 15 VDC capacitor | R2—1,500-ohms, ½-watt resistor |
| IC1—HEP 590 (Motorola) | S1—SPST switch |

IC 2 CB Mobile-to-Base Power Unit

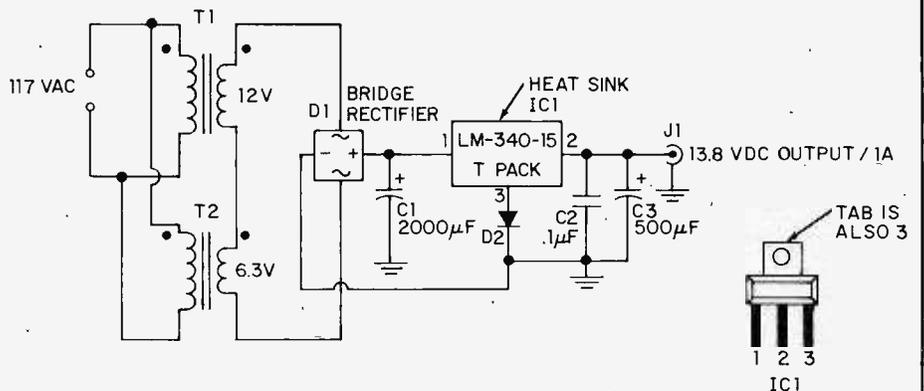
□ CB mobile transceivers and 3 to 5-watt CB handie-talkies are easily converted to base station operation with this 13.8 volt regulated power

unit. Transformers T1 and T2 should be rated 2 amperes. When T1 and T2's secondaries are connected, test the transformer(s) output voltage

with an AC voltmeter. If the meter indicates approximately 6.3 volts, reverse the connections of *either* transformer's *primary* or *secondary*,

PARTS LIST FOR CB MOBILE-TO-BASE POWER UNIT

- C1—2000-uF, 25-VDC electrolytic capacitor
- C2—0.1-uF Mylar capacitor
- C3—500-uF, 25-VDC electrolytic capacitor
- D1—Bridge rectifier, see text
- D2—Silicon rectifier, 50 PIV, 3 amperes
- IC1—Voltage regulator, LM-340-15 (T-package)
- T1—12-volt, 2-ampere filament transformer
- T2—6.3-volt, 2-ampere filament transformer



but *not both*. The meter will then read about 18 VAC. Complete the rest of this project only after you are certain the output voltage from the transformer(s) is about 18 VAC.

IC1 must be heat sunk to the cabinet. Note that IC1's tab is a "hot" terminal; make certain it is insulated from the cabinet with a power tran-

sistor insulator or a mica washer. Coat both sides of the insulator (washer) with silicon heat sink grease. And make certain the mounting screw is insulated from the cabinet; use fiber shoulder washers under the screw.

Connect rectifier D2 exactly where shown in the circuit. D2 should be

rated at least 50 PIV at 3 amperes. Bridge rectifier D1 is rated 50 PIV at 6 amperes. Do not substitute a 3 ampere bridge rectifier for D1 unless you heat sink it to the chassis. (Heat sinking for D1 is suggested for both the 3 and 6 ampere types.)

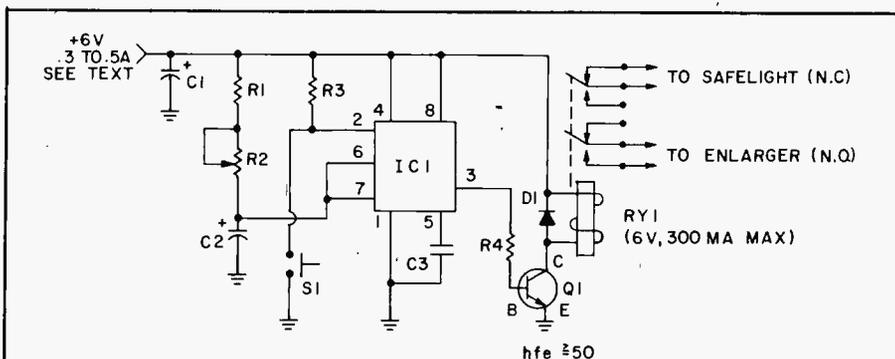
IC 3 Photo Timer

NEW 1976

□ You can spend \$50 to \$125 for a photo-enlarger timer but chances are you're not going to get more than a fancy version of this easy-to-build circuit. If you use a DPDT relay, as shown, your safelights can be wired to turn on when the enlarger turns off and vice versa.

If R2 is 1-megohm the timer's range is about 1 to 110 seconds. If R2 is 1.5-megohms the timer's range is approximately 1 to 165 seconds. The precise range will be determined primarily by C2's accuracy, so use a reasonably good quality capacitor for C2, but don't get a precision or MIL-spec part; it's not necessary.

If you use a low current relay for RY1, say less than 100-mA at 6-VDC, you can eliminate Q1 and connect the relay directly from IC terminal 3 to ground. If you use a heavy-duty relay, as high as 300-mA at 6-volts, use Q1. The power input should be 6-volts (doesn't have to be regulated) at 300-mA, or 500-mA for a heavy-duty relay. We suggest any popular-brand low cost relay, such as P&B, Magnacraft or Calctro.



PARTS LIST FOR PHOTO TIMER

Resistors ½ watt, 10%, unless otherwise specified.
R1—10,000-ohms
R2—1.0- or 1.5-megohm linear taper potentiometer (see text)
R3—22,000-ohms
R4—560-ohms
 Capacitors rated 6-VDC or higher
C1—100- μ F electrolytic
C2—100- μ F electrolytic (see text)

C3—0.01- μ F capacitor
IC1—Integrated circuit timer type 555 (any package)
Q1—NPN transistor, Radio Shack 276-2030 or equiv.
D1—Silicon rectifier, 1N4003, equiv. or higher PIV rating.
RY1—6-VDC relay, see text
S1—N.O. push-button or momentary contact switch.

Potentiometer R2 should be linear taper. After the timer is assembled attach a large pointer knob to R1's shaft, and using an electric clock with a sweep second hand as a reference, calibrate timing control R2.

If the unit is assembled in a metal cabinet use a three-wire linecord to ground the cabinet. If you use an all plastic cabinet with no exposed metal hardware that can be touched you can use a two-wire linecord.

IC 4 Lie Detector

NEW 1976

□ When a person is under mental stress one of the physiological changes includes a lowering of the body's skin resistance, and one of the characteristics measured by the modern lie detector is skin resistance.

Our "lie detector" works the same way: it measures the body's skin resistance. In typical use you would

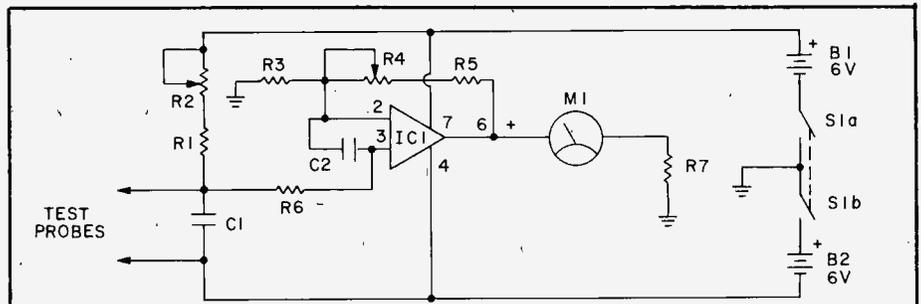
connect one test probe, actually a length of non-insulated wire taped to the skin, to each hand, arm, or wrist, adjust control R2 for a meter null (zero meter reading), and then ask your questions. If a question causes the subject mental stress you will usually see this stress indicated by an increase in the meter reading.

Potentiometer R4 serves as a sensitivity control. To avoid pinning the meter start with R4 at about the mid position: increasing the resistance increases the gain, while decreasing the resistance reduces the gain and the meter reading.

If you want to avoid taping the probes to your subject you can use

the inexpensive, less-than-\$1-a-pair bicycle clips available in most department and sporting goods stores. Solder the test probe wires to the clips and then bend the clips so they hold onto the hand or arm gently but firmly. Wiping the area under the clips with alcohol will improve overall sensitivity.

If long test probes are used, say in excess of 3-feet, shielded wire is suggested, with the shield for each test probe wire connected to the chassis ground—the junction between switches S1a and S1b. You can also use two-wire shielded cable (two wires in one shield) and fan the wires out a foot or so from under the probe end.



PARTS LIST FOR LIE DETECTOR

Resistors ½- or ¼-watt, 10%, unless otherwise specified
R1, R5—10,000-ohms
R2, R4—1-megohm potentiometer
R3, R6—1,000-ohms
R7—560-ohms
C1, C2—0.01- μ F, 25 VDC or higher

IC1—Operational amplifier, type 741
S1—Switch, DPST
B1, B2—6 volt battery, Burgess Z4 or equiv.
M1—Meter, 0-1 mA DC

IC 5 SWL's Super Calibrator

□ Providing WWV referenced outputs at 1 MHz, 100 kHz, 10 kHz and 1 kHz, this super calibrator looks quite difficult to assemble, but if you lay it out for a printed circuit board you'll find it's one of the easiest projects to build and get working because there's very little that can go wrong if the ICs and the crystal are okay.

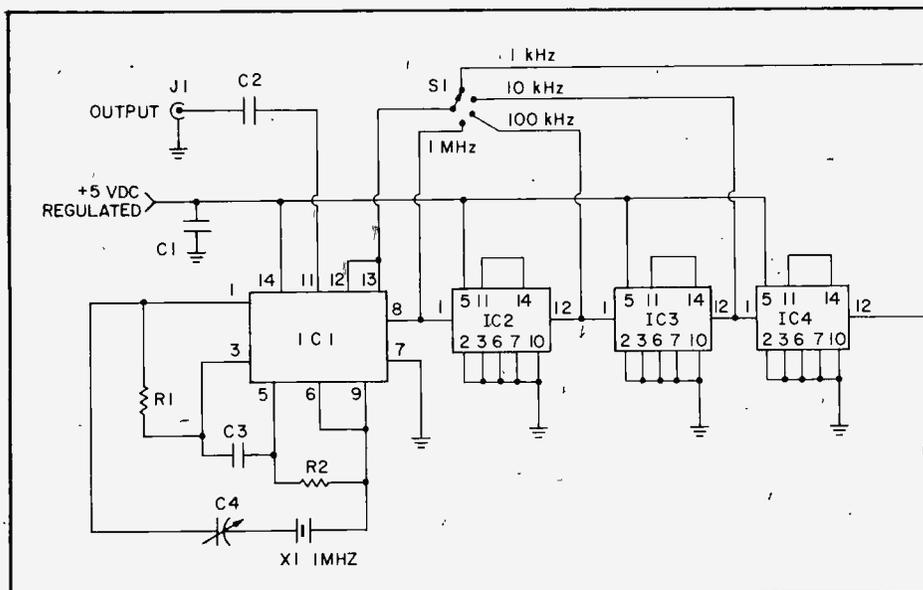
IC1 serves as both the oscillator and buffer amplifier. Another buffer amplifier is used for the output amplifier (terminals 11, 12 and 13),

IC1's output at pin 8 is a buffered 1 MHz. ICs 2, 3 and 4 are *divide by 10 frequency dividers* providing outputs of 100 kHz, 10 kHz and 1 kHz. Since all outputs are square waveform, all output signals are rich in harmonics and so can be used to calibrate receiver dials to well above 60 MHz for the 1 MHz output and to at least 30 MHz for the 100 kHz and 10 kHz outputs. The 1 kHz harmonics can range up to 30 MHz depending on your receiver's sensitivity. The calibrator's output at jack J1 can be con-

nected directly to the receiver's antenna input terminals without affecting the calibrator's output frequency.

The unit is set to zero-beat with WWV with trimmer capacitor C4. It can be assembled in any type of cabinet, but a PC board is specifically recommended for circuit stability.

Power must come from a 5-volt regulated source and we recommend the LM340 5-volt three-terminal regulator for this project. Make certain capacitor C1 is installed as close as possible to IC1 pin 14.



PARTS LIST FOR SWL'S SUPER CALIBRATOR

R1, R2—220-ohms, ½-watt, 10%, resistor
C1, C2, C3—0.01- μ F, 10-VDC or higher, capacitor
C4—5-50-pF trimmer capacitor
X1—1-MHz crystal, Calectro J4-1900 or equiv.
IC1—Integrated circuit type SN7400
IC2, IC3, IC4—Integrated circuit type SN7490
S1—SP4T switch
J1—Output jack (phono type suggested)

IC 6

5V/3A For Digital Projects

□ The 5-volt power supply is almost the universal power source for digital projects. Only problem is the 5 volts must be highly regulated, for a power line transient riding through the supply can zap a board full of ICs. This supply gives you full protection against transients, as well as providing tight regulation. The entire regulator is contained in IC1; no other components other than the filter capacitor and rectifier are needed. For full 5 ampere output IC1 requires a

heat sink of 30 square inches; but if you use a metal cabinet 3 x 4 x 5 inches or larger the cabinet itself serves as the heat sink. Since pin 3 on IC1 is grounded (to the cabinet), all you need is some silicon heat sink grease between the IC and the cabinet—no insulator.

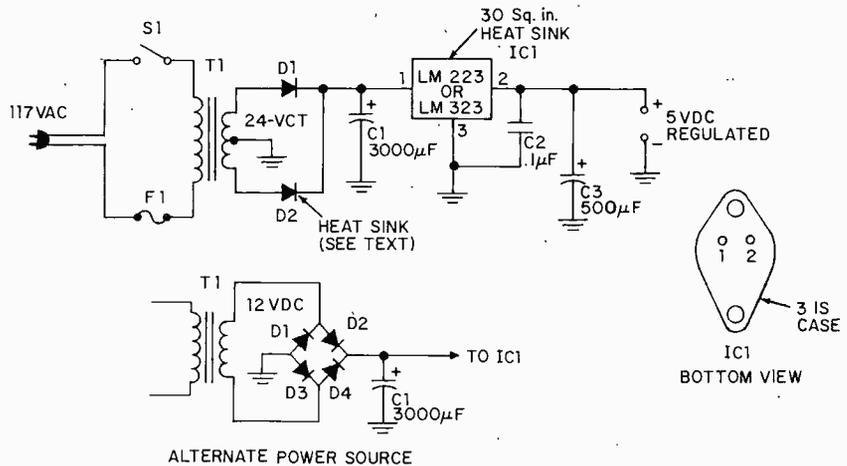
Power transformer T1 must be rated for the maximum current you will use or need. If you want the full 5 amperes T1 must be rated 5 amperes. But if you will need less cur-

rent, say 2 amperes, T1 can be rated 2 amperes.

Rectifiers O1 through O2 are available with ratings up to 3 amperes in the standard coaxial mounting. For greater current capacity the rectifiers must be heat-sinked (electrically isolated) to the cabinet, or other sink. A 10-ampere bridge rectifier such as sold by Calectro and Radio Shack can be substituted, but make certain it is heat sunk to the chassis.

PARTS LIST FOR 5V/3A FOR DIGITAL PROJECTS

- C1—3000- μ F, 25 VDC electrolytic capacitor
- C2—0.1- μ F Mylar capacitor
- C3—500- μ F, 10 VDC electrolytic capacitor
- D1-D4—See text
- F1— $\frac{1}{4}$ ampere, 3AG
- IC1—5-volt regulator, LM223 or LM323
- S1—Spst slide or toggle switch
- T1— see text



IC 7

Protect-A-Volt

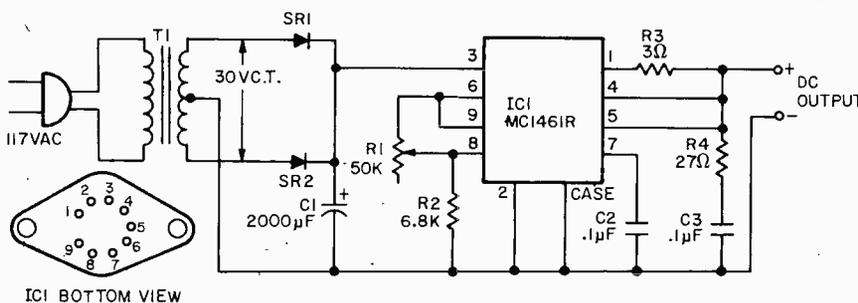
□ A simple turn of a knob sets Protect-a-Volt's output voltage anywhere in the 3 to 20-volt range—and with full short circuit protection! Should there be a wiring error in the powered project, this supply automatically

shuts down the output voltage until the overload is removed. The maximum output current (short circuit protection) has been established by resistor R3's value to 200 mA. Power transformer T1's rating should not

exceed 200 mA as extra current capacity could not be handled by the

PARTS LIST FOR PROTECT-A-VOLT

- C1—2000- μ F, 25 VDC capacitor (see text)
- C2, C3—0.1- μ F, 75 VDC disc or Mylar capacitor
- IC1—Motorola MC-1461R
- R1—50,000-ohms pot
- R2—6,800-ohms, $\frac{1}{2}$ -watt resistor
- R3—3-ohms, $\frac{1}{2}$ -watt resistor
- R4—27-ohms, $\frac{1}{2}$ -watt resistor
- SR1, SR2—Silicon rectifier, 50 PIV, 1A
- T1—Power transformer; 117 VAC primary, 30 VC.T.: 200 mA secondary (see text)



integrated circuit.

To make this project easy to build, and to sharply reduce total cost, it was necessary to eliminate a fully off, or zero output, setting, for Voltage Adjust control R1. The minimum

output voltage is 3V. The maximum voltage from T1's secondary must be 30V rms if the secondary is center-tapped; 15V rms if there is no center-tap and a bridge-rectifier is substituted for silicon rectifiers SR1 and

SR2. Capacitor C1's voltage rating must be 25 volts minimum. Do not eliminate high-frequency-compensation network components R4/C3.

IC 8 Notch Filter Oscillator

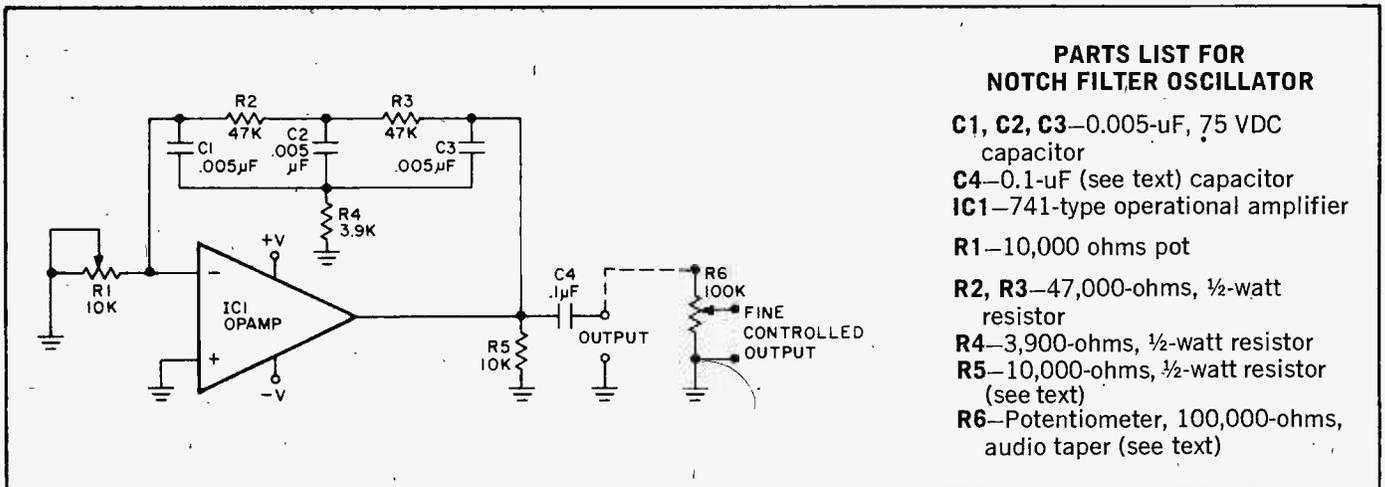
□ Every experimenter's spare parts box has the necessary components for our Notch Filter 1 kHz Oscillator. It's suitable for testing audio equipment, signal tracing or tape recorder bias adjustments. Integrated circuit IC1 can be just about any operational amplifier sold through "surplus dealers." The 1 kHz "notch filter" from the amplifier output to the inverting or negative (-) input determines the

output frequency. Notch Filter Oscillator's non-inverting or positive (+) input is grounded.

The power supply is bi-polar; use any voltage up to ± 15 VDC. While resistor R5 is not needed in many instances, its use insures your Notch Filter Oscillator project's success. Potentiometer R1 sets the output level; its maximum value will approach the total power supply volt-

age. If fine output control is desired, add potentiometer R6.

When your Notch Filter Oscillator is connected to a DC circuit, connect a DC blocking capacitor in series with R6's wiper arm. If the oscillator is to drive circuits of less than 10K ohm impedance, substitute a 1-uF non-polarized capacitor for C4, rated to the power supply's voltage.



IC 9 Electric Butler Intercom

NEW 1976

□ Using a miniature 1 watt IC power amplifier, our Electric Butler provides very high sensitivity and a loud, clean output. Wiring and layout is not critical as long as capacitors C4 and C5 are installed directly at IC1's terminals. Capacitor C6 can be as low as 100 uF if you want to cut costs and are willing to give up a little bass response. While S1 can be a standard

DPDT switch, a spring-return type will keep the Master station always monitoring the Remote.

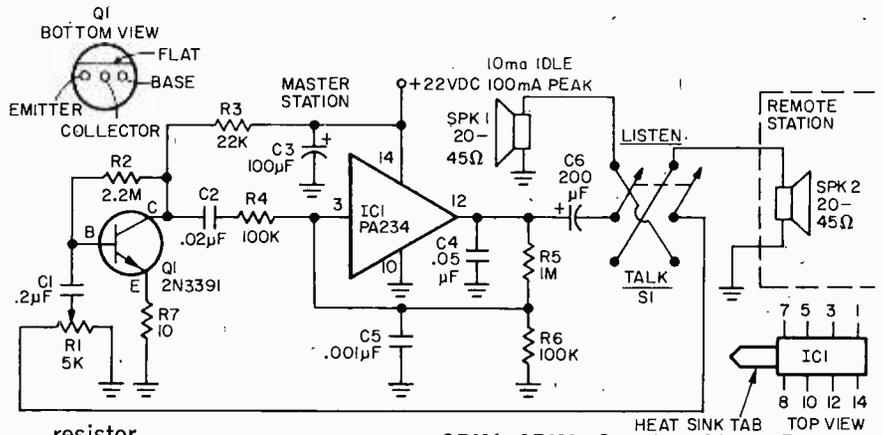
The speakers can be any "intercom type" rated from 20 to 45 ohms. Though miniature 16 ohm speakers can be used, they do not have the power handling capacity of the "intercom" speaker. If there appears to be some high frequency instability, use

a shielded wire between S1 and R1; make a single-shield ground at R1.

If an AC power supply is used, it must be rated for at least 100 mA drain. If a battery supply is used, figure the 10 mA idling current; the batteries will be able to deliver the 100 mA maximum output peak current. Solder a 1 inch square tin heat sink to IC1's tab during construction.

PARTS LIST FOR ELECTRIC BUTLER INTERCOM

- C1**—0.2- μ F, 3 VDC capacitor
- C2**—0.02- μ F, 3 VDC capacitor
- C3**—100- μ F, 25 VDC capacitor
- C4**—0.05- μ F, 75 VDC capacitor
- C5**—0.001- μ F, 10 VDC capacitor
- C6**—200- μ F, 25 VDC capacitor (see text)
- IC1**—General Electric PA-234
- Q1**—NPN transistor 2N3391 (HEP 726)
- R1**—Potentiometer, 5,000-ohms, audio taper resistor
- R2**—2.2 megohms, $\frac{1}{2}$ -watt resistor
- R3**—22,000-ohms, $\frac{1}{2}$ -watt resistor
- R4, R6**—100,000-ohms, $\frac{1}{2}$ -watt resistor



- R5**—1 megohm, $\frac{1}{2}$ -watt resistor
- R7**—10-ohms, $\frac{1}{2}$ -watt resistor

- SPK1, SPK2**—Speaker, 20 to 45 ohms, (see text)
- S1**—Switch; DPDT (see text)

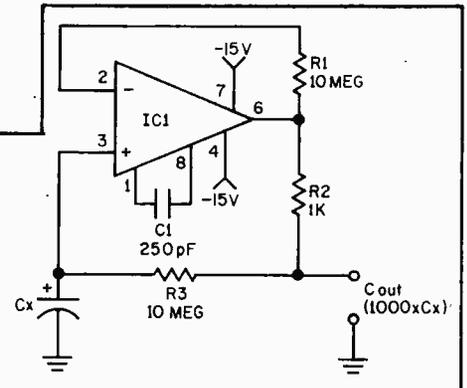
IC 10 C Booster

Suppose you needed a 10,000- μ F capacitor; do you think it could squeeze on your project's printed circuit board? The answer is yes because it need be no larger than a transistor. By using a capacitance amplifier, the value of any capacitor can be boosted by a factor of 1000X. Capacitor C_x is the value to be boosted; the effective capacity appears at the terminals indicated C. If C_x is 10 μ F the effective capacity that appears at the out-

put terminals is 1000 x 10 μ F or 10,000 μ F. Almost any capacity value can be used for C_x .

PARTS LIST FOR C BOOSTER

- C1**—250-pF disc capacitor, 50 VDC or better
- IC1**—SE537 Integrated Circuit (Signetics)
- R1, R3**—10-megohm, $\frac{1}{2}$ -watt resistor
- R2**—1000-ohm, $\frac{1}{2}$ -watt resistor

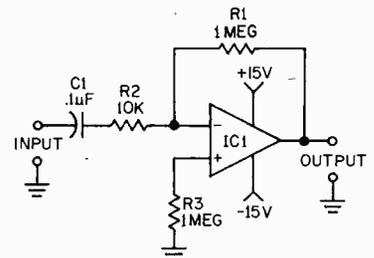


IC 11 The Basic Amplifier

This general purpose amplifier features a power gain of 100 (20dB) and can be used as a preamplifier for a microphone, receiver, signal tracer, etc. The IC is internally compensated, providing stable performance with a flat frequency response to about 10 kHz with a gradual roll-off to 20 kHz. The overall gain can be reduced to 10 by increasing the value of R2 to 100,000-ohms. IC1 is available in several different packages; use the one most convenient for your particular component layout. R3 connects to the

PARTS LIST FOR THE BASIC AMPLIFIER

- C1**—0.1- μ F Mylar capacitor, 25 VDC
- IC1**—Type 741 operational amplifier
- R1, R3**—1 megohm, $\frac{1}{2}$ -watt resistor
- R2**—10,000-ohm, $\frac{1}{2}$ -watt resistor, (see text)



non-inverting (+) input of the IC, R1 between the output and the inverting (-) input. No pin connec-

tions are given because the IC is available in many different configurations.

IC 12

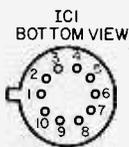
Bi-Polar Power Amp

□ It is inconvenient when working with IC preamplifiers requiring bipolar power sources to convert to a single-ended power source for the power amplifier. Our Bi-Polar Amp, however, can be driven from a bipolar power supply. One of the benefits enjoyed by Bi-Polar Amp is that a

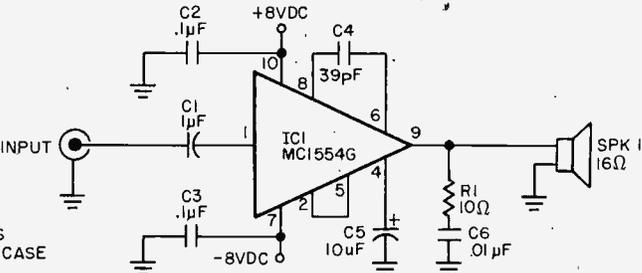
large, expensive output coupling capacitor isn't needed. Since the device responds well into the high frequency range, capacitors C2 and C3 must be placed directly at the IC terminals to prevent high frequency oscillation. While capacitor C1 can be an electrolytic type, a non-polarized 1 uF is

suggested.

The amplifier's input impedance is 10,000 ohms, a suitable value for solid-state projects. Voltage gain is 36. If less overall gain is required (say, 10X), disconnect pins 2 and 4 and connect pin 5 to ground through capacitor C5.



NOTE: LEAD 7 OF IC1 IS CONNECTED TO CASE



PARTS LIST FOR BI-POLAR POWER AMP

C1—1-uF, voltage rating at least equal to peak input voltage from preceding stage, capacitor
 C2, C3—0.1-uF, 10 VDC capacitor
 C4—39-pF, 100 VDC disc capacitor
 C5—10-uF, 10 VDC capacitor
 C6—0.01-uF, 25 VDC capacitor
 IC1—Motorola MC-1554G
 R1—10-ohms, ½-watt resistor
 SPK1—16-ohm speaker

IC 13

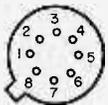
100X Instrument Amp

□ When voltages drop too low to be indicated on your scope or VTVM, just connect our 100X Instrument Amplifier ahead of your test gear and you get full-screen or full-scale readings. With an input impedance of 1 megohm, and a flat frequency response from DC to 20 kHz and beyond, the 100X Instrument Amplifier provides a gain of exactly 100 when potentiometer R2's wiper is at the top (full gain).

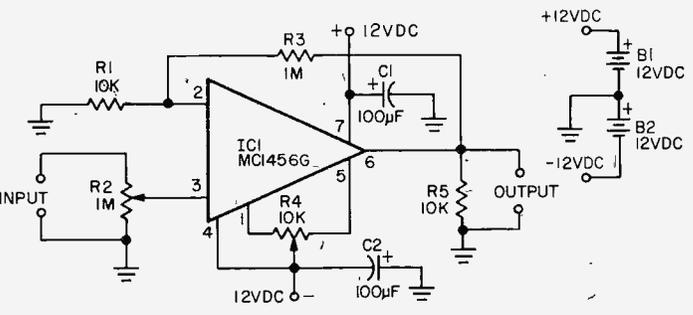
Connected ahead of a VTVM, the 100X Instrument Amplifier will convert, for example, a 10 mV DC level into 1V. Here's a value that can be read on your VTVM! Similarly, if connected ahead of a scope's vertical input, the amp boosts a signal that will just cause a wiggle on the CRT to almost a full screen trace. The maximum input signal level for undistorted output is 100 mV peak-to-peak. Naturally, higher input signals

can be used because of the attenuation provided by sensitivity control R2.

After you've completed the 100X Instrument Amplifier, connect a VTVM across the output, adjust R4 for a zero DC meter reading. From time to time check the DC output; if it has drifted off zero, simply readjust R4. It might happen that changing R2's setting over a wide range might cause the output to drift off zero; if



IC1 BOTTOM VIEW



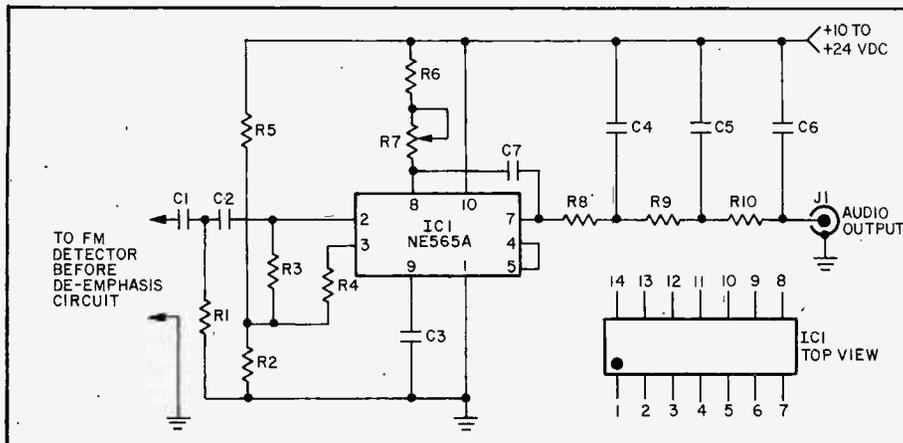
PARTS LIST FOR 100X INSTRUMENT AMPLIFIER

B1, B2—Battery, 12V
 C1, C2—100-uF, 15 VDC capacitor
 IC1—Motorola MC-1456G
 R1—10,000-ohms, ½-watt, 5% resistor
 R2—Potentiometer, 1 megohm
 R3—1 megohm, ½-watt, 5% resistor
 R4—Potentiometer, 10,000-ohms linear taper
 R5—10,000-ohms, ½-watt resistor

IC 16 SCA Adaptor

PARTS LIST FOR THE SCA ADAPTOR

- C1, C2**—510-pF, 500 VDC ceramic disc capacitor
C3, C7—0.001- μ F, 75 V Mylar capacitor
C4, C6—0.018- μ F, 500 VDC ceramic disc or Mylar capacitor
C5—0.047- μ F, 75 VDC Mylar capacitor
IC1—Signetics NE565A
J1—Phono jack
R1, R2, R3, R4—4700-ohm, 1/2-watt resistor
R5—10,000-ohm, 1/2-watt resistor
R6—1800-ohm, 1/2-watt resistor
R7—5000-ohm potentiometer
R8, R9, R10—1000-ohm, 1/2-watt resistor



□ This simple but very effective SCA Adaptor can be assembled on a section of perfboard about 2-in. x 3-in. in size. All components should be firmly soldered to push-in terminals. The input *must* connect to the FM receiver's detector output before the de-emphasis network. The SCA output at J1 can be connected to any

relatively high-gain amplifier—the output level is about equal to that of a crystal microphone.

The FM receiver must be tuned to a station you know has SCA programming. Then adjust potentiometer R7 for a clean SCA audio output. Potentiometer R7's adjustment is not critical—the subcarrier is pulled in

when R7's adjustment is near the correct setting. A metal cabinet is suggested. If desired, a *pre* de-emphasis output jack can be installed on the FM receiver or tuner so that the normal (after de-emphasis) output can feed the hi-fi system independent of the SCA output.

IC 17 Porta-Groove Amp

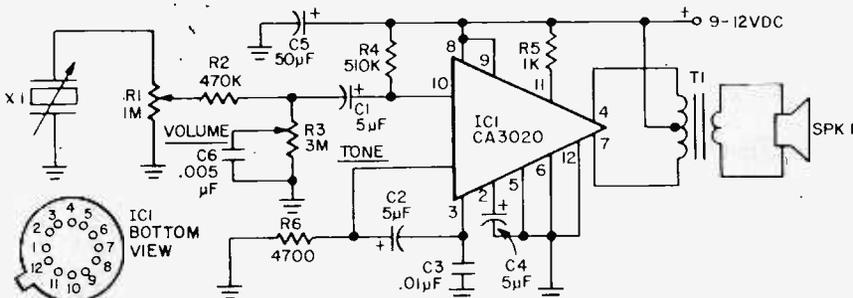
□ Just add a battery-powered motor to our Porta-Groove Amp, and you've made a portable phonograph of considerably better quality than you can buy. Phono pickup X1 must be the ceramic type—either the usual high impedance or so-called low impedance (actually several thousand ohms) ceramic type can be used.

Transformer T1 should have a primary impedance anywhere from 150 to 300 ohms center-tapped. The secondary should match the speaker impedance. Do not use a sub-miniature T1; for good sound quality T1 must have sufficient "iron," so make certain it can handle approximately 25 mA average current.

A 6-inch speaker will deliver remarkably good sound quality, at least the equal of a good quality table radio. Two 6V lantern batteries or eight D cells easy give Porta-Groove Amp enough oomph. Do not use C or AA cells; they cannot give even reasonable life with the 20 mA idling drain, 140 mA peak power drain.

PARTS LIST FOR PORTA-GROOVE AMP

- C1, C2, C4**—5- μ F, 6 VDC
C3—0.01- μ F, 10 VDC
C5—50- μ F, 15 VDC
C6—0.005- μ F, 15 VDC
R1—Potentiometer, 1 megohm audio taper
R2—470,000-ohms, 1/2-watt resistor
R3—Potentiometer, 3 megohms
R4—510,000-ohms, 1/2-watt resistor
R5—1,000-ohms, 1/2-watt resistor
SPK1—Speaker, 3.2, 4 or 6-8 ohms
T1—Output transformer, 150 to 300



ohms center-tapped primary coil to speaker impedance (see text) (Calectro D1-729 or equiv.)

IC1—RCA CA3020 or CA3020A
X1—Ceramic phono pickup (see text—Calectro S2-288 or equiv.)

IC 18

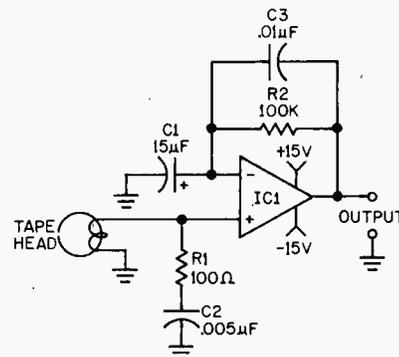
Tape Head Preamp

□ Is it worth about \$20 to have another tape or cassette player? From time to time surplus dealers offer complete tape or cassette mechanisms—everything ready-to-go except for the electronics, and at rock-bottom prices of \$10, \$15 or \$20. All the mechanism needs is this equalized tape head preamplifier. Though the power supply is rated at ± 15 VDC, almost optimum results will be obtained with supply voltages as low as ± 7 VDC. Two ordinary .9-volt transistor radio batteries will power the preamp for many hours.

The op amp, IC1, is internally compensated and no special wiring practices are needed; the preamp can be built in just about any enclosure,

PARTS LIST FOR TAPE HEAD PREAMP

- C1—22- μ F electrolytic capacitor, 25 VDC or better (Calectro A1-128)
- C2—0.005- μ F disc capacitor, 25 VDC or better
- C3—0.01- μ F disc capacitor, 25 VDC or better
- IC1—Type 741 op amp
- R1—100-ohms, $\frac{1}{2}$ -watt resistor
- R2—100,000-ohms, $\frac{1}{2}$ -watt resistor



though the connecting wire from the tape head should be shielded. R1 connects to the non-inverting (+) input of the IC, R2 between the out-

put and the inverting (-) input. No pin connections are given because the IC is available in many different pin configurations.

IC 19

Stereo Mike Preamp

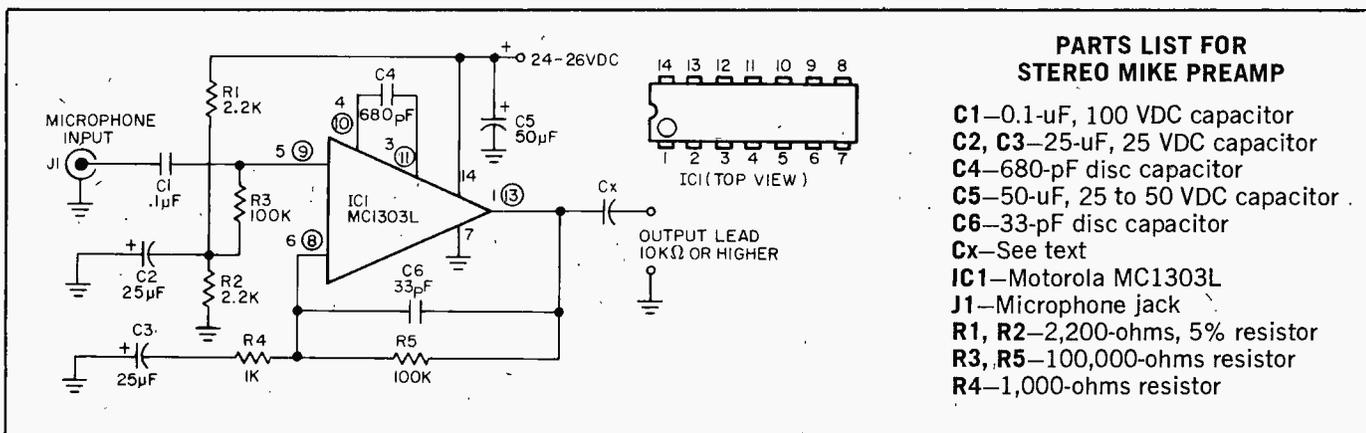
□ A dual IC gives hi-fi amplification for a stereo microphone pair. Low distortion and full-fidelity frequency response characterize this mike preamp. With resistors R1 and R2 providing a center-tap for the power supply, the IC can be powered from a standard single-ended power supply, or series connected batteries.

Be very careful to observe the cor-

rect polarity for capacitors C2 and C3. In the event the unit motorboats (low frequency oscillation), install a 0.1 μ F capacitor from pin 14 to ground.

The connections for one of the two amplifiers is shown circled; the connections for the second amplifier are uncircled. Pins 7 and 14 are common to both amplifiers. Capacitor Cx's

value is determined by the load impedance. It should be of such value as to provide the desired overall low frequency response; 0.1 μ F is suggested for high impedance output loads (100K and higher), while 10 μ F is suggested for low impedance loads.



PARTS LIST FOR STEREO MIKE PREAMP

- C1—0.1- μ F, 100 VDC capacitor
- C2, C3—25- μ F, 25 VDC capacitor
- C4—680-pF disc capacitor
- C5—50- μ F, 25 to 50 VDC capacitor
- C6—33-pF disc capacitor
- Cx—See text
- IC1—Motorola MC1303L
- J1—Microphone jack
- R1, R2—2,200-ohms, 5% resistor
- R3, R5—100,000-ohms resistor
- R4—1,000-ohms resistor

IC 20

Comm-Press Log Amp

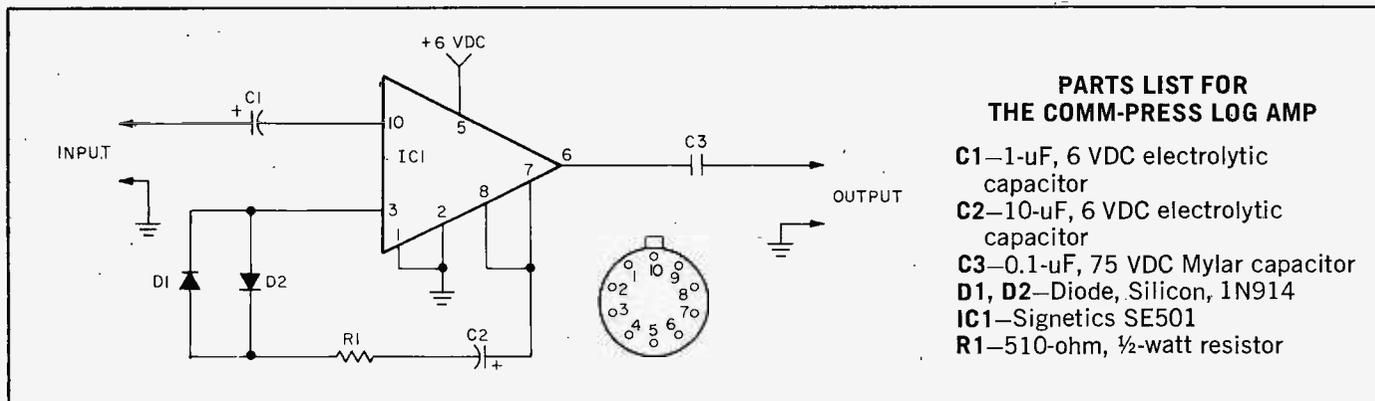
□ A log amplifier is a device that takes a large change in input signal and converts it to a small change in output. Hook one into a communications system and both low and loud sounds come out at almost the same level giving you a lot more talk power; it sounds just like the hard-sell commercials on TV. The input level should be about 0.1 volt peak for an

output voltage of about 1 volt peak.

Since this is a high frequency device, lead dress and good power supply bypassing at the power supply terminals are required. Keep the ground leads short. If a microphone preamplifier is used before the log amplifier, connect a volume control before the log amp's input.

Some experimentation will be

needed for optimum P.A. operation. Because of the much higher average voice power, a P.A. system using a log amp compressor might appear to be more sensitive to acoustic feedback (howling). Actually, you will have much more voice output before the howling starts.



PARTS LIST FOR THE COMM-PRESS LOG AMP

- C1—1- μ F, 6 VDC electrolytic capacitor
- C2—10- μ F, 6 VDC electrolytic capacitor
- C3—0.1- μ F, 75 VDC Mylar capacitor
- D1, D2—Diode, Silicon, 1N914
- IC1—Signetics SE501
- R1—510-ohm, 1/2-watt resistor

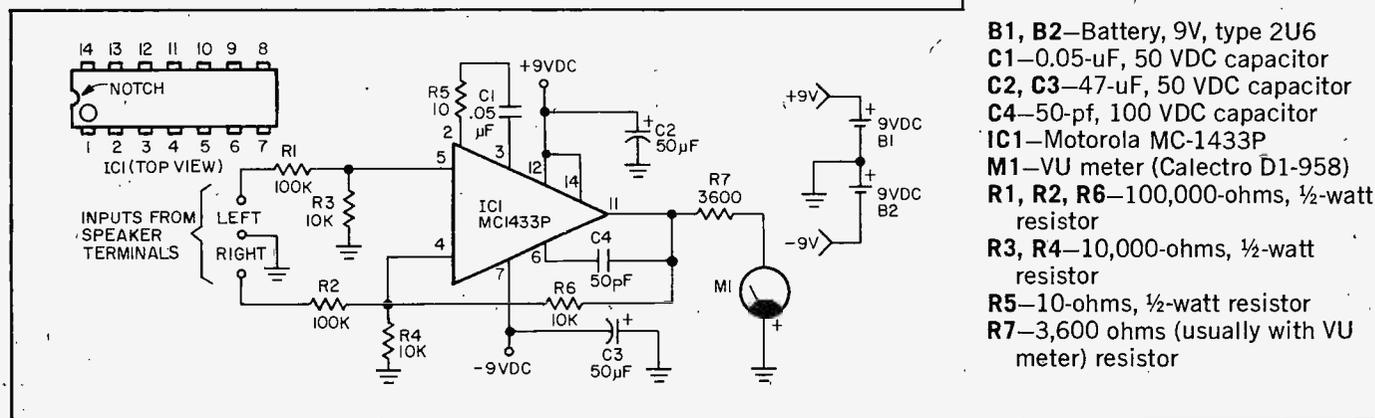
IC 21

Stereo Balance Meter

□ By comparing the difference between channel outputs when feeding a mono signal, this differential stereo balancer meter allows you to set your stereo amplifier for precise electrical balance. Wiring is not critical; the circuitry can very easily be battery powered using a bi-polar battery connection as shown.

To use, set your stereo amplifier to mono—then adjust the balance control until meter M1 indicates a null (minimum reading). If you cannot obtain a null it indicates there is a phase reversal—which should be corrected—between the signal input and the speaker terminals. This circuit works on the differential principle. When an

amplifier is in perfect balance there is no difference in mono output voltage between channels. So our differential amplifier indicates zero difference on the meter.



PARTS LIST FOR STEREO BALANCE METER

- B1, B2—Battery, 9V, type 2U6
- C1—0.05- μ F, 50 VDC capacitor
- C2, C3—47- μ F, 50 VDC capacitor
- C4—50-pf, 100 VDC capacitor
- IC1—Motorola MC-1433P
- M1—VU meter (Calectro D1-958)
- R1, R2, R6—100,000-ohms, 1/2-watt resistor
- R3, R4—10,000-ohms, 1/2-watt resistor
- R5—10-ohms, 1/2-watt resistor
- R7—3,600 ohms (usually with VU meter) resistor

IC 22

Cigar-Size Amplifier

Using an IC no larger than a fly, Cigar-Size Amplifier delivers almost 250 mW into a 16-ohm speaker. A 50 mV input signal coming from a source whose output impedance is 1000 ohms or lower is required for maximum output. The power supply

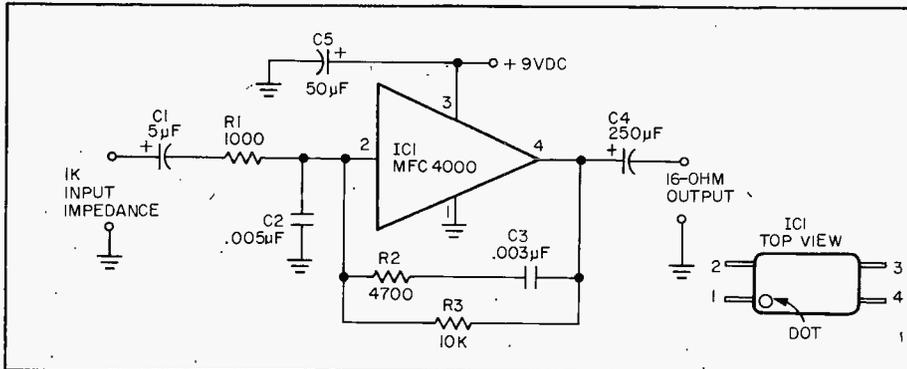
can be a 9 volt type 2U6 battery; the idling current is no higher than 6 mA. Best way to keep things small is to use a printed circuit board assembly or a mini-mount as shown.

Cigar-size amplifier can serve as a general utility amplifier for checking

out low-level audio projects, or it can serve as a monitoring amplifier for tape and cassette decks.

PARTS LIST FOR CIGAR-SIZE AMPLIFIER

- C1—5- μ F, 10 VDC capacitor
- C2—0.005- μ F, 10 VDC capacitor
- C3—0.003- μ F, 10 VDC capacitor
- C4—250- μ F, 10 VDC capacitor
- C5—50- μ F, 10 VDC capacitor
- IC1—Motorola MFC 4000
- R1—1,000-ohms, 1/2-watt resistor
- R2—4,700-ohms, 1/2-watt resistor
- R3—10,000-ohms, 1/2-watt resistor



IC 23

Record Remote Amplifier

Here's a professional performance record remote amplifier suitable for the hobbyist, amateur recordist or professional broadcast engineer. The input is any microphone with an output impedance up to 50,000 ohms, or for professional use, the input can be

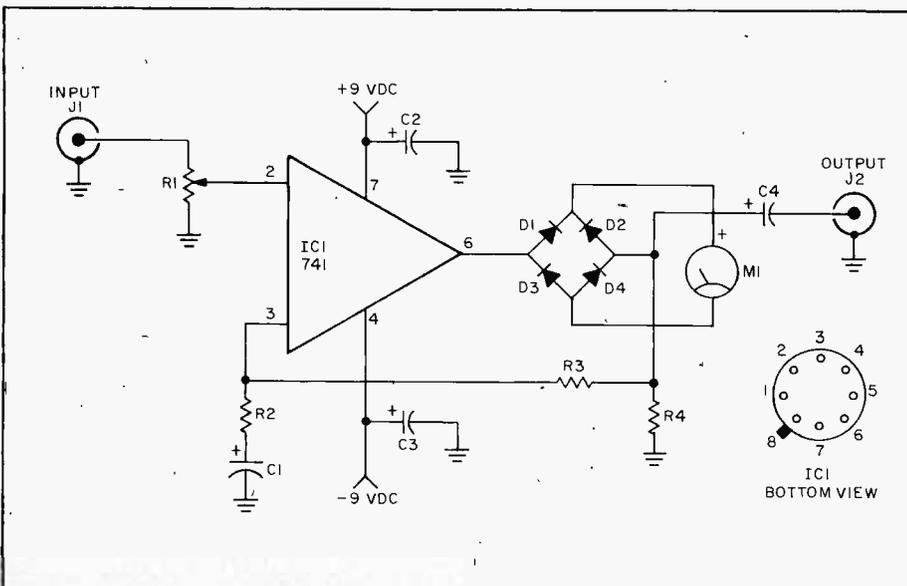
at line level. Output is 500-ohms at line level with a built-in VU meter indicating output level. When the distance between the remote amplifier and its associated equipment is less than 25 feet the amplifier can be connected to any hi-fi type, high imped-

ance input (10,000-ohms or higher).

For long line or professional applications, connect a 500/500 line matching transformer to output jack J2. Capacitor C4 is 0.1 μ F for all applications except when used with a line matching transformer. When a

PARTS LIST FOR RECORD REMOTE AMPLIFIER

- C1—220- μ F, 12 VDC electrolytic capacitor
- C2, C3—47- μ F, 50 VDC electrolytic capacitor
- C4—0.1- μ F or 25- μ F, 12 VDC capacitor (see text)
- D1, D2, D3, D4—1N60
- IC1—Type 741 operational amplifier
- J1, J2—Shielded jacks
- M1—VU meter with internal rectifier removed (Calectro D1-930 or equiv.)
- R1—50,000-ohm audio taper potentiometer
- R2—100-ohm, 1/2-watt resistor
- R3—15,000-ohm, 1/2-watt resistor
- R4—560-ohm, 1/2-watt resistor



transformer is used C4 is 25 μ F. Better results can be obtained with a line matching transformer if the transformer primary replaces R4 (eliminating C4).

M1 is a standard VU meter whose internal rectifier has been removed (open the case and unsolder the rectifier).

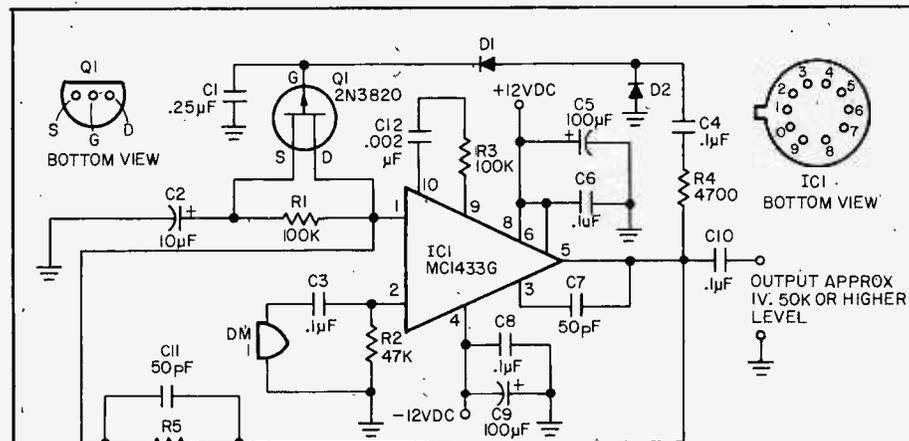
Total current drain is less than 5 mA, and the bi-polar power supply can consist of two transistor radio type 9-volt batteries.

IC 24 Microphone Compressor

Operating directly from microphone level and providing a nominal 1V output, this compressor delivers 20 dB of compression (essentially distortion-free limiting) and will give ultimate talk-power to P.A. systems and ham or CB transmitters. Fact is, some sideband transmitters might not be able to handle the almost continuous "peak power" output of our compressor!

The only restriction on its use is that the microphone, DM1, must be the dynamic type: any impedance from 50 to 50,000 ohms will work. If DM1 can be permanently connected to the circuit, components R2 and C3 can be eliminated. But they must be used if there is any possibility DM1 will be disconnected. No substitution can be made for transistor Q1.

Capacitors C6 and C8 must be installed directly at the IC terminals for instability suppression. Capacitors C5 and C9 can be installed anywhere that's convenient. A bi-polar 12V supply (well filtered) is required. Power can be provided by batteries



PARTS LIST FOR MICROPHONE COMPRESSOR

- | | |
|--|--|
| C1 —0.25- μ F, 10 VDC capacitor | R2 —47,000-ohms, 1/2-watt resistor |
| C2 —10- μ F, 10 VDC capacitor | R3 —100-ohms, 1/2-watt resistor |
| C3, C4, C6, C8, C10 —0.1- μ F, 75 VDC capacitor | R4 —4,700-ohms, 1/2-watt resistor |
| C5, C9 —100- μ F, 15 VDC capacitor | R5 —1 megohm, 1/2-watt resistor |
| C7, C11 —50-pF, 75 VDC disc capacitor | DM1 —Dynamic microphone (see text) |
| C12 —0.002- μ F, 25 VDC capacitor | D1, D2 —Germanium diode, 1N60 or equiv. |
| IC1 —Motorola MC-1433G | Q1 —FET transistor, type 2N3820 (Texas Instruments) |
| R1 —100,000-ohms, 1/2-watt resistor | |

(for total hum-free operation) because the current requirement is ap-

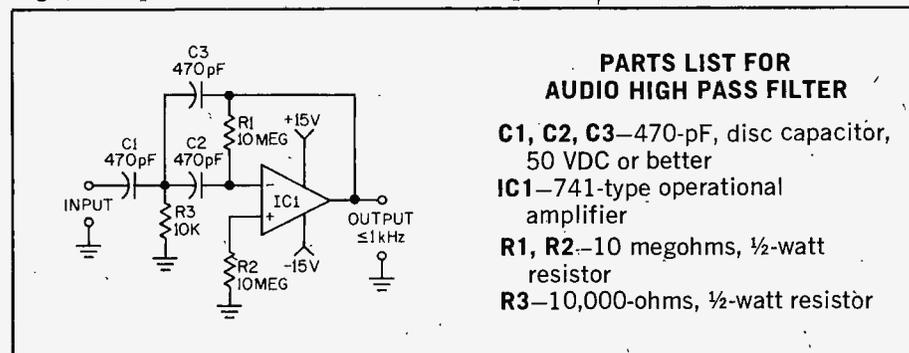
proximately 15 mA. Any gain controls must come after the output at C10.

IC 25 Audio High Pass Filter

A high pass filter is a handy device to have around. Depending on the corner (turnover) frequency you select it can serve as a hum filter, distortion meter or highly-selective audio equalizer. The values of C1, C2, C3 and R1 provide a corner frequency of 1000 Hz. The IC has internal compensation so special wiring techniques are unnecessary. No pin connections are given because the 741 IC is available in many different pin configurations. Check the manufacturer's specs for the particular IC

used. R2 connects to the non-inverting (+) input of the IC, R1 between

the output and the inverting (-) input.



PARTS LIST FOR AUDIO HIGH PASS FILTER

- | |
|---|
| C1, C2, C3 —470-pF, disc capacitor, 50 VDC or better |
| IC1 —741-type operational amplifier |
| R1, R2 —10 megohms, 1/2-watt resistor |
| R3 —10,000-ohms, 1/2-watt resistor |

IC 26

Hi-Level 4-Channel Mixer

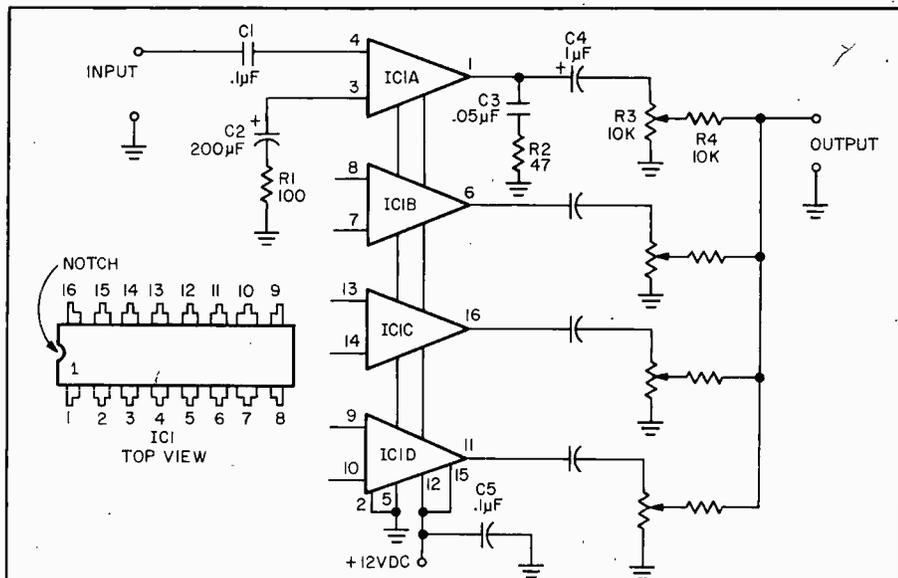
□ Best signal to noise ratio in a microphone mixer is always obtained if amplification is provided ahead of the loss in the mixer network. You can easily put this idea to work with our mixer—a full-fidelity, professional-grade microphone mixer that contains four independent amplifiers within the integrated circuit.

For simplification, our schematic shows only the connections for one of the four amplifiers; the others are identical to the first.

Note that the power supply is a single-ended 12 VDC (negative grounded); it must be well filtered, or, use a battery supply. The current requirements are approximately 30 mA total. The power supply is internally connected to the amplifiers.

To prevent high frequency oscillation, components C3, R2 and C5 must be installed directly at the IC's terminals.

Any 50 to 50,000 ohm dynamic microphone can be used. However, crystal and ceramic mikes won't work with Pro-Mix; the medium imped-



PARTS LIST FOR HI-LEVEL MIXER

- C1—0.1-µF, 3 VDC capacitor
- C2—200-µF, 3 VDC capacitor
- C3—0.05-µF, 75 VDC disc capacitor
- C4—1-µF, 15 VDC capacitor
- C5—0.1-µF, 15 VDC capacitor

IC1—RCA CA 3052

- R1—100-ohms, ½-watt resistor
- R2—47-ohms, ½-watt resistor
- R3—Potentiometer, 10,000-ohms audio taper
- R4—10,000-ohms, ½-watt resistor

ance IC's medium input impedance will excessively load down a high im-

pedance mike, resulting in sharp, low-frequency attenuation.

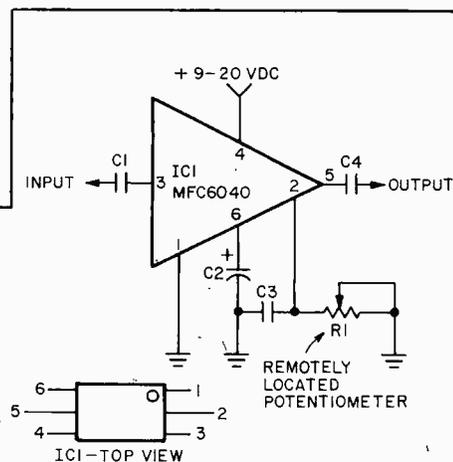
IC 27

Far Out Gain Control

□ One of the problems of locating a volume control in a remote location is that of hum and noise pickup; as a general rule, the greater the wire length the greater the hum and noise picked up. With an electronic attenuator the entire problem is eliminated, for the volume control wires carry only a DC control voltage which causes an integrated circuit amplifier's gain to vary by as much as 90 dB. Hum and noise picked up in the DC control wires are not impressed on the amplified audio signal.

No layout precautions are required and any type of assembly can be used. If desired, the amplifier gain can be voltage controlled by eliminating po-

tentiometer R1 and applying 3.5 to 6 volts DC directly to pin 2. With 3.5 VDC the amplifier works at full gain. The attenuation increases to a maximum of 90 dB as the control voltage is increased to 6 VDC.



PARTS LIST FOR THE FAR OUT GAIN CONTROL

- C1—0.47-µF, 25 VDC capacitor
- C2—50-µF, 25 VDC capacitor
- C3—680-pF, 500 VDC ceramic disc capacitor
- C4—0.1-µF, 75 VDC Mylar capacitor
- IC1—Motorola MFC 6040
- R1—50,000-ohm potentiometer

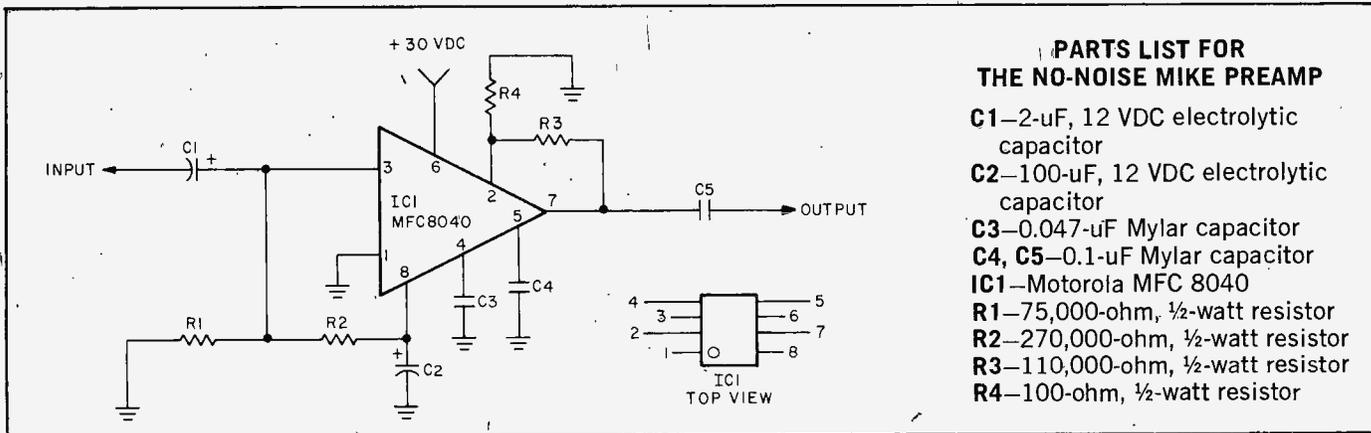
IC 28

No-Noise Mike Preamp

□ Packing a walloping 60 dB gain with a 7 volt output, this mike preamp nevertheless is almost dead quiet. The input impedance is about 75,000-ohms; output impedance about 100-

ohms. Actual maximum output voltage depends upon the load resistance, ranging from 7 volts output into a 10,000-ohm load to 4 volts output into a 1000-ohm load. Parts layout is

not critical and any type of assembly can be used. The power supply current is typically 8 mA, with a maximum of 12 mA.



PARTS LIST FOR THE NO-NOISE MIKE PREAMP

- C1—2- μ F, 12 VDC electrolytic capacitor
- C2—100- μ F, 12 VDC electrolytic capacitor
- C3—0.047- μ F Mylar capacitor
- C4, C5—0.1- μ F Mylar capacitor
- IC1—Motorola MFC 8040
- R1—75,000-ohm, 1/2-watt resistor
- R2—270,000-ohm, 1/2-watt resistor
- R3—110,000-ohm, 1/2-watt resistor
- R4—100-ohm, 1/2-watt resistor

IC 29

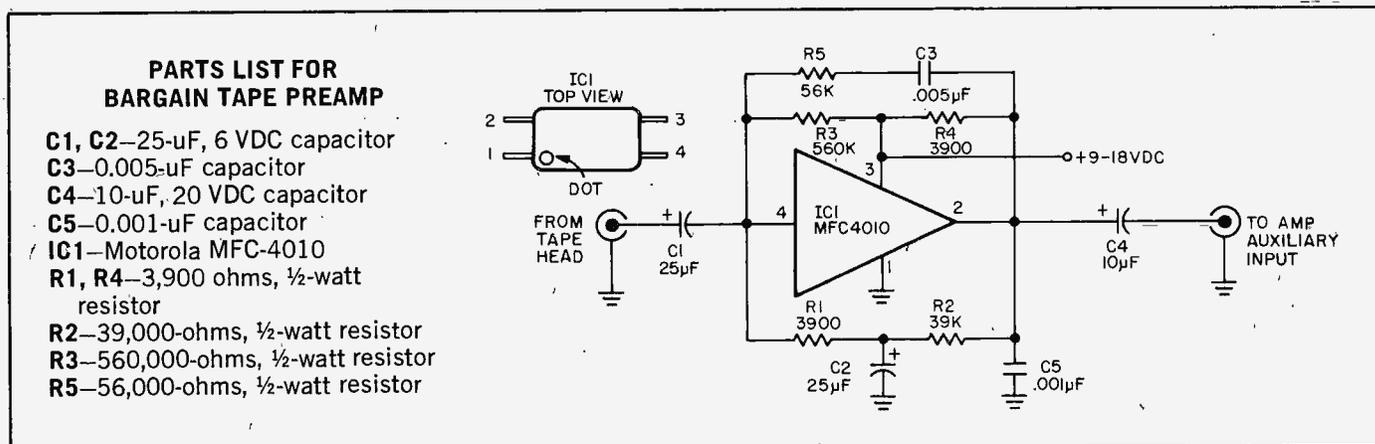
Bargain Tape Preamp

□ From time to time you'll find bargains at dealers selling tape and cassette deck mechanisms at rock bottom prices—often less than \$20! Complete with heads, these decks need only the electronics to get them working. The preamp provides both the amplification and equalization. You can feed its output directly into an amplifier's auxiliary input. Overall frequency re-

sponse is suitable for cassettes and 3 $\frac{3}{4}$ IPS reel-to-reel tapes. Since the actual required equalization is determined partially by the playback head characteristics, it might be necessary to modify or "tailor" the equalization; this is done by small changes in the value of capacitor C3 and resistor R5.

If assembled on a small printed circuit board, the preamp can be

tucked under the tape mechanism's base plate. The power supply can be anything from 9 to 18 volts at approximately 3 mA. Transistor type radio batteries will do; if batteries are used they must be bypassed with a 25- μ F capacitor. And, be sure you observe proper battery polarity.



PARTS LIST FOR BARGAIN TAPE PREAMP

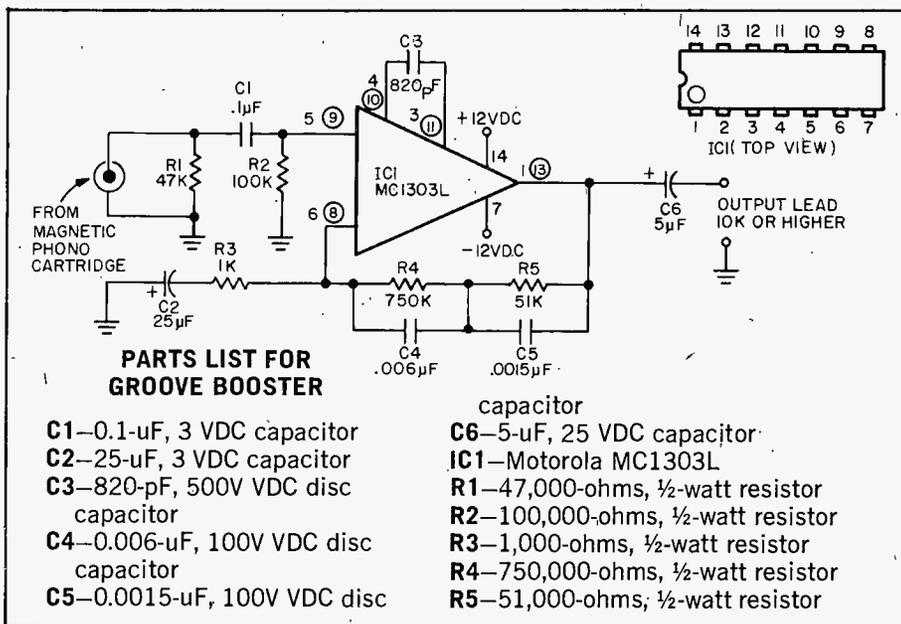
- C1, C2—25- μ F, 6 VDC capacitor
- C3—0.005- μ F capacitor
- C4—10- μ F, 20 VDC capacitor
- C5—0.001- μ F capacitor
- IC1—Motorola MFC-4010
- R1, R4—3,900 ohms, 1/2-watt resistor
- R2—39,000-ohms, 1/2-watt resistor
- R3—560,000-ohms, 1/2-watt resistor
- R5—56,000-ohms, 1/2-watt resistor

IC 30

Groove Booster

□ Using a dual operational amplifier IC, the Groove Booster will provide a fully equalized 1 V rms output from standard phono magnetic pickups. The terminal numbers which are circled on the schematic are the connections for one of the two independent stereo amplifiers on the single IC chip.

The uncircled numbers are the terminals for the stereo second IC. Power supply terminals #14 and #7 are common to both stereo amplifiers. Note that the power supply is ± 12 volts to ground. Two 6-volt batteries in series can be used for each side of the power supply. If batteries are used, connect 25- μ F capacitors from pins 7 and 14 to ground—and get their polarity correct.



CB LINGO

(Continued from page 12)

Keep Your Nose Between the Ditches and Smokey Out of Your Britches—

Drive safely and look out for speed traps and speeding fines.

Keep the Greasy Side Down and the Shiny Side Up—Drive safely.

Kenosha Cadillac—Any car made by AMC.

Let the Channel Roll—Let others break in and use the channel.

Mercy—Oh, wow! (Yes, truckdrivers really do say this.)

Negatory—No. Negative reply.

On the Move—Driving, moving.

On the Side—Parked or pulled over on the shoulder.

Other Half—Wife (usually) or husband.

Plain Wrapper—Police car with no markings; unmarked car.

Picture Taker—Same as "Camera"—a police radar unit.

Pickum-Up—Light truck; pickup truck.

Polish Ham—Your Editor, Julian Martin.

Pounds—Number on S-meter (S-3 is three pounds, etc.).

Pregnant Roller Skate—Volkswagen.

Put the Good Numbers on You—Threes and eights—best regards, etc.

Rake the Leaves—Back door or last vehicle in string, bringing up the rear.

Ratchet Jaw—Nonstop talker.

Rest-Um Up—Roadside rest area.

Rig—CB radio; tractor (double meaning).

Rocking Chair—Vehicle that's between the front door and back door in a string of vehicles.

Roger Rollerskate—Passenger car going more than 20 mph over the limit.

Roller Skate—Small car.

Seatcovers—Occupants of passenger car, usually attractive females.

Shake the Leaves—Act as lead vehicle to decoy any Smokies out of hiding. See also "Beat the Bushes."

Six Wheeler—Passenger car pulling a trailer.

Smokey—The police.

Smokey on Four Legs—Mounted police (used in New York City and Chicago only):

Smokey the Bear—State Police Patrol (with or without a Smokey the Bear hat).

Smokey with Ears—Police listening on CB.

Stack them Eights—Best regards.

Sweeping Leaves—Bringing up the rear. See also "Back Door," and "Raking the Leaves."

Thirty Three—10-33, This is an emergency.

Threes on You—Best regards.

Threes and Eights—Lots of best regards.

Tijuana Taxi—Well marked police car.

Train Station—Traffic court that fines everybody.

Two Wheeler—Motorbike, motorcycle.

Two Way Radar—Radar used from moving police car.

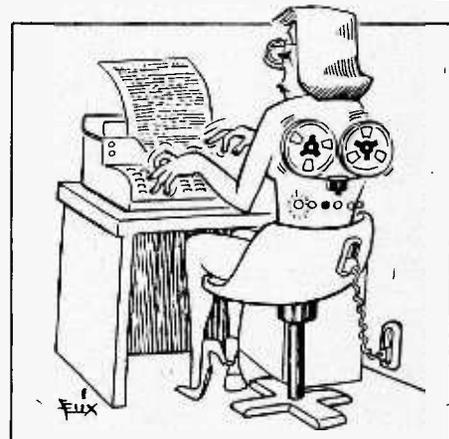
Wall to Wall—Peg full-scale on S-meter.

Wall to Wall Bears—High concentration of police with strict enforcement, traps, etc.

We Gone—Stopping our sending, will listen.

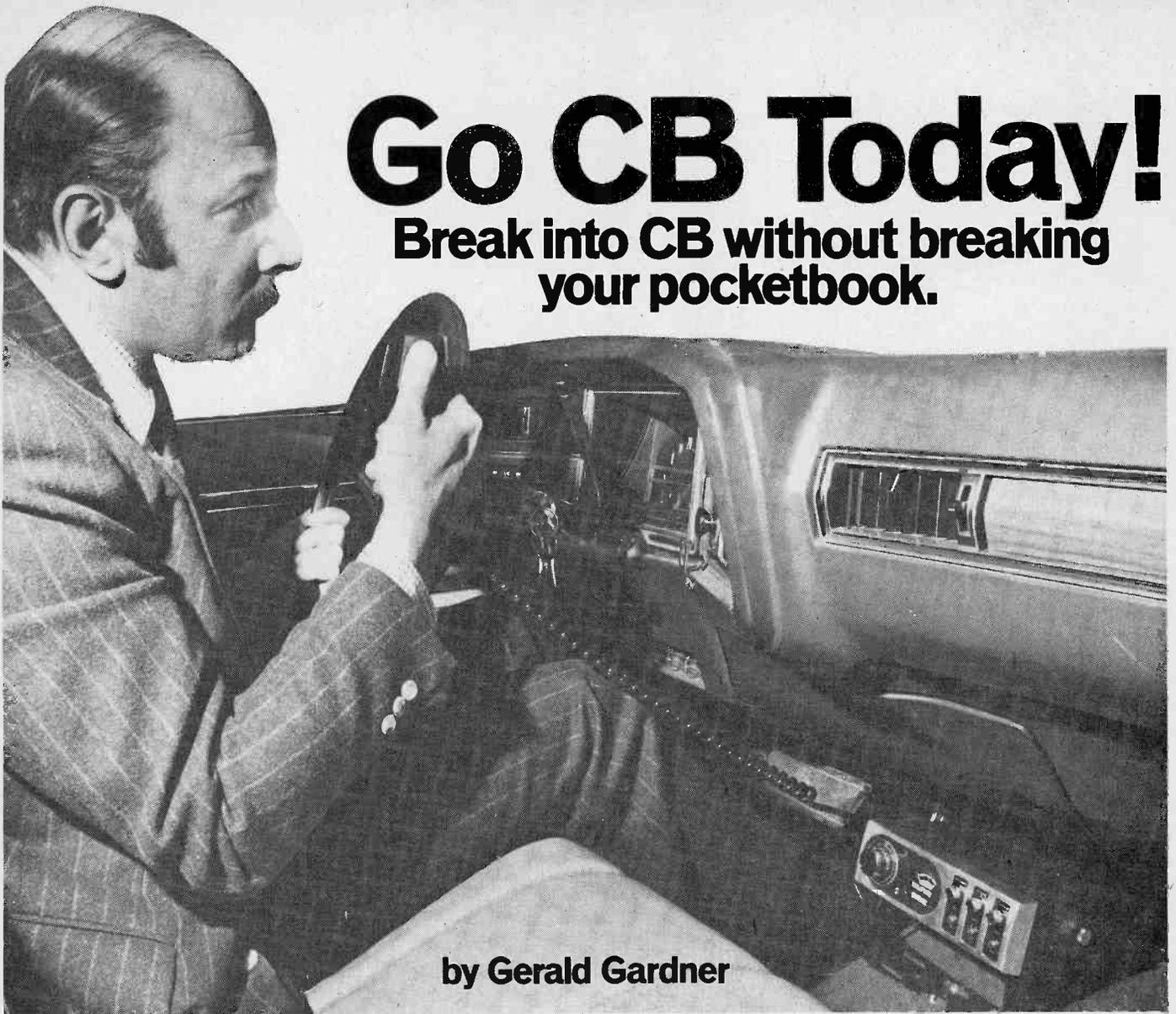
Wrapper—Color; "Blue wrapper" is a blue car, usually an unmarked police car.

XYL—Wife. (Stands for ex-young lady.)



Go CB Today!

Break into CB without breaking
your pocketbook.



by Gerald Gardner

BACK IN THE pioneer days of Citizens Band (CB) radio there was only one basic type of transceiver—it turned on and off, the volume could be adjusted, it had a squelch, and more often than not it operated on one, two, or three channels. Color it cheap.

Of course, those were the days when CB operators were as scarce as Eskimos in Ecuador; nobody knew about fancy refinements, state-of-the-art, and that sort of thing. The majority of CB manufacturers were hand-constructing a few dozen CB rigs per week to meet their needs.

I suppose that by now you've heard that the awkward child has grown up; CB radio has turned into the darling of the public, a 9-headed monster for the FCC, and one of the few industries which is still smiling (and often back-ordered) through the current industrial/economic "situation."

And, as you might have imagined, the equipment design, styling, refinements, and *prices* have come a long way up the pike since the old days. Special-

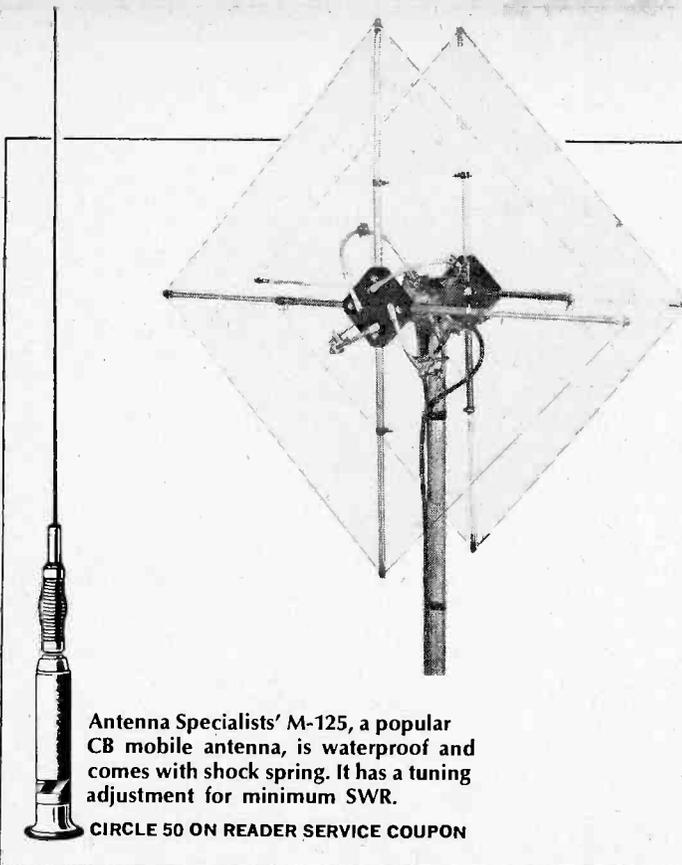
ized CB rigs are available for installation in cars, trucks, boats, and even motorcycles! To add spice to the market, CB rigs with all sorts of exotic technical gizmos and developments now confront the CB shopper, things such as single-sideband (SSB), crystal synthesis, power-booster modulation, all channel operation, speech clipping, remote control, telephone handsets, tone alert, integrated circuits, light emitting diodes, receive preamplification, variable sensitivity, public-address systems, tone control, VOX, mechanical and ceramic filters, noise blankers, digital alarm clocks, desk mikes, fully metered functions, dual base/mobile power supplies, and lots of designer styling. Naturally, as hoped for by the manufacturers, sets containing combinations of these features are sensational sellers in the CB marketplace—some tipping the scales at the \$600 price mark!

Why the Rip-Off? What's happened is that, somewhere in the backwash and dust of all this clamor, the poor soul who just wants to get on the air, no

strain, no pain, has gotten the impression that unless he can unload about \$1300 on a base station (and there's still that mobile installation to think of too!), there is hardly any point in trying to get involved in CB radio, for certainly any installation which doesn't include a \$600 rig, a monster \$350 directional beam and rotor perched atop a 50-foot \$175 to \$350 transmission tower and fed with 20¢-per-foot super-low-loss coaxial cable, will not put even a feeble signal across the neighborhood. *Not so!*

Back in the past, CBers forgot their humble roots, that they could operate quite effectively for most local communications purposes with a rather minuscule investment. Today's CBers have forgotten that while all of the chrome and frills are spiffy to have (if you have the cash to invest), these extras are far from being absolutely necessary in order to fulfill CB's basis premise, that of being able to get a message from here to somewhere else.

Yes, in the midst of the glitter and

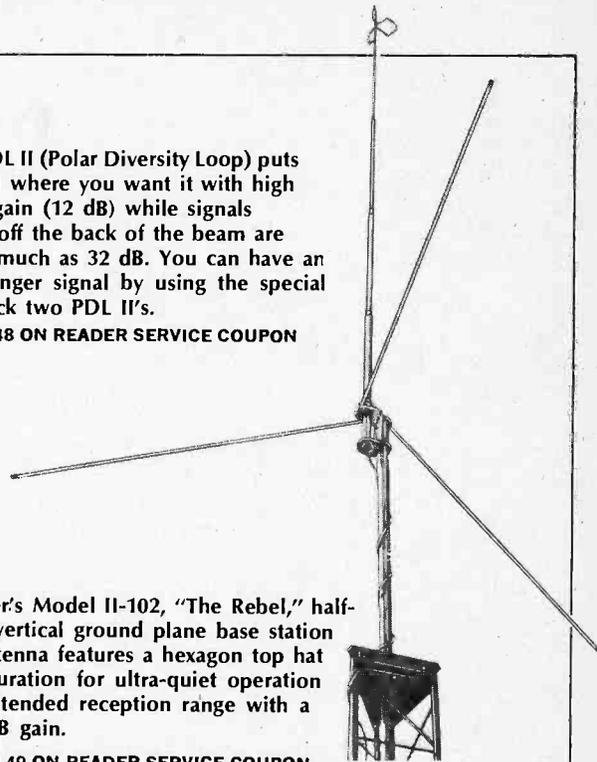


Antenna Specialists' M-125, a popular CB mobile antenna, is waterproof and comes with shock spring. It has a tuning adjustment for minimum SWR.

CIRCLE 50 ON READER SERVICE COUPON

Avanti PDL II (Polar Diversity Loop) puts the signal where you want it with high forward gain (12 dB) while signals received off the back of the beam are down as much as 32 dB. You can have an even stronger signal by using the special kit to stack two PDL II's.

CIRCLE 48 ON READER SERVICE COUPON



Breaker's Model II-102, "The Rebel," half-wave vertical ground plane base station CB antenna features a hexagon top hat configuration for ultra-quiet operation and extended reception range with a 3.75 dB gain.

CIRCLE 49 ON READER SERVICE COUPON

dazzle of space-age exotic technology, the consumer has managed to *disremember* that beneath the facade of knobs, meters, gadgets, and chrome of even the most spectacular deluxe CB rig there lurks (in one form or another, and by whatever fancy technical terms it may be described) a 5-watt transmitter and a 7-MHz receiver; and these same two components were part of a CB rig 15 years ago, and they are still part of even the most inexpensive CB gear today!

And while you can put as much as \$350 into a great-looking tower, you can still get your message from here to there without one—or with something a lot less costly which will accomplish the same purposes. You can, if you wish, spend \$350 on an antenna and rotor, but you can also send your signal out in all directions for about 5 percent of this cost.

And you can also get your signal to travel to the antenna without the deluxe accommodations of coax costing 20¢ per foot.

Many Just Don't Know. The fact of the matter is that CB is a consumer market, and the average CB consumer is not sufficiently hip to the ins and outs of CB radio in order to avoid overbuying, even without any coaxing from a high-pressure salesman. If a \$3000 Chevy is good, a \$6000 Buick is twice as good, right? So if a \$1300 CB installation is great, a \$650 installation is fair, and a \$325 installation is a joke, right? Wrong!

Inexpensive CB gear is still being produced, quietly and with far less hullaba-

loo than the stuff with the fancy trimmings. Let's see how a fully operational and effective CB station might be assembled on a shoestring. Let's see if each and every one of the frills is necessary to your installation, to your needs.

First, decide exactly what you want of your CB installation. Most often the SWLer in his shack wishes to communicate to one or more base stations.

You and your SWL pals can select one channel (or maybe two) on which to communicate. You don't need the full 23-channel rig. A 3 or 6-channel CB transceiver will do the job inexpensively.

Next, let's really think about the chrome trim and the wood-grain finish—pretty, but it doesn't make the old signal any louder, does it?

You get the idea: Start evaluating things like clocks, variable sensitivity, and other cost-adding features. How often will you use a public-address system, for instance? Start scratching these features from your list.

What's Available. Now, let's see what you might buy. You could go to Lafayette and buy their Micro-66 which has 6 channels and costs only \$69.95. Radio Shack offers a Realistic TRC-11, 6 channels for only \$79.95. Yes—look through the catalogs—there's the Royce 1-590 (\$69.95), SBE's Capri II (\$89.95), and all the rest. Many manufacturers produce CB rigs for under \$80, and you'll be surprised to see that they aren't all bare-bones models; most seem to be rather nicely designed and several incorporate a few deluxe fea-

tures. Of course these CB rigs require a regulated 13.8-volt power supply to operate the rig at home. Cost for the power supply is about \$30 or less.

A Roof-Topper. Now we get to the antenna, which you need to radiate your signal. If you absolutely *must* get the very last drizzle of signal into a remote corner of the county, you will probably require an expensive band-blaster running several hundred dollars. Want good general coverage? Well, don't overlook the old CB standby, the *ground plane* type antenna. There was a time when every CB base station used one, and you can still get them for about \$12.95 and it will let you communicate in all directions without the need of a rotor to turn it, and it will send out your signal for about as much distance you would need for normal local communications. If you choose to operate the CB in your car, save money by purchasing any inexpensive mobile antenna that catches your fancy. Mobile antennas are all so well designed today that it would be hard to find a lemon at any price, even if you went looking for one.

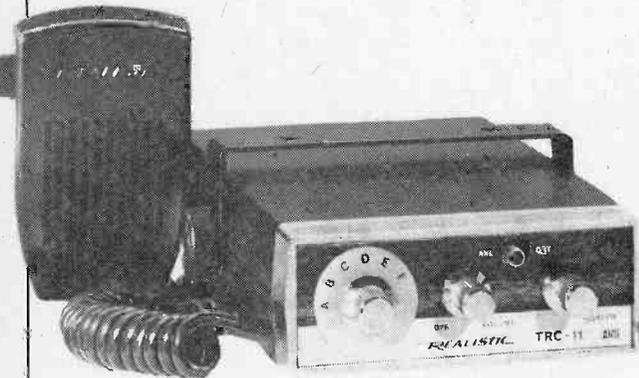
If you've heard that to stretch your coverage you must put your base station antenna atop a tower, that is quite true. Now, maybe you can get adequate coverage with the antenna right on the roof of the building and you can avoid the whole question—for a base station antenna atop the roof (or chimney) of even a 2-story frame house will cover most suburban communities. A jazzy communications tower which will run your antenna up 50 feet will probably



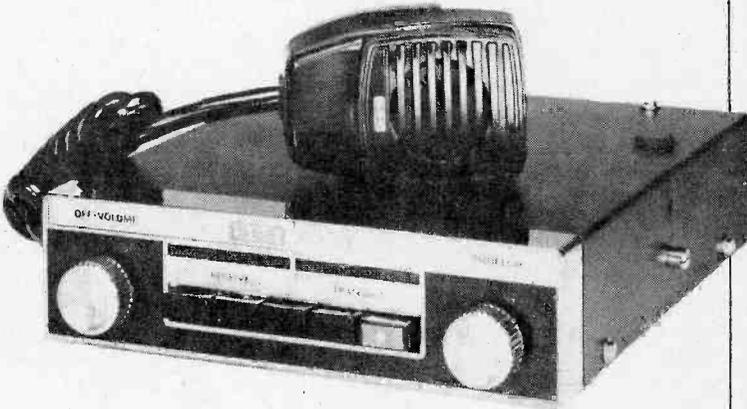
CIRCLE 46 ON READER SERVICE COUPON
 Lafayette Micro-66 full-power 6-channel CB rig is about as small as they come. Optional extra accessories include an AC power supply for home operation and portable battery pack for back packers.



CIRCLE 47 ON READER SERVICE COUPON
 Royce 1-590 3-channel mobile full-power transceiver is a bargain hunter's dream. Slide volume control and mini-packaging are indicative of quality guts inside.



CIRCLE 31 ON READER SERVICE COUPON
 Realistic TRC-11 CB transceiver gives 6-channel coverage and full-power punch at a low price.



CIRCLE 45 ON READER SERVICE COUPON
 SBE Capri II features push-button 5-channel frequency selection, comes with channel 9 crystals and a budget price tag.

set you back \$175 to \$350. But here's a suggestion which can save you big cash: check out the prices of telescoping TV masts. You can get a 50-footer for less than \$25, and it will hold up your ground plane with ease. And if you don't need quite that much height, there are all sorts of telescoping TV masts of lesser heights for lower prices.

You may also come to feel that the coaxial cable which feeds signals between the CB set and antenna is a vital link in your ability to effectively communicate, and, in actual fact, it is. Some CB operators go to hysterical ends to insure that not even the most miniscule pinch of signal is lost in the process. Towards this end they purchase sophisticated low-loss cable which sets 'em back at least 20¢ per foot—a 50-foot run of the stuff costs \$10, plus the cost of the connector at each end. The amount of loss, however, that they would have suffered in 50 feet of less expensive type RG-58A/U coaxial cable would have been insignificant to the point of being practically undetectable in their most difficult communications.

A 50-foot length of RG-58A/U cable would cost about \$3.70, and the two connectors 60¢ each—or you can buy the cable with the connectors already attached for \$6; and since putting the connectors onto the cable is a tricky soldering job for a novice, it's an affordable luxury you might wish to use to your advantage.

The Bottom Line. Now let's see where we stand—a CB rig for about \$80, a \$13 antenna atop a \$25 mast, connected together with \$6 worth of cable. Grand total, including a few extra dollars for miscellaneous hardware: about \$125 for a complete, effective, and versatile CB station—about 1/10th the cost of going the full route!

Maybe you'd like to think of it as a 90 percent discount, or a \$1200 rebate—for certainly you will have effective local coverage with this shoestring CB station. After all is said and done, what more did you really want?

The editors of 101 ELECTRONIC PROJECTS are providing readers with a free booklet from the Electronics Industries Association (EIA) about CB radio.

If you would like a copy, just fill out the coupon, check the correct box, and send it in. And don't forget "Kathi's CB Notes" for straight info on how to get and fill out an FCC license application. And if you want to stay current on what's happening in CB, follow Kathi Martin's CB column in every issue of ELEMENTARY ELECTRONICS. ■

Kathi's CB Notes
 101 ELECTRONIC PROJECTS
 229 Park Ave. South
 New York, N.Y. 10003

Yes, I'd like to receive the EIA booklet about CB radio.

I would also like to receive information about the specific CB products advertised in this issue.

Be sure to include copy of "Kathi's CB Notes."

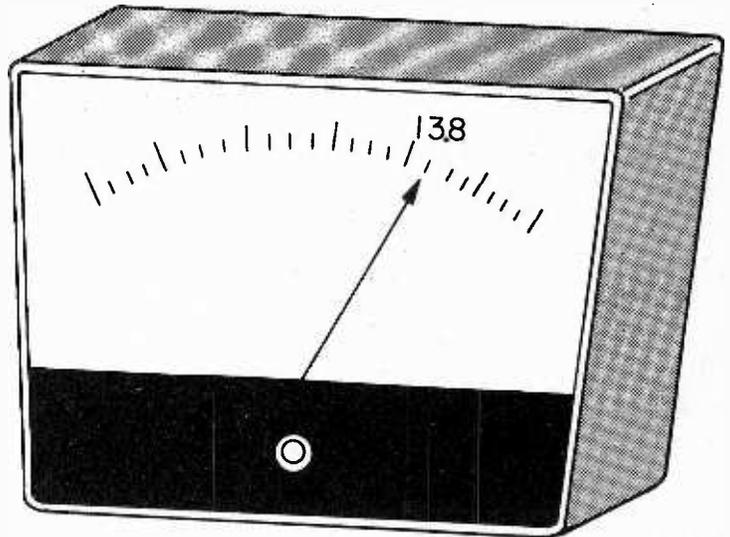
Name _____ (Please Print)

Address _____

City _____

State _____ Zip _____

CB Power Mate for Maxi-Output



Here's the partner to power your mobile CB rig at home to its maximum capability—four watts RF output.

By Herb Friedman, W2ZLF

SO YOU'VE JUST upgraded your Citizen's Band setup with a shiny new transceiver specified to give you four watts out—the legal maximum—or perhaps, if you've converted to the more efficient SSB (single sideband) operation, as many progressive CBers are doing these days, 12 watts, P.E.P. You've paid a couple of hundred dollars for this new equipment and are going to use it at home as your base station—even though it could be operated mobile, in your car, from its 12-volt system.

You hook it up to the 12-volt DC power supply you used at home with your old, lower-powered rig and it

seems to work fairly well. You contact a few nearby CBers easily enough. But it doesn't seem to be getting out much farther than your earlier transceiver, which has considerably lower power output. What's wrong? Where did the power go?

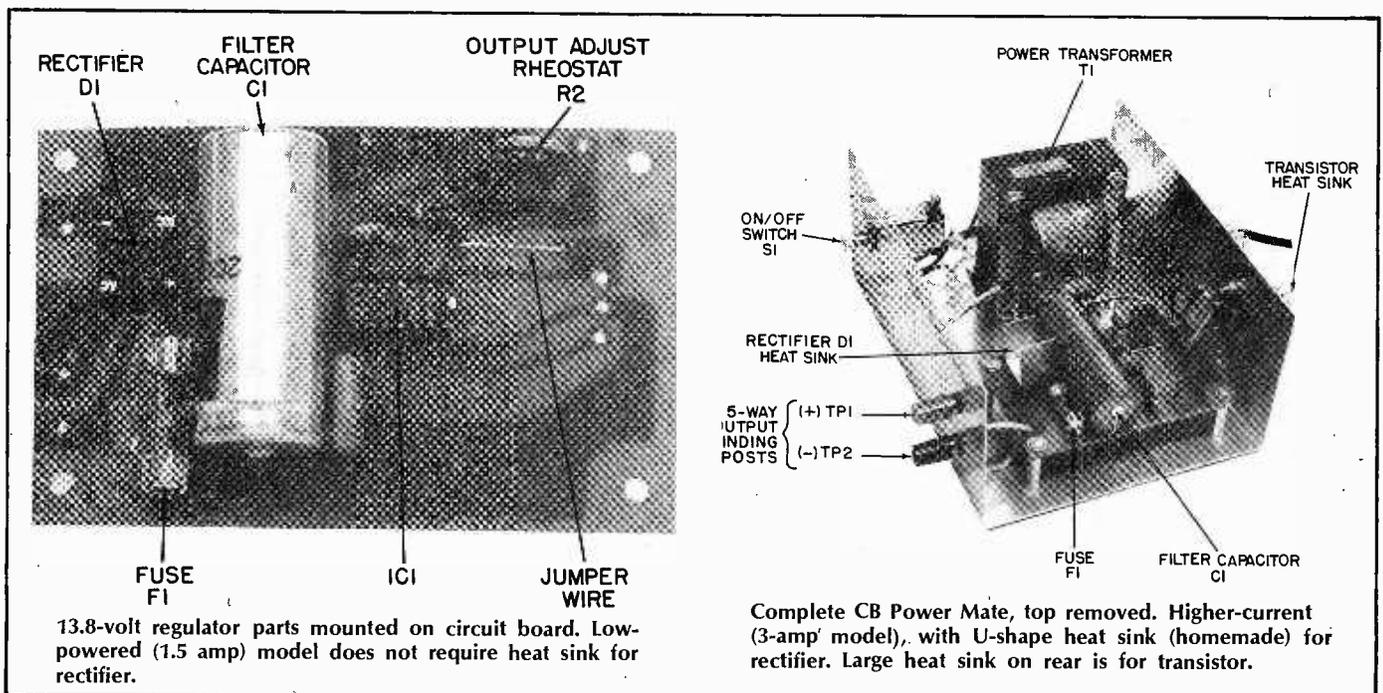
You're probably not feeding the new set the 13.8 volts it was designed to get from the electrical system of your car when the generator is running, charging the battery, as well as powering the rest of the electrical system in addition to accessories like a mobile transceiver.

The 117-volt AC to 12-volt DC power supply you used with the earlier transceiver may have supplied it with

current at 12 volts, but it can't provide the 13.8 volts, at higher current, which your new set needs to put its rated power on the air.

To be sure, check the actual power supply voltage you're feeding to the CB set.

What Voltage? To check the actual output of your old power supply, get out your voltmeter and measure the voltage being fed to your transceiver. It probably reads around 12 volts (maybe a bit more when the transceiver isn't turned on). You turn the CB set on to *Receive* and get a good solid 12 volts (or maybe as high as 13). So far so good. Now switch the set to *Transmit*.



13.8-volt regulator parts mounted on circuit board. Low-powered (1.5 amp) model does not require heat sink for rectifier.

Complete CB Power Mate, top removed. Higher-current (3-amp model), with U-shape heat sink (homemade) for rectifier. Large heat sink on rear is for transistor.

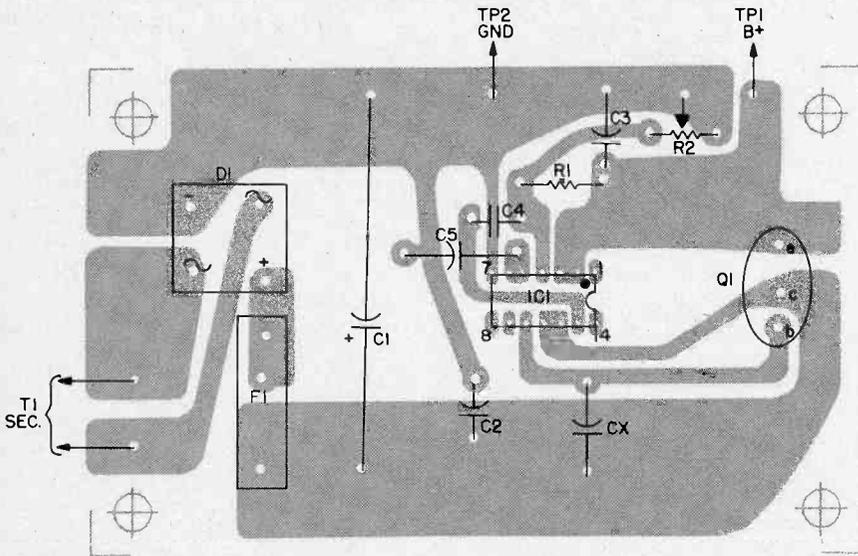
CB POWER MATE

The input power voltage drops to around 10 volts! Turn it off.

That power supply might have been OK with a lower-powered unit, but it just doesn't make it with this higher-powered job. The four watts of transmitting output you paid for when you bought this new rig is only 2.5 to 3 watts now. This is because your power supply hasn't got the output voltage

The difference between 12.0 and 13.8 volts amounts to 15% less transmitter power. If the supply puts out only 10 or 11 volts when it's under a heavier-than-usual load the loss can be as high as 25 percent. It could be a lot less. If that power supply's output regulation is so poor that it puts out only eight or nine volts with your new CB transceiver the transmitter might not work at all.

To insure maximum performance from your mobile transceiver when powering it with AC house current, you must use a 13.8 volt *regulated* power



You can make it easily from kit purchased at electronic parts stores. Positions of parts shown actually are located on back side of board. See full size template in story. Copper foil side of board is shown down.

regulation it needs—the ability to put out constant voltage, within its specified limits, regardless of variations in the required current. In addition, your mobile transceiver was designed to work from a DC power supply of 13.8 volts; when the car is running that's what it gets, to charge the battery. (Ever notice how the lights are dimmer when you run them without the motor turning over? That's the difference between 13.8 and 12 volts (or even less, if your battery is on low charge or about to conk out with a weak cell).

It's Only 1.8 Volts. "So what's 1.8 volts?" some people may ask. "Most electronic components are manufactured to a tolerance of 10%, and we see that most schematics have their voltages specified $\pm 20\%$."

Won't most equipment and circuits operate over a wide range of voltages from their power supplies? Yes, they will often operate, in many cases quite well, but not power output circuits. They just won't deliver the specified output. Equipment which draws substantial current can only produce its rated output when it gets power at the voltage specified by the design engineers.

supply. Regulation provides exactly 13.8 volts under a wide variety of loads—from full load to no load—and also compensates for AC line voltage fluctuations if they occur.

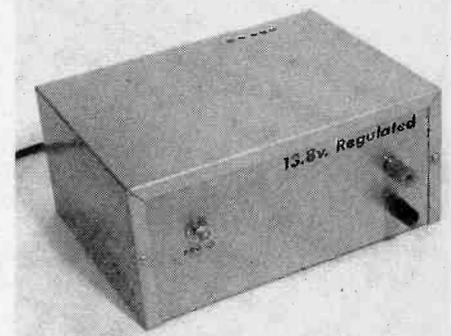
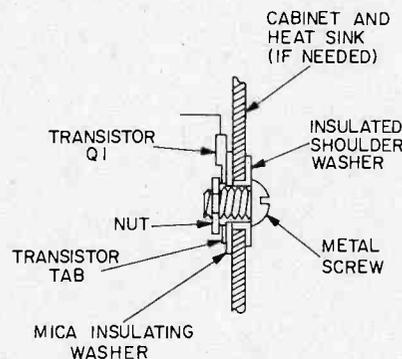
Although a regulated supply can cost from \$50 to \$100, you can build the *CB Power Mate*, as shown in the photographs for about \$20 to \$25 (or even less if you're good at scrounging parts

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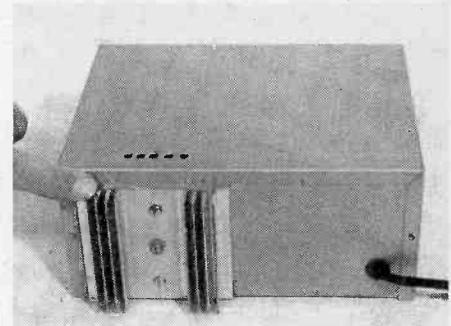
Although a regulated supply can cost from \$50 to \$100, you can build the *CB Power Mate*, as shown in the photographs for about \$20 to \$25 (or even less if you're good at scrounging parts

supply. Regulation provides exactly 13.8 volts under a wide variety of loads—from full load to no load—and also compensates for AC line voltage fluctuations if they occur.

How to mount transistor to dissipate heat into metal cabinet (and external heat sink, in 3-amp model). Use silicone grease on both sides of insulating mica washer. Tape over screw head (outside case) to protect against external short.



Front view of CB Power Mate shows On/Off switch, red (+) and black (−) power output binding posts. Rear view of higher-powered version has finned heat sink to dissipate heat from regulating transistor. Quarter-inch holes on top of unit are for ventilation.



or have a junkbox of used components). The same supply can be used as an AC-to-DC power source for high power walkie-talkies (one-watt or more output) which require exactly 12 volts, because this supply can be adjusted at the flick of a finger to any mobile power voltage—even six volts. Your regulated supply can be built to handle any current needed, up to three amperes. The current capacity is determined by the output of the power transformer, T1, and filter capacitor C1, the two most costly items in this project. Thus you can save money by building only the current capacity you actually need.

How It Works. The first section of the CB Power Mate (the 117-volt step-down transformer T1, the rectifier, and the large capacitor, C1) supplies *unregulated* current at between 15 and 35 volts, depending on the number of turns in the secondary of T1. The rest of the supply is the regulator section. The size of the voltage drop across the regulator depends on the resistance of transistor Q1, which varies according to its base bias. The bias is controlled by the action of the IC, which gets its commands from the voltage applied to pin 4. This voltage is taken from the junction of R1 (1800 ohms) and R2 (500-ohm rheostat), which are a voltage divider across the power supply output. Initially R2 is set to provide the desired volt-

CB POWER MATE

sistor. Also be sure to hold each transistor lead with a pair of long-nose pliers as a heat sink when you solder to the transistor leads.

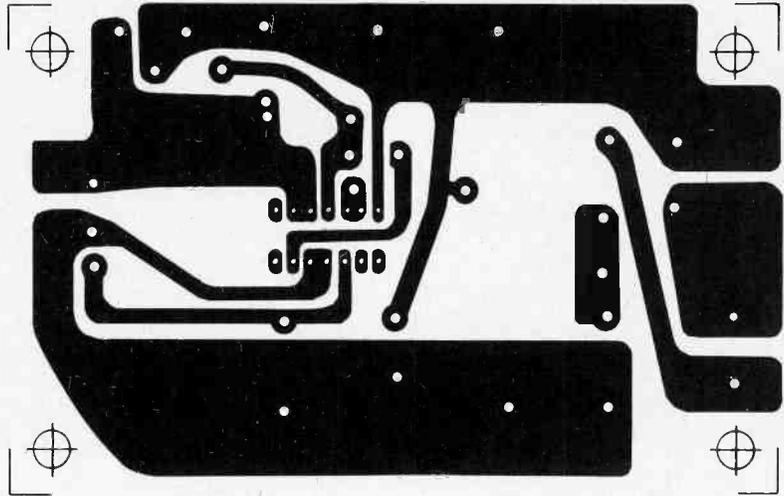
For the high-current CB Power Mate the bridge rectifier has a hole in the center to which you can secure the homemade heat sink. To make this, take a piece of scrap aluminum the width of the sink or larger and bend it in a U-shape with the ends sticking up in the air about an inch. Secure the sink to the rectifier with a #6 screw, a lockwasher between the screw and the rectifier, and a lockwasher and a nut on top of the heat sink. (The screw feeds in from the terminal or lead side of the rectifier.)

Also, for the high-current Power Mate the transistor uses the special heat sink with fins on the back of the cabinet (as shown in the picture). Q1 is installed the same way for both models. Drill a 1/4-in. hole through the sink and the cabinet. Bend Q1's leads outward, away from its mounting tab. Using a mica insulator from a power rectifier (preferably) or a power transistor mounting kit, coat both sides of the mica with silicone heat sink grease. Position the insulator over the hole in the cabinet and place an insulated shoulder washer (from a 5-way binding post) in the cabinet hole, from outside the cabinet. Pass a #6 screw through the sink, the cabinet, and the mica insulator.

Then install Q1, a lockwasher, and a nut. Tighten the screw slightly more than hand tight. Check with an ohmmeter to be sure there's no short between the tab of Q1 and the cabinet. You should read infinity—no connection. If you have a short (one ohm or less) look for an improperly-seated shoulder washer or for a metal chip from the drilling.

Final Assembly. Before final assembly, with the parts *not* mounted in the box, drill a row of five 1/4-in. holes in the cabinet directly over Q1, and five more holes in the lower left of the cabinet, near the transformer. These will provide adequate ventilation. Then put a small piece of tape over the head of the screw which secures the transistor, to prevent a (possible) external short.

Complete all wiring before installing the IC. Plug it into its socket so that pin 1, which has a dot molded next to it, faces the edge of the printed circuit board farthest away from the rectifier. Pin 1 should be toward the wires going to the board from the transistor. Install the fuse in its clips, set the rheostat,



Exact-size template for printed circuit board you can make. Location of holes for integrated circuit are critical—exercise care in drilling. Copper foil side is shown up.

R2, to its mid-position, and connect the voltmeter to the output of the power supply (the binding posts). Plug in the CB Power Mate's AC cord and observe the meter. It should rise to some value and stay there. If it wanders, or rises and falls back down to zero, disconnect the AC power and check for a wiring error. If the voltmeter remains steady, adjust R2 very slowly for the desired voltage, 13.8 volts (or 12, or whatever depending on the set you are going to power with it). That's it—your CB Power Mate is ready to use.

Optional Protection. If you want to build-in the *maximum current limiting* (to make sure the supply will turn off if a short suddenly appears outside it), you can substitute a resistor for the jumper on top of the board. To figure the value of the resistor, follow these steps:

1. Find the value in ohms of the resistor, which we will call "R." The formula is: $R = \frac{0.6}{X}$ where "X" is the current the transceiver draws when transmitting.

2. If the current is 2 amps, then the formula gives us: $R = \frac{0.6}{2} = 0.3$.

3. Now we must find the power rating of the resistor. Power is $W = I^2R$, where I is the current. Since we know that R is 0.3 ohms, and that the current is 2 amps, we get: $W = 2 \times 2 \times 0.3$ or $W = 4 \times 0.3 = 1.2$ watts. For safety we double the rating, giving us 2.4 watts.

4. So, we need a 0.3 ohm, 2.4 watts

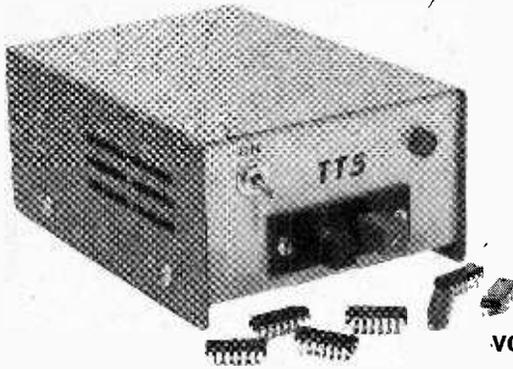
(or more, since that exact wattage isn't available). The nearest larger wattage rating should be used. Two 0.6 ohm, 2-watt resistors in parallel would do nicely.

In Use. Now plug your CB Power Mate in, connect the positive and negative leads of the 13.8-volt power supply to the Plus and Ground connections on your transceiver, and start contacting your fellow CBers . . . with the maximum legal power which you paid for with your new set. Why not get it?

Of course the CB Power Mate is only needed in your home. In your car the transceiver will be getting the 13.8 volts it needs, if that electrical system is operating correctly.

Caution: Don't try to use the CB Power Mate at settings higher than 13.8 volts with a transceiver which requires that voltage. Trying to increase a transmitter's RF power output that way will probably result in blowing out components in the transceiver, because many transceivers are designed to just accept 13.8 volts, with not much safety factor above that. Be sure the Power Mate is set for exactly 13.8 volts before you turn on the transceiver, not any higher.

If you're not certain that your voltmeter is reading DC volts accurately, you can calibrate it very closely by using several new flashlight cells (not nicads—just ordinary, good condition—tested in flashlight—batteries). These cells, in good condition, put out exactly 1.56 volts each. Four cells in series should read 6.24 volts. $8 \times 1.56 \text{ V} = 12.48 \text{ V}$. Or you can get 13.94 V from nine cells. ■



Hobbyist Power Supply For TTL

TTL-type digital integrated circuits require a steady 5 volts for superior operation. Get ready for TTL projects with this ultra-simple, high performance regulator.

by Herb Friedman

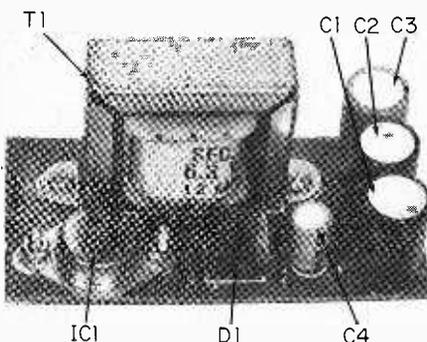
ELECTRONICS IS going digital! Not only are space TV photos relayed by digital techniques, but inter-country TV sound across the big pond (Europe) uses bits to represent audio. Right here in the U.S. we find TV receivers and FM tuners are "going digital." Even hobby projects such as you'll find here in e/e are using digital ICs.

The 7400 series of digital ICs is presently the most popular digital device "family," primarily because of its rock-bottom cost and easy handling; and it is more than likely that many hobby or experimenter projects you're going to run across in the next year or so will use the 7400 series of TTL (Transistor Transistor Logic).

The only problem is that TTL almost always requires a tightly regulated 5-volt power supply, and take careful note of those words *tightly regulated*. Often, the 7400-series device will instantly "blow" if 6 volts or a line transient is applied. The margin for error when working with TTL is essentially zero. While a zener diode can be used to provide, say, 5.1 volts, they are not easy for the average experimenter to find, nor do they necessarily provide protection against line voltage transients or short circuit protection.

What's needed is a full voltage regulator having both current and short circuit protection. Should the supply run

The completed supply ready for installation in a cabinet or project. Pilot lamp I1, which also serves to discharge the output capacitor, is not part of the PC board assembly.



hot due to excess current drain, or should a wiring error or breakdown in the external circuit short-out the power supply, the supply will automatically turn off, thus protecting both the power supply components and the connected circuit.

While you can always use a handful of components to build a 5-volt regulated supply for TTL—assuming you could possibly find the necessary components in your area—it's much easier to use a LM-309K, a single IC that contains *all* the components of a power supply regulator in a standard TO-3 case. Best of all, the LM-309K can be purchased locally for about \$2.50; and that's probably less than the cost of discrete components if you decided to build from scratch.

Inside Look. The LM-309K 5-Volt Regulator is available from many surplus dealers and Radio Shack. Mounted on a PC (printed circuit) or perboard, it can safely deliver up to 1 ampere. Mounted on a heat sink you can squeeze out 3 amperes. The LM-309K gives the average experimenter everything he's looking for in a TTL power supply: tight regulation, transient protection, thermal shutdown, and short circuit turn-off.

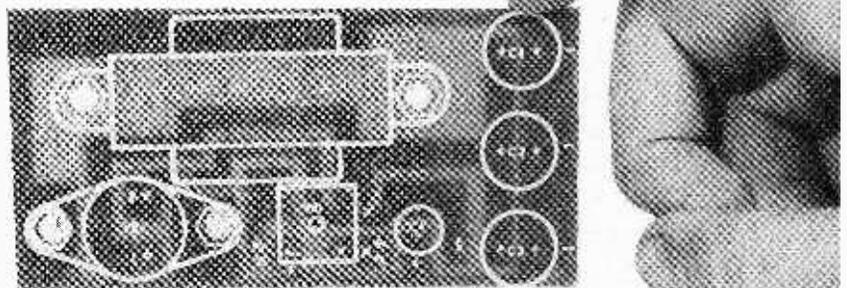
A typical TTL 5-volt supply using the LM-309K that's suitable for the experimenter is shown. It's a rather easy circuit to build and provides 5 volts at up to 1 ampere with the IC mounted on a PC board. If you want to

avoid the fuss and bother of making your own PC board, you can use a pre-drilled factory-made board which we'll describe later.

Transformer T1 is an ordinary 6.3-volt filament transformer rated at least 1 ampere. Capacitors C1, C2, and C3 can be replaced with a single 3000- μ F unit rated at least 15 volts, but you'll find it much easier to locate three 1000- μ F capacitors. Diode bridge D1 should be rated 5 to 6 amperes to handle the peak current load of the heavy filtering (C1, C2, C3). Do not try to get by with a 1-ampere bridge rectifier.

Capacitor C4 provides a low power supply impedance to the connected circuit; do not eliminate C4. Also, pilot lamp I1 should not be eliminated or its position in the circuit changed because it is used to discharge C4 when the power supply is turned off. Without I1 C4 might retain a charge for several minutes after the 117 VAC input power has been removed and can cause headaches and grief. When? Suppose you connect up your project thinking there's no voltage from a supply that's turned off!

To insure long life, and since the



Easiest way to build the power supply is to use this Radio Shack PC board. All holes are pre-drilled and the component positions are "screened" on the top side. Back-lighting shows the heavy copper foil showing through; it means customization without fear of damage to the foil strips.

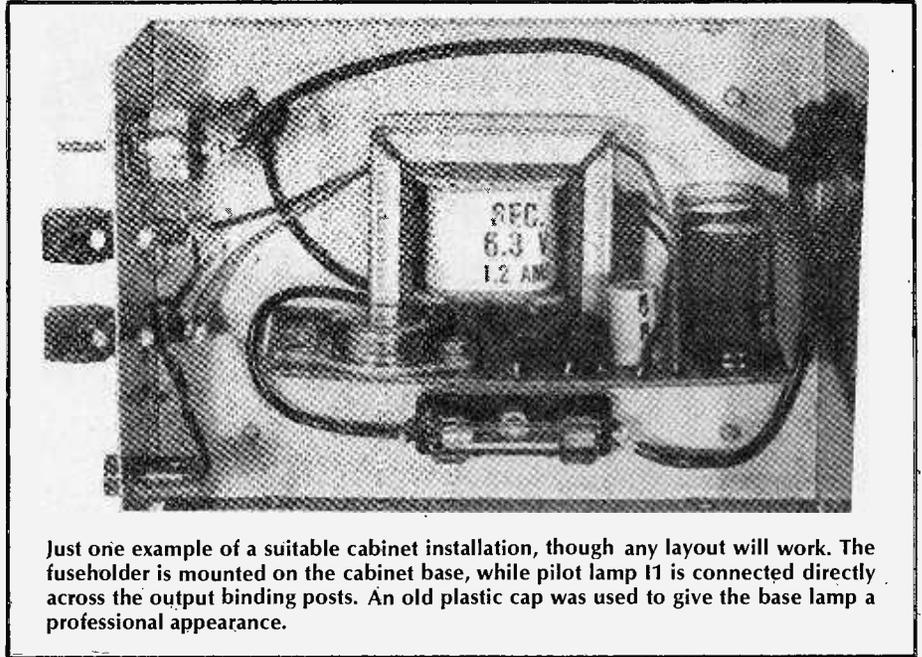
pilot lamp doesn't have to be bright enough to read by, I1 is a 12 volt/25 mA lamp—one of those miniature pilot assemblies that comes with attached leads. Connected to 5 volts, it's bright enough to see even in sunlight.

The supply shown in the photographs is assembled on a factory pre-drilled PC board available from Radio Shack for \$1.49. The top side has the component locations screened in white paint. While the transformer mounting holes are spaced for the Radio Shack 273-050 6.3-volt filament transformer, you can, however, use any rated transformer although you may have to drill new holes. A rear-lighted photograph shows the extra-wide copper foil that permits easy customizing of the PC board.

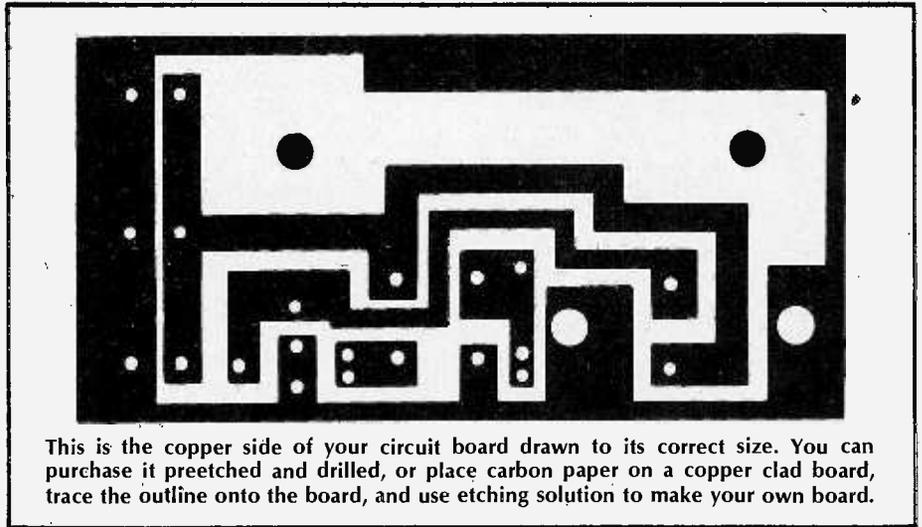
More Data. The instructions supplied with the Radio Shack PC board indicate a different pilot lamp connection than shown in our schematic. For this supply do not follow the Radio Shack connections; install the pilot lamp exactly as indicated in our schematic.

The entire supply—except for power switch S1, pilot lamp I1, and fuse F1—is on the PC board which you can install in any type of cabinet. The complete supply shown uses a 4 x 2½ x 6-in. metal cabinet, with the PC board end mounted by L brackets fashioned from scrap aluminum. The fuse holder is mounted on the base of the cabinet. Output is from two spring-loaded pushbutton terminals, but you can substitute 5-way binding posts or any other output connections you prefer.

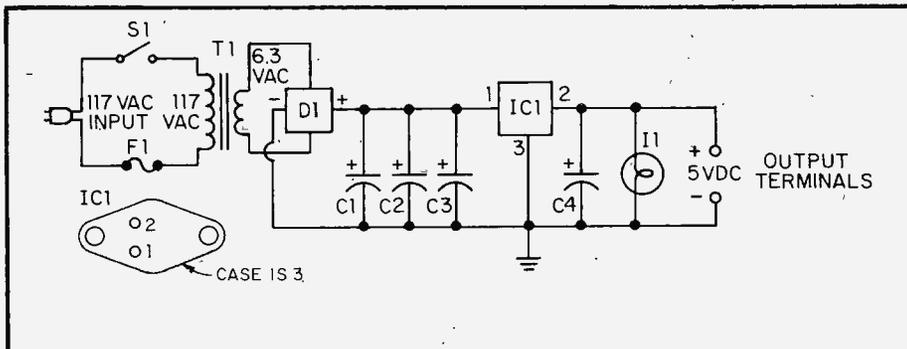
Fuse F1 can be anything from ⅛ to ¼ ampere. Use a standard fuse such as 3AG—not a slow-blow type.



Just one example of a suitable cabinet installation, though any layout will work. The fuseholder is mounted on the cabinet base, while pilot lamp I1 is connected directly across the output binding posts. An old plastic cap was used to give the base lamp a professional appearance.



This is the copper side of your circuit board drawn to its correct size. You can purchase it preetched and drilled, or place carbon paper on a copper clad board, trace the outline onto the board, and use etching solution to make your own board.



PARTS LIST FOR TTL POWER SUPPLY

- C1, C2, C3—1000- μ F, 15-VDC or higher electrolytic capacitor, see text
- C4—100- μ F, 15-VDC or higher electrolytic capacitor
- D1—50-volt, 6-amp diode bridge rectifier
- F1—¼-amp fuse, fast-acting
- I1—12-volt, 25-mA pilot lamp, see text

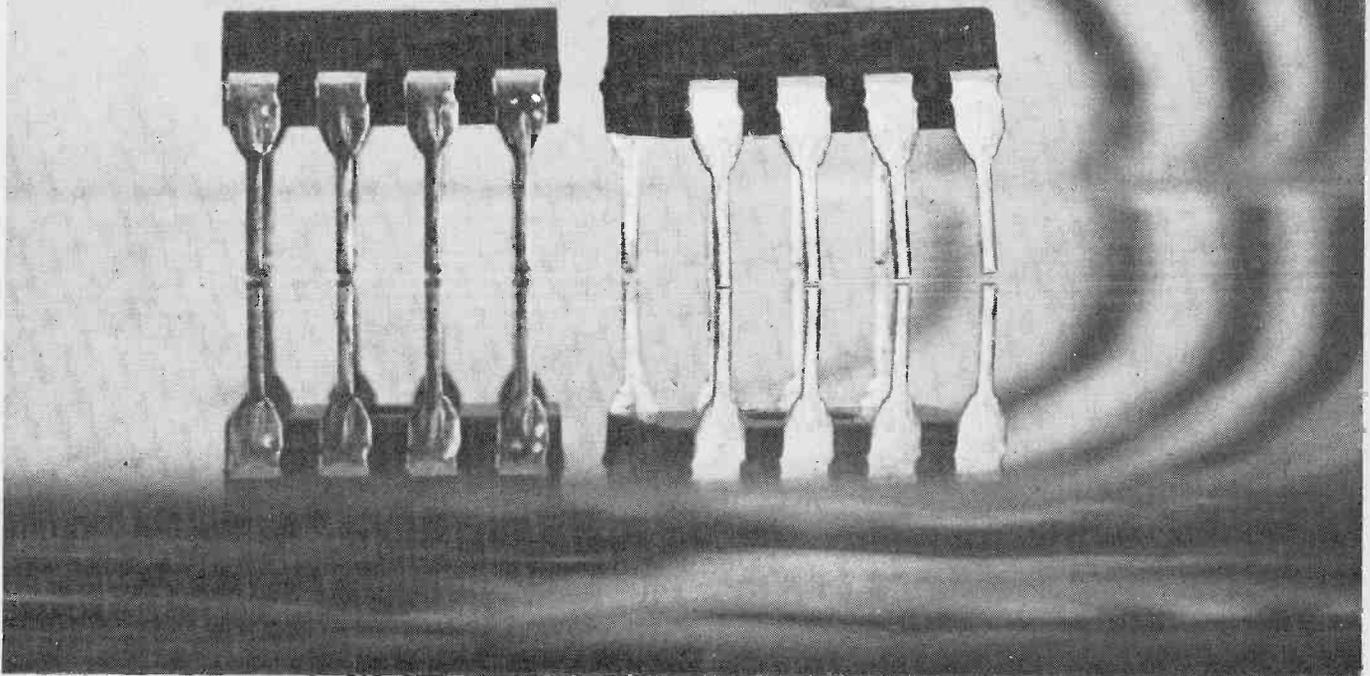
- IC1—LM-309K IC voltage regulator (National Semiconductor Corp.)
- S1—spst switch
- T1—6.3-VAC, 1-amp or better transformer
- Misc.—cabinet, fuse holder, pushbutton or other type terminals, circuit board (optional), wire, solder, hardware, etc.

Too Hot. If the last things you solder are the IC terminals, let everything cool down before you check out the supply. If IC1 is excessively hot—from soldering heat—the automatic thermal protection shuts down the output and you won't get any output voltage. A meter connected across the output terminals will indicate zero. After you are certain IC is cool, measure the output; it should be 5 volts. Next, connect your voltmeter across either C1, C2, or C3, then short circuit the output terminals. If you have assembled everything correctly the meter will indicate approximately 10 volts even though the output is shorted. After the short is removed you should read 5 volts at the output terminals.

The only thing to keep in mind when using this TTL 5-volt supply is that the output current is automatically limited to 1 ampere.

AN OLD FLASH FROM A NEW IC

by Jackson Kaye



HOW WOULD YOU LIKE a circuit that flashes a light-emitting diode (LED) for over a year on one single "C" size flashlight?

Your answer may be, "Wonderful, but what can I use it for?" That answer is found in the IC which happens to be a National Semiconductor LM3909. This unique pulse-generating integrated circuit can actually be used to drive

LEDs from a 1-volt source, even though 1.6 volts is normally needed to turn the LED on. This chip should find wide usage in indicators, test gear, alarms, and timing applications.

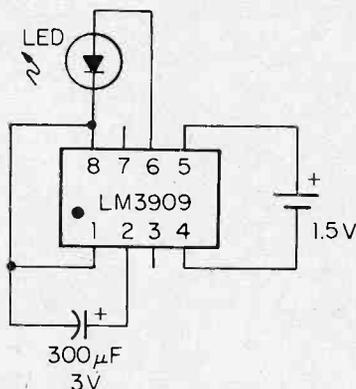
The high performance IC (LM3909) can deliver 200 milliamp pulses, or oscillate at over 200 kHz. Thus, applications as an SCR trigger, square-wave generator, and milliwatt DC-to-DC converter are practical. For instance, the ability to drive an 8-ohm speaker directly allows design of extremely simple and low cost audible alarms and audio continuity testers, also operating on 1.5 volts DC.

The IC can operate over a temperature range of -25°C to 70°C and is supplied in an 8-lead plastic Mini-DIP package experimenters will have no trouble working with. But before we get involved with industrial circuits, let's have fun with an ultra-simple LED flasher.

Build It. In LED flasher applications the average power drain from the battery is only 700 microwatts—practically no battery drain at all. Such long-lived flashers can aid in finding flashlights, emergency equipment, mooring floats, power switches, valves and locks in total darkness. Construction of an LED flasher is simple. It is not necessary to mount parts on a printed circuit board as the author did; perf board and flea

clips will do fine. Use an IC socket for the LM3909 to avoid accidental damage and make the same IC available for other projects and experiments. Follow the schematic diagram (Fig. 1) then solder in the 1.5-volt dry cell last after carefully inspecting all connections. Hook-up time should be under one-half hour for a circuit consisting of only four parts. The LED will flash once each second. The table in Fig. 1 gives life expectancy for carbon-zinc (standard) and alkaline dry cells.

The dry cell connected in the circuit of Fig. 1 will deliver approximately



CELL SIZE	STANDARD CELL	ALKALINE CELL
AA	3 MONTHS	6 MONTHS
C	7 MONTHS	15 MONTHS
D	1.3 YEARS	2.6 YEARS

Fig. 1. Simple LED flasher that produces about a one flash per second repetition rate.

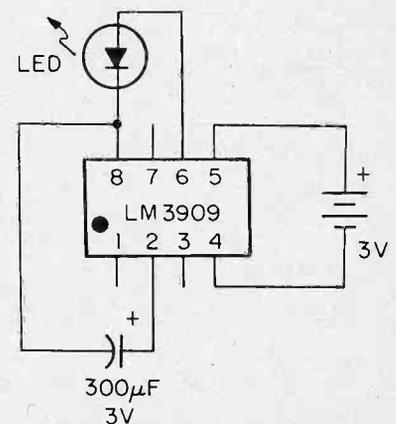


Fig. 2. A 3-volt flasher with a nominal flash rate of one flash per second. Battery drain is about 0.77 milliamperes.

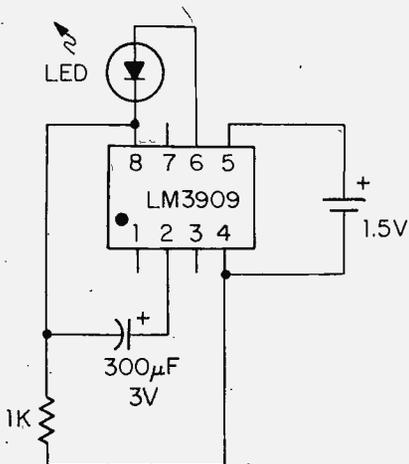


Fig. 3. This fast blinker produces 2.5 flashes per second with an average dry cell drain of 1.2 milliamperes.

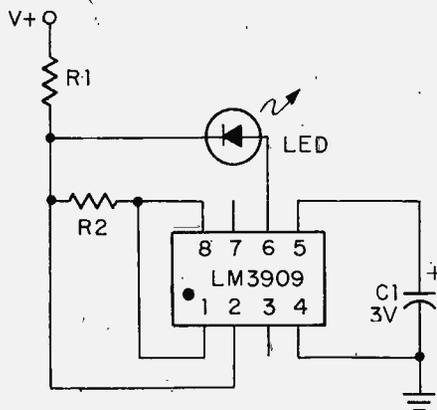


Fig. 4. Power-on flasher indicates that power is available on a DC bus. Resistor R1 is the series voltage dropping resistor for the circuit and must be one watt.

V+ (VDC)	C1 (µF)	R1 (OHMS)	R2 (OHMS)	V+ RANGE (VDC)
6	400	1000	1500	5-25
15	180	3900	1000	13-50
100	180	43000	1000	85-200

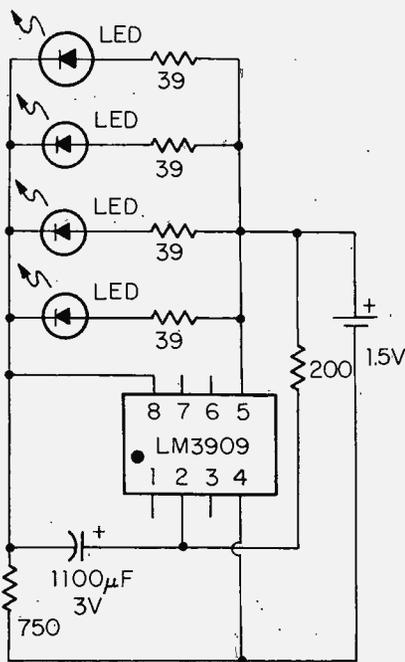


Fig. 5. Four parallel LEDs driven by one IC. Nominal flash rate is 1.3 flashes per second average, with a dry cell drain of only 2 mA.

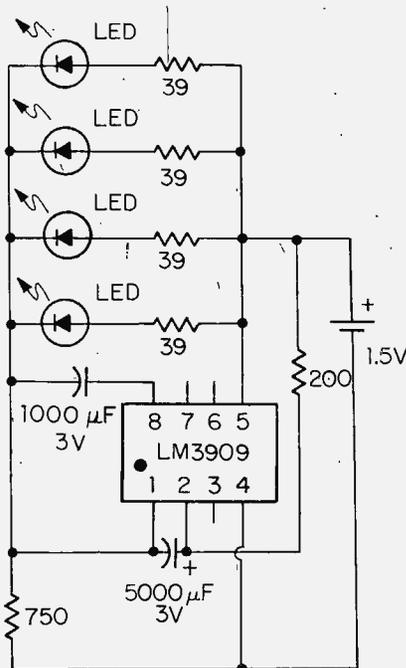


Fig. 6. This circuit is almost identical to Fig. 5. Slight circuit change produces 1.5 flashes per second with a lower dry cell current drain of 1.5 milliamperes.

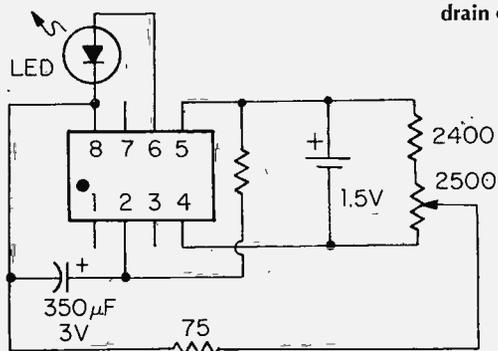


Fig. 7. This variable flasher adjusts the flashing rate from zero to 20 flashes per second. Dry cell drain increases with flashing rate.

0.65 milliamperes at 1.5 volts when new and eventually drop to 0.3 milliamperes at 1.15 volts which is about when the circuit will fail to operate. Since a long in-circuit life of the battery is expected of this and other circuits presented in this article, clad or "leakproof" batteries are recommended for any application where the circuit is left unattended for several months or more. Nickel cadmium cells are not recommended.

Other Ideas. The LED flasher just detailed in this article is only one of several gadgets you can make using the LM3909 integrated circuit. For example, 3 volts DC is commonly found in flashlights, so it follows that a 3-volt flasher circuit (Fig. 2) can be packed in a flashlight container. The blinking LED indicates where the flashlight is and that the batteries are putting out at least 2.2 volts (minimum flash level). The flash rate of this circuit is 1.1 flashes per second.

A faster blink rate is possible from a 1.5 VDC source, about 2.5 flashes per second, with the addition of a resistor and some slight circuit modification (Fig. 3).

You can use the basic LED flasher circuit idea to hook up a high-voltage indicator as shown in Fig. 4. The circuit is connected across the line to ground and blinks when the voltage is present. The table given with Fig. 4 indicates three DC line voltages that can be monitored: 6, 12, and 100 VDC. The voltage range column in the table lists the minimum voltage for firing the circuit and the maximum safe voltage

permissible. Install the parts values indicated and the circuit will flash the LED approximately twice each second.

The LM3909 IC can flash more than one LED. Fig. 5 shows four LEDs in parallel driven by one IC and 1.5 VDC. To increase shelf life of this flasher use a "D" size dry cell. The blink rate of this circuit is approximately 1.3 flashes per second with an average battery drain of 2 milliamperes. If battery life is important, then use the alternate circuit shown in Fig. 6. The battery current drain is reduced 25 percent from 2 to 1.5 milliamperes. No matter how you cut it, the current drain of either circuit is very low.

Maybe what you want is a variable flasher. Here, in Fig. 7, the flash frequency per second of the LED is variable from zero to 20. Increasing the number of flashes per second increases battery drain because the LED is the major user of the circuit's power. An increase of 1 to 20 flashes per second increases the battery drain 20 times.

The LM3909 can be used for more than flashing a LED. A typical application is for generating 1-kHz square waves. The diagram in Fig. 8 is simple to hook up. The 18,000-ohm potentiometer is not a frequency control; it adjusts the symmetry of each half of the square wave. The 1-kHz output passed through a suitable blocking capacitor may be used to troubleshoot troublesome audio and RF circuitry.

The circuit in Fig. 9 shows a simple "buzz box" continuity and coil checker. The loudspeaker can be one of those salvaged from an old transistor radio. Low impedance loudspeakers are not efficient in this circuit.

The last circuit offered is an incandescent bulb flasher. The LM3909 in Fig. 10 flashes a #47 lamp at the rate of 1.5 flashes per second. Placing the #47 lamp in a suitable flashlight reflector will beam the bulk of the flash energy down a road to alert pedestrians and oncoming cars of a potential hazard.

All the capacitors shown in the schematic diagrams are electrolytic types. The flash rates and frequencies assume that the capacitors are within $\pm 5\%$ tolerance. However, most electrolytic capacitors are rated -20% , $+100\%$ of their stated values and flash rates will vary somewhat. If the circuit you wired up does not flash the LED, suspect the LED. LEDs that cause such problems exhibit a large increase in conduction between 0.9 and 1.2 VDC. This LED is not defective because it will work in other circuits, but not with the LM3909. The LED used by the author is a National NSL5027.

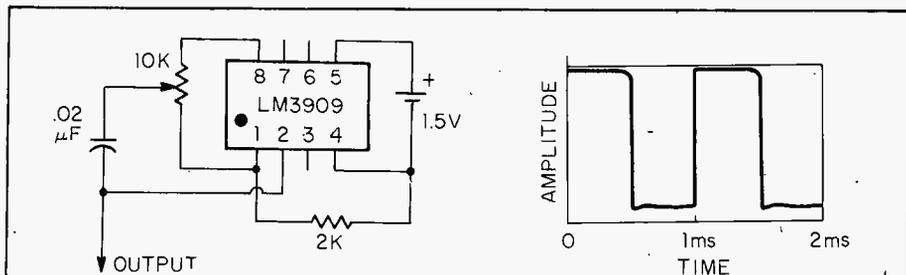


Fig. 8. The LM3909 can be used in a 1-kHz oscillator circuit. The 10K potentiometer is for adjusting symmetry in the output signal.

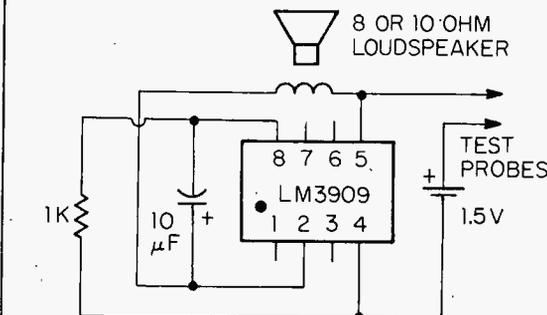


Fig. 9. The LM3909 can be used to generate a buzzing signal when the dry cell circuit is closed. The difference between shorts, coil windings, and a few ohms of resistance can be heard. You could train your ears to measure low resistance by sound output.

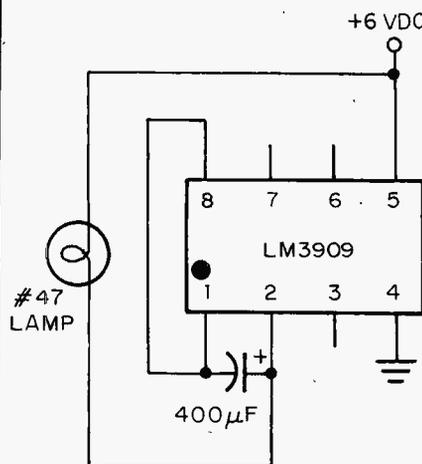


Fig. 10. The flash rate is about $1\frac{1}{2}$ Hz. Plenty of light will be concentrated in a beam if you build this one in an old flashlight case with a shiny reflector.

PARTIAL PARTS LISTING FOR NEW FLASH

Note—See individual schematics for parts values. This is an experimenter's project. If you don't have the ideal values listed in these working circuits, experiment! Innovate, substitute, have fun!

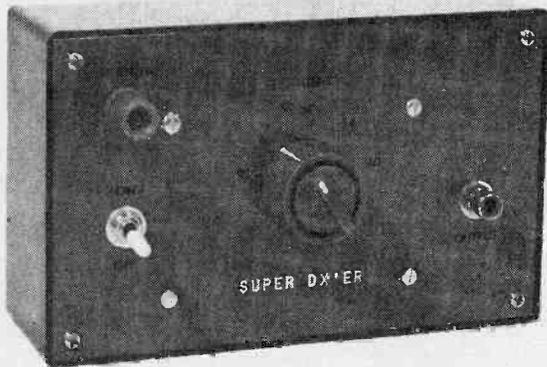
- 1/2-watt resistors
- 8-ohm speaker
- 10,000-ohm potentiometer
- 0.02- μ F capacitor
- 10- μ F electrolytic capacitor
- #47 lamp

WHERE TO BUY THE LM 3909

The IC National Semiconductor LM 3909 is available from O.E. Morsco, 2403 Charleston Road, Mountain View, CA 94043. The price is \$2.00 each (including postage and handling).



The author assembled the LED flasher diagrammed in Fig. 1. Circuitry is so simple there is no need for you to fashion a printed circuit board. Point-to-point wiring on a perf board with flea clips is good enough for this simple circuit.



SUPER DX_{ER}

Our outboard rig makes QSL waves—adds 20dB minimum gain to any shortwave receiver

CAN YOU REMEMBER the early days of TV—back to the mid- and late-1940s—when the Joneses, who had the only TV in the neighborhood, would strain to clean up a snowy, flickering picture by adjusting a “booster” that sat on the top of their 12-in. phosphor cyclops?

Well, more often than not those outboard boxes, with their 6J6s in push-pull tunable circuits, didn't amount to the proverbial hill-of-beans. Those World War II vintage tubes were not at all well suited to the new-fangled wide-band requirements of TV. But later on as the technology advanced, and more powerful transmitters were built, good, solid pictures became the rule.

Unlike the old TV boosters, today a good booster for short wave receivers—a preselector—can be designed with all the advantages of the latest solid-state devices; and, to boot, it can be simple and very easy to build. It's the easiest way to turn any receiver into an even hotter signal sniffer. You use a booster (a very high gain RF amplifier) between the antenna and the receiver antenna terminals. A good one will also provide sharp image rejection by adding a relatively high-Q circuit to the re-

ceiver input. Image signals (which often take the pleasure out of receivers with low frequency single-conversion IF amplifiers by jamming desired signals) vanish as if by magic when passed through a high-Q booster or preselector. In short, a top quality super booster such as the SUPER DXER, will add another dimension of performance to any shortwave receiver.

What It Can Do. The SUPER DXER provides from 20 to 40 dB of signal boost—the exact amount is determined by the particular input characteristics of your receiver. Figuring on 6 dB per S-unit, that's an increase of better than 3 to 6 S-units. In plain terms, the SUPER DXER will bring in stations where all your receiver will pick up running bare-foot is its own noise.

The SUPER DXER's input is a diode protected FET (field effect transistor); the protection diodes are built into the FET so that excessively strong input signals, and even static discharges, will not destroy Q1. Since the FET's input impedance is many thousands of megohms, there is virtually no loading of the L1/C1 tuning circuit; its “Q” remains high and provides a very high degree of image-signal attenuation.

The SUPER DXER output circuit is a

low impedance emitter follower, and it will match, with a reasonable degree of performance, just about any receiver input impedance. As long as your receiver has two antenna terminals, one “hot” and one ground, you can use the SUPER DXER.

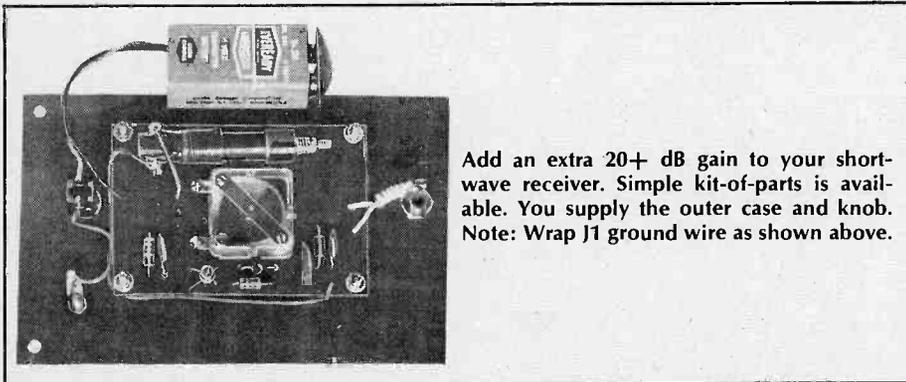
Optimum performance will be obtained if your receiver is equipped with an antenna trimmer. Just as the antenna trimmer peaks the receiver for use with any type of antenna, it also adds something extra when matching the SUPER DXER.

Set Bandpass. The SUPER DXER has a tuning range of slightly more than 3-to-1 between 5 and 21 MHz. That means if the low end is set to 5 MHz, the upper limit will be slightly higher than 15 MHz (3 times 5). If the lower limit is set at 7 MHz, the upper frequency limit will be slightly higher than 21 MHz. Since the slug in tuning coil L1 is adjustable, you can select any operating range between 5 and 21 MHz.

SUPER DXER, though a very high gain device, is absolutely stable if built exactly as shown and described. There will be no spurious oscillations or response. It is possible that changes in the component layout or construction will result in self-oscillation at certain frequencies; hence, make no modifications or substitutions unless you are qualified.

Getting Started. Your first step is to prepare the printed circuit board. Using steel wool and a strong household cleanser such as Ajax or Comet, thoroughly scrub the copper surface of a 2¼-in. x 3¼-in. copper-clad board. Any type will do—epoxy or fiberglass; the type of board is unimportant. Rinse the board under running water and dry thoroughly.

Cover the copper with a piece of carbon paper—carbon side against the



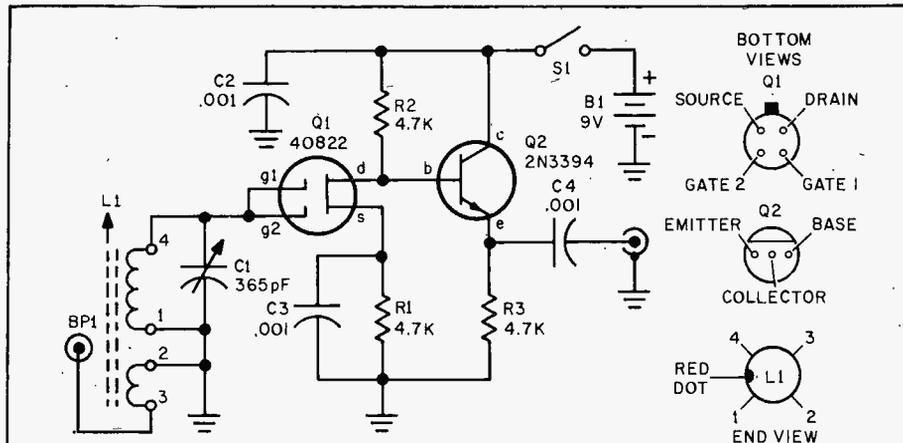
Add an extra 20+ dB gain to your shortwave receiver. Simple kit-of-parts is available. You supply the outer case and knob. Note: Wrap J1 ground wire as shown above.

copper—and place under the full-scale template we have provided. Secure the PC board in position with masking tape. Using a sharp pointed tool such as an ice pick, indent the copper foil at each component mounting hole by pressing the point of the tool through the template and carbon paper. Next, using a ball point pen and firm pressure, trace the foil outlines on the template.

After all foil outlines have been traced, remove the PC board from under the template and, using a resist pen, fill in all the desired copper foil areas with resist. Make certain you place a dot of resist over the indents at each of the corner mounting holes. Pour about one inch of etchant into a small container and float the PC board—copper foil down—on top of the etchant. Every five minutes or so gently rock the container to agitate the etchant. After 15 or twenty minutes check the PC board to see if all the undesired copper has been removed. When every trace of the undesired copper is gone, rinse the board under running water, and then remove the resist with steel wool or a resist “stripper.”

Continue. Drill out all the mounting holes marked by an indent with a #57, 58, or 59 bit—this includes the corner mounting and C1 mounting holes. Then drill the corner mounting holes for a #6 screw, and use a 5/16-in. bit for the C1 mounting hole.

Install tuning capacitor C1 first. Tuning capacitor C1 should be the type provided in the kit of parts. It has a plastic dust cover and a long shaft. Do not use the type supplied with a short



PARTS LIST FOR SUPER DXER

- B1—9-volt battery (Eveready 216 or equal) and connector
- BP1—insulated binding post
- C1—365-pF subminiature tuning capacitor
- C2, C3, C4—0.001-uF, 25-VDC or better ceramic disc
- J1—RCA-type phono jack
- L1—5 to 20-MHz antenna coil, Custom Components SW-520
- Q1—MOSFET, RCA 40822
- Q2—npn transistor, 2N3394
- R1, R2, R3—4700-ohm, 1/2-watt resistor
- S1—spst switch (power on-off)

A kit of all the above components including the printed circuit board is available from the Electronic Hobby Shop, Box 192, Brooklyn, N.Y. 11235. Price of \$24.50 includes postage. New York State residents must add sales tax. No foreign orders. Allow 6-8 weeks for delivery. Postal Money Order speeds delivery.

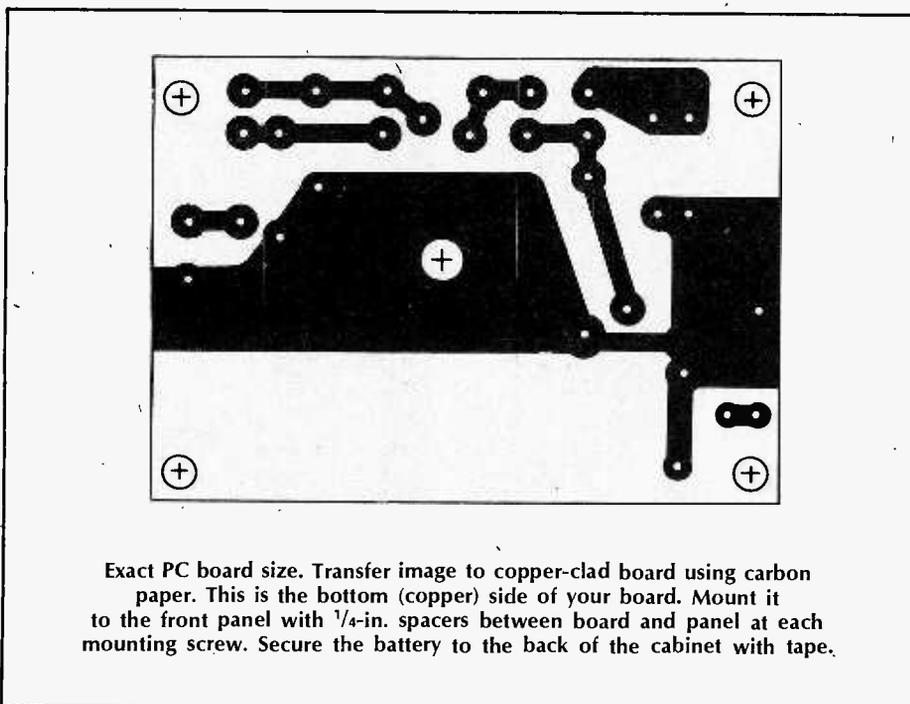
shaft to which a tuning dial for the broadcast band can be attached. Remove the mounting nut and ground washer from C1's shaft. Then make certain the shaft's retaining nut is tight. It is usually supplied loose. Discard the ground washer and secure C1 to the PC board with the mounting nut. Then install tuning coil L1. Make note of two things about L1: the terminal end of L1 has a large red dot (ignore any other marks); L1 must be positioned so the

red dot faces the bottom edge of the PC board—the edge closest to the coil. Also note that the lug connected to the top of the fine-wire primary is adjacent to the bottom of the heavy-wire secondary. When the red dot is facing the edge of the PC board, both these lugs are against the board. Solder the lugs to the matching holes in the PC board. Use the shortest possible length of wire to connect the remaining primary (fine-wire) terminal to the antenna input printed foil. Connect the remaining L1 terminal (heavy wire) to its matching hole with solid, insulated wire—form a right angle bend in the wire so it doesn't touch L1. Now mount the remaining components.

Orienting Q. Note that Q1 is positioned properly when the small tab on the case faces the nearest edge of the PC board. Also note that the round edge of Q2 faces the nearest edge of the PC board. The flat edge of Q2's case should face C1.

Because the printed copper foil faces the front panel when the assembly is mounted in the case, and is therefore inaccessible for soldering, the connecting wires to front panel components should be installed at this time. Solder 6-in. solid, insulated wires to the antenna, output, and output ground, and +9V foils. Solder the negative (usually black) wire from the battery connector to the ground foil.

The SUPER DXER is mounted in a standard plastic or Bakelite case approximately 6 3/8-in. x 3 3/16-in. x 1 7/8-



Exact PC board size. Transfer image to copper-clad board using carbon paper. This is the bottom (copper) side of your board. Mount it to the front panel with 1/4-in. spacers between board and panel at each mounting screw. Secure the battery to the back of the cabinet with tape.

SUPER DXER

in. The front panel must be aluminum. If the cabinet is not supplied with an aluminum panel, obtain an optional or accessory metal panel. Do not use a plastic panel.

Drill a 3/8-in. hole in the center of the front panel. Position the PC assembly over the hole with C1's shaft fully inserted through the hole, and mark the locations for the four PC board mounting screws. Drill the panel and temporarily secure the PC board to the panel. Then locate the positions for power switch S1, antenna input binding post BP1, and output jack J1. Make certain J1 is as close to the PC board output terminals as is possible—within 1 1/2 inches.

Remove the PC board and drill the holes for the panel components. Power switch S1 can be any inexpensive spst type such as a slide switch. Install the panel components and then the PC board. To prevent the copper foil on the underside of the PC board from shorting to the panel, place a 3/8-in. plastic or metal spacer, or a stack of washers, between the PC board and the panel at each mounting screw. Connect the panel components to the appropriate wires extending from the PC board and the SUPER DXER is ready for alignment.

Alignment. Prepare a length of 50 or 52-ohm coaxial cable (such as RG-58) that will reach from the SUPER DXER's output jack to the receiver antenna input terminals. Solder a standard phono plug to one end. Take care that you do not use ordinary shielded cable such as used to interconnect hi-fi equipment; coaxial cable is a must.

Connect the coax between the SUPER DXER and your receiver. Rotate the C1 shaft fully counterclockwise and install a pointer knob so that the pointer extends to the left (9 o'clock position). Connect your antenna to binding post BP1. Then, set L1's slug so that the *bottom* of the screwdriver slot is level with the very *top* of L1. This will provide a frequency range of approximately 5 to 15 MHz. If you back out the slug 1/4 inch, the frequency coverage will be from approximately 7 to 21 MHz. You can use any in-between slug adjustment.

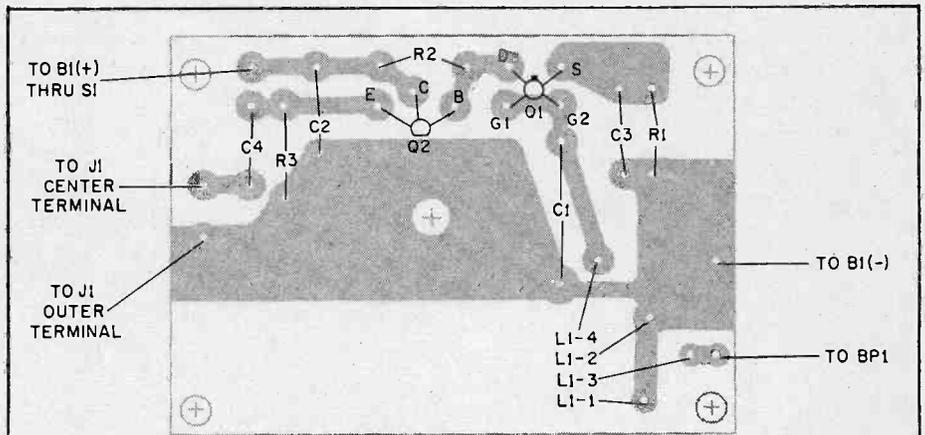
Turn on the receiver and booster, and set the receiver tuning to 5 MHz, or whatever frequency you selected for the

"bottom end." Adjust C1 for maximum received signal or noise and mark the panel accordingly. Repeat the procedure at approximately 7, 10, 14, and 15 (or 20) HMz. The panel markings are important because the SUPER DXER's tuning is so sharp it must be preset to near the desired frequency or you'll receive nothing—neither signal nor noise. The panel markings complete the adjustments.

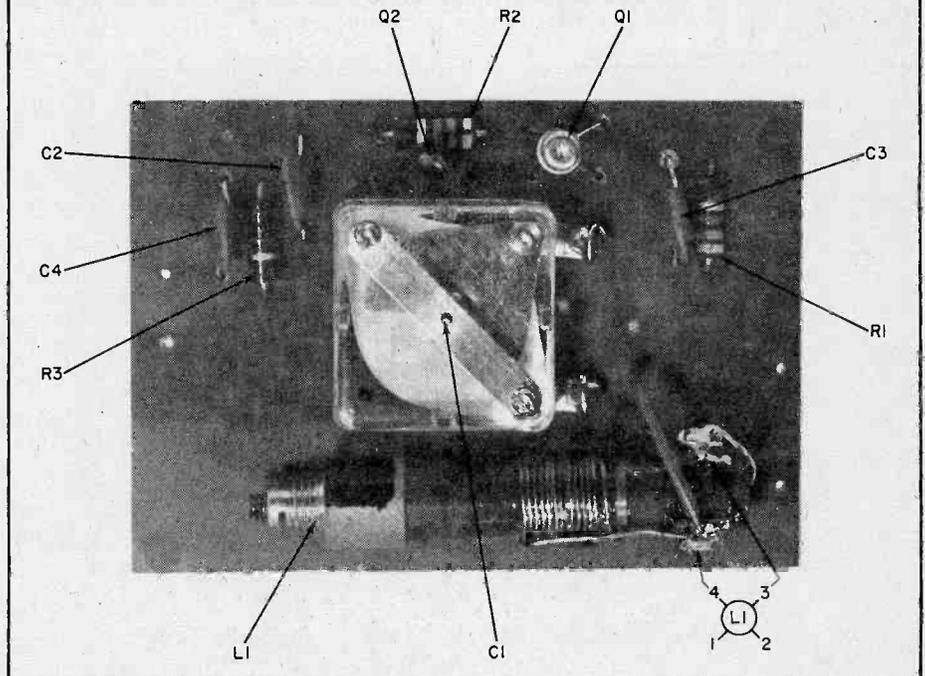
Pull 'em In. To prevent self-oscillation, you must keep the antenna wire as far as possible from the coaxial output cable. To receive a signal, set C1 to the approximate desired frequency and then tune in the signal on the receiver. Finally, peak C1's adjustment for maximum signal strength as indicated on your receiver's S-meter, or listen carefully for an increase in speaker volume. Keep in

mind that, if the signal is sufficiently strong to begin with, the receiver AVC will "absorb" the SUPER DXER's boost, and the speaker volume will probably remain the same, though the S-meter reading will increase. SUPER DXER's boost will be most apparent on very weak signals, digging out those signals below the receiver's usual threshold sensitivity, making them perfectly readable.

Don't worry about strong signals overloading your SUPER DXER; it is virtually immune to overload even from excessively strong signals. However, the booster's output can be so high as to overload the input of some budget receivers. If this occurs simply reduce the booster's output by detuning C1 just enough to drop the overall signal strength below the receiver's overload value. Happy DXing! ■

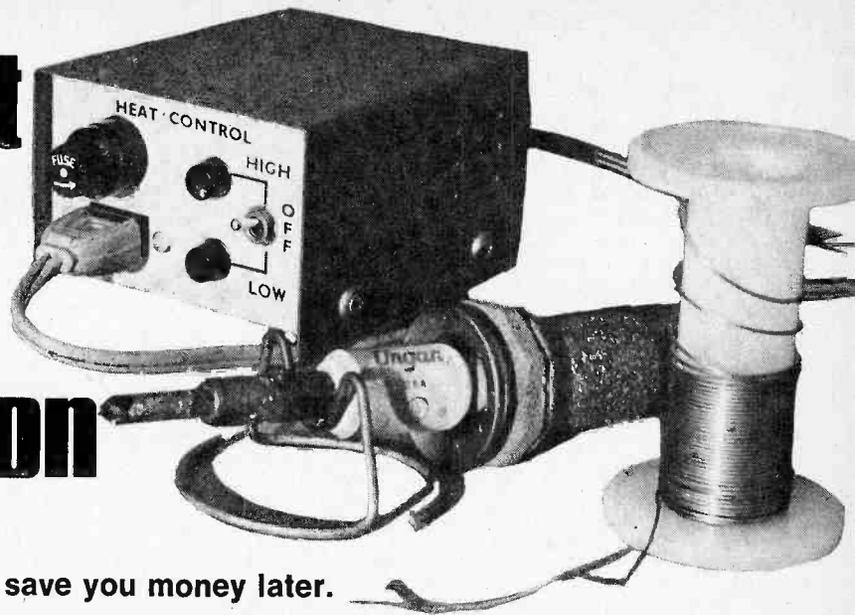


For exact part placement on PC board, see diagram above. View is from component (top) side of your Super DXer board. Layout below shows a completed Super DXer. Pins 3 and 4 of the dual winding coil L1 are shown in an end view for clarity.



Build a Heat Controller for Your Soldering Iron

By John Keidel and Frank Cicchiello



Inexpensive and easy to build, it will save you money later.

One trick that old timers have used for years is to connect a diode in series with a medium-to-heavy duty soldering iron. This halves the value of the iron's wattage rating, making it especially use-

ful for soldering transistors, integrated circuits and low-wattage resistors.

But this arrangement limits the versatility of the iron, since there are times when one may wish to solder to a metal

chassis or make other heavy-duty type connections. The soldering iron Heat Controller described here provides low/high-wattage versatility in a compact case, with a convenience outlet.

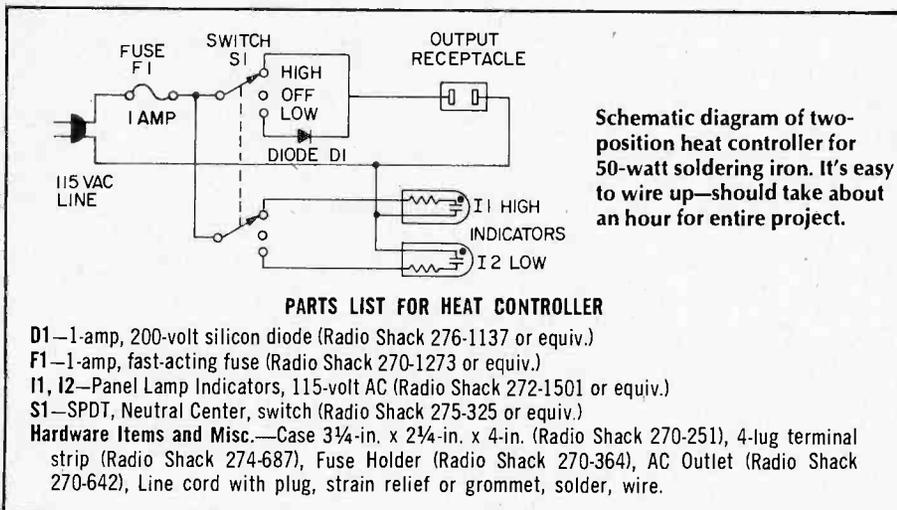
How It Works. Diode D1 shown in Fig. 1 provides half wave rectification of the AC line voltage when switch S1 is in the *Low* position. Throwing switch S1 to the *High* position allows full line voltage to be applied to the soldering iron receptacle. The center *OFF* position removes power from the outlet. Fuse F1 prevents any harmful effect if the iron's element should become short-circuited. Indicator lamps I1 and I2 add a professional touch to the equipment, and also act as On-Off pilot lights.

Construction. All components except diode D1 are mounted on the case. Diode D1 is soldered to a terminal strip, which also provides terminal points for the various interconnecting wires. Wiring is point-to-point and not critical. The photo illustrates the location of the components. Transfer letters are used for the individual panel markings.

This is a very easy project, and the hour or so it takes to assemble it (once you've got the parts together) will be quickly repaid by the added convenience of having two different iron heats to work with.

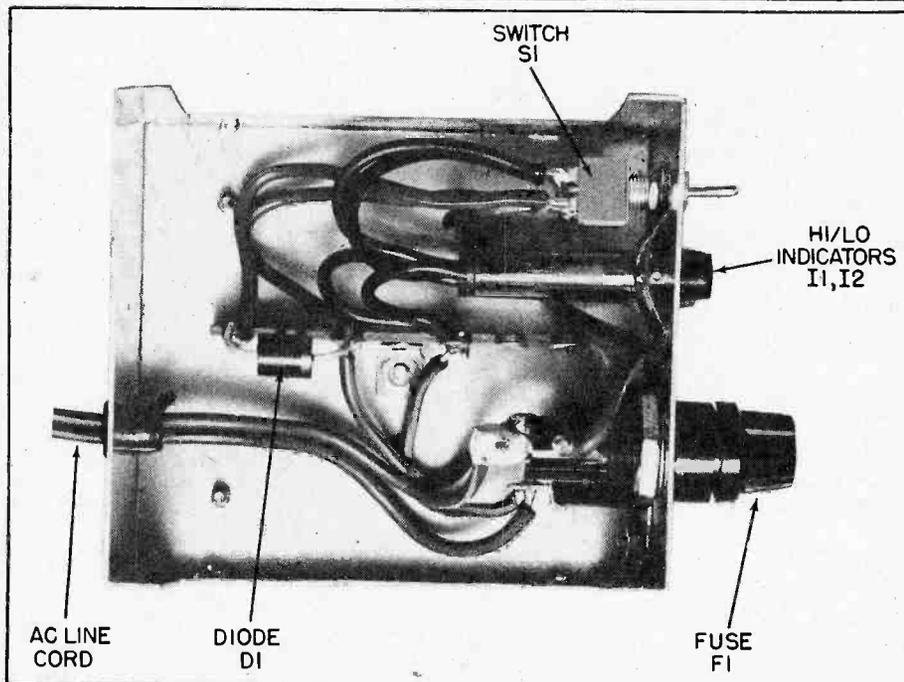
Using the Heat Controller with a 50-watt soldering iron which takes various tips will handle about 95 percent of all your soldering iron work. It's only the very occasional super-heavy job that will require anything else, and that would require a much bigger iron anyhow. ■

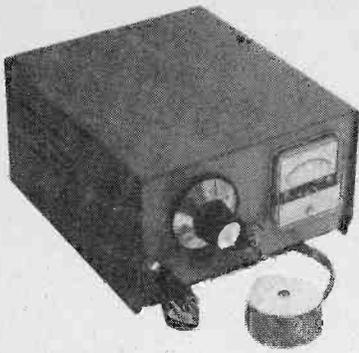
Mechanical layout of heat controller. Putting this project together is not only good practice for beginners—it gives you a versatile tool which will make future projects easier.



PARTS LIST FOR HEAT CONTROLLER

- D1—1-amp, 200-volt silicon diode (Radio Shack 276-1137 or equiv.)
- F1—1-amp, fast-acting fuse (Radio Shack 270-1273 or equiv.)
- I1, I2—Panel Lamp Indicators, 115-volt AC (Radio Shack 272-1501 or equiv.)
- S1—SPDT, Neutral Center, switch (Radio Shack 275-325 or equiv.)
- Hardware Items and Misc.**—Case 3¼-in. x 2¼-in. x 4-in. (Radio Shack 270-251), 4-lug terminal strip (Radio Shack 274-687), Fuse Holder (Radio Shack 270-364), AC Outlet (Radio Shack 270-642), Line cord with plug, strain relief or grommet, solder, wire.





DARKROOM PRINTING METER.

Print-paper saver gives you fine B&W prints sooner!

by Herb Friedman

TRY TO grind out wallet-size prints or enlargements from a full 36-exposure roll in only one evening and you'll know just how frustrating life can be. Every change in magnification and negative density means a different exposure. And if you use test strips or exposure guides to hit the correct exposure you're making at least two prints for every one you need.

The way to take all this drudgery out of your darkroom work is to use an electronic printing meter, a device that takes only seconds to indicate the correct exposure, regardless of whether the enlarger is at the top or bottom of the rack, or whether the exposure and negative development is over or under.

A quick example will illustrate how easy it is to make prints with a printing meter. Let's assume you have just chocked the negative in the enlarger and have cropped the picture exactly the way you want it. Now you take the probe from a printing meter—which you have previously calibrated for a 10 or 20-second exposure—place it on the easel at the point of maximum light transmission through the negative (the black reference in the print—deepest shadow) and adjust the lens diaphragm until the printing meter's pointer indicates some reference value you have previously selected.

That's the whole bit. Expose the paper for your normal 10 or 20-second exposure and the first print will be a good print. Maybe even a great print. If you're grinding out wallet-size jobs for the whole family, each print from each frame will have the same excellent quality.

A Hint. The key to successful use of a printing meter lies in the fact that, except for some particularly artistic work, any print will look decent to excellent if there is some deep black, even if it's just a spot of black; for the black to highlight or border-white contrast gives the visual appearance of a full contrast range, even if the greys are merged. For those who do portraiture, a printing meter can be user-calibrated for "flesh tones."

The printing meter shown in the photographs has been especially designed for construction and use by the typical e/e photographer/electronics

hobbyist. It features a calibration—called "speed"—adjustment to accommodate slow to fast enlarging papers (such as Polycontrast and Kodabromide) and readily available parts, many of which will be found in the typical experimenter's junk box. The layout is non-critical—any cabinet can be substituted; there are no critical shielded circuits (not even shielded wire is used); and except for the photoresistor sensor, just about any component quality will do. There is absolutely no sense in building the project with the best components money can buy because the best components won't affect the final performance one iota.

Construction. The unit shown is assembled in a 5¼ x 3 x 5½-in. metal utility cabinet. Connecting jack J1 is optional as the photoresistor sensor, PR1, can be hard-wired into the circuit. If you use a jack, note that it must be the three-terminal type such as is used for stereo connections; the ground connection is not used since neither PR1 lead is grounded. Do not use an ordinary phone or phono jack as they will ground one of the PR1 leads. Plug P1 must similarly be a matching three-terminal stereo type. Either miniature or full-size jacks and plugs can be used.

Power switch S1 can be anything you care to use—lever, slide, or toggle. Use the least expensive slide switch if you're trying to keep the cost down.

The meter, M1, is a Lafayette Radio 99-26262 illuminated 0-1 mA S-meter. This meter was selected because it has built in pilot lamps with 6 and 12-volt connections. When 12-volt-connected to T1, which is 6 volts, the pilot lamps are dim enough not to affect the sensor and bright enough so that you can see the pointer in the darkroom. Meter M1 mounts in a 1½-in. hole, which can be cut with a standard chassis punch (if you have the punch).

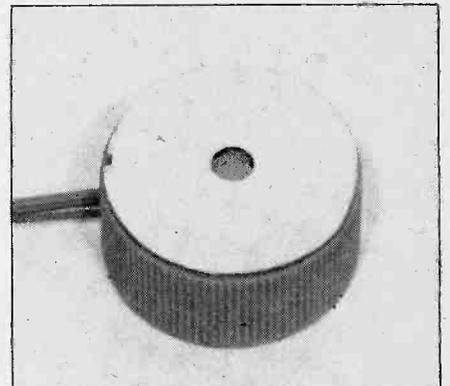
Sort Them. The meter scales are jammed with numerals that can be confusing in the darkroom so the best bet is to paint out the unwanted "calibrations" using Liquid Paper or Liquid KO-REC-TYPE, products used to correct typewriter errors (available in stationery stores). First, snap the plastic cover off the meter. It might feel secure but it's not. Grasp the top of the cover and

force the cover outward and down, taking care that when it snaps free the pointer isn't damaged. Next, remove the scale by taking out the two small screws and sliding the scale out from under the pointer. Do not attempt to paint the scale while it is mounted in the meter as a single drop of the fast-setting correction fluid can ruin the meter if it gets into the pivot bearing. When re-installing the scale, hold the screws with a tweezer or long-nose pliers until you "catch" the first few threads. When the scale is secure, snap the meter's cover into position. (On the unit shown all scales and markings other than 0-to-1 have been painted out, as the 0-to-1 scale is the most convenient to see under dim lighting.)

Note that meter M1, power switch S1, and jack J1 have been positioned on the front panel so as to provide the maximum room for the speed control's calibrated knob. Use the largest possible knob as the greater the calibrations the easier it is to reset the control to a desired paper speed.

Power transformer T1 can be any 6.3-volt filament transformer rated 50 mA or higher. (A 6-volt transformer scrounged from a portable cassette recorder will work just fine.)

Power Filter. If the line voltage in your home is known to be reasonably constant, assemble the unit as shown in the schematic. If your local utility likes to bounce the line voltage, or if appliances cause your line voltage to vary (indicated by dimming lights), install zener diode D5 across points A and B.



The sensor is really a large tuning knob with photoresistor PR1 embedded in epoxy, plastic or RTV rubber adhesive.

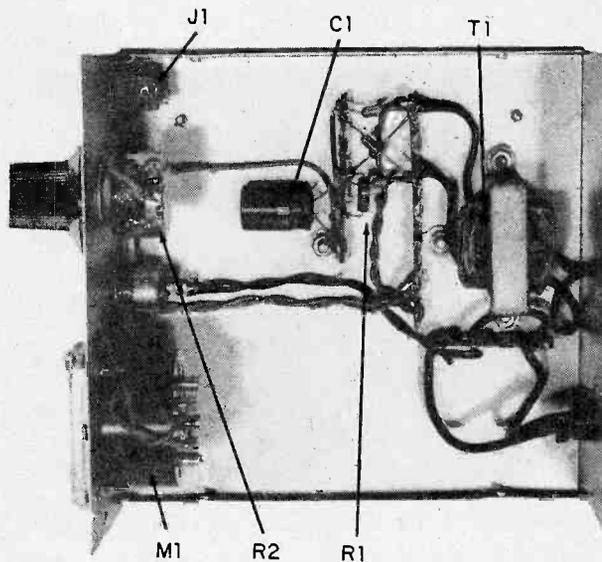
The zener will provide a regulated 6 volts, with the slightly lower circuit voltage (6 VDC rather than 9 VDC) providing slightly reduced sensitivity. Normally, you will not need D5, so there's no need to get it unless you're certain you need it.

In order to get speed control R2 to increase sensitivity in the expected clockwise direction, its ground terminal is opposite to the usual volume control ground. Facing R1's shaft with its terminals sticking up, the ground terminal is the one on the left.

Meter M1 has five terminals. The one designated "+" and the one adjacent to it are the meter terminals. The three terminals above the meter terminals are the pilot lamps. The extreme end pilot lamp terminals are the 12-volt connections. The center terminal is not used for the 12-volt connection.

The Eye. The only assembly that requires some care is the sensor. The sensor itself is a photoresistor; however, the photoresistor doesn't have enough heft to maintain its position on the easel, so it must be mounted in a support that can maintain its position without falling over. The sensor assembly shown consists of PR1 epoxy-cemented into a relatively large knob. The knob must be plastic—not metal, though it can have a metal decorative rim—and it's best if there is a recess on the top even if the recess is produced by a rim. Remove the set screw and drill out the set screw hole with a bit approximately 3/16-in. (not critical). Then, using a 3/8-in. bit, drill through the shaft hole clear through the top of the knob. If the shaft hole has a brass (or other metal) bushing make certain the drill bit removes all the metal.

Pass the PR1 leads through the hole in the knob from the top. Tape it in



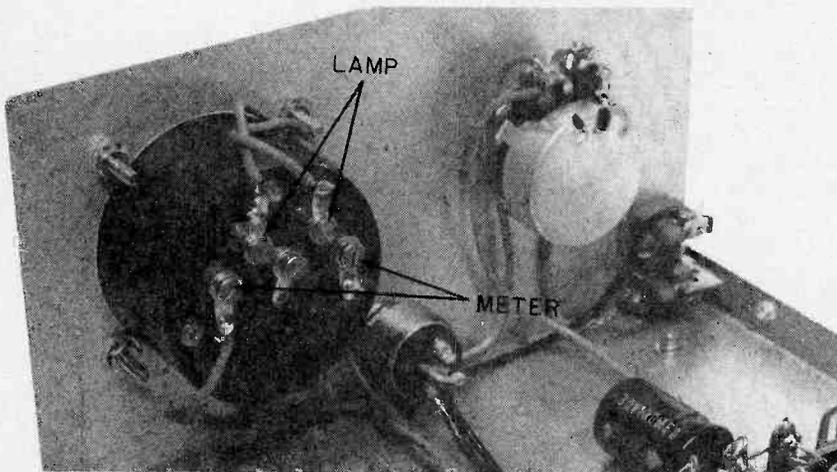
Nothing is critical so don't crowd the layout. Two parallel terminal strips provide the tie points for the rectifier diodes and power supply

position. Feed a section of linecord or speaker wire through the setscrew hole and solder the wires to PR1 as close as possible to the knob. Trim away the excess PR1 leads; they should not protrude below the knob. Remove the tape holding PR1, get PR1 as close to the center of the knob as possible, and then pour in a quantity of fast-setting epoxy or liquid plastic from a knob repair kit or plastic modeling kit, and let it set a few minutes until the plastic hardens. Keep the level of the epoxy or plastic below the top of PR1—use less rather than more. If you can't get epoxy or plastic you can use G.E.'s silicon RTV rubber (adhesive, caulk, window sealer, etc.); but the RTV rubber must cure for at least 24 hours. Similarly, pack the bottom of the knob with epoxy, plastic or rubber.

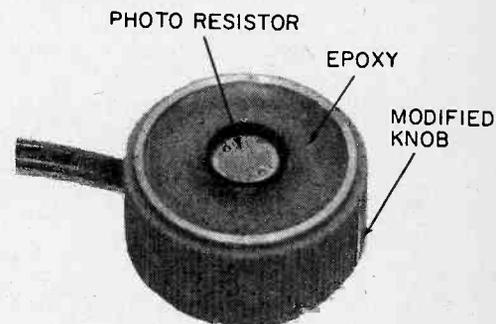
Mask Down. Now, the surface area of the photoresistor is too large for small prints—4 x 5 or smaller—and even

some 8 x 10s. So cut a disc the diameter of the knob from shirt cardboard or a manila file folder (but not oak-tag) and using a standard hand punch (such as used in schools) punch a hole in the center of the disc. Apply rubber cement to the rim of the knob and the inside rim of the disc. When the cement is dry drop the disc on the knob so the hole exposes a small part of the photoresistor's surface. It's not all that critical; the hole doesn't have to be precisely over the center of the photoresistor. However, the unit is calibrated for a punch-size hole and might not work properly if the disc is not used, or if the hole is a hand made "pinhole." Use the punch.

Using the Meter. The first step is to select a decent reference negative and make a good print using a 10, 15, or 20-second exposure. We suggest 20 seconds as it will become your standard exposure, and will be



The specified meter has five terminals. The two on the bottom row are for the meter movement. The top row terminals are for the 12-volt lamp connection. The remaining terminal is for a 6-volt lamp connection and is not used.



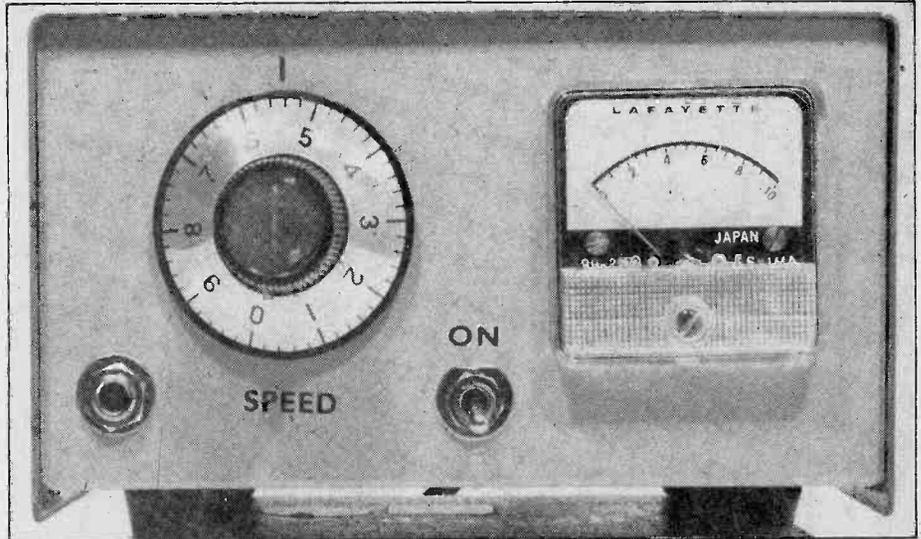
After the sensor is completed, punch a hole in a matching cardboard disc and cement the disc over the sensor. The hole provides a smaller sensitive area required for prints 4 x 5 or smaller. Better results with larger prints are also obtained with the mask.

DARKROOM PRINTING

sufficiently long to allow moderate dodging. When you are certain you have a print exactly the way you want it, and without disturbing the enlarger's controls, place the printing meter's sensor under the *brightest* light falling on the easel—it produces black (maximum shadow) on the final print. Now turn on the printing meter and allow about five seconds for warm up. Adjust speed control R2 so the meter pointer indicates any meter reading you want to use as a reference. It doesn't matter what the reading is as long as you always use the same reference for the standard exposure time. For example, 0.2 on the meter scale is a good choice because it is well illuminated by the meter lamps. But you might just as easily select mid-scale as the reference meter reading. It doesn't make any difference; just be consistent.

Once you have adjusted the speed control for the reference meter reading note on a piece of paper or in a notebook the dial reading from the speed control's calibrated knob. This is the reference speed value for the particular printing paper. For example, let's say you made the test print on Polycontrast using the #2 filter, and the speed knob indicates 5.6. Next time you want to print using Polycontrast with a #2 filter you simply set the speed knob to 5.6, put the sensor under the darkest shadow area and adjust the lens diaphragm for a reference meter reading. Everything will be set for your standard exposure time.

Changing Filters. Kodak provides a speed rating for all their papers and you can easily work out the correct (or close) speed control settings without making a "perfect" test print for each



Use the largest calibrated knob you can install without interference by other-panel components. The greater the calibration area on the knob the easier it is to preset the paper speed with accuracy.

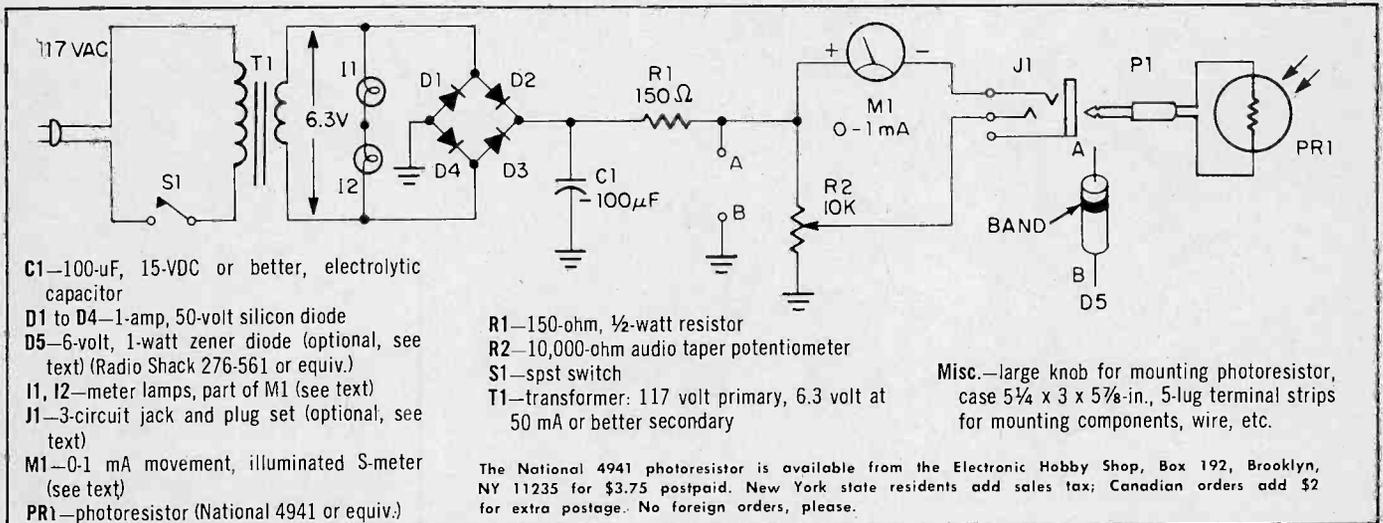
type and grade of paper. For example, changing from a #2 to #4 filter usually means increasing the exposure by a 3.5X factor. If your #2 exposure is 10 seconds, the #4 exposure will be 35 seconds—somewhat long. You can, however, open up the lens diaphragm for a 3.5X light increase (close enough value) and adjust the speed control for the reference meter reading. The new speed control setting is the speed value for the #4 filter. You can do this with variable contrast filters or numbered printing paper.

While the most pleasing print usually has some black, there are times when there can be no black, such as snow scenes, portraits, etc. You can peg the speed control's calibration to a grey corresponding to a skin tone, or any other degree of grey you might desire. The only thing you cannot do is calibrate the meter for highlights, since

the meter might not have enough sensitivity for slow papers, and highlights can completely fool the meter.

If desired, you can take a speed control calibration reading for each type of paper (using your standard negative) for both shadow detail and intermediate grey. This way, you can quickly set up for typical snapshots, scenics, or portraits.

Keep In Mind. The sensor has a slight light memory, so we suggest the sensor be turned face down when not being used and the power switch be turned on and off in the dark, though you can keep the darkroom illuminated by a safelight with the power switch on. Meter readings, however, must be taken with all room lights off; only the enlarger should be on and the print meter should be positioned so that its meter lamps do not illuminate the sensor (even slightly).



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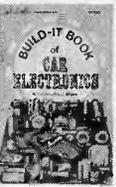
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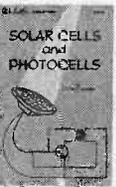
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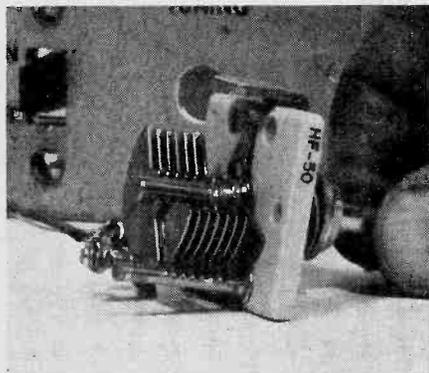
(Continued from page 15)



Considering the out-of-sight price of meters, never discard a meter. In fact, the meter shown in the photo was used in four projects and is currently being worked into a new project. Meters are hard to come by, so look to junk electronic items where meters are a part of the unit.

ously mentioned 5 for \$1 pots, 3 for \$1 switches, IC sockets and other components. Look through the projects and make a list of those you think you might build in the coming months and then consolidate their parts lists. You'll often find the same part or component used several times, allowing you to take advantage of specially-priced bulk sales. You can often save upwards of \$25 to \$50 on a handful of projects by buying in "bulk quantities."

Getting The Right Voltage. For some unaccountable reason the major parts-line distributors such as Radio Shack, Lafayette, and Calectro are under the delusion all hobbyists are interested in *filament* transformers and use only 6.3, 12.6, and 24 volts AC. If you wanted three voltages that are specifically not needed by hobbyists those are the three. Also, the current ratings on these filament transformers are often



When salvaging old projects keep your eyes open for parts you can't get anymore, even if you can't think of a need for them now. A few years ago this capacitor was standard stock in just about any "radio parts store." If you needed one today you'd find it easier to locate the Holy Grail or a golden-egg-laying goose. And you'd pay what a golden egg is worth. This type of salvage is literally worth its weight in gold. Save it all.

WHERE TO BUY COMPONENTS

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J. W. Miller Division
Bell Industries
Box 5825
Compton, CA 90224

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111 Jericho Turnpike
Syosset, NY 11791

Radio Shack
2617 West 7th Street
Fort Worth, TX 76107

Allied Electronics Corporation
P.O. Box 1544
Fort Worth, TX 76101

Fair Radio Sales
Box 1105
Lima, OH 45802

Edmund Scientific Company
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Barrington, NJ 08007

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New York, NY 10012

Burstein-Applebee
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3011 Norwich Avenue
Pueblo, CO 81008

Circuit Specialists Company
P.O. Box 3047
Scottsdale, AZ 85257

Poly Paks
Box 942
Lynnfield, MA 01940

many, many times what you need for an experimenter project and you wind up paying for a lot of iron you'll never use. When you consider 12-volt filament transformers have gone beyond \$5 in cost while a 3-terminal regulator now sells for as low as \$1.50, it's really insane to stick with the wrong value transformer. Shop around in the surplus dealer ads and pick up anything close to what you need, then knock it down with a buck-and-a-half regulator; that way you not only wind up with the right DC voltage—you get it regulated to boot. For example, one surplus dealer recently offered 36-volt center-tapped, 1-ampere transformers for \$1.50 each. With a \$1.50 3-terminal regulator the cost came to \$3 for a 5-, 9-, 12- or 15-volt DC supply. Until the national component packagers come to realize that the day of the vacuum tube is over and that hobbyists need power transformers rated for typical solid-state operating voltages, your best and least expensive bet is to use a higher-voltage surplus transformer and regulate down to the needed voltage. Several 3-terminal regulator projects will be found in this book.

Summing Up. The way to insure you get all the components you need at the lowest possible price is to use the same tactics as a professional purchasing agent. He would never accept the first price offered. First, he would check several references and catalogs to determine the lowest and highest possible prices, and then he would generally invite bids if the order was sufficiently large. While no one is going to bid on your ten or twenty dollar order, there's no reason you can't use the professional and amateur price guides and catalogs. You'll be amazed at the wide range of prices for the very same component. Quite often, you simply won't be able to get the lowest cost because the local

distributor has some fixed minimum sale that comes out to more than the whole project is worth; but if you know the OEM price you have some idea of what the part is really worth—and somewhere out there is a surplus dealer with the same part at the OEM price or slightly higher.

How do you know who sells what component(s)? By assembling your own "professional buying guide." Invest a few dollars in a three-ring binder and a hole punch. Then send away for every electronic parts catalog that's offered—by anyone. If some outfit wants a quarter or half dollar to put you on a periodic "surplus parts" mailing list give a few of them a try; invest a dollar.

When you receive each catalog or flyer run through it for a mental picture of *who* sells *what*, and for *how much*. If the catalog or flyer is just a few pages punch holes in the edge and place it in the binder. If you keep the binder next to the standard catalogs from Lafayette, Allied Electronics, Radio Shack, B-A, McGee and other major suppliers you'll have a centralized purchasing library that will allow you to easily compare prices.

For maximum convenience make up a single page list of who has the best buys in certain components. For example, if you find a dealer with rock-bottom prices on silicon rectifiers you simply enter "silicon rectifiers—Dealer's Name." In this way you can check quickly where to get lowest cost components. If you don't have an entry on your list it means no one you know of *yet* has bargain prices so you might as well browse through all your catalogs and flyers.

Now plug in that soldering iron, get out the long nose pliers and diagonal pliers and start building—time's a-wastin'.

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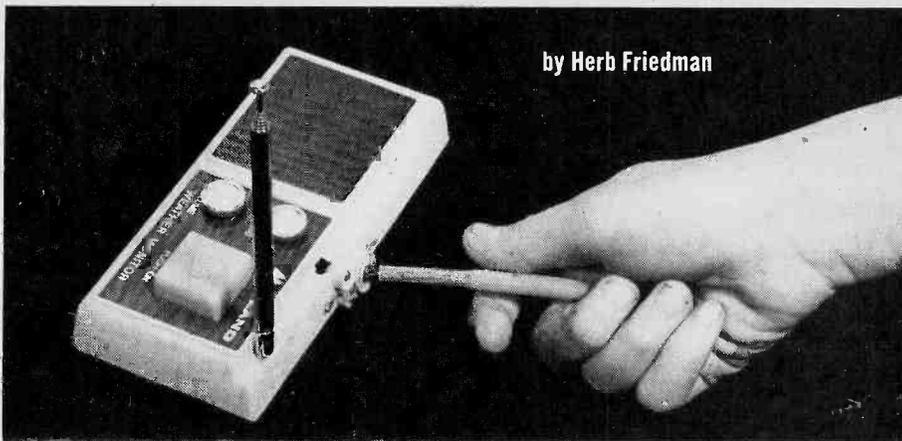
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Getting bored by the temp-humidity index? Slide an inexpensive weather monitor up or down for some exciting signal hunting!

BECAUSE they're priced so low, generally from \$10 to \$20, the "weather monitor" has been a hot gift item for the electronics experimenter, so you probably have one. Tuning the weather station frequencies of 162.40 and/or 162.55 MHz, these small, inexpensive radios are supposed to keep you up to date on the latest weather conditions. But as you've probably discovered yourself, unless you're a boat owner with need for tide and sea conditions, you get a more up-to-date report from your local news station—AM or FM.

Also, reception is probably not all that great. The recommended receiver sensitivity for weather station reception is 0.6 μ V for a 50-mile range, and these inexpensive weather receivers can't get anywhere near this kind of sensitivity.

But there's no need to let an unused weather receiver sit on the shelf. Fortunately, very few models use crystal control tuning, and they are easily converted to a police or fire monitor, or even a sound channel receiver for the higher VHF TV stations. But remember, there won't be any super-sensitivity. TV stations might be received some 30 or 40 miles from the transmitter, but you'll have to be within 2 miles or so of the average police or fire transmitter to pick them up. If you live near an airport you might get coverage of the aircraft frequencies above 108 MHz, but with sharply reduced sensitivity.

The weather monitors are generally similar in electronic design, though the packaging might be anything from a cube to a desk-top pen holder. The circuits are bare-minimum superhet receivers with a local oscillator tuned over a limited range by a panel control. Generally, there are two panel controls, one for *volume* and one for *fine tuning*. The fine tuning knob might have calibrations for *both* weather frequencies, or no calibration at all. It doesn't make

any difference as long as the local oscillator is tunable.

To change the weather monitor tuning range, all you need do is connect a small external trimmer capacitor across the oscillator tuning capacitor—the fine tuning control. The value of capacitor will determine which frequencies are tuned. Keep in mind that as you tune lower in frequency the sensitivity is sharply reduced, particularly below about 160 MHz. A capacitor with a maximum value of 7 pF will get you down to the police/fire frequencies. A 60 pF maximum trimmer will get you about to the top of the FM band, but tuning will be extremely critical and sensitivity will be very low.

A 60 pF trimmer will also get you some of the TV sound carriers above 162 MHz. How can you receive signals above 162 MHz if the tuning range is lowered? Simple. The harmonics of the local oscillator are used to receive the TV stations. For example, if you lower the monitor's oscillator to, say, 100 MHz, the oscillator's harmonic output is also 200 MHz, and a very weak 300 MHz. (The monitor's front end appears to pass the frequencies above the design-range, 162 MHz, with greater sensitivity than lower frequencies.)

Tear It Down. To experiment you must first get the circuit out of its cabinet. Keep in mind these weather monitors are inexpensive and designed to be assembled quickly by unskilled workers. Don't go looking for tricky or difficult assembly sub-systems. Generally, one or two screws are all that's holding the cabinet together. If necessary, unsolder the speaker wires, battery wires and on-off switch wires, and remove the circuit board from the cabinet. Locate the trimmer capacitor used for the fine tuning and its two solder terminals. Solder a 3-in. length of solid, insulated wire to each terminal.

Check how the board fits the cabinet and mark the outside of the cabinet nearest the fine tuning. Drill two small

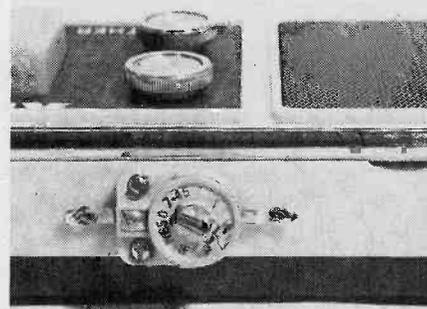
holes at the mark and then install a trimmer capacitor on the cabinet near the holes. Or, you don't have to secure the trimmer if you feel you will experiment with different capacitor values, but it will be difficult to tune the stations with a "floating" trimmer. You can't hand-hold the trimmer because the capacitance from your hand will affect the tuning adjustments.

Slip the wires from the fine tuning control through the holes you've drilled in the cabinet and seat the circuit board. Then reassemble the monitor.

Connect the wires protruding through the cabinet to the trimmer capacitor using the shortest possible leads (cut off the excess).

That's the whole bit. Use an insulated alignment-type screwdriver to adjust the trimmer. You'll probably be able to tune a few TV stations immediately. Tuning police/fire calls or anything else will be more difficult because transmissions in these services are short and fast. You can preset the tuning by using a signal generator or a well calibrated grid dip oscillator.

Remember, this is a fun project. Don't hope for more than acceptable reception. But then who knows, you might be able to tune your favorite TV channel and keep track of the program while working in your shop. ■



Install a small trimmer on the cabinet at a point just outside the internal trimmer.

“Learn an honest trade,” my old man used to say, “and you’ll never have to knuckle under to any man.”

(A TRUE STORY)

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“If it wasn’t for my ICS training as an

electrician, I’d still be in some dead-end job—hating what I was doing, taking orders from everyone, and never getting any thanks for it.

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Bill De Medio is one of our outstanding graduates. He’s hard working. He’s in a growing field. And he has good training.

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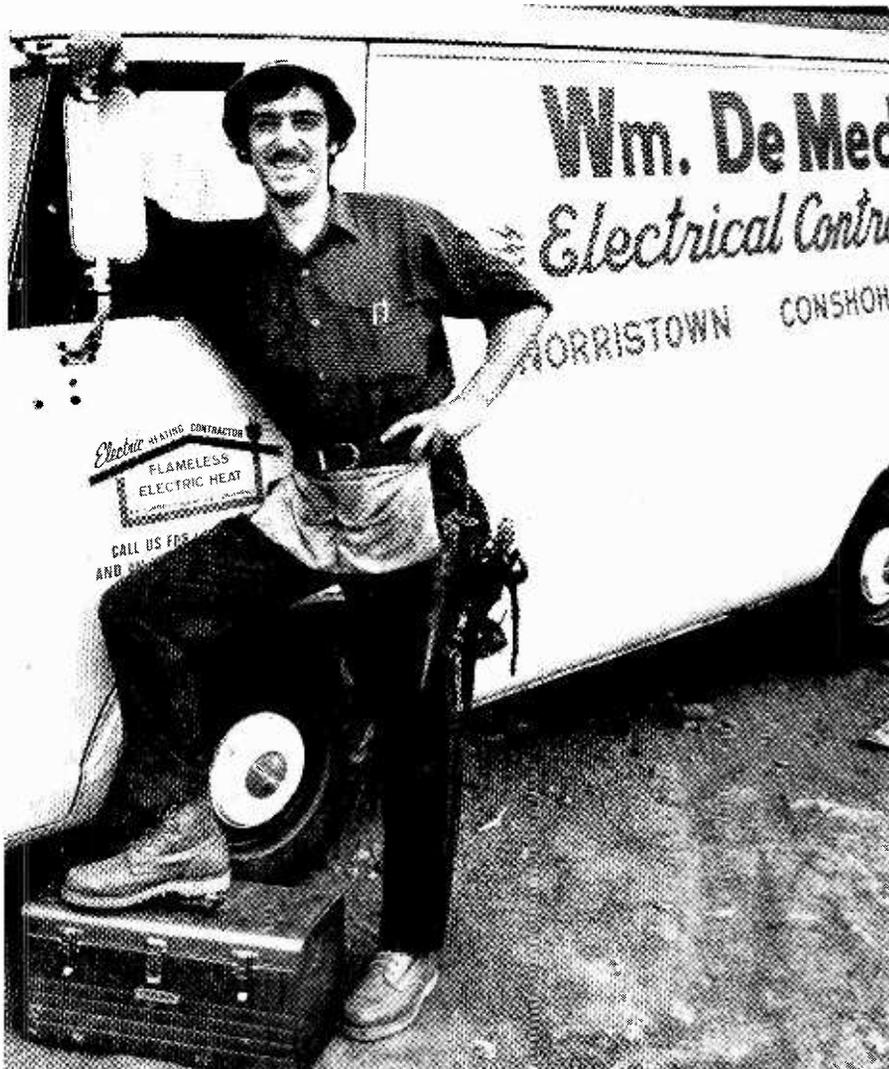
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At 26, Bill De Medio has more freedom, more security, and gets more respect than guys twice his age. (Photograph by Frank Cowan.)

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Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the low price you pay. The Signal Tracer alone is worth more than the price of the kit.

THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job, with a future, you will find the "Edu-Kit" a worth-while investment.

Many thousands of individuals of all

ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a Professional Radio Technician.

Included in the "Edu-Kit" course are Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector Circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering, punched metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build twenty different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, hardware, and solder, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, coils, volume controls and switches, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C. Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

FREE EXTRAS

• SET OF TOOLS

- SOLDERING IRON
- ELECTRONICS TESTER
- PLIERS-CUTTERS
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector, and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

FROM OUR MAIL BAG

J. Stataitis, of 25 Poplar Pl., Waterbury Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself. I was ready to spend \$240 for a Course, but I found your ad and sent for your Kit."

Ben Valerio, P. O. Box 21, Magna, Utah: "The Edu-Kits are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to work with Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute I worked with the different kits; the Signal Tracer works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Trouble-shooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

A Printed Circuit is a special insulated chassis on which has been deposited a conducting material which takes the place of wiring. The various parts are merely plugged in and soldered to terminals.

Printed Circuitry is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.

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