

# ELECTRONIC PROJECTS FOR UNDER \$15

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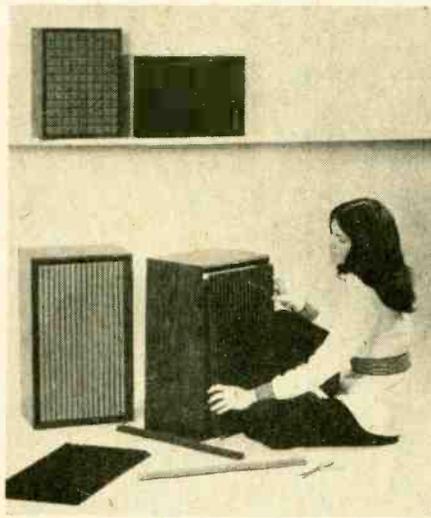
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Showcase of New Products

### Foam Speaker Grille Kits

Do-it-Yourself kits featuring sculptured-foam speaker grilles for replacement of conventional grille cloth on stereo and hi-fi speakers have been developed by Republic Systems Corp., 9160 S. Green Street, Chicago, IL 60620. In addition to providing a modern "sculptured" look to speakers, the new foam grilles also make stereo and hi-fi systems sound better.



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Unlike grille cloth, sculptured-foam does not distort sound, even in higher frequency ranges. The flexible urethane foam is "acoustically transparent," permitting sound to pass through as though there were no grille at all, for purest reproduction. Each kit contains sculptured foam grille, self-sticking attachment material and instructions for fast, easy installation. Available in 15 x 8-in. and 14 x 24-in. sizes, the foam grille can be easily cut with household shears to fit smaller speakers. The foam grilles are a rich black color which blends with any style speaker. Grilles can also be sprayed with latex paint for any color desired. Prices range from \$7 to \$14.50.

### Trucker Sticks

Designed especially to overcome many of the communications problems encountered by the professional trucker, Avanti's new mobile antenna system featuring two 48-in. center-loaded "Fazer" antennas in co-phased arrangement, and mounted to the outside rear view mirrors, the system is said to minimize the problem of a skewed or shifted radiation pattern, and to increase

(Continued on page 6)

WHO'S WHO ON

# 101

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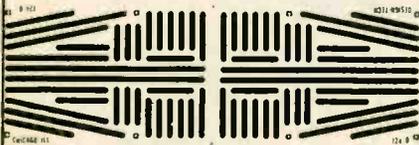
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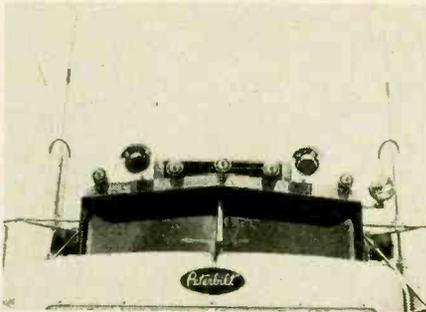
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## Hey, Look Me Over

(Continued from page 4)

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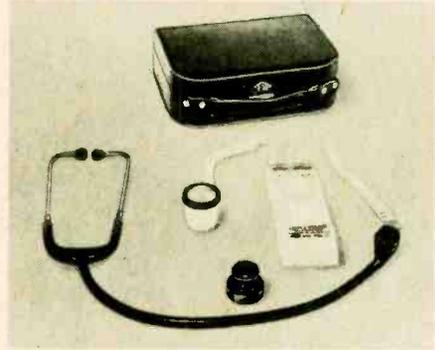


CIRCLE 16 ON READER SERVICE COUPON

any rear view bracket arrangement, including west coast types, and is readily removeable for transfer from one vehicle to another. The Avanti co-phasing harness used in the Fazer system connects quickly and easily to the mirror mounts. Sells for \$39.95. Avanti Research & Development, Inc., 340 Stewart Avenue, Addison, IL 60101.

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A transistorized electronic stethoscope that amplifies sound up to 10,000 times while eliminating extraneous sounds is designed to help one hear better and diagnose more accurately, whether patients are people, sick engines or industrial equipment. Completely portable, the electronic case clips to shirt pocket.



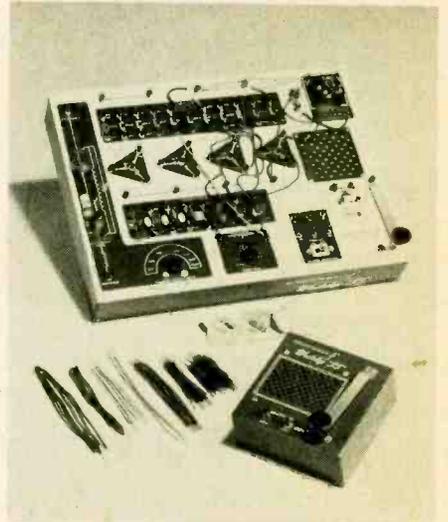
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It measures just 1 x 2 x 5½ inches. System includes case, binaural headpiece, two chestpieces (flat and bell type), coiled telephone-type cord, 10-stage volume control, batteries and leather carrying case. Auxiliary receptacle makes it easy to hook up to amplifiers, speakers, tape recorders. It can also be hooked up to a second set of binaurals so that two persons can listen simultaneously. Instructions are included. Listed as stock number 71,714, it is

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(Continued on page 8)

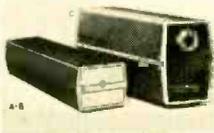
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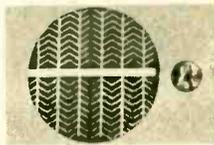
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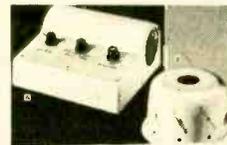
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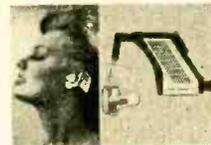
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International's inline amplifier provides 14 db gain flat within 1 db over a range of 10 to 1,000 MHz. Impedance 50 ohms. Requires 20 VDC @ 50 ma. For increased gain additional amplifier may be added. Uses BNC type terminals.

### SPECIFICATIONS

**Range:** 10 to 1,000 MHz  
**Impedance:** 50 ohms  
**DC Input\*:** 20 VDC 50 ma  
**Gain\*\*:** 14 db  
**Flatness:**  $\pm 1$  db (Ref. 500 MHz)  
**Operating Temperature:** -25 to +70°C  
**Noise Figure:** 9 db  
**VSWR Output:** 2.0  
**Output capability for -60 db near Intermodulation distortion:** 100 MV

\*Will operate 12 to 24 VDC with some loss in characteristics.  
 \*\*May cascade for additional gain with consideration of noise and flatness.

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## Hey, Look Me Over

(Continued from page 6)

systems. This results in more complete combustion for improved mileage, faster starting in cold or wet weather and cleaner exhaust emissions. It also increases plug and point life, reducing the need for tuneups. Installation may be easily accomplished in a few minutes on any 4, 6, or 8-cylinder engine having a 12 VDC negative ground electrical system. No rewiring of the vehicle's original



**CIRCLE 18 ON READER SERVICE COUPON**

ignition system is needed, and an In-Out switch permits instant performance comparisons. The Micronta Capacitive Discharge Ignition System is priced at \$54.95. Also available in easy-to-assemble kit form under Radio Shack's ArcherKit brand name for \$39.95. Radio Shack has more than 3,000 stores and Authorized Sales Center in all 50 states, Canada and abroad.

### High Voltage Probe

Need a self-contained, direct reading, high voltage and current measuring probe providing for the safe measurement of voltage up to 40,000 Volts DC, and for separate current measurements up to 200 mA, DC? Then look at EICO's Model HVP-5 direct reading, high voltage and current measuring probe. It enables you to accurately measure the high anode voltage of a color picture tube and with a flick of the switch monitor the



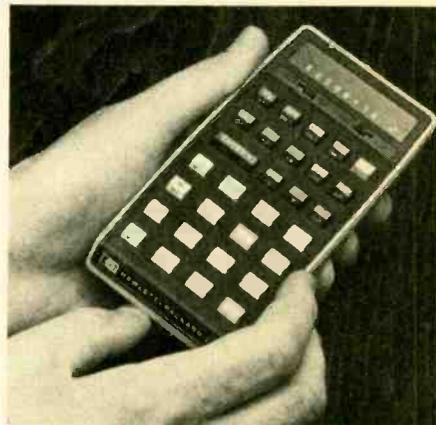
**CIRCLE 19 ON READER SERVICE COUPON**

cathode current drawn by the horizontal output tube or the output stage. The high voltage supply affects the focus and the X-ray emission level of the set. The amount of current drawn by the horizontal output stage determines the life of these components. The EICO HVP-5's two circuits are completely separate. Only the meter is switched. The EICO HVP-5 cannot be damaged by placing the function switch in a mA position while measuring high voltage. This feature allows the technician to switch from the mA position to the HV position without disrupting the operation of the set under test. List: \$29.95. Get all

the facts by writing to EICO, Electronic Instrument Co., Inc., 283 Malta St., Brooklyn, NY 11207.

### Scientific Calculator

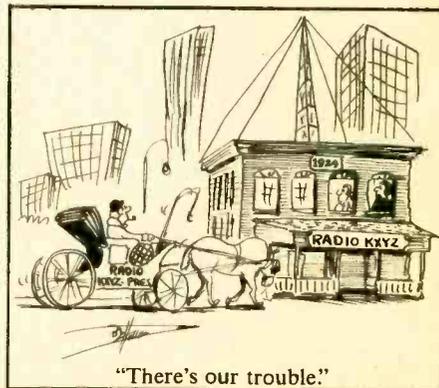
The HP-21 scientific calculator, the first of a new generation of Hewlett-Packard pocket calculators, was introduced today. It is priced at \$125. The six-ounce HP-21 is the smallest and lowest priced model in HP's line. It is designed primarily for scientists, engineers and students. Scientific calculators like the HP-21 also are finding increasing use in marine and aircraft navigation, surveying, medicine and education. The HP-21 has trigonometric and logarithmic functions. In addition, the user can calculate in either degrees or radians; convert from polar to rectangular coordinates and vice versa; format and round the display in either fixed or scientific notation; and perform register arithmetic (+, -,  $\times$ ,  $\div$ ) with the contents of its single addressable memory. Like other HP pocket calculators, the HP-21 features the company's RPN logic system with a four-memory stack that holds



**CIRCLE 20 ON READER SERVICE COUPON**

intermediate answers and automatically brings them back when needed in a calculation. The HP-21 comes with an owner's handbook, soft carrying case and an AC adapter/recharger that allows the calculator to be operated on AC while its batteries are recharging. Optional accessories include a security cradle and a reserve power pack (with batteries). The HP-21, like other HP

(Continued on page 10)



"There's our trouble."

# ELECTRONICS INFORMATION CENTER

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We would like to know about you. Please help us by placing an "X" in the appropriate boxes. • Do you own a CB transceiver? <sup>76</sup>  Yes <sup>77</sup>  No • If your answer is Yes, please check appropriate boxes below if you have one or more of the types indicated. <sup>78</sup>  Base Station <sup>79</sup>  Mobile Unit <sup>80</sup>  Portable • Do you use CB in your work? <sup>81</sup>  Yes <sup>82</sup>  No • <sup>83</sup>  Please enter my subscription for 8 issues at \$3.98 and bill me.

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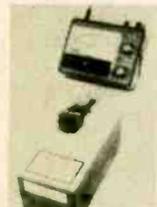
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Use your A-4 with the  $\frac{5}{8}$  in. dia. STANDARD probe as a LIGHT METER. Features? Four sensitivity ranges: EV-EVS-LV settings; ASA settings from 3 to 25,000;

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3 ft. Easel Probe

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3 ft. Mini Probe

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EEJ/A

Send the meter and probe(s) with cable length (3-12 ft.) as indicated below. I understand that if I am not satisfied, I may return the meter within 10 days for a complete refund.

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\$99.95 with \_\_\_\_\_ ft. long Standard probe, exposure calculator and carrying case and manual.

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## Hey, Look Me Over

(Continued from page 8)

pocket calculators, will be sold through leading college bookstores and department stores, by direct mail and through HP's calculator sales force. Write to Inquiries Manager, Hewlett-Packard Company, 1501 Page Mill Road, Palo Alto, CA 94304.

### Super VOM

Triplet has a new concept in analog VOM, the "Extrachance" Model 60. No repair bills if you goof on this one. It's drop-proof, burn-out proof, designed to be super-safe for the user and can be easily maintained in the field. It's the perfect tester for the beginner and professional, be he experimenter, hobbyist,



CIRCLE 21 ON READER SERVICE COUPON

technician, electronics trade school student. It's priced at only \$90. The model 60 VOM measures VDC to 1000 in 8 steps, VAC to 1000 in 6 steps, DC amps to 1 in 4 steps, resistance 10 Megohms in 5 steps, decibels from -20 to +52 in 5 steps, and output volts (AC) to 300 in 5 steps. Get more facts by writing to Triplet Corp., Dept. PR, Bluffton, OH 45817.

### FET Multimeter

A new pocket FET Multimeter offers full VTVM ranges and a 10 megohm input, completely protected against over-load. Packaged in a rugged, pocket-size, polypropylene case with attached cover the Hickok Model 350 provides features which include: a meter with 1 millivolt resolution on 3 easy-read mirrored scales plus dB and battery condition, hi/low ohms ranges, and true autopolarity with a polarity indicator. High impedance FET circuitry permits VTVM type ranges in this compact unit. Nine voltage ranges of 0.1 to 1000 and seven hi/lo ohms ranges from 100 to 100M center scale make the Model 350 a truly versatile service tool. One year service can be expected from the two 9-volt transistor radio batteries. The Hickok Model 350

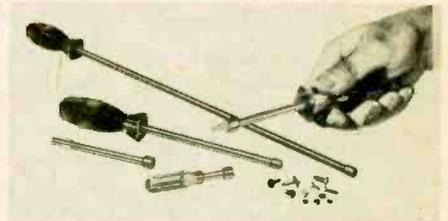


CIRCLE 22 ON READER SERVICE COUPON

Pocket FET Multimeter comes complete with two test leads and instruction manual. Priced at \$119.00. For more information, write to Instrumentation & Controls Division, Hickok Electrical Instrument Co., 10514 Dupont Avenue, Cleveland, OH 44108.

### Magnetic Nutdrivers

Four styles of magnetic fixed-handle nutdrivers, each in two sizes, are available from Xcelite. The magnetic line also includes two sizes of interchangeable shanks which fit all their Series 99 handles, both regular and ratchet types. The permanent alnico magnet in the insulated socket holds fasteners firmly for easy, one-hand driving or retrieving upon removal—cuts lost time, motion or fumbling in close quarters. Styles range



CIRCLE 23 ON READER SERVICE COUPON

from a 3 $\frac{1}{2}$ -in. overall midget pocket clip to a super long 20 $\frac{3}{4}$ -in. driver, all in  $\frac{1}{4}$ -in. and  $\frac{5}{16}$ -in. hex openings. Intermediate lengths are 7-in. and 10-in. The comfort-contoured plastic handles, color-coded red or amber for easy hex opening identification, are designed for maximum torque with minimum pressure. Write to Xcelite for their catalog. They're at Apex, NC 27502.

### For the Man on the Go

A new "Super Case" containing 48 professional problem solving tools is now being offered by Vaco. Included are 7 pliers, 2 wrenches, 2 reversible screw drivers, 13 specialty drivers, 7 hollow shaft nut drivers, 4 screw holding drivers, 4 testers, 2 crimping and stripping tools, plus 7 unusual type tools for specific

(Continued on page 101)

# So Watt?\*

How big you succeed in electronics today—bigger pay...better job...personal enjoyment—depends on how far you take the basics!

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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**

### His Cycles Hertz

I'm doing some loudspeaker testing. Amateur stuff, you know, and I find that my signal generator does some strange things at low frequencies. I put about 50 cycles (Hertz to you) in and raise the level. Well, as the sound gets louder, the frequency jumps to 100 cycles above a certain sound level input. My oscilloscope says nothing is wrong with the generator, but my hearing says yes. What am I to believe—my eyes or my ears?

—I.N., Los Angeles, CA

Your ears, because the loudspeaker is doubling the frequency after the level gets too high for the cone to faithfully follow the 50 Hertz (cycles to you) sweep. This is loudspeaker distortion. You'll find this distortion decreases as the frequency increases. Hey, fellah, you're beginning to get into what's wrong with cheap audio systems. Now you'll appreciate the better loudspeakers.

### He Wants to Practice

Enclosed you will find a schematic of an

electrical stimulator used in acupuncture which I took to a radio parts store for the parts listed. They supplied all the parts listed except the wire coils, and they said the coils would have to be hand wound. What am I to do?

—M.G., Jacksonville, FL

I'm not publishing the schematic because I don't want to lose any readers. As for your patients, Doc, don't build the gadget and you won't lose any, either.

### Let Go of My Shoe

How can I make a clock radio from an electric alarm clock and an electric radio? I would like to wire it some way so that when the alarm goes off the radio will automatically come on and play.

—R.S., Duarte, CA

You're pulling my leg, aren't you? I priced an inexpensive clock-radio on sale for only \$19.95 and bought it—the price was right. Considering the time and expense you have to go through on your proposed project, you must be pulling my leg. Let go!

### It Was a Long Wait

When will the sunspots be at their lowest?

—A.R., Little Rock, AR

We should hit a low spot in the cycle about summer, 1975. Sun spots vary from day to day, and even at the height of activity a few sun-spot-free days may occur permitting DXs that normally would not occur. Sun spots introduce considerable atmospheric noise and, when very active, break down the normal pattern of ionized layers surrounding earth, causing communication havoc.

### Getting Started

Hank, what kind of beam antenna should I get? I plan to get involved with SW monitoring.

—T.F., Norfolk, VA

Forget the beam—stick with a long wire until you consider yourself a hotshot. I fooled with a beam for a while until I discovered I spent more time rotating the antenna than listening to DX. Leave the beam stuff to the CIA and scoop in the world of DX with your long wire.

### Mighty Low

I have just purchased a new car (an Audi 100LS) and it came with a three-band radio. On one of these three bands, marked "L," the dial reads 1.5 to 2.9. I have no idea if this might be 150 to 290 kHz or not. Could you please tell me what frequencies these really are? If it

(Continued on page 14)

# HOW TO SOLVE YOUR STORAGE PROBLEMS WITH A TOUCH OF STYLE

- #J-TA—Tape Album (holds 6)
- #J-R7—45's (holds 20)
- #J-R10—10" Records (holds 20)
- #J-R12—12" Records (holds 20)

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CASES**



Decorative, sturdy, in rich leatherette. Exclusive design on back is gold tooled on Black, Brown, or Green—sides black. Center divider separates records up to 20 in original jackets. Tape Cases hold 6 tapes in their original boxes.



**DELUXE CASSETTE  
STORAGE CASES**  
(Includes presensitive labels for titling)

#JC-60 holds 60 Cassettes. 13½" high, 12½" deep, 5½" wide. Storage slots are tilted to keep cartridges from falling out. Outer case embossed in gold on black, brown or green.

#JC-30 holds 30 Cassettes. 5½" high, 6½" deep, 5½" wide. Same color choices.



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\_\_\_\_\_ #JC-30 \$11.95 ea., 3 for \$33.  Black  Brown  Green

\_\_\_\_\_ #JC-60 \$16.95 ea., 3 for \$48.  Black  Brown  Green

Check colors for the items below  Black  Brown  Green

\_\_\_\_\_ #J-TA—Tape Album \$5.95 each, 3 for \$17

\_\_\_\_\_ #J-R7—45's \$5.95 each, 3 for \$17

\_\_\_\_\_ #J-R10—10" Records \$6.50 each, 3 for \$18.50

\_\_\_\_\_ #J-R12—12" Records \$6.50 each, 3 for \$18.50

I enclose check or money order in amount of \$ \_\_\_\_\_

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# LITERATURE LIBRARY

101. Kit builder? Like weird products? *EICO's* 1975 catalog takes care of both breeds of buyers at prices you will like.

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* 1975 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'* cat. of latest CB and VHF/UHF innovations: base & mobile antennas, test equipment (wattmeters, etc.), 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 nut-drivers with "piggyback" handle to increase length and torque. A handy show case serves as a bench stand also.

110. *Turner* has colorful booklets on their Signal Kicker antennas, which are computer optimized for CB. Another booklet covers their communications microphones.

111. *Midland's* line of base & mobile CB equipment, marine transceivers & accessories, and scanner receivers are illustrated in a new full-color 16-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.

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; TVI filters; automotive noise suppressor kits; SWR Power and FS meters, etc.

146. *Robyn International* has 4-color "spec" sheets for each model of their CB (base and mobile) transceivers and monitor-scanner lines.

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

119. *Browning's* mobiles and its famous Golden Eagle base station, are illustrated in detail in the new 1975 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* 1975 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" 1975 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.

124. *Mosley Electronics* reports that by popular demand the Model A-311 3-element CB beam antenna is being reintroduced. Send for the brochure.

125. *RCA Experimenter's Kits* for hobbyists, hams, technicians and students are the answer for successful and enjoyable projects.

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

129. *Semiconductor Supermart* is a new 1975 catalog listing project builders' parts, popular CB gear, and test equipment. It features semi-conductors—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's* new full-color catalog for CB transceivers and accessories is now available. Send for a free copy. They also have a free brochure on their line of scanner receivers.

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* has a packet of information for you. The "Citizens two-way radio" answers all the questions from how to operate one to how much they will cost to operate. A booklet on Pace's scan/monitors to keep you informed is included.

138. *Shakespeare's* new pocket-size catalog lists and describes their full line of fiberglass CB antennas, mounts and accessories offered in 1975.

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.

149. *Cush Craft* has a catalog on *Citizens Band Antennas* for every purpose. The Ringo base antenna is featured, as is the new Superfire 8-element horizontal/vertical power beam.

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.

101 Electronic Projects, Box 886  
Ansonia Station, New York, N.Y. 10023

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

Indicate total number of booklets requested. \_\_\_\_\_

101	102	103	104	105	106	107	108	109	110	111	112
113	114	115	116	117	118	119	120	121	122	123	124
125	126	127	128	129	130	131	132	133	134	135	136
137	138	139	140	141	142	143	144	145	146	147	148
149	150										

NAME (print clearly) \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY  
1975 ED.

STATE \_\_\_\_\_

ZIP  
Not Valid After November 15, 1975

## ASK HANK, HE KNOWS!

(Continued from page 12)

will help, I received stations CRK at 2.1 and CCZ at 2.5 and MKP at 2.8 on the dial.

—J.F.R., Pittsburgh, PA

The stations you're hearing are LF air radio beacons. They transmit their calls repeatedly in morse code and are used by planes for checking location and direction. Many of them operate in approximately the 200 to 400 kHz range. Normally a dial marked 1.5 would indicate 1.5 MHz, 1,500 kHz. But apparently in this case, the Audi people intend it to mean 150 to 290 kHz. Incidentally, in Europe, some long-wave broadcasting stations use these frequencies, for example, the one-million-watt Radio Luxembourg outlet on 236 kHz and the BBC's Droitwich station on 200 kHz.

### Needs Lots of Work

Hank, what is the best kind of home study course to take? I know very little about electronics and want to go all the way.

—T.T., Newton Falls, OH

The best course to take is the one you will complete. Too many youngsters begin home study courses and quit after a few lessons when they discover self-education takes work, dedication to their goal, continuous effort, and drive. Get started and stick to it. You'll thank me in 15 years—you said all the way!

### Wrong End

I installed a VU meter on my FM receiver and some of the local FM stations are overmodulating their signals. Should I report them to the FCC?

—F.J., Waco, TX

Save your stamps! A transmitter's clipping should be measured at the transmitter, and not at your receiver. All you are measuring is volume, and your ears can do the job better.

### What Channel?

I saw nude forms and naked women's bodies on TV late at night. Why does the FCC allow this?

—H.D., Bronx, NY

We may have seen the same program on breast cancer. I believe the FCC allows this because it will save the lives and health of many women. I'm not the kind of guy that goes to X-rated pictures, but this program, and others like it, are A-OK with me.

### Dunno

Hank, what is the operating frequency of the Memphis, Tennessee police department? They won't tell me.

—J.P., Memphis, TN

I won't either, only because I don't know. You could go to one of a few services that claim they know, but all they'll tell you is the frequencies assigned. Let's say Memphis police have six frequencies. One is a general call channel, two seldom used, and three held in reserve. Which frequency

should you buy a crystal for? I dunno. But the guy selling monitor receivers in Memphis does 'cause he's selling lots of them. Why not ask him. He's the guy standing next to a Regency hi/lo band monitor at the local electronics store.

### Can You Help Out?

Δ F. H. Heberling has an old, like-new Remler Infradyne Amplifier, Type 700, made by Gray & Danielson Mfg. Co. It takes three tubes which have "Remler Type 50" near the sockets. He needs to know tube types, and what A and B batteries to use. Write to him at Bakers-town, PA 15007.

Δ DXers Radio Club would like to communicate with other clubs as reported by Scott Freiman (11 years old). If interested, write to Scott at 1-26A Pinehurst Dr., Lakewood, NJ 08701.

Δ Fred Caughlin picked up a Skyline Radiophone, Model IA30 and would like information and schematic diagrams of the unit. Write to Fred at 11094 71st Ave. N.E., Brooks, Oregon 97305.

Δ Is there anyone who will etch a printed circuit board and drill holes for a reasonable price from a drawing? If so, write to Peter Retsof, 18 Pierce St., Milton, MA 02186.

Δ If anyone has the schematic diagrams for a Decca DR343 or International Transistor Corp. Model FAP314 (both portable radios), please send them to Emanuel Cattolica, 7861 Barbi Lane, La Palma, CA 90623. ■

# a little overdone

by Jack Schmidt



"I'm going to come back tonight. I have a little hum problem with my kid's mono phonograph."



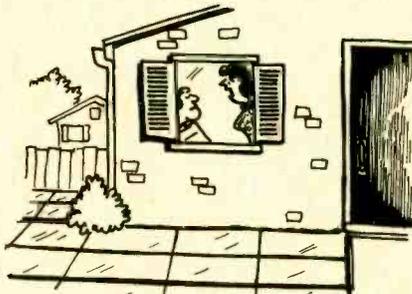
"It all started when Marvin tried to mow the lawn with a laser!"



"They didn't have your brand tape cleaner so I ran them through the dishwasher."



"Well, you ought to reach Jimmy Wilson now . . . our antenna just fell through his roof."



"What vegetable garden? Your solar cells take up the whole yard!"



"Microwaves flood the driveway and yard so we know when the dog is home!"

# 101

## ELECTRONIC PROJECTS FOR UNDER \$15 1975 EDITION

**A**LMOST EVERY EXPERIMENTER will acknowledge that the best part of electronics is building his own projects and putting them to use. The fact is, in this day of inflation nothing satisfies as much as discovering that some expensive equipment you *must* have can be homebrewed for pennies.

Unfortunately, in this age of blister-packed parts, it's not unusual to find the most critical part of a construction project unavailable at any price; and even if you had the schematic for a device that could turn lead into gold, it would be of no use if you couldn't locate the parts.

Well, you won't have the "missing part" problem with the projects in this book. While you won't find a lead-into-gold schematic, you will find more than 100 useful projects which take standard components; items available at just about any moderately-stocked electronic parts distributor.

We have expended considerable effort to make certain every project will work with the components specified and that the components are generally available in your local stores or that direct substitutes are generally available. Every project in this book has been constructed and de-bugged. The parts lists have been checked and double-checked to insure no indus-

trial-only component has been used. Where a project originally called for an industrial component, we have searched out a suitable hobbyist equivalent, or we are certain the device is available from the "surplus" dealers, such as a specialized integrated circuit (IC) which is not, as yet, blister-packaged. Many of these surplus dealers advertise in national hobbyist publications such as *ELECTRONICS HOBBYIST* and *ELEMENTARY ELECTRONICS*, so if you can't find the part at your local store, check the ads in the hobby magazines. (It is a good idea to send away for all the component catalogs you can before you start building projects.)

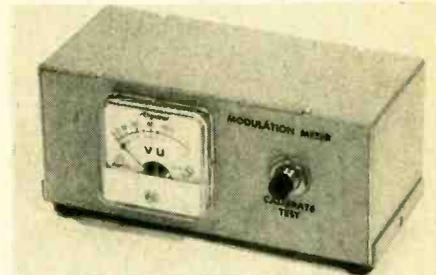
Most of the projects are non-critical and can be assembled in any type of enclosure, or just on a "breadboard." Where the layout, wiring or enclosure might affect performance, we so specify and suggest the proper techniques. (For safety's sake, all 110 volt leads and terminals should be fully taped and/or insulated.)

The same thing is true for heat sinks and special transistor and IC mounting. When nothing is said about heat sinks or mounting, anything goes. But if specific recommendations are given, they are necessary to avoid self-destruction of the device.

Some of the voltage and current

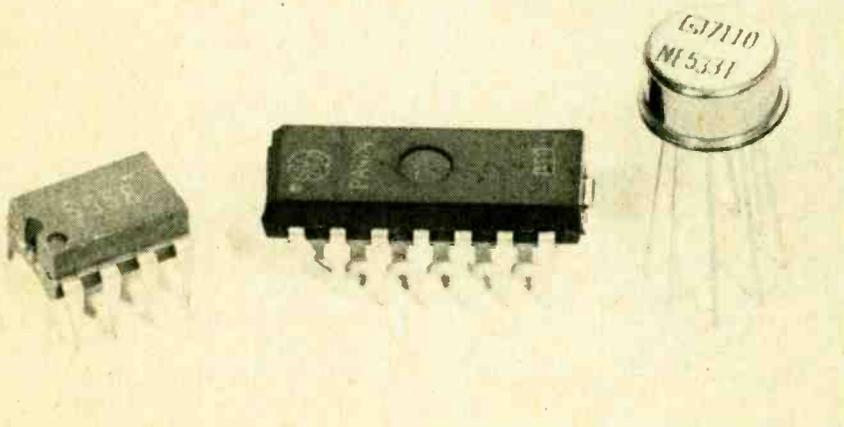
ratings might appear excessive—much greater than needed. But we have allowed for safety factors and a few wiring errors, and the ratings keep possible "disasters" to a minimum. If you decide to make a substitution for a specified component, make certain the device can handle the circuit voltage and has the same general ratings as the specified component. While you can always use higher ratings, *never* go lower. For example, if the project calls for a silicon rectifier rated 50 PIV at 500 mA, you can substitute 100 PIV at 1 ampere. You should not, however, substitute 25 PIV or 100 mA. Similarly, if a capacitor is rated for 25 VDC, you can use 50 VDC, but do not substitute a capacitor rated *less* than 25 VDC.

SCRs (silicon controlled rectifiers) are the exception to this rule, because their gate sensitivity often depends upon the reverse voltage (PIV) rating. Always try to use the SCR speci-



Here's how the "CB Modulation Monitor" looks when assembled in a 2 x 2 x 4 inch Minibox. The VU meter has two scales; the one indicated as 0-100 is directly in percent modulation. A pushbutton switch has been substituted for the toggle switch specified in the parts list.

The same IC is often available to the hobbyist in different packages such as the half-minidip (left), DIP or dual-in-line (center), or round (right). While many ICs are packaged in two or more styles, at any given time only one type of package might be available on the hobbyist market.



fied or a direct substitute. Check the specifications of the substitute carefully.

**Tolerance for Success.** Resistor and capacitor values should be exactly as specified. If a 1000-ohm 10% resistor is specified, use 1000 ohms, not 930 or 1100 ohms. You can, however, use a more precise tolerance than specified; for example, you can substitute 5% or 1% resistors for a specified 10% type. But keep in mind that none of the projects will work any better because you have used more expensive components. The only thing a "better quality" component will do is increase the total cost of the project—it will not improve performance. All the projects will work with the tolerances specified; when "precision" parts are required it is so specified in the parts list.

To make construction as goof-proof as possible, two types of capacitor symbols are used in the schematics. The symbol with a straight and curved line—with a "+" over the straight line—means an *electrolytic* capacitor and it must be wired with the correct polarity, as indicated. The curved line is a warning that the polarity must be double-checked, as the project probably won't work if the capacitor connections are reversed.

Those capacitors indicated by two straight lines are *non-polarized* and can be installed without regard to any

markings—they have no polarity, although occasionally the "outside foil" may be indicated. This is usually connected to the ground, or negative, point (if, in fact, there is a ground or negative side to the circuit in question).

Quite often a component rating will appear to be completely out of the ballpark, such as a 500 VDC rating for a capacitor going into a circuit powered by a 9-volt battery. In all cases we have tried to specify the least expensive component that will work, so if a 0.001  $\mu$ F 500 VDC capacitor costs less than a 0.001  $\mu$ F 10 VDC capacitor, we have specified the 500-volt type.

Since electrolytic capacitors often represent a substantial part of the project's total cost, always try to use the least expensive capacitors you can find. If the value or type is critical, it is so specified.

Potentiometers can be any type or style unless *audio* or *linear* taper is specified. When battery types are suggested do not substitute one with a smaller current capacity as the current requirements for a battery project have been taken into account, and the battery with the minimum required current capacity has been specified in the parts list. You can always substitute a battery with a higher current capacity (but not higher voltage).

**Whoops.** There are normal gain variations between solid-state devices of the same type, and these variations might affect a project's performance. If you build an amplifier that distorts at high level, or an oscillator that fails to "start," try changing the bias resistor(s) within a  $\pm 20$  percent range of the specified value.

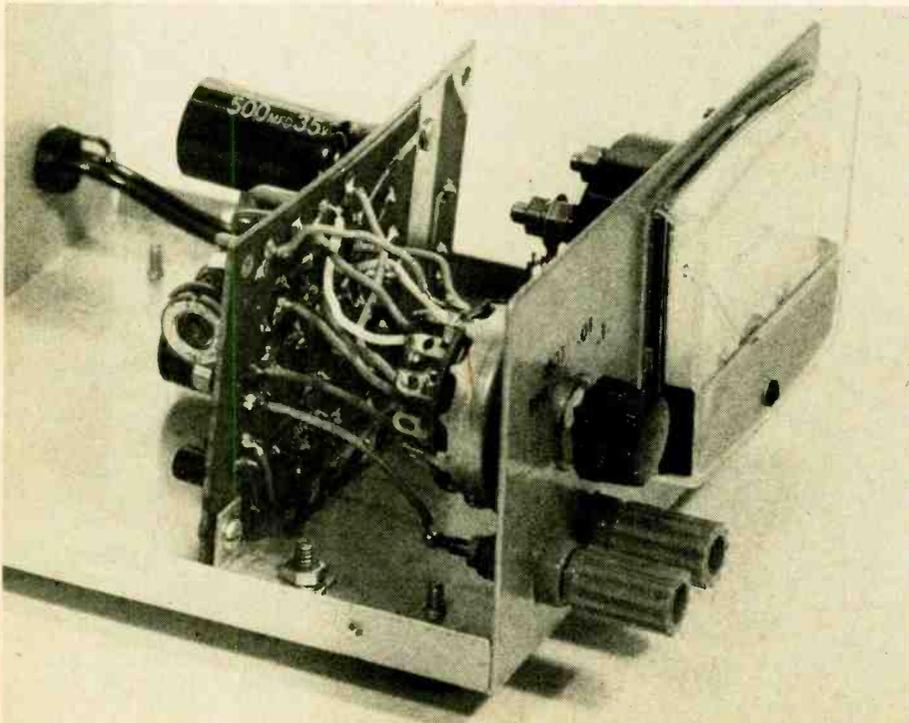
Integrated circuits require extra care in handling and checkout. Whereas a short circuit or incorrect voltage polarity *might* damage a transistor, you can almost bet it will instantly *Zap* an IC, with no possibility of a second chance. Before applying power to an IC project, triple-check all power supply connections, capacitor polarities, signal input levels (if the project is an amplifier) and the heat sink (if a sink is called for). Be certain there are no short circuits, and take extra care when using test leads that IC terminals are not accidentally shorted; the briefest short will destroy an IC.

**Shop for Components.** It was not too many years ago that a hobbyist wanting to build a magazine project could run down to his local radio store, plunk the parts list on the counter, and walk out with *every* item on the list (as well as with a few suggestions from the counterman on how to build the project, for he was also a hobbyist).

Today, there are no more radio stores, they have become "electronic distributors," and most of them don't stock a complete line of hobby parts. The fact is, even the most uncomplicated construction project can take visits to two or three stores plus a couple of orders to mail order houses. And with all this you must still cross your fingers and hope that after you've put out ten dollars or so you won't find the most critical component—the one without which the project can't work—is permanently out of stock.

But there are some tricks to component shopping which can almost guarantee you'll get all the parts with the least possible effort, and you

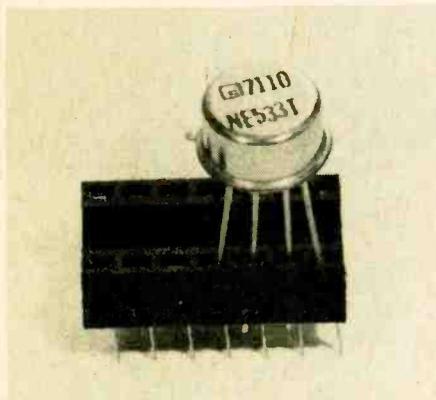
**If you have several wires to run from a printed circuit board to a panel switch, you'll have fewer problems (and the least cross-wire signal leakage) if you mount the board directly behind the switch so short connecting wires can be used.**



might save a few dollars as well.

Component shopping is easy if you have a mental or written note on *who* sells *what*, for it is virtually impossible for any store to stock everything that's used in hobby projects.

Let's start with transistors because they are getting harder and harder to get if you're looking for a specific type. For example, the popular 2N3391, which is used in many projects, is virtually unavailable outside the larger cities (and soon won't be available in the cities). The reason for this situation is easy to understand. There are now thousands upon thousands of solid-state types, and no distributor can afford to stock even a small sample of everything that's available. Actually, as far as hobbyist and consumer equipment is concerned, maybe a hundred or so substitutes can replace most transistors, for there is not much effective difference between many transistor types other than for narrow-band specialized use. Similarly, a handful of integrated circuits can be used interchangeably in hobbyist projects; for example, in audio applications there's no effective difference between a 741, 741C or MC1741, etc.



The DIP socket is the easiest to use for the TO-5 ICs. Simply fan out the IC leads into two lines, bend the leads straight with long nose pliers, and then insert the IC straight into the DIP socket.

Heat sinks are rated in terms of "square inches of radiating surface," with the fins providing much of the surface area. The three sizes shown are marked with their rated area. Handbooks usually have tables showing the required area for specific heat dissipation.

**Hobby Brands.** Because of this "universality" of solid-state devices, several manufacturers and distributors have established a line of general replacements, generally blister-packed in quantities of one-per-package. The most extensive line is the Motorola HEP. Unless you have some rare esoteric device there is probably a HEP you can use as a direct substitute in hobbyist projects. The HEP line includes transistors, ICs, SCRs, rectifiers, zener diodes, heat sinks, etc. Just about anything Motorola makes available to industry has a substitute in the HEP line. Another extensive line of solid-state devices is RCA's SK Series. Rather extensive replacement guides are available for the HEP and SK lines, which also include characteristics, should you feel like doing your own designs. The HEP and SK guides should be right at hand when you build a project, as these components are not only available from the mail order houses such as Lafayette and Burstein-Applebee, but also from the larger local electronic parts distributor.

A rather complete line of replacements is also available from Radio Shack, for which they publish their own transistor substitution guide. Radio Shack replacements are available only from Radio Shack stores or franchised dealers.

A more limited selection of replacement transistors is available under the Calectro label; the replacements are geared more closely to the type of solid-state devices used by hobbyists. Calectro is available in local electronic parts stores. Other similar lines are also available in "chain" stores and mail order distributors.

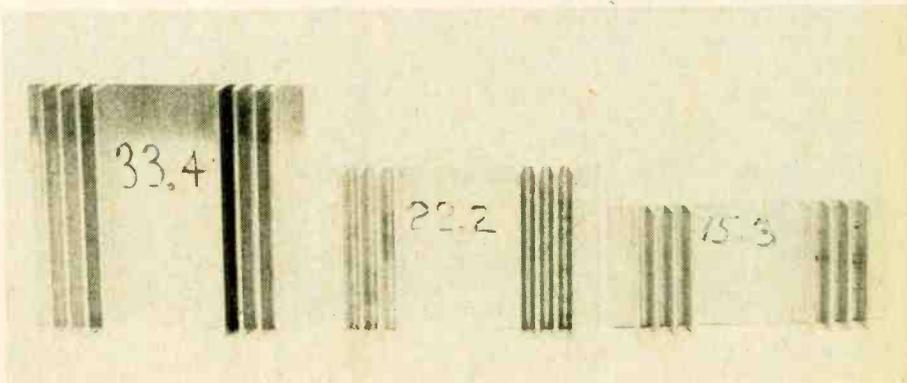
Though a small selection of popular integrated circuits is available in

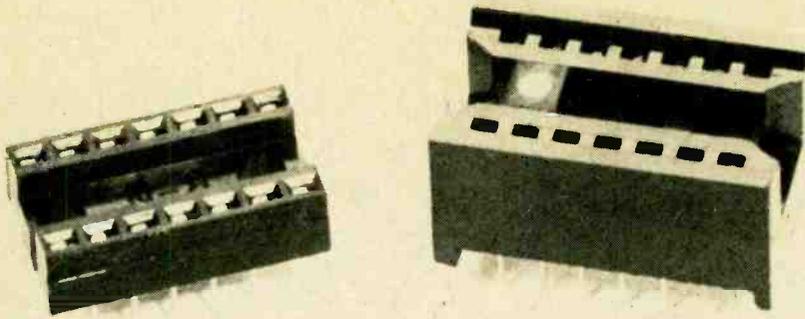
the job-rack lines such as HEP, RCA and Calectro, and under the Radio Shack label, the most complete assortment of specialized ICs is to be found with smaller "surplus" and specialized dealers who usually take small advertisements in the hobbyist publications: Circuit Specialists, Poly-Paks, Solid State Sales, ADVA Electronics, Digi-Key, James, Altaj and Value-Pak. Keep these names in mind because they also handle a good assortment of oddball items such as heat sinks, LEDs, keyboards and capacitors, just to name a few.

**Digging Up Caps.** Capacitors often represent a substantial part of a project's total cost, and unusual values are not the easiest things to locate. Calectro and Sprague have a rather complete assortment of capacitors from Mylar to ceramic to electrolytic which are job-racked at local parts distributors. Calectro also provides different types of variable capacitors, as does Radio Shack, which has what is probably the most extensive assortment of "hobbyist" capacitor types and values. Large assortments of the usual and not-so-usual "standard brand" capacitors are also available from mail order houses such as Lafayette and Burstein-Applebee.

When your projects require the highest quality capacitor, such as tantalum, there's Allied Electronics, among other standard brand houses, though you will most often get the most for your money from the "surplus" dealers—assuming they stock the values you need.

Coils have always been a problem for the hobbyist, now more than before. If you need to wind your own coils, standard hobbyist needs are to be found among the coil forms in the Calectro and Radio Shack lines, along with experimenter type coils such as





Things do go wrong, so ICs should always be connected into a circuit through a socket. Both sockets shown are for the 14 pin DIP. The one on the left is called low profile. Either serves the purpose as far as the hobbyist is concerned. The low profile model is generally used where space is at a premium.

transistor IFs, broadcast band ferrite antennas, etc. When you need a specific coil such as the ones from J. W. Miller, which are used in many experimenter projects, you will probably find the one you need in the Lafayette, B-A and Allied Radio catalogs. Each does not necessarily stock the same Miller coils as the others, so you will need catalogs from all three. J. W. Miller also job-racks for local distributors, though the stocking distributors might be few and far between.

If a project you're building calls for a North Hills or Cambion form or coil, head straight for the nearest Miller dealer; he has the necessary cross-index. When it comes to coils and forms, if it's not in the Calectro, Radio Shack and J. W. Miller lines you probably won't be able to get it. If your project calls for an amateur radio type form or coil such as B&W, or a torroid coil, turn to the ads in the back pages of the ham magazines—that's your best bet.

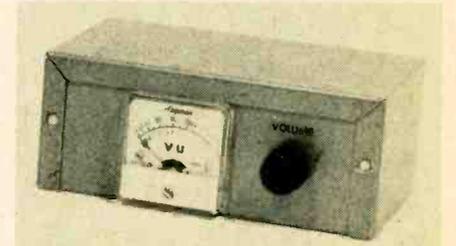
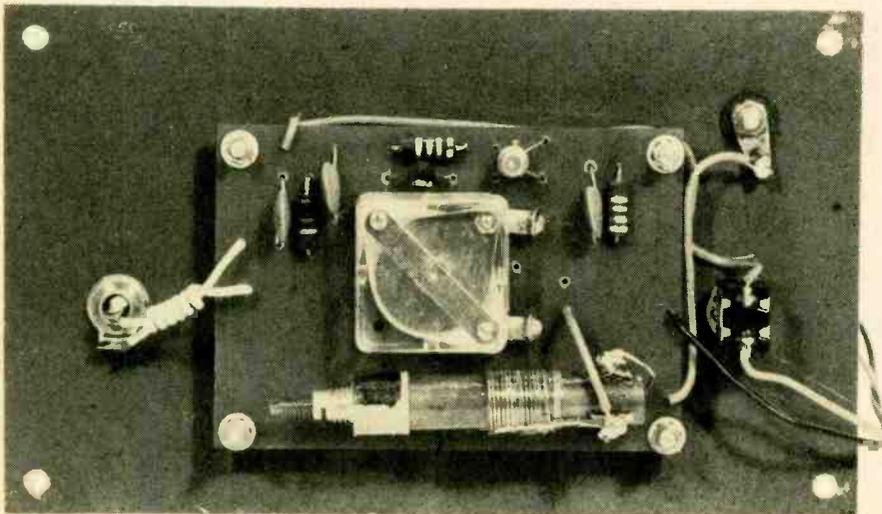
Once you get past the transistors

and coils any hobby project should be a piece of cake. Controls of any variety are available from just about any parts source, as are resistors and standard-voltage filament transformers—6.3, 12, 24 (25.5)—which can be used for solid-state power supplies. If you need some special transformer voltage or a high current rating, it's almost a wipe-out. The blister pack outfits have yet to discover any voltage other than the three previously mentioned. Standard brand power transformers of various voltages and current capacities are available from the mail order houses, but at a stiff price. Two sources of unusual power transformers at virtually rock bottom prices are the yellow pages of the B-A catalog and McGee Radio. On the other hand, miniature and sub-miniature transistor audio transformers are now available blister-packed on job-racks, so you should be able to pick them up at your local distributor.

**Overruns: Super Cheap.** A really inexpensive source for discontinued models and manufacturers' overruns

on speakers and relays suitable for hobbyists are B-A and McGee; you'll often find the standard brand you're looking for, for pennies on the dollar. The same applies to meters. If you need a specific meter sensitivity, you can find the popular values in the Lafayette, Calectro and Radio Shack lines, as well as Calectro's "Brand X" label. But if you're willing to take the meter sensitivity needed with some oddball scale calibration, or if you're willing to settle for an older, non-modern case, you can get some outstanding buys from the "surplus" houses which generally advertise in the back of amateur radio magazines. Another terrific source for odd equipment at budget prices is the local "strippers," smaller surplus dealers that buy up military surplus, old test gear, etc., and then strip the items into their components, selling off the screws, switches, jacks, meters, etc. The stuff is used, but often it's the only way to squeeze what is normally expensive hardware into your budget.

For example, you might pick up a ceramic switch suitable for a radio frequency project for a fraction of the



The complete "Remote Amplifier" including the two 9-volt batteries can be packaged in a 2 x 2 x 4-in. Minibox. If you're not used to "tight-quarters" assembly, use a larger cabinet such as a 3 x 4 x 5 in. size.

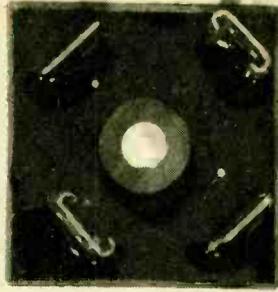
This "SWL Booster" can be assembled on a small printed circuit board. The board can then be secured to the metal panel of a standard plastic cabinet, as shown.

price it would cost at an industrial electronic parts distributor (assuming you could meet his minimum order price to begin with). You might also find waterproof switches and jacks which just aren't available to the hobbyist anymore, and possibly instrument cabinets for less than the cost of a modern control knob.

Speaking of cabinets, they are becoming more difficult to obtain, not to mention the cost. Metal cabinets can easily be the most expensive part of a project, assuming you can get what you need. In small sizes there are some excellent cabinet buys from the blister-packers, and standard mini-boxes from the mail order houses. But once you get to the larger sizes they are not only almost impossible to get, but extremely expensive (the cost of some popular sizes has doubled in less than a year). Here's where your local surplus dealer comes in handy. From time to time he picks up job lots of cabinets: generally one size, sometimes two. If the cabinets are something like 3 x 4 x 5, 5 x 3 x 7 or 5 x 5 x 7, stock up. These are almost universal sizes—not too small and not too large—and if you can pick them up for less than \$3 you'll be way ahead of the game. (The 5 x 3 x 7 is perhaps the most popular hobbyist size and is presently listed for almost \$5.)

Speaking of stocking up, you can really save a bundle by buying bargains before you need them. For example, a couple of ordinary 1/2-watt resistors will cost from 25 to 30 cents when blister-packed. But you can often buy an assortment of "standard" resistor values for \$2, \$3 or \$4, depending on whether there's fifty or a hundred pieces in the assortment. Similarly, if you purchase specials, or in reasonable quantity, a 90-cent capacitor becomes 12 or 13 cents. A few capacitor values can handle most solid-state projects. Use a 25 VDC rating and stock up on a few 2.2  $\mu$ F, 10  $\mu$ F, 47 (50)  $\mu$ F, 100  $\mu$ F and perhaps 1000 and 2000  $\mu$ F for power supplies. You'll be amazed how

When a lot of heat sinking is required in a small space, you can use a double-finned sink, as shown at left. The black "color" of the anodized aluminum sink provides additional heat dissipation capacity.



If a silicon rectifier bridge has a hole in the center, a heat sink must be secured if you want to use the full rated capacity. Most often, the metal chassis is all that's needed for a bridge rectifier heat sink.

these few values cover most hobby needs. Sources for capacitor buys in reasonable quantity are Mouser and EDI.

**Other Specialties.** Special buys in switches, trim pots, panel lamps and other miscellaneous items which often run up a project's expense are available from B&F Enterprises and John Meshna, in addition to the surplus houses mentioned previously.

In short, what we're saying is to get as many "surplus" catalogs as you can, even if you must send a dime or a quarter. The savings will more than pay you back for the postage costs.

Sometimes a project will call for a crystal. Since these must usually be ground for a specific frequency you're better off getting the crystal from a manufacturer or major distributor. International Crystal is one of the best sources for the hobbyist.

And should you still be using tubes

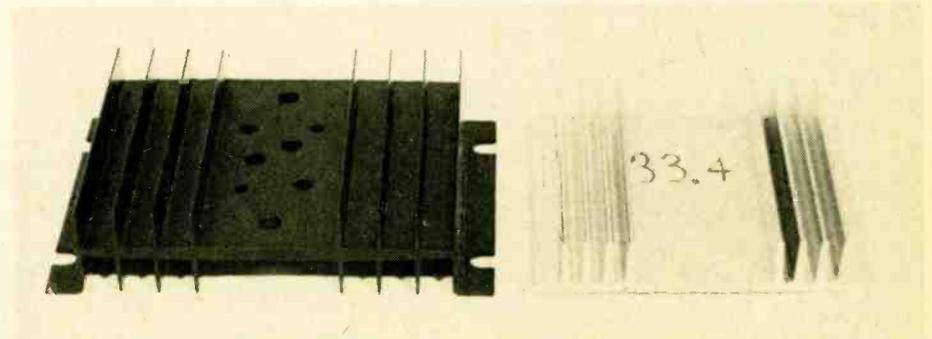
in projects, or need some for a repair job, you'll get a real low price from Cornell.

**Summing Up.** The way to insure that you get all the components you need for a project at the lowest possible cost is to assemble your own purchasing guide. Invest a few dollars in a three ring binder and a hole punch. Then send away for any catalog that's advertised. If a distributor doesn't advertise a catalog, at least ask to be placed on the mailing list. When you receive the catalogs or flyers, run through them for a mental picture of what components are available and from whom. Place small catalogs and flyers in the binder and keep the binder next to your standard catalogs from Lafayette, Allied Electronics, B-A, McGee, etc., so you have a centralized "purchasing library." For maximum convenience, make up a single page list of what is available from whom, so you can go directly to the catalog you need. For example, a few typical entries might be: Digital and Linear ICs—Solid State Sales; Replacement Transistors—HEP, SK, Radio Shack, Calectro; Electrolytics—Mouser; Scientific—Edmund Scientific, etc.

You will find these sources stock virtually any component called for in a hobbyist project, and you'll probably wind up with the least expensive components.

Just ordinary common sense in construction and checkout will insure success. Keep in mind that we'd like to hear from you concerning your favorite projects and circuits, possible modifications you develop through experimentation, and any thoughts you might have on 101 ELECTRONIC PROJECTS.

Now plug in that soldering iron, pick up the long nose pliers and get going—time's a-wasting! ■



## 1 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,

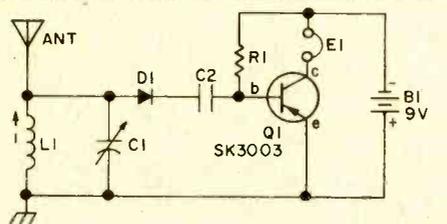
set C1's dial to the known frequency of a strong local station and adjust L1's slug until you hear the station in the phones.

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.

### PARTS LIST FOR CRYSTAL-TRANSISTOR RADIO

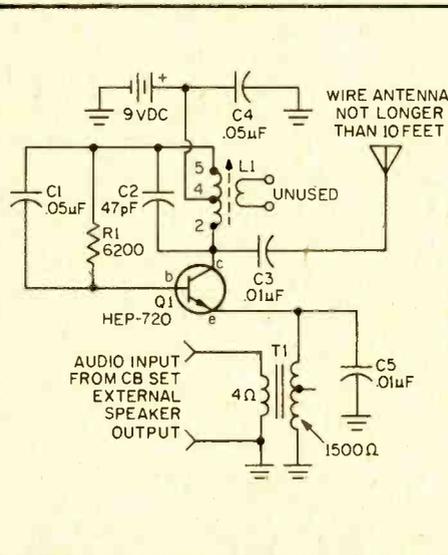
- B1**—9-V battery
- C1**—365-pF tuning capacitor
- C2**—0.2- $\mu$ F, 10-VDC capacitor
- D1**—1N60 diode
- E1**—Hi-impedance magnetic earphone (Calectro J4-825)
- L1**—Ferrite antenna coil
- Q1**—SQ3003 (RCA)
- R1**—100,000-ohm, ½-watt resistor



## 2 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 instantly 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 in-



### PARTS LIST FOR COMMUNICATIONS REBROADCASTER

- C1, C4**—0.05- $\mu$ F disc capacitor, 50 DC or better
- C2**—47-pF silver mica capacitor, 100 VDC or better
- C3, C5**—0.01- $\mu$ F disc capacitor, 50 VDC or better
- L1**—Oscillator coil, Miller 2022 (Do not substitute)
- Q1**—NPN transistor, HEP-720
- R1**—6200-ohm, ½-watt resistor, see text
- T1**—Output transformer, 4 ohms to 1000 or 2500 ohms

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

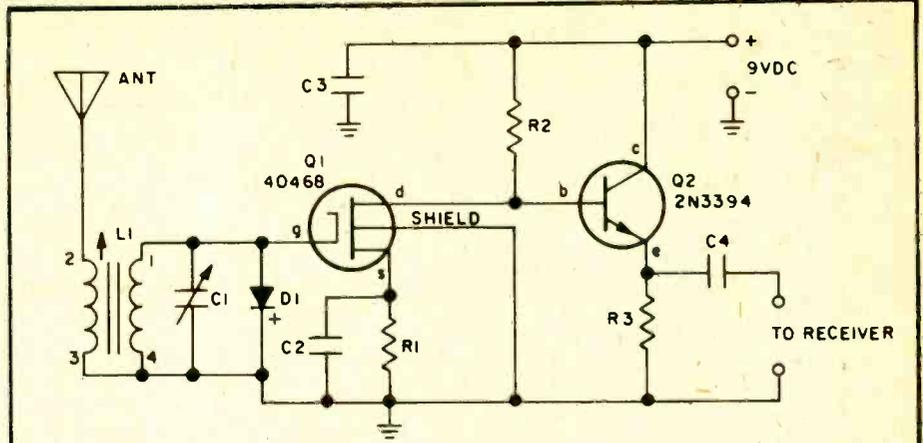
# 3 SWL's FET Booster

□ 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-uF, 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, 1/2-watt resistor
- R2—2400-ohm, 1/2-watt resistor
- R3—4700-ohm, 1/2-watt resistor

# 4 Flood Monitor

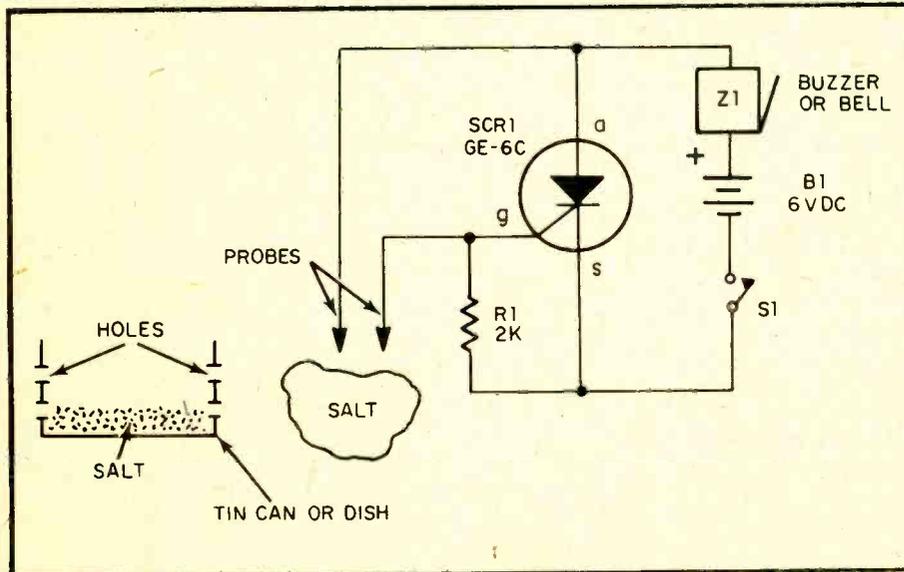
□ Basements are no longer basements: they are now playrooms, workshops, Ham and CB shacks, and hobby rooms, with a lot of expensive electronic equipment and furnishings that can be damaged if a water pipe breaks or the washing machine overflows.

This flood monitor will warn you instantly of water flooding by sound-

ing an alarm bell. When water mixes with a small pile of salt the resulting puddle shorts the probes, thereby applying a trigger to SCR1's gate. The SCR fires, closing the alarm buzzer or bell circuit. Any sensitive-gate SCR such as the GE C6 series can be used.

The salt can be placed in a small metal can about the size of a small

ash tray. Drill a series of holes around the can as close as possible to the bottom. Secure the probes so they are suspended right above the salt. Any water flowing into the can will mix with the salt and cause a conducting puddle that will rise to the probes. The probes can be about 1/4-in. of exposed solid insulated wire. The wires can be taped to the side of the can, just as long as the exposed tips don't contact the can.



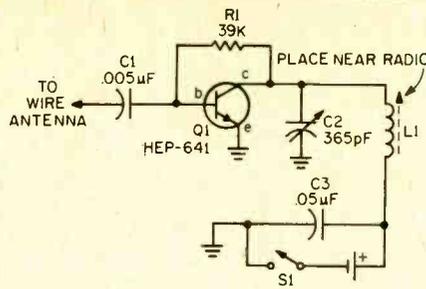
## PARTS LIST FOR FLOOD MONITOR

- B1—6-volt lantern battery
- R1—2000-ohms, 1/2-watt resistor
- S1—Spst switch
- SCR1—Silicon controlled rectifier, GE C6 10 volts PIV or higher (GE-C6 or equiv.)
- Z1—6-volt alarm bell or buzzer

## 5 Pep Up a Pocket BCB

### PARTS LIST FOR PEP UP A POCKET BCB

- B1**—15-volt penlight AA battery
- C1**—0.005- $\mu$ F disc capacitor, 25 VDC or better
- C2**—365-pF miniature tuning capacitor with dial
- C3**—0.05- $\mu$ F disc capacitor, 25 VDC or better
- L1**—Loopstick for C1
- Q1**—NPN transistor, HEP-641, Calectro K4-501, or equiv.
- 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

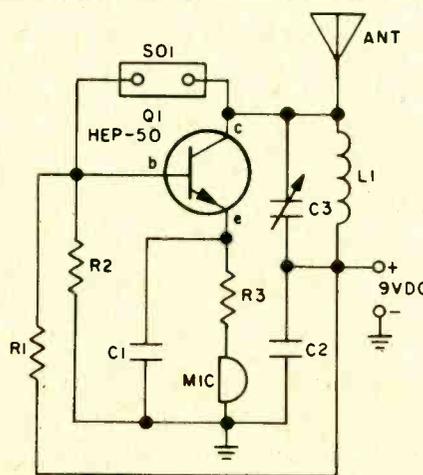
broadcast band DX'ing with that pocket portable the bank gave you when you opened an account.

Assemble the unit in a small plastic cabinet with coil L 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 lopstick 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.

## 6 Flea Power CB

### PARTS LIST FOR FLEA POWER CB

- C1, C2**—0.001- $\mu$ F, 50-VDC disc capacitor
- C3**—60-pF trimmer capacitor
- L1**—10 turns #16 enameled wire wound on  $\frac{3}{8}$ -in. form, spaced 1 in. end to end
- MIC**—Carbon microphone element
- Q1**—HEP-50 npn transistor
- R1**—47,000-ohm,  $\frac{1}{2}$ -watt resistor
- R2**—10,000-ohm,  $\frac{1}{2}$ -watt resistor
- R3**—330-ohm,  $\frac{1}{2}$ -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 type) battery.

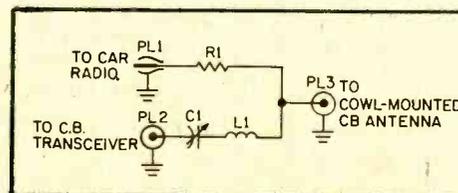
## 7 Get BC from a CB Antenna

□ 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-mounted CB whip, install the CB duplexer 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 duplexer 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



### GET BC FROM A CB ANTENNA

- C1**—40-pF trimmer capacitor
- L1**—RF choke, Ohmite Z-144 or equiv.
- R1**—560-ohm,  $\frac{1}{2}$ -watt resistor

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

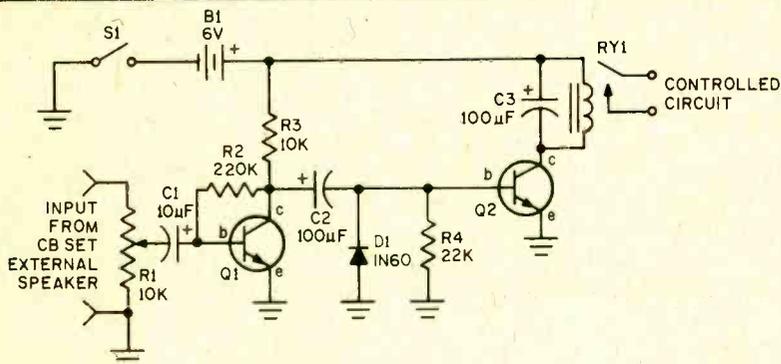
would short-out. Instead, the broadcast signals pass through R1 to the car radio.

Build the duplexer 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

# Walkie-T for RC



**PARTS LIST FOR WALKIE-T FOR RC**

- B1**—6-volt lantern battery
- C1**—10-uF electrolytic capacitor, 15 VDC or better
- C2, C3**—100-uF electrolytic capacitor, 15 VDC or better
- D1**—Germanium diode, 1N60 or equiv. such as Calectro KA-550

- Q1, Q2**—NPN transistor, 2N3394
- R1**—10,000-ohm potentiometer (Calectro B1-683)
- R2**—220,000-ohm, ½-watt resistor
- R3**—10,000-ohm, ½-watt resistor
- R4**—22,000-ohm, ½-watt resistor
- RY1**—6-volt relay

Just a CB walkie-talkie and this radio control unit is all it takes to remote start a tape recorder, trip a concealed camera, sound an alarm, or, well, do just about anything that has to be done over relatively long, wireless control distances.

The radio control senses the audio output of the walkie-T, causing relay Ryl to close. Those Ryl contacts operate the tape recorder, camera tripper, etc. Audio output from a walkie-talkie, such as is available at the remote speaker output, is connected across sensitivity control R1. When the walkie-talkie receives a modulated, sustained signal such as the sound "ah-h-h-h," relay Ryl closes and remains closed as long as the sound is sustained.

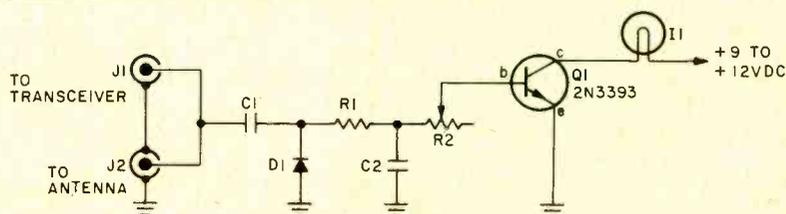
The unit should be assembled in a metal cabinet. Adjust sensitivity control R1 slightly higher than needed for dependable triggering by the received sound.

## 9

# 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



**PARTS LIST FOR THE CB MODULATION LAMP**

- C1**—5-pF, 500 VDC ceramic disc capacitor
- C2**—100-pF, 500 VDC ceramic disc capacitor
- D1**—Germanium diode, 1N60 or Calectro K4-550
- I1**—6 or 8-volt, 30 to 60 mA

- miniature lamp (Calectro E2-475 or equiv.)
- J1, J2**—Coaxial jack
- Q1**—NPN transistor, 2N3393 or equiv. (see text)
- R1**—10,000-ohm, ½-watt resistor
- R2**—10,000-ohm potentiometer

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

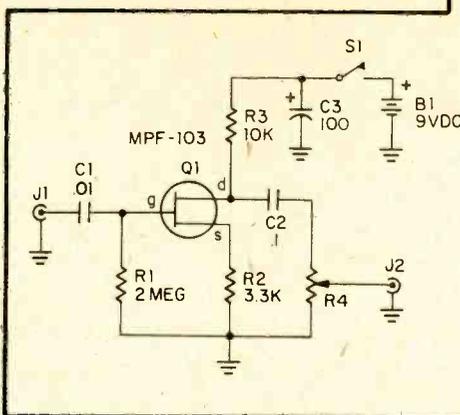
gardless of R2's adjustment, substitute a higher gain transistor for Q1 (try a 2N3392).

# 10

## 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.



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 milliam-

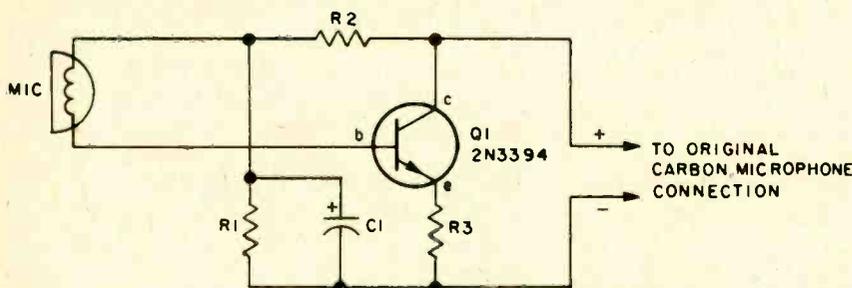
### PARTS LIST FOR TALK POWER BOOSTER

- B1—9-volt battery (Type 2U6 or equiv.)
- C1—0.01-uF capacitor
- C2—0.1-uF Mylar capacitor
- C3—100-uF, 10 VDC capacitor
- J1, J2—Jacks to match existing microphone equipment
- Q1—FET, Motorola, MPF-103
- 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

peres. 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.

# 11

## Dynamic Mike Matcher



### PARTS LIST FOR DYNAMIC MIKE MATCHER

- C1—10-uF, 10-VDC electrolytic capacitor
- MIC—Microphone magnetic replacement element
- Q1—2N3394 npn transistor
- R1—2200-ohm, ½-watt resistor
- R2—6800-ohm, ½-watt resistor
- R3—240-ohm, ½-watt resistor

□ Good pitching beats good hitting—and a good magnetic mike beats a good carbon mike. This one-transistor carbon microphone converter

takes a carbon mike input and converts it to the magnetic variety.

Note that no ground connection is used, even if the circuit is built in a metal cabinet. MIC is a replacement-type magnetic element that is substituted for the original carbon element. Using miniature components the entire converter amplifier can also be housed in the original microphone case.

To avoid destruction of Q1, the unit must be connected properly the first time. The "+" lead, which goes to Q1's collector, connects to the carbon mike input that supplies a positive voltage.

# 12

## SWL's Crystal Marker

□ Can't find that rare, weak SW signal from Lower Slobbovia? You will if you use this SW frequency spotter. Obtain crystals on or near your favorite SW stations, plug 'em into the spotter and you'll transmit powerhouse markers on the shortwave

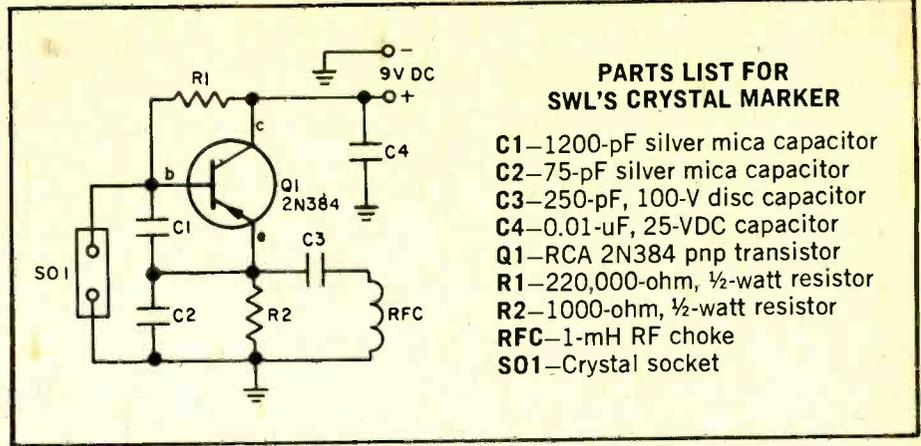
bands. If your receiver has a BFO it will sound a loud *beep* when you tune the spotter's signal. With no BFO, simply tune around the frequency until the receiver gets deathly quiet. Either way, you'll calibrate your receiver with great accuracy.

The spotter can be assembled on a small section of perfboard with flea clips for tie points. For good performance, all components must be firmly mounted and well soldered. A common 2U6 9-volt battery in the circuit will last for months, if not for

its total shelf life.

Crystals in this circuit are fundamental type, not overtone. Many low-cost surplus crystals are available, but even if you can't get the correct frequency, 25¢ might get you right next door. A few dollars for a new crystal will put you directly on frequency if you want the utmost accuracy.

A connection between the spotter and receiver is not needed. Simply position the spotter near the receiver antenna and start tuning until you find the marker signal.



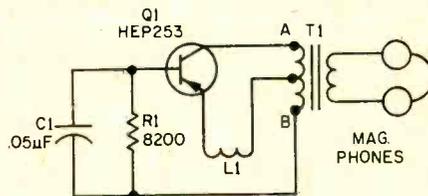
**PARTS LIST FOR SWL'S CRYSTAL MARKER**

- C1—1200-pF silver mica capacitor
- C2—75-pF silver mica capacitor
- C3—250-pF, 100-V disc capacitor
- C4—0.01-uF, 25-VDC capacitor
- Q1—RCA 2N384 pnp transistor
- R1—220,000-ohm, ½-watt resistor
- R2—1000-ohm, ½-watt resistor
- RFC—1-mH RF choke
- SO1—Crystal socket

# 13 Parasite CW Monitor

**PARTS LIST FOR PARASITE CW MONITOR**

- C1—0.05-uF disc capacitor, 50 VDC or better
- L1—2 to 6 turns on ½-in. form, see text
- Q1—PNP transistor, HEP-253
- R1—8200-ohm, ½-watt resistor
- T1—Miniature transistor transformer, 500 ohms center tapped to 500 ohms (Calectro D1-728 or equiv.)



Here's a self-powered CW keying monitor that doesn't require a direct connection to the transmitter or transmission line. Simply 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, ½-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 ½-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.

# 14 Basic Color Organ

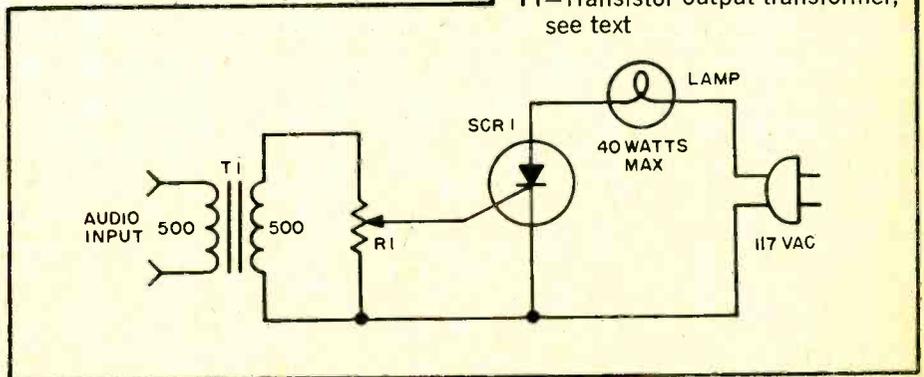
This simple color organ is certain to keep your party from becoming a drag. Connected to your hi-fi amplifier's speaker output (across the speaker terminals) it will throb in time to the music. Paint the bulb red or deep blue and your party room will take on the atmosphere of a rock club.

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, G.E.-X5
- T1—Transistor output transformer, see text

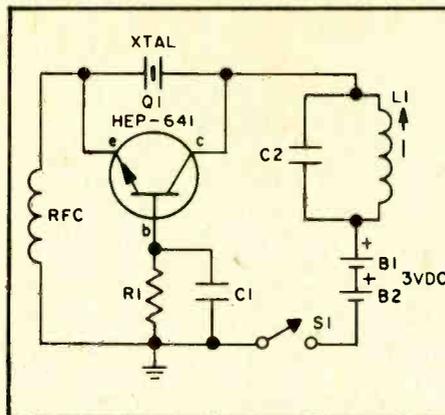


# 15 Standard 100 kHz Oscillator

Few shortwave receivers below the deluxe class have really accurate dial calibration. But with a 100-kHz frequency standard you'll know with great precision where the receiver is tuned.

The calibrator is a common-base oscillator producing sufficient signal through the air if constructed in a plastic cabinet. With a metal cabinet, a short antenna approximately 12-in. long should be connected to Q1's collector through a 50-pF capacitor. In some instances the antenna will have to be connected to the receiver antenna terminal.

Wiring is not critical and almost any layout will work. If the oscillator



## PARTS LIST FOR STANDARD 100 KHZ OSCILLATOR

- B1, B2—1.5-V AAA battery
- C1—0.01- $\mu$ F, 10-VDC capacitor
- C2—220-pF silver mica capacitor (Calectro A1-008 or equiv.)
- L1—Coil, 2-18 mH
- Q1—HEP-641 npn transistor (Calectro K4-051 or equiv.)
- R1—750,000-ohm,  $\frac{1}{2}$ -watt resistor
- RFC—2.5 mH RF choke
- S1—Spst switch
- XTAL—100-kHz crystal

doesn't start, change R2's value by approximately 20% until you get consistent oscillator operation. If you want to zero beat the crystal against station WWV, install a 50-pF trim-

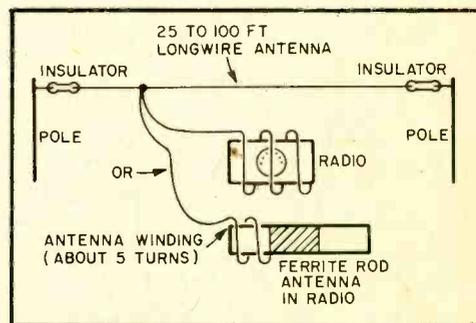
mer in series or in parallel with the crystal. Use whichever connection works since the specific crystal type determines the series or parallel connection.

# 16 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.



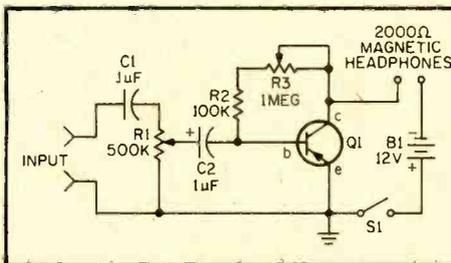
# 17 Hi Z Earphone Booster

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.



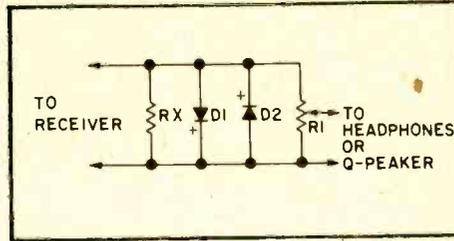
## PARTS LIST FOR HI Z EARPHONE BOOSTER

- B1—Battery, 12 volts (two RCA VS068 in series or equiv.)
- C1—0.1- $\mu$ F capacitor, 15 VDC or better
- C2—1- $\mu$ F electrolytic capacitor, 15 VDC or better
- Q1—PNP transistor, 2N2613 or equiv.
- R1—500,000-ohm audio taper potentiometer
- R2—100,000-ohm,  $\frac{1}{2}$ -watt resistor
- R3—1-Megohm potentiometer, any taper

# 18

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



### PARTS LIST FOR EARPHONE LIMITER FOR CW

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

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.

# 19

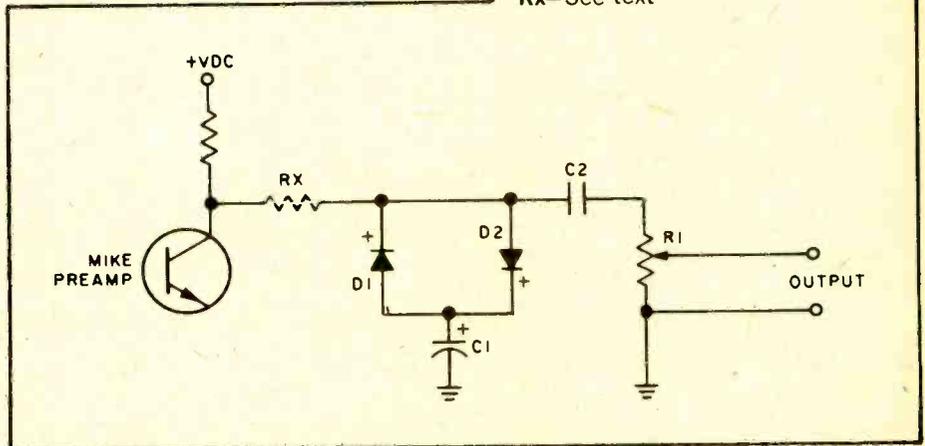
## Audio Peak Limiter

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.



### PARTS LIST FOR AUDIO PEAK LIMITER

- C1—100-uF electrolytic capacitor (see text)
- C2—0.1-uF capacitor
- D1, D2—1N60 diode or Calectro K4-550
- R1—50,000-ohm, audio taper potentiometer
- Rx—See text

# 20

## 29¢ Mag. Phone Filter

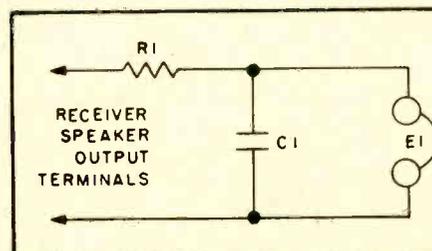
If you're tired of copying CW signals through the grind without a Q-multiplier on your receiver, the 29¢ Mag. Phone Filter is the next best answer. It's the cheapest route to greater selectivity.

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.

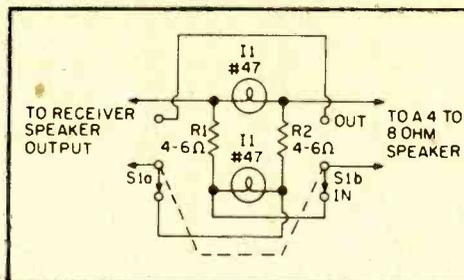


### PARTS LIST FOR 29¢ MAG. PHONE FILTER

- C1—0.005-.05-uF capacitor (see text)
- E1—2000-ohm magnetic headset (Calectro J4-825)
- R1—100,00-ohm, 1/2-watt resistor

## 21 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

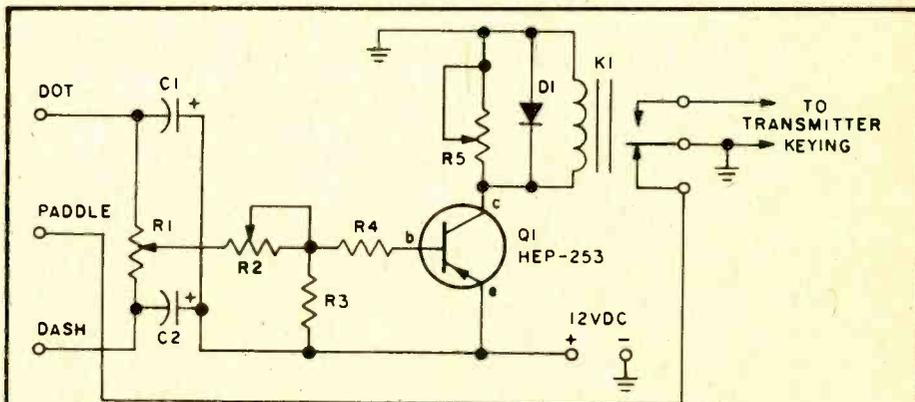
considering the low cost and ease of construction. Just about any enclosure, plastic or metal, can be used. The components can even lie on the table.

## 22 Ham's Electronic Keyer

This is not the equal of a \$50 electronic keyer, but it's a lot easier to use than an ordinary hand key.

When the paddle terminal connects to the dot terminal, C1 starts to charge. When C1's voltage causes Q1 to conduct, collector current pulls in relay K1, thereby keying the transmitter. When K1 grounds the paddle terminal, C1 discharges, causing Q1 to stop conducting and dropping out the relay. When K1's paddle connection is restored to ground the cycle repeats until the paddle is released.

Dashes work in similar fashion. Potentiometer R1 sets the dot-dash ratio, potentiometer R2 sets the speed. Potentiometer R5 drops out the relay just before Q1 stops conducting and has a slight effect on the dot-space ratio.



### PARTS LIST FOR HAM'S KEYS

C1—3- $\mu$ F, 6-VDC electrolytic capacitor  
C2—10- $\mu$ F, 6-VDC electrolytic capacitor  
D1—1N60 diode or Calectro KA-550  
K1—12-VDC relay (Calectro D1-967)

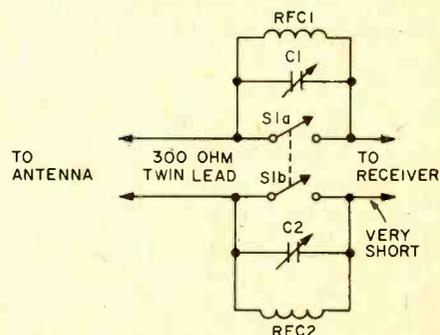
Q1—HEP-253 pnp transistor  
R1—10,000-ohm linear potentiometer  
R2—50,000-ohm potentiometer  
R3—1200-ohm, 1/2-watt resistor  
R4—560-ohm, 1/2-watt resistor  
R5—5000-ohm potentiometer

## 23 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

### PARTS LIST FOR THE KNOCKOUT FILTER

C1, C2—40-pF trimmer capacitor  
RFC1, RFC2—0.22- $\mu$ H RF choke, any type  
S1—Dpst slide switch  
Misc—300-ohm twinlead, metal cabinet



output and the receiver.

The filter *must* be assembled in a metal cabinet with ¼-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, tune in the offending station and use an insulated alignment screwdriver to adjust trimmer capacitors C1 and C2 for *minimum* signal strength.

## 24 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.

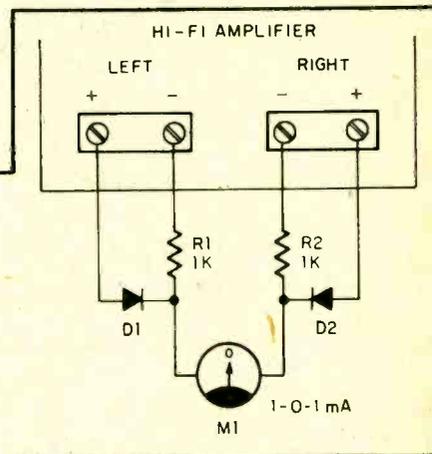
Meter M1 can be a zero-center DC milliammeter rated 1-0-1 mA or less. Alternately, you could use a standard meter but the pointer might be driven off-scale to the left while making adjustments, though the meter won't be damaged—it will just be an inconvenience.

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

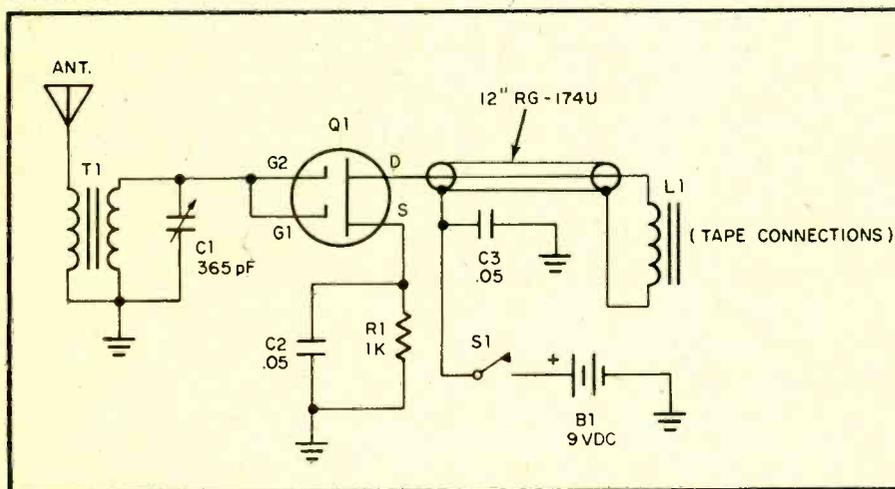
the left and right channel balance until meter M1 indicates zero; meaning the left and right output level are identical—that's balance.

### 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%



## 25 Wireless BC Booster



### PARTS LIST FOR WIRELESS BC BOOSTER

- B1—9-volt transistor battery
- C1—365-pF tuning capacitor (Radio Shack 272-1431 or equiv.)
- C2, C3—0.05-uF disc capacitor
- L1—Loopstick coil
- 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 protection 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 sig-

nal 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.

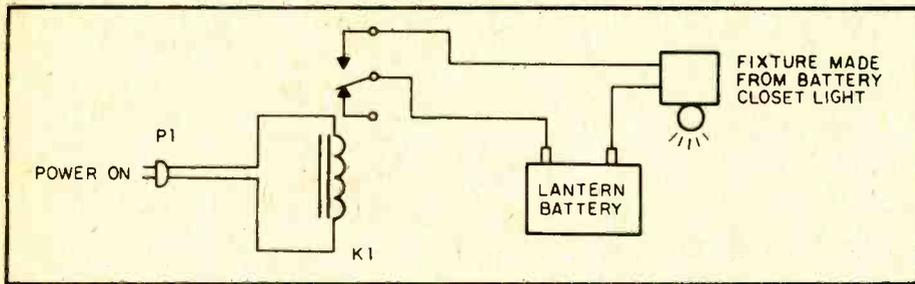
The antenna can be any length of wire from 3 feet or longer. If you use a metal cabinet connect the antenna into the circuit through an insulated binding post.

## 26 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 public 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.

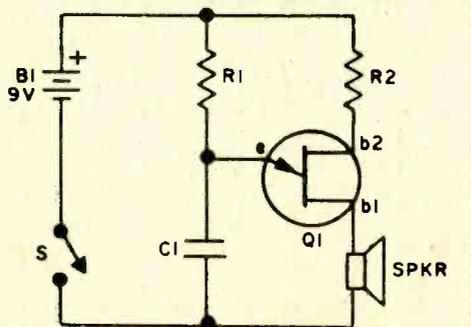
The lamp is one of those inexpensive battery-operated closet lamps sold by mail order houses. They normally work off two C-cells (3 volts), so you'll have to replace the bulb with a 6-volt flashlight or high intensity bulb. Don't try to use the existing batteries and bulb; the C-cells won't run long 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.

## 27 Mike Input Generator

### PARTS LIST FOR MIKE INPUT GENERATOR

- B1—Type 216 9-V battery
- C1—0.1- $\mu$ F, 50-VDC capacitor
- Q1—Unijunction transistor—HEP-310
- R1—10,000-ohm, 1/2-watt resistor
- R2—47-ohm, 1/2-watt resistor
- S1—Spst switch
- Spkr—8-ohm miniature speaker

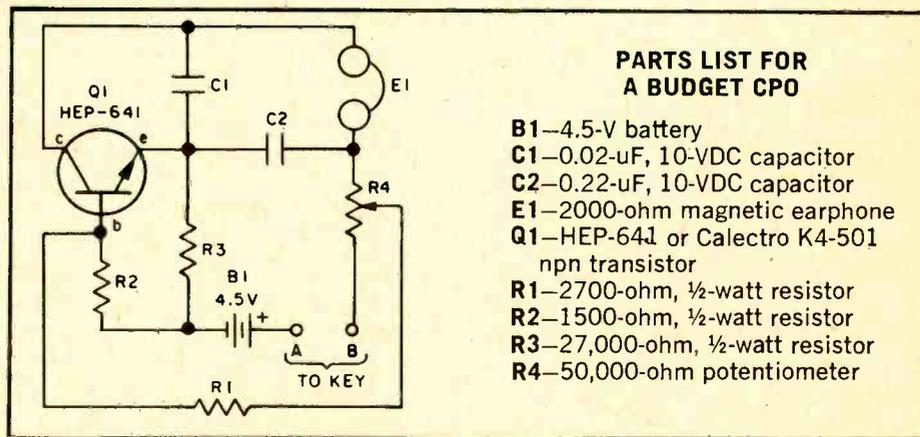


□ You can always feed an audio generator into a mike input to check an AF system, but how do you check the mike? Saying "woof, woof, hello, test" gets mighty tiring. Instead, clamp the generator to the front of the mike with a rubber band and you'll send continuous tone *through the mike*. It lets you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

## 28 A Budget 800-Hz CPO

□ Components you have lying about might make this simple, budget CPO (code practice oscillator). Using component values given, the tone frequency is approximately 800 Hz. It can be changed by substituting different values for C1 and C2, but maintain the same capacity ratio. That is, C2 should always be about 10 times larger than C1. Battery current drain is only about 1 milliamper.



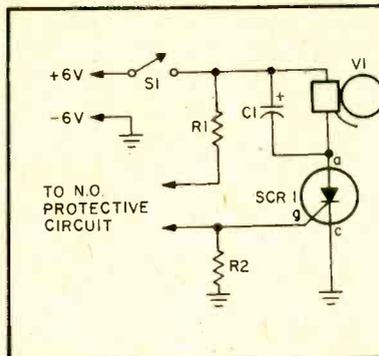
### PARTS LIST FOR A BUDGET CPO

- B1—4.5-V battery
- C1—0.02- $\mu$ F, 10-VDC capacitor
- C2—0.22- $\mu$ F, 10-VDC capacitor
- E1—2000-ohm magnetic earphone
- Q1—HEP-641 or Calectro K4-501 npn transistor
- R1—2700-ohm, 1/2-watt resistor
- R2—1500-ohm, 1/2-watt resistor
- R3—27,000-ohm, 1/2-watt resistor
- R4—50,000-ohm potentiometer

# 29

## 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.

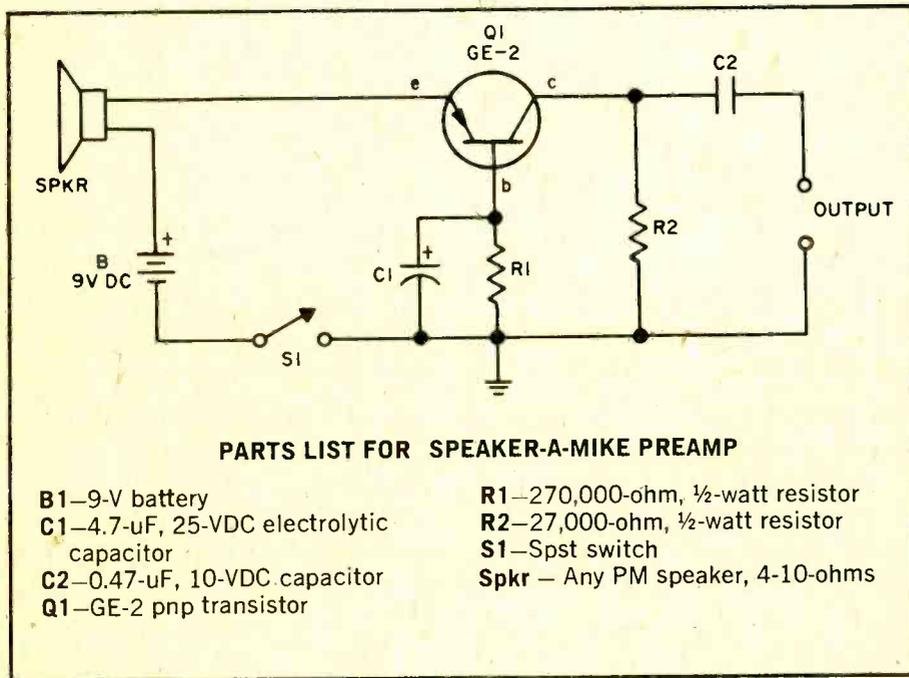


### PARTS LIST

- C1—47- $\mu$ F, 12 VDC electrolytic capacitor (Calectro A1-108 or equiv.)
- 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 (General Electric C106 series)
- V1—6 VDC alarm bell (Audiotex 30-9100)

# 30

## Speaker-A-Mike Preamp



### PARTS LIST FOR SPEAKER-A-MIKE PREAMP

- B1—9-V battery
- C1—4.7- $\mu$ F, 25-VDC electrolytic capacitor
- C2—0.47- $\mu$ F, 10-VDC capacitor
- Q1—GE-2 pnp transistor
- 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

□ 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- $\mu$ F capacitor at C2 allows the preamp to work into loads of 7000 ohms or higher.

# 31

## 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

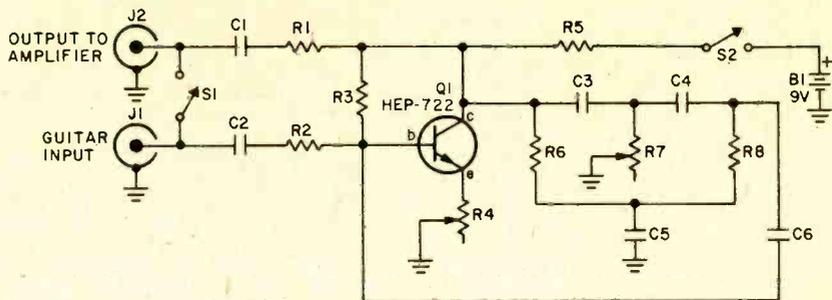
way up high. Just about any construction can be used. If you build it in a metal box, use a push switch for switch S1 and you'll be able to key the effect in and out with your foot.

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- $\mu$ F Mylar capacitor
- C3—.47- $\mu$ F Mylar capacitor
- C4—.02- $\mu$ F Mylar capacitor
- C5, C6—.01- $\mu$ F Mylar capacitor
- J1, J2—Phono jack
- Q1—NPN transistor, HEP-722 or 723
- R1, R2—22,000-ohm,  $\frac{1}{2}$ -watt resistor
- R3—470,000-ohm,  $\frac{1}{2}$ -watt resistor
- R4—2000-ohm trimmer potentiometer



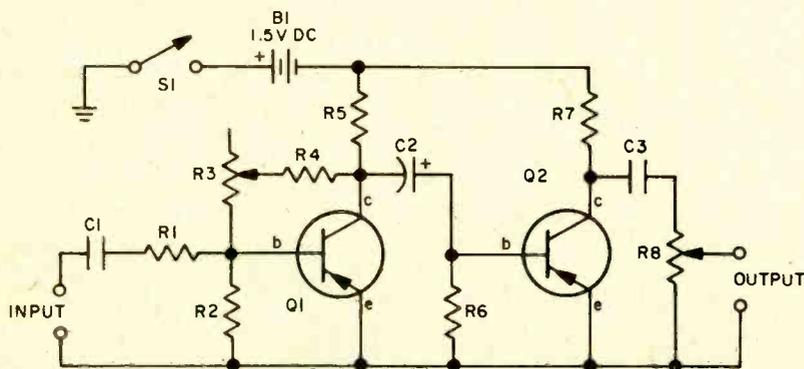
- R5, R6, R8—56,000-ohm,  $\frac{1}{2}$ -watt resistor

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

## 32 Fancy Guitar Fuzzbox

### PARTS LIST FOR FANCY GUITAR FUZZBOX

- B1—1.5-V AA battery
- C1, C3—0.1- $\mu$ F, 50-VDC capacitor
- C2—4.7- $\mu$ F, 10-VDC electrolytic capacitor
- Q1, Q2—pnp transistor—HEP-632
- R1, R6—22,000-ohm,  $\frac{1}{2}$ -watt resistor
- R2—18,000-ohm,  $\frac{1}{2}$ -watt resistor
- R3—1-megohm pot
- R4—100,000-ohm,  $\frac{1}{2}$ -watt resistor
- R5, R7—10,000-ohm,  $\frac{1}{2}$ -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.

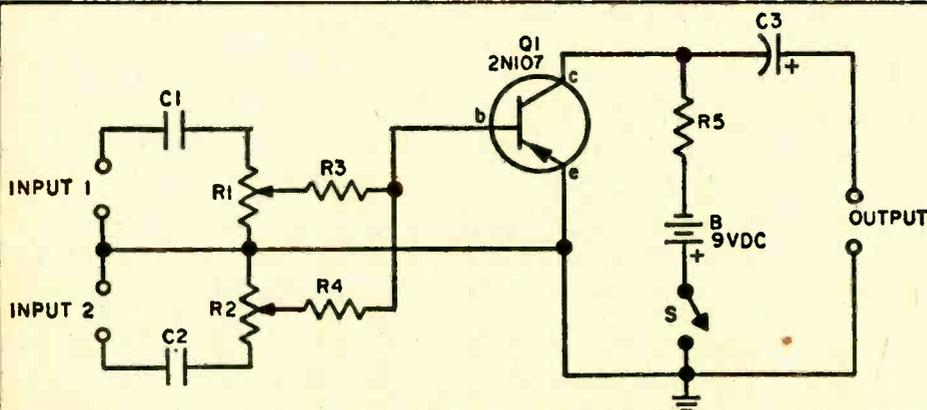
Since the fuzz effect cannot be completely eliminated by R3, fuzz-free sound requires a bypass switch from the input to output terminals.

The switch should completely disconnect the fuzzbox output; the input can remain in parallel with the bypass switch.

## 33 Budget Mike Mixer

### PARTS LIST FOR BUDGET MIKE MIXER

- B1—9-V battery
- C1, C2—0.1- $\mu$ F, 50-VDC capacitor
- C3—10- $\mu$ 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



□ 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.

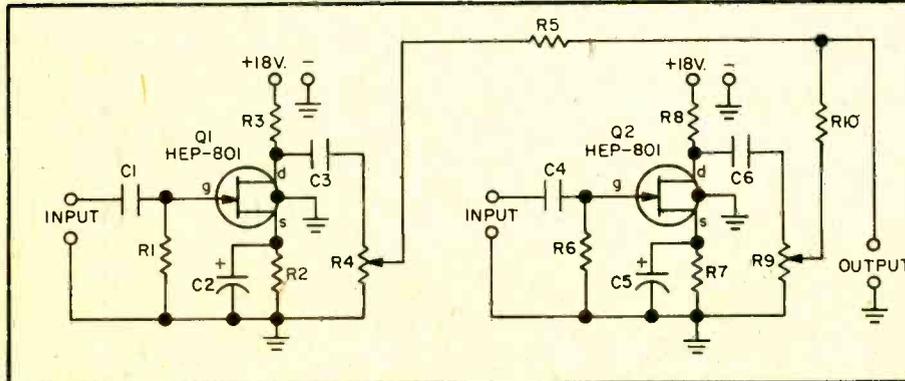
## 34 Hi-Fi Mike Mixer

□ For serious recording of anything other than speech and sound effects, two mikes are always better than one. Our hi-fi mike mixer does its mixing after amplification so the amplifiers compensate for the mixer loss first, thereby improving the signal-to-noise ratio as compared with simple mixers that mix first and amplify after the mixer.

Using FET semiconductors with their *high input* impedance, this basic mixer can be used with high impedance crystal and ceramic microphones. It does not attenuate low frequency response whatsoever through low impedance loading of the microphone. The mixer's response is 10 to 20,000 Hertz.

Two mixers can be built into the

same cabinet for stereo use. Even with two independent (stereo) mixers, current drain is on the order of a few milliamperes and two series-connected 2U6-type batteries can be used.



### PARTS LIST FOR HI-FI MIKE MIXER

- C1, C4—0.05- $\mu$ F, 50-VDC capacitor
- C2, C5—22- $\mu$ F, 10-VDC electrolytic capacitor
- C3, C6—0.1- $\mu$ F, 50-VDC capacitor
- Q1, Q2—HEP-801 or Calectro K4-634 FET transistor
- R1, R6—2-megohm, 1/2-watt resistor
- R2, R7—6800-ohm, 1/2-watt resistor
- R3, R8—560-ohm, 1/2-watt resistor
- R4, R9—500,000-ohm, audio taper potentiometer
- R5, R10—100,000-ohm, 1/2-watt resistor

## 35 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

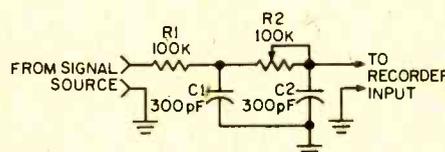
need to apologize. Just pass his records through the Tape Dubbing Filter and he'll never know *wh' hoppen'* to the noise—it will all be gone.

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, 50 VDC or better
- R1—100,00-ohms, 1/2-watt resistor
- R2—100,000-ohm potentiometer, any taper

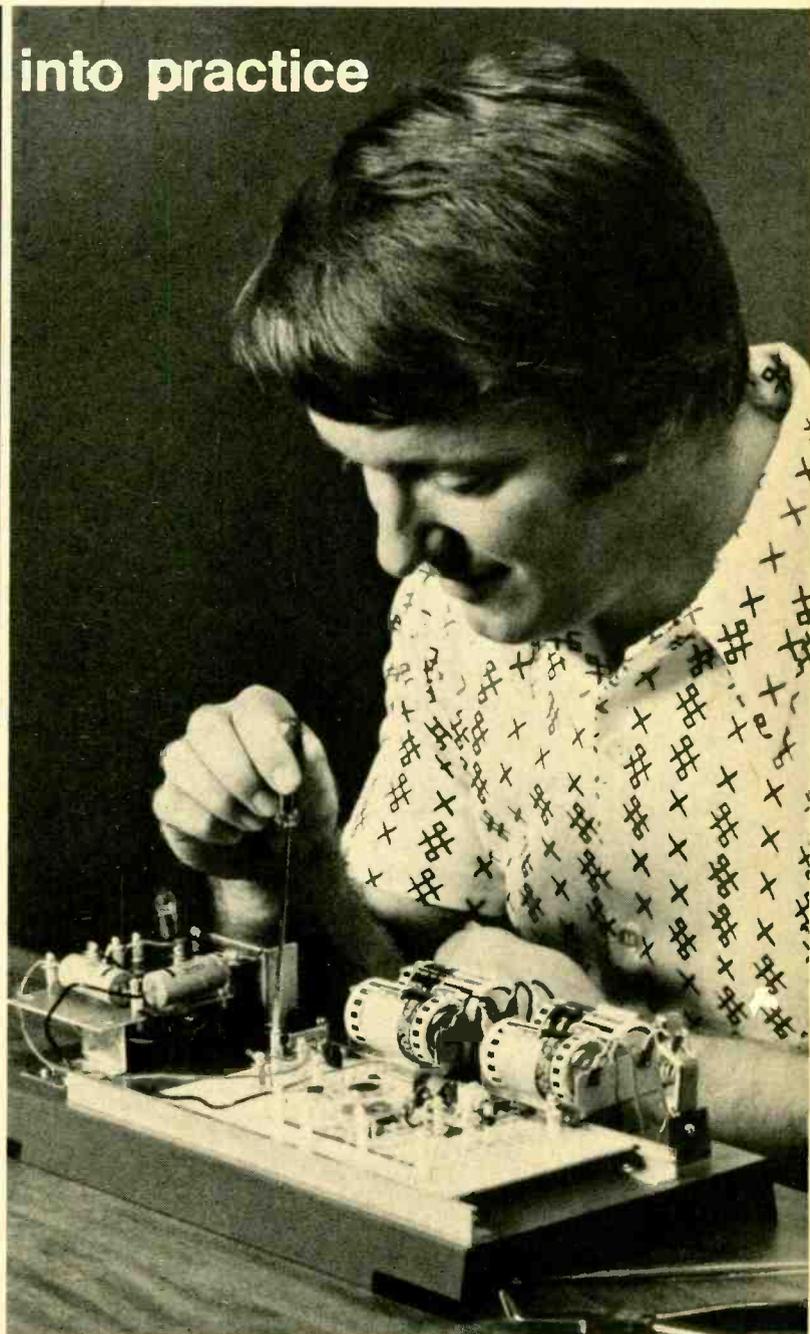


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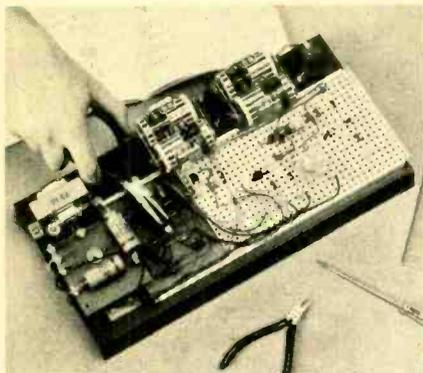
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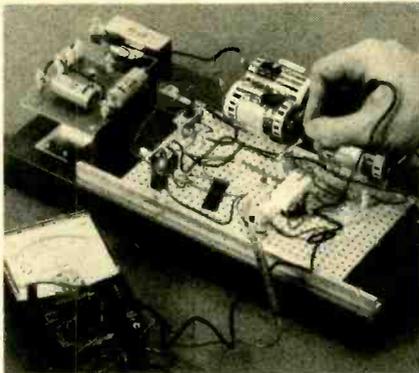
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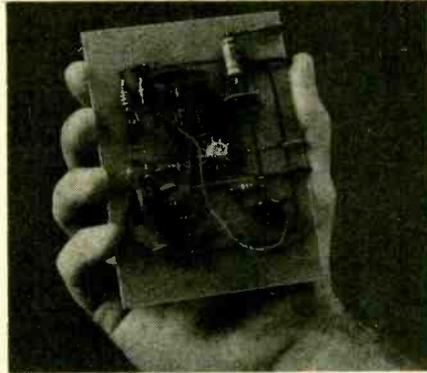
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# 36

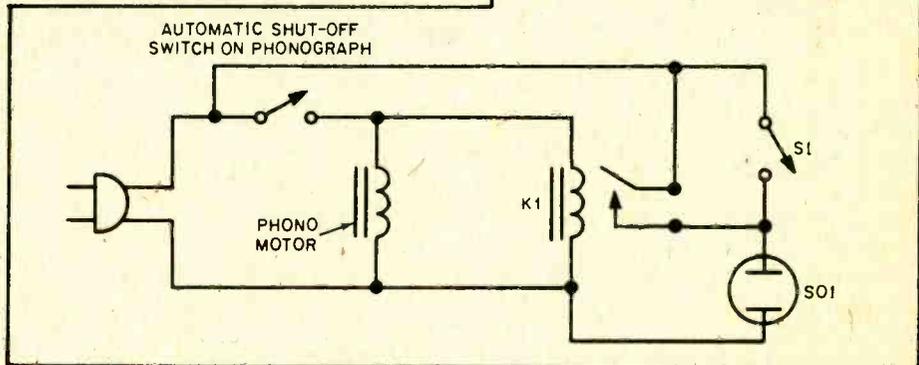
## Automatic Hi-Fi Shutoff

□ 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)

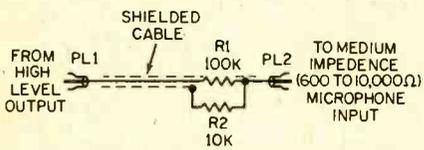


# 37

## 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, or from across the speaker, 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

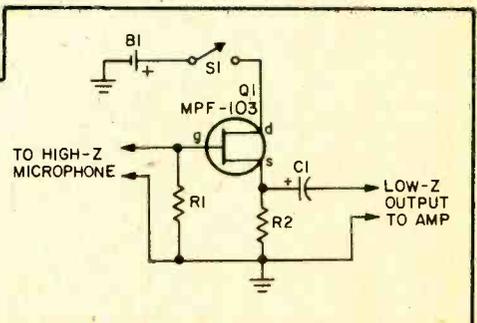
level. This recorder bridging cord provides about 50 dB attenuation in a single, easy-to-handle assembly. Connect resistor R1 in series with the shielded cable hot lead. Connect the free end of R1 to recorder plug PL2 and one end of resistor R2. Fold R2 back adjacent to R1 and solder the free end to 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.

# 38

## 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 (Calectro K4-634, Motorola MPF-103, etc.)
- R1—2-megohm, ½-watt resistor
- R2—150-ohm, ½-watt resistor
- S1—Spst switch



□ 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.

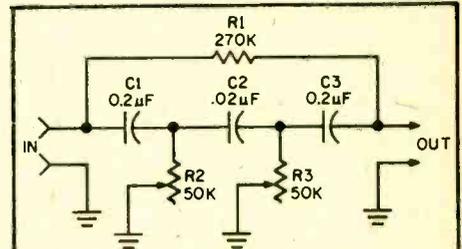
The output can be run into any microphone input-rated from 150-ohms up to high impedance. The cir-

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.

## 39 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- $\mu$ F mylar capacitor
- C2—0.02- $\mu$ F mylar capacitor
- R1—270,000-ohm, 1/2-watt resistor
- R2, R3—50,000-ohm potentiometer, linear taper

## 40 Headphone Control Box

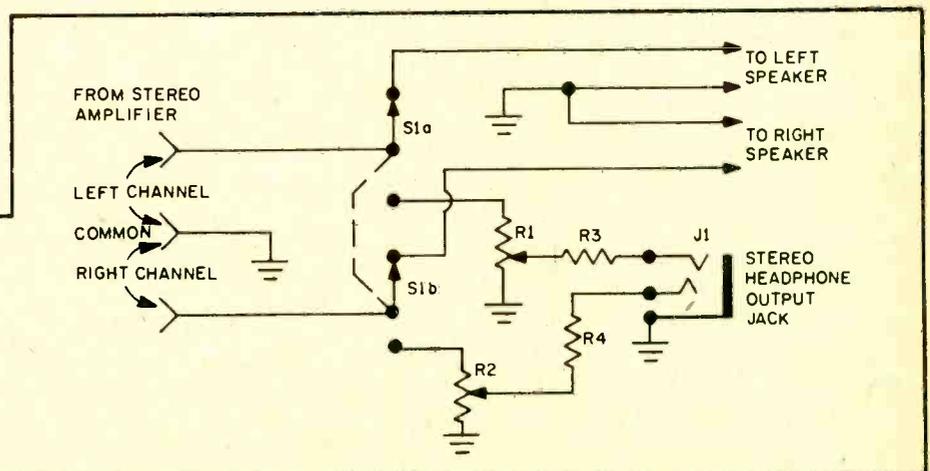
□ Even if your stereo set doesn't have a headphone output you can still get the intimate sound of headphone listening by adding this easy to build stereophone controller. Unlike a simple switching system, the controller has individual level controls for both the left and right cans (phones), thus allowing you to balance the phone volume without upsetting the amplifier control settings. When the speakers are re-connect-

ed by switch S1, the amplifier is at its normal volume level. Volume controls R1 and R2 should be wirewound types rated at least 2 watts if your stereo amplifier has a power output greater than 10 watts. If your amplifier's output is less than 10

watts, R1 and R2 can be any wirewound type rated 2 watts or less. Resistors R3 and R4 only serve to protect the phones against damage in the event you have the controls set for full volume when you switch to phone operation.

### PARTS LIST FOR HEADPHONE CONTROL BOX

- J1—Stereo phone jack
- R1, R2—50-ohm wirewound variable resistor, see text
- R3, R4—150-ohm, 1/2-watt resistor
- S1—Dpdt switch



# 41 Audio Z-Matcher

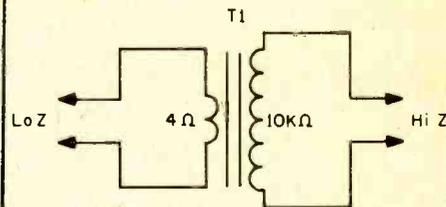
□ Headphone outputs aren't standard. On some equipment the phone output might be low impedance such as for hi-fi type headphones; on other equipment the phone output might be "high Z" such as 5000 or 10,000 ohms. Connect low-Z phones to a high-Z output and the volume level will fall to next-to-nothing, 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 terminals; 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.

## PARTS LIST FOR AUDIO Z-MATCHER

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

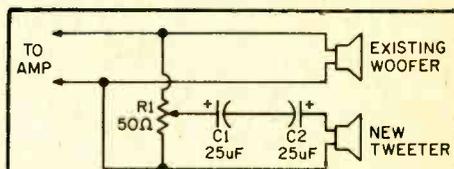


# 42 Add-A-Tweeter

□ 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

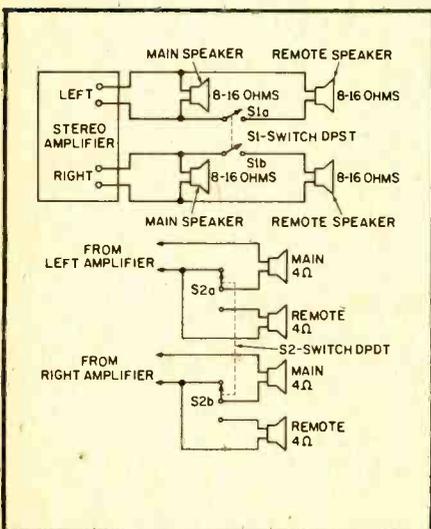
about 1500 Hz up to pass into the tweeter. By keeping the lows out of the tweeter, the highs come out cleaner, and there's no chance of the greater low frequency power "blowing" the tweeter. Potentiometer R1 is used to match the tweeter's output level to that of the woofer—because small speakers are 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-μF electrolytic capacitor, 50 VDC  
 R1—50-ohm wirebound potentiometer, 1 or 2 watts.  
 Misc.—Cone type tweeters such as the Lafayette 99-01562 are suitable for use with this circuit.

# 43 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.

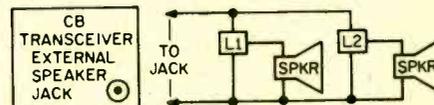
# 44 Remote Volume Control

□ Your CB rig, or SW receiver, or hi-fi amplifier 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

## PARTS LIST FOR REMOTE VOLUME CONTROL

- L1, L2—8-ohm L pad (Calectro 52-176 for stereo; Calectro 52-175 for mono, or equivalent)
- PL1—Plug to match your external speaker jack



speaker from full off to full on, without affecting the volume at the other speakers. Regardless of the imped-

ance of the speakers you're using, best results are obtained with 8 ohm L pads.

# 45 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.

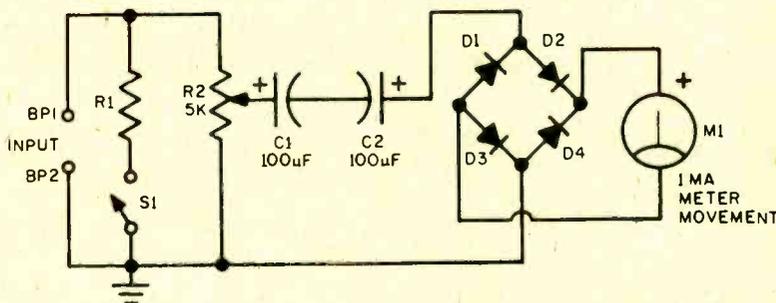
The meter scale must be hand calibrated, and will take some time and effort, but once done it's done for good. Remove the scale cover from meter M1 and borrow an AC variable autotransformer, or connect a 1000 Hz signal generator to the amplifier output. Connect the output of the autotransformer (or amplifier) 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- $\mu$ 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.

# 46 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 *mini-*

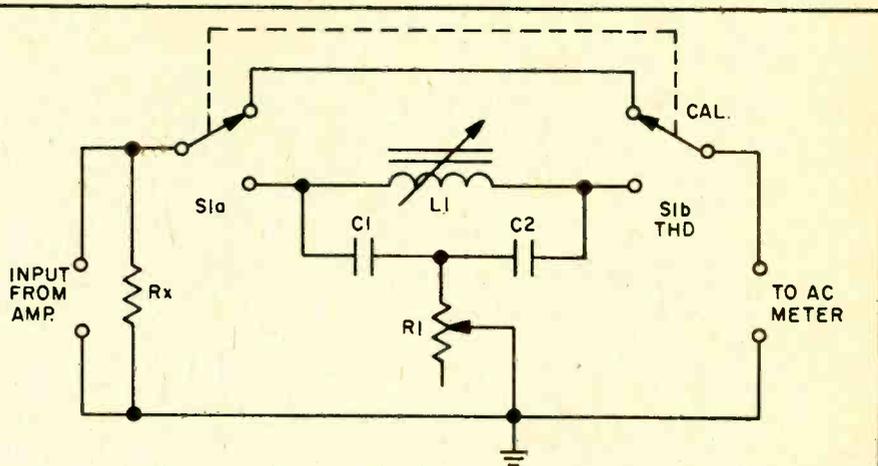
*um* meter reading.

The percent harmonic distortion is equal to the *minimum* reading divided by the *calibrate* reading x 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

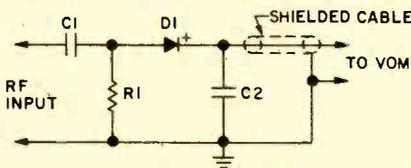
- C1, C2—0.01- $\mu$ F, 100-VDC capacitor, 5%
- L1—UTC VC-15 variable inductor (Do not substitute)
- R1—500,000-ohm pot
- R<sub>x</sub>—Amplifier load resistor (see text)
- S1—Dpdt switch



## 47 RF Probe for VOM

#### PARTS LIST FOR RF PROBE FOR VOM

- C1—500-pF, 400-VDC capacitor
- C2—0.001- $\mu$ F, disc capacitor
- D1—1N4149 diode
- R1—15,000-ohm, 1/2-watt resistor



□ Assemble this accessory in a metal can, add a shielded cable and you'll make relative measurements of RF voltages to 200 MHz on a 20,000 ohms-per-volt multimeter. RF voltage must not exceed approximately 100V, the breakdown rating of the 1N4149.

## 48 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.

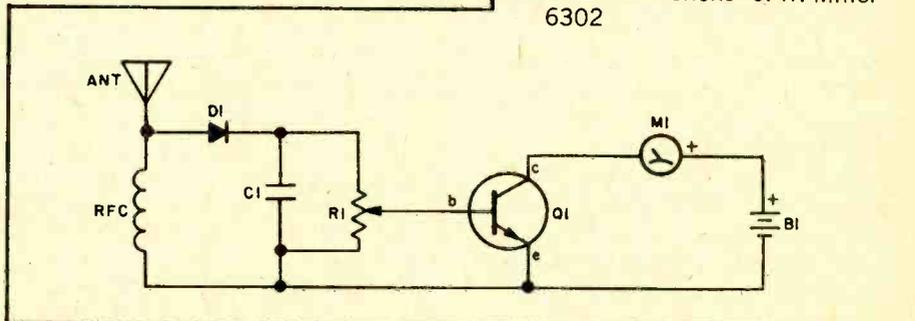
Dependable frequency range is approximately 3 to 30 MHz. A metal enclosure is recommended, with a stiff wire antenna about 6 in. long. For compactness, RFC should be a miniature 2.5-mH choke.

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.

#### PARTS LIST FOR TRANSISTORIZED FSM

- B1—1.5-V AA battery
- C1—0.001- $\mu$ F disc capacitor
- D1—1N60, Calectro K4-550 diode
- M1—0-1 mA DC meter
- Q1—nnp transistor—HEP-726
- R1—50,000-ohm potentiometer
- RFC—2.5-mH choke—J. W. Miller 6302



# 49

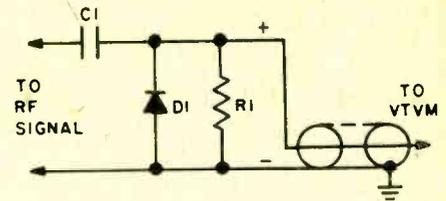
## RF Probe for VTVM

Three components are all that's needed to make a VTVM measure RF voltage up to 200 MHz (depending on the diode used). The probe should be built in a metal can with shielded wire for the connecting lead to the VTVM. Connect the shielded wire to the metal can and solder if possible.

The diode rectifies the RF voltage, while the capacity of the shielded ca-

### PARTS LIST FOR RF PROBE FOR VTVM

- C1—50-pF disc capacitor
- D1—1N60, Calctro K4-550 diode
- R1—20-megohm, ½-watt resistor



ble provides filtering. The output of the probe is positive, with the VTVM indicating the peak value of the RF waveform. To determine the RMS value, multiply the VTVM reading by 0.707. The maximum RF

voltage that can be applied is limited by the diode. A 1N60 is limited to 30V peak RF voltage. For higher voltage-handling capacity, substitute a higher voltage small signal detector diode.

# 50

## 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

### PARTS LIST FOR EASY FIELD STRENGTH METER

- C1—365-pF variable capacitor
- C2—.005-uF disc capacitor
- D1—1N60 diode
- J1, J2—Phone tip jack
- J1—Coil (see text)
- M1—0-1 mA DC meter

wire and frequency.

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

A 50- $\mu$ A meter, M1, provides maximum sensitivity combined with reasonably rugged construction.

# 51

## Slider for CB Receivers

A crystal-controlled CB rig with overtone crystals and an IF of 1300 to 1500 kHz can be converted to full 23-channel tuning with this adapter. It works on circuits where the crystal connects from oscillator grid to ground.

Use a 1-in. wood dowel for L1's form. Wind the coil as tightly as possible and stretch it to a length of 1 inch. Connection is made to the transceiver with the shortest possible length of RG-58A/U coaxial cable. The shield connects to the transceiver's chassis and to the bottom end of L1.

Set C3 so its plates are fully

closed, then adjust C2 until channel 1 is received. Depending on the IF frequency, C3 might tune slight more or less than the full band. If so,

change C1's value very slightly to obtain only 23-channel coverage with C3. Making C1 smaller narrows the tuning range.

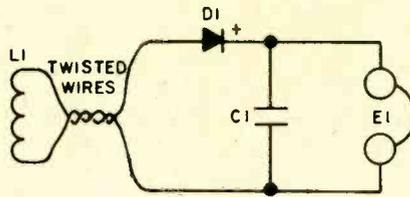
### PARTS LIST FOR SLIDER FOR CB RECEIVERS

- C1—10-pF silver mica capacitor
- C2—40-pF trimmer capacitor
- C3—30-pF variable capacitor
- C4—47-pF disc capacitor
- L1—Coil, 5 turns #16 enameled wire wound on 1-in. dia. form. Spaced 1 in. end to end

## 52 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 1½-in. dia. form, use any thin gauge wire



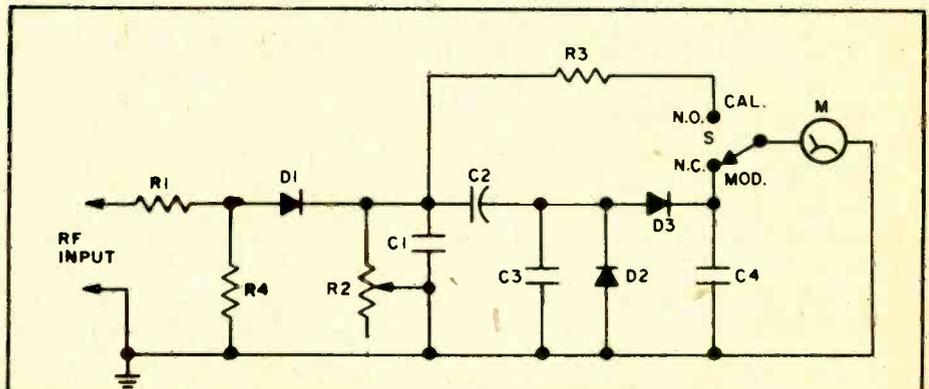
□ This simple modulation monitor for AM ham transmitters requires no connection to the transmitter. Just position the loop near the final tank or antenna matching coil until the signal is heard in the headphones.

## 53 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

- |  |                                  |
|--|----------------------------------|
| <b>C1</b> —500-pF, 100-VDC capacitor                             | (Alco P-1000 or Calectro D1-939) |
| <b>C2</b> —10- $\mu$ F, 10-VDC electrolytic capacitor            |                                  |
| <b>C3</b> —200-pF, 100-VDC capacitor                             |                                  |
| <b>C4</b> —300-pF, 100-VDC capacitor                             |                                  |
| <b>D1, D2, D3</b> —1N60 or Calectro K4-550 diode                 |                                  |
| <b>M1</b> —0-1 mA DC high-speed meter                            |                                  |
| <b>R1, R4</b> —1000-ohm, ½-watt resistor                         |                                  |
| <b>R2</b> —1000-ohm pot (Calectro B1-660)                        |                                  |
| <b>R3</b> —910-ohm, ½-watt resistor, 5%                          |                                  |
| <b>S1</b> —Spdt spring-return switch (Calectro E2-115 or equiv.) |                                  |

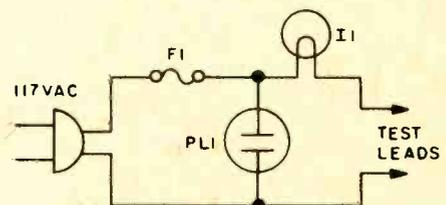
## 54 Appliance Tester

□ 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

### PARTS LIST FOR ALLIANCE TESTER

- F1**—Fuse to match load
- I1**—50-watt lamp
- PL1**—AC receptacle



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.

## 55 455 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- $\mu$ F, 25-50-VDC capacitor  
**C2**—47-pF silver mica capacitor (Calectro A1-004 or equiv.)  
**C3**—15-pF silver mica capacitor  
**L1**—3.4-5.8 mH RF coil (J.W. Miller 21A473RB1)  
**Q1**—GE-5 npn transistor  
**R1**—330,000-ohm,  $\frac{1}{2}$ -watt resistor  
**R2**—5000-ohm, pot (Calectro B1-680) resistor  
**XTL**—455-kHz crystal

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

immediate and consistent starting each time the power is applied.

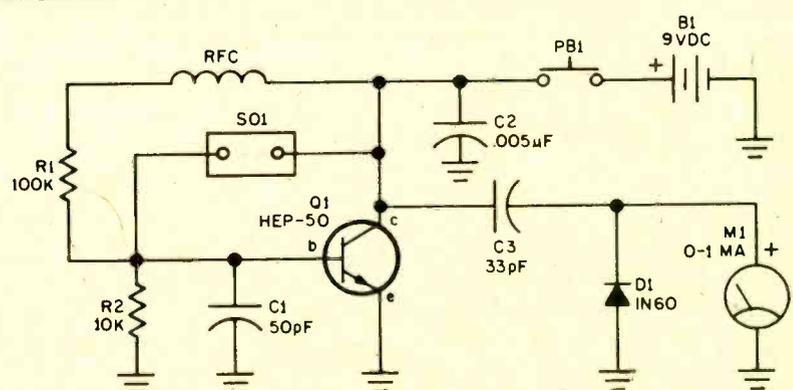
## 56 Test Osc. for Crystals

### 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- $\mu$ F disc capacitor, 25 VDC or better  
**C3**—33-pF disc or mica capacitor, 100 VDC or better  
**D1**—Diode, 1N60 or Calectro K4-550  
**M1**—Meter, 0-1 mA DC (Calectro D1-905 or equiv.)  
**PB1**—Normally open push button switch  
**Q1**—NPN transistor, Calectro K4-510  
**R1**—100,000-ohm,  $\frac{1}{2}$ -watt resistor  
**R2**—10,000-ohm,  $\frac{1}{2}$ -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

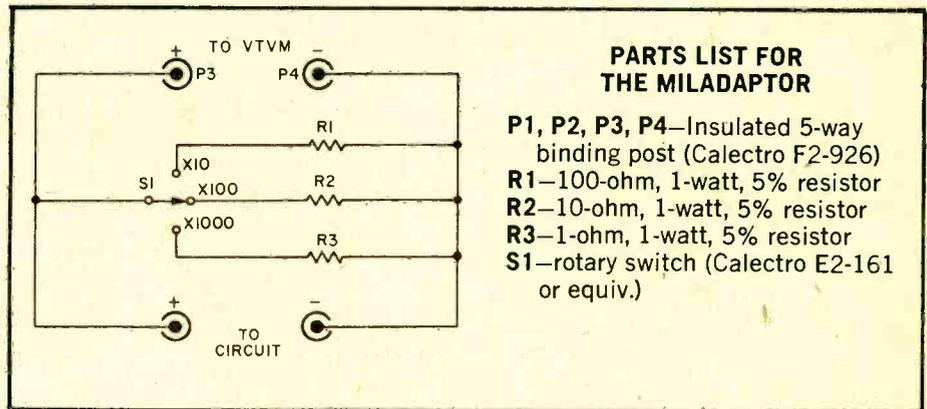
its meter reading; if it's good its output should approximate that of the reference crystal. Take care that you don't compare apples with oranges; the reference crystal should be the

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.

## 57 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



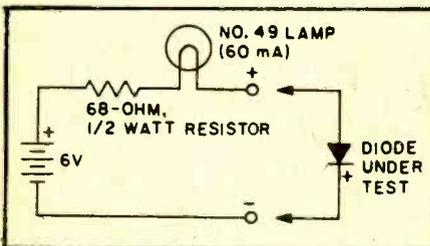
### PARTS LIST FOR THE MILADAPTOR

- P1, P2, P3, P4—Insulated 5-way binding post (Calectro F2-926)
- R1—100-ohm, 1-watt, 5% resistor
- R2—10-ohm, 1-watt, 5% resistor
- R3—1-ohm, 1-watt, 5% resistor
- S1—rotary switch (Calectro E2-161 or equiv.)

always start with S1 in the X1000 position and downrange until the

VTVM indicates a convenient reading.

## 58 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.

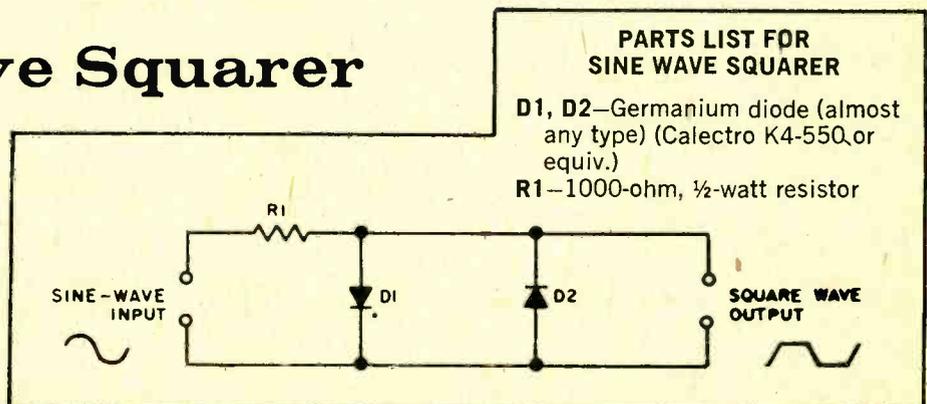
If the diode is good, the lamp will light in one direction, and remain

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.

## 59 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-



### PARTS LIST FOR SINE WAVE SQUARER

- D1, D2—Germanium diode (almost any type) (Calectro K4-550 or equiv.)
- R1—1000-ohm, 1/2-watt resistor

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.

## 60 Budget Scope Calibrator

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

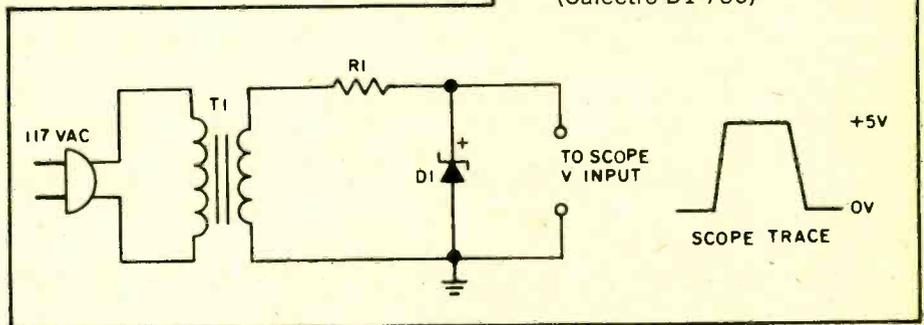
When the top of zener diode D1 goes negative it conducts and voltage across the diode is essentially zero. When the voltage at the top of the zener goes positive, it builds until it reaches 10 V. At that point the diode conducts, dropping five volts across D1. The result is a square wave which varies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

### PARTS LIST FOR BUDGET SCOPE CALIBRATOR

- D1—10V, 0.4-watt Zener diode—HEP-101
- R1—270-ohm, ½-watt resistor
- T1—117 to 12.6 VAC filament (Calectro D1-750)



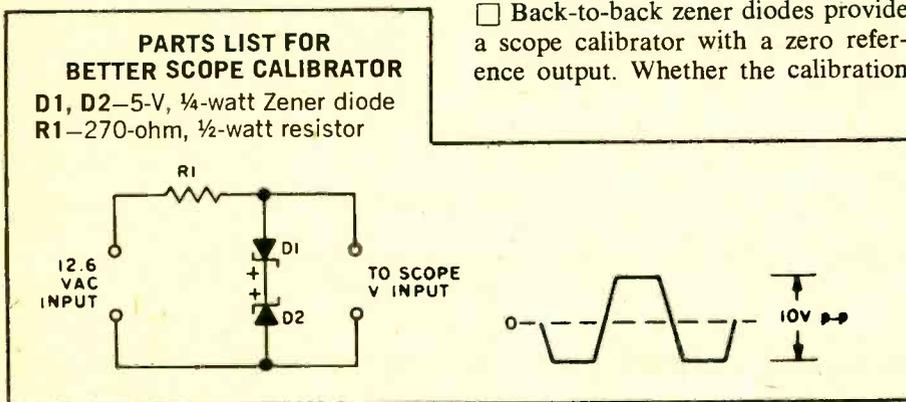
## 61 Better Scope Calibrator

- ### 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.



## 62 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 transmit-

ter'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 cir-

cuit shown will just about fill a 5-in. scope from edge to edge with virtually no loss at the transmitter.

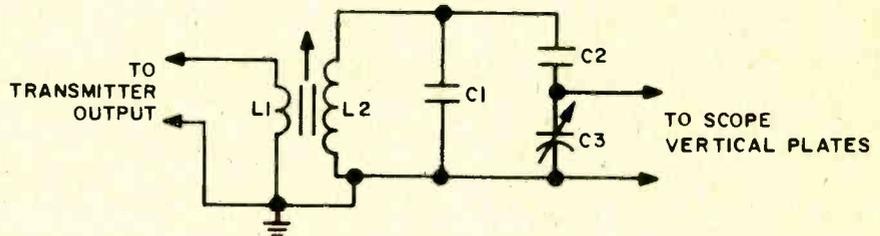
First, wind L2 on the center of a  $\frac{3}{8}$ -in. slug-tuned form. Then wind L1 adjacent to the ground end of L2. Connect L1 across the transmitter output with the CB antenna system

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.

#### PARTS LIST FOR SCOPE YOUR CB SIGNAL

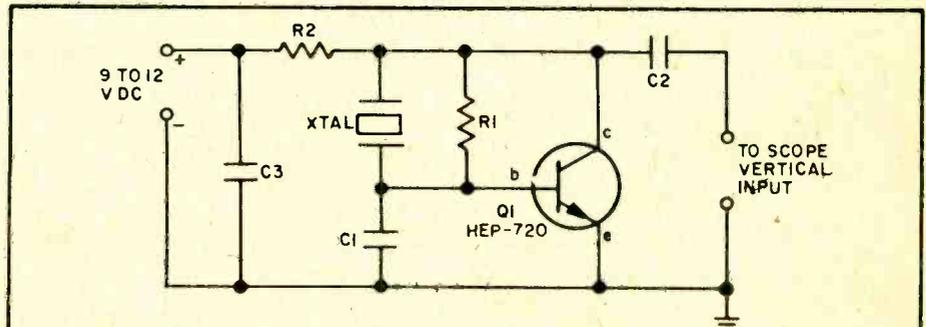
- C1, C2—5-pF silver mica capacitor
- C3—60-pF trimmer capacitor (Calectro A1-247)
- L1—3 turns #22 solid, plastic-insulated wire, adjacent to ground end of L2
- L2—4 turns #18 enameled wire, centered on form
- 1— $\frac{3}{8}$ -in. RF slug-tuned coil form (Calectro D1-895 or J. W. Miller 4400-2)



## 63

### 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- $\mu$ F, 25-VDC capacitor | R1—100,000-ohm, $\frac{1}{2}$ -watt resistor |
| C2—0.002- $\mu$ F, 25-VDC capacitor    | R2—1000-ohm, $\frac{1}{2}$ -watt resistor    |
| Q1—HEP-720 npn transistor              | Xtal—100-kHz crystal                         |

## 64

### Magnetizer-Demagnetizer

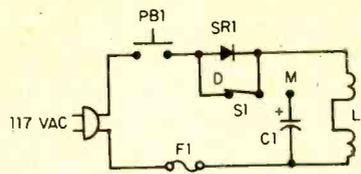
□ Quite often it's most handy to magnetize your tools to start a screw or nut into a blind spot. On the other hand, there are times when your tools must have absolutely no trace of magnetism, such as when adjusting a tape

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.

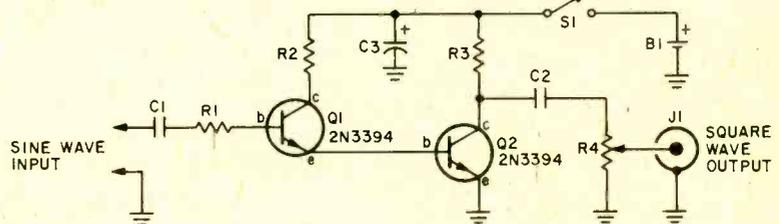


**PARTS LIST FOR  
MAGNETIZER-DEMAGNETIZER**  
C1—40- $\mu$ F, 200 VDC cap (Calectro A1-180)

- F1—5-ampere fuse  
L1—TV focus coil, see text  
PB1—normally-open pushbutton switch (Calectro E2-142 or equiv.)  
S1—Spdt switch  
SR1—Silicon rectifier, 400 PIV, 1 A. (Calectro K4-557 or equiv.)

## 65 Active Square Shaper

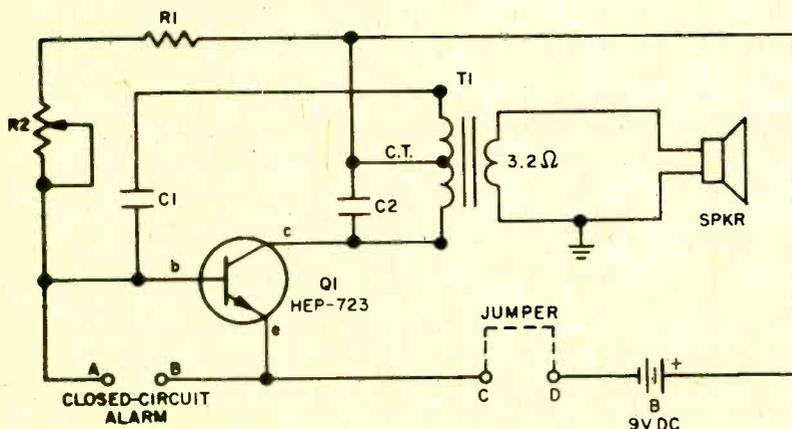
□ A quick-and-dirty square wave generator for audio amplifier tests can be fashioned from a standard signal generator and the Square Shaper. Simply drive the Square Shaper with about 1 volt from the generator; the maximum output at jack J1 will be a square wave of about 1 volt peak-to-peak. Just about 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

- B1—1.5-V "C" battery  
C1, C2—0.2 or 0.25- $\mu$ F, Mylar capacitor (Calectro A1-083 or equiv.)  
C3—47- $\mu$ F, 3 VDC electrolytic capacitor (Calectro A1-108 or equiv.)  
J1—Phono jack  
Q1, Q2—NPN transistor, 2N3394  
R1—100,000-ohm, 1/2-watt resistor  
R2, R3—470-ohm, 1/2-watt resistor  
R4—100,000-ohm audio taper potentiometer (Calectro B1-665)  
S1—Spst switch

## 66 Useful Tone Oscillator



### PARTS LIST FOR USEFUL TONE OSCILLATOR

- B1—9-V battery  
C1, C2—0.02- $\mu$ 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 (Calectro D1-741 or equiv.)

□ The circuit is a Harley 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 jumper across C and D and 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.

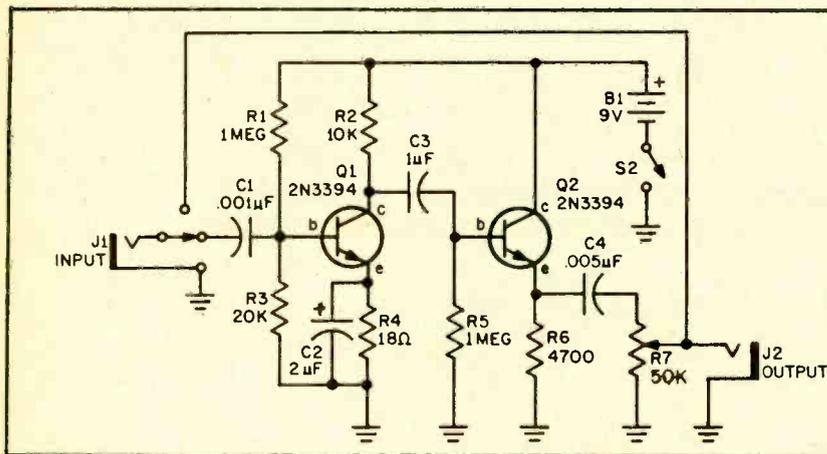
Service Note: If the unit fails to oscillate, generally due to transistor differences, change C2's value slightly.

## 67 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- $\mu$ F disc capacitor 25 VDC or better (Calectro A1-125 or equiv.)
- C2—2- $\mu$ F electrolytic capacitor, 15 VDC or better (Calectro A1-125)
- C3—1- $\mu$ F electrolytic capacitor, 15 VDC or better
- C4—0.005- $\mu$ F disc capacitor, 15 VDC or better
- J1, J2—Phone jack
- Q1, Q2—NPN transistor, 2N3394
- R1, R5—1 megohm, 1/2-watt resistor
- R2—10,000, 1/2-watt resistor
- R3—20,000-ohm, 1/2-watt resistor, 5 percent
- R4—18-ohm, 1/2-watt resistor
- R6—4700-ohm, 1/2-watt resistor
- R7—50,000-ohm potentiometer (Calectro B1-685 or equiv.)
- S1—Switch, spdt (twang in-out)
- S2—Switch, spst (on-off)

## 68 Lights-On Alerter

□ 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

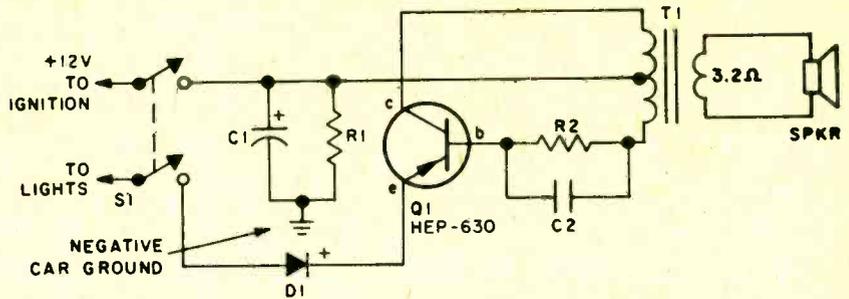
complete power path for Q1. Diode D1 prevents positive battery voltage from flowing through Q1 to the lights. When lights and ignition are on, Q1's collector and emitter are positive and the tone generator re-

mains off. When the lights are on and the ignition is off, Q1's (ground) terminal 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 dashboard so R1 is connected through the cabinet to the car's chassis, thereby completing a negative battery connection.

### PARTS LIST FOR LIGHTS-ON ALERTER

- C1—30-uF, 25-VDC capacitor
- C2—0.25-uF, Mylar cap (Calectro A1-083)
- D1—1-A, 50-PIV rectifier (Calectro K4-555)
- Q1—HEP-630 pnp transistor
- R1—15,000-ohm, ½-watt resistor
- R2—680-ohm, ½-watt resistor
- S1—Dpst switch
- Spkr—8-ohm speaker (Calectro S2-200)
- T1—500-ohm CT pri. to 8-ohm sec. output transformer (Calectro D1-712)

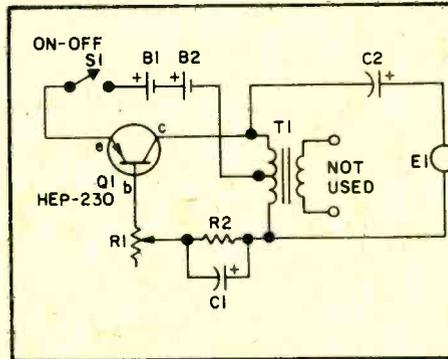


## 69

### 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 headphone.



### PARTS LIST FOR ANGLER'S BITE BOOSTER

- B1, B2—1.5-V AAA battery
- C1, C2—47-uF, 12-VDC electrolytic capacitor (Calectro A1-108)
- E1—Crystal earphone (Calectro Q4-213)
- Q1—Motorola HEP-230 or Calectro K4-520 pnp transistor
- R1—5000-ohm pot (Calectro B1-673)
- R2—27,000-ohm, ¼-watt resistor
- S1—Spst switch, part of R1
- T1—Subminiature transistor output transformer: 500-ohm center primary to 8-ohm secondary (Calectro D1-712)

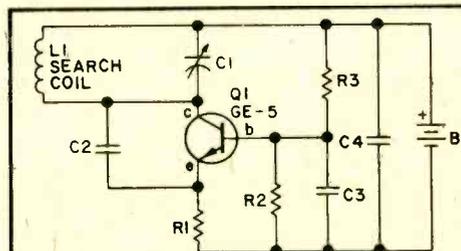
## 70

### Lo-Parts Treasure Locator

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



### PARTS LIST FOR LO-PARTS TREASURE LOCATOR

- B1—9-VDC transistor battery
- C1—280-pF trimmer or variable capacitor (Calectro A1-248)
- C2—100-pF, 100-V silver mica capacitor (Calectro A1-006)
- C3—0.05-uF, disc capacitor
- C4—4.7-uF, 12-V electrolytic capacitor (Calectro A1-102)
- L1—Search coil consisting of 18 turns of #22 enamel wire scramble wound on 4-in. diameter form
- Q1—GE-5 or Calectro K4-501 npn transistor
- R1—680-ohm, ½-watt resistor
- R2—10,000-ohm, ½-watt resistor
- R3—47,000-ohm, ½-watt resistor

station," Capacitor C1 is adjusted so the locator oscillator "beats" against 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 oscilla-

tor's frequency and changing the "beat tone" in the radio.

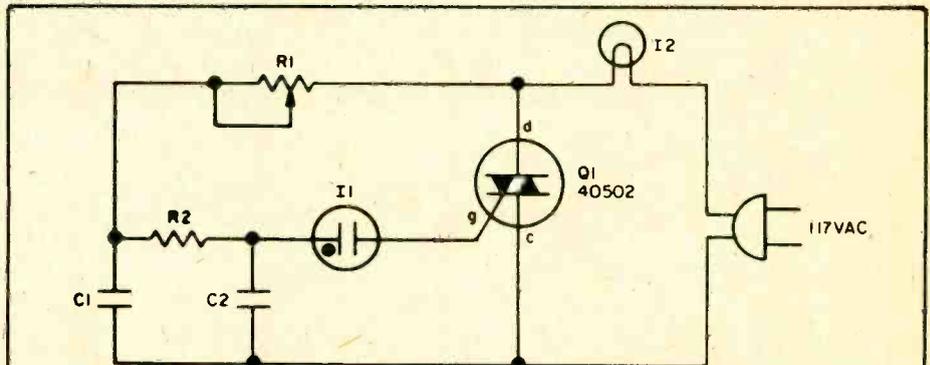
The search coil consists of 18 turns of #22 enameled wire *scramble wound* (which means don't be neat) on a 4-in. diameter form, which can be a cardboard tube or a wood puck

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.

## 71 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 400-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. (Calectro K4-586 comes with trigger replacing I1.)



PARTS LIST FOR LO-COST LAMP DIMMER

C1, C2—0.068- $\mu$ F, 200-VDC capacitor

I1—NE-2 neon lamp (Calectro E2-480)

I2—External lamp not to exceed

400 watts

Q1—RCA 40502 Triac

R1—50,000-ohm, pot. (Calectro B1-685)

R2—15,000-ohm, 1/2-watt resistor

## 72 Light Controlled Relay

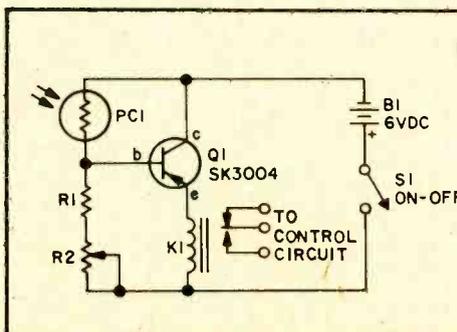
□ With only a handful of low-cost components this photo relay turns a light on or off according to general room illumination.

Q1 can be any general purpose pnp transistor of the 2N109 or 2N217 variety, though greater sensitivity is obtained with the 2N2613 type. Relay K1 is a high-sensitivity type like the Sigmas used by model radio control hobbyists.

Potentiometer R2, part of a voltage divider consisting of photocell PC1, R1 and R2, is set so that with normal illumination falling on PC1 the base bias current (through PC1) is just below the value needed to generate the collector-emitter current required

to activate relay K1. When additional light falls on PC1, photocell resistance decreases, thereby increasing the base bias, which causes greater collector current to flow and the relay closes.

This circuit can be controlled by sunlight so K1 drops out at dusk to turn on a night light. Or use a flashlight to trip K1 for "killing" TV commercials by shorting the TV speaker connections.



PARTS LIST FOR LIGHT CONTROLLED RELAY

B1—6-V battery

K1—1000-ohm, 2-3 mA sensitive relay

PC1—RCA 4425 photocell

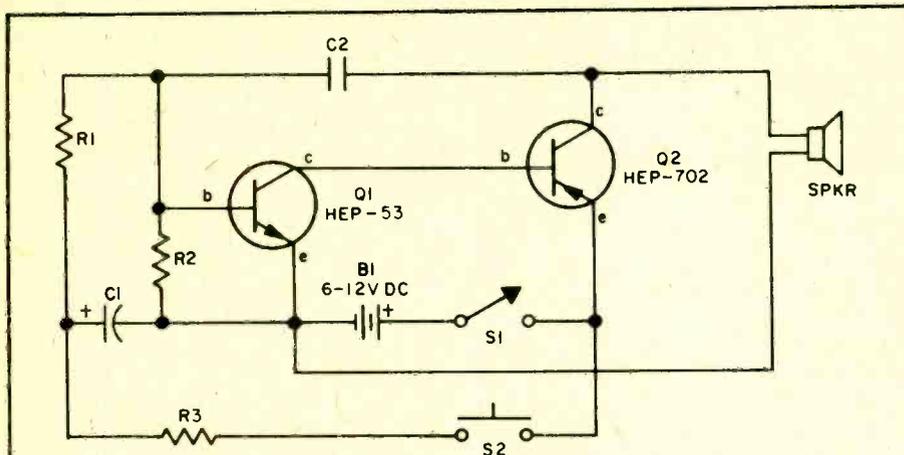
Q1—SK-3004 (RCA) pnp transistor

R1—120-ohm, 1/2-watt resistor

R2—5000-ohm potentiometer

S1—Spst switch

# 73 Yelp Oscillator



## PARTS LIST FOR YELP OSCILLATOR

- |   |   |
|---|---|
| <b>B1</b> —6-V or 12-V battery                        | <b>R1, R2</b> —56,000-ohm, ½-watt resistor                          |
| <b>C1</b> —30- $\mu$ F, 15-VDC electrolytic capacitor | <b>R3</b> —27,000-ohm, ½-watt resistor                              |
| <b>C2</b> —0.02- $\mu$ F, 75-VDC capacitor            | <b>S1</b> —Spst switch  |
| <b>Q1</b> —HEP-53 or Calectro K4-506 npn transistor   | <b>S2</b> —N.O. pushbutton switch (Calectro E2-142)                 |
| <b>Q2</b> —Motorola HEP-702 pnp transistor            | <b>SPKR</b> —8-ohm speaker or PA horn (Calectro S2-245/6 or equiv.) |

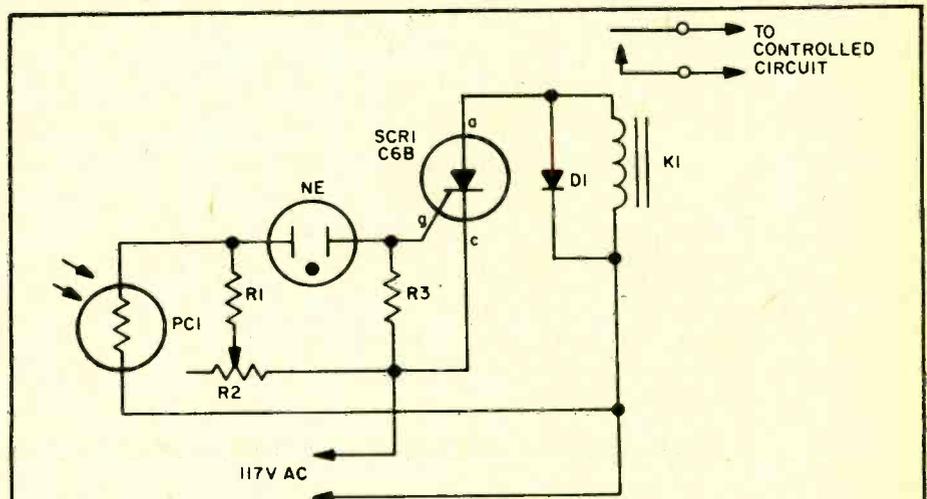
□ A real screamer! Use a public-address type amplifier and horn under the hood of your car and you'll punch a hole in the tightest traffic jam. (Be certain, of course, that you hold a position that entitles you to a siren.)

Build this yelper in a small box and hold the PA mike 2-3 inches from the 8-ohm speaker. Press pushbutton 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 when S1 is pressed, Q1 is too "leaky."

# 74 Commercial Killer

□ A flashlight beam stabs out—the irritating TV commercial for underarm 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.



## PARTS LIST FOR COMMERCIAL KILLER

- |  |  |
|--|--|
| <b>D1</b> —400-PIV silicon diode (Calectro K4-557) | high light level; CL704 or CL705 photocell for low light level |
| <b>K1</b> —Guardian IR-610L-A115 latching relay    | <b>R1</b> —22,000-ohm, ½-watt resistor                         |
| <b>NE</b> —NE-83 neon lamp                         | <b>R2</b> —1-megohm potentiometer                              |
| <b>PC1</b> —Clairex photo cell CL505 for           | <b>R3</b> —100-ohm, ½-watt resistor                            |
|  | <b>SCR1</b> —GEC6B silicon-controlled rectifier                |

# 75

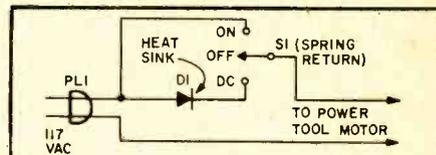
## AC Motor Power Brake

□ 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.

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.

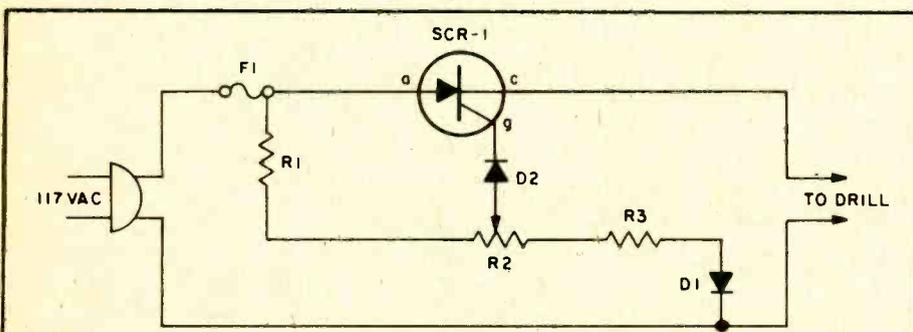


### PARTS LIST FOR AC MOTOR POWER BRAKE

- PL1—AC plug
- SR1—Silicon rectifier, 200 PIV, 20 A. (General Electric IN3210, A40B)
- S1—Spdt switch. Center off, one side spring return (G.C. 35-0414)
- Misc.—Metal cabinet

# 76

## Power Tool Torque Control



### PARTS LIST FOR POWER TOOL TORQUE CONTROL

- |  |  |
|--|--|
| D1, D2—1A, 400 PIV silicon rectifier (Calectro K4-557 or equiv.) | R2—250-ohm, 4-watt potentiometer                                 |
| F1—3-A "Slo-blo" fuse  | R3—33-ohm, ½-watt resistor                                       |
| R1—2500-ohm, 5-watt resistor                                     | SCR1—3-A, 200-PIV silicon controlled rectifier (Calectro K4-584) |

□ 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.

# 77

## 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

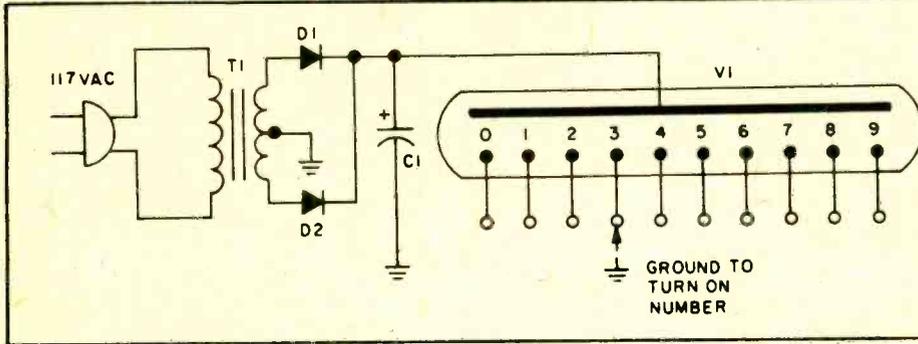
mA minimum.

The same power supply can be used for additional *Nixies*, each connecting 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- $\mu$ F, 250-VDC electrolytic capacitor (Calectro A1-180)  
 D1, D2—1A, 400-PIV silicon rectifier (Calectro K4-557 or equiv.)  
 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)



## 78 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

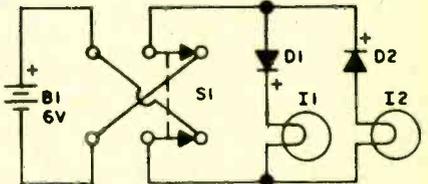
diode D2 blocks the flow of DC to the lamp.

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 (Calectro K4-555 or equiv.)  
 I1, I2—6.3-V, 0.15-A, #40 pilot lamp (Calectro E2-437)  
 S1—Dpdt toggle switch



## 79 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.

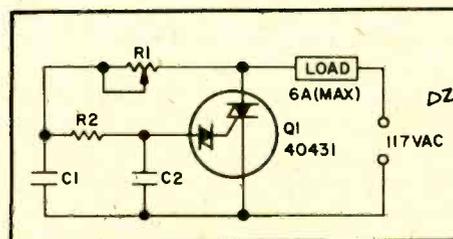
Unlike other speed controllers, which require an external trigger device, Q1 combines both the Triac and Diac trigger diodes in the same case.

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

vided with a heat sink, which can be the metal cabinet. Build up a marble-size 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 cabinet.

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- $\mu$ F, 200-VDC capacitor  
 Q1—RCA 40431 Triac-Diac  
 R1—100,000-ohm linear taper potentiometer (Calectro B1-686)  
 R2—10,000-ohm, 1-watt resistor

# 80

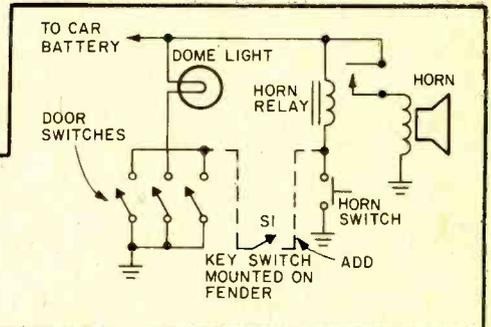
## Easy Auto Theft Alarm

□ 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.

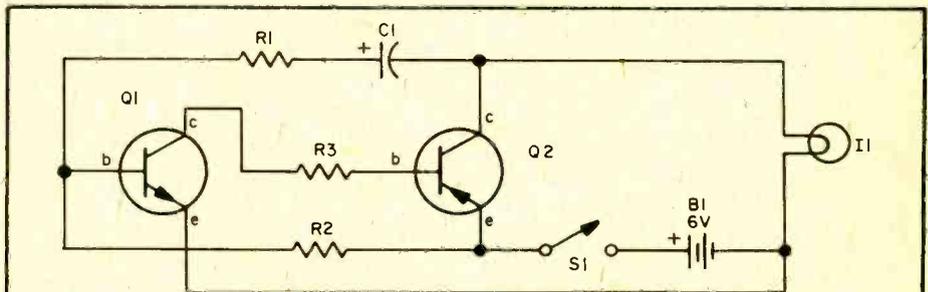


# 81

## 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**

B1—6-volt lantern battery  
C1—2- $\mu$ F, 25-VDC electrolytic capacitor (Calectro A1-125 or equiv.)  
I1—No. 49 pilot lamp  
Q1—npn transistor, HEP-641,

Calectro K4-501  
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

# 82

## Doorknob Security Alarm

□ 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 out-

put is applied to Q2 which holds the SCR1 gate almost at ground potential. When someone touches the doorknob, 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 only be turned off by opening reset

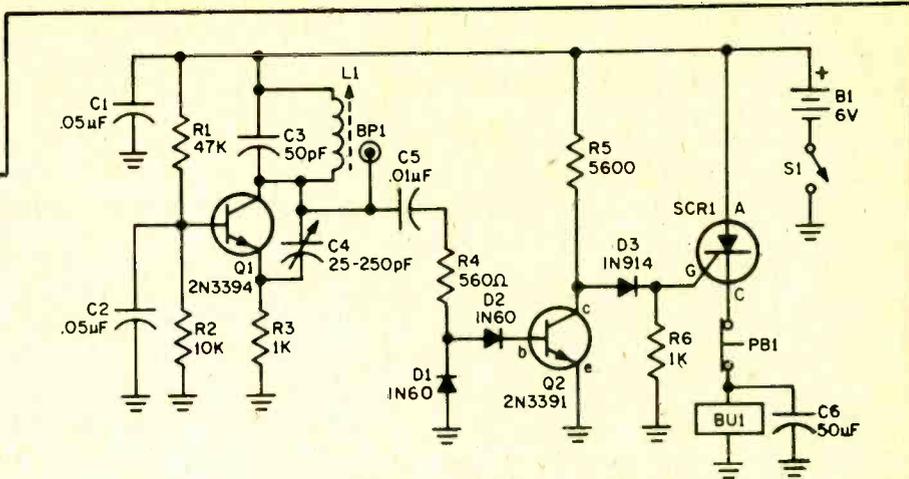
switch PB1.

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.

### PARTS LIST FOR DOORKNOB SECURITY ALARM

- B1**—6-volt battery, Burgess Z4 or equiv.
- BP1**—Binding post (Calectro F2-926)
- BU1**—6-volt buzzer
- C1, C2**—0.05 disc capacitor, 25 VDC or better
- C3**—47-pF silver mica capacitor (Calectro A1-004 or equiv.)
- C4**—300-pF trimmer (Calectro A1-249)
- C5**—0.05-uF, 25 VDC capacitor
- C6**—50-uF electrolytic capacitor, 25 VDC or better
- D1, D2**—Diode, 1N60 (Calectro K4-550)
- D3**—Diode, 1N914, HEP-156



- L1**—15-uH adjustable RF coil (Miller 4205, or equiv.)
- BP1**—Pushbutton switch (reset)
- Q1**—2N3394
- Q2**—2N3391
- R1**—47,000-ohm, ½-watt resistor
- R2**—10,000-ohm, ½-watt resistor
- R3, R6**—1000-ohm, ½-watt resistor
- R4**—560-ohm, ½-watt resistor
- R5**—5600-ohm, ½-watt resistor
- R6**—1K
- S1**—Switch, spst (on-off)
- SCR1**—Silicon Controlled Rectifier, General Electric C6U (Listed in EDI Catalog)

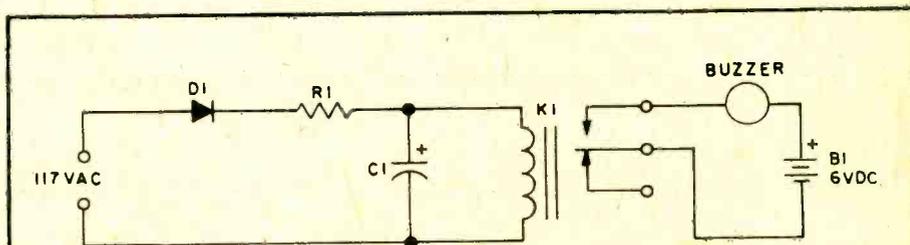
## 83

# 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-uF, 150-VDC capacitor (Calectro A1-179)
- D1**—Silicon diode (Calectro K4-557)
- K1**—3000-5000-ohm sensitive relay coil (Calectro D1-963 or equiv. See text)
- R1**—10,000-ohm, ½-watt resistor
- BUZZER**—1-6-VDC commercial home buzzer

## 84

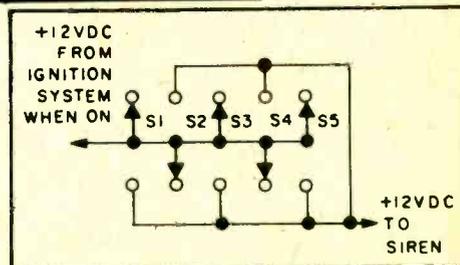
# Auto Ignition Maze

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 spst

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

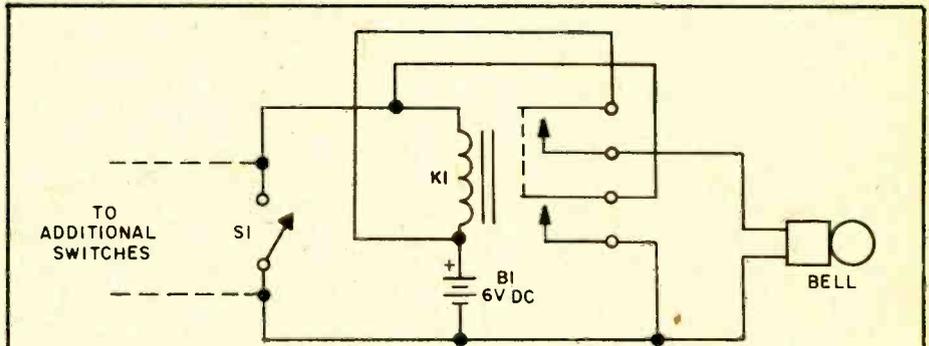
# 85

## 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
- BELL—6-VDC alarm bell
- K1—6-VDC dpst relay (Calectro

- D1-975 or equiv.)
- S1—Spst n.o. switch

# 86

## Foil-A-Burglar Alarm

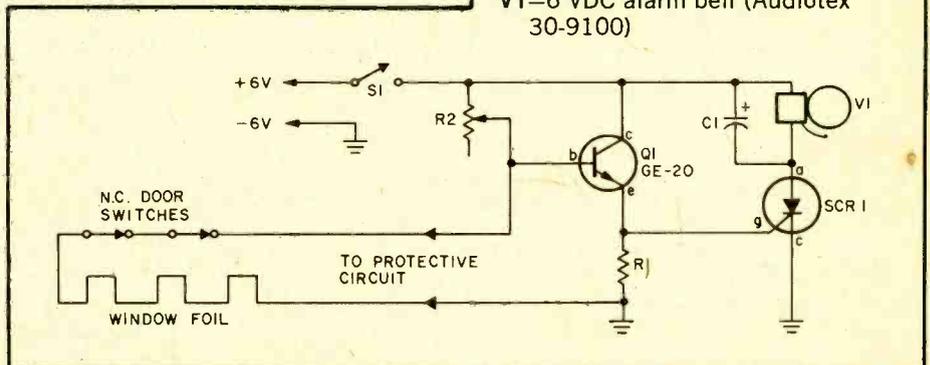
□ This professional type burglar alarm can be used to protect windows or glass areas by using window foil that "breaks" a circuit as the glass is broken. It's an alarm that is triggered when the protective circuit is *opened*. All protective door and window circuits must be *normally closed* and series 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  $\mu$ A. To adjust, connect a voltmeter (10 VDC range) across resistor R1, open the protective circuit and adjust potentiometer R2 so the

meter indicates a voltage rising towards 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- $\mu$ F, 12-VDC electrolytic capacitor (Calectro A1-108 or equiv.)
- Q1—NPN transistor, GE-20 or equiv.
- 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 (G.E. C106 series or equiv.)
- V1—6 VDC alarm bell (Audiotex 30-9100)



# 87 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.

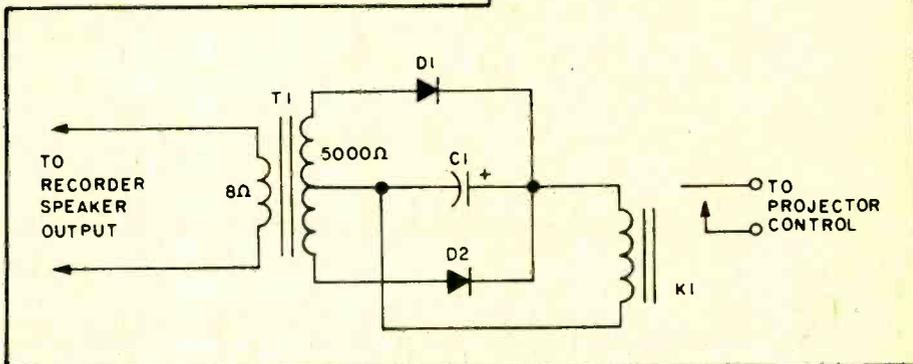
Record your commentary on the left track. At the instant you want slides to change, record a one-second noise or tone burst on the right track. Connect the programmer between the recorder's right speaker output and the projector's remote control cable. Make a test run to determine the right-track volume 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.

## PARTS LIST FOR SLIDE SHOW STOPPER

- C1—22- $\mu$ F, 50-VDC electrolytic capacitor (Calectro A1-152)
- D1, D2—Calectro K4-555
- K1—2500-ohm coil plate-type relay
- T1—4000 to 5000-ohm CT audio output transformer (Calectro D1-740 or equiv.)



# 88 Photo Print Meter

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

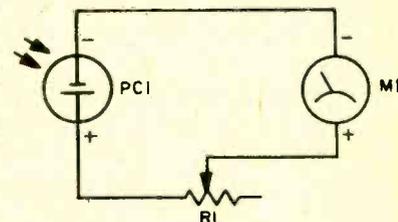
Meter M1 can be just about anything up to 0-1 DC mA. But if you prefer low light levels and long exposures, install a sensitive meter of 500  $\mu$ A or less.

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- $\mu$ A DC meter (Calectro D1-901 or D1-907)
- PC1—Solar cell (Calectro J4-801)
- R1—5000-ohm potentiometer linear taper

# 89 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 is supplied with a heat sink which must, in turn, be connected to a larger heat sink. The entire unit is assembled in a metal cabi-

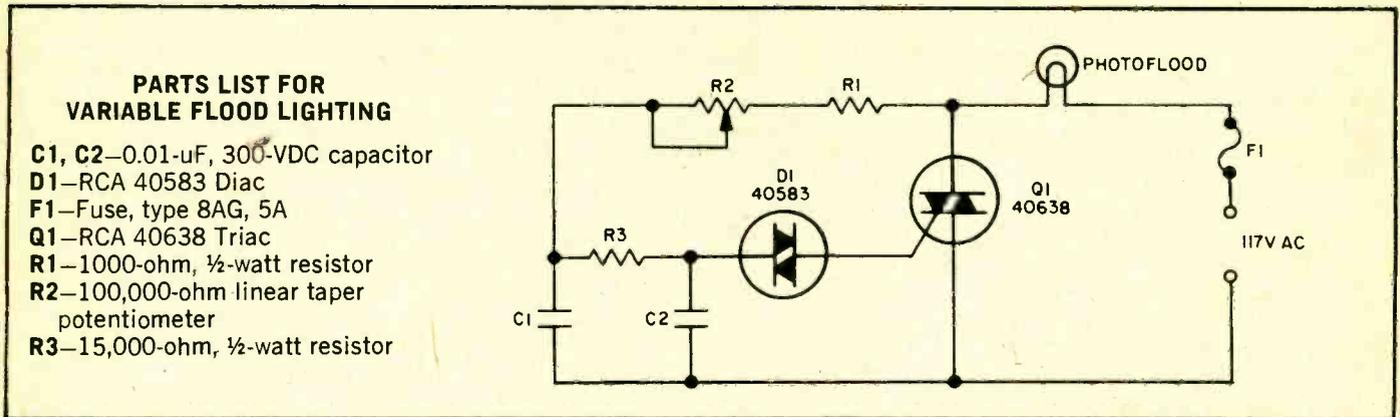
net with Q1's heat sink epoxy-cemented to the cabinet for heat dissipation.

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.



## 90 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.

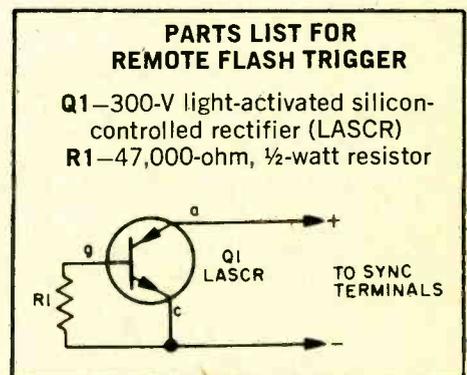
Transistor Q1 is a light-activated silicon-controlled rectifier (LASCR). The gate is tripped by light entering a small lens built into the top cap.

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.

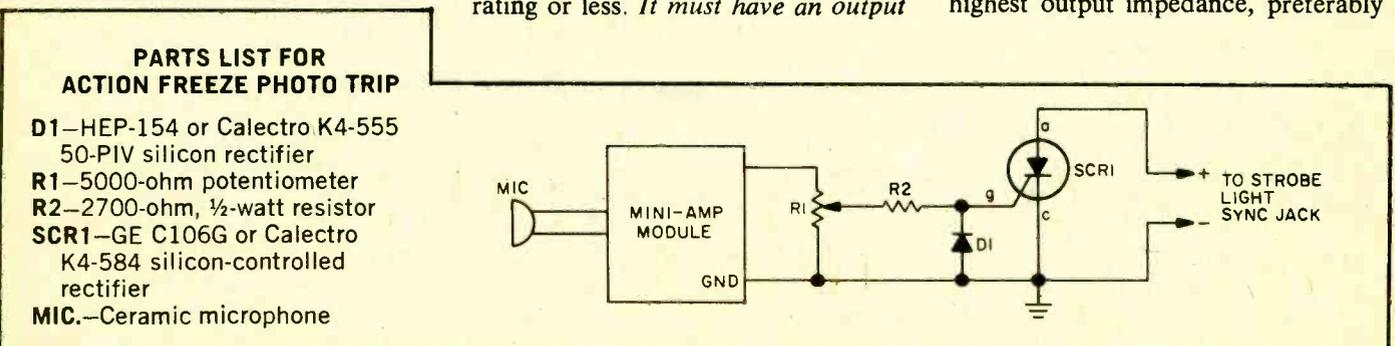


## 91 Action Freeze Photo Trip

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 connections 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.

## 92

# 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.

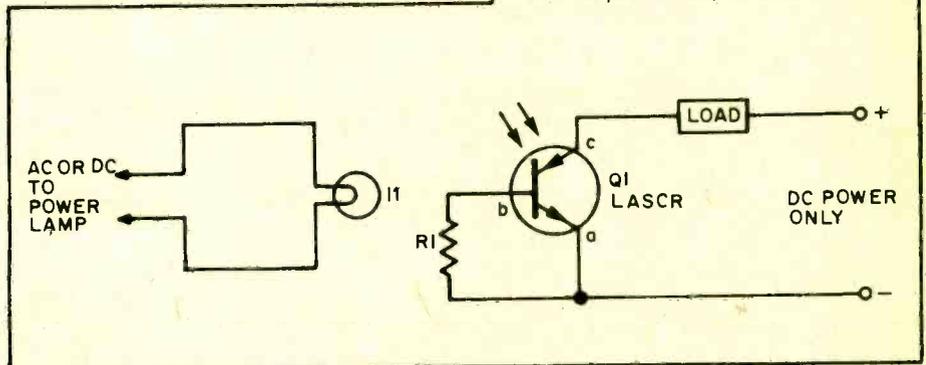
The triplamp can be any ordinary flashlight bulb powered by two D cells. When the lamp is turned on the LASCR gate is closed, causing current to flow through the load and the LASCR anode (a) cathode (c) circuit.

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.

### PARTS LIST FOR LIGHT POWER CONTROL

- I1—Flashlight bulb or pilot lamp (see text)
- Q1—Light-activated-silicon-controlled rectifier (LASCR, GE—see text)
- R1—47,000-ohm, ½-watt resistor



## 93

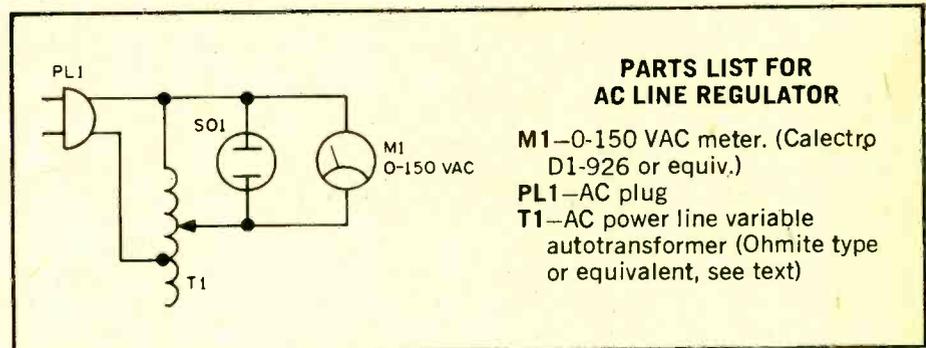
# Line Regulator

□ 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

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.



### PARTS LIST FOR AC LINE REGULATOR

- M1—0-150 VAC meter. (Calectrp D1-926 or equiv.)
- PL1—AC plug
- T1—AC power line variable autotransformer (Ohmite type or equivalent, see text)

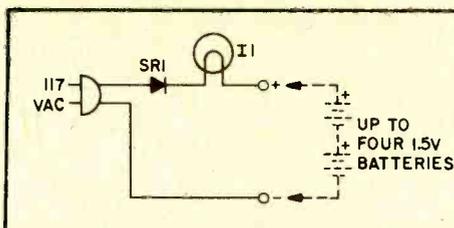
# 94

## 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 (Calectro K4-557 or equiv.)

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

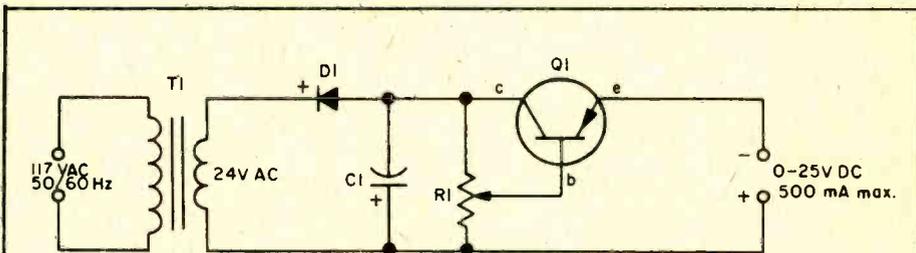
NiCads stamped with a charge rate of approximately 20 to 25 mA.

# 95

## 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- $\mu$ F, 50-V capacitor
- D1—1-A, 400 PIV-silicon rectifier (Calectro K4-557)
- Q1—40-W, pnp power transistor
- R1—2000-ohm potentiometer
- T1—24-VAC, 117-VAC primary filament transformer (Calectro DI-752)

# 96

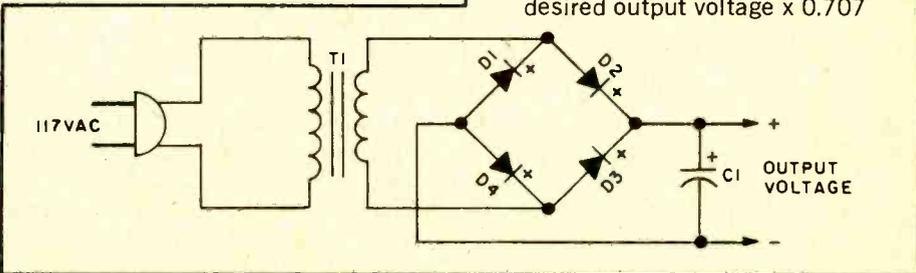
## Basic Power Supply

□ 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

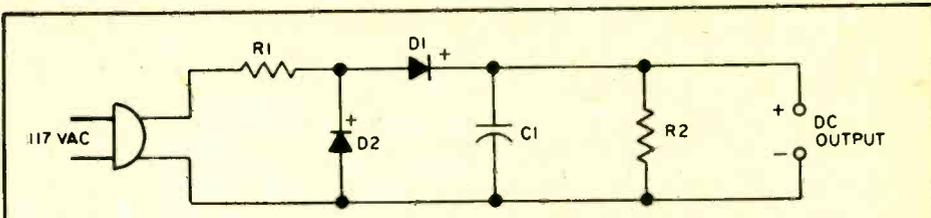
- C1—2500- $\mu$ F electrolytic capacitor, voltage rating at least 1.5 times higher than output voltage
- D1, D2, D3, D4—1A, 400-PIV silicon rectifier (Calectro K4-557)
- T1—Transformer; 117-VAC primary, secondary voltage equal to desired output voltage  $\times$  0.707

# 97

## 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 (Calectro K4-555).



PARTS LIST FOR LO HUM POWER SUPPLY

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

\*For lower current, decrease value of R2

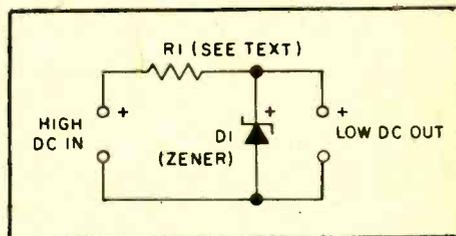
# 98

## 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.

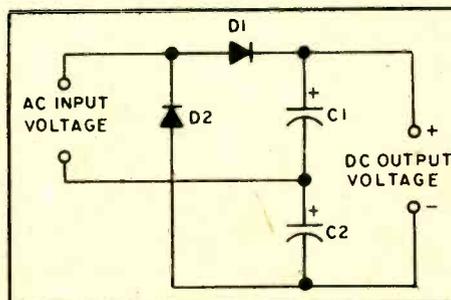
The power rating for the zener diode is determined by the voltage across the diode squared, divided by diode's nominal internal resistance. You can calculate the internal resistance by working backwards from the zener's power rating. As an example: a 9-volt, 1-watt zener would have a nominal internal resistance of  $R = E^2/W$ ,  $81/1$ , or 81 ohms. It's not precisely accurate, but close enough.



# 99

## 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-uF and rated at twice the DC output voltage. The larger the capacity, the greater will be the filtering.



PARTS LIST FOR A VOLTAGE DOUBLER

C1, C2—100-uF electrolytic capacitor or larger, WVDC should be twice DC output voltage  
D1, D2—500-milliamper (or larger) rectifying diode rated PIV at least twice DC output voltage

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

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

is the sum of the charge across C1 and C2.

# 100

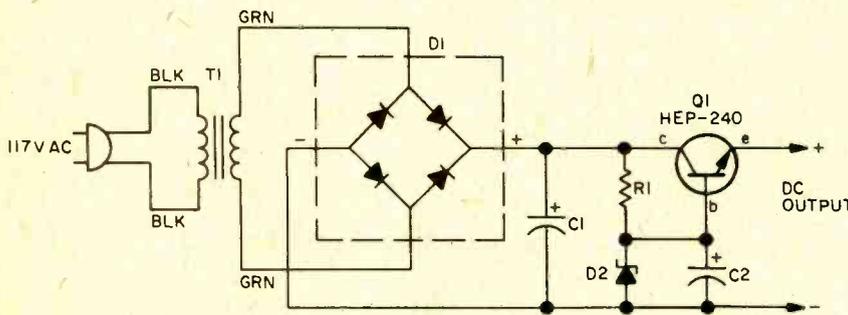
## A Regulated Nine

□ 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  $\mu\text{F}$ .



### PARTS LIST FOR A REGULATED NINE

- C1—470- $\mu\text{F}$ , 25-VDC electrolytic capacitor
- C2—100- $\mu\text{F}$ , 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,  $\frac{1}{2}$ -watt resistor
- T1—12-V filament transformer (see text)

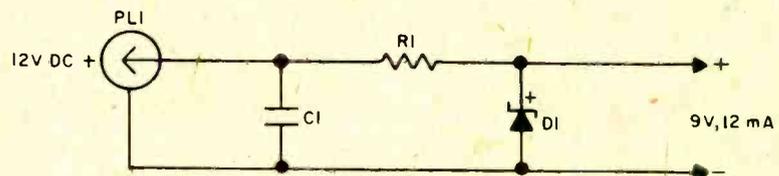
# 101

## 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- $\mu\text{F}$ , 400-VDC capacitor
- D1—1-watt, 9.1-V Zener diode—HEP-104 or Calectro K4-560
- PL1—Cigarette lighter plug (Calectro N4-029)
- R1—150-ohm,  $\frac{1}{2}$ -watt resistor

# 30

# INTEGRATED CIRCUIT PROJECTS

## IC 1

### Hi-Level 4-Channel Mixer

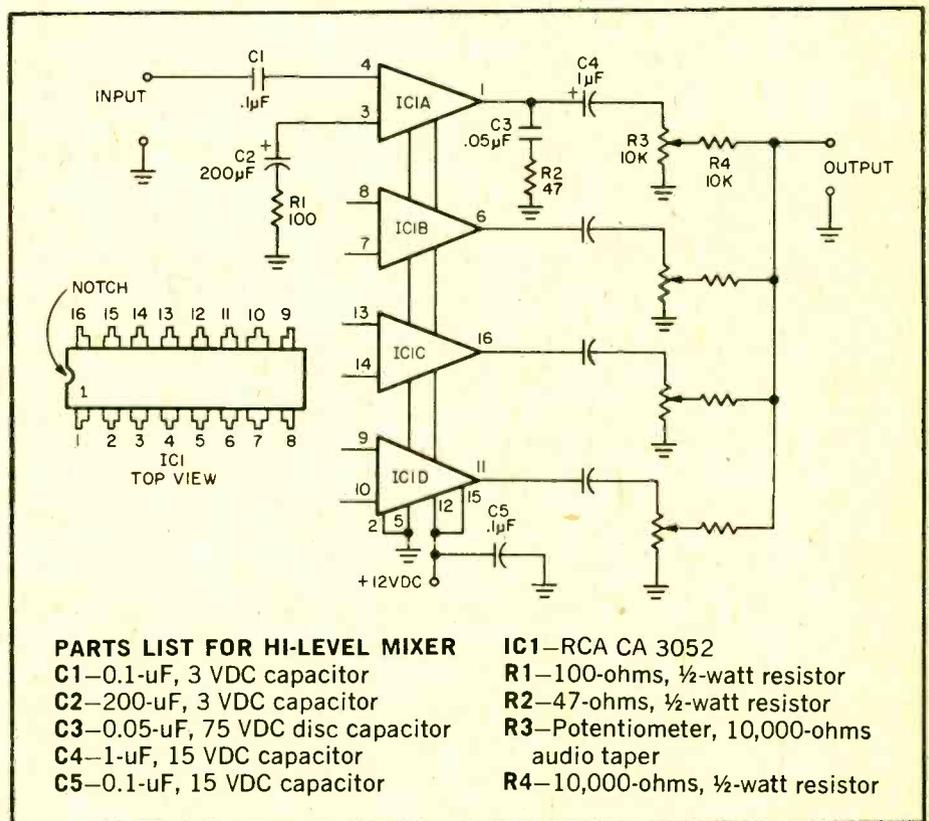
□ Best signal to noise ratio in a microphone mixer is always obtained if amplification is provided ahead of the loss in the mixer network. You can easily put this idea to work with our mixer—a full-fidelity, professional-grade microphone mixer that contains four independent amplifiers within the integrated 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 impedance IC's medium input impedance will excessively load down a high impedance mike, resulting in sharp, low-frequency attenuation.



## IC 2

### 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

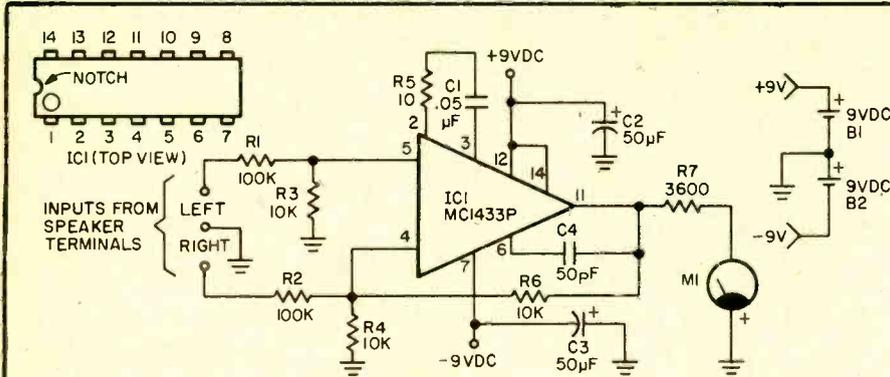
circuitry can very easily be battery powered using a bi-polar battery connection as shown.

To use, set your stereo amplifier to mono—then adjust the balance control until meter M1 indicates a null (mini-

mum 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- $\mu$ F, 50 VDC capacitor
- C2, C3—47- $\mu$ 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

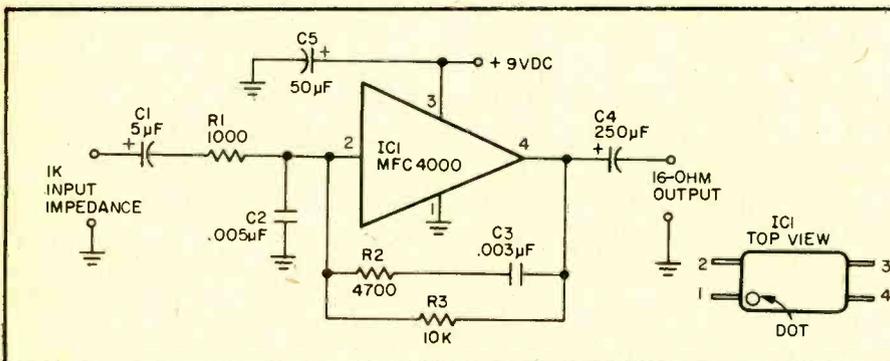
## IC 3 Cigar-Size Amplifier

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- $\mu$ F, 10 VDC capacitor
- C2—0.005- $\mu$ F, 10 VDC capacitor
- C3—0.003- $\mu$ F, 10 VDC capacitor
- C4—250- $\mu$ F, 10 VDC capacitor
- C5—50- $\mu$ 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 4 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  $\mu$ F for all applications except when used with a line matching transformer. When a



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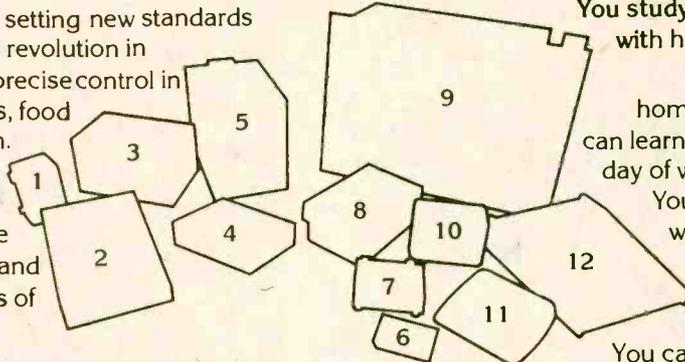
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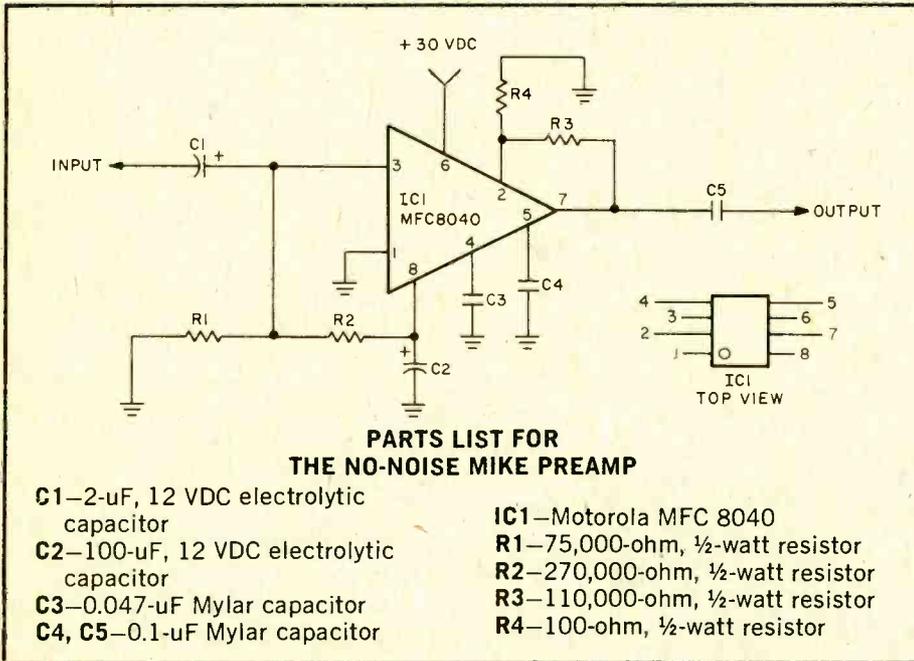
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supply (well filtered) is required. Power can be provided by batteries (for total hum-free operation) because the current requirement is ap-

proximately 15mA. Any gain controls must come after the output at C10.

## IC 6 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.

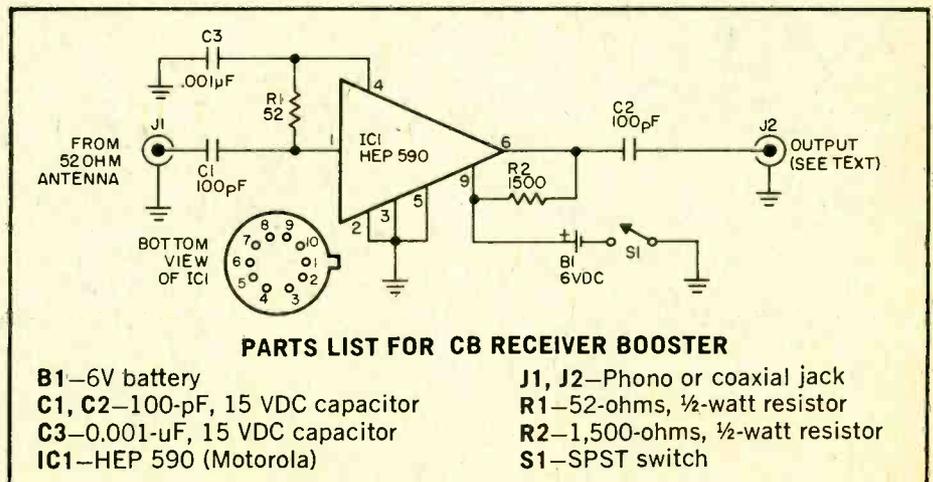
## IC 7 CB Receiver Booster

□ Connect CB Booster ahead of a low cost receiver, and you'll hear CB signals as if they were coming from your backyard. Using no tuned circuits, the CB 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.

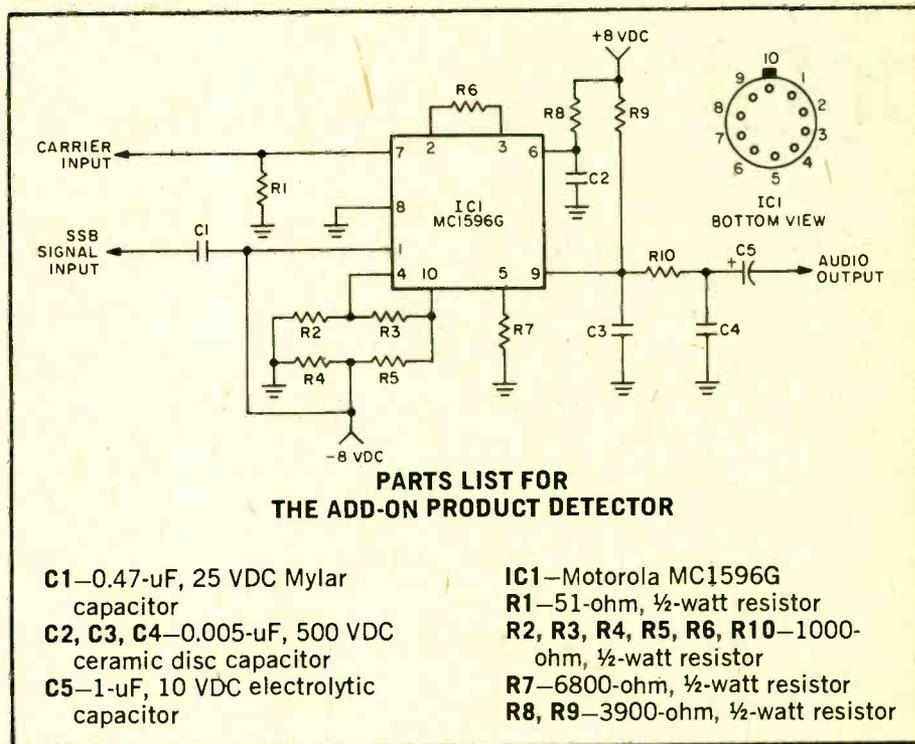


# IC 8

## Add-on Product Detector

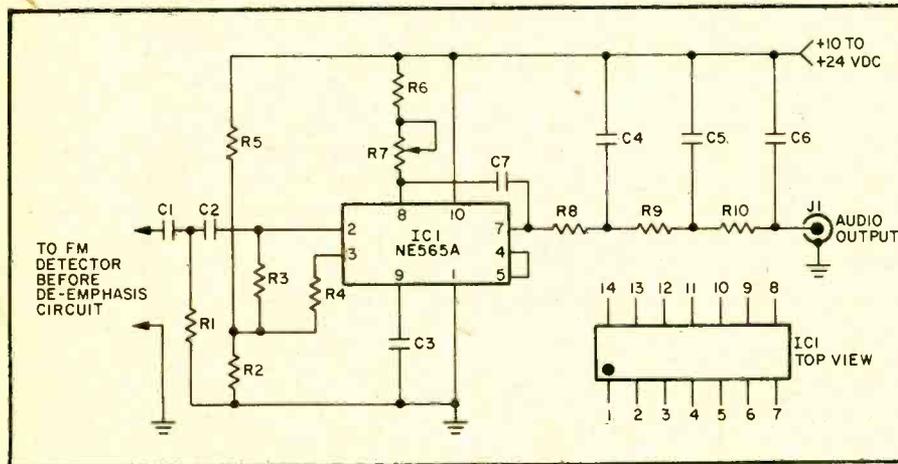
□ Many an old receiver is still a good receiver except for SSB reception. With a product detector, your old reliable can deliver good SSB reception on a par with many modern solid-state receivers. This product detector can be easily added to most old receivers; the only critical input requirements are an SSB signal input level of 5 to 500 mV and a carrier (BFO) input level of about 300 mV. The output is the demodulated audio.

Best results are obtained from a crystal-controlled carrier oscillator, rather than a variable frequency oscillator. A rigid construction is suggested, either printed circuit or on a perf-board with push-in terminal connections. The power supply is bipolar 8 volts, though a bi-polar 9-volt power source can be substituted. Since the current requirement is less than 5 mA, ordinary transistor radio 9-volt batteries can be used as the power source.



# IC 9

## SCA Adaptor



### PARTS LIST FOR THE SCA ADAPTOR

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

gested. If desired, a *pre* de-emphasis output jack can be installed on the FM receiver or tuner so that the nor-

mal (after de-emphasis) output can feed the hi-fi system independent of the SCA output.

## IC 10

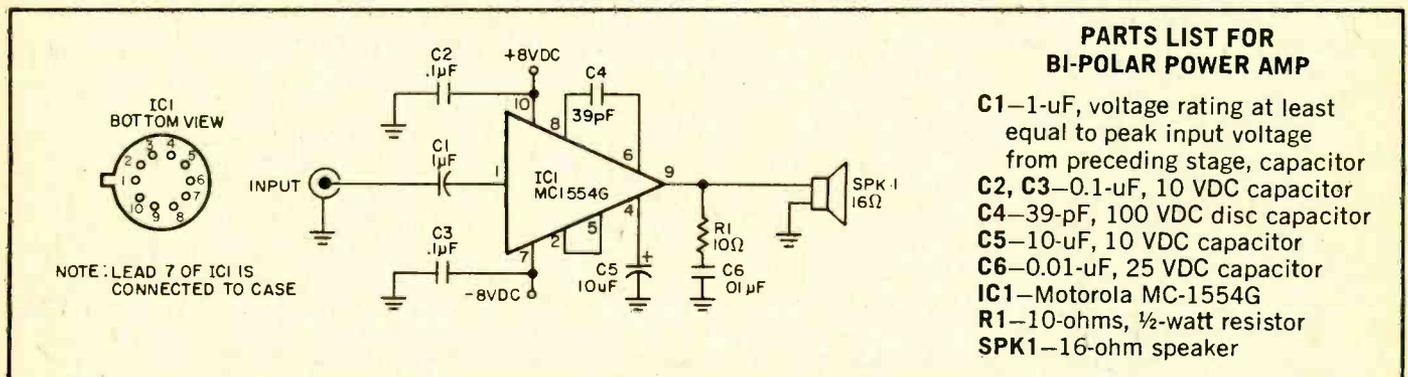
### Bi-Polar Power Amp

□ 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.



## IC 11

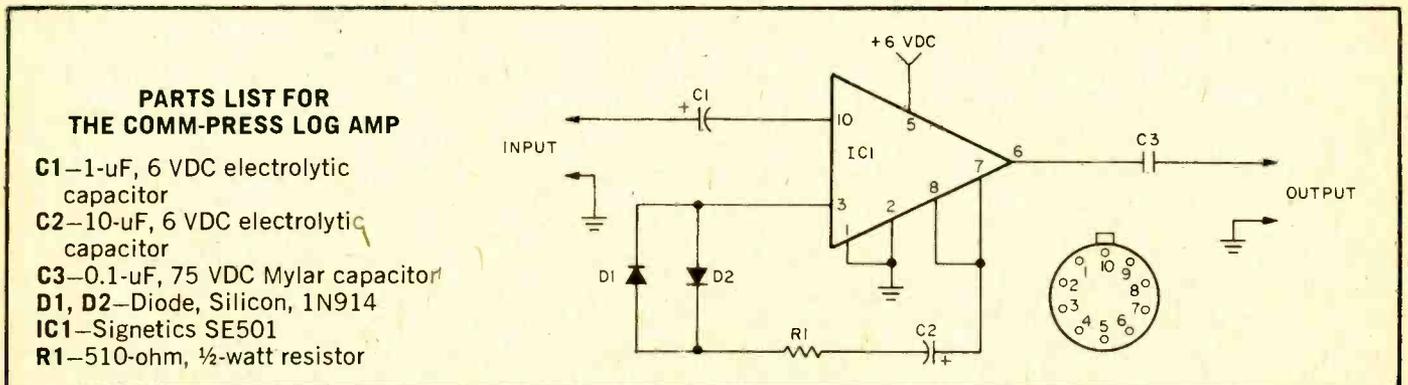
### Comm-Press Log Amp

□ 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 feed-

back (howling). Actually, you will have much more voice output before the howling starts.

## IC 12

### Far Out Gain Control

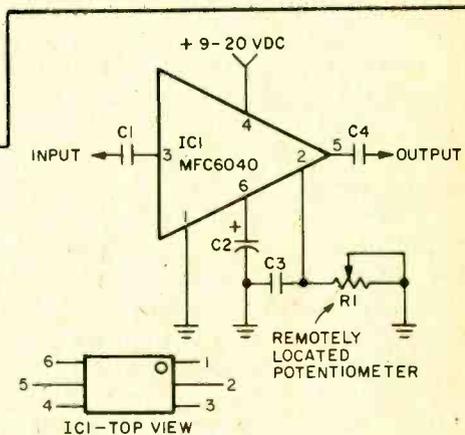
One of the problems of locating a volume control in a remote location is that of hum and noise pickup; as a general rule, the greater the wire length the greater the hum and noise picked up. With an electronic attenuator the entire problem is eliminated, for the volume control wires carry only a DC control 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

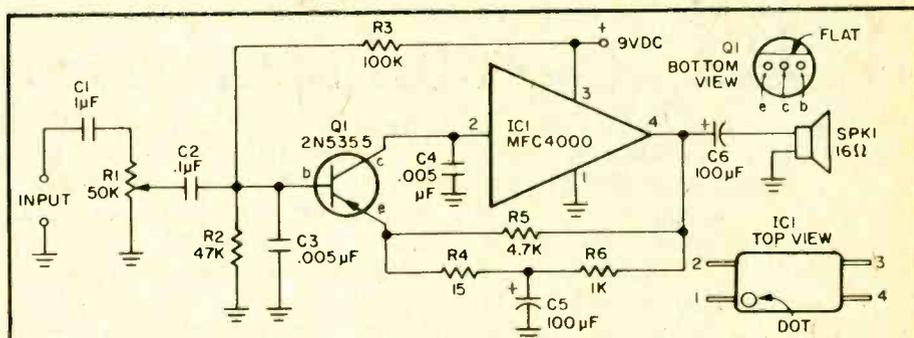
- C1—0.47- $\mu$ F, 25 VDC capacitor
- C2—50- $\mu$ F, 25 VDC capacitor
- C3—680-pF, 500 VDC ceramic disc capacitor
- C4—0.1- $\mu$ F, 75 VDC Mylar capacitor
- IC1—Motorola MFC 6040
- R1—50,000-ohm potentiometer



## IC 13

### Mighty Mite Signal Tracer

Featuring extremely high gain suitable for tracing signals directly from microphones and magnetic pickups, our Mighty Mite signal tracer can be made small enough to sit directly on the back of the speaker magnet. Though intended for checking transistor circuits, Mighty Mite can be used with tubed equipment if capacitor C1 has a 600 VDC minimum rating, and if volume control R1 is always started from its off position. Regardless of the size speaker used, Mighty Mite's speaker impedance must be 16 ohms minimum, though higher impedances work better. Power output is approximately 250 mW; more than sufficient output level from a solid-state signal tracer small enough to hide on the back of a speaker magnet.



#### PARTS LIST FOR MIGHTY MITE SIGNAL TRACER

- C1—0.1- $\mu$ F, 600 VDC capacitor (see text)
- C2—0.1- $\mu$ F, 10 VDC capacitor
- C3, C4—0.005- $\mu$ F, 10 VDC capacitor
- C5—100- $\mu$ F, 3 VDC capacitor
- C6—100- $\mu$ F, 10 VDC capacitor (250  $\mu$ F for better low-frequency response with large speakers)
- IC1—Motorola MFC-4000

- R1—Potentiometer, 50,000-ohms, audio taper resistor
- R2—47,000-ohms, 1/2-watt resistor
- R3—100,000-ohms, 1/2-watt resistor
- R4—15-ohms, 1/2-watt resistor
- R5—4,700-ohms, 1/2-watt resistor
- R6—1,000-ohms, 1/2-watt resistor
- Q1—PNP transistor, G.E. 2N5455 or equiv.
- SPK1—16-ohm speaker (see text)

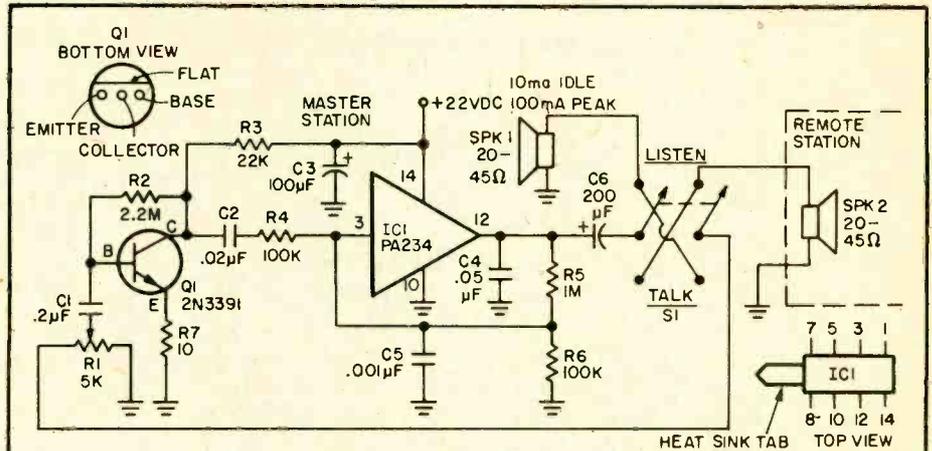
# IC 14

## Electric Butler Intercom

□ 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-uF, 3 VDC capacitor
- C2—0.02-uF, 3 VDC capacitor
- C3—100-uF, 25 VDC capacitor
- C4—0.05-uF, 75 VDC capacitor
- C5—0.001-uF, 10 VDC capacitor
- C6—200-uF, 25 VDC capacitor (see text)
- IC1—General Electric PA-234
- Q1—NPN transistor, Calectro K4-507 or G.E. 2N3391

- R1—Potentiometer, 5,000-ohms, audio taper resistor
- R2—2.2 megohms, ½-watt resistor
- R3—22,000-ohms, ½-watt resistor
- R4, R6—100,000-ohms, ½-watt resistor
- R5—1 megohm, ½-watt resistor
- R7—10-ohms, ½-watt resistor
- SPK1, SPK2—Speaker, 20 to 45 ohms, (see text)
- S1—Switch, DPDT (see text)

# IC 15

## Carbon Mike Simulator

□ Ever hear a telephone voice on radio or TV? The effect is usually created by passing the signal from a high quality microphone through a bandpass amplifier—a device that attenuates the frequencies on both sides of a selected frequency. Bandpass amplifiers are also effective at providing mid-frequency boost—presence, as it's called in hi-fi terms.

The center frequency of this bandpass amplifier is determined by the values of C1, C2, C3, R2, R3, and R4. The exact frequency can be determined from the formula shown. To start, assign a value of 100,000 ohms to R2 and R3 (use ½-watt resistors).

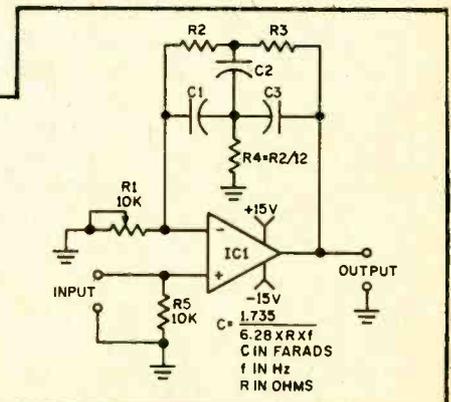
To avoid hum pickup, the unit

should be assembled in a metal cabinet. Potentiometer R1 serves as the Q-control; it determines the degree of boost at the center frequency. Adjust R1 for the desired effect. R5 connects to the non-inverting (+) input of the IC, R1 between ground and the in-

verting (-) input. No pin connections are given because the IC is available in many different configurations.

### PARTS LIST FOR CARBON MIKE SIMULATOR

- C1, C2, C3—(C1 equals C2 equals C3, see formula) capacitor
- IC1—Type 741 op amp
- R1—10,000-ohm pot resistor
- R2, R3—(R2 equals R3, see text) resistor
- R4— $R4 = R2/12$  resistor
- R5—10,000-ohm, ½-watt resistor



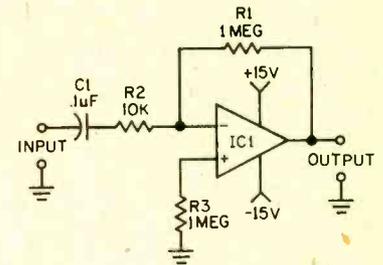
# IC 16

## 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- $\mu$ F Mylar capacitor, 25 VDC
- IC1—Type 741 operational amplifier (Calectro K4-590 or equiv., see text)
- R1, R3—1 megohm, 1/2-watt resistor
- R2—10,000-ohm, 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 17

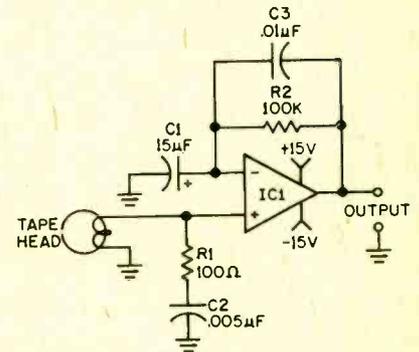
## Tape Head Preamp

□ 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  $\pm 15$  VDC, almost optimum results will be obtained with supply voltages as low as  $\pm 7$  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- $\mu$ F electrolytic capacitor, 25 VDC or better (Calectro A1-128)
- C2—0.005- $\mu$ F disc capacitor, 25 VDC or better
- C3—0.01- $\mu$ F disc capacitor, 25 VDC or better
- IC1—Type 741 op amp
- R1—100-ohms, 1/2-watt resistor
- R2—100,000-ohms, 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 18

## 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 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.

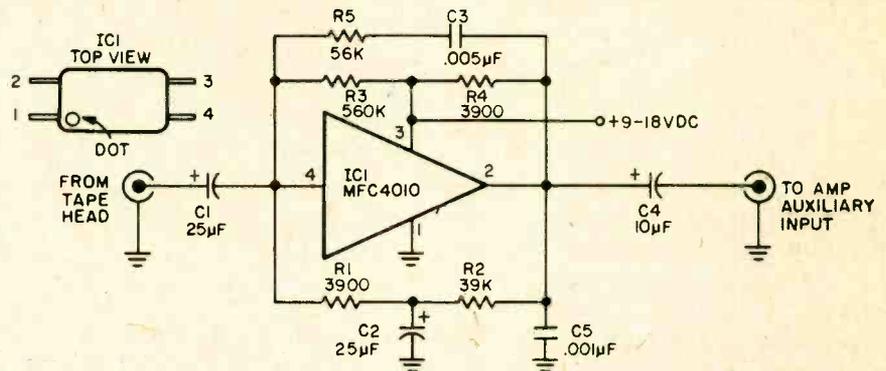
If assembled on a small printed circuit board, the preamp can be

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- $\mu$ F capacitor. And, be sure you observe proper battery polarity.

#### PARTS LIST FOR BARGAIN TAPE PREAMP

- C1, C2—25- $\mu$ F, 6 VDC capacitor
- C3—0.005- $\mu$ F capacitor
- C4—10- $\mu$ F, 20 VDC capacitor
- C5—0.001- $\mu$ 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



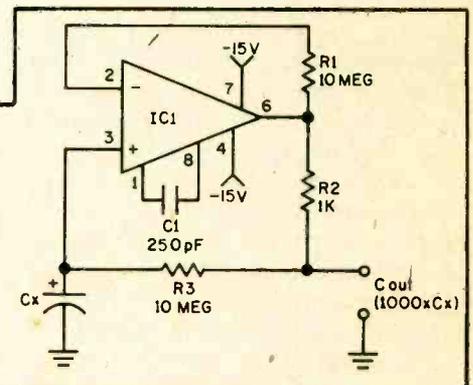
## IC 19 C Booster

Suppose you needed a 10,000- $\mu$ 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 Cx is the value to be boosted; the effective capacity appears at the terminals indicated C. If Cx is 10  $\mu$ F the effective capacity that appears at the out-

put terminals is 1000 x 10  $\mu$ F or 10,000  $\mu$ F. Almost any capacity value can be used for Cx.

#### PARTS LIST FOR C BOOSTER

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



## IC 20 Notch Filter Oscillator

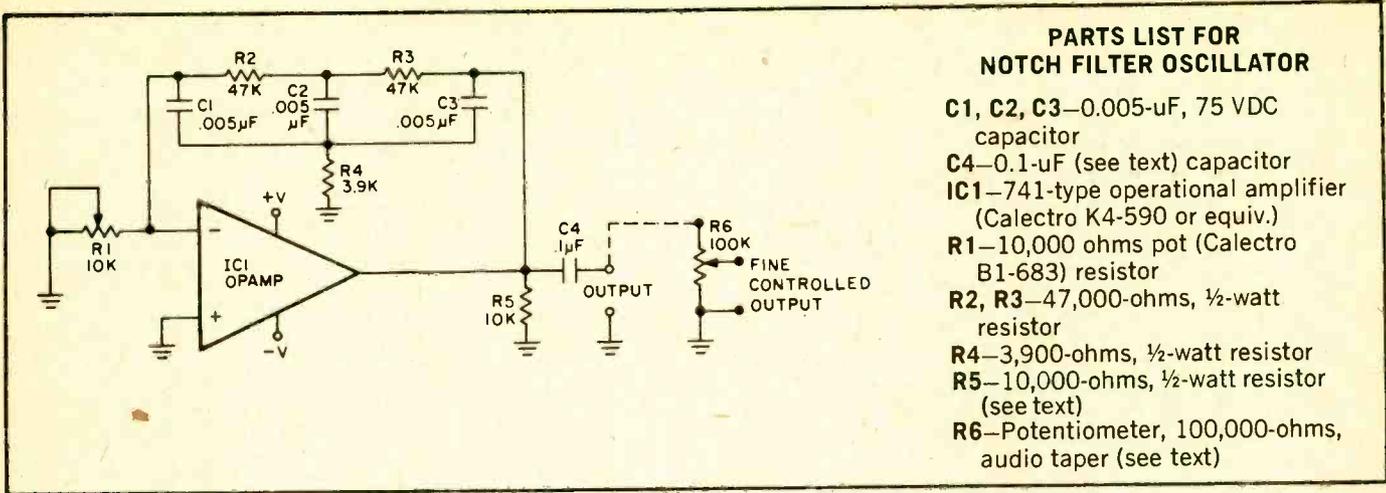
Every experimenter's spare parts box has the necessary components for our Notch Filter 1 kHz Oscillator. It's suitable for testing audio equipment, signal tracing or tape recorder bias adjustments. Integrated circuit IC1 can be just about any operational amplifier sold through "surplus dealers." The 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  $\pm 15$  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- $\mu$ F non-polarized capacitor for C4, rated to the power supply's voltage.



**PARTS LIST FOR NOTCH FILTER OSCILLATOR**

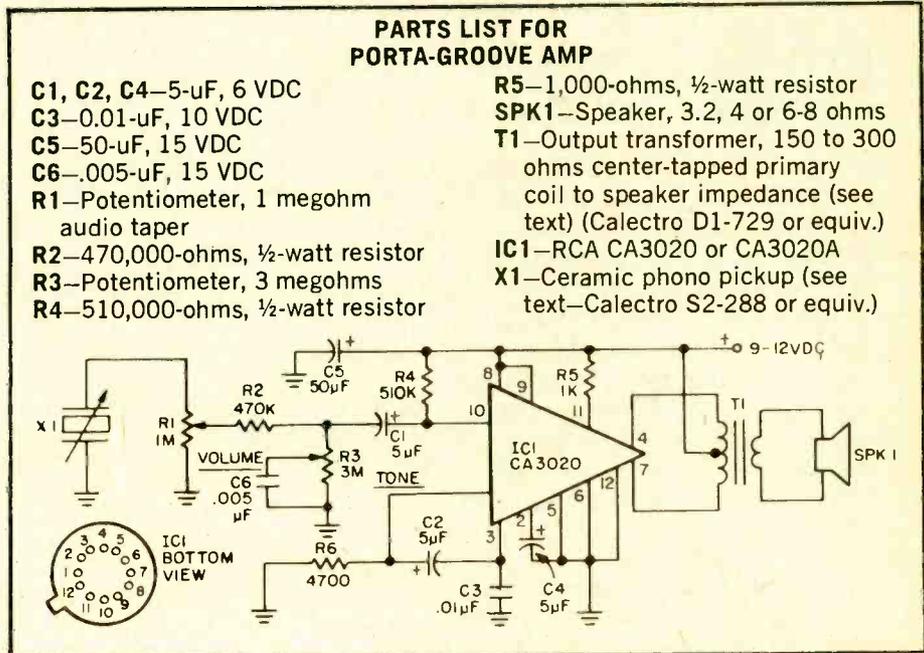
- C1, C2, C3—0.005-µF, 75 VDC capacitor
- C4—0.1-µF (see text) capacitor
- IC1—741-type operational amplifier (Calectro K4-590 or equiv.)
- R1—10,000 ohms pot (Calectro B1-683) resistor
- R2, R3—47,000-ohms, ½-watt resistor
- R4—3,900-ohms, ½-watt resistor
- R5—10,000-ohms, ½-watt resistor (see text)
- R6—Potentiometer, 100,000-ohms, audio taper (see text)

# IC 21 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



**PARTS LIST FOR PORTA-GROOVE AMP**

- C1, C2, C4—5-µF, 6 VDC
- C3—0.01-µF, 10 VDC
- C5—50-µF, 15 VDC
- C6—.005-µF, 15 VDC
- R1—Potentiometer, 1 megohm audio taper
- R2—470,000-ohms, ½-watt resistor
- R3—Potentiometer, 3 megohms
- R4—510,000-ohms, ½-watt resistor
- R5—1,000-ohms, ½-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.)

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.

# IC 22 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 pre-

amp. 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,

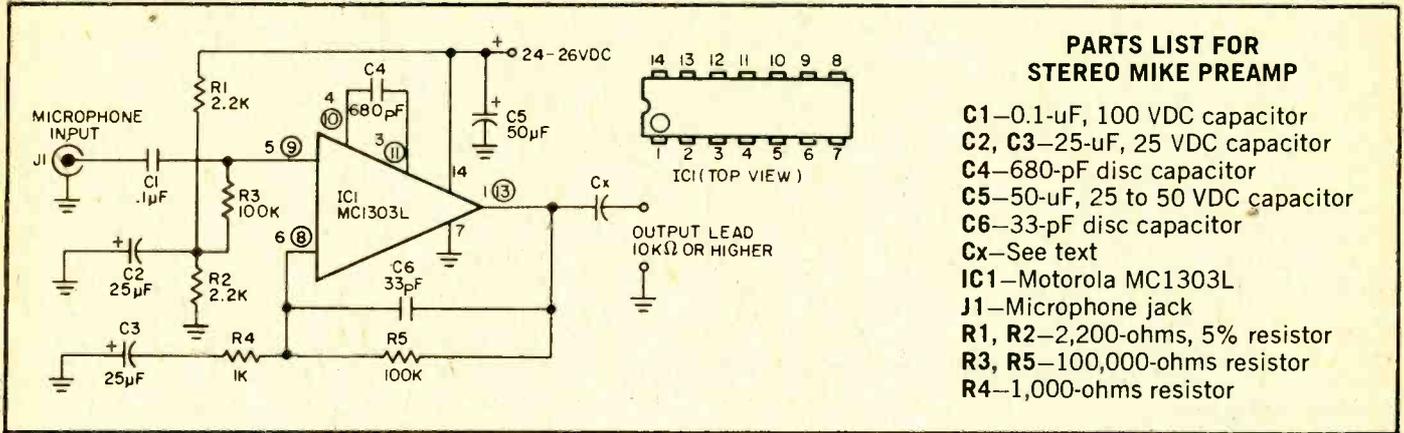
or series connected batteries. Be very careful to observe the correct polarity for capacitors C2 and C3. In the event the unit motorboats

(low frequency oscillation), install a 0.1 uF 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 C<sub>x</sub>'s value is determined by the load impedance. It should be of such value as to provide the desired overall low

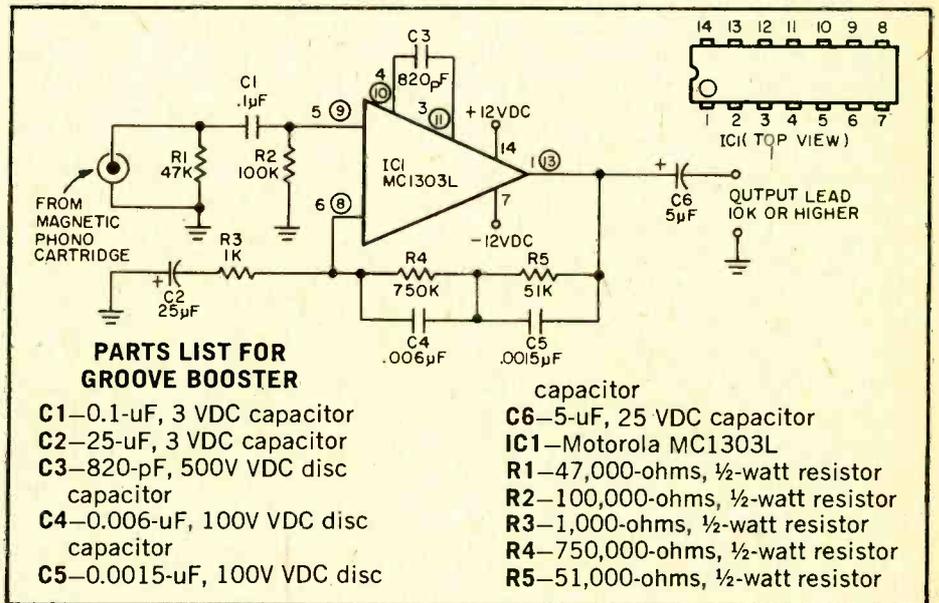
frequency response; 0.1 uF is suggested for high impedance output loads (100K and higher), while 10 uF is suggested for low impedance loads.



## IC 23 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-uF capacitors from pins 7 and 14 to ground—and get their polarity correct.



## IC 24 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).

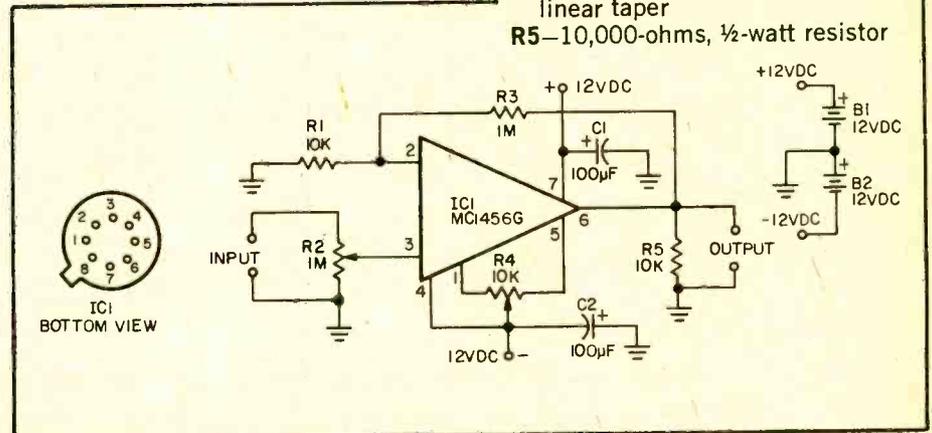
Connected ahead of a VTVM, the 100X Instrument Amplifier will convert, for example, a 10 mV DC level into 1V. Here's a value that can be read on your VTVM! Similarly, if connected ahead of a scope's vertical input, the amp boosts a signal that will just cause a wiggle on the CRT to almost a full screen 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 so, simply readjust R4. If you are primarily concerned with AC measurements, the output DC zero drift is unimportant, and a 0.1- $\mu$ F capacitor can be connected between the 100X Instrument Amplifier and your VTVM or scope.

#### PARTS LIST FOR 100X INSTRUMENT AMPLIFIER

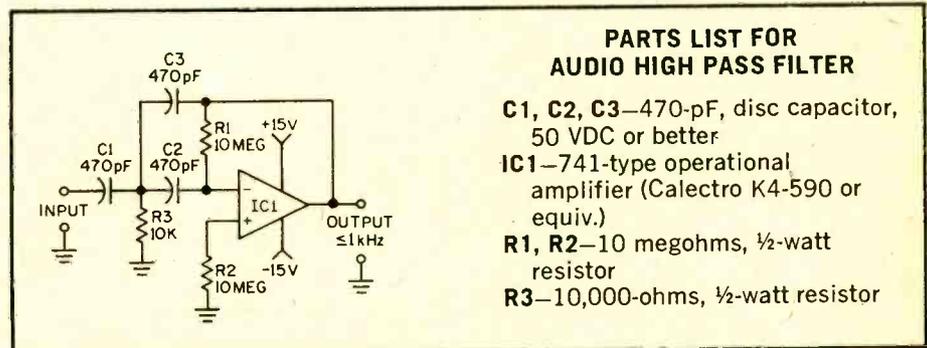
- B1, B2—Battery, 12V
- C1, C2—100- $\mu$ F, 15 VDC capacitor
- IC1—Motorola MC-1456G
- R1—10,000-ohms, 1/2-watt, 5% resistor
- R2—Potentiometer, 1 megohm
- R3—1 megohm, 1/2-watt, 5% resistor
- R4—Potentiometer, 10,000-ohms linear taper
- R5—10,000-ohms, 1/2-watt resistor



## 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



#### PARTS LIST FOR AUDIO HIGH PASS FILTER

- C1, C2, C3—470-pF, disc capacitor, 50 VDC or better
- IC1—741-type operational amplifier (Calectro K4-590 or equiv.)
- R1, R2—10 megohms, 1/2-watt resistor
- R3—10,000-ohms, 1/2-watt resistor

used. R2 connects to the non-inverting (+) input of the IC, R1 between

the output and the inverting (-) input.

## IC 26

### Protect-A-Volt

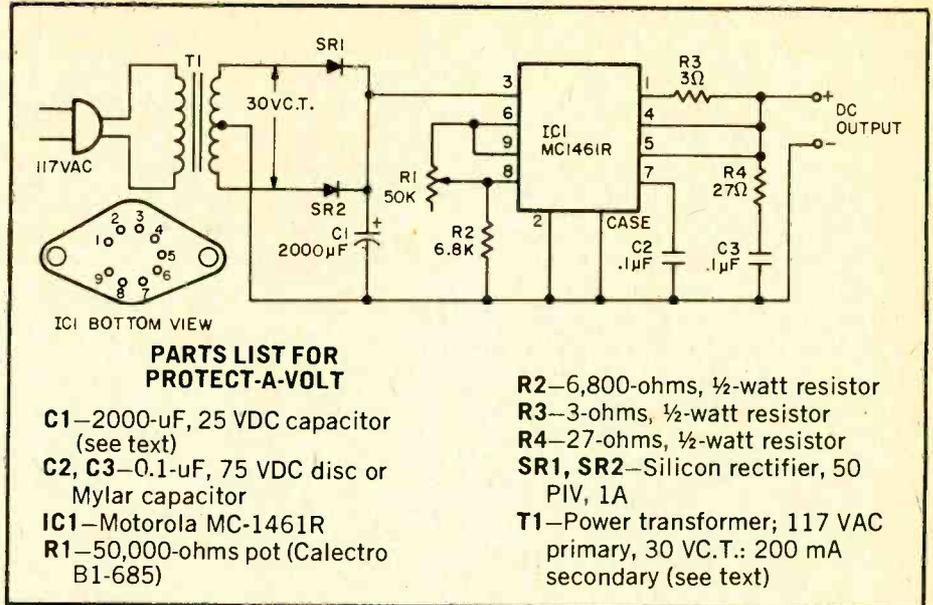
□ A simple turn of a knob sets Protect-a-Volt's output voltage anywhere in the 3 to 20-volt range—and with full short circuit protection! Should there be a wiring error in the powered project, this supply automatically

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 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 27

### Bi-Polar Power Supply

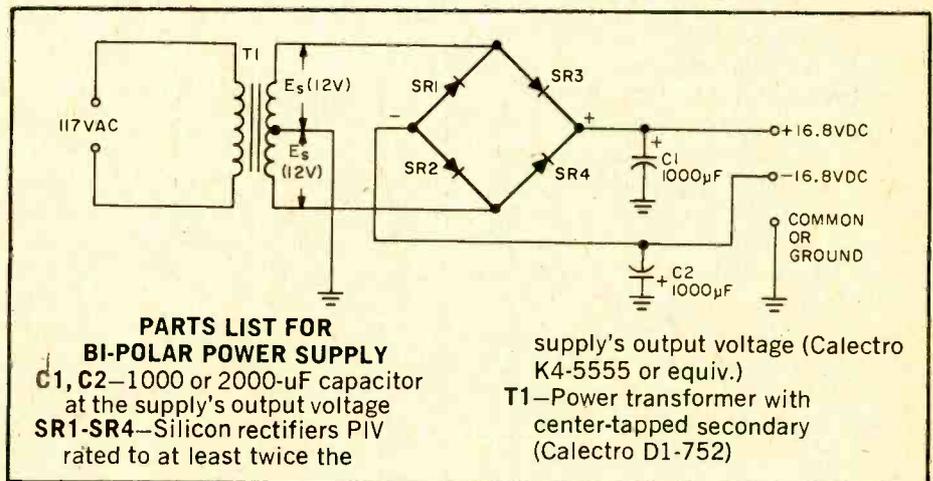
Most IC circuits require a Bi-Polar power supply. That is, a power source with two outputs—one positive with respect to ground and the other negative with respect to ground. A standard bridge rectifier circuit will provide a Bi-Polar output if the transformer's secondary is center-tapped to ground.

Filter capacitors C1 and C2 should be at least 1000  $\mu$ F (2000  $\mu$ F preferred) at a voltage rating at least equal to the supply's output voltage.

The supply's output voltage is equal to 1.4 times  $E_s$ . Voltage  $E_s$  equals one-half Transformer T1's peak secondary voltage. For example, assume that T1's secondary voltage is 24 volts (rms) center-tapped;

the voltage on each side of the center-tap ( $E_s$ ) is 12. The supply's output voltage is therefore  $12 \times 1.4$  or  $\pm$

16.8 VDC. Always remember that each Bi-Polar output is derived from half T1's secondary voltage.



## IC 28

### Ten Meter DX'er

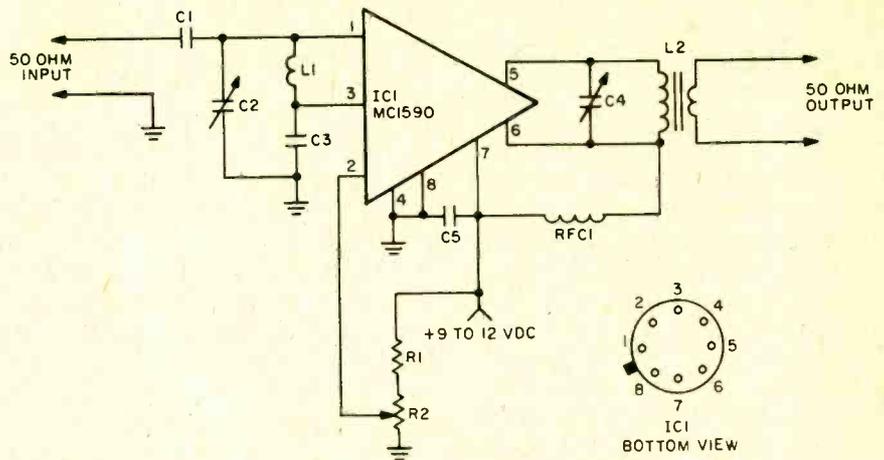
Though many budget communication receivers are outstanding performers on the lower Ham bands they often poop out on 10 Meters; yet 10

Meters is a real hot DX band with much of the action. To perk up reception, simply connect our Ten Meter DX'er between the antenna

and receiver, and you'll hear signals you didn't know existed. With 50 dB of power gain in any 1 MHz segment, the Ten Meter DX'er will boost the

### PARTS LIST FOR TEN METER DX'ER

- C1**—50-pF, 500-VDC ceramic disc capacitor
- C2, C4**—50-pF trimmer capacitor
- C3**—0.002-uF silver mica capacitor
- C5**—0.002-uF, 500 VDC ceramic disc capacitor
- IC1**—Motorola MC1590G
- L1**—12 turns #22 enameled wire on Micro Metals T37-6 toroid core
- L2**—Primary, 17 turns #20 enameled wire on Micro Metals T44-6 toroid core. Secondary, 2 turns #20 enameled wire.
- R1**—10,000-ohm, ½-watt resistor
- R2**—10,000-ohm potentiometer
- Misc.—Metal cabinet, shielding material.



Also, because of the very high gain, careful wiring and short ground leads are essential. Also, capacitor C5 must be connected directly at IC1's pin 7.

Potentiometer R2 adjusts the DX'er's gain, and should be adjusted

to just below the point where the DX'er overloads. To align, tune in a signal in the center of the desired frequency coverage and adjust trimmer capacitors C2 and C4 for maximum signal strength.

28 to 29 MHz or 29 to 30 MHz range with no extra tuning or attention.

## IC 29 CB Power Supply

□ 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 supply. 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*, 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.

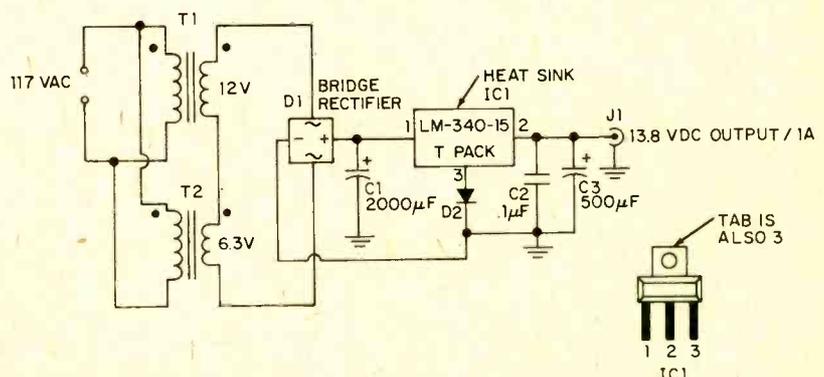
IC1 must be heat sunk to the cabinet. Note that IC1's tab is a "hot" terminal; make certain it is insulated from the cabinet with a power transistor insulator or a mica washer. Coat both sides of the insulator (washer) with silicon heat sink

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.)

### PARTS LIST FOR CB POWER SUPPLY

- 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



# IC30

## 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.

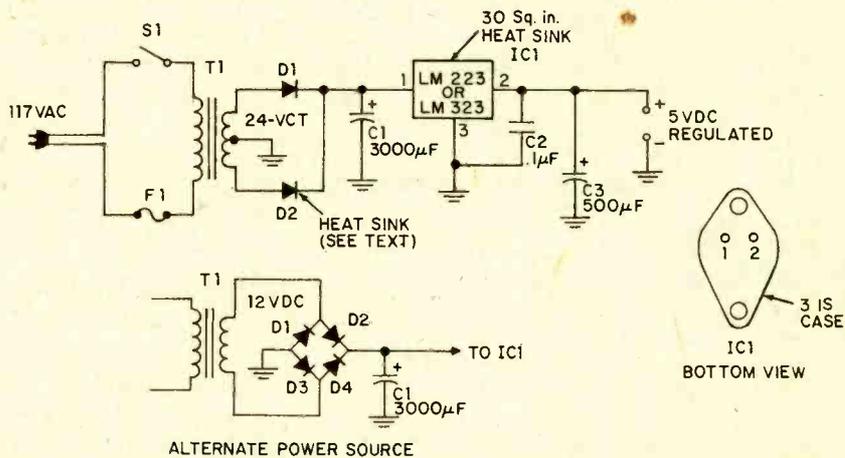
Power transformer T1 must be rated for the maximum current you will use or need. If you want the full 5 amperes T1 must be rated 5 amperes. But if you will need less cur-

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 sinked to the chassis.

### PARTS LIST FOR 5V/3A FOR DIGITAL PROJECTS

- C1—3000- $\mu$ F, 25 VDC electrolytic capacitor
- C2—0.1- $\mu$ F Mylar capacitor
- C3—500- $\mu$ 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

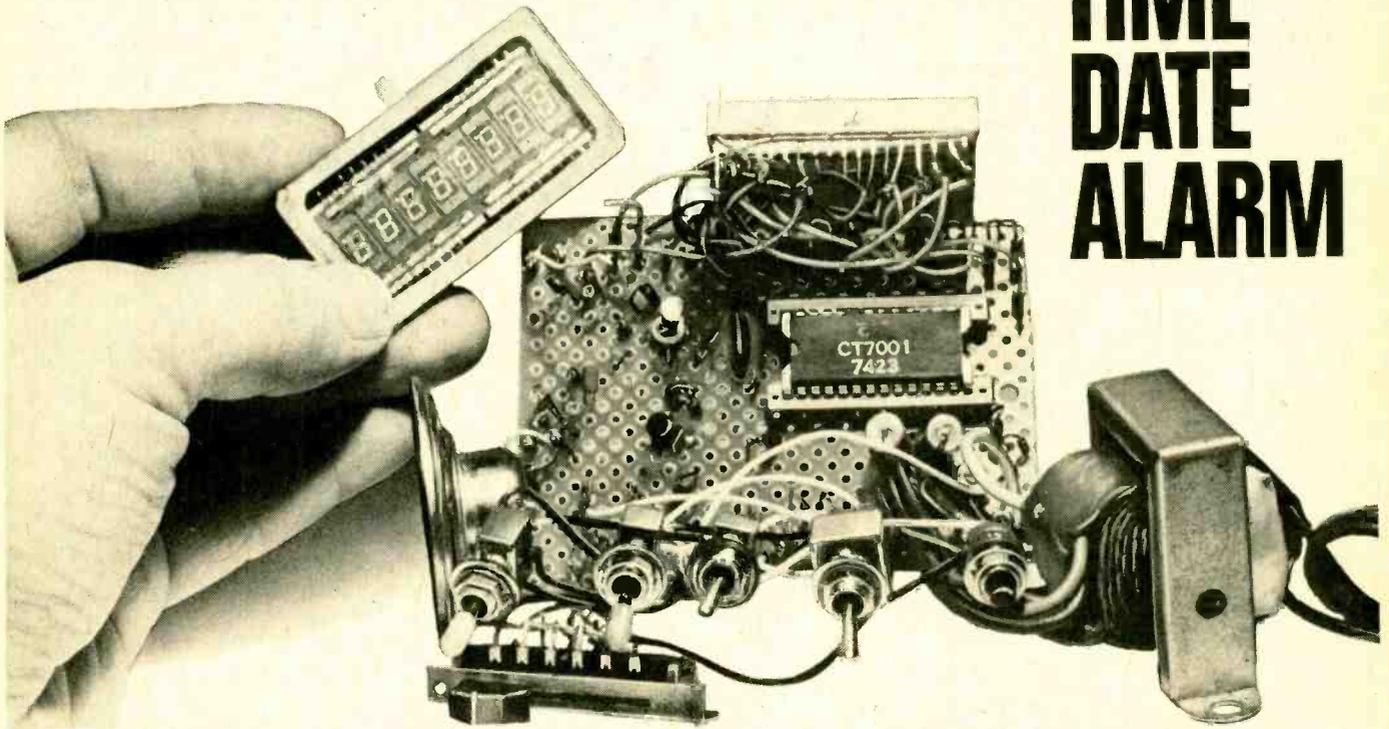


## What's your favorite circuit?

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.

INFLATION-BUSTING DIGITAL CLOCK PROJECT...

**TIME  
DATE  
ALARM**



# MAXICLOCK

The basic parts—IC, display, transformer, and IC socket—actually cost one half as much as you can pay for similar items used in our last clock!

by C. R. Lewart

**T**IME FREEZE! What's time freeze? To tell you the truth, nothing that great . . . we think it's everything *else* about this digital clock that's so great!

First of all, it's even simpler to build than our first clock project—a very popular one published over a year ago. Secondly, you'll find that even fewer parts do more jobs.

But today the best feature is one that is uppermost in everybody's mind—the major parts cost. In fact, the overall clock cost is just about *half* the price of our previous clock project. *It's the least expensive electronic digital clock we could find*—kit, project, or assembled—that has just about every feature you can think of in a line-powered digital clock.

It is a 6-digit clock. It is a calendar. It is a 24-hour alarm clock. It has a

10-minute snooze alarm. It has provision for internal battery power operation. It can be operated in either the 12- or 24-hour mode. It knows the days of the month (you update just once every four years at leap year). It is simple to build *without* a printed circuit board because there are no driver transistors for the display. It uses a standard low-cost "calculator" type display, and the display is internally wired—only 13 connections operate all 42 segments of the six-digit display. And all the display connections are made to an IC connector for ease of assembly.

It all adds up to one thing: You should be able to build this clock for a price considerably lower than digital clocks with fewer features. And, oh yes, about time freeze: It's the simple "seconds hold" feature you get with this

clock. With it you set the time ahead a minute or two, wait for your time standard (WWV, local radio, Ma Bell, etc.) to count down to zero, flick the function switch, and watch your clock start counting from "00" seconds every time. A small feature, perhaps, but something everyone appreciates.

Other features of the clock are as follows: You can select between time, date, alarm "set" time, or time/date display (a time display for 8 seconds followed by a date display for 2 seconds). A 50 or 60 Hz switch and the time freeze feature let you set time with ease (in the 50 Hz position, the clock will run 20 percent faster on a 60 Hz line). You also have a "snooze" button to recycle the alarm by ten minutes. *There is only one switch for setting hours, minutes, days, and months!* Ad-

# MAXICLOCK

ditional features are an "alarm is set" red LED indicator, leading zero blanking, and a green LED to indicate p.m. The clock also provides an optional 24-hour display, stand-by battery power, and display brightness control.

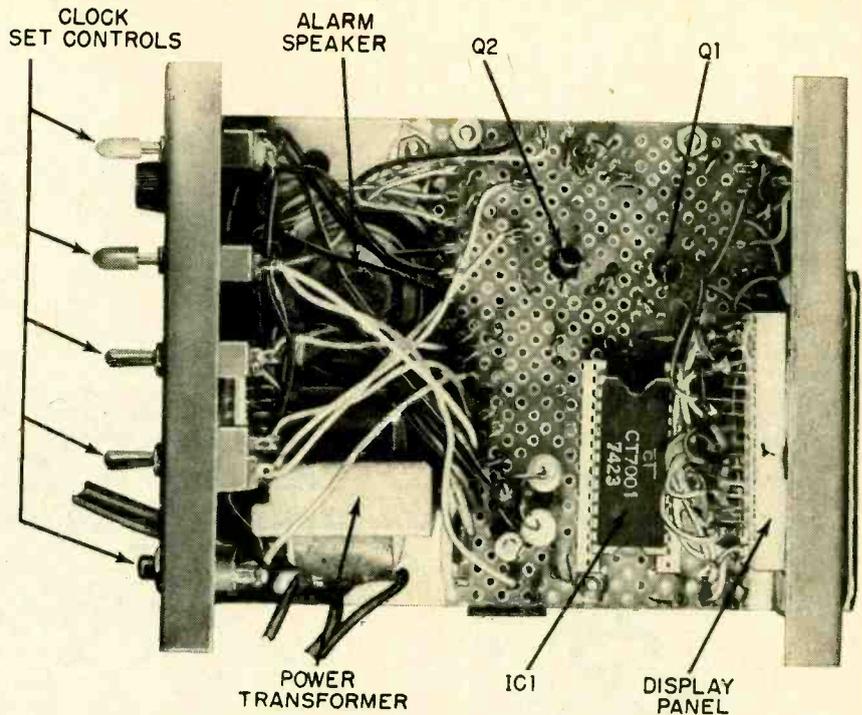
**How Does It Work?** The brain of the clock is the Cal-Tex CT7001 integrated circuit consisting of thousands of transistors; it counts down the line frequency to seconds, minutes, days, and months. Internal memories record the number of days in each month and the alarm settings. To avoid large numbers of wire leads, the display digits are multiplexed, which means that "gating" signals (digit turn-on signals) are applied in sequence to the "control" grid of each digit. But it happens so fast you "see" a continuous 6-digit display. The display segments of all digits are connected in parallel right inside the display case. It comes pre-wired that way in its compact enclosure.

The first transistor, Q1, turns the leading zero off when the "SF" segment (see schematic) appears—this is the only segment not required to form digits 1 and 2. The second transistor, Q2, is a programmed unijunction transistor which drives the speaker to sound the alarm. You can change the sound of the alarm by making C1 smaller or larger as you desire.

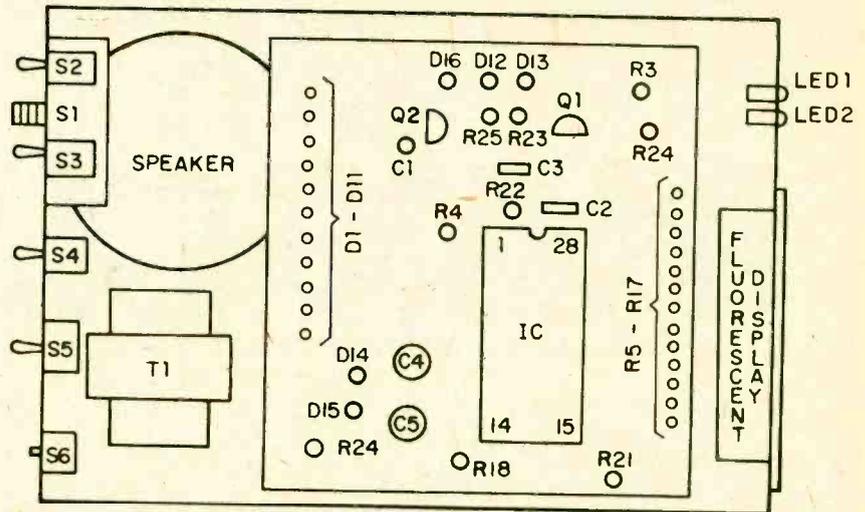
**Construction.** To build the clock we used point-to-point wiring on a 3 x 4-in. perf board. The clock fits into a 3 x 4 x 5-in. cabinet, but you may want to build it in a slightly larger cabinet with different styling. If your soldering skills are limited, we would recommend a 4 x 5 x 6-in. cabinet. All external connectors are brought out to push-in terminals at the edge of the perf board.

Be careful handling the integrated circuit. A socket for the IC is a must. Install the IC in the socket only when you are finished with all the wiring to prevent a static charge from damaging it.

The display is quite sturdy, though dropping it on its edge on the concrete basement floor (as we did during construction) will definitely wipe it out! Cut a hole in the front of the cabinet for the display and attach it with a bracket, glue, or masking tape. All display connections are brought out on pins similar to a 14-pin dual in-line IC. The pins have to be bent slightly to fit into the IC socket. To improve visibility, we recommend putting a sheet of smoked or green-blue plastic or glass in front of the display.



Birds-eye view of major parts location in a compact and very tight design. Consider building your clock in a more original setting for wall (or even built-in) display with hidden power cord.



**Optional Features.** You may want to drop some of the features provided in the basic clock to simplify its construction. You may also want to add a few extra features if you feel strongly about them. Mix and match; it's up to you.

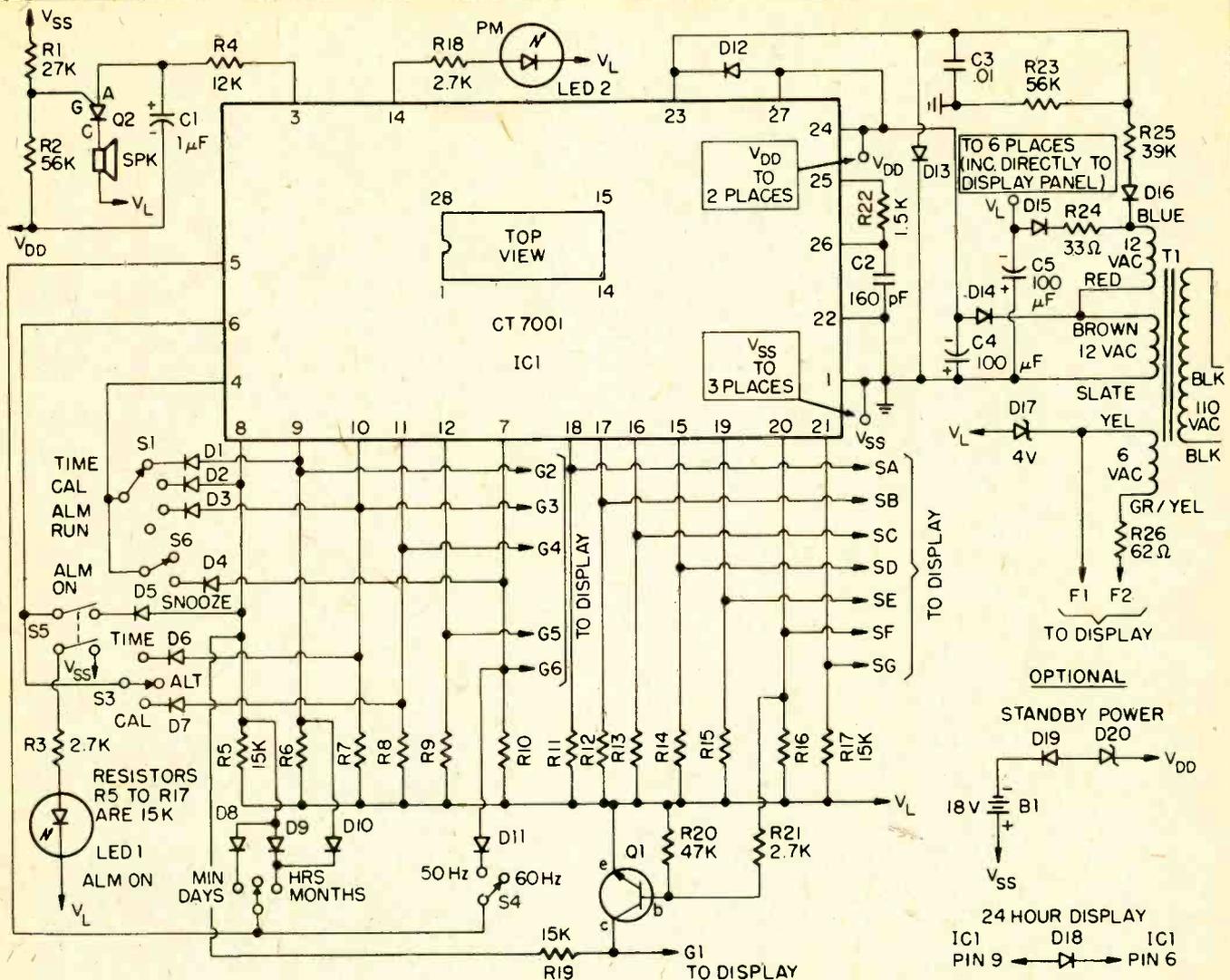
- Leading or blanking zero in the 24-hour mode. If you prefer a leading 0 (05 15 45 instead of 5 15 45) leave out Q1 and R19 to R21.

- Display brightness. If you would like to control the intensity of the display, replace R24 with a 500-ohm potentiometer connected as a rheostat.

- Twenty-four-hour display. You can choose the 24-hour mode instead of the 12-hour mode simply by connecting DI8 as shown on the schematic. The

clock must be reset when switched from 12- to 24-hour display.

- Stand-by battery power. A couple of 9-volt batteries as shown on the schematic will provide stand-by power. When the AC is on they do not supply any current to the circuit. When the AC is off the drain on the batteries is only about 3 mA. Though the display will be off, an internal oscillator will keep the counters running so that the correct time and date will be displayed when the power returns. For this option, replace R22 with a 5000-ohm potentiometer connected as a rheostat. Adjust it by unplugging the clock for one minute at a time (with a stand-by battery installed). Then, check whether it is fast



- B1**—Pair of 9-volt transistor radio batteries.  
Note: required only when standby battery power option is included.
- C1**—1- $\mu$ F capacitor, any type, 50 VDC or better
- C2**—150 or 160-pF disc capacitor, 50 VDC or better  
Note: You can parallel-connect a 100-pF and 47-pF to obtain an approximate value.
- C3**—0.01- $\mu$ F disc or tubular capacitor, 50 VDC or better
- C4, C5**—100- $\mu$ F electrolytic capacitor
- D1 to D11, D16, D18**—General purpose silicon diodes such as 1N914
- D12, D13**—General purpose germanium diodes such as 1N34
- D14, D15, D19**—1-amp, 200-volt silicon diodes, 1N4003
- D17**—4-volt,  $\frac{1}{2}$ -watt zener diode
- D20**—6-volt,  $\frac{1}{2}$ -watt zener diode
- IC1**—Time/date/alarm clock-on-a-chip (Cal-Tex CT7001, do not substitute.)

- LED1**—Red light emitting diode, alarm-on indicator
- LED2**—Green light emitting diode, p.m. indicator
- Q1**—Npn silicon transistor, HEP S0007
- Q2**—Programmable unijunction transistor, HEP S9001
- R1**—27,000-ohm,  $\frac{1}{2}$ -watt resistor
- R2, R23**—56,000-ohm,  $\frac{1}{2}$ -watt resistor
- R3, R18, R21**—2700-ohm,  $\frac{1}{2}$ -watt resistor
- R4**—12,000-ohm,  $\frac{1}{2}$ -watt resistor
- R5 to R17, R19**—15,000-ohm,  $\frac{1}{2}$ -watt resistor
- R20**—47,000-ohm,  $\frac{1}{2}$ -watt resistor
- R22**—1500-ohm,  $\frac{1}{2}$ -watt resistor, see text
- R24**—33-ohm,  $\frac{1}{2}$ -watt resistor, see text
- R25**—39,000-ohm,  $\frac{1}{2}$ -watt resistor
- R26**—62-ohm,  $\frac{1}{2}$ -watt resistor
- S1**—4-position, single-pole rotary or slide switch
- S2**—Spdt center-off toggle switch
- S3**—Spdt center-off toggle switch
- S4**—Spst toggle switch

- S5**—Dpst toggle switch
- S6**—Normally open pushbutton switch
- T1**—Power transformer, P8361
- Z1**—7-segment, 8-digit fluorescent display with internally strapped segments for multiplex display system, ISE DP89A used by author
- Misc.**—Small 3.2- or 8-ohm speaker used only if alarm option is included (Radio Shack 40-262 or equiv.); cabinet (author used 3 x 4 x 4 $\frac{1}{2}$ -in. unit but suggests larger size for novice builders such as Radio Shack 270-253 which is 5 $\frac{1}{4}$  x 3 x 5 $\frac{3}{8}$ -in.); wire, solder, hardware, 14-pin DIP IC sockets for display (2 required), etc.

A partial kit of parts consisting of a Cal-Tex CT7001 (IC1), the ISE DP89A display panel (Z1), and a 28-pin socket for IC1 is available from Photolume Corp., 118 E. 28th Street, New York, NY 10016 for \$26.95 postpaid. Power transformer T1 can be added to the basic kit for an additional \$3 at the time of your original order only (total for 4 items noted in this offer is \$29.95 postpaid). Postal money order will speed delivery. Otherwise allow 6 to 8 weeks for delivery. (New York residents must add sales tax.)

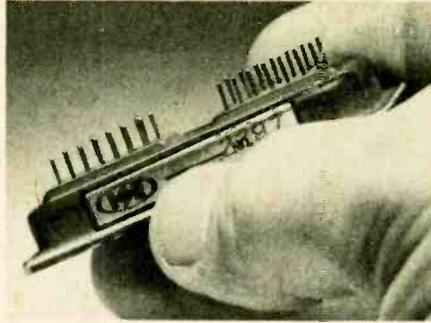
# MAXICLOCK

or slow when the AC power is again applied and adjust R22 in the direction which will reduce error.

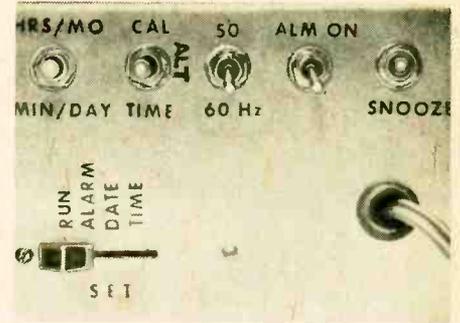
**Operation.** Set the time, date, and alarm by turning S1 to the proper position (either *time*, *date*, or *alarm*). Then flip and hold S2 in the *hour/months* or *minute/day* position—whichever you wish to set. You will notice that the function you have elected to set will increment at one digit per second for as long as S2 is in the off-center position. You will also notice that setting one function will not affect any other function. This feature allows you to set February 29 in a leap year without upsetting any other function. You will also note that moving S1 to *time* stops the clock. When S2 is then actuated, seconds will reset to 00. These two imaginative features make for precise and easy time setting. After making all your settings, return S1 to its normal *run* setting.

The display mode, *time-only*, *date-only* or *alternate* (time and date), is selected with S3.

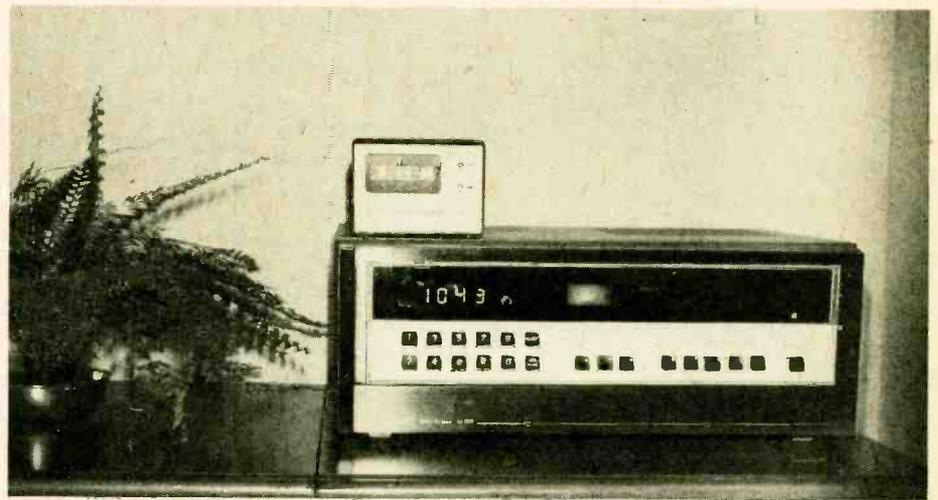
The *alarm on* switch S5 also turns on a red LED to make you aware that the



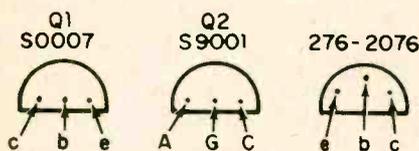
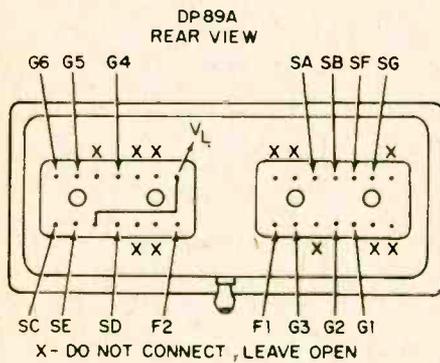
Just a pair of 14-pin dual-in-line IC sockets are needed to connect this compact display with the circuit board. Display is actually an 8-digit device originally for calculator use. Here we blank the third and fifth digits to separate hours, minutes, and seconds.



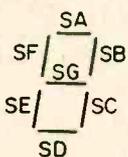
"Set" switch S1 (see the schematic) tells the clock which of its three functions you want to adjust with the left hand switch (S2). Just hold S2 in the up position to set hours or months; hold it down to adjust minutes or day of the month.



This hi-fi setting is strictly digital with your home-brew digital clock and Heath's AJ-1510 "digital" FM tuner. Hi-fi fans can even add Infinity Systems' Class D Switching Power Amp.

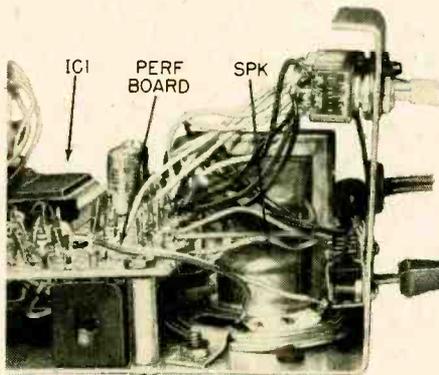


BOTTOM VIEW



SEGMENT IDENT

DIODES



Perf board mounting is simple enough if you use spacers, screws, and nuts as shown. You can mount the display panel (Z1) with anything from double-sided tape to epoxy glue. If you select the alarm option, you must use a small speaker; it can face downward (as shown) or forward for more sound. The kit of basic parts includes the 28-pin IC socket—see parts list for details.

alarm is set. The warning light may save you from being awakened at 7 a.m. on a weekend.

The alarm can be set up to 23 hours, 59 minutes in advance (let the alarm ring for a minute, or better still, just turn it off for a minute before flipping S5 back on for tomorrow morning's greeting). Switch S6 is the snooze button and will give you another ten minutes sleep in the morning if you can manage to give it a nudge.

When you set *time* or *alarm*, the p.m. light will indicate whether your setting corresponds to a.m. (light off) or p.m. (light on).

**The Wrap-Up.** So that's it! A clock project that gives you more for less is e/e's style. Our supplier of hard-to-find items has promised to hold the line on prices (see the parts list), so we expect these optional features and useful functions to bring our readers the best clock their inflation-fighting dollars can buy. ■

# YOUR CB

# CAN TELL TIME



Tired of all those fancy experimenter projects good for everything but a CB shack? Here's a goof-proof project that puts SW broadcasts on a CB without modifications!

by Malcolm K. Smith

**T**HE receiver in your CB transceiver is almost certainly an excellent signal grabber with good selectivity and sensitivity. But, it's crystal controlled to receive only the CB channels. There is, however, a simple way to make your CB serve as a high quality rig for VHF monitoring, short wave listening, checking the National Weather Service forecasts, or getting an accurate time and frequency signal. All you need is a simple device called a converter that requires no changes to the inside of your rig. And, best of all, building a converter is a breeze, because it can be made from low cost modules available in kit form.

There are many exciting signals you can receive on your CB with a converter, but the most useful ones are the precision time and frequency broadcasts sent out by CHU in Canada and the National Bureau of Standards station WWV in Fort Collins, Colorado. Let's say you've just built the e/e MAXICLOCK—a first class digital clock; surely you need something better than a DJ's idea of the time to set your clock. Or, if you're interested in accurate calibration of a

receiver or transmitter, you need the precision standard frequency given by WWV. And now, if you'd like to tell time with your CB using a converter, what is a converter, and how does it work?

A converter mixes together an input signal—let's say CHU at 7.335 MHz—with a signal from a "local oscillator" (LO) in the converter itself. When two signals are mixed, out come new signals at the sum and difference of the original frequencies. Suppose you mix the 7.335 MHz signal from CHU with an LO signal of 19.730 MHz; one of the output signals is their sum—27.065 MHz, the frequency of channel 9.

**Simplex Circuit.** Take a look at the block diagram which is nearly the schematic of a converter; the 7.335 MHz signal is amplified by the RF amplifier and fed into the mixer where the LO signal (19.730 MHz) is added to it. The sum frequency (27.065 MHz) is fed into the antenna input jack of your CB (tuned to channel 9), and from the speaker you now hear the time signals. You have "converted" 7.335 MHz to 27.065 MHz!

Incidentally, the workings of CB receivers were well described in e/e for July-August 1974. If you have that issue, the article on page 45, "Discover Your CB Receiver," gives a good explanation of converters.

Our CB time converter uses three easy-to-build and low-in-cost modules available from the International Crystal Mfg. Co., 10 North Lee, Oklahoma City, Okla., 73102. Each module performs one function and consists of a transistor, a tuned "LC" circuit, and other components mounted on a printed circuit board. The three kits needed here are: SAX-1, the RF amplifier; MXX-1, the RF mixer; and OX, a crystal controlled local oscillator. You will have to buy an "EX" crystal for each frequency to be received unless you have one of the old tunable receivers such as the Lafayette Comstat 19, which can be manually tuned over a range of about 300 kHz. In that case, you would require only one crystal to cover this 300 kHz range.

**Pinpoint Hertz.** How do you calculate the required crystal frequency? First, determine the frequency you wish to

# CB TIME CONVERTER

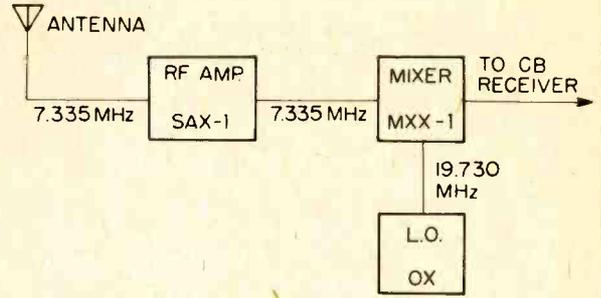
receive; let's say WWV on 10.0 MHz. This is a good first choice since WWV seems to come in well at most times. Next, decide on the channel to use; channel 9 is probably best, since there will be very few strong CB signals to leak through and interfere with the converter signal. The frequency of channel 9 is 27.065 MHz.

The next step depends on whether you are going to convert "up" or "down." Here you are converting up to a higher frequency, and so you subtract the desired frequency from the channel 9 frequency to get the LO frequency as follows—channel 9 frequency (27.065 MHz) minus the desired signal frequency (10.000 MHz) gives the "LO" frequency, 17.065 MHz.

Now suppose you want to receive a frequency higher than channel 9, say a National Weather Service Station on 162.55 MHz. Incidentally, NWS weather and many other VHF signals are frequency modulated (FM). Your CB rig is not designed to receive FM, but, surprisingly enough, it does a pretty good job (don't try, however, to build a converter for the FM broadcast band; your CB rig can't handle their large frequency shifts).

Here you get the LO frequency by subtracting the channel 9 frequency from the desired frequency, since this is "down" conversion, as follows—desired signal frequency (162.55 MHz) minus the channel 9 frequency (27.065 MHz) gives the "LO" frequency 135.485 MHz.

With three easy to construct and inexpensive kits, which come with an etched and drilled PC board, you can electronically "slide" your CB receiver down to pick-up short wave broadcasters like WWV, CHU, or even the Voice of America.



**3-Way Cut.** So, you want a crystal of frequency 135.485 MHz, right? Wrong! There is a slight complication in using the OX oscillator at frequencies over 60 MHz. You can't use the basic or fundamental frequency of the crystal. You have to use what are called its harmonics—frequencies which are two or three or more times the fundamental. Here you use the third harmonic—three times the fundamental. Therefore, the crystal frequency should be *one third* the LO frequency. The NWS crystal is, therefore,  $135.485 \div 3 = 45.1617$  MHz. The table gives crystal frequencies for a few other common signals.

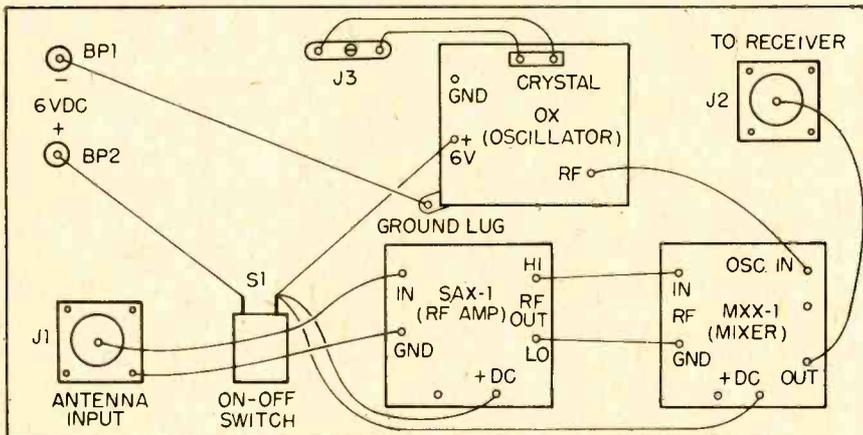
In addition to the International Crystal modules and EX crystals, you'll also need a few small parts and a box or cabinet for mounting. The cabinet requirements are not critical; a small metal box or one with a metal cover should serve well. The common bakelite box with aluminum cover is fine. A box about 4 x 8 x 2½-in. is good because it gives you plenty of room for batteries, connectors, etc.

The ICM kits are quite complete; you'll need only wire and solder to

build the modules. International Crystal provides detailed instructions for selecting the right components from the ones they supply and for assembling the individual modules. The diagram shows you how to connect the modules together to produce a converter. Before mounting the boards, check your soldering carefully. Look very carefully at the joints where the input and output terminals meet the copper foil. They can easily work loose; it's a good idea to solder each one individually. Use the bolts and spacers supplied to mount the modules on a metal chassis; drill four ¼-in. holes in a square 1¾-in. on a side for these bolts.

**Input-Output.** SO-239C coaxial jacks handle the coax cables to the antenna and the transceiver. An spst switch and a snap-type battery clip take care of power connections. A nine-volt transistor radio battery is an adequate power source. However, we prefer to use four AA cells in a holder; the rig works fine on six volts and these cells last longer than the nine volt battery. For long term monitoring you may want to use an external AC power supply; the two

Here's why we stamp this project "goof-proof." Three little sure-fire PC board project kits and a few wires to plug them together pick up short-wave broadcasts and "convert" them to CB channel 9. That's where your CB set takes over. It "picks up" the converted signal; that's why no modification to the CB set is ever required.



## PARTS LIST FOR CB TIME CONVERTER

- BP1, BP2—5-way binding posts
- J1, J2—SO-239, chassis-mount coaxial jacks
- J3—Optional crystal socket for "EX" (HC-6/U) type crystals (Amphenol 9748-16-10 or equiv.)
- S1—Spst toggle switch (ON-OFF)
- Misc.—Four-cell AA battery holder, cabinet with metal cover about 4-in. x 8-in. x 2-in., PL-259 coax connectors for input/output signals, wire, solder, etc.

In addition, the following "Experimenter" kits will be required from International Crystal Mfg. Co., Inc., 10 N. Lee, Okla. City, OK 73102: OX oscillator @ \$2.95, MXX-1 mixer @ \$3.50, SAX-1 RF amplifier @ \$3.50, and the proper EX crystal (see text) @ \$3.95. Postpaid.

## COMMON CRYSTAL FREQUENCIES

Station	CHU	WWV	NWS weather	Marine calling, distress
Freq. (MHz)	7.335	10 5	162.55 162.40	156.8
Crystal (kHz)	19,730.000	17,065.000 22,065.000	45,161.666 45,111.666	43,245.000

binding posts are for this connection.

One last refinement, that is not necessary but certainly is convenient, is an external crystal socket. As shown in the diagram, mount the socket near the OX module and connect two leads (as short as possible) from the OX socket to the terminals of the new socket. This allows you to change frequencies over a narrow range without removing the unit from its case.

A special word here about using your converter on different frequencies: You should follow the ICM instructions carefully in choosing the right coil and capacitor for the kits. For the OX oscillator, the "yellow dot" coil will probably cover the range you want for time listening. However, with the SAX and MXX, the yellow dot has to be matched with the right capacitor: the 100 pF capacitor tunes the range 5.4 to 8.5 MHz—just right for CHU. For WWV you need the 47 pF capacitor that tunes 8.5 to 13 MHz.

When the modules are securely mounted, make the connections between the units as shown in the diagram. Note that the negative battery terminal is connected to chassis ground with a solder lug. Connections to the boards are made with the little connectors supplied. Take it easy and work carefully with them. First cut your wire to the right length, then strip about 1/4-in. of insulation from each end. Hold the "open" end of the connector with long nose pliers; squeeze the connector around the wire end. Secure the wire in place by flowing in some solder. Careful! Don't let solder get into the round end that mates with the pin on the PC board.

**Setup.** For testing and adjusting your converter, an RF signal generator is useful, but not essential. The tuned circuits in the SAX and MXX can be peaked using an on-the-air signal from CHU or WWV. Adjust the slugs in the coils for maximum volume from the speaker.

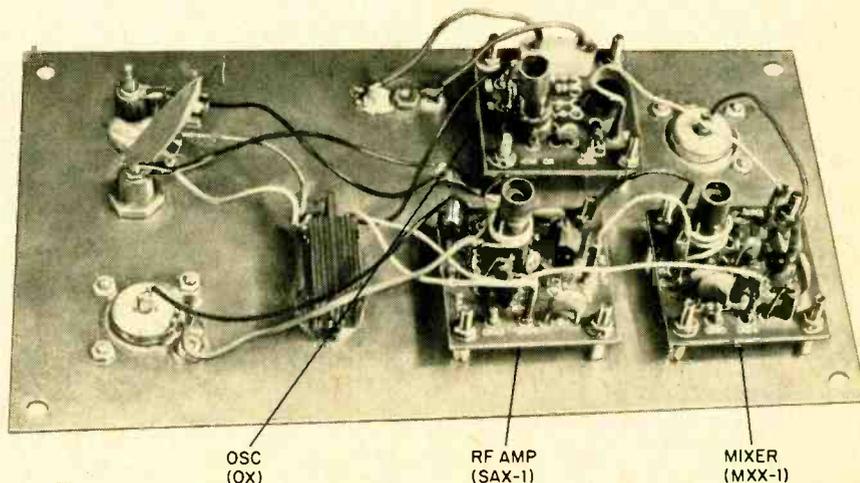
Of course, your converter needs an antenna to function properly. When radio propagation conditions are good, almost any piece of wire connected to the center (ungrounded) input will

serve. We get good results by connecting both wires from a monitor antenna to the center terminal. This is, in effect, a long vertical antenna. Your CB antenna will probably not work well, since most good CB antennas are effectively grounded for any frequencies except the CB channels (good for lightning protection, but not for receiving 10 MHz).

**Shortwave Fix-Tuned.** There are many shortwave broadcast stations around the world you might try to snag with a fix-tuned receiver like the one here. The radio can be left "on," always tuned exactly to the broadcaster's frequency. When "skip" on the shortwave bands is just right, and the station is broadcasting, you will be ready to copy. While a separate crystal for every possible frequency is a financial impossibility, and not very practical anyway,



A front panel mounted crystal socket permits moderate shifting of the received frequency without internal retuning. If you use an external 6-volt supply, be sure to remove the dry cell.



you can keep a crystal or two around for your most often used frequencies.

Here is a selected list of shortwave broadcast stations which may interest you. Of course, you should confirm reception in your area with a regular tunable shortwave receiver before sinking your good bucks into a crystal.

**Voice of America**, Greenville, N.C., 15160 kHz, 2345 GMT, relaying programs of the Organization of American States; Greenville, N.C., 15235 kHz, 1900 GMT.

**Canadian Broadcasting Corporation**, Sackville, N.B., 11720 kHz, 0200 GMT, Northern Service newscast; Sackville, N.B. 15190 kHz, 0100 GMT, Radio Canada International's foreign service in English.

**CFRX**, Toronto, Ontario, 6070 kHz, can be heard during the evening hours in North America with programs of CFRB, sounding much like a popular music format U.S. commercial BCB station.

**Voice of the Andes, HCJB**, Quito, Ecuador, 11745 kHz, English may be heard around 0300 GMT. Or, in the mornings, try 15115 kHz about 1300 GMT.

**Radio Peking**, Peking, People's Republic of China, 15060 kHz. You can find this station broadcasting in English around 0200 GMT.

**Radio Australia**, Melbourne, Australia, 11785 kHz. Plenty of English programs from this down under station; listen in about 1400 GMT.

**Radio Tahiti**, Papeete, Tahiti, 15170 kHz. With music that runs the gamut from U.S. pops to Polynesian melodies, listen for this station from its sign-on at 0300 GMT.

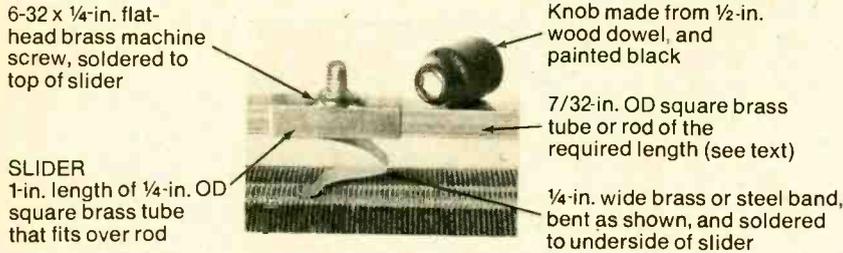
This little converter now makes your CB into a red hot receiver. With the right LO crystals, you can cover your favorite frequency-stops from 3 MHz to 170 MHz. Good signal hunting! ■

Both young and old radio buffs usually start out with a crystal set . . .

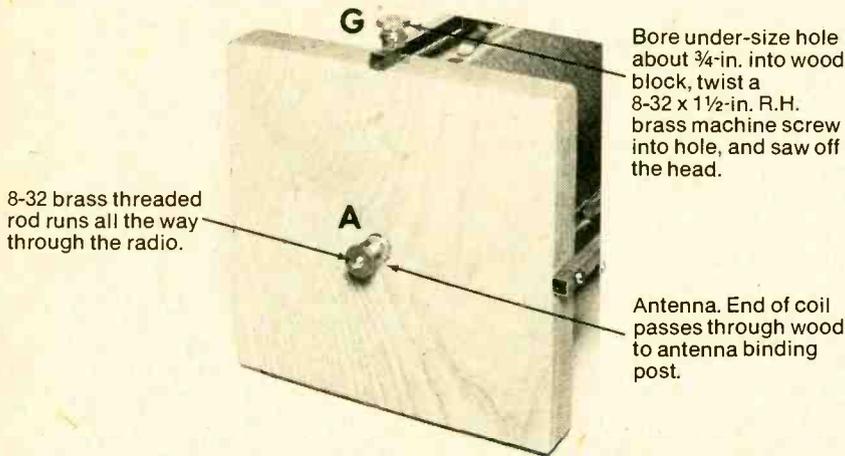
# OATMEAL BOX CRYSTAL

**Fig. 1**

Sliding contacts made from brass and steel.



**Fig. 2** Antenna and ground end of the Quaker Oats radio.



**A**SK JUST about any radio old-timer, including this writer, and he will probably tell you that his first radio was a home-brew slide tuning coil wound on an oatmeal box, a cat whisker and galena crystal detector, and a pair of earphones. This picture story shows how to make such a radio, and it looks much like the writer's first radio built not long after World War I.

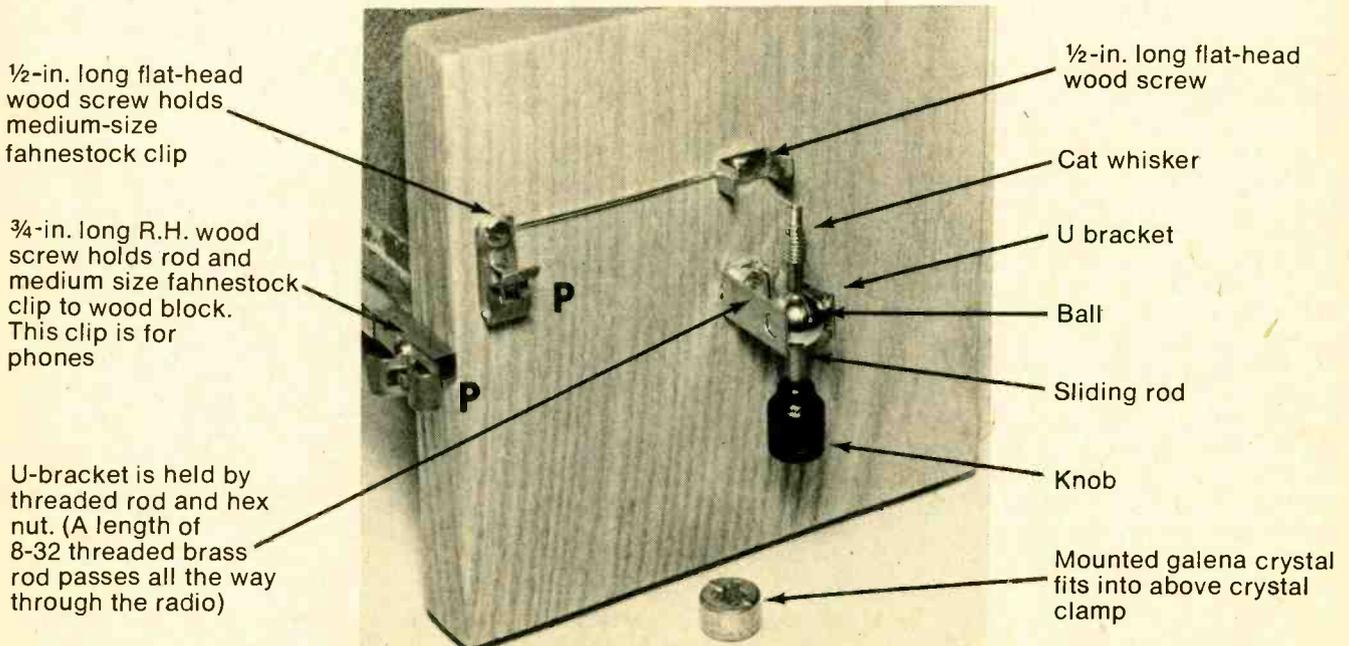
First, make the coil. Remove the two end covers from an 18-ounce, round Quaker Oats box, and cut the tube to a length of about 6 1/2-in. Give the tube a coat of shellac inside and out to moisture-proof it.

The writer used #21 single-cotton-covered enamelled copper magnet wire, and after the coil was wound the cotton was colored green by painting it with India ink to make it look like the old-time green silk-covered wire which is no longer being made. If you prefer, use #20 or #21 enamelled or nylon-coated copper magnet wire, and one pound should easily do it.

**Get Going.** Punch two small holes through the tube at each end, about 1/2-in. from the ends, to anchor the ends of your coil. To do a tight, smooth and neat job of winding the coil, tie the end

**Fig. 3**

Crystal detector end of the Quaker Oats radio.



if your "taste" dates to earlier days, try—

# RADIO

by Art Trauffer

of the wire to some object outdoors where there is plenty of room, and unwind a couple hundred feet of wire, and pull the wire tight to stretch out any bends in the wire. Cut off the wire and anchor the end in the two small holes near one end of the tube, and dab a bit of cement to hold it fast. Now wind the coil by turning the tube slowly while you walk towards the tied end of the wire, and when the tube is full of wire cut off the wire and anchor the end in the two holes at the other end of the tube and put on a dab of cement. This trick will give you a neat professional-looking coil.

As shown in the photos, the two wood end blocks for the coil measure 5 x 5 x 3/4-in. and are sanded smooth, stained, and varnished. The writer's first project used oak.

Bore a 3/16-in. hole through the exact center of each wood block; these are for the length of 8-32 threaded brass rod that passes through the coil and holds the wood end blocks. One end of the threaded rod holds the U-bracket of the crystal detector (Fig. 3), and the other end of the rod serves as the antenna binding post (Fig. 2).

Note in Fig. 2 that the end of the coil nearest to the antenna binding post passes through a small hole in the wood block and is clamped between the two washers of the antenna binding post; this automatically connects the coil end to the U-bracket of the crystal detector also.

Figs. 2 & 3 give details for mounting the slide rods, the earphone Fahnestock clips, the ground binding post, and the clamp that holds the galena crystal. The simple hook-up is shown in Fig. 4. Fig. 1 gives all details for making the two sliders that will contact the coil.

**Contact.** Perhaps the hardest job of all is to do a neat job of removing the insulation from the coil when making the two bare wire paths for the sliders. Use fine sandpaper and be careful not to sand off too much of the copper. When you are through brush away any fine copper dust between the turns of the wire. You will get a neater job if you use enamelled wire instead of cotton-covered wire.

For best results with this crystal radio, use a long antenna, a cold water pipe ground, a sensitive galena crystal, and a sensitive high-impedance pair of magnetic earphones.

Your basic materials may be the same, but the bucks required to buy them have certainly bounced upward from bygone days! It cost the editor 49¢ for this box which had four different prices on the top ranging from 49 up to 55¢.

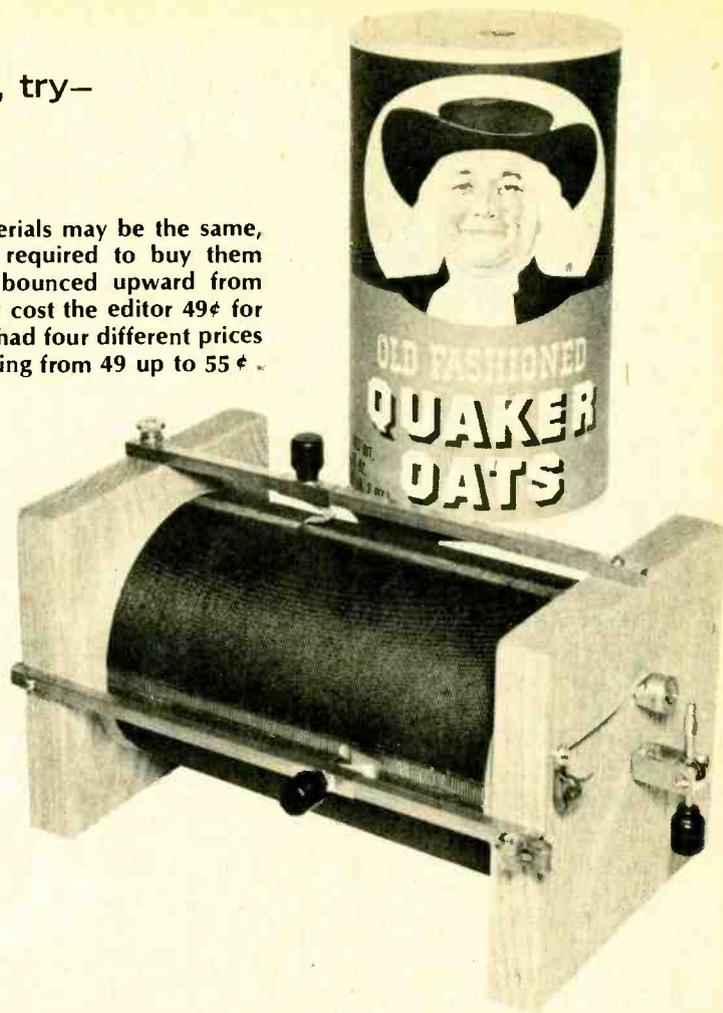
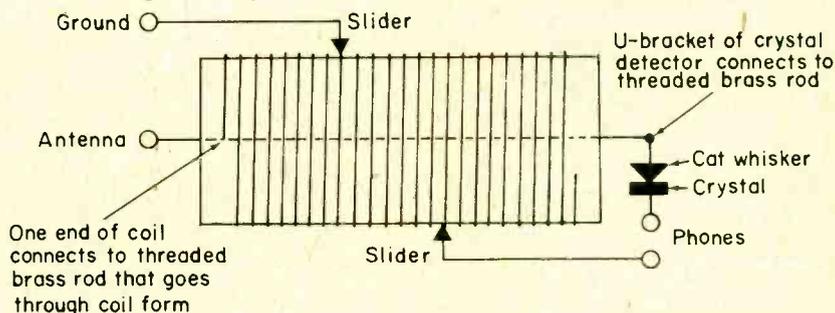


Fig. 4 Simple schematic for the crystal radio.



#### BILL OF MATERIALS FOR QUAKER OATS BOX CRYSTAL RADIO

- 1 round Quaker Oats box (18 oz.)
- 1 lb. #20 copper magnet wire, for winding coil (see text)
- 2 pieces 5-in. x 5-in. x 3/4-in. oak, walnut, or mahogany (for coil end blocks)
- 1 foot of 8-32 threaded brass rod (to pass through coil form)
- 1 8-32 brass hex nut (holds crystal detector U-bracket to wood block)
- 2 12-in. lengths 7/32 OD square brass tubing or solid rod (for slider tracks)
- 3 3/4-in.-long round-head wood screws (hold brass rods to wood blocks)
- 1 8-32 x 1 1/2-in. round-head brass machine screw, with hex nut and ornamental thumb nut to fit (for ground binding post)
- 3 inches of square brass tubing to fit snugly over slider rods (for making the two sliders)
- 2 6-32 x 1/4-in. flat-head brass machine screws (to hold knobs to top of sliders)

- 3 inches 1/2-in.-wide brass band (for slider)
- 4 inches of 1/4-in.-wide brass band (for making slider contact blades)
- 2 medium-size fahnestock clips (for phones binding posts)
- 1 1/2-in. long flat-head wood screw (holds one fahnestock clip to wood block)
- 1 unmounted crystal detector stand (K/D Stand 9-14, Modern Radio Labs.)
- 1 mounted galena crystal for above detector stand (9-1 MRL Steel Galena, Modern Radio Labs., P.O. Box 1477, Garden Grove, CA 92642)
- 1 1/2-in. long flat-head wood screw (holds crystal clamp to wood block)

Note: Those who do not have near-by hobby shops or large hardware stores can get most of the above hardware from MRL, P.O. Box 1477, Garden Grove, CA 92642. Send them 25¢ for a copy of their catalog.

# RADIO HISTORY

by Art Trauffer

□ Here are some ideas suggesting how to make novel pen sets that bring back fond memories to old-timers in wireless and radio. The pen sets also fascinate newcomers in radio and electronics, and they make nice gifts. As shown in the illustrations, an early wireless or radio item such as a vacuum tube, crystal detector stand, or spark gap is mounted on a block of marble, onyx, or wood, and then a funnel and pen is added to complete the desk pen set.

Old-timers in radio might want to use the crystal detector they made or bought for their first crystal set, or the first tube they used when they graduated to tube sets, or the spark gap they made or bought to use with their Ford spark coil transmitter. Newcomers in radio and electronics can purchase the above early items from antique radio collectors, or they can make their own crystal detector stands and spark gaps using the illustrations as guides.

Marble and onyx blocks can sometimes be found at sales, or they can be purchased from large electric lamp supplies firms, or from firms that make sports trophies. Funnels and pens can be purchased from the larger hobbies and crafts dealers. The table gives some purchasing tips. To mount items on marble and onyx blocks you can either drill holes using high-speed drills (at slow speeds), or masonry drills, or you can simply cement the items on the blocks using epoxy glue or the new industrial "wonder glues." ■

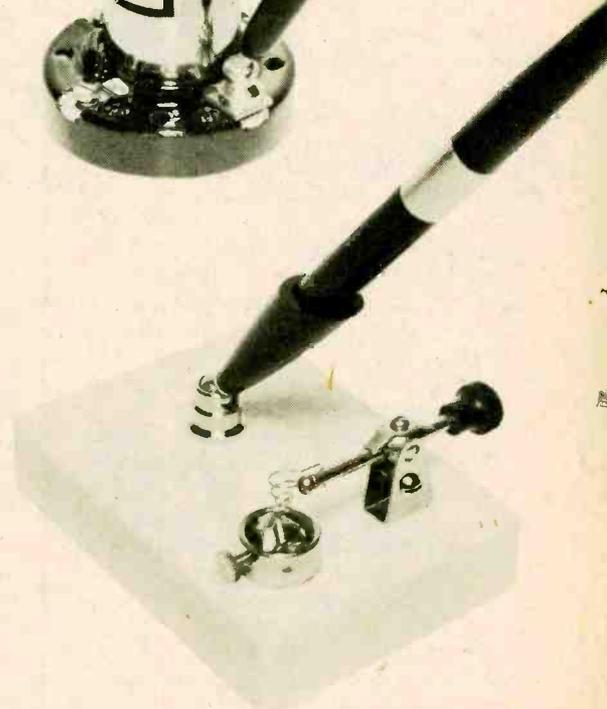


*Here is a Western Electric 216-A triode tube mounted on a block of onyx purchased at a sale for a few cents. The four pins on the bottom of the tube base were soldered to a small brass disc and then the brass disc was cemented to the onyx block with epoxy glue. The ball joint of the pen funnel was also glued to the onyx block.*

*A novel pen set idea is a Western Electric 203-D triode (similar to a VT-1) mounted in an RCA UR-542 porcelain bayonet-type socket. One of the binding post screws was removed from the socket and a 6-32 x 3/4 in. flat-head machine screw was passed through the hole to hold the ball joint of the pen funnel. If desired, you can cement the pen funnel to the socket using epoxy, or "miracle glue." Four small felt pads were added to the bottom of the socket.*

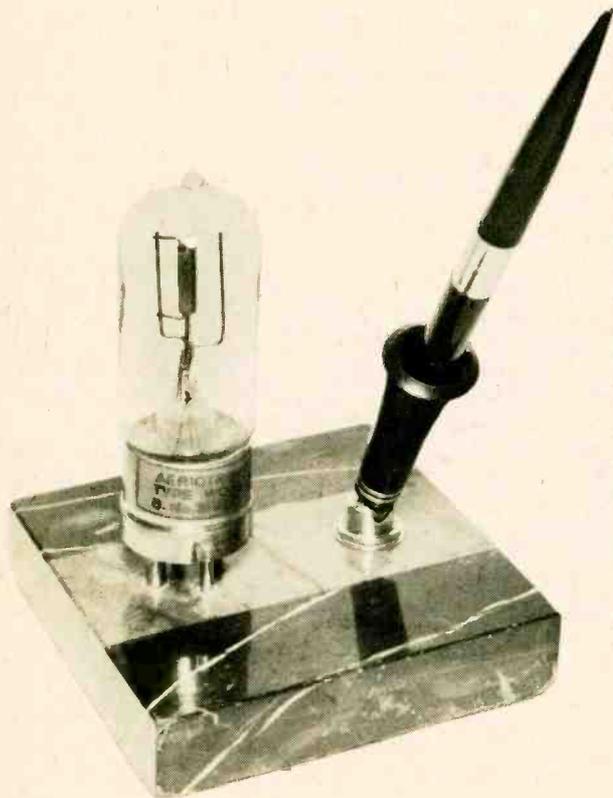


*The author used a marble block removed from a discarded basketball trophy purchased for 75¢ at a Salvation Army store. The hole in the block was used for mounting a funnel and pen. The crystal detector parts were glued to the block with epoxy glue.*



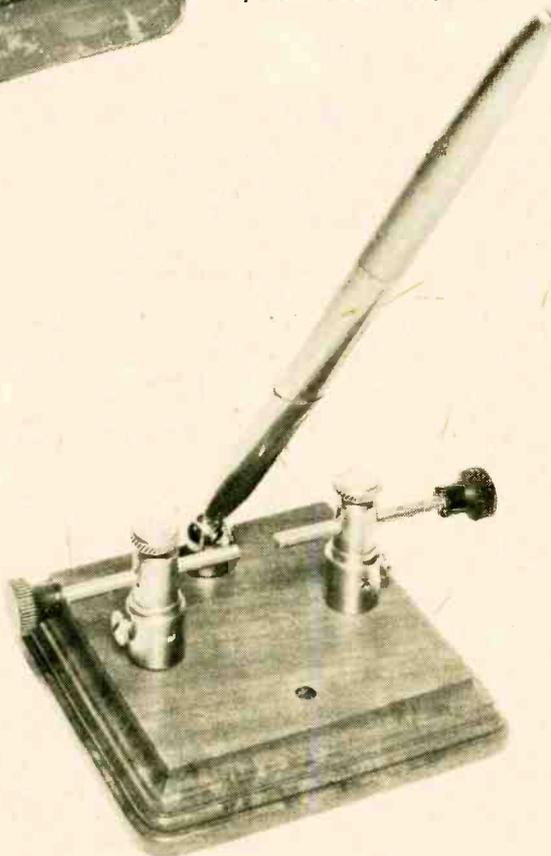
# ON YOUR DESK

Bring back the days of "wireless" glory with these fascinating and useful souvenirs!



*Here we have the famous Westinghouse Aeriotron (WD-11) triode tube which made a big hit in the early 1920s because you could heat the filament (1.1 volts) with a 1½-volt drycell instead of using a 6-volt storage battery. In this case, the author used a desk pen set purchased at a rummage sale for 50¢, and drilled four small holes for the tube base pins to fit in, and then used epoxy glue to hold it fast. Green felt was glued to the bottom of the marble to protect polished desk surfaces.*

*Here is a home-brew stationary spark gap, such as used in the early days of radio—known then as "wireless." Many of you old-timers will recall using a Ford Model-T spark coil to provide the high voltage for the spark! Assembly is easy. Simply pass a machine screw through one of the mounting holes in the base of the spark gap to hold the ball joint of the pen funnel. Glue felt to the bottom of the base to protect polished desk surfaces.*



## POSSIBLE SOURCES FOR DESK PEN SET MATERIALS

### Marble and Onyx Blocks

Salvation Army, Goodwill Stores, auctions, rummage sales  
Gilbert & Miller, Inc.,  
239 New Main St., Yonkers, NY 10701. (This company supplies marble and onyx blocks, as well as pens and pen funnels. Write for catalog.)

### Pens and Pen Funnels

Gilbert & Miller, Inc. (see address above) Large hobbies and crafts supplies stores

### Green Felt

Notions and yard goods departments of department stores

### Early Vacuum Tubes

Antique radio collectors (The following two antique radio newsletters also might be helpful: *Antique Radio Topics*, published by Antique Radio Press, P.O. Box 42, Rossville, IN 46065—50¢; and *The Horn Speaker*, published by Cranshaw Publications, P.O. Box 12, Kleberg, TX 75145—also 50¢.)

Watch ads in *Collectors News*, *Antique Trader*, etc. for antique radio collectors and dealers wanting to sell early radio vacuum tubes.

### Crystal Detector Stands

Modern Radio Labs., 1477-G, Garden Grove, CA 92642  
Bill Baker, Route 3, Box 1134, Troutdale, OR 97060 has some Kilbourne & Clark crystal detector stands (circa early 1920s) to sell. Write him for prices.

### Crystals

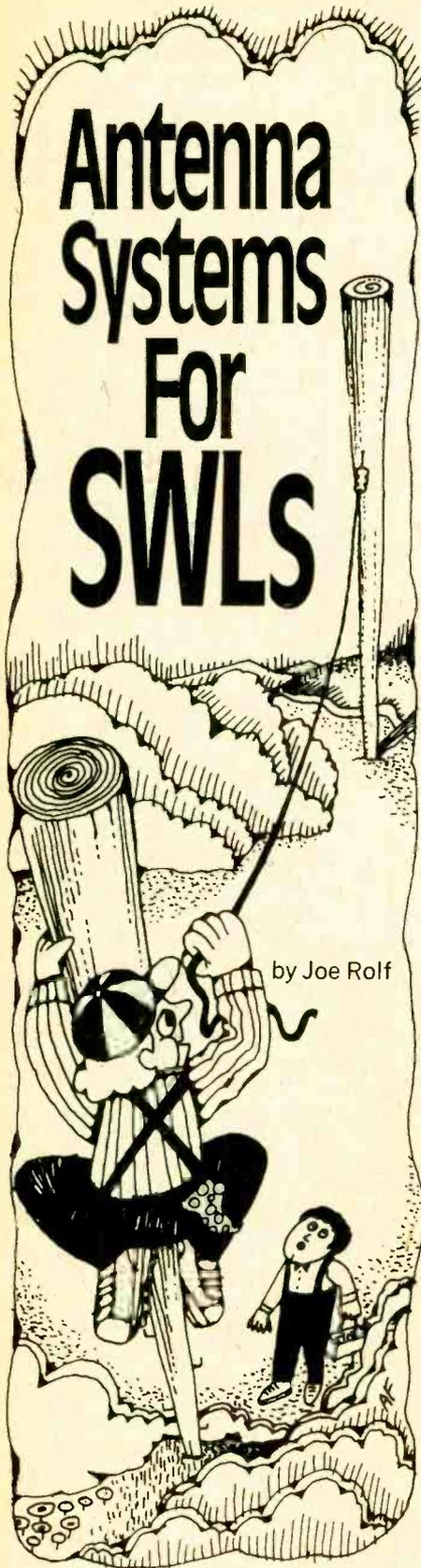
Modern Radio Labs. (see address above) sells various types of crystals. Write for details and prices  
Art Trauffer, 120 Fourth Street, Council Bluffs, IA 51501 sells genuine MPM (Million Point Mineral) unmounted galena crystals in original factory boxes (circa early 1920s) at 50¢ each, plus postage.

### Spark Gaps

Buy from antique radio collectors and dealers.

# Antenna Systems For SWLS

by Joe Rolf



These antenna ideas will help you pull in those elusive shortwave stations.

**I**F YOU'RE AN armchair shortwave (SW) traveler, you've probably already read through the shortwave stations listed in White's Radio Log, located in *e/e's* sister publication COMMUNICATIONS WORLD. Maybe, with mouth-watering anticipation, you've tried to hear Rabaul, Upper Volta, Yemen, Hanoi, or Vientiane. If you haven't been successful, be patient; because that's what it takes—patience—plus a good SW antenna. We can't supply the patience, but here are some good antenna ideas which are sure to help.

No matter what shortwave receiver you're using, a good antenna is a must to bring in those distant stations. If it weren't, the manufacturer wouldn't have supplied antenna terminals! The problem is what kind of antenna—a hunk of wire? or maybe something more scientific? We'll help you make the decision by telling you a little about SW antennas and how they work.

Shortwave antennas can be short and simple or they can be complicated and cover several acres. For shortwave listening most of us are limited to the short and simple ones—those that fit in a backyard and don't cost too much. But even a simple antenna, properly designed and installed, can work wonders.

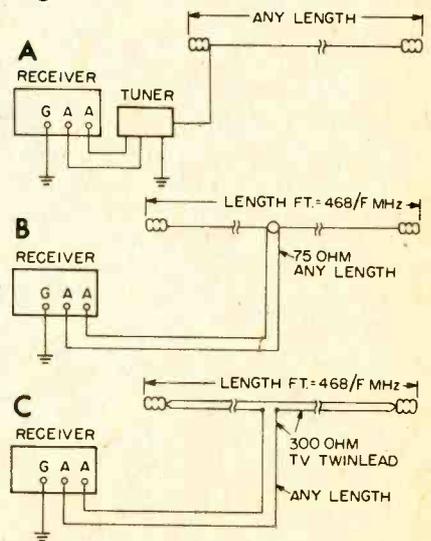
Fig. 1 shows several commonly used SW antennas with lengths shown for the SW broadcast bands. The antenna in Fig. 1A is known as an unbalanced end-fed longwire. It can be hung horizontally or vertically, or a combination of both. When hung horizontally it has some degree of directionality, while it tends to be omnidirectional when vertical. This antenna will work well on all frequencies if it is made long enough, or it can be cut to operate at only certain frequencies. It works best with an antenna tuner that can be located at the receiver, since the lead-in is part of the antenna's total length. The longwire has a high terminal impedance and always operates best with a tuner that matches the antenna to the receiver. With an antenna tuner, it is an ideal antenna to run around the eaves of the house, or across the attic.

**Another Type.** Figs. 1B and 1C show the popular centered balanced dipole. This antenna can also be hung vertically or horizontally and uses two balanced leads to the receiver that can be any length. This antenna is always cut to a resonant length, though it will also work well at three times the resonant frequency. For instance, an antenna that works in the 90 meter SW band (3.2-3.4 MHz) will also work for the 31 meter band (9.5-9.7 MHz). If space is limited, its ends can be bent down (or

even back) as much as 25 percent before reduction in performance becomes serious. Fig. 1B shows a single-wire dipole fed with 75-ohm feedline which can be plastic appliance cord. Fig. 1C shows the folded dipole version built from 300-ohm twinlead. The folded dipole, incidentally, will work well at half the resonant frequency.

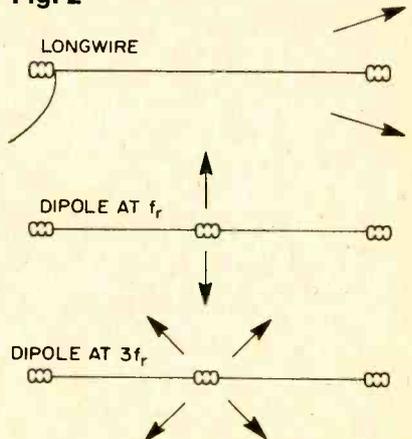
As previously mentioned, a vertical antenna tends to be omnidirectional, while a horizontal antenna tends to have directional characteristics. For general around-the-globe listening the vertical antenna is probably best, though low frequency resonant antennas are difficult to orient in this position because of their length.

Fig. 1



**Directionals.** If you are interested in DX from a particular part of the globe, however, the directional characteristics of a horizontal antenna can work for you. Fig. 2 shows the direction of maximum pickup for the horizontal longwire and dipole. By looking at a globe and determining the shortest path to the

Fig. 2



area you want to hear, you can position your antenna and use its directional characteristics to advantage.

Fig. 3 shows how directionality can be further increased by bending the ends of the dipole inward. This type of antenna can be easily built by using a center support, such as a TV mast, and bringing the ends in and down toward the ground. For best results, the ends of the antenna must be 10 feet or more above the earth.

A more elaborate antenna that will "look" in any one of four directions can be made by mounting two dipoles in this manner at right angles and connecting the lead-in to different elements to achieve the desired direction. This deluxe array has a disadvantage in that you must have easy access to the top, or center part, in order to change lead-in connections.

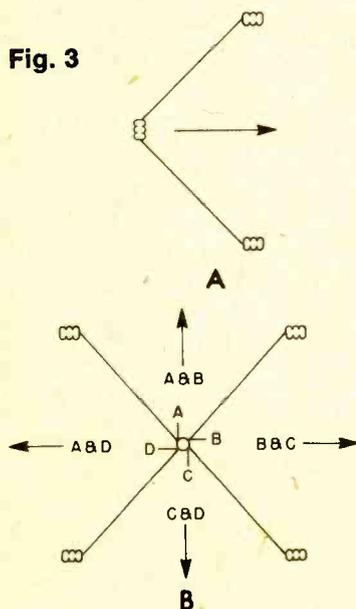
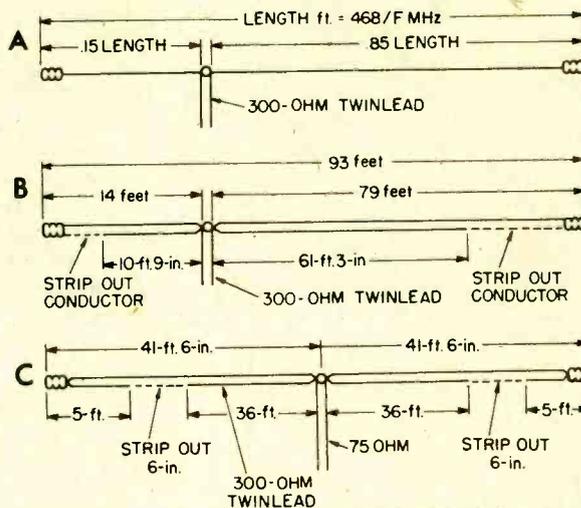


Fig. 3

Fig. 4



Fortunately, choice DX can be logged on any of the eleven international broadcast bands; but it is difficult (if not impossible) for the serious SW listener to come up with a good antenna for each of eleven bands. Few SWLs have the real estate or inclination to put up a single tuned antenna for each band, so a couple of multiband antennas running in different directions is often the answer. Fig. 4 shows simple multi-band antennas that can be used; and, through compromises, they will give all around performance.

**Still Around.** The basic antenna shown in Fig. 4A was popular in the 1930s, and is known as the "windom" antenna. It can be fed with 300-ohm TV twinlead, and works well on even harmonics of the fundamental frequency.

Figure 4B shows how, by using 300-ohm twinlead, two antennas can be

connected to the same lead-in to give satisfactory performance on the 60, 49, 41, 31, 25, 19, 16, 13, and 11 meter bands. This permits coverage of 9 of the 11 international broadcast bands with a single antenna. By tying the lead-ins together at the receiver and using an antenna tuner, this antenna becomes a longwire, making it probably the most versatile SW antenna available.

Another multiband antenna shown in Fig. 4C consists of two centered dipoles made from 300-ohm twinlead connected to the same feedline. This antenna has the advantage of being short (nice for small city lots, or apartment dwellers) and performs well on the 60, 49, 41, 25, 19, 16, 13, and 11 meter bands. Again, it can be connected as a longwire at the receiver and used with an antenna tuner.

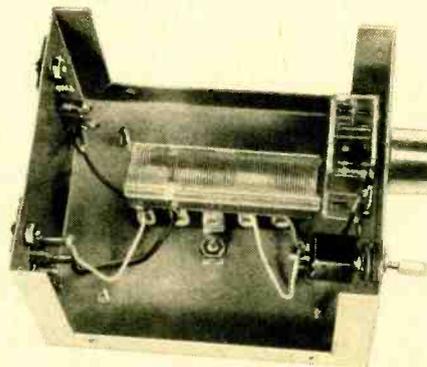
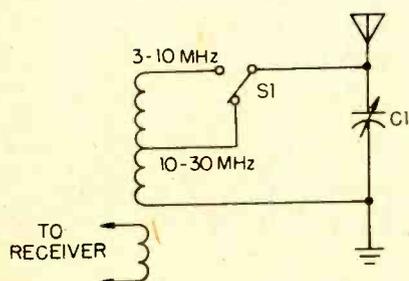
The circuit of a simple SWL antenna

(Continued on page 102)

## BUILD A SIMPLE SWL ANTENNA TUNER

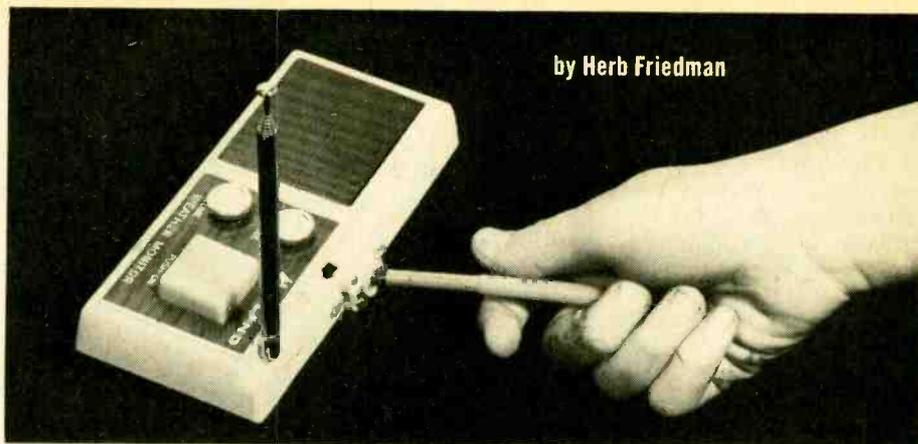
Here's a simple antenna tuner any SWL can whip together in an evening and use for a lifetime. Neatness counts when monkeying with low level RF, so mimic the author's model for best results. Keep solder connections clean.

Fig. 5



- C1—365-pF miniature variable capacitor
  - L1—31 turns/in., 5/8-in. diam. coil stock, B&W 3008, Air Dux 532T, etc.
- Note: Measure coil and cut 1/2-in. from one end. Remove one turn in either direction. Measure 1/2-in. and solder tap to one turn (bend adjacent turns inward for access). Coil ends mount to terminal strip for stability.
- S1—Spdt toggle switch
- Misc.—2-lug terminal strips for antenna, ground and receiver connections, knobs, wire, solder, 3 1/4 x 2 1/4 x 4-in. cabinet, etc.

# ROCK BOTTOM COST HIGH BAND MONITOR



by Herb Friedman

Getting bored by the temp-humidity index? Slide an inexpensive weather monitor up or down for some exciting signal hunting!

**B**ECAUSE 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  $\mu$ 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

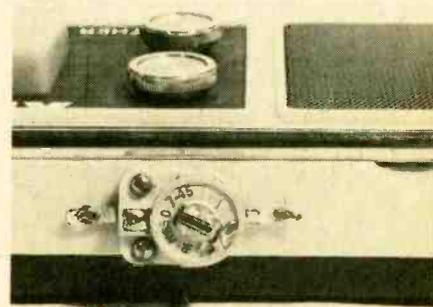
holes at the mark and then install a trimmer capacitor on the cabinet near the holes. Or, you don't have to secure the trimmer if you feel you will experiment with different capacitor values, but it will be difficult to tune the stations with a "floating" trimmer. You can't hand-hold the trimmer because 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.

# Electro Motive Force Multiplier

Try your voltage multiplier theory this new way!

by Thomas R. Sear

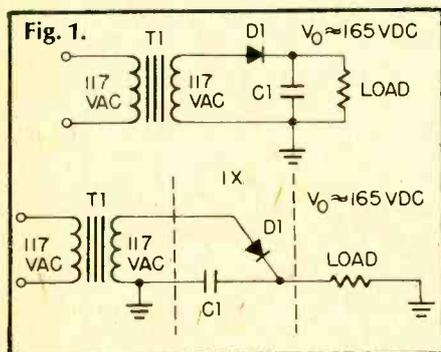
**W**HEN YOU NEED a power supply for a high voltage, low current application, your best bet is a voltage multiplying type power supply. They are simple. They are inexpensive. And you can develop almost any voltage you want by selecting the transformer used and cascading basic multiplier stages. The only limiting factor is the ratings of the components you can obtain.

Basically, a voltage multiplier circuit consists of simple, inexpensive diodes and capacitors connected in such a way as to develop a DC output voltage that is some multiple of the peak value of the input voltage. Only one diode and one capacitor are required for each time you want to multiply the voltage. As a safety factor, a transformer should be used to isolate the power supply from the line voltage. But part of the beauty of using voltage multipliers to obtain high voltage is that you don't have to begin with an expensive high voltage transformer.

**How It Works.** Voltage multiplier circuits will operate with any type of waveform as the input. The only factor that might be considered is the switching time of the diodes used. The rise time and fall time of the input signal must be slower than the time that the diodes require to reverse conduction—sort of like the frequency response of an amplifier. However, since most power supplies operate from 60-Hz power, this factor will not affect most experimenters. The reason the frequency of the input is interesting is because the ripple content of the power supply output can be reduced by operating the circuit at a higher frequency.

Referring to Fig. 1, note that the basic voltage multiplier circuit is none other than our old friend the humble

The standard half-wave power supply.



half-wave power supply. This simple circuit forms the basis for a complete family of voltage multiplying circuits, and is shown both in the standard schematic format and a simplified form that will facilitate the development of additional multiplier circuits.

With little or no current required from this power supply, the value of the DC output voltage will approach the peak value of the AC input voltage. For example, if T1 were simply an isolation transformer, with primary and secondary voltages of 117 Vrms, the theoretical DC output from a half-wave power supply would be  $1.414 \times 117$ , or about 165.4 VDC.

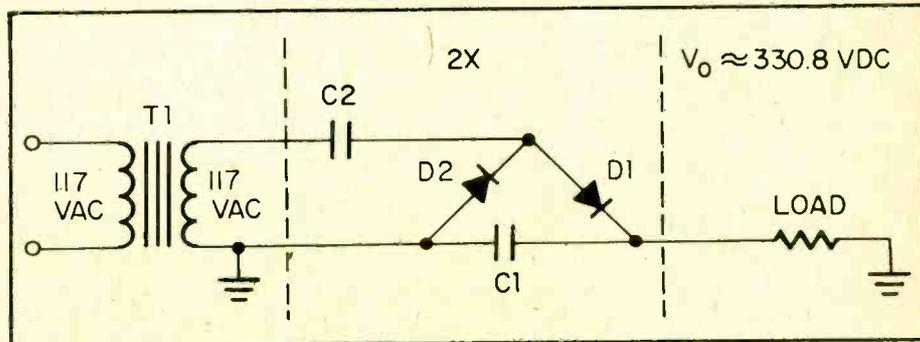
In practice, because of circuit losses, the actual output voltage will decrease as more current is required from the circuit. We will discuss how to estimate the output voltage of a given circuit shortly.

cascade three doubler circuits. And so on. As most things are, it is simple once you see the patterns involved.

**The Fog Lifts!** Notice the basic pattern that forms voltage multiplier circuitry. Beginning with the half-wave circuit shown in Fig. 1, and moving from the load toward the transformer, each additional stage of multiplication is simply a diode and a capacitor connected as follows: The diode that is being added to the circuit has its cathode connected to the anode of the previous diode, and its anode connected to the "opposite" side of the circuit; the capacitor being added is connected to the anode of the previous diode on one end, and to the transformer at the other end. Notice also that the capacitors being added alternate from one side of the circuit to the other.

This basic pattern can be continued until the input voltage has been multi-

Fig. 2. Basic voltage doubler circuit.



**Double Up.** By adding a second diode and capacitor combination to the basic half-wave circuit, as shown in Fig. 2, it becomes a voltage doubler circuit—effectively multiplying the peak value of the input voltage by two. Notice that the new diode, D2, and capacitor, C2, are connected in series (cascade) with the original diode, D1, and capacitor, C1, and are between them and the transformer, T1.

The circuits shown in Figs. 1 and 2 are the basis of all voltage multiplication. The voltage tripler circuit shown in Fig. 3 is merely the doubler circuit shown in Fig. 2 connected in cascade with the half-wave circuit shown in Fig. 1. Likewise, the quadrupler circuit shown in Fig. 4 is simply two doubler stages connected in cascade. To multiply a voltage five times just cascade two doubler circuits with a half-wave circuit. To multiply a voltage six times just

plied as many times as desired. The ultimate value will, of course, depend upon the voltage ratings of available components.

**Component Ratings.** When building voltage multiplier circuits there is one basic rule to follow: all components should be rated for at least *two times* the peak value of the input voltage. For example, if the secondary voltage of T1 is 200 Vrms, the peak-inverse voltage (PIV) of all diodes and the working voltage (WVDC) of all capacitors should be at least  $1.414 \times 200 \times 2$ , or 566 volts. Most transformers will satisfy your requirements as built, but it is always good practice to verify the voltage rating of the windings to preclude problems.

At voltage values of 1000 volts or more, special consideration should be given to wiring insulation and physical

(Continued on page 102)

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## Voltage Multiplying

(Continued from page 99)

spacing of all components to prevent arcing within the power supply.

As load requirements increase, adequate ventilation must be considered. The diodes, and to some extent the capacitors, dissipate heat because of forward-drop, switching, and leakage losses. This heat must be removed to prevent the diodes from going into thermal runaway.

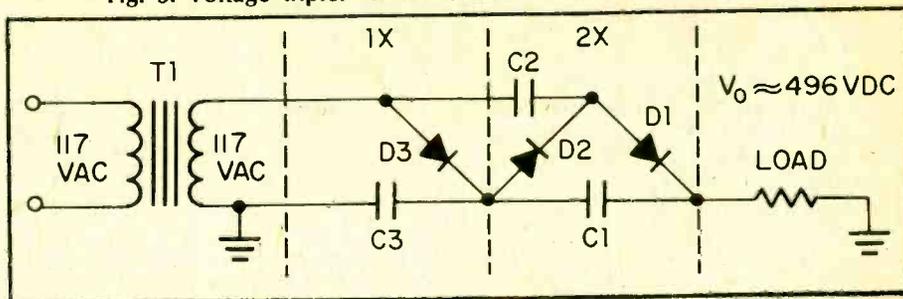
Capacitor values should be as large as practical, but some values may become too expensive to be considered for your application. Though filtering and regulation will be improved by using large values of capacitance, there is a point beyond which the improvement isn't worth the cost. The optimum value of capacitance can be calculated using (for you math whizzes)

$$C = \frac{N^3 I_o}{720 (N V_P - V_o)} \quad (1)$$

For simplicity, all capacitors should have the same value and voltage rating. The value computed using formula number (1) is not absolute; the nearest value available at your parts house, or found in your junk box, will suffice.

**Determining Output Voltage.** The output voltage of any multiplier circuit

Fig. 3. Voltage tripler circuit—basic half-wave and a doubler.



with a load is a function of the input voltage, the source impedance, the capacitor values, the forward voltage drop of the diodes, and the frequency of the input voltage. By assuming that the diodes are ideal (no voltage drop across them in the forward direction) and if the values of all capacitors are made equal (generally the best way to go) the approximate output voltage from a given circuit can be calculated using

$$V_o = N V_P - \frac{N^3}{720(C)} I_o \quad (2)$$

if the input frequency is 60 Hz—as will be the case in most instances.

If you have decided to use a specific circuit configuration (say a tripler), know the output voltage that you want, and have selected the capacitors that you "must" use, you can calculate the required input voltage using

$$V_{IN} (\text{PEAK}) = \frac{V_o + \frac{N^3 I_o}{720(C)}}{N} \quad (3)$$

In formulas (1), (2), and (3)

C = the value of the capacitors used in the voltage multiplier circuit. All capacitors should have the same value.

I<sub>o</sub> = the amount of current required from the power supply.

N = the number of diodes used in the voltage multiplier circuit.

V<sub>o</sub> = the output voltage expected from the voltage multiplier circuit.

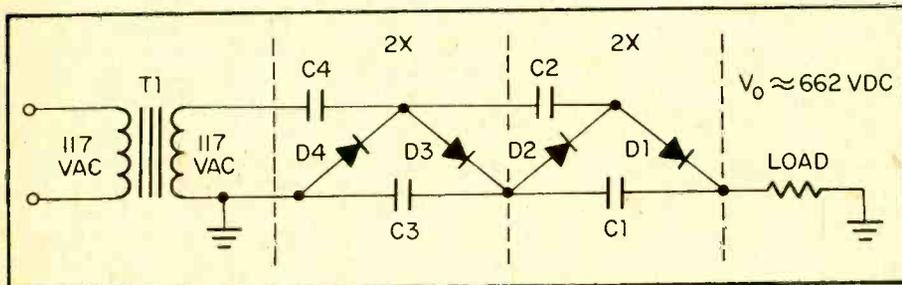
V<sub>P</sub> = the peak value of the transformer secondary voltage.

If a negative output voltage is desired merely reverse all the diodes in a voltage multiplier circuit. All other considerations remain the same.

If the math leaves you cold, you can still build voltage multiplier circuits by making some educated assumptions. Use the largest values of capacitance that you can locate, say 10 to 20 microfarads, and assume that the voltage output will be approximately 70 percent of the theoretical value if the power supply were unloaded. This procedure will provide valid results, and the power supply output will be within normal tolerances for most applications.

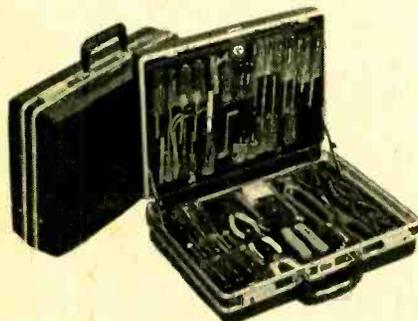
One last word of caution. These supplies can add up to a lethal dose of the old EMF. Take care. ■

Fig. 4. Voltage quadrupler circuit—two voltage doublers.



## Hey, Look Me Over

(Continued from page 10)



CIRCLE 24 ON READER SERVICE COUPON

problem solving areas. A total of 48. Heavy duty attache case has simulated black leather exterior and measures 19 x 14 x 6-in. Pallets have pockets of heavy duty, see-thru vinyl. Top section has pocket for technical manuals and bottom section has compartments for test meters and other gear. All tools are unconditionally guaranteed and priced at \$240.00. For further information write: Vaco Products Company, 510 North Dearborn Street, Chicago, IL 60610.

## Tip-Top Cleaner

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information, write Panasonic, 200 Park Avenue, New York, NY 10017.



CIRCLE 26 ON READER SERVICE COUPON

## Antenna Systems for SWLs

(Continued from page 97)

tuner that you can easily build is shown in Fig. 5. Details of the tuner built in a small utility box is shown in the photographs. This SWL antenna tuner can be used to improve the performance of any longwire antenna. Select the proper range for C1 with S1 and peak C1 for best S-meter output on your receiver. Fig. 6 is a photo of the completed SWL

antenna tuner ready for connection to your antenna system and receiver.

**Summing Up.** The best antenna for

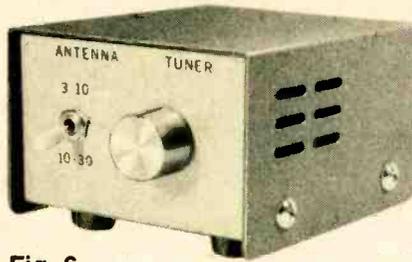


Fig. 6

you depends on the type of DX hunting you want to do and the space available. A long-wire with the antenna tuner shown will work well for general listening. If you're interested in a particular part of the work and a particular band, a single frequency dipole pointed in the right direction will give excellent results. If you want one antenna that will do as much as possible, use a multi-band antenna. In any case, those hard to log DX stations will come a lot quicker with any of these antennas, mounted as high as possible. ■

# TRACE SIGNALS WITH YOUR TAPE RECORDER

□ A signal tracer can be easily improvised by using a cassette tape recorder (any tape recorder will do), a capacitor, and an earphone (or loudspeaker), connected as shown in the diagrams. Use the "monitor" switch to hear the output, or connect a loudspeaker or earphones, as shown. Connect the input to the auxiliary jack if tracing high level signals, and to the microphone jack if tracing low level signals.

Switch the recorder to the *record* mode to trace signals. It may be necessary to defeat the "erase protect" sensing lever in cassette recorders by pressing on it before pushing down on the *record* button. Otherwise, operate the recorder with a cassette in place.

**How It's Done.** Probing with the capacitor lead at the collector and base of each transistor in a circuit, in turn, allows the signal to be traced through the circuit; and faults, such as a dead stage, can be found in a few minutes.

If the amplitude of the input signal is too high, simply connect an attenuator (Fig. 2) across the input terminals to the tracer, as shown, and adjust the potentiometer for correct volume.

While the circuit is useful for trac-

Fig. 1

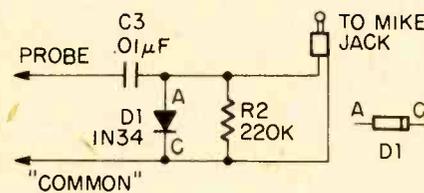


Fig. 2

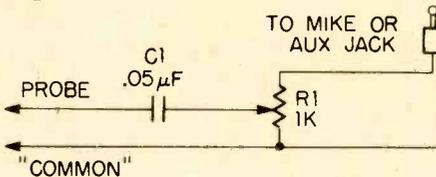
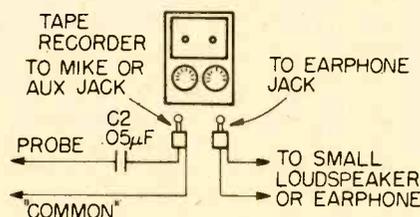


Fig. 3



by Hugh Gordon

ing the audio sections of an amplifier or receiver, you may also want to trace the radio frequency (RF) sections. This may be done by replacing the capacitor with a simple diode demodulator probe, a sketch of which is shown in Fig. 3.

**Safety First.** One good guide by which you should govern yourself when puttering about an apparently defective TV set, is not to perform any adjustment, poking, prying, snooping, cleaning, etc., that you would not permit a six-year-old child to do. After all, why is a child's life dearer than yours when TV service technicians are available to do the task efficiently and safely? ■

### PARTS LIST FOR A SIGNAL TRACER

- C1, C2—0.05-uF disc capacitor
- C3—0.01-uF disc capacitor
- D1—1N34, general purpose germanium diode
- R1—1000-ohm potentiometer, any available type
- R2—220,000-ohm, ½-watt resistor

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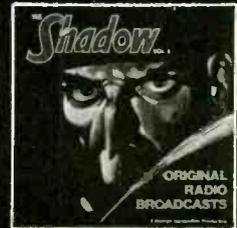
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L. Tom Mix



M. Flash Gordon



N. Edgar Bergen & Charlie McCarthy



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P. Blondie & Dagwood



Q. Soap Operas



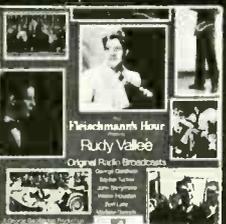
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