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1	Rebroadcaster	26	Enlarger Meter
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4	Automatic AC-DC Power Supply	29	Low-V Remote Control
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6	Easy Auto Theft Alarm	31	Supply for SS Projects
7	Photo Light Control	32	Regulated 9-V Supply
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9	Twang-A-Matid	34	Zener Regulator
10	Speak-A-Mike Preamp	35	Carbon Mike Converter
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12	BCB Mini Booster	37	Sideband Scrambler
13	Probe Calibrator	38	100-kHz Freq. Standard
14	Powerhouse Larynx	39	Headset Q-Peaker
15	Modulated 100 kHz Calibrator	40	Audio Signal Tracer
16	Budget CPO	41	Easy Radio Control
17	Fish Caller	42	Field Strength Meter
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20	Electronic Combo Lock	45	Electronic Keyer
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23	Slide Synchronizer	48	Tenna-Blitz Light
24	FM Interference Filter	49	S-9er for SWLs
25	Simple IF Signal Generator	50	Sine Wave Squarer

20 Passive Circuits

1	Audio Wattmeter	6	Mike Desensitizer
2	Load Matcher	7	Stereo Shutoff
3	Remote Speaker Setup	8	CB Sniffer Probe
4	FM Tuning Meter	9	Tape Dubbing Filter
5	Record Restorer	10	Tweeter Crossover

30 Integrated Circuit Projects

1	GP Amplifier	8	Stereo See-Saw
2	Spy-Size Amplifier	9	Audio High Pass Filter
3	Tape Head Preamp	10	Carbon Mike Simulator
4	Super 15 Amplifier	11	Mighty Mite
5	100X Instrument Amp	12	Notch Filter Oscillator
6	CB Booster	13	Electric Butler
7	Great Equalizer	14	C Boost

. . . and there's more!

ELECTRONIC PROJECTS FOR UNDER $15

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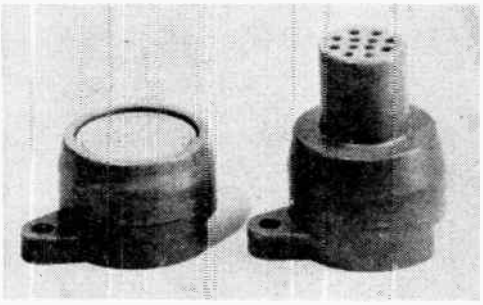
New Products

A New Buzzer

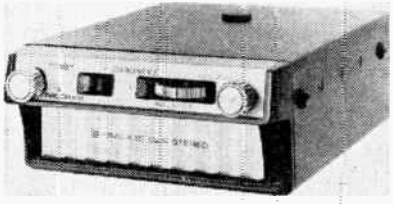
Here's a highly reliable audible warning device, an electronic buzzer. No moving contracts, non sparking, not subject to mechanical wear and compact. Ideal for the automobile and hobby use. Output characteristics: 3.0 kHz frequency, 30 mA working current,



84 dB sound level at 4 feet. Available for either 12-V or 24-V DC with male and female spade terminals to safeguard against polarity reversal. Weighs 1¼ ounces. Tested to one million on/off operations and 500 hours of continuous running. Price: $3.50. Write to Noblart Company, 5151 Carol Avenue, Skokie, Illinois 60076.

One for the Road

The Pioneer Model TP-222 Mini 8-Track Car Stereo, only 2-in. high by 4¾-in. wide by 6½-in. deep—possibly the most compact of its kind—is small enough to fit in the glove compartment, the unit features a unique 4-



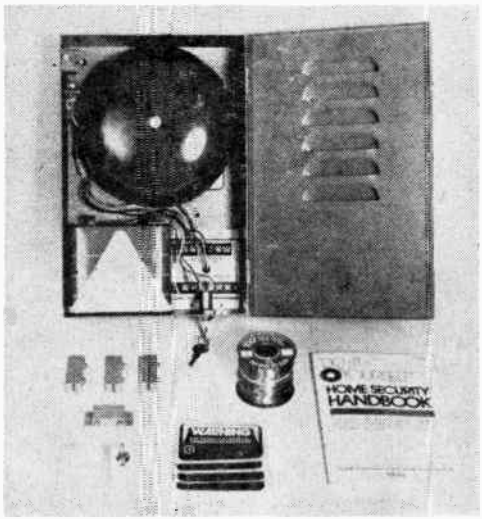
program vertical headshift mechanism which provides precise tapehead contact and minimizes crosstalk. A shielded capstan provides trouble-free tape feed. Other features are automatic and manual track change; volume, tone and balance controls, and track indicator lights. The TP-222 plays any 8-track 2-channel cartridge (up to 80 minutes with twin pack). Unit is powered by any 12 Volt

New Products

negative-ground system. Manufacturer's suggested list is $54.95. For further information, circle No. 39 on Reader Service Page.

Apartment Alarm

The Eico SS-200 is a complete self-contained, ready-to-install solid-state, closed-circuit burglar alarm system. The opening of any protected door or window, cutting of the alarm wires or tampering with the cabinet will cause the alarm to sound. A built-in time-delay circuit makes the SS-200 ideally suited for do-



it-yourself apartment installations. This feature eliminates the need for an on/off entrance door key lock switch. The 25-30 second time delay allows you sufficient time to shut the alarm off upon entering the apartment. The alarm system is activated only after you leave the apartment and close the exit door. There is no need to rush out for fear the alarm will ring before you can get out. Other professional features include extra loud 8-in. alarm bell, tamper proof cabinet (front and rear), expandable system-additional closed circuit sensors may be added at any time to meet future needs, reliable all solid state circuit design. Suggested retail price is $74.95. For more information, circle No. 34 on Reader Service Page.

4-Channel Receiver

Olson Electronics has introduced an all-new 240-watt 4-channel stereo FM/AM receiver, the Teledyne RA-632. The price, including a walnut finish enclosure, is $229.50. The RA-632 features a 4-channel amplifier for discrete quadraphonic sound from tapes, and a

universal decoder for matrixed or synthesized 4-channel sound from broadcasts, records and tapes. Other features include FM muting, an FET/IC front end with a ceramic filter, dual FM and AM tuning meters, dual concentric bass and treble controls for independent adjustment of both front and rear channels, front and rear channel headphone jacks, push-in terminals for all speakers, main and remote, and a "joystick" control for easy balancing of all channels. Teledyne audio components are available at over 70 Olson stores nationwide or by mail from Olson Electronics. Olson will supply a free catalog if you circle No. 42 on Reader Service Page.

CB Antenna

The Antenna Specialists Company has announced a rooftop version of its hefty new Big Momma CB mobile antenna, which is also unconditionally guaranteed not to burn out. Big Momma II (Model M-411) features a flat base mount accommodating a ¾ in. hole for car roof or other flat surface mounting. Like her namesake, the antenna features a heavy-duffy, oversize loading coil with virtually unlimited reserve power handling capability, and a copper and nickel plated whip that runs exceptionally cool. The suggested list price is $29.95. Specifications available to those who circle No. 44 on Reader Service Page.

Flea Power

There's a new QRP rig on the marketplace. It's the Heathkit HW-7, a three-band QRP (low power) CW Transceiver with VFO and provision for crystal transmit operation. Band coverage is the CW portion of 40, 20 and 15 meters. Solid-state transceiver circuitry, featuring both built-in VFO and crystal transmit capabilities, makes the HW-7 ideally suited for novice use. The sensitive synchrodyne detector receiver circuitry offers readable signals with 1 uV input or less. Carefully designed transmitter circuitry provides input

New Products

power of 3 watts on 15 meters. Band changing and tuneup are simplified with pushbutton band selection and single-control main tuning featuring 6:1 vernier drive with virtually backlash-free operation. Built-in sidetone and relative power meter are also provided. Unit can be operated from an accessory AC power supply, or 12 V batteries . . . offering complete flexibility for standby, camping, emergency operation, or as a primary rig. Kit goes together on a single circuit board in a couple of evenings . . . sells mail order for $69.95 F.O.B. Benton Harbor, Michigan. For further information, circle No. 1 on Reader Service Page.

Speaker-Headphone Control Center

Introducing a new remote control station which accommodates two pairs of stereophones. Made by Koss, the Model T-5A offers

complete stereophone listening control from the comfort of a favorite chair. The T-5A features separate channel volume/balance controls for one set of stereophones; the second jack accommodates headphones with its own earcup volume controls, for added versatility. An on/off convenient speaker switch allows the listener to select "Stereophone Only" or "Speakers and Stereophones" operation. The T-5A is handsomely styled in walnut-like and black tones. It is a compact 3⅛ by 3⅛ by 2⅝-in. in size and includes a flat control

READERS SERVICE PAGE

101 101 101

ELECTRONIC PROJECTS

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• The Editor of 101 ELECTRONIC PROJECTS—1973 ISSUE offers readers an easy way to get additional information about products and services advertised in this issue. To become proficient in your hobby you must obtain the correct quality parts, knowledge, test gear, tools and many other items. Become a knowledgeable buyer by obtaining information on the products and services mentioned in this issue, and keyed with a Reader Service Number, it's yours for the asking. Just follow the instructions below and the literature you requested will be sent to you promptly and at no cost. It will be a pleasure to serve you.

• The coupon below is designed for your convenience. Just circle the numbers that appear next to the advert sement or editorial mention that interests you. Please limit your selections to 15 or less. Then, carefully print your name and address on the coupon. Cut out the coupon and mail to 101 ELECTRONIC PROJECTS, Box 886, Ansonia Station, New York, N.Y. 10023. Do it today!

Mail Coupon to: **This offer expires September 30, 1973**

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• Okay, I want some information and I want it fast. Please arrange to have the literature whose numbers I've circled at right sent to me as soon as possible. I understand this is a free service; however, I must limit the circled items to 20.

1	2	3	4	5	6	7
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Address_____

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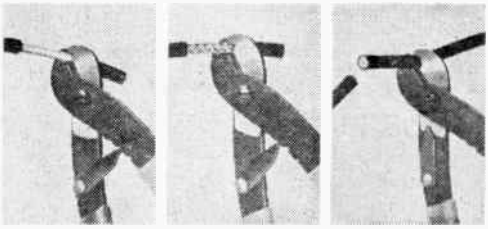
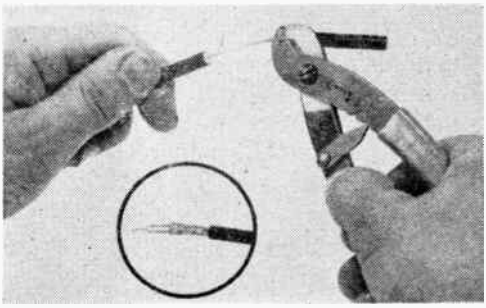
New Products

cable. Retails at $9.95. For more information, circle No. 36 on Reader Service Page.

Stripper/Cutter for RG-59U

Xcelite has just added to its line the No. 590 Coax Stripper/Cutter, designed specifically for use with the popular RG-59U coaxial cable. Featured is a three-position selector

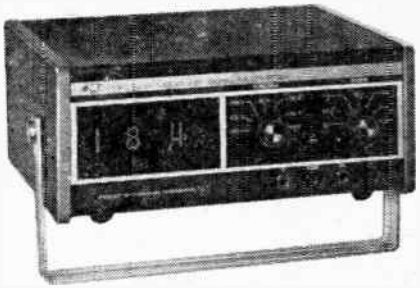




lever. With the lever in Position 1, the hardened and ground blades cut cleanly through the jacket, shielding, and dielectric without fraying, to expose the undamaged conductor. Position 2 removes the jacket and shielding, while Position 3 strips the jacket off without damage to the shielding, or dielectric. With the selector lever disengaged, the entire coax cable, in fact many other wires and cables, too, can be cut neatly to length. Handles have cushion grips for user comfort and to lessen fatigue. The No. 590 Coax Stripper/Cutter, made in USA, has a list price of $4.75. For more information, circle No. 33 on Reader Service Page.

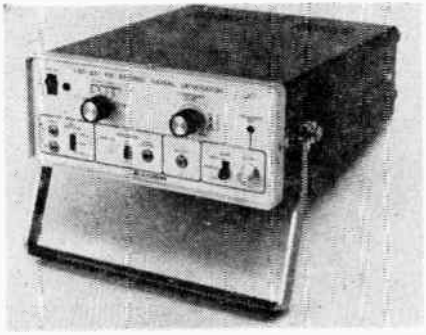
Digital Multimeter

Dynascan Corp. has added a new solid-state digital multimeter to its popular B&K line of test instruments. It's the Model 281. Features include a large, 2½ digit numerical display with automatically positioned decimal point, 100% overrange capability, full overload protection, positive overrange and wrong polarity indication, high sensitivity, 1% accuracy and 10 megohms input impedance. The large readout is easily read at a distance, making it unnecessary to be right on top of the unit to take a reading. This is a great advantage at all times, but especially when monitoring—you can be working on something else and still be able to read the 281 without being close to it. The 281 is lightweight and easily portable; the convenient 5-position handle doubles as a stand, for comfortable eye-level viewing. It operates from 105-125 VAC, 50-60 Hz and is supplied with test leads and B&K's PR-21 probe with switchable 100K ohm isolation resistor that prevents capacitive loading when measuring DC in RF circuits. Selling price of the Model 281 Digital Multimeter is $169.95. For more information, circle No. 35 on Reader Service Page.



Stereo Generator

Precision and stability are the important features of the Model LSG-231 Multiplex Stereo Generator introduced by Leader Instruments Corporation. The LSG-231 has a pilot signal frequency of 19 kHz with ±2 Hz accuracy. The 1 kHz audio signal is accurate to ±1%. Signal separation is rated at 50 db with output voltage at 0 to 3 V rms continuously



variable. Specifically useful in the field or on the workbench, this new product offers such high reliability that many technicians may not find it necessary to use a scope. It is easy to operate, compact and complete with a handy

(Concluded on page 111)

LITERATURE LIBRARY

101. Kit builder? Like weird products? *EICO's 1973* 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* 1973 lineup of CB transceivers & VHF/UHF receivers (public service/business bands—police, fire, etc.)

104. A pamphlet from *Electra* details the 6 models of the Bearcat III, a scanning monitor receiver.

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

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

107. Get *Antenna Specialists'* cat. of latest CB and VHF/UHF innovations: base & mobile antennas, test equipment (wattmeters, etc.), accessories.

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

109. Compact is the word for *Xcelite's* 9 different sets of midget screwdrivers and nutdrivers "piggyback" handle to increase length and torque. "Show case" serves as bench stand.

110. *Bomar* claims to have C/B crystal for every transceiver . . . for every channel. The catalog gives list of crystal to set interchangeability.

111. A *Turner* amplified mike helps get the most from a CB rig. This free brochure describes line of base & mobile station models.

112. *Midland* has recently published a 4-color brochure that folds out to 17 in. x 21 in., printed on both sides. Over 40 CB and scanner products are featured.

113. For everything in electronics—get the 1973 catalog from EDI (Electronic Distributors, Inc.). 152 pages of leading brands at bargain prices.

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

115. *Olson Electronics'* 188-p. fully-illustrated 1973 catalog has leading national brands, all in the electronic product categories.

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

117. Get the free, new twenty-four page *HUSTLER* CB and Monitor antenna catalog featuring improved antennas and accessories for base station and mobile operation.

118. *Teaberry Electronics* has information on CB radios—Twin "T," Big "T," Mini "T" II, and Five by Five; also information on Scan "T" Monitor radio receiver.

119. *Burstein-Applebee's* new 1973 catalog has over 280 pages of Radio-TV/Electronics bargains. Selling for $2, it is offered free to our readers.

120. For a colorful leaflet on the Golden Eagle Mark III SSB receiver and the Mark III SSB transmitter, write to *Browning Laboratories.*

121. *Edmund Scientific's* new catalog contains over 4000 products that embrace many sciences and fields.

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

123. *Radio Shack's* 50 Anniv. cat. has 180 pages, colorfully illustrated, of complete range of hi fi, CB, SWL, ham equip. and parts (kits or wired) for electronics enthusiasts.

124. It's just off the press—*Lafayette's* all-new 1973 illustrated catalog packed with CB gear, hi-fi components, test equipment, tools, ham rigs, and more.

125. *Mosley Electronics, Inc.* is introducing 73 CB Mobile Antenna Systems. They are described and illustrated in a 9-page, 2-color brochure.

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

127. You can become an electrical engineer only if you take the first step. Let *ICS* send you their free illustrated catalog describing 17 special programs.

128. *Avanti* antennas (mobile and base for CB and VHF/UHF) are fully described and illustrated in new catalog.

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

130. Semiconductor Supermart is a new 1973 catalog listing project builders' parts, popular CB gear, and test equipment. It features semiconductors.—all from *Circuit Specialists.*

131. *Heath's* new 1973 full-color catalog is a shopper's dream—chockful of gadgets and goodies everyone would want to own.

132. *E. F. Johnson's* 1973 line of CB tranceivers and CB accessory equipment is featured in a new all-line brochure. Send for your free copy today.

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

134. Free 1973 Catalog describes 100s of *Howard W. Sams* books for the hobbyist and technician. It includes books on projects, basic electronics and many related subjects.

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Not Valid After September 30, 1973

ASK HANK, HE KNOWS!

Hank Scott, our Workshop Editor, wants to share his project tips with you. Got a question or a problem with a project you're building—ask Hank! Please remember that Hank's column is limited to answering specific electronic project questions that you send to him. 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

What's in a Name?

How did the Balun coil get its name?

—P.J., Brownsville TX

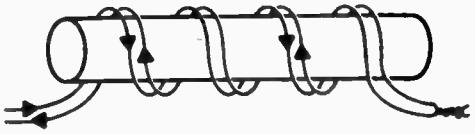
You mean Balun, which is a shortened term derived from "BALanced-to UNbalanced transformer." A Balun (and it's not a coil, but a transformer) is used to correctly match impedances of unbalanced coax lines to balanced dipole antennas.

He's Stuck with Hi-C

I tried to make a high-wattage, non-inductive resistor by wrapping copper wire on a wood form using a bifilar winding. I was very careful, but the resistor still has a high power factor. What's wrong?

—B.D., Chicago IL

A bifilar winding consists of two wires wrapped at the same time. When the winding is finished, one set of ends are connected together. Thus,



as the current tends to form a magnetic field in one direction, its return path, which is in the opposite direction, generates an equal and opposing magnetic field. Hence, no traceable inductance. However, the more turns you make on the wood form, the more capacitance. You can't win!

Then Comes L, M, N and More

My father said I should know about the "K-shell". Hank, what the beep is a K-shell?

—D.G., Elizabeth NJ

Electrons for orbital shells around the atom's nucleus. The K-shell consists of two electrons at the most. A hydrogen atom has one. A helium atom has two electrons. And all other atoms have two electrons in the K-shell with additional electrons in outer shells.

Time on His Hands

In the September-October 1972 ELEMENTARY ELECTRONICS *column you were thinking of buying one of Sprague's quart-milk-bottle size, 3-volt one-farad capacitor, but couldn't find a reason to do so. How about hooking one up in a timer circuit to signal when your retirement age finally rolls around! I hope that's a long time off anyway—enjoy your column.*

—B.W., Indianapolis ID

I hope I can retire tomorrow when I'm 26 years old. Or is it 36, no . . . maybe . . . Heck, I'm young at heart. That's all that matters. Thanks for your kind comment.

Help, I'm Being Robbed

I am planning on installing a burglar alarm system in my home that is somewhat different from the usual "noise makers." In an effort to catch the crook rather than just scare him away, I want to connect a cassette recorder with my CB rig so that if someone should break into my house, the cassette and CB rig would come on and a recorded message would be transmitted. The message would tell my call sign, location, name, what is happening, and to call the police. The message would be transmitted about four times on channel 9 and then the recorder and rig would shut itself off. My question, would this be legal?

—C.B., Petersburg VA

It would be legal only if you are being robbed at the time and the burglar is over 18 years of age, a U.S. citizen, and has your permission to operate your CB set. Why not buy a big dog?

How Many What?

How many watts equal one horsepower?

—V.P., Washington DC

745.7 watts.

Black Light

I want to experiment with ultra-violet light. Where can I get parts and materials?

—A.G., Smithers, B.C.

Write to Edmund Scientific at Dept. JM, 300 Edscorp Bldg., Barrington NJ 08007. They have an advertisement in this issue for their catalog, which, by the way, lists many ultra-violet supplies.

Inflation—Phase 3

Does a CB license cost $25?

—L.T., Estes Park CO

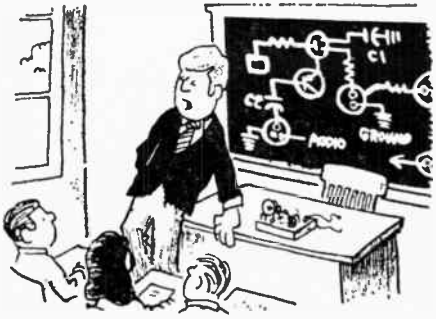
The price is only $20, but the inside talk is a fee boost is in the works. ■

THE LEARNING EXPERIENCE

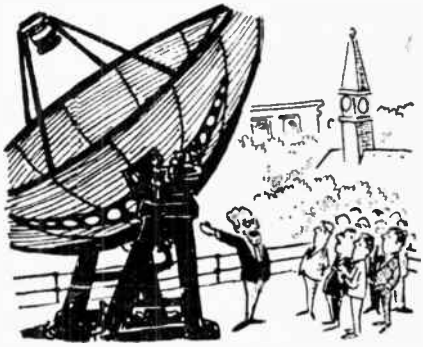
by Jack Schmidt

"And then he gets the electrons excited in the wachamacallit and they fly away."

"That was a 'hot wire,' Marion, not a 'hot circuit'!"

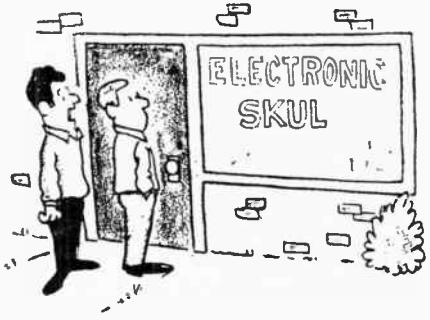


"... and then the capacitor.... er ... ah ... capacits!"



"It picks up radio waves from gaseous nebulae, and blacked out professional games"

"... then the radar waves bounce off your speeding car back to the little black box in my car."



"It doesn't look like a good school to me, Harry!"

20 PASSIVE CIRCUIT PROJECTS

With this 1973 issue of "101" the Editors have gathered a number of new circuits labled *passive*. It is a group of 20 circuits usually consisting only of resistors, capacitors, diodes or inductors. We define passive circuits as those that do not connect directly to a battery, AC supply, solar cell or similar power source. Amplification devices such as discrete transistors or operational IC amplifiers are not used in passive circuits.

As an example, the BC-CB DUPLEXER project prevents transmitted and received CB RF power from entering your auto radio even though both use the same CB whip antenna. The duplexer is a passive circuit, composed entirely of resistive, capacitive and inductive elements, that electrically permits the .55 to 1.6 MHz AM signal to pass only to the AM radio, not to the CB set. Similarly, a 27.135 MHz CB signal (CH15) *picked up by the same antenna* will be electronically routed directly to the CB set—bypassing completely the AM radio.

So, passive circuits you find in this issue do not require any type of "gain" devices; they are, in addition, fairly simple projects that are used to improve the operation or make measurements of other electronic equipment. How about you getting active with a passive circuit today?

PASSIVE CIRCUIT 1 Audio Wattmeter

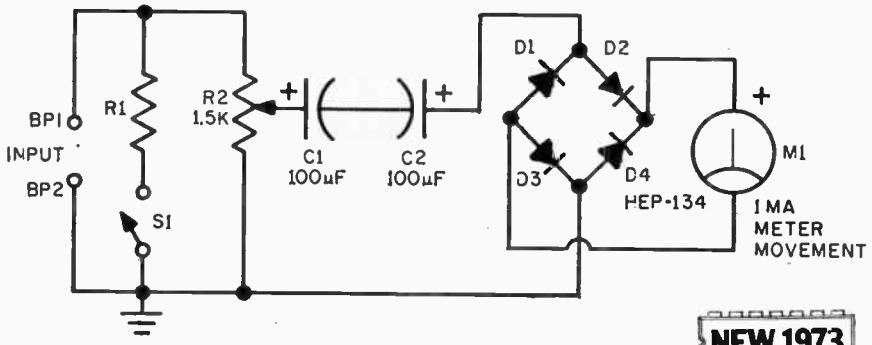
Here's an easy way to measure an amplifier's output power without trying to convert voltage to power measurements. Resistor R1 provides the load for your amplifier and should be rated at least twice the maximum amplifier power output; for example, if your amp puts out 25 watts, R1 should be rated at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

101 ELECTRONIC PROJECTS

1973 EDITION

YOU CAN BUILD THESE IN ONE EVENING

- Audio Wattmeter
- Impedance Matcher
- Remote Speaker Setup
- FM Tuning Meter
- Record Restorer
- Mike Desensitizer
- Stereo Shutoff
- CB Sniffer Probe
- Tape Dubbing Filter
- Tweeter Crossover
- AC Line Regulator
- Z-Matcher
- Tube Quick-Check
- Can Controller
- Speaker Extender
- RF Sniffer
- BC-CB Duplexer
- RF Probe
- RF Filter
- SWL's Squelch



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across 8 ohms. Adjust potentiometer R2 for a full 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.

PARTS LIST FOR AN AUDIO WATTMETER

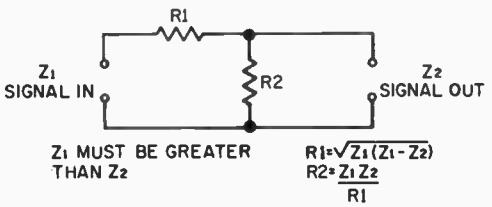
BP1, BP2—Insulated binding posts
C1, C2—100 uF, 50 VDC
D1, D2, D3, D4—Diode, HEP-134
M1—0-1 mA DC meter
R1—8-ohm, 100-watt resistor, see text
R2—1500-ohm linear taper patentiometer

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

PASSIVE CIRCUIT 2 Load Matcher

Most audio circuits transfer their maximum power at minimum distortion only when the output impedance is matched to the load impedance. But it is often necessary to connect equipment of differing impedances. For example, how do you correct an amplifier with a 600 ohm output into an amplifier with a 50 ohm input? Usually, if the 50 ohm input is connected across the amplifier with a 600 ohm output, the excessive loading caused by 50 ohms will sharply reduce the output of the 600 ohm amplifier, and will generally increase the distortion sharply.

A minimum loss pad is the device used to match a high impedance to a low impedance. Though there is always a signal level loss through a pad, the circuit shown provides the absolute minimum loss that



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can be obtained while providing a precise match. If the resistance values work out to odd values, such as 134 ohms, use the closest standard value. Though 5 percent tolerance resistors are suggested, almost as good performance will be obtained with 10 percent resistors.

PASSIVE CIRCUIT 3 Remote Speaker Setup

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.

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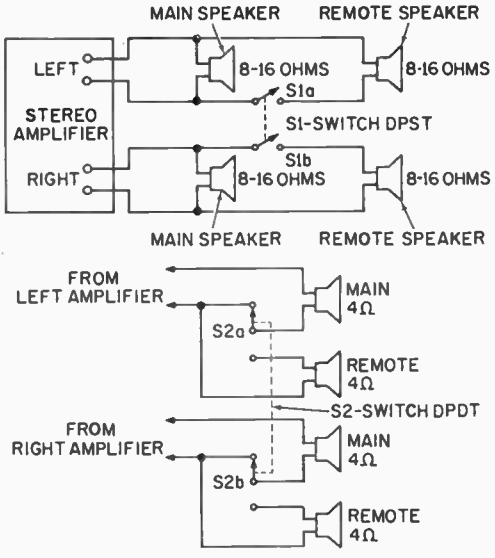
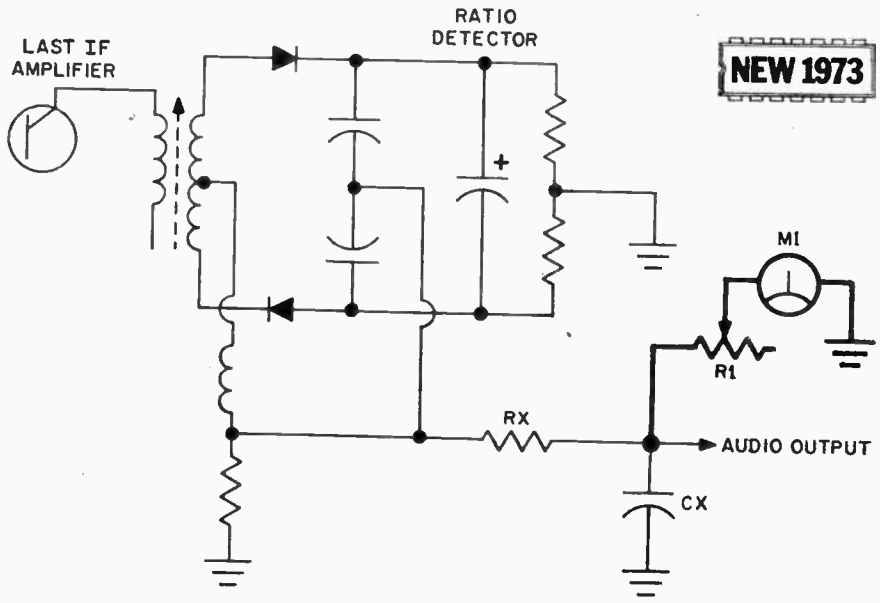


PASSIVE CIRCUIT 4 FM Tuning Meter



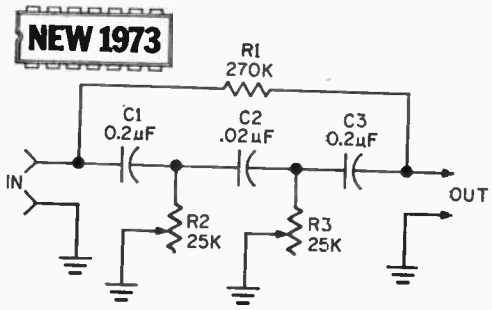
Those inexpensive portable Public Service Radios do a fine job of receiving police and fire calls. But if you're not tuned precisely to the center channel of the base station, it's more than likely you don't hear the much weaker signals from the mobiles. With an FM Tuning Meter hooked onto your public service inhaler, you'll be able to copy any signal that can fight its way into the antenna terminals. The schematic shows a detector circuit common to most public service portables. Resistor Rx and capacitor Cx form the de-emphasis network. Connect one end of sensitivity control R1 to the junction of Rx and Cx as shown. Meter M1 is the zero center miniature type; one rated either 50 or 100 microamperes will be satisfactory. Adjust R1 so the meter pointer is not driven offscale when the signal is detuned to the extreme of the sidebands. Proper tuning is then indicated when the meter shows center scale.

PARTS LIST FOR FM TUNING METER

M1—50 or 100 uA meter, zero center
R1—1 megohm miniature potentiometer

PASSIVE CIRCUIT 5 Record Restorer

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 midband 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 midband frequencies. The Record Re-



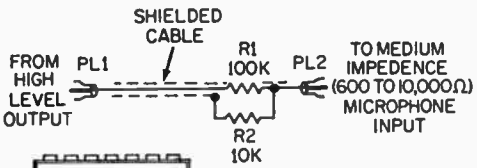
storer should be assembled in a metal cabinet to prevent hum pickup. Connect the output of your phonograph to the restorer input. Connect the output of the restorer to your tape recorder. Set potentiometer R2 to maximum resistance and adjust potentiometer R3 for the most pleasing sound. If R3's adjustment 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 RECORD RESTORER

C1, C3—0.2 uF mylar capacitor, 25 VDC or better
C2—0.02 uF mylar capacitor, 25 VDC or better
R1—270,000-ohm, ½-watt resistor
R2, R3—25,000-ohm potentiometer, linear taper

PASSIVE CIRCUIT 6 Mike Desensitizer

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.



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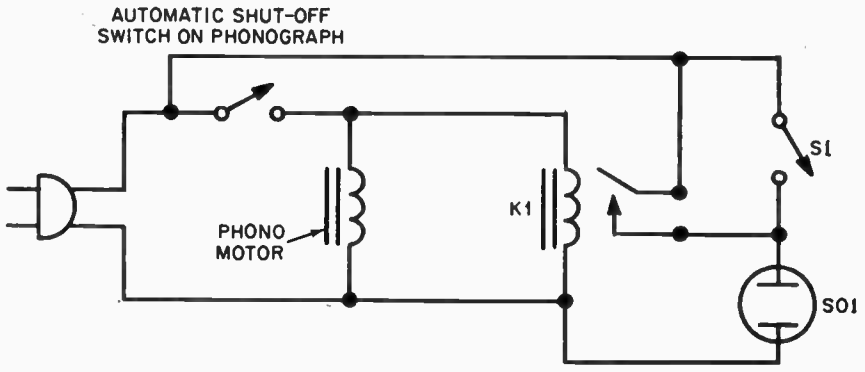
PARTS LIST FOR MIKE DESENSITIZER

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

PASSIVE CIRCUIT 7 Stereo Shutoff



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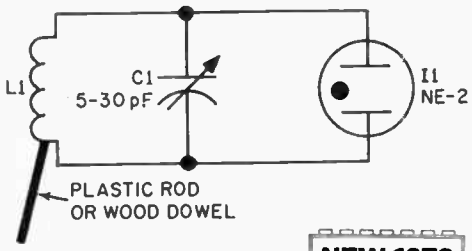
It happens to just about everyone. One minute you're listening to the hi-fi, the next you're called away to answer the doorbell or a phone call. You forget all about the music, the record plays through, the automatic turntable shuts off—but the amplifier stays on until you happen to pass by and notice 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 STEREO SHUTOFF

K1—117 VAC relay with contacts rated at least 5 amperes at 117 VAC (Radio Shack 275-207)
S1—Switch, SPST (shutoff bypass)
SO1—AC socket

PASSIVE CIRCUIT 8 CB Sniffer Probe

It's often difficult if not impossible to detect RF in mini-power RF circuits such as used in walkie-talkies; generally, service grade test equipment just isn't sensitive enough. Next time you're working on a CB walkie-talkie and can't tell if a lower power RF amplifier is working, just throw together a CB Sniffer Probe from remains of the old junk box. Better yet, why not be prepared in advance because all new components will cost less than $10. A small plastic rod about 6 inches long, cemented to L1, will allow you to use the sniffer as a probe. To align, place the sniffer near the antenna of a known good walkie-talkie, key the transmitter, and using an insulated alignment screwdriver adjust trimmer capacitor C1 for maximum brilliance of neon lamp I1.



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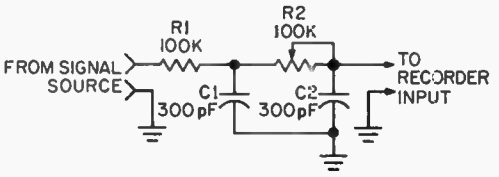
PARTS LIST FOR CB SNIFFER PROBE

C1—5 to 30 pF trimmer capacitor
I1—NE-2 neon lamp
L1—RF choke, Ohmite Z-144 or equiv.

PASSIVE CIRCUIT 9 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 signal source such as a record player and your tape recorder. It's cut-off frequency starts at about 5000 Hz, attenu-



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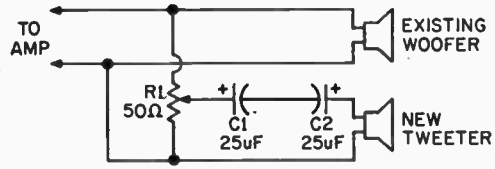
ation increasing at the higher noise producing frequencies. Control R2 allows you to shift the "corner" frequency slightly up or down to obtain more or less high frequency attenuation as needed. For proper operation, the recorder input impedance should be at least 100,000 ohms. Some solid state recorders 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—300 pF disc capacitor, 50 VDC or better
R1—100,000-ohms, ½-watt resistor
R2—100,000-ohm potentiometer, any taper

PASSIVE CIRCUIT 10 Tweeter Crossover



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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 TWEETER CROSSOVER

C1, C2—25 uF electrolytic capacitor, 25-50 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.

PASSIVE CIRCUIT 11 AC 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.

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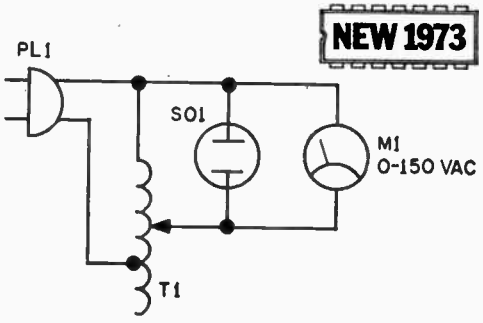


The autotransformer normally has an operating output of from 0 to 150 VAC, so that's a reserve of at least 30 volts. When the power line dips, simply crank up the

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.

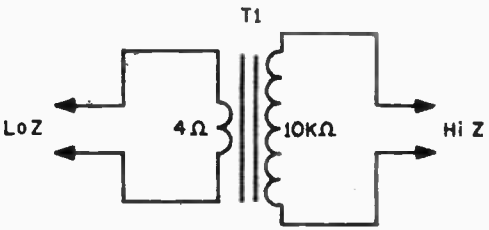
PARTS LIST FOR AC LINE REGULATOR

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

PASSIVE CIRCUIT 12 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.



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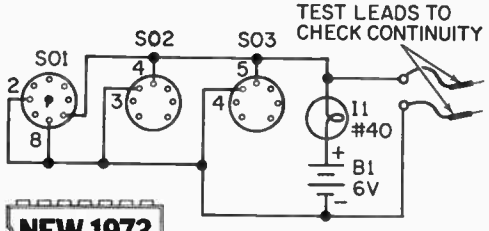
PARTS LIST FOR Z-MATCHER

T1—Audio output transformer; 4-8 ohm primary, 10,000 ohm secondary (Allied 705-0532; Lafayette 33-85085; UTC ultracompact type A-35 for professional applications).

PASSIVE CIRCUIT 13 Tube Quick Check



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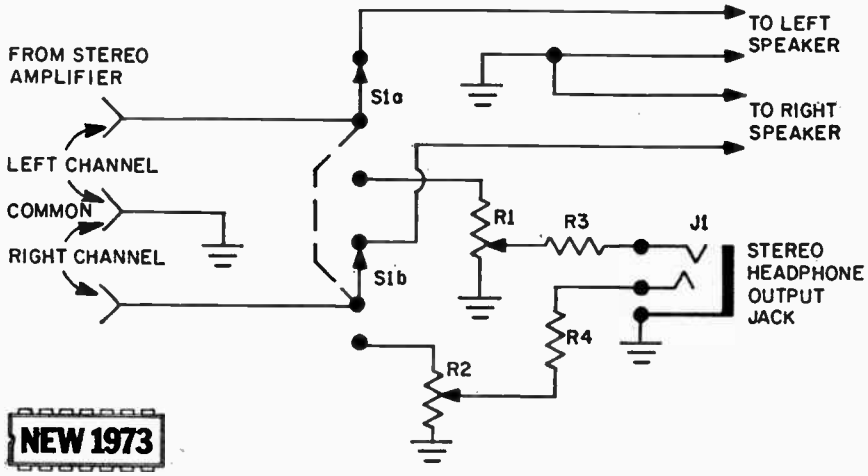
Most tube failures are caused by open filaments, so you can save a lot of time when troubleshooting radios, TV and communications gear by using this almost instantaneous tube checker. Simply plug a tube into the matching socket; if the filament is okay, lamp I1 will light. If you have any oddball tubes that use sockets other than the standard three shown, simply build them into the checker. The continuity test leads also allow you to check filaments in tubes that won't fit the sockets.

PARTS LIST FOR TUBE QUICK-CHECK

B1—6 volt battery, Burgess Z4 or lantern type
I1—#40 pilot lamp
SO1—Octal socket
SO2—7 pin socket
SO3—9 pin socket

PASSIVE CIRCUIT 14

Can Controller



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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-connected 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. Resistor 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.

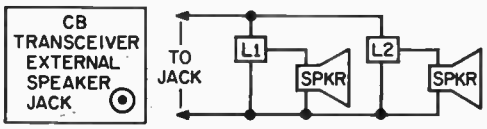
PARTS LIST FOR CAN CONTROLLER

J1—Stereo phone jack to match plug on headphones
R1, R2—50-ohm wirewound variable resistor, see text
R3, R4—150-ohm, ½-watt resistor
S1—Switch, DPDT

PASSIVE CIRCUIT 15

Speaker Extender

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 speaker from full off to full on, without affecting the volume at the other speakers. Regardless of the impedance of the speakers you're using, best results are obtained with 8 ohm L pads.



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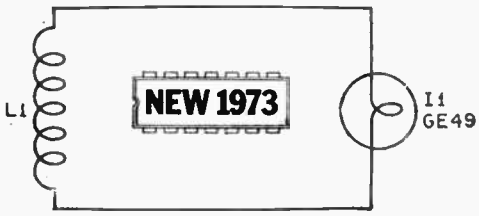
PARTS LIST FOR SPEAKER EXTENDER

L1, L2—8 ohm L pad (Lafayette 99-61400, for stereo; Lafayette 99-61343 for mono, or equivalent)
PL1—Plug to match your external speaker jack

PASSIVE CIRCUIT 16 RF Sniffer

PARTS LIST FOR RF SNIFFER

I1—#49 pilot lamp
L1—Coil, see text

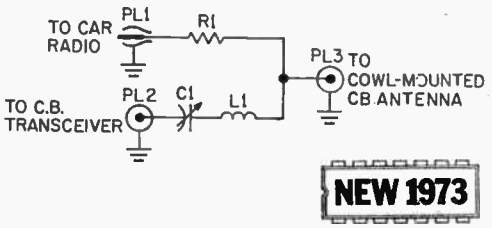


The easiest way to start servicing low power ham transmitters is to first localize where the power gets lost. An R.F. Sniffer made from an ordinary #49 pilot lamp and a few turns of wire will instantly indicate if there's RF in a tank circuit. Carefully, so you don't get near the high voltage, bring the sniffer close to the tank coil. If RF is present, lamp I1 will glow—no glow, no RF. Coil L1 can be any diameter from about one-half to one inch or greater. Use about 10 turns for 80 meters, 5 turns for 40 and 20 meters and 3 turns for 10 meters.

PASSIVE CIRCUIT 17 BC-CB Duplexer

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



PARTS LIST FOR THE BC-CB DUPLEXER

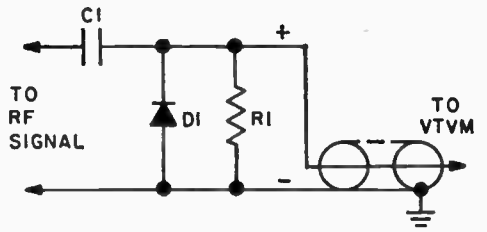
C1—30 pF trimmer capacitor
L1—RF choke, Ohmite Z-144 or equiv.
R1—560-ohm, ½-watt resistor

PASSIVE CIRCUIT 18 RF Probe

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 cable provides filtering. The output of the probe is positive, with the VTVM indicating the peak value of the RF waveform. To determine the RMS

PARTS LIST FOR RF PROBE FOR VTVM

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

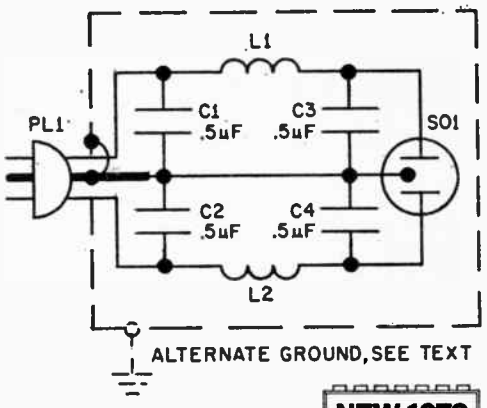


value, multiply the VTVM reading by 0.707. The maximum RF voltage that can be applied is limited by the diode. A 1N60 is limited to 30V peak RF voltage. For higher voltage-handling capacity, substitute a higher voltage small signal detector diode.

PASSIVE CIRCUIT 19 RF Filter

PARTS LIST FOR THE RF FILTER

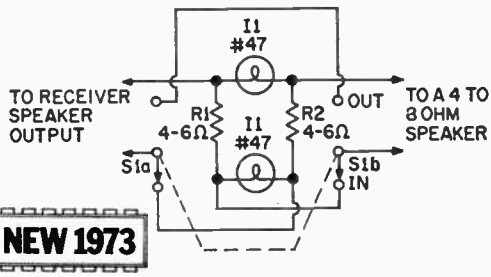
C1, C2, C3, C4—0.5 uF mylar capacitor, 150 VDC or better
L1, L2—95 turns of #16 enameled wire closewound on a ¾-in. wood dowel approximately 6 inches long.
PL1—3-wire AC plug
SO1—3-wire AC socket



NEW 1973

It's not uncommon for the RF output of a medium to high power transmitter to leak into the AC power lines, causing your signal to be picked up by radio, TV and hi-fi sets. Actually, just about all transmitters from the 5 watt CB rigs to the Amateur's full-gallon can sock it to the power lines. Most often, it takes a brute-force filter to squash the interference. First, try the filter right at the transmitter; if it doesn't cure the problem you might have to place a filter at each radio, etc., which is picking you up. This filter must be constructed in a metal cabinet. The ground end of all capacitors should return to the electrical ground through a 3-wire plug. If this does not eliminate the interference, lift the capacitors off the electrical ground, connect them to the cabinet, and ground the cabinet separately. Either way, the cabinet must be grounded—directly to a water pipe or through the electrical (third wire) ground.

PASSIVE CIRCUIT 20 SWL's Squelch



NEW 1973

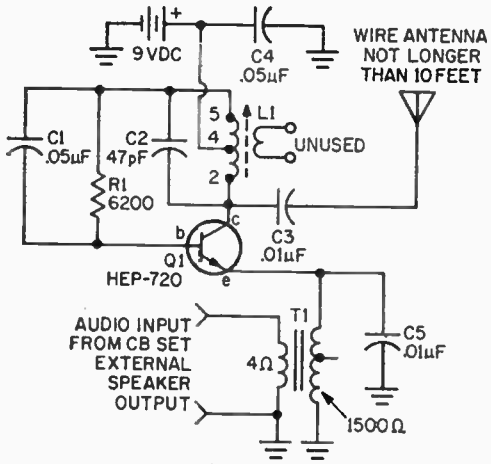
It's almost a universal rule that two-way radios have a squelch control, a device that mutes the background noise until a station is received. Even public service radios now include a squelch, so why put up with ear-jarring noise when listening on your SWL receiver. Just a couple of #47 pilot lamps scrounged from old tube radios

(Continued on page 112)

101 ELECTRONIC PROJECTS FOR UNDER $15

1 Rebroadcaster

NEW 1973



PARTS LIST FOR REBROADCASTER

C1, C4—0.05 μF disc capacitor, 25 VDC or better
C2—30 or 47 pF silver mica capacitor, 100 VDC or better
C3, C5—0.01 μF disc capacitor, 25 VDC or better
L1—Oscillator coil, Miller 2022
Q1—NPN transistor, HEP-720
R1—6200-ohm, ½-watt resistor, see text
T1—Output transformer, 4 ohms to 1500 or 2500 ohms

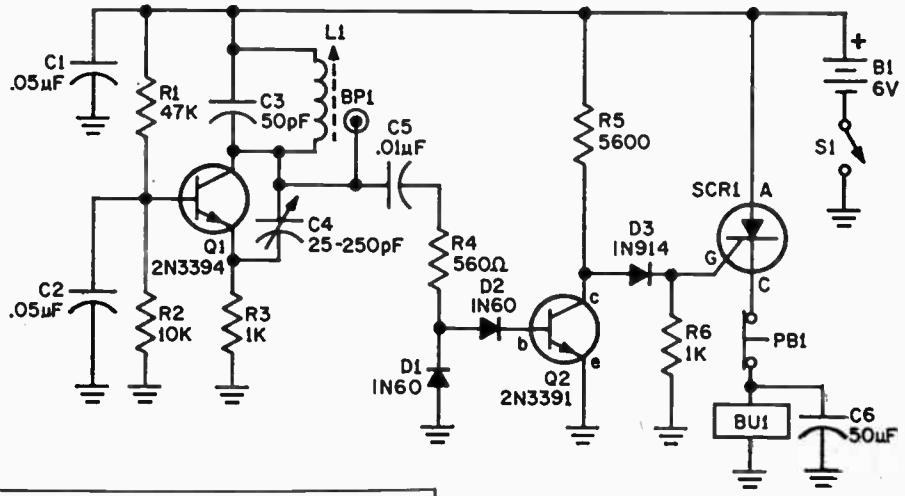
One way to keep an ear on the Amateur or Citizens band while working around the house or searing steaks out on the patio, is to install a lot of remote speakers. An easier way is to feed the audio signal from your CB or amateur receiver into a broadcast band Rebroadcaster and radiate the signals throughout 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 input current exceeds 10 mA, increase the value of R1 in 20% increments until the current is below 10 mA. The antenna wire cannot exceed 10 feet. Adjust slug L1 so the rebroadcaster operates on an unused BC frequency. The audio input connects to the speaker or headphone output of your communications equipment. Adjust the volume on the receiver for a high, undistorted transmission by the rebroadcaster.

2 Motel Alarm

NEW 1973

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



PARTS LIST FOR MOTEL ALARM

B1—6 volt battery, Burgess Z4 or equiv.
BP1—Insulated binding post
BU1—6 volt buzzer
C1, C2—0.05 disc capacitor, 25 VDC or better
C3—50 pF silver mica capacitor, 500 VDC
C4—25-250 pF trimmer
C5—0.05 uF, 25 VDC
C6—50 uF electrolytic capacitor, 25 VDC or better
D1, D2—Diode, IN60, HEP-135
D3—Diode, IN914, HEP-156
L1—15 uH adjustable RF coil (Miller 4205)
PB1—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
S1—Switch, SPST (on-off)
SCR1—Silicon Controlled Rectifier, General Electric C6U (Listed in EDI Catalog)

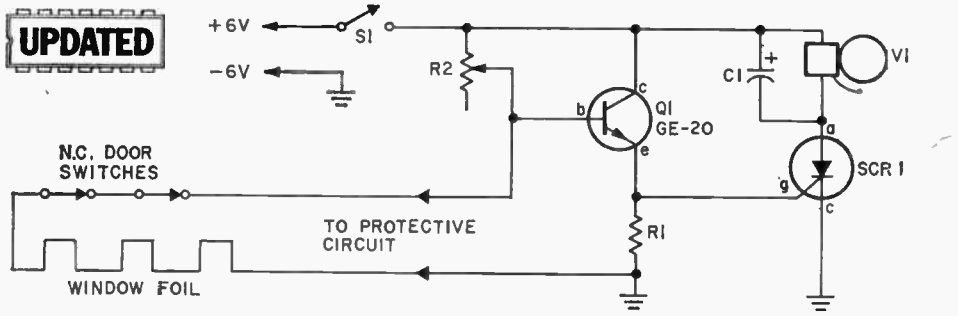
NEW 1973

circuit Q1 is an oscillator with a connection through binding post BP1 to the doorknob. As long as Q1 oscillates, its rectified output is applied to Q2 which holds the SCR1 gate almost at ground potential. When someone touches the 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.

3 Professional 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

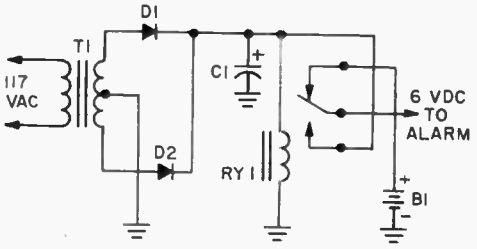


is an AC powered 6 VDC source or a lantern battery; standby current is about 100 *u*A. To adjust, connect a voltmeter (10 VDC range) across resistor R1, open the protective circuit and adjust potentiometer R2 so the meter indicates a voltage rising towards 1 volt. The alarm bell should ring before 1 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 PROFESSIONAL BURGLAR ALARM

C1—50 uF, 6 VDC electrolytic capacitor
Q1—NPN transistor, GE-20 or equiv.
R1—1000-ohm, ½ watt resistor
R2—250,000-ohm potentiometer
S1—SPST switch
SCR1—Silicon controlled rectifier rated 12 PIV or higher (General Electric C106 series)
V1—6 VDC alarm bell

4 Automatic AC-DC Power Supply



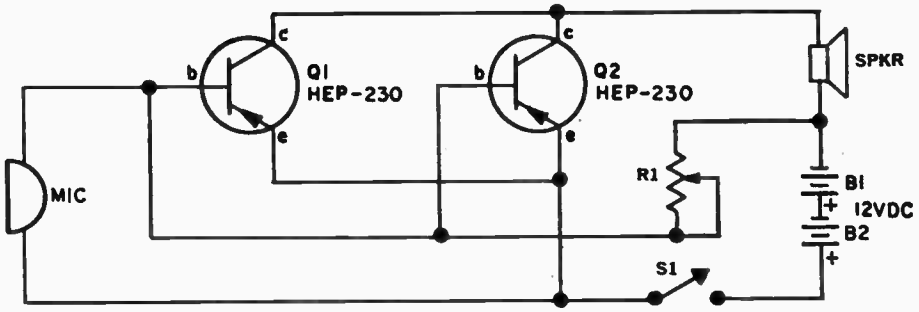
PARTS LIST FOR AUTOMATIC AC-DC POWER SUPPLY

B1—6V lantern battery
C1—100 uF, 16 VDC electrolytic capacitor
D1, D2—Silicon rectifier rated 25 PIV at 1 A or higher
RY1—Relay, 6 VDC approximately 20 mA (Potter & Brumfield RS5D-6 or equiv.)
T1—12.6 volt center-tapped filament transformer rated 1 A or higher.

Both home-brew and battery operated burglar alarm kits are made fail-safe with this automatic AC power supply. Normally, power for the alarm comes from the line powered 6VDC power source; this prevents circuit alarm systems and signal lights from prematurely exhausting the battery. If the AC power line should fail for any reason, relay RY1 releases to switch in standby battery B1. As soon as the power line is restored, RY1 pulls in and again disconnects the battery. Relay RY1's contacts are shown in the power line off (battery on) position.

5 Power Megaphone

Just about any power transistor can be used in this megaphone. It's suitable for boats, playing fields, etc. Transistors Q1 and Q2 are the 2N301 type, generally available in "five-for-$1" experimenter kits.
Transistors Q1 and Q2 are parallel-con-



nected to handle the required power and speaker matching. The microphone is a carbon type such as a telephone handset. If a regular carbon mike is used, the push-to-talk (PTT) switch can be connected in place of S1 to provide PTT operation. There's no warm-up or "capacitor charge" time. Batteries B1 and B2 are 6 V lantern types. The unit should be built in a metal case which can also serve as a transistor heat sink. Use insulators coated with silicon heat-sink grease between each transistor and the case.

Potentiometer R1 is adjusted for maximum sound output consistent with lowest distortion.

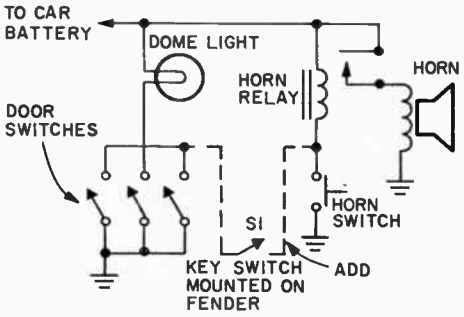
PARTS LIST FOR POWER MEGAPHONE

B1, B2—6-V lantern battery
M1—Carbon microphone
Q1, Q2—HEP-230/232 pnp transistor (Motorola)
R1—5000-ohm. potentiometer
S1—Spst switch
SPKR—4-ohm speaker or horn

6 Easy Auto Theft Alarm

PARTS LIST FOR EASY AUTO THEFT ALARM

S1—Fender-mounted key switch.



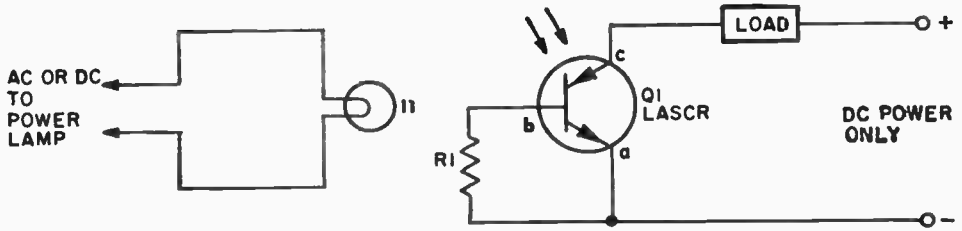
A single fender-mounted key switch is all that's needed to turn your car's horn and courtesy lights into a burglar or theft alarm! Simply install keyswitch S1 on the fender, connect one terminal to the horn relay and the other to the courtesy-light door-switch wiring, as shown by the dotted lines. When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

7 Photo Light 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.

PARTS LIST FOR PHOTO LIGHT 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



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.

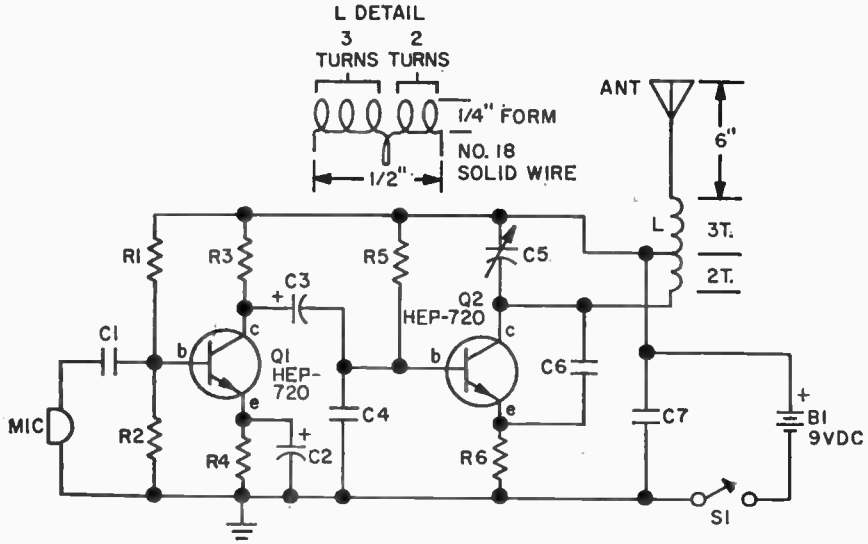
8 FM Wireless Mike

Just speak or play into the microphone and you'll broadcast to an FM receiver at distances up to 50 feet (maybe 100 feet if the wind is right). Use standard RF wiring precautions and make coil L1 exactly as shown. Best speech clarity is obtained by using a crystal or ceramic mike. For music reproduction, substitute a dynamic mike element.

The unit can be assembled on a perfboard using push-in terminals for tie points. The case must be metal to prevent hand capacitance from continuously changing the output frequency. Pass the 6-in. solid wire antenna through the metal case using a ¼-in. hole and a matching rubber grommet for an insulator.

PARTS LIST FOR FM WIRELESS MIKE

B1—9-V battery, Type 2U6
C1—0.05-uF, 3-VDC capacitor
C2—20-uF, 3-VDC electrolytic capacitor
C3—5-uF, 12-VDC electrolytic capacitor
C4—47-pF, 25-VDC capacitor
C5—5-30 pF trimmer capacitor
C6—6.8-pF ceramic capacitor
C7—0.01-uF, 10-VDC capacitor
L1—See pictorial detail
MIC—Crystal or ceramic microphone element
Q1, Q2—npn transistor HEP—720
R1—47,000-ohm, ½-watt resistor
R2—33,000-ohm, ½-watt resistor
R3—1500-ohm, ½-watt resistor
R4—3300-ohm, ½-watt resistor
R5—100,000-ohm, ½-watt resistor
R6—470-ohm, ½-watt resistor
S1—Spst switch



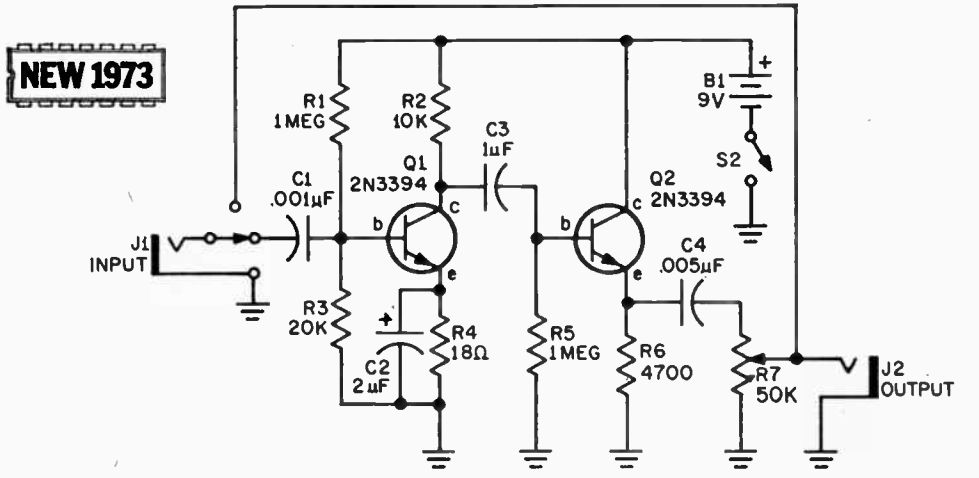
9 Twang-A-Matic

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 feedthrough. Various degrees of twang is obtained by varying the output so the guitar pickups with the level controls built into the guitar.

PARTS LIST FOR TWANG-A-MATIC

B1—9 volt battery Eveready 246 or equiv)
C1—0.001 uF disc capacitor 15 VDC or better
C2—2 uF electrolytic capacitor, 15 VDC or better
C3—1 uF electrolytic capacitor, 15 VDC or better
C4—0.005 uF disc capacitor, 15 VDC or better
J1, J2—Phone jack
Q1, Q1—NPN transistor, 2N3394
R1, R5—1 megohm, ½-watt resistor
R2—10,000, ½-watt resistor
R3—20,000-ohm, ½-watt resistor, 5 percent
R4—18-ohm, ½-watt resistor
R6—4700-ohm, ½-watt resistor
R7—50,000-ohm audio taper potentiometer
S1—Switch, SPDT (twang in-out)
S2—Switch SPST (on-off)



10 Speak-A-Mike Preamp

PARTS LIST FOR SPEAK-A-MIKE PREAMP

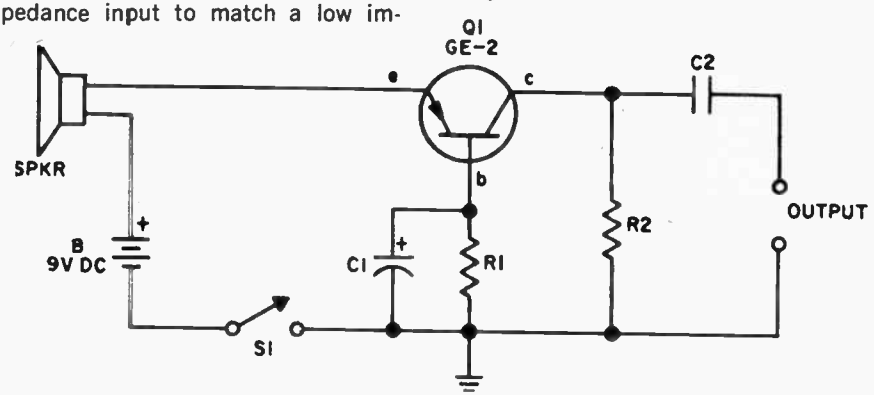
B1—9-V battery
C1—6-uF, 25-VDC electrolytic capacitor
C2—0.47-uF, 10-VDC capacitor
Q1—GE-2 pnp transistor
R1—270,000-ohm, ½-watt resistor
R2—27,000-ohm, ½-watt resistor
S1—Spst switch
SPKR—Any PM speaker, 4-10-ohms

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 an

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 uf capacitor at C2 allows the preamp to work into loads of 7000 ohms or higher.



11 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.

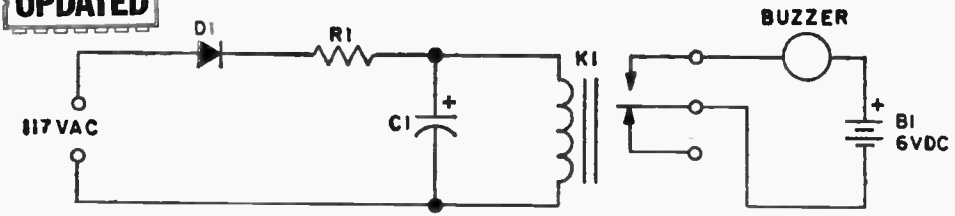
To keep current consumption (and operating costs) at rock bottom, a very sensitive relay is used for K1. As long as AC power is supplied, K1 is activated and the buzzer contacts are held open. When power fails, K1's contact springs back, completing the battery connection to the buzzer.

PARTS LIST FOR POWER FAILURE ALARM

B1—6V dry-cell battery
C1—25-uF, 150-VDC capacitor
D1—IN4003 silicon diode
K1—3000-5000 ohm sensitive relay coil (see text)
R1—10,000-ohm, ½-watt resistor
1—6-VDC commercial home buzzer

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

UPDATED

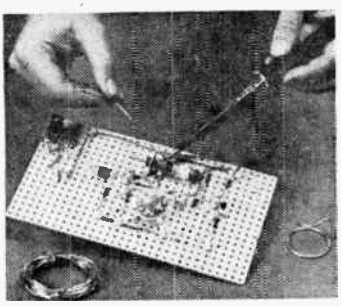


12 BCB Mini Booster

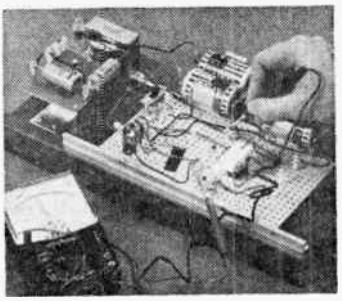
NEW 1973

Here's a low cost project that can pack a lot of extra sensitivity into a 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 upwards of 10 feet 80 antenna wire to the input, and position the Mini-Booster flat against the pocket radio with L1 directly behind the lopstick antenna built into the radio. Tune capacitor

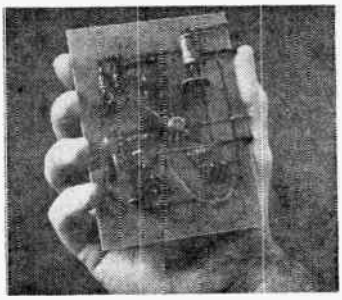
You get your own 161-piece electronics laboratory... with authentic electronic components used by industry!



You learn how to construct circuits and connect them with a soldering iron, which is part of your CIE laboratory equipment. This "hands on" experience is extremely valuable in applying what you learn.



Testing and troubleshooting are an important part of your learning experience. Included in your laboratory is a precision "multimeter" to diagnose electrical and electronic troubles quickly and accurately.



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Here's how two outstanding CIE students carved out new careers: After his CIE training, Edward J. Dulaney, President of D & A Manufacturing, Inc., Scottsbluff, Nebraska, moved from TV repairman to lab technician to radio station chief engineer to manufacturer of electronic equipment with annual sales of more than $500,000. Ed Dulaney says, "While studying with CIE, I learned the electronics theories that made my present business possible."

Marvin Hutchens, Woodbridge, Virginia, says: "I was surprised at the relevancy of the CIE course to actual working conditions. I'm now servicing two-way radio systems in the Greater Washington area. My earnings have increased $3,000. I bought a new home for my family and I feel more financially secure than ever before."

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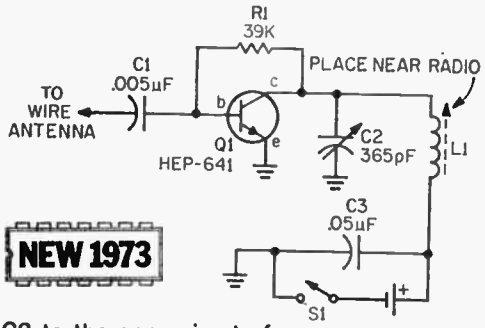
CIRCLE NO. 2 ON PAGE 9 OR 108

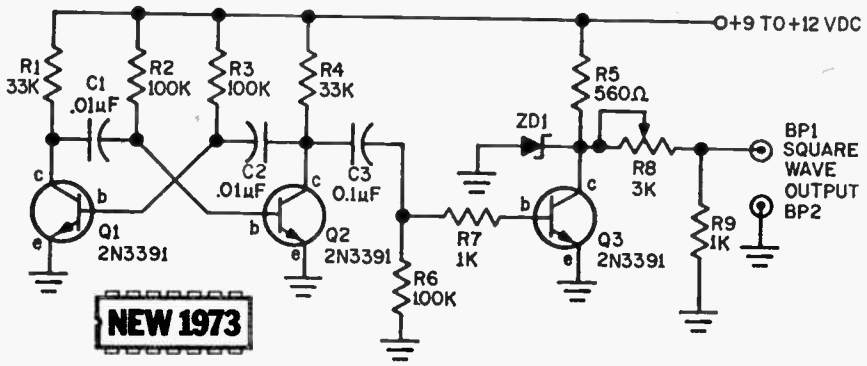


C2 to the approximate frequency you want to receive, then turn on the radio and listen to the signals boom in. Keep in mind that the receiver's normal AVC action will mask any boost applied to strong signals.

PARTS LIST FOR THE BCB MINI BOOSTER

- **B1—15 volt penlight AA battery**
- **C1—0.005 uF disc capacitor, 25 VDC or better**
- **C2—365 pF miniature tuning capacitor with dial**
- **C3—0.05 uF disc capacitor, 25 VDC or better**
- **L1—Ferrite loop antenna (Radio Shack 270-1430)**
- **Q1—NPN transistor, HEP-641**
- **R1—39,000-ohm, ½-watt resistor**
- **S1—Switch, SPST (on-off)**

13 Probe Calibrator



One of the hallmarks of a professional laboratory oscilloscope is the combination precision voltage and test probe calibrator. While the voltage calibrator is self explanatory, the probe calibrator is not. Capacitive divider probes which are used for high frequency observations must have the small internal trimmer properly adjusted if the probe is not to attenuate or peak the higher frequencies. The probe is calibrated by feeding in a precise square wave and then adjusting the trimmer capacitor in the probe for optimum square display.

The Lab Calibrator is the same type device as you'll find in the most expensive scopes. It provides a precise 5 Volt peak-to-peak square waveform of approximately 1000 Hz. To calibrate the probe and scope, you first adjust the probe's capacitor for optimum square waveform, then adjust the scope's vertical calibrator for the proper 5 volt peak-to-peak display. The power supply can be any filtered DC voltage from 9 to 12 volts. Binding post BP1 is insulated; BP2 can be connected to the metal enclosure. If a plastic enclosure is used, make certain BP2 is connected to the circuit ground. Adjust R8 for 5 volt peak-to-peak output.

PARTS LIST FOR PROBE CALIBRATOR

- **BP1, BP2—Binding posts, see text**
- **C1, C2—0.01 uF disc capacitor, 25 VDC or better**
- **C3—0.1 uF mylar capacitor, 25 VDC or better**
- **Q1, Q2, Q3—NPN transistor, 2N3391**
- **R1, R4—33,000-ohm, ½-watt resistor**
- **R2, R3, R6—100,000-ohm, ½-watt resistor**
- **R5—560-ohm, ½-watt resistor**
- **R7, R9—1000-ohm, ½-watt resistor**
- **R8—3000-ohm potentiometer**
- **ZD1—Zener diode, 6 volts, 1 watt (Radio Shack 276-561, HEP-103 or equiv)**

14 Powerhouse Larynx

Though the design is simple and easy to build, this one-transistor loudhailer puts out a powerhouse shout. The circuit, except for the mike, can be mounted in a metal cabinet with a paging horn or trumpet speaker mounted on top.

Transistor Q1 must be provided with a heat sink, which may be the cabinet itself. Take care, however, that Q1's case—the collector—is insulated from the cabinet with hardware provided in a power transistor mounting kit.

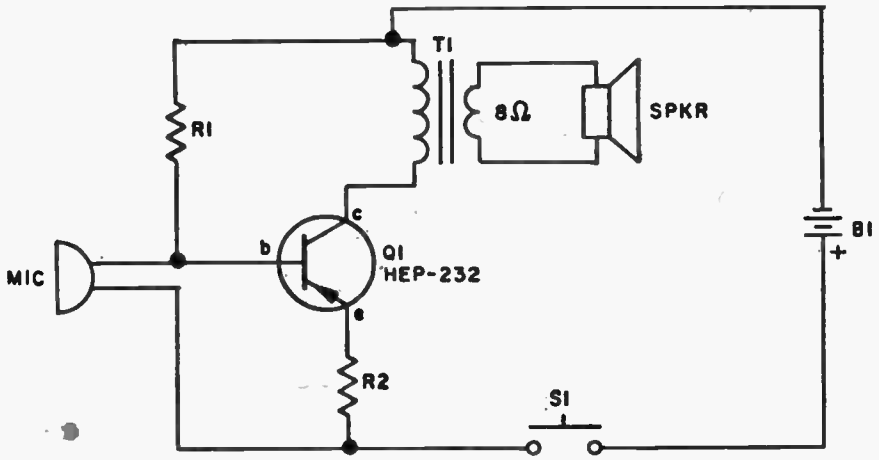
The microphone can be a surplus carbon type or telephone transmitter element.

The entire unit can be assembled inside a speaker-trumpet if care is taken to acoustically isolate the microphone from the speaker to prevent howling feedback.

Note carefully that transformer T1 must be rated for at least 5 watts. Do not use a miniature transistor transformer.

PARTS LIST FOR POWERHOUSE LARYNX

- **B1**—6-VDC battery, lantern type or four "D" alkaline cells in series
- **MIC**—Carbon microphone
- **Q1**—Motorola HEP-232 pnp transistor
- **R1**—270-ohm, ½-watt resistor
- **R2**—1-ohm, 4-watt resistor
- **SPKR**—8-ohm impedance, horn-type speaker
- **S1**—Normally-open pushbutton switch
- **T1**—8 to 24-ohm, 5-watt audio output transformer—Lafayette 33-57011



15 Modulated 100 kHz Calibrator

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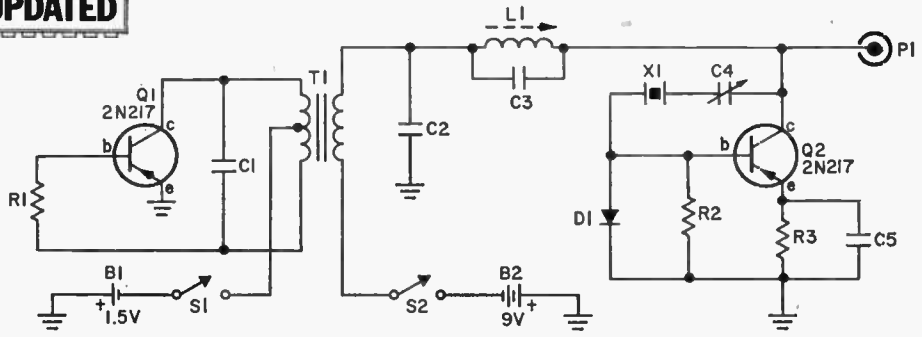


If the part of the short wave band you like to monitor is so jammed with signals you can't find the markers from a standard 100 kHz calibrator, this modulated calibra-

tor is the next best thing to a frequency meter. Just turn on the modulator with switch S1 and each marker will turn into a raucous growl that will stand out in any mass of heterodynes. Once you have the marker tuned in you can turn off the modulator for precise frequency alignment. The unit can be zero-beat to WWV by adjusting trimmer capacitor C4. For optimum performance the unit should be assembled in a metal enclosure with every part firmly tied down to terminal strips or perf-board. Normally, a clip lead attached to output binding post P1 will radiate a healthy signal into the receiver. If the signal is too weak at the higher frequencies simply connect the clip lead between binding post P1 and the reciever's antenna terminal. To adjust coil L1, temporarily connect a 0-10 mA DC meter between battery B2's positive terminal and ground. Using an insulated alignment screwdriver, adjust slug L1 for a peak meter indication of approximately 1.5 mA. Then remove the meter and reconnect the normal ground connection.

PARTS LIST FOR MODULATED 100 KHZ CALIBRATOR

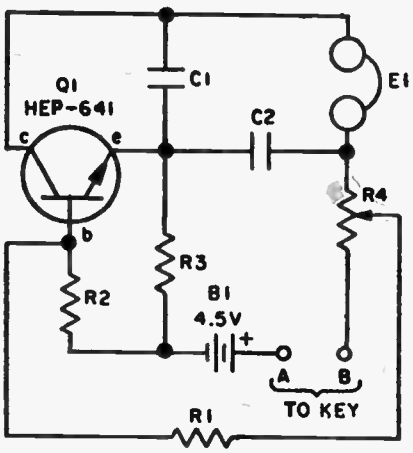
B1—1.5 volt AA battery
B2—9 volt battery type 2U6
C1—0.1 uF, 25 VDC capacitor
C2, C5—0.05 uF, 500 VDC ceramic disc capacitor
C3—750 pF, 500 VDC silver mica capacitor
C4—180 pF trimmer capacitor
D1—Germanium diode, 1N60
L1—2-18 mH width coil (J. W. Miller 6314)
P1—Insulated 5-way binding post
Q1, Q2—PNP transistor, 2N217 or 2N1357
R1—15,000-ohm, ½ watt resistor
R2—100,000-ohm, ½ watt resistor
R3—680-ohm, ½ watt resistor
S1, S2—SPST switch
T1—Transistor output transformer (Lafayette Radio TR-119)
X1—100 kHz crystal

16 Budget CPO

PARTS LIST FOR BUDGET CPO

B1—4.5-V battery
C1—0.02-uF, 10-VDC capacitor
C2—0.22-uF, 10-VDC capacitor
E1—2000-ohm magnetic earphone
Q1—HEP-641 npn transistor (Motorola)
R1—2700-ohm, ½-watt resistor
R2—1500-ohm, ½-watt resistor
R3—27,000-ohm, ½-watt resistor
R4—50,000-ohm potentiometer

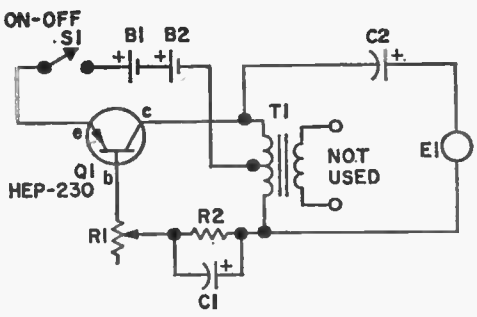
Components you have lying about might make this simple, budget CPO (code practice oscillator). Using component values given, the tone frequency is approximately 800 Hz. It can be changed by substituting different values for C1 and C2, but maintain the same capacity ratio. That is, C2 should always be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



17 Fish Caller

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.

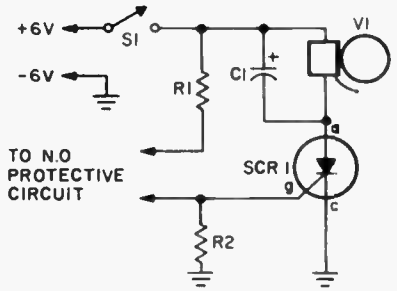
For proper operation T1 must be subminiature type about half as large as your thumb. E1 must be a crystal headphone (supplied with some transistor radios).



PARTS LIST FOR FISH CALLER

B1, B2—1.5-V AAA battery
C1, C2—50-uF, 25-VDC electrolytic capacitor
E1—Crystal earphone
Q1—Motorola HEP-230 pnp transistor
R1—2500-ohm potentiometer
R2—27,000-ohm, ¼-watt resistor
S1—Spst switch, part of R1
T1—Subminiature transistor output transformer: 500-ohm center tapped primary to 3.2-ohm secondary—Lafayette Radio 33-85580

18 Open Circuit Burglar Alarm

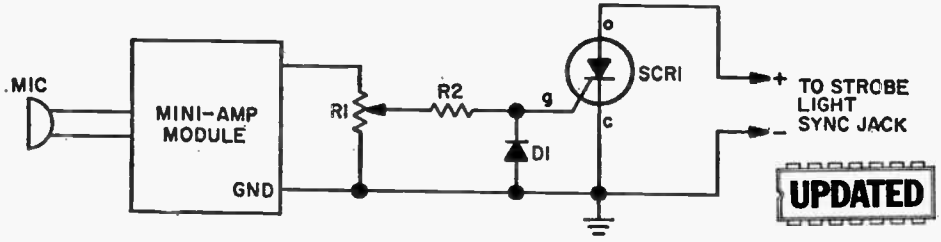


This simple electronic latch-up alarm circuit handles normally open protective devices such as concealed floor-mat switches. All protective devices are connected in parallel and the alarm is tripped as soon as any of the devices are closed. There is no standby current and a battery power source will 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 FOR OPEN CIRCUIT BURGLAR ALARM

C1—50 uF, 6 VDC electrolytic capacitor
R1—4700-ohm, ½ watt resistor
R2—1000-ohm, ½ watt resistor
S1—SPST switch
SCR1—Silicon controlled rectifier, rated 12 PIV or higher (General Electric C106 series)
V1—6 VDC alarm bell

19 Stop Motion



PARTS LIST FOR STOP MOTION

D1—Motorola HEP-154 50-PIV silicon rectifier
MIC—Ceramic microphone
R1—5000-ohm potentiometer
R2—2700-ohm, ½-watt resistor
SCR1—GE C106G silicon-controlled rectifier

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 re-

sistor 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.

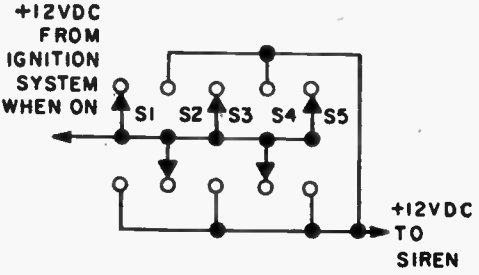
20 Electronic Combo Lock

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

Switches S1 through S5 are spdt rather than spst only to keep all external switch markings the same. It would be a dead giveaway if two keying notches or lettering were reversed.

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



21 Stereo Balancer

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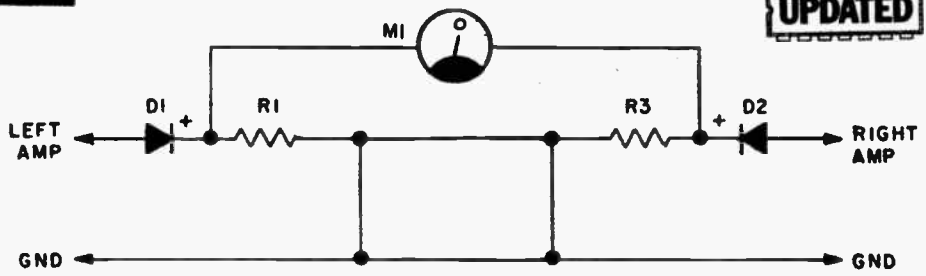


It looks ridiculously simple, but this instrument will give you precise volume and tone control balance between left and right stereo amplifiers.

For maximum convenience, the meter is a zero-center type. Resistors should be at least five percent and the diodes a matched pair. Note that the lead for each side that goes directly to the meter is connected, between the junctions of D1/R1 and D2/R3.

Optimum stereo level and phase balance occurs for matched speakers when the meter indicates "0". If the meter indicates either side of zero, the levels are not matched or the wires are incorrectly phased. Check incorrect phasing by making certain the meter leads are connected to the amplifier "hot" terminals.

An ordinary 0-1 mA DC meter can be substituted. You adjust for zero reading, but keep in mind that the meter pointer can be driven in the reverse direction off-scale. Use only as much amplifier power as necessary for a visible meter indication. Those parallel wires on the schematic diagram show circuit symmetry. Only one wire is, of course, actually necessary.

PARTS LIST FOR STEREO BALANCER

D1, D2—IN914 diode
M1—1-0-1 mA DC meter, zero center
R1, R3—560-ohm, ½-watt resistor, 5%

22 "Serutan" Crystal Rig

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.

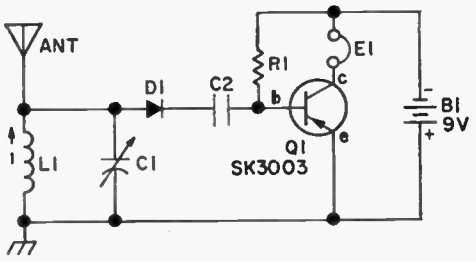
L1 is any ferrite antenna coil for the broadcast band, while E1 must be a magnetic headset for maximum output level. To align the receiver, set C1's dial to the known frequency of a strong local station and adjust L1's slug until you hear the station in the phones.

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.

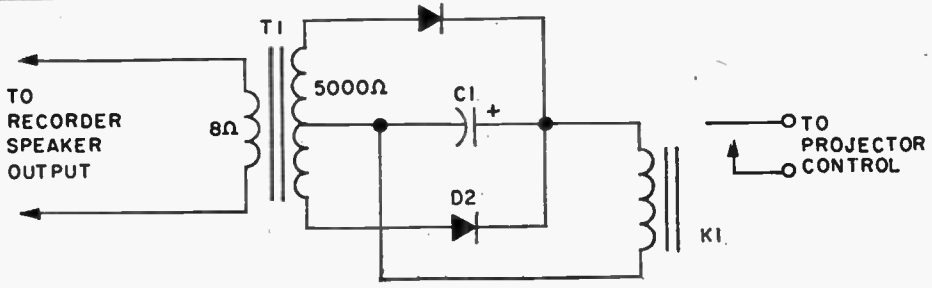
To feed the radio's output into an amplifier and speaker, replace the headphone with a 1000-ohm ½-watt resistor. Connect a .1 mfd, 25VDC capacitor from Q1's collector to the amplifier input. Then be sure to connect radio's ground to the amplifier ground.

PARTS LIST FOR "SERUTAN" CRYSTAL RIG

- B1—9-V battery
- C1—365-pF tuning capacitor
- C2—0.2-uF, 10-VDC capacitar
- D1—1N60 diode
- E1—1000-3000-ohm impedance magnetic earphone
- L1—Ferrite antenna coil (Laopstick)
- Q1—SK3003 (RCA); HEP-250 (Motorola)
- R1—100,000-ohm, ½-watt resistor



23 Slide Synchronizer



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.

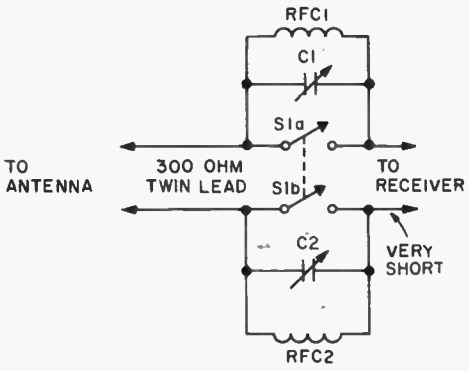
PARTS LIST FOR SLIDE SYNCHRONIZER

- C1—25-uF, 50-VDC electrolytic capacitor
- D1, D2—Motorola HEP-156
- K1—2500-ohm coil plate-type relay
- T1—5000-ohm CT audio output transformer

24 FM Interference Filter

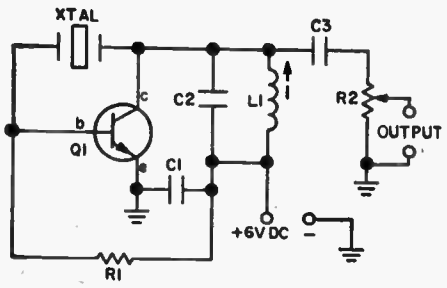
PARTS LIST FOR THE INTERFERENCE FILTER

C1, C2—30 pF trimmer capacitor
Misc—300-ohm twinlead, metal cabinet
RFC1, RFC2—0.22 uH RF choke, any type
S1—DPST slide switch



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

25 Simple IF Signal Generator



PARTS LIST FOR SIMPLE IF SIGNAL GENERATOR

C1—0.05-uF, 25-VDC capacitor
C2—50-pF silver mica capacitor
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, ½-watt resistor
R2—5000-ohm, potentiometer
XTL—455-kHz crystal

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 oscillator fails to start every time, adjust L1's slug *slightly* until you obtain immediate and consistent starting each time the power is applied.

26 Enlarger Meter

Every print a good print! That's what you get with the Enlarger Meter.

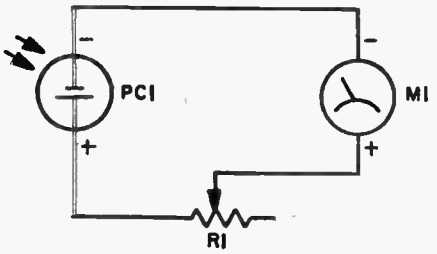
Meter M1 can be just about anything up to 0-1 DC mA. But if you prefer low light levels and long exposures, install a sensitive meter of 500 uA or less.

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 negative. 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 ENLARGER METER

M1—100, 250, or 500-mA DC meter
PC1—Solar cell (Radio Shack 276-115)
R1—5000-ohm potentiometer linear taper



27 Voltage Tripler

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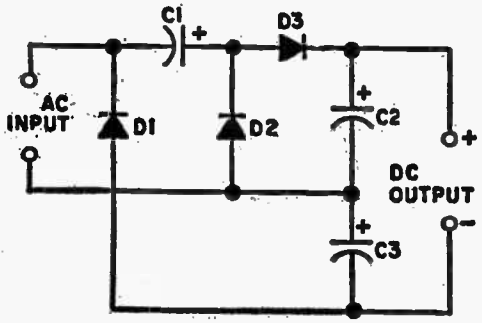


When you need high voltage but don't have a power transformer, a voltage tripler may work. It provides DC output approximately three times higher than the line voltage.

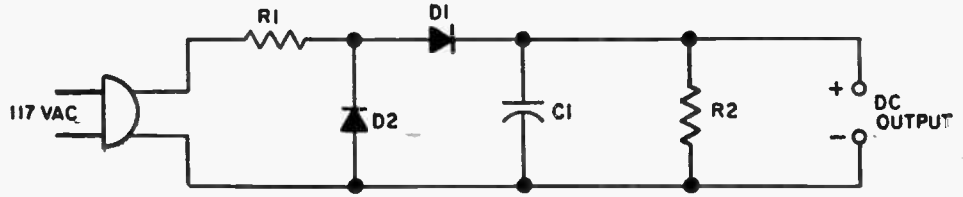
C1 is approximately 8 to 20 uF at 150VDC, and C2 and C3 should be a minimum of 100 uF at 300VDC. The larger the value for C2 and C3, the better the filtering.

On the negative half-cycle, C1 charges through diode D2, while C3 charges through D1. On the positive-half cycle, C1's charge, plus the line voltage, charges C2 through D3. The output is the voltage across C2, which is the line voltage plus the charge from C1, plus the added voltage of C3. The total is almost three times the line voltage.

PARTS LIST FOR VOLTAGE TRIPLER

C1—16-uF, 150-VDC electrolytic capacitor
C2, C3—140-uF, 300-VDC electrolytic capacitor
D1, D2, D3—IN4007

28 Preamp Low-Ripple 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.

PARTS LIST FOR LOW-RIPPLE SUPPLY FOR PREAMPS

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

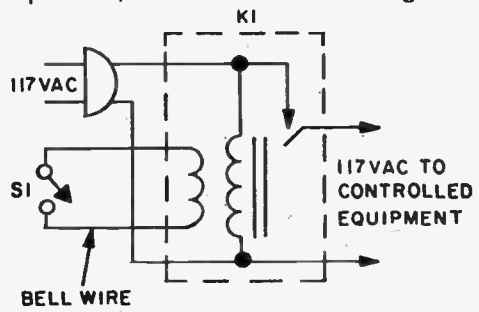
*For lower current, decrease value of R2

D1 and D2 are silicon rectifiers rated at a minimum of 200 PIV at any current.

29 Low-V Remote Control

Using ordinary bell wire you can safely control a remote 117 VAC power source. Secret behind it all is a unique hysteresis relay, K1. Normally, K1's coil represents a high impedance; no current flows through the coil so the relay contacts stay open. When S1 closes the loop on the hysteresis coil, the impedance of the main coil drops. Current flows and the contacts close.

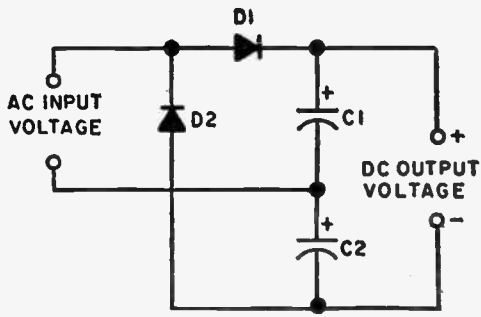
When S1 is open, the voltage across its terminals from the hysteresis coil is approximately 30V. When S1 is closed, current through the hysteresis loop is almost unmeasurable. It's safe enough for ordinary bell wire to do the controlling.



PARTS LIST FOR LOW-VOLTAGE REMOTE CONTROL

K1—Hysteresis relay (Alco)
S1—Spst switch
Misc.—Bell wire

30 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.

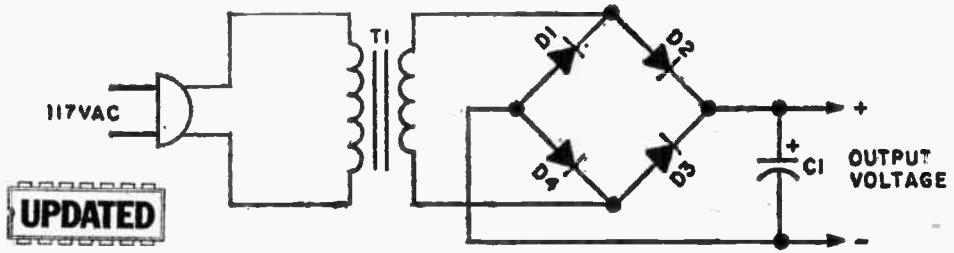
On the positive half-cycle, C1 is charged through silicon diode D1. On the negative half-cycle, C2 is charged through D2. The DC output voltage is the sum of the charge across C1 and C2.

PARTS LIST FOR VOLTAGE DOUBLER

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

31 Supply for SS Projects

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



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solid-state projects.

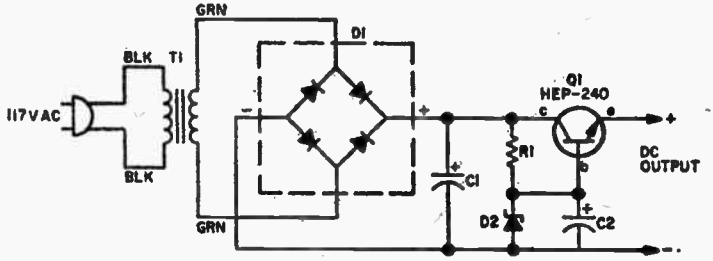
The output voltage is equal to the secondary voltage multiplied by 1.4. Or, working backwards, the secondary voltage must be 0.707 times the desired output voltage.

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 POWER SUPPLY FOR SS PROJECTS

C1—2500-uF electrolytic capacitor, voltage rating at least 1.5 times higher than output voltage
D1, D2, D3, D4—1A, 200-PIV silicon rectifier—IN4003
T1—Transformer; 117-VAC primary, secondary voltage equal to desired output voltage x 0.707

32 Regulated 9-V Supply



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 μF.

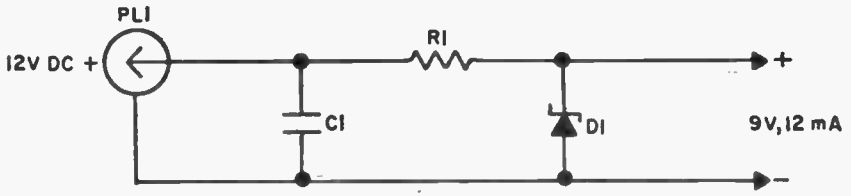
PARTS LIST FOR REGULATED 9-V POWER SUPPLY

C1—500-uF, 25-VDC electrolytic capacitor
C2—100-uF, 15-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, ½-watt resistor
T1—12-V filament transformer (see text)

33 Car Voltage for Q Radios

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



PARTS LIST FOR CAR VOLTAGE FOR Q RADIO

C1—0.05-uF, 400-VDC capacitor
D1—1-watt, 9.1-V Zener diode—HEP-104
PL1—Cigarette lighter plug
R1—150-ohm, ½-watt resistor

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.

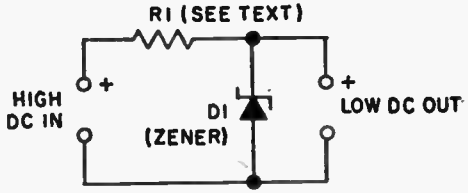
The adapter is rated for a current of 12 mA maximum. A good rule of thumb is that a radio powered by a Burgess type 2U6 battery can safely operate on the adapter.

34 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 dissipated by R.

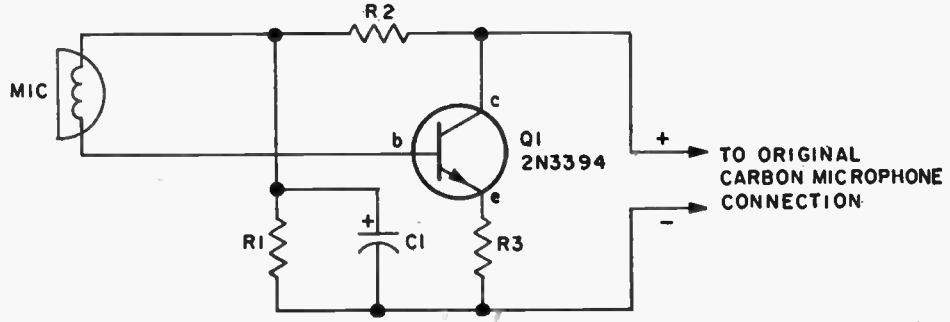
The power rating for the zener diode is determined by the voltage across the diode squared, divided by diode's nominal internal resistance. You can calculate the internal resistance by working backwards from the zener's power rating. As an example: a 9-volt, 1-watt zener would have a nominal internal resistance of $R=E^2/W$, 81/1, or 81 ohms. It's not precisely accurate but close enough. (No parts list)



35 Carbon Mike Converter

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 compon-



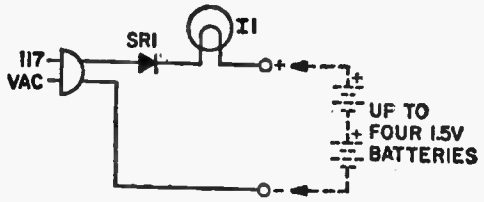
ents the entire converter amplifier can also be housed in the original microphone case. To avoid destruction of Q1, the unit must be connected properly the first time. The "+" lead, which goes to Q1's collector, connects to the carbon mike input that supplies a positive voltage.

PARTS LIST FOR CARBON MIKE CONVERTER

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

36 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.

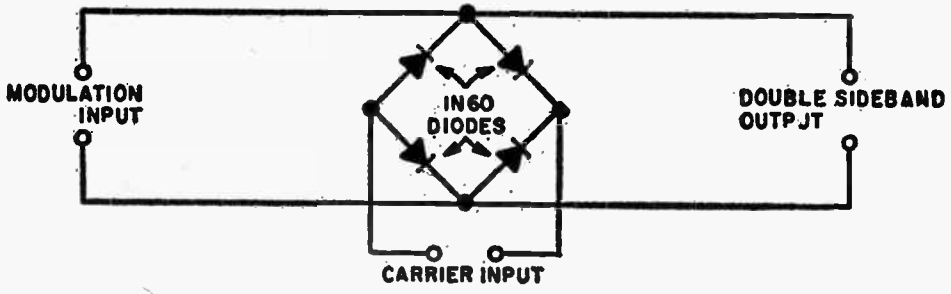
The lamp maintains constant charging of approximately 20 mA through one to four 1.5-volt batteries. But you can go as high as 22.5 volts for either batteries in series or a single battery.

Give small penlight batteries about 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.

PARTS LIST FOR DRY-CELL BATTERY CHARGER

I1—No. S-6 6-watt candelabra lamp
SR1—200-PIV, 1A silicon rectifier—Radio Shack 276-1102

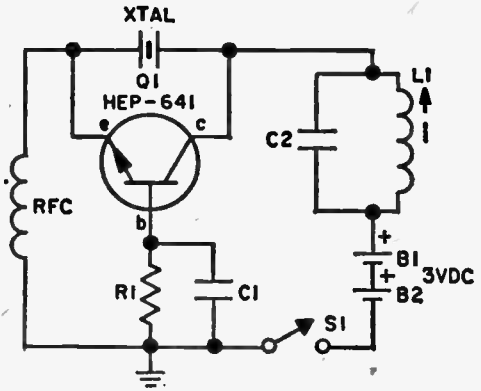
37 Sideband Scrambler



Feed audio modulation to one input, a carrier to another and the output of this sideband generator will be upper and lower sideband with supressed carrier. Where is it used? Try a sideband rig or a telephone speech scrambler. Work the scrambled signal into the modulation input to unscramble your speech scrambler output.

38 100-kHz Freq. Standard

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.

PARTS LIST FOR 100-kHz FREQUENCY STANDARD

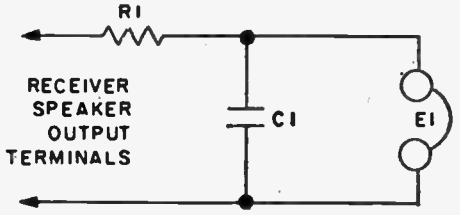
B1, B2—1.5-V AAA battery
C1—0.01-uF, 10-VDC capacitor
C2—200-pF silver mica capacitor
L1—Coil, 2-18 mH
Q1—HEP-641 npn transistor (Motorola)
R1—750,000-ohm, ½-watt resistor
RFC—2.5 mH RF choke
S1—Spst switch
XTAL—100-kHz crystal

Wiring is not critical and almost any layout will work. If the oscillator 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 trimmer in series or in parallel with the crystal. Use whichever connection works since the specific crystal type determines the series or parallel connection.

39 Headset Q-Peaker

If you're tired of copying CW signals through the grind without a Q-multiplier on your receiver, the 29¢ Headset Q-Peaker 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

PARTS LIST FOR HEADSET Q-PEAKER

C1—0.005-.05 uF capacitor (see text)
E1—2000-ohm magnetic headset
R1—100,000-ohm, ½-wott resistor

isolates the resonant circuit to prevent a receiver's low output impedance from reducing the "Q" of the headset circuit.

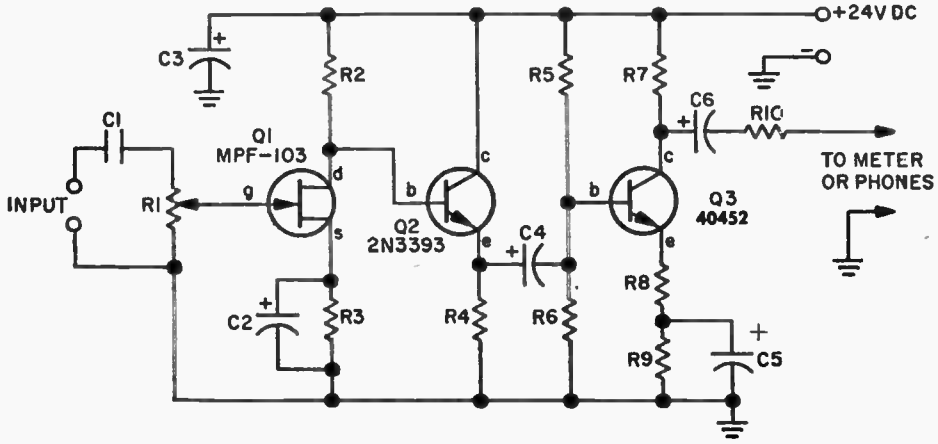
The exact value of C1 depends on the particular headset. Try different values in the range shown until the desired resonant frequency or peaking action is obtained.

40 Audio Signal Tracer

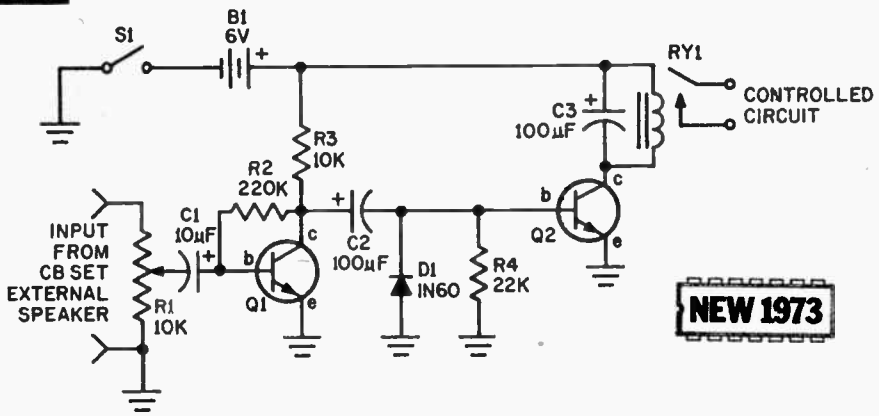
PARTS LIST FOR AUDIO SIGNAL TRACER

C1—.01-uF, 400-VDC capacitor
C2—100-uF, 6-VDC electrolytic capacitor
C3—250-uF, 50-VDC electrolytic capacitor
C4, C6—10-uF, 25-VDC electrolytic capacitor
C5—200-uF, 6-VDC capacitor
Q1—Motorola MPF-103 FET transistor
Q2—2N3393 npn transistor
Q3—40452 npn transistor
R1—2-megohm potentiometer
R2—33,000-ohm, ½-watt resistor
R3, R7—2200-ohm, ½-watt resistor
R4, R 10—4700-ohm, ½-watt resistor
R5—68,000-ohm, ½-watt resistor
R6—22,000-ohm, ½-watt resistor
R8—18-ohm, ½-watt resistor
R9—1000-ohm, ½-watt resistor

Got servicing problems on audio equipment? Then sniff them out quickly with an audio signal tracer. This tracer has enough gain to fill headphones with a thundering roar on the output from a microphone or magnetic pickup. Substitute a VU meter for the headphones and you can make relative level measurements starting at the pickup through the power amplifier.



41 Easy Radio Control



PARTS LIST FOR EASY RADIO CONTROL

B1—6 volt lantern battery
C1—10uF electrolytic capacitor, 15 VDC or better
C2, C3—100 uF electrolytic capacitor, 15 VDC or better
D1—Germanium diode, 1N60 or equiv. such as HEP-135
Q1, Q2—NPN transistor, 2N3394
R1—10,000-ohm potentiometer
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, Potter and Brumfield RS5D-6 or equiv.

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.

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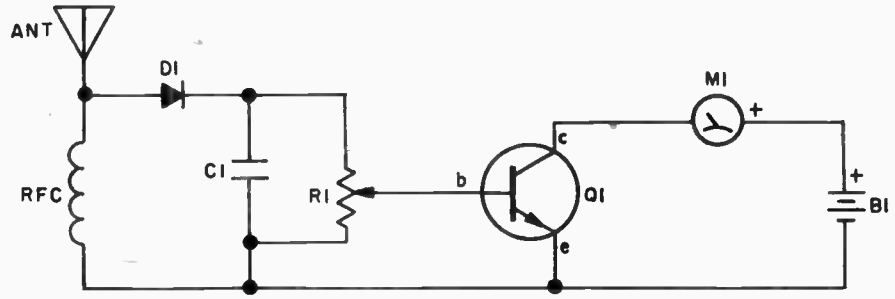
The unit should be assembled in a metal cabinet. Adjust sensitivity control R1 slightly higher than needed for dependable triggering by the received sound.

42 Field Strength Meter



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.

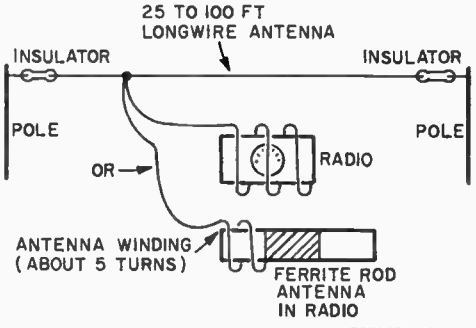
To operate the unit, sensitivity control R1 is adjusted for ⅓ to ¾-scale reading. Avoid working too close to the top of the scale, since it can saturate transistor Q1, producing full-scale readings at all times. Back off on R1 as you make transmitter adjustments to keep the needle at approximately half scale. Any high-gain npn small-signal transistor can be substituted for Q1.

PARTS LIST FOR FIELD STRENGTH METER

B1—1.5-V AA bottery
C1—0.001-uF, 100-VDC capacitor
D1—1N60 diode
M1—0-1 mA DC meter
Q1—npn transistor—HEP-726
R1—50,000-ohm potentiometer
RFC—2.5-mH choke—J. W. Miller 6302

43 No Parts BC Booster

Just about any transister 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.



44 3-Way Tone Generator

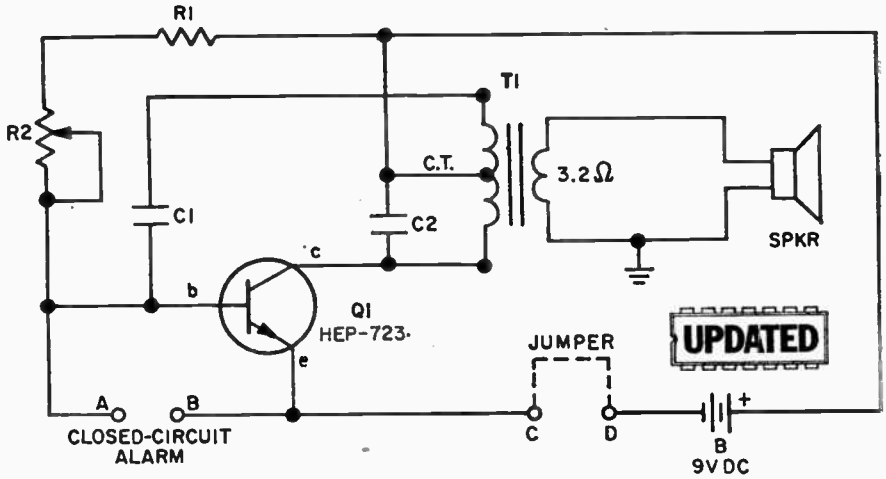
Add a terminal or two and an ordinary CPO (code practice oscillator) becomes a three-way threat, serving as a CPO, tone generator or intruder alarm.

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.

PARTS LIST FOR THREE-WAY TONE GENERATOR

B1—9-V battery
C1, C2—0.02-uF, 25-VDC capacitor
Q1—npn transistor, HEP-723
R1—10,000-ohm, ½-watt resistor
R2—250,000-ohm potentiometer
SPKR—3.2-ohm speaker
T1—Output transformer: 5000-ohm, center-tapped primary to 3.2-ohm secondary (must not be miniature transistor type)



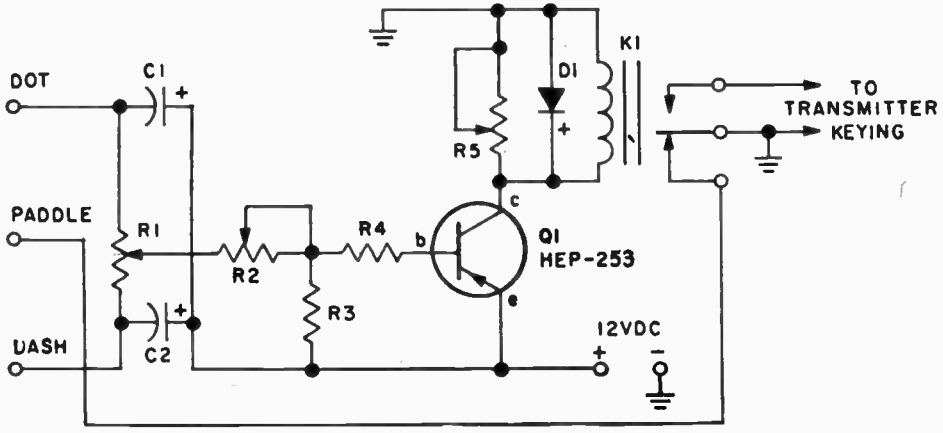
For use as a signal generator, connect C and D and attach a shielded test signal lead directly across the speaker terminals.

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

45 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



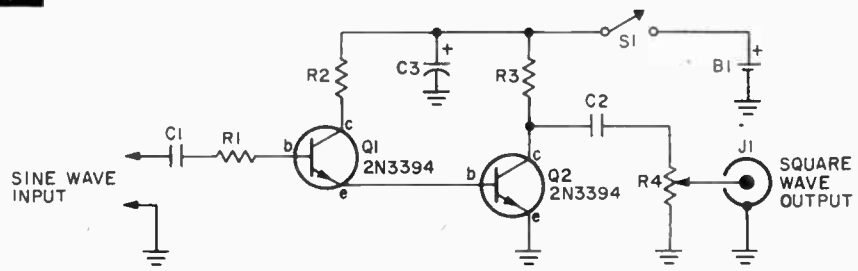
dot terminal, C1 starts to charge. When C1's voltage causes Q1 to conduct, collector current pulls in relay K1, thereby keying the transmitter. When K1 grounds the paddle terminal, C1 discharges, causing Q1 to stop conducting and dropping out the relay. When K1's paddle connection is restored to ground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

C1—3-uF, 6-VDC electrolytic capacitor
C2—10-uF, 6-VDC electrolytic copacitor
D1—1N60 diode
K1—12-VDC relay (P&B RS-5D)
Q1—Motorola HEP-253 pnp transistor
R1—10,000-ohm lineor potentiometer
R2—50,000-ohm potentiometer
R3—1200-ohm, ½-watt resistor
R4—560-ohm, ½-watt resistor
R5—2,500-ohm potentiometer

46 Square Shaper



A quick-and-dirty square wave generator for audio amplifier tests can be fashioned from a standard signal generator and the Square Shaper. Simply drive the Square Shaper with about 1 volt from the generator; the maximum output at jack J1 will be a square wave of about 1 volt peak-to-peak. Just about any general purpose small-signal transistor can be used for Q1 and Q2, and any resistance value reasonably close to 470-ohms will be okay for R2 and R3. You can even substitute some surplus PNP transistors such as the 2N404 and 2N109 by simply reversing the polarity of battery B1.

PARTS LIST FOR THE SQUARE SHAPER

B1—1.5 V "C" battery
C1, C2—0.2 or 0.22 uF, 75 VDC Mylar capacitor
C3—50 uF, 3 VDC electrolytic capacitor
J1—Phono jack
Q1, Q2—NPN transistor, 2N3394
R1—100,000-ohm, ½ watt resistor
R2, R3—470-ohm, ½ watt resistor
R4—100,000-ohm audio taper potentiometer
S1—SPST switch

47 Headlight Minder

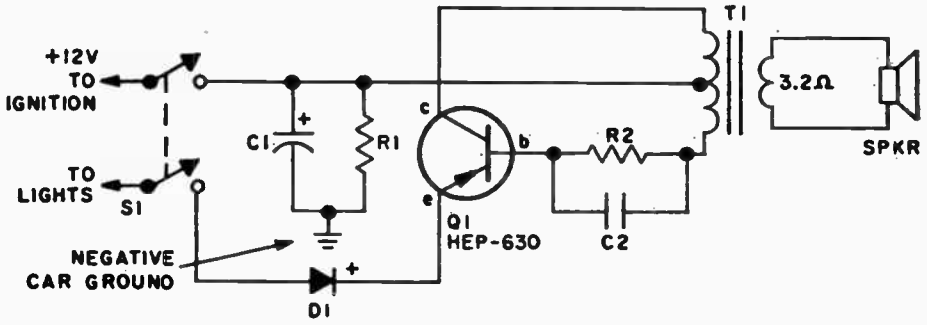
No more dead batteries in the morning; the Headlight Minder lets you know, loud and clear, if your lights are on when the ignition is off.

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 remains 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.

PARTS LIST FOR HEADLIGHT MINDER

C1—30-uF, 25-VDC capacitor
C2—0.2-uF, 25-VDC capacitor
D1—500-mA, 50-PIV silicon rectifier
Q1—HEP-630 pnp transistor
R1—15,000-ohm, ½-watt resistor
R2—680-ohm, ½-watt resistor
S1—Dpst switch
SPKR—3.2-ohm speaker
T1—500-ohm CT primary to 3.2-ohm secondary audio autput transformer

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.



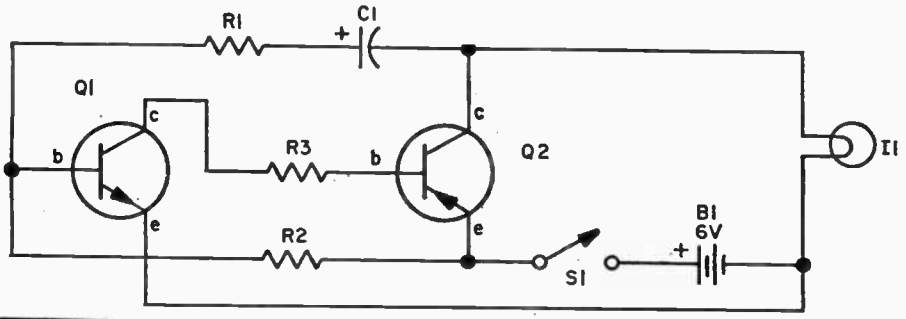
48 Tenna-Blitz Light

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 TENNA-BLITZ LIGHT

B1—6-V battery
C1—2-uF, 10-VDC electrolytic capacitor
I1—No. 49 pilot lamp
Q1—npn transistor—HEP-641
Q2—pnp transistor—HEP-739
R1—470-ohm, ½-watt resistor
R2—1-megohm, ½-watt resistor
R3—2700-ohm, ½-watt resistor
S1—Spst switch



49 S-9er for SWLs

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

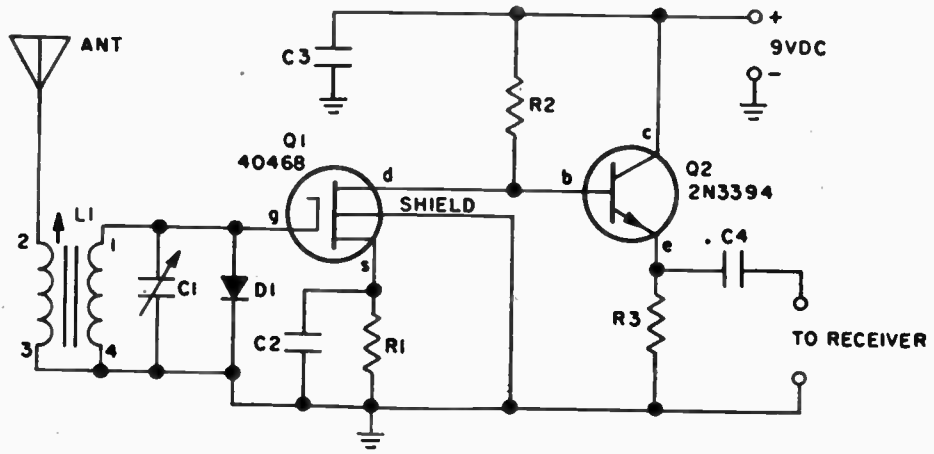
PARTS LIST FOR S-NINER FOR SWLS

C1—365-pF tuning capacitor
C2, C3—0.05-uF, 25-VDC capacitor
C4—500-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
Q2—2N3394 npn transistor
R1—470-ohm, ½-watt resistor
R2—2400-ohm, ½-watt resistor
R3—4700-ohm, ½-watt resistor

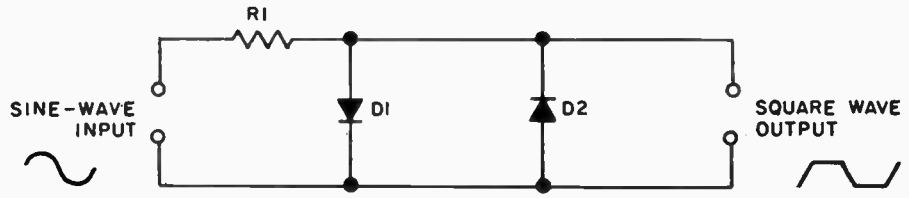
Diode D1 protects against excess gate voltage caused by nearby transmitters, while Q1 serves as an emitter follower to match the medium output impedance of the FET transistor to the low input impedance of the receiver.

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.



50 Sine Wave Squarer



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

To prevent loading and possible distortion of the sine wave input a 1000-ohm resistor should be connected between the squarer and the generator.

PARTS LIST FOR SINE WAVE SQUARER
D1, D2—Germanium diode (almost any type)
R1—1000-ohm, ½-watt resistor

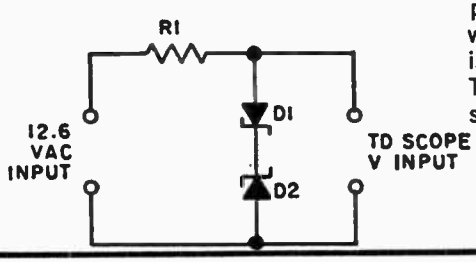
51 Scope Calibrator

Back-to-back zener diodes provide a scope calibrator with a zero reference output.

PARTS LIST FOR CHEAPIE SCOPE CALIBRATOR
D1, D2—5-V, ¼-watt Zener diode
R1—270-ohm, ½-watt resistor

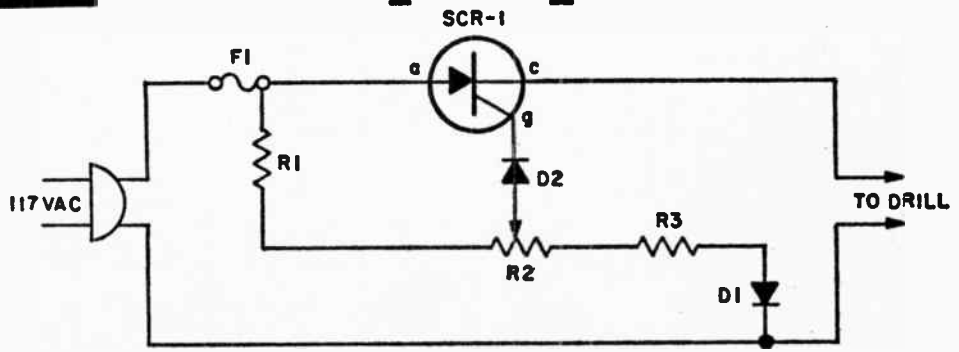
Whether the calibration voltage is fed to a scope's AC or DC input, the baseline will not have to be readjusted.

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.

52 Uni-Torque Speed Control



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

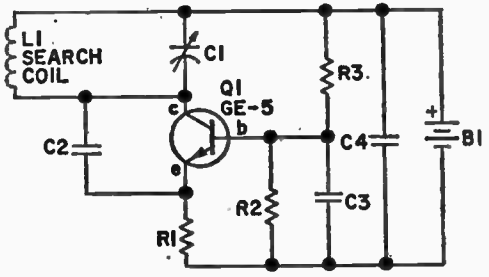
When the drill slows down, a back voltage developed across the motor—in series with the SCR cathode and gate—decreases. The SCR gate voltage therefore increases relatively as the back voltage is reduced. The "extra" gate voltage causes the SCR to conduct over a larger angle and more current is driven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

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

PARTS LIST FOR UNI-TORQUE SPEED CONTROL

D1, D2—500-mA, 200 PIV silicon rectifier
F1—3-A "Slo-blo" fuse
R1—2500-ohm, 5-watt resistor
R2—250-ohm, 4-watt potentiometer
R3—33-ohm, ½-watt resistor
SCR1—3-A, 200-PIV silicon controlled rectifier

53 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 station," Capacitor C1 is adjusted so the locator oscillator "beats" against the received signal, producing a whistle in the receiver. When

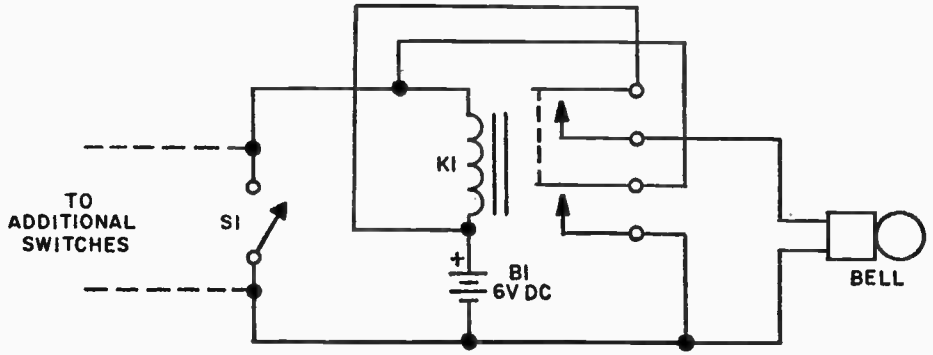
the search head passes over buried metal, the metal changes the inductance of L1, thereby changing the locator oscillator's frequency and changing the "beat tone" in the radio.

The search coil consists of 18 turns of #22 enameled wire scramble wound (which means don't be neat) on a 4-in. diameter form, which can be a cardboard tube or a wood puck or even plastic—anything but metal. After the coil is wound and checked for proper operation, saturate the coil with coil dope or G.E.'s RTV adhesive. If a single loop of the coil is not firmly cemented the unit will be unstable.

PARTS LIST FOR TREASURE LOCATOR

B1—9-VDC transistor battery
C1—280-pF trimmer or variable capacitor
C2—100-pF, 100-V silver mica capacitor
C3—0.05-uF, 25-V disc capacitor
C4—5-uF, 12-V electrolytic capacitor
L1—Search coil consisting of 18 turns of #22 enamel wire scramble wound on 4-in. diameter form
Q1—GE-5 npn transistor
R1—680-ohm, ½-watt resistor
R2—10,000-ohm, ½-watt resistor
R3—47,000-ohm, ½-watt resistor

54 Latching Burglar Alarm



PARTS LIST FOR LATCHING BURGLAR ALARM

B1—6-V lantern battery
BELL—6-VDC alarm bell
K1—6-VDC dpst relay—P & B KA11DY
S1—Spst n.o. switch

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 ball contact circuit when the wire is pushed or pulled.

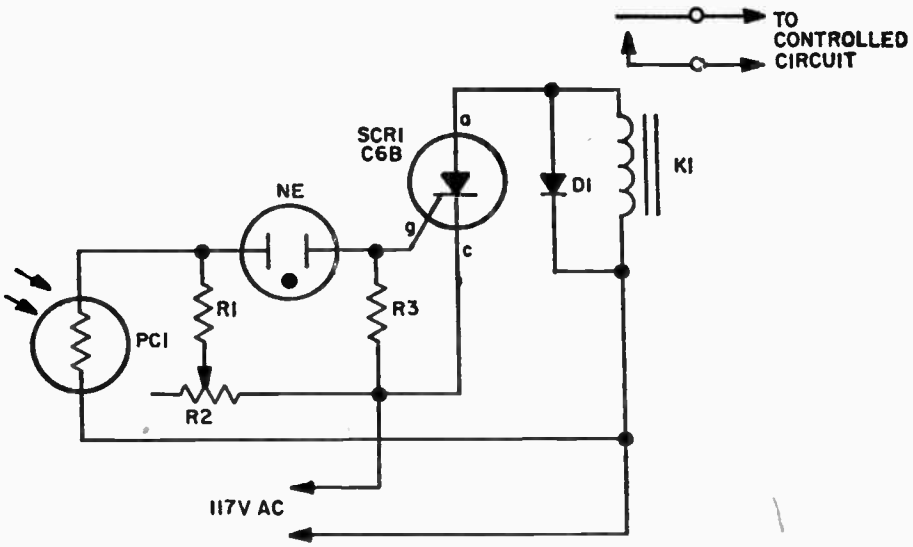
When a security switch closes the series battery circuit, relay K1 pulls in. One set of contacts close the alarm bell circuit, while the second set "latches" the battery circuit. Even if the security switches are opened, the alarm remains on. To disable the alarm, or for reset, install a concealed switch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

55 Light-Controlled Switch

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 con-

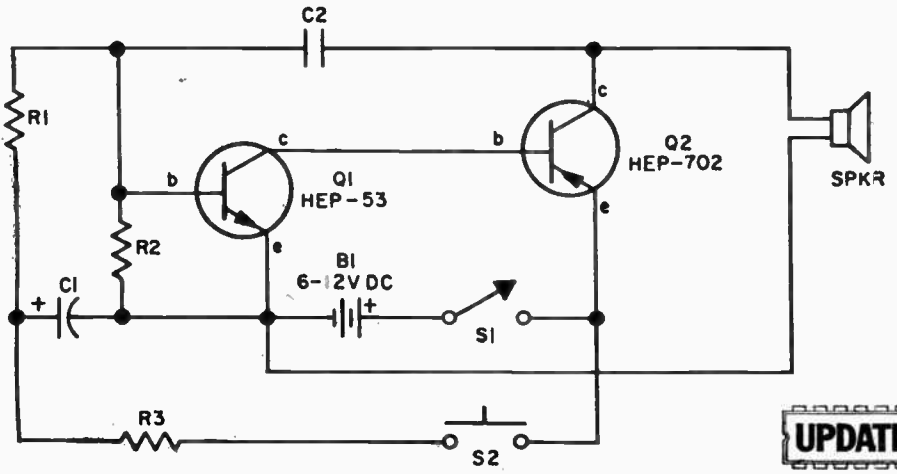
tacts, the second impulse closes them, etc. To prevent ambient light from tripping the photocell, it should be recessed at least an inch inside a metal or cardboard tube.



PARTS LIST FOR LIGHT-CONTROLLED SWITCH

D1—200-PIV silicon diode
K1—Guardian IR-610L-A115 latching relay
NE—NE-83 neon lamp
PC1—Clairex CL505 for high light level; CL704 or CL705 for low light level
R1—22,000-ohm, ½-watt resistor
R2—1-megohm potentiometer
R3—100-ohm, ½-watt resistor
SCR1—GEC6B silicon-controlled rectifier

56 Scream Generator



UPDATED

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 screamer in a small box and hold

PARTS LIST FOR SCREAM GENERATORS

B1—6-V or 12-V battery
C1—30-uF, 15-VDC electrolytic capacitor
C2—0.02-uF, 75-VDC capacitor
Q1—Motorola HEP-53 npn transistor
Q2—Motorola HEP-702 pnp transistor
R1, R2—56,000-ohm, ½-watt resistor
R3—27,000-ohm, ½-watt resistor
S1—Spst switch
S2—N.O. pushbutton switch
SPKR—8-ohm speaker or PA horn

the PA mike 2-3 inches from the 8-ohm speaker. Press push-button switch S2 and the siren starts up, shifting to a higher frequency. Release it and the tone slides down until you send it up again by punching S2. Adjustment of overall tone quality is made by changing C2 to another value. If the siren pulsates before the pushbutton switch is pressed, Q1 is too "leaky." Try a different transistor.

57 Budget Lamp Dimmer

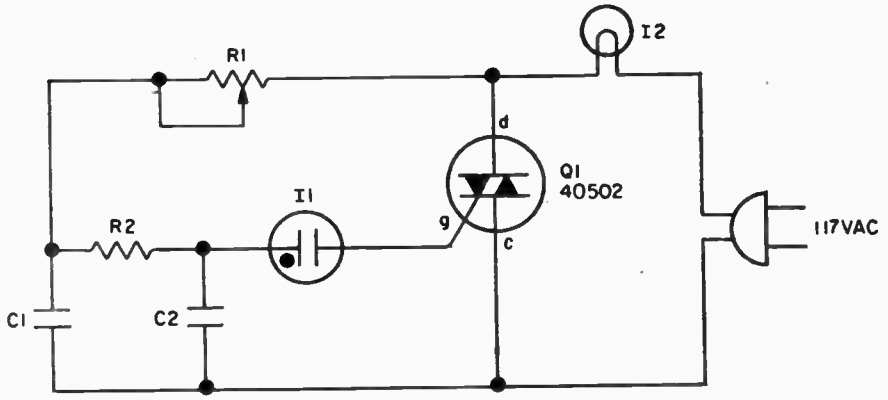
With miniature components and extreme care you can build a low power lamp dimmer right into a socket. Without a heat sink, Triac Q1 handles up to a 400-watt lamp.

Instead of a relatively expensive trigger diode, an ordinary neon lamp of the NE-83 or NE-2 variety can be used. (An NE-83 is treated for dark operation and will provide more consistent operation.)

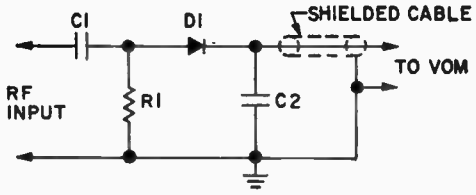
Because the neon does not trip the gate until it conducts, the lamp turns on at medium brilliance. The lamp can then be backed off to a soft glow. Because the neon drops out when the applied voltage falls below the neon holding voltage of approximately 40V the lamp cannot be adjusted as low as it can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

PARTS LIST FOR BUDGET LAMP DIMMER

C1, C2—0.068-uF, 200-VDC capacitor
I1—NE-83 or NE-2 neon lamp
I2—External lamp not to exceed 400 watts
Q1—RCA 40502 Triac
R1—50,000-ohm, potentiometer
R2—15,000-ohm, ½-watt resistor



58 RF Probe for VOM

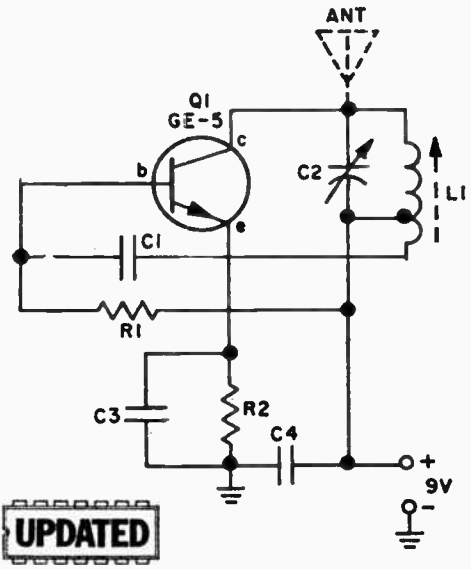


Assemble this accessory in a metal can, add a shielded cable and you'll make relative measurements of RF voltages to 200 MHz on a 20,000 ohms-per-volt multimeter. RF voltage must not exceed approximately 100V, the breakdown rating of the 1N4149.

PARTS LIST FOR RF PROBE FOR VOM

C1—500-pF, 400-VDC capacitor
C2—0.001-uF, disc capacitor
D1—1N4149 diode
R1—15,000-ohm, ½-watt resistor

59 Sideband Sideman



UPDATED

Placed near a multiband transistor portable, this BFO allows reception of CW and SSB signals in addition to the normal reception.

The BFO is a Hartley oscillator tunable across the broadcast band. Oscillator harmonics extend to the higher shortwave frequencies where they "beat" against CW and SSB stations. It provides standard BFO tone reception of CW signals and reasonably good reception on moderate to strong SSB signals.

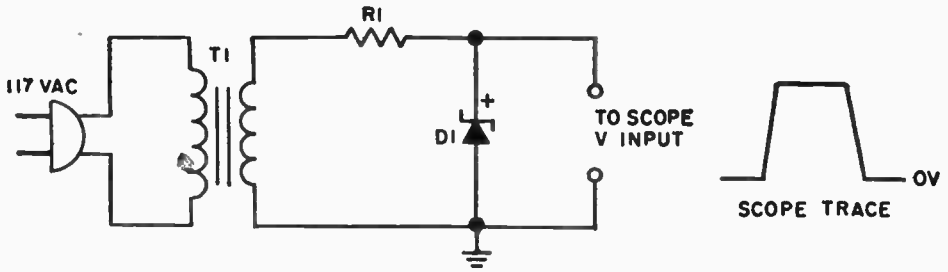
Once C2 is adjusted to the proper beat frequency, the BFO is positioned near the transistor radio for optimum reception. No antenna is needed if the unit is assembled in a plastic cabinet.

The BFO can also be used as a radio-type code practice oscillator with a range of approximately 20 feet. Connect a 10-ft. antenna on a nearby BC radio. To send Morse code, insert a key in series with one battery lead.

PARTS LIST FOR BFO FOR SIDEBAND SIDEMAN

C1, C3, C4—0.05uF, 25-VDC capacitor
C2—360-pF variable capacitor
L1—Tapped BC antenna coil
Q1—GE-5 transistor
R1—2200-ohm, ½-watt resistor
R2—68-ohm, ½-watt resistor

60 Budget 10V Swinger



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 division. The scope's vertical attenuator then provides multiples of the calibration

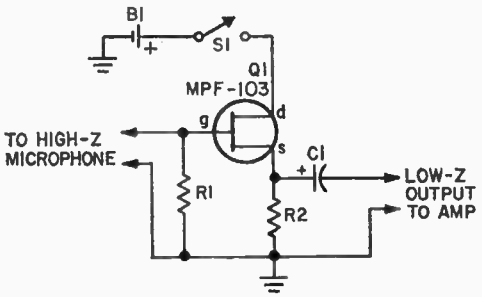
PARTS LIST FOR BUDGET 10V SWINGER

D1—10V, 0.4-watt Zener diode—HEP-101
R1—270-ohm, ½-watt resistor
T1—177 to 12.6 VAC filament

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.

61 Mike Matcher

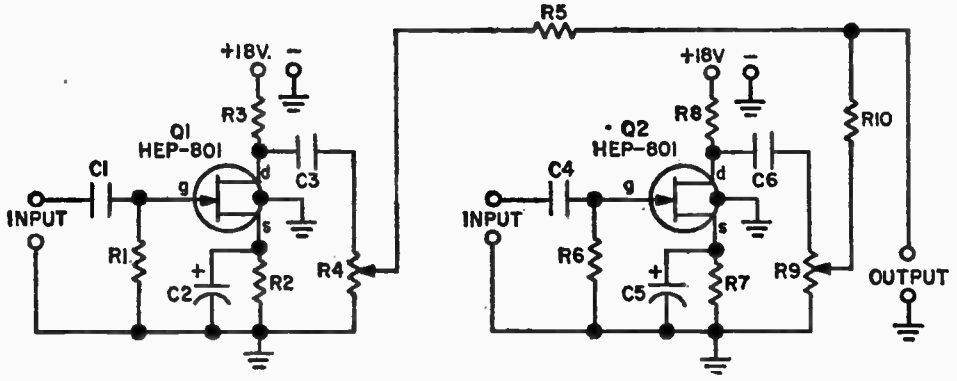
Try to run a high impedance mike line for more than 25 feet and you're sure to get high frequency losses and hum pickup. But this simple junk-box project mounted in a small metal enclosure on the mike stand will convert the mike's output to a low impedance that can run for hundreds of feet without hum pickup or losses. The output can be run into any microphone input rated from 150-ohms up to high impedance. The circuit 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, such as the Motorola MPF-103.



PARTS LIST FOR MIKE MATCHER

B1—1.5 volt AA battery
C1—10 uF, 3 VDC electrolytic capacitor
Q1—Field effect transistor (see text)
R1—2-megohm, ½ watt resistor
R2—150-ohm, ½ watt resistor
S1—SPST switch

62 Super Mike Mixer



For serious recording of anything other than speech and sound effects, two mikes are always better than one. Our super 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

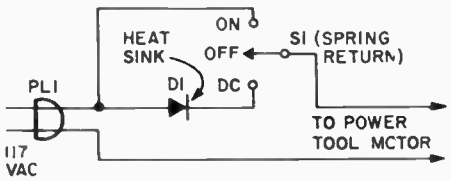
PARTS LIST FOR SUPER MIKE MIXER

C1, C4—0.05-uF, 10-VDC capacitor
C2, C5—25-uF, 6-VDC electrolytic capacitor
C3, C6—0.1-uF, 25-VDC capacitor
Q1, Q2—Motorola HEP-801 FET transistor
R1, R6—2-megohm, ½-watt resistor
R2, R7—6800-ohm, ½-watt resistor
R3, R8—560-ohm, ½-watt resistor
R4, R9—500,000-ohm, audio taper potentiometer
R5, R10—100,000-ohm, ½-watt resistor

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 transistor 2U6-type batteries can be used.

63 Dynamic 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 Dynamic Brake. The unit must be assembled in a metal enclosure as the enclosure provides the heat sink for silicon rectifier D1. This diode has only one solder terminal, the case is the second terminal. Place a single strip of plastic electrical tape on the bottom of SR1's case, thoroughly coat SR1's case with epoxy adhesive and cement SR1 to the enclosure (heat sink). When the adhesive is dry solder one connecting wire directly to SR1's case, the remaining wire connects to the terminal. Polarity is not important; any wire can go to any SR1 terminal.



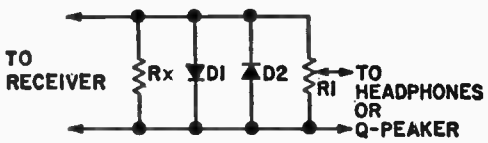
PARTS LIST FOR DYNAMIC BRAKE

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

Switch S1 is a center-off, one side spring return. With S1 on, AC will be fed to the motor and the motor will run. To brake the motor, simply press S1 down and a quick shot of DC will instantly stop it. The switch returns to the center off position when released. This Dynamic Brake can only be used with AC motors; it will not brake universal (AC-DC) motors.

64 Headphone Limiter

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 headphone 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.



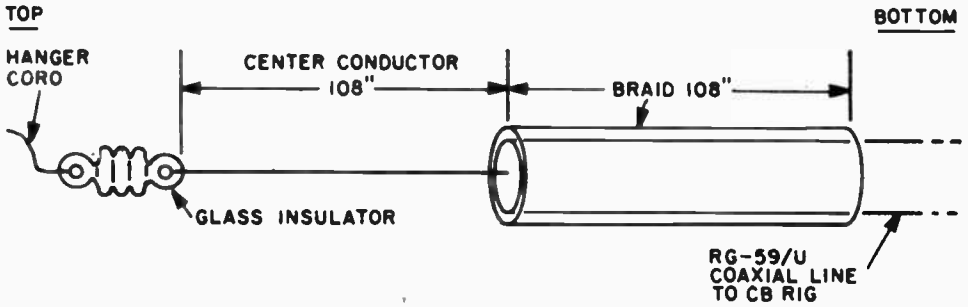
PARTS LIST FOR HEADPHONE LIMITER

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

65 Portable CB Antenna

A large antenna always beats the small one, so why use a dinky loaded whip for portable work? Make your own coaxial antenna from a length of RG-59U coaxial cable.
Cut away the outer insulation for 108 inches and fold the shield braid back along

the cable. Attach a glass or ceramic insulator to the end of the center conductor and hang the antenna from a tree, roof, pole or window. Attach the lower end of the cable to your transceiver. Keep away from metal poles and buildings.



66 Budget Mike Mixer

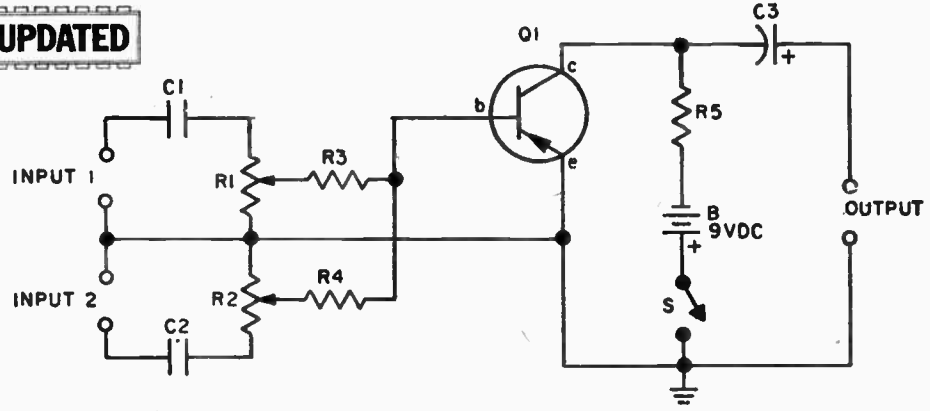
Using components often found in an experimenter's junk box, this two-channel mike mixer handles high impedance or dynamic microphones. Level controls R1 and R2 should not be run wide open with hi-Z mikes since the input impedance then becomes the value of R3 and R4, or 100,000 ohms. If a hi-Z mike is loaded by less than 1 megohm, the low frequency response of the mike is attenuated.

Transistor Q1 can be almost any general purpose type such as the 2N107 or 2N217. However, the better the transistor, the better the signal-to-noise ratio. Top quality high-gain transistors should not be used since relatively high leakage current of experimenter-grade transistors provides the base bias current. Transistors with low leakage might produce high distortion because of low "internal" base bias.

PARTS LIST FOR BUDGET MIKE MIXER

B1—9-V battery
C1, C2—0.1-uF, 6-VDC capacitor
C3—10-uF, 15-VDC electrolytic capacitor
Q1—Pnp general purpose transistor, GE-2
R1, R2—2-megohm audio toper potentiometer
R3, R4—100,000-ohm, ½-watt resistor
R5—15,000-ohm, ½-watt resistor
S1—Spst switch

UPDATED



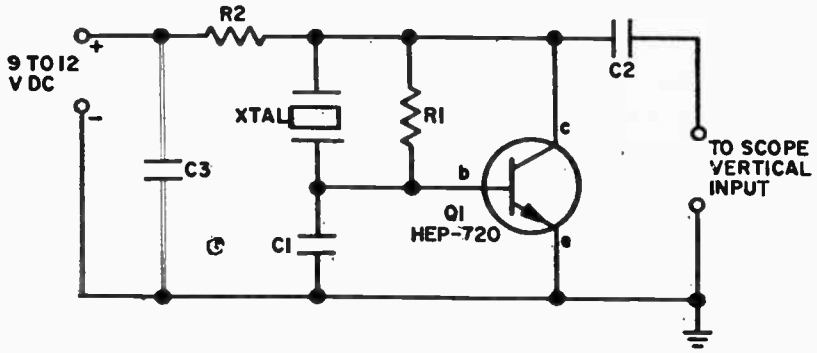
67 Scope Calibrator

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

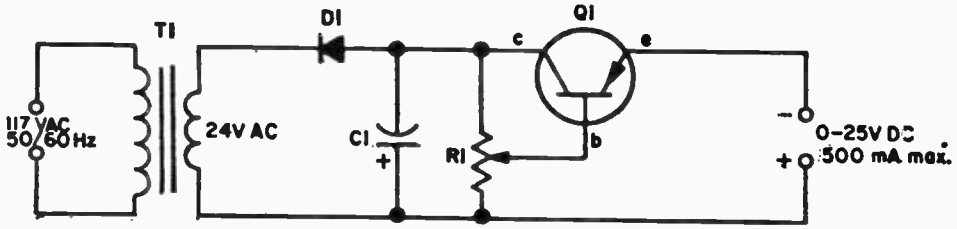
represents 1 MHz, or 1 microsecond. If the scope is adjusted for 10 cycles on 10 graticule divisions, or 1 cycle per division, each division represents 100 kHz or 10 microseconds. Now if the scope's time base oscillator is sufficiently stable so it doesn't drift too far off, you can make precise measurements of an unknown pulse width, length and frequency.

PARTS LIST FOR SCOPE CALIBRATOR

C1, C3—0.01-uF, 25-VDC capacitor
C2—0.002-uF, 25-VDC capacitor
Q1—HEP-720 npn transistor
R1—100,000-ohm, ½-watt resistor
R2—1000-ohm, ½-watt resistor
Xtal—100-kHz crystal



68 NiCad Battery Charger



PARTS LIST FOR NICAD BATTERY CHARGER

C1—100-uF, 50-V capacitor
D1—500-mA, 100-PIV silicon rectifier
Q1—40-W, pnp power transistor
R1—2000-ohm potentiometer
T1—24-VAC, 117-VAC primary filament transformer

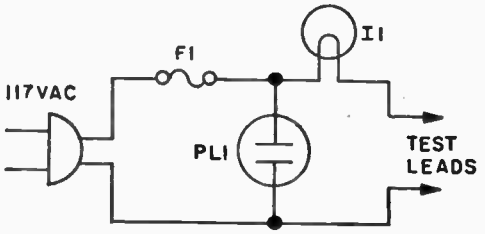
Providing an adjustable output voltage up to 35 VDC and maximum output current of 500 mA, this battery charger handles just about any NiCad battery used by experimenters and consumer equipment.

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.

69 Appliance Tester

PARTS LIST FOR APPLIANCE TESTER

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



A simple circuit consisting of a 50 watt lamp, fuse and power outlet is all that's

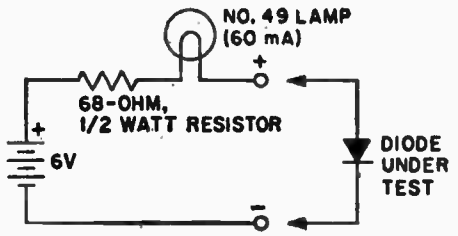
needed to check out appliances such as toasters and electric coffee pots.

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

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

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

70 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.

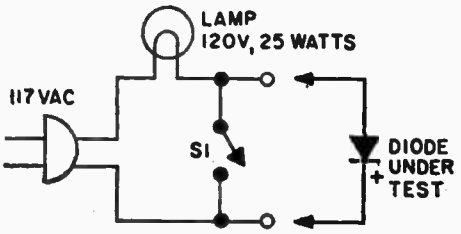
To test diodes rated under 60 mA, a lower current lamp must be substituted in the checker.

71 Silicon Rectifier Tester

This simple GO/NO-GO tester spots defective rectifier diodes before they are connected into a circuit. It is intended only for silicon rectifiers rated higher than 200 mA and indicates open and shorted conditions.

The lamp must be as specified: 120 V at 25 watts. Do not use a larger lamp or the diode might be destroyed.

Close switch S1 to check the lamp by turning it on. Connect the diode both ways, opening S1 for the test. One way the lamp should go on; reversing the diode should cause the lamp to extinguish. If the lamp stays on in both directions, the diode is shorted. If the lamp stays out in both directions the diode is open.

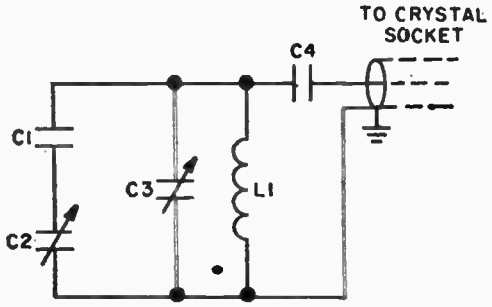


72 CB Tuning Adapter

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

PARTS LIST FOR CB TUNING ADAPTER

C1—10-pF silver mica capacitor
C2—17.5-pF trimmer capacitor
C3—30-pF variable capacitor
C4—47-pF, 100-VDC disc capacitor
L1—Coil, 5 turns #16 enameled wire wound on 1-in. dia. form. Spaced 1 in. end to end



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 slightly 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.

73 Speech Snipper

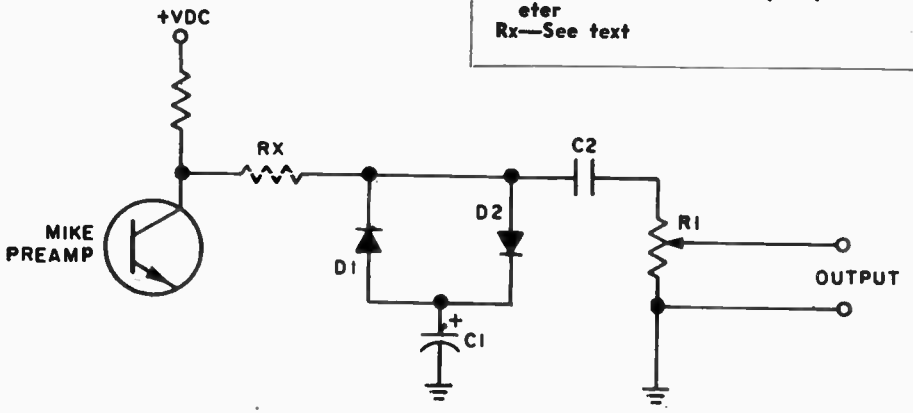
An effective speech clipper for transmitters and PA systems can be made from only two diodes and a capacitor.

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 overmodulation 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.

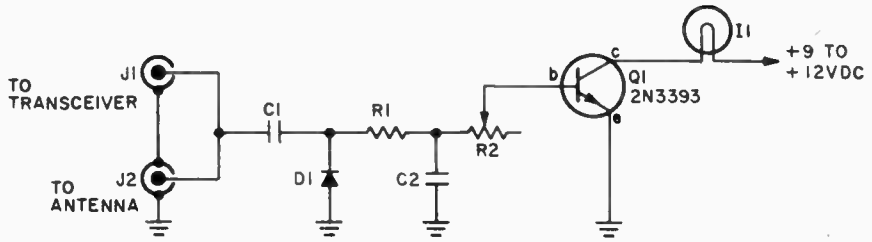
PARTS LIST FOR SPEECH SNIPPER

C1—100-uF electrolytic capacitor (see text)
C2—0.1-uF capacitor
D1, D2—1N60 diode
R1—25,000-ohm, audio taper potentiometer
Rx—See text



74 CB Modulation Lamp

Less than a buck is all that's needed to be certain that what you put into the mike is

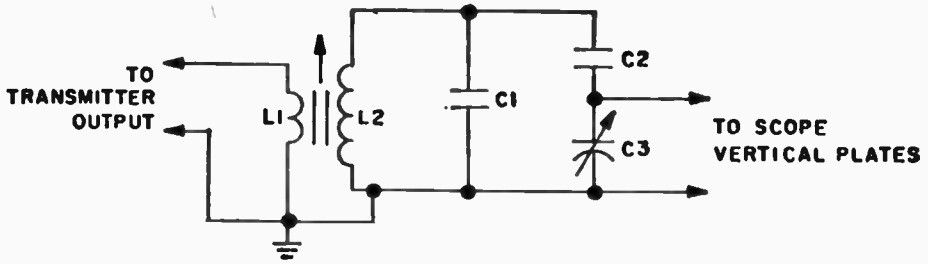


really getting to your sky hook. Working directly from a minute sample of the transceiver's RF output, the Modulamp will glow only if there is a carrier output and modulation. So if no one replies to your call and the lamp glows in step with your modulation, you can at least be certain it's not the transceiver that's at fault. If the unit is built into a small metal box, jacks J1 and J2 should match the existing transmission line connectors. If you build the Modulamp directly into your transceiver, simply connect capacitor C1 to the RF output jack (and forget about J1 and J2). To adjust, simply talk into the mike in your normal voice and adjust trimmer potentiometer R2 until lamp I1 flashes in step with the modulation. If I1 will not flash regardless of R2's adjustment, substitute a higher gain transistor for Q1 (try a 2N3392). Just about any transistor rated 250 mW or more will work.

PARTS LIST FOR THE CB MODULATION LAMP

C1—5 pF, 500 VDC ceramic disc
C2—100 pF, 500 VDC ceramic disc
D1—Germainium diode, 1N60
I1—6 or 8 volt, 30 to 60 mA miniature lamp
J1, J2—Coaxial jack.
Q1—NPN transistor, 2N3393 or equiv. (see text)
R1—10,000-ohm, ½ watt resistor
R2—10,000-ohm potentiometer

75 CB Scope Stretcher



PARTS LIST FOR CB SCOPE STRETCHER

C1, C2—5pF silver mica capacitor
C3—45-pF trimmer capacitor
L1—3 turns #22 solid, plastic-insulated wire, adjacent to ground end of L2
L2—4 turns #18 enameled wire, centered on form
1—⅜-in. RF slug-tuned coil form (J. W. Miller 4400-2)

Critical inspection of a transmitter signal and accurate measurement of modulation is possible only with an oscilloscope. Unfortunately, a CB transmitter's RF output is so low the scope pattern is barely discernible —unless you use this booster. Since a scope's vertical plate connections operate at a high input voltage, it requires that a CB transmitter's output be fed to a resonant circuit to step up to high RF voltage. The circuit shown will just about fill a 5-in. scope from edge to edge with virtually no loss at the transmitter.

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

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.

76 CB Xmission Line Monitor

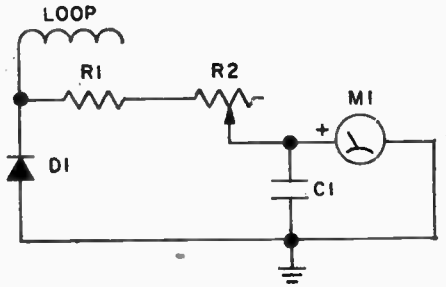
This monitor "steals" an insignificant amount of power, yet keeps constant watch on a CB rig's RF output. If a failing tube starts to drop the output, the line monitor immediately lets you know it.

The device can be built in a separate metal cabinet or customized into the transceiver's cabinet.

Wiring between D1, R1, R2, and C1 must be as short as possible. The loop consists of four or five turns of insulated, solid hookup wire wrapped around an exposed part of the output coax cable. Remove a part of the shield at a point near the RF output jack, for example. An alternate pickup is about 6 in. of wire slipped under the coax shield. If the shield is broken, solder a heavy copper wire to join the broken ends to avoid messing up your antenna's transmission line.

PARTS LIST FOR CB TRANSMISSION LINE MONITOR

C1—0.001-uF, 100-VDC disc capacitor
D1—1N914 diode
M1—0-1 mA DC meter
R1—1500-ohm, ½-watt resistor
R2—10,000-ohm potentiometer



Vary the number of turns in the loop to secure approximately half-scale meter indication. Potentiometer R2 serves as a coarse sensitivity control.

77 Candle Power Control

UPDATED

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

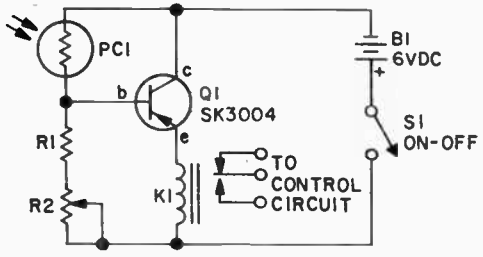
Q1 can be any general purpose pnp transistor of the 2N109 or 2N217 variety, though greater sensitivity is obtained with the 2N2613 type. Relay K1 is a high-sensitivity type like the Sigmas used by model radio control hobbyists.

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

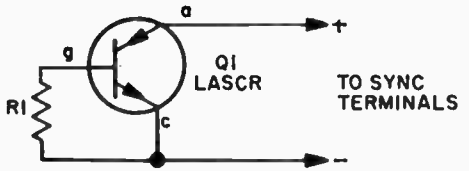
PARTS LIST FOR CANDLE POWER CONTROL

B1—6-V battery
K1—1000-ohm, 2-3 mA sensitive relay
PC1—RCA 4425 photocell (RCA)
Q1—SK-3004 (RCA) pnp transistor
R1—120-ohm, ½-watt resistor
R2—5000-ohm potentiometer
S1—Spst switch



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.

78 Remote Flash



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

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

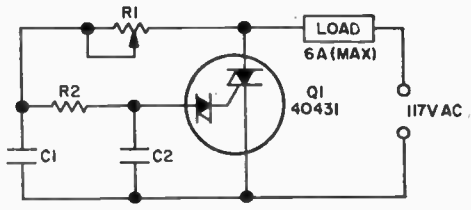
No reset switch is needed. Voltage at the flash's sync terminals falls below the LASCR's holding voltage when the flash is fired, thereby turning off the LASCR.

PARTS LIST FOR REMOTE FLASH
Q1—300-V light-activated silicon-controlled rectifier (LASCR)
R1—47,000-ohm, ½-watt resistor

79 RPM Speed Control

PARTS LIST FOR RPM SPEED CONTROL

C1, C2—0.1-uF, 200-VDC capacitor
G1—RCA 40431 Triac-Diac
R1—100,000-ohm linear taper potentiometer
R2—10,000-ohm, 1-watt resistor



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

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

The motor used for the load must be limited to 6 amperes maximum (or 740 watts). Triac Q1 must be provided with a heat sink, which can be the metal cabinet. Build up a 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.

80 Wink and Blink

If a light blinks and winks someone will stop and look—and that's the purpose behind this attention-grabber.

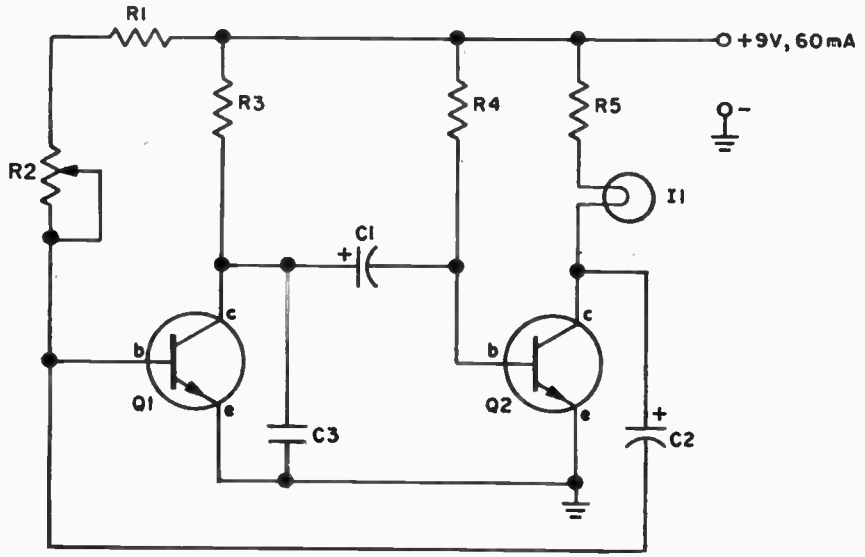
When power is first applied, current flows

through Q2 and lamp L1 lights. Then, feedback through capacitor C2 causes Q1 to conduct. As C1 discharges through Q2's base, Q2 is turned off, thereby extinguishing the lamp. When C1's voltage equalizes, Q2 turns on again and the cycle is repeated . . . flip-flop, flip-flop. Potentiometer R2 determines the flip-flop rate, hence, the blink rate.

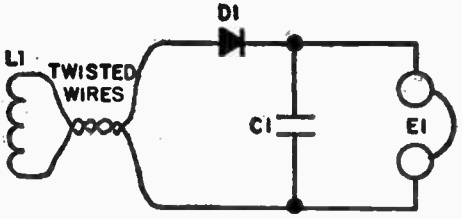
"Junk box" pnp transistors (instead of npn types) can be substituted if polarity is reversed at the battery, C1 and C2.

PARTS LIST FOR WINK AND BLINK

C1—10-uF, 15-VDC electrolytic capacitor
C2—30-uF, 15-VDC electrolytic capacitor
C3—0.2-uF, 25-VDC capacitor
I1—No. 49 panel lamp
Q1, Q2—npn transistor—HEP-723
R1—4700-ohm, ½-watt resistor
R2—1-megohm potentiometer
R3, R4—10,000-ohm, ½-watt resistor
R5—120-ohm, ½-watt resistor



81 Modulation Monitor



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.

PARTS LIST FOR MODULATION 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

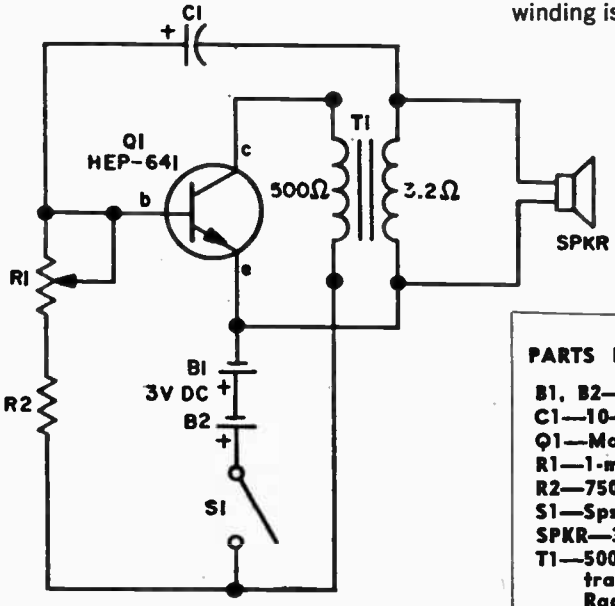
82 Click Clack Timer

Providing equally spaced clicks from 3 to 300 per minute, this click generator is either an electronic metronome or an interval timer, say, for photo enlarging.

Transistor Q1 functions as an amplifier, but positive feedback from T1's secondary to Q1's base causes the circuit to regenerate. This produces a steady stream of clicks in the speaker. The rate of oscillation, or number of clicks per minute, is determined by R1's setting.

With a little time and patience, a dial affixed to R1's shaft can be calibrated in "beats per second" by comparing the output of the click generator with a standard metronome. A calibration point for "one click per second" can be marked on the dial for photo exposure control.

If the generator does not click when power is first applied, interchange the two leads from T1's secondary. Do not interchange the speaker leads! Note: T1's 3000-ohm winding is not used.



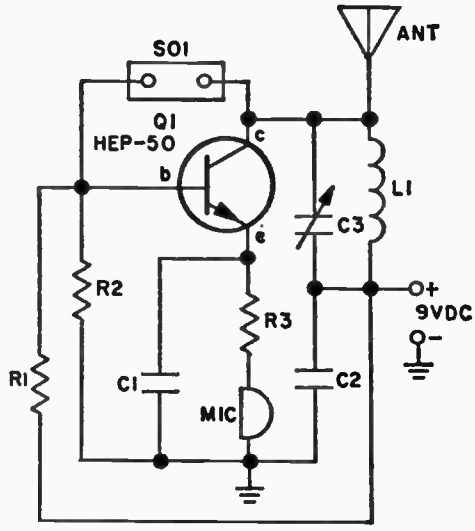
UPDATED

PARTS LIST FOR CLICK CLACK TIMER

B1, B2—1.5-V D battery
C1—10-uF, 6-VDC electrolytic capacitor
Q1—Motorola HEP-641 npn transistor
R1—1-megohm potentiometer
R2—7500-ohm, ½-watt resistor
S1—Spst switch
SPKR—3.2-ohm, 2½-in. dia. speaker
T1—500 to 3.2 ohm miniature audio transistor transformer—Lafayette Radio 99-61327

83 Radio Pager

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



PARTS LIST FOR RADIO PAGER

C1, C2—0.001-uF, 100-VDC disc capacitor
C3—50-pF trimmer capacitor
L1—10 turns #16 enameled wire wound on ⅜-in. form, spaced 1 in. end to end
MIC—Carbon microphone element
Q1—Motorola HEP-50 npn transistor
R1—47,000-ohm, ½-watt resistor
R2—10,000-ohm, ½-watt resistor
R3—330-ohm, ½-watt resistor
SO1—Crystal socket

transceiver, but not enough to cause receiver overload.

If only one crystal frequency is needed, socket SO1 can be eliminated and an overtone 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.

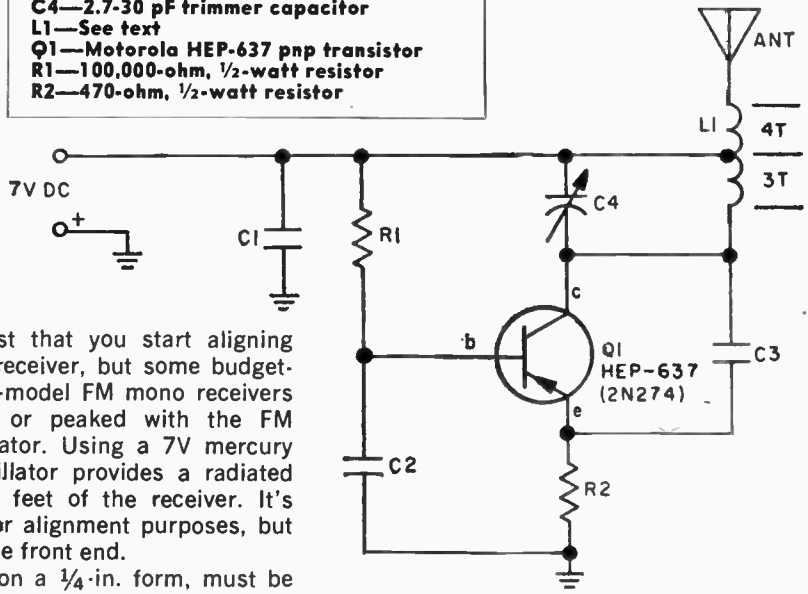
To tune; receive the signal on an S-meter-equipped receiver and adjust trimmer C3 for maximum output. Key the transmitter a few times to check crystal activity. If starting is intermittent, slightly alter C3's adjustment until operation is consistent.

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

84 FM Alignment Oscillator

PARTS LIST FOR FM ALIGNMENT OSCILLATOR

C1, C2—500-pF, 100-VDC capacitor
C3—5-pF silver mica capacitor
C4—2.7-30 pF trimmer capacitor
L1—See text
Q1—Motorola HEP-637 pnp transistor
R1—100,000-ohm, ½-watt resistor
R2—470-ohm, ½-watt resistor



We don't suggest that you start aligning your stereo FM receiver, but some budget-priced and early-model FM mono receivers can be aligned or peaked with the FM Alignment Oscillator. Using a 7V mercury battery, the oscillator provides a radiated signal within 10 feet of the receiver. It's strong enough for alignment purposes, but won't overload the front end.

Coil L1, wound on a ¼-in. form, must be made with extra care. The 4-turn section is tight-wound, no spacing between turns. The 3-turn section is spaced—after winding—to a length of ⅜-in. from the tap to the end of the coil. The tap is made by scraping off some enamel, tinning the bare area, then soldering a solid bare wire to the tap. Frequency is preset by adjusting C4.

85 Shortwave Spotter

UPDATED

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

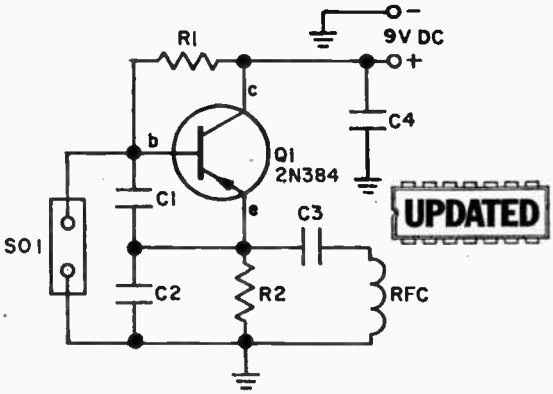
soldered. A common 2U6 9-volt battery in the circuit will last for months, if not for its total shelf life.

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 SHORTWAVE SPOTTER

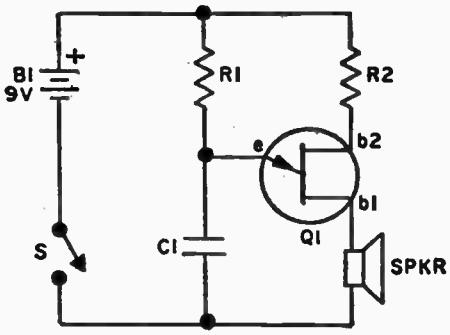
C1—1200-pF silver mica capacitor
C2—75-pF silver mica capacitor
C3—250-pF, 100-V disc capacitor
C4—0.01-uF, 25-VDC capacitor
Q1—RCA 2N384 pnp transistor
R1—220,000-ohm, ½-watt resistor
R2—1000-ohm, ½-watt resistor
RFC—1-mH RF choke
SO1—Crystal socket



86 Mike Beeper

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 Mike Beeper to the front of the mike with a rubber band and you'll send continuous tone *through the mike*. It lets you take your time checking the mike, connecting cable, jacks, amplifiers, etc.

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



PARTS LIST FOR MIKE BEEPER

B1—Type 216 9-V battery
C1—0.1-uF, 10-VDC capacitor
Q1—unijunction transistor—HEP-310
R1—10,000-ohm, ½-watt resistor
R2—47-ohm, ½-watt resistor
S1—Spst switch
Spkr—3.2 or 8-ohm miniature speaker

87 Photoflood Dimmer

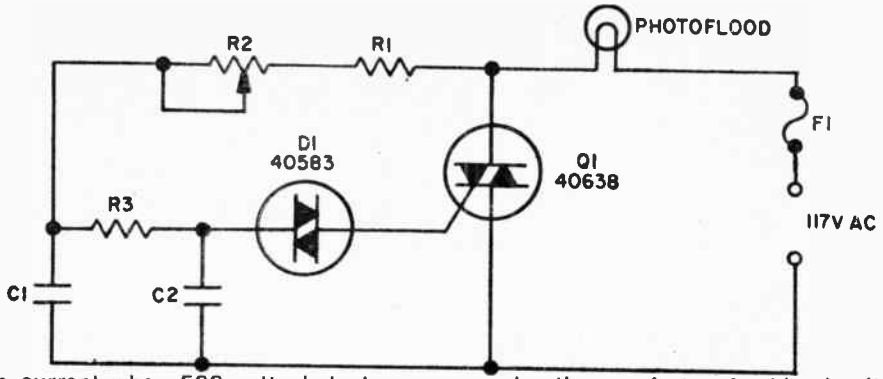
All the flexibility of a professional photo studio's variable lighting can be yours with this 500-watt lamp dimmer.

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

Fusing must be employed. Otherwise, the

PARTS LIST FOR PHOTOFLOOD DIMMER

C1, C2—0.01-uF, 300-VDC capacitor
D1—RCA 40583 Diac
F1—Fuse, type 8AG, 5A
Q1—RCA 40638 Triac
R1—1000-ohm, ½-watt resistor
R2—100,000-ohm linear taper potentiometer
R3—15,000-ohm, ½-watt resistor



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.

88 Direct-Coupled Radio

PARTS LIST FOR DIRECT-COUPLED RADIO

B1, B2—1.5-V battery
C1—365-pF variable capacitor
E1—2500-5000 ohm earphone
L1—Topped ferrite antenna coil
Q1, Q3—Motorola HEP-641 npn transistor
Q2—Motorola HEP-253 pnp transistor
R1—5000-ohm potentiometer
R2—100-ohm, ½-watt resistor

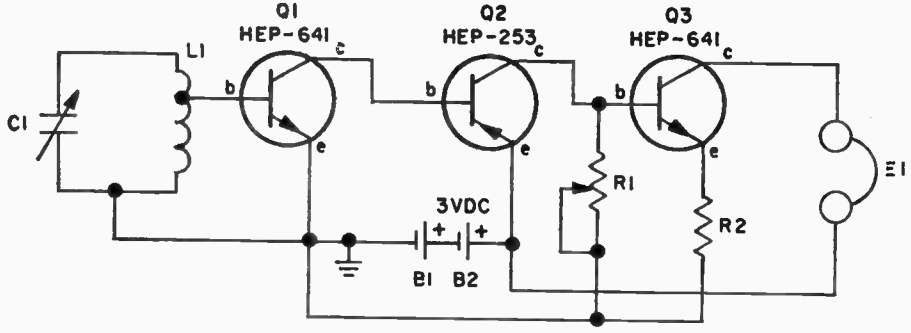
A shirt-pocket project, this direct-coupled radio uses transistor Q1 as a diode detector and first audio amplifier. Detection is across the base-emitter junction which operates as a diode. Normal base-emitter capacitance provides RF filtering. L1 can be a tapped (transistor type) ferrite antenna coil. Tuning capacitor C1 is a miniature *poly*-type variable.

Earphone E can be magnetic or crystal as long as its impedance is in the 2500- to 5000-ohm range.

Control R1 is adjusted for best earphone sound—or least distortion consistent with maximum volume.

During construction, carefully note that npn and pnp transistors are used. Don't intermix them since reverse polarity voltage can destroy a transistor.

Batteries B1 and B2 are the penlight (AAA) type—good for many hours of service.



89 CB Modulation Meter

You can measure CB audio modulation percentage with the accuracy of the local

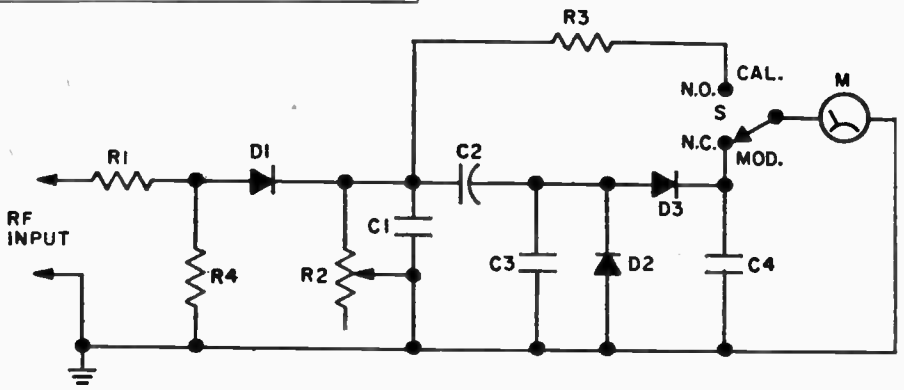
broadcast station—'cause you'll be using the same type system.

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%.

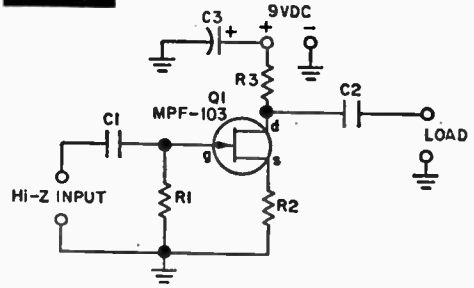
Better accuracy is assured if R2's adjustment and meter calibrating point is compared against a scope modulation pattern. Don't compare this meter against commercial CB modulation meters. On a tone signal, this one is less accurate, but on speech modulation, the commercial models are not as accurate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

PARTS LIST FOR CB MODULATION METER

- C1—500-pF, 100-VDC capacitor
- C2—10-uF, 10-VDC electrolytic capacitor
- C3—200-pF, 100-VDC capacitor
- C4—300-pF, 100-VDC capacitor
- D1, D2, D3—1N60 diode
- M1—0-1 mA DC high-speed meter
- R1, R4—1000-ohm, ½-watt resistor
- R2—1000-ohm potentiometer
- R3—910-ohm, ½-watt resistor, 5%
- S1—Spdt spring-return switch



90 Mike Powerhouse



PARTS LIST FOR MIKE POWERHOUSE

- C1, C2—0.05-uF, 25-VDC capacitor
- C3—100-uF, 15-VDC electrolytic capacitor
- Q1—Motorola MPF-103 FET transistor
- R1—2-megohm, ½-watt resistor
- R2—3300-ohm, ½-watt resistor
- R3—10,000-ohm, ½-watt resistor

Approximately 10 dB of extra micriphone amplification for CB and ham transmitters, tape recorders and PA amplifiers is provided by the field effect transistor. Since an FET's input is many megohms, the amplifier's input impedance is determined by gate resistor R1, which is 2 megohms. It's a suitable load for high impedance crystal and ceramic microphones.

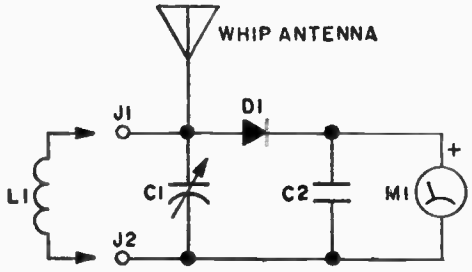
The amplifier is "flat" from 20 to 20,000 Hz. Low frequency response can be attenuated for communications use by reducing the value of C2 to one half.

Power supply by-pass capacitor C4 must be used regardless of whether the voltage supply is a rectifier or battery. If C4 is not used there might be severe low frequency attenuation, sharply reduced gain or instability.

The amplifier's output can be connected to any load of 50,000 ohms or greater, which includes just about every piece of equipment except those specifically designed for low impedance microphones.

91 Budget FSM

High sensitivity without amplification is obtained when a field strength meter (FSM) is tuned to its operating frequency. With a poly-type miniature capacitor for C1, the FSM can be built in a pocket-size cabinet.
Tuning range is from 1.5 to 144 MHz, depending on the choice of coil L1. The coil can use phone tip jacks for a plug-in connection for band changing. Consult any coil table for L1's winding data since coil construction depends on the type of wire and frequency.
Even greater sensitivity is obtained if a more sensitive meter is used. A 50-uA meter, M1, provides maximum sensitivity combined with reasonably rugged construction.

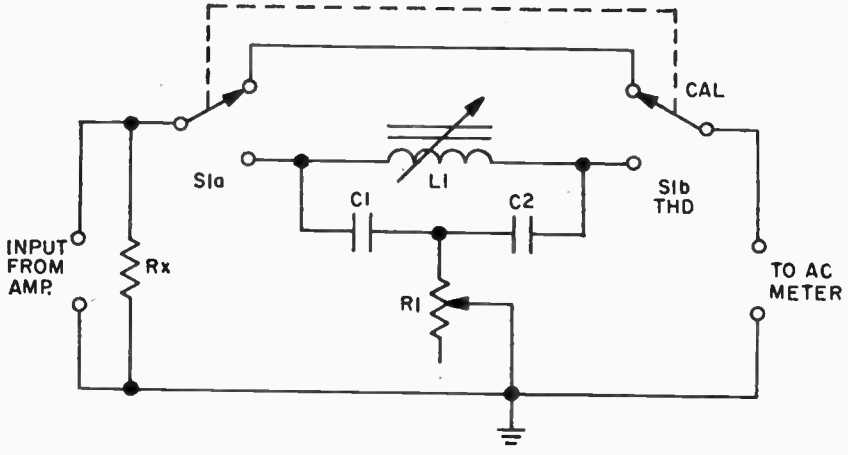


PARTS LIST FOR BUDGET FSM
C1—365-pF variable capacitor
C2—.005-uF, 100-VDC capacitor
D1—1N60 diode
J1, J2—Phone tip jack
J1—Coil (see text)
M1—0-1 mA DC meter

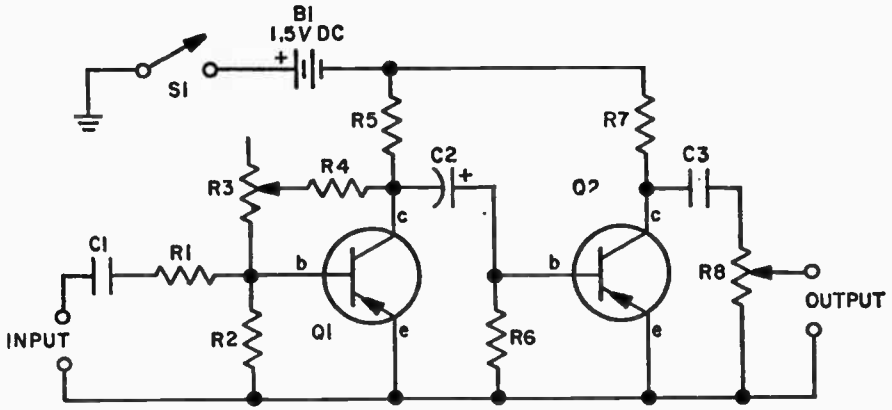
92 Audio Distortion Meter

This 1-kHz distortion meter is extremely accurate and is handy for measuring the distortion of power amplifiers.
Resistor Rx is the load resistor for the amplifier; 4, 8 or 16 ohms at the appropriate power rating. The AC meter can be an AC-VIVM or a 20,000 ohms/volt VOM. Adjust the amplifier for the desired power output, set switch S1 to the calibrate position and note the meter reading. Set S1 to the THD (Total Harmonic Distortion) position and adjust both coil L and resistor R for the *minimum* meter reading.
The percent harmonic distortion is equal to the *minimum* reading 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-uF, 100-VDC capacitor, 5%
L1—UTC VC-15 variable inductor
R1—250,000-ohm potentiometer
Rx—Amplifier load resistor (see text)
S1—Dpdt switch



93 Fancy Fuzzbox



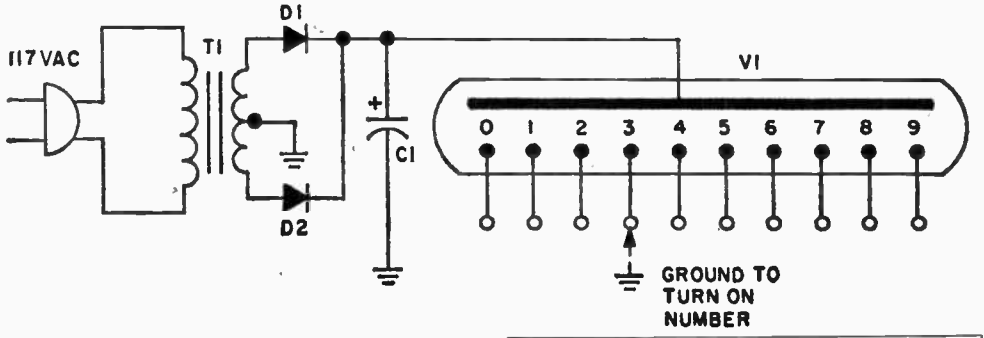
Add that 'way-out fuzz sound to any electric guitar by connecting the Fuzzbox between your guitar and amplifier. Potentiometer R3 sets the degree of fuzz, R8 the output level.

Since the fuzz effect cannot be completely eliminated by R3, fuzzy-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.

PARTS LIST FOR FANCY FUZZBOX

B1—1.5-V AA battery
C1, C3—0.1-uF, 3-VDC capacitor
C2—5-uF, 3-VDC electrolytic capacitor
Q1, Q2—pnp transistor—HEP-632
R1, R6—22,000-ohm, ½-watt resistor
R2—18,000-ohm, ½-watt resistor
R3—1-megohm potentiometer
R4—100,000-ohm, ½-watt resistor
R5, R7—10,000-ohm, ½-watt resistor
R8—50,000-ohm, audio-taper potentiometer
S1—Spst switch

94 Nixie Numbers



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,

PARTS LIST FOR NIXIE NUMBERS

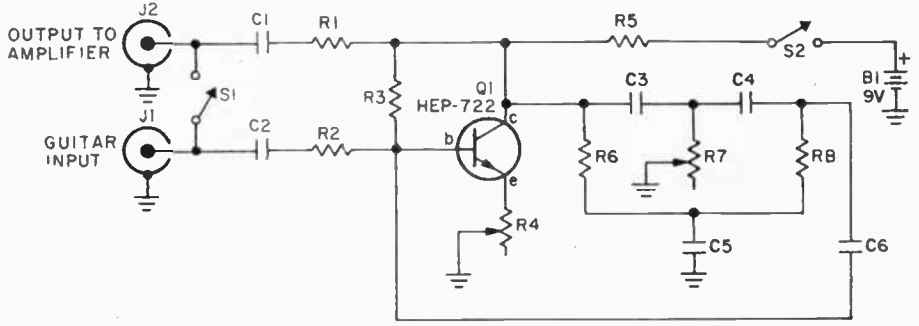
C1—30-uF, 250-VDC electrolytic capacitor
D1, D2—200-mA, 400-PIV silicon rectifier
T1—117-V primary, 250-V secondary, 25-mA center-tapped power transformer
V1—Neon readout tube (National Electronics NL840)

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.

95 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 adjust 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 adjusting potentiometer R7.

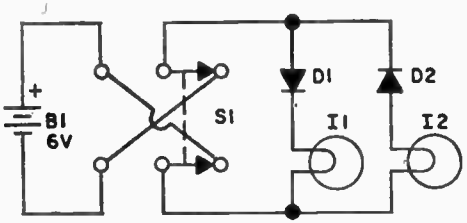
PARTS LIST FOR FUNK BOX

B1—9V type 2U6 battery
C1, C2—.1 uF Mylar capacitor
C3—.05 uF Mylar capacitor
C4—.02 uF Mylar capacitor
C5, C6—.01 uF Mylar capacitor
J1, J2—Phono jack
Q1—NPN transistor, HEP-722 or 723
R1, R2—22,000-ohm, ½ watt resistor
R3—470,000-ohm, ½ watt resistor
R4—2000 or 5000-ohm trimmer potentiometer
R5, R6, R8—56,000-ohm, ½ watt resistor
R7—10,000-ohm potentiometer
S1, S2—SPST switch

96 Two-Way Signaller

PARTS LIST FOR TWO-WAY SIGNALLER

B1—6-V battery, 4 D cells in series
D1, D2—50-PIV 1 A silicon diode, HEP-154(S)
I1, I2—6.3-V, 0.15-A, miniature bayonet base pilot lamp
S1—Dpdt toggle switch (Cutler Hammer 7591-KP)



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

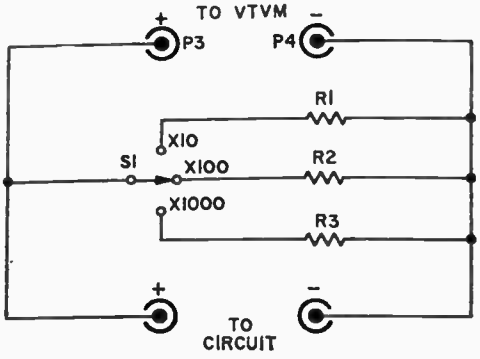
the positive battery terminal feeds the top wire, the D1/I1 circuit is operative and only lamp I1 lights up. Lamp I2 remains off because diode D2 blocks the flow of DC to the lamp.

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 transmitted signal.

97 Miladaptor

Less than $2 worth of parts is all it takes to convert your VTVM into a DC milliammeter. 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 volt 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 always start with S1 in the X1000 position and downrange until the VTVM indicates a convenient reading.

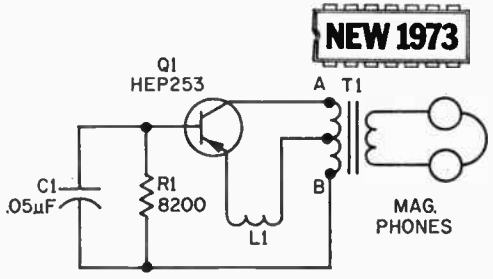


PARTS LIST FOR THE MILADAPTOR

P1, P2, P3, P4—Insulated 5-way binding post
R1—100-ohm, 1 watt, 5% resistor
R2—10-ohm, 1 watt, 5% resistor
R3—1-ohm, 1 watt, 5% resistor
S1—SP3T rotary switch (Mallory 5M1113, Centralab 1484 or equiv.)

98 Off-Air CW Monitor

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 transformer connections A and B.



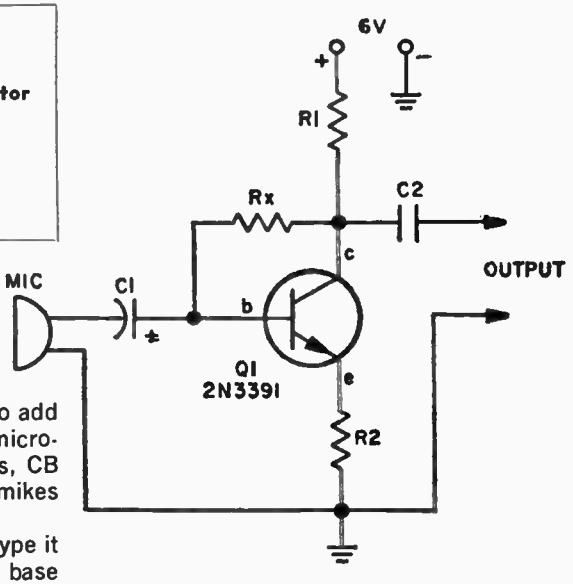
PARTS LIST FOR OFF-AIR CW MONITOR

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

99 Low-Z Mike Preamp

PARTS LIST FOR LOW-Z MIKE PREAMP

C1—10-uF, 15-VDC electrolytic capacitor
C2—0.47-uF capacitor
Q1—2N3391 npn transistor
R1—10,000-ohm, ½-watt resistor
R2—15-ohm, ½-watt resistor
RX—See text

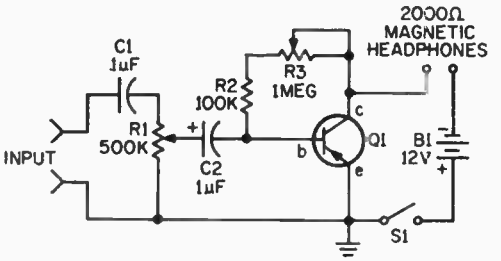


Just a handful of parts is all it takes to add up to 30 db gain for low-impedance microphone inputs found on tape recorders, CB rigs, etc. The circuit is suitable for mikes in the 50- to 1000-ohm range.

Because transistor Q1 is a high-gain type it is very sensitive to slight changes in base bias. Hence, bias resistor Rx must be tailored for each transistor. Temporarily connect a 2 megohm potentiometer in place of Rx and adjust the pot until the collector to ground voltage is 3V. Measure the pot's resistance and substitute a fixed resistor(s) within 10% of the measured value.

100 Headphone Amplifier NEW 1973

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.

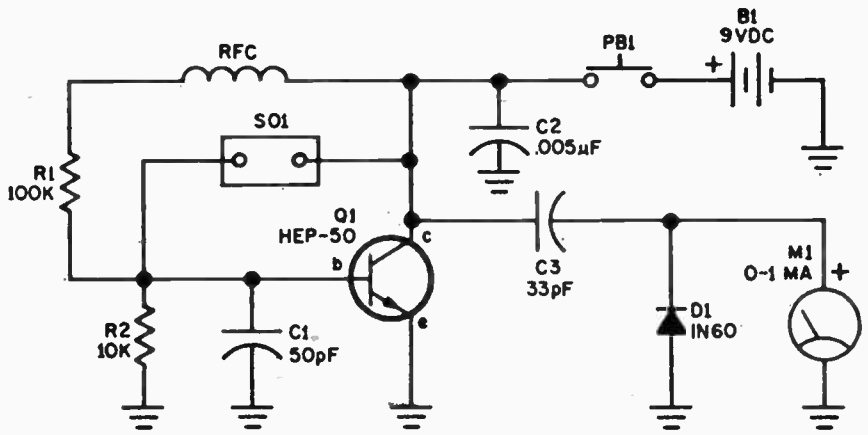


PARTS LIST FOR HEADPHONE AMPLIFIER

B1—Battery, 12 volts (two RCA VS068 in series or equiv.)
C1—0.1 uF capacitor, 15 VDC or better
C2—1 uF electrolytic capacitor, 15 VDC or better
Q1—PNP transistor, 2N2613 or equiv.
R1—500,000-ohm audio taper potentiometer
R2—100,000-ohm, ½-watt resistor
R3-1 megohm potentiometer, any taper

101 Crystal Tester

NEW 1973



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 crystals. 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.

PARTS LIST FOR THE CRYSTAL TESTER

B1—9 volt transistor radio battery
C1—50 pF disc capacitor, 100VDC or better
C2—0.005 uF disc capacitor, 25 VDC or better
C3—33 pF disc capcitor, 100 VDC or better
D1—Diode, 1N60, HEP-135
M1—Meter, 0-1 mA DC (Calectro D1-905 or equiv.)
PB1—Normally open push button switch
Q1—NPN transistor, HEP-50
R1—100,000-ohm, ½-watt resistor
R2—10,000-ohm, ½-watt resistor
RFC—2.5 mH RF choke
SO1—Socket to match crystals, see text

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, ½ watt, 10 percent resistor in series with meter M1.

What's your favorite circuit?

If you have a circuit that you honestly believe should be in this 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.

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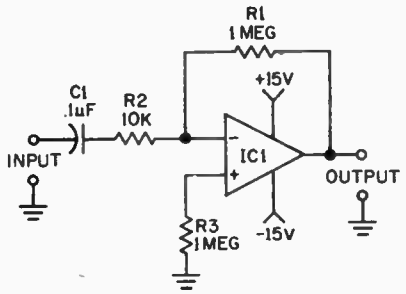
CIRCLE NO. 1 ON PAGE 9 OR 108

30 INTEGRATED CIRCUIT PROJECTS

IC 1 GP Amplifier

NEW 1973

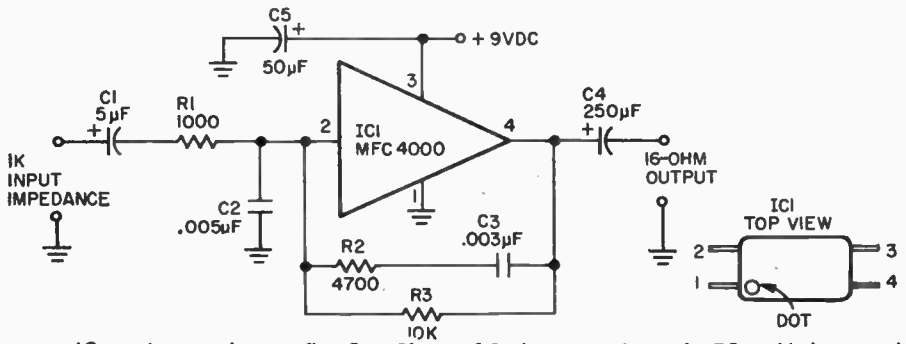


This general purpose amplifier features a power gain of 100 (20dB) and can be used as a preamplifier for a microphone, receiver, signal tracer, etc. The IC is internally compensated, providing stable performance with a flat frequency response to about 10 kHz with a gradual roll-off to 20 kHz. The overall 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 non-inverting (+) input of the IC, R1 between the output and the inverting (−) input. No pin connections are given because the IC is available in many different configurations.

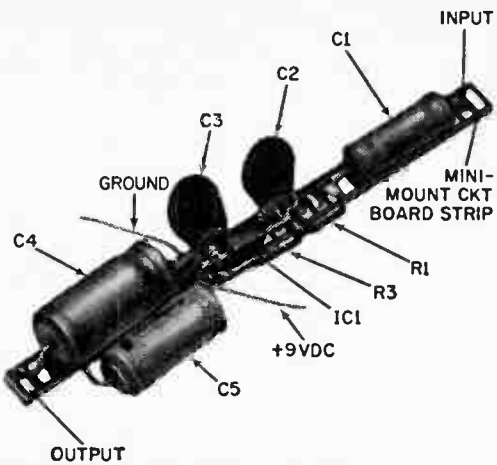
PARTS LIST FOR GP AMPLIFIER

C1—0.1 uF Mylar capacitor, 25 VDC
IC1—Type 741 operational amplifier (Radio Shack 270-010 or equal, see text)
R1, R3—1 megohm, ½-watt resistor
R2—10,000-ohm, ½-watt resistor, (see text)

IC 2 Spy-Size Amplifier



Using an IC no larger than a fly, Spy-Size Amplifier delivers almost 250 mW into a 16-ohm speaker. A 50 mV input signal coming from a source whose output im-



PARTS LIST FOR SPY-SIZE AMPLIFIER

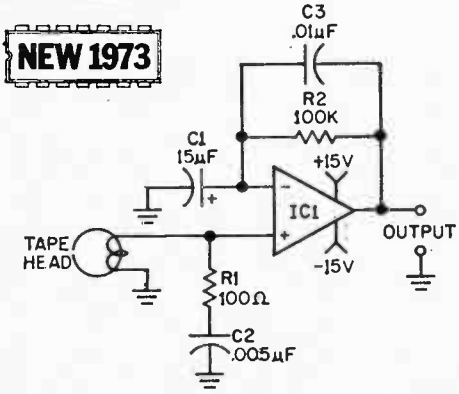
C1—5uF, 10 VDC
C2—0.005 uF, 10 VDC
C3—0.003 uF, 10 VDC
C4—250 uF, 10 VDC
C5—50 uF, 10 VDC
IC1—Motorola MFC 4000
R1—1,000-ohms, ½-watt
R2—4,700-ohms, ½-watt
R3—10,000-ohms, ½-watt

pedance 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 6mA. Best way to keep things small is to use a printed circuit board assembly or a mini-mount as shown.

Spy-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.

IC 3 Tape Head Preamp

NEW 1973



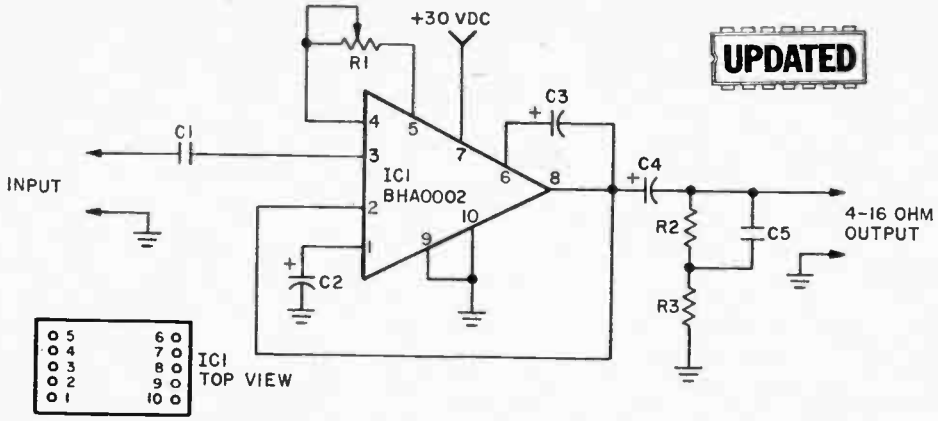
Is it worth about $20 to have another tape or cassette player? Fom time to time surplus dealers offer complete tape or cassette mechanisms—everything ready-to-go except for the electronics, and at rock-bottom prices of $10, $15 or $20. All the mechanism needs is this equalized tape head preamplifier. Though the power supply is rated at ±15 VDC, almost optimum results will be obtained with supply voltages as low as ±7 VDC. Two ordinary 9 volt transistor radio batteries will power the preamp for many hours. The opamp, IC1, is internally compensated and no special wiring practices are needed; the preamp can be built in just about any enclosure, though the connecting wire from the tape head should be shielded. R1 connects to the non-inverting (+) input of the IC, R2 between the output and the inverting (—) input. No pin connections are given because the IC is available in many different pin configurations.

PARTS LIST FOR TAPE HEAD PREAMP

C1—15 uF electrolytic capacitor, 15 VDC or better
C2—0.005 uF disc capacitor, 25 VDC or better
C3—0.01 uF disc capacitor, 25 VDC or better
IC1—Type 741 opamp (Radio Shack 276-010 or equal, see text)
R1—100-ohms, ½ watt resistor
R2—100,000-ohms, ½ watt resistor

IC 4 Super 15 Amplifier

Just 350 millivolts input is all it takes for the Super 15 to push 15 watts output into a 4 ohm load or 10 watts into an 8 ohm load. Frequency response is better



UPDATED

than +0/−3 dB 20 to 20,000 Hz and distortion at full power is a smidgen over 0.5% THD. The input impedance is about 20,000-ohms, and should be driven by a low impedance source such as a 600-ohm output transistor preamplifier. The power supply should be rated at least 1.2 amperes for mono and 2.5 amperes for a stereo pair. Bias adjust potentiometer R1 must be set in the following manner—set R1 so the full resistance is in the circuit, then connect a voltmeter (0-25 VDC) from pin 8 to ground. Adjust R1 so that the meter indicates exactly one half the supply voltage; for example, if the supply voltage at pin 7 is 30 volts there should be 15 volts from pin 8 to ground.

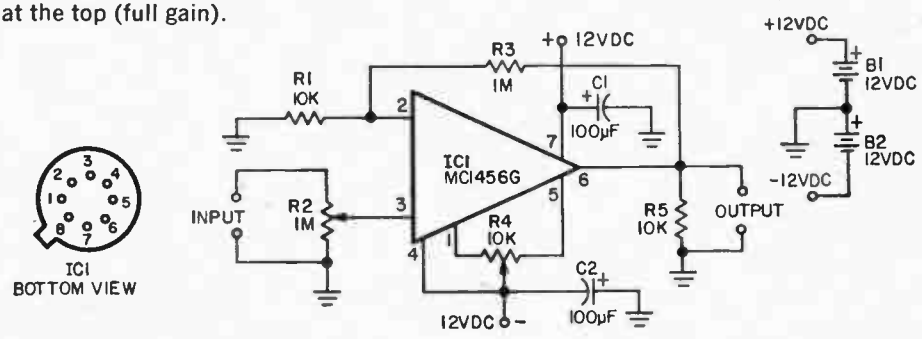
PARTS LIST FOR SUPER 15 AMPLIFIER

C1—0.22 uF, 75 VDC Mylar capacitor
C2—250 uF, 3 VDC electrolytic capacitor
C3—50 uF, 30 VDC electrolytic capacitor
C4—2000 uF, 30 VDC electrolytic capacitor
C5—0.05 uF, 75 VDC Mylar capacitor
IC1—Solitron BHA0002. Send $12.25 to Solitron Devices, 256A Oak Tree Road, Tappan, NY 10983.
R1—1000-ohm trimmer potentiometer
R2—470-ohm, ½ watt resistor
R3—22-ohm, ½ watt resistor

IC 5 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 10mV 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



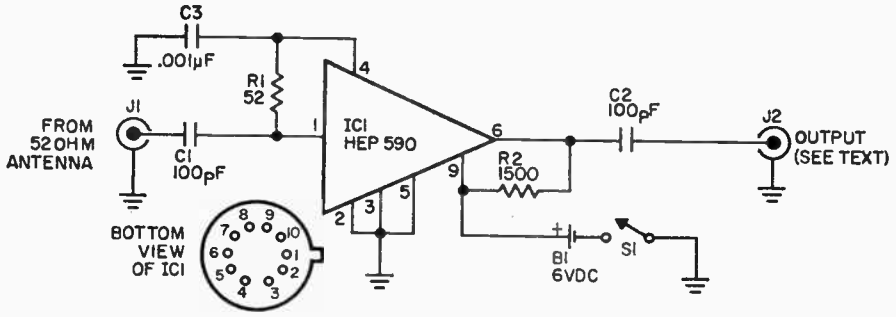
PARTS LIST FOR 100X INSTRUMENT AMPLIFIER

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

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 uF capacitor can be connected between the 100X Instrument Amplifier and your VTVM or scope.

IC 6 CB 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.

PARTS LIST FOR CB BOOSTER

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

IC 7 Great Equalizer

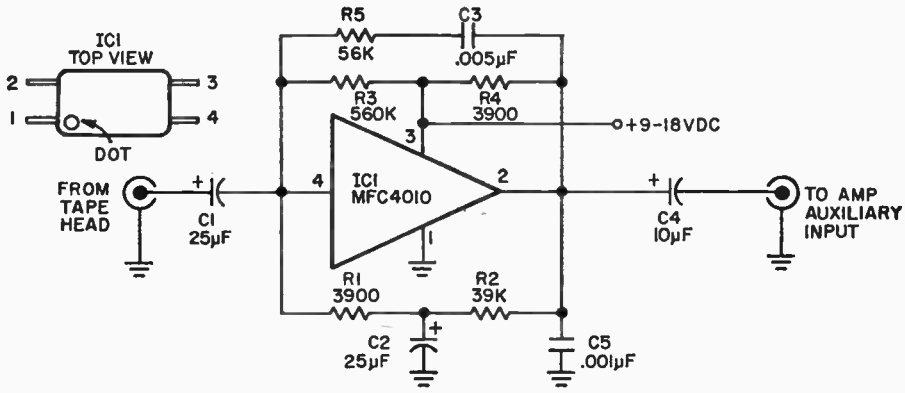
From time to time you'll find bargains at dealers selling tape and cassette deck mechanisms at rock bottom prices—often less than $20! Complete with heads, these decks need only the electronics to get them working. The Great Equalizer provides both the amplification and equalization. You can feed its output directly into an amplifier's

auxiliary input. The Great Equalizer's overall frequency response is suitable for cassettes and 3¾ 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 Great Equalizer can be tucked under the tape mechanism's base plate. The power supply can be anything from 9 to 18 volts at approximately 3mA. Transistor type radio batteries will do; if batteries are used they must be bypassed with a 25 uF capacitor. And, be sure you observe proper battery polarity.

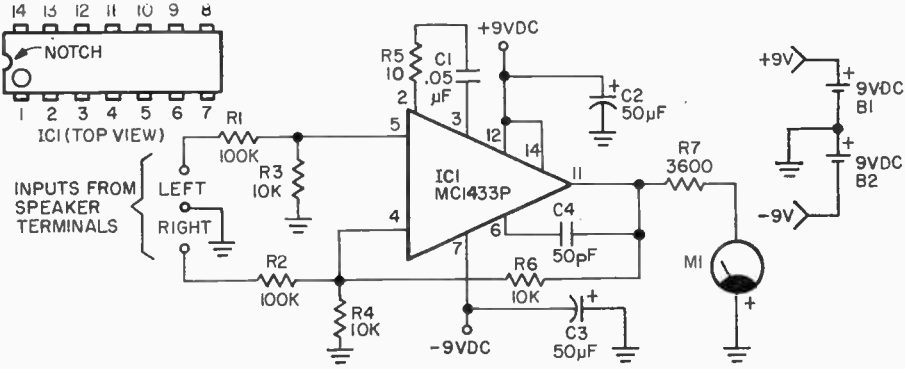
PARTS LIST FOR THE GREAT EQUALIZER

C1, C2—25 uF, 6 VDC
C3—0.005 uF
C4—10 uF, 20 VDC
C5—0.001 uF
IC1—Motorola MFC-4010
R1, R4—3,900 ohms, ½-watt
R2—39,000-ohms, ½-watt
R3—560,000-ohms, ½-watt
R5—56,000-ohms, ½-watt



IC 8 Stereo See-Saw

By comparing the difference between channel outputs when feeding a mono signal, this differential stereo balancer allows you to set your stereo amplifier for precise electrical balance. Wiring is not critical; the Stereo See-Saw can easily be battery powered using a bi-polar battery connection as shown. To use, set your stereo amplifier to mono—then adjust the balance control until meter M1 indicates a null (minimum reading). If you cannot obtain a null it indicates there is a phase reversal—which should be corrected—between the signal input and the speaker terminals. Stereo See-Saw works on the differential principle. When an amplifier is in perfect balance



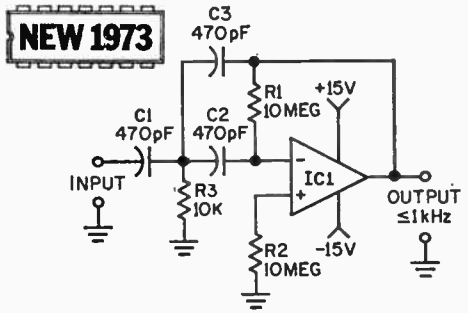
PARTS LIST FOR STEREO SEE-SAW

B1, B2—Battery, 9V, type 2U6
C1—0.05 uF, 10 VDC
C2, C3—50 uF, 10 VDC
C4—50 pF, 10 VDC
IC1—Motorola MC-1433P
M1—VU meter
R1, R2, R6—100,000-ohms, ½-watt
R3, R4—10,000-ohms, ½-watt
R5—10-ohms, ½-watt
R7—3,600 ohms (usually with VU meter)

there is no difference in mono output voltage between channels. So our Stereo See-Saw differential amplifier indicates zero difference on the meter.

IC 9 Audio High Pass Filter

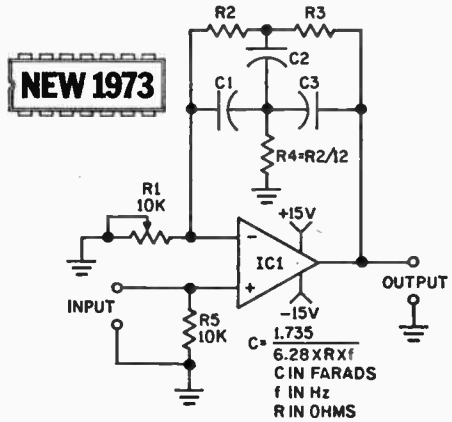
A high pass filter is a handy device to have around. Depending on the corner (turnover) frequency you select it can serve as a hum filter, distortion meter or highly-selective audio equalizer. The values of C1, C2, C3 and R1 provide a corner frequency of 1000 Hz. The IC has internal compensation so special wiring techniques are unnecessary. No pin connections are given because the 741 IC is available in many different pin configurations. Check the manufacturer's specs for the particular IC used. R2 connects to the non-inverting (+) input of the IC, R1 between the output and the inverting (—) input.



PARTS LIST FOR AUDIO HIGH PASS FILTER

C1, C2, C3—470 pF, disc capacitor, 50 VDC or better
IC1—741 type operational amplifier (Radio Shack 276-010 or equal, see text)
R1, R2—10 megohms, ½-watt resistor
R3—10,000-ohms, ½-watt resistor

IC 10 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-

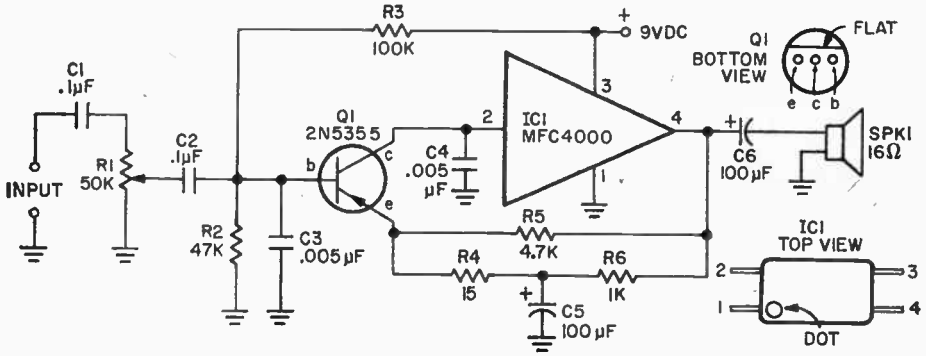
PARTS LIST FOR CARBON MIKE SIMULATOR

C1, C2, C3—(C1 equals C2 equals C3, see formula)
IC1—Type 741 opamp (Radio Shack 276-010 or equal, see text)
R1—10,000-ohm linear potentiometer
R2, R3—(R2 equals R3, see text)
R4—R4=R2/12
R5—10,000-ohm, ½-watt resistor

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

IC 11 Mighty Mite

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.



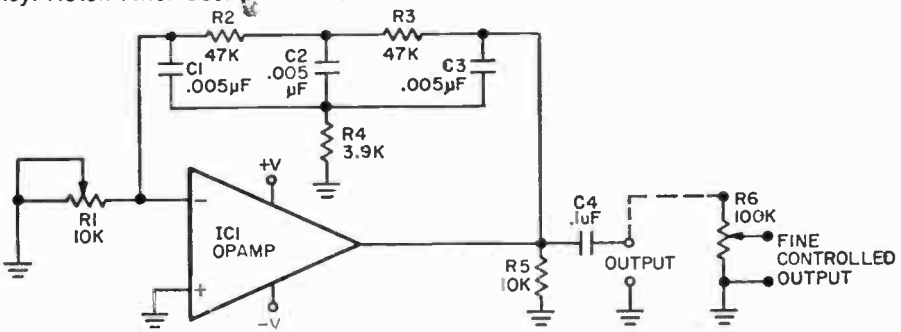
PARTS LIST FOR MIGHTY MITE SIGNAL TRACER

C1—0.1uF, 600 VDC (see text)
C2—0.1 uF, 10 VDC
C3, C4—.005 uF, 10 VDC
C5—100 uF, 3 VDC
C6—100 uF, 10 VDC (250 uF for better low-frequency response with large speakers)
IC1—Motorola MFC-4000
R1—Potentiometer, 50,000-ohms, audio taper
R2—47,000-ohms, ½-watt
R3—100,000-ohms, ½-watt
R4—15-ohms, ½-watt
R5—4,700-ohms, ½-watt
R6—1,000-ohms, ½-watt
Q1—PNP transistor, G.E. 2N5355 or equiv.
SPK1—16-ohm speaker (see text)

IC 12 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 the maximum rating of the particular OpAmp you use. 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 voltage. If fine output control is desired, add potentiometer R6. When your Notch Filter Oscillator is connected to a DC circuit, connect a DC blocking capacitor in series with R6's wiper arm. If the oscillator is to drive circuits of less than 10K ohm impedance, substitute a 1 uF non-polarized capacitor for C4, rated to the power supply's voltage.

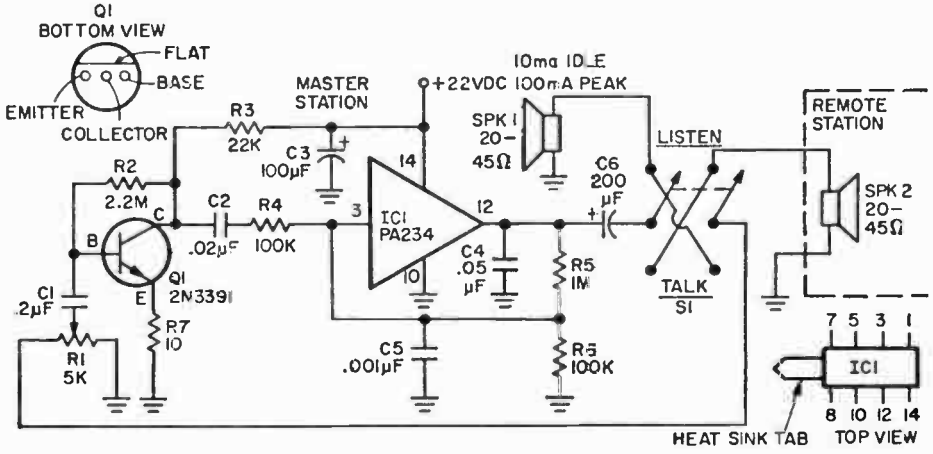


PARTS LIST FOR NOTCH FILTER OSCILLATOR

C1, C2, C3—0.005 uF, 75 VDC
C4—0.1 uF (see text)
IC1—"surplus" operational amplifier
R1—Potentiometer, 10,000 ohms
R2, R3—47,000-ohms, ½-watt
R4—3,900-ohms, ½-watt
R5—10,000-ohms, ½-watt (see text)
R6—Potentiometer, 100,000-ohms, audio taper (see text)

IC 13 Electric Butler

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.

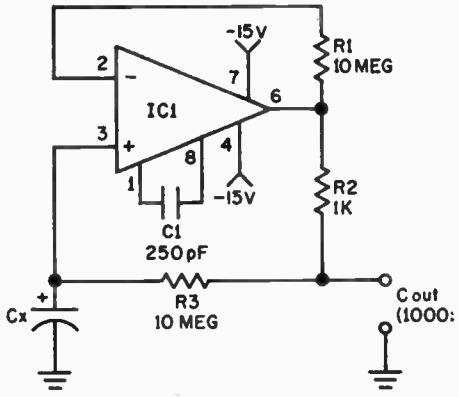
If an AC power supply is used, it must be rated for at least 100 mA drain. If a battery supply is used, figure the 10 mA idling current; the batteries will be able to deliver the 100 mA maximum output peak current. Solder a 1 inch square tin heat sink to IC1's tab during construction.

PARTS LIST FOR ELECTRIC BUTLER

C1—0.2 uF, 3 VDC
C2—0.02 uF, 3 VDC
C3—100 uF, 25 VDC
C4—0.05 uF, 75 VDC
C5—0.001 uF, 10 VDC
C6—200 uF, 25 VDC (see text)
IC1—General Electric PA-234
Q1—NPN transistor, G.E. 2N3391
R1—Potentiometer, 5,000-ohms, audio taper
R2—2.2 megohms, ½-watt
R3—22,000-ohms, ½-watt
R4, R6—100,000-ohms, ½-watt
R5—1 megohm, ½-watt
R7—10-ohms, ½-watt
SPK1, SPK2—Speaker, 20 to 45 ohms, (see text)
S1—Switch, DPDT (see text)

IC 14 C Boost

NEW 1973



Suppose you needed a 10,000 μF capacitor; do you think it could squeeze on your project's printed circuit board?

PARTS LIST FOR C BOOST

C1—250 pF disc capacitor, 50 VDC or better
IC1—SE537 Integrated Circuit (Signetics)
R1, R3—10 megohm, ½-watt resistor
R2—1000-ohm, ½-watt resistor

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 μF the effective capacity that appears at the output terminals is 1000 x 10 μF or 10,000 μF. Any capacity value can be used for Cx.

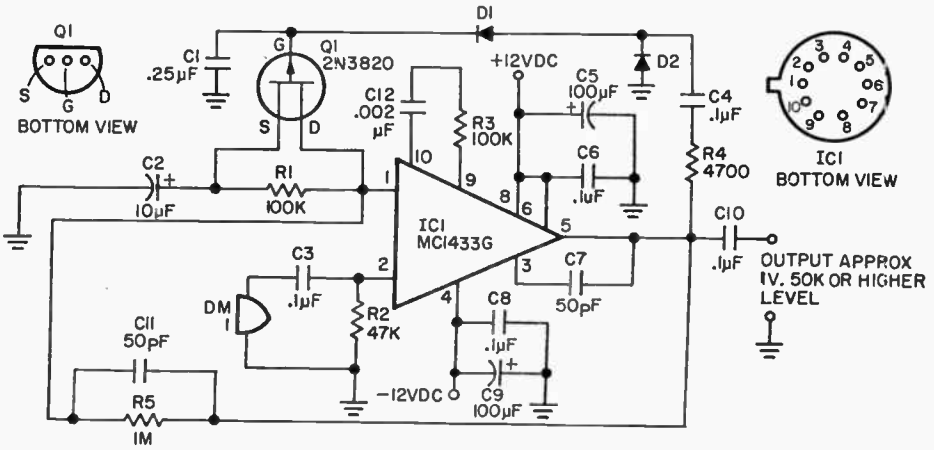
IC 15 Squeeze Box

Operating directly from microphone level and providing a nominal 1V output, Squeeze Box delivers 20dB of compression (essentially distortion-free limiting) and will give ultimate talk-power to P.A. systems and ham or CB transmitters. Fact is, some sideband transmitters might not be able to handle the almost continuous "peak power" output of our Squeeze Box!

The only restriction on its use is that the microphone, DM1, must be the dynamic type: any impedance from 50 to 50,000 ohms will work. If DM1 can be permanently connected to the circuit, components R2 and C3 can be eliminated. But they must be used if there is any possibility DM1 will be

disconnected. No substitution can be made for transistor Q1.

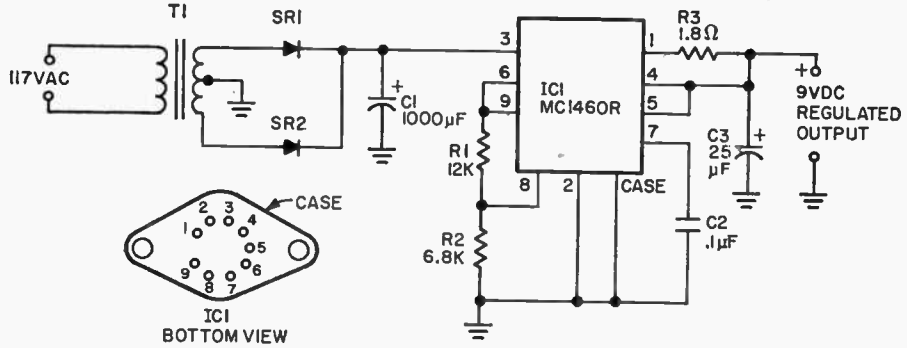
Capacitors C6 and C8 must be installed directly at the IC terminals for instability supression. Capacitors C5 and C9 can be installed anywhere that's convenient. A bipolar 12V supply (well filtered) is required. Power can be provided by batteries (for total hum-free operation) because the current requirement is approximately 15mA. Any gain controls must come after Squeeze Box's output.



PARTS LIST FOR SQUEEZE BOX

C1—0.25 uF, 10 VDC
C2—10 uF, 10 VDC
C3, C4, C6, C8, C10—0.1 uF, 75 VDC
C5, C9—100 uF, 15 VDC
C7, C11—50 pF, 75 VDC disc
C12—0.002 uF, 25 VDC
IC1—Motorola MC-1433G
R1—100,00-ohms, ½-watt
R2—47,000-ohms, ½-watt
R3—100-ohms, ½-watt
R4—4,700-ohms, ½-watt
R5—1 megohm, ½-watt
DM1—Dynomic microphone (see text)
D1,D2—Germanium diode, 1N60 or equiv.
Q1—FET transistor, type 2N3820

IC 16 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.

PARTS LIST FOR PROTECT-A-VOLT

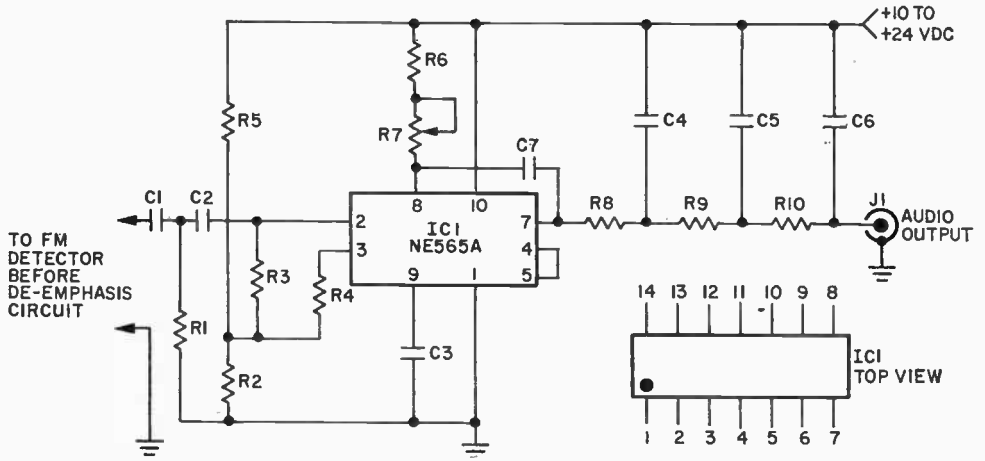
C1—2000 uF ,25 VDC (see text)
C2, C3—0.1 uF, 75 VDC disc or Mylar
IC1—Motorola MC-1461R
R1—50,000 ohm linear potentiometer
R2—6,800-ohms, ½-watt
R3—3-ohms, ½-watt
R4—27-ohms, ½-watt
SR1, SR2—Silicon rectifier, 50 PIV, 500 mA
T1—Power transformer; 117 VAC primary, 30 VC.T.: 200 mA secondary (see text)

IC 17 SCA Adaptor

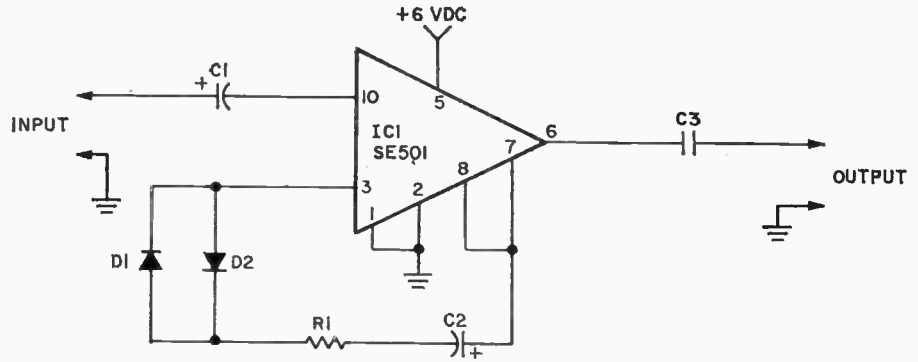
This simple but very effective SCA Adaptor can be assembled on a section of perf-board about 2-in. x 3-in. in size. All components should be firmly soldered to push-in terminals. The input *must* connect to the FM receiver's detector output before the de-emphasis network. The SCA output at J1 can be connected to any relatively high gain amplifier—the output level is about equal to that of a crystal microphone. The FM receiver must be tuned to a station you know has SCA programming. Then adjust potentiometer R7 for a clean SCA audio output. Potentiometer R7's adjustment is not critical—the subcarrier is pulled in when R7's adjustment is near the correct setting. A metal cabinet is suggested. If desired, a pre de-emphasis output jack can be installed on the FM receiver or tuner so that the normal (after de-emphasis) output can feed the hi-fi system independent of the SCA output.

PARTS LIST FOR THE SCA ADAPTOR

C1, C2—510 pF, 500 VDC ceramic disc capacitor
C3, C7—0.001 uF, 75 V Mylar capacitor
C4, C6—0.018 uF, 500 VDC ceramic disc or Mylar capacitor
C5—0.047 uF, 75 VDC Mylar capacitor
IC1—Signetics NE565A (dual in-line package phase-locked loop)
J1—Phono jack
R1, R2, R3, R4—4700-ohm, ½ watt resistor
R5—10,000-ohm, ½ watt resistor
R6—1800-ohm, ½ watt resistor
R7—5000-ohm potentiometer
R8, R9, R10—1000-ohm, ½ watt resistor



IC 18 Comm-Press Log Amp



A log amplifier is a device that takes a large change in input signal and converts it to a small change in output. Hook one into a communications system and both low and loud sounds come out at almost the same level giving you a lot more talk power; it sounds just like the hard-sell commercials on TV. The input level should be about 0.1 volt peak for an output voltage of about 1 volt peak. Since this is a high frequency device, lead dress and good power supply bypassing at the power supply terminals are required. Keep the ground leads short. If a microphone preamplifier is used before the log amplifier, connect a volume control before the log amp's input. Some experimentation will be needed for optimum P.A. operation. Because of the much higher average voice power, a P.A. system using a log amp compressor might appear to be more sensitive to acoustic feedback (howling). Actually, you will have much more voice output before the howling starts.

PARTS LIST FOR THE COMM-PRESS LOG AMP

C1—1 uF, 6 VDC electrolytic capacitor
C2—10 uF, 6 VDC electrolytic capacitor
C3—0.1 uF, 75 VDC Mylar capacitor
D1, D2—Diode, Silicon, 1N914
IC1—Signetics SE501
R1—510-ohm, ½ watt resistor

IC 19 Porta-Groove Amp

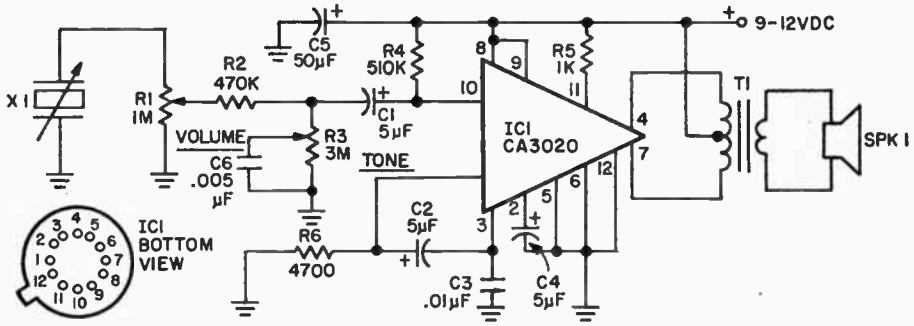
Just add a battery-powered motor to our Porta-Groove Amp, and you've made a portable phonograph of considerably better quality than you can buy. Phono pickup X1 must be the ceramic type—either the usual high impedance or so-called low impedance (actually several thousand ohms) ceramic type can be used.

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 subminiature T1; for good sound quality T1 most have sufficient "iron", so make certain it can handle approximately 25mA 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

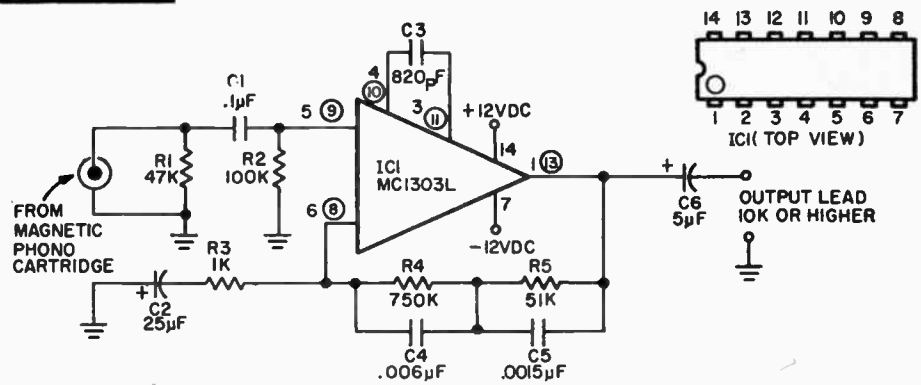
PARTS LIST FOR PORTA-GROOVE AMP

C1, C2, C4—5 uF, 6 VDC
C3—0.01 uF, 10 VDC
C5—50 uF, 15 VDC
C6—.005 uF, 15 VDC
R1—Potentiometer, 1 megohm audio taper
R2—470,000-ohms, ½-watt
R3—Potentiometer, 3 megohms
R4—510,000-ohms, ½-watt
R5—1,000-ohms, ½-watt
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)
IC1—RCA CA3020 or CA 3020A
X1—Ceramic phono pickup (see text)



batteries or eight D cells easy give Porta-Groove Amp enough oomph. Do not use C or AA cells; they cannot give even reasonable life with the 20mA idling drain, 140 mA peak power drain.

IC 20 Groove Booster



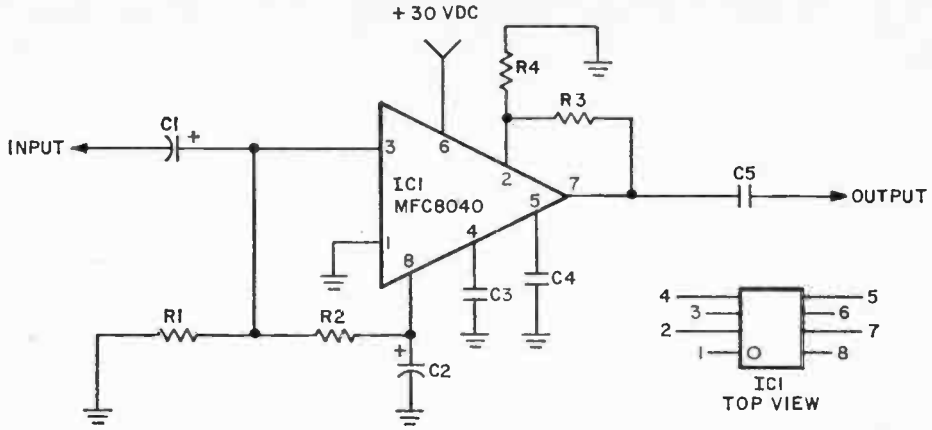
Using a dual operational amplifier IC, the Groove Booster will provide a fully equalized 1 V rms output from standard phono magnetic pickups. The terminal numbers which are circled on the schematic are the connections for one of the two independent stereo amplifiers on the single IC chip. The uncircled 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. ■

PARTS LIST

C1—0.1 uF, 3 VDC
C2—25 uF, 3 VDC
C3—820 pF, 500V VDC disc
C4—0.006 uF, 100V VDC disc
C5—0.0015 uF, 100V VDC disc
C6—5 uF, 25 VDC
IC1—Motorola MC1303L
R1—47,000-ohms, ½-watt
R2—100,000-ohms, ½-watt
R3—1,000-ohms, ½-watt
R4—750,000-ohms, ½-watt
R5—51,000-ohms, ½-watt

IC 21 Silent Mike Preamp

Packing a walloping 60 dB gain with a 7 volt output, this mike preamp never-

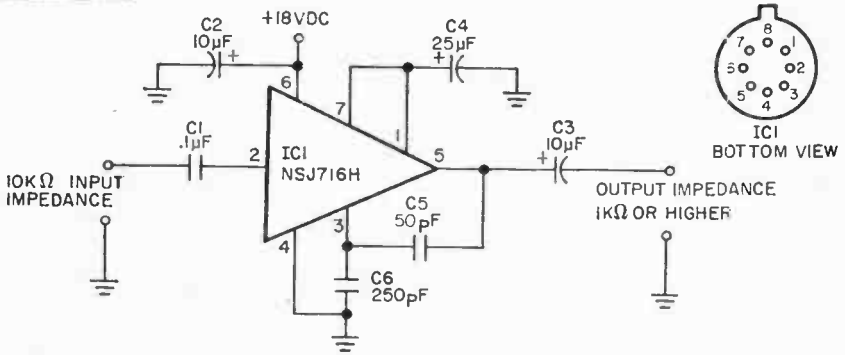


theless is almost dead quiet. The input impedance is about 75,000-ohms; output impedance about 100-ohms. Actual maximum output voltage depends upon the load resistance, ranging from 7 volts output into a 10,000-ohm load to 4 volts output into a 1000-ohm load. Parts layout is not critical and any type of assembly can be used. The power supply current is typically 8 mA, with a maximum of 12 mA.

PARTS LIST FOR THE SILENT MIKE PREAMP

C1—1 uF, 3 VDC electrolytic capacitor
C2—100 uF, 6 VDC electrolytic capacitor
C3—0.05 uF, 75 VDC Mylar capacitor
C4, C5—0.1 uF, 75 VDC Mylar capacitor
IC1—Motorola MFC 8040
R1—75,000-ohm, ½ watt resistor
R2—270,000-ohm, ½ watt resistor
R3—110,000-ohm, ½ watt resistor
R4—100-ohm, ½ watt resistor

IC 22 Gabber Grabber



Gabber Grabber works best with the 10,000 ohm microphones and telephone pickup coils supplied with most solid-state recorders. It provides 26dB gain, and is ideal when a single microphone is used for conference recording or when remote telephone monitoring through a pickup coil is desired. The 18V power supply can be two series-connected 9V transistor radio batteries. Since the IC is a high frequency device, its leads should be kept as short as possible. A socket holding the IC is suggested but not required. A soldering iron rated no higher than 25 watts helps you whip together Gabber Grabber.

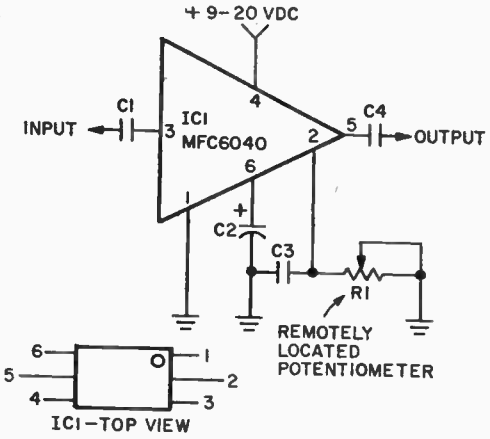
PARTS LIST FOR GABBER GRABEER

C1—0.1 uF, 25 VDC
C2, C3—10 uF, 25 VDC
C4—25 uF, 25 VDC
C5—50 pF
C6—250 pF
IC1—Fairchild NSJ716H

IC 23 Far Out Gain Control

PARTS LIST FOR THE FAR OUT GAIN CONTROL

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



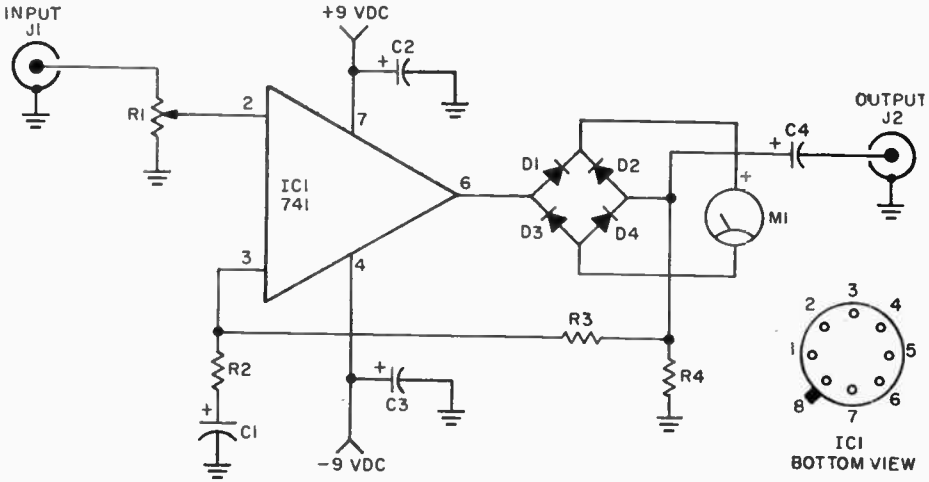
One of the problems of locating a volume control in a remote location is that of hum and noise pickup; as a general rule, the greater the wire length the greater the hum and noise picked up. With an electronic attenuator the entire problem is eliminated, for the volume control wires carry only a DC control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

IC 24 Professional Remote Amplifier

Here's a professional performance 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 impedance 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 uF for all applications except when used with a line matching transformer. When a transformer is used C4 is 25 uF. Better results can be obtained with a line matching transformer if the transformer primary replaces R4 (eliminating C4). M1 is a standard VU meter whose

PARTS LIST FOR PROFESSIONAL REMOTE AMPLIFIER

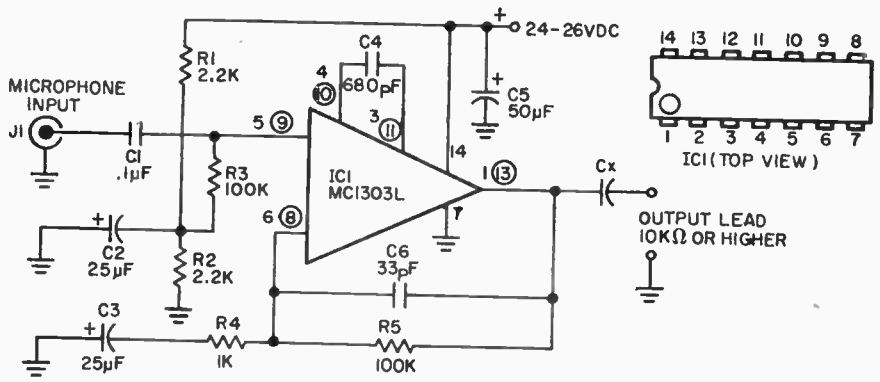
C1—200 or 250 uF, 3 VDC electrolytic capacitor
C2, C3—50 uF, 12 VDC electrolytic capacitor
C4—0.1 uF or 25 uF, 12 VDC capacitor (see text)
IC1—Type 741 operational amplifier
J1, J2—Shielded jacks
M1—VU meter with internal rectifier removed
R1—50,000-ohm audio taper potentiometer
R2—100-ohm, ½ watt resistor
R3—15,000-ohm, ½ watt resistor
R4—560-ohm, ½ watt resistor



internal rectifier has been removed (open the case and unsolder the rectifier). Total current drain is less than 5 mA and the bi-polar power supply can consist of two transistor radio type 9 volt batteries.

IC 25 Hot Lips

A dual IC gives Hot Lips its hi-fi amplification for a stereo microphone pair. But there's no mumbo-jumbo with Hot Lips—low distortion and full-fidelity frequency response characterize this mike preamp. amplifier are uncircled. Pins 7 and 14 are common to both amplifiers. Capacitor Cx's value is determined by the load impedance connected to Hot Lips. It should be of such value as to provide the desired overall low



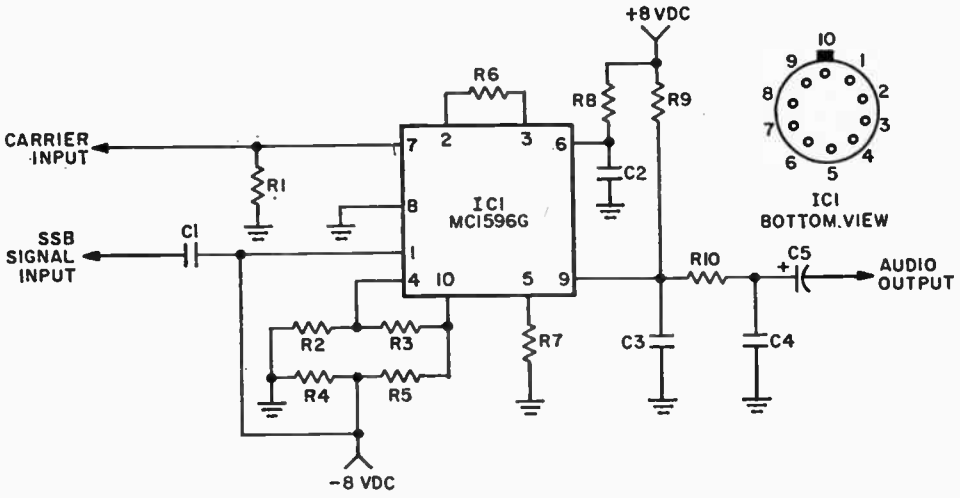
With resistors R1 and R2 providing a center-tap for the power supply, the IC can be powered from a standard single-ended power supply, or series connected batteries. Be very careful to observe the correct polarity for capacitors C2 and C3. In the event the unit motorboats (low frequency oscillation), 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

PARTS LIST FOR HOT LIPS

C1—0.1 uF, 100 VDC
C2, C3—25 uF, 25 VDC
C4—680 pF disc
C5—50 uF, 25 to 50 VDC
C6—33pF disc
Cx—See text
IC1—Motorola MC1303L
J1—Microphone jack
R1, R2—2,200-ohms, 5%
R3, R5—100,000-ohms
R4—1,000-ohms

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 26 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 bi-polar 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.

PARTS LIST FOR THE ADD-ON PRODUCT DETECTOR

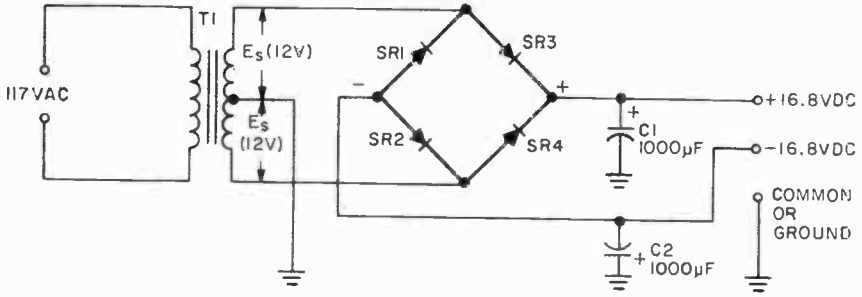
C1—0.47 uF, 25 VDC Mylar capacitor
C2, C3, C4—0.005 uF, 500 VDC cermic disc capacitor
C5—1 uF, 10 VDC electrolytic capacitor
IC1—Motorola MC1596G
R1—51-ohm, ½ watt resistor
R2, R3, R4, R5, R6, R10—1000-ohm, ½ watt resistor
R7—6800-ohm, ½ watt resistor
R8, R9—3900-ohm, ½ watt resistor

IC 27 Bi-Polar Power Supply

PARTS LIST FOR BI-POLAR POWER SUPPLY

SR1-SR4—Silicon rectifiers PIV rated to at least twice the supply's output voltage
C1, C2—1000 or 2000 uF at the supply's output voltage
T1—Power transformer with center-tapped secondary

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.

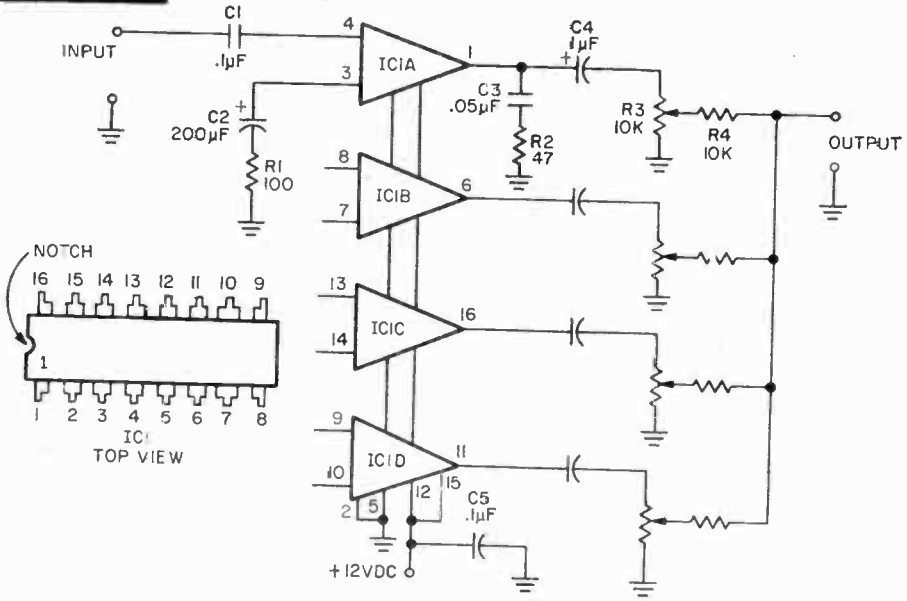


Filter capacitors C1 and C2 should be at least 1000 uF (2000 uF preferred) at a voltage rating at least equal to the supply's output voltage.

The supply's output voltage is equal to 1.4 times Es. Voltage Es 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 (Es) is 12. The supply's output voltage is therefore 12 x 1.4 or ± 16.8VDC. Always remember that each Bi-Polar output is derived from half T1's secondary voltage.

IC 28 Pro-Mix



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 Pro-Mix—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.

(Turn page)

PARTS LIST FOR PRO-MIX

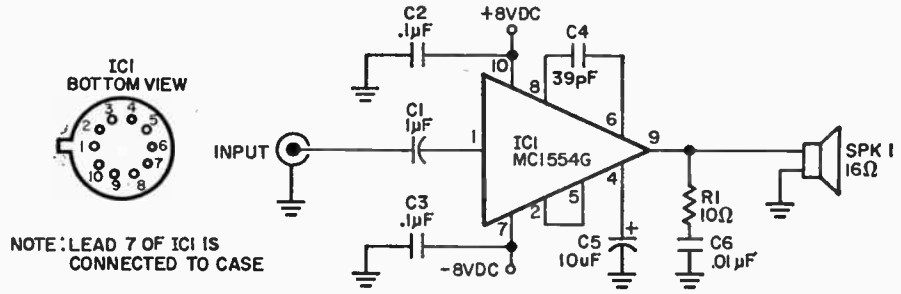
C1—0.1 uF, 3 VDC
C2—200 uF, 3 VDC
C3—0.05 uF, 75 VDC disc
C4—1 uF, 15 VDC
C5—0.1 uF, 15 VDC
IC1—RCA CA3052
R1—100-ohms, ½-watt
R2—47-ohms, ½-watt
R3—Potentiometer, 10,000-ohms audio taper
R4—10,000-ohms, ½-watt

Note that the power supply is a single-ended 12VDC (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 attentuation.

IC 29 Bi-Polar Amp

It is inconvenient when working with IC preamplifiers requiring bi-polar power sources to convert to a single-ended power source for the power amplifier. Our Bi-Polar Amp, however, can be driven from a bi-polar 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.



PARTS LIST FOR BI-POLAR AMP

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

IC 30 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 28 to 29 MHz or 29 to 30 MHz range with no extra tuning or attention. Also, because of

(Continued on page 112)

OpAmp

A ready-to-go amp with a zillion applications

the little OpAmp can fill most any bill you have in mind

Just as a child builds houses and castles by adding one toy block to another, so too will the electronic engineer in the 1970s design all types of electronic equipment by adding one block to another. But he won't be using toy blocks—he will use operational amplifiers—the basic building blocks of electronics.

The operational amplifier, or OpAmp, is considered a basic electronic circuit building block because, just as is the case with the child's block, the OpAmp becomes whatever the designer wants it to be in a circuit. For example, the OpAmp in the triangle above serves as a low- or high-gain AF amplifier, a line amplifier, a preamplifier, an oscillator, a mixer, a modulator, a multivibrator, a detector, etc. You name it and the OpAmp can do it within the limitations of the device's bandwidth.

Certainly you can always arrange a group of discrete components to do any of the above-mentioned jobs, but what makes the OpAmp unique and important is that in addition to the OpAmp itself, just a few additional components are required to fabricate a complete module. Circuit functions are changed by changing the value of just some of the external components or the way they are connected.

Goodies Do Come in Small Packages. When the OpAmp is an IC, rather than discrete components, the entire OpAmp is in a small package (as in the photo above), and the external associated components for a given circuit may number four or five. Changing the value or connection of only one or two of these components completely changes the OpAmp's function. The OpAmp is not a new development that has evolved from the availability of ICs. OpAmps, predating these new IC types, were wired packages of discrete components that afforded no savings in cost. However, the IC OpAmp certainly has tipped the scales the other way. These new units cost but a fraction of what the older ones did, both in dollars and in space requirements. Progress surely pays dividends—collect yours by using OpAmp.

Easy Does It. Another advantage of OpAmp is that without having to make yards and yards of calculations you can be fairly certain of the end results, within broad limits. As an example, suppose you wanted to construct a microphone preamplifier having 60 dB of gain (1000 ×). You would have to calculate all the constants of many discrete components associated with two or three transistors and/or FETs—and you'd still have to breadboard the circuit to iron out the bugs. But, using an OpAmp the only calculation would be:

$$Gain = R1/R2$$

and since R2 would be known, your total effort would be to calculate the proper value for R1 and connect it into the circuit.

Does it all sound too easy? If we were to delve deeply into OpAmp theory you'd have another 100 pages or so to read. But OpAmps are available predesigned with cer-

OpAmp

tain characteristics, such as input impedance, gain, bandwidth, overload voltage, etc., clearly specified. All that is required of the experimenter is for him to select the few components needed for his particular application. Particularly for the newcomer to electronics, practical application of the OpAmp can be easily handled. As long as you know what result to expect from your connections of the components, you can get started on OpAmp applications immediately. The how and why can come later.

AC, DC or Both. The schematic of a typical OpAmp is shown in Fig. 1. We could go into differential inputs, constant current sinks, split outputs and all the other technical terms that are impressive. But, in all probability most of this terminology would be meaningless to the experimenter and hobbyist. What is important, as noted in Fig. 1, is the absence of coupling capacitors. The OpAmp is DC coupled, and its output is self-center tapped. The OpAmp can handle either AC, DC or both simultaneously, and the output is normally at DC ground potential. As it is usually powered by a bi-voltage power supply as shown in Fig. 2, the OpAmp's output can be set to the center tap or ground potential and usually is in experimenter's applications.

Input Polarity Controls Output. Observe in Fig. 2 that the OpAmp has separate inputs indicated as positive (+) and negative (−) respectively. The input impedance of the device is the internal impedance between these two inputs. The input polarity determines what the polarity will be at the output when a voltage is applied to the input. The positive input is non-inverting, and the output voltage will have the same polarity as the input voltage. The negative input is inverting, therefore, the output voltage will be 180° out of phase with the input voltage. Keep this point in mind, as we'll come back to it later. Knowing this fact at this point will help you to understand the workings of the OpAmp.

Differential input is a term that you will run across frequently as you work with OpAmps. It means that the amplifier responds to the *difference* in voltage between the input terminals which may be either AC or DC. If a 1.5-V battery is connected across the input terminals the difference voltage is 1.5 V. It doesn't matter to which input the positive battery terminal is applied, the difference voltage will still be 1.5 V. The output voltage of the amplifier, the voltage between the amplifier output terminal and ground, is equal to the open loop gain of the amplifier times the differential voltage. If the open loop gain is 1000, and the differential input voltage is 1 millivolt, the output voltage is 1 *mV* × *1000 or 1 volt.*

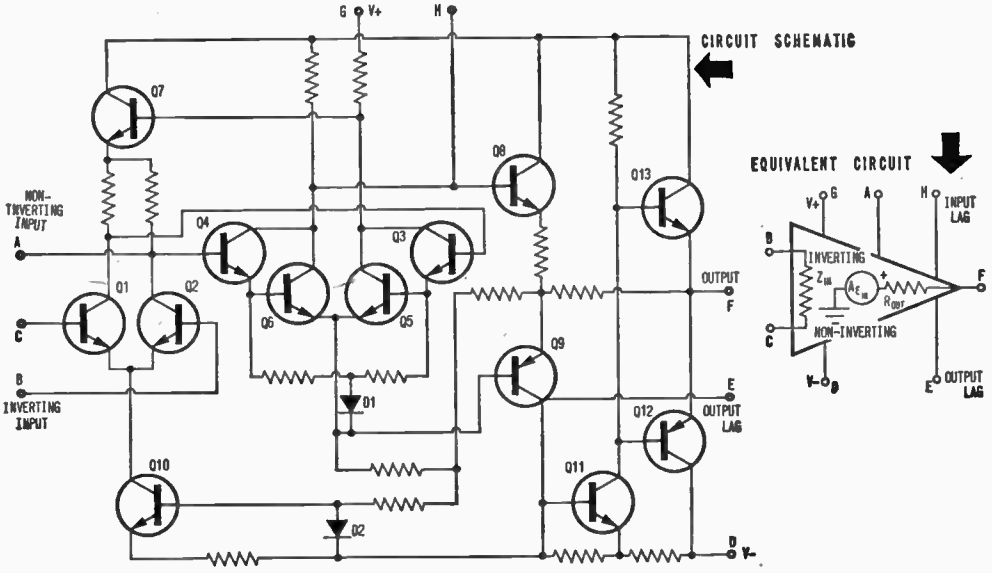


Fig. 1. Schematic and equivalent circuit of IC operational amplifier. Since device is DC coupled, it can be used for both AC and DC amplification. Output can be either in phase or out of phase with input signal.

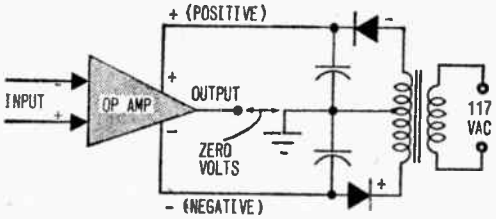


Fig. 2. OpAmp boasts two inputs: inverting input indicated as "—" and non-inverting input indicated as "+", DC output from power supply is half total supply voltage and of two differing polarities.

Open Loop—Closed Loop. Open loop gain refers to the gain of the OpAmp, or any amplifier, as rated by the manufacturer. Open loop gain or maximum gain, is achieved by connecting the amplifier as shown in Fig. 3A. Closed loop gain refers to the gain of the amplifier after a feedback network has been connected from its output to its input. Fig. 3B indicates how negative feedback is derived by connecting amplifier output to the inverting (−) input. If the amplifier should include both negative and positive feedback, which is unusual in experimenter's circuits, the closed loop gain will be the total resultant gain of the device. It is easy to calculate the closed loop gain. Essentially, it is derived by dividing Rf by Rb1 (where Rf = feedback resistance and Rb1 = its associated bias resistance—see Fig. 3B).

When the loop is closed, which occurs

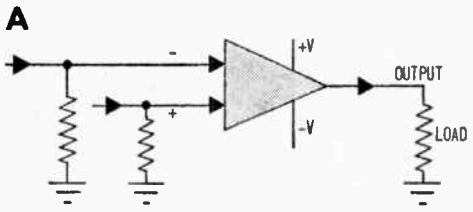
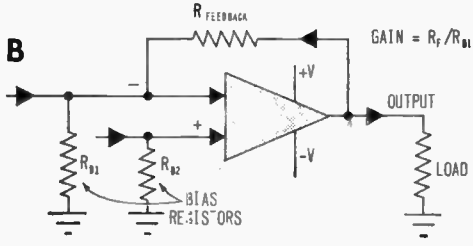


Fig. 3A. Open-loop gain results when amplifier is connected as shown and is maximum gain available. Fig. 3 B. Closed-loop gain is device's gain after feedback has been applied; it's equal to Rf/Rb.



when feedback is applied, the inverting (−) input bias resistor becomes part of a feedback voltage divider consisting of Rf in series with Rb1. It can be shown mathematically that, when the input signal is applied between the inverting input and ground, the closed loop gain equals Rf/Rb. When the input signal is applied between the non-inverting (+) input and ground, the closed loop gain equals Rf/Rb+1. Since the factor of +1 is generally insignificant, we can consider that, for experimental use, the closed loop gain is as previously stated. If Rb is 1000 ohms, and Rf 1 megohm, as shown in Fig. 3B, the closed loop gain will be equal to 1 megohm/1000 ohms or 1000. This is equivalent to gain of 60 dB, since gain in dB equals 20 log voltage gain. Regardless of the linear OpAmp used, resistors having these values will always produce the same gain if the amplifier's open loop gain is greater than the closed loop gain. It is not possible to get a closed loop gain higher than open loop gain. For example, an Rf/Rb ratio that produces total gain of 60 dB for one amplifier will not produce 60 dB gain in another amplifier if the latter has a gain of only 50 dB.

Bear in mind that regardless of whether it is an open or closed loop unit, the OpAmp output voltage will be in phase with the non-inverting (+) input and out of phase with the inverting (−) input. For example, assuming the OpAmp in Fig. 3B has a gain of 1000, if 1 millivolt is applied across the input, with the positive voltage connected to the non-inverting (+) input, the output voltage to ground will be +1 volt. If we reverse the input (−) the output voltage to ground will be −1 volt.

Offset Voltage.—What Is It? An important consideration is the offset voltage, which usually refers to the inherent differential voltage, but can also mean a desired DC input voltage difference.

In normal operation, if both inputs are grounded through a resistor, and no input voltage is applied, theoretically the output voltage should be equal to the ground voltage. In actual practice there is a small inherent difference voltage, called the offset voltage, which naturally produces a slight output voltage. If you specifically wanted a quiescent output voltage other than zero you would apply a DC potential to the inputs through a bias resistor and this voltage would be called the operating offset voltage.

(Continued overleaf)

OpAmp

We will spend some time on offset voltage since understanding it will help you trouble shoot experimental projects. In normal linear amplifier operation a zero offset voltage is essential so that output voltage to ground will be zero. This affords the most flexibility in audio and RF circuits. If the output voltage is at zero, the output signal can swing equally to both positive and negative sides of the power supply. For example, if the supply is a +15 V, −15 V (total 30 V) unit, the signal could swing 15 V peak either side of ground (zero output voltage) or 30 V peak-to-peak. But if an offset voltage caused the output voltage to be +10 V under no-signal conditions, the output voltage could only swing +5 V before overload. So for most operations the offset voltage should be as close to zero voltage as is possible.

Taking Advantage Of Offset Voltage. However, for specific applications, offset voltage can be applied deliberately. For example, assume a 30-millivolt peak pulse must be amplified to 30 volts peak. Obviously, this can't be accomplished with zero output voltage and a +15 V, −15 V supply, as the maximum possible swing is only 15 V in either direction. Therefore, by applying an offset voltage that drives the output voltage to −15 V, this leaves a full 30 volts available for a 30-V output voltage swing, and when the 3-*u*V peak signal is applied the output voltage can swing the full 30 V from −15 through zero to +15 volts.

Therefore, you can see the offset voltage can be an advantage or disadvantage, depending on the type of signal with which you are working.

Beware Of Offset Voltage. An important point to keep in mind about offset voltage is, that for zero output voltage the DC resistance path from both inputs to ground must be identical. An OpAmp's input is a transistor, and as all transistors require a bias current, which, though quite small (measured in microamperes), nevertheless does exist. Since the bias current flows through the bias resistor it produces a voltage drop across the resistor. If the resistance paths to ground for the two inputs differ, the voltage drop across the resistors will differ, and the voltage at the OpAmp's inputs will be different. You will have an offset voltage condition. So, as a general rule, the DC path from both inputs to ground must be identical to avoid an unwanted offset voltage.

OpAmp As An AC Amplifier. Bear in mind that the resistance for the OpAmp's inputs includes the entire resistance associated with each input. For example, in Fig. 3B the 1-megohm Rf resistance in series with the output circuit resistance is also in parallel with the 1000-ohm bias resistor. Since feedback resistor Rf alone is greater than 10 times the bias resistor it can be ignored but you will run across many circuits where Rf is an appreciable part, or all, of the DC resistance, and it must be taken into account.

A practical example of the Rf factor is in the tape-head equalized preamp shown in Fig. 4. Since the amplifier is intended for a relatively high input impedance, an 820 k resistor is used for the positive input bias

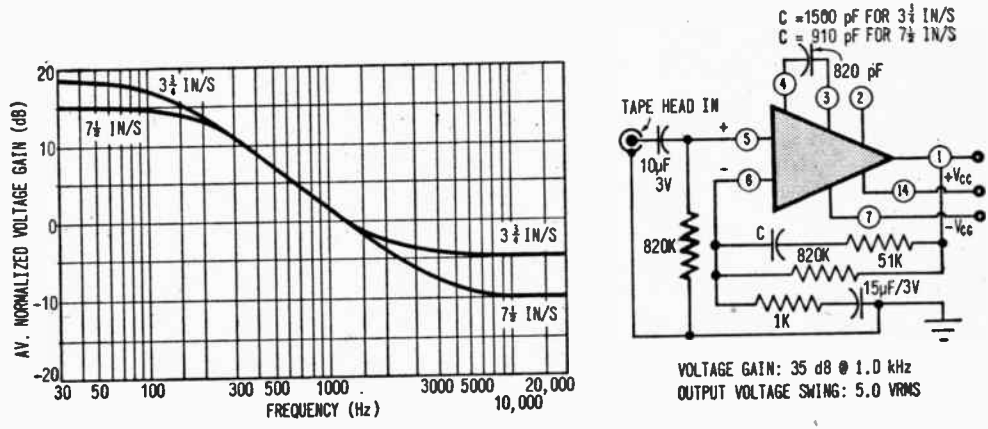


Fig. 4. Circuit for NAB-equalized tape-head preamp using Motorola MC1303L preamplifier. Only one channel is shown here—second channel utilizes other half of IC and is wired exactly the same.

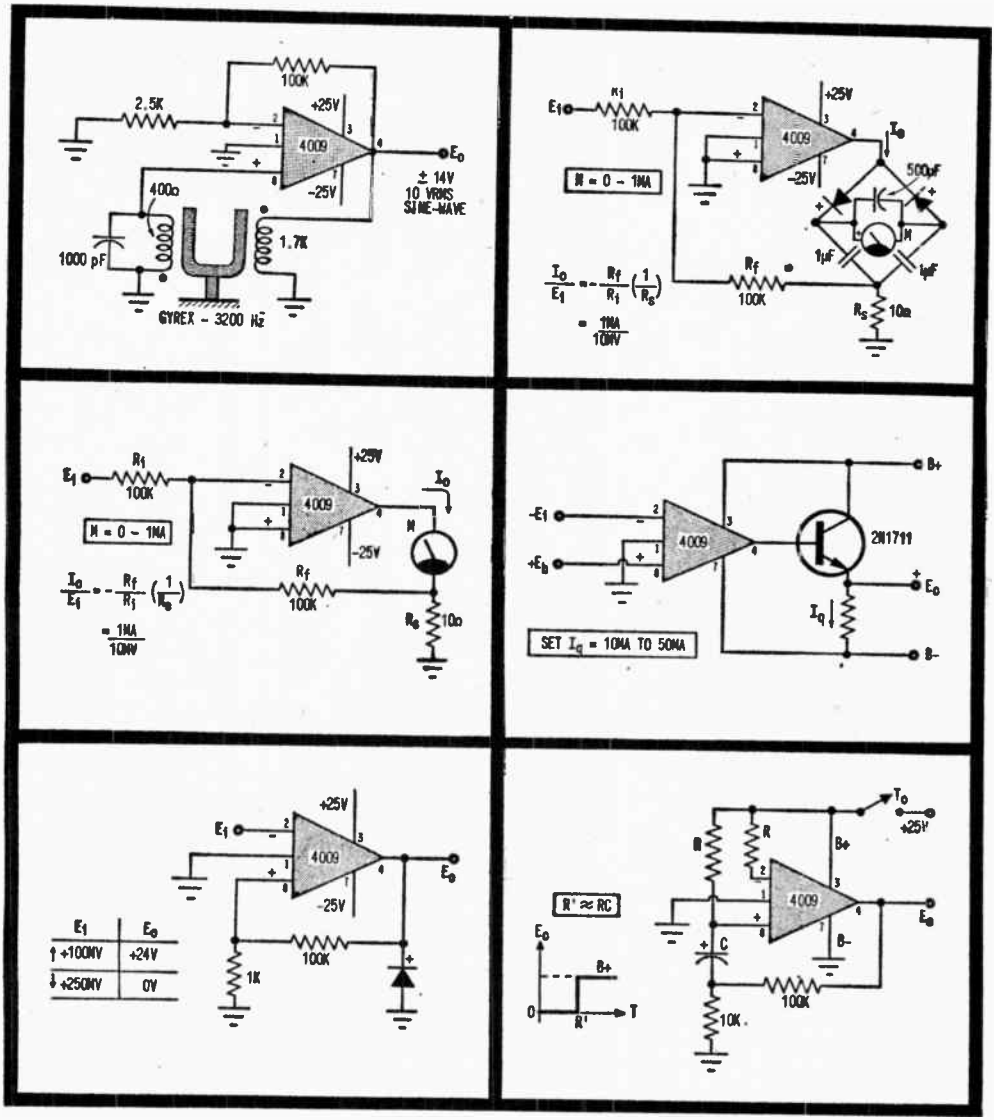


Fig. 5. Six circuits using 4009 OpAmp, available from OpAmp Labs, 172 S. Alta Vista Blvd., Los Angeles, Calif. 90036 for $10.00 ea., postpaid. Circuits, from left to right, are 1) tuning fork oscillator, 2) AC millivoltmeter, 3) DC millivoltmeter, 4) DC medium-power amplifier, 5) Schmitt trigger, 6) fast turn-on timer.

resistor. Now an identical 820,000-ohm resistor in the negative input, which will be used for frequency equalization, is going to result in extremely large feedback resistors. Instead, we use a 1000-ohm negative input load (no longer bias) resistor and isolate it from ground with a 15-*u*F capacitor. While there is no DC path to ground, the capacitor provides an AC path so that the 1000-ohm resistor can be used for the AC feedback. To provide the equal negative input bias resistance we then connect an 820,000-ohm resistor between the negative input and the output. Since the output is at ground potential both inputs "see" the same resistance value to "ground" and there is no offset voltage. The 820,000-ohm input resistor, in combination with the parallel RC series circuit, produces the proper equalization.

OpAmp As A DC Amplifier. In the previous example you have seen the application of the OpAmp as an AC amplifier. If you go through the calculations you will find

OpAmp

that the AC gain at mid-frequency is determined by the 820,000-ohm resistor and it is identical to the DC gain, again from the formula: Gain = Rf/R bias. By the way, the Motorola MC1303L used in the previous example has a slightly different configuration from the usual OpAmp but is one of the best devices available for the experimenter as it behaves like an OpAmp and with reasonable care is indestructible.

So now we have two practical uses for the OpAmp: a) as a DC amplifier and b) an AC amplifier. By connecting the OpAmp to eliminate the input-blocking and negative input capacitor, the OpAmp can be used for simultaneous DC and AC amplification if you allow for a developed offset voltage.

You're Just Getting Your Feet Wet. This article should provide enough information to get you started on your own experiments, and enough help to get you started building and servicing OpAmp circuits. You must keep in mind that an offset voltage determines the output DC voltage and only AC requires DC isolation of the feedback path bias resistor. Then you should not have too much difficulty calculating and building your own circuits. The only problem you may have is with stability, and you should take precautions to prevent the entire circuit from oscillating. Many OpAmps have a frequency response that extends well into RF, and, just as in any RF circuit, sloppy wiring will cause self-oscillation. Use standard RF wiring techniques, a lot of point-to-point grounds and a 0.1-μF bypass capacitor from each side of the power supply to ground, connected directly at the OpAmp leads, and you'll greatly reduce the possibility of instability.

Going Beyond AC and DC. Once you get beyond the audio and DC experiments why not give some oddball circuits a try? In Fig. 5 we show a number of useful circuits that are easy to build and easy to understand. All circuits are designed around an OpAmp Labs type 4009—but you can try them with any OpAmp, though you may have to change a few parts values to get them going. One tip to help you when working with oscillator circuits is to concentrate on feedback to the positive (+) input, as shown in the Wein bridge oscillator. If you remember your basic theory you will recall that negative feedback reduces gain while positive feedback drives the amplifier towards oscillation until there is sufficient positive feedback to sustain oscillation (same idea as in a receiver Q-multiplier). So, if you can't get an oscillator to start oscillating, make certain you have sufficient positive feedback. Quite often, the same OpAmp circuit will combine both negative and positive feedback, as in the Wein bridge oscillator, and too much feedback will prevent oscillation. The solution then is to increase positive feedback. If this isn't always possible, try decreasing negative feedback.

Why Is OpAmp a Building Block? This is a question you should know the answer to at this point. The reason for its being called a building block is that a complete operating entity can be assembled by stacking together several OpAmps. Let's look at a receiver as a practical example. Long before OpAmps were available, receiver design often required several engineers. One designed the front end, another an IF amplifier to match the front end output, perhaps another for the audio amplifier and finally a technician to connect them all together

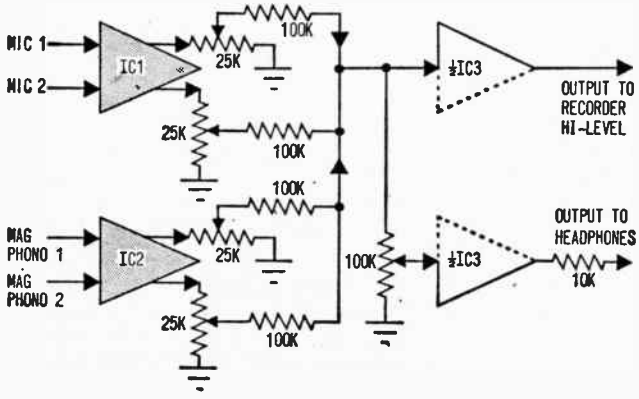


Fig. 6. Just for fun, try designing your own 4-channel mixer using Motorola's MC1303L stereo preamplifier IC. Block diagram gives basic info—you supply all details.

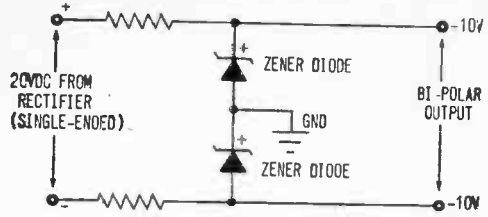


Fig. 7. Getting bi-polar output for OpAmp circuitry may pose problems, but solutions are easier than you might expect. One is to toss in a couple of Zeners: input is single-ended; output, bi-polar.

and iron out the bugs. More modern components generally required one engineer and a technician to de-bug the set. Again the design was circuit-to-circuit, so that one circuit matched another.

But with OpAmp design each circuit becomes a separate building block that will mate with any other block—just as toy blocks can be mated. Let's assume you build a front end for a receiver, you know the desired output voltage and the required matching impedance. You then select an off-the-shelf OpAmp for the IF amplifier having the required input impedance (no matching problem), add a tuned circuit and a resistor in the feedback loop to establish the circuit's resonant frequency and gain, and once again, before the circuit is built, you know the output voltage and impedance. For the AF amplifier you select an OpAmp having the required impedance, add the correct feedback resistor for the desired gain and your amplifier is complete. This is possible because an OpAmp can produce either high or low power out, and a single OpAmp can provide the entire voltage gain and power output stages of the AF section of your receiver.

You can take the same building block approach with other circuits. Each circuit function can be designed as a building block, the entire circuit being achieved when they are all connected together.

Let's Experiment. Here's a useful building block project you may want to try. Starting with a Motorola MC1303L stereo preamplifier, in building block fashion, design a 4-channel mixer/amplifier in which: two channels are for mikes, two for magnetic phono or tape head inputs, and having a high level output. Try this approach, one MC1303L will be used for the two mike channels, one for the two equalized channels for magnetic phono pickup or tape head, and one half of an MC1303L as the output amplifier, with the half remaining as an amplifier for a VU meter or headphone monitor amplifier. Fig. 6 is a block diagram to get you started—from there on you're on your own. However, because locating a bi-polar power supply can be an Excedrin headache, we'll help you out with the power supply.

Bi-Polar or Single-Ended. A bi-polar supply is, as we have previously discussed, a power supply that produces an equal voltage either side of the center tap or ground, since the center tap is generally grounded. Using a power transformer single-ended secondary, as in Fig. 7, you can provide a zero voltage point, or phantom-ground by connecting two Zener diodes across the rectified output of the supply. The junction of the two Zeners serves as the ground, or center tap. The major problem with this arrangement is that you must select the correct series resistor and each half of the supply will be a half-wave rectifier. Also, this requires a fair amount of filtering, achieved either through large, expensive capacitors or a capacity-multiplied transistor regulator.

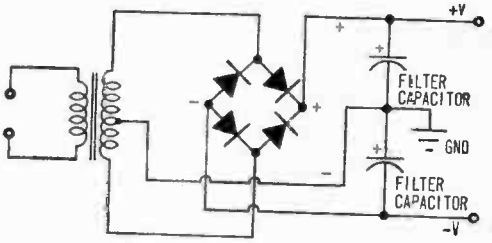


Fig. 8. Even cheaper way to achieve bi-polar output is to combine bridge rectifier with center-tapped power transformer. Full-wave output is easy to filter, ideal for most OpAmp circuits.

An alternative approach is shown in Fig. 8 above. Using a power transformer having a split-secondary (center tapped) and a bridge rectifier, you produce a center-tapped supply with full-wave rectification on both sides, which requires much smaller filter capacitors.

The more popular power source is a single-ended power supply having positive and negative output leads—generally either side may be grounded. By connecting two 4700-ohm resistors across the supply, the junction of the resistors becomes the center tap (ground) and each side of the supply will provide output voltages of opposite polarity with respect to the center tap or ground. ■

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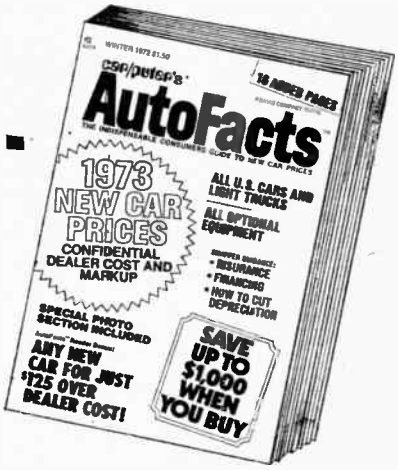

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Continued from page 10

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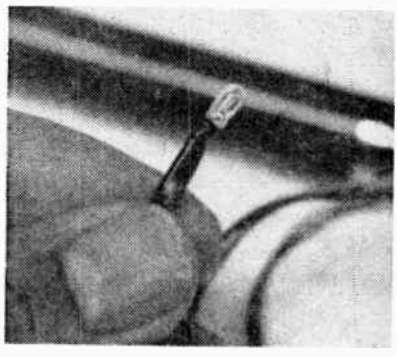

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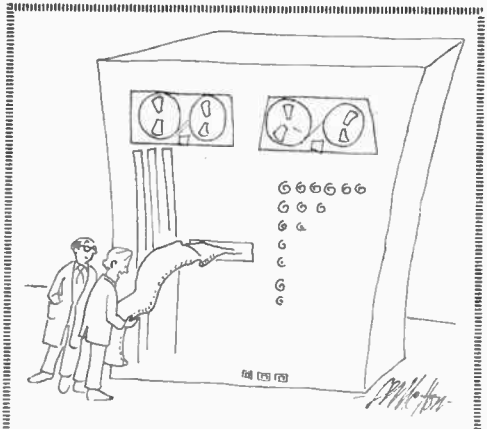
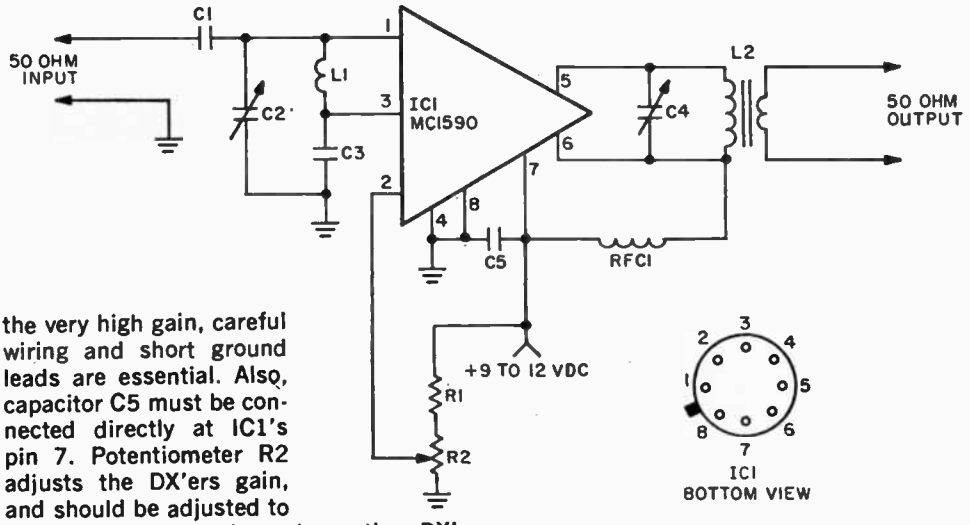


"No doubt about it, Nickolaus, that is a dirty limerick!"

30 IC Circuits

Continued from page 100



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'ers 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.

PARTS LIST FOR TEN METER DX'ER

C1—50 pF, 500 VDC cermic 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.

"A poor man's 4-channel rig!"

20 Passive Circuits

Continued from page 24

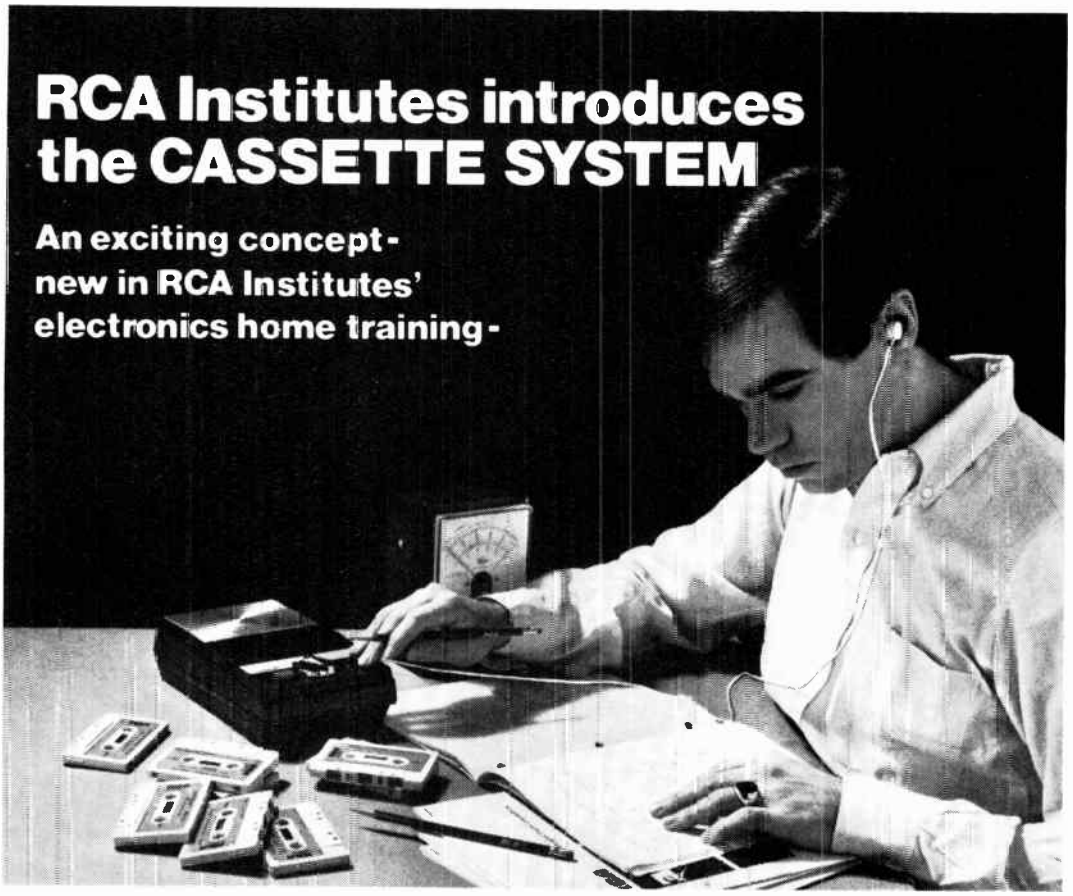
and two resistors are all that's needed to squelch your SW receiver. And if you can't scrounge the lamps, they're available at just about every radio parts distributor and service shop. Switch S1 is needed only to bypass the squelch for very weak signals. In many instances, the circuit will provide a 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.

PARTS LIST FOR SWL'S SQUELCH

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

RCA Institutes introduces the CASSETTE SYSTEM

An exciting concept - new in RCA Institutes' electronics home training -



It's almost like having an instructor in your own home.

Now, another breakthrough from the company that brought you AUTOTEXT! It's the new RCA Institutes' CASSETTE SYSTEM, the innovative, learning-by-hearing approach designed to get you started more quickly and easily towards an electronics career. The CASSETTE SYSTEM adds an extra dimension to AUTOTEXT, RCA's step-by-step, planned instruction which simplifies the mechanics of learning. As you play the cassette tapes, you'll have an instructor guiding you through your AUTOTEXT lessons. Explaining the material as you read it. And now the CASSETTE SYSTEM is available as an optional extra to all students enrolling in basic, fundamental, and career programs.

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In addition, you get the all-important "Hands-On" training. You perform experiments and build a number of pieces of electronics test equipment that are yours to keep. In the Master TV/Radio Servicing program you build and keep an all solid-state black & white TV set and a color TV set, oscilloscope and multimeter.

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BUILD 20 RADIO and Electronics Circuits

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Training Electronics Technicians Since 1946

Now Includes
- ★ 12 RECEIVERS
- ★ 3 TRANSMITTERS
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- ★ SIGNAL TRACER
- ★ AMPLIFIER
- ★ SIGNAL INJECTOR
- ★ CODE OSCILLATOR

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ EXCELLENT BACKGROUND FOR TV
- ★ SCHOOL INQUIRIES INVITED
- ★ Sold In 79 Countries

YOU DON'T HAVE TO SPEND HUNDREDS OF DOLLARS FOR A RADIO COURSE

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL.

You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build Receiver, Transmitter, Square Wave Generator, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the low price you pay. The Signal Tracer alone is worth more than the price of the kit.

THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment. Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations. Then practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector Circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build twenty different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, coils, volume controls and switches, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C. Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

Progressive "Edu-Kits" Inc., 1189 Broadway, Dept. 505FC Hewlett, N.Y. 11557

FREE EXTRAS

- SET OF TOOLS
- SOLDERING IRON
- ELECTRONICS TESTER
- PLIERS-CUTTERS
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

FROM OUR MAIL BAG

J. Stataitis, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself. I was ready to spend $240 for a Course, but I found your ad and sent for your Kit."

Allen Valerio, P. O. Box 21, Magna, Utah: "The Edu-Kits are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to work with Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute I worked with the different kits; the Signal Tracer works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Trouble-shooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

A Printed Circuit is a special insulated chassis on which has been deposited a conducting material which takes the place of wiring. The various parts are merely plugged in and soldered to terminals.

Printed Circuitry is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.

Please rush me free literature describing the Progressive Radio-TV Course with Edu-Kits. No Salesman will call.

NAME .....

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CIRCLE NO. 11 ON PAGE 9 OR 108