FUN PROJECTS EVERYONE WANTS!

ELECTRONICS HOBBYIST

SPRING-SUMMER 1977 $1.35 CC 02396

By the Editors of ELEMENTARY ELECTRONICS

IMPROVE YOUR CB

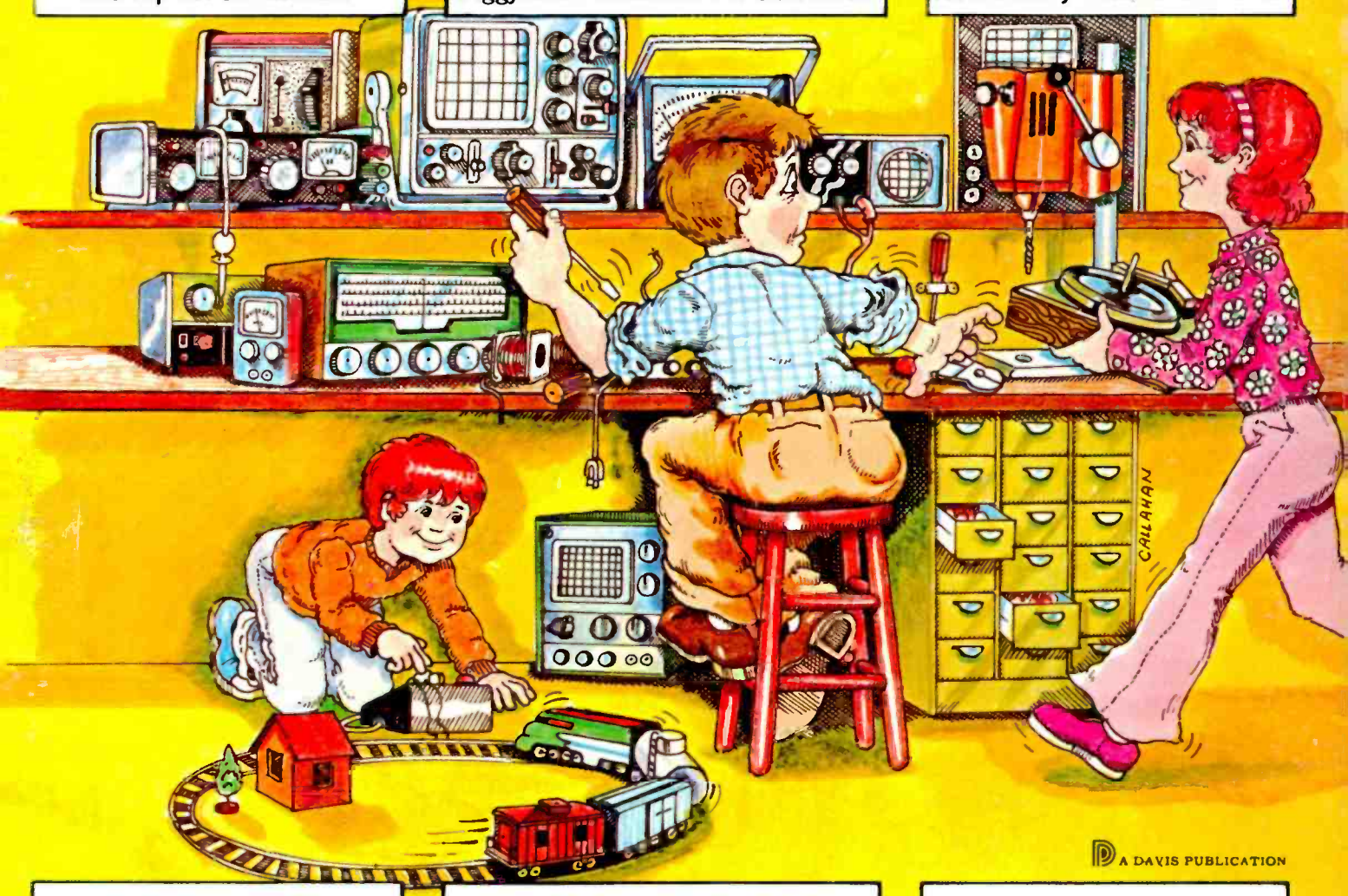
Kill SWR for CB DX
Convert Pocket Scanner to CB
Anti-Rip-Off CB Antenna

RADIO PROJECTS

Power Up Antique Radios
Build a See-Through Crystal Set
Piggyback Preselector For Shortwave

TEST GEAR

One Second 555 IC Tester
Make Your Own Meter
Auto Battery Monitor and Tester



A DAVIS PUBLICATION

10 QUICKIE PROJECTS

Photo Timer • Signal Tracer
• Intercom • Mike Compressor
• and more!

PROJECTS FOR THE HOME

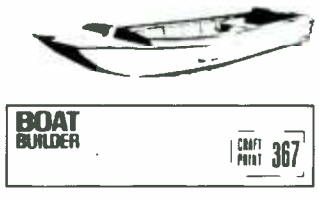
Handy AC Outlet Checker
6-Digit LED Clock for $10
Design Your Own Speaker System

PLUS:

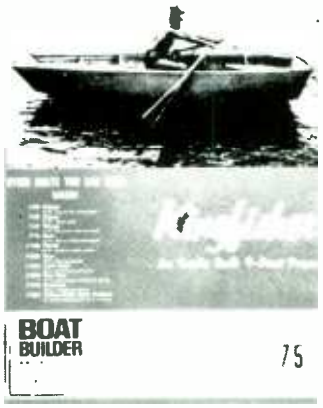
AC Speed Control • Record SW
Broadcasts • CB New Products
• and much, much more!

Build the REAL THING—Yourself!

Get top mileage from your own craft skills



367. ROBIN is a versatile skiff that can be used for hunting or fishing, as a yacht club tender, or a work boat. It is rugged, yet its plywood construction makes it easy to build; no special jig or tools are needed. It can take a motor of 7-10 hp. L.O.A., 12'; beam, 5'1". $5.00

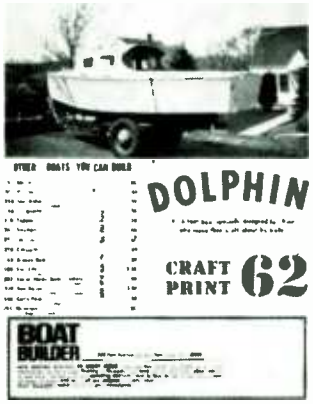


75. KINGFISHER is a modern version of the Scandinavian pram developed hundreds of years ago. It rows easily, sails well, and propels nicely with a small outboard motor. Its 90 lb. weight and small size make it ideal to car-top; construction is plywood. L.O.A., 9'; beam, 4'. $5.00

245. CAT'S PAW catamaran provides a stable base for a lot of sail area to make for fast sailing. And she's easy to build because of her straight-sided hulls, flat sheer, and straight bow and stern. It's an ideal boat in which to learn sailing. L.O.A., 12', beam, 6'2"; sail area, 85 sq. ft. $6.00

343. MINIMOST is an 8' outboard sports hydro you can build in just 15 hours, and at a cost of less than $25 for materials. Its advanced underhull design makes speeds in the 30 mph range possible with a 10 hp motor. L.O.A., 8'. $5.00
Full-size pattern set 344 $15.00

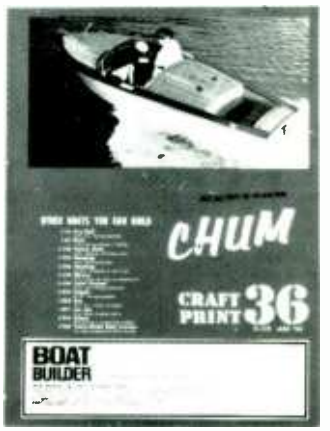
Make it with Craft Prints and save hundreds of $S!



62. DOLPHIN is small and light enough to be transported anywhere by trailer, yet it will accommodate two persons for extended cruising or a party of four on day trips. Plywood is used throughout, and the hull is designed to get the most from modest power. L.O.A., 16'; beam, 5'9". $5.00

356. TABU gets up on plane, just like an outboard, to provide speeds up to four times higher than those possible with a conventional hull of the same size. Hull is of plywood, covered with resin and Dynel cloth. L.O.A., 16'; beam, 4'8"; draft, centerboard down, 2'6"; sail area, 165 sq. ft. $5.00

371. JAMAICAN is a sailing surfboard of unique construction. Fiberglass and Dynel cloth are stretched and stapled in place over a wooden framework, then resin is applied. No special building jigs or forms are needed. Foamed-in-place polyurethane adds stiffness. L.O.A., 12'; beam, 3'. $5.00



36. CHUM is a speedy little runabout that can be built as a single cockpit or double cockpit model. Use a lightweight engine of no more than 100 hp for top performance. Construction is of marine plywood over hardwood frames. Decks are of mahogany-faced plywood. L.O.A., 15'6" $5.00

COMPLETE AND MAIL TODAY

EHS7

Boat Builder 229 Park Avenue S. New York, N.Y. 10003

Enclosed is _____. Please add 50¢ for postage and handling. Send me the Craft Print(s) I have checked below:

☐ #367 $5.00 Add 50¢
☐ #245 $6.00 Add 50¢
☐ #62 $5.00 Add 50¢
☐ #371 $5.00 Add 50¢
☐ # 75 $5.00 Add 50¢
☐ #356 $5.00 Add 50¢
☐ #36 $5.00 Add 50¢
☐ #343 $5.00 Add 50¢
☐ #344 $15 full-size pattern set. Add 50¢

SATISFACTION GUARANTEED.

Name _____

Address _____

City _____ State _____ Zip _____

The chances are excellent that...

You have a talent other people are willing to pay for!

You're "handy" around your house, have the ability to fix things, and "make them work right"... that's why there may be a rewarding career for you in Electronics.

A career in Electronics?

Absolutely. Because you're interested in *things*. How they work. Why they work. How to take them apart and put them back together. Plus . . . you've got a head for detail work.

Your chances are excellent

With the right kind of *specialized* technical training, you can have a challenging, financially rewarding future waiting for you in Electronics. Think of the career opportunities . . . computers, aerospace, 2-way radio communications, radio/TV broadcasting, medical electronics, to name just a few.

And, surprisingly, you don't need a college degree!

All you need to do to qualify for one of these exciting career fields is to build upon the technical aptitude you already have . . . just put your hands and your head to work with a CIE Electronics career course.

You learn by doing

The CIE method of instruction is the refinement of over 40 years of Electronics, independent home-study experience. It works. And you don't need *any* prior electronics experience. A CIE *career* course can take you from ground zero right up to training in Lasers, Microminiaturization, Radar, Analog Computers, and various applications in Communications.

In some CIE courses, you'll perform "hands on" experiments and tests with your own CIE Experimental Electronics Laboratory. And, if TV technology and digital Electronics are your main interest, you can select from several courses that involve working with and troubleshooting a TV. (And the TV is yours to keep, too!) This combination of "head and hands" learning *locks in* your understanding of the crucial principles you'll use on-the-job in your new career. But, don't kid yourself . . .

Electronics is not an "easy" science and CIE courses are not "snaps." Subject matter is technical, thorough, and challenging. It has to be. We're training you for a *career*. So the presentation of ideas is logical, written in easy-to-understand language . . . you progress step-by-step, at your own pace.

CIE Education by mail

There is no need to "go back to the classroom" with CIE. Because you learn at *home* or wherever else is convenient. You keep your present job and income. No cross-town commutes. *You* decide when and where *you* study best.

Your eventual success . . . at CIE and in your electronics career . . . will be determined by your own motivation and self-discipline. You *can* do it. And CIE can show you how.

Put your talent to full use

We believe that you may be a "natural" for Electronics, and we'd like to tell you more about potential career fields and our school. We'll be glad to send you our complete package of FREE career information if you'll send in the card or coupon or write CIE (include name and date of this publication), 1776 E. 17th St., Cleveland OH 44114. For your convenience, we'll try to have a school representative call to assist you in course selection. As soon as we receive your request, we'll mail you our school catalog, complete G.I. Bill details and booklet on FCC License preparation. There's no obligation.

Let's discuss your new career in Electronics, NOW! Send for your FREE school catalog and career information TODAY.

CIE **Cleveland Institute of Electronics, Inc.**
1776 East 17th Street, Cleveland, Ohio 44114
Accredited Member National Home Study Council

Yes, I want your FREE school catalog and career information package.
EB-22

Print Name_____

Address_____ Apt._____

City_____ State_____ Zip_____

Age_____ Phone (Area Code) _____ No. _____

Check box for G.I. Bill information: ☐ Veteran ☐ On Active Duty

THE STAFF

Electronics Group Coordinator and Editor-in-Chief
Julian S. Martin, WA2CQL

Managing Editor
Morgan W. Godwin, W4WFL

Technical Editor
Charles Graham, W1HF!

Associate Editor
Christine Begole, KFC3553

Citizens Band Editor
Kathi Martin, KGK3916

Editorial Assistant
Sandra Barack

Workbench Editor
Hank Scott

Art Director
Ralph Rubino

Assistant Art Director
Augustus Ginnochio

Cover Art Director
Irving Bernstein

Art Assistants
Bob Modero
Joni Erlon

Production Director
Carol Bartee

Production Editor
Geri Brakatselos

Advertising Director
David J. Miller, KCX1268

Advertising/Research Associate
Jyll Holzman

Newsstand Circulation Director
Don Gabree

Director of Market Development
James C. Weakley

President and Publisher
Joel Davis

Vice President and General Manager
Leonard F. Pinto

Vice President and Treasurer
Victor C. Stabile, KBP0681

MPA

MEMBER IHF INSTITUTE OF HIGH FIDELITY

ELECTRONICS HOBBYIST is published semi-annually by Davis Publications, Inc. Editorial and business offices: 229 Park Avenue South, New York, New York 10003. Advertising offices: New York, 229 Park Avenue South, 212-OR 3-1300; Chicago, 520 N. Michigan Ave., 312-527-0330; Los Angeles: J. E. Publishers' Rep. Co., 8732 Sunset Blvd., 213-659-3810.
EDITORIAL CONTRIBUTIONS must be accompanied by return postage and will be handled with reasonable care; however, publisher assumes no responsibility for return or safety of manuscripts, artwork, or photographs. All contributions should be addressed to the Editor-in-Chief, ELECTRONICS HOBBYIST, 229 Park Avenue South, New York, New York 10003.

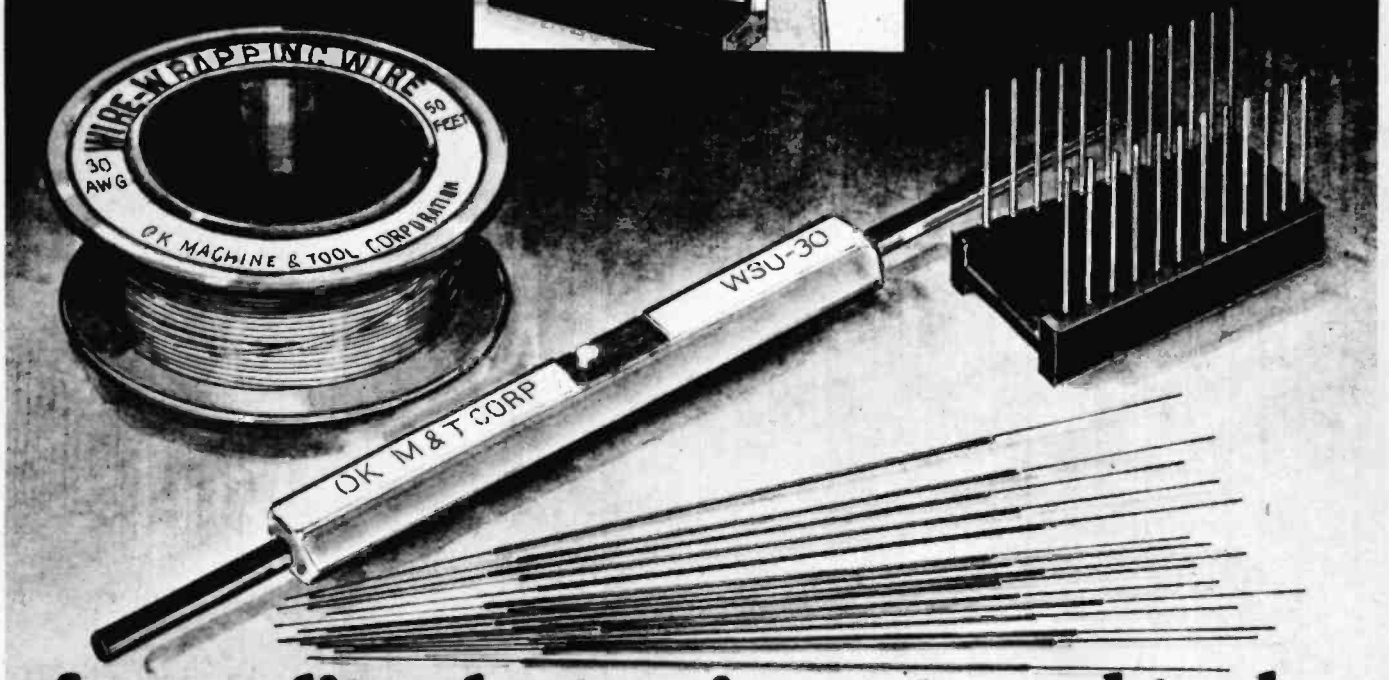
ELECTRONICS HOBBYIST

PROJECTS **SPRING—SUMMER 1977**

SNAPPY IDEAS

COLUMNS

ok wire wrapping center...



for quality electronic parts and tools.

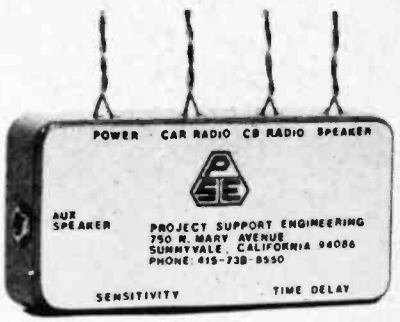
OK MACHINE & TOOL CORPORATION
3455 Conner St., Bronx, N.Y.10475 / (212) 994-6600 / Telex 125091

CIRCLE 7 ON READER SERVICE COUPON

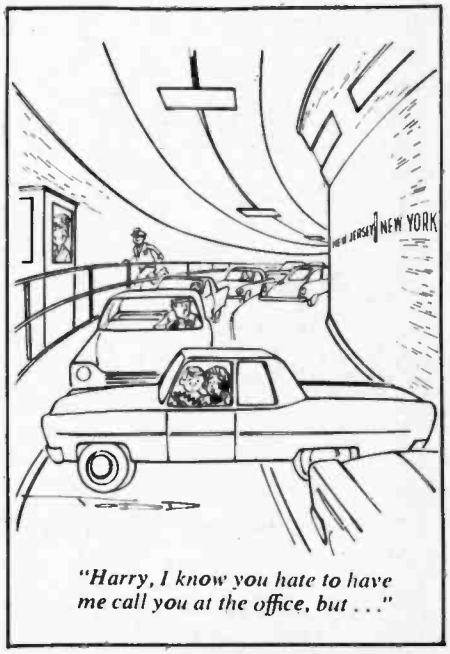
New Products

Never Miss a Call

Project Support Engineering has an automatic voice actuated switching circuit for CB enthusiasts called AVASC. The AVASC installs beween the car radio speaker and the CB unit. When there is no CB signal present, the car radio, tape deck, etc. will play through the car speaker. When a call comes in through the CB unit, the AVASC disconnects the car radio while simultaneously putting the CB call through the car radio speaker. There is an adjustable time delay in the AVASC that enables the user to choose 0 to 15 seconds to compensate for any delays in the conversation. When the incoming transmission is completed, the AVASC automatically switches the car radio back on and is ready for the next transmission. The suggested retail price of the AVASC is $29.95. Write to Project Support Engineering, 750 N. Mary Avenue, Sunnyvale, CA 94086 for complete info.



CIRCLE 68 ON READER SERVICE COUPON



"Harry, I know you hate to have me call you at the office, but . . ."

Scanner for Listener

Shortwave listening originally started with DX hounds straining their ears for any sound that could possibly be a foreign SW station, and the more distant the better. Today, SWLs have become as interested in the action on police, fire, and marine bands. Many of them now get their weather reports via NWS broadcasts and like to listen in on CB and business radiotelephone conversations. Surveyor's Model 10P Scanner, covering the VHF Hi/Lo and UHF bands, lets them get in on the action and hear it, not as some later TV news report, but as it happens. The Surveyor 10P Scanner has two facilities with great appeal to listeners. It lets the listener program easily and quickly to any frequency on the three bands. There is also a priority switch that is the listener's assurance of hearing transmission on Channel 1, even though a signal is being received on another channel at the same time. And, of course, a fully tunable squelch for complete noise control. Completely solid-state throughout, the 10P can be used at home or mobile with a power converter. Its dual conversion circuit is an assurance of knife edge selectivity, working against spillover from one channel to the next. The 10P has a 10-channel capacity and all channel numbers are uncrowded and clearly visible. The unit comes equipped with an AC and DC power cord, mounting bracket, hardware and an antenna for indoor use. The suggested list price of the 10P Scanner is $189.00. For further information, please write to Surveyor Manufacturing Corporation, 7 Electronics Court, Madison Heights, MI 48071.

CIRCLE 45 ON READER SERVICE COUPON

Good Sound 3-Ways

Olson Electronics announces a new three way 10-inch speaker system as part of their Acoust-Aire family of hi-fidelity speaker systems. The new model is SP-355, a 10-inch three-way acoustic suspension speaker with a 10-inch woofer with a 4 lb. magnet, a 5-inch sealed back mid-range speaker with ½ lb. magnet, and a 2¼-inch super tweeter with ½ lb. magnet. The crossover points are at 2200 and 6000 Hz. Cabinet construction is oiled walnut laminated over ⅝-inch thick acoustic wood. The finish is mar and scuff proof, the cabinet is fiberglass filled. Power handling capacity of 3 watts RMS with a frequency response of 30 to 20,000 Hz at 8 ohms. Cabinet size is 13¼ x 22¾ x 10⅝-inches. Shipping weight is 32 lbs. The SP-355 retail selling price is $69.00. For more information, write to Olson Electronics, 260 South Forge Street, Akron, OH 44327.

CIRCLE 56 ON READER SERVICE COUPON

Programmable Crystal-Less Scanner

Here's a ten-channel AC/DC crystal-less scanner receiver which digitally serves up 16,000 different radio frequencies. It's the Opti/Scan by SBE which takes its name from a unique optical card reader used in programming the device's memory. With a pre-programmed card inserted in the unit, ten channels can be sequentially scanned for continuous automatic monitoring. Frequencies to be scanned can easily be

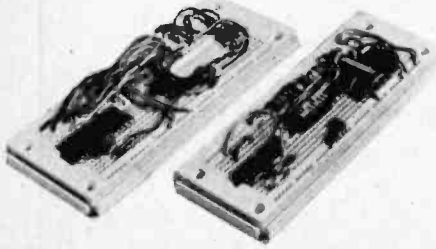
New Products

CIRCLE 69 ON READER SERVICE COUPON

changed simply by inserting a different pre-programmed card which is approximately the size of credit cards. Any frequency within the public service, land mobile, marine, or business-industrial FM bands (30-50 MHz, 150-170 MHz, 450-470 MHz, and 490-510 MHz can be programmed). Frequencies on any of the four bands can be mixed on a single card. The unit comes with antennas that cover all bands—VHF Lo/Hi, UHF—and can be operated in either manual or scan mode. It boasts receiver sensitivity of less than half a microvolt and utilizes highly selective filters to insure good cross modulation characteristics. SBE's Opti/Scan is priced at $348.95. Further information is available by writing SBE, Inc., Dept. P, 220 Airport Blvd., Watsonville, CA 95076.

Solderless Breadboards

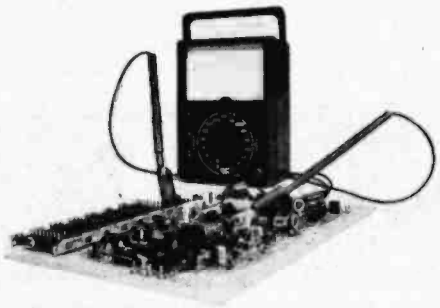
Continental Specialties has two new solderless breadboarding sockets. Designated Experimentor 300 and Experimentor 600, the new one-piece sockets both provide 94 five-point terminals, plus two 40-point bus strips, for a total of 550 solderless tie-points. Experimentor 600, priced at $10.95, has a 6/10-inch center channel, making the only socket currently on the market with full 4-terminal fan-out for microprocessors, clock chips, RAMs, ROMs and other larger DIP packages. Experimentor 300, priced at $9.95, has a 3/10-inch center channel that is perfect for smaller DIPs. Both Experimentor sockets also accept transistors, LED's, resistors, capacitors, pots—virtually all types of discrete components, as well as lengths of #22-30 solid hookup wire for interconnection—with plug-in ease. Both Experimentor sockets also feature a unique interlocking system that permits sockets to be snapped together, mixed or matched, vertically or horizontally, to provide optimum configurations for almost any type of circuit, and instantly disconnected or reconnected, without tools, to meet requirements. CSC Experimentor sockets are available now from CSC distributors and dealers, or directly from CSC's East- or West-Coast offices. For more information, contact CSC at 44 Kendall St., Box 1942, New Haven, CT 06509.



CIRCLE 41 ON READER SERVICE COUPON

FET Volt-Ohmmeter

The new solid-state drop-proof, burn-out-proof model 64 FET Volt-Ohmmeter by Triplett has six low-power ohms ranges. Battery operated, the Model 64 has an open circuit voltage of only 90 mV for fast incircuit resistance and continuity measurements without biasing or destroying sensitive diodes, ICs or transistors. The model 64 was developed for use in test laboratories, manufacturing quality control departments, field servicing, plant maintenance and vocational or trade schools. The colorful bright green 29-range tester is also easy to use

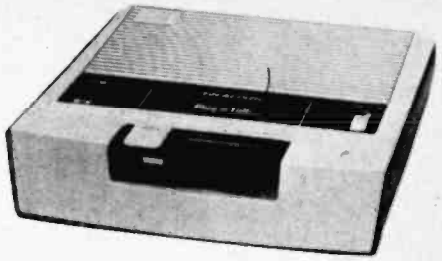


CIRCLE 51 ON READER SERVICE COUPON

with its single range selector switch. A single selector switch simplifies access to 29 ranges, including: DC Volts 0-0.3, 1, 3, 10, 100, 300, 1000; AC Volts 0-0.3, 1, 3, 10, 30, 100, 300, 1000; Ohms Low Power 0-1k, 10k, 100k, 1M, 10M, 100M: Ohms Conventional 1000M; Junction Test forward and reverse conduction. For further information on the new multi-range Model 64 Volt-Ohmmeter priced at only $130.00, and additional accessories to extend its use in highly specialized applications, contact the Triplett Corporation, Marketing Dept., Bluffton, OH 45817.

FM Wireless Intercom

Radio Shack's 2-channel, 3-station FM wireless intercom is a convenient home or office communications system. Called the SelectaCom, it works on frequency modulation (FM) to provide interference-free sound. An adjustable squelch control (like on your CB) on the rear of each unit eliminates background noise when they are not in use. Each Selecta-

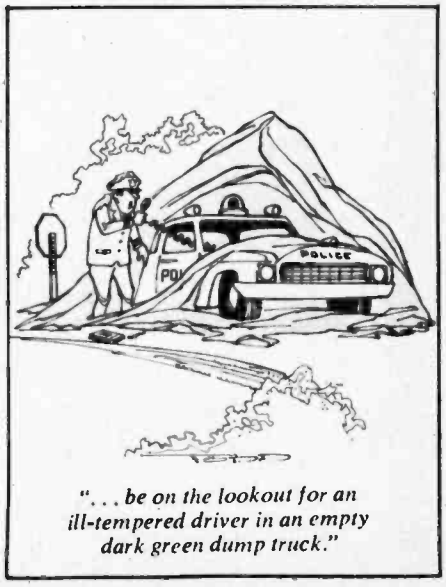


CIRCLE 46 ON READER SERVICE COUPON

Com unit has a volume-on/off thumbwheel control and a red LED pilot lamp which glows while the unit is on. A selector switch lets you operate on either channel A or B. Located just above the talk bar is a call lever which can be used to "beep" the other stations. The talk bar can be locked on for use as a remote babysitter or monitor. Each unit can be moved easily from room to room, upstairs or downstairs, to the basement, garage or patio. Just plug one into the nearest electrical outlet for instant audible contact with the other stations. The Realistic SelectaCom FM Intercom, priced at $119.95, is sold and serviced exclusively by Radio Shack. Radio Shack stores and dealers are found in all 50 states and Canada.

16-In-One Mike

With 16 different equalization possibilities, the Shure tape recording microphone allows the user to control equalization by means of four filter switches located right on the body of the microphone. The microphone, called the Model 516EQ E-Qualidyne, has filter switches tailored to the microphone's response characteristics. For example, by activating the microphone's high frequency switch, a user can smooth out nasal and sibilant "sss" sounds. Activating the unit's low frequency switch results in the reduction of resonating "boominess." Up to 16 different combinations of switch settings change the microphone's characteristics from mellow to



"... be on the lookout for an ill-tempered driver in an empty dark green dump truck."

CIRCLE 32 ON READER SERVICE COUPON

bright, or strengthen or de-emphasize mid-range material. The Model 516EQ E-Qualidyne also offers an excellent unidirectional pickup pattern to minimize the pickup of unwanted background noises. A highly efficient mechanical isolation mount also reduces handling and stand noises. The Model 516EQ E-Qualidyne is available singly for $75.00 and in pairs for stereo tape recording for $135.00. For further information, write to Shure Brothers, Inc., 222 Hartrey Avenue, Evanston, IL 60204.

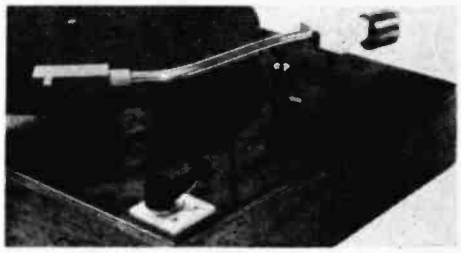
Simple Security

The trouble with many anti-theft car devices is that the hookup is a lot of work. The new compact Model 3001 "Quick Connect" (Q.C.) Auto and CB Security System requires only a 3 wire hook-up to intermittently sound any car horn after illegal entry. No horn relay is required. The system is designed to protect CB radios, scanners, speakers, tape deck, stereo radios and your auto from being ripped-off by thieves. It is also for use in RVs, sports cars, and trucks. It can be installed in less than 30 minutes. The simple Q.C. alarm system is triggered by current flow caused when any light in the automobile is turned on by opening any door. If equipped with a light, the vehicle trunk or hood is also protected by the system. The System's circuitry beeps the car horn for 2½ minutes to scare-off would-be thieves. The system then shuts down and automatically rearms itself. Excessive battery drain or horn damage associated with continuous horn operation is avoided, and the system shutdown feature also eliminates the nuisance problem of accidently tripped alarms. For further information on this mobile CB security system, available nationwide at CB and automotive distributors and selling for only $17.95, contact Harcor International, Inc., 744 Algonquin Road, Dept. PR., Arlington Heights, IL 60005.

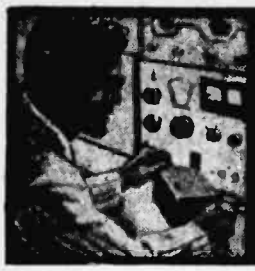
CIRCLE 42 ON READER SERVICE COUPON

Pneumatic Tone Arm Lift

The new pneumatic tone arm lift by Audio-Technica is an important addition to single-play turntables without built-in cueing devices. The arm operates by air pressure rather than fluid, thus eliminating leakage and pressure changes due to temperature. The AT6005 Pneumatic Arm Lift is easily mounted on most turntable bases and raises tone arms 9/64-inch. For flexibility in mounting, the new A-T lift features a 20-inch rubber tube which permits placing the lift actuator on any turntable base location. The tone arm lift's price is $29.95. Audio-Technica U.S., Inc., headquartered at 33 Shiawassee Avenue, Fairlawn, OH 44313 is where you write for more info. ■



CIRCLE 63 ON READER SERVICE COUPON



ASK HANK, HE KNOWS!

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

Hank Scott, Workshop Editor
ELECTRONICS HOBBYIST
229 Park Avenue South
New York, NY 10003

Thought in Harness

Is co-phasing two antennas that important, or is one antenna really enough?
—K. D., So. Fallsburgh, NY

If you are using two antennas on one vehicle, yes. If you are using one antenna, and would like to know if two are better, yes. But let me say that two antennas do not give you twice the signal that one would offer. What two antennas do is give an improved omnidirectional radiation pattern better than one antenna does. Of course, we are talking about mobile antennas mounted on the worst ground plane in the world—you car. The harness of cables interconnecting the antennas and the CB set do two things of importance. One, the harness provides the correct cable lengths so that the antennas will be in step with each other, and two, the harness provides the antennas' impedance matching for minimum SWR and power transfer. This is co-phasing and it may be important to you.

Calculators Count

Hank, why should I learn how to do log problems using tables and long-hand as required in my school when the pocket calculator my Dad bought for me does it all in seconds? Please don't mention my name as the school's principal reads ELEMENTARY ELECTRONICS,
—X.X., Some City, MN

Okay, X.X., as you say! The solving of Log problems is not as important as understanding that logs are really numbers that are expressed by exponents of 10. When you multiply two numbers, you add their exponents. Once you know all the ins and outs of exponents and logs, use your calculator. Me, I still use the old fashioned slide rule on difficult problems. It takes longer and gives me time to think. Once I know exactly what I am doing, the calculator is the greatest.

Sheets Stop Eddies

Why do they use laminated iron sheets to make up the iron core of a transformer in power supplies?
—T.S., Oklahoma City, OK

The use of metal laminations greatly reduces eddy current losses. These eddy currents in the iron core of a transformer serve no useful purpose and expend energy in the form of heat. Just touch the iron core of a power transformer after it has been in use, and you'll feel the heat. Imagine the heat loss multiplied several times when a single iron bar is used in place of laminations. The heat could burn the insulation and melt the copper wire.

It Is Not the Mailman

I tore out the information postcard in ELEMENTARY ELECTRONICS, *circled several numbers, mailed it and nothing came in three weeks time. What gives?*
—H. M., Burlington, NC

The mail does take time, but the biggest delay is the handling of the postcards. When we receiver your card, your name and numbered literature request is cranked into a computer. The computer combines all the requests and they are mailed to the manufacturer, who does need some time to stuff the envelopes and send the mail out. It's complicated, and takes time. Sorry. But it's worth while waiting for the literature.

The Stories They Tell

My dad told me that scientists, in the years to come, will be able to make atom bombs in kitchen sinks. Can this be true?
—R. L., Stockton, CA

The chef at my local diner does it now. Give him a place to stand and enough hash, and he'll move the earth.

Dial Troubles

How do I know the frequency calibrations on my SWL receiver dial are accurate? *—H. N., Macon, GA*

I can tell you for sure—it's not accurate. I checked my receiver with an RF signal generator and an electronic frequency counter. Pumping a known signal into my rig proved the dial was a little off. I did some fine tuning adjustments in the RF circuit, but some error still remained. So, I made up a calibration chart for each band. At each half-inch across the eight-inch dial I knew how many cycles to add or subtract to each dial reading. In general, the error possibility increases as the band frequency increases.

It's in White's

How can I get a list of FM stations in my state? *—D. M., Ft. Worth, TX*

Pick up a copy of the latest COMMUNICATIONS WORLD magazine. In it you'll find White's Radio Log which lists AM. FM and TV stations for the U.S. and Canada. Can't find a copy? Then write to COMMUNICATIONS WORLD. 229 Park Avenue South. New York, NY 10003 and enclose a check for $1.25 plus 35¢ for postage and handling.

Gets the Lead Out

What would happen if a lead acid battery was shorted out by a heavy bus bar that could not melt? My buddy says nothing, but I don't think so. What do you think?
R.K., New Hyde Park, NY

The lead acid cell, like any other battery, will tend to overheat and maybe even to self-destruct. Excessive heating in a lead-acid battery causes sulfation, plate bucking and electrolyte boil-off. The next result will be an interior short in one of the cells. If the battery survives, its overall capacity to deliver its rated ampere-hours will be greatly reduced.

Saves Old Copies

Where can I get the Clairex CL5M5L photocell, (can't substitute) for Color Analyser project described in ELEMENTARY ELECTRONICS *September-October 1974 issue.*
—J.R., Bronx, NY

Send a check to cover the amounts of $3.00 for each photocell and $1.00 for postage and handling to Electronics Hobby Shop, Box 192, Brooklyn, NY 11235. Tell 'em Hank sent you.

It's the Truth

Nick Nemec did not know that he had a receiving set in his head until the first radio broadcasting station in Newark, New Jersey, went on the air. Nick worked in a machine shop near the station sharpening tools on a carborundum grindstone. Despite its screeching and whining as he pressed the blades against it, Nick heard music or talking. After a time he became frightened and asked Jim, who worked nearby, "Jim, you hear music playing now?" "No, Nick, whatsa matta? You hear music?" "Yeah!" "You hearing angels, maybe, Nick? "No, Jim, angles." "Let's go tell the boss," answered Jim. When they walked into the boss's office, his new radio was playing softly. "Liber Gott," exploded Nick. "It's playing the tune I got in my head!" The boss, a practical man, took Nick to the radio staiton. The manager, puzzled, agreed to put Nick in a soundproof room and let him report what he heard. Nick reported accurately the programs aired. Nick was examined by a great number of doctors, none of whom uncovered any abnormalities or could suggest any remedy for his misery. Finally, they sent him to a dentist. As the dentist scraped away the plaque covering Nick's teeth, he discovered bits of carborundum lodged in the molars. As this was cleaned out the music died. The carborundum had created an atmosphere in Nick's mouth favorable to reception of the electro-magnetic waves sent out by the station. With shining teeth Nick walked out of the dentist's office once more able to enjoy peace and quiet in his own head. Hank, this is a true story!
P.K.R., Colorado Springs, CO

Who cares! It's a nice story.

We Did Something Right

I am in a poor reception area. I couldn't resist using the info in Dan Ramsey's "Mini-Cost Multiband Antenna" article (to construct an FM antenna for my stereo system). I cut the twin lead 5-ft. 6-in. long—long enough to trim it for any FM channel. I trimmed one wire to 4-ft. 9⅝-in. for 97.3 MHz, our favorite FM station —CJCA Edmonton, Alberta, Canada. Then I connected the twin lead to coax as per Dan's instructions, and hooked it up to

my tuner. Well, our reception is so good now, people swear our FM is as good as our records and tapes. Thanks for a great article, Hank.

—D.F., Edmonton, Alberta

Keep the good comments coming in even if I don't deserve them. It's the authors who do the original work and the editors who check it out and get it into print. My contribution is to go for coffee and try not to get underfoot.

I Can't Hear You

I was wondering if you could print or send me the plans for a CB preamplifier. I have the problem of being heard better than I can hear.

—R. H., Gardnerville, NV

You don't need plans, you need servicing. It is commonly understood, that, if you can be heard, you can hear on the CB channels and vice-versa. Your receiver may be out of wack. Have it checked. And if it is okay, but just poor, then buy a commercial type preamp. They are inexpensive and easy to install. EICO makes a nice CB preamp.

No Choice

I just got my CB license and it has four letters, not three. Which ones should I use?

—C. H., Tampa, FL

Your call begins with KAAC and you use all four letters. The FCC ran out of three letter calls. The way CB is going, they'll run out of four letter calls. Check the FCC Rules in this issue. They made a change.

So Long TVI

I hear the FCC will require the owner of CB sets causing TVI to add low-pass filters to the RF output. I like the idea, and is it true? —C. E., New Orleans, LA

It's true and I think it's a good idea also. The TVI filter will not harm or reduce the efficiency of the CB set. If anything, it's a reminder that the set needs some retuning by a qualified serviceman.

MHz to kHz

Could you tell me how to convert kHz frequency numbers into MHz numbers, because all the radios I come across are in MHz instead of kHz.

—J. J., Gloversville, NY

It's easy, really! Just divide kHz by 1000 to get to MHz, or multiply MHz by 1000 to get kHz. For example: 1 MHz = 1000 kHz; 10 MHz = 10,000 kHz; 30 MHz = 30,000 kHz; 21.75 MHz = 21,750 kHz. Just examine the examples given and you'll have no trouble doing it yourself.

Wants More Juice

Is it possible to increase the charging capacity (power) of one six-twelve volts battery charger?

—P. C., Trujillo Alto, PR

I'd say no! The transformer is designed for a certain maximum current. To replace it would require a large expense. Also, the meter, rectifiers, and possibly the internal wiring must be replaced. It's easier to buy a new unit.

The Law Has Ears

Is it illegal to tape program material off TV and radio programs?

—D. D., Little Chute, WI

If you record for your own personal use, the answer is no! You may play back the material for your viewing or hearing and include your immediate family, in your home. However, do not attempt to sell the material or use it to entertain others. For example, a restaurant owner recorded some musical programs and played it back for his patrons to enjoy while they ate. You guessed it, he was sued and lost in court. Just keep it to yourself and no one will (or can) complain

It's in White's

How can I get a list of FM stations in my state? —D. M., Ft. Worth, TX

Pick up a copy of the latest COMMUNICATIONS WORLD magazine. In it you'll find White's Radio Log which lists AM, FM and TV stations for the U.S. and Canada. Can't find a copy? Then write to COMMUNICATIONS WORLD, 229 Park Avenue South, New York, NY 10003 and enclose a check for $1.25 plus 35¢ for postage and handling.

It Is Not the Mailman

I tore out the information postcard in ELEMENTARY ELECTRONICS, *circled several numbers, mailed it and nothing came in three weeks time. What gives?*

—H. M., Burlington, NC

(Continued on page 16)

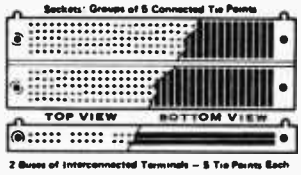
EVERY PROJECT ANOTHER REASON TO

Whether you're a hobbyist or serious experimenter, CSC's line of precision digital/electronics design and testing equipment can take the manual labor out of your labors of love.

In fact, we can not only save you literally hundreds of hours a year, but *hundreds of dollars* as well. On parts, accessories and test equipment.

Want proof? Read on — you'll see why we're the fastest-growing company in the field!

QT Sockets and Bus Strips*— time-saving, money-saving solderless breadboarding — the CSC way

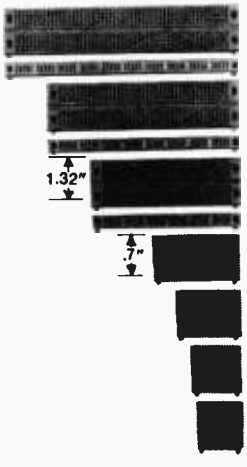


Our expandable, interlocking breadboarding system not only saves you hours of soldering, desoldering and resoldering, it also saves wear and tear on your components.

Resistors, capacitors, transistors, DIP's, LED's, micro-processors, etc., all connect with plug-in, plug-out ease. *Preassembled sockets with durable nickel-silver non-corrosive 5-point terminals* provide low-resistance interconnections you can arrange and rearrange at will. (And jumpers, where required, are short lengths of solid #22-30 AWG wire.)

Use QT Sockets and Bus Strips for designing, troubleshooting, interconnecting, patching and dozens of other applications. Our unique snap/lock mechanism joins units in seconds, so you can add-on or take-off at will.

Check the chart below for sizes and prices.
10 modestly-priced models to choose from — still at our original low prices.
All can be top or through-the-panel rear mounted.



	Length	Hole - to-Hole	Terminals	Unit Price $
QT-59S	6.5"	6.2"	118	12.50
QT-59B	6.5"	6.2"	20	2.50
QT-47S	5.3"	5.0"	94	10.00
QT-47B	5.3"	5.0"	16	2.25
QT-35S	4.1"	3.8"	70	8.50
QT-35B	4.1"	3.8"	12	2.00
QT-18S	2.4"	2.1"	36	4.75
QT-12S	1.8"	1.5"	24	3.75
QT-8S	1.4"	1.1"	16	3.25
QT-7S	1.3"	1.0"	14	3.00

*U.S. Pat. No. 235,554

All Prices Shown Are Manufacturer's Recommended List. Prices and Specifications Subject to Change Without Notice.

CONTINENTAL SPECIALTIES CORPORATION
44 KENDALL STREET/ BOX 1942
NEW HAVEN, CT 06509

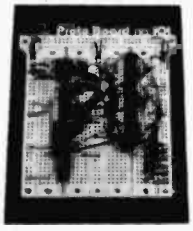
CIRCLE 11 ON READER SERVICE COUPON

IN THIS MAGAZINE IS READ THIS AD.

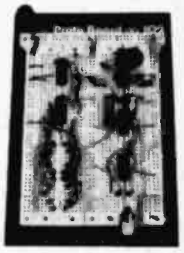
Build projects, test circuits, check components as fast as you can think... with CSC Proto-Board® Solderless Breadboards!

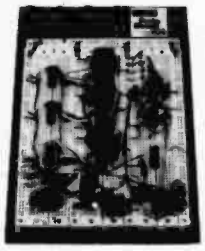
The right size for every circuit! The CSC Proto-Board system gives you the convenience and versatility of QT Bus Strips and Sockets *already mounted,* in use-tested configurations, on sturdy metal ground/baseplates** with non-marring feet. They're great for a wide variety of audio and digital projects, and you save money by using components over and over again.

PB-101—940 solderless tie points: ten 14-pin DIP capacity. Two QT-35S breadboarding sockets plus four QT-35B bus strips. Excellent for audio and smaller digital projects. Measures 4.5″ wide x 5.8″ long x 1.4″ high (114 x 147 x 35mm); weighs 9 oz. (.26 Kg). **Price: $29.95**

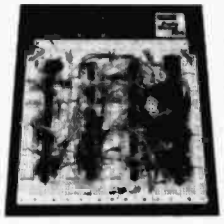


PB-102—1240 solderless tie points: twelve 14-pin DIP capacity. Two QT-47S breadboarding sockets, three QT-47B and one QT-35B bus strips. You'll want this one for intermediate digital needs, more complex audio projects among other things. Measures 4.5″ wide x 7″ long x 1.4″ high (114 x 178 x 35mm); weighs just 10 oz. (.31 Kg). **Price: $39.95**





PB-103—2250 solderless tie points: twenty-four 14-pin DIP capacity. Three QT-59S breadboarding sockets, four QT-59B and one QT-47B bus strips plus four 5-way binding posts. For all but the very largest circuits. Lets you build calculators, interfaces, complex switching circuits, etc. Measures 6″ wide x 9″ long x 1.4″ high (152 x 229 x 35mm); weighs 1.25 lb. (.57 Kg). **Price: $59.95**



PB-104—3060 solderless tie points: thirty-two 14-pin DIP capacity. Four QT-59S breadboarding sockets, seven QT-59B bus strips plus four 5-way binding posts. It's the largest breadboard we made for the largest projects you care to tackle—a CPU, encoder, complex display . . . just about anything. Measures 8″ wide x 9.8″ long x 1.4″ high (203 x 248 x 35mm); weighs 1.75 lb. (.79 Kg). **Price: $79.95**

Save even more with Proto-Board Kits! Invest ten minutes of your time, using nothing more than a screwdriver and a pair of pliers, and you can have all the time-saving, money-saving features of CSC's Proto-Board system, for even less money! CSC Proto-Board Kits come with all hardware, non-marring feet and sturdy base-plate. And unlike other kits, *all sockets are pre-assembled,* eliminating tedious assembly and assuring long, trouble-free life.

PB-6 Kit—630 solderless tie points: six 14-pin DIP capacity. Most economical way to take advantage of Proto-Board speed and convenience. One pre-assembled QT-47S breadboarding socket, two assembled QT-47B bus strips, four 5-way binding posts, metal ground/plane/base-plate, all required hardware. 10 minute assembly with pliers and screwdriver. Measures 6″ long x 4″ wide x 1.4″ high (152 x 102 x 34mm); weighs 7 oz. (.20 Kg). **Price: $15.95**

PB-100 Kit—760 solderless tie points: ten 14-pin DIP capacity. 21% larger capacity than PB-6 Kit. Comes with two pre-assembled QT-35S breadboarding sockets, one assembled QT-35B bus strip, two 5-way binding posts, pre-drilled and screened base-plate, non-marring feet and all required hardware. Fast 10 minute assembly. Measures 4.5″ wide x 6″ long x 1.4″ high (114 x 152 x 35mm). Weighs 7.5 oz. (.21 Kg). **Price: $19.95**

Now! Proto-Board convenience, plus regulated power! No need to hunt for a power supply when you're working with these CSC Proto-Board units. Built-in power supplies give you the DC power you need, with laboratory-precision regulation, plus low ripple and noise. Choose the PB-203 for digital circuits and other projects requiring 5V or less (with external components) or for maximum flexibility, the PB-203A, with 5VDC plus two independently-adjustable voltage sources.

PB-203—2250 solderless tie points: twenty-four 14-pin DIP capacity. *The Ultimate!!* All Proto-Board features *plus* short-proof, fused 5VDC, 1A regulated power supply with only 10mV ripple and noise at 0.5A; on-off toggle switch and pilot light. Three QT-59S breadboarding sockets plus four QT-59B and one QT-47B bus strips. Power supplied via two of the four 5-way binding posts. It all adds up to lots of capacity plus the proper DC voltage for most digital and many analog IC's. Measures 9.75″ long x 6.6″ wide x 3.25″ high (248 x 168 x 83mm). Weighs 5 lb. (2.27 Kg). For 117 VAC, 50/60 Hz (220 VAC, 50/60 Hz; also available at slightly higher cost). **Price: $75.00**

PB-203A—*The Ultimate . . . plus!!* All the features of the PB-203 including regulated 5VDC supply *plus* additional power supply flexibility (separate regulated +15VDC and −15VDC, 0.5A supplies, each with internally and independently adjustable output voltage; ripple and noise of + and −15V supplies, 10mV at 0.25A). Connections for 3 power supply voltages and ground available at four 5-way binding posts. Same size as PB-203; weighs 5.5 lb. (2.5 Kg). For 117 VAC, 50/60 Hz (220 VAC, 50/60 Hz; also available at slightly higher cost). **Price: $120.00**

TURN PAGE FOR MORE CSC PRODUCTS AND EASY ORDER FORM

**PB-100 has fibreglass-reinforced plastic baseplate.

8 MORE WAYS TO DO IN A LOT LESS TIME-FOR

CSC's Design-Mate™ Series. Laboratory precision at a hobbyist's price.

We knew what you were looking for when we created the Design-Mate Series. So we put the emphasis on laboratory precision and professional performance instead of needlessly expensive fancy cabinetry. Check it out! Check it all out!

DESIGN-MATE 1
BREADBOARD/CIRCUIT DESIGNER

Design-Mate 1 gives you everything you need for fast, easy solderless circuit design in a single compact package. QT speed and versatility for circuit design and modification as fast as you can push in (or pull out) a lead, using one QT-59S breadboarding socket and two QT-59B bus strips, mounted on the top panel. Adjustable, precision-regulated 5-15 VDC 600 mA short-circuit-proof fused supply, with less than 20 mV noise and ripple at rated output (9W max.). Built-in 0-15VDC meter lets you monitor voltages in circuit or supply. Top panel supply and meter connections are easily made via four 5-way binding posts; on-off and voltage adjustment controlled by potentiometer; bright LED indicates power. Measures 7.5″ wide x 6.5″ deep x 3.25″ max. high (191 x 165 x 83mm); weighs 3 lb. (1.4 Kg). For 117 VAC, 50/60 Hz (12W); also available for 220 VAC, 50/60 Hz at slightly higher cost. **Price: $54.95**

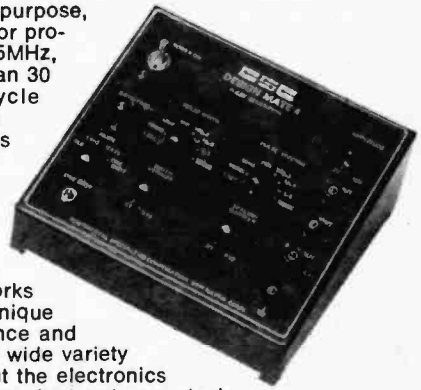
DESIGN-MATE 2
FUNCTION GENERATOR

Design-Mate 2 gives you a lot of signal generator for very little money. Advanced IC circuitry produces stable low-distortion sine waves (less than 2% THD), fast-rise-and-fall-time square waves (less than 0.5 microseconds across 600 ohms) and high-linearity triangle waves (better than 1% over range). Frequency is accurate—and repeatable—to 5% of dial setting, in 5 ranges: 1-10Hz, 10-100Hz, 100Hz-1KHz, 1-10KHz, 10-100KHz. Shortproof output is adjustable, 100mV-10V P-P for all waveforms, into open circuit. **Controls, switches, indicators and connectors:** toggle power switch with LED indicator; function selector switch; range switch; frequency selector dial (1-10 in 100 increments); amplitude control; twin 5-way binding posts. Measures 7.5″ wide x 6.5″ deep x 3.25″ high (191 x 165 x 83mm); weighs 2 lbs. (0.91 Kg). For 117 VAC, 50/60 Hz; also available for 220 VAC, 50/60 Hz at slightly higher cost. **Price: $69.95**

DESIGN-MATE 3
R/C BRIDGE

Design-Mate 3 is an indispensible tool for professionals and hobbyists alike. Makes precision resistance and capacitance measurements in seconds, with positive LED indication. Readings are accurate within 5% of the dial setting at any range—resistance: 10-100 ohms, 100-1K, 1K-10K, 10-100K, 100K-1 meg; Capacitance: 10-100pF, 100-1,000pF, .001-.01μF, .01-.1μF, .1-1μF. Simple 2-control operation: set range with switch, then turn Null Adjust dial until both LED are lit. **Switches, controls, indicators and connectors:** toggle power switch with LED indicator; range selector switch; Null Adjust dial (1-10 in 100 increments); LED null indicators; twin 5-way binding posts. Measures 7.5″ wide x 6.5″ deep x 3.25 max. high (191 x 165 x 83mm); weighs 2 lbs. (0.91 Kg). For 117 VAC, 50/60 Hz; also available for 220 VAC, 50/60 Hz, at slightly higher cost. **Price: $59.95**

DESIGN-MATE 4
MULTIPURPOSE PULSE GENERATOR



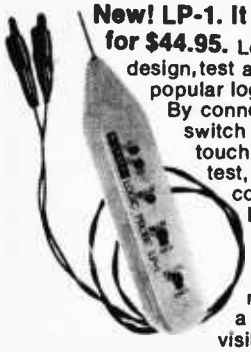
Design-Mate 4 is a multi-purpose, multi-mode pulse generator providing pulses from 0.5Hz-5MHz, rise and fall times less than 30 nsec and 10^7:1 duty cycle range, compatible with CMOS and TTL. It provides the precision, flexibility and versatility of a laboratory instrument, priced low enough for the workbench of every engineer, technician, student and hobbyist who works with digital circuitry. Its unique combination of performance and price makes it ideal for a wide variety of applications throughout the electronics industry. Design-Mate 4 may be used as a clock source, delayed pulse generator, synchronous clock source, manual system stepper, pulse stretcher, clock burst generator, in tandem with one or more DM-4's used to gate the output of one or more additional DM-4's. **Price: $124.95**

COMPLETE INSTRUCTIONS AND APPLICATION DATA PROVIDED!!

All Prices Shown Are Manufacturer's Recommended List. Prices and Specifications Subject to Change Without Notice.

A LOT MORE PROJECTS- A LOT LESS MONEY.

CSC's Digital testers save your sanity. And your money.



New! LP-1. It digs up a lot of information for $44.95. Logic Probe 1 is a compact, versatile design, test and trouble-shooting tool for all popular logic families and digital applications. By connecting the clip leads, setting a switch to the proper logic family and touching the probe to the node under test, you get an instant picture of circuit conditions.

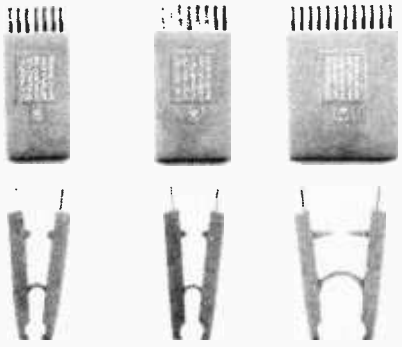
LP-1 combines the functions of level detector, pulse detector, pulse stretcher and memory—makes one-shot, low-rep-rate, narrow pulses—nearly impossible to see, even with a fast scope—easily detectable and visible.

LM-1. It lets you check digital IC's faster than a scope, safer than a voltmeter, for a lot less than you might guess—only $74.95.

Logic Monitor™ 1 speeds digital design and testing by accurately and automatically displaying static and dynamic logic states of DTL, TTL, HTL and CMOS DIP IC's. All in a compact, self-contained 16-pin circuit-powered unit. Use it to effortlessly trace signals through counters, shift registers, gating networks, flip-flops, decoders, etc. Clip it over any DIP IC up to 16 pins, and each contact connects to a single "bit" detector with high-intensity LED readout. Logic 1 (high voltage) turns LED on; Logic "0" (low voltage or open circuit) keeps LED off. A power-seeking gate network automatically locates supply leads and feeds them to the Logic Monitor's internal circuitry.

Proto-Clip™* IC Test Clips pay for themselves the very first time you use them.

Use Proto-Clip Connectors By Themselves...



PC-14 (14-pin Proto-Clip) $4.50 each

PC-16 (16-pin Proto-Clip) $4.75 each

PC-24 (24-pin Proto-Clip) $8.50 each

Or With Pre-Wired Cables

The reason's as simple as the time you'll save testing, signal tracing or wiring in DIP's. Not to mention the cost of IC's ruined by accidental shorts. A Proto-Clip is the foolproof, short proof way to bring up leads from crowded circuit boards. Its patented, molded design and unique gripping teeth free hands for other work. Built to withstand tough day-to-day use, CSC clips are available with or without cable for 14- 16- and 24-pin DIP's starting at $4.50.

*U.S. Pat. No. 3,914,007

	Cable length inches	Price Single clip	Price Dual clip
PC-14-	12	7.50	14.50
PC-14-	18	7.75	14.75
PC-14-	24	8.00	15.00
PC-14-	30	8.25	15.25
PC-14-	36	8.50	15.50
PC-16-	12	8.25	15.75
PC-16-	18	8.50	16.00
PC-16-	24	8.75	16.25
PC-16-	30	9.00	16.50
PC-16-	36	9.25	16.75
PC-24-	12	12.00	25.00
PC-24-	18	12.25	25.25
PC-24-	24	12.50	25.50
PC-24-	30	12.75	25.75
PC-24-	36	13.00	26.00

NOTE: S=single clip (on one end of cable); D=dual clips (on both ends of cable). When ordering Proto-Clip units with cable, include Part No., cable length and Single (S) or Dual (D)—for example: PC-16-24-D is 24" cable with a PC-16 at both ends.

CONTINENTAL SPECIALTIES CORPORATION
44 KENDALL STREET
P.O. BOX 1942
NEW HAVEN, CT 06509

NAME

STREET ADDRESS

CITY STATE ZIP

This is your shipping label. Please print clearly.

24 HOUR SERVICE

ORDER FORM

FOR OFFICE USE ONLY

No.

QTY.	Stock Number	Unit Price $	Unit Price ¢	Total Price $	Total Price ¢

TOTAL

CONN. OR CALIF. SALES TAX

POSTAGE & HANDLING (see chart below)

TOTAL AMOUNT ENCLOSED

FOUR FAST, EASY WAYS TO ORDER

☐ Include payment ($5.00 min.)
☐ C.O.D. U.S.A. only. You pay postage and fees.
☐ Charge ($10.00 min.) Please fill in below.

AMERICAN EXPRESS ☐
BANK AMERICARD ☐
MASTER CHARGE ☐

Bank No. 4 numbers above your name

Credit Card No.

☐ In a hurry? Telephone!

East Coast—203-624-3103
West Coast—415-421-8872

Expiration Date

Signature

The CSC Guarantee: We guarantee complete satisfaction, or your money back. Return unsatisfactory merchandise prepaid within 10 days for full refund.

☐ I have ☐ I have not purchased from CSC before

CONTINENTAL SPECIALTIES CORPORATION

POSTAGE & HANDLING CHART

Orders—	Add—
up to $10.00	$1.50
$10.01-25.00	2.00
$25.01-50.00	2.50
$50.01 & over	3.00

Prices, specifications and conditions of sale are subject to change without notice.

CIRCLE 12 ON READER SERVICE COUPON

ASK HANK, HE KNOWS!

(Continued from page 11)

The mail does take time, but the biggest delay is the handling of the postcards. When we receiver your card, your name and numbered literature request is cranked into a computer. The computer combines all the requests and they are mailed to the manufacturer, who does need some time to stuff the envelopes and send the mail out. It's complicated, and takes time. Sorry. But it's worth while waiting for the literature.

The Stories They Tell

My dad told me that scientists, in the years to come, will be able to make atom bombs in kitchen sinks. Can this be true?
–R. L., Stockton, CA

The chef at my local diner does it now. Give him a place to stand and enough hash, and he'll move the earth.

Spin-a-Wheel TV

I am interested in early mechanical television systems incorporating the spinning disc. I have found only one early electronic text which briefly outlines the system. Obviously these units were not very popular, but just out of curiosity I would like to know approximately when this system was in use, how many receivers were actually purchased and used by consumers.

–J. R., Allen Park, MI

TV dates back to 1884 when Paul Nipkow got a patent on a scanning disc. In 1930, NBC started broadcasting scanning disc type TV and CBS did so in 1931, both in New York City and on an experimental basis. CBS continued the broadcasts until 1933. The same year, RCA introduced an all electronic TV system. How many scanning disc viewers there were is not known. Sorry I can't help you any further.

Lend a Hand, Boys

Each issue we report on readers requesting assistance; and each issue brings its return of "thank yous." It's nice to help nice people.

Δ James Cummins of 249 Hampden St., Chicopee, MA 01013 needs the schematic diagram for the Engineered Electronics PR-101 power supply.

Δ Charles Howard of 608 Aetna St., Salem, OH 44460 has an Ozarka radio and would like to know about it and its value.

Δ A Murdock Neutrodyne radio (3-gahg tuning and 5 tubes) needs fixing and UV-201A tubes. Send help to Michael Perry, 611B Ellen Drive, Goodlettsville, TN 37072.

Δ Vern Kleinendorst wants the Lake Superior ore ship frequencies. Send info to 1815 River Rd., Grand Rapids, MN 55744.

Δ A Symphonic TPS-30 solid-state TV needs a new transformer, and Jay Surdyka needs help. Write to him at 41 Goodrich St., Hartford, CT 06114.

Δ Jerry Bolin of 16576 Sarah St., Mojave, CA 93501 can use an FM multiplex adapter for his Heathkit AJ-30 tuner.

Δ Victor King needs a schematic diagram for a Magnavox Clock/Radio C003, Run 3. He's at 832 E. Garfield, Glendale, CA 91205.

Δ Sorry, we cannot handle requests for equipment sales. Why not try our Classified Ads Section.

Δ Merle Hobbs of Rt. #1, Box 160B, Pittsburg, KS 66762 needs schematic diagram and service data for a Knight CB, Model Safari I.

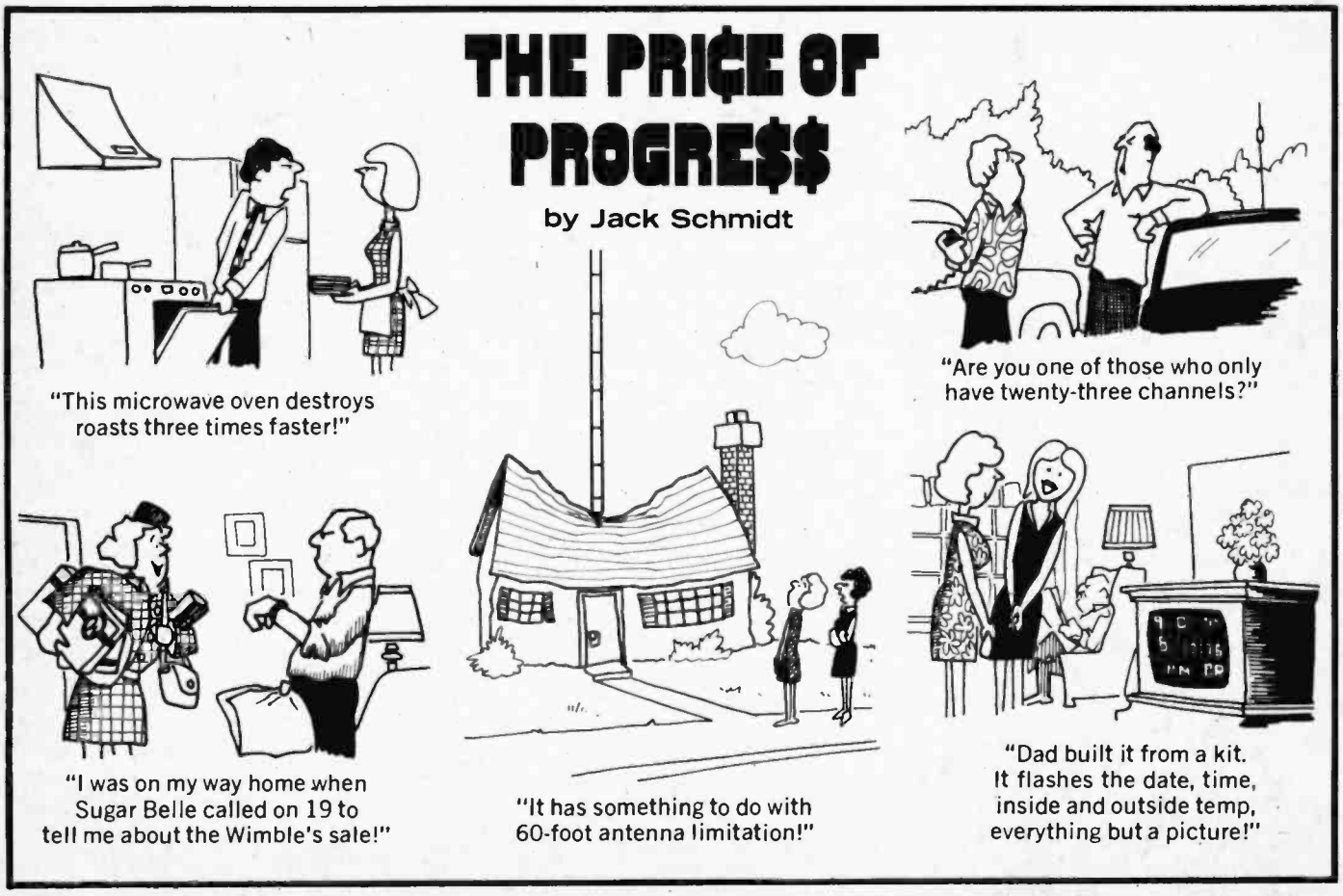
Δ Wayne West, 106 E. El Camino, Phoenix, AZ 85020 needs schematic diagrams for the following: RT-70/GRC transceiver, APN-9 Loran navigation set, and ARC-3 receiver.

Δ Hallicrafter S-38 receiver in need of repair. Send schematic diagram and other data to John E. Hinant, 2712 Stacie Rd., Richmond, VA 23224.

Δ Carroll M. Brown of 1233 Crestview Dr., Hurst, TX 76053 wants the schematic diagram for a Hammarlund HQ-110 receiver.

Δ Erice Haggland of 7220 Mt. Vernon, Riverside, CA 92504 needs diagrams and info on the SC-759A receiver and RA-94 power supply. Also, he can use a VT-145.

Δ Help a Watterson shortwave receiver, model 67, be restored by supplying a schematic diagram to Cedric Silverthorn, 4110 Leeshire, Houston, TX 77025. ■



ELECTRONICS HOBBYIST
SPRING-SUMMER 1977

by T. R. Fox

MEASURE THE WIND!

Easy-to-wire, accurate, anemometer uses ICs and LED-readout.

Increasing energy costs have driven many people to thinking of alternate sources of power, such as solar energy and water power. But the technology for these natural energy sources is still quite expensive and complicated to install. It'll be at least several years before the cost of most natural energy systems comes down enough and the parts are easy enough for most people to install. Wind power for generating electricity, on the other hand, has been available for many years. For several decades farmers and others in rural areas have used windmill generators as standby electricity and in some cases, as their main power supply. Windmills and wind-driven electrical generators can be bought off the shelf by anyone, and require no expertise other than the usual home mechanic skills to set up.

Have you wondered if there's enough wind where you live to drive a windmill electrical generator? Do you know if there's enough wind to fly that big kite you've often thought of constructing? Is there enough wind coming over the hills near your area so you can get into hang-gliding? Or do you live in -ea where tornadoes or hurricanes sometimes strike. so, it could literally be a matter of life-and-death for you to read the wind-speed easily, with an accurate, easy-to-install anemometer (windspeed meter). That's what the Digital Wind-speed Meter is—an accurate anemometer using the latest digital TTL (transistor-transistor logic) integrated circuits.

Though this project isn't recommended for someone who's never built any solid-state projects before, it should be easy enough for anyone who has built one or two simpler projects such as most of those published in *Electronics Hobbyist.*

In addition, it's the sort of project which will get you started easily in digital logic circuitry, the circuits and components which are the basic building blocks of computers and most other advanced electronics today.

How Anemometers Work. There are two types of electronic anemometers in general use. One type uses air cups or a wind turbine to turn a tiny electric generator whose output is directly connected to a milliammeter. The faster the wind blows, the faster the generator turns and the higher the meter reads. This type of anemometer is simple and reliable but it usually is not accurate.

A more sophisticated type uses air cups to turn a shaft to produce electric pulses. The pulses are integrated by a capacitor and related circuitry to produce a DC voltage whose magnitude is directly proportional to the wind speed. This voltage is aso displayed on a meter. This method is easier to calibrate, and thus is more accurate than the simple generator method. By

DIGITAL WINDSPEED METER

using state-of-the-art digital electronics, improvement can be made upon this method of measuring the wind's speed. Instead of the round-about method of adding up the electric pulses by charging up a capacitor, why not just count them directly? The digital anemometer described here does just that. The result is a more accurate sophisticated instrument that is easier to read and cheaper to build.

How It Works. The theory behind the digital anemometer is simple. See Fig. 1. The wind turns a shaft which has streamlined plastic cups attached to it. On one rod that holds two oppositely directed cups are placed two small magnets. A reed switch is mounted on the stationary base beneath the rotating cups so that it will be operated by the rotating magnets above. Each time the cups make a full revolution, the reed switch opens and closes twice. The pulses generated by this reed switch trigger a one-shot multivibrator (TTL-7412) which cleans up the pulses, eliminating contact-bounce and other error pulses. The cleaned-up pulses are then fed to a TTL NAND gate which is controlled by the 555 one-shot multivibrator. The 555's one-shot output pulse is manually adjustable to let us calibrate the anemometer. Another 555 astable multivibrator provides automatic triggering pulses for the 555 one-shot as well as supplying reset and blanking pulses for the counters and decoders. The resulting controlled and cleaned up pulses (which originated in the reed switch) are counted on two TTL decade counters and displayed on two LED displays.

Construction. The rotating wind sensor is made up of 4 plastic cups, mounted with 3/32-in. or 1/8-in. rods to a slot-car motor or similar cheap and readily available bearing. (The brushes of the motor can be removed if desired.) The egg-shaped containers in which *Leggs* nylons are sold are ideal for the plastic cups which catch the wind.

The rods which support the cups can be steel welding rods or (better) copper or brass. One rod should be one foot long and the other two should be six inches long.

Next, obtain a small cylindrical piece of a solid metal that is easily solderable —brass or copper is best. Drill two holes, using bits the same size as the rods, at right angles to each other through this cylinder of metal as shown in Fig. 2.

Now center the 12-in. rod in the cylinder. Insert the two shorter rods in the remaining two open holes in the cylinder, as shown in Fig. 3. Using acid-flux, solder the rods to the cylinder.

Mount the motor, which is used as the bearing, in a 2-in. long piece of two-by-four. To mount the motor, drill and file a hole in the wood large enough to take the motor. Cover the motor's case with epoxy glue and insert it in the hole as shown in Fig. 4.

Using a bit as close to the diameter of the motor's shaft as possible drill a hole about 1/2-in. deep in the bottom of the cylinder (see Fig. 3) which now has rods soldered to it. Insert the motor shaft into this hole and solder it, using acid-core flux.

(If steel is used, secure with epoxy glue.)

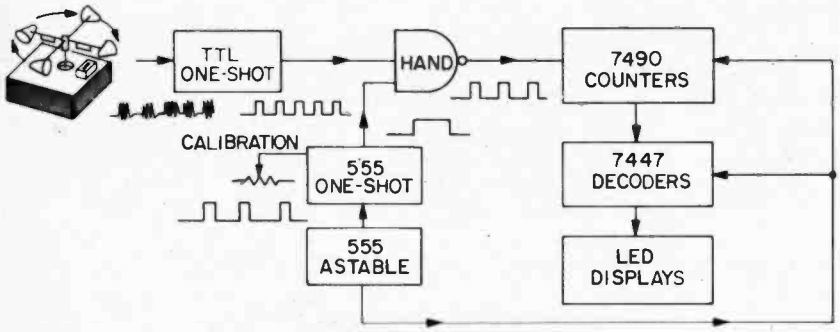
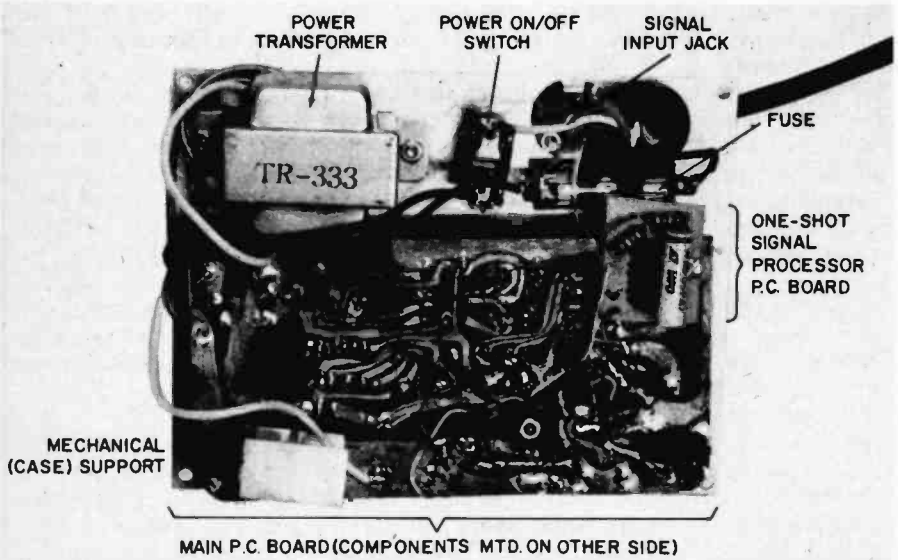


Fig. 1—Block diagram for digital anemometer. As the calibration control is varied it changes the duration of the pulse put out by the 555 one-shot. This acts as a variable window for the pulses coming from the windspeed sensor permitting accurate readout of the LEDs.



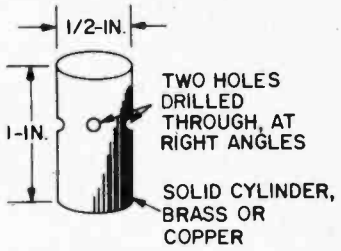


Fig. 2—Centerpiece of windspeed sensor.

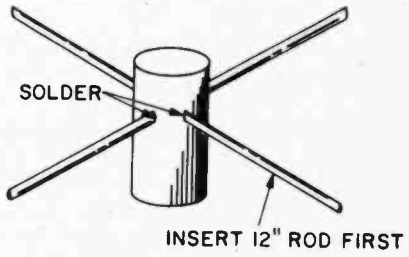


Fig. 3—Assembly of rods and centerpiece to form rotor.

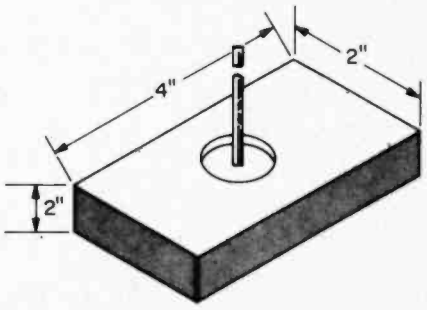


Fig. 4—Wood block mount with bearing.

Now mount the four plastic cups to the rod, taking care to correctly orient the cups. Drill holes in the cups and insert the rods in the holes. Keep the cups in place with epoxy or other good glue.

Next we mount the magnets on the rods. If copper or brass rods are used, great, just solder or glue the magnets to the undersides of two opposite rods, centering them one inch from the pivot. The reed switch is then mounted on the wood base so the magnets pass a quarter of an inch above it.

If the rod is iron or steel, we have a problem because it will distort the magnet's magnetic field. This problem is overcome by using a non-magnetic spacer between the magnet and the rod —¼-in. is enough space. A ¼-in. x 1-in. piece of wood is glued to the rod and then the magnet glued to the wood. Since there is very little weight involved, a good glue will hold the magnet fine. This completes the construction of the wind sensor.

Circuit Assembly. To build the cir-

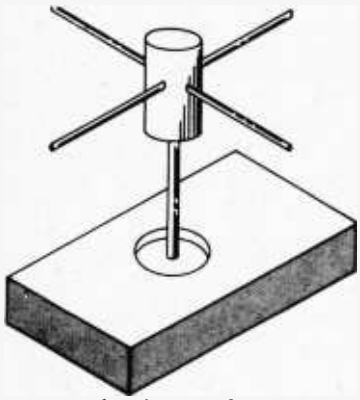


Fig. 5—Rotor in place on bearing.

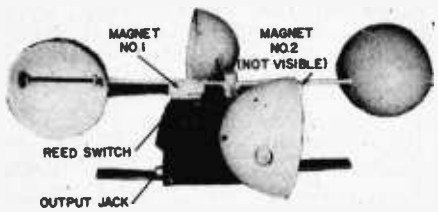


Fig. 6—Completed unit. Adjust height of reed switch so magnets pass about ¼-in. over it or less.

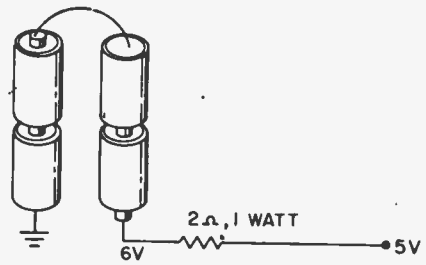
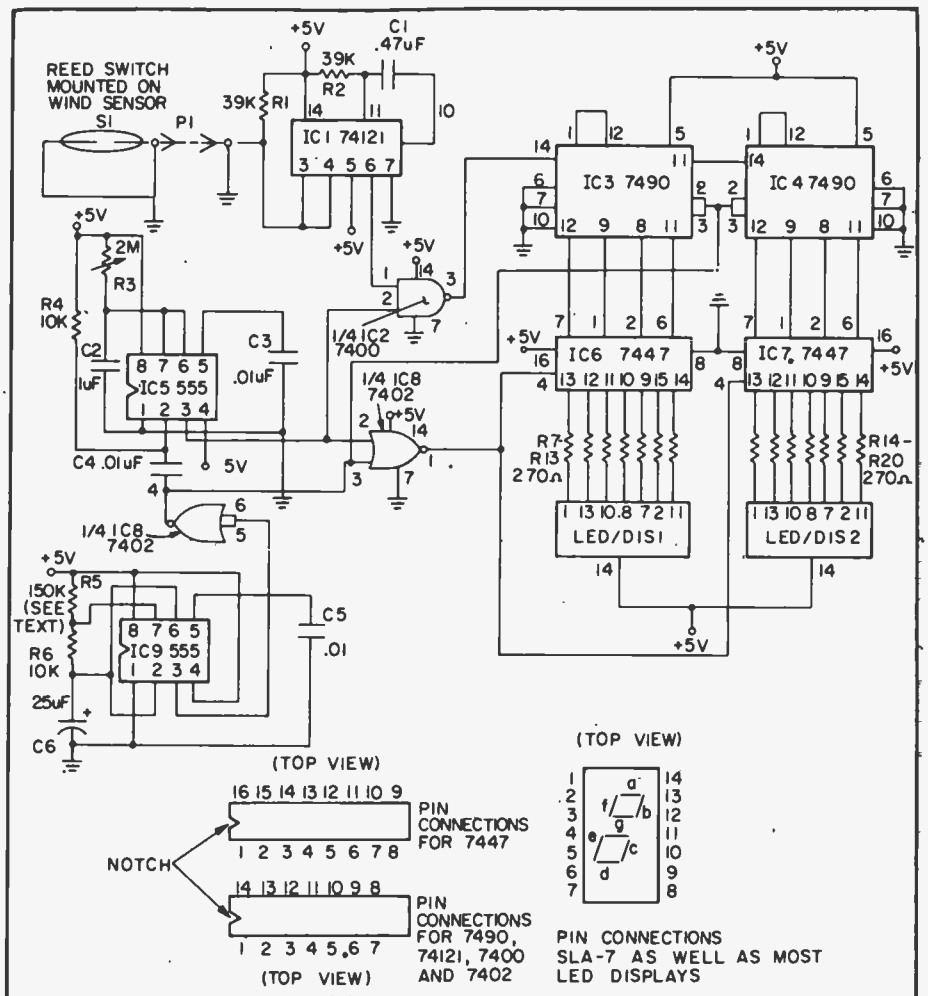


Fig. 7—Temporary battery power supply for use when calibrating the instrument in an automobile.



Be very careful when inserting ICs into their respective sockets. Be sure right types are inserted and oriented so that IC half-moon keys align correctly with sockets.

PARTS LIST FOR DIGITAL WINDSPEED METER

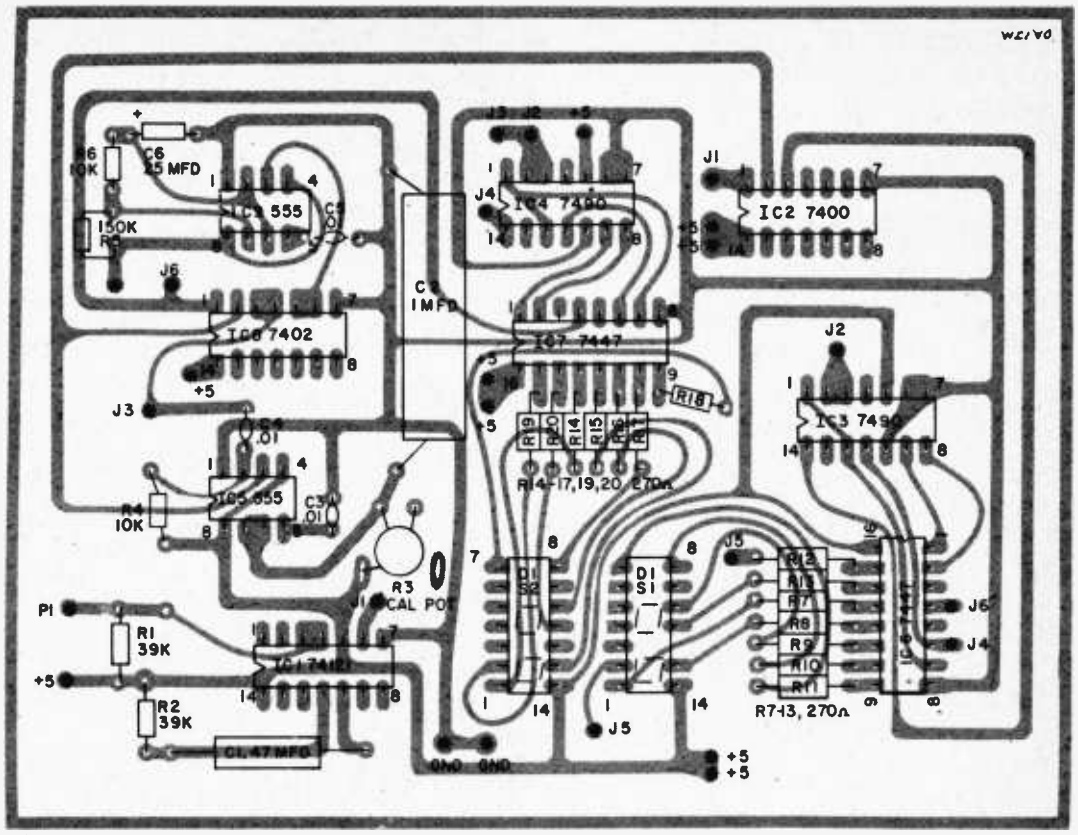
C1—0.47-uF, 50-VDC capacitor
C2—1.0-uF, 50-VDC capacitor
C3, C4, C5—0.01-uF, 50-VDC capacitor
C6—25-uF, 35-VDC or more electrolytic capacitor
LED1, LED2—LED display numerals (Radio Shack 276-053 or equiv.)
IC1—74121 monstable multivibrator integrated circuit, TTL type
IC2—7400 NAND gate integrated circuit, TTL type
IC3, IC4—7490 decade counter integrated circuit, TTL type
IC5, IC9—NE555 integrated circuit
IC6, IC7—7447 BCD-to-Decimal decoder, TTL type
IC8—7402 NOR gate, TTL type
P1—2-connector jack (& matching plug for cable) RCA-type phono plug recommended
R1, R2—39,000-ohm, ¼-watt resistor
R3—2-megohm printed circuit board-mounting potentiometer (Allied Radio 854-6287 or equiv.)
R4, R6—10,000-ohm, ¼-watt resistor
R5—150,000-ohm, ¼-watt resistor
R7—R20—270-ohm, ¼-watt resistor (14 needed)
S1—Miniature reed switch (Radio Shack 275-033 or equiv.)

Misc.—Four plastic cups such as the containers Leggs stockings come in. Two small magnets such as the "Magic" magnets most hardware stores carry. One 12-in. and two 6-in. pieces of copper or brass rod, ⅛- or 3/32-in. diameter (Brookstone, Peterborough, NH 03458 can supply two 12-in. 3/32-in. brass rods at 25 cents each, plus 70 cents for postage & handling). One slot car motor or equiv.), for use as bearing. One piece of copper or brass rod about 1-in. long, ½-in. diameter (solid). One 2-in. piece of wood two-by-four. Epoxy glue, solder, mounting brackets (two) for wood block, screws. Ten IC sockets.

PARTS LIST FOR TTL POWER SUPPLY

An ideal power supply for the Digital Wind Meter is the regulated power supply for TTL logic ICs described on page 96.

DIGITAL WINDSPEED METER



Pictorial shows the location of components as seen from the bottom (through the foil pattern) as they would be viewed in soldering to the foil. To get a full size foil pattern send a stamped, self-addressed envelope to: Electronics Hobbyist, Digital Windspeed Template, 229 Park Ave. South, New York, NY 10003.

cuit use any convenient layout on a perf board. The position of the components is not critical. If you haven't worked with ICs before you'll be better off soldering IC sockets in place on the perf board, and connecting the other components to the pins of the IC sockets. If you've had a fair amount of experience and can solder ICs directly into a circuit without overheating the pins (using a pair of long-nose pliers as a heat sink while soldering to each pin), do it that way.

The main job in wiring the anemometer lies in making the printed circuit board. The pattern shown can be made by using the simple resist method. Simply draw the pattern with a felt-tipped resist pen on the foil side of the printed circuit board, place in etching solution for an hour or so and drill the holes marked. The somewhat more sophisticated, yet still easy, non-camera photo method can also be used.

If a small 25-watt soldering iron is used, the *ICs* can be soldered directly to the board, although IC sockets are less risky. Be sure to orient the notch on the *ICs* as shown in the component layout diagram. It is always wise to use IC sockets when mounting display LEDs. Be sure to either bend back or cut off pin 12 on the socket which is used to mount Display No. 1.

Unless double sided PC boards are used, jumpers made up of hookup or bare wire are needed. Place jumpers between the two J1s, J2s, J3s, J4s, J5s and J6s. In addition, interconnect the +5 VDC points on the PC board with jumpers (6 needed).

Connect the two leads from the remote mounted reed switch to points P1 and to one of the two GNDs.

Connect the plus power supply lead to the +5 point at the top of the board. Connect the other supply lead to the other GND point which is also located at the top of the board.

The 5-volt regulated TTL power supply described by Herb Friedman on page 61 of this issue of Electronics Hobbyist is ideal for this project. This power supply is compact enough to easily fit in the same case as the logic unit.

The entire circuit can be mounted in any convenient size bakelite or aluminum case with aluminum panel. For a smart appearance, spray paint the panel with some auto-touch-up white lacquer. Use dry transfer decals for the lettering.

Cut a slot in the panel so the two digit LED display can be readily seen. If desired, the switch to turn on the power can be an inexpensive slide switch but a toggle switch is more reliable and easier to mount. The circuit board and all other components should be mounted to the back of the front panel for ease of accessibility.

If one desires a longer display time, increase R5 from the recommended 150k to 220k or even 270k.

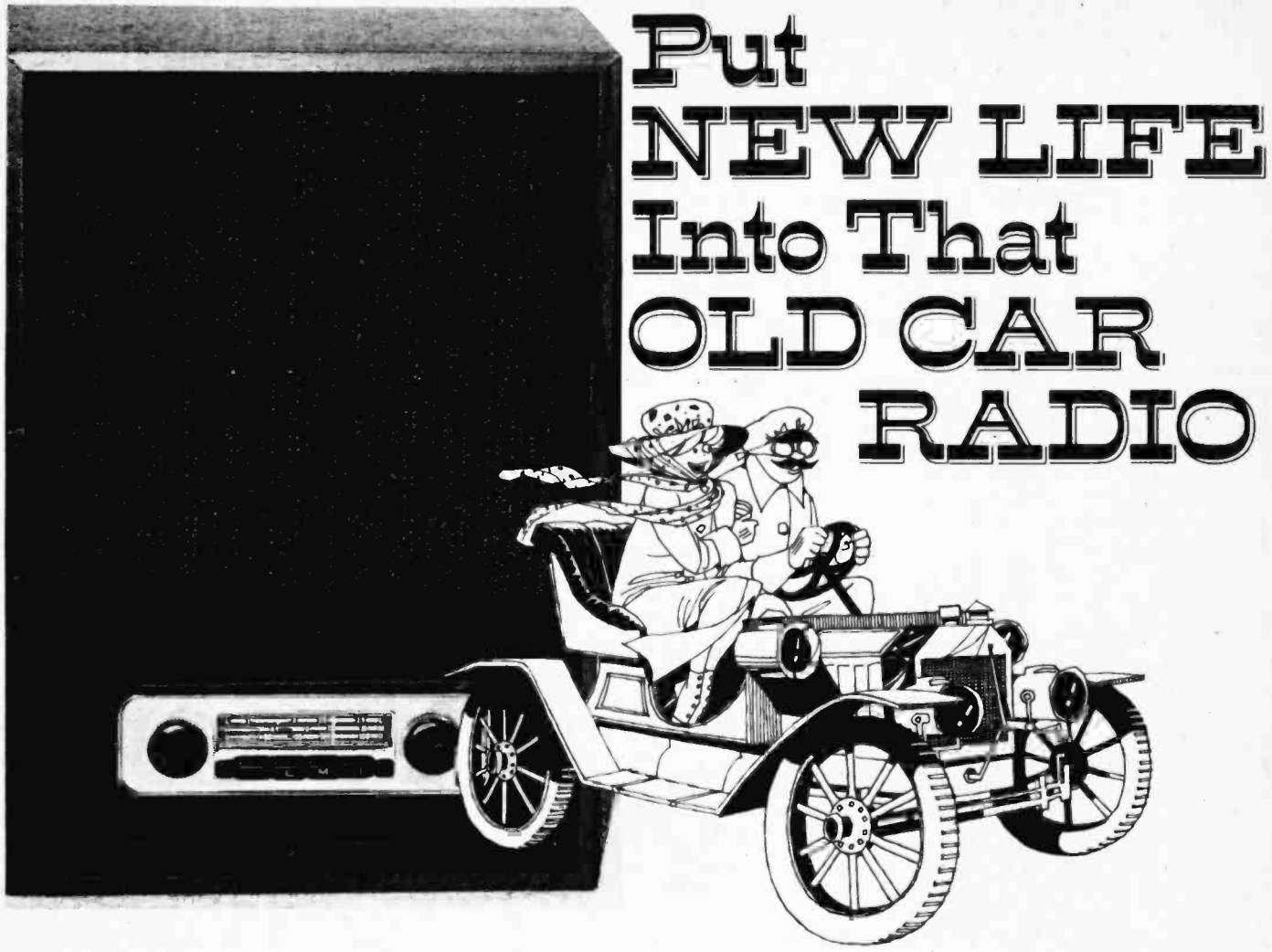
Any type of two-conductor connecting jack can be mounted on the front panel (I used an RCA-type jack) as long as the appropriate plug is used. The two wire cable which connects the rotary wind sensor to the electrical unit must be long enough to reach from the roof to the place in your home where you want to keep the display unit. Any kind of shielded cable, including audio cable or microphone cable is OK. Coax such as RG-59/U is fine, but don't buy it special for this job because it costs much more than other (audio) cable.

Calibration. This anemometer is easily calibrated since there is just one pot to adjust. As an initial test, plug the unit in and connect the wind sensor to the display unit. After a few seconds warmup the unit should show 00 then go momentarily blank. Turn the cups by hand and a number should appear on the display for a second or two and then disappear for a second. Now turn the cups as fast as you can by hand and adjust the calibration pot to read as close as possible to 20. If everything so far works OK, it is time to take the anemometer for a ride. If not, go back to Square One and check your wiring and the seating of the LED display modules.

The anemometer should be calibrated against an accurate automobile's speedometer. Since the anemometer will be away from the regular house supply, you will have to take along a 5-volt

(Continued on page 100)

Put NEW LIFE Into That OLD CAR RADIO



With a loudspeaker and a simple power supply your old car radio will become a high-quality home receiver. Good for DXing, too.

by Gary McClellan

☐ For years now Americans have bought 10 million or so new cars every year, and most of those cars have radios in them when new. As a result millions of used cars are sold by their original owners each year. Now the price a car dealer will pay, or allow you on a used car is a combination of the so-called "book" value, which he gets from a little blue book, and of the bargaining. He doesn't care whether your used car has a radio or not, and many people, knowing this, take out the car radio before trading in the old bus on a new one. The result is that there are hundreds of thousands of used car radios lying around in garages, attics and cellar storehouses, waiting to be thrown out some year in the annual spring cleaning.

Most of these radios are perfectly good, but won't be used because it's usually too much trouble to install them in a car other than the one they were originally set up for.

But there's no reason such sets can't be put to work as house radios, especially since they will almost always work better than most table model radios, and even most console sets you can buy today. Their tone is as good or better than most home sets—obviously we're not comparing them with high fidelity component sets, which cost many times more than regular table or console radios. Their selectivity and sensitivity is also better than that of most home sets because they have an RF (radio frequency) amplifier stage ahead of the converter stage, and most home sets don't bother with an RF amplifier stage which car sets need.

Going for AM DX? DX fans can have a ball with converted car radios. The sensitivity and selectivity of most car sets, when combined with a good outside antenna can get you AM stations from all over the country. Here in California I've been able to get stations like KOMA, Oklahoma City, WLS Chicago, and many others regularly, at night. For more on AM DXing see ELEMENTARY ELECTRONICS Sept./Oct. 1976 "The Secrets of Split-Frequency DX." White's Radio Log, regularly published in our sister publication, COMMUNICATIONS WORLD, is an excellent source of info on the super DXing you can do on AM radio.

Car Radios Are Better. The typical car radio was built to perform in one of the toughest environments—your car. The set has to work with a ridiculously small antenna, and yet get distant stations. It also must have enough volume to overcome road noise and tone quality to offset the shortcomings of the small, poorly baffled speakers found in most cars. And to top it off, the car radio must perform well over a wide temperature range.

Conversion is easy and inexpensive.

NEW LIFE

All you have to do is add a power supply, antenna, and a good speaker to a car set and you are in business! So if you have an old car radio, or know where you can get one, don't pass it up. You won't know how good radio can be until you convert a car set to home use.

First Get Your Radio. What car radios are best for conversion? Just about any old car radio can be converted to home use, provided it's a *transistor set*. Tube sets will be too old, and more important to us, they use much too much current (to heat up the tube filaments) to be practical for conversion to home use.

You can use an AM-only set, or an FM/AM set. If it's a really recent car radio it may be one which has a four- or eight-track tape player built in, and with a stereo radio section. If it has a tape player you'll have to use a heavier power supply than if it's just a radio receiver, but that's the only other restrictions (besides no tube sets).

Of course the car radio should be a 12-volt unit. 6-volt car radios haven't been made for quite a while, though it's possible you might happen across one. And don't convert one of those fancy car radios which has "signal seeking" (sometimes called "Wonder Bar," because you just touch a little bar to activate it). These sets have a motor inside the set to drive the tuning mechanism and the tuning dial. The motor draws several amperes of current, and would require a heavy power supply costing much too much. In addition, these automatic-tuning units are likely to get out of whack, and they're not easy to repair. In fact many car radios have been consigned to the junk box just because the auto tune failed and it was too expensive to repair.

And another thing. Try to use a radio which has all its knobs and the dial plate. It'll save you the trouble of scrounging around to find matching knobs and a dial escutcheon plate later. However, if you happen to already have a good car radio—for example, one with separate bass and treble tone controls, don't let the absence of knobs hold you back. They *are* available at some specialized stores. And you *can* make up a new escutcheon plate from a piece of scrap aluminum.

Check It Out First. Before you convert the car radio to home operation, be sure it's working OK, or is worth repairing. To do this make up an antenna as shown in the diagram, and connect it and a speaker (just about any speaker will do) and a power supply to the radio as shown.

Hook up a 12-volt battery or battery eliminator to the radio, being careful to hook the positive (red) side, usually marked +, to the "hot" lead of the radio. The negative (ground, or common) nearly always goes to the case of the radio. Check the markings first to be sure.

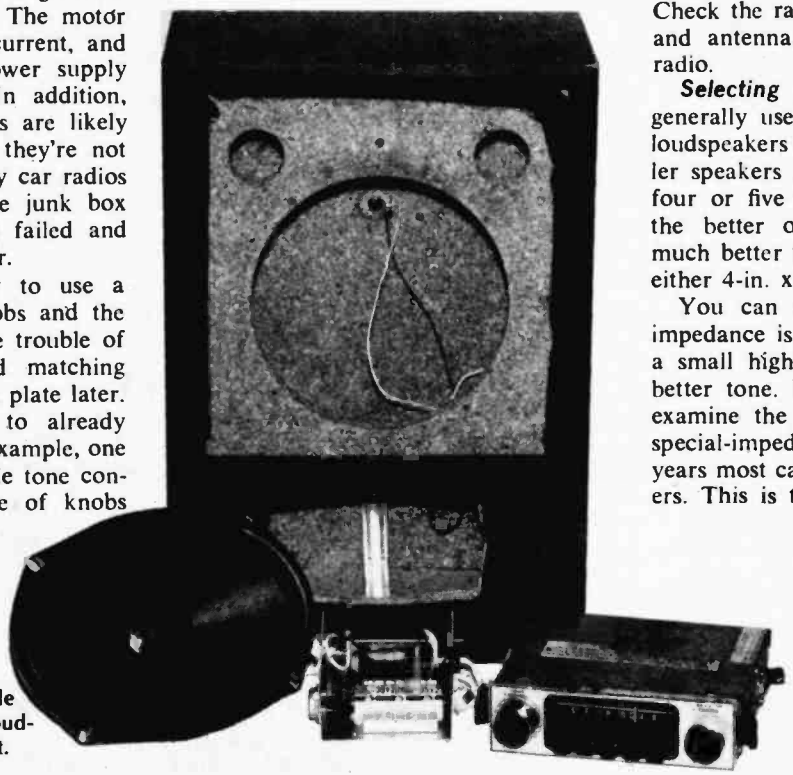
Adjust the antenna trimmer capacitor to get maximum sensitivity. This is done by setting the tuning dial to a weak station around the high end of the dial (1400 kHz is ideal) and adjusting trimmer C2 for maximum volume. The setting of C2 will be different when you connect the final antenna to the set, later. Measure the current drawn by the radio. Most solid state sets draw ½ amp or less—if its draws much more than this we suggest you use a commercial power supply such as those made for CB radios and tape players. The Radio Shack 22-127 power supply will work fine in most cases. Make sure that the radio works properly. Clean it off and wipe the dial glass clean. Spray the volume/tone controls with a good control cleaner, and remove the dial lamp. This will save power and allow the power supply to run cooler.

Making the Conversion. Start by building the power supply shown unless you buy one. If you use the commercial power pack mentioned, skip this section. I built my supply on a 4-in. x 3½-in. piece of U-shaped aluminum. The components, with the exception of transformer T1 are all mounted on the sides of the "U", which are about 1½-in. high. You can build yours in the same way, or mount the parts in a commercial chassis instead. Or you can mount the power supply on the top or back of the radio. But just be sure if you do this that you can install the radio in a cabinet. Install the components and wire them up, being careful of the connections of IC1, a voltage regulator. The case is ground so you don't have to isolate the case from the chassis. When you complete the component wiring, add leads at least three feet long so that the power supply may be easily attached to the radio.

You have an option at this point as to how you connect the AC power switch. You may use a separate unit as I did with the second radio shown, or open up the set and use the existing switch. If you choose this method, be sure to carefully remove the existing wires and solder them together. Then connect the AC wires from the power supply. Connect up the ground and 12-volt positive wires to complete the job. Check the radio out again with speaker and antenna. If all's well, install the radio.

Selecting a Loudspeaker. You can generally use any of a wide variety of loudspeakers with a car radio. The smaller speakers supplied with car sets are four or five inches in diameter, while the better ones, which usually have much better tone, are oval-shaped units either 4-in. x 6-in., or 6-in. x 9-in.

You can use one of these, if the impedance is correct, or you can go to a small high fidelity speaker for even better tone. First you should carefully examine the radio to see if it uses a special-impedance speaker. For many years most car sets used 3.2-ohm speakers. This is the nominal value if there



Car radios may be converted for home use using any convenient enclosure, a simple power supply, and a better loudspeaker, as shown at the right.

is no special indication. Many of today's sets use higher impedances, however, such as 10, 20, or even 40 ohms. If the set you're converting is so marked, you can use one of the Radio Shack multi-impedance speakers listed in the Parts List. If it's not specially marked, use any speaker of 3.2, 4, or 8 ohms. Choose the largest speaker, with the heaviest magnet (and costing the most, generally) for the best tone.

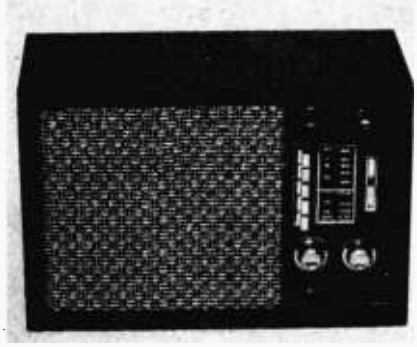
Installation. This is where you get to exercise your creative talents. There are many different places you can mount your converted car radio. You can go my route and install it in a speaker cabinet. This worked great because reject cabinets were available from a local speaker company for $1.00 each. I installed both radios in reject cabinets. I bought speakers to match the cut-outs (8 inches in both cases). Then I added grille cloth to cover the speaker area and installed it. If you do this you will find the going very easy as most of the work has been done for you by the cabinet manufacturer.

Some other places you can put your radio are in a room divider or end table. Or how about the wall in your kitchen? What about under a shelf in a cabinet? The choice is up to you. If you have room for the radio only, you can locate the speaker somewhere else.

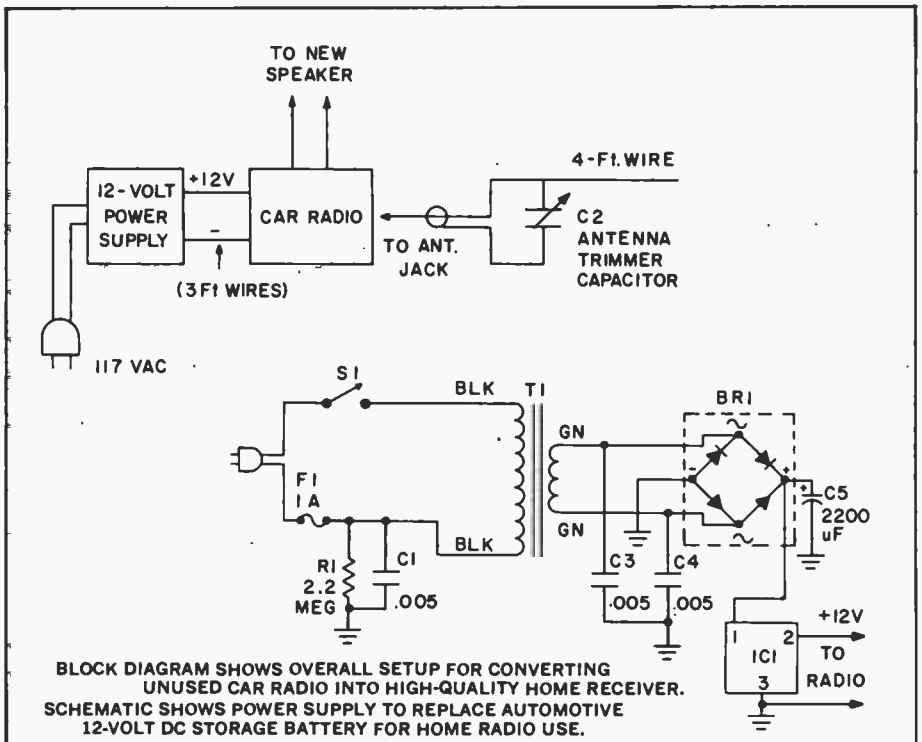
Operation. After you have installed the radio, power supply, and speaker, connect the antenna. Place C2 in a convenient spot where you can get at it. Then turn on the radio and tune in a weak station around 1400 KHz on the dial. Adjust C2 for maximum volume. The antenna lead may be stapled around the back of the cabinet. If you've converted an AM/FM set you might wind several turns of the antenna around the AC cord for better reception. The lead may also have to be carefully positioned for best results on FM. This was necessary for the two radios that are seen here. That's all there's to it! Sit back and enjoy your new radio. You'll be amazed at the performance; it will far outstrip the radio receivers you buy in the drugstores, and the AM sections of all but the best stereo sets, too!

If You Don't Have A Car Radio. If you don't have one, a good place to get car radios is from junk yards and used car dealers. Better yet, check out flea markets, garage sales, and other similar places. You'll generally be able to bargain and get a set for a lower price from the former sources. You shouldn't have to pay over $10.00 for a set. You might get a radio that needs repairs and cut the price even farther. I bought several broken radios for fifty cents each, fixed them, converted them and gave them away as gifts! ■

Another loudspeaker cabinet (cost: $1.00!) houses this converted car radio. Sounds great!



Out of a VW and into a reject speaker cabinet goes this car radio. AM, FM, and short-wave.



BLOCK DIAGRAM SHOWS OVERALL SETUP FOR CONVERTING UNUSED CAR RADIO INTO HIGH-QUALITY HOME RECEIVER. SCHEMATIC SHOWS POWER SUPPLY TO REPLACE AUTOMOTIVE 12-VOLT DC STORAGE BATTERY FOR HOME RADIO USE.

CONVERSION PARTS LIST FOR CAR RADIO

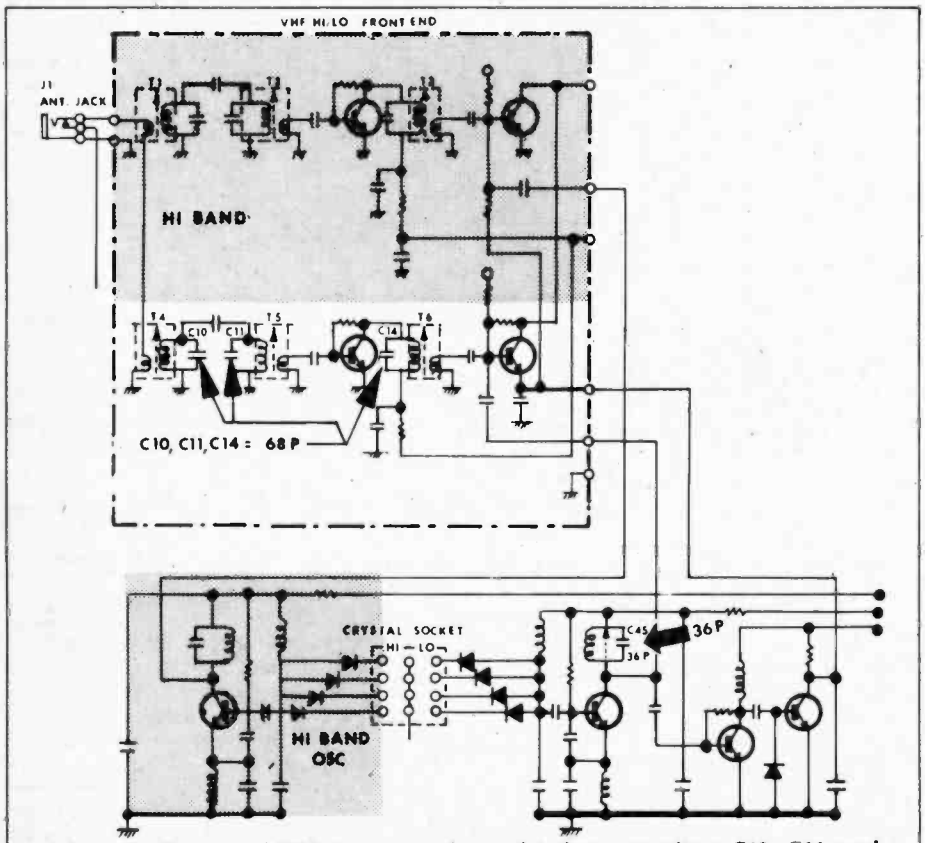
BR1—6-ampere, 50-volts AC or better bridge rectifier.
C1, 3, 4—0.005-uF, 600-volts or better capacitor.
C2—365-500-pF (maximum) trimmer capacitor.
C5—2200-uF, 35-VDC or better electrolytic capacitor.
F1—1-ampere fuse.
IC1—Voltage regulator chip.
R1—2.200,000-ohm ½-watt resistor.
S1—SPST switch.
T1—Power transformer, 117 VAC primary, 12.6-volt, 1.2-amp.
Loudspeakers—Oval car speakers, 4-in. x 6-in. or 6-in. x 9-in. multi-impedance units, 10, 20, 40 ohms, if required—see text.
Misc.—Fuse holder, AC line cord and plug, car radio antenna plug obtainable at radio parts suppliers).

This easy conversion takes four little parts and some new

SCAN THE

☐ Now that the 18 wheelers have moved to channel 19, how can we monitor 19, and 9, and one or more "preferred" channels all at the same time? The logical answer would be to get a 4-channel scanner but every scanner I have seen has been for VHF-FM or UHF-FM, hence is incapable of receiving the CB channels. There are just two solutions to this problem—trade in your present transceiver for one with built-in scanning, or convert a VHF/Lo band scanner to the CB frequenices.

The most practical scanner for such a conversion is the Realistic PRO-6 VHF Hi-Lo Pocket Scanner. It has a low profile when placed on my base station transceiver, the price is low, it covers 30 to 50 MHz as well as 148-174 MHz, and the conversion to CB frequencies can be done by almost any CBer. Perhaps the most important reason for selecting the PRO-6 is the use of a discriminator to detect FM and the lack of limiter circuits. This because limiter circuits will clip amplitude modulation, thus preventing detection of CB signals, which are AM (amplitude modulation).



Schematic diagram of PRO-6 scanner shows the three capacitors C10, C11, and C14 which are replaced in the front end (top). One capacitor, C45, is changed in oscillator. Slight retuning of T2 through T6 is only other task required.

Figuring the Circuit Values. To make the conversion of the PRO-6 from 30 to 50 MHz to the 27 MHz region of CB frequenices, we have to lower the resonant frequenices of the RF circuits and the crystal oscillator circuit. The schematic illustrates the PRO-6 front end (RF/Mixer circuits) and the crystal oscillator for both Hi and Lo bands. Capacitors C10, C11, and C14 in the front end RF stages are 33 picofarads which resonate at the center of the 30-50 MHz band. This gives us a 40 MHz center frequency and the ideal CB center frequency would be Channel 12 or 27.105 MHz. From a Sylvania Electric Products Inc. nomograph on Inductance-Capacitance-Reactance, we calculate the new values for C10, C11, and C14 to be 69 picofarads and the inductance to be 0.5 microHenries. Now we insert these values into the formula for resonant frequency:

$$fr = \frac{1}{2\pi\sqrt{LC}}$$

where fr is in MHz,
2π is equal to 6.28,
L is equal to 5×10^{-7}, and
C is equal to 60×10^{-12}.

This figures out to a center frequency of 27.308 MHz, which is well within the range of variable inductance to tune downward to 27.105 MHz: Channel 12. 69 picofarads would be ideal (since it calculates out to 27.110 MHz) but it is not a standard capacitor value. Too, this is less than two percent variation from the standard value of 68 pF.

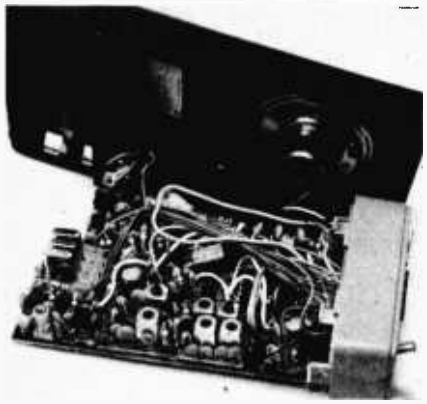
The actual conversion of the front end for 27 MHz use requires only that one replace C10, C11, and C14, plus a little retuning of T4, T5, and T6. In fact, the only problem lies in getting into the inside of the PRO-6.

First, remove the battery box and the two Phillips head screws on each side of the PRO-6's case below the battery box. Once these two screws are removed, grasp the set's case about mid-

crystals—it lets you monitor any CB channels you want with this off-the-shelf-scanner.

TOP OF 40

by James A. Gupton, Jr.



Top case removed to show crystals (left) and transformers (front, center). See the drawings for component identification.

section and apply a squeezing pressure to the sides while lightly lifting the case bottom section. Once the bottom section of the case is removed, the printed circuit board is accessible. Note the Phillips head screw in the center of the printed circuit board. Remove this screw and carefully remove the upper section of the case. Proceed carefully, for all the wires connecting to the scanner head are also connected to the board, and must not be pulled lose.

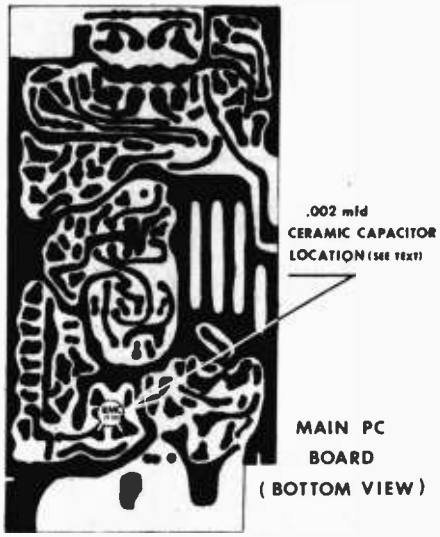
Careful Work. Once the case has been removed, we have full access to the component side of the printed board. The first thing one sees is the high density of components—there is not much room to work, and the close spacing of components requires careful work to prevent accidental shorting of leads during the solder operations. I solved this minor problem by winding a short length of No. 14 solid copper wire around the tip of my solder iron and filing a chisel solder tip on the end of the wire. This makes a long-reach solder tip that can get in between the closely mounted components without spreading solder over anything which might cause a short.

Follow the photographs and board layouts to correctly locate and identify capacitors C10, C11, and C14. You will note that C10 and C11 are located on the outside edge of the front end circuit board, and can be easily removed for replacement. C14, on the left side of T6, is difficult to remove without damaging the front end circuit board. If you have carefully removed C10 and C11 and have not damaged or shortened these capacitors leads, you can use one of these 33 pF capacitors to parallel C14 by forming a small hook on each lead and soldering these hooks to (the original) C14.

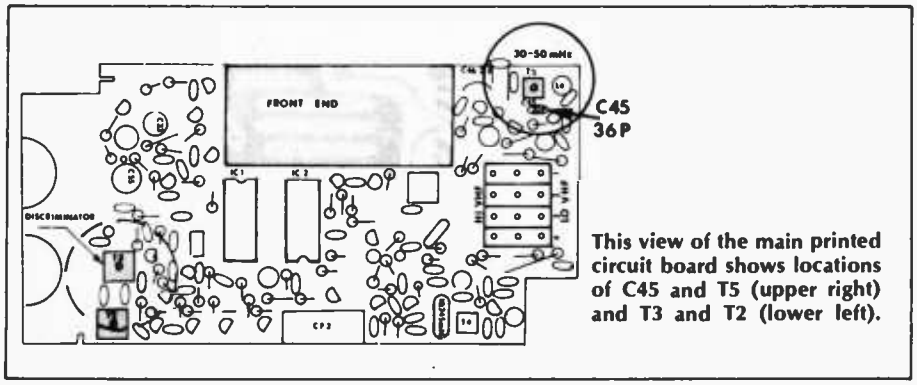
The next step is to replace crystal oscillator capacitor C45. This is a 20 pF ceramic capacitor that we will replace with a 36 picofarad silver mica capacitor. A ceramic capacitor works as well as silver mica, if that's what you happen to have on hand. Space is limited, but since the foil side of the board is readily available, C45 can be removed without difficulty.

Now the Crystals. Before the retuning can be done, we must insert the crystals into the crystal socket. The PRO-6 uses type HC crystals and they must be 10.7 MHz *higher* in frequency than the desired frequency. As an example, for Channel 12 we would order a crystal frequency of 37.805 MHz instead of 27.105 MHz. It is also advisable to separate each of your crystal frequencies by one or two channels to prevent co-channel reception. This is because the PRO-6 scanner is broader-tuned than most CB transceivers.

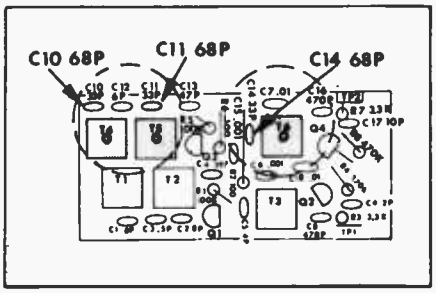
To retune the front end section, the best method uses a modulated RF generator set at 27.105 MHz and a detector probe attached to *Test Point* 2. Then T4, T5, and T6 are tuned for maximum output. The best way to peak the crystal oscillator is to inductively couple a digital frequency counter to oscillator coil T-5. However, since not many CBers have such elaborate test equipment, we must fall back on the gear we have, and use the output of our base or mobile station as a signal



Bottom view of main printed board shows location of additional .002 uF capacitor which is sometimes also required.



This view of the main printed circuit board shows locations of C45 and T5 (upper right) and T3 and T2 (lower left).

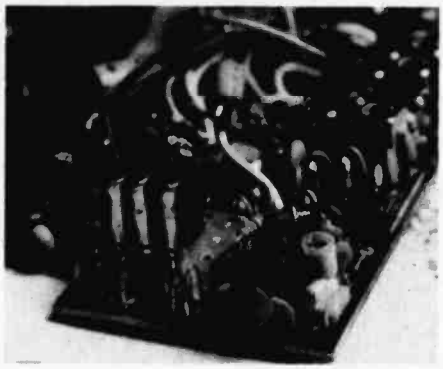


Front end layout shows location of the three small capacitors which are replaced along with transformers T2 through T6.

SCAN TOP 40

source. To do this, we prepare a dummy load connector by soldering a 5 watt-52 ohm carbon resistor to a PL-259 connector as shown in the drawing. Remove the antenna coax and replace it with the dummy load connector. Next attach a short-wire antenna (12-20 inches) to the antenna socket on the scanner and drape it near the dummy load. You may have to place the antenna inside the case for maximum signal. Now attach the PRO-6 ear plug, and activate your transmitter with some form of modulation such as a portable radio playing music. Tune T4, T5 and T6 for maximum output. For more precise tuning, connect the leads of an AC voltmeter across the speaker leads and tune for maximum output.

Discriminator Adjustment. Since the PRO-6 employs a discriminator for FM detection, the AM of CB can be detected by *slope* detection. Note the circled discriminator transformers T2 and T3 in the circuit board pictorial. Alternatingly adjust the core slugs of T3 then T2 for distortionless detection. Should you be unable to eliminate voice distortion, install a 0.002 uF. ceramic capacitor across the detection diode as shown.



Front end crystals are plugged into socket at left above. Three crystals are shown, but PRO-6 accepts up to four.

After completing the retuning, and adjusting the discriminator for AM detection, replace the top case section. Again be careful that no undue strain is applied to the circuit board leads and that the Charger/Operate AC socket is not dislodged from its position.

Replace the small Phillips head screw and attach the case bottom section. Be sure that the case ends engage with the scanning head and Charge/Operate AC socket before you permit the locking tabs to snap into place. Replace the two long Phillips head screws and the battery box. Your converted PRO-6 scanner is now ready to scan the desired CB frequencies. To use your base antenna, simply solder the short scanner antenna lead to the *Receive* section of the receive/transmit relay.

40-Channel CB Frequencies	
MHz	**MHz**
26.965	27.235 **(24)**
26.975	27.245 **(25)**
26.985	
27.005	
27.015	27.255 **(23)**
27.025	
27.035	
27.055	27.265 **(26)**
27.065 **(9)**	27.275
27.075	27.285
27.085	27.295
27.105	27.305
27.115	27.315
27.125	27.325
27.135	27.335
27.155	27.345
27.165	27.355
27.175	27.365
27.185 **(19)**	27.375
27.205	27.385
27.215	27.395
27.225 **(22)**	27.405

The Realistic PRO-6 pocketable Scanner for VHF-Hi/Lo, which covers the 30-50 and the 148-174 MHz bands, is Radio Shack number 20-171, and

(Continued on page 100)

EASY WAY TO RECORD

To record shortwave or other broadcasts just plug a telephone pick-up coil into a cassette recorder, then attach the pick-up to the headset.

☐ Have you ever wanted to record shortwave broadcasts, the code practice sessions that are transmitted daily by W1AW while you are studying for your ham license or maybe you wanted to capture the action of the local VHF police band?

If you use headphones for listening there is a very easy way to record these broadcasts. Use the type of telephone pick-up coil that has a suction cup on it. These pick-ups are designed to record telephone conversations when placed on a telephone's earpiece but they work equally well when placed on a pair of earphones.

I used an Arista model 321 telephone pick-up coil but similar pick-ups are available from Radio Shack (part no. 44-533, $1.49), and others, including Lafayette and Calectro.

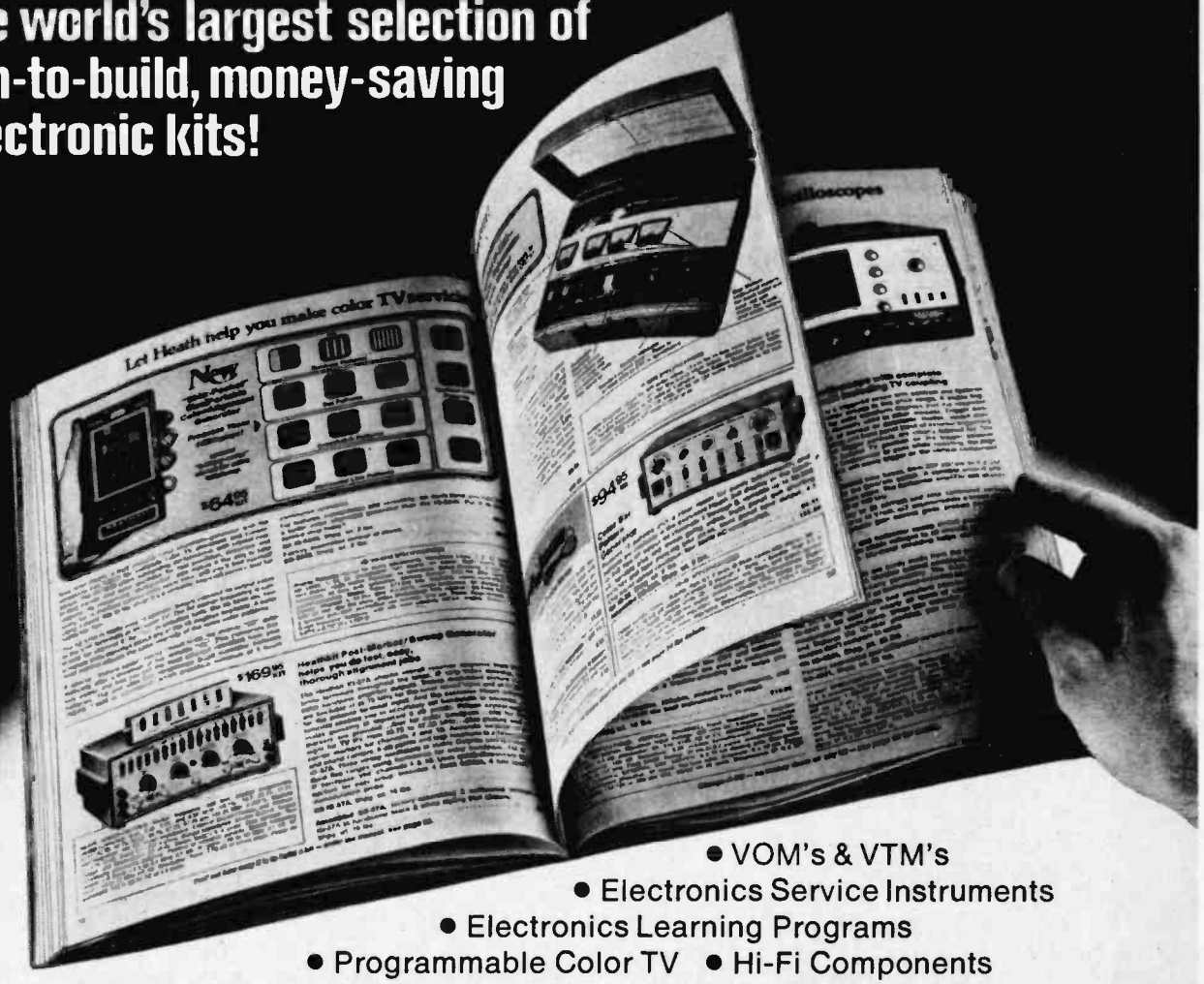
Have fun with your new gadget. Recording short wave broadcasts and other transmissions you tune in on can add a lot to the pleasure of your listening. If you're not sure of a station's identity or something else that's said, just play back the tape until you've got it. You can also impress your friends by letting them hear that rare one from Mongolia you logged last night after digging for it for the past year or so.

Listening to recordings is one of the best ways to learn the code, and, if you or a friend have a receiver that can receive code, you can have an almost unlimited supply of practice material by recording the regular code practice transmissions from W1AW, headquarters station of the American Radio Relay League, Newington, Connecticut. W1AW transmits on a number of frequencies so you should be able to hear it on at least one regardless of what part of the U.S. or Canada you live in. The complete W1AW code practice schedule appears in the League's official journal, QST, and is also available on request from the Communications Department, ARRL, 225 Main Street, Newington, Connecticut 06111. ■

FREE

THE NEW HEATHKIT CATALOG

the world's largest selection of fun-to-build, money-saving electronic kits!



- VOM's & VTM's
- Electronics Service Instruments
- Electronics Learning Programs
- Programmable Color TV • Hi-Fi Components
- Amateur Radio • Radio Control Modeling Equipment
- Digital Clocks & Weather Accessories • Marine, Auto & Aircraft Accessories

Read about the nearly 400 electronic kits you can build and service yourself. The famous Heath assembly manuals guide you every step of the way, and our quality design assures top performance from every kit you build.

Send for your copy today!

Heath Co., Dept. 26-26
Benton Harbor, Michigan 49022

HEATH
Schlumberger

Heath Company, Dept. 26-26
Benton Harbor, Michigan 49022

Please send me my FREE Heathkit Catalog.
I am not on your mailing list.

Name_____

Address_____

City_____ State_____ Zip_____

CL-602B

CIRCLE 1 ON READER SERVICE COUPON

SUPER DXER

Our outboard rig makes QSL waves—adds 20dB minimum gain to any shortwave receiver

CAN YOU REMEMBER the early days of TV—back to the mid- and late-1940s—when the Joneses, who had the only TV in the neighborhood, would strain to clean up a snowy, flickering picture by adjusting a "booster" that sat on the top of their 12-in. phosphor cyclops?

Well, more often than not those outboard boxes, with their 6J6s in push-pull tunable circuits, didn't amount to the proverbial hill-of-beans. Those World War II vintage tubes were not at all well suited to the new-fangled wide-band requirements of TV. But later on as the technology advanced, and more powerful transmitters were built, good, solid pictures became the rule.

Unlike the old TV boosters, today a good booster for short wave receivers—a preselector—can be designed with all the advantages of the latest solid-state devices; and, to boot, it can be simple and very easy to build. It's the easiest way to turn any receiver into an even hotter signal sniffer. You use a booster (a very high gain RF amplifier) between the antenna and the receiver antenna terminals. A good one will also provide sharp image rejection by adding a relatively high-Q circuit to the receiver input. Image signals (which often take the pleasure out of receivers with low frequency single-conversion IF amplifiers by jamming desired signals) vanish as if by magic when passed through a high-Q booster or preselector. In short, a top quality super booster such as the SUPER DXER, will add another dimension of performance to any shortwave receiver.

What It Can Do. The SUPER DXER provides from 20 to 40 dB of signal boost—the exact amount is determined by the particular input characteristics of your receiver. Figuring on 6 dB per S-unit, that's an increase of better than 3 to 6 S-units. In plain terms, the SUPER DXER will bring in stations where all your receiver will pick up running barefoot is its own noise.

The SUPER DXER's input is a diode protected FET (field effect transistor); the protection diodes are built into the FET so that excessively strong input signals, and even static discharges, will not destroy Q1. Since the FET's input impedance is many thousands of megohms, there is virtually no loading of the L1/C1 tuning circuit; its "Q" remains high and provides a very high degree of image-signal attenuation.

The SUPER DXER output circuit is a low impedance emitter follower, and it will match, with a reasonable degree of performance, just about any receiver input impedance. As long as your receiver has two antenna terminals, one "hot" and one ground, you can use the SUPER DXER.

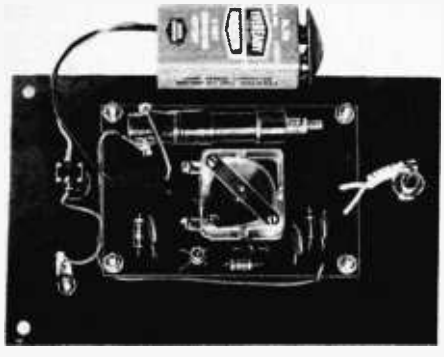
Optimum performance will be obtained if your receiver is equipped with an antenna trimmer. Just as the antenna trimmer peaks the receiver for use with any type of antenna, it also adds something extra when matching the SUPER DXER.

Set Bandpass. The SUPER DXER has a tuning range of slightly more than 3-to-1 between 5 and 21 MHz. That means if the low end is set to 5 MHz, the upper limit will be slightly higher than 15 MHz (3 times 5). If the lower limit is set at 7 MHz, the upper frequency limit will be slightly higher than 21 MHz. Since the slug in tuning coil L1 is adjustable, you can select any operating range between 5 and 21 MHz.

SUPER DXER, though a very high gain device, is absolutely stable if built exactly as shown and described. There will be no spurious oscillations or response. It is possible that changes in the component layout or construction will result in self-oscillation at certain frequencies; hence, make no modifications or substitutions unless you are qualified.

Getting Started. Your first step is to prepare the printed circuit board. Using steel wool and a strong household cleanser such as Ajax or Comet, thoroughly scrub the copper surface of a 2¼-in. x 3¼-in. copper-clad board. Any type will do—epoxy or fiberglass; the type of board is unimportant. Rinse the board under running water and dry thoroughly.

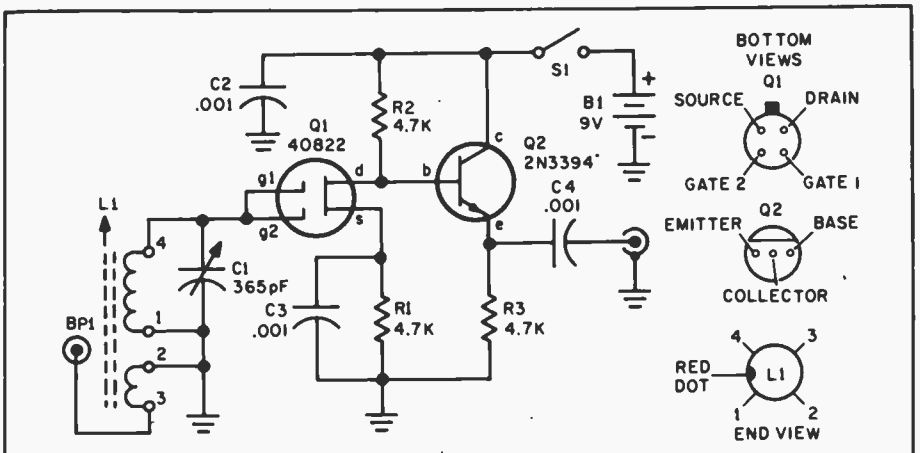
Cover the copper with a piece of carbon paper—carbon side against the



Add an extra 20+ dB gain to your shortwave receiver. Simple kit-of-parts is available. You supply the outer case and knob. Note: Wrap J1 ground wire as shown above.

copper—and place under the full-scale template we have provided. Secure the PC board in position with masking tape. Using a sharp pointed tool such as an ice pick, indent the copper foil at each component mounting hole by pressing the point of the tool through the template and carbon paper. Next, using a ball point pen and firm pressure, trace the foil outlines on the template.

After all foil outlines have been traced, remove the PC board from under the template and, using a resist pen, fill in all the desired copper foil areas with resist. Make certain you place a dot of resist over the indents at each of the corner mounting holes. Pour about one inch of etchant into a small container and float the PC board—copper foil down—on top of the etchant. Every five minutes or so gently rock the container to agitate the etchant. After 15 or twenty minutes check the PC board to see if all the undesired copper has been removed. When every trace of the undesired copper is gone, rinse the board under running water, and then remove the resist with steel wool or a resist "stripper."



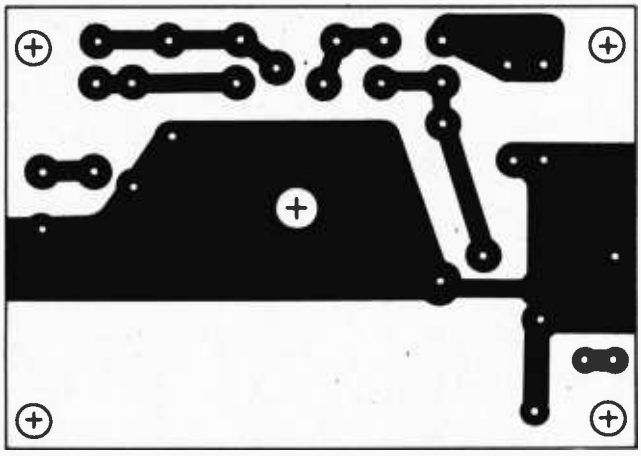
PARTS LIST FOR SUPER DXER

B1—9-volt battery (Eveready 216 or equal) and connector
BP1—insulated binding post
C1—365-pF subminiature tuning capacitor
C2, C3, C4—0.001-uF, 25-VDC or better ceramic disc
J1—RCA-type phono jack
L1—5 to 20-MHz antenna coil, Custom Components SW-520
Q1—MOSFET, RCA 40822
Q2—npn transistor, 2N3394
R1, R2, R3—4700-ohm, ½-watt resistor
S1—spst switch (power on-off)

The Printed circuit board for the Super DXer is available from Electronics Hobby Shop, Box 192, Brooklyn, NY 11235 for only $4.95. US orders add $1.50 for postage and handling: Canadian orders add $3.00. No foreign orders, please. Postal money orders will speed delivery; otherwise allow 6-8 weeks for delivery.

Continue. Drill out all the mounting holes marked by an indent with a #57, 58, or 59 bit—this includes the corner mounting and C1 mounting holes. Then drill the corner mounting holes for a #6 screw, and use a 5/16-in. bit for the C1 mounting hole.

Install tuning capacitor C1 first. Tuning capacitor C1 should be the type provided in the kit of parts. It has a plastic dust cover and a long shaft. Do not use the type supplied with a short shaft to which a tuning dial for the broadcast band can be attached. Remove the mounting nut and ground washer from C1's shaft. Then make certain the shaft's retaining nut is tight. It is usually supplied loose. Discard the ground washer and secure C1 to the PC board with the mounting nut. Then install tuning coil L1. Make note of two things about L1: the terminal end of L1 has a large *red* dot (ignore any other marks); L1 must be positioned so the red dot faces the bottom edge of the PC board—the edge closest to the coil. Also note that the lug connected to the top of the fine-wire primary is adjacent to the bottom of the heavy-wire secondary. When the red dot is facing the edge of the PC board, both these lugs are against the board. Solder the lugs to the matching holes in the PC board. Use the shortest possible length of wire to connect the remaining primary (fine-wire) terminal to the antenna input printed foil. Connect the remaining L1 terminal (heavy wire) to its matching hole with solid, insulated wire—form a right angle bend in the wire so it doesn't touch L1. Now mount the remaining components.



Exact PC board size. Transfer image to copper-clad board using carbon paper. This is the bottom (copper) side of your board. Mount it to the front panel with ¼-in. spacers between board and panel at each mounting screw. Secure the battery to the back of the cabinet with tape.

Orienting Q. Note that Q1 is positioned properly when the small tab on the case faces the nearest edge of the PC board. Also note that the round edge of Q2 faces the nearest edge of the PC board. The flat edge of Q2's case should face C1.

Because the printed copper foil faces the front panel when the assembly is mounted in the case, and is therefore inaccessible for soldering, the connecting wires to front panel components should be installed at this time. Solder 6-in. solid, insulated wires to the antenna, output, and output ground, and +9V foils. Solder the negative (usually black) wire from the battery connector to the ground foil.

The SUPER DXER is mounted in a standard plastic or Bakelite case approximately 6⅜-in. x 3 3/16 -in. x 1⅞-

SUPER DXER

in. The front panel must be aluminum. If the cabinet is not supplied with an aluminum panel, obtain an optional or accessory metal panel. Do not use a plastic panel.

Drill a ⅜-in. hole in the center of the front panel. Position the PC assembly over the hole with C1's shaft fully inserted through the hole, and mark the locations for the four PC board mounting screws. Drill the panel and temporarily secure the PC board to the panel. Then locate the positions for power switch S1, antenna input binding post BP1, and output jack J1. Make certain J1 is as close to the PC board output terminals as is possible—within 1½ inches.

Remove the PC board and drill the holes for the panel components. Power switch S1 can be any inexpensive spst type such as a slide switch. Install the panel components and then the PC board. To prevent the copper foil on the underside of the PC board from shorting to the panel, place a ⅜-in. plastic or metal spacer, or a stack of washers, between the PC board and the panel at each mounting screw. Connect the panel components to the appropriate wires extending from the PC board and the SUPER DXER is ready for alignment.

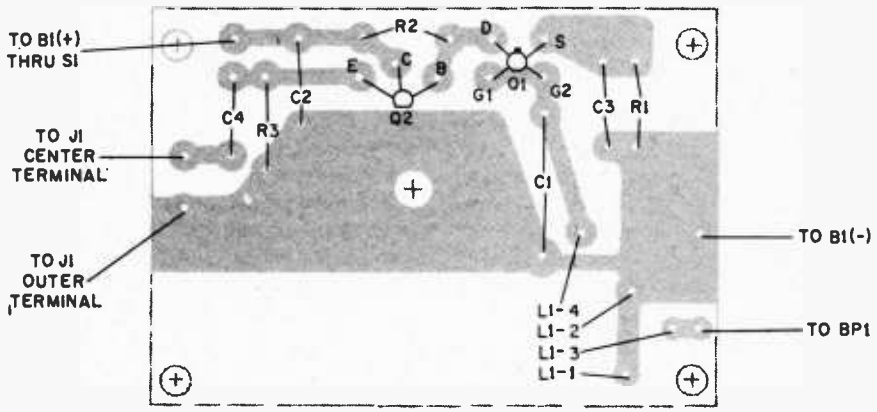
Alignment. Prepare a length of 50 or 52-ohm coaxial cable (such as RG-58) that will reach from the SUPER DXER's output jack to the receiver antenna input terminals. Solder a standard phono plug to one end. Take care that you do not use ordinary shielded cable such as used to interconnect hi-fi equipment; coaxial cable is a must.

Connect the coax between the SUPER DXER and your receiver. Rotate the C1 shaft fully counterclockwise and install a pointer knob so that the pointer extends to the left (9 o'clock position). Connect your antenna to binding post BP1. Then, set L1's slug so that the *bottom* of the screwdriver slot is level with the very *top* of L1. This will provide a frequency range of approximately 5 to 15 MHz. If you back out the slug ¼ inch, the frequency coverage will be from approximately 7 to 21 MHz. You can use any in-between slug adjustment.

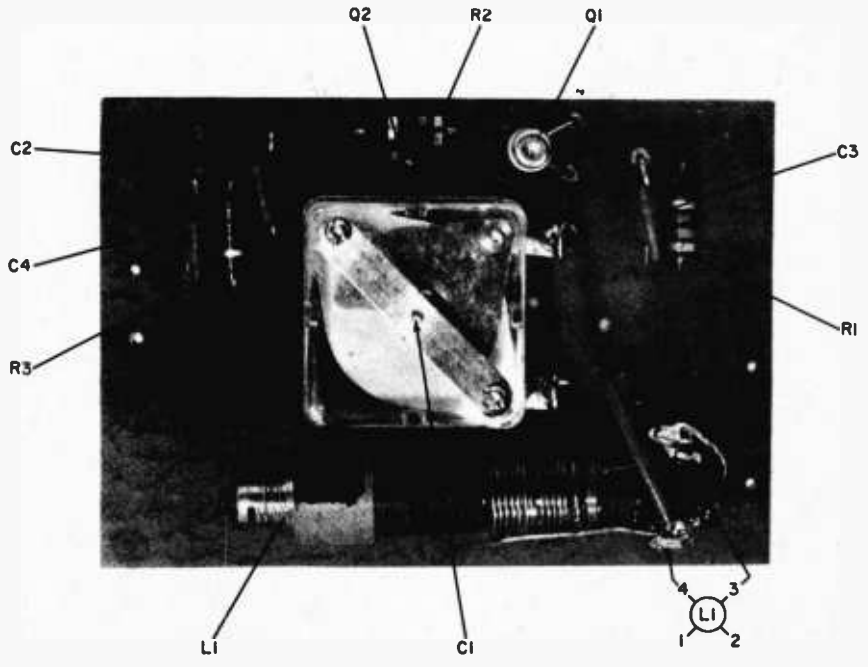
Turn on the receiver and booster, and set the receiver tuning to 5 MHz, or whatever frequency you selected for the "bottom end." Adjust C1 for maximum received signal or noise and mark the panel accordingly. Repeat the procedure at approximately 7, 10, 14, and 15 (or 20) HMz. The panel markings are important because the SUPER DXER's tuning is so sharp it must be preset to near the desired frequency or you'll receive nothing—neither signal nor noise. The panel markings complete the adjustments.

Pull 'em In. To prevent self-oscillation, you must keep the antenna wire as far as possible from the coaxial output cable. To receive a signal, set C1 to the approximate desired frequency and then tune in the signal on the receiver. Finally, peak C1's adjustment for maximum signal strength as indicated on your receiver's S-meter, or listen carefully for an increase in speaker volume. Keep in mind that, if the signal is sufficiently strong to begin with, the receiver AVC will "absorb" the SUPER DXER's boost, and the speaker volume will probably remain the same, though the S-meter reading will increase. SUPER DXER's boost will be most apparent on very weak signals, digging out those signals below the receiver's usual threshold sensitivity, making them perfectly readable.

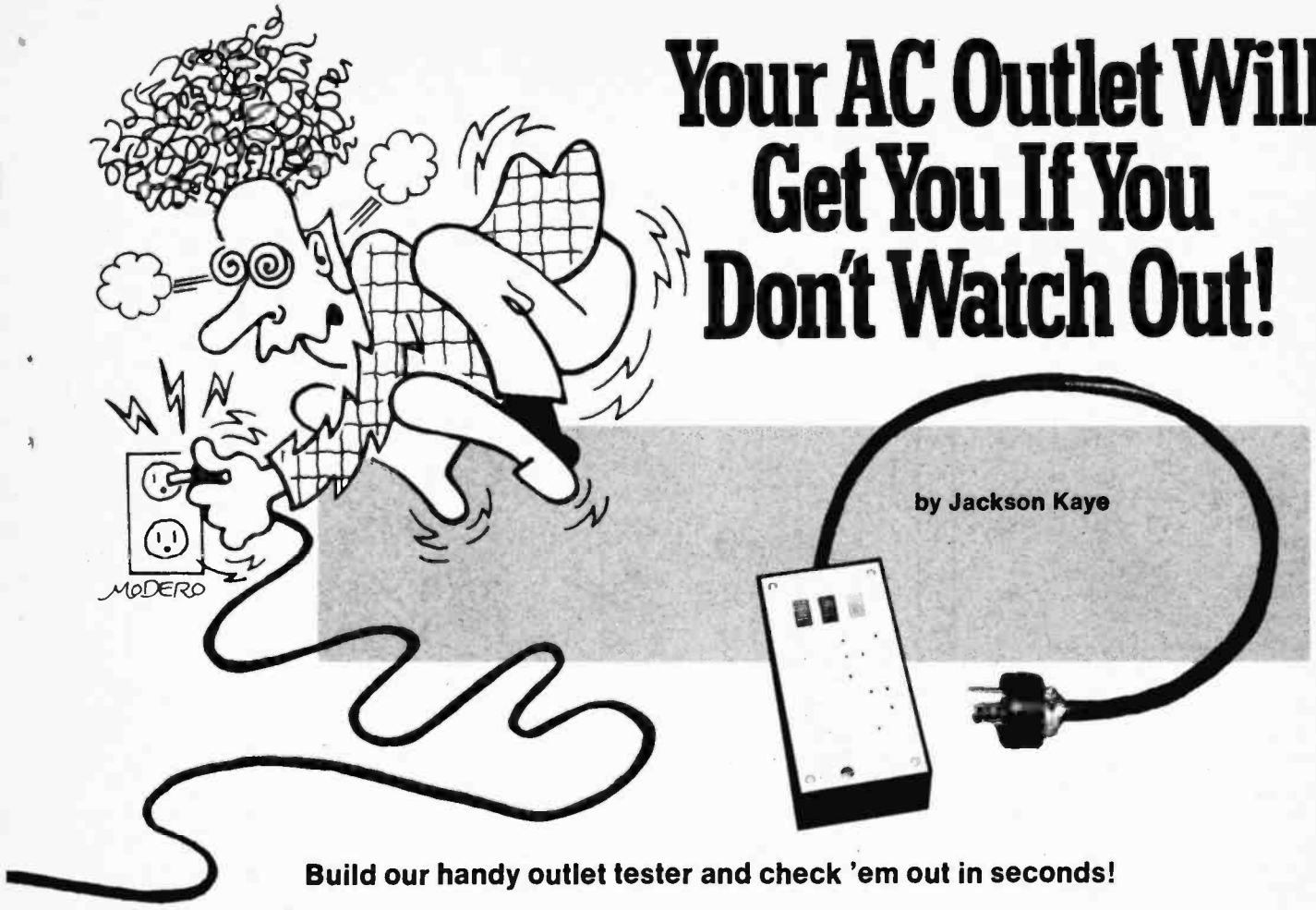
Don't worry about strong signals overloading your SUPER DXER; it is virtually immune to overload even from excessively strong signals. However, the booster's output can be so high as to overload the input of some budget receivers. If this occurs simply reduce the booster's output by detuning C1 just enough to drop the overall signal strength below the receiver's overload value. Happy DXing! ■



For exact part placement on PC board, see diagram above. View is from component (top) side of your Super DXer board. Layout below shows a completed Super DXer. Pins 3 and 4 of the dual winding coil L1 are shown in an end view for clarity.



Your AC Outlet Will Get You If You Don't Watch Out!

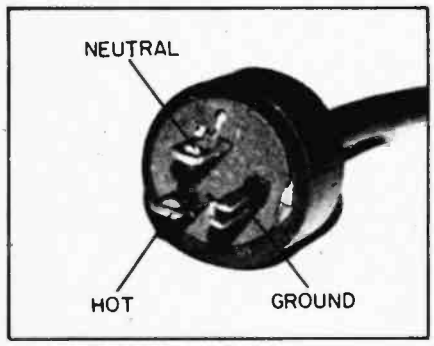


by Jackson Kaye

Build our handy outlet tester and check 'em out in seconds!

☐ The convenient, apparently very friendly, three-prong AC power outlet in your home may *kill* you! Yes, it sits in the wall waiting for you to plug in a power tool or household appliance complete with three-prong plug, you trusting to all of its safe outward appearances and ending up shocked to death's door.

The three-slot AC power outlet offers considerable protection to appliance users provided the outlet is connected correctly to the AC lines. But we all know hardly anybody is going to pull all the outlets from their wall boxes in one's home and check the wiring—it's too much work. And what about your neighbors, relatives and friends who don't know what to check or what to do! You don't want to pull their outlets also?



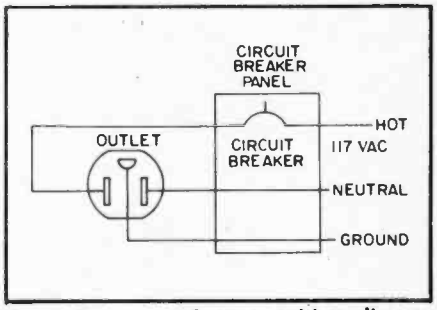
The business end of a line cord. Prong wiring must match outlet's for safety.

The obvious answer is a "quickie" test set that you can plug in safely to a wall outlet to give you a visual indication that the outlet is wired correctly. That's what Test-Out, a handy self-contained visual indicator, does in seconds and you can build it cheaply.

What It Does. Test-Out is a neon bulb indicating device that is plugged into the wall outlet. When the indication is normal, the outlet is wired correctly and you can so unplug it and go to the next outlet. When the indication is other than normal, the color-coded neon indication lets you know what's wrong and tells you what to do to make it safe.

The AC outlet is where it's all at, so you have to know about its wiring hookup before you proceed. This drawing shows the wiring of typical outlet. In your home almost all of the outlets are in-wall installations with the wall plate flush against the wall and duplex outlet plastic mold protruding slightly. The three wires in the box connect to the outlet—the black (hot) wire to the brass screw, the white (neutral) wire to the chrome-plated screw, and the green or bare (ground) wire to the green-painted screw. When wired in this fashion, the outlet is connected as shown at upper right, page 66.

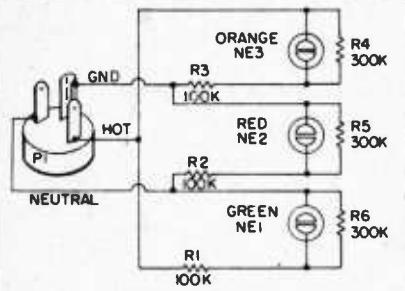
A lamp connected to the hot terminal and to either remaining slot, neutral or ground, will be illuminated. This is exactly what happens in Test-Out. When Test-Out is plugged into an outlet that is correctly wired, both the green and orange lights come on. See the schematic diagram on the next page. Trace the circuit for yourself. Now imagine that the outlet into which Test-Out is plugged has the *hot* and *neutral* wires reversed. The *green* and *red* lights will come on. This is a common wiring



Here's how your house's wiring diagram would look if it had only one outlet.

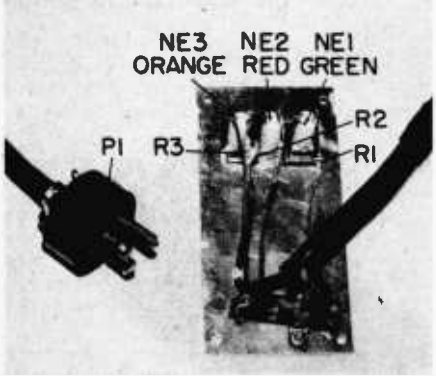
Your AC Outlet Will Get You

fault, and should be corrected whenever it occurs. Some other less common, but still dangerous wiring faults or bad connections Test-out can detect in a wall outlet are: *open ground* circuit, *hot* and *ground* connections *reversed*, *open neutral* connection, *neutral* connection *hot* while the *hot* connection is *open*, and *hot open* or no-power. Each possible fault has its own light pattern



PARTS LIST FOR TEST-OUT

NE 1-3—Neon lamp indicator with 100,000-ohm, ½-watt current-limiting resistor
P1—AC line plug, 3-pronged.
R1-3—100,000-ohm limiting resistor (supplied with neon lamp indicators)
R4, R5, R6—220,000 or 330,000 ohm, ½ watt resistor
Misc.—Plastic case with alumnium cover, approx. 5-in. x 2½-in. x 1⅝-in. (Radio Shack #270-233 or equiv.); heavy duty, 3-wire rubber-covered line cord about 3-ft. long; 3-terminal strip; hardware; wire; solder; etc.



Wiring is simple, but don't rush ahead. Wire neatly and recheck wiring carefully. Neon balance resistors R4, R5 and R6 are hidden behind the neon lamp indicators.

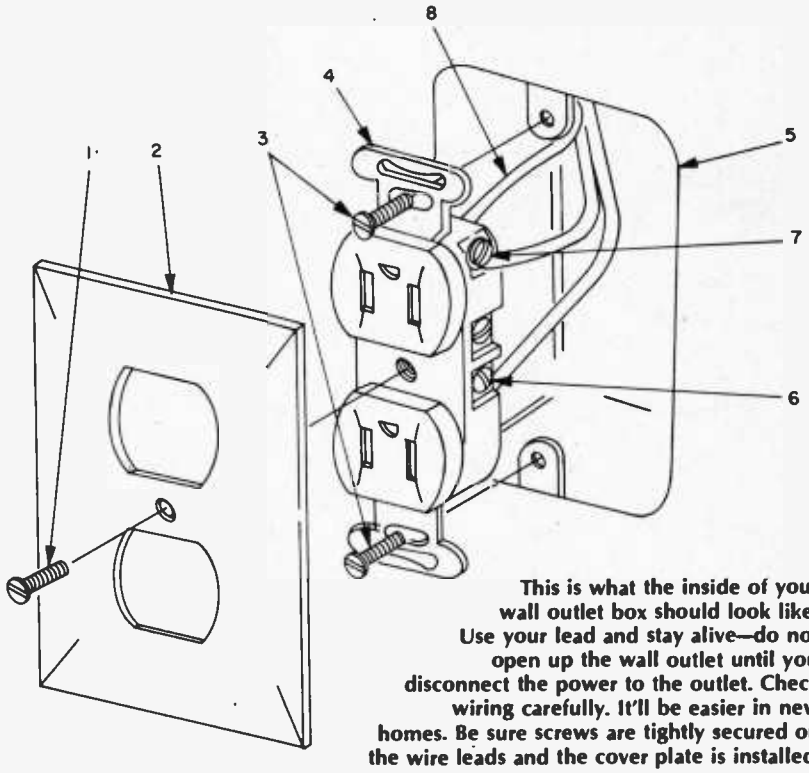
indication which is given in the Table. When you make your own Test-Out unit, copy the Table and paste it on the case for rapid trouble and correction information.

Assembly of Test-Out. Building Test-Out is as simple as stepping in a bucket. The black plastic case with aluminum cover measures approximately 5 x 2½ x 1⅝-in. and has three rectangular neon lamp sets with external limiting resistors mounted on the aluminum cover, with the green lens on the left, red in middle, and orange (amber) at right. A hole is drilled in the box for the heavy-duty line cord to pass. The line plug is also heavy-duty type with built-in wire clamp. Overbuilding here is important because the line cord and plug will take considerable pulls and strain in the normal course of using Test-Out. Don't get cheap material here! A three-terminal strip will make wiring easier (see photo).

Paint the aluminum cover any light color and screw cover to box when wiring is complete. Check unit by applying power first to hot prong and neutral prong on the plug. The green light should go on. Now switch the neutral connection to the ground prong. The orange light should come on. Lastly, the power leads should be connected across the neutral and ground leads—the red light should come on. If all is well, Test-Out is ready for work after the handy-reference Table is copied and cemented on Test-Out's aluminum panel.

Put Test-Out to work at once. You will be surprised how many outlets are improperly wired. Be sure to throw off the circuit breaker before rewiring an outlet. ■

1—Cover plate screw
2—Cover plate
3—Outlet mounting screws
4—Outlet
5—hole for box in wall
6—White wire connected to chrome-plated screw
7—Green or bare wire connected to green screw
8—Black wire connected to brass screw (screw not shown)



This is what the inside of your wall outlet box should look like. Use your lead and stay alive—do not open up the wall outlet until you disconnect the power to the outlet. Check wiring carefully. It'll be easier in new homes. Be sure screws are tightly secured on the wire leads and the cover plate is installed.

AC OUTLET FAULT TABLE

WHAT IT MEANS	GREEN	ORANGE	RED
WIRING OKAY	●	●	◎
HOT & NEUTRAL REVERSED	●	◎	●
OPEN GROUND	●	◎	◎
HOT & GROUND REVERSED	◎	●	●
OPEN NEUTRAL	◎	●	◎
NEUTRAL IS HOT HOT IS OPEN	◎	◎	●
HOT OPEN OR NO POWER	◎	◎	◎

BULB ON ● BULB OFF ◎

An Ounce Of CB Prevention Will Save Your Rig

by Richard E. Hudson

☐ Along with the increase of CB's popularity is an alarming increase of CB theft. They're being stolen and sold all over the United States and it's hard to tell which is being done the most.

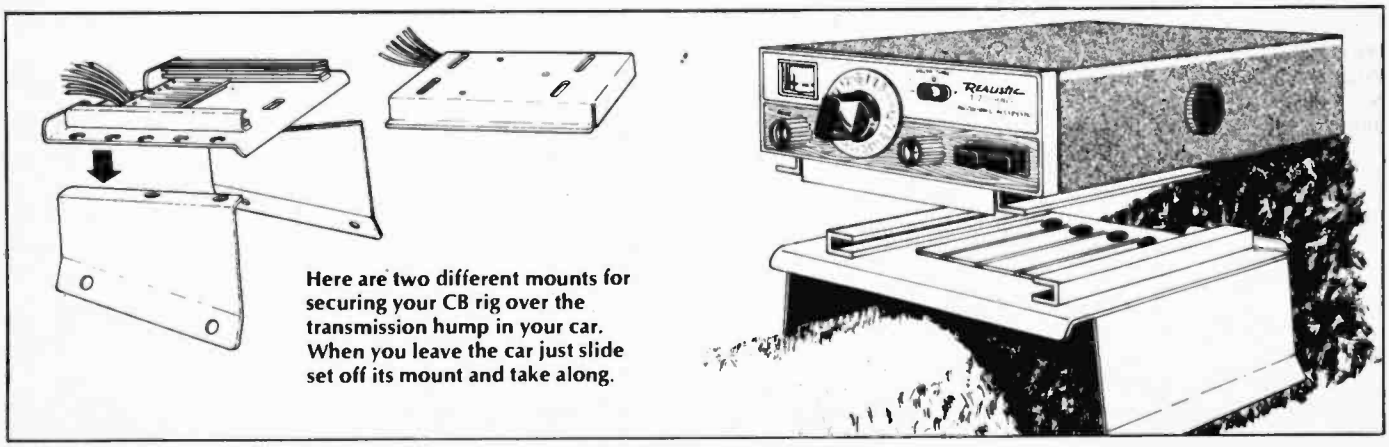
I've heard of cases where CB radios have been stolen, resold, stolen and resold again and again, almost like a chain-letter! Anything as popular as CB is to the average honest citizen is just as popular, to the average thief. There was a time when car thievery was a nighttime practice confined mainly to backstreets, alleys, and houses in rich neighborhoods whose occupants were away, and thieves back then were a frowned-upon minority. But now thieves are bolder and there seem to be more of them, at least, when it comes to CB.

Last year, from Nov. 1 through the 17th, Toledo, Ohio police received theft reports on 258 stolen CB radios valued at $54,000. Based on this they predicted a loss of more than $100,000 worth of CB equipment for that month alone.

CB theft is also a statewide problem in Nebraska, according to a survey recently conducted by their Crime Commission covering October and November of last year. They reported 511 radios stolen in October and 428 in November for a total loss estimated at $164,000. The survey reported that radios were taken from 882 vehicles, with 64% of them forcibly entered. That means that damage was done to 2/3 of the autos while the thieves were doing their work. And that really runs into big money for repairs.

In Ft. Worth area, police report CB theft their greatest headache, with something like 400 stolen rigs a month. They say that it has tapered off a bit in recent months, but they don't expect this to last long.

One truck driver went so far as to call it a fad that even honest people are getting caught up in. He based this



Here are two different mounts for securing your CB rig over the transmission hump in your car. When you leave the car just slide set off its mount and take along.

CBPrevention

claim on the fact that he had been approached on several occasions within the past year by friends-of-friends offering to sell him his choice of CB equipment at flagrantly cheap prices. And he went on to say that many of his trucker friends were losing one and two radios a year because of theft. He cited one of his buddies who had two radios stolen within a month, both while his truck was being serviced, with the engine running! He termed the CB theft situation so bad that, "it's become a national disgrace."

You can see CB theft is not an isolated problem. It's all over, and running rampant.

Regardless of this, most of the CBers I've talked to who have lost CBs to thieves don't plan to give up. They have already or plan to replace that stolen unit because it's a valuable piece of equipment to have on those long trips, out fishing or hunting, even for personal around-town emergencies, like unexpected car trouble.

Thus CB theft has generated a market for a number of anti-theft devices. Some are pretty ingenious, but only a few are really effective as permanent deterrents.

Auto Alarms. Among these devices is a sensitive electronic auto alarm you can install in about 15 minutes. It not only goes off when your radio is tampered with, but you can wire it so that it sounds off should anybody decide to include your antenna as part of the loot. You can buy a good auto alarm from most consumer electronics stores. Radio Shack offers an excellent alarm that'll work on any standard 12-volt negative ground vehicle, for $34.95.

Another ingenious device consists of a small CO_2 bottle that lets off a dense cloud of tear gas the second a thief tries to man-handle your radio. Check your local CB stores first. If they don't have it, you can mail order it from Miltronics, Inc., 12015 Manchester, St. Louis, MO 63131. A one-bottle kit with instructions and mounting hardware costs $7.95, plus an extra 85¢ to cover mailing cost. You can get a two-bottle kit for $14.

Locking Brackets. There are the various locking devices that strap to your radio and bolt to the floor or under your dash. Most are made of heavy, black-finished steel with a tamper-proof lock furnished with two keys.

These make it easy to remove your radio and carry it with you—by far the best protection when you plan to be absent from your car for any length of time. And because it takes a thief more time to crack one of these beefed-up contraptions, they're less apt to make off with your radio the few minutes it takes you to run in and out of a store. Thus you don't have the inconvenience of removing the radio everytime you park.

One disadvantage here is that the experienced thief often comes prepared with a crowbar or other "big stick" instrument to use on super-strong mounting devices. That, plus trying to remove the CB radio in the shortest possible time, will guarantee you a damaged car or radio, or both. There's always the possibility, too, of returning to your car to find a mangled radio, still strapped securely in place!

But, if you think this type of mount will suit you perfectly, then plan on spending from $14 to $40 for one. Most are available at your local CB store.

The Best Answer. Even better than the massive, lockable radio set brackets are the (cheaper) floor and under-dash mounting devices designed to make it easy to remove and reinstall your CB rig, either for use in another vehicle, or for safekeeping. These provide slip-in, slide-out convenience without any buttons, knobs, keys, or levers, and they're extremely easy to use. However, since they have no keys, you must always remember to remove them. If you happen to forget and leave a set in your parked car in one of these brackets, you can just kiss your set goodbye. And the thief will love you for it, because it makes his job so easy.

Police everywhere recommend these mounting devices above all others. The reason is that they allow you to remove your radio quickly for locking in the trunk when the car is parked. They reason that it's better to lose a radio than to have your car sustain several hundred dollars worth of damage as well. If you can make it easier for the thief, at least your loss will be confined to the value of the CB radio—you'll be spared a car-repair bill.

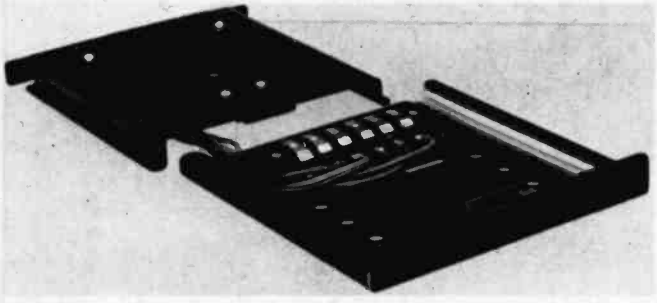
There are many mounting devices like these and they sell for $4 to $10 at most CB stores. In Ft. Worth the two most popular slide mounts are sold by Radio Shack stores. The reason for their popularity is due to their sturdy design, the ease with which you can install and operate them, and their reasonable price. Each sells for $7.95.

Radio Shack's under-dash mount no. 270-016 consists of only two parts—a female section which attaches to the radio cabinet and a male section which attaches permanently under the dash. You simply slide the female section, with the CB set, onto the male section to secure it. Then when you leave your parked car, just slide the radio off the male mount and place it in the trunk of your car for safekeeping while you're away.

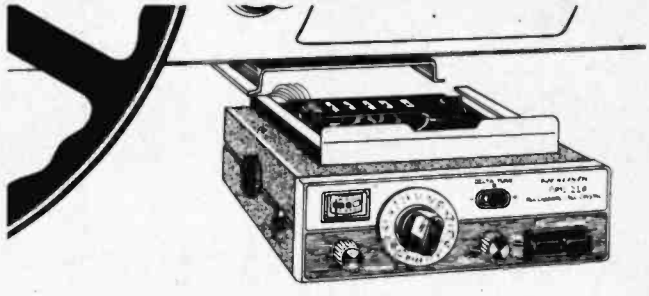
Radio Shack's floor mount no. 270-018 operates the same as the under-dash mount, except that it has two additional plates which allow mounting on the transmitter shaft hump in the floor of your car. It's ideal where under-dash space is limited.

A Safe Antenna Mounting. Keeping your antenna is yet another problem. However, it's one that's not neglected by the manufacturers. Of the many devices they've turned out, by far the best I've seen for the price is the "Flip-Flop" antenna mount. For $11.95, plus

(Continued on page 101)



Radio Shack's convenient slide mount comes in two pieces
Upper (left) unit secures under car dash with three or four screws.



CB transceiver is secured to lower
slide-in bracket with several screws. Antenna plugs in to rear panel.

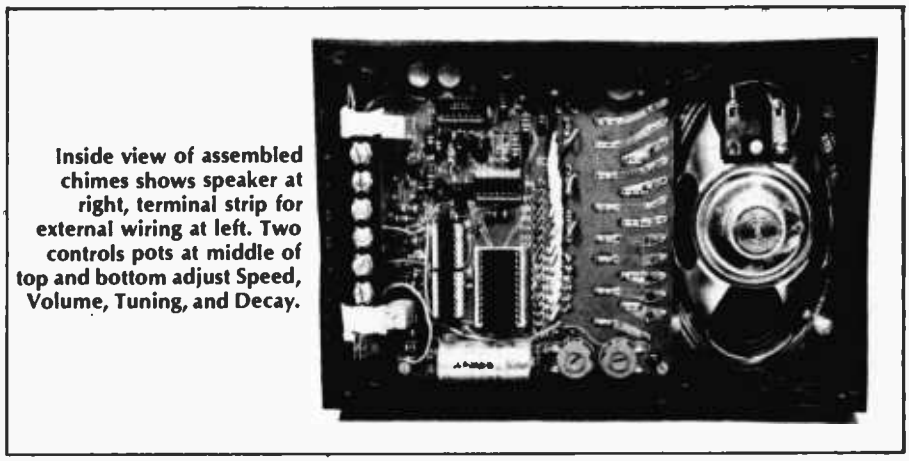
build this kit...

Heath TD1089 Programmable Electronic Chimes

Easy two-evening project plays any tune you choose.

☐ Throwing a party at home, and want to make a splash with the people when they ring your bell? You can program these chimes to play Hail, Hail, the Gang's All Here, Beat Me Daddy, Eight to the Bar, or any other happy tune you choose. Children's party? You can welcome those guests with Mary Had A Little Lamb when they press the doorbell. Christmas? Your door chime plays Jungle Bells. A birthday? It's Happy Birthday. With Heathkit's TD-1089 Programmable Door Chimes you can welcome visitors to your home with sixteen notes from any song, spanning a full octave from middle C with all the sharps and flats.

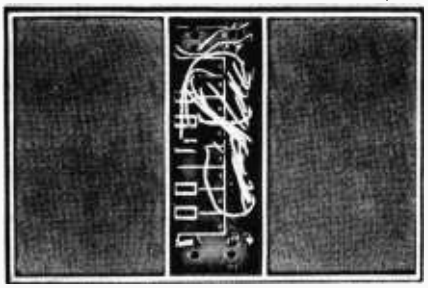
The TD-1089 is completely electronic, there are no motors, cams, or levers. Housed in a cabinet 8⅝-in. wide x 5¾-in. high x 2⅝-in. deep the TD-1089 looks like any other small door chime, but instead of solenoids and tone bars the cabinet conceals an electronic music synthesizer, front and rear door ring controls, a voltage regulator, audio amplifier and a loudspeaker. Everything needed for electronic chimes except the power transformer is built into the cabinet. The power transformer is the standard 16-volt doorbell transformer available in most hardware stores. It can be located anywhere in the home with ordinary bell wire used to connect the electronic chimes—the exact same arrangement most of us use for standard doorbells and chimes.



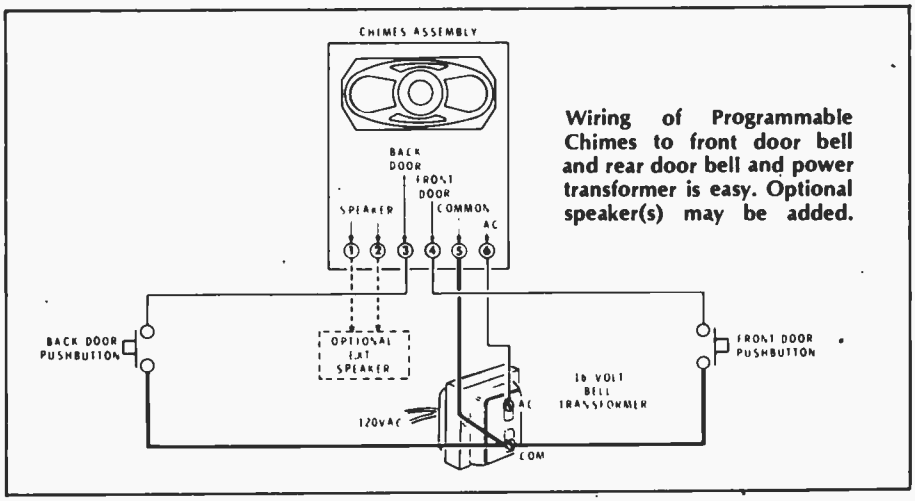
Inside view of assembled chimes shows speaker at right, terminal strip for external wiring at left. Two controls pots at middle of top and bottom adjust Speed, Volume, Tuning, and Decay.

More Sound, Too. Though the TD-1089 has a built in speaker capable of substantial volume, terminals are provided for remote or extension speakers that can be placed in remote corners of your home, down in the shop, or out in the garage.

Several user adjustments are provided: A *tuning* control to set the scale to a full octave; a *beat* control that ranges from the stately "Hymn of Thanksgiving" to "Happy Birthday"; a *decay* control that "tunes" the electronically generated sound to a chime-like sound (a slow beat requires a different setting than a rapid beat), and a *volume* control for the audio output amplifier (which affects the level of the internal



Front view of chimes with programming panel cover removed. Programming wires may be replugged anytime to change tune. For more information circle number 31 on Reader Service Coupon.



Wiring of Programmable Chimes to front door bell and rear door bell and power transformer is easy. Optional speaker(s) may be added.

Heath Chimes

and remote speakers).

The entire circuit—except for the speaker, is assembled on a single printed circuit board. The front of the board has the programming wires and terminals, which are accessible through a removable front panel, as shown in the photographs. Though it looks like the programming wires are a rat's nest, it is all reasonably neat and orderly while you're programming—it gets messy-looking when the wires are folded down and out of the way.

The wires that program the notes for each beat are arranged in an orderly line numbered 1 thru 16. The terminals for each note are clearly marked, for example E, F#, A# (B-flat), etc. There are three terminal posts for each note, allowing the note to be programmed for three separate beats. If you require the same note for more than three beats you can use one of three auxiliary circuits, actually an extra three terminals per auxiliary that can be connected to a note, thereby providing up to five connections for each note.

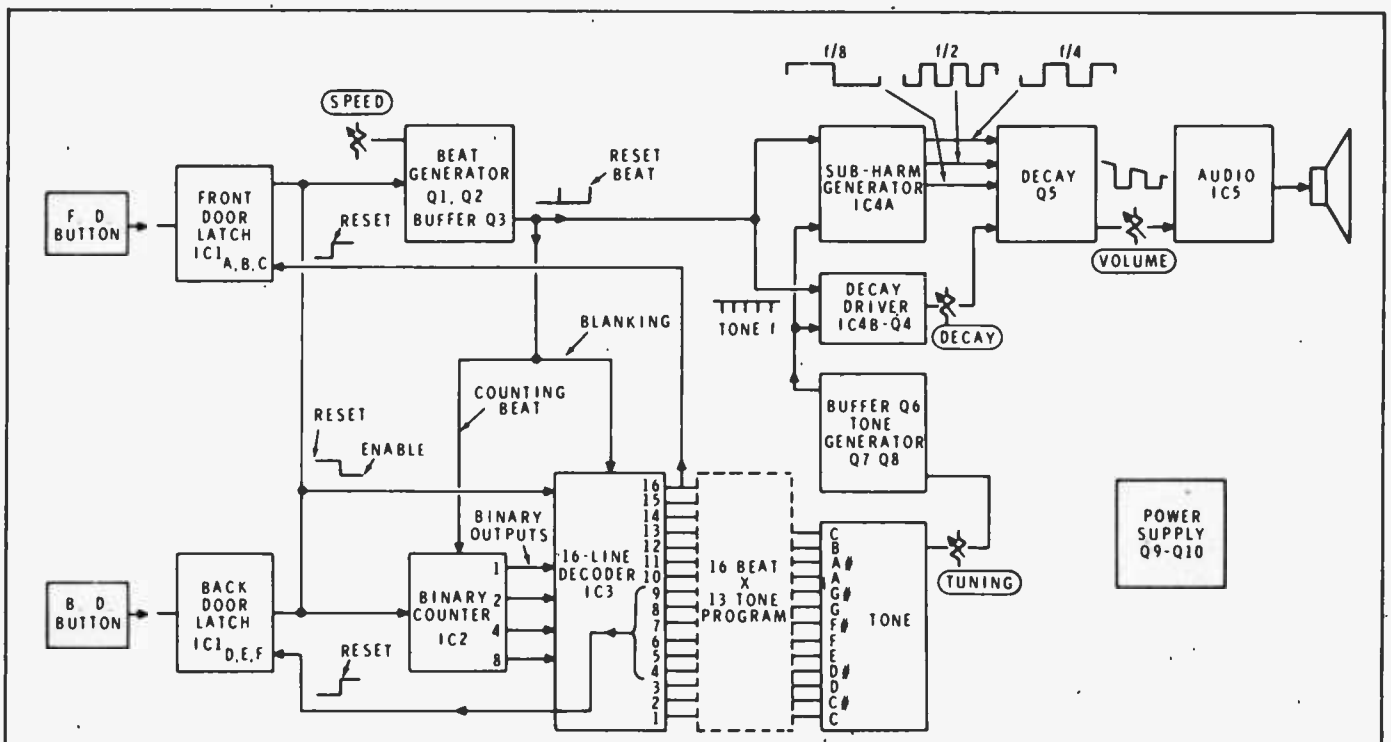
How to Hook Up. In addition to the terminal post connections for the notes and the auxiliaries there are posts labeled 4, 5, 6, 7, and 8, and a small programming wire that plugs into any of these posts. This is the programming for the rear door. When the front doorbell is pressed all sixteen beats (notes) will be played. When the rear doorbell is pressed only those notes programmed: 4, 5, 6, 7 or 8, will be played. In this way you know if the guest is at the front or rear.

Quick Test Provision. A special set of test terminals is provided so you can check the front and rear tunes without going to the doorbells. Simply touch the test wire to the F (front) terminal and the entire sixteen beat melody plays. Touch the test wire to the B (back) terminal and the programmed number of beats for the back (rear) door plays. In this manner you can easily check the programming for any melody. The 72-page instruction manual lists the correct notes and beat programming for twenty three melodies including Happy Birthday and Shave And A Haircut, Two Bits, but you can program virtually any melody that can be compressed into one octave. The manual also has detailed troubleshooting procedures in case you've done anything wrong.

Summing Up. The Heathkit Programmable Electronic Chimes, priced at $44.95 in kit form (mail order), worked as well as claimed and better than expected. Because the scale has sharps it is possible to program a complete melody, rather than a "simplified" melody as required when only natural notes are available. It is also possible to program a beat to be note-free, thereby maintaining the expected rhythm and melody. Overall, the Heathkit electronic chimes is quite a sophisticated device even though it can be built, tuned, and programmed by the average electronic hobbyist. (Assembly is more than a beginner's project". But certainly not an intermediate or advanced level.)

One word of caution, however. You cannot generally substitute the electronic chimes directly for the usual electromechanical door chimes installed by the builder because they work off three wires—a common power wire and front and rear doorbell wires. The electronic chimes, however, require four wires for fornt and rear circuits because both power transformer wires must be connected to the unit in addition to a wire from the front and rear doorbells. Be certain you can snake the additional power transformer wire to where the electronic chimes will be installed.

For additional information circle number 31 on the Reader Service coupon. ■



Simplified description of the block diagram shown above. Action starts when either doorbell button (at left) is pressed, energizing beat generators Q1 & Q2. Their output pulses drive binary counter IC2 whose output sequentially expresses numbers in a four-line (binary) code which is decoded by IC3. These signals are routed via the programmed hard-wiring into the tone generator which drives the decay driver and subharmonic generator IC4A. After level set by the volume adjust, the signal is amplified to drive the speaker(s). IC1 contains two latches, which ensure that only one pushbutton has control until the entire tune sequence is completed.

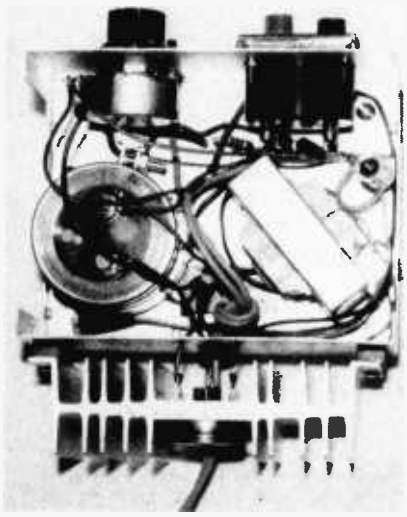
POWER UP

FOR ANTIQUE RADIOS

Collectors can power the filaments of old radios with this simple supply as well as supplying all the power for modern equipment.

by Jim Fred

☐ One of the most important things the serious antique radio collector needs if he wants to make those old radios work, is a power supply for heating the filaments of those ancient tubes. This is a low-voltage, variable output DC power supply. If you have an old enough tube manual you will find that various antique tube filaments need voltages of 1.1 to 5, as well as 14 volts DC at currents ranging from .06 to as high as 0.3 amperes. In addition to using it for operating the filaments of antique radios you can operate transistorized car radios when testing or repair them on the bench, and even charge many kinds of batteries, provided you don't try to draw much more than about 1.5 amperes of current from this supply. You might even use it for electroplating the nickel-plated binding posts, knobs, hex nuts, washers and lever-type switch handles which most antique radios built before 1928 have (such as Aeriola Jr. and Sr., and the Radiola III and IIIA).



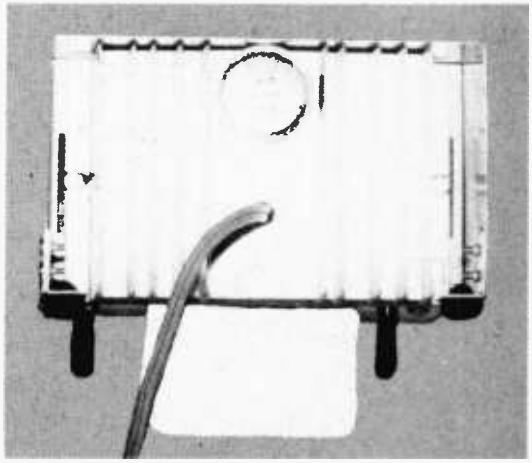
Top view of power supply shows placement of the parts. Small parts location is not critical. Keep leads short, and taut.

Now I love old tube radios, and I hate the new transistor sets, but transistors and diodes do have their proper place, and one of those is in power supplies such as this one.

This unit can supply from zero to 13 volts DC, at currents up to 1.5 amperes. This will handle the filament requirements of most sets with up to five tubes. For instance a one-tube Crosley Pup requires 3.3 volts at .063 amperes, while a six-tube set may require 5 volts at 1.5 amperes. Most pre-1928 battery sets fall within these limits.

How It Works. The transformer steps the line voltage down to 12.6 volts, which is changed into pulsating DC by the bridge rectifier. The switch is used to turn the power on and off while the pilot light indicates that the power is on. The capacitor smoothes out the pulsations and helps prevent hum in the radio whose filaments are being lighted. The potentiometer varies the voltage applied to the base of the power transistor. Varying the base voltage changes the operating characteristics of the transistor and causes the output voltage to vary.

How To Build It. This project is an ideal one for the beginning collector. There are no etched circuit boards to make, nor any critical wiring. You can make the supply as simple or as fancy as you like. If you will look at the photographs you can see that I made the cabinet from scratch, rescaled the meter, and made the dial plate. You too can add these distinctive touches to make a one-of-a-kind power supply. I do this because I enjoy designing and building from scratch and also because I don't like the garden-variety gray ham-



Rear view of power supply shows mounting of regulator transistor on massive heat sink. Long rubber feet (bottom) are optional.

mertone boxes you can buy. For those of you that don't want to spend the time I have called out easily-obtained commercial parts and sources in the parts list.

Construction. The photographs show where the parts are placed inside the cabinet. Arrange the parts you are using in the approximate positions shown and mark the mounting holes. The holes in the bottom of the box are 5/32 inch in diameter to clear 6/32 machine screws. All components are mounted with ⅜-in. long by 6/32 pan head screws and hex nuts.

The panel is similarly marked by laying the parts down and marking their location. The potentiometer specified needs a ⅜-in. hole; the switch and pilot light holes will depend on the parts you use. On the back of the box are the holes for the transistor leads, the line cord grommet, and the heat sink mounting blocks.

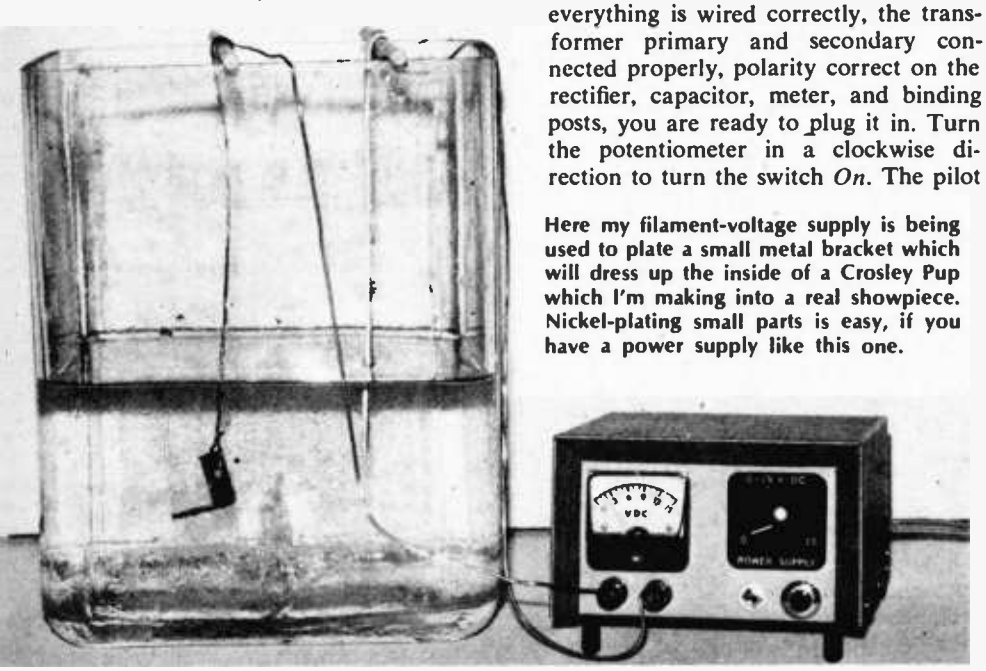
Final Assembly and Wiring. Mount all the components in the bottom of the box, and place the insulating blocks on the back of the box. Be sure the mounting screws are short enough that they do not go all the way through the blocks and short the heat sink to the aluminum box. The collector lead of the transistor connects directly to the body of the transistor and is in turn fastened to the heat sink. Use a lock-type solder lug to mount the transistor to the heat sink.

Mount the front panel components with the proper hardware. After mounting the meter lay a soft cloth on the bench so the plastic meter face will not be damaged. Insert the rubber grommet, run the line cord through it and the clearance hole. Now you are ready to wire all the parts together. Follow the schematic drawing carefully and you will have no trouble.

Testing It Out after you are sure everything is wired correctly, the transformer primary and secondary connected properly, polarity correct on the rectifier, capacitor, meter, and binding posts, you are ready to plug it in. Turn the potentiometer in a clockwise direction to turn the switch *On*. The pilot light should light. If there is no smoke turn the knob clockwise and the meter should begin to indicate. With no load the meter pointer may go off scale. You will exceed 15 volts output only if you have no load on the power supply. The meter reading should be quite linear with the rotation of the voltage control.

Caution. Because the collector of many power transistors is connected to the outside case of the transistor, you must take care to isolate the negative output (emitter, in this circuit) of the power supply from the case. That's because the heat sink, being tied to the outside of the aluminum case, is not at quite the same (negative) potential as the negative output terminal. Another way of handling this problem is to do what I did—mount the heat sink on insulators before securing it to the aluminum cabinet. Then the negative output terminal can be tied to the case, as in most DC supplies.

You now have a power supply to be proud of, and you have a useful addition to your electronic workshop. In addition to operating antique battery radios, you can operate transistorized auto radios and even charge many kinds of batteries. Just remember you are limited to 2 amperes of current. ■



Here my filament-voltage supply is being used to plate a small metal bracket which will dress up the inside of a Crosley Pup which I'm making into a real showpiece. Nickel-plating small parts is easy, if you have a power supply like this one.

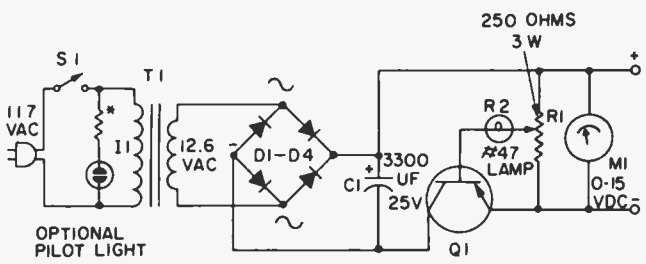
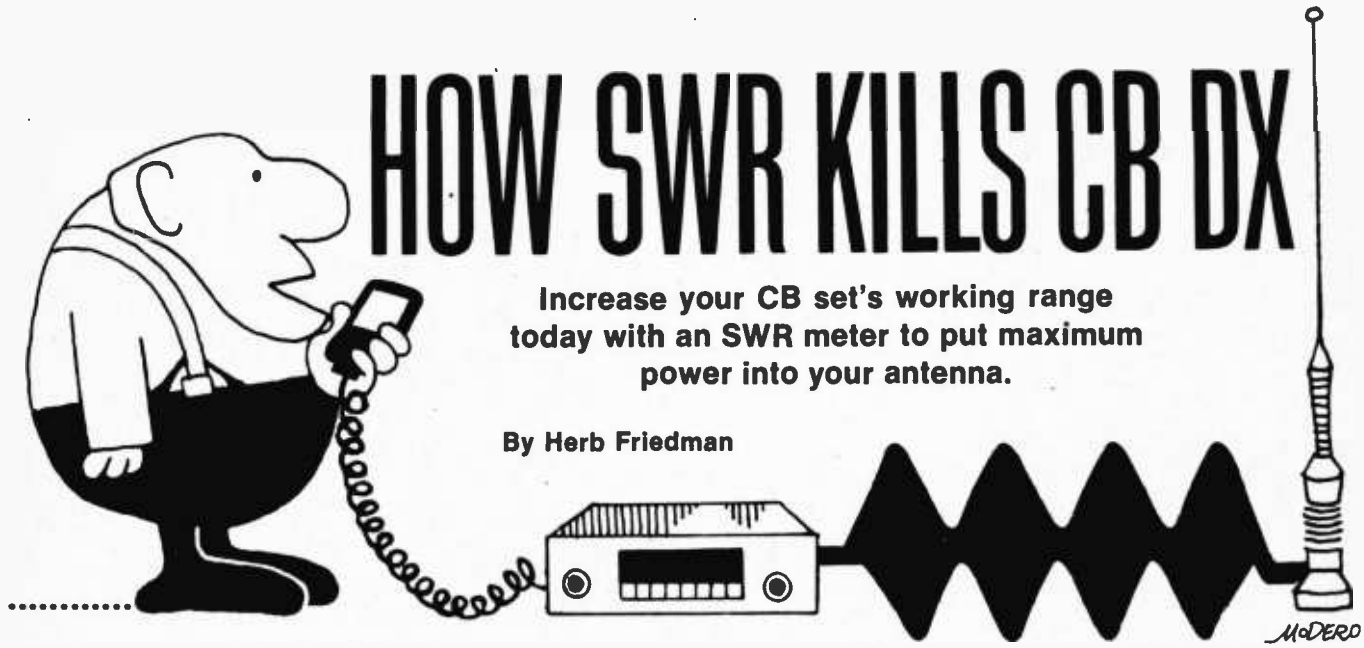


Diagram shows easy-to-build circuit that supplies 0 to 13 VDC, at currents up to 1.5 amperes, to power antique radio filaments, operate modern transistor radios and a variety of electrical and electronic equipment in the home and shop.

PARTS LIST FOR ANTIQUE RADIO POWER SUPPLY

C1—Electrolytic capacitor, 3300 uF or more, 25 or more volts.
D1-4—Bridge rectifier, 2-A, 50 or more volts.
I1—indicator neon lamp assembly, including limiting resistor, for 117 VAC.
M1—Panel meter, 0-15 volts DC.
Q1—Power transistor, PNP, 3-amperes or more collector current.
R1—Potentiometer, wire wound, 250-ohm, 3 or more watts.
R2—No. 47 incandescent pilot lamp used as variable resistor, 150 mA, 6.3 V, bayonet base.
S1—AC power line switch, SPST.
T1—Power transformer, 117 VAC to 12.6 V, 1.2 A or more.
Misc.—Transistor heat sink, binding posts, cabinet, aluminum approx. 5-in. x 3-in. x 6-in., socket for #47 lamp, knob, heat sink insulators, dial plate, line cord.

HOW SWR KILLS CB DX



Increase your CB set's working range today with an SWR meter to put maximum power into your antenna.

By Herb Friedman

ALTHOUGH MOST CBers are familiar with the term SWR, which means *standing wave ratio*, very few actually know how SWR affects a CB station's overall performance. In some cases SWR is absolutely meaningless to the CBer, having little or no effect on the station's signal. In other cases SWR can reduce a CB station's effective output to almost zero.

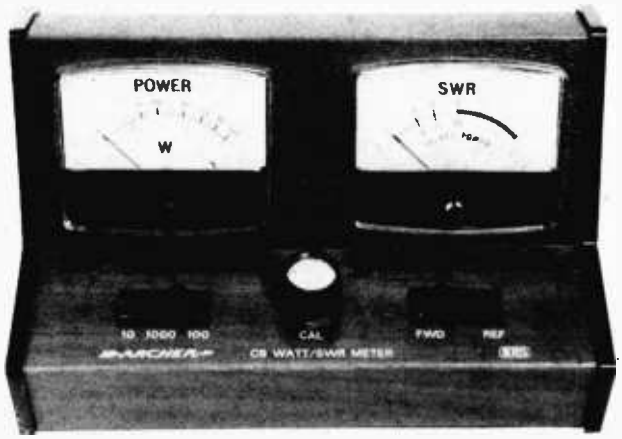
SWR is the *ratio* of the transmission line *impedance* to the antenna *impedance*, at resonance (the operating frequency). An SWR (ratio) is written "2:1", which can be described in words as "2 to 1." For example, if the transmission line impedance is 50 ohms and the antenna impedance is 100 ohms the SWR is equal to 100/50, or 2:1. It is not 50/100 or 0.5:1. Putting it another way, if the transmission line impedance is 50 ohms the antenna impedance can be either 25 or 100 ohms for a 2:1 SWR.

The SWR figure is important because the antenna does not accept all the power delivered by the transmission line when the antenna impedance differs from that of the line, and the SWR tells how much power is turned back by the line/antenna mismatch instead of being radiated by the antenna. The power that is turned back is called *reflected* power, and it is used up as heat dissipated in the transmission line and in the transmitter's output circuit. The Table shows the percentage of power reflected back for typical SWR values. Note that at an SWR of 3:1 there's 25 percent of the power at the output end of the transmission line (the antenna end) reflected back, instead of radiated out into the air from the antenna. In addition, there's always a natural loss of power in the line before the power gets to the antenna. Thus the SWR indicates a loss from the already-lowered (by line loss) output.

You will not be surprised to know that it's pretty difficult to measure the actual antenna impedance when the antenna is mounted on its mast or tower. Fortunately, when the reflected power flows back down the line the phase difference of current and voltage meeting the forward power sets up voltage and current *standing waves* on the line. By measuring the minimum and maximum values of these current or voltage standing waves we determine the ratio of forward-to-reflected power, which is the SWR of the antenna system. Since voltage is easier to measure than current the typical CB SWR meter indicates forward and reflected power through a voltage measurement, so the indicated SWR is actually *VSWR*—meaning SWR determind through a voltage measurement. All in-line CB SWR meters are really VSWR meters—the terms (*SWR* and *VSWR* being interchangeable.

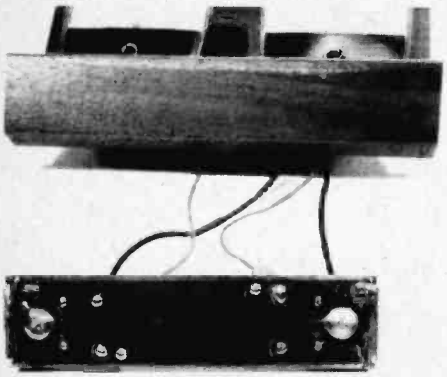
Using the SWR Meter. In commercial installations, SWR is generally determined by measuring the forward and reverse power and then calculating the SWR. A much easier way to find the SWR is to use a meter that can be adjusted to indicate full scale on the forward power regardless of the actual level of the forward power. The reverse power is then indicated as a proportion of the full-scale reading. If the reverse power was 25 percent of the forward power the meter would always indicate the same reading regardless of the actual forward power as long as the meter was always calibrated to indicate full scale on the forward power. And this is the way most CB SWR meters work. They connect in series with the transmission line and sense the forward and reverse power. The user, by adjusting a *calibrate* control, sets the meter to indicate full scale on the forward power. When the meter is switched to read reverse power the scale calibration is directly in SWR; and some scales are calibrated to indicate both the SWR and the percent reflected power. Since the SWR meter senses *voltage* it absorbs very little, almost no RF energy. Thus it can be left permanently in the transmission line circuit, giving a continuous indication of the antenna system's SWR.

Some of the latest service shop SWR test meters have automatic full-scale



Radio Shack's combination power-SWR meter is in-line instrument capable of checking most transmitters up to 1000 watts (on amateur radio rigs).

HOW SWR KILLS CB DX



Middle foil of printed circuit is the center conductor; on either side of it are the forward and reverse power sensors.

calibration, so the meter reads out directly in SWR without the need to first calibrate the meter for the forward power.

How SWR Meters Work. Regardless of whether forward calibration is manual or automatic, SWR meters used for CB all use the same type of inductive forward-reverse power sensor shown in the schematic. Wires positioned on each side of a coaxial center conductor sense the forward and reverse RF energy in terms of standing wave ratio. The RF energy is rectified and filtered to a DC voltage which is proportional to the RF energy. The meter then uses the DC to indicate the SWR value.

In modern CB SWR meters it has become common practice to use a small printed circuit board for the RF sensor of SWR meters. The coax center conductor and the forward and reverse sensing wires are etched from copper on a printed circuit board, as shown in the photograph. Pictured here is a Radio Shack combination SWR and output power meter. The output power meter consists of the forward power sensor with an internal calibration control (not accessible to the user) and a scale calibrated in watts rather than SWR. A selector switch allows the CBer to set the scale calibration for 10, 100, or 1000 watts. Obviously, the 10 watt-scale is fine for CB, but since a power-SWR meter can be used for other services in addition to CB in the range of 3 to 30 MHz the additional calibrations (100 and 1000 watts) allow the meter to be used for these other applications without internal modification.

One photograph shows the RF forward-reverse power sensor. Flipping the unit over lets you see the attached coaxial connectors, which are shown in detail in the next photograph. When the whole thing is assembled all the CBer sees is a panel with RF connectors labeled *Antenna* and *Transmitter*. No damage will occur if the connections made to the antenna and the set are reversed. The meter will simply read backwards. That is, the forward power will be indicated when the meter is set for reverse power, and vice versa.

What Typical Values Mean. The closeup photograph of the SWR meter scale illustrates the typical *SWR/Percent Reverse Power* calibration common to most SWR meters used for CB. The top scale shows SWR values—note that there is no calibration above 3:1 because anything greater than 3:1 is simply not acceptable. If values near 3:1 are found the antenna system should be tuned or repaired, or an antenna matcher should be used.

The bottom scale represents *Percent Reverse Power*. It shows that an SWR of 3:1 means 25 percent of the power is reflected back from the antenna. An SWR of 1.5:1 means that only 4 percent of the power arriving at the antenna is reflected.

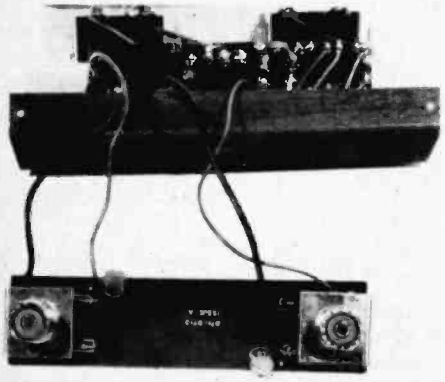
Useful CB Test Instrument. One of the latest CB service test instruments is

Detailed view of SWR meter face shows relation between SWR and percent of power returned. Markings show 25% of power is lost at 3:1 SWR.

the Sencore CB41 Automatic Performance Tester. It indicates power output, SWR, and percent modulation. Note that there is no forward power calibration control. This is because it is automatically calibrated when the *SWR Test Switch* is depressed. Since the meter is intended for use in service shops, its SWR scale is calibrated green, yellow and red to indicate good, passable and defective conditions, Of course it also has the usual SWR number markings.

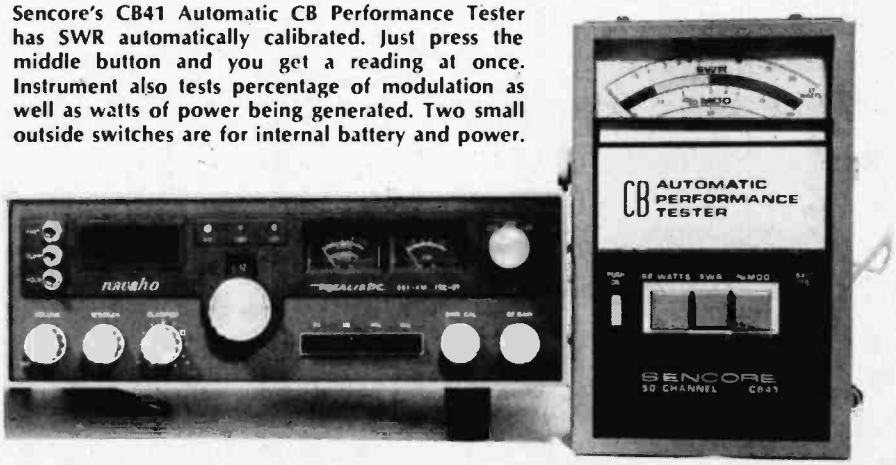
In addition to the normal reflected power loss one must remember that SWR increases all other antenna system losses. Further, the SWR reading is rarely accurate on long transmission lines because of the inevitable line losses. Starting with the SWR multiplier effect; if the normal line loss is say, 3 dB per 100 feet of coax transmission line, a moderately high SWR will add 1 dB additional loss. Further, the same loss is added to the return power loss so that an SWR meter working into 100 feet of cable sees a lower-than-actual return power, and therefore indicates a lower-than-actual reflected power. Normally the SWR indication is lower, to

(Continued on page 99)



Here's the reverse (rear) of the sensor boad, showing the coaxial cable connectors for input and output.

Sencore's CB41 Automatic CB Performance Tester has SWR automatically calibrated. Just press the middle button and you get a reading at once. Instrument also tests percentage of modulation as well as watts of power being generated. Two small outside switches are for internal battery and power.



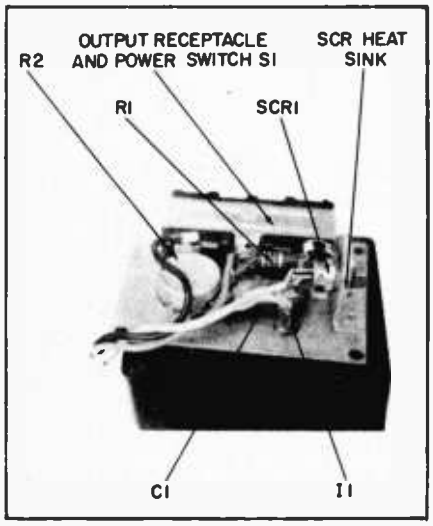
BUILD SELECT-A-SPEED MOTOR CONTROL

Beginner's project that provides choice of speeds for electric drill and other AC devices.

by the Electronic Assembly Class
Central High School, Bridgeport, Connecticut

We have all become conditioned to expect rapid transportation via fast cars, streamlined trains and supersonic jets. We've learned to expect instant . . . cash, credit, headache and stomach relief, rebates, replays and foods. No wonder we seldom think of speed in terms of anything less than maximum. 'Twould seem practically un-American.

However, those of us who have to work with non-ferrous metals, with plastics, or hard woods, find it important to get intermediate ranges of speed (rpm) with portable electric drilling equipment. The Select-A-Speed motor controls described here accomplish this goal. The smaller model continuously varies the rpm of portable ¼-inch electric drill motors, and the larger unit provides incremental speed changes using a switching arrangement, a feature not previously seen on a control of this kind.



View inside speed control which is continuously variable. Note SCR heat sink.

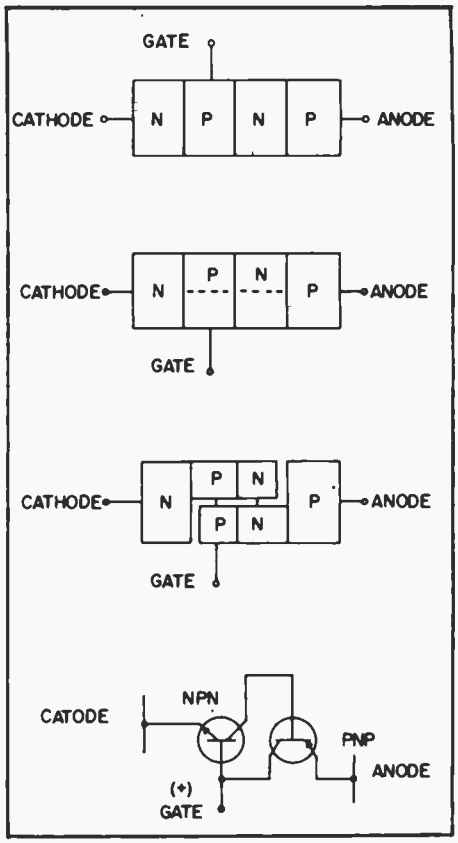
How It Works. The heart of these units, a silicon controlled rectifier (SCR) is a four-layer device whose construction is shown in the diagram. Alternate half-cycles provide the forward bias to cause the conduction, which occurs when the gate is properly triggered. The RC time constant, provided by the resistance and the capacitance controls the rate of charge of C1. Here's how the circuit acts.

C1 will discharge through I1 when the charge on C1 is equal to the ionizing potential of I1, thus providing the gate with a signal. Once triggered, conduction is sustained until the negative half-cycle reverse-biases the SCR at which time conduction ceases until the cycle is repeated. As more resistance is introduced the RC time constant is increased. The resulting increased phase shift further delays the time at which the gate is triggered. This causes the SCR to conduct for less time, and the available load power is thus diminished.

Can Control Many Devices. This versatile unit also functions well as a temperature-control device for pencil-type soldering irons, and also regulates the intensity of conventional desk lamps as well as photo-floods.

In addition it works well to control the speed of electric sewing machines and other small motor-driven hand tools. However, you *must not* try to use it to control devices which have transformers in them, such as soldering guns (pencils are OK), high intensity lights, etc. Of course it won't work at all with fluorescent lights, because lower voltage won't be sufficient to work the starter.

Any number of switch positions may be incorporated. One prototype of ours had ten. Whether you opt for three,



Silicon-controlled rectifier is a four-layered device. Simplification is shown at top. Gate voltage cuts off current between cathode (left) and anode (right). At bottom is a schematic diagram showing the SCR acts as though it were two transistors, an NPN and a PNP, together. Positive voltage on gate (of NPN) causes that "transistor" to conduct.

SELECT-A-SPEED

four . . . or ten, the option merits consideration. Having this choice eliminates sharpening drill bits so frequently as would be required without speed selection. Utilizing too high a speed for a given material is similar to "running in place" . . . neither gets you anyplace; both are dulling! Operating at speeds less than those recommended tends to cause breakage and invite physical harm to one's person.

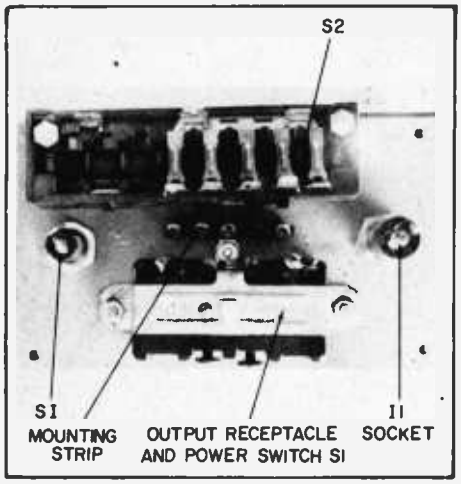
The resistors may be of any wattage and their ohmic resistance figured on the basis of the speeds most useful to you. We actually found the resistor values for optimum operation by using a resistance substitution box.

Parts placement is not critical. The controlling SCR should definitely be heat-sinked. Be sure that the SCR is electrically insulated from the sink or chassis. It is necessary to use silicone grease to insure proper heat transfer. Don't exceed the wattage rating of the SCR!

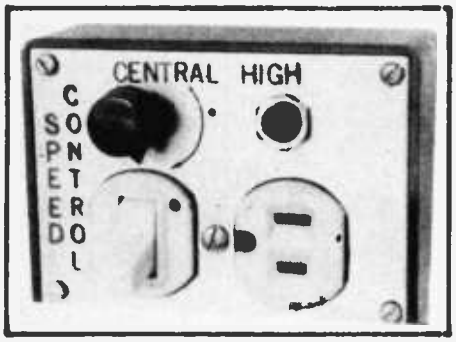
All switches used in our prototype models were bought through a source of surplus supplies. Each was modified to meet our particular needs. Incidentally, we noted no appreciable difference in speed between conditions of load and no load.

A photograph of the waveforms was taken across the load with the SCR as the controlling device. The SCR was apparently conducting during 90 degrees.

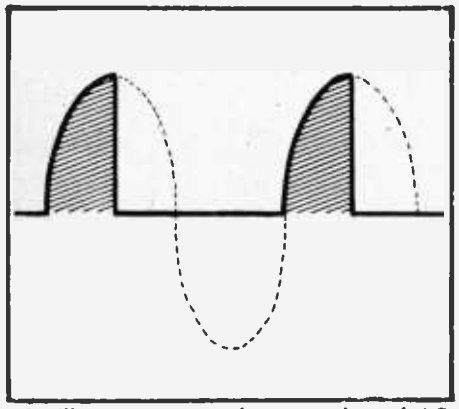
The industrial electronics class of the Career Education Department of Bridgeport Central High School worked on this project. Special credit is due Anthony D'Andrea, Torcato Caldas, Brad Hechler, and Chris Shamiss. Class instructor, under whose supervision this project was completed, is Edward M. Allen. ■



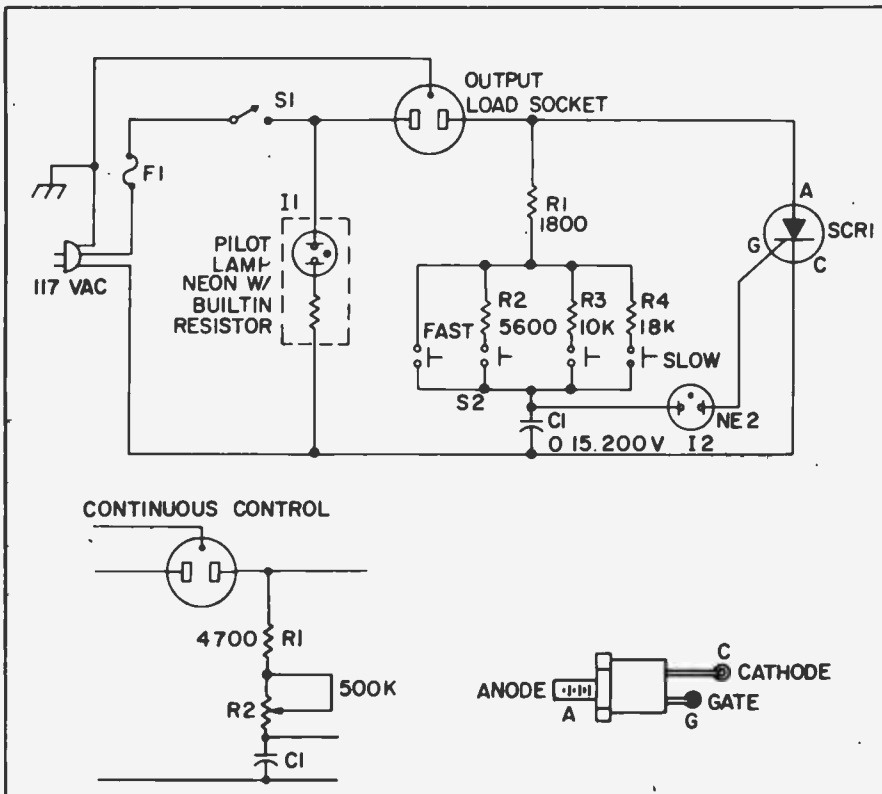
View inside 4-speed control shows push-button switch at top. Similar to fan controls.



Variable-speed unit uses potentiometer for smooth, continuous control.



Oscilloscope screen shows portion of AC sine wave during which SCR permits current to flow (cross-hatched parts).



PARTS LIST FOR 4-SPEED CONTROL

C1—0.1 to 0.2-uF, 200-V DC (or better) capacitor
I1—Indicator light, neon, with resistor built into holder, 117 VAC
J1—Outlet socket and toggle switch, duplex unit, 117 VAC (from electrical or hardware store).
Q1—Silicon-controlled rectifier, 200 VDC or better, 8A (Motorola HEP-R1243 or equiv.)
R1—1800 ohm, ¼- or ½-watt resistor
R2—5,600-ohm, ¼- or ½-watt resistor
R3—10,000-ohm, ¼- or ½-watt resistor
R4—18,000 or 20,000-ohm, ¼- or ½-watt resistor
S1—part of J1, above
S2—4-position pushbutton switch, heavy duty electrical (10A or better). From electrical or hardware store (similar to switches used on large fans, blenders, etc.)
Misc.—Aluminum utility box, 6-in. x 3- or 4-in. x 2-in. or more

PARTS LIST FOR CONTINUOUSLY-VARIABLE CONTROL

Substitute the following parts in the 4-speed control list above:
R1—4700-ohm, ¼- or ½-watt resistor
R2—50,000-ohm potentiometer, linear taper
Note: omit **R3** and **R4**.

Build this long range microphone and . . .

Bug Mother Nature

by F. J. Bauer

With a parabolic mike offering sonic and electronic amplification you're in tune with Helix Aspera to Yellow-bellied Sapsuckers!

ENGLISHMAN George Riley lives in Kent, works in London, and goes home to an unusual hobby.

"It all started about a couple of years ago when I borrowed a friend's parabolic directional microphone dish. This type of equipment is hyper-sensitive and can be pinpointed to record a sound without external noise interference. I was using it to record the sound of crickets when I suddenly heard a strange 'slurping crunching' sound. This turned out to be a large snail making the most of some hard grass. From then on I was hooked," says George.

Experts such as zoologist Donald J. Borror have used the parabolic microphone technique to produce 33⅓ rpm records that sonically illustrate ornithology books and booklets.*

After stumbling over a couple of radar antenna dishes a few years ago, I finally decided to put one of them to work. Since I was no microwave expert, I decided to try an acoustic application. After all, I reasoned, a parabolic dish is a parabolic dish whether it is used for reflecting and focusing microwaves or sound waves. The result is the parabolic microphone described in this article.

If you want to go all out for added gain, look over the surplus dealers' list for an 18-inch or larger aluminum model. As nearly as I can tell with the test equipment available, the 18-inch reflector adds about 10-dB gain to the microphone.

Construction. It's simple enough as reference to the photos will reveal. The mount for the dish is made of wood

and masonite. The dish is held in place by three threaded rods which also serve as the microphone support. Almost any kind of rod material will do, as long as it is or can be threaded. I happened to have some odd pieces of 9-gauge aluminum clothesline which threaded easily with a 10-32 die. Make the rod length about 7½ inches to allow sufficient leeway for adjusting the microphone for optimum focus. A small bracket or block may be added where the dish touches the wooden base to add rigidity, and a hole in the center of the base will make it convenient to mount the whole assembly on a camera tripod.

Any low-priced ceramic or crystal microphone cartridge will work well with this reflector. The one shown in the photograph happens to be out of a pre-WW II hearing aid!

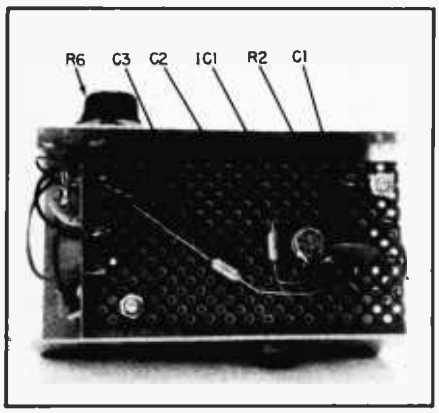
Mount the microphone cartridge on the rods with rubber bands. The exact method of attaching the rubber bands to the microphone cartridge is left to the ingenuity of the builder, since this will largely depend upon the physical configuration of the microphone.

Next route a 16-inch piece of shielded microphone cable from the microphone along one of the rods, through the dish (but inside the back plate), and terminate the cable in a phono plug. The cable should have sufficient slack so that it may be easily plugged into the amplifier box. Also, be sure to allow sufficient lead slack at the microphone end of the cable so that the shock mount effect of the rubber bands is not nullified. This will complete the microphone reflector assembly, which should be set aside until the amplifier is built.

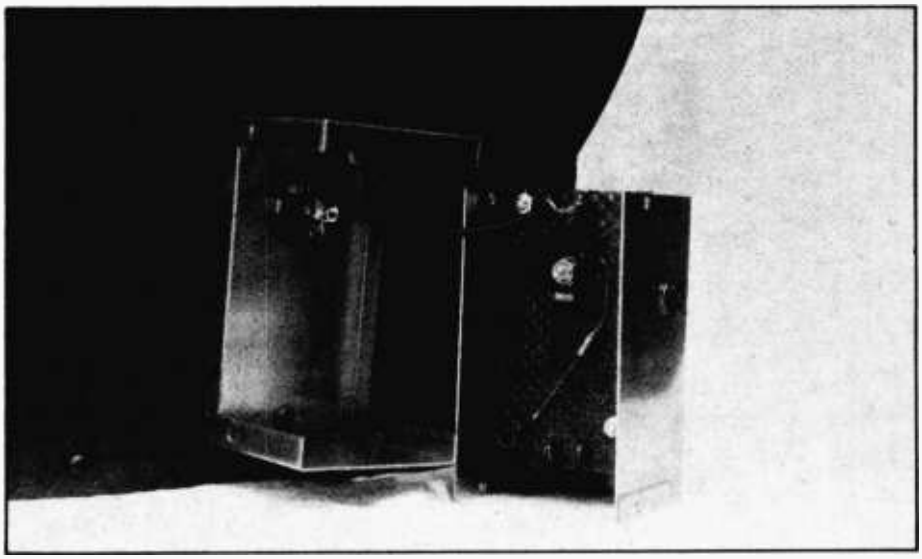
Electronics. The amplifier is a three stage affair using an RCA CA3018 integrated circuit. Transistors Q3 and Q4 are used as a Darlington pair in an emitter-follower circuit in the first stage. This provides the necessary high input impedance required by the crystal microphone. The two following stages utilize Q1 and Q2 respectively as conventional common emitter amplifiers. The average gain per stage is about 38 dB.

Capacitor C4 across audio gain control R6 provides a 3-dB roll-off at 15 kHz, thus limiting amplifier frequency response to the desired audio range. In addition to limiting the frequency response, this capacitor also reduces the tendency of the amplifier to oscillate at higher frequencies, which could result in instability and low output. The 3-dB point at the low frequency end is about 70 Hz, sufficient for this application.

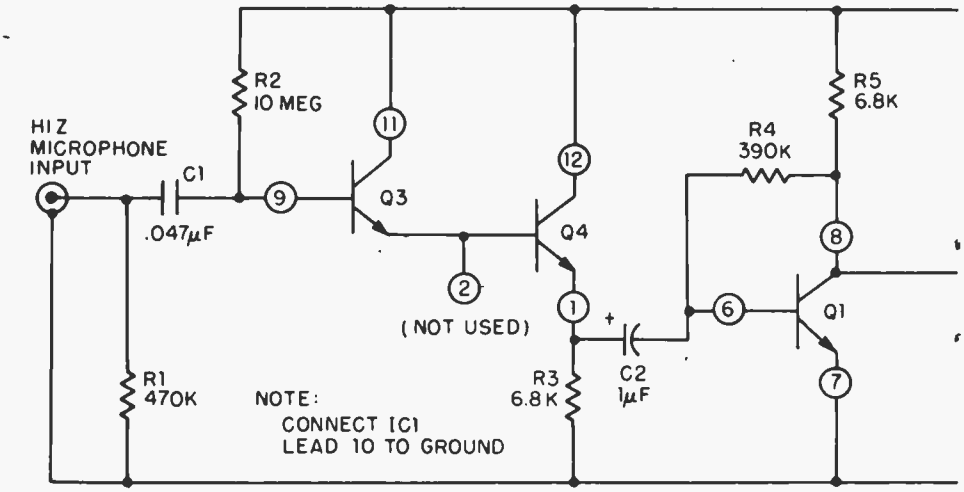
Two 9-volt transistor batteries are used to power the amplifier; not because of high current drain, but, to avoid common coupling between the output stage



Place components above and below the raised perf board. High impedance circuit makes it necessary to shield the amp in a metal box.

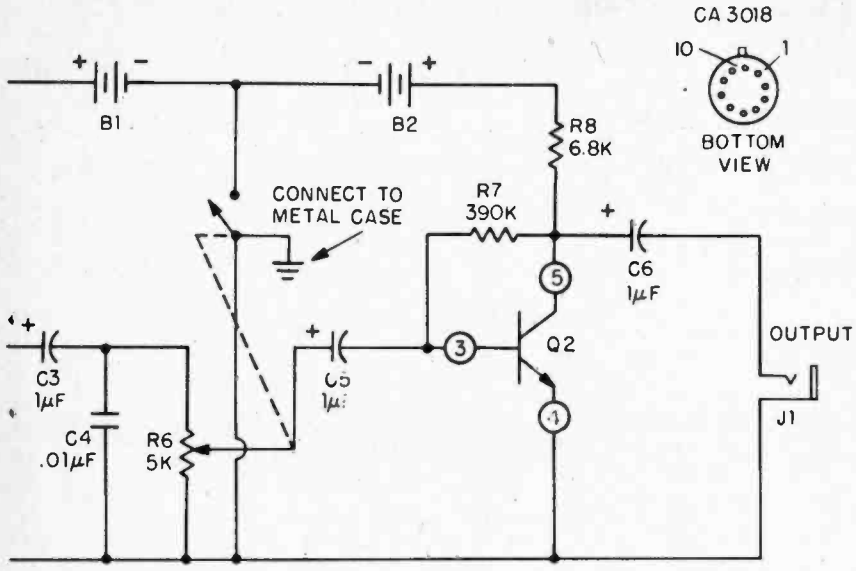


Suspend the microphone you use from rubber bands that extend to the support rods. Or, a clamp wrapped in foam packing material holds Riley's microphone securely.



PARTS LIST FOR A PARABOLIC MICROPHONE

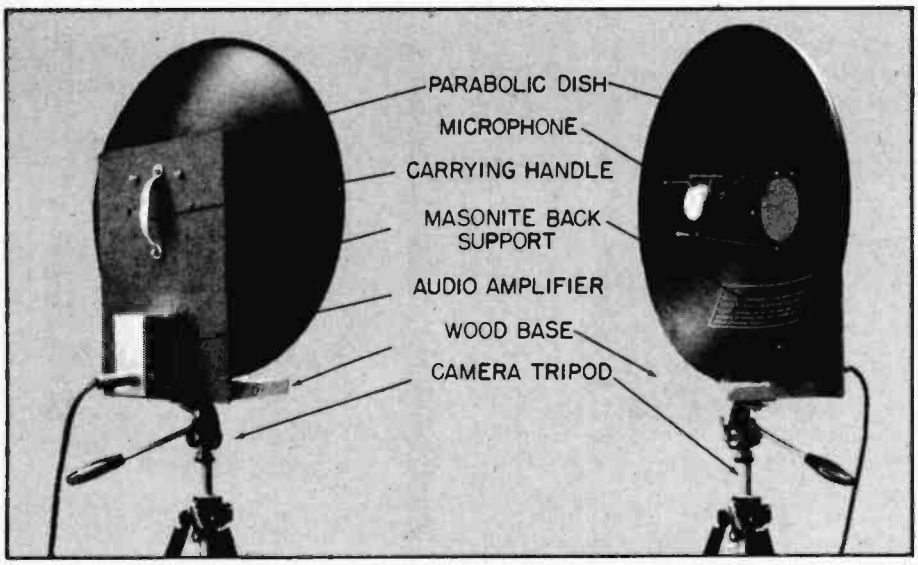
B1, B2—2U6-type 9-volt battery
C1—0.047-uF disc or tubular capacitor
C2, C3, C5, C6—1-uF electrolytic (observe polarity) or tubular capacitor, 35 volts or better
C4—0.01-uF ceramic disc capacitor
IC1—3018 integrated circuit (RCA CA3018), available from Circuit Specialists Co., Box 3047 Scottsdale, AZ 85257; $2.00 postpaid
R1—470,000-ohm, ¼-watt resistor
R2—10-megohm, ½-watt resistor
R3, R5, R8—6800-ohm, ¼-watt resistor



R4, R7—390,000-ohm, ¼-watt resistor
R6—5,000-ohm audio taper potentiometer with spst switch
Misc.—Aluminum case, 2 x 4-in. perf board, plugs, jacks, hardware, push-in terminals, microphone (high impedance crystal, see text), wire, solder, etc.
Note: The ETCO catalog lists a "government surplus" aluminum parabolic reflector. ETCO Electronics, 464 McGill Street, Montreal 125, Canada.

and earlier stages of the amplifier. An RC decoupling network could, of course, be used instead of two batteries, but it was found that oscillation would occur in spite of the decoupling network after the batteries had been in service for awhile. Two batteries absolutely guarantee against amplifier instability during the useful life of the batteries. The total current drain of the amplifier, by the way, is only 1.5 mA.

No trouble should be experienced with the amplifier if the original layout is followed. All amplifier components are mounted and wired on the perf board as shown. The volume control, capacitor C4, and the earphone jack are mounted on the part of the minibox that serves as a cover and battery holder. All connecting wires are soldered to push-in terminals on the perf board, and the perf board is mounted above the batteries with small bolts and spacers. After assembly, connect the microphone to the amplifier input with a short piece of cable.



The audio amplifier cabinet cover is secured to the Masonite back support permitting snap removal of amplifier chassis for inspection.

Check Out. When testing the amplifier on the bench, either have the microphone connected to the input terminals or substitute a half-megohm resistor for the microphone input. If you have a hum problem it is probably caused by nearby AC wiring. (I had to turn off power to the workbench whenever I tested the amplifier out of its case.) Alternatively, you may find a place in the house that is hum free; make your tests there. With the amplifier completely enclosed in its case, there is absolutely no hum pickup problem.

When you are satisfied that the amplifier is stable and working properly, solder the short microphone cable to the input terminals and mount the amplifier in its case. You are now ready to set up the microphone for maximum gain. To do this, you will need a code practice oscillator or other source of audio signal and an AC voltmeter with a ten-volt range connected to the amplifier output.

Set the equipment up in a clear area. Enable the CPA and adjust the audio gain so that the voltmeter reads two volts or less. Next move the microphone cartridge towards and away from the center of the dish to find the microphone position giving the greatest output. Do not let the voltmeter reading go above three volts because overloading the amplifier will make it difficult to find the point of maximum gain. After finding the best position for the microphone, secure the rubber bands on the support rods with dabs of cement.

The parabolic snooper may be used in several ways. As a portable field instrument, just plug in a set of 2000-ohm earphones and be on your way through the woods. The unit will also work as a combination microphone-preamplifier with any amplifier or tape recorder. However, if you are using a speaker for monitoring outside noises, be sure to have sufficient acoustic isolation between the microphone and speaker, such as closed doors and windows. If you don't, all the world will know by your feedback howl that you are listening. When using the unit with an audio power amplifier it is best to run the gain quite high on the amplifier and adjust the system gain as needed with the preamp gain control.

Now you're ready for a new world of close-up sound. ■

°*Common Bird Songs*, the title of a booklet and record by Borror, is available from Dover Publications, 180 Varick Street, New York 10014 for $3.50 postpaid; order number 21829-5. It provides songs of sixty species such as the Robin, Cardinal, Bluejay, Bobolink, and Tufted Titmouse!

YOU CAN BECOME A LOUDSPEAKER SYSTEMS DESIGN ENGINEER OVERNIGHT

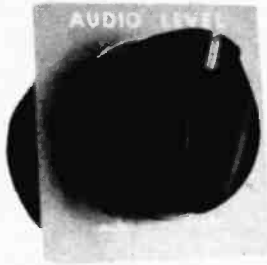
Take one low-priced cabinet enclosure kit, select two or three speaker drivers plus a crossover network from a jam-packed catalog, and assemble your very own Mark I loudspeaker system in a couple of hours.

by Herman Johnson

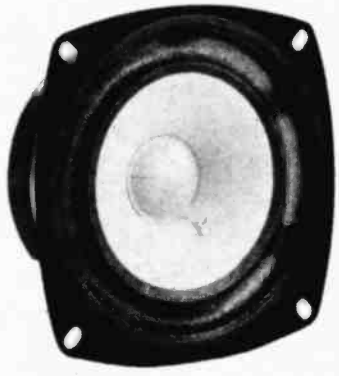
YOU CAN FURTHER ENJOY the kit habit by assembling your own speaker enclosure kit the way you like it. That's right! It's all possible because Radio Shack's 40-1960 enclosure kit includes adaptors permitting a wide choice of driving units (woofer, tweeter, and midrange) and crossover networks. The enclosure is easy to assemble and looks as good as any speaker you will find in any high fidelity store or audio salon. The finish is wood grain vinyl that will take more punishment and mishandling without showing it than a real wood-finished cabinet. The kit accommodates a great variety of drivers to make widely differing systems. This is due to the design of the speaker baffle board with cutouts which may be changed using adaptors and covers for each of the openings. All hardware (nuts, bolts and screws), assembly and mounting instructions, and a sub-baffle for mounting a grille cloth are included in the kit. The instruction manual supplied illustrates some of the combinations of drivers which can be used with the enclosure. This article explains a few details not covered explicitly in the manual, and lists the components for three recommended sets of components which will give good sound when used with this enclosure kit.

What's included. When you open the kit package, you'll see that the cabinet parts, speaker baffle and back closure panel are all made of particle board. The cabinet material and the baffle are ⅝-in. thick. The back panel is ½-in. board. You should seal all of the machine-cut panel edges and cut-outs in the baffle and edges of the back with clear resin sealer to prevent flakeoff because cut edges of particle board are soft and flaky. Also seal inside the front groove (baffle recess), the recessed edge for the back panel and the surfaces of the 45-degree mitre cuts that form the cabinet corners. The cabinet parts, top, bottom, and sides are joined into one piece, held together by the vinyl veneer. When you fold the cabinet to its rectangular shape (see Fig. 1 of the instructions), you should tape all of the outside corners with masking tape to reinforce the 90-degree bends of the vinyl, while you are handling the pieces. The corners must open up for insertion of the speaker baffle into the groove. It is best to prepare the baffle for speaker mounting before it is inserted into the cabinet.

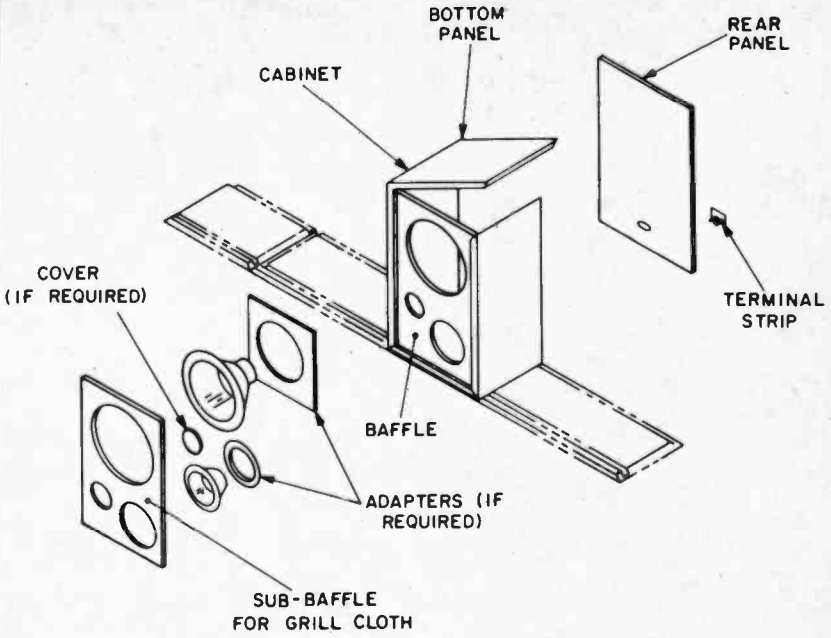
10-inch woofer driver



Level control



4-inch midrange driver



Exploded view of Radio Shack 40-1960 universal speaker enclosure kit. Various adapter plates permit variety of different size drivers to be used (Note that the drivers shown here are not included in this loudspeaker enclosure kit).

The speaker baffle has pre-cut openings of 11-, 5-, and 3-in. diameters for woofer, midrange, and tweeter drivers, respectively. Two adapters are furnished to fit over the 11-in. opening for mounting an 8- or 10-in. woofer and two are supplied for mounting 4- or 5-in. midrange units. A 4-in. blanking cover is included to close the tweeter opening if necessary. All of the adapters are made of ⅛-in. hardboard. The inside dimensions of the cabinet are 13-inches wide, by 22¼-inches high, by 8¾-inches deep—a volume of almost 1½-cubic feet. This volume is a bit small for a 12-in. driver considering the units available to the home constructor. Hence, my recommendation is to install an 8- or 10-in. woofer in the large opening using of one of the adapters. The adapter cut-outs have been punch-cut, so it is a good idea to smooth their cut edges with sandpaper.

Mounting drivers. You should mount all the components on the front baffle board—*from the front*, and seal up the back of the cabinet by gluing it in place permanently. This will ensure that the enclosure remains airtight. Front mounting the drivers instead of screwing them to the back of the front baffle has two advantages.The drivers displace a bit less volume inside the enclosure when mounted this way, and they are much easier to remove for checking or replacement, if replacement should be required. Sufficient space is available between the front of the enclosure and the baffle for mounting adapters on the front face of the baffle, and to clear the grille material.

Small nails are supplied in the hardware package with the suggestion that adapters be centered over the openings and nailed to the baffle. However, nails do not hold in particle board as well as screws and centering an adapter over an opening is easier said than done. A better way is to screw the adapter to the baffle through holes located 45-degrees away from the pre-punched speaker mounting holes in the adapters. Particle board is smooth-faced on both sides while hardboard is smooth-faced one side, embossed on the other side. The smooth faces butted together will provide a good seal for air-tightness, when secured by four (4) screws.

Horn tweeter

Adjustable crossover

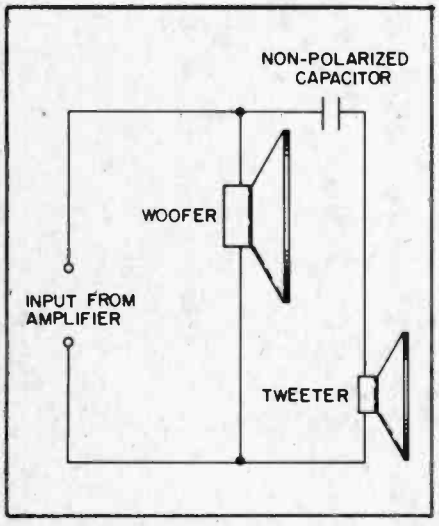
Completed speaker system

LOUDSPEAKER SYSTEMS

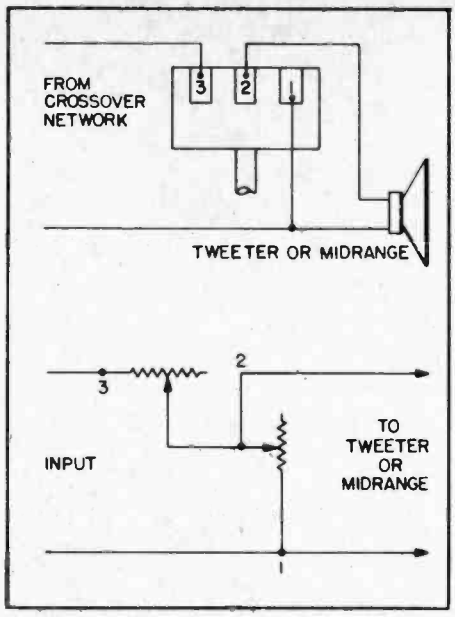
3-way systems. For a 3-way speaker system, one of the two round adapters permits mounting a 4- or 5-in. midrange speaker in the 5-in. diameter opening in the baffle. Or, a 6-in. midrange unit can be mounted in this opening. One adaptor has a 7-in. outside diameter with a 3⅝-in. cut-out, while the other adaptor has a 9-in. outside diameter with a 4-in. cut-out. Preparation of either of these adaptors is identical except that the hole centers should be 6-inches apart at 45 degrees from the prepunched speaker mounting holes. Since these parts are round, it is a bit more difficult to locate the hole centers for mounting to the baffle. The important thing to observe is to keep the four holes one-half-inch outside the baffle opening and 90 degrees apart. A penciled layout on paper placed over the round adapter will permit making the hole locations accurate. Mark one of the four holes to insure they line up correctly.

Midrange tones are the easiest to reproduce, and that is one reason even small 4- or 5-in. cones can do a good job with this part of the audio spectrum as part of a three-driver system. At high volume levels these units are often so loud compared to the woofer and the tweeter that they overbalance those drivers. That's why a midrange control is often installed to lower the midrange sound level.

Figure 2 in the instructions shows how to mount a horn tweeter or a cone tweeter, depending on how much money you've decided to spend and the kind of sound you prefer. The tweeter opening is a 3-in. opening which will take many dome tweeters and plenty of the smaller cone units which are on the market. The horn tweeter which is one of our choices unfortunately won't mount from the front here, but it can be accessible through the woofer opening.



Two-driver speaker system, with simplest possible crossover network—a capacitor to block lows from the tweeter.



Top sketch shows how to connect a level control for adjusting output of a tweeter or midrange driver. Lower diagram is schematic of same. May also be used to control remote speaker system volume.

2-way systems. For 2-way systems, the 3-inch opening is covered up with the 4-inch cover by four screws or securely. glued. The 5-in. opening is then used for the tweeter because it provides space for front mounting, similar to the previously-described mounting for woofer and midrange components. The ¼-in. hard board ring centers the unit and moves the mouth of the horn back flush with the face of the 7-in. adaptor. All speaker components should, whenever possible, be mounted with their front faces flush with the front face of the baffle, to avoid the tunnel effect caused by the thickness of the baffle. Most high-quality tweeter units can be mounted directly on an adapter.

General. It is good practice to drill a pilot hole for each screw, drive the screw in part way to start threads and then remove the loose displaced material around the hole. This is very important when sandwiching parts together, (hard board to particle board). Holes drilled through the material must also be cleaned, particularly on any side that is to be mated to the face of another material. A countersink turned by hand does the job nicely.

Caulk all joints with a non-hardening compound such as Mortite to make it air tight. The back can be made air tight, for removal, by installing ⅜-in. (self-stick) weather stripping to the recess provided.

At least 50 percent of the surface area inside the cabinet should be lined with one-in. glass wool (common grade fiberglass insulation) on the top, one side and one the back. The purpose of this acoustic damping is to eliminate any midrange reflections that might introduce unwanted coloration to the reproduced sound. Spots of glue will hold the fiberglass in place.

Front Grille. Cut your grille cloth material about 2 inches longer and wider than the sub-baffle that is furnished in the kit, and staple it to the back. Glue one-in. square pieces of hard board or card board in the upper corners of the baffle for mounting the Velcro retainers for the grille. Or if you prefer, a sculptured foam grille is available (Radio Shack No. 40-1946). You can cut it to fit over the entire length and width of the cabinet if desired to obtain a "modern" look.

Stiffen Rear Panel. The only weak part of this cabinet is the ½-inch back panel. The back should be reinforced by sandwiching a piece of ⅜ or ½-in. Celotex (building board) 12⅜ by 21⅝-in., centered on what will be the inside face of the back. Liberally coat both surfaces with glue (furnished in the kit) and weight it down until dry. High acoustic power is generated inside an enclosure at high, sound volume levels, that will cause a ½-in. back to vibrate. A buzzing panel colors and absorbs low frequency sound. The Celotex reduces the volume slightly but it stiffens the back. Drill a small hole through the Celotex when you mount the terminal strip on the back for wiring.

If you want to experiment, you can try using a 12-in. woofer with as low a free-air resonance as possible, and comple-

Enclosure kit with drivers on baffle board, ready to close up.

ment it with the tweeter and mid-range driver suggested in the list at the top of the next page. The crossover network in that list has nominal crossover frequencies of 500 and 330 Hz, so just about any woofer will be good for use with these two other drivers (tweeter and mid-range). Consult the specs of the woofer maker carefully before you purchase any woofer other than those listed here.

Three good systems. Three loudspeaker systems which can be put together in this enclosure are described in the paragraphs which follow. They are not by any means the only groups of components you could put together, but they are made up from driver units which are readily available and which have been tested to see that they work well together.

System 1. Radio Shack's enclosure instructions suggest a basic two-way system which uses a 10-inch woofer (Radio Shack 40-1331, priced around $17) connected in parallel with a horn tweeter (Radio Shack 40-1279, priced about $16). The tweeter is more efficient than the woofer, but use of a one *u*F non-polarized capacitor (Radio Shack 272-996) in series with the tweeter pushes the crossover frequency up rather high, and reducing the output of the tweeter. Thus the two speakers are fairly well matched. Low-frequency sound is good at low volume levels and the high frequencies are excellent.

System 2. An improved system using the same woofer and tweeter as in System 1 can be assembled by adding a 4-in. full-range speaker (Radio Shack RS-40 1197, priced at $10) to handle the mid-frequencies. The three drivers are connected using a crossover network (Radio Shack number 40-1339, listed for $10) in place of the simple one-*u*F capacitor of system number one. A plastic cover must be installed over the back of the 4-in. unit to isolate its cone from the acoustic power generated by the woofer. A flanged plastic dessert bowl large enough to clear the back of the 4-in. unit is ideal. Screw it to the baffle with four 6 x ⅜-in. self-tapping screws. A tiny hole must be punched in the side of the cover for hook-up wire. The network provides frequency division at 500 and at 3300 Hz. Hook-up instructions provided with the enclosure permit this hookup with or without controls for midrange and tweeter output. It is recommended that the crossover network be installed inside the cabinet on the bottom near one side to clear the woofer. Access to controls (if used) can be had by removing the woofer adapter. Once the controls are set it is not likely that they will need to be changed. Power handling is up to 20 watts. This is an excellent system for home use at low volume levels.

System 3. System 2 can be improved so that it will handle considerably more power by substituting a heavier woofer for the one used in Systems One and Two. This is a heavy-duty Philips woofer which costs $28, about $12 more than the first woofer. However, you can save money on this system by using a less expensive tweeter (Radio Shack 40-1909, $6.00).

There are many other good woofers, tweeters, and midrange drivers which can be mounted in this enclosure kit. The better the drivers, the better will be the sound you get, provided you match the volume level of the drivers using the level controls. Above is a list of some of recommended components for installation in the enclosure. ■

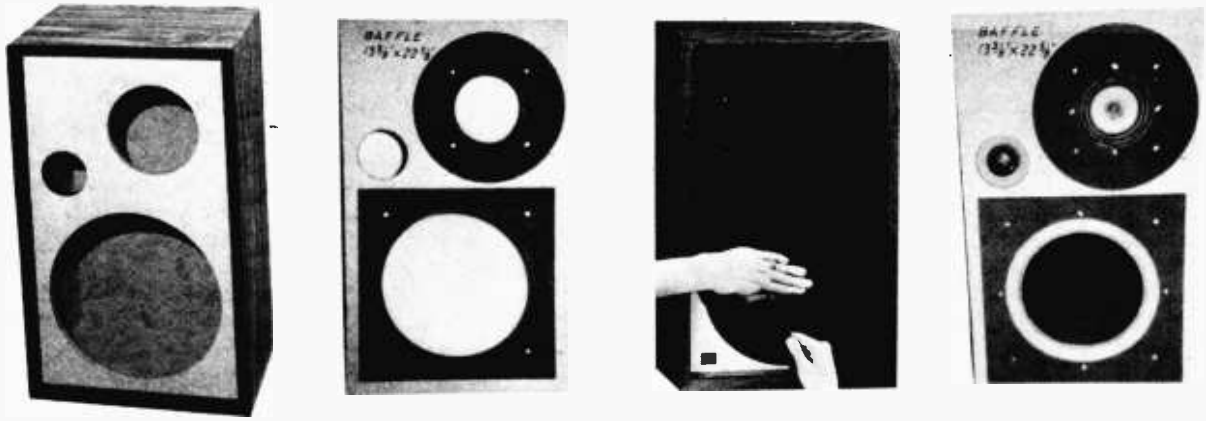
MATCHED LOUDSPEAKER COMPONENTS

System One
10-inch woofer, Radio Shack 40-1331
Horn tweeter, Radio Shack 40-1279
1-uF non-polarized capacitor, Radio Shack 272-996

System Two
Woofer and tweeter same as above
Add 4-inch cone for midrange (Radio Shack 40-1197)
Use 3-way crossover network in place of 1-uF capacitor (Radio Shack 40-1339)

System Three
Improve System One or Two by susbtituting heavy-duty woofer, Norelco AD10100/W from McGee Radio, 1901 McGee St., Kansas City, Mo. 64108

Universal speaker enclosure kit, Radio Shack 40-1960
Level control for midrange and/or tweeters. Radio Shack 40-980
Optional sculptured grille, w/easy-mount Velcro attaching tabs, Radio Shack 40-1946



Left photo shows completed enclosure kit without drivers installed, and without any of the adapters which are supplied. Next is the front baffle with adapter for the 12-inch woofer opening to permit use of a 10-inch woofer, and an adapter to permit use of a 4-inch midrange in the 5-inch opening. Right hand picture shows how the optional sculptured grille snaps into place, using Velcro push-on holders which attach to board with staples. Remaining picture shows baffle with the drivers installed in adapters.

IT IS A LITTLE KNOWN FACT, but the simple act of using jumper cables to start (boost) a car with a dead battery can lead to severe personal injury. It's true!

A good Samaritan in California was helping his neighbor start his car by jumping the battery. The battery exploded and our hero got a face full of sulfuric acid for his trouble. A man in Pennsylvania noticed another charging his batteryincorrectly. When he attempted to rearrange the cables from the charger there was some sparking, and the battery exploded.

The reason for both of these accidents, and many others, is the fact that a battery being charged produces hydrogen gas, a very combustible and explosive element. The longer a battery is charged the greater the accumulation of hydrogen, and the greater the danger of a serious explosion. All that is required is a single spark as one connects either of the jumper cables to a battery post.

How does one avoid such an occurrence? Simple. Just follow the step-by-step procedure given below whenever you need to jump one battery to another.

10 steps to safe battery boosting

By Thomas R. Sear

1. Ensure that the ignition switches and all electric accessories, including the lights, are turned off in both cars.

2. Verify that both batteries are rated for the same voltage. Most automotive-type batteries are 12-volt models these days; but many older cars, as well as some of the smaller models, may have a 6-volt battery.

3. Remove the dustcaps from each cell of both batteries, and make certain that the electrolyte reaches the FULL-mark. If not, ordinary tap water can be used to top-off each cell if distilled water is not available. If the dead battery is to be recharged, the dustcaps should be left off to prevent any buildup of pressure due to the rapid release of hydrogen gas from the battery fluid.

4. Cover the battery openings to prevent any splashing acid from reaching your skin or clothing. Your handkerchief will suffice.

5. Attach only one jumper cable at a time. Connect one end of the *red* jumper cable to the positive terminal of the good battery first. This is the terminal marked with a +, a P, or POS. Then connect the other end to the positive terminal of the dead battery.

6. Connect one end of the *black* jumper cable to the negative terminal of the good battery. This is the terminal marked with a −, an N, or NEG. Then connect the other end to a point on the frame of the car with the dead battery at least 18 inches from the battery.

7. Start the engine of the car with the good battery. Allow the car to warm up for a few minutes, holding engine speed to a fast idle.

8. Start the engine of the car with the dead battery. If the engine starts, proceed to Step 9. If it doesn't, turn off the ignition and wait several minutes. Don't flood the engine with too much gasoline. If the battery is completely dead, wait about half an hour so the battery may be charged by the running car. Try to start the dead car again. Now, if successful, proceed to Step 9. If the car cannot be started, see a mechanic.

9. Disconnect the jumper cables by reversing the order in which they were connected. Keep the car with the bad battery running at a fast idle until it is warmed up. The chance of stalling is thus greatly reduced.

10. Replace the dustcaps on the dead battery.

Some final notes: It's always best to determine why the car didn't start in the first place and have the car adjusted or repaired. Repeated battery boosts are unwise and unsafe. Also, because of the hydrogen gas present when batteries are involved, *never* smoke a cigarette near a battery that is being charged. ■

BUILD 20 RADIO and Electronics Circuits

PROGRESSIVE HOME RADIO-T.V. COURSE

Reg. U.S. Pat. Off.

Training Electronics Technicians Since 1946

Now Includes
- ★ 12 RECEIVERS
- ★ 3 TRANSMITTERS
- ★ SQ. WAVE GENERATOR
- ★ 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, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector Circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering 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.

FREE EXTRAS

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

SERVICING LESSONS

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

FROM OUR MAIL BAG

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

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

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

PRINTED CIRCUITRY

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

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

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

Progressive "Edu-Kits" Inc., 1189 Broadway, Dept. 520EN Hewlett, N.Y. 11557

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

NAME.....

ADDRESS.....

CITY & STATE.....ZIP.....

PROGRESSIVE "EDU-KITS" INC.

1189 Broadway, Dept. 520EN Hewlett, N.Y. 11557

CIRCLE 6 ON READER SERVICE COUPON

the MOVING COIL

Build our accurate model of a moving coil meter and

LEARNING ELECTRONIC THEORY is dull, dull, dull. Right? Not necessarily. In some cases you can learn a lot and still have a lot of fun. How? Leave your theory textbook behind and build a current-measuring gadget that will allow you to see electronic theory in action.

Moving coil meters are used universally in all types of test instruments to measure DC current because they are highly sensitive, rugged and reliable, and relatively inexpensive. They may also be used to measure AC current by first rectifying the AC with a small meter rectifier.

Our project uses the moving coil principle in a simplified form of indicating meter. You can learn more about this form of meter by building our easy-to-construct project.

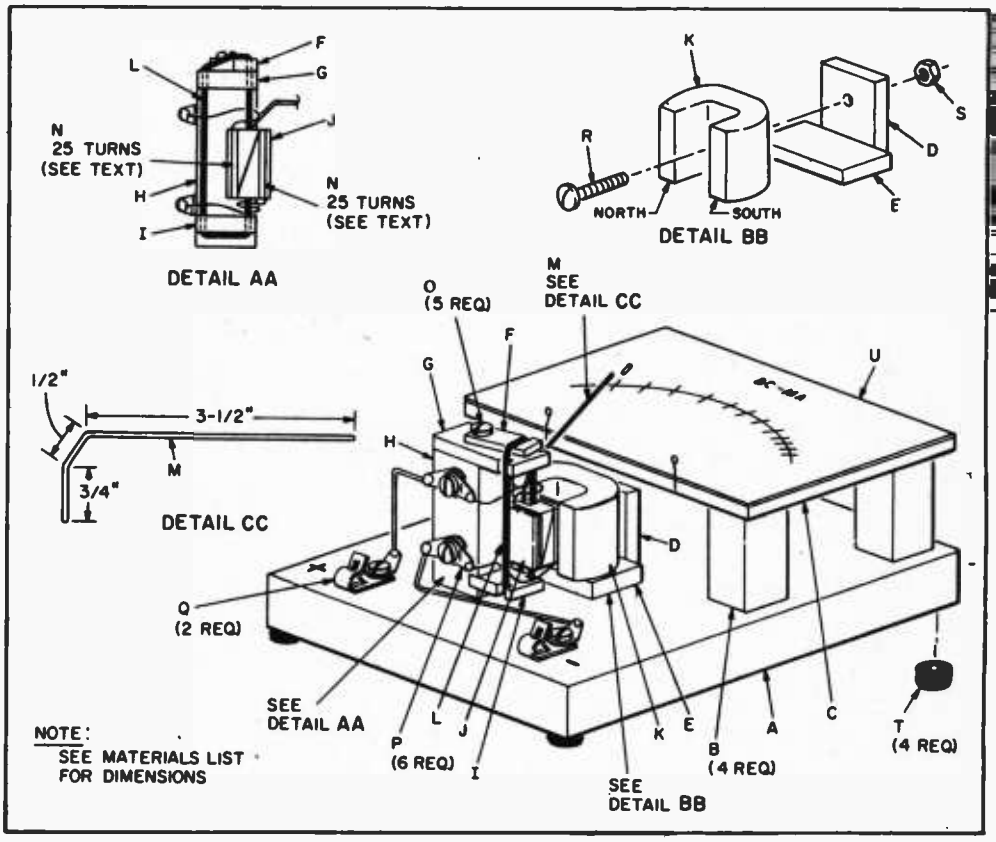
How It Works. The operation of the moving coil type of meter is based on the attraction between a permanent magnet and the magnetic field of a movable coil of fine wire. The coil is pivoted in the center of the space between the poles of the magnet, and has a return spring (to return the meter pointer to zero). This spring is usually of a spiral form in commercial meters, but our meter unit uses a rubberband coil suspension in place of both the pivot and spiral zero return spring.

When DC current flows through the coil, it produces a magnetic field that is attracted to the permanent magnet's magnetic field. This attraction imposes a turning force on the coil, that rotates the coil and moves the attached pointer over the meter scale. The amount of turning force is dependent on the amount of DC current flowing through the coil. The more DC current, the more the coil rotates. The meter is calibrated in DC current indications.

Construction. As can be observed from our photos and drawing, our model of a moving coil meter has been made in a very simplified form to facilitate construction. It's a taut-band moving coil instrument by virtue of the rubber band suspension of the moving coil assembly. We used wood for the various supporting structures because it's easier to work with and most everyone has the few hand tools required.

Size is relatively unimportant. However, we suggest you follow the dimensions and construction details given in the drawing and Parts List. In this way you should have no difficulty in making the meter and you won't have to fiddle with changing the number of turns of wire for the moving coil to compensate for a change in physical size.

You should cut out all of the various pieces of wood and sand them smooth before actually starting to assemble the meter. Mount rubber feet on the bottom four corners of the base (A) and then glue the 4 supports (B) to base (A), as shown in the pictorial drawing. Next cement the scale plat-



In this explicit exploded view, you can see in detail the more varied steps of the Moving Coil Meter assembly. To find the name of each part, refer to the Parts List.

METER

learn exactly how they work—by Charles Green, W6FFQ

form (C) to these supports. We used our electric glue gun, but epoxy cement, Elmer's glue. Pliobond, or similar adhesives can be used with equal success.

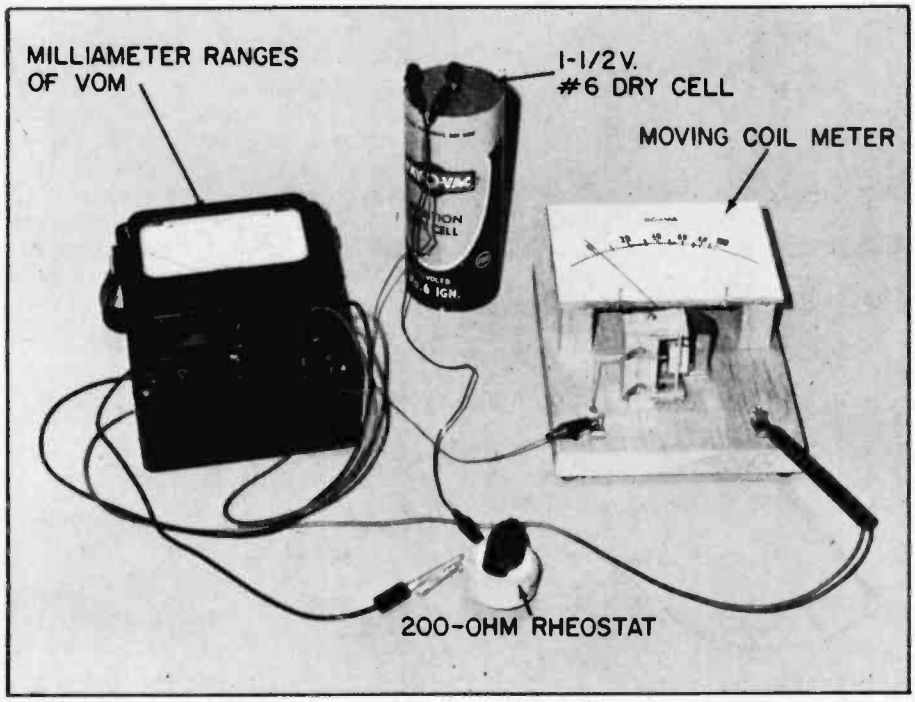
Now you're ready to cement the magnet and moving coil assembly supports to base (A). Pieces D, E, G, and I are made from ¼-inch plywood. First step is to cement D and E in their respective locations and fasten the magnet in place. The magnet used in our unit has a mounting hole. If the magnet you use isn't drilled at the bottom center of the *U* to allow a bolt to go through it to hold the magnet in place, it too can be cemented to D and E.

At this point the main support block (H) should be readied for cementing. But first you must notch it out so that piece I can be properly fastened to it. Hold H on the base (A) near piece E and mark H so that the top of the notch will be even with the top of E. The notch should be about ¼-inch deep. The best way to determine its depth is to hold piece G in position at the top of H and place piece I so that its notched end is even with the notched end of G. Mark the depth of the notch in block H based on the position of the end of piece I that will be inserted in the notch where its end is matched with piece G as mentioned above. Be sure that the notch in block H is cut square so that the surface of piece I will be square with the surface of block H where I is cemented in place. The notches in the free ends of I and G are required only to hold the rubber band in position. Cement block H in position, and also piece G to block H as shown in drawing.

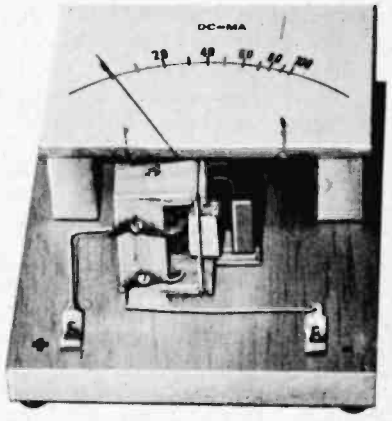
The form block J for the moving coil is made from balsa wood, which is lighter in weight than any other wood and therefore contributes to the sensitivity of the instrument. Cut a notch in the center of J as shown in our drawing. The rubber band (L) is cemented in this notch. We used a rubber band approximately 6¾ x ⅜ x 1/16 inch. The coil is made in two sections by winding 25 turns of #38 enameled magnet wire on one half of J and by repeating this winding process in the same direction on the other half of J. Put a touch of cement to the ends of each coil to hold the wire in place and have 6-inch lengths of the start and finish of the 2-section coil for future connection to it. Mount the coil assembly by stretching the rubber band over pieces G and I, centering it vertically within the height of the pole pieces of the magnet.

Now for a Pointer. Straighten out a 4¾-inch length of #18 gauge bare copper wire and then form it as shown in the drawing. The pointer is cemented into the notch in block J so that it rests near the O end (left side) of the scale platform. Piece F is used to make final O rest position adjustments after a scale has been cemented in position.

Fasten two double solder lugs to block H; these are intermediary connecting points for the two wires from the coil. Form a helix like a hairspring with each of these leads so that they will wind up as the coil assembly moves clockwise. Solder the end of the wire from the top helix to the top lugs and the bottom helix to the bottom lugs. Mount two Fahnestock clips or binding posts along the front edge of the meter baseboard and connect them to the solder lugs on H, using #18 solid base wire. Since meter polarity is determined

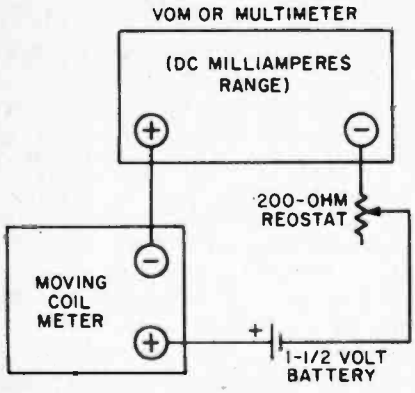


A volt-ohmmeter is very helpful in calibrating the Moving Coil Meter project. If you don't have a VOM handy, try a 0-100 mA milliameter in the same circuit.

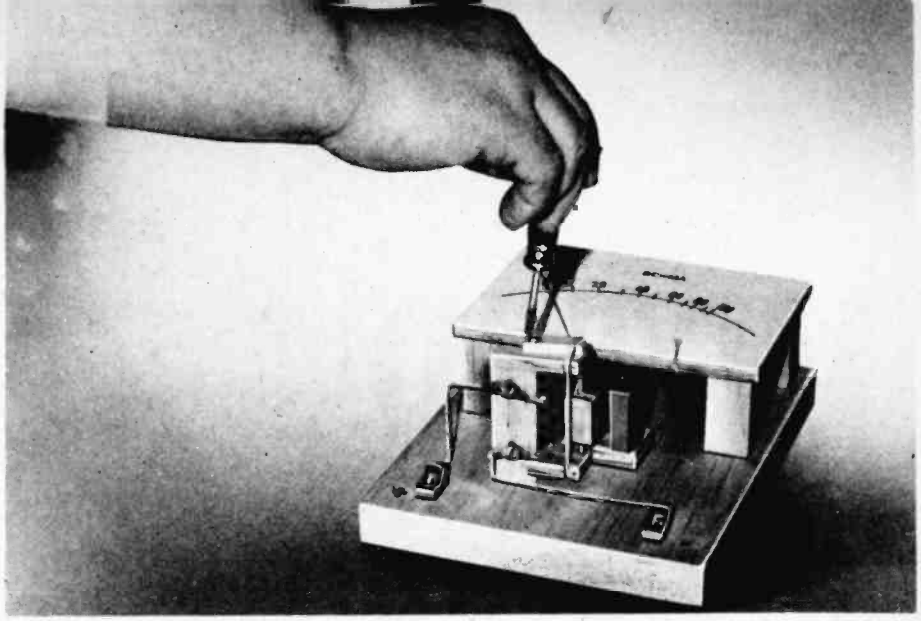


Here's how your finished MCM will look. Its innards are very similar to a bought meter.

MOVING COIL METER



Any 0-100 mA or higher milliameter will test your MCM just as well as a VOM or multimeter, provided its accuracy is fairly good.



To zero the pointer of your Moving Coil Meter project, all you need to do is loosen the screw as shown, and move the wooden block, thus repositioning the coil assembly.

by magnet polarity and the direction of current flow, established by how the coil is wound, the correct polarity markings of the meter should be determined when you calibrate the instrument.

Calibration. In order to calibrate this instrument, you'll need a potentiometer having roughly 20 ohms resistance, a 1½-volt battery and a DC milliammeter, preferably a multi-range one available as part of a VOM.

Now you are ready for the calibration scale that's mounted on the platform C made during the framework construction. The scale is drawn on a piece of heavy white paper (U) which will be cemented to the platform after the calibration marks have been drawn. (Rub-on numerals, such as Datak, make a neat scale.) Temporarily fasten this white paper (U) to platform C, draw an arc as shown in the photo and place a mark on the left-hand side for a zero reference point.

Connect a 1½-volt battery, a 200-ohm potentiometer (used as a rheostat) a multimeter set on DC milliamp ranges (or a milliammeter), and the moving coil meter you have just built, as shown in the calibration diagram.

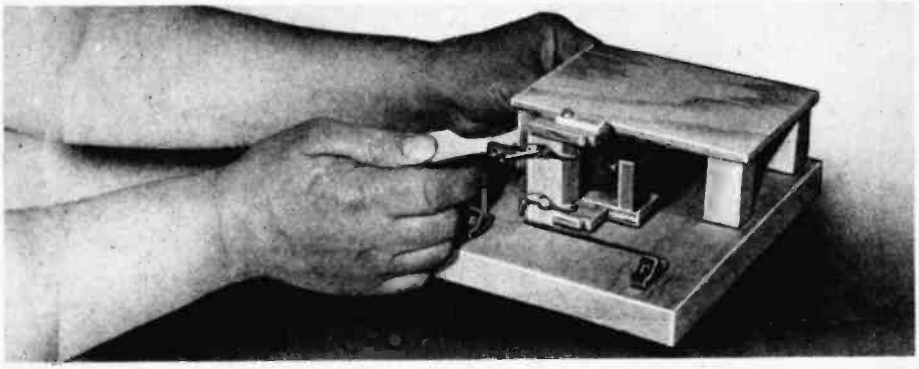
Set the potentiometer for maximum resistance and at the start use the highest milliamp range of the multimeter. If the pointer on your moving coil meter deflects to the left, below the established O point, reverse connections to it and then mark the binding posts + and —. Use the connection diagram to determine their polarity markings after connecting the meter so that the pointer moves to the right.

Slowly turn potentiometer to reduce resistance in the circuit and note the readings of the multimeter milliamp range selected. Mark your moving coil meter with the same readings shown on the milliammeter. We divided the 0-100 scale into 10 mA divisions. In the manufacture of DC moving coil meters spring tensions, spacing and coil weight are carefully controlled so that these meters are linear. For this reason commercial milliammeters have uniform spacing between divisions. Our moving coil meter doesn't have such uniformity because of the variations in the rubber band used for suspension and tension, and because it's difficult to maintain accuracy of positioning the various pieces and to be assured of the strength of magnetic field developed by the magnet. Once you have established the calibration points they can be considered accurate.

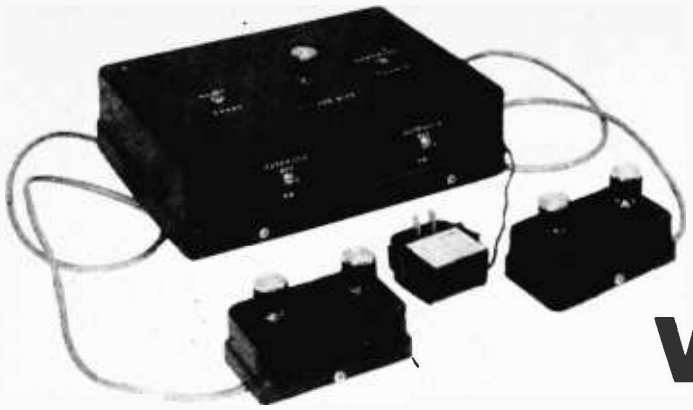
Now that you have marked the scale in pencil you can remove it from the platform and apply the permanent markings. Permanently fasten the scale in position and stand back to admire your work. If you used reasonable care in following the instructions, you'll have good reason to be proud of your handiwork. ■

PARTS LIST FOR MOVING COIL METER

A—6 x 7 x ¾-inch white pine
B—¾-inch square x 1½-inch white pine (4 required)
C—4 x 5 x ¼-inch plywood
D—1¼ x 1 x ¼-inch plywood (see text)
E—1¾ x 1 x ⅜-inch plywood
F—⅜ x 1 x 3/16-inch white pine with end notch
G—¾ x 1½ x ¼-inch plywood with end notches
H—¾-inch square x 2-inch white pine (see text)
I—¾ x ⅞ x ¼-inch plywood with end notches
J—½-inch square x ¾-inch balsa wood with slot
K—Alnico magnet
L—Rubberband (see text)
M—Meter pointer (#18 copper wire—see text)
N—50 turns #38 enameled magnet wire (see text)
O—Five #4 x ½-inch wood or sheet metal screws
P—Solder lugs (6 required)
Q—Fahnestock clips (2 required)
R, S—8-32 x 1 or 1¼-inch machine screw and nut
T—4 rubber bumpers
U—4 x 5½-inch heavy white paper for meter scale
Misc.—Hookup wire, 200-ohm rheostat, 1½-V. battery, VOM or DC milliameter



Assembling this moving coil meter is an excellent project for anyone who is handy with tools—and it teaches you how instrument (panel) meters work to measure voltage, as well as current in most electronic circuits.



join the fun with...

Interfab Pong-IV Video Game Kit

Preassembled printed circuit board with 43 ICs needs only soldering

VIDEO GAMES ARE POPPING UP everywhere; amusement centers, theater lobbies, cocktail lounges and even on jetliners. For 25¢ a game you can pit your skill against any opponent, with complex electronic wizardry acting as referee. These games offer various formats, from space-ships firing "laser beams" to cars racing through a maze of electronic walls. Still among the most popular video games are the ones that simulate ping-pong or tennis.

Although several companies now market ready-made units that connect to your TV set to convert the screen into an electronic playground, you may prefer the satisfaction of putting one together yourself, saving some money, and getting a more versatile game, as well as learning a lot in the process.

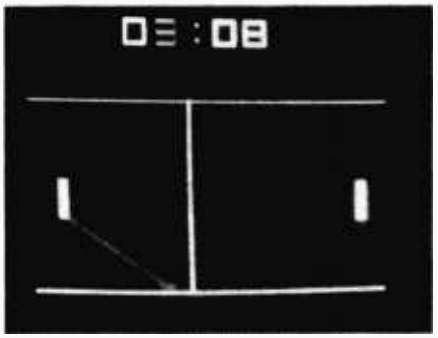
The Interfab Corporation's *Pong IV* video game comes in kit form and has some features not found in other video games. In addition, it's the least expensive kit seen to date.

Features. Set up for two players, with a separate control box for each, *Pong IV* includes an AC power supply, so no batteries are needed. It plays two games—just flip a switch to go from tennis to handball, with the entire court shown on the TV screen. Digital numbers appear above the court throughout the game to keep score. A pushbutton switch allows you to start a new game at any time. Ball speed is random, sometimes fast, sometimes slow. The ball bounces from the court walls and the players' paddles at random angles. A control is provided to change paddle size—large paddles for beginners, smaller and smaller paddles as the players become better at the game. Also, the paddles can be moved horizontally, as well as up and down on the court, so you can play close to the net for a real challenging game. Sound is built into the main cabinet. A small speaker beeps each time the ball contacts a wall or paddle, and emits a raucous Bronx cheer whenever a player misses a ball. A special feature is that either or both players can be set on automatic, with the computer in control. Thus you can play against the machine, or even watch the computer play against itself!

Pong IV Kits. *Pong IV* is available in three kit forms: Standard, Pre-Soldered, and Completely Assembled. The *Pong IV-D* standard kit contains everything but solder and glue; even predrilled control boxes and main cabinet, nuts, screws, spacers, washers and wire. To make for easy assembly all the 18 diodes, 4 transistors, 42 capacitors, 93 resistors and 43 Integrated Circuits (ICs) are already mounted on the single 2-sided printed circuit board (PCB)!

Pong-IV kits with all parts spread out. Printed circuit board has all resistors, capacitors transistors and ICs already in place. Needs only soldering.

For further information circle no. 73 on the Reader Service coupon.



Pong-IV puts this picture on your TV screen. Left player has just returned ball, to bounce off sidewall (photo bottom).

The parts are held in position by a plastic blisterpack covering on top of the board, with the board bottom open for soldering. It would take at least two extra hours—probably more—for you to identify and stuff the printed circuit board yourself, with the possibility of getting the parts inserted in the board improperly. After soldering the components into the board you connect wires to the external controls, install them in the cabinet supplied, and that's it, you're done! Interfab supplies an assembly manual, which includes a number of voltage checks you should make before applying the power. They also include a goodly number of trouble-shooting steps, with symptoms and corrective steps.

The Pong IV-C pre-soldered kit takes construction one step further. The entire printed circuit board is furnished soldered, and with continuity checked out. Since there are over 900 solder joints on this board many people will be willing to pay the extra $10 charged for this—especially since bad soldering is the biggest cause of problems.

Semi-kit Version. The PONG IV-B Completely Assembled Kit is soldered, cabled, tuned for proper horizontal and vertical oscillator frequencies, and checked out. You only need to mount the switches and potentiometers in their proper locations in the main case and

Pong-IV Video Game

control boxes, which have pre-drilled holes.

Building the Pong IV-D. We built a *Pong IV-D* standard kit just to see how tough it would be. It took about 8 hours, proceeding very slowly and carefully, using a small-tipped 25-watt soldering iron. This is *not* a beginner's kit, since it requires a lot of very careful soldering, and some wire cabling. The instructions, while not elaborate, are adequate. Even though Interfab has carefully stuffed the printed circuit board, it's a good idea to verify that all the ICs are inserted properly. We found one IC pin bent under instead of projecting through the board, and another IC had one whole row of pins not inserted into the PCB holes. Examine the underside of the printed circuit board with a magnifying glass before soldering to see that all IC pins are projecting through their holes.

Further Assembly. After soldering and clipping excess wires from all the discrete components (resistors and capacitors) remove the blisterpack covering from the top of the board and check to see that all parts are firmly soldered to the board. Using two screws and nuts provided, ground the LM309K regulator IC. Add diode D3 from R25 to D16, as shown in the assembly drawing Interfab furnishes with the kit, and add the jumpers specified in the instructions.

Mount the potentiometers, two in each control box, and one in the main case top. You may have to enlarge the holes slightly with a file or reamer. The control knobs supplied push very hard onto the smooth shafts—this is intentional, so that the knobs will slip on the shaft if turned too hard against the control, rather than destroying the stop! Following the wiring diagram and using the 6-conductor cable provided, wire the controls, noting each wire color on the wiring diagram for later reference. Now temporarily set the control boxes aside.

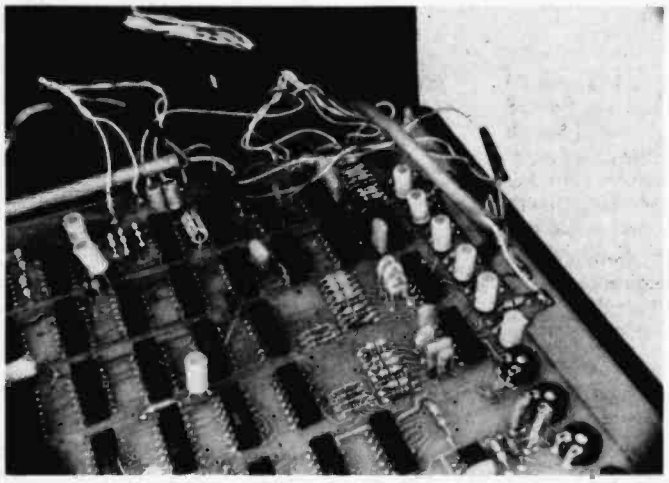
Wired kit with top lifted shows connections from board to the control and switches in top cover. Not shown here are the two players' manual controls.

Mechanical Assembly. Next, glue the speaker in the bottom of the main cabinet, above the small holes that form the speaker grille. Mount the printed circuit board, component side up, into the cabinet bottom using the long screws, spacers and nuts. Solder the speaker wires to the terminals on the board shown in the assembly drawing. The wiring diagram also shows you all the wiring between controls, switches and the board. Carefully wire between the circuit board and the various switches and controls, including the control boxes. If you get wires connected to the wrong *terminal* on a switch or control, they can be reversed later on, when you test the game, but don't connect the wires to the wrong switch or control. Cable wires that follow similar paths together by weaving the wires before soldering, or by bundling them together with cord or tape, to improve the appearance.

Connecting to Your TV. Until recently *Pong IV* was sold with a self-contained UHF transmitter built right on the printed board. This converted the video output of *Pong IV* to a modulated UHF signal between Channels 72 and 82. By simply connecting the *Pong IV* UHF output leads to the UHF terminals of your TV, you could tune in the *Pong IV* picture with your TV's UHF tuner, at the high end of the band. However, the FCC has been vigorously enforce its regulations regarding Class 1 TV Devices, requiring FCC type-approval—a long and expensive path for a small manufacturer. Interfab has therefore discontinued providing the UHF parts with the kit. The PCB is etched, however, for the addition of the UHF transmitter should you desire to add it. Included with Interfab's instructions is a circuit and parts list, and the description of how to build a simple UHF transmitter from a 2N5770 transistor, 4 resistors, 2 capacitors and a piece of brass or copper. This transmitter's 5 milliwatt low-power signal broadcasts on approximately 860 MHz, where no commercial TV signals currently broadcast, and thus will not create any interference.

Preassembled UHF Transmitter. As an alternative to building the UHF transmitter described above you can buy a PXV-2A transistorized modulated oscillator kit for $8.50 postpaid from ATV Research, 13th and Broad-

(Continued on page 100)



Closeup of printed circuit board shows some of the 43 ICs and many resistors which come already in position. Upper left is top cover with control and switches.

Manual control seen from bottom to show wiring from the two potentiometers.

Hobbyist Power Supply For TTL

TTL-type digital integrated circuits require a steady 5 volts for superior operation. Get ready for TTL projects with this ultra-simple, high performance regulator.

by Herb Friedman

ELECTRONICS IS going digital! Not only are space TV photos relayed by digital techniques, but intercountry TV sound across the big pond (Europe) uses bits to represent audio. Right here in the U.S. we find TV receivers and FM tuners are "going digital." Even hobby projects such as you'll find here in e/e are using digital ICs.

The 7400 series of digital ICs is presently the most popular digital device "family," primarily because of its rock-bottom cost and easy handling; and it is more than likely that many hobby or experimenter projects you're going to run across in the next year or so will use the 7400 series of TTL (Transistor Transistor Logic).

The only problem is that TTL almost always requires a tightly regulated 5-volt power supply, and take careful note of those words *tightly regulated*. Often, the 7400-series device will instantly "blow" if 6 volts or a line transient is applied. The margin for error when working with TTL is essentially zero. While a zener diode can be used to provide, say, 5.1 volts, they are not easy for the average experimenter to find, nor do they necessarily provide protection against line voltage transients or short circuit protection.

What's needed is a full voltage regulator having both current and short circuit protection. Should the supply run hot due to excess current drain, or should a wiring error or breakdown in the external circuit short-out the power supply, the supply will automatically turn off, thus protecting both the power supply components and the connected circuit.

While you can always use a handful of components to build a 5-volt regulated supply for TTL—assuming you could possibly find the necessary components in your area—it's much easier to use a LM-309K, a single IC that contains *all* the components of a power supply regulator in a standard TO-3 case. Best of all, the LM-309K can be purchased locally for about $2.50; and that's probably less than the cost of discrete components if you decided to build from scratch.

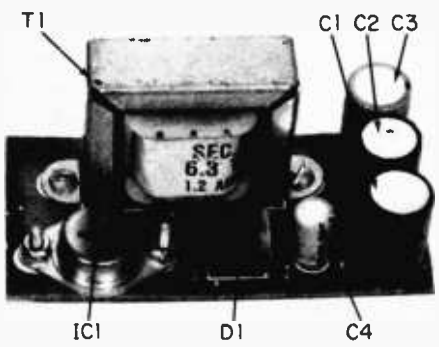
Inside Look. The LM-309K 5-Volt Regulator is available from many surplus dealers and Radio Shack. Mounted on a PC (printed circuit) or perfboard, it can safely deliver up to 1 ampere. Mounted on a heat sink you can squeeze out 3 amperes. The LM-309K gives the average experimenter everything he's looking for in a TTL power supply: tight regulation, transient protection, thermal shutdown, and short circuit turn-off.

A typical TTL 5-volt supply using the LM-309K that's suitable for the experimenter is shown. It's a rather easy circuit to build and provides 5 volts at up to 1 ampere with the IC mounted on a PC board. If you want to avoid the fuss and bother of making your own PC board, you can use a predrilled factory-made board which we'll describe later.

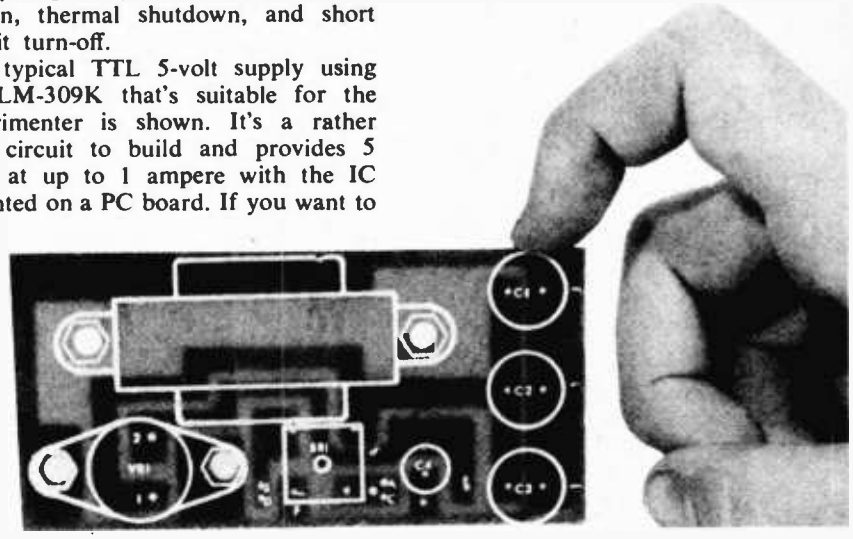
Transformer T1 is an ordinary 6.3-volt filament transformer rated at least 1 ampere. Capacitors C1, C2, and C3 can be replaced with a single 3000-*u*F unit rated at least 15 volts, but you'll find it much easier to locate three 1000-*u*F capacitors. Diode bridge D1 should be rated 5 to 6 amperes to handle the peak current load of the heavy filtering (C1, C2, C3). Do not try to get by with a 1-ampere bridge rectifier.

Capacitor C4 provides a low power supply impedance to the connected circuit; do not eliminate C4. Also, pilot lamp I1 should not be eliminated or its position in the circuit changed because it is used to discharge C4 when the power supply is turned off. Without I1 C4 might retain a charge for several minutes after the 117 VAC input power has been removed and can cause headaches and grief. When? Suppose you connect up your project thinking there's no voltage from a supply that's turned off!

To insure long life, and since the



The completed supply ready for installation in a cabinet or project. Pilot lamp I1, which also serves to discharge the output capacitor, is not part of the PC board assembly.



Easiest way to build the power supply is to use this Radio Shack PC board. All holes are pre-drilled and the component positions are "screened" on the top side. Backlighting shows the heavy copper foil showing through; it means customization without fear of damage to the foil strips.

Supply For TTL

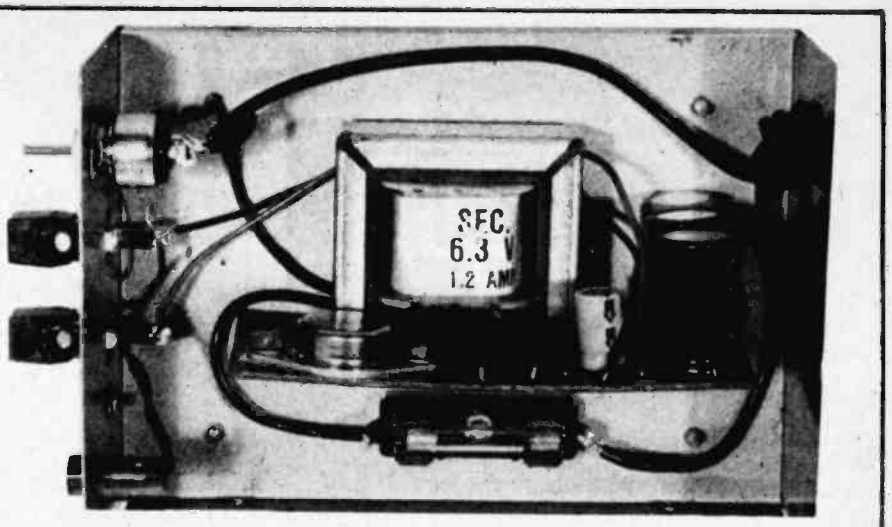
pilot lamp doesn't have to be bright enough to read by, I1 is a 12 volt/25 mA lamp—one of those miniature pilot assemblies that comes with attached leads. Connected to 5 volts, it's bright enough to see even in sunlight.

The supply shown in the photographs is assembled on a factory pre-drilled PC board available from Radio Shack for $1.49. The top side has the component locations screened in white paint. While the transformer mounting holes are spaced for the Radio Shack 273-050 6.3-volt filament transformer, you can, however, use any rated transformer although you may have to drill new holes. A rear-lighted photograph shows the extra-wide copper foil that permits easy customizing of the PC board.

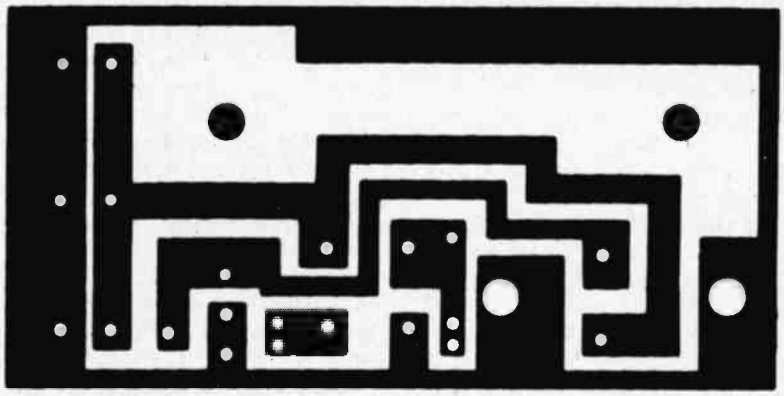
More Data. The instructions supplied with the Radio Shack PC board indicate a different pilot lamp connection than shown in our schematic. For this supply do not follow the Radio Shack connections; install the pilot lamp exactly as indicated in our schematic.

The entire supply—except for power switch S1, pilot lamp I1, and fuse F1—is on the PC board which you can install in any type of cabinet. The complete supply shown uses a 4 x 2⅜ x 6-in. metal cabinet, with the PC board end mounted by L brackets fashioned from scrap aluminum. The fuse holder is mounted on the base of the cabinet. Output is from two spring-loaded push-button terminals, but you can substitute 5-way binding posts or any other output connections you prefer.

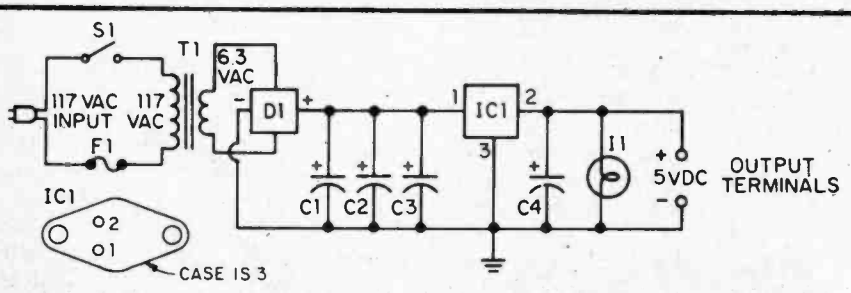
Fuse F1 can be anything from ⅛ to ¼ ampere. Use a standard fuse such as 3AG—not a slow-blow type.



Just one example of a suitable cabinet installation, though any layout will work. The fuseholder is mounted on the cabinet base, while pilot lamp I1 is connected directly across the output binding posts. An old plastic cap was used to give the base lamp a professional appearance.



This is the copper side of your circuit board drawn to its correct size. You can purchase it preetched and drilled, or place carbon paper on a copper clad board, trace the outline onto the board, and use etching solution to make your own board.



PARTS LIST FOR TTL POWER SUPPLY

C1, C2, C3—1000-uF, 15-VDC or higher electrolytic capacitor, see text
C4—100-uF, 15-VDC or higher electrolytic capacitor
D1—50-volt, 6-amp diode bridge rectifier
F1—¼-amp fuse, fast-acting
I1—12-volt, 25-mA pilot lamp, see text
IC1—LM-309K IC voltage regulator (National Semiconductor Corp.)
S1—spst switch
T1—6.3-VAC, 1-amp or better transformer
Misc.—cabinet, fuse holder, pushbutton or other type terminals, circuit board (optional), wire, solder, hardware, etc.

Too Hot. If the last things you solder are the IC terminals, let everything cool down before you check out the supply. If IC1 is excessively hot—from soldering heat—the automatic thermal protection shuts down the output and you won't get any output voltage. A meter connected across the output terminals will indicate zero. After you are certain IC is cool, measure the output; it should be 5 volts. Next, connect your voltmeter across either C1, C2, or C3, then short circuit the output terminals. If you have assembled everything correctly the meter will indicate approximately 10 volts even though the output is shorted. After the short is removed you should read 5 volts at the output terminals.

The only thing to keep in mind when using this TTL 5-volt supply is that the output current is automatically limited to 1 ampere. ■

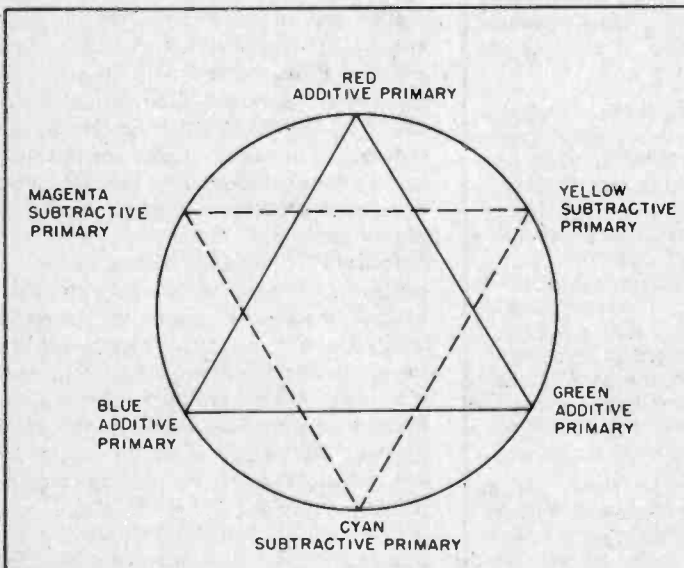
Darkroom Color Analyzer

by Herb Friedman

It's easy to make quality, bright color prints at home with modern color chemistry and this electronic color analyzer!

ONE OF THE SHUTTERBUG'S most satisfying accomplishments is producing his own color prints. For years the time spent on and the cost of making color prints were discouraging, but with modern color chemistry, such as the Beseler system, you can turn out quality color prints *in less time than for black and white* (about 3 minutes), and the prints will be far superior to anything you're likely to get from a color lab.

One thing that takes the drudgery out of color work—besides the chemistry—is a color analyzer, a device that gives you the correct filter pack and exposure time at the very first crack. Most often, the very first print made with the analyzer will be *good*. At most, it will take perhaps 0.10 or 0.20 change of filtration for a *superb* print. This is a lot less expensive and time-consuming than making test print after test print. In fact, it's really the color analyzer that puts the fun into making your own color prints!



Any one of the primary colors on this circle is composed of its immediately adjacent colors in equal amounts. Each primary-color is also complementary to the color directly across the center of the circle. Complementary colors added together form neutral densities. It is the balancing of additive primary colors of photographic light sources and subtractive-type color filters that provides control in color print photography.

Color Analyzers Are Not Cheap. A decent one costs well over $100, and a good one runs well over $200. But if you've got even a half-filled junk box you can make your own color analyzer for just the junk parts and perhaps $10 to $15 worth of new components.

A color analyzer is basically a miniature computer. You make a "perfect" print the hard way—by trial and error—and then calibrate the analyzer to your filter pack and exposure time. As long as you use the same box of paper and similar negatives, all you need to do to make a good color print is focus the negative, adjust the filter pack and exposure so the analyzer reads "zero," and hit the enlarger's timer switch. Even if you switch to a completely different type of negative, the analyzer will put you well inside the ballpark, so your second print is a winner. (And even if

the filtration is off, the exposure will probably be right on the nose.)

Construction. The color analyzer shown was specifically designed for the readers of this magazine—essentially an electronics hobbyist with an interest in photography. All components are readily available in local parts stores or as junk box parts. Several protection devices have been designed into the circuit so accidental shorts won't produce a catastrophe. The printed circuit board template has foils for both incandescent and neon meter lamps, as well as extra terminals so you can use either a socket and plug or hard wiring for the color comparator and exposure sensor. In short, you can make a lot of changes to suit your individual needs.

The template for IC1 uses a half-minidip, Signetics V-type package lead arrangement. However, you can also use an IC with a round (TO-5) configuration. If anything is wrong with the IC you can get the TO-5 out easily. The half-minidip removal might result in destruction of the PC board. We'll explain how to install the TO-5 IC on the PC board later.

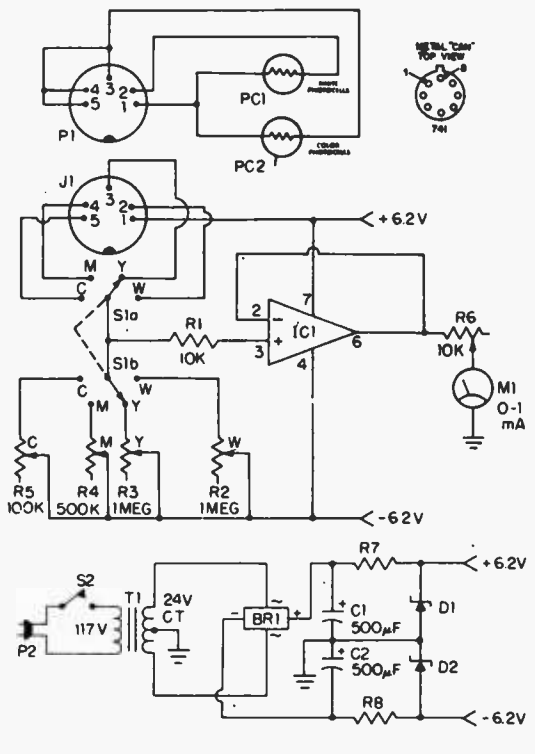
You can either buy or make the printed circuit board (see parts list). Either way, the first step is to prepare the printed circuit board. If you do it yourself, make it any way you like, using free-hand or template resist. Nothing is critical, but be certain there are no copper shorts between the terminals for IC1. Use a #56 bit for all holes. Then use a larger bit for transformer T1's mounting screws (#4 or #6 screws), a ¼-in. bit for resistor R6, and a #30 to 40 bit for the linecord connections (any bit that will allow the linecord wires to pass through the board).

Assemble the power supply and check it out before any other components are installed. Install transformer T1 first. Any 24-volt or 25.2-volt center-tapped transformer that will fit on the board will be fine. Get something small, like 100 milliamperes. A Wescom 81PK-100 is a perfect fit.

Bridge rectifier BR1 is the low cost "surplus" found in many distributors. This type has the positive and negative outputs at opposite ends of a diamond. The AC connections are the remaining opposite ends. Note that BR1 is installed in such a manner that its negative output is farthest from transformer T1 while the positive output is nearest to T1. Make certain your bridge rectifier has the same lead configuration; if it is different, modify the printed circuit template to conform to the rectifier you're using. Get it right the first time.

Finally, install C1 and C2, R7 and R8, and zener diodes D1 and D2. Take care that the capacitors and zener diodes are installed with the polarity correct. If the capacitors have their negative leads marked with an arrow or line, these markings face the *opposite edges* of the PC board (negative to the outside). The zener diodes are installed so that their cathodes (the banded ends) face each other towards the center of the board.

Initial PC Checkout. When the power supply is completed, temporarily connect a linecord. Connect the negative lead of a meter rated 10 volts DC or higher to the foil between T1's mounting screws (that's ground). Connect the meter's positive lead to the junction of R7 and D1, which is in the center of the board; the meter should indicate approximately +6.2 volts DC. Then connect the positive meter lead to the R8 and D2 junction, which is near the edge of the board. You should get approximately −6.2 volts DC. If the voltages

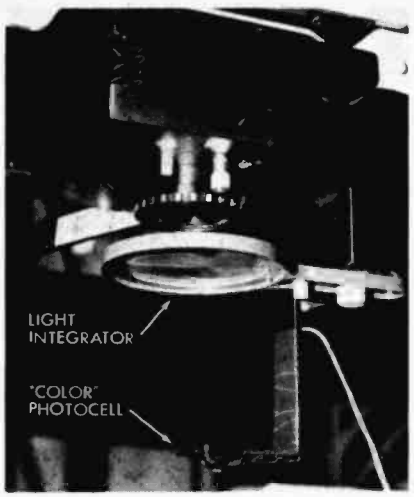


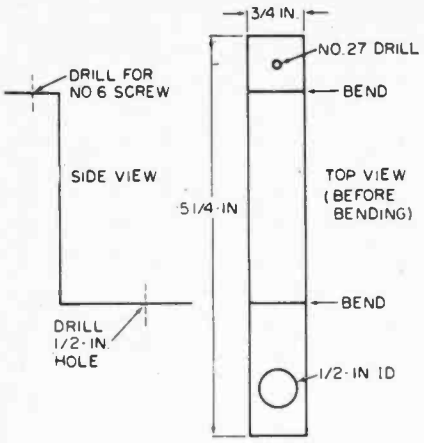
PARTS LIST FOR COLOR ANALYZER

BR1—50-PIV, 0.5-amp or higher silicon bridge rectifier
C1, C2—500-uF, 10-VDC or better electrolytic capacitor
D1, D2—6.2-volt, 1-watt zener diode
IC1—type 741C operational amplifier, see text
J1—5-pin socket, DIN-type (optional, see text)
M1—0 to 1-mA DC meter, see text
P1—5-pin plug, DIN-type (optional, see text)
PC1, PC2—Clairex CL5M5L photocell, **do not** substitute
R1—10,000-ohm, ½-watt resistor
R2, R3—1-megohm potentiometer, see text
R4—500,000-ohm potentiometer, see text
R5—100,000-ohm potentiometer, see text
R6—10,000-ohm trimmer potentiometer (Mallory MTC-14L4 for exact fit on PC board)
R7, R8—820-ohm, ½-watt resistor
R9—100,000-ohm, ½-watt resistor
S1—2-pole, 4-position rotary switch (Allied Electronics 747-2003; adjust stops for 4 positions)
S2—spst switch
T1—117-volt primary, 24 to 26.6-volt secondary transformer, see text for point-to-point wiring (Note: you can also use two less expensive 12-volt transformers with secondary windings connected in series-aiding, if you have the space.)

The printed circuit board for the Color Analyzer is available direct from Electronics Hobby Shop, Box 192, Brooklyn, NY 11235 for only $5.50. US orders add $1.50 for postage and handling; Canadian orders add $3.00. No foreign orders, please. Postal money orders will speed delivery; otherwise allow 6-8 weeks for delivery.
If you cannot obtain the Clairex Type CL5M5L photocell locally, write to Electronics Hobby Shop at the above address, enclosing $3.50 for each photocell. U.S. orders add $1.50 for postage and handling. Canadian order add $3.00. No foreign orders, please. New York State residents add sales tax. Postal money orders speed delivery; otherwise allow 6-8 weeks for delivery.

Misc.—cabinet, pilot lamp for meter, 2-in. or 3-in. size Kodak Wratten filters #70, #98, and #99 (available from photo supply dealers), calibrated knobs, wire, solder, hardware, etc.





The color comparator photocell Z-bracket is installed under a light integrator. If your enlarger has a filter holder under the lens, attach the Z-bracket to the holder.

are far apart in value, or if the polarity is wrong, make certain you find the mistake *before* installing IC1.

Disconnect the linecord and complete the PC assembly. If you use a 24 or 28-volt pilot lamp to illuminate the meter you connect to the holes adjacent to T1's secondary (24-V) leads. If you plan to use a neon illuminator, install a 100,000-ohm resistor (R9) on the PC board and connect the lamp to the holes marked "neon." The lamp must have as little illumination as possible. Incandescent 24 or 28-volt lamps must be the miniature or "grain of wheat" type rated approximately 30 to 60 mA; the lamps come with attached leads. Do not use pilot lamps of the 100 to 500 mA variety. The excessive light will confuse the analyzer.

To install IC1 when it is the metal can TO5 type, fan out the #1 to 4 leads and #5 to 8 leads so they form two straight lines. Note that the lead opposite the tab on a TO5 package is #8. Insert the leads into the board leaving about ¼ inch between the IC and the board. The IC is correctly installed if the tab faces *away* from the transformer towards the nearest edge of the PC board. Solder IC1 and cut off the excess lead length.

The edge of the PC board nearest IC1 has four sets of paired foil terminals. These are provided as mounting terminals if you connect the photocell comparator and sensor without the use of a plug and jack. However, we strongly suggest the use of the specified DIN-type connectors as they allow for easy repairs if the connecting wires break. (The connectors aren't *that* costly).

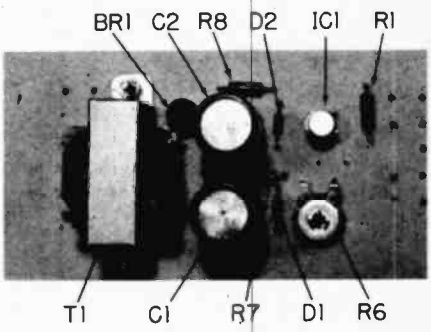
Potentiometers R2 through R5 can be linear or audio taper, though audio taper gives a slightly smoother adjustment; use whatever you have in stock.

The analyzer shown is built in a Bud 7-inch AC-1613 Universal Sloping Cabinet. This is the least critical item and you can substitute whatever cabinet you prefer. Just be certain the cabinet will accommodate the type of meter you use.

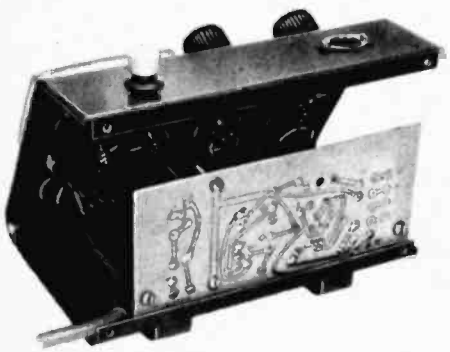
Meter M1 should be O-1 mA with a zero-center scale. But these are expensive, so you can substitute any standard 1-mA meter you want. You will simply calibrate the instrument for zero-center.

If you use a neon pilot lamp mount it directly above the meter and shield the forward brilliance with a piece of black tape; the lamp should radiate straight down onto the meter scale. If you use the meter in the parts list, remove the front cover by pulling it forward. Then remove the meter scale. As shown in the photographs, place a black dot approximately 3/16-inch wide at the center of the scale. If you want, you can also modify the meter for the incandescent lamp. Drill a ¼-inch hole in the lower right of the meter *from the rear*. Position the meter in the cabinet and mark the location of the meter hole on the panel. Remove the meter and drill a ⅜-inch hole in the panel. When the meter is installed you can pass a "grain of wheat" lamp through the panel into the meter. Reassemble the meter and complete assembly.

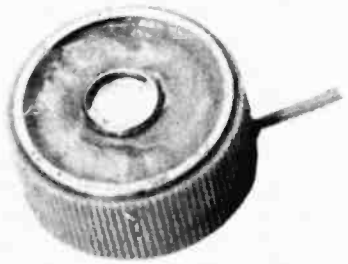
The Comparator. The photocells used for the comparator and exposure sensor, P1 and P2, must be Clairex type CL5M5L. Make no substitutions. From a piece of scrap aluminum ¾ to 1 inch wide, fashion a Z-bracket to the dimensions shown. Drill a ½-inch hole close to the end of the longer Z-leg. Fasten the other end of the Z-leg to your enlarger's under-lens filter holder. If your enlarger does not have a filter

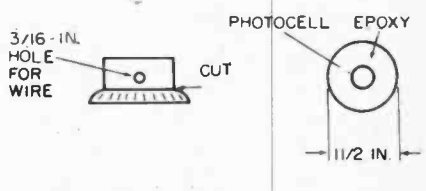


This is the parts location when our PC board is used. To get a free template of the PC board, send a Self-Addressed Stamped Envelope to: Davis Publications, Dept. T, 229 Park Ave. South, New York, NY 10003.



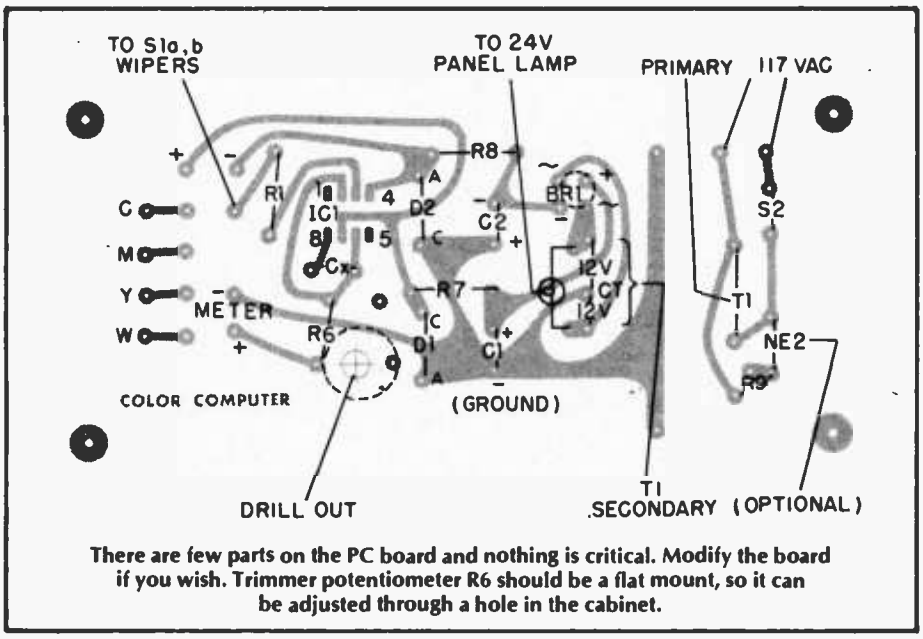
Rear view of author's color analyzer shows vertical mounting of the circuit board.





The exposure sensor photocell is mounted in anything that will keep it in place on the easel. This example was epoxy-cemented into a large control knob after the outside dial section was ground off. In typical operation, the sensor is placed under the lens with the light integrator or filters.

holder, or if it has a permanent swing-away red filter under the lens, mount a Paterson swing-away light integrator (available from local photo shops) under the lens. Fasten the short leg of the Z-bracket to the integrator—which has pre-drilled holes—so that the ½-inch hole is on the optical center of the lens. Then cement photocell P2 in the hole and attach the connecting wires; these can be extra-thin zip cord such as used for short-length speaker connections. (This whole bit reads a lot more complicated than it is. Use the photographs as a guide.)



There are few parts on the PC board and nothing is critical. Modify the board if you wish. Trimmer potentiometer R6 should be a flat mount, so it can be adjusted through a hole in the cabinet.

Photocell P1, which measures the exposure light, can be mounted in anything heavy enough to hold it in place on the easel. The photographs show the photocell epoxy-cemented in an oversize control knob.

When the complete analyzer is assembled, attach oversize calibrated knobs such as the Calectro E2-715 to R2 through R5. The knob calibrations are important so they should run out to the very edge of the knob skirt. If the calibrations don't run to the edge you won't be able to preset the controls with any reasonable degree of accuracy. Place a fine line or other indicator directly above each knob.

Checkout. Connect the photocells to the control unit and apply power. Don't worry if the meter pins at either end of the scale. Set switch S1 to the extreme clockwise position and adjust R2 through R5 until you find the control that changes the meter reading. Mark the switch and the control "C" for cyan. (We suggest you paint the cyan knob insert a blue-green. Also paint the other knobs the appropriate color.) Advance S1 one position clockwise, find the correct knob and label both "M" for magenta. Advance the switch another position clockwise, find the knob and label both "Y" for yellow. The last switch position and knob is labeled "W" for white (white light exposure). Make certain the C, M, and Y controls are reading P2, the color comparator mounted under the enlarger lens.

Set S1 to any position, set all other controls to their mid-position, and turn on bright room lights. If the meter pins out or approaches full scale deflection, adjust trimmer control R6 so the meter pointer just pins (don't be afraid to pin the meter). Depending on the amount of light the meter pointer will pin right (for bright light) and left (for dark or very low light). This is normal and there will be no damage to the circuit or the meter. (Note: If you use a zero-center meter the pointer will barely pin on both sides.)

Close-up of meter face showing a small scale-illumination lamp in lower right corner. This lamp should not be operated at full voltage to avoid fogging the film.

Install the Z-bracket under the lens. If your enlarger uses a filter holder under the lens insert a diffusion screen or glass, or a Beseler Light Integrator or similar ground glass in the filter holder. You are now ready to make color prints.

The first thing you need to make fine quality color prints is a high speed chemistry, such as the two-step Beseler system which can produce a finished print in two minutes. The second item you need is the electronic color analyzer for which we've already given you the plans.

Color Variables. Color materials such as the negative, printing paper, enlarger lamp, and even color correction filters vary in their sensitivity to light colors from batch to batch, roll to roll, and time to time. Even the enlarger's optical system can have a color cast. For this reason it is generally impossible to place a negative in your enlarger, expose the paper, and develop a good—let alone decent—color print.

To avoid upsetting a control setting while groping for the on-off switch in the darkroom, mount switch S2 as far as possible from the controls.

Provides a wealth of worthwhile info for photographers interested in the color print techniques available from Kodak or your photo dealer. Their publication No. E-66.

One way we can correct for these variables is through an *additive* exposure, exposing the paper through blue, green, and red filters for differing lengths of time. Since blue, green, and red create all the colors in additive printing, any correction can be obtained by controlling the precise timing of each exposure. The additive system is a pain in the neck for the hobbyist, for the slightest desired change in the color rendition or saturation (exposure) can involve changes in the exposure through all three filters.

A printing system that's easier to use and more favored by hobbyists is the *subtractive* exposure. A single filter pack made up of two of the filters known as YELLOW, MAGENTA, and CYAN makes all the color corrections at the same time. This filter pack is placed between the enlarger lamp and the negative; virtually all modern enlargers have a drawer in the lamphouse to accommodate a filter pack. A single exposure through the filter pack is all that's required to make a color print. Some of the more expensive enlargers have what is termed a "dichroic head" with variable filters as part of the light system; the exact value of filtration is simply dialed by the user. Again, all the color correction is provided at one time by the dichroic head so only a single exposure is needed.

More Info. A full and complete treatment of both types of color printing is contained in the Kodak publication *Printing Color Negatives;* this book is a required reference for anyone who wants to make quality color prints. The book also gives the most convenient operating procedures for electronic color analyzers.

The subtractive printing procedure is particularly well adapted for use with a color analyzer, is the easiest method for the amateur, and is exceptionally fast-handling, so the illustrations to follow will refer to the subtractive system.

An electronic color analyzer basically consists of a photocell (vacuum tube photomultiplier or photoresistor) positioned under the lens, blue, green, and red filters mechanically positioned over the photocell (or positioned over the cell by hand) and a meter that indicates the amount of light falling on the cell. The meter is connected to the photocell through independent potentiometers as shown in the figure. Color analyzer readings will be accurate for most negatives and lighting situations as long as the same box of printing paper is used. The system needs to be recalibrated only when the printing paper is changed (so purchase boxes of at least 100 sheets to avoid extra work).

The first step is to make a really fine print from a decent negative. You can do it the hard way, one print at a time, or use a Beseler Subtractive Calculator which puts you inside the ball park on the first try. When you have made a print with satisfactory flesh tones and color saturation don't disturb the enlarger or timer controls.

To Continue. . . . Place the color analyzer's probe on the easel or swing it under the lens (if it is mounted on the enlarger). Install a light integrator—which is nothing more than a piece of ground glass or its equal—under the lens, between the lens and the analyzer's probe. The light integrator scrambles the picture into a diffused "white light" which contains all the color elements of your negatives and the filter pack. Place a blue filter (Kodak Wratten No. 98) on top of the light integrator. (Note that most hobbyist analyzers have a selector switch that also mechanically positions the correct filter over the photocell.) Turn on the enlarger and adjust the analyzer's *yellow* control for a convenient reference meter reading. (Usually, center-scale or "null" is used as the reference reading, but any meter reading can be used as a null.)

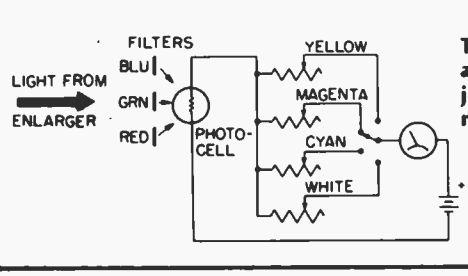
Remove the blue filter, install a green filter (Kodak Wratten No. 99), switch the analyzer to MAGENTA and adjust the *magenta* control for a null meter reading. Remove the green filter, install a red filter (Kodak Wratten No. 70), switch the analyzer to CYAN and adjust the *cyan* control for a null meter reading (the color controls yellow, magenta, and cyan refer to the color of the subtractive filters in the filter pack). Finally, remove all filters from under the lens, switch the analyzer to WHITE and adjust the *white* control (exposure control) for a null meter reading.

(The color analyzer in this project uses a separate photocell for the exposure. If you look at the easel you'll see a shadow cast by the Z-bracket holding the color comparator cell. Position the exposure cell on the easel so it is just off the edge of the shadow. If you prefer, you can place several thicknesses of opaque paper over the color comparator cell and use it for the white measurement, though we suggest you use the separate cell.)

Modern color print chemistry techniques from Beseler include this subtractive color calculator to aid filter selection.

When all the controls are adjusted you have programmed the color characteristics and exposure of your "reference" print into the analyzer, and you should note the control settings and exposure time for future use.

Down to Business. Now assume you want to make a print from another negative. Put the new negative in the enlarger. Then set the degree of enlargement and focus, leaving the lens wide open. Place the analyzer's probe under the lens, install the light integrator and set the analyzer's switch to CYAN. Install the red filter on top of the light integrator and adjust the lens aperture until the meter indicates null. Switch the analyzer to MAGENTA, install the green-reading filter and note the meter reading. If it is not at null, add or remove magenta filters (from the filter pack) until the meter shows a null. Then switch the analyzer to YELLOW, install the blue-reading filter and

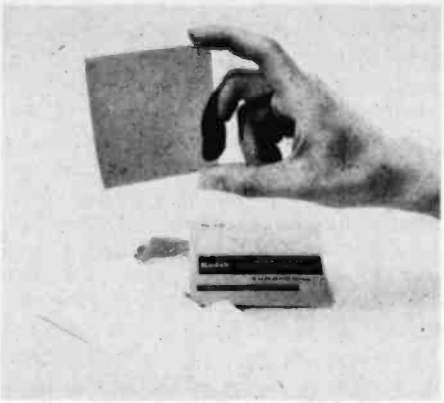


The basic color analyzer. Once controls are matched to a "standard" negative, just select filters for a null on the meter for each individual color and white.

modify the yellow filtration in the filter pack until the meter shows a null. Finally, set the analyzer to WHITE, remove all reading filters and adjust the lens aperture for a null indication.

Through the color analyzer you have now established a new filter pack and exposure for the new negative. If the new negative uses similar lighting to the referenee negative the print should be perfect. If the lighting was considerably different the print will be good—acceptable to most people, but requiring just a slight filter pack modification for a great print.

Swinging Filters. In the previous example the filter pack would wind up with magenta and yellow filters—which is what is generally needed. Some Kodacolor negatives, however, might require cyan lters plus magenta *or* yellow (but never all three). This information will have been programmed into the color analyzer, so you will have no difficulty if you make a slight modification in procedure. The first meter reading, the one where you adjust the lens's aperture, should be made for the filter you are *not* using in the filter pack. For example, if your basic filter pack has cyan and magenta, switch the analyzer to YELLOW, place the blue-reading filter in position on the light integrator, and close down the lens for a null indication. Then proceed with the other readings. If your reference negative did not require cyan in the filter pack, if it had yellow, magenta, or both, and you find a new negative just can't be pulled in for null meter readings with yellow and magenta filters, it indicates the new negative requires cyan filtration, so start with the assumption that yellow is not



Kodak color printing filters. Typical filter designation CP20Y means color filter with a .20 density; the color is yellow.

required. If you still can't null the meter, it means magenta should *not* be in the filter pack.

As we mentioned, a more thorough discussion and procedure for using a color analyzer is found in Kodak's *Printing Color Negatives.*

Most, but not all, commercial color analyzers use photomultiplier tubes which have no light memory, nor are they confused by infrared from the enlarger lamp. These units are, as you would expect, relatively expensive. Low cost models use photoresistors.

More Data. Photoresistors are infrared-sensitive and they have a light memory, both of which can confuse the meter. The infrared is easily handled by installing a heat or infrared filter glass in your enlarger (it should be there to protect the negative anyway). The light memory is handled by using a consistent measurement procedure. The best way is to turn the enlarger off, install the reading filter and the light integrator, turn off the bright room lights, count to five, and then turn the enlarger *on*. Take the meter reading, or adjust the appropriate color control, slide the new reading filter in place before withdrawing the old one, switch the analyzer, and make the new meter reading. Repeat this for the third reading filter. You'll note that this procedure keeps bright white light from falling on the photocell between meter readings. If you want to change filters under room lights, make certain there are about five seconds of darkness between turning the room lights out and turning the enlarger on.

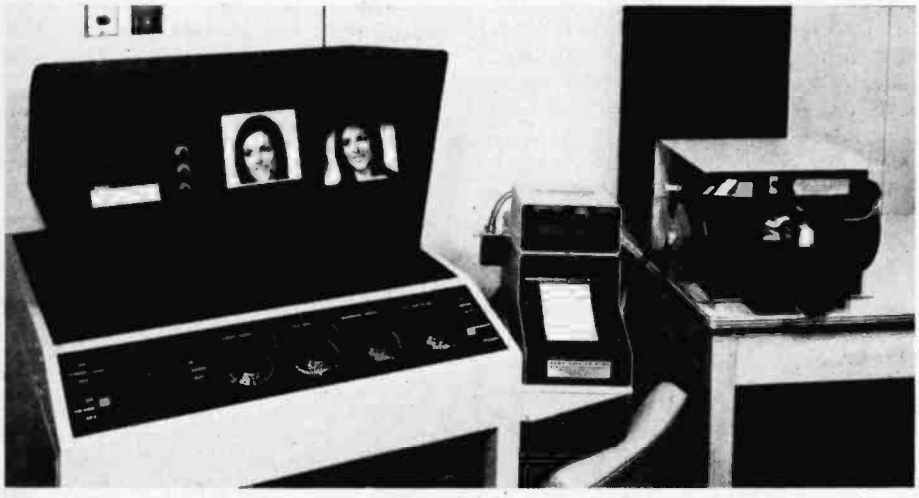
The whole bit might sound somewhat complicated, but after you've run through the procedure once or twice to get the hang of things it shouldn't take you more than a minute or so for a full color analysis of a new negative.

The Kodak Wratten filters needed are available from professional camera shops. For the construction project, color analyzer 2-in. or 3-in. Kodak Wratten filters Nos. 98 (blue), 99 (green), and 70 (red) are recommended. If you have difficulty obtaining these specific filters you can make the following substitutions, through the analyzer's precision will be slightly reduced: 47B (blue), 61 (green), and 92 (red).

The Pro Shop. We could not close without some words on commercially processed color prints such as you might order from a drugstore or camera shop. Commercial color labs have as high (if not higher) a remake rate than the amateur if *quality* color prints are desired. As a general rule, it takes two tries to get a decent color print, so the hobbyist with a color analyzer is way ahead of the game because he can turn out, at worst, two *good* prints for each three first tries. The average is even higher than this as the hobbyist gets skilled in the use of a color analyzer.

Commercial labs come close to a hobbyist's results only when they are equipped with a video analyzer such as the Kodak Video Color Negative Analyzer Model 1-K; and Kodak only claims a 75%+ first try acceptance rate for their analyzer. The video analyzer is a 5-in. x 5-in. TV display. The operator views the color negative as a positive color TV image, and adjusts the TV's controls for proper color balance and brightness (saturation). The control settings are translated to the printing equipment's filter adjustments so that the final print is similar to the image displayed on the TV.

The video analyzer is a fast and easy way to get good color prints on the first try, but since video analyzers cost in the thousands, the color analyzer is the best thing going for the hobbyist. ■



Professional equipment used by color labs includes this Kodak Video Color Negative Analyzer. It uses a 5-in. color TV screen to assist an operator in selecting the correct filter.

CHIP-TOCK IS A TIP-TOP LED CLOCK

Six-digit LED readout mounts anywhere to show hour, minutes and seconds, in 12-hour or 24-hour format.

by Alex F. Burr

ELECTRONIC PROJECTS UNTIL A FEW YEARS AGO used only *analog* circuits—that is, the output was proportional to the input (another term for analog circuitry is *linear*). But now more and more devices and circuits are using digital techniques and circuitry, instead of the older analog methods. Anybody who wants to stay on top of what's happening in electronics today had better get familiar with digital components and design, and there's no better way to start than to build a simple digital device, learning digital basics the easy way.

One of the simplest projects you can build is a digital clock. The clock you can build from this article is called Chip-Tock. And while you're doing it you'll be working with the building blocks of digital computers; an MSI (medium scale integrated circuit), LED-display readout numerals, and transistor drivers for the readout digits.

One or two pleasant evenings of work is all it takes to assemble Chip-Tock, once you've gotten all the parts together and studied the diagrams and pictures thoroughly. When you've completed Chip-Tock you'll have a six-digit electronic clock operating from the AC power line, either in the usual 12-hour format, or if you prefer, as do the military, radio amateur operators (hams), and others, a 24-hour format. Chip-Tock will work either on the 60-Hz current which is most widely used, or on the 50-Hz power used elsewhere. The circuit diagram shows how few parts are used in addition to the chip, LEDs, and transistors. Actually additional parts include only switches—to make it easy to set the clock, or to stop it—a few capacitors and resistors (plus parts for the simple power supply. Power transformer T1 can be just about anything which supplies at least 200 milliamperes at 12-volts AC out of its secondary terminals. However if you can't find a transformer in your junk box the transformer in the Parts List is a good choice because it's so small, and it costs less than $1.75.

LED Readout Display. Any of several seven-segment LED readouts may be used in Chip-Tock, depending on how far away you want to be able to read the time. However, the specified LED inserts directly into the printed circuit board shown in the Parts List, while you'd have to make up a hand-wired board for LEDs other than those specified.

You'll find the layout of the specified LED, Fairchild Semiconductor FND-70, at the lower left of the schematic diagram. Notice that each of the seven segments on the LED is designated by a letter, A through G, which is connected to pins numbered 1 through 10. Two pins 1 and 6, are set aside for common cathode connections. Any of ten digits can be displayed by applying current to two or more segments. For example, a "1" is lit up by connecting to B and C, a "6" is shown by connecting to A, C, D, E, F, and G, and "8" is obtained by lighting up all the segments (excepting, of course, the decimal point at the lower left of the numeral segments).

It's a Baby Computer. The heart of Chip-Tock is IC1, National Semiconductor's MM5314 digital clock integrated circuit which has 24 pins. It's almost a small-scale, *special*-purpose computer which does only one job. Big computers, such as the IBM 370, are called *general*-purpose computers, because they can be programmed to do any of thousands of complex jobs. It's not necessary to know what goes on inside the chip, so long as we know what we have to put into it, and what we get out of it. Inside IC1 are dozens of tiny transistors, resistors and capacitors, already connected and just waiting for us to make the external connections.

Inputs and Outputs. The only signal input to Chip-Tock is at pin 16. Resistor R8 is used along with capacitor C2 to pick up a 60-Hz pulse signal from the AC power line (through T1). This 60-Hz signal connects to pin 16 of the clock chip. The circuits inside the chip count the pulses and divide them to get the signals for hours and minutes which control the display—the LED readout. If you're going to be using Chip-Tock in an area which has 50-Hz AC power, disconnect pin 11 from ground and leave it unconnected.

The signal outputs are on the right of the chip shown in the schematic diagram on pins 3 through 9 and 17 through 22. When the voltage on any of pins 3 through 9 is high (approximately 5 volts) the segment of the LED readout connected to that pin will light up. Pin 3 controls segment A, pin 4 segment B, and so on.

Multiplexing the Readout. If all the digits on Chip-Tock were kept lit up

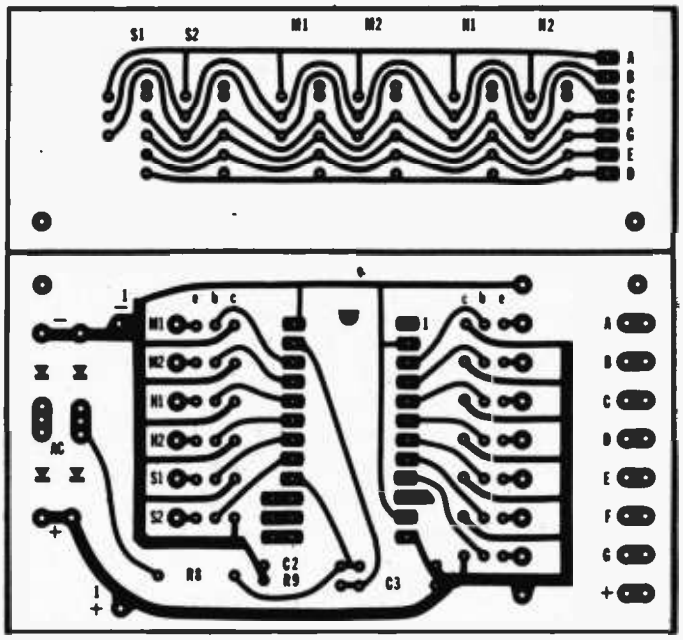
CHIP-TOCK IS TIP-TOP

constantly it would take more circuit components, so a scheme called multiplexing is used. This multiplexing system has the LEDs lit up intermittently, but they go on and off so fast, one after another, that it looks to the human eye as though they are all on all of the time. The clock chip actually drives (through the transistor drivers) only one of the six LED display digits at any one time. Which LED is actually lit is determined by the voltage output at pins 17 through 22. These are switched about a thousand times a second, so there's no "flicker" to the eye and they all appear to be on at once.

The chip circuitry coordinates the segment-controlling pins (3 through 9) with the digit-driver pins (17-22) so that the desired number is formed on each of the six LEDs. Pin 17 controls the first (least significant) *seconds* numeral and pin 18 controls the other *seconds*. Pin 19 controls the first (least significant) *hours* numeral, while pin 20 works the other *hours*. Finally, pin 21 goes to the first *minutes* numeral, and pin 22 controls the other *minutes* one. This component-saving display technique is multiplexing.

The other pins on the IC have control functions. When pin 10 is grounded, the time is shown in the standard 12-hour format, but when it is left unconnected, the clock will run for 24 hours before it starts over again. Pins 11 and 2 are grounded, and pin 12 is connected to the DC supply. Pins 13, 14, and 15, marked *Time Set*, are used to set the clock, or to stop it and hold the display (so the actual time can catch up with the numbers shown). When pin 14 is grounded (by momentary action switch S2, labeled *Slow*) the clock will speed up, with the *minutes* indication speeding by in only seconds. If pin 15 is grounded (by switch S2, labeled *Fast*), the hours numerals change in just a few seconds. Once you've run the numerals a bit past the actual time you press switch S1, labeled *Hold*, and wait until the real time catches up to the LED-indicated time. Releasing the switch then lets the clock go ahead, telling the correct time. Pin 23 goes to an RC network which controls the multiplexing frequency. This frequency, roughly 1000 Hz, is not critical. Pins 1 and 24 are not used.

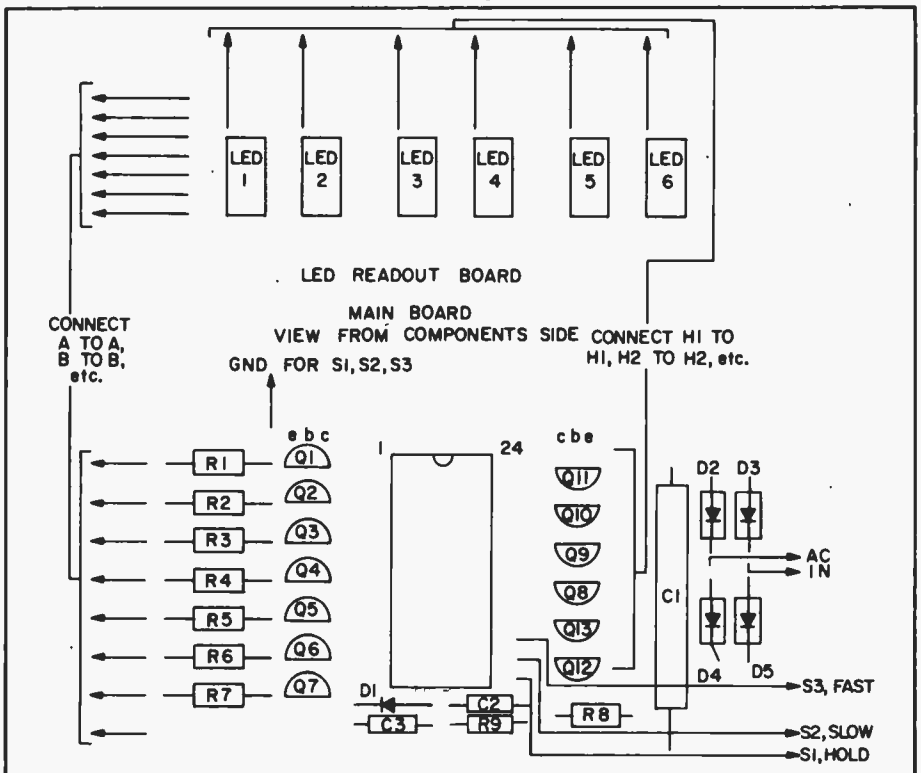
Transistor Driver Switches. The LEDs each require about 20 mA of current when they are lit, and this is more than the IC can handle. Therefore the IC outputs are used to switch transistors Q1 through Q13 on or off, and these transistors, called drivers, are used as switches to control the current to the LEDs. There are seven NPN segment drivers, and six PNP drivers. The schematic diagram shows only two NPN and two PNP driver transistors, to keep the diagram uncluttered.



Full-size foil pattern for Chip-Tock. Top part is for readout digits; may be separate from main circuit board.

Power Supply. Chip-Tock uses a conventional power supply. It is a full-wave bridge rectifier type, with four rectifier diodes, connected so as to maximize the voltage and current from the secondary winding of the rather small power transformer. The bridge rectifier power circuit is widely used in modern transistor circuits.

Building It. Construction of Chip-Tock is straightforward and the layout and placement of parts is non-critical if you use perf-board construction. It is advisable however, particularly if this is one of your first projects, to use the printed circuit board shown in the Parts



Layout of components on circuit board(s). Foil is on other side of the board. Readout may be remote from main board.

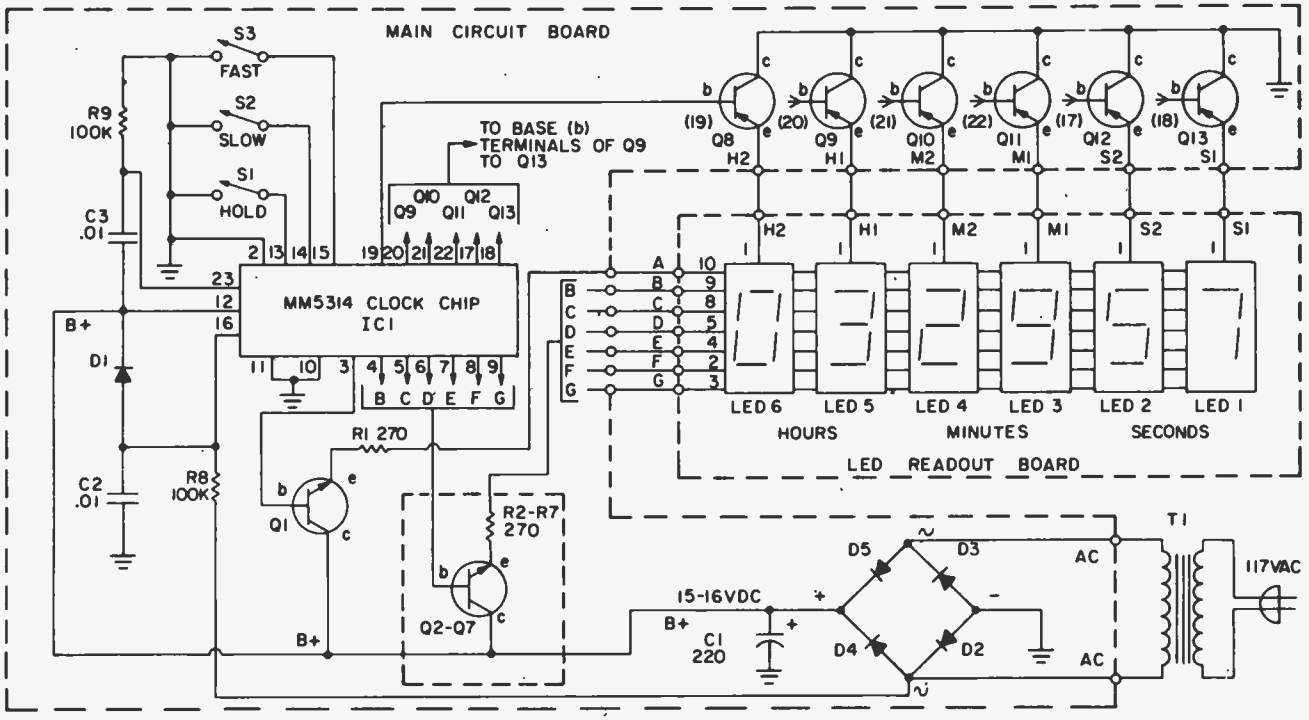
List. It will save you a great deal of time and effort.

The first thing you should do is get hold of the integrated circuit clock chip IC1, a Motorola MM5314, and the LEDs, which may not be generally available. Two good sources for these components are shown in the Parts at the end of the Parts List.

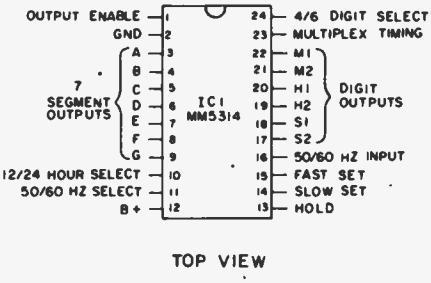
There is one thing you should be very careful about. This clock chip is an MOS device (metal oxide semiconductor), which requires care in handling to prevent damage. It should not be left anywhere near the project until you're finished. You should use an IC socket, and solder that to the board, plugging the IC into the socket only after all other work on the unit is completed. A 24-pin socket may not be readily available, but you can easily make use of the 28-pin kind which is easy to pick up. Just leave four socket holes unconnected. Again, don't let the IC get anywhere near your soldering iron. The iron you use should be one with a small tip, such as the Radio Shack 64-7020 25-watter, or their 30-watt unit (64-2068), if you prefer the "gun" grip to the pencil grip.

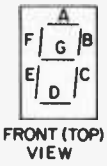
There are two printed circuit boards—one for the LEDs and one for the main

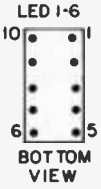
(Continued on page 98)

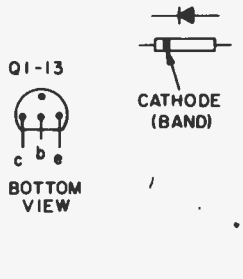


NOTE:
1. FOR 50 HZ OPERATION REMOVE GROUND FROM PIN 11
2. FOR 12-HOUR OPERATION GROUND PIN 10
3. ALL CAPACITORS SHOWN IN μF
4. ALL RESISTORS IN OHMS









CHIP-TOCK PARTS LIST

C1—220-uF, 25 VDC, electrolytic capacitor
C2, 3—0.01-uF, capacitor, mylar, ceramic, or disc
D1—1N34 or 1N60 general-purpose diode, any small-signal diode will work
D2-5—Miniature rectifier diode, 1A or more, 50 VDC or more
IC1—National clock chip integrated circuit MM5314N—24-pin. See suppliers listed.
LED1-6—LED, common cathode (Fairchild FND-70, numerals 0.25-in. high)
Q1-7—NPN driver transistor 2N3904
Q8-13—PNP driver transistor 2N4403
R1-7—270-ohm resistors, ¼-or ½-watt
R8, 9—100,000-ohm resistor, ¼-or ½-watt
S1-3—Normally-open, momentary-close miniature switches
T1—Power transformer 120 volts primary, about 15 volts secondary—voltage not critical
Misc.—IC socket, 24-pin. If not available, use 28-pin socket. Aluminum case (optional) 4-in. x 2¼-in. x 2¼-in.

You should check these suppliers for availability and price of the integrated circuit module before you buy the other parts. IC1, the LED readout digits, and the printed circuit board are available from S.D. Sales Co., Box 28810, Dallas, TX 75228. In case of unavailability, they are also available (board slightly different) Optoelectronics, Inc., Box 219, Hollywood, FL 33022. Larger LED readout digits are also available from Optoelectronics.

LITERATURE LIBRARY

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

302. *International crystal* has illustrated folders containing product information on radio communications kits for experimenters (PC boards; crystals; transistor RF mixers & amplifiers; etc.).

303. *Regency* has a new low cost/high performance UHF/FM repeater. Also in the low price is their 10-channel monitoradio scanner that offers 5-band performance.

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

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

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

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

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

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

311. *Midland Communications'* line of base, mobile and hand-held CB equipment, marine transceivers, scanning monitors, plus a sampling of accessories are covered in a colorful 16-page brochure.

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

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

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

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

317. *Teaberry's* new brochure presents their complete lines of CB and marine transceivers and scanners for monitoring police, fire and other public service frequencies.

318. CBers, *GC Electronics'* 16-page catalog offers the latest in CB accessories. There are base and mobile mikes and antennas; phone plugs; adaptors and connectors; antenna switchers and matchers; TVI filters; automotive noise suppressor kits; SWR power and FS meters; etc.

319. *Browning's* mobiles and its famous Golden Eagle base station, are illustrated in detail in the new 1977 catalog. It has full-color photos and specification data on Golden Eagle, LTD and SST models, and on "Brownie," a dramatic new mini-mobile.

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

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

322. *Radio Shack's* 1977 catalog colorfully illustrates their complete range of kit and wired products for electronics enthusiasts—CB, ham, SWL, hi-fi, experimenter kits, batteries, tools, tubes, wire, cable, etc.

323. Get *Lafayette Radio's* "new look" 1977 catalog with 260 pages of complete electronics equipment. It has larger pictures and easy-to-read type. Over 18,000 items cover hi-fi, CB, ham rigs, accessories, test equipment and tools.

327. *Avanti's* new brochure compares the quality difference between an Avanti Racer 27 base loaded mobile antenna and a typical imported base loaded antenna.

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

329. Semiconductor Supermart is a new 1977 catalog listing project builders' parts, popular CB gear, and test equipment. It features semiconductors—all from *Circuit Specialists*.

330. There are over 450 electronic kits described in *Heath's* new catalog. Virtually every do-it-yourself interest is included—TV, radios, stereo & 4-channel, hi-fi, etc.

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

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

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

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

335. The latest edition of the *TAB BOOKS* catalog describes over 450 books on CB, electronics, broadcasting, do-it-yourself, hobby, radio, TV, hi-fi, and CB and TV servicing.

337. *Pace* communications equipment covers 2-way radios for business, industrial and CB operations. Marine radiotelephones and scanning receivers are also in this 16-p. book.

338. "Break Break," a booklet which came into existence at the request of hundreds of CBers, contains real life stories of incidents taking place on America's highways and byways. Compiled by the *Shakespeare Company*, it is available on a first come, first serve basis.

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

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

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

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

352. Send for the free descriptive bulletin from *Finney* Co. It tells all about their new auto FM radio signal booster (eliminates signal fading).

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

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

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

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

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

358. *PixTronics* announces its new Model 200 Super Sensitive Electronic Darkroom Exposure Meter, used to determine the correct exposures of all black-and-white and color negatives. Useable with any enlarger.

359. *Electronics Book Club* has literature on how to get up to 3 electronics books (retailing at $58.70) for only 99 cents each . . . plus a sample Club News package.

ELECTRONICS HOBBYIST
Box 1849, G.P.O.
New York, NY 10001

SPRING/SUMMER 1977
Void After June 3, 1977

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

301	302	303	304	305	306	307	308	310	311	312	313
315	316	317	318	319	320	321	322	323	327	328	329
330	331	332	333	334	335	337	338	342	344	345	350
352	353	354	355	356	357	358	359				

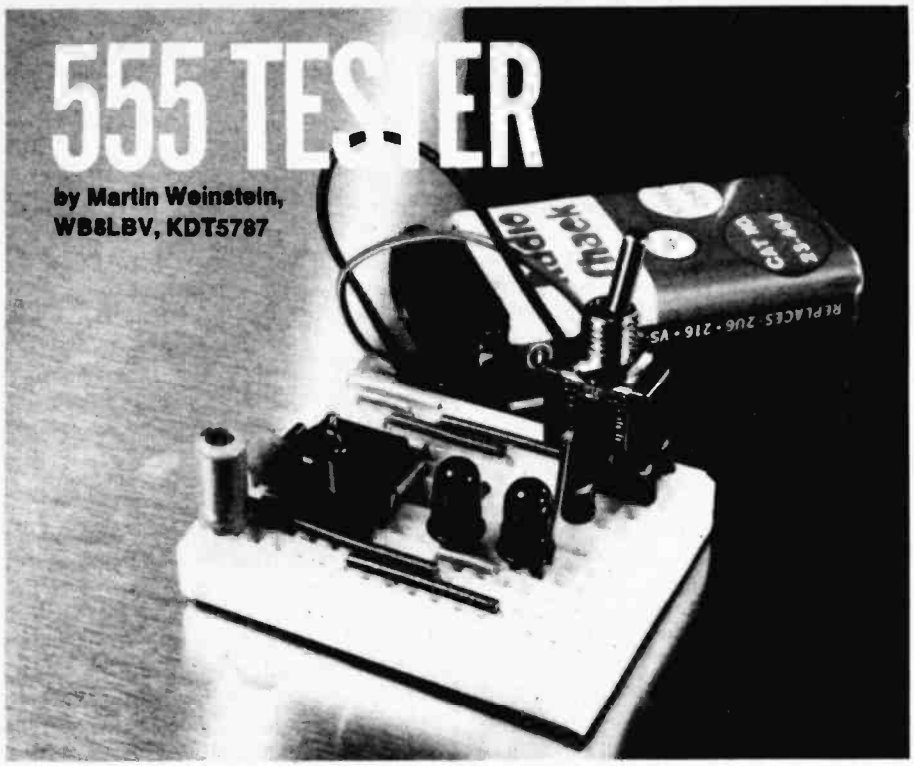
NAME (print clearly) _____

ADDRESS _____

CITY _____ **STATE** _____ **ZIP** _____

555 TESTER

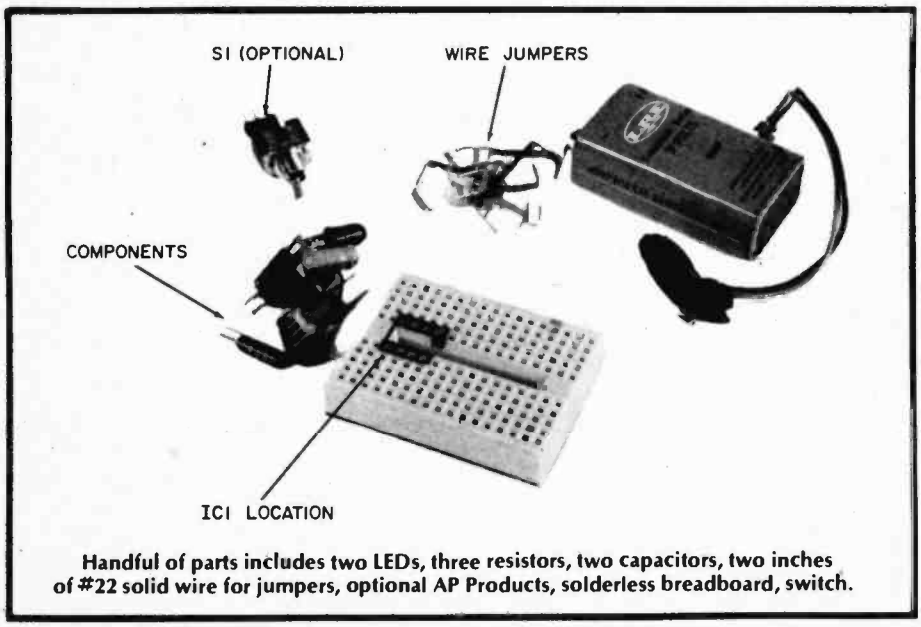
by Martin Weinstein,
WB8LBV, KDT5787



You can test surplus 555 integrated circuit chips in one second with this easy-to-build, simple, project.

ONE OF THE MOST frequently-used integrated circuits today is the 555 timer chip. It's an 8-pin IC, most often found in the Mini-DIP package (rectangular, with the pins in two rows or four each of the long sides). It's also seen in the less-common round transistor-like shape, the TO-5 or TO-99 packages.

It's an IC which can produce a time-delay from a few micro-seconds to about an hour, with five percent accuracy. It can also run free as an oscillator, at frequencies as high as a megahertz (1 MHz) or as low as one pulse per hour! The only external parts are one or two resistors and a capacitor. It can also be used as a comparator, a Schmitt trigger, a controlled switch, and much much more. And today, even though the prices of new integrated circuits are still coming down, you can find untested 555s on the surplus market at great bargains.



Handful of parts includes two LEDs, three resistors, two capacitors, two inches of #22 solid wire for jumpers, optional AP Products, solderless breadboard, switch.

This project shows a ready way to test these widely-used, widely-available ICs.

Inside, the 555 has many transistors and other components, arranged to make up the following circuits: two comparators, one flip-flop (which is a bistable multivibrator), and an output stage. Connections are brought out to several terminals (up to 8) which hobbyists call "pins."

Inside the 555. First we have a comparator, a kind of balancing beam. It looks at two inputs and compares them. Some comparators supply an output when the voltage at one of its inputs is *larger* than the other. Other comparators, like this one, provide an output when both inputs are *equal*.

Now look at the two inputs this comparator is connected to. One input is a voltage divider inside the 555. This consists of a string of three identical resistors connected between Vcc (B+) and ground (−). Since this leg of the comparator is connected 2/3 of the way up the resistor string, it always measures a voltage equal to two-thirds of the supply voltage.

The other input leg of the comparator is connected to the external timing chip capacitor you use in your particular 555 IC timer circuit. The timing capacitor is charged through a timing resistor (two, actually, series-connected and tapped by a connection to pin 7 in most applications). Together, the timing resistor and timing capacitor determine how fast the 555 will oscillate (or how long an output pulse it will deliver). Here's how.

When the charge on the timing capacitor at pin 6, the *threshold* input, reaches a value equal to the voltage at the on-chip voltage divider (2/3 Vcc), the comparator turns *on*. When the comparator turns on, it toggles the flip-flop that switches the 555 output.

The flip-flop also turns on a transistor that discharges the timing capacitor.

How It Works. To start the 555 working, a trigger pulse at pin 2 initially sets the flip-flop to turn the 555 *on*. It does this by comparing the input pulse to 1/3 Vcc at a second comparator. This turns off the transistor across the timing capacitor and allows the timing capacitor to begin to charge. The 555 stays *on* until the timing cycle turns it *off* again by resetting the control flip-flop.

The timing cycle can be made to start over again by applying a pulse to the *reset*, pin 4. This turns on the transistor that discharges the timing capacitor, thereby delaying the charge from reaching 2/3 vcc.

In some applications, the *reset* (pin 4) is connected to the *trigger* input

555 TESTER

(pin 2) so that each new input trigger signal restarts the timing cycle.

When the *threshold* voltage at pin 2 drops, at the end of a timing cycle, that voltage drop can be used to start a new timing cycle immediately by connecting pin 6 to pin 2, the trigger input. This is how the 555 works when it is used as an astable (free-running) oscillator.

The 555 output circuit includes two high current transistors, each capable of handling 200 ma. One transistor is connected between the *output* pin 3 and Vcc, the other between pin 3 and *ground*. Thus, so you can use pin 3 to either supply Vcc to your load (*source*) or provide a ground for your load (*sink*).

Testing is Fast and Easy. I once asked an applications engineer friend of mine how he could tell if a particular gadget of his would work. "Make sure it isn't between you and the door, and then plug it in and turn it on!" he said.

This 555 tester borrows on his advice. Instead of trying to measure specific conditions at each pin (the way most tube and transistor testers make their tests), it plugs the 555 under test right into a simple circuit and puts it to work. A good 555 will flash the LEDs alternately. A bad 555 will cause either or both of the LEDs to light and remain lit, but without flashing.

Construction is Fast. The prototype circuit you see here is built on a modern solderless breadboard, this one an A P Products terminal strip. A spring clip behind each hole grips both wires and component leads. Since each conductive metal spring clip is five "holes" long, the breadboard is organized as a group of five-tie-point terminals.

Jumper wires are used to connect between terminals, and component leads may be inserted directly. Any solid wire from #30 to #20 slips right in and holds securely. I prefer to use #22 solid, and I've bought it in several colors to help me keep track of what's going where. A quarter inch or so of insulation stripped from each end provides a perfect jumper.

The Tester's Circuit. The 555 performs as a simple astable oscillator, alternately flashing the two LEDs. We can drive both LEDs from the single output (pin 3) because of the way the 555 is designed. It is made to either *source* (provide a positive voltage, and thereby current, to its load) or *sink* (provide a minus voltage–ground connection, for the load current) its output. So by connecting one LED from B+ to pin 3 (sinking output) and the other between pin 3 and GND (sourcing output), we can take advantage of both capabilities.

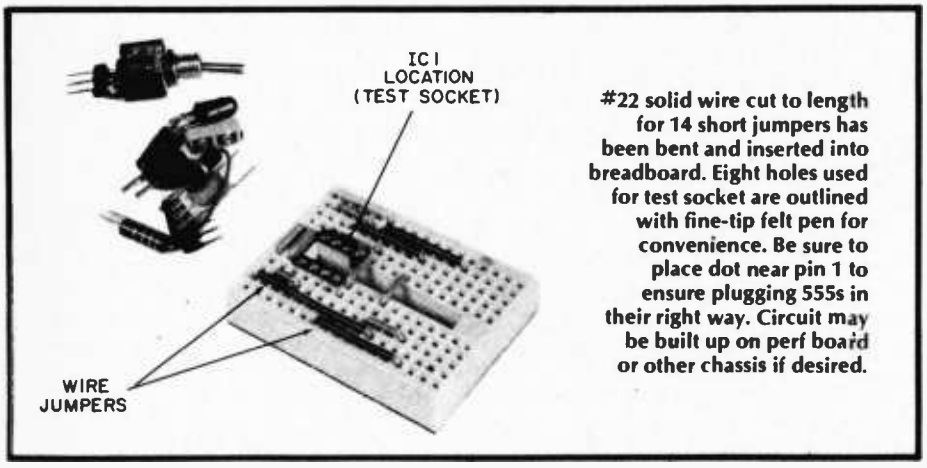
You will notice that I've not included the usual current-limiting resistor in series with each LED. What actually happens is that a single resistor, R1, limits current through the entire circuit. In addition to protecting the LEDs from too much current, it does the same for the 555 under test, and it also prolongs battery life. Finally, it also protects the tester's circuitry in case the 555 under test has a dead short between any combination of pins, as often happens when ICs are removed from surplus printed circuit boards, leaving solder bridges.

The circuit's time constant, which governs the flashing rate, was chosen to make the flash easily discernible. Too quick a flash rate could appear to be a steady *on*. Too slow a flash might look like just one LED lighting. You can alter the flashing rate by changing the value of C2.

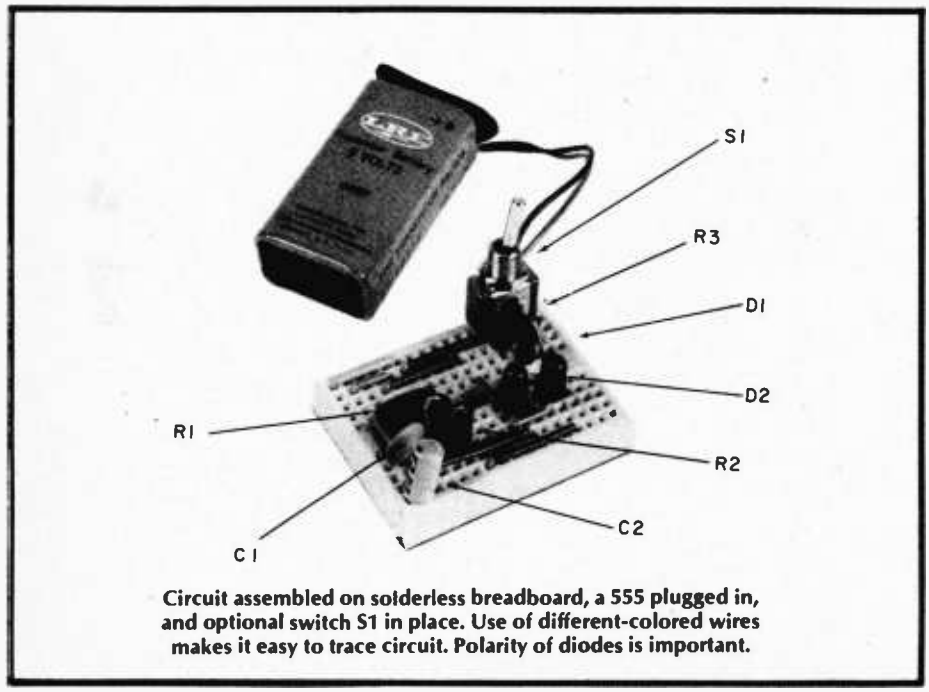
R2 and R3 also affect the flash rate, and the ratio of their values determines the *duty cycle* (how long one LED is illuminated versus how long the other is on, in this case). While other values for R2 and R3 could have been chosen, the values shown here were used for several reasons. For one, they're standard and easy to find. Second, they yield a very readable flash rate. And most important, they fit within the ratio-of-resistances required by the internal workings of the 555.

Building It. If this is your first experience with solderless breadboards, it's only fair to warn you that they can be habit-forming.

You'll have the circuit together in less time than it takes to lay out a



#22 solid wire cut to length for 14 short jumpers has been bent and inserted into breadboard. Eight holes used for test socket are outlined with fine-tip felt pen for convenience. Be sure to place dot near pin 1 to ensure plugging 555s in their right way. Circuit may be built up on perf board or other chassis if desired.



Circuit assembled on solderless breadboard, a 555 plugged in, and optional switch S1 in place. Use of different-colored wires makes it easy to trace circuit. Polarity of diodes is important.

printed circuit board or solder up a haywire circuit. You won't need any hardware at all. You can even leave out the switch if you like, and plug and unplug the leads to the battery.

One of the reasons these solderless broadboards are so fast and easy is that they're designed with a .1-in. x .1-in. hole spacing. Modern DIP (dual in-line package) ICs are designed with leads spaced in multiples of .1-in. So everything we use can plug right into the breadboard. An IC socket here would only be redundant.

This standard .1-in. spacing appears in another handy device that AP Products makes called a *header*. The header is a plastic strip with small contact posts every .1-in. You can break off as many of these as you need, with 36 of them being supplied on each strip. I soldered a piece of header to the back of a small toggle switch so it could plug right in, too. Another small piece soldered to the battery connector makes the entire project plug-in easy.

Follow the diagrams and illustrations as you place each part in position in the breadboard. Mark the breadboard with a felt-tipped pen to show where the 555 under test plugs in, and be sure to index pin 1. Also mark the positive and negative battery connection points.

Jumper Wires. Use #22 solid wire. Cut about ½ inch longer than jump (connection) needed. Strip ¼-inch of each end bare and bend at right angles. You will need one .1-in. jumper, one .2-in., six .3-in., one .4-in., one .5-in., one .6-in., two .7-in. and one 1-in. long.

Be very careful removing 555s from the tester to avoid bending their pins. Use an IC removal tool if you have one. If you don't a small screwdriver used as a lever in the deep depression in the center of the IC will let you ease it out safely.

Smoke Test. It won't burn up, if you've been careful. There aren't very many ways to do this circuit wrong. But just to be on the safe side, double check your wiring before you connect the battery.

Then, with no 555 in the circuit, connect the battery and turn the switch (if you've included it) *on*.

If you've wired everything correctly, both LEDs will light. The most likely cause of a LED not lighting, assuming your wiring is correct, is that it has been plugged into the board backwards.

Now go ahead and plug in a 555. Choose one you know is good. The LEDs should start flashing. Play with the value of C2 to alter the rate.

Using the Tester. Since the solderless breadboard is its own chassis, you're ready to go.

I have yet to find a surplus 555 that isn't in a DIP package, but even those 555s that come in transistor-style TO-5 or TO-99 cases usually follow the same lead arrangement. So identify pin 1, plug your 555 in and turn it on.

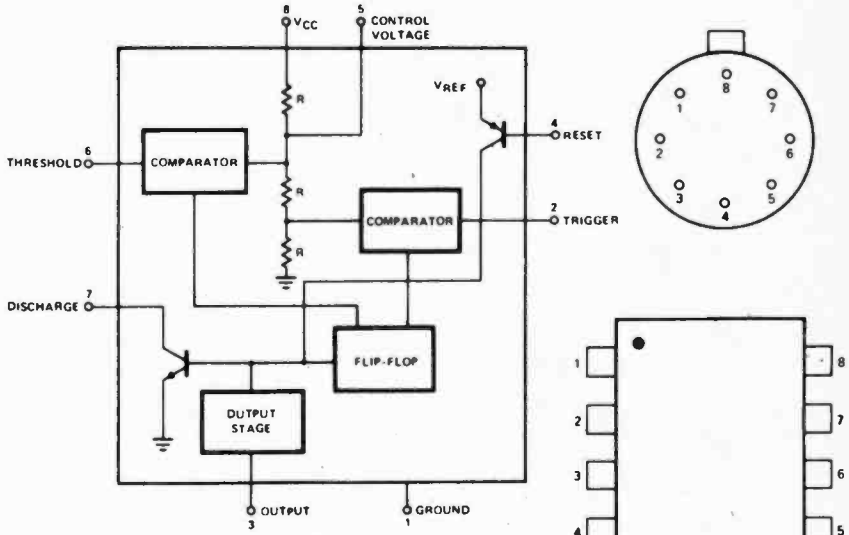
If both LEDs come on, your 555 is open. If only one comes on, or if neither comes on, your 555 is either open or shorted. If there are no visible solder bridges between pins and no pins are missing, the open or short must be internal. Perhaps you could use a 555 that tests bad as an ornament; you sure can't use it for electronics.

A good 555 will always flash both LEDs. It's that simple.

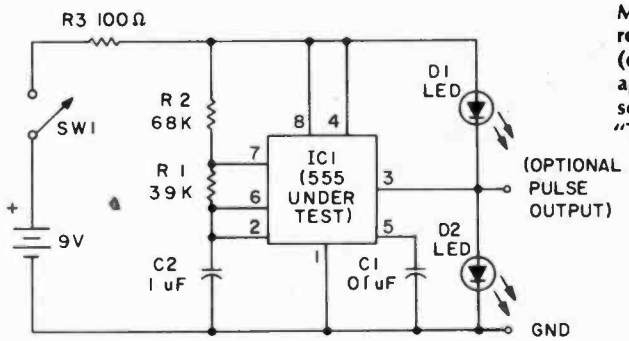
Your handy tester even provides a bonus. With a good 555 in place, you can use the pin 3 output as a clock pulse to drive TTL circuitry. You can use the pulse directly, but a small resistor or capacitor will help keep things safe. Remember to use pin 1 for *ground*.

By the way, it probably took you longer just to read this article than it will take you to build your tester. ■

INSIDE THE 555



Block diagram shows major components of timer.



Most 555s come in rectangular mini-DIP (dual in-line package), but they're also found in round "TO-" package.

PARTS LIST FOR 555 TESTER

C1—.01-uF capacitor

C2—1-uF, 16-volts or better electrolytic capacitor

D1, D2—LED red indicators

R1—100-ohm, ½-watt resistor

R2—68,000-ohm, ½-watt resistor

R3—39,000-ohm, ½-watt resistor

S1—SPST subminiature switch (optional—see text) (Radio Shack 275-324 or equiv.)

Misc.—Jumper wire, #22 solid. insulated, various colors (Radio Shack, 278-1306 or equiv.) Solderless breadboard and header strip—AP Products 217L terminal strip. Available at dealers, or order AP 923273, $4.75; Headers are 929834-01, $.87 for, a strip of 36. Add $1.00 for postage and handling on mail orders to AP Products Inc., Box 110-EE, 72 Corwin Drive, Painesville, OH 44077.

DARKROOM PRINTING METER.

Print-paper saver gives you fine B&W prints sooner!

by Herb Friedman

TRY TO grind out wallet-size prints or enlargements from a full 36-exposure roll in only one evening and you'll know just how frustrating life can be. Every change in magnification and negative density means a different exposure. And if you use test strips or exposure guides to hit the correct exposure you're making at least two prints for every one you need.

The way to take all this drudgery out of your darkroom work is to use an electronic printing meter, a device that takes only seconds to indicate the correct exposure, regardless of whether the enlarger is at the top or bottom of the rack, or whether the exposure and negative development is over or under.

A quick example will illustrate how easy it is to make prints with a printing meter. Let's assume you have just chocked the negative in the enlarger and have cropped the picture exactly the way you want it. Now you take the probe from a printing meter—which you have previously calibrated for a 10 or 20-second exposure—place it on the easel at the point of maximum light transmission through the negative (the black reference in the print—deepest shadow) and adjust the lens diaphragm until the printing meter's pointer indicates some reference value you have previously selected.

That's the whole bit. Expose the paper for your normal 10 or 20-second exposure and the first print will be a good print. Maybe even a great print. If you're grinding out wallet-size jobs for the whole family, each print from each frame will have the same excellent quality.

A Hint. The key to successful use of a printing meter lies in the fact that, except for some particularly artistic work, any print will look decent to excellent if there is some deep black, even if it's just a spot of black; for the black to highlight or border-white contrast gives the visual appearance of a full contrast range, even if the greys are merged. For those who do portraiture, a printing meter can be user-calibrated for "flesh tones."

The printing meter shown in the photographs has been especially designed for construction and use by the typical e/e photographer/electronics hobbyist. It features a calibration—called "speed"—adjustment to accommodate slow to fast enlarging papers (such as Polycontrast and Kodabromide) and readily available parts, many of which will be found in the typical experimenter's junk box. The layout is non-critical—any cabinet can be substituted; there are no critical shielded circuits (not even shielded wire is used); and except for the photoresistor sensor, just about any component quality will do. There is absolutely no sense in building the project with the best components money can buy because the best components won't affect the final performance one iota.

Construction. The unit shown is assembled in a 5¼ x 3 x 5⅞-in. metal utility cabinet. Connecting jack J1 is optional as the photoresistor sensor, PR1, can be hard-wired into the circuit. If you use a jack, note that it must be the three-terminal type such as is used for stereo connections; the ground connection is not used since neither PR1 lead is grounded. Do not use an ordinary phone or phono jack as they will ground one of the PR1 leads. Plug P1 must similarly be a matching three-terminal stereo type. Either miniature or full-size jacks and plugs can be used.

Power switch S1 can be anything you care to use—lever, slide, or toggle. Use the least expensive slide switch if you're trying to keep the cost down.

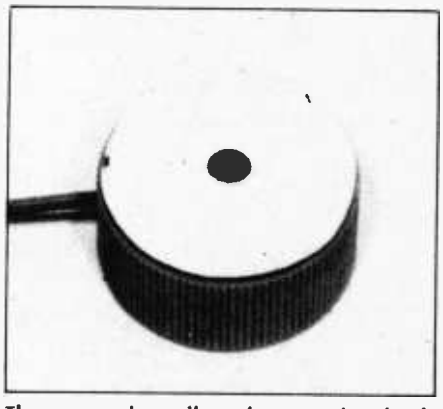
The meter, M1, is a Lafayette Radio 99-26262 illuminated 0-1 mA S-meter. This meter was selected because it has built in pilot lamps with 6 and 12-volt connections. When 12-volt-connected to T1, which is 6 volts, the pilot lamps are dim enough not to affect the sensor and bright enough so that you can see the pointer in the darkroom. Meter M1 mounts in a 1½-in. hole, which can be cut with a standard chassis punch (if you have the punch).

Sort Them. The meter scales are jammed with numerals that can be confusing in the darkroom so the best bet is to paint out the unwanted "calibrations" using Liquid Paper or Liquid KO-REC-TYPE, products used to correct typewriter errors (available in stationery stores). First, snap the plastic cover off the meter. It might feel secure but it's not. Grasp the top of the cover and force the cover outward and down, taking care that when it snaps free the pointer isn't damaged. Next, remove the scale by taking out the two small screws and sliding the scale out from under the pointer. Do not attempt to paint the scale while it is mounted in the meter as a single drop of the fast-setting correction fluid can ruin the meter if it gets into the pivot bearing. When reinstalling the scale, hold the screws with a tweezer or long-nose pliers until you "catch" the first few threads. When the scale is secure, snap the meter's cover into position. (On the unit shown all scales and markings other than 0-to-1 have been painted out, as the 0-to-1 scale is the most convenient to see under dim lighting.)

Note that meter M1, power switch S1, and jack J1 have been positioned on the front panel so as to provide the maximum room for the speed control's calibrated knob. Use the largest possible knob as the greater the calibrations the easier it is to reset the control to a desired paper speed.

Power transformer T1 can be any 6.3-volt filament transformer rated 50 mA or higher. (A 6-volt transformer scrounged from a portable cassette recorder will work just fine.)

Power Filter. If the line voltage in your home is known to be reasonably constant, assemble the unit as shown in the schematic. If your local utility likes to bounce the line voltage, or if appliances cause your line voltage to vary (indicated by dimming lights), install zener diode D5 across points A and B.

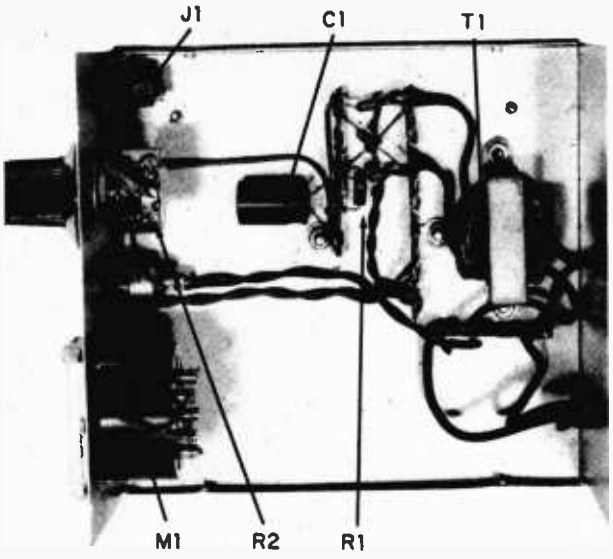


The sensor is really a large tuning knob with photoresistor PR1 embedded in epoxy, plastic or RTV rubber adhesive.

The zener will provide a regulated 6 volts, with the slightly lower circuit voltage (6 VDC rather than 9 VDC) providing slightly reduced sensitivity. Normally, you will not need D5, so there's no need to get it unless you're certain you need it.

In order to get speed control R2 to increase sensitivity in the expected clockwise direction, its ground terminal is opposite to the usual volume control ground. Facing R1's shaft with its terminals sticking up, the ground terminal is the one on the left.

Meter M1 has five terminals. The one designated "+" and the one adjacent to it are the meter terminals. The three terminals above the meter terminals are the pilot lamps. The extreme end pilot lamp terminals are the 12-volt connections. The center terminal is not used for the 12-volt connection.



Nothing is critical so don't crowd the layout. Two parallel terminal strips provide the tie points for the rectifier diodes and power supply

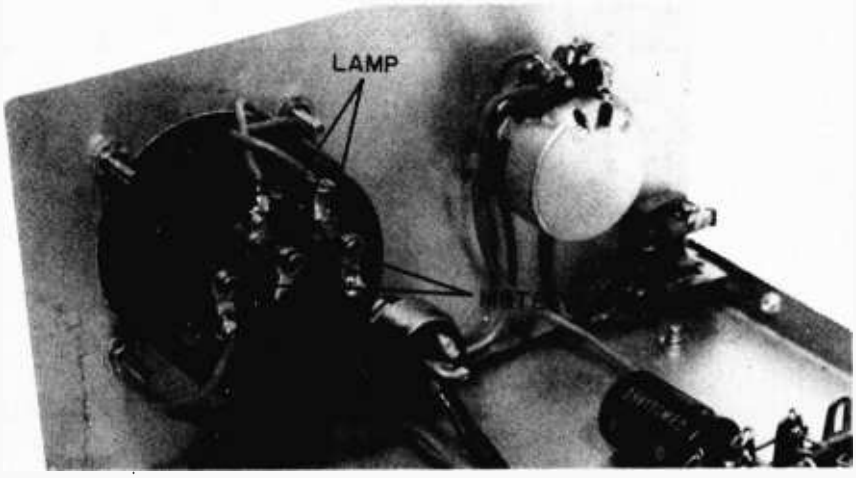
DARKROOM ECONOMY PROJECT

The Eye. The only assembly that requires some care is the sensor. The sensor itself is a photoresistor; however, the photoresistor doesn't have enough heft to maintain its position on the easel, so it must be mounted in a support that can maintain its position without falling over. The sensor assembly shown consists of PR1 epoxy-cemented into a relatively large knob. The knob must be plastic—not metal, though it can have a metal decorative rim—and it's best if there is a recess on the top even if the recess is produced by a rim. Remove the set screw and drill out the set screw hole with a bit approximately 3/16-in. (not critical). Then, using a ⅜-in. bit, drill through the shaft hole clear through the top of the knob. If the shaft hole has a brass (or other metal) bushing make certain the drill bit removes all the metal.

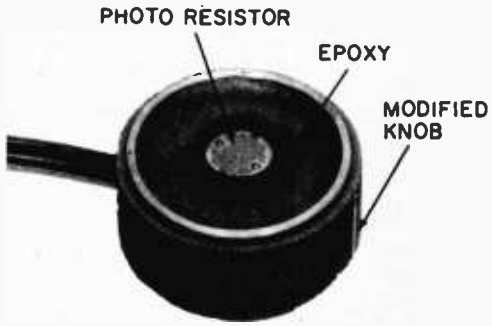
Pass the PR1 leads through the hole in the knob from the top. Tape it in position. Feed a section of linecord or speaker wire through the setscrew hole and solder the wires to PR1 as close as possible to the knob. Trim away the excess PR1 leads; they should not protrude below the knob. Remove the tape holding PR1, get PR1 as close to the center of the knob as possible, and then pour in a quantity of fast-setting epoxy or liquid plastic from a knob repair kit or plastic modeling kit, and let it set a few minutes until the plastic hardens. Keep the level of the epoxy or plastic below the top of PR1—use less rather than more. If you can't get epoxy or plastic you can use G.E.'s silicon RTV rubber (adhesive, caulk, window sealer, etc.); but the RTV rubber must cure for at least 24 hours. Similarly, pack the bottom of the knob with epoxy, plastic or rubber.

Mask Down. Now, the surface area of the photoresistor is too large for small prints—4 x 5 or smaller—and even some 8 x 10s. So cut a disc the diameter of the knob from shirt cardboard or a manila file folder (but not oak-tag) and using a standard hand punch (such as used in schools) punch a hole in the center of the disc. Apply rubber cement to the rim of the knob and the inside rim of the disc. When the cement is dry drop the disc on the knob so the hole exposes a small part of the photoresistor's surface. It's not all that critical; the hole doesn't have to be precisely over the center of the photoresistor. However, the unit is calibrated for a punch-size hole and might not work properly if the disc is not used, or if the hole is a hand made "pinhole." Use the punch.

Using the Meter. The first step is to select a decent reference negative and make a good print using a 10, 15, or 20-second exposure. We suggest 20 seconds as it will become your standard exposure, and will be



The specified meter has five terminals. The two on the bottom row are for the meter movement. The top row terminals are for the 12-volt lamp connection. The remaining terminal is for a 6-volt lamp connection and is not used.



After the sensor is completed, punch a hole in a matching cardboard disc and cement the disc over the sensor. The hole provides a smaller sensitive area required for prints 4 x 5 or smaller. Better results with larger prints are also obtained with the mask.

sufficiently long to allow moderate dodging. When you are certain you have a print exactly the way you want it, and without disturbing the enlarger's controls, place the printing meter's sensor under the *brightest* light falling on the easel—it produces black (maximum shadow) on the final print. Now turn on the printing meter and allow about five seconds for warm up. Adjust speed control R2 so the meter pointer indicates any meter reading you want to use as a reference. It doesn't matter what the reading is as long as you always use the same reference for the standard exposure time. For example, 0.2 on the meter scale is a good choice because it is well illuminated by the meter lamps. But you might just as easily select mid-scale as the reference meter reading. It doesn't make any difference; just be consistent.

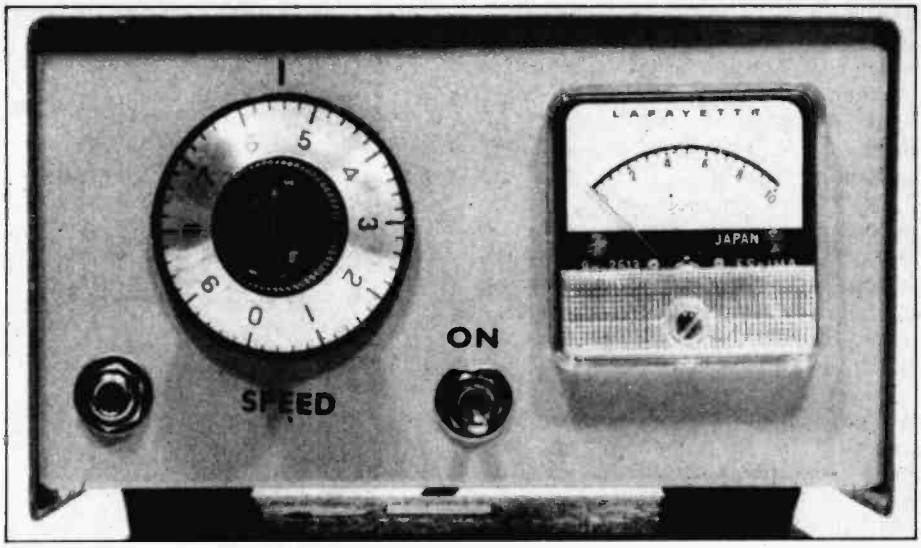
Once you have adjusted the speed control for the reference meter reading note on a piece of paper or in a notebook the dial reading from the speed control's calibrated knob. This is the reference speed value for the particular printing paper. For example, let's say you made the test print on Polycontrast using the #2 filter, and the speed knob indicates 5.6. Next time you want to print using Polycontrast with a #2 filter you simply set the speed knob to 5.6, put the sensor under the darkest shadow area and adjust the lens diaphragm for a reference meter reading. Everything will be set for your standard exposure time.

Changing Filters. Kodak provides a speed rating for all their papers and you can easily work out the correct (or close) speed control settings without making a "perfect" test print for each type and grade of paper. For example, changing from a #2 to #4 filter usualy means increasing the exposure by a 3.5X factor. If your #2 exposure is 10 seconds, the #4 exposure will be 35 seconds—somewhat long. You can, however, open up the lens diaphragm for a 3.5X light increase (close enough value) and adjust the speed control for the reference meter reading. The new speed control setting is the speed value for the #4 filter. You can do this with variable contrast filters or numbered printing paper.

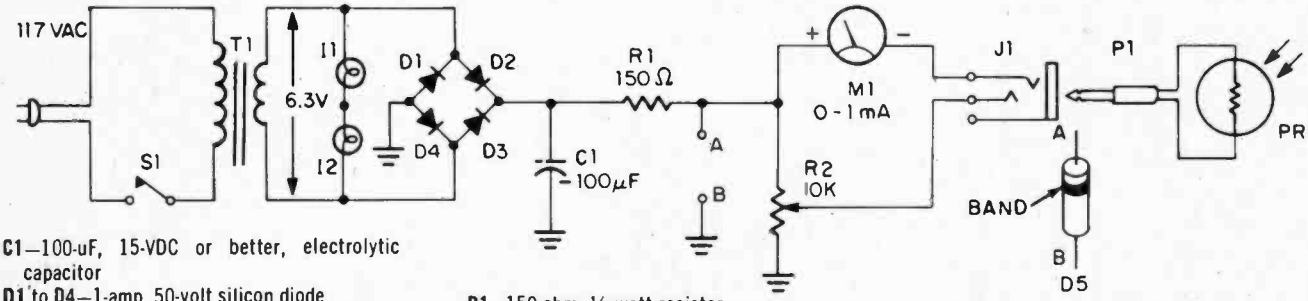
While the most pleasing print usually has some black, there are times when there can be no black, such as snow scenes, portraits, etc. You can peg the speed control's calibration to a grey corresponding to a skin tone, or any other degree of grey you might desire. The only thing you cannot do is calibrate the meter for highlights, since the meter might not have enough sensitivity for slow papers, and highlights can completely fool the meter.

If desired, you can take a speed control calibration reading for each type of paper (using your standard negative) for both shadow detail and intermediate grey. This way, you can quickly set up for typical snapshots, scenics, or portraits.

Keep In Mind. The sensor has a slight light memory, so we suggest the sensor be turned face down when not being used and the power switch be turned on and off in the dark, though you can keep the darkroom illuminated by a safelight with the power switch on. Meter readings, however, must be taken with all room lights off; only the enlarger should be on and the print meter should be positioned so that its meter lamps do not illuminate the sensor (even slightly). ■



Use the largest calibrated knob you can install without interference by other panel components. The greater the calibration area on the knob the easier it is to preset the paper speed with accuracy.



C1—100-uF, 15-VDC or better, electrolytic capacitor
D1 to **D4**—1-amp, 50-volt silicon diode
D5—6-volt, 1-watt zener diode (optional, see text) (Radio Shack 276-561 or equiv.)
I1, I2—meter lamps, part of M1 (see text)
J1—3-circuit jack and plug set (optional, see text)
M1—0-1 mA movement, illuminated S-meter (see text)
PR1—photoresistor (National 4941 or equiv.)
R1—150-ohm, ½-watt resistor
R2—10,000-ohm audio taper potentiometer
S1—spst switch
T1—transformer: 117 volt primary, 6.3 volt at 50 mA or better secondary
Misc.—large knob for mounting photoresistor, case 5¼ x 3 x 5⅞-in., 5-lug terminal strips for mounting components, wire, etc.

The National 4941 photoresistor is available from Electronics Hobby Shop, Box 192, Brooklyn, NY 11235 for $3.85. New York State residents add sales tax. US orders add $1.25 for postage and handling; Canadian orders add $3.00. No foreign orders, please. Postal money order speeds delivery; otherwise allow 6-8 weeks for delivery.

CB NEW PRODUCTS

Electronics Hobbyist looks over some of the newest transceivers, antennas and accessories for you to use in CB contacts this year!

New Carry Bag for CB

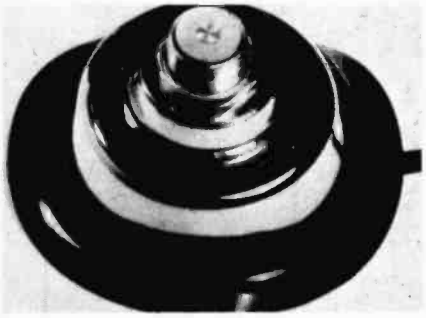
CB Sacks of Alexandria, Virginia, has introduced a new carrying case for citizens band radios to facilitate the CBers taking their rigs with them when they leave their vehicles . . . to avoid radio rip-offs. The new case, called the CB Sack, features a dual layer, heavy vinyl exterior and fully padded, shock resistant interior. Rigid top supports prevent

CIRCLE 57 ON READER SERVICE COUPON

gapping while the CB radio is being carried. The case also features an extra-long waterproof zipper, and a separate inside microphone compartment. CB Sack fits almost all CB units, and is manufactured to military specifications. Its non-stretch web strap adjusts for hand or shoulder carrying. The entire unit is a rich dark blue. CB Sacks are available for $10.95 (postpaid) from CB Sacks, 8807 Linton Lane, Alexandria, VA 22308.

Waterproof CB Antenna Mount

The Antenna Specialists Co. has announced an exclusive new waterproof antenna mount that will soon be incorporated into many of



CIRCLE 55 ON READER SERVICE COUPON

the Company's mobile CB antennas. It allows the CB user to eliminate potential short out or rust problems encountered at car washes by making it easy for him to remove the coil and whip assembly without damage or coil detuning difficulties. The new mount also makes it possible for the CBer to remove his antenna for protection from vandals and thieves. The dramatic product innovation makes use of a rugged spring pin and a sealed contact assembly which prevents the entry of water and other unwanted substances. For further information, contact The Antenna Specialists Co., 12435 Euclid Avenue, Cleveland, OH 44106.

Shakespeare Has Two

The Shakespeare GBS/3 AC Power Converter is all you need to turn your mobile CB unit into a base station transceiver. Compact and easily installed, the GBS/3 is designed to convert conventional 110-115 volts AC to 11-15 volts DC. The same operating voltage found in most automobiles. Now you can enjoy CB communications in your home without the added cost of a base station transceiver. Sells for $19.95. The Shakespeare GBS/5 extension speaker makes a dramatic difference in your CB reception. Voices come through clean and clear. Easy to understand. Natural, not garbled. You get outstanding clarity across the entire voice range, with less static and interference. Mounted in a

CIRCLE 53 ON READER SERVICE COUPON

rugged cabinet, the GBS/5 comes complete with positioning brackets and 10-ft. of cable. Ideal for four wheelers, 18-wheelers and vans. Perfect for boats, campers or any vehicle where normal reception is less than optimum. The GBS/5 sells for $14.50. For more information, write to Shakespeare Company, Electronics Group, 2805 Millwood Avenue, Columbia, SC 29250.

CB Headset

Telex's new lightweight CB headset, Model CB-88, features a noise-cancelling power microphone that delivers clear, crisp voice transmission even in a moving vehicle where wind, traffic, and engine noise normally interfere with sound quality. The mike has a variable-gain amplifier and is mounted on a pivoting boom so that it can be positioned close to the lips and moved aside when not in use. A push-to-talk switch has a clip for convenient attachment to shirt or blouse. The headset, weighing less than three ounces, closely follows the design of pilots' headsets, of which Telex is a leading manufacturer. Incoming signals are carried direct-

CIRCLE 51 ON READER SERVICE COUPON

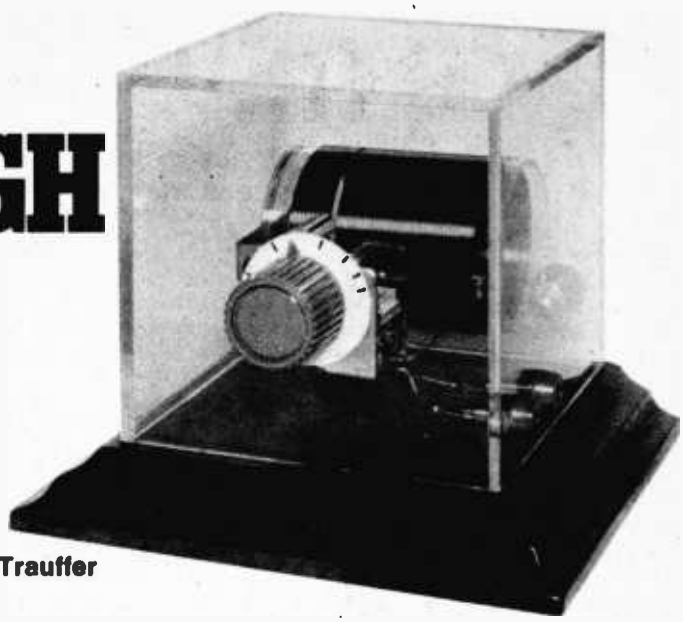
ly to the ear by means of a soft eartip, allowing even weak signals to come in clearly. The unit can be used with either the left or right ear, and—if desired—can be worn without the headband. An adapter is furnished which allows the ear-piece to be clipped to the user's eyeglasses. This also allows the CBer to monitor the radio in private without disturbing passengers. Price is below $70. Detailed information may be obtained by writing Telex Communications, Inc., 9600 Aldrich Avenue So., Minneapolis, MN 55420.

The Long Gainer

Anixter-Mark introduces The Long Gainer—a new tunable CB base loaded stainless steel antenna that can be easily adjusted to cover all channels across the band. Just a simple turn of the frequency adjustment screw brings in the desired channel clearly on any one of the 40 available. The smart-looking Long Gainer has a long lasting stainless steel whip and deluxe mount with coaxial cable designed for easy snap-on installation. No drilling is required, because it mounts easily to the trunk lip. A genuine PL-259 coaxial connector that insures long life is also included. Maximum height is 60-in. Sells for $31.75. For more information, write to Anixter Bros., Inc., 4711 Golf Rd., One Concourse Plaza, Skokie, IL 60076.

CIRCLE 49 READER SERVICE COUPON

Build the SEE-THROUGH CRYSTAL RADIO RECEIVER



by Art Trauffer

☐ Have you ever wanted to recreate those old days of listening to AM radio on a crystal set and headphones? No tubes, no batteries, no hum, no nothing but pure clean sound drifting out of the ether into your headset? If you have the yen to get a crystal set which has the advantage of using a crystal diode instead of the old unreliable cats-whisker and galena crystal, this radio is the one for you to build. In addition to being about as good a power-supplyless AM receiver as you can make, it's also a pleasure to look at.

It closely resembles the beautiful glass-enclosed radio receivers that were custom-built by manufacturers for display in radio exhibitions in the 1920's. Manufacturers of radio receiver kits mounted and wired their kits in glass cabinets so the visitors could see the "works" from all angles instead of lifting the lid to look inside. Those glass cabinet radios are now rare collectors items.

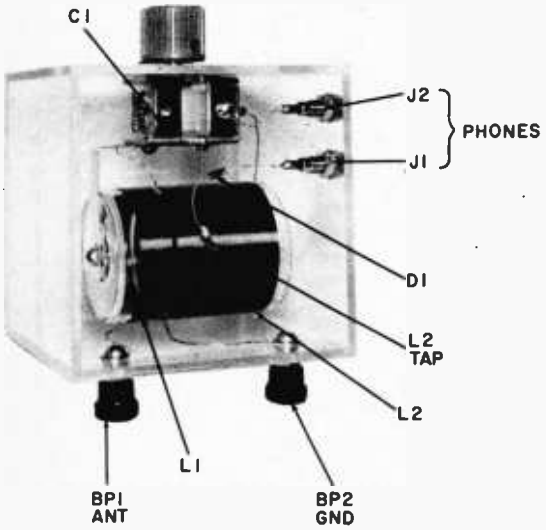
This crystal radio also saves you the work and expense of making a wood cabinet, and it is low-loss for radio frequencies because the cabinet and coil form are made of styrene plastic which is a good dielectric material. The cabinet is simply a clear plastic 4-in. square photo display cube, and the coil form is a clear plastic pill container about 2-in. in diameter.

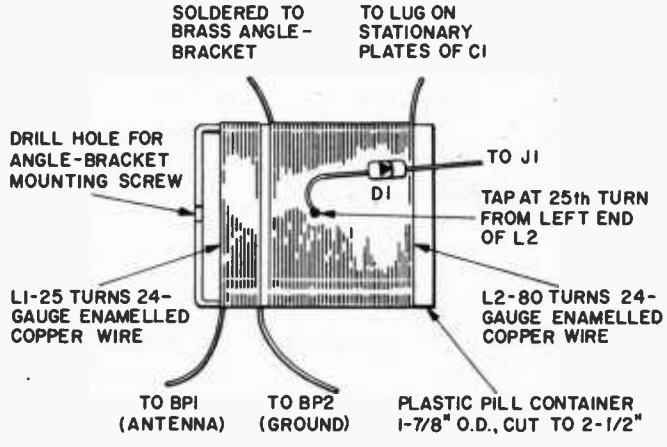
Circuit Description. The simple schematic diagram shows a time-tested hookup which is still widely used, but it's improved here by connecting one side of the crystal diode to a tap on the secondary, L2. This greatly increases the receiver's selectivity and helps you separate the powerful local stations.

Making the Coil. To make coils L1 and L2 the four ends of the coils are anchored in small holes drilled through the wall of the plastic container and spotted with Duco cement. You can also make small holes by pushing a hot sewing needle through the plastic. To make the tap on the coil, simply twist a small loop in the coil and spot it with Duco cement. Scrape the enamel insulation off the loop, and solder to it.

Build Your Own or Ours. The plastic cube makes a very attractive enclosure, as you can see in the photographs. However, the parts layout isn't at all critical, and you can breadboard this radio any way you want, so long as it's wired correctly. If you want to have a beautiful-looking radio you can show off you'll follow the model I made which is shown in the photographs.

Mounting The Parts. The photograph shows how the parts mount inside the plastic box. The coil form is mounted to the rear of variable capacitor C1 by means of a brass angle-bracket. Use lockwashers wherever needed to hold the screws, binding posts, and phone tip jacks securely to the plastic material.



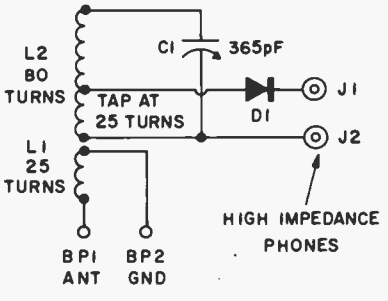


Apart from getting hold of the parts, construction of the See-Through Crystal Set should take you less than two hours in all. You can use any kind of box you want, but the lucite box shown will make it into a real showpiece.

When assembling and wiring this receiver be careful not to scratch the plastic, and keep the soldering iron well away from the plastic. If you use rosin core solder, protect the plastic by covering it with pieces of paper taped in place to keep the rosin from splattering on the plastic.

The completed crystal radio is mounted on a fancy walnut base purchased from a woodworking shop. The plastic box is secured to the wood base by spotting the four corners of the bottom of the box with Duco cement. The dial for the pointer knob is simply a small disc of white double-weight paper held to the plastic box with a spot of Duco cement. Make pencil marks at the places where your local stations come in.

Use of a pair of sensitive high-impedance magnetic or crystal earphones, a good connection to a cold water pipe, and a long outdoor antenna (for best results, put up a long single-wire, random-length antenna.) With a simple crystal set it becomes particularly important that the antenna-ground system be the best possible. Remember, unlike its bigger cousin, the superheterodyne, the crystal set does not have rf amplifiers and other circuitry to help it pull in all those signals floating around out there in the ether. ■



PARTS LIST FOR CRYSTAL RADIO

BP1, 2—Binding posts for antenna and ground connections; may be any convenient type
C1—365-pF variable tuning capacitor, single-gang.
D1—Small-signal, general purpose diode, similar to 1N34.
J1, 2—Jacks for headphones (dependent on phone(s) selected.

Misc.—Headphone(s), high impedance. May be crystal or magnetic, or small earphone as supplied with transistor radios and portable tape machines; plastic photo display cube, approx. 4-in. each dimension; plastic pill container, 1 7/8-in. diameter, for use as coil form; 1/4-lb. 24-gauge enamelled copper magnet wire (Radio Shack 278-004 or equiv.); brass mounting strip, assorted screws, nuts and lockwashers.

Talk Power Booster

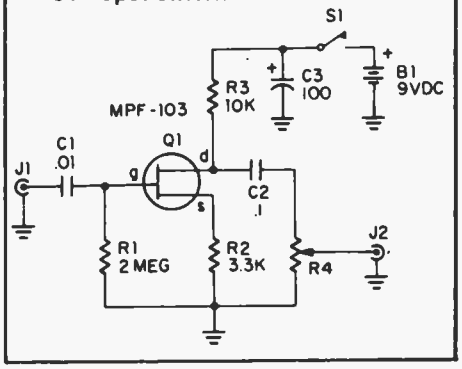
☐ If your CB or Ham rig is a little shy on talk power, this 10 dB talk power booster will give your signal that extra edge through the QRM. The input impedance is high enough to handle anything from a low impedance dynamic mike to a crystal or ceramic model. You can run the booster into just about any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

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

Jacks J1 and J2 match your existing microphone and transmitter connectors. Battery B1 can be the type used for small transistor radios as the current drain is but a few milliamperes. Capacitor C3 must be used regardless of what you use for a power supply. A metal cabinet is suggested to keep hum and RF out of the microphone system. ■

PARTS LIST FOR TALK POWER BOOSTER

B1—9-volt battery (Type 2U6 or equiv.)
C1—0.01-uF capacitor
C2—0.1-uF Mylar capacitor
C3—100-uF, 10 VDC capacitor
J1, J2—Jacks to match existing microphone equipment
Q1—FET, Motorola, MFP-103 (Radio Shack 276-2028)
R1—2-megohms, ½-watt resistor
R2—3300-ohms, ½-watt resistor
R3—10,000-ohms, ½-watt resistor
R4—50k or 100k audio-taper potentiometer.
S1—Spst switch



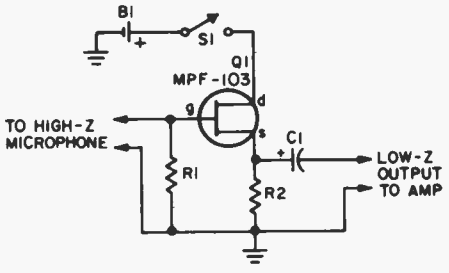
Hi-to-Lo Z Mike Amp

☐ 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. ■

PARTS LIST FOR HI-TO-LO Z MIKE AMP

B1—1.5-volt AA battery
C1—10-uF, 12 VDC electrolytic capacitor
Q1—Field effect transistor, Motorola MPF-103 (Radio Shack 276-2028)
R1—2-megohm, ½-watt resistor
R2—150-ohm, ½-watt resistor
S1—Spst switch



This Piggyback SWL

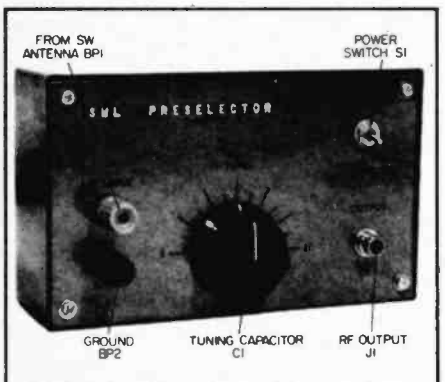
Add 20 dB of valuable signal-grabbing power

by Herb Friedman W2ZLF

BACK BEFORE EVERYTHING came in transistorized subminiature packages, virtually all serious SWLs and radio amateurs used a preselector ahead of the main receiver. No, not a *preamplifier*, we said a *preselector*. A preamplifier simply provides amplification, usually over a broad range of frequencies. With early single-conversion receivers, and the new solid-state high performance, budget-priced, single-conversion receivers, a preamplifier amplifies the image signal interference along with the desired signal. But a preselector, that's a whole 'nother thing. A preselector is a tuneable, high-Q preamplifier that passes only the desired signal frequency, and usually provides considerable attenuation at the image frequency.

Unfortunately, preselectors have so much gain and sensitivity they had to be built like the Rock of Gibraltar in a cabinet almost as large as the rock itself in order to avoid self-oscillation. Many preselectors were as large as the boat anchors we used to call receivers, so like those old tube-type boat anchors, the preselector went the way of the Dodo.

But a preselector can still give a receiver a good solid kick in the antenna terminals, often digging out signals where you thought none existed. And the preselector can still reduce image interference in those inexpensive solid-state receivers that have terrific sensitivity and great stability, but poor image rejection because they're only single-conversion. What's that? You've got no room for a big boat anchor? Who mentioned anything about size? Using up-to-date technology and components, the same as you've got in that new receiver, you can build a rock-stable preselector that's got more selectivity than those old monsters, will work off an ordinary transistor radio 9-volt battery (or a lightweight line-powered supply) and will provide enough extra front-end selectivity to practically *squash* image interference in single-conversion receivers. Best of all, you can make the whole thing so small it can be glued right to the back of a sub-miniature tuning capacitor—hence the name—"Piggyback Preselector." The unit shown in the schematic and photographs provides from two to three S-units extra sensitivity (about 12 to 20 dB extra gain), depending on the particular receiver it's used with.

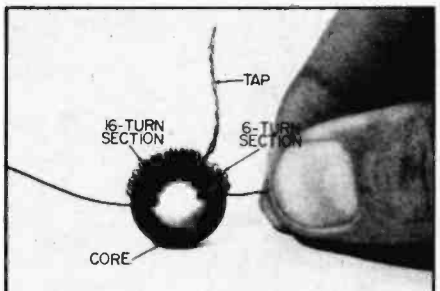


Plastic cabinet may be used but the front panel should be aluminum or other metal. Input (BP1) and output (J1) connections must be kept apart.

The Design. Input coil L1 is home-brewed on a toroid form. Since toroids have exceptionally high Q the input tuning is razor sharp—sharp enough to attenuate the image frequencies. In fact, if this unit is tuned to 10 MHz while the receiver is tuned to 20 MHz virtually no signal will pass through the preselector into the receiver. On the other hand, when the preselector is tuned to the desired frequency it can really snatch signals up out of the noise level.

Don't worry about static signals blowing Field Effect Transistor Q1 because it's a special type with built-in protection diodes from the gates to the source and drain. In normal operation the diodes are inactive, and Q1's input impedance is extremely high and does not load down L1. Transistor Q2 acts as a matching device and power amplifier, providing a low impedance output for the input of the associated receiver.

Both L1's input impedance and the preselector's output impedance have been adjusted so the unit delivers good performance with every combination of antenna and receiver. While it might be



A toroid coil is the easiest home-brew because neatness doesn't count. If the turns aren't spaced just so, or the turns unwind a bit as you make the coil, it won't make any difference. Just spread the turns so they take up about one-half of the form. Don't spread turns to take up entire form.

Preselector Will Make You a Pro in One Evening

possible to get slightly improved overall performance by specific tailoring of the input and output for a given antenna type and receiver, we make no recommendations and suggest you build the model as described with no changes or substitutions. Only if you cannot obtain the specified Q1 should you try a substitute, and a 40673 is suggested. The 40673, however, might require some experimentation with the values of R1 and R2. The correct values provide approximately 5 mA to Q1 and 1 mA to Q2. Bear in mind, however, that we suggest the unit be assembled exactly as described.

The unit shown covers the SWL frequencies from approximately 5 to 21 MHz, actually reaching the top of the 15-meter amateur band. To get optimum coverage of the 15-meter band one turn can be removed from L1 (we'll explain this later). This modification will provide a greater 15 meter adjustment range for tuning capacitor C1.

C1 is a sub-miniature tuning capacitor with a *long shaft* and a plastic dust cover over the stator and rotor plates. (It is available from Radio Shack as No. 272-1341. Do not substitute a similar capacitor that has a calibrated tuning knob and lacks the dust cover. The shaft on the specified capacitor also provides the panel mounting while the dust cover is the support for the rest of the project.)

Construction. We built the entire preselector, except the transistor radio battery which supplies the power, on a special type of perf board which has circles on the back of each hole to facilitate soldering and securing the components in place. We recommend, however, that you make a printed circuit board from the layout shown, unless you are somewhat experienced in point-to-point wiring. The location of the components on the circuit board is shown in another drawing.

You'll have no special assembly problems as long as you follow the parts layout shown in the photographs. The unit will be completely stable and free of birdies and dead spots as long as the input is at one end of the board and the output is at the other end. But if you re-arrange the layout and get the input and output within an inch or so of each other it will almost certainly oscillate, and fail to work.

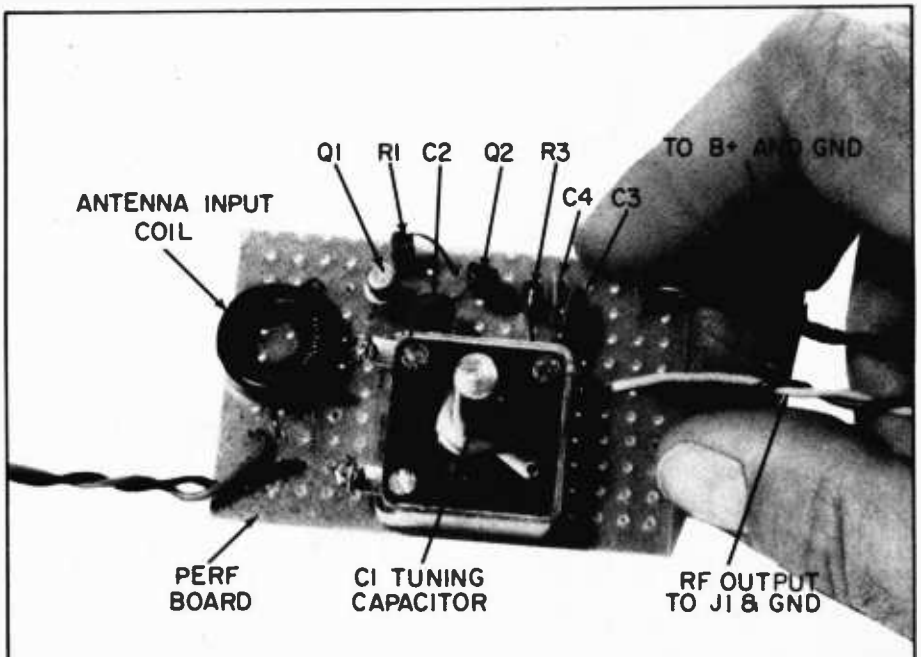
Mark off the approximate location of the tuning capacitor on the circuit board and then complete the board assembly, including the power, input and output wires. These can be about six inches long.

Toroid Assembly. L1 presents no winding problems as even sloppy assembly will work—that's the nice part about toroid coils. Use solid, enameled #24 copper wire to wind the coil. Clamp about three feet of wire in a vise and pull gently on the free end until the wire goes dead slack. By thus taking the spring out of the wire you make it so it won't unwind as you make the coil. Wind six turns, tightly, around the toroid core and bring the end out about two inches. Fold the wire back to the core, forming the ground tap, twist the wires a few times to secure them, and then wind sixteen additional turns *in the same direction as the first six.* Using a knife or razor, scrape the insulation from the wire ends and the tap. Then tin the wires and the tap with solder. Spread the turns so they are roughly equal-spaced, using about one-half the total core. Do not spread the turns to take up the entire core, as is usually suggested. This time, half way is best.

This coil will give frequency coverage with this tuning capacitor about 5 MHz to 21 MHz—just about to the top of the amateur 15 meter band. If you want to be able to tune through 15 meters with tuning capicitor C1, eliminate one turn of the coil's longer winding—make it 15 turns. Do not make any changes to the initial six turn winding. This is the antenna winding and remains the same.

Board Construction. Assemble the perf board circuit as shown—everything except C1. Using silicone rubber adhesive such as G.E.'s RTV, cement the circuit board to the back of C1. After the adhesive has set (overnight), connect C1 across L1's secondary. Make certain C1's rotor, which connects to the tuning shaft, is wired to L1's grounded tap. Use an ohmmeter to determine C1's ground (shaft) terminal if you can't tell by looking. But don't guess; if you guess wrong the tuning will change when you remove your hand from the tuning knob.

Okay, it's all wired. What will you do with the piggyback preamplifier? Since the total current drain is about



The completed preselector ready for installation in a cabinet. The circuit board cements to the back of the tuning capacitor. Note that L1 is flat against the board and all wiring to other parts is also installed on the board. Board may be perf-type shown, or, recommended for beginners, the printed circuit type described in text.

PIGGYBACK SWL PRESELECTOR

5 mA you can use an ordinary transistor radio battery for a power supply and shove the whole thing into a plastic utility cabinet as shown. Just as long as the front panel is aluminum (or other metal) a plastic cabinet can be used.

If you don't like using battery power you can use a slightly larger cabinet and assemble the power supply shown in the schematic. But remember, you only need a 5-mA capacity, so keep T1 small. If you end up using a standard filament transformer for T1 the cost might exceed several years' supply of batteries.

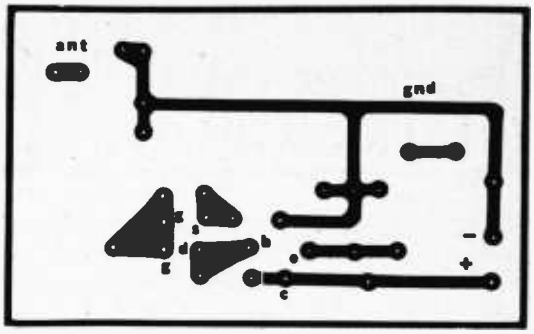
Final Connections. Use some kind of coaxial output connector for J1. Even a standard phono jack can be used. Use coaxial cable such as RG-58 or RG-59 between the preselector and receiver and keep it as short as possible.

If you have a *longwire* or *random* antenna use 5-way binding posts for the input (remember, the antenna post must be insulated from the panel). If you have a coaxial antenna system eliminate the ground binding post and substitute a coaxial connector for BP1. This connector can also be the phono type.

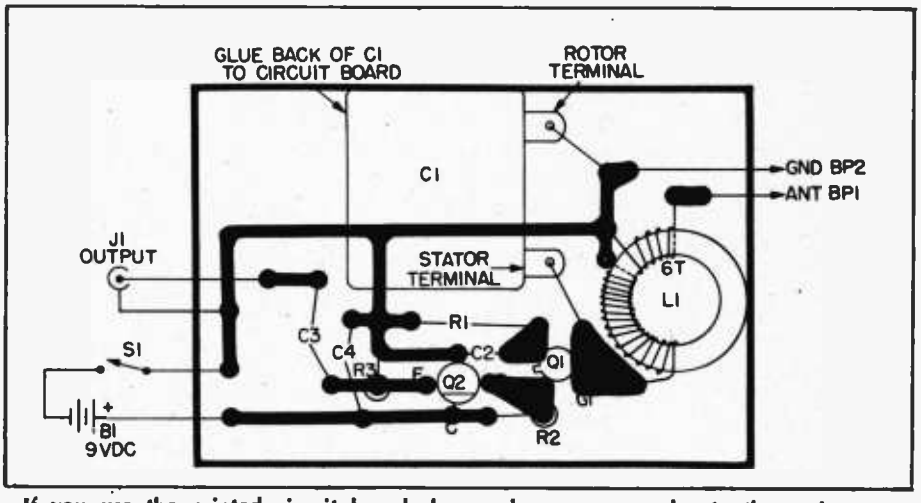
Calibrate! The tuning is so sharp the preselector must be tuned near the desired frequency or you might not hear anything at all in the receiver. Use whatever calibrations on the panel you find necessary to put the preselector tuning inside the ballpark.

After a signal is tuned in on the receiver, peak it with the preselector. If the receiver has an antenna trimmer or tuning control make certain you also peak the signal with the trimmer.

If some local signals come in strong enough to overload the unit, just detune it slightly to reduce its sensitivity and get rid of the overload. ■



Full-size layout for printed circuit board (foil side up) is shown here.



If you use the printed circuit board shown above you can locate the various components on the board by means of this drawing. Parts side is shown.

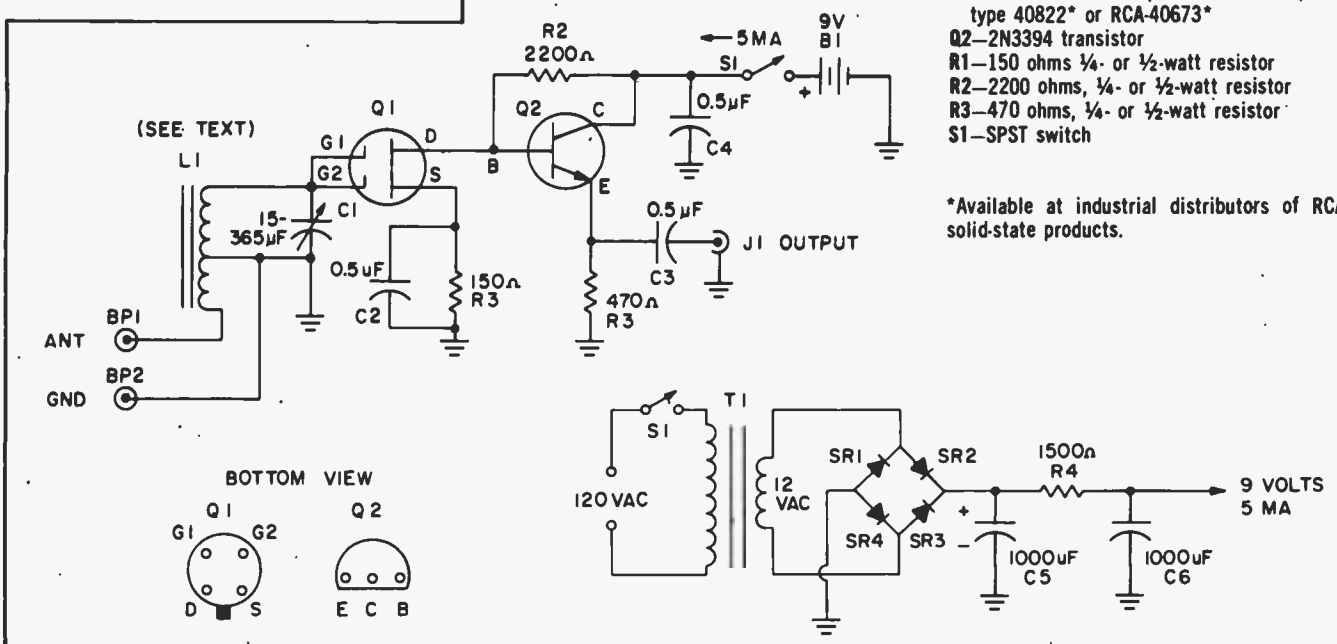
PARTS LIST FOR PRESELECTOR POWER SUPPLY

C5, C6—1000 uF 15 VDC capacitor
R4—1500 ohms, ½-watt resistor
SR1 through SR4—Silicon rectifier bridge, 50 PIV
T1—Power transformer 12-VAC secondary

PARTS LIST FOR SWL PRESELECTOR

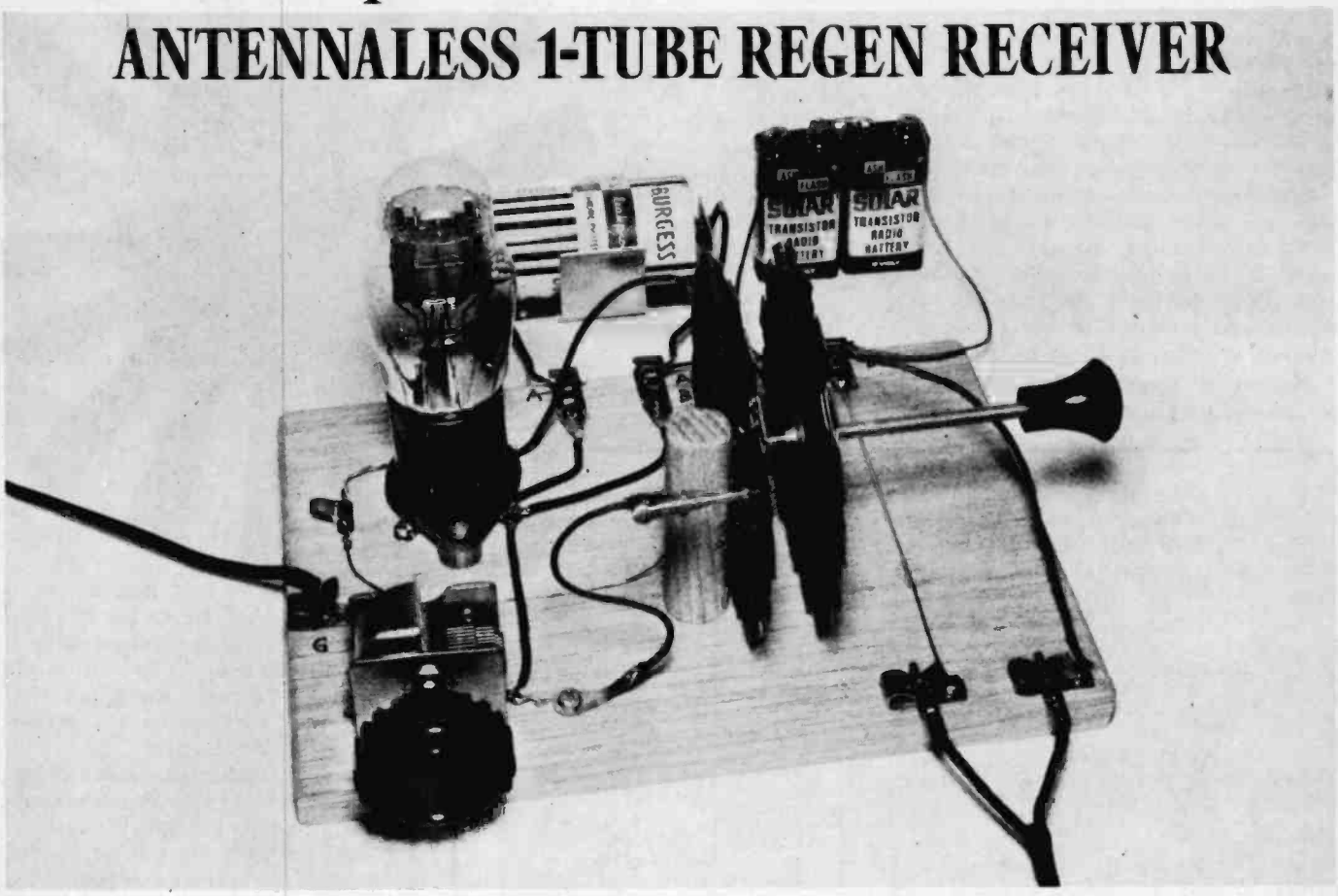
B1—9VDC transistor radio battery
BP1, BP2—5-way binding posts
C1—365 pF subminiature variable tuning capacitor
C2, 3, 4—0.01 or 0.5 μF ceramic disc capacitors, 100 VDC
J1—Phono input jack
L1—Amidon T68-2 toroid coil form, $1.75 postpaid from Amidon Associates, 12033 Otsego St., No. Hollywood, CA 91607.
Q1—FET with internal protective diodes, RCA type 40822* or RCA-40673*
Q2—2N3394 transistor
R1—150 ohms ¼- or ½-watt resistor
R2—2200 ohms, ¼- or ½-watt resistor
R3—470 ohms, ¼- or ½-watt resistor
S1—SPST switch

*Available at industrial distributors of RCA solid-state products.



Build an antique

ANTENNALESS 1-TUBE REGEN RECEIVER



This model-maker's delight actually works!

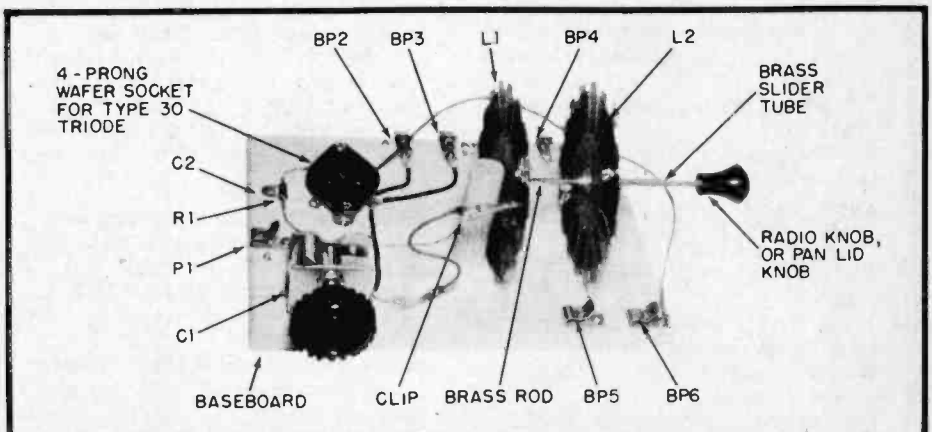
by Art Trauffer

A NUMBER of people would like to build a one-tube regenerative receiver, similar to the popular one-tubers of the early 1920s, but they hesitate, thinking that a long outdoor antenna is needed. So here's a novel receiver, resurrected from an item in Hugo Gernsback's RADIO NEWS magazine of the early 1920s, which requires no antenna and works well with only a connection to your water pipe! As a bonus, you will get less man-made and natural static!

This breadboarded regen receiver is beautiful in its simplicity, and you can probably find most of the parts in your "junk box." Coils L1 and L2 are the highly efficient "spiderweb" type of coils that were popular in the old days, and for capacitor C1 you could use the RF section of a gang capacitor salvaged from a junked AC-DC table radio. You can use any low-filament-voltage, low-filament-drain triode tube for V1. The writer used a type 30 in this project, since it has a filament drain of only .06 amps, making it easy on the "A" battery For a "B" battery, you need only two or three 9-volt transistor batteries connected in series.

Spiderweb Coils. The drawing of the coil form is an *actual size* pattern for making the two spiderweb coil orms. The writer used gray sheet fiber used for electrical insulation, but if you cannot obtain this use stiff cardboard and two coats of shellac.

Stationary coil L1 consists of 55 turns of #26 gauge enameled copper magnet wire, having three taps near the outside of the coil. In winding the spiderweb coils you start on the inside of the forms and wind to the outside. Punch two small holes in the form and anchor the end of the wire in these holes, allowing six inches of wire for connections later. Wind about 25 turns on the form; then twist a small loop in the wire for a tap;



All wired and ready to pull in those DX casts. Wiring is point-to-point, see schematic.

then wind 15 more turns and make another tap. The 55th turn (outside end of winding) will be tap number 3. Put a little Dupont Duco cement on the twist of each tap to make the taps rigid so you can scrape off the enamel on the taps for clip connections later on.

Spiderweb coil L2 is the feed-back coil, or "tickler coil" as it was sometimes called in the old days. L2 has about 50 turns of #26 wire, and no taps. Note that both coils should be wound and mounted so the turns of wire are in the same direction.

Putting It Together. Referring to photo of the regen radio, the hardwood baseboard (oak, walnut, maple, etc.) is 7½ in. by 5½ in. by ½ in. The supporting upright for the coil assembly is a 2½ in. length of ½ in., or ⅝ in. round or square wood dowel, screwfastened at the bottom using a 1 in. flathead wood screw and glue.

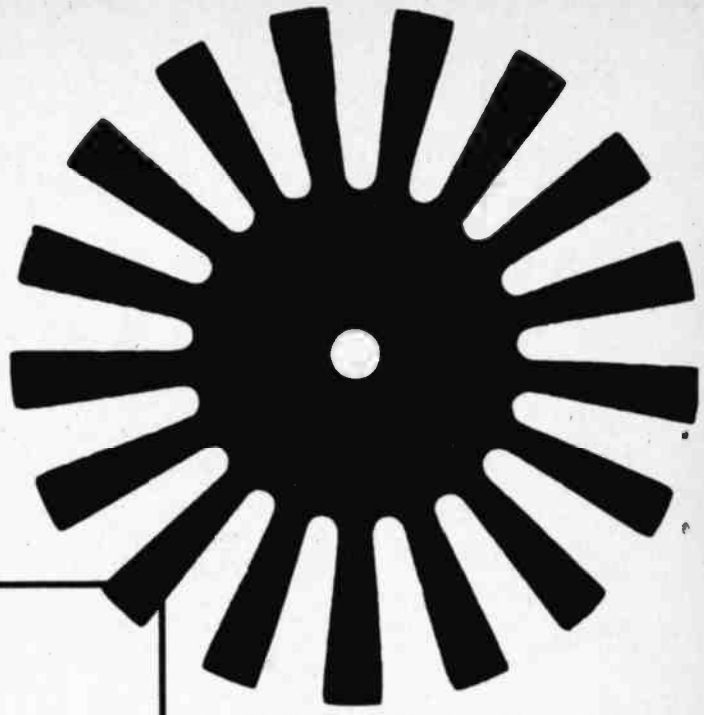
To make the adjustable assembly for the coils, use small diameter brass tubing (two telescoping lengths) obtainable at hobby and crafts supply stores. The author used ⅛ in. diameter tubing for the stationary support "rod," and mating tubing for the sliding "rod," but you may want to use larger, more rigid pieces. The stationary member is about 3½ in. long, and the sliding member is about 3 in. long.

Drill holes of the required size through the center of coil L1 form, and through the wood upright dowel near the top. Pass the stationary brass rod through the hole in the coil form and into the hole in the dowel. Glue or Duco cement is used to hold coil L1 securely to the wood upright.

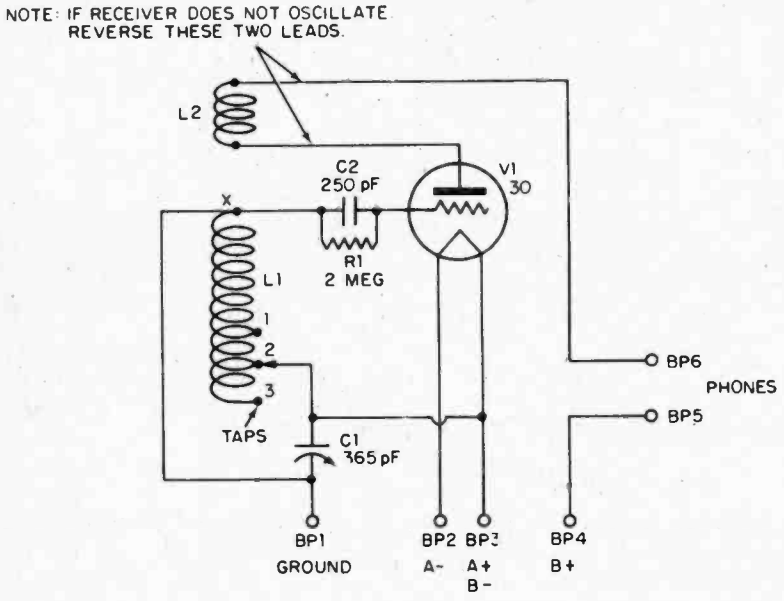
Drill a hole of required size through center of coil L2 form, and cement the coil form securely to one end of sliding brass tube. A knob goes on the other end of this brass tube.

The tube socket (type depending on tube used) is supported by two standoff metal collars, as shown.

The schematic diagram shows the simple hookup. Connections should be soldered wherever possible. Use a sensitive pair of high-impedance magnetic earphones when listening. A size D flashlight cell will last for a while with a type 30 tube, but a No. 6 ignition battery will last longer. No switch is used—simply disconnect the "A" battery! For the "B" battery, connect two or three 9 volt transistor batteries, in series. ■



Spiderweb coil form shown at right is same-size pattern. Use it to make another. You'll need two.

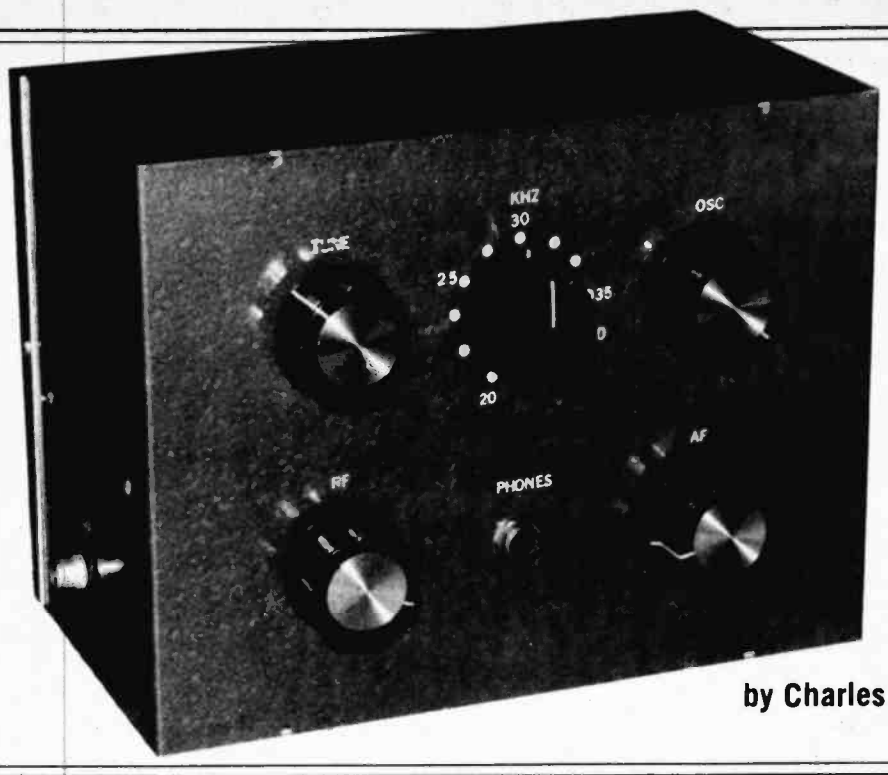


PARTS LIST FOR ANTENNALESS 1-TUBE REGEN RECEIVER

C1—365-pF. variable capacitor
C2—250 or 220-pF. (.00025 uF) ceramic disc capacitor
R1—2-megohm, ½-watt resistor.
V1—any low filament voltage, low filament drain, triode vacuum tube (Author used type 30)
1—baseboard-mounting socket for vacuum tube (V1)
BP1-BP6—medium-size Fahnestock clips
L1—home-made spiderweb coil, with three taps (see text)
L2—home-made spiderweb feed-back ("tickler") coil (see text)
1—#26 gauge enameled magnet wire for L1 and L2
1—4-in. by 8-in. piece gray sheet fiber, for making coil forms (see text)
1—wood baseboard, 7½-in. by 5½-in. by ½-in. hardwood
L—round or square ½-in. wood dowel, 2½-in. long (holds spiderweb coil assembly)
2—round or square telescoping brass tubing, for spiderweb coil slider (see text).

Misc.—hardware: Knob for C1. Mounting screws for C1. Mounting screws for Fahnestock clips. Soldering lugs. Mounting screws and stand-off collars for tube socket. Hookup wire. Flexible wire for "tickler" coil (L2) pigtail leads. Small alligator clip. Pair high-impedance magnetic earphones. "A" battery for V1. "B" battery for V1. Two or three 9-volt transistor batteries connected in series. (see Antennaless text).

For type 30 tubes, try the following sources: Mr. George Haymans, WA4NED, Box 468, Gainesville, Georgia 30501.
Modern Radio Labs., P.O. Box 1477, or 10322 Ballard Drive, Garden Grove, California 92642.
Or any of the other surplus tube mail-order firms that advertise in radio and electronics magazines.
Other low filament voltage, low drain, triode tubes: 1H4-G, 1G4-GT, VT-24/864, 1B5/25S, 1H5-GT, 1LE3, 1LH4.



by Charles Green W6FFQ

SUB-BASEMENT RADIO

EXPERIMENTER'S DELUXE FET/IC VLF RECEIVER

JUST AS MANY of the "cliff dwellers" in modern multi-story apartment buildings have little-known basements and sub-basements, the radio spectrum has a "basement" LF (low frequency) band and a mysterious "sub-basement" VLF (very low frequency) band, little known to many electronics hobbyists and experimenters. The LF band goes from 300 kHz down to 30 kHz, and the VLF band from 30 kHz down to 3 kHz.

The lower portion of the LF band, from about 60 kHz to the upper portion of the VLF band (about 18 kHz), is used by the National Bureau of Standards to transmit coded, standard-frequency signals (similar to WWV). Special receivers are used for proper reception of these signals, which automatically adjust electronic laboratory generators to coincide with the standard frequencies. The U.S. Navy has found that the VLF band signals will penetrate into salt water and has established giant high powered transmitting stations that communicate with submerged submarines anywhere in the world.

Other nations maintain transmitting stations in the LF/VLF region for scientific and navigational purposes. These stations are subject to changes in frequency, power, and time of broadcast since there is still considerable experimentation. The stations usually transmit their call signs in CW at periodic intervals for identification.

Receivers for the LF/VLF "basement" transmissions are usually quite complex, but you can sample the activity in this portion of the rf spectrum with our simplified receiver project which covers the most popular portion of the bands from 20 to 50 kHz. This frequency coverage can be changed by using different values of inductances than specified in our plans. Plans are also included for a VLF-style loop antenna to be used with the receiver instead of the usual outdoor dipole antenna used in the higher frequencies. Inasmuch as VLF wavelengths are many miles long, a half wave antenna dipole is impractical at these frequencies.

The receiver uses two ICs and three FETs in a simplified regen detector circuit with a two-stage rf amplifier. Good audio volume is provided for earphone reception, and the receiver is housed in a compact metal utility box. Perf board style construction is used for ease in building the receiver.

The Circuit. Very low frequency signals picked up by the loop antenna are fed through coax cable to the input of IC1, the rf amplifier stage. The amplified signals are fed through C3 to the coil L1 and the second rf amplifier stage, IC2. L1 and the input capacity of IC2 act as a broadly tuned circuit for VLF signals: R2 controls the rf amplification.

Capacitor C6 couples the amplified rf signals to the oscillating detector stage of FET Q1. These signals are tuned by L2 and the S1 switch-selected capacitors of C8 to C18. Variable capacitor C7A/B acts as a fine tuning control for the VLF signals, and R5 controls the oscillation point and, therefore, the sensitivity of the detector stage.

The detected audio signals are fed through the low pass filter R7/C20 and coupling capacitor C21, to the audio gain control R8 and audio amplifier stage Q2. The amplified audio signals are coupled via the L3/C23 peak filter to the second audio amplifier stage of FET Q3. The peak filter is tuned to approximately 800 Hz to provide better receiver selectivity of the

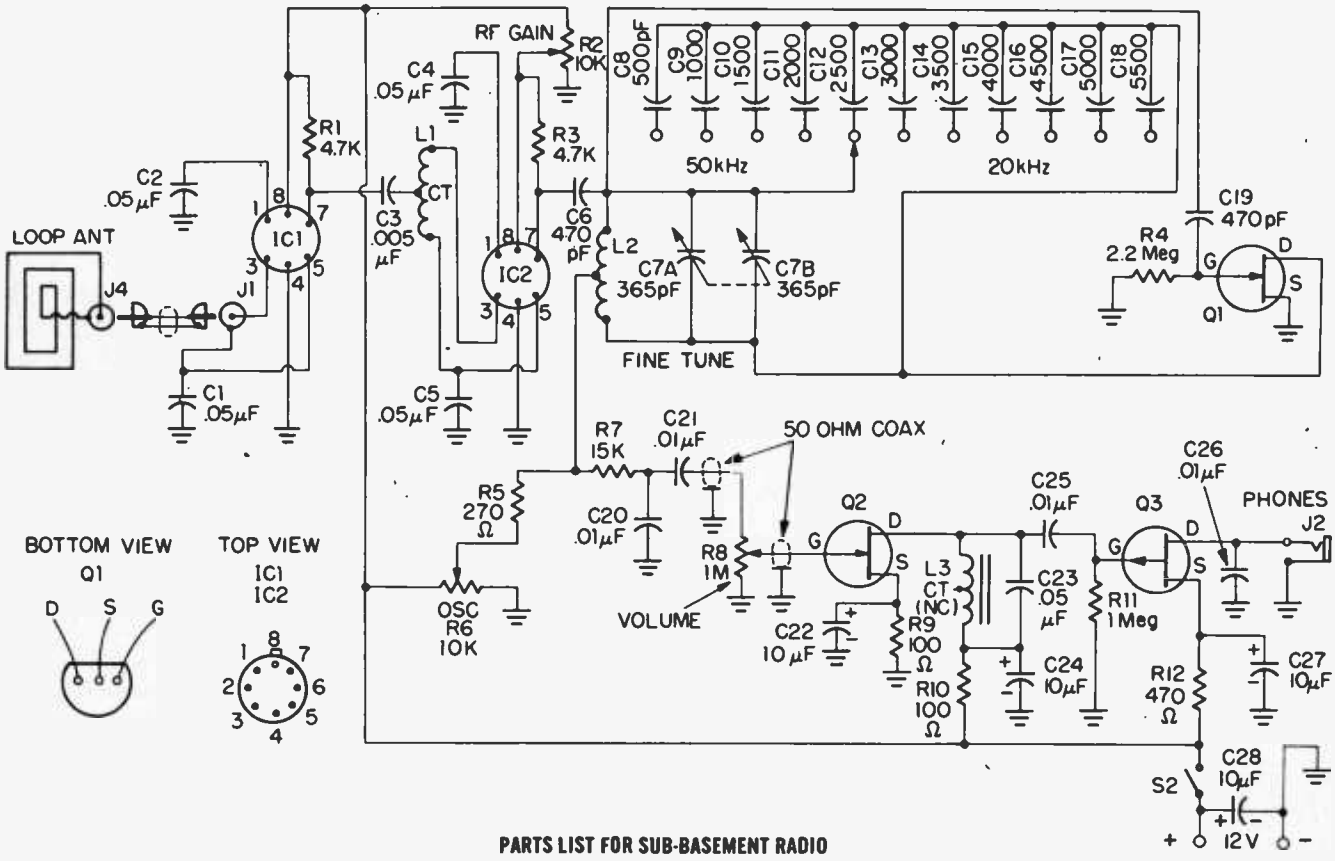
SUB-BASEMENT RADIO

VLF signals. The amplified signals are fed from the drain circuit of Q3 to J2 and can drive high impedance earphones (2000-ohm type).

Field effect transistors Q2 and Q3 form the audio amplifier stages. Q3 is a P-channel FET and therefore requires a relatively negative potential on its "drain" terminal. This is accomplished by grounding the drain through the earphone and returning the "source" to the positive power supply terminal.

Construction. Coils L1 and L2 are made from miniature transistor audio transformers by removing the laminated iron core. We used 10,000-ohm to 2,000-ohm center-tapped transformers for the coils in our receiver. The connections are made to the 2,000-ohm center-tapped winding only; the leads to the 10,000-ohm winding should be cut off close to the coil form. Coil L3 is a 1,000-ohm CT to 8-ohm miniature output transformer and is used *with* its iron core intact. The 1,000-ohm winding is used (no connection is made to the center tap), and the 8-ohm and center tap leads should be cut off close to the coil form.

The receiver operation is at low rf frequencies, but the wiring of the receiver should still be carefully done. For best results, follow our component layout as shown in the photos. Your best way to start construction is to cut a 4¼ x 7⅞-in. section of perf board and install it approximately halfway up the LMB-146 aluminum box. We used two 4¼-in. lengths of sheet aluminum



PARTS LIST FOR SUB-BASEMENT RADIO

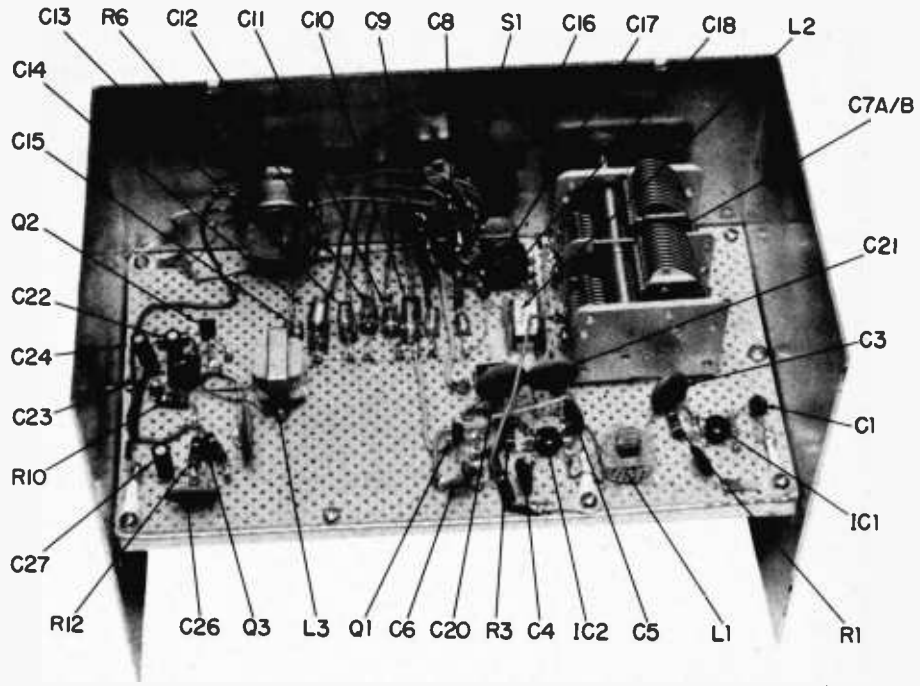
C1, C2, C4, C5, C23—0.05-uF capacitor, 12-VDC or better
C3—0.05-uF capacitor, 12-VDC or better
C6, C19—470-pF capacitor
C7A/B—dual-gang 365-pF variable capacitor (TRW 273 or equiv.)
Note—A dual-gang 365-pF variable capacitor may be difficult to obtain. You can go the same route as pioneer radio builders by using two single-gang 365-pF variable capacitors and operate them in tandem (turn each knob the same amount).
All capacitors 15-VDC or better
C8—500-pF (see text for all capacitors, C8 to C18)
C9—1000-pF
C10—1500-pF
C11—2000-pF
C12—2500-pF
C13—3000-pF
C14—3500-pF
C15—4000-pF
C16—4500-pF
C17—5000-pF
C18—5500-pF
C20, C21, C25, C26—0.01-uF capacitor
C22, C24, C27, C28—10-uF electrolytic capacitor, 16-VDC
IC1, IC2—703-type integrated circuit
J1, J3—insulated phono jack, RCA type (see text)
J2—two-conductor phone jack
L1, L2—inductors made from small 10k to 2k audio driver transformers
L3—inductor made from small 1k to 8-ohm audio output transformer (see text)
Q1—N-channel FET, HEP-802 (Motorola)
Q2—N-channel FET (see text)
Q3—P-channel FET (see text)
R1, R3—4700-ohm, ½-watt resistor
R2, R6—10,000-ohm potentiometer, linear taper
R4—2.2 meg, ½-watt resistor
R5—270-ohm, ½-watt resistor
R7—15,000-ohm, ½-watt resistor
R8—1 meg potentiometer, audio taper
R9, R10—100-ohm, ½-watt resistor
R11—1 meg, ½-watt resistor
R12—4700-ohm, ½-watt resistor
S1—single pole, 11 position rotary switch (Calectro E2-161 or equiv.)

Misc.—aluminum cabinet 8-in. x 6-in. x 4½-in. (Author used LMB 146), perf board, push-in clips, 50-ohm coaxial cable, knobs, hook-up wire, No. 28 enameled wire, plastic tape, solder, etc.

bent into brackets with sides approximately ¼ x ½-in. (½-in. side mounted to the box wall, and the ¼-in. side mounted to the perf board). Additional lengths of ¼-in. wide sheet metal stiffeners were added to the side of the perf board to increase the rigidity of the board. This may not be necessary in your unit.

More Mechanics. Locate C7A/B on the front panel as shown in the photos, and then cut a ½-in. or larger hole for the shaft. This will allow the frame of C7A/B to be mounted to the perf board and allow the shaft to protrude through the front panel without touching the metal panel. Note that the shaft *must be* insulated from the panel, or it will short the B+ at the detector circuit. If necessary, you can use an insulated coupling for the shaft. Make sure that you use a plastic tuning knob to minimize the possibility of short circuits.

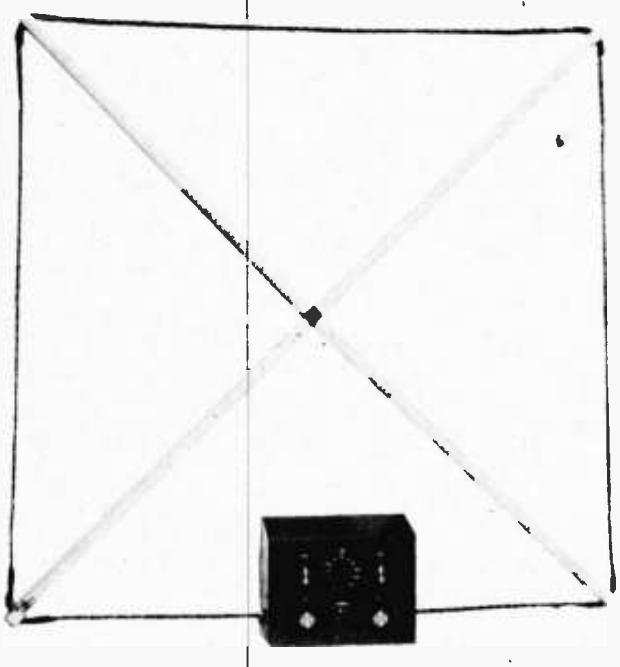
Locate and install the remainder of the front and side panel controls and components as shown in the photos. Make sure that you install serrated washers between the control bushings and the inside of the panels to prevent accidental disturbance of the position of the controls. Also, use insulating washers for J1 to keep the jack body from electrical contact with the box panel and electrical ground.

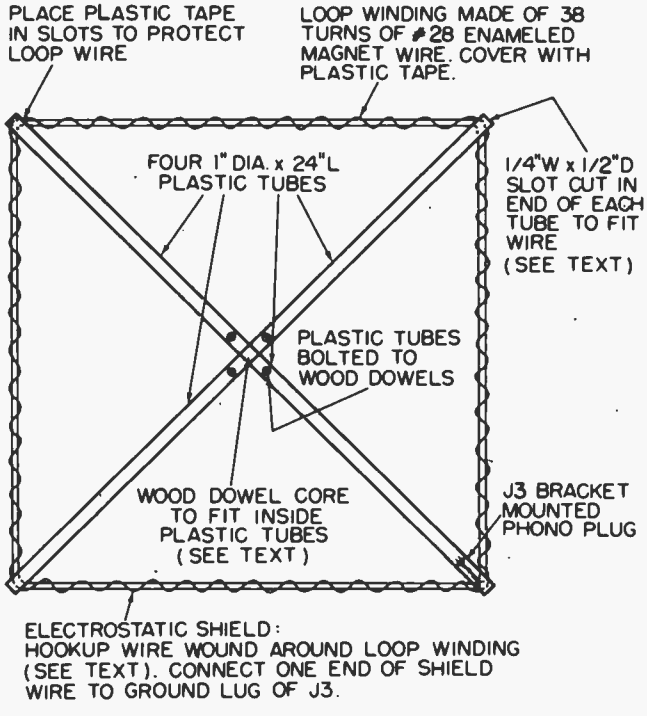


These are the major parts locations for the perf board. Note dual-gang cap C7A/B.

Most of the components on the perf board are connected to push-in clips. Keep the component leads as short as possible and group them around their particular IC or FET as shown in the photos. Wire the components as indicated in the schematic drawing and position the leads as shown in the board photo.

Coil forms L1 and L2 can be either cemented to the top of the perf board, or (as in our unit) held with an application of hot plastic glue from an electric glue gun. Use short lengths of coax or shielded wire to connect R8 to the perf board components as shown in the

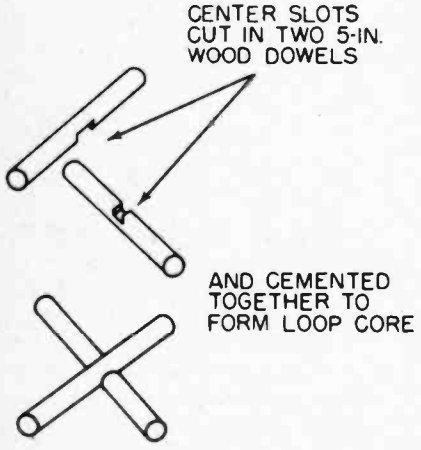




Reinforced PVC tubes available from building supply outlets are lighter and easier to work with than dowel sticks when building an open air antenna support frame. The RCA-type phono connector makes a convenient way to use standard audio cable.

photo. Connect ground lugs at the board corners and on the C7A/B mounting screws for the necessary electrical circuit connections.

Capacitors C8 to C18 should have as accurate a capacity value as possible (select them on a capacitor bridge if possible), and they can be either ceramic or polystyrene types. Mount them with short leads around S1 and connect them with straight direct leads to the S1 lugs. If necessary, you can parallel capacitors to make up the required capacity values. Connect the remainder of the front and side panel controls and jacks to the board circuits, and position the leads as shown in the photos.



Dowel sticks for this assembly are available from lumber yards, hardware store and hobby shops. Notch with a wood chisel or a keyhole saw or whittle with a pocket knife.

The Loop Antenna. As shown in the drawing, the loop antenna is composed of four 1-in. diameter x 24-in. long plastic tubes. We used polyvinyl chloride (PVC) tubes that can be obtained from a building supply store. Or any type of plastic tube can be used as well. The plastic tubes are fitted over a wood-dowel center core as shown in the drawing, and the loop antenna wires are wound over the slots in the tube ends.

Begin construction of the loop antenna by cutting center slots in two 5-in. long wood dowels (of a diameter to fit snugly into the plastic tubes), and cement them together as shown in the drawing. Wood screws can be used in place of cement, or hot glue from an electric glue gun can be used as we did in our model.

Cut the plastic tubes to size and then

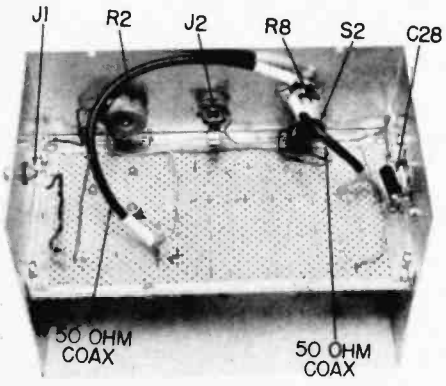
The front panel control knob "osc" sets the regenerative feedback point of the detector FET Q1 (it sets the audible "plop" point!). That "tune" knob is actually a fine-tune of the bandswitch-like "kHz" (course) control.

cut a ¼-in. x ½-in. deep slot on one end of each tube. Then mount the tubes to the wood dowel core with the slotted ends outward and parallel to allow the loop antenna wires to be wound around the ends as shown in the drawing.

Place plastic tape in the tube slots to prevent the wire from being abraded, and wind the loop with 38 turns of #28 enameled magnet wire, and cover the wires with a layer of plastic tape. Connect the loop leads to a phono jack (J4) mounted on the end of one of the plastic tubes.

To minimize noise pickup, wind an electrostatic shield composed of a spiral winding of hookup wire around the antenna loop. Leave about 1-in. spacing between the electrostatic shield wire turns, and connect one end of the wire to the "low" side (shell) of J4. The other end of the electrostatic shield wire should be taped so that it will not cause any accidental short circuits.

A length of good quality phono or coax can be used to connect the loop antenna to the receiver. Make sure that the "low" sides of P4 and J1 are connected together (the outside shells of the jacks).



Experimenters should use a short length of 50-ohm coaxial cable for vol. control R8 connections (mini-type RG-174U or RG-58 U).

Range and Panel Markings. We used rub-on decals for the panel markings for our receiver model, but neatly drawn pen and ink markings on white tape can be used as well.

The receiver does not require any calibration for exploratory operation on the VLF band, and you can designate the approximate frequency of the S1 kHz switch as follows: 20 kHz (C18=5500 pF), 25 kHz (C15=4000 pF), 30 kHz (C13=3000 pF), 35 kHz (C10=1500 pF), 40 kHz (C9=1000 pF), 45 kHz (C8=500 pF).

For more accurate calibration with the transformers you used for L1 and L2, connect an audio oscillator to J1 through an isolating audio transformer.

Testing and Operation. The loop antenna can be suspended with a length of cord from one of the plastic tubes for easy rotation and operation indoors. Or the loop can be placed on a wooden chair for temporary operation. Note, however, that the loop should be away from AC appliances for best performance.

Set all controls to the extreme counter-clockwise position, and connect the receiver to a 12 volt DC power supply or battery. Connect the loop antenna to J1 with either coax or a length of good quality phono cable, and plug in a set of high impedance earphones at J2.

Adjust the *audio gain* (R8), *rf gain* (R2) and *fine tune* (C7A/B) controls to mid-range. Adjust the *osc* control (R5) clockwise until the detector circuit (Q1) is oscillating. There will be a "click" or "plopping" sound in your earphones when the detector stage first falls into an oscillating condition. Keep adjusting the *osc* control (R5) near this point for best sensitivity when tuning for signals. Adjust R8 and R2 for best reception of signals.

Adjust the *fine tuning* control (C7A/B) for each setting of S1 as you listen in on the VLF band from 20 kHz to 50 kHz. Reposition the loop antenna as necessary for best reception of signals. Practice is required to obtain the proper "feel" for operating the receiver controls. You can also try different loop antenna assemblies with different turns of wire for best results in VLF reception over different portions of the band. You can experiment with the tuning range by changing the values of L1 and L2.

Remember, this is an experimenter's project exploring the little-known, little-tuned very low frequencies. It's a good first-step project into VLF; why not "kick in" right now! ■

This Plain Jane occasional table conceals...

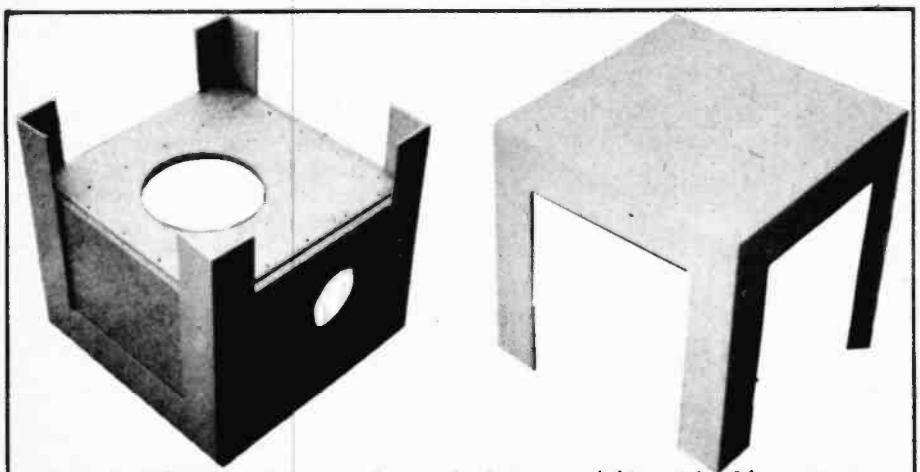
SOUND FORCE

a 3-way speaker system with downward facing woofer!

by Herman F. Johnson

REMEMBER that old saying once in common use, "Children should be seen but not heard!" A loudspeaker should be the direct opposite, it should be heard but not seen. A speaker system need not look like one of the "common box" variety, either. This one *is* a box system, but it was designed to fit into a popular piece of furniture—the small occasional table known as a "parsons table." By employing one of these tables to house a speaker system, the enclosure can be made of unfinished material; wood joints and jointing screws are hidden from view; and for convenience in assembly, the screws are driven from the outside, into the enclosure.

This is a high performance 3-way system that employs speaker components available at Radio Shack. The enclosure is designed to provide outstanding bass performance from a small system. The bass output is enhanced by locating an 8-inch high compliance woofer facing downward toward the floor. A 5-inch midrange driver and a super tweeter face forward to provide the all important midrange and high frequencies. The woofer is rolled off at 500 Hz. The tweeter picks up the highs from 3300 Hz and up. Of course, the midrange unit operates from 500 Hz to 3300 Hz. This frequency division is supplied by a 3-way crossover network that contains sound level controls for the treble and highs. The power handling capacity is rated at 60 watts.



Check the Bill of Materials appearing on the last page of this article. Of course, you must have one set of materials for each speaker you wish to build. You should always use "zip" cord for speaker connections on moderate and high power installations; never that thin stuff sometimes sold on spools as "speaker hook-up wire." Use it for connecting intercoms, if you must, but stick to the #18 for hi-fi.

Construction. Before you purchase the speakers, locate a 16-in. cube-shaped occassional table. They are made of high gloss plastic in black, yellow, red and gray colors. Take a good look at the construction of the table before you decide upon the color. The table legs must be right angle shaped, not square, and it should be of one-piece construction rather than the kind with removable legs. These tables are usually found in stores that feature unfinished furniture.

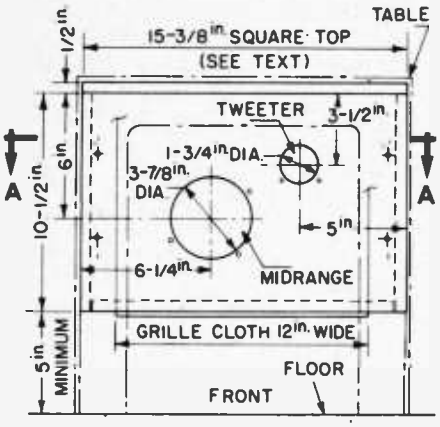
When you have obtained the table that suits your decor, check the inside dimensions between adjacent legs at the under side of the top. This dimension should be 15½-inches in both directions. The dimension 15⅜-in. at the top of the drawing labeled front Elevation allows for 1/16 of an inch at all sides of the top panel for grille cloth covering of the front and both sides of the enclosure. If the dimensions are less than 15½-in. between legs, the square dimensions of the top panel should be reduced accordingly. The dimensions of the top determine the overall dimensions of the other panels.

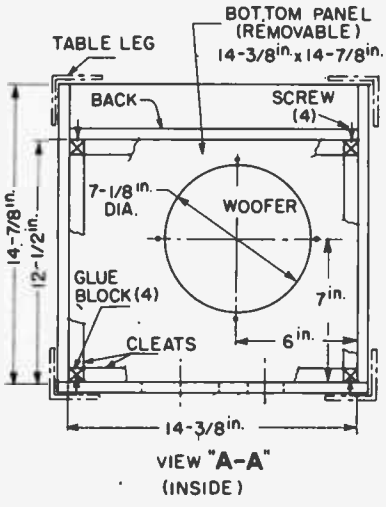
View "A-A" in the drawing (top removed) indicates the location of all the panels, supporting cleats and glue blocks. Details "A" and "B" locate the cleats. Round dots indicate the location of brads that secure each cleat and glue block to a panel. Details "C" and "D" provide the locations of screw holes (round dots) in the top and bottom panels.

Construction Sequence. You will need a half sheet (48 x 48-in.) of plain particle board, ½-inch thick. Half a sheet is more than enough to build one enclosure, but it is not enough for a stereo pair. When the panels have been cut to size as indicated in the drawings, lay out the center locations for the speakers as shown in the front elevation view and in view "A-A." Carefully cut the midrange and woofer openings with a sabre saw. The 1¾-in. diameter opening for the tweeter is best cut by a hole saw chucked into an electric drill.

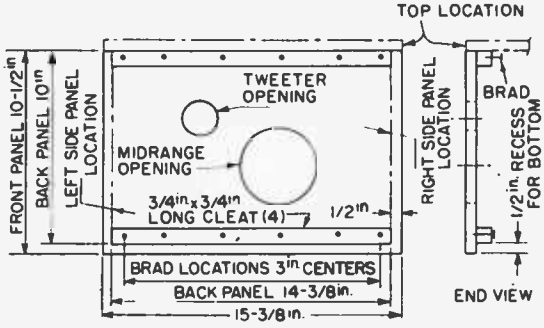
Ten feet of ¾-in. square pine is required for cleats and glue blocks. See

SOUND FORCE



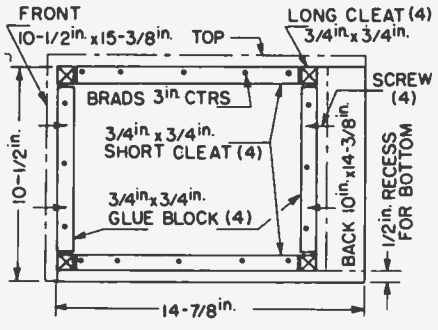


VIEW "A-A"
(INSIDE)

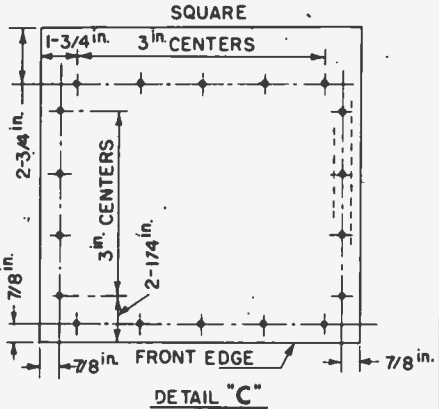


DETAIL A
FRONT PANEL, INSIDE FACE
(BACK PANEL SIMILAR, WITHOUT SPEAKER OPENINGS)

A look at the front and rear (top and bottom, left) of the forward-facing speaker panel. Inside view A-A (above) is a drawing of what you would see if you could look down from the top into the speaker enclosure. The bottom panel which supports the downward-facing woofer is held to the four cleats with screws which are positioned as shown in detail "D" at right.

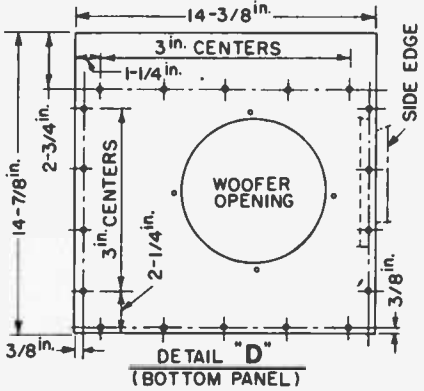


DETAIL "B"
LEFT SIDE PANEL, INSIDE FACE
(RIGHT SIDE PANEL SIMILAR)



DETAIL "C"
(TOP PANEL)

To complete your "box within a box" you will require panels for the left and right sides as detailed on B above; you will also require the top piece shown in detail C. This can be planed or filed as necessary to fit the inside chracteristics of your table. Remember, the back panel is similar to the front panel (detail A) but without the speaker openings.



DETAIL "D"
(BOTTOM PANEL)

the Bill of Material for the lengths. The glue blocks are the vertical corner reinforcements, all others are labeled cleats. Pencil-outline the location of each cleat and glue block on one side of each front, back and side panel. Start on the back panel where two long cleats are aligned along the panel edges as indicated in Detail "A". These lines serve as guides when glue is applied. One inch brads secure each cleat and glue block to the panels. Countersink the brads about ⅛-in. below the surface. The use of cleats assists in the assembly and insures construction of an air tight enclosure (air tightness is a basic requirement to obtain good bass performance).

Next, lay out the screw hole centerlines on the top and bottom panels as shown in Details "C" and "D". Center punch each screw location and drill 1/16-in. holes as indicated. Then, assemble the front, sides, and back panel in the position shown in view "A-A" and align the top panel. You are now ready to mark screw locations into the top side of the cleats with the 1/16-in. drill. At this point you should examine the screw locations to see if any screw is likely to hit a brad when it is driven. If a screw location appears to be too close to a brad, it is best to drill another hole ¼ or ½-in. away from the brad. When you are satisfied that all screws will clear, reassemble the same panels, down side up, and repeat this process for the bottom panel. When you are satisfied that all screw holes are in the clear, re-drill all of the holes 7/64-in. diameter and countersink for No. 6 screws. It is to be noted that four (4) screw holes are required in the front and back panels for screwing into the glue blocks. All of the panel edges should be given a coating of resin sealer to prevent flake off.

You are now ready for the final assembly—except for the preparation of screw holes to mount the speakers. This data follows under speaker component installation, below. Coat all mating surfaces with white glue between the panel and the cleats; then, screw the top down firmly. Do the same for jointing the front and back panels to the glue blocks you have installed on the sides.

Speaker Component Installation. All of the speakers are mounted to the inside face of the panels. However, the diameters indicated in the drawings will allow the two cone drivers to be "backed in" to their respective openings on the inside faces of the panels, so each driver will be centered in the opening. In this position, center punch all four (4) mounting holes from the frame of each unit. Remove the speakers and drive ½-in. No. 8 sheet metal

screws into the panels about ¼-inch deep. Then, remove the screws and scrape off the displaced wood around each screw hole. This procedure will prevent damage to the cone of a speaker should a screwdriver slip when driving a screw. The woofer and the tweeter should be mounted with screws. The hole locations you have marked for the mid range unit should be drilled 11/64-in. or 3/16-in. in diameter for 8-32 machine screws.

The back of the midrange cone must be isolated in the enclosure from the woofer. This is readily accomplished by bolting a plastic cover over the back side of the midrange driver. A dessert bowl was used by the author. Any bowl that is quite stiff and has a flanged edge all around will do the job nicely. There is no need for a gasket. The edge of the bowl can be clamped to the smooth back surface of the speakers frame by the mounting bolts.

The recessed space behind the back panel is convenient for mounting the crossover network. Draw a horizontal pencil line on the back panel at 4¼-in. from the bottom edge and center mark the location for two ½-in. No. 6 pan head sheet metal screws 4⅞-in. apart. Drive these screws in about half way. Slotted openings are provided on the back of the network for hanging it on two screws. The network is a self contained unit. Hence, three sets of connecting wires must be brought through holes in the back panel for connections between each speaker and a 12-screw terminal strip on the network. Drill holes through the back panel at 1½-in. from the bottom edge for a snug fit to the hookup wires. Follow the instructions attached to the network for connection to the speakers with jumper wires between designated terminals to engage the installed tweeter and midrange level controls that are located on the front of the network.

Cut the speaker hookup wire (zip cord is fine) in about 24-in. lengths. Solder one of these to the woofer terminal lugs, one to the midrange lugs (through a snug fit hole in the side of the plastic cover), and the third to the pull-type binding posts located on the tweeter. Red dot terminals on the speakers should be connected to their respective plus (+) terminals on the network (2, 8, and 10). Unmarked terminal lugs should be connected to the negative (common) terminals on the network (1 and 6). Since two wires must be connected to terminal 6 in a 3-way system, it is a good idea to use spade connectors. The input terminals are located adjacent to terminals No. 1 and 2. The input terminal adjacent to terminal No. 2 is the plus (+) terminal.

Sound Damping. A minimum amount of damping material is recommended to be installed inside the enclosure to absorb reflections from the inside surfaces, back to the woofer. Cut two pieces of one-inch thick fiberglas to fit over the cleats and glue blocks at the back and on one side. And, cut a third piece to fit over the cleats at the top. Staple or thumb tack the damping material to the cleats.

Your enclosure is now complete except for the final installation of the bottom panel containing the woofer. Install four (4) lengths of ⅜-in. by ¼-in. self-stick foam weather strip tape on the face of the bottom cleats along the inside edge of each cleat to insure air tightness under the bottom panel. Then, screw it down in place.

Grille cloth provides an attractive method of covering the exposed unfinished front and side panels. It is sold by most electronic parts stores by the foot from rolls 32 or 36-in. in width. Three 12-in. wide strips about 14-in. long will cover the front and both sides when centered so that the edges are between the panels and the table legs as indicated in the front elevation view. Pick out a soft, cloth-like, grille material that will take a smooth right angle bend. Coat the edges with rubber cement, about ½-in. wide, with a paint brush to prevent fraying. Staple or tack an end edge of the material to the bottom edge of the front panel (a paper stapler will do the job if held firmly), then draw it up over the edge of the top panel and staple it to the top. Repeat this process for covering both side panels. It is also a good idea to cover the woofer should a pet crawl under and damage the cone. Staple an 8½-in. square piece of grille cloth to the bottom panel.

Before inserting the enclosure into the table, examine the inside skirt edges of the table below the top. If these edges are a sharp right angle, round them over with a file to avoid abrasion of the grille.

With the table in an upside down position, lower the enclosure down between the legs. Then drill two holes 9/64-in. diameter through the table legs and into both side panels in a low position about 11-in. below the top of the table and at about 1¼-in. from the outside right angle corner of each leg. Drive ¾-in. No. 6 round head, plated, wood screws in until the table leg is drawn snug to the enclosure. These four screws are all that is required to support the enclosure in the table.

Operation. As stated earlier, the bass response is robust. If the lows are too strong for your ears, cut back on your bass control at your receiver. It is of considerable advantage to have variable output for both the midrange driver and the tweeter. The midrange control should be advanced more than half way and the tweeter control to about one-quarter turn for most rooms. ■

BILL OF MATERIAL FOR SOUND FORCE

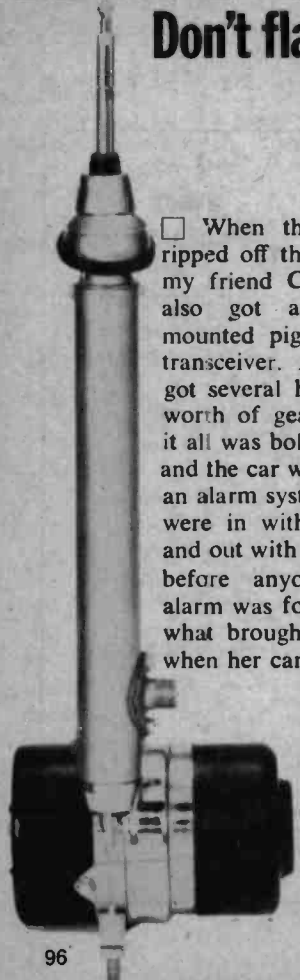
Quantity	Name	Size	Material
1	top panel	15 3/5-in. sq.	½-in. particle board
1	bottom panel	14⅜-in. x 14⅞-in.	
2	side panel	14⅜-in. x 14⅞-in.	½-in. particle board
1	front panel	10½-in. x 15⅜-in.	½-in. particle board
1	back panel	10-in. x 14⅜-in.	½-in. particle board
4	long cleats	¾-in. sq. x 14⅜-in.	pine
4	short cleats	¾-in. sq. x 11-in.	pine
4	glue blocks	¾-in. sq. x 8-in.	pine
44	flat head wood screws	1-in. No. 6	—
4	machine screws	1¼-in.	—
7	sheet metal screws	½-No. 8	—
60	wire brads	1-in.	—
1	occasional table	16-in. x 16-in. x 16-in.	plastic
1	woofer	8-in. (Radio Shack 40-1341)	—
1	mid-range	5-in. (Radio Shack 40-1292)	—
1	tweeter	1¾-in. (Radio Shack 14-1274)	—
1	network	3-way (Radio Shack 40-1339)	—

Misc.—Grille cloth, rubber cement, glue, speaker cord, connectors, 4-sq. ft. of 1-in. fiberglass, etc. (Author used Sycro "Parsons Table" from Sycro division, Dart Industries, Inc., Syracuse, NY 13201)

ANTI-RIP-OFF CB ANTENNA

Don't flag your CB rig with a CB antenna! Foil thieves with the Tenna CBE-10 electric-driven antenna that disappears!

by Herb Friedman
W2ZLF



☐ When the local hoods ripped off the CB rig from my friend Celia's car they also got a tape player mounted piggyback on the transceiver. All in all they got several hundred dollars worth of gear even though it all was bolted to the dash and the car was protected by an alarm system. The hoods were in with a coathanger and out with the gear before before anyone knew the alarm was for real. Wonder what brought this on Celia when her car was in a parking lot along with several hundred other cars? An antenna sticking up above the rooftops — a beacon announcing to one and all, "Hey, there's some expensive equipment in this heap."

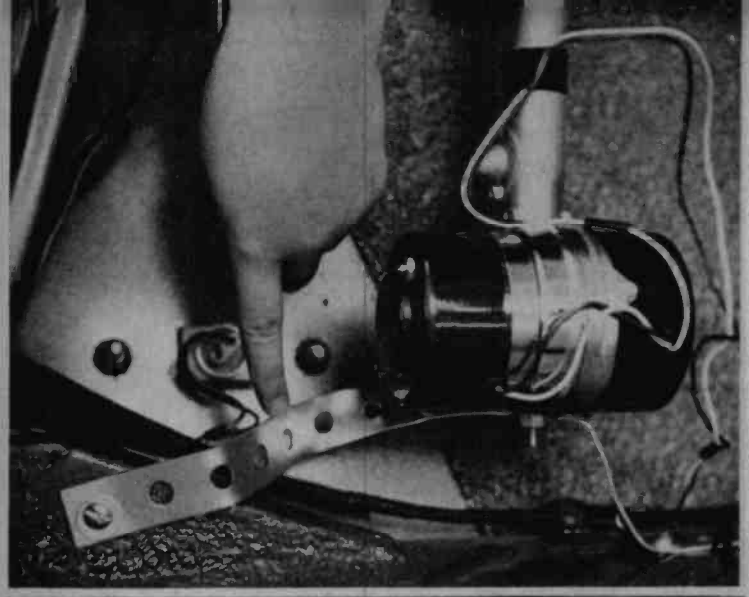
So when Celia came to me asking how to avoid having her new rig ripped off I suggested a Tenna CBE-10 electric antenna—a CB antenna that disappears from sight when not being used.

Here's How It Works. At the base of of the antenna is a small electric motor that drives an elevator assembly. When the antenna is switched off the motor telescopes the antenna down inside the vehicle with only a small stub sticking out, just like the concealed antennas Tenna makes for GM, Chrysler and Ford cars. When the antenna is switched On the motor drives the center-loaded antenna up and out. When the antenna reaches full height the power is automatically removed from the motor.

To insure the rig isn't keyed to transmit while the antenna is down, which might damage some early solid-state transmitters, the Tenna CBE-10 has a special wiring circuit that applies the power to the CB transceiver. Turn the antenna switch to *Up*, meaning antenna extended, and power is applied to the CB rig. Turn the control switch to *Down* and the power to the set is turned off while the antenna does its disappearing act.

Take careful note that the Tenna CBE-10 resembles several other motor driven CB antennas but the Tenna has one really big advantage: it is center loaded and the loading coil disappears into the car. The copies of the Tenna model have base loading coils and the coils remain outside when the antenna is lowered, almost shouting out "Hey, I'm a CB antenna!" And the external base coil provides a nice handgrip for vandals. The Tenna CBE-10, however, leaves little sticking out of the car with almost nothing for a vandal to grab on to.

The Tenna CBE-10 is supplied with a coaxial cable with connectors on both ends (PL-259 standard coaxial type at the transceiver end), control wire har-



Photos at left (on facing page) shows antenna along with coaxial cable and control wire harness prior to installation. Photo 2 shows how easy it is to cut hole in car fender for mounting antenna. Tool is Greenlee punch, available at hardware or electronic supply stores for a couple of dollars. Just drill ¼-in. hole with your electric drill, put punch in place and tighten with adjustable wrench. The punch will soon cut a nice clean hole for antenna mount. Photo 3 shows how antenna is tuned for minimum SWR on channel 12 (if you're on 23) or channel 19 (if on 40). Photo 4 shows how bottom end of power-driven antenna is held in place with metal strap (supplied). Sealing installation with silicone plastic keeps it waterproof. In photo 6, above, Celia shows how high antenna extends. In 7 she's following it down with her finger while I depress the switch inside car. You can see it installed under the dash in picture 8.

ness with a factory-installed connector for the back of the supplied control switch, a sturdy metal switch mounting bracket, and installation hardware.

Where To Put It. The pictures show how Celia's CBE-10 was installed on her car. One note of caution, however, before you get into your installation. The antenna can fit inside the front fender of some "full size' cars, but you simply might not have the dexterity required to complete the installation in a front fender. A better location is on the rear deck. And Tenna recommends two locations, one right behind the rear window where trunk lip antennas are usually installed. There is generally not enough room, however, in intermediate and compact cars for this mounting location. For smaller size cars I suggest the rear fender location used on Celia's '73 Valiant. Note that some modern cars such as the Volare and Aspen have no room at all for a trunk-mounting antenna of any type other than a lip, or rain-channel mount. Make certain you can install a Tenna CBE-10 in your car before you purchase the unit.

The photographs show how easy it is to install the Tenna CBE-10. You run the (supplied) coax from the front to rear using the same wiring channel or rear-seat channel you'd use for any other antenna, and don't forget to run the wiring cable for the motor along with the coax. Then follow the steps as above on this page and the facing page.

Adjusting Antenna. After the installation is complete the antenna must be adjusted for minimum SWR. A special set of wrenches is provided for making this adjustment. You will have no problem as long as you connect the power wire to a circuit controlled by the ignition switch, because the tuning adjustment must be made with the antenna partially retracted, and you can only stop the retraction by turning off the main power. So follow instructions and connect the antenna power wire to a *fused* accessory circuit controlled by the ignition switch.

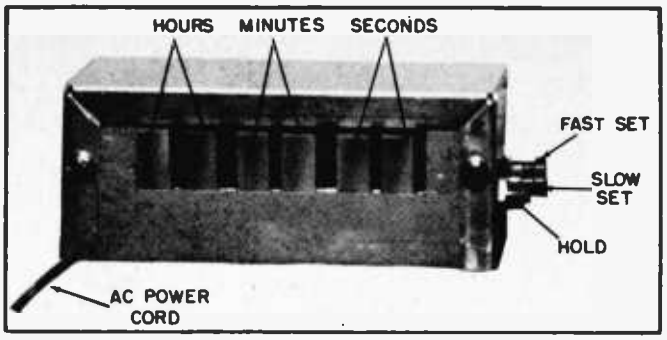
How does it work? Terrific! Tuned for minimum SWR on channel 12 (almost 1.1:1) the worst-case SWR on channels 1 and 23 was only 1.8:1, and that's great for a short, center-loaded whip. The stub sticks out two to three inches when the antenna is retracted, the exact length determined by the SWR adjustment.

So grab your tools and follow the steps as we show you how to install your own electric antenna. ■

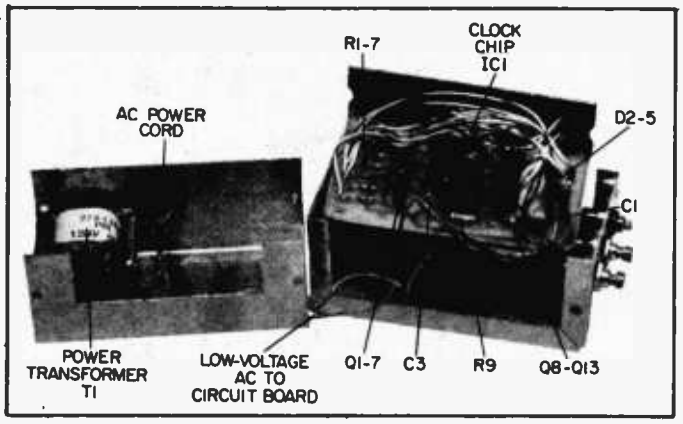
CHIP-TOCK LED CLOCK

(Continued from page 71)

clock cricuit. This arrangement provides flexibility because you can separate the two by up to several feet with just a few wires between them. If you decide to keep them together to keep size at a minimum, as shown in the photographs, that's okay too. The Parts List gives the author's cabinet size, but you can use any type you wish.



Finished Chip - Tock digital clock with push-buttons for setting at right. Make up your own case, even with readout remote from rest of clock.



Digital clock after assembly, just prior to securing case and plugging it in. Power transformer may be potted with any good epoxy.

Larger Readouts. Some experienced constructors may wish to substitute larger LED digits on Chip-Tock, such as the Litronix DL 750 common-cathode units, which are 0.65-in. high (compared to 0.25-in. for the FND-70). These will work fine, but they require the following changes: (1) hard-wiring from the readout board to accommodate the wider spacing of the larger LEDs, and (2) wiring into the circuit is slightly different. Consult the technical data sheet supplied with the DL 747s.

Trouble-shooting Hints. In some areas, the AC power line generates transients (spikes, or large pulses of very short duration) which may cause Chip-Tock to run fast. In such cases, the addition of a 0.01 microfarad, 1.4 kilovolt (or more) capacitor to each side of the power transformer primary terminals to the building ground will filter out these transients.

If you have time errors caused by radio-frequency interference, connect a 0.01 disc capacitor (50 volts or more) across the terminals of switches S2 and across switch terminals S2 and S3.

How Long Will It Take? An experienced constuctor should take less than two hours to build Chip-Tock after the printed circuit board is available. If you're a beginner it might take as much as three or four hours, once you've got all the parts collected and you've studied the diagrams and this article. Good luck, and enjoy your Chip-Tock! ■

TRACE SIGNALS WITH YOUR TAPE RECORDER

by Hugh Gordon

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

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

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

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

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

Fig. 1

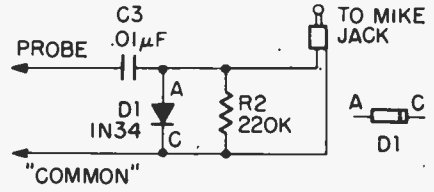


Fig. 2

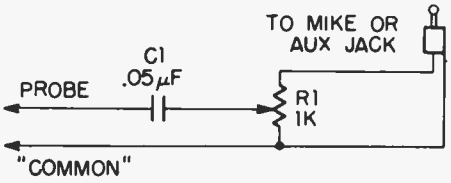
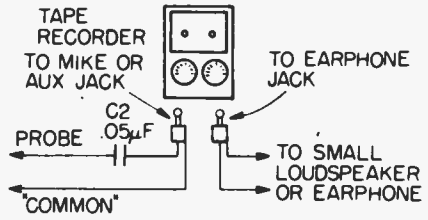


Fig. 3



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

PARTS LIST FOR A SIGNAL TRACER

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

new and choice

Photo Darkroom Meter

☐ If you've ever had trouble trying to figure out the correct exposure settings for your photographic negatives, there's a new electronic exposure meter on the market that could solve many of your enlarging problems. It promises to end guesswork, frustration and wasted time and material when you're working in the darkroom. The Model 200 darkroom meter, manufactured by PixTronics, eliminates the need for test exposure strips in B & W or color enlarging.

The meter, weighing two and a half pounds, offers many darkroom conveniences. There is an easy to read illuminated meter dial with two scales. The first is a 0-100 numerical scale with a center null point, and the second is a 0-3.0 optical density scale for direct density readings. The meter also has three sensitivity ranges for reading negatives of any density and a sensitivity control to make reference readings for fast exposure determination. The sensitivity control can also be used with an easel probe to find correct paper grades for projection printing.

The 110-volt meter is supplied with a special easel probe. The three-foot probe cable plugs into the meter. The probe has 7/32-in. and 3/32-in. apertures that can handle all exposure requirements. If you're involved in something such as ground glass photography, a cylindrical regular probe is available.

The model 200 electronic darkroom exposure meter, special easel probe and instruction manual are available by mail for $87.50. The additional regular probe is priced at $10.50. The manufacturer offers buyers a 15-day free trial period and a six-month guarantee. Write to: Wilfred Brown, PixTronics, 681 E. 46th St., Brooklyn, New York 11203. ■■■

SWR Kills CB DX

(Continued from page 42)

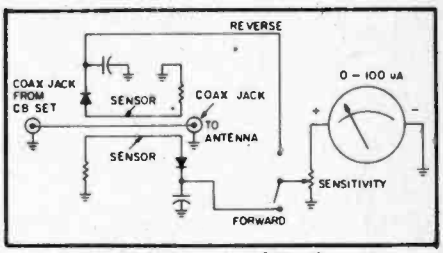
begin with, because of line loss.

To understand this, assume the SWR meter is connected at the input of about 100 feet of RG-58/U, which has a line loss of 3 dB per 100 feet. Also assume the SWR is 2:1, meaning 11 percent of the power is reflected back from the antenna. If we feed 4 watts into the line only 2 watts will get to the antenna end of the line because of the 3-dB loss .11 percent, or 0.2 watts, will be reflected by the antenna/line mismatch. But now, in traveling back down the line the 0.2 watt reflected power is also attenuated 3 dB so only 0.1 watt arrives at the meter. The meter sees only 2.5% reflected power—it knows nothing about line losses, so it indicates less than the actual 2:1 VSWR.

Comparison of SWR with Reflected Power (from antenna back)

SWR	Percent of power reflected
1:1*	0.00%
1.1:1	0.22%
1.2:1	0.82%
1.5:1	4.00%
2:1	11.40%
2.5:1	18.00%
3:1	25.00%

*Not attainable



Sensor picks up tiny bit of power via capacitance to drive SWR meter.

So you see, though an SWR meter is an important part of every CB installation, you still must keep in mind that it can be fooled, not only by normal line losses but by standing wave impedance variations (which we have not discussed). Nevertheless, and in spite of these errors the SWR meter is the CBer's most reliable, low-cost indicator of the condition of the antenna system, as well as of the match between the transmission line, and the antenna. ■

Prevent CB Theft

(Continued from page 36)

a dollar extra to cover mailing, you can purchase it from Shur-Lok Mfg. at 413 North Main Street, Hutchins, Texas 75141 if you can't get at your store.

The Flip-Flop installs inside the trunk on the left or right side so that it can goose-neck up through the crack between the trunk lid and car body. Where the goose-neck protrudes there's a small platform for mounting an antenna. The unique thing about this mount is that it's equipped with a hinge which allows you to open the trunk lid and lay the antenna down inside without removing it from the mount.

There are other advantages in mounting an antenna like this, but the greatest is that you can conceal the evidence that your car's equipped with CB radio.

It's Up To You. Don't place all of your confidence in anti-theft mounting devices. They'll give you protection up to a point. Beyond that it's up to you to develop and exercise good habits that'll complement whatever devices you choose.

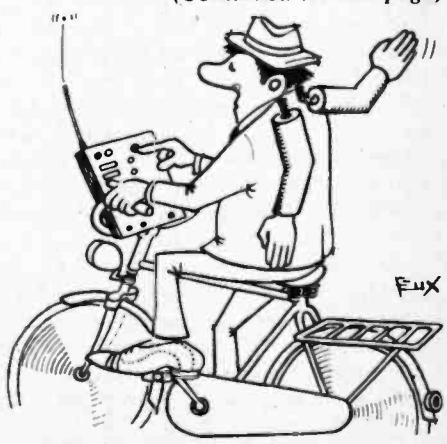
You can learn a lot from friends who've had CBs stolen. Talk with them and find out what they'd do differently if they had to go through it again. Also, your local police department is a good place to go for advice. They can tell you what the current CB theft rate is in your area, what to expect in coming months, where and when most thefts take place, and what precautions to take.

The Toledo police reported that most thefts in their area were confined to large parking areas with minimum security, such as, shopping centers, bowling alleys, churches, etc. Ft. Worth police have reported the same, plus high incidence of theft to cars parked on back streets and in driveways at homes during the late hours of night.

Now, these precautions are the good habits you are to develop and exercise.

So, the habit you'll want to get into when you park in areas like these is that of removing your radio and either placing it in the trunk of your car or carrying it with you.

(Continued on next page)



Prevent CB Theft

(Continued from page 99)

The Toledo and Ft. Worth police and the Nebraska Crime Commission offer these recommendations for combating CB theft:

1. Lock your car doors—they still offer some protection.
2. Engrave the manufacturer's serial number on the radio cabinet, inside and out, along with your social security or license number.
3. Report persons offering to sell CB gear at bargain prices, especially, if the manufacturer's serial number is removed or marred beyond legibility. These are the two most common signs of stolen CB radios.
4. Don't purchase stolen radios. You only contribute to the theft problem by creating a market for them.

Police say that it's against the law to have a CB radio in your possession that does not have a legible serial number on it. Getting caught with a radio like this can get you a stiff fine or even some time in the pokey. And the police in many areas are pulling more spot checks every month on CB-equipped vehicles for radios with marred or removed serial numbers.

CB theft is a serious nationwide problem. Do yourself a favor and learn all you can to keep it from happening to you before you lay money down for that new CB rig. You'll save yourself some real headaches, if you do. ■

Scan Top of 40

(Continued from page 26)

sells for $119.95. Other PRO-6 models are available, at the same price, for 450-470 MHz (PRO-5, UHF), and for 148-174 MHz only (PRO-4A) at $99.95. For more information, Circle number 32 on the Reader Service coupon.

With the extra 17 channels which become available to CBers on January 1, 1977 (and on sets which go on sale thereafter) there will be a lot of wide open space for the CB communicator who wants to work without interference. There will be so much empty space that you just won't believe you're on CB at all—at least until people start discovering what a pleasure it is to work uncluttered channels. If you want to find lots of good space on these new channels, or even on the old ones, just get hold of a PRO-6 pocketable VHF Scanner and make this super-fast conversion. You'll be glad you did. ■

Digital Wind Meter

(Continued from page 20)

battery supply. In order to drop the voltage to the required 5 VDC, you must connect a 2 ohm resistor in series with a 6 volt battery.

With someone else driving, take the unit in an auto on a nearly calm day and drive as steadily as possible at a certain definite speed, say 30 mph. Drive up and down a quiet road, with the wind sensor held out the window and adjust the calibration pot so the display will read an average value of 30.

Use. The wind sensor should be mounted on a roof or other location where there are few obstructions. Because of the one-shot ahead of the NAND gate, the anemometer may suddenly go blank when winds are of hurricane speed. So if the display one minute shows 75 mph and the next minute 00, don't stick your head out the window to see if something happened to the wind sensor on your roof, a tree might just be sailing by.

A simple way of checking your speedometer is to drive down an expressway at 55 and have someone time you between two mileposts. Then get your hand calculator out and divide 3600 by the number of seconds it took you to travel the mile. The result is your true speed. ■

Pong IV Video Game

(Continued from page 60)

way, Dakota City, Nebraska 68731. You simply feed the video output of *Pong IV* (collector-to-emitter of Q4) through a shielded cable to the PXV-2A, then connect the output of the PXV-2A to your VHF antenna terminals on the TV (being sure to disconnect the regular antenna) and tune to an unused channel between 2 and 6. (When you build the PXV-2A Kit, you program the desired output channel).

If you don't want to build an r-f modulator, then you can feed the Pong IV video output directly into the video amplifier input of your TV set.

Playing the Game. After you've connected *Pong IV* to your TV set, plug in the *Pong IV* wall transformer. You should hear the game beeping. Now tune the TV until you get an indication of a signal being received. Adjust R1 and R2 for vertical and horizontal hold, R7 and R8 for court borders, and R78 and R79 for score position on the screen. Once these are adjusted, they don't need to be set again. Choose either tennis or handball with the selector switch. The ball will be traveling randomly around the court, but there will be no paddles until you press the start button.

In about three seconds the first serve will go to the right-hand player. From then on, anytime a player misses the ball, the score adds one for the opponent, and the next ball is served to the one who missed last. 18 is game, and when this score is reached by either side, the paddles disappear and the ball goes back to bouncing randomly against the walls until the RESET button is pushed, which also makes the score 00:00. You can control both the horizontal and vertical movement of the paddles unless a player is on automatic. In that case you control horizontal, and the computer controls the vertical. You can also vary the paddle size from small to large.

Problems? Interfab offers a repair service for $15, including return postage.

Conclusion. Pong IV is a challenging kit that can be built by any patient hobbyist with reasonable mechanical aptitude and good soldering technique. The result is a game in which you'll take a lot of personal pride. You'll amaze your friends with your skill and intelligence, and you'll be the hit of every party!

Pong IV-D kits are available for $79.50 from the Interfab Corp., 27963 Cabot Road, Laguna Niguel, CA 92677. *Pong IV-C*, which has the printed circuit board parts soldered to the board, costs $89.50, and the completed kit, *Pong IV-B*, is priced at $99.50. Add $4.00 shipping chargest for each unit, and 6% sales tax for California residents. For further information circle no. 73 on the Reader Service coupon. ■

"Breaker 10, Little Buddy . . . My handle is Jaws . . . what's your 20!"

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

A photo print-timer that does everything but turn out the lights! Designed by a darkroom craftsman, it features instant reset, backlighted digit-set dials, pushbutton stop and start.

A battery-operated dickey flasher —guaranteed to liven up **any** party! Suddenly, your shirt buttons start flashing sequentially! Some people laugh. Others just stare. But it's funniest when they try to ignore you!

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

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

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

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

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

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

Mail coupon today for your complimentary copy!

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

But that's not all. You also get instructive articles on electronics, CB and shortwave. Lively columns. Exciting features that make ELEMENTARY ELECTRONICS America's most absorbing, down-to-earth magazine for the electronics and radio hobbyist.

Invaluable Basic Courses in electronic theory!

For example, you get the fundamental training you need to construct your projects successfully—or lay the groundwork for an electronics career.

Each issue presents a Basic Course that helps you master an important aspect of electricity or electronics. Recent subjects included: *Resistors in Combination. Understanding Transformer Action. Introduction to Alternating Current.* And *Understanding Semiconductors.*

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

A magazine with a personality all its own!

You'll meet a lot of interesting people in the pages of ELEMENTARY ELECTRONICS Like Hank Scott, our Workshop Editor. He conducts a regular letters-from-readers column called "Ask Hank, He Knows!" If you have any trouble on a project—or with *anything* electrical—just ask Hank. He knows!

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

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

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

What's more, they have fun. Which means *you'll* have fun, too!

SPECIAL INTRODUCTORY OFFER:

Just mail this coupon, and we'll send you a complimentary copy of ELEMENTARY ELECTRONICS.

Send no money now. We'll bill you later for a year's subscription—a total of six bimonthly issues for $3.49. But if you don't agree the magazine is everything we say it is, simply write "Cancel" across the face of the bill. Send it back to us, keeping the complimentary copy. And you won't owe a cent.

Act today. We're confident that once you see your first copy of ELEMENTARY ELECTRONICS, you'll wonder how you did without it for so long!

ELEMENTARY ELECTRONICS
P.O. Box 2600
Greenwich, CT 06830

YES! Please send, without cost or obligation, my get-acquainted copy of ELEMENTARY ELECTRONICS. If I find it is everything you say it is, bill me for a year's subscription (5 additional issues, for a total of 6 in all) at just $3.49. If I don't wish to subscribe, I will write "Cancel" across your bill, return it, and that will end the matter. Either way, the complimentary copy is mine to keep.

Name (please print)

Address

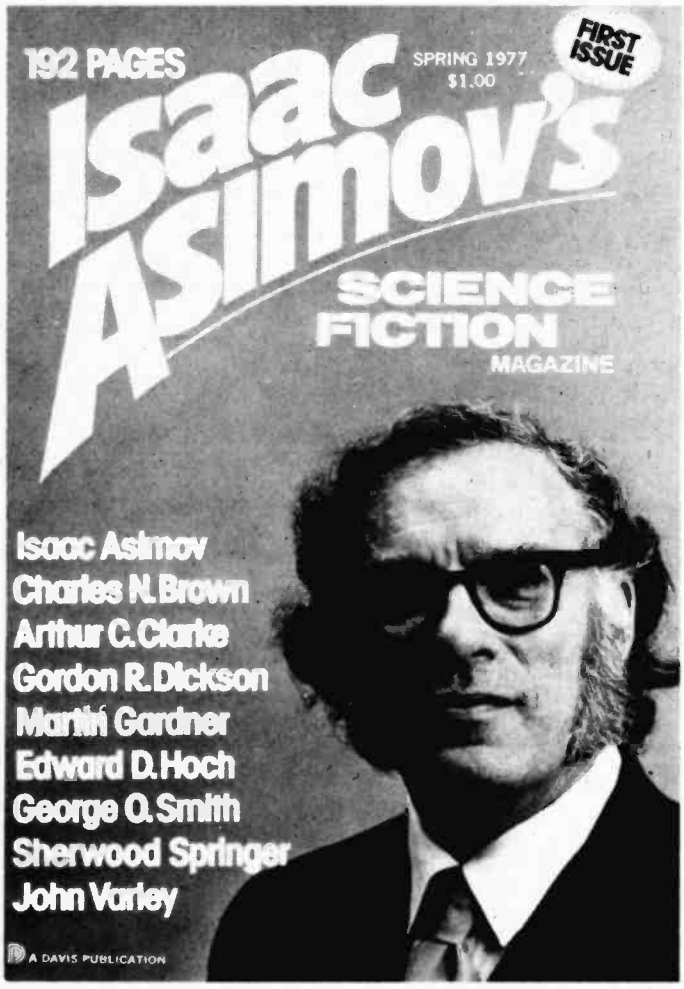
City

State Zip

NO-RISK GET-ACQUAINTED COUPON
SEND NO MONEY! H7C000

ANNOUNCING WHAT SCIENCE FICTION READERS HAVE BEEN WAITING FOR!

—the first quarterly science fiction magazine edited by the most respected and prolific writer in the field! —Published by Davis Publications, Inc.



If you're an SF aficionado, you'll simply want to know how to order a subscription to Isaac Asimov's brand new magazine!

You'll not want to miss the best and all-new science fiction, edited by the man whose following has made the Pied Piper look like a loner.

FIRST ISSUE IS AVAILABLE NOW

ORDER CHARTER SUBSCRIPTION TODAY

and we'll deliver 4 quarterly issues to your doorstep.

Isaac Asimov's Science Fiction Magazine
229 Park Avenue S., New York, NY 10003

☐ Enclosed is $5.40 for 4 issues (includes shipping and postage).

Name_____
(please print)

Address_____

City_____ State_____ Zip_____

EHS7

CLASSIFIED MARKET PLACE

ELECTRONIC HOBBYIST—is published annually. The rate per word for CLASSICIED ADVERTISEMENT is $1.00—payable in advance—minimum ad $15.00. Capitalized words 40¢ per word additional

ADDITIONAL INCOME

UNLIMITED EARNINGS (not a scheme). Product sample and details $2.00. Refundable. Narwid Electronics, 61 Bellot Rd., Ringwood, NJ 07456.

AGENTS WANTED

GET cash commission with each order from friends, neighbors, for America's finest shoes. Easy. Profitable. No experience needed. Selling outfit free! Mason Shoes, K-256, Chippewa Falls, WI 54729.

BLUEPRINTS, PATTERNS & PLANS

NEW CRAFT PRINT CATALOG—Choose from over 100 great easy-to-build plans. Send $1.25 (completely refunded with your first order). BOAT BUILDER, (CP Div.)—299 Park Avenue South, New York, NY 10003.

BOOKS & PERIODICALS

INCOME Educational, Professional, Sports, Music. List 25¢. Wright's, C-222-S.M., Clintonville, WI 54929.

BUSINESS OPPORTUNITIES

FREE Secret Book "2042" Unique, Proven Enterprises." Fabulous "Little Knowns" Work home! HAYLINGS—E14, Carlsbad, CA 92008.

$30.00 HUNDRED Stuffing Our Circulars into Stamped Addressed Envelopes. Immediate Earnings. Beginners Kit $2.00. COLOSSI, 1433-61 Street, DC-2, Brooklyn, NY 11219.

MAKE Magnetic Signs. Big profits. Details, Universal, Lenora, KS 67645.

1000% PROFIT Bronzing Baby Shoes. Free Literature. NBC, Box 1904-DG, Sebring, FL 33870.

HOMEWORK! BIG MONEY addressing, mailing envelopes. Exciting offer 10¢. Linco Services, 3636 Peterson, Chicago 60659.

$25 DAILY POSSIBLE stuffing envelopes! Free details. Srevices, Box 715D, Lynbrook, NY 11563.

MAKE $1000 per month mailing letters. Free details. Tate, Box 443-DP, Morehead City, NC 28557.

NEW IMPORTS REPORT: Our newsletter lists foreign firms and their new products for U.S. distribution. Write for information. International Intertrade Index, Box 636-SM, Newark, NJ 07101.

$10,000 GUARANTEED OR OWE ME NOTHING. No competition. $1,000 per hour possible. Details Free. American, Dept. G, P.O. Box 11065, Orlando, FL 32803.

$300 WEEKLY. Stuff envelopes. Addressed stamped envelope. Aquarius, Box 18438, Milwaukee, WI 53218.

MAKE money. $16,000 or more and have fun. No experience. Dollar gives you details. Box 264, Fort Erie, Ontario L2A 5M9.

NATIONAL BUSINESS COUNCIL. Needs Distributors. Amazingly profitable. Details, NSBAC Box 1127, Topeka, KS 66601.

BUY IT WHOLESALE

STRATUS HOVERCRAFT. Flies over land or water. Completely portable. Details $1.00. Unique Sales, P.O. Box 534, Nitro, WV 25143.

DETECTIVES

POLICE SECURITY INVESTIGATIVE schematics and equipment listings. Quimtronix, Box 546-DV, Seattle, WA 98111.

EDUCATION & INSTRUCTION

UNIVERSITY DEGREES BY MAIL! Bachelors, Masters, Ph.D.s . . . Free revealing details. Counselling. Box 389 EH-27, Tustin, CA 92680.

ELECTRICAL EQUIPMENT & SUPPLIES

APPLIANCES, STEREOS, TELEVISIONS, CB's—Name brands discounted. Douglas 35-105 Arrowwood, Groton, Connecticut 06340.

INFORMATIVE HANDBOOK—For people with an interest in electronics and desire to know more. Covers basic electricity, resistors, capacitors, microwave, facts on frequency, about fuses, circuit breakers, crystals and much more. Send $1.50 for your copy (includes postage) to: Electronics Theory Handbook, 229 Park Avenue South, N.Y., NY 10003.

ELECTRICAL EQUIPMENT & SUPPLIES—Cont'd

FREE 36-page catalog, updated 5 times a year. Everything for the electronics hobbyist—from TV antenna wire to the latest stereo music equipment. ELECTRONIC DISTRIBUTORS, INC. 4900 N. Elston Av., Chicago, IL 60630 EH-3.

EMPLOYMENT INFORMATION

OVERSEAS Jobs—now hiring! All occupations. High pay. Transportation. Computerized reports, $2.00. Transworld, International Airport, Box 90502-EED, Los Angeles, CA 90009.

FORMULAS & TRADE SECRETS

HAVE YOU EVER WONDERED how some people seem to have all the luck and succeed in business? Let us tell you: It's not luck. Details free with S.A.S.E. Motivation, 461 Alter Ave., Staten Island, NY 10306.

HYPNOTISM

FREE Fascinating Hypnosis Information! Startling! DLMH, Box 487, Anaheim, CA 92805.

MAGIC TRICKS, ETC.

FREE Trick and Magic Catalog 25¢ Magic & Fun Box 1936-AV, New York, NY 10017.

MAGNETS

MAGNETS. All types. Specials-20 disc, or 10 bar, or 2 stick, or 8 assorted magnets, $1.00. Magnets, Box 192-E, Randallstown, MD 21133.

MONEYMAKING OPPORTUNITIES

STUFF, MAIL ENVELOPES!! $250.00 profit per thousand possible. Offer details: Stamped self-addressed envelope. Kings, B-21487E-EH-37, Fort Lauderdale, FL 33316.

RECEIVE 10, unique moneymaking plans. $1.00. FLICKINGER, Box 44, Antioch, IL 60002.

NEW-HOME-BUSINESS, Earn $100.-$625.00 DAILY. Be your own boss! Free details. Stamped envelope—Business Box 38287, Houston, TX 77088.

$1,000 MONTHLY possible stuffing envelopes. Free details. DB, 928 Asbury, Evanston, IL 60202.

FREE "1001 ODDS"! $10,000-$100,000 actually made at home by oddballs! You'll never get over it! Publico-E, Carlsbad, CA 92008.

$500.00 WEEKLY! IMMEDIATE, Guaranteed home income stuffing envelopes. FREE Supplies! Send 25¢, Stamp. Profits, B725-DP3, Belen, NM 87002.

$1,000 MONTHLY POSSIBLE! Mailing Commission letters. Information—FREE! Opportunities. Box 721SM, Lynbrook, NY 11563.

MAKING BIG MONEY with AMAZING CB RADIO RELATED PRODUCT BUSINESS. Write: Armand Peres, 2505 Egleston, Burton, MI 48509.

GET INTO BROADCASTING! Earn big money! Start your own station! Free booklet, "Broadcasting," Box 5516GL3 Walnut Creek, CA 94596.

MAKE MONEY NOW! Pros reveals how to write an effective classified ad. Get "How To Write A Classified Ad That Pulls." Includes certificate worth $2.00 towards a classified ad. Send $1.50 (includes postage) to R. S. Wayner, Davis Publications, Inc., 229 Park Avenue South, New York, NY 10003.

MAKE $1,000 MONTH MAILING LETTERS. 2 Stamps, details. Diamond, Rt. 1, Box 137, Diamond, MO 64840.

$500.00 PROFIT Stuffing 1000 envelopes, 25 Cents Details: Canapro Enterprises, Box 215C, Station "H," Montreal, Que., Canada.

RECEIVE 10, unique moneymaking plans. $1.00. FLICKINGER, Box 44, Antioch, IL 60002.

$1,000 MONTHLY possible stuffing envelopes. Free details. DB, 928 Ashbury, Evanston, IL 60202.

CASH FOR BOXTOPS, Labels, details 15¢. Refund Bulletin, Box 503, Cape Girardeau, MO 63701.

$3 HOURLY stuffing envelopes. Easy work. Details free. Feldco, Box 238 Ryder, Brooklyn 11234.

$1,000.00 MONTHLY possible stuffing envelopes. National, Box 4314, Baltimore, MD 21223.

$250 WEEKLY Possible Stuffing letters. Free details. Colonial, Box 1336, Paradise, CA 95969.

MONEYMAKING OPPORTUNITIES—Cont'd

$25.00 DAILY POSSIBLE stuffing envelopes! Details FREE. SERVICE, Box 715SM, Lynbrook, NY 11563.

GET INTO BROADCASTING! Become DJ, engineer. Start own CABLE/FM station, get free tapes-records. Free booklet: "Broadcasting." Box 5516-GC4. Walnut Creek, CA 94596.

BORROW MONEY. No credit check—7 little known secret ways $2.00. Lee Enterprises, 6501 North 8th, Fresno, CA 93710.

$400 WEEKLY POSSIBLE, Clip Newspapers/Stuff envelopes, Proven program. Send stamped addressed envelope, E. MASON, Box 9473-P3B, Fresno, CA 93792.

OF INTEREST TO WOMEN

AMAZING Find. Collection 100-Year-Old Pioneer Recipes. Write: Mormans, 3975 Rawhide, SLC, UT 84120.

PERSONAL

SINGLE? Widowed? Divorced? Nationwide introductions! Identity, Box 315-DC, Royal Oak, MI 48068.

"DATE WITH DIGNITY" Professional Matching. Drawer 6765, Fort Worth, 76115 (817) 921-0281 Anytime.

BEAUTIFUL MEXICAN GIRLS Wanting American Boy-Friends. Details, Photos "Free." World, Box 3876-DC, San Diego, CA 92103.

JAPANESE Girls Make Wonderful Wives. We have large number of listings. Many interested in marriage. Only $1.00 brings application, photos, names, descriptions, questionnaire, Etc. Japan International, Box 156 AA, Carnelian Bay, CA 95711.

DATES GALORE! Meet singles-anywhere. Call DATELINE, toll-free (800) 451-3245.

OVER 1000 beautiful ladies photos, world's largest matrimonial catalog $5.00. Interpress: Box 12, Toronto M4A 2M8 or Box 737, Ft. Lauderdale, FL 33302.

LATIN AMERICAN GIRLS appreciate their men. Let us introduce you to a dark-eyed, unspoiled beauty. Complete application package and photo selection only $2.00: Maria Garcia, Box 80801D, San Diego, CA 92138.

ADULT Pleasure Products—over 600 items! Giant catalog $1.00. Clifton's D-1068, Saugus, CA 91351.

JAPANESE introductions! Girls' photographs, descriptions, brochure, details, $1.00 INTER-PACIFIC, Box 304 SC, Birmingham, MI 48012.

BEAUTIFUL MEXICAN GIRLS! Correspondence! Photos, information $1.00. "Latins," Box 1716-DB, Chula Vista, CA 92012.

PHOTOGRAPHY-PHOTO FINISHING & SUPPLIES

SAVE HUNDREDS OF DOLLARS!!! Make your own S & M Densitometer. Send $3.00 for detailed drawings and instructions. A must for successful photography in your darkroom. Order direct: S & M Instruments, Dept. EH-3. 229 Park Avenue South, N.Y., NY 10003.

RADIO & TV

TV TUBES 36¢ each. Send for Free 48 page color catalog. Cornell. 4217-W University, San Diego, California 92105.

"CRYSTAL Experimenter's Handbook"—50¢. "20 Crystal Set Plans" Handbook—50¢. Catalog 25¢. refundable. Laboratories, 1477-EH, Garden Grove, CA 92642.

REMAILING SERVICE

CONFIDENTIAL! Remail, forwarding-receiving service rates by month or letter. For information, oma Verde Wy, Sacramento, CA 95822.

STAMP COLLECTING

ISRAEL set. Free Approvals. W-B Stamps Co., Wilkes-Barre, PA 18703.

SURPLUS EQUIPMENT

GIANT Bargain Packed Canadian Surplus Catalogs $1.00. Etco Electronics-DG, Box 741, Montreal "A."

THERE IS NO CHARGE FOR THE ZIP CODE—PLEASE USE IT IN YOUR CLASSIFIED AD

Learn to service Communications/CB equipment at home...with NRI'S COMPLETE COMMUNICATIONS COURSE

Learn design, installation and maintenance of commercial, amateur, or CB communications equipment.

The field of communications is bursting out all over. In Citizens Band alone, class D licenses grew from 1 to over 2.6 million in 1975, and the FCC projects about 15 million CB'ers in the U.S. by 1979. That means a lot of service and maintenance jobs . . . and NRI can train you at home to fill one of those openings. NRI's Complete Communications Course covers all types of two-way radio equipment (including CB), AM and FM

Transmission and Reception, Television Broadcasting, Microwave Systems, Radar Principles, Marine Electronics, Mobile Communications, and Aircraft Electronics. The course will also qualify you for a First Class Radio Telephone Commercial FCC License or you get your tuition back.

Learn on your own 400-channel digitally-synthesized VHF transceiver.

You will learn to service all types of communication equipment, with the one unit that is designed mechanically and electronically to train you for CB, Commercial and Amateur communications: a digitally-synthesized 400-channel VHF transceiver and AC power supply. This 2-meter unit gives you "Power-On" training. Then we help you get your FCC Amateur License with

special instruction so you can go on the air.

The complete course includes 48 lessons, 9 special reference texts, and 10 training kits. Included are: your own electronics Discovery Lab, Antenna Applications Lab, CMOS Frequency Counter, and an Optical Transmission System. You'll learn at home, progressing at your own speed, to your FCC license and into the communications field of your choice.

NEW CB SPECIALIST COURSE NOW OFFERED

NRI now offers a special course in CB Servicing. You get 37 lessons, 8 reference texts, your own CB Transceiver, AC power supply and multimeter . . . for hands-on training. Also included are 14 coaching units to make it easy to get your commercial radio telephone FCC license—enabling you to test, install, and service communications equipment.

NRI offers you five TV/Audio Servicing Courses

NRI can train you at home to service TV equipment and audio systems. You can choose from 5 courses, starting with a 48-lesson basic course, up to a Master Color TV/Audio Course, complete with designed-for-learning 25" diagonal solid state color TV and a 4-speaker SQ™ Quadraphonic Audio System. NRI gives you both TV and Audio servicing for hundreds of dollars less than the two courses as offered by another home study school.

All courses are available with low down payment and convenient monthly payments. All courses provide professional tools and "Power-On" equipment along with NRI kits engineered for training. With the Master Course, for instance, you build your own 5" wide-band triggered sweep solid state oscilloscope, digital color TV pattern generator, CMOS digital frequency counter, and NRI electronics Discovery Lab.

™Trademark of CBS Inc.

NRI's complete computer electronics course gives you real digital training.

Digital electronics is the career area of the future . . . and the best way to learn is with NRI's Complete Computer Electronics Course. NRI's programmable digital computer goes far beyond any "logic trainer" in preparing you to become a computer or digital technician. With the IC's in its new Memory Kit, you get the only home training in machine language programming . . . experience essential to trouble shooting digital computers. And the NRI programmable computer is just one of ten kits you receive, including a TVOM and NRI's exclusive electronics lab. It's the quickest and best way to learn digital logic and computer operation.

You pay less for NRI training and you get more for your money.

NRI employs no salesmen, pays no commissions. We pass the savings on to you in reduced tuitions and extras in the way of professional equipment, testing instruments, etc. You can pay more, but you can't get better training.

More than one million students have enrolled with NRI in 62 years.

Mail the insert card and discover for yourself why NRI is the recognized leader in home training. No salesman will call. Do it today and get started on that new career.

APPROVED UNDER GI BILL
if taken for career purposes. Check box on card for details

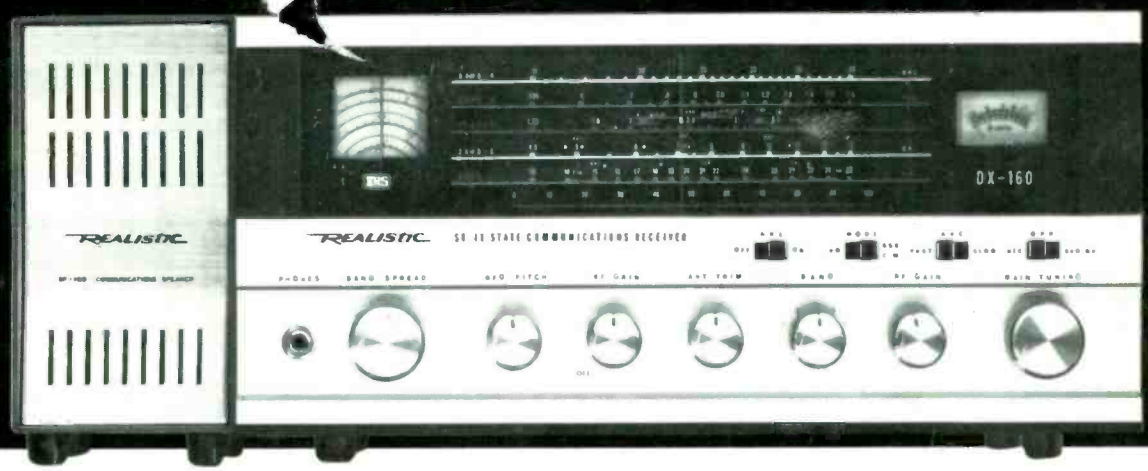
NRI SCHOOLS
McGraw-Hill Continuing Education Center
3939 Wisconsin Avenue,
Washington, D.C. 20016

37-017

Earthquakes, military coups, robberies, fires, drama in the air, on land, at sea...

Two Realistic® ways to follow the action around town

around the world



Realistic PRO-16A. At home or in your car†, even the dullest night comes alive over this deluxe 16-channel scanning monitor. Hear all kinds of emergency calls, weather flashes, even ship-to-shore and mobile phone conversations. A professional-feature model, with a Channel 1 priority circuit, switchable scan delay, and much more. Hear the news as it happens — for just 229.95*. Crystals optional extra, 5.95 each.

Realistic DX-160. Tune in on "the global village" with this versatile 5-band receiver. Monitor all types of transmissions from all over the world — clandestine stations, local news, music, political broadcasts from places like London, Paris, Moscow and beyond! Eleven controls and switches really pull out those distant stations. For Ham, CB, SWL and AM dx-ing — what a way to travel! Just 159.95*.

FREE!
Come in for your copy of our colorful 1977 catalog and see what's *really* new in electronics 164 pages. 2000 items.

SOLD ONLY WHERE YOU SEE THIS SIGN:

Radio Shack®

A TANDY COMPANY • FORT WORTH, TEXAS 76107
OVER 5000 LOCATIONS IN NINE COUNTRIES

*Price may vary at individual stores and dealers. Both models U.L. listed.
†Mobile use in some states and localities may be unlawful or require a permit — check with local authorities.