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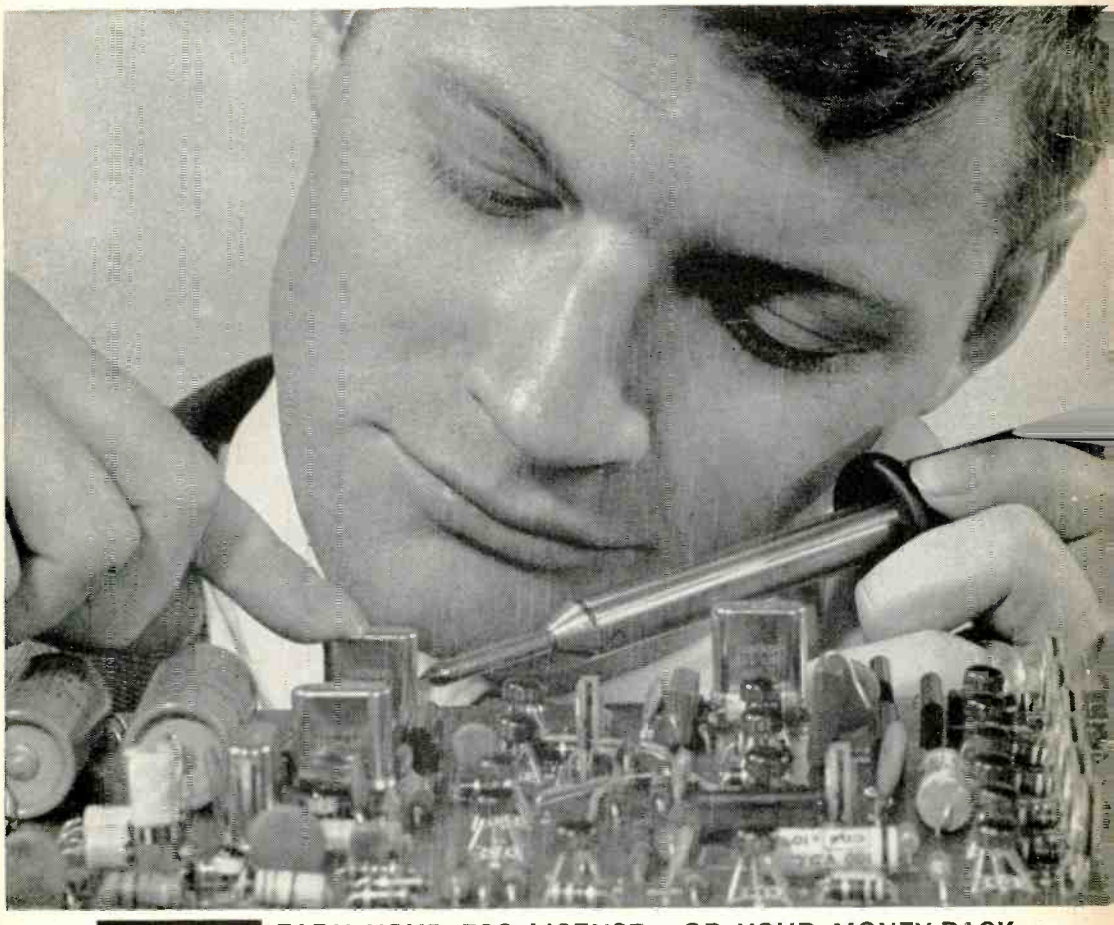

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POPULAR ELECTRONICS

VOLUME 29 NUMBER 4 **OCTOBER, 1968**

WORLD'S LARGEST-SELLING ELECTRONICS MAGAZINE

POPULAR ELECTRONICS is indexed in the Readers' Guide to Periodical Literature

This month's cover photo by Conrad Studios

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Everybody bulls, bluffs and brags about their tape recorders.

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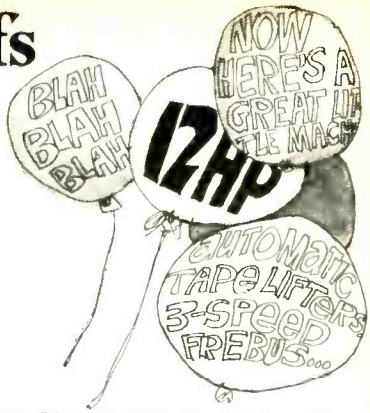

It seems like all tape equipment manufacturers chatter about all sorts of features.

One talks automatic threading. Others boast automatic reverse. Still more hit you with 4 heads, sound-with-sound, dual capstan drive, automatic tape lifters, 3-speed operation and on and on.

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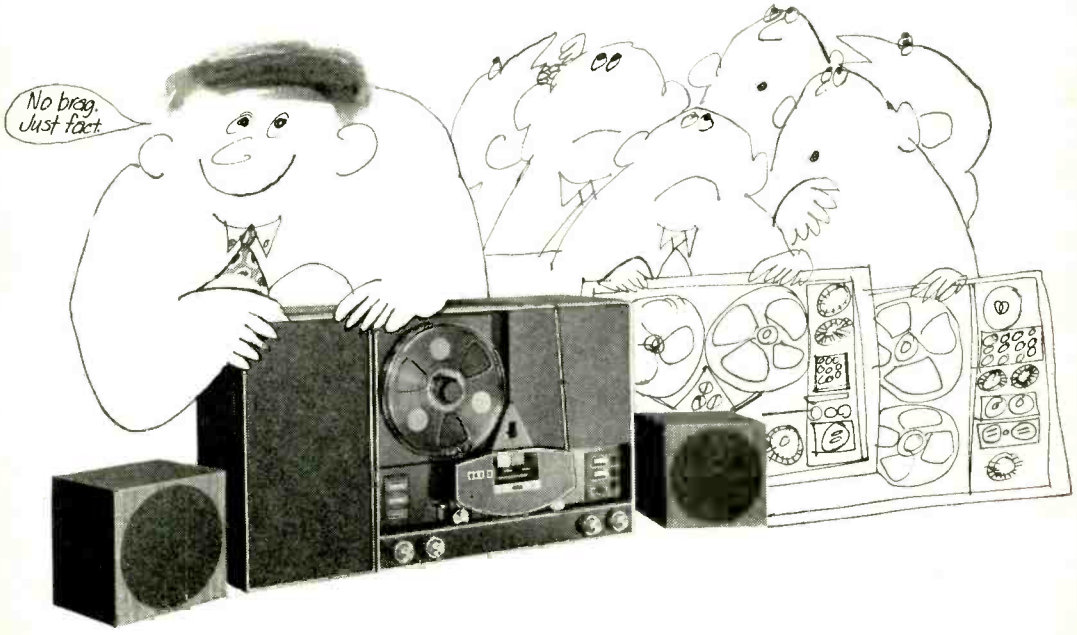

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letters

FROM OUR READERS

DIGITAL MULTIMETER WANTED

Congratulations on your new series of construction articles featuring Don Lancaster's "Low Cost Counting Unit" (February, 1968). Now I am particularly looking forward to an article describing how to build a digital multimeter. As an engineer, I am constantly frustrated in my attempts to make measurements to 1% tolerances with conventional meters. The only thing that has thus far prevented me from buying a digital multimeter is the high prices asked for them. I sincerely hope that POPULAR ELECTRONICS can come up with a price-smashing digital instrument.

FRED MOORE
ROCKVILLE, MD.

During the past few months, we have received literally scores of requests asking us to publish construction plans for a digital volt/multimeter. These requests have not gone unheeded, and those readers who want such an article to appear will not have too long to wait—one is already in the works. We cannot say exactly when the article will appear nor how much the kit of parts will cost. But rest assured that, when the article does appear, construction and parts costs will be only a fraction of the prices demanded for comparable commercial instruments.

WHAT'S INSIDE THE IC'S?

If anything can make me lose interest in a construction project published in POPULAR ELECTRONICS it is the use of integrated circuits which leave too much to the imagination. When I see an IC project, I just pass it by. However, if you showed a schematic diagram of the interior of the IC's you use, it might not be so bad.

J. F. LYCETT
ELCO, PA.

There are two important reasons why we do not show schematic diagrams of the components inside the IC's that appear in our project articles. The first of these is space limitations. Consider, if you will, the modern IC; it usually contains a dozen to several score components—some contain as many as 40 transistors, maybe a dozen diodes, and a multitude of resistors. Including a schematic diagram of even a simple IC is out of the question if all outboard components are to be shown. Add to this the fact that a bad component in an IC usually means replacement of the entire IC—repairs are impossible.

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D. J. Grantham, President

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LETTERS (Continued from page 8)

In addition to space limitations, there is another good reason for leaving out the schematics of IC's: they really aren't necessary. There are only three important things you have to know when using an integrated circuit: the characteristics of the input, the characteristics of the output, and the power requirements. What happens inside the IC is incidental. Either it operates as it should or it doesn't—no other information is necessary.

A great deal of thought has gone into our diagram format for IC projects. As it now stands, POPULAR ELECTRONICS provides more information in the schematic diagrams than the great majority of electronics magazines.

HOW TO CHECK DIODES WITH TEST ADAPTER

The "Transistor Test Adapter For Your VTVM" (July, 1968) is very useful for checking transistors, but how about diodes? Can it be used for checking diodes, and if so, what steps must be followed?

RICHARD W. ORAM
URBANA, ILL.

The test adapter can serve only as a "short/open/good" indicator for diodes. First, connect the diode to be tested to the EMITTER and COLLECTER binding posts. Set S3 to any position, S4 to TEST and S5 to Iceo/h_{FE}. Now, move S1 from one position to the other (NPN and PNP) while observing the meter. If the diode is good, the meter should indicate slightly less than the supply voltage with S1 in one position, and essentially zero volts in the other position. The same supply voltage reading in both positions of S1 indicates that the diode is shorted; zero voltage readings in both positions of the switch indicate that the diode is open.

"PEOPLE DETECTOR" ANTENNA

What is the green and gold device that is shown mounted atop the "Amazing People Detector" (cover photo, June, 1968)?

HAROLD C. HAMPTON
WASHINGTON, D.C.

The device referred to is the antenna and support column for the "People Detector." The gold sections are the antenna elements, while the green acrylic rod is an insulated support. A thin wire, connected at one end to the antenna elements, terminates at the bottom threaded section of the support to allow the screw protruding from the cover to make contact with the elements. The antenna elements shown were fabricated from brass channeling. The antenna design shown was selected for esthetic appeal—not to suggest the best possible configuration.

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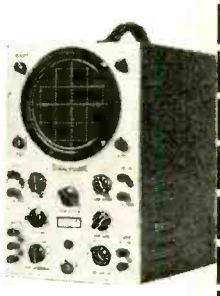

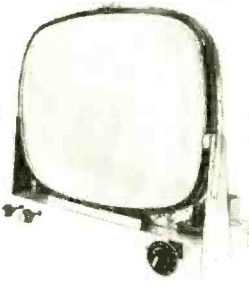

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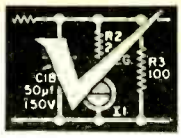

OPERATION ASSIST

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

RCA Model V-215 superhet receiver, 1942 anniversary model. Schematic, parts list, and any other information needed. (Dale E. Wimmer, Rte. #3, Box 350-28, Springfield, Mo. 65804)

Grundig TK819 tape recorder. Schematic needed. (Paul Christie, 44-10 MacNish St., Elmhurst, N.Y.)

Heathkit Model DX-20 transmitter. Manual and instructions needed. (Joe Gabai, 1112 Glenview St., Philadelphia, Penna. 19111)

E.F. Johnson "Pacemaker" SSB transmitter. Operating manual needed. (Clayton Laster, 10915 Burr Oak Dr., San Antonio, Texas 78230)

Paco Model ST-26 FM tuner-amplifier. Source for parts needed. (Sgt. Philip I. Roberts, 2093238, USMC, NROTC Unit, University of Utah, Salt Lake City, Utah 84115)

Philco Model 610 receiver. Schematic and source for parts needed. (Dennis Guza, 22919 Fureon, St. Clair Shores, Mich. 48082)

Crosley Model 179 receiver. Schematic, operating instructions, and source for parts needed. (Chuck Kellum, RR1, Box 3, Mooresville, Ind. 46158)

RCA Radiola 46 Model AR596. Service manual, instruction book, schematic, and parts list needed. (William Boston, 5702 Second Ave., Vienna, W. Va. 26101)

Webcor Model EP2612-1 tape recorder. Operating manual and schematic needed. (John J. McKelvey, III, 5916 N. Marvine St., Philadelphia, Penna. 19141)

Heathkit Model GR-91 SW receiver. Instruction manual needed. (William Goble, 330 Wood St., Clarion, Penna. 16214)

Atwater Kent Model 70 type L chassis. Schematic, operating instructions, and source for parts R14-17 needed. (Michael McFarlane, 422 S. Marks St., Ft. William, Ont., Canada)

Herbert H. Horn Radio Mfg. Co. Model 66MT receiver, circa 1935 or earlier; has 6 tubes; tunes BC and 49 to 16 meters. Schematic needed. (Earl A. Edwards, 518 E. First St., Tucson, Ariz. 85705)

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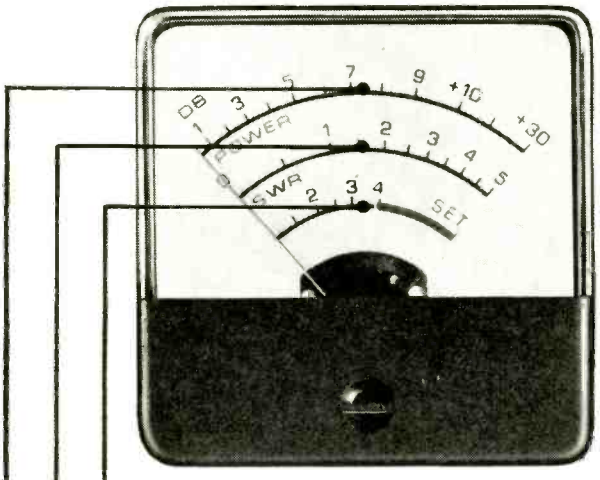

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QUIET

SEMICONDUCTOR HANDBOOK, Second Edition

by Robert B. Tomer

Behind most of the rapid changes taking place in industrial electronics are transistors and integrated circuits. This book brings together most of the pertinent information needed to understand the many types of semiconductors now on the market, their operating characteristics, circuit design procedures, and typical applications. A general discussion, including the basic physics and chemistry used in making transistors, is presented to help the reader select the devices best suited to his needs. In its new edition, this book includes the most recent aspects of industrial electronics—including IC's, thermoelectricity, and solar-energy conversion.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, Ind. 46206. Soft cover. 288 pages. $5.25.

PIN-POINT TV TROUBLES IN 10 MINUTES

by Howard P. Manly

This book is so well illustrated with text, photos, schematic diagrams, and drawings of oscilloscope waveform patterns that even a beginner to TV servicing should have little difficulty in pinpointing the more than 700 TV receiver troubles described. To really simplify troubleshooting, more than 50 charts spotted throughout the book are keyed to an all-inclusive, five-page master chart designed to help locate quickly the correct chart to use. For certain faults requiring special location and correction measures, suggested troubleshooting procedures are clearly presented. The beginning of each section in the book gives information on circuit peculiarities, methods of improving performance, making service tests and adjustments, and checking components.

Published by Tab Books, Blue Ridge Summit, Pa. 17214. Soft cover. 372 pages. $6.95.

MATHEMATICS FOR ELECTRONICS

by Forrest Barker and Gershon J. Wheeler

To provide the basic mathematics needed for the study and practice of applied electronics, this book was written as a text for formal training curricula. However, it is also especially suited for self-study. Each section is self-contained to allow maximum flexibility in coverage. The book offers all of the popular methods of circuit analysis used in modern electronics, demonstrating mathematics as a practical, time-saving tool for the electronics

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LIBRARY (*Continued from page 14*)

enthusiast and student. Many of the problems given are based on actual electronic equipment to provide a motivation for the student to pursue his studies.

Published by Addison-Wesley Publishing Co., Reading, Mass. 01867. Hard cover. 742 pages. $12.50.

MODERN ELECTRONIC CIRCUIT DESIGN

by James D. Long

The author establishes for engineers and engineering-level hobbyists the principles and laws required for circuit design and demonstrates how to apply them to typical design problems. Circuit designers are shown, in step-by-step fashion, the exact procedure to follow in planning efficient and effective practical electronic circuits. Almost every design procedure illustrated is accompanied by a worked-out example. The book is virtually complete in its presentation, including not only the design ideas, but also the mathematics that goes with them.

Published by McGraw-Hill Book Company, 330 West 42 St., New York, N. Y. 10036. Hard cover. 284 pages. $12.50.

ELECTRONIC ENGINEERING NOMOGRAMS

by Max H. Applebaum

A nomogram is a graphical means of determining an unknown value when two or more interdependent values in the same formula are known. Engineers, technicians and hobbyists have found that nomograms simplify design work where very precise accuracy is not required. This book is an encyclopedia of nomograms dealing with vacuum tubes, transistors, conversion tables, transmission lines, filters, etc. The spiral binding of this book permits it to lie flat and the extra large pages eliminate uncertainties in checking values.

Published by Tab Books, Blue Ridge Summit, Pa. 17214. Hard cover with wire spiral spine. 175 pages. $9.95.

UNDERSTANDING ELECTRONICS UNITS AND STANDARDS

by Earl J. Waters

It is impossible to really understand electronics unless you know exactly what is meant by such terms as volt, ohm, ampere, etc. This book is devoted to the nonmathematical explanation of the terms commonly used in electronics. Starting with basic fundamentals of atomic structure and units of measurement, it progresses through current, voltage, resistance, energy and power, capacitance, inductance, time, and frequency. Each of the ten chapters closes with review questions that will help the reader to further understand the subject covered.

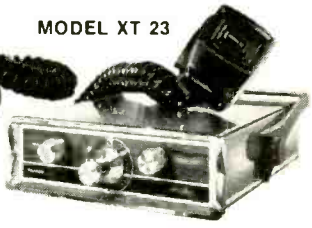
Published by Howard W. Sams & Co., Inc., 4306 West 62 St., Indianapolis, Ind. 46206. Soft cover. 128 pages. $3.25.

Our CB success has gotten out of hand.

MODEL XM 2300

MODEL M 2300

MODEL T 23



MODEL XT 23

Introducing our first great line of 5W base/mobile rigs.

Fanon, world leader in hand-held CB and intercommunication is ready with its first great line of base station/mobile rigs.

Not the largest line in the field—but the finest. Carefully and skillfully developed and engineered for top performance. Units you can place your confidence in...and all made in the U.S.A.

and the finest hand-held CB rig ever produced.

MODEL IC-5000. 3 space age IC Circuits for the ultimate in range and performance. 5 watts & 6 channels. Power boost antenna. Range booster. PA facility. Converts to base station with optional AC power supply. **$99.95**

MODEL M 2300—18 tube performance. Unique modulation sampler. Range expand. All 23 channels. Dual conversion. Built-in PA system — transistorized power supply. **$189.95**

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MODEL XT 23—The finest solid state mobile rig on the market. All 23 channels. Unsurpassed adjacent channel rejection. Helps pierce "skip"

Protected against overload, mismatched antenna and incorrect polarity. Base reflex type audio. Push/pull on-off switch with volume control.

Push/pull noise limiter and squelch. True PA system. **$199.95**

(All prices shown are East Coast suggested retail.)

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FANON ELECTRONIC INDUSTRIES, 439 Frelinghuysen Ave., Newark, N.J. 07114

Your new line looks great! Please send me additional information. I'm especially interested in:

M 2300 ☐ XM 2300 ☐ T 23 ☐ XT 23 ☐ IC 5000 ☐

Name _____ City _____

Address _____ State _____ County _____ Zip _____

CIRCLE NO. 20 ON READER SERVICE PAGE

Two more examples of how RCA Institutes provides up-to-the-minute Home Training in all phases of electronics:

NEW CATV LESSONS

The demand is heavy for technicians in the booming field of CATV (Community Antenna Television Systems).

CATV was initially used to make it possible for large numbers of television receiver users to get good reception in remote areas through the use of a common antenna. It now brings to more people more programs than are available from local stations. It also improves reception where multipath signal transmission exists.

RCA Institutes includes two comprehensive lessons, covering the practical phases of CATV systems and servicing in Television Servicing and Communications courses and programs at no additional total tuition cost. Get in on the ground floor of this rewarding and expanding field. Send for full information today!

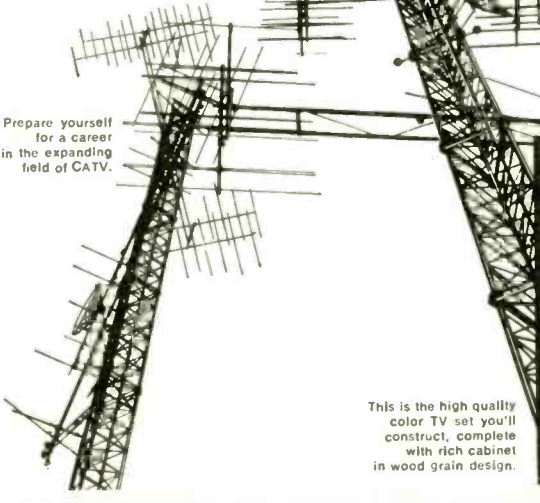
NEW COLOR TV KIT

To make courses even more practical and to better prepare you for a more rewarding future, RCA Institutes now includes an exciting Color TV Kit in both the beginner's program and the advanced course in color TV servicing. The cost of the kit is included in the tuition—nothing extra to pay. You also get five construction/experiment manuals plus a comprehensive service manual.

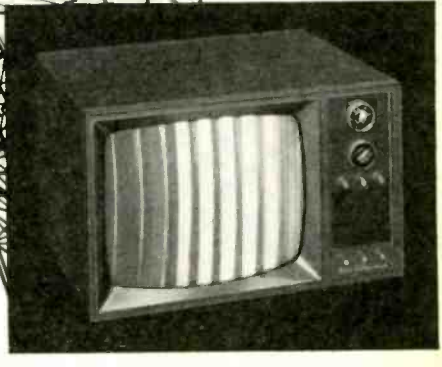
You'll receive all the materials and components to perform over 50 information-packed experiments. When you finish you'll have constructed an 18" (measured diagonally) high quality, color TV set, complete with rich cabinet in wood grain design.

Get all the details on RCA Institutes' valuable new Color TV Kit!

&



Prepare yourself for a career in the expanding field of CATV.



This is the high quality color TV set you'll construct, complete with rich cabinet in wood grain design.

SEND THE ATTACHED CARD TODAY!

Learn electronics at home faster, easier, almost automatically—with RCA AUTOTEXT

Are you just a beginner with an interest in the exciting field of electronics? Or, are you already earning a living in electronics and want to brush-up or expand your knowledge in a more rewarding field of electronics? In either case, AUTOTEXT, RCA Institutes' own method of Home Training will help you learn electronics more quickly and with less effort, even if you've had trouble with conventional learning methods in the past.

THOUSANDS OF WELL PAID JOBS ARE OPEN NOW TO MEN SKILLED IN ELECTRONICS!

Thousands of well paid jobs in electronics go unfilled every year because not enough men have taken the opportunity to train themselves for these openings. RCA Institutes has done something positive to help men with an aptitude and interest in electronics to qualify for these jobs.

HOME STUDY CAN TRAIN YOU FOR REWARDING CAREER OPPORTUNITIES

To help fill the "manpower gap" in the electronics field, RCA Institutes has developed a broad scope of Home Training courses, all designed to lead to a well paying career in electronics in the least possible time. You also have the opportunity to enroll in an RCA "Career Program" exclusively created to train you quickly for the job you want! Each "Career Program" starts with the amazing AUTOTEXT Programmed Instruction Method. And, all along the way, your program is supervised by RCA Institutes experts who become personally involved in your training and help you over any "rough spots" that may develop.

VARIETY OF KITS ARE YOURS TO KEEP

To give practical application to your studies, a variety of valuable RCA Institutes engineered kits are included in your program. Each kit is complete in itself, and yours to keep at no extra cost. You get the new Programmed Electronics Breadboard for limitless experiments, including building a working signal generator, multimeter, and a fully transistorized superheterodyne AM receiver.

ONLY FROM RCA INSTITUTES—TRANSISTORIZED TV KIT—VALUABLE OSCILLOSCOPE

All students receive a valuable oscilloscope. Those enrolled in the Television program receive the all-new transistorized TV Kit. Both at no extra cost and only from RCA Institutes.

CHOOSE THE "CAREER PROGRAM" THAT APPEALS MOST TO YOU

Start today on the electronics career of your choice. Pick the one that suits you best and mark it off on the attached card.

- Television Servicing
- Telecommunications
- FCC License Preparation
- Automation Electronics
- Automatic Controls
- Digital Techniques
- Industrial Electronics
- Nuclear Instrumentation
- Solid State Electronics
- Electronics Drafting

ADVANCED TRAINING

For those already working in electronics, RCA Institutes offers advanced courses. You can start on a higher level without wasting time on work you already know.

2 CONVENIENT PAYMENT PLANS

RCA Institutes offers a unique tuition plan that lets you progress at your own pace. You only pay for lessons as you order them. You don't sign a contract obligating you to continue the course.

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However, if you desire, RCA Institutes also offers a convenient monthly payment plan.

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If you prefer, you can attend classes at RCA Institutes Resident School, one of the largest of its kind in New York City. Coeducational classroom and laboratory training, day and evening sessions, start four times a year. Simply check "Classroom Training" on the attached card for full information.

JOB PLACEMENT SERVICE, TOO!

Companies like IBM, Bell Telephone Labs, GE, RCA, Xerox, Honeywell, Grumman, Westinghouse, and major Radio and TV Networks have regularly employed graduates through RCA Institutes' own placement service.

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RCA

NEW PRODUCTS

Additional information on products covered in this section is available from the manufacturers. Each new product is identified by a code number. To obtain further details on any of them, simply fill in and mail the coupon on page 15 or 95.

STEREO TUNER AND AMPLIFIER COMPONENTS

The famous Model AR-15 stereo receiver made by the *Heath Company* is available as separate components—a tuner and an amplifier—for the component stereo buff. The Model AJ-15 tuner features preassembled, prealigned front end; 1.8-μV sensitivity; two crystal filters in the i.f. strip for a perfect response curve (no alignment ever needed); and a stereo-threshold switch for selection of the most acceptable stereo quality. A noise-operated squelch hushes between-station noise, and a stereo-only switch automatically rejects mono programs during tuning. The companion Model AA-15 stereo amplifier, capable of 150 watts of output power (8-40,000 Hz±1 dB at 1 watt) has virtually the same specifications and controls as the amplifier built into the AR-15 receiver. Both new units are fully solid-state and have "Black Magic" panel lighting.

Circle No. 75 on Reader Service Page 15 or 115

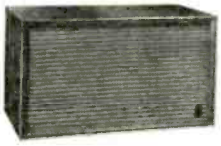
KIT THAT TEACHES RECEIVER THEORY

The "Comancho" Model 2001 eight-transistor superheterodyne receiver kit made by Graymark Enterprises, Inc., is designed to teach the basics of superhet receiver theory. Despite the compactness of the completed kit, the "Comancho" provides ample volume, high selectivity, and good sensitivity. A 36-page instruction manual, supplied with the kit, contains schematic and block diagrams and provides an easy-to-understand project approach to assembly and circuitry/function comprehension.

Circle No. 76 on Reader Service Page 15 or 115

ACOUSTIC—SUSPENSION SPEAKER SYSTEM

Allied Radio Corporation's Model 2300CK three-way acoustic-suspension speaker system has an overall frequency response of 25-20,000 Hz; yet it sells for less than $100. The system consists of a 12" woofer with a 2" voice coil and 6.75-lb. ceramic magnet assembly; compression-type mid-range speaker with diffraction horn; tweeter designed for wide-angle dispersion; balance control for adjustment of highs to room acoustics; and 1000/5000-Hz electrical crossover network. The cabinet is made of ¾" paneling with sculptured walnut molding, and a special-weave grille cloth is used to provide unrestricted passage of all audio frequencies. The speaker system is available fully built and in kit form.



Circle No. 77 on Reader Service Page 15 or 115

TRANSISTORIZED TELEPHONE AMPLIFIER

A transistorized amplifying device that fits almost any telephone earpiece is available from *Saxton Products, Inc.* The "Astro-Com" telephone amplifier has a snug-fitting band for attachment and is small enough to fit into a pocket or purse. Volume is adjustable and a normal speaking voice can be amplified up to five times, making it especially suited to high-noise areas in the home, office, or factory. It comes complete with a 25-hour B-103 Saxitone Battery.

Circle No. 78 on Reader Service Page 15 or 115

STEREO RECEIVER/SPEAKER COMBO

A pair of two-way bookshelf-size speaker systems and a 30-watt solid-state AM/FM stereo receiver make up *Kenwood Electronics'* Model KS-33 hi-fi package. The tuner has a 2.5-μV sensitivity with 0.6% harmonic distortion. Input terminals to the amplifier section are provided for phono, auxiliary, and tape record and playback. The receiver incorporates automatic, silent switching from stereo to mono, an automatic stereo light, and an illuminated tuning meter. The matching speaker systems are housed in heavy, hermetically-sealed walnut enclosures. Two speakers are in each enclosure: a 6½" air-suspension woofer and a 2¾" cone-type tweeter.

Circle No. 79 on Reader Service Page 15 or 115

THE "SIGHT" OF SOUND

Beams of light in brilliant, ever-changing colors swirl and whirl, spill and splash with every beat and blast of music with the

PRODUCTS (*Continued from page 22*)

"MusicVision" color organs recently introduced by *Edmund Scientific Company*. Made up of very few parts, the MusicVision projects light patterns that are motivated by changes in the frequency and intensity of the sound waves. It works as follows: sound vibrations generated by a speaker cause a flexible mirrored surface to oscillate. Then a beam of light that first passes through a revolving color wheel is focused onto the mirrored surface. Several "MusicVision" systems are available, ranging from the most elaborate console model to a very inexpensive do-it-yourself experimenter's kit.

Circle No. 80 on Reader Service Page 15 or 115

PROFESSIONAL SPEAKER COLUMN

The *Argos Products Company's* "Thunder Column" Model 200 portable speaker system is especially designed for today's demanding musician who wants the sound to be focused toward his audience. The system will handle up to 200 watts peak power with a frequency response of 60-13,500 Hz. An exclusive "Cretian Trap" internal baffling system effectively dampens high-frequency bleed-off and virtually eliminates rear-port feedback. The system is fuse protected to accept power overloads without damage, and the speakers are "crush" protected by a steel grille.

Circle No. 81 on Reader Service Page 15 or 115

FM STEREO HEADSET

Based on the use of integrated circuits, the Model RF-10 FM stereo headset available from *Panasonic* contains its own receiver, speakers, and power source. The RF-10 has tuning, balance, tone, and power controls in addition to a mono-stereo switch. The padded headphones contain a telescoping whip antenna that extends from over each earpiece. The over-the-head connecting band can be adjusted to fit any wearer. The RF-10 is powered by three 'AA" batteries.

Circle No. 82 on Reader Service Page 15 or 115

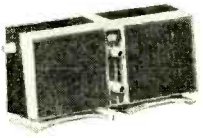
PA/HOME RECORDING MICROPHONES

Three series of public-address microphones suitable for home recording are available from *Astatic Corporation*. The Series 810 are ultra-cardioid microphones, while the Series 820 and 840 are omnidirectional probe and lavalier microphones, respectively. Each microphone is available with or without switches and in brushed chrome or brushed-satin gold finish. Model 810 has a 25-dB front-to-back ratio, and its unidirectional pickup pattern minimizes reverberation problems in difficult installations. Its frequency response is 40-15,000 Hz, and its impedance can be quickly changed to high or low. Model 820, with the same frequency response, is particularly suited for hand-held use. Model 840 is a low-impedance microphone featuring a 50-12,000-Hz lavalier and 50-16,000-Hz hand-held frequency response. The switched version model number of each microphone series is suffixed by the letter "S".

Circle No. 83 on Reader Service Page 15 or 115

PUBLIC SERVICE BAND RECEIVER

Professional quality reception of the police, fire, and civil-defense bands is claimed for a new public service band receiver available from *Trojan Electronics, Inc.* The receiver is designed to pick up signals of one to six requested frequencies anywhere in the 150-174 MHz band. Interference is overcome by an adjustable squelch control. A delta fine tuning control is provided for minimum-distortion reception even in difficult and distant areas. The receiver has a 0.5-μV sensitivity, and its solid-state circuitry is designed to operate from a 117-volt a.c. source. Also, instead of the common 90-day warranty, the new receiver is guaranteed on parts and labor for a full year.



Circle No. 84 on Reader Service Page 15 or 115

SOLID-STATE RHYTHM BOX

Nine rhythms are featured in the *Olson Electronics, Inc.* Model X-81 rhythm instrument. These include waltz; swing; surfin; twist; bossa-nova; samba; rhumba; mambo; and cha-cha. The instruments simulated are: bass drum; conga drum; tom-tom; claves; cymbals; maracas; and snare drum. Other features include tempo and volume controls, pushbutton rhythm selector, and on/off switch. The Rhythm Instrument can play through guitar, hi-fi, or almost any other type of audio amplifier. It automatically selects the instruments to match the rhythms; two rhythm patterns can even be mixed to create one new pattern. Foot controls are also provided for turning on and off the rhythms.

Circle No. 85 on Reader Service Page 15 or 115

NEW FINCO® COLOR SPECTRUM T.M. antennas are "signal customized" for better color reception...

"the ANTENNA that captures the RAINBOW"

FINCO has developed the Color Spectrum Series of antennas—"Signal Customized" — to exactly fit the requirements of any given area. There is a model scientifically designed and engineered for your area.

Check this chart for the FINCO "Signal Customized" Antenna best suited for your area.

STRENGTH OF UHF SIGNAL AT RECEIVING ANTENNA LOCATION ▼	Strength of VHF Signal at Receiving Antenna Location				
	NO VHF ▼	VHF SIGNAL STRONG ▼	VHF SIGNAL MODERATE ▼	VHF SIGNAL WEAK ▼	VHF SIGNAL VERY WEAK ▼
NO UHF →		CS-V3 $11.50	CS-V5 $18.50 CS-V7 $25.95	CS-V10 $37.95	CS-V15 $50.95 CS-V18 $59.50
UHF SIGNAL STRONG →	CS-U1 $10.50	CS-A1 $19.95	CS-B1 $31.50	CS-C1 $45.95	CS-C1 $45.95
UHF SIGNAL WEAK →	CS-U2 $15.95	CS-A2 $23.95	CS-B2 $41.95	CS-C2 $54.50	CS-D3 $73.50
UHF SIGNAL VERY WEAK →	CS-U3 $22.95	CS-A3 $32.50	CS-B3 $52.50	CS-C3 $62.95	CS-D3 $73.50

All Prices Subject to Change

NOTE: In addition to the regular 300 ohm models (above), each model is available in a 75 ohm coaxial cable downlead where this type of installation is preferable. These models, designated "XCS", each come complete with a compact behind-the-set 75 ohm to 300 ohm balun-splitter to match the antenna system to the proper set terminals.

FINCO — MADE BY THE WORLD FAMOUS COLOR / BLACK & WHITE TELEVISION COMPONENTS AND ACCESSORIES

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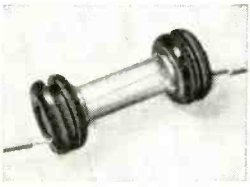
CIRCLE NO. 21 ON READER SERVICE PAGE

PARTS/METHODS/IDEAS/GADGETS/DEVICES

tips & techniques

PIGTAILS FOR 3AG FUSES

It is often difficult to obtain pigtail-type fuses from local electronics parts dealers—they just aren't as common as they used to be. So, what do you do if you need to replace this type of fuse in a hurry? You *can* solder wires to the caps of conventional fuses, taking the chance that this will not "blow" the fuse as a result of the applied heat. A second and safer alternative is to secure pigtails to the fuse caps with snug-fitting rubber grommets. You simply force 3/16" rubber grommets over the fuse caps, wedging the wire pigtails between the grommets and caps. This home-brew technique will suffice temporarily until you can stock up on regular pigtail-type fuses.



Tod Wagner

MONO ADAPTER FOR STEREO HEADPHONES

Chances are that you have comfortable headphones which you would like to use with your communications receiver without changing the plug on the headphones or the jack in the receiver. This can be accomplished by mounting a two-circuit jack and a one-circuit plug at opposite ends of a 35-mm color film cannister. The plug should be offset to one side of the cannister as shown in the photo so that, when the cannister is closed, the jack won't interfere with the plug. (Also, the offset phono plug allows the adapter to be used with receivers, such as the Drake SW-4A, that have a panel extension.) Wire the two "signal" contacts on the jack and the "signal" contact on the plug together. Do the same for the "common" contacts. Finally, screw on the cannister top, and the adapter is ready to use. —*A. A. Wicks*

INEXPENSIVE ISOLATION TRANSFORMER

Many hobbyists and experimenters have hesitated to buy a line-isolation transformer because of the high price. Yet, for less than $9, you can assemble a 120 volt-ampere isolation

here's the real low-down on radiation angle:

How do you increase the "reach power" of a CB base antenna? One way is to design a *low down angle of radiation*—a technique antenna engineers have wrestled with for years

Radical new approach—the Mini-Skirt!

Another engineering first from A/S—a new and highly effective counterpoise capacity loaded "skirt" that drastically lowers the radiation pattern . . . effectively concentrates radiated power where you want it (*out*, not up!) produces an excellent 3+dB gain for greater communications range.

Compact . . . looks great . . . mounts anywhere!

Small, graceful, Mini-Skirt "fits" anywhere. Only 12'-6" tall, skirt radius just 32"!

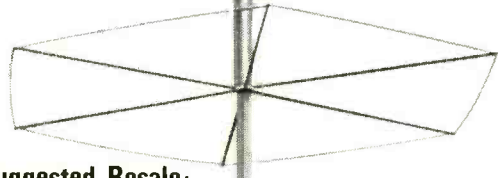
Professional design, electrically, mechanically!

Mini-Skirt employs a professional-type coaxial feed for maximum power transfer impedance matching. It is constructed of polished aluminum with solid aluminum radials and skirt linkage ring (wind rating over 90 MPH!) yet weighs only 5 lbs VSWR: a professional-standard 1.5:1 or better!

The spectacular new

MINI-SKIRT

Model M-200 coaxial-feed CB Base Station Antenna



Suggested Resale: $19.95

"Stripes of Quality"®

the antenna specialists co.

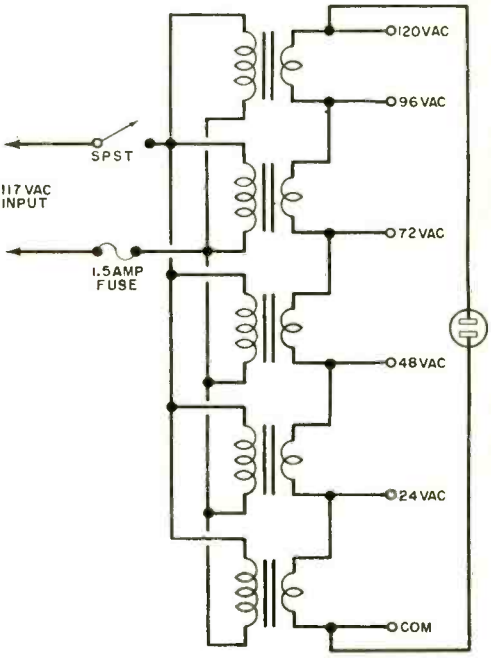
Div. of Allen Electric & Equipment Co.
12435 Euclid Ave., Cleveland, Ohio 44106
Export Offices: 2200 Shames Dr., Westbury, N.Y. 11590

CIRCLE NO. 4 ON READER SERVICE PAGE

TIPS

(*Continued from page 26*)

transformer setup and have taps spotted at 24-volt intervals as a bonus. What you need are five 117-volt primary/24-volt, 1-ampere secondary transformers—available for as low

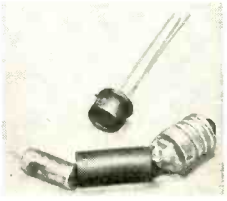


as $1.79 each from Lafayette Radio Electronics (catalog number 99 H 6266). Wire all primary windings in parallel with each other; wire the secondaries in series in the proper phase as shown in the schematic drawing. Then, protect the setup by inserting a 1.5-ampere fuse in one of the lines of the primary circuit. Attach a line cord across the primary and an a.c. receptacle across the entire string formed by the secondaries.

—*Frank H. Tooker*

HEAT-SHRINKABLE TUBING COUPLES PHOTOCELL TO LIGHT SOURCE

The next time you build a project that uses a photocell control circuit, use heat-shrinkable tubing to join the lamp and photocell mechanically end-to-end to produce a light-tight coupling. After butting the lamp and photocell together, slip a length of the heat-shrinkable tubing over the two. The length of tubing used should be adequate enough to allow ¼" overhang at the ends of the lamp and photocell. Shrink the tubing, making sure the overlap makes a good seal.



—*Royland Pettersen*

Scott's new LR-88 receiver takes the

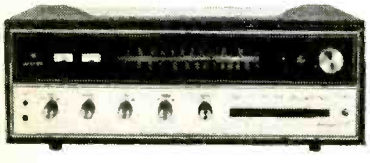
out of kit building

Building a kit used to be something you couldn't do with ladies and children present, but Scott's new LR-88 AM/FM stereo receiver kit has changed all that. First, there's the instruction manual. In clear and simple language, it leads you, step-by-step, through every stage of the assembly process. And each stage is illustrated . . . full-size, full-color. Next, there's Scott's ingenious new Kit-Pak®. The parts for each assembly stage are in individual compartments, keyed to the instructions. All wires are color-coded, and pre-cut and pre-stripped to the proper sizes. Difficult or critical sections are pre-wired, pre-aligned, pre-tested, and factory-mounted on printed circuit boards. Is soldering your bugaboo? Scott has provided push-on solderless connectors for the hard-to-get-at spots.

About thirty painless hours after you've started, you've completed one great receiver. The LR-88 is the 100-Watt kit brother to Scott's finest factory-wired beauties. It includes the famous Scott silverplated Field Effect Transistor front end, Integrated Circuit IF strip, all-silicon output circuitry . . . in fact, all the goodies that would cost you over a hundred dollars more if Scott did all the assembling. Performance? Just check the specs below . . . and you'll be amazed at how great a receiver sounds after you've built it yourself. Treat yourself to a weekend of fun and years of enjoyment . . . see the Scott LR-88 at your dealer's today.

LR-88 Control Features: Dual Bass and Treble; Loudness; Balance; Volume compensation; Tape monitor; Mono/stereo control; Noise filter; Interstation muting; Dual speaker switches; Stereo microphone inputs; Front panel headphone output; Input selector; Signal strength meter; Zero-center meter; Stereo threshold control; Remote speaker mono/stereo control; Tuning control; Stereo indicator light. **LR-88 Specifications:** Music Power rating (IHF), 100 Watts @ 4 Ohms; Usable sensitivity, 2.0 μV; Harmonic distortion, 0.6%; Frequency response, 15-25,000 Hz $\pm$ 1.5 dB; Cross modulation rejection, 80 dB; Selectivity, 45 dB; Capture ratio, 2.5 dB; Signal/noise ratio, 65 dB; Price, $334.95.

You'll swear by it



Write for complete information on the new Scott components and kits.
H.H. Scott, Inc., Dept. 520-10,
Maynard, Mass. 01754
Export: Scott International,
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Maynard, Mass. 01754

Walnut case optional extra

H.H. SCOTT®

CIRCLE NO. 38 ON READER SERVICE PAGE

BUILD THE SPORTS TIMER

Get thousandths-of-a-second accuracy up to 10 minutes—useful for a variety of sports events

THE AVAILABILITY OF LOW-COST decimal-readout counting units has created an entirely new "ball park" of experimentation for the advanced electronics hobbyist. This new area is digital-readout instruments and we will be publishing several articles on such projects in the months to come. The first is the "Sports Timer," a real-time clock, described here.

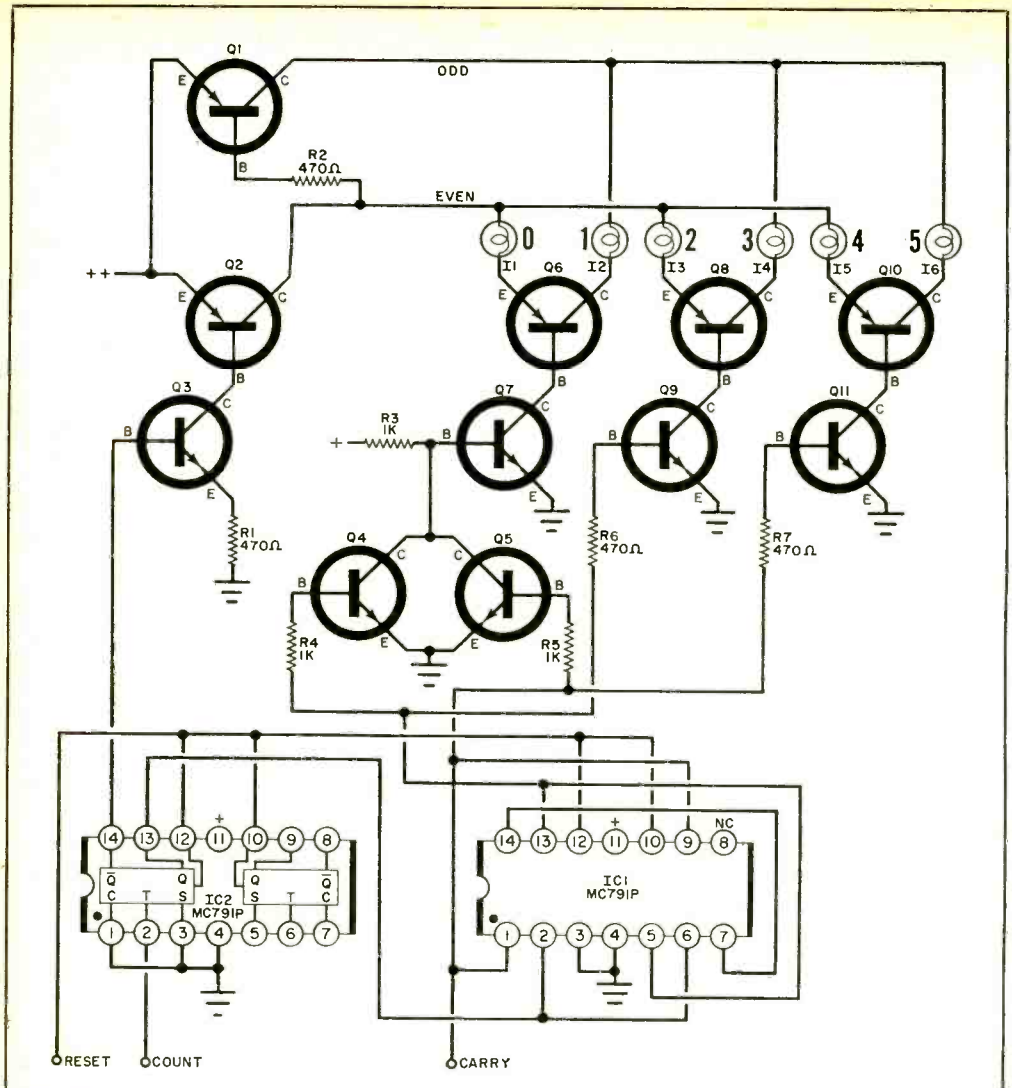


Fig. 1. The modulo-6 counter indicates only up to five, then returns to zero. Simultaneously, it passes a carry (trigger) pulse to the next decade counter.

The clock is basically a combination of two previous projects ("Low-Cost Counting Unit," February 1968, page 27, and "Ultra-Fast Electronic Stopwatch," March 1968, page 27) with the addition of a modulo-6 counter that counts, and indicates, to 5 and then returns to zero. This counter is required in real-time measurements in order to get the 5 needed in measuring 59 seconds or 59 minutes before switching to the next register. (Remember that the original counter reads out to 9 before returning to zero.)

The "Sports Timer" is designed to read out to 9 minutes and 59.999 seconds,

PARTS LIST

I1-I6—6.3-volt, 50-mA pilot light and cap assembly (Southwest Technical Products #0-6.3 or similar)
IC1, IC2—MC791P dual JK flip-flop integrated circuit (Motorola)
Q1, Q2, Q4, Q6, Q8, Q10—MPS3638 or 2N5139
Q3, Q5, Q7, Q9, Q11—MPS2923 or 2N5129
R1, R2, R6, R7—470-ohm, ½-watt resistor
R3, R4, R5—1000-ohm, ½-watt resistor
A complete kit of parts for the modulo-6 counter is available from Southwest Technical Products Corp., 219 W. Rhapsody, San Antonio, Texas 78216, for $10.00, postpaid in U.S.A.

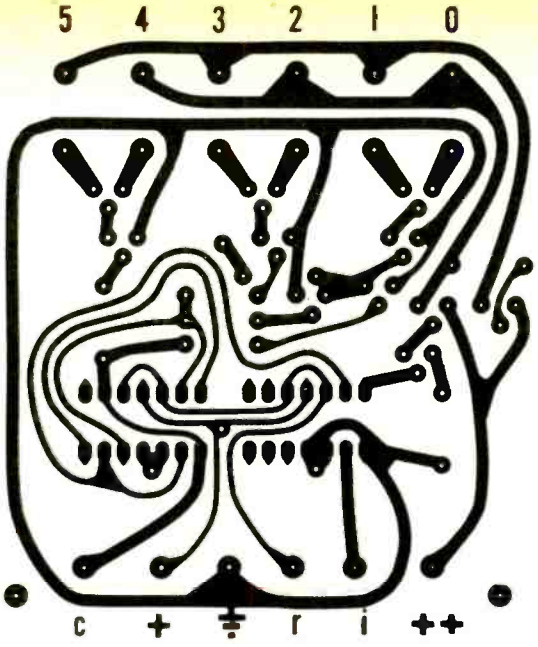


Fig. 2. Actual-size foil pattern for the modulo-six counter. It is the same size as the boards used for the other circuits (see text) simplifying construction of timer.

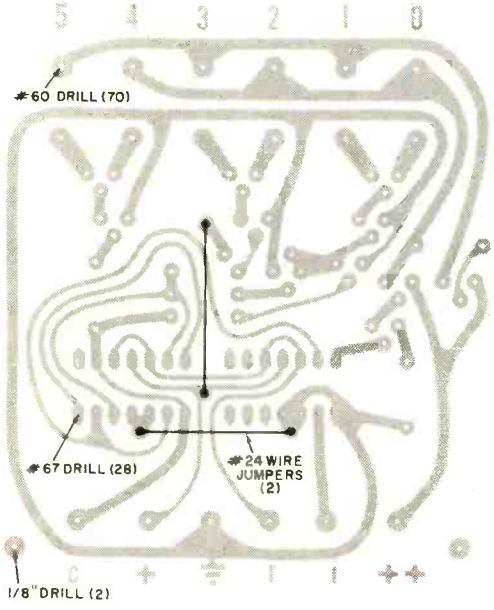


Fig. 3. Drill the PC board as shown here, and add the two insulated jumpers on component side of board.

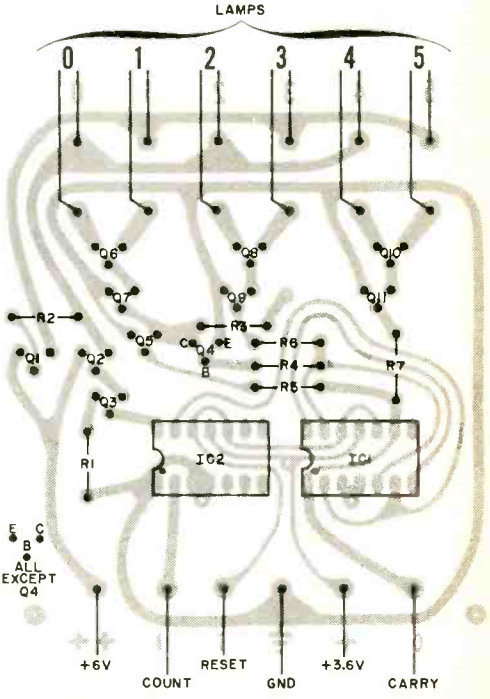
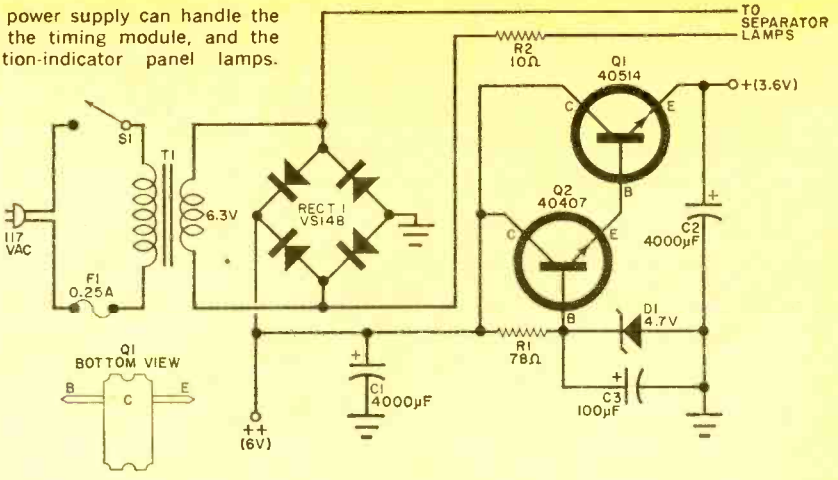


Fig. 4. Mount the components as illustrated here making sure that you orient the semiconductors properly. Note Q4 is not installed in same was as Q1-Q11.

Fig. 5. The power supply can handle the six DCU's, the timing module, and the three position-indicator panel lamps.



PARTS LIST

C1, C2—4000-μF, 6-V electrolytic capacitor
C3—100-μF, 15-V electrolytic capacitor
D1—4.7-V zener diode
F1—0.25-A fuse
R1—78-ohm, 1-W resistor (two 39-ohm, 1-W resistors in series)
R2—10-ohm, ½-W resistor
RECT1—Full-wave bridge rectifier (Varo VS148, or similar)
S1—S.p.s.t. switch
T1—Filament transformer; secondarys 6.3 V, 2 A
Q1—40514 power transistor (RCA)
Q2—40407 transistor (RCA)
Misc.—Heat sink for Q1, fuse holder, silicone grease, wire, solder, four standoffs, etc.
A complete kit of parts is available from Southwest Technical Products Corp., 219 W. Rhapsody, San Antonio, Texas 78216, for $9.75, postpaid in U.S.A.

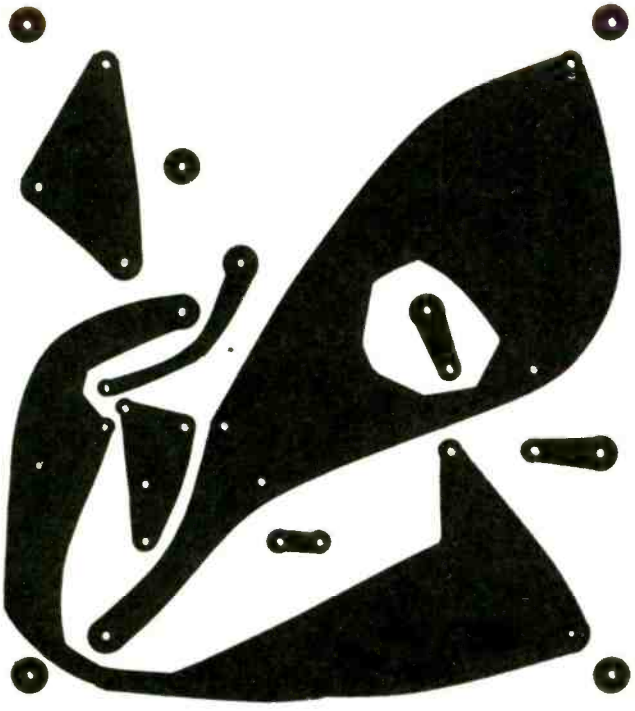


Fig. 6. Actual-size foil pattern for power supply. Like all the other PC boards, this one is also available etched and drilled (see Parts List for ordering details).

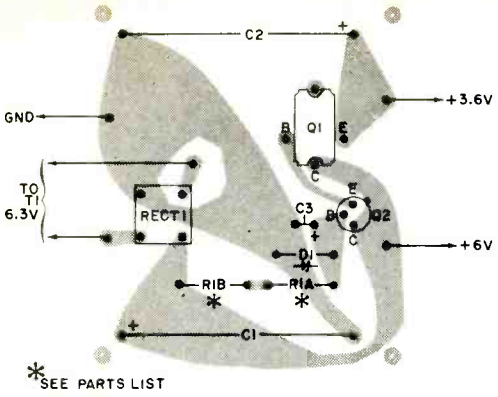


Fig. 7. Component installation on the power supply PC board. Note that R1 is two resistors in series.

which should be sufficient for the majority of track events, auto races, swimming contests, ski runs, etc. If desired, however, the maximum time can be extended to read up to 9 hours, 59 minutes and 59.999 seconds. Besides sporting events, the clock can be used to time tape recordings and speeches and has applications in laboratories, photo darkrooms, or any other activity where an illuminated readout clock capable of measuring to small parts of a second can be used.

The clock can be started and stopped in a variety of ways. A photoelectric start-and-stop circuit (described in this article) is one way; others include the operation of mechanical contacts, such as pushbutton switches or step-on doormat switches. If desired, the clock can be started from a microphone and amplifier system adjusted to pick up the crack of the starter's pistol. The number of triggering methods possible is limited only by the imagination of the user.

Construction. Because the decade counting units and the crystal-controlled timing circuit have already been described in detail (see the previously mentioned issues of POPULAR ELECTRONICS) only the modulo-6 counter will be covered here.

The basic modulo-6 counter (schematic shown in Fig. 1) uses two low-cost IC's, eleven transistors, 7 resistors, and six incandescent bulbs. Cost of this counter is $10 (see Parts List). An actual-size printed-circuit-board foil pattern is shown in Fig. 2, while Fig. 3 shows how the board is to be drilled and the location of the two jumpers required. These jumpers are made from #24 solid wire and are added on the component side of the board.

When mounting the components, as shown in Fig. 4, be sure to observe the correct positioning of all semiconductors, noting that the IC's are identified by a notch and dot code at one end. Use a low-wattage soldering iron and fine solder to make all connections.

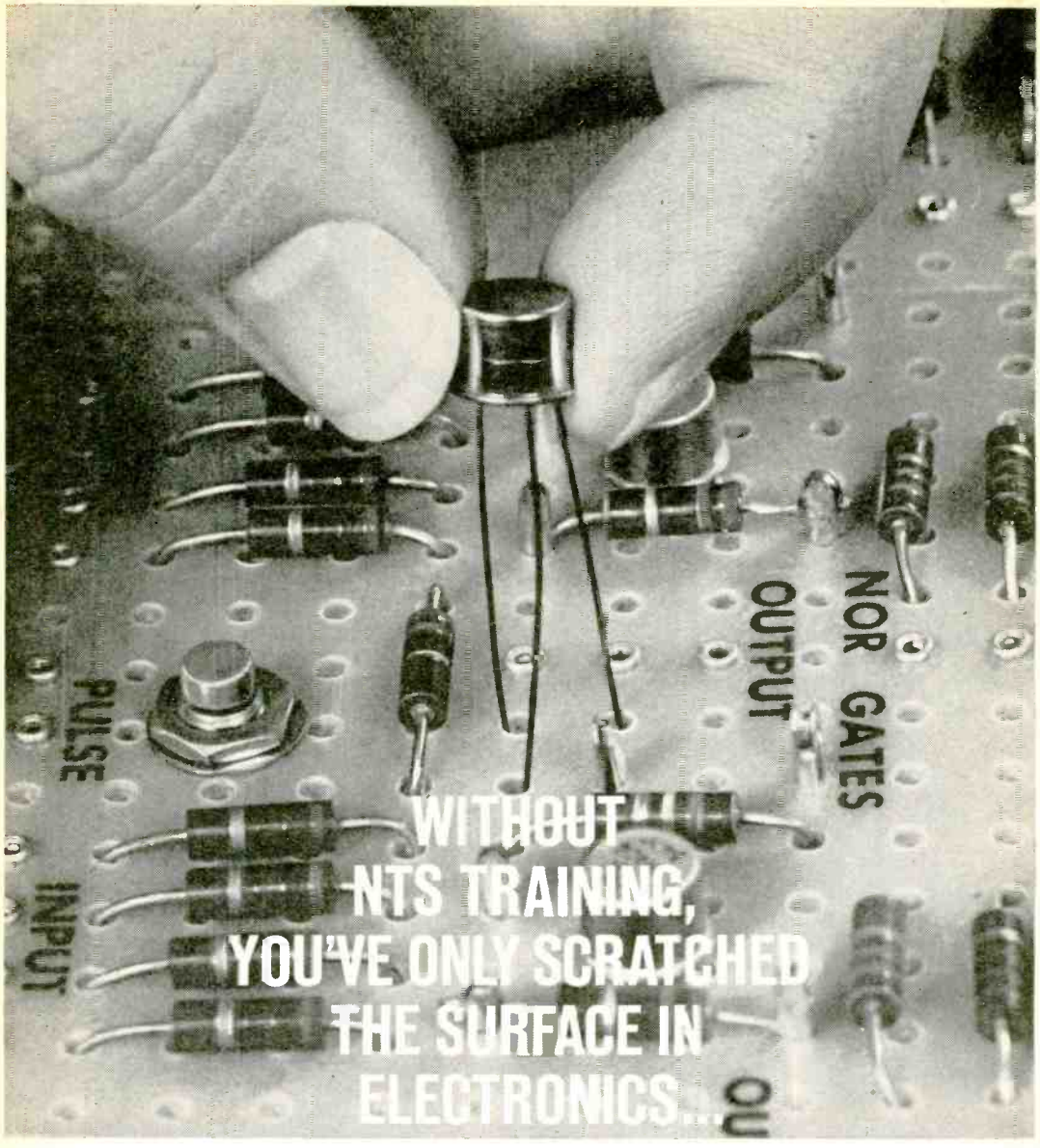
If desired, a readout-lamp display bracket can be cut and bent from a piece of 1/32" aluminum similar to that shown in the February issue. Pop rivets can be used to secure the bracket to the board. Press the plastic lamp covers into the six holes, then press the bulbs into the plastic covers. After each bulb is wired to its correct terminals, use black "instant transfer" numerals to identify them, coating the numbers with a clear acrylic spray to prevent accidental removal.

Note that, in the finished clock, lamp mounting brackets are not used on any of the readouts, but holes are drilled in the front panel using the lamp brackets (provided with each kit) as a template. If you select this method of construction, be sure to leave *all* lamp leads as long as possible before soldering the far ends to the PC boards.

To duplicate the "Sports Timer" shown in the photos, you will need five 0-9 counting units, one 0-5 counting unit, a crystal-controlled timer, three 6.3-volt lamps and plastic covers, a power supply, and a chassis.

Power Supply. The power supply provides 3.6 volts at very low ripple for use by the IC's, 6 volts for the numerical-display incandescent lamps, and approximately 6.3-volts a.c. for the three position-indicator lamps (two making up the colon, and one for the decimal point). A suitable supply, shown in Fig. 5 consists of a transformer-powered bridge rectifier followed by a two-transistor, zener-diode-controlled regulator. The separator lamps get power from *T1* through dropping resistor *R2*.

The power supply can be assembled on the printed board shown actual size in Fig. 6. All parts, with the exception of power transformer *T1*, fuse *F1*, and dropping resistor *R1* are mounted on the board as shown in Fig. 7.



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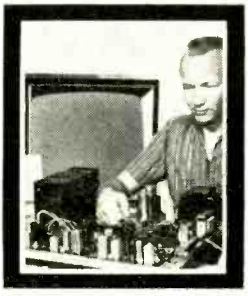

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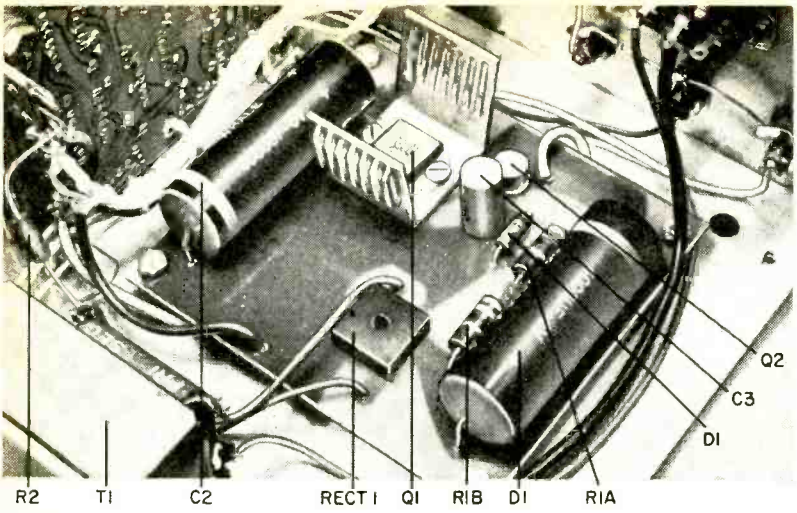

To prevent components from shorting against chassis, install spacers between the chassis and the power supply board.

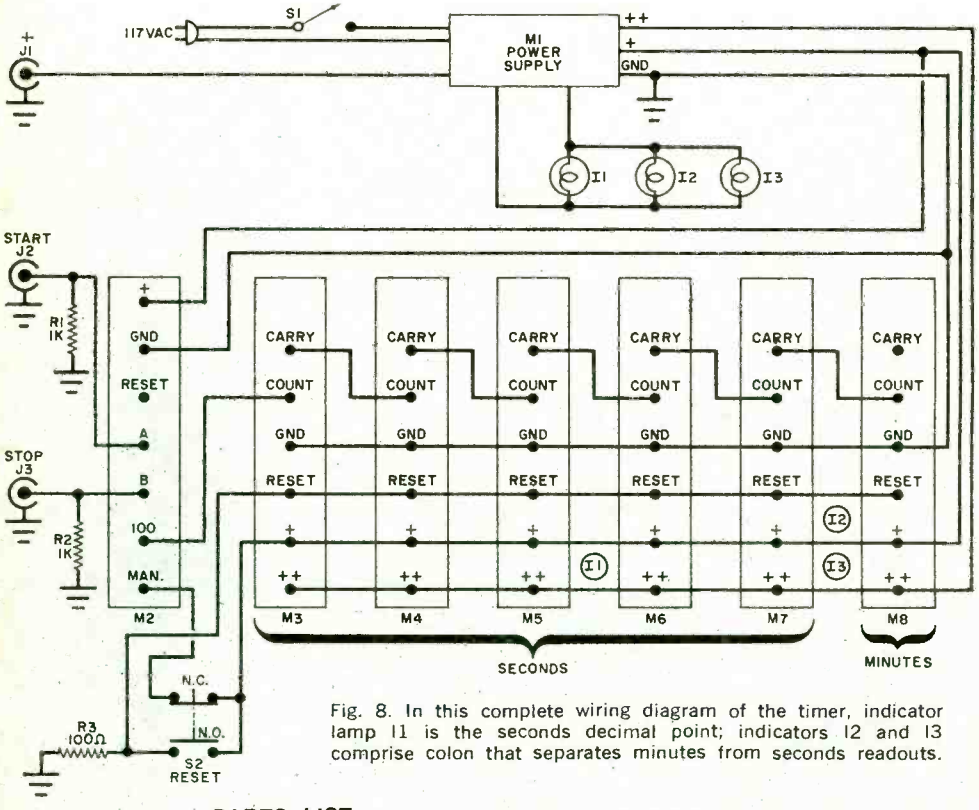

Fig. 8. In this complete wiring diagram of the timer, indicator lamp I1 is the seconds decimal point; indicators I2 and I3 comprise colon that separates minutes from seconds readouts.

PARTS LIST

I1, I2, I3—6.3-V, 50-mA pilot light and cap assembly, two green, one red (Southwest Technical Products #0-6.3, or similar)
J1, J2, J3—Phono jacks, RCA types
M1—Power supply
M2—Timing module
M3, M4, M5, M6, M8—Decade counting unit
M7—Modulo-6 counter
R1, R2—1000-ohm, ½-W resistor
R3—100-ohm, ½-W resistor
S1—S.p.s.t. switch
S2—S.p.s.t. momentary pushbutton switch
Misc.—Chassis, mounting hardware, line cord, adhesive-contact plastic (optional), wire, solder, etc.

The following parts are available from Southwest Technical Products Corp., 219 W. Rhapsody, San Antonio, Texas 78216: Timing module kit with 100-kHz, 0.005% crystal, $24; decade counters, $12; chassis, punched, primer coated, and with covering material for top, $6.50.

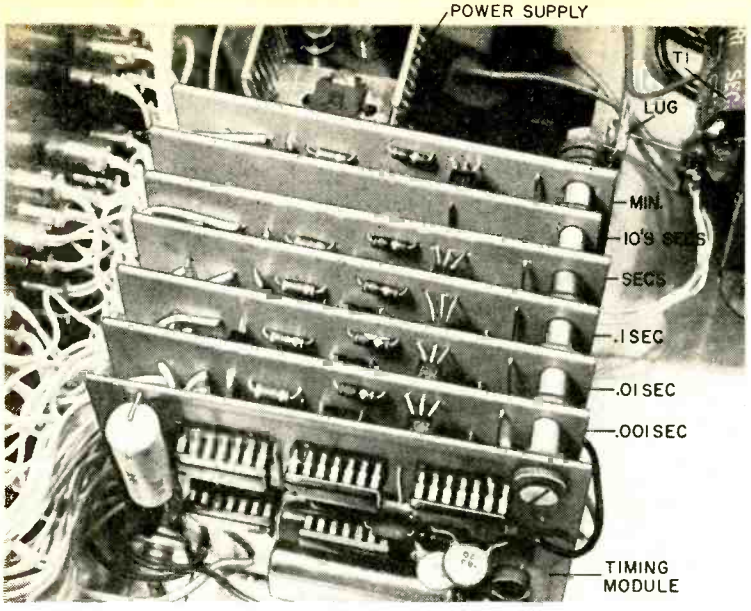

Fig. 9. Timing module and DCU circuit boards should be stacked for space conservation and neatness. Use ½"-long insulated spacers (or metal spacers and fiber washers) between each board for adequate separation. Board designations from bottom to top are M2 through M8.

Assembly. The 10" wide by 3½" high by 7" deep metal chassis, used by the author consists of two U-shaped sections. One serves as the mounting chassis for the completed circuit (Fig. 8) and the other is used as the cover.

Start the assembly by drilling the required holes in the front panel for the readouts, using the lamp bracket as a template. The plastic lamp covers are press-fit into the holes, and the lamps are press-fit into their covers. Therefore, when assembling the counters, use the full length of wire provided with each lamp. Don't forget to drill the three holes for the position identifier lamps. Drill a hole to accept the RESET push-button *S2*, power ON-OFF switch *S1*, and three phono jacks *J1*, *J2* and *J3*.

Before mounting any components on the front panel but after drilling the required holes, cover the entire front panel with a contact-adhesive plastic coating whose pattern or color appeals to you. Use a sharp knife to remove the material from the area where the holes are. Apply the front panel markings with any type of instant-transfer lettering. The box outline was made with thin black tape. The author used a red plastic cover for the decimal indicator (*I1*) and a green cover for the colon indicator (*I2, I3*).

The interior layout is shown in Fig. 9. The seven printed boards are separated from each other with ¼" spacers at the two rear mounting holes. If metal

(*Continued on page* 112)

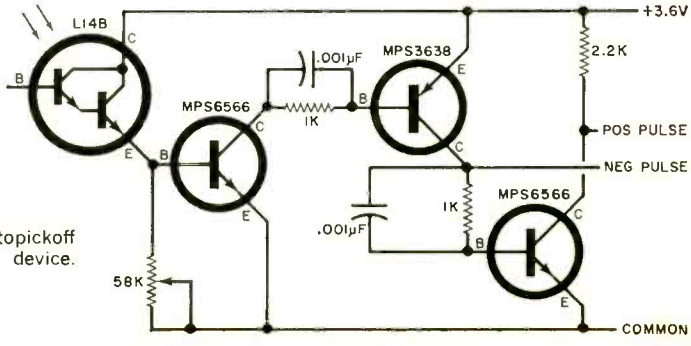

Fig. 10. Suggested photopickoff for use as a start/stop device.

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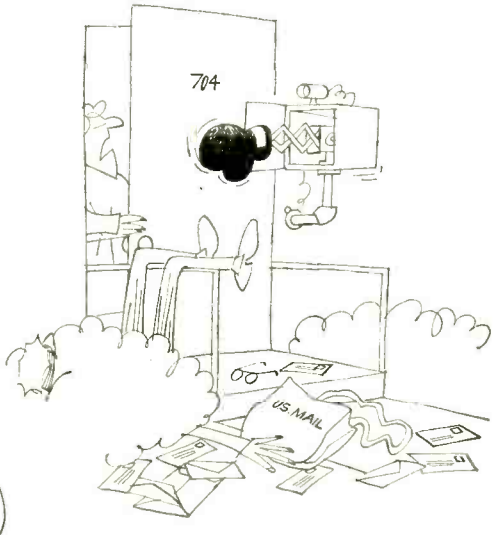
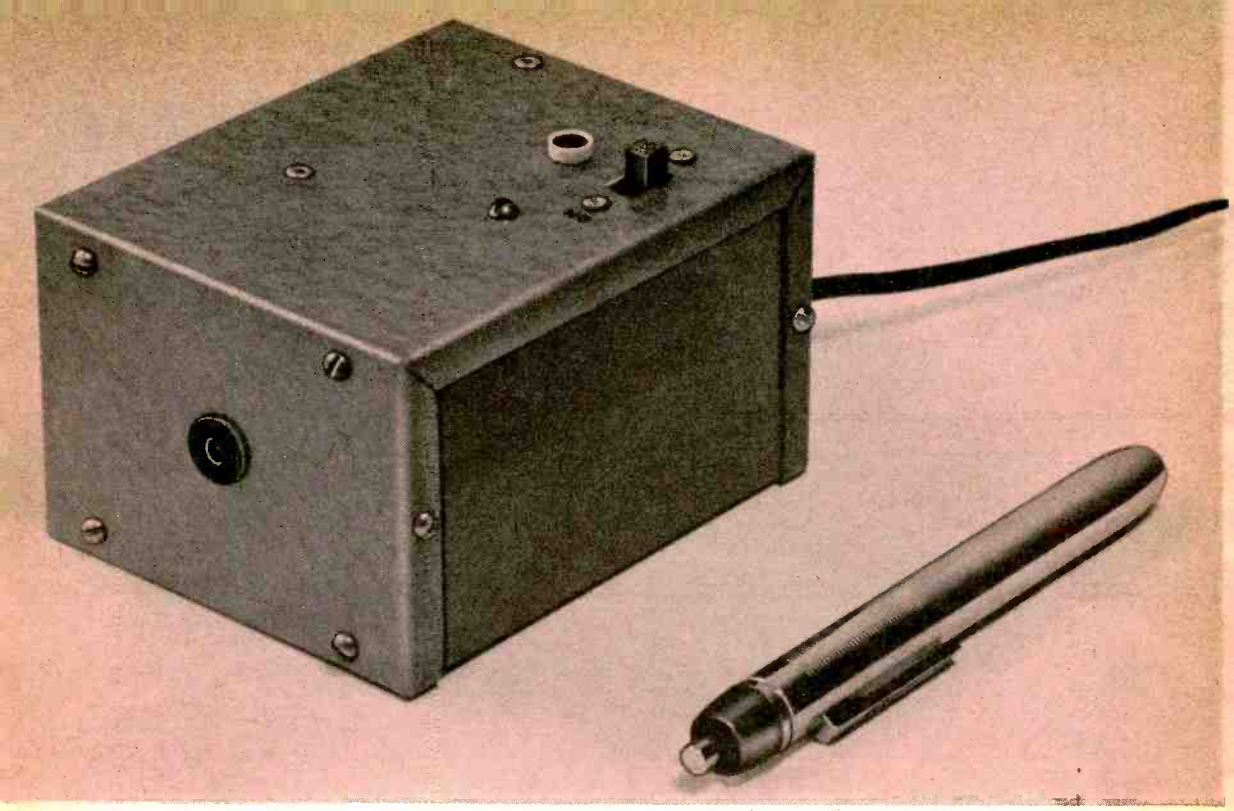
Here's my license. May I see your license to operate a radar unit?

It has an awful hollow, ringing sound.



George, you forgot to turn off your burglar alarm.

Everytime I log a Chinese station, an hour later I want to log another.



Blow Your Mind With Our FREQ-OUT ELECTRONIC LOCK

SUPER-SECRET PHOTOELECTRIC LOCK USES MODULATED LIGHT BEAM KEY

BY JOHN S. SIMONTON, JR.

THERE ARE ALL KINDS of electrical and electronic locks. None of them, however, is quite like the "Freq-Out." The "key" to this lock is a modulated beam of light which is turned on and off at a rate of about 2000 times a second. The key, using an inexpensive integrated circuit, is about the size of a pocket penlight. The Fotolock circuit can't be fooled by incandescent or fluorescent lights operating on 60-Hz power, and no amount of vigorous hand waving can break a light beam fast enough to open this lock.

While the operating range of the key described here is two or three feet, experiments with a well-focused beam from a larger flashlight indicate that the principle could be applied to longer-range operations—such as a remote control garage-door opener. Under normal lighting conditions, a much greater distance can be covered with the modulated beam than with one which is unmodulated.

The Freq-Out itself uses 117-volt a.c. line power and can be used as an intrusion alarm which cannot be bypassed

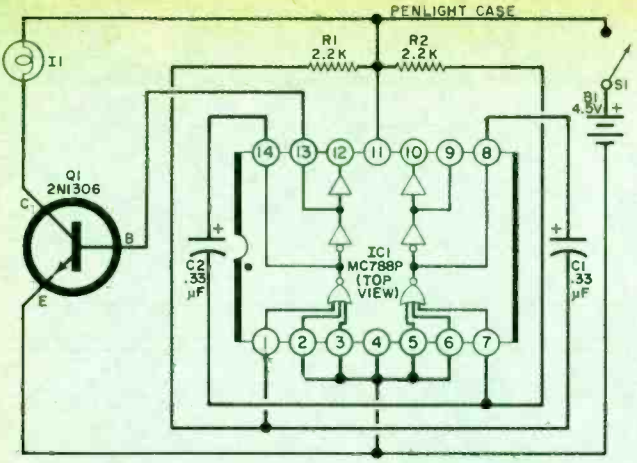


Fig. 1. The IC and associated components form a 2-kHz oscillator. This drives the transistor which in turn powers the flashlight lamp. In operation, the lamp flashes are so fast that the lamp appears to be turned on all of the time.

PARTS LIST

B1—1.5-volt hearing-aid batteries (Mallory M-76 or similar)
C1, C2—0.33 µF, 35-volt tantalum capacitor (Kemet KR33C35 or similar)
I1—#222 flashlight lamp
IC—Dual-buffer integrated circuit, MC788P (Motorola)
Q1—2N1306 transistor
R1, R2—2200-ohm, ¼-watt resistor
Misc.—Eveready #315 penlight, insulating tape, styrofoam, etc.

Note—The following parts are available from PAIA Electronics, Inc., Box 14359, Oklahoma City, Okla. 73114: penlight modulator board $1.10; PC for high-power modulator $2; kit of parts for penlight modulator with penlight less batteries $6.50; kit of parts for high-power modulator less lamp, reflector, and power supply $7.50.

with an ordinary flashlight. It is insensitive to ambient light conditions and there are no finicky sensitivity adjustments to be made.

Modulator. If you plan to build the penlight key or modulator (Fig. 1) a printed circuit board is an absolute must. You can make your own using Fig. 2 as a guide, or you can purchase a PC board (see Parts List). When soldering components to the board, use a clean iron and lots of patience. Note that the location of the notch on the integrated circuit is keyed with a small dot on the circuit board.

As shown in Fig. 2, there are only three external connections to be made to the printed circuit in the modulator. These go to the negative side of the battery, the tip contact of the lamp, and the penlight case. For simplicity, you may

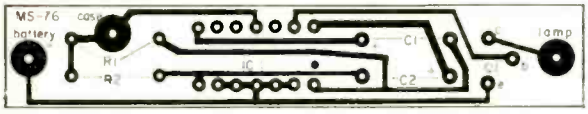


Fig. 2. Actual-size printed board for the modulator. It will fit into the penlight case with room to spare.

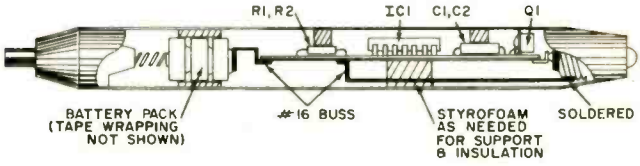
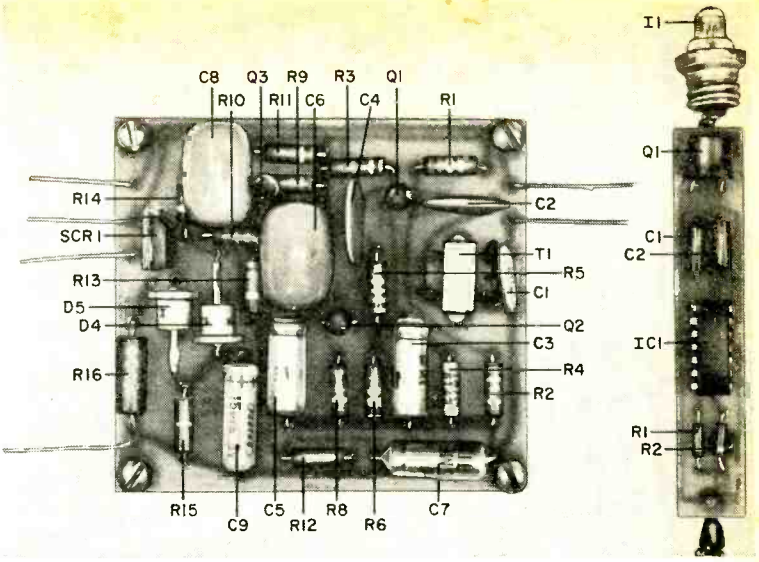


Fig. 3. The entire modulator is assembled within the penlight using styrofoam cut to make a tight fit.



The completed demodulator (left) and penlight modulator (right) before installing them in their packaging. Because some transistors have "hot" cases, it may be necessary to insulate Q1 of modulator, using plastic tape.

prefer to run a piece of #16 wire from the circle marked "case" on the printed circuit board to the rim contact of the lamp, thereby making the connection to the case through the base of the lamp. The lamp used in the modulator is the same #222 lamp supplied with most penlights.

Contacts for the battery and lamp can be formed of #16 wire and soldered directly to the large circles provided for them on the ends of the board. These contacts will be able to withstand greater stress if small tabs are formed on the ends of the wires and inserted into the holes in the board before soldering. The 2N1306 used for *Q1* is in a standard TO-5 package and can be fitted into the penlight case if care is used. Some manufacturers connect one of the elements of this transistor to the case so you may need to wrap a layer of tape around it to prevent shorting to the penlight case.

Power for the modulator is supplied by three MS-76 hearing-aid cells wired in series. Form the cells into a battery pack by stacking them and wrapping their outer edges with a piece of electrical tape. The tape not only holds the cells together, but also prevents the edges from shorting out against the penlight case.

The completed key device is assembled as shown in Fig. 3. Use as much electrical tape and styrofoam as necessary to prevent shorts between the board and the penlight case. Although the printed circuit board shown was designed for an Eveready #315 penlight, there is no reason why it shouldn't fit in any case designed to use two AA batteries. Be sure that the penlight switch disconnects both the point marked "case" on the PC board

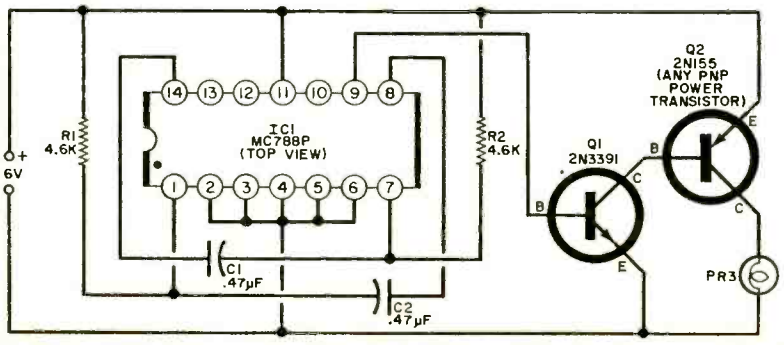


Fig. 4. This high-power modulator has a greater range than the penlight version. If the lamp is mounted within a three-inch, or larger, reflector, it can be used as an intrusion warning alarm.

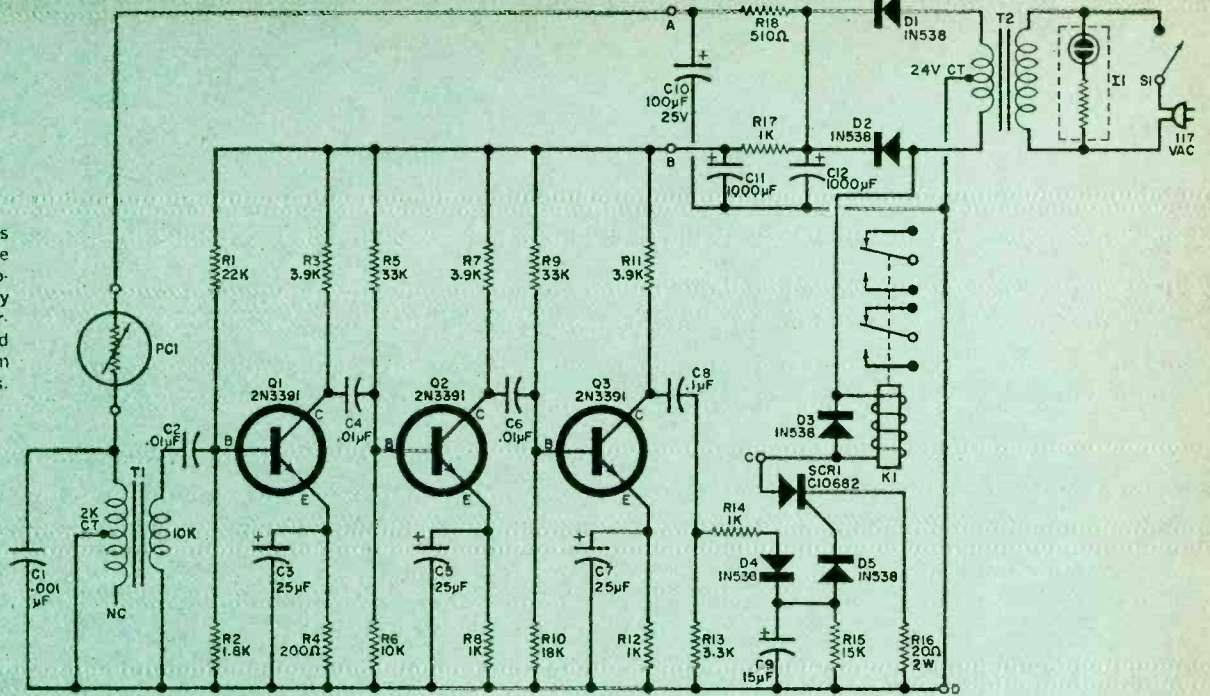


Fig. 5. Because the demodulator is a high-gain amplifier, take care that the input circuit is not located where it can pick up stray signals. This could lead to erratic operation. The lettered and open small circles on the diagram are the printed-board connections.

PARTS LIST

C1—.001-μF capacitor
C2, C4, C6—.01-μF capacitor
C3, C5, C7—25-μF, 3-volt electrolytic capacitor
C8—0.1-μF capacitor
C9—15-μF, 3-volt electrolytic capacitor
C10—100-μF, 25-volt electrolytic capacitor
C11, C12—1000-μF, 25-volt electrolytic capacitor
D1-D5—1N538 diode
I1—Neon lamp assembly (with resistor for 117 volts)
K1—D.p.d.t. relay, 6-volt d.c. coil
PC1—Photocell (Clairex CL703L or similar)
Q1, Q2, Q3—2N3391 transistor
R1—22,000-ohm
R2—1800-ohm
R3, R7, R11—3900-ohm
R4—200-ohm
R5, R9—33,000-ohm
R6—10,000-ohm
R8, R12, R14, R17—1000-ohm
R10—18,000-ohm
R13—3300-ohm
R15—15,000-ohm
R18—510-ohm
R16—20-ohm, 2-watt resistor
S1—S.p.s.t. switch

All Resistors ½ watt

SCR1—Silicon controlled rectifier (GE C106B2 or similar)
T1—Transistor driver transformer; 10,000-ohm primary, 2000-ohm C.T. secondary
T2—Filament transformer; secondary 24 volts C.T., 1 ampere
Misc.—Standoffs, rubber grommet, strain relief, line cord, utility box, wire, solder, etc.

Note—The following parts are available from PAIA Electronics, Inc., Box 14359, Oklahoma City, Okla. 73114: demodulator PC board $2.50: kit of electronic parts and circuit board for demodulator less power supply, case, and relay $16.50.

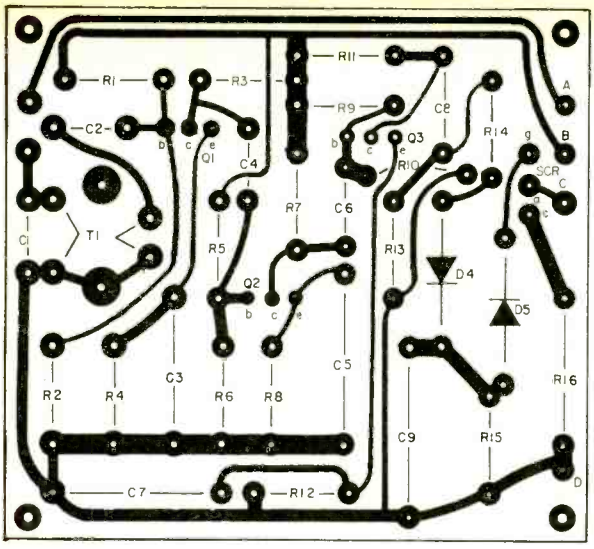


Fig. 6. Actual-size printed board for the demodulator. This also shows where the various components are to be installed on the finished circuit board.

and the outer lamp contact from the positive side of the battery pack.

For applications requiring greater range than is possible with the penlight, a larger flashlight and reflector should be used. Adapting the PC board for use in a flashlight which holds two D cells should be no problem. A PR-6 lamp should be substituted for the 222 usually used in the penlight.

If the Freq-Out is to be used as an intrusion alarm, the modulator requires a larger source of power. The schematic shown in Fig. 4 is for a unit of this type which has worked well for the author. Either a 6-volt lantern battery or a suitable power supply is used in this case. A 3½-inch reflector salvaged from an old flashlight and a PR-3 lamp are required.

Demodulator. Because the first three stages of the demodulator form a high-gain amplifier (Fig. 5), care should be taken in construction to avoid unintentional feedback and subsequent parasitic

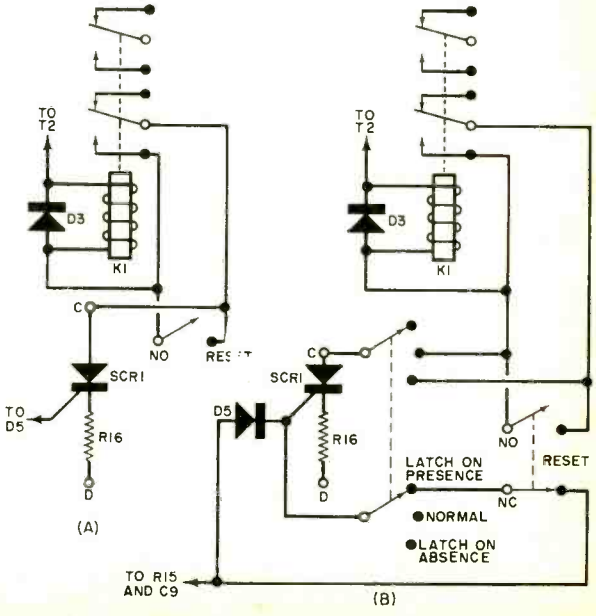


Fig. 7. Two relay configurations that may be used. In (A), the relay remains closed even after the light beam has been restored. In (B), the relay may be latched on in the presence of light, latched on in the absence of light, or operated as usual in the normal mode.

oscillation. You may make your own PC board using Fig. 6 or you can purchase one (see Parts List).

The wiring of the circuit board is straightforward, though you should use the usual precautions when soldering the semiconductors in place. Notice that transformer *T1* has been turned around so that one half of what would ordinarily be the secondary is used as the primary. It is not important which half of the secondary you use. Cut off the unused lead on the transformer so that it doesn't come in contact with some other component.

In the unit shown in the photos, the PC board is mounted on ceramic standoffs in one end of a conventional 3″ × 4″ × 5″ utility box. There should be sufficient clearance behind the board to mount the photocell in a rubber grommet.

The power-supply components in the prototype unit were soldered to a six-lug terminal strip (no grounded lugs) which was then fastened to the otherwise unused section of the utility box. Choose the location for the terminal strips carefully so that, when the two halves of the box are united, there will be no physical contact between components in the two halves. Tying all the wires going to the power supply into a cable not only gives a neat, professional appearance, but also helps prevent short circuits.

The line cord is brought into the case through an insulated strain relief. One side of the line is connected directly to *S1* and the other to *T2* through a single, ungrounded lug. Be very careful that neither side of the a. c. power line is grounded to the utility box.

When mounting *K1*, note that diode *D3* is wired directly to the coil terminals of the relay and is not on the printed circuit board. It is very easy to get the polarity of this diode wrong, so be very careful. In some applications the Freq-Out may be used to control power-line voltages, so the author mounted a multicontact plug on the back of the case for the relay contact circuits. With this arrangement, there are never any current-carrying conductors exposed.

Applications. Most applications of the Freq-Out require only that it act as a simple switch which closes in the presence of the modulated light beam and opens again when the light is interrupted. To use it as an electric door lock, connect one of the sets of normally open contacts on *K1* in series with a standard electric door-latch assembly. Locate the Freq-Out in a position where it can "look" out a window, but not too far from the key beam.

For some uses you may wish to have the electronic portion of the Freq-Out concealed in a closet or drawer and the photocell at some remote location. The

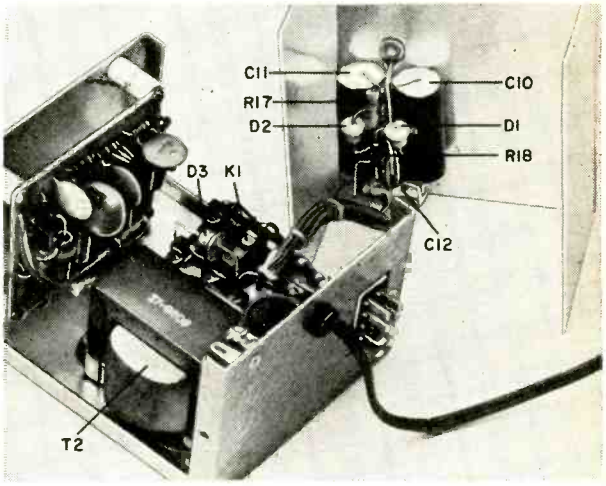
(*Continued on page* 116)

HOW IT WORKS

Modulator. The basis for the light-beam modulator is a dual-buffer integrated circuit (Motorola MC788P). The addition of *R1*, *C1*, *R2*, and *C2* converts the IC into an astable multivibrator having a frequency of approximately 2 kHz. One of the buffered outputs of the oscillator is used to switch transistor *Q1* and its load, *L1*.

Demodulator. The modulated light beam striking *PC1* allows a varying current to flow in the low-Q, resonant circuit composed of *C1* and the primary of *T1*. This circuit is tuned to the operating frequency of the modulator. The output of *T1* is amplified in three stages which are designed to pass only frequencies above about 800 Hz. The output of the amplifier is detected and filtered by *D4* and *C9* before being used to turn on *SCR1*. Resistor *R14* provides a slight time delay in the voltage built up across *C9* to prevent relay chatter due to sudden transients. The SCR is a half-wave rectifier used to energize relay *K1*.

Resistors *R15* and *R17* are used to filter the power supply and also to decouple the photocell from the amplifier. Resistor *R18* also limits the current flow through *PC1* under high ambient light conditions.



Assemble PC board and other components in the box as shown, with connector on one end for relay circuits.

COVER STORY

Build NOISE BLANKER

Impulse noise suppressor can be added to any SWL, Ham or CB receiver

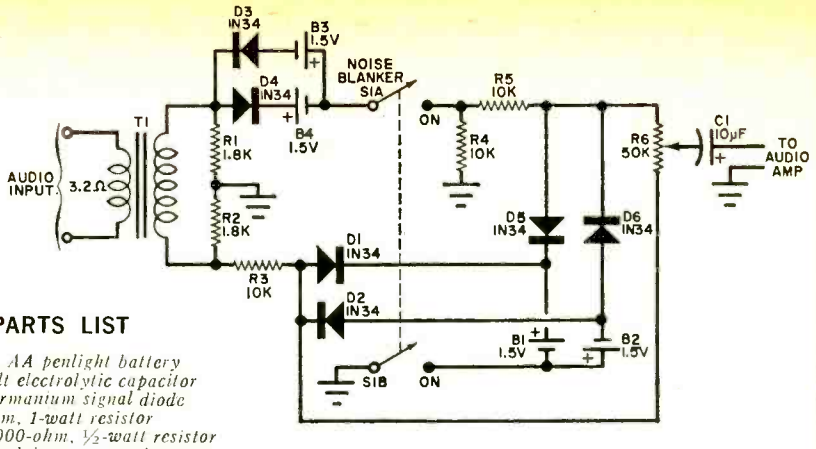
BY A. E. McGEE, Jr., K5LLI

AUTOMOBILE-IGNITION and electrical-impulse noise is a serious problem for the ham station operator or SWL who lives near a busy street. Most commercial receivers have noise clipping provisions, but the circuit used is not effective for SSB or CW operation. Some receivers have no noise limiter of any kind. If your receiver is deficient in this respect and if you are bothered by ignition noise or other noise created by electrical impulses, the "Audio Noise Blanker" is what you need.

The noise blanker works equally well with SSB, AM, and CW signals. It accepts a signal that is nearly indistinguishable because of impulse noise and makes it 90% readable. It is not necessary to modify your receiver; the noise blanker is connected between the low-impedance output of the receiver (3.2 to 16 ohms) and the speaker. The noise blanker itself requires no external power supply. An audio amplifier, which is used to raise the low-level output of the blanker to a comfortable speaker level, does require a power supply.

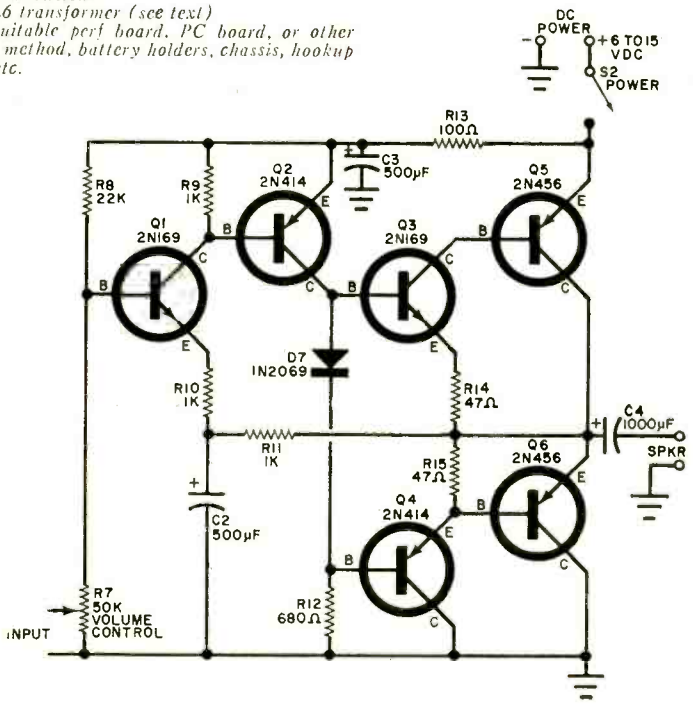
Construction. The circuit of the noise blanker is shown in Fig. 1. It can be assembled on a printed circuit board, on perf board, or with point-to-point wiring on multi-tab standoffs. The author's version, shown in Fig. 2, uses perf board. (Most of the board is taken up by the audio amplifier, which will not be described here since any type of circuit can be used. Even the compact audio modules available at low cost from any electronics distributor will do. Remember, however, that you must supply power for this audio amplifier.)

Transformer *T1* is a 50L6 audio output transformer, but any other type can be used if it has a low-impedance speaker winding and a 2000- to 5000-ohm pri-



PARTS LIST

B1-B4—1½-volt, AA penlight battery
C1—10μF, 15-volt electrolytic capacitor
D1-D6—1N34 germanium signal diode
R1, R2—1800-ohm, 1-watt resistor
R3, R4, R5—10,000-ohm, ½-watt resistor
R6—50,000-ohm miniature potentiometer
S1—D.p.s.t. switch
T1—501.6 transformer (see text)
Misc.—Suitable perf board, PC board, or other wiring method, battery holders, chassis, hookup wire, etc.



PARTS LIST

C2, C3—500-μF, 15-volt electrolytic capacitor
C4—1000-μF, 15-volt electrolytic capacitor
D7—1N2069 silicon rectifier diode
Q1, Q3—2N169 transistor
Q2, Q4—2N414 transistor
Q5, Q6—2N456 transistor
R7—50,000-ohm potentiometer
R8—22,000-ohm
R9, R10, R11—10,000-ohm
R12—680-ohm
R13—100-ohm
R14, R15—47-ohm
All resistors ½-watt
S2—S.p.s.t. switch

Fig. 1. Diode circuits in the noise blanker (top) clip the audio input to eliminate noise represented by spikes. Clean signal is then amplified in the audio amplifier (bottom).

mary winding. Diodes *D1* through *D6* can be any general-purpose, germanium, signal units—such as 1N34. Be sure to observe the polarities on the diodes, and, when soldering, use a heat sink on the leads.

Adjustment. Balance potentiometer *R6* can be adjusted by ear, or, for more exact results, with an oscilloscope. Connect the low-impedance output of the receiver speaker to the blanker input (see Fig. 3) and connect the blanker output to the audio amplifier. Turn on the receiver and the amplifier and place noise-blanker switch *S1* in the OFF position. Set the receiver volume control to its normal position and turn the audio amplifier gain up so that you can hear a signal. Adjust the Noise Blanker amplifier gain to a comfortable listening level and turn *S1* ON. Turn up the receiver volume control until the speaker output is very distorted. Adjust balance control *R6* until the audio output is at a minimum. This will be close to the mid-position of *R6*. Once

HOW IT WORKS

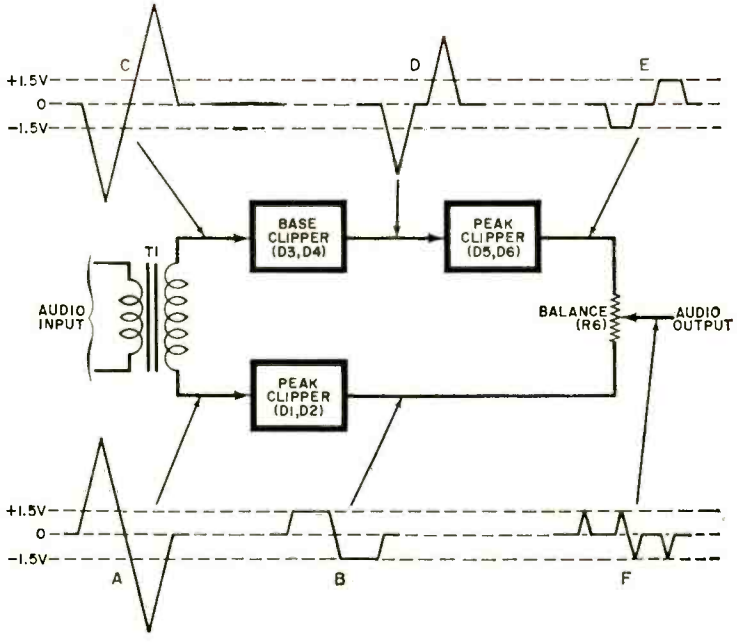
Assume that a high-level noise pulse, whose amplitude greatly exceeds the blanking level, enters the system. After passing through transformer *T1*, where it is split into two identical signals 180° out-of-phase with each other, the signal takes two different paths as shown in the diagram.

In the lower path, the signal (waveform A) passes through a peak clipper consisting of diodes *D1* and *D2* which are connected in opposite polarity and are in parallel with the signal path and ground. When the noise-pulse amplitude reaches the voltage level equal to the reverse bias on the diodes, both diodes conduct and shunt everything above this level to ground. The truncated signal (waveform B) is then passed to balance potentiometer *R6*. This type of circuit is called a peak clipper, and similar circuits are found in many receivers.

The other input signal, waveform C, is fed to a base clipper consisting of a pair of diodes. *D3* and *D4*, connected in opposite polarity and in series with the signal path. The arrangement does not allow the signal to pass until its amplitude exceeds the blanking level. The portion of the signal that exceeds the level (waveform D) is passed to a peak clipper consisting of reverse-biased diodes *D5* and *D6* which are connected in opposite polarity between signal and ground. Operation is the same as in the *D1*, *D2* peak clipper.

The two clipped output signals, waveforms B and E, are applied to opposite ends of balance potentiometer *R6*. If the rotor of this potentiometer is adjusted to receive signals of equal amplitude, the composite signal appearing as the audio output then looks like waveform F. Note that this signal contains far less power than the original input waveform, and even less power than a peak-clipped waveform.

The result is that, regardless of how great the noise is compared with the desired signal, any noise pulse that exceeds the blanking level will not only be greatly reduced, but will in fact have an audio power less than that of the desired signal. Thus the noise can hardly be heard.



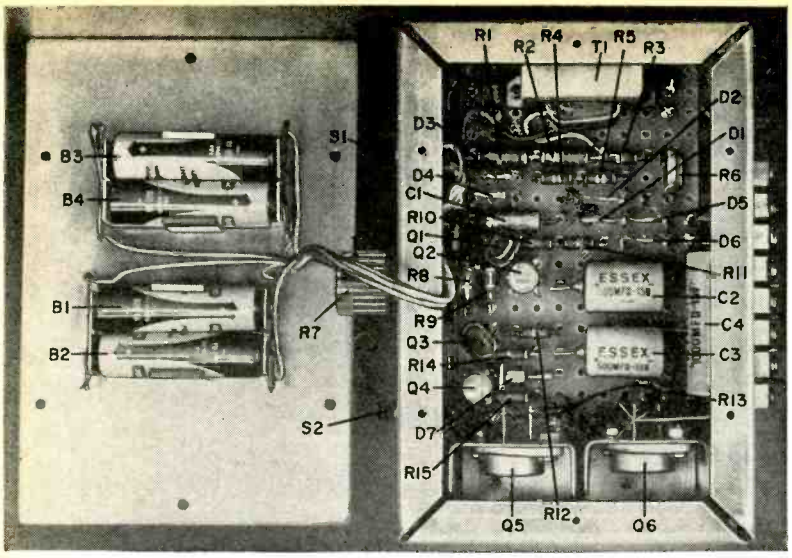
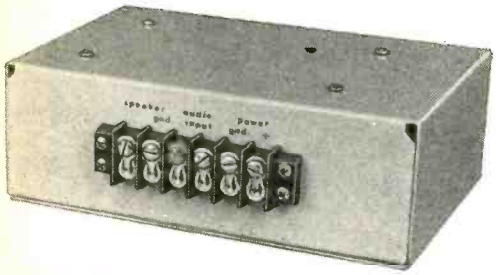


Fig. 2. In layout used by the author, much of the circuit is part of the audio amplifier. If a separate amplifier module is used, the blanker assembly is made smaller. Arrangement of components is not critical. The four batteries are for the noise blanker only. The amplifier requires a separate battery or a power-supply unit.



Connections to the circuit are made through a six-terminal barrier strip.

R6 is adjusted, it will remain correct for a long period of time unless components age or are replaced.

Operation. Tune in a signal, set the external audio amplifier gain for a comfortable listening level, and advance the receiver volume control until some audio distortion is noticed. At this point, back off the receiver volume control slightly until the audio is clear. This means that the noise blanker is operating properly; the receiver volume control is now the blanking-level control, and the audio output level is controlled by the gain control on the Noise Blanker amplifier.

When you tune in very weak or very strong signals, the receiver volume control may need to be readjusted, depending on the effectiveness of the receiver a.g.c. system. If the receiver volume control is set too low, the noise blanker will not be as effective as desired; if the receiver audio control is too high, the desired audio will be distorted.

The noise blanker does not begin to work until the amplitude of the impulse noise is greater than that of the signal; it works best when the noise amplitude is several times that of the signal. Therefore, it is important that the noise pulse not be limited or suppressed by the receiver. In some cases, turning off the receiver a.g.c. may improve the noise suppression characteristics of the system.

The noise blanker has been used very successfully with a mobile SW receiver in an automobile having no ignition-noise suppression. In this case, reception without the blanker was nearly impossible unless the signal was exceptionally strong. With the blanker, even the weakest signals are not bothered by the ignition noise.

Fig. 3. The noise blanker connects between the receiver loudspeaker output and external audio amplifier.

Batteries *B1* through *B4* will last approximately as long as their shelf life since the current drawn by the reverse-biased diodes is only a few micro-amperes. Fresh batteries will last about a year before showing signs of leakage—an indication that they must be replaced.—30—

DREAM RECEIVERS FOR THE SWL

POPULAR ELECTRONICS LOOKS AT THE $300-$1200 CLASS AND FINDS SOME INTERESTING SURPRISES

BY OLIVER P. FERRELL

SHORT-WAVE LISTENING is one of the oldest forms of electronic experimentation. Although some people think that SWL'ing has seen its heyday, they are unaware of the growing importance attached to SWL'ing by scores of foreign countries. To the non-SWL, communism is remote and detached; but to the SWL, it is an ideology that is preached, practiced, and proclaimed each and every minute—from Havana to Tashkent and from Berlin to Peking.

Although Americans have little reason to believe that they are fed "prepared" news, there is a positive resurgence in SWL'ing among people who want to be informed. Obviously, some of the information broadcast on short waves is strictly propaganda, but the intensity of feeling and the magnitude of the undercurrent frequently tells more than words alone.

In the photo above the receivers (reading from left to right, top and bottom) are: SW-4A, SS-1BS, SB-310, R-530, R-4B, and HQ-225.

The quality of short-wave programming has improved vastly in the past few years; today the technique of deluging the listener with diatribe is largely reserved for Radio Peking. Almost all of the programs of the communist-bloc broadcasters have entertainment and cultural and informative value. Listeners' contests abound and only a few broadcasters don't publish program guides or encourage letters from listeners.

Of course, listening to the friendly and not-so-friendly broadcasters outside the communist bloc has its own rewards and fascination. While Radio Australia discusses the serious implications in Southeast Asia, Radio RSA justifies apartheid, and the Voice of Nigeria, the suppression of Biafra. For the SWL the events of the day are not words on a printed page.

Getting on Frequency. When short-wave broadcasters were fewer and schedules more haphazard, the necessity for the

CAPSULE CIRCUIT INFO

R.L. Drake SW-4A: A hybrid (6 tubes, 7 transistors, 8 diodes) dual-conversion 11-band superhet tuning a mix of long wave (150-500 kHz), AM broadcast (450-1550 kHz), and international short-wave broadcasting bands (49, 41, 31, 25, 19, 16, 13, and 12 meters) in 500-kHz wide crystal-controlled segments. Fixed 5-kHz wide selectivity. No built-in calibrator, noise limiter, blanker, or provision for SSB/CW reception. Manual fine adjustment for dial calibration. $289.00.

R.L. Drake R-4B: Big brother of the SW-4A, the R-4B is basically a 6-band ham receiver with provision to tune 10 additional 500-kHz wide segments between 1.5 and 30.0 MHz. (These could be the 120, 90, 60, 49, 31, 25, 19, 16, 13, and 12 meter bands.) Dual-conversion, the hybrid (10 tubes, 10 transistors, 2 IC's, 17 diodes) R-4B features a tunable passband filter with four selectivity positions (4.8, 2.4, 1.2, and 0.4 kHz). Built-in 25-kHz calibrator and noise blanking. Built-in tunable "notch" filter useful for attenuating interfering heterodynes. Tunable BFO for SSB and CW reception. Manual fine adjustment for dial calibration. $430.00.

Galaxy R-530: All solid-state (52 transistors, 31 diodes) dual-conversion superhet with 59 tuning ranges each 500-kHz wide (0.5-30.5 MHz, inclusive). Unusual front-end design features first mixer fed by "phase-lock" oscillators. Operator manually presets desired 500-kHz tuning segment. Indicator tells when oscillators are locked and dial calibration is accurate. Three selectivity options (6.0, 2.1, and 0.5 kHz). Built-in 50-kHz calibrator. Reception of SSB and CW signals, crystal-controlled and variable BFO, respectively. Built-in noise blanking adjusted for SSB and CW. Adjustable attenuator in r.f. stage for preventing signal overload. Manual fine adjustment for dial calibration. $695.00.

Hammarlund HQ-225: All solid-state (26 transistors, 15 diodes) dual-conversion superhet tuning 24 segments 200 kHz wide in the spectrum 3.4-30.0 MHz. Very similar to ham-band receiver HQ-215, but tuning 60, 49, 41, 31, 25, 19, 16, 13, and 12-meter bands. Built-in 100-kHz calibrator and self-adjusting noise limiter. Three selectivity options (6.0, 2.1, and 0.5 kHz). Reception of SSB and CW signals, crystal-controlled and variable BFO, respectively. Built-in tunable "notch" filter for heterodyne reduction. Manual fine adjustment for dial calibration. $569.50.

Heathkit SB-310: A dual-conversion superhet (all tubes) with 9 tuning ranges each 500-kHz wide. As purchased, the SB-310 tunes 75, 49 (5.7-6.2 MHz as opposed to 6.0-6.5 MHz in all other receivers mentioned here), 41/40, 31, 25, 20 (ham), 19, 16, and 11 (CB) meter bands. Three selectivity options (5.0, 2.1, or 0.4 kHz). Built-in 100-kHz calibrator. No noise limiting or blanking. Reception of SSB and CW signals, crystal-controlled and variable BFO, respectively. $249.00 (kit only). (Kit to substitute 13-meter band for CB also available from manufacturer.)

Squires-Sanders SS-IBS: Dual-conversion superhet (all tubes) custom-made and primarily designed for international and regional short-wave broadcast reception. Tunes 9 bands (75, 49, 41, 31, 25, 19, 16, 13, and 12 meters in 500-kHz wide segments), plus fixed tuned to 10.0 MHz WWV. Features unusual front-end circuit to attain freedom from cross-modulation and overload from nearby transmitters. Built-in three-position selectivity (8.0, 5.0, and 2.5 kHz). Built-in 100-kHz calibrator. Reception of SSB and CW signals, crystal-controlled and variable BFO, respectively. Built-in noise limiter for SSB and CW only. Noise silencer (outboard) optional, cost extra. Motor drive on tuning dial for fast frequency change. Digital-counter frequency readout—not adjustable. $1225.00.

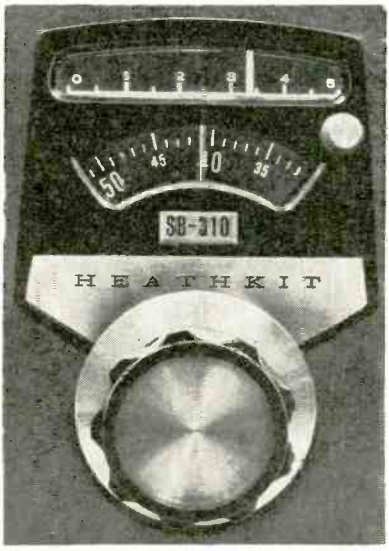
SWL to have an accurately calibrated receiver was minimal. But, as international broadcasters doubled, redoubled and tripled the number of watts pumped into the ionosphere, and as the number of stations quadrupled, receiver requirements began to change. Selectivity is now as important as—or more a necessity than—sensitivity. Calibration—knowing either the frequency on the receiver dial, or tuning to the frequency announced in the broadcaster's schedule—is rapidly becoming of paramount importance.

For years, SWL's have struggled with non-SWL bandspread dials, or out of sheer desperation have prepared graph calibrations to match arbitrary bandspread dial markings. Radio amateurs have always been fortunate in having receivers more or less accurately calibrated to the five major ham bands. And in the early 1960's when a receiver manufacturer introduced a combination ham/SWL flipover, calibrated bandspread dial, it unfortunately was equally disliked by both hams and SWL's.

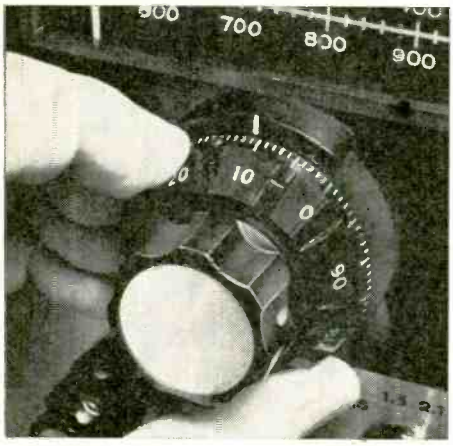
Accurate dial calibration is of little advantage if it is not augmented by stability. The best proven way of achieving this objective is through the use of a crystal-controlled oscillator. Thus, by its very nature, a good, rock-stable, accurately calibrated receiver—for either ham or SWL—must be dual conversion; one of the two mixing oscillators must be crystal controlled. Of course, attaining stability by this method also means that

Squires-Sanders IBS receiver has the eight main international broadcast bands calibrated on a slide rule dial. Figures visible in window are on digital rotary wheels and denote kilohertz. Three position selectivity control is also seen. This custom-made receiver is used by the VOA.

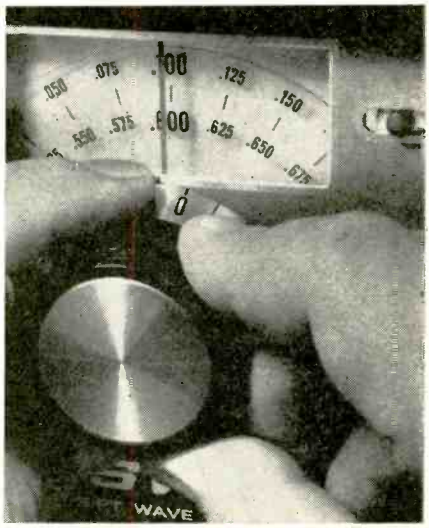
Hammarlund HQ-225 dial scale is printed on the edge of a large rotating wheel. Receiver tunes in 200-kHz segments. Knob to left of the scale is adjustment for positioning the hairline. Knob to the right is a dimmer control for dial lamps. Both HQ-225 and SS-IBS have smooth dial mechanisms and fingertip control.



Using Heathkit SB-310 (left) the operator would read hundreds in top window and single kilohertz increments below. A full report on this kit was in the April 1968 issue of POPULAR ELECTRONICS.



Two-speed dial knob is featured in brand-new Galaxy R-530. Skirt of knob reads in one kilohertz increments. Hairline may be shifted back and forth for adjusting dial calibration. The slide-rule dial above reads 0-500 or 500-1000.



Drake SW-4A and R-4B has two separate adjustments for setting dial accuracy. Hairline can be moved by button in upper right. Skirt of tuning knob may be slipped so that 0-25 scale agrees with hairline and pointer.

some limit must be set for the range of the tunable oscillator—since it is the dial of the tunable oscillator that will be linearly calibrated. In the receivers discussed in this article, the tunable limit is either 200 or 500 kHz. Thus, tuning ranges in "dream" receivers are sharply segmented and not 3 or 4 continuous bands as in receivers selling for under $150.

How They Do It. The simplest and most direct approach to combining calibration accuracy, stability, and selectivity is seen in the Heathkit SB-310. The circuit in this receiver includes a crystal-controlled (9 selections) first oscillator and a carefully fabricated "Linear Master Oscillator" (LMO) as the 500-kHz calibrated second oscillator. The principal i.f. is 3.395 kHz and selectivity is a function of crystal filters. The nominal AM bandwidth is 5 kHz at −6 dB and 15 kHz at −60 dB. In tests, the SB-310 dial calibration was within ± 1.0 kHz.

The Drake SW-4A also employs a simple circuit, but with an entirely different approach. The fixed-frequency second oscillator is made crystal-controlled and the first oscillator frequency is the difference between another crystal stage (11 selections) and a tunable 500-kHz wide VFO. Selectivity is controlled by a crystal lattice between the two mixer stages and the two 455-kHz i.f. stages. Nominal bandwidth is 5 kHz at −6 dB and 16 kHz at −60 dB. Dial calibration of the SW-4A under test was better than ± 1.5 kHz.

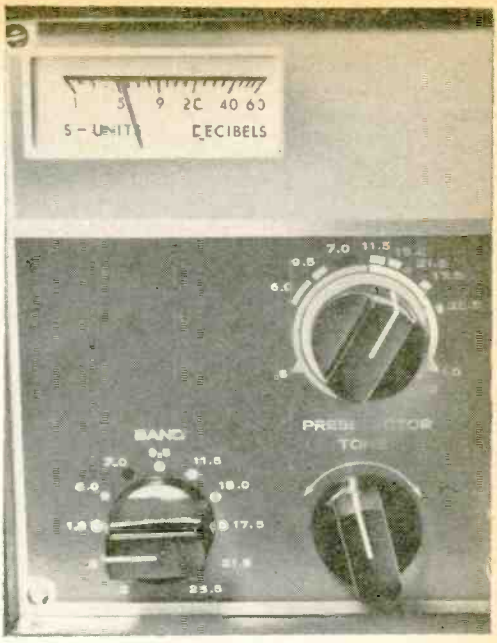
The essential differences between the SW-4A and Drake R-4B are reflected in the number of crystal selections (16) and the special second i.f. of 50 kHz. Incorporated in the 50-kHz i.f. is a notch filter and a passband tuner of four high-Q LC circuits. Although this tuner and filter combination is basic to SSB reception, the SWL can make good use of them to "move out from under" interfering heterodynes in the international broadcast bands. Nominal AM selectivity on the R-4B is 4.8 kHz at −6 dB and 20 kHz at −60 dB, but the SWL may find the sharper 2.4 kHz at −6 dB (8.2 kHz at −60 dB) more advantageous. Dial calibration of the R-4B was better than ± 1.5 kHz.

The straightforward design of the SB-310 is refined in the new Hammarlund HQ-225. Up to twenty-four crystals may be switched into the first oscillator circuit. The tunable second oscillator covers only 200 kHz, thus breaking the frequency spectrum into more segments and spreading the linear tuning scale over a considerable span. The second i.f. is 455 kHz and selectivity is controlled by Collins mechanical filters. The nominal AM selectivity is 6 kHz at −6 dB and about 13 kHz at −60 dB. Built into the HQ-225 is an "inverted" Q-multiplier which provides a tunable notch (40 dB deep) across the 455-kHz i.f. Dial calibration on the HQ-225 receiver that was tested by POPULAR ELECTRONICS was within ± 0.5 kHz.

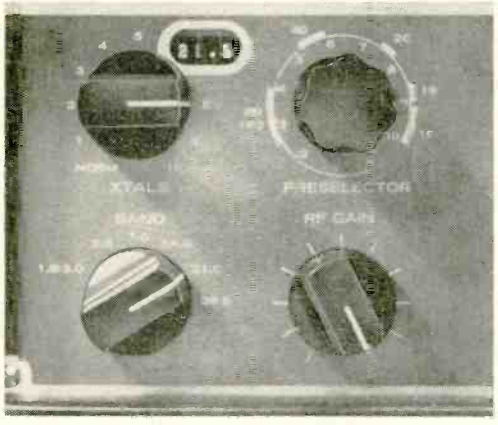
If you took all of the essential ingredients in the SB-310 and HQ-225 and refined them to the Nth detail, you would probably come up with the Squires-Sanders IBS. Ten crystals set the frequency of the first oscillator while the second oscillator is a remarkably accurate and stable "Variable Local Oscillator" (VLO). Both mixers use the special 7360 beam deflection tube in balance output circuits. The second i.f. is at 1.0 MHz and selectivity is controlled by a multiple section 2.5-kHz crystal bandpass filter. A combination of high Q i.f. transformers and switch-selectable "bottom inductance" add the 5.0 and 8.0 kHz bandwidths. The nominal 5 kHz bandwidth is at −6dB and about 25 kHz at −60 dB; however on the sharper 2.5 kHz position, the −60 dB width is only 5.0 kHz. Dial calibration of the IBS was better than ± 0.2 kHz.

Something New Has Been Added. In each of the five receivers discussed above, the number of tuning ranges was limited by the number of crystals that could be switched into the first oscillator circuit. A method of avoiding this difficulty has been known for several years, but until the introduction of the Galaxy R-530, these receivers were both complex and very expensive. While the R-530 is far from uncomplicated, it does make use of a first oscillator circuit that provides 59 tuning ranges each 500-kHz wide. Calibration and stability of this first oscillator are achieved by beating two crystals and purposely generating a large number of difference-frequency harmonics. These harmonics (Galaxy calls this

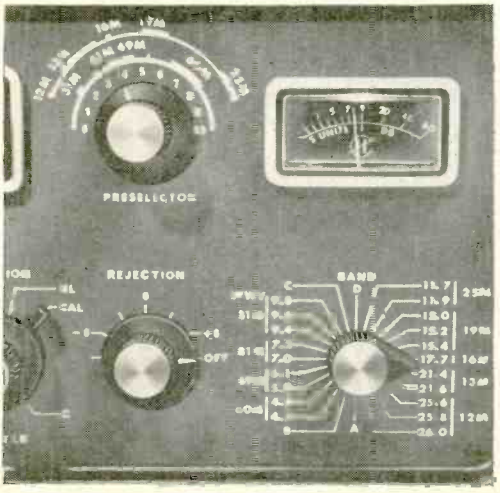
One revolution of SS-IBS dial tunes 10 kHz. Rapid frequency shifting possible with motor drive. Button on right goes up frequency, left button down.



Controls on SW-4A are few and far between. Eleven tuning ranges are identified by dots and bars in various colors. The SW-4A was the only one of group with a tone control.

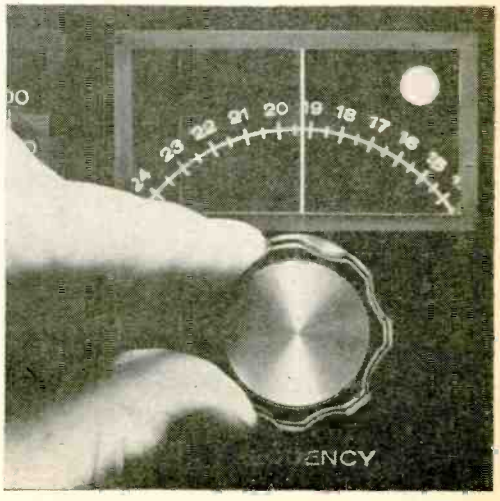


Drake R-4B (left) is a ham band receiver, with provision to tune 10 additional 500 kHz segments. Band identification appears in peek-a-boo window as switch labelled XTALS is rotated. Put switch is NORM position and R-4B reverts to ham receiver.



Hammarlund HQ-225 has busy-looking bandswitch because it tunes 200-kHz segments to provide extra bandspread. Control REJECTION kills heterodynes.

Galaxy R-530 uses "phase lock" principle to set 59 separate tuning bands each 500 kHz wide. The R-530 is the only all-band SWL receiver reported on in this article.



THERE ARE OTHERS

This article was written to emphasize the trend toward specialized SWL receivers. Similar products are offered by other manufacturers. The National HRO-500 (see POPULAR ELECTRONICS, August, 1965) and the two Collins receivers (51S-1 and 75S-3C) are particularly good examples.

A wide variety of medium-priced communications receivers is available to the SWL from Allied Radio, Hallicrafters, Lafayette Electronics, and Radio Shack.

a "Spectrum Generator") are used to establish accurately the true frequency of a tunable oscillator that is really the first oscillator. The principle of finding the right harmonic is called "phase lock."

Once the first oscillator frequency has been chosen, the remainder of the R-530 circuit is largely straightforward. The second oscillator is tunable and the i.f. is at 9.0 MHz. Selectivity is a function of crystal lattice filters with the nominal AM filter 5 kHz at −6 dB. Dial calibration on the R-530 tested was about ± 1.0 kHz on most bands.

Likes and Dislikes. For various periods of time, ranging from a few days to several months, each receiver discussed in this article was put through its paces. Our logs show the reception of 78 countries on the international broadcasting bands between April 1 and July 30. Here are a few subjective opinions about this equipment.

Liked: The slide-rule dial scale of the SS-IBS—the one receiver truly calibrated for the SWL. *Liked:* Soft lighting and ease of handling of the SW-4A—simplicity personified. *Disliked:* Lack of preselector band identification on the SB-310. *Disliked:* Stiff dial mechanism of the R-530—although this may have been due to the "newness" of the receiver tested. *Liked:* S-meter honesty of the SS-IBS, SW-4A, an R-4B. *Disliked:* Touchy preselector tuning on HQ-225—could have used a vernier drive here. *Liked:* Ease of tuning in SSB on SS-IBS—smoothest receiver of all. *Liked:* HQ-225 where receiving antenna was disconnected when tuning for crystal calibrator harmonics. *Liked:* All receivers with headphone jack on front panel—although R-4B recently moved this jack to side of receiver, user can rewire it to front panel. *Liked:* Notch and pass-band controls on R-4B—just great when you have two signals only 5 kHz apart. *Disliked:* Total absence of noise limiting or blanking on SW-4A and SB-310—a great shame since not every listener has an electrically quiet receiving location.

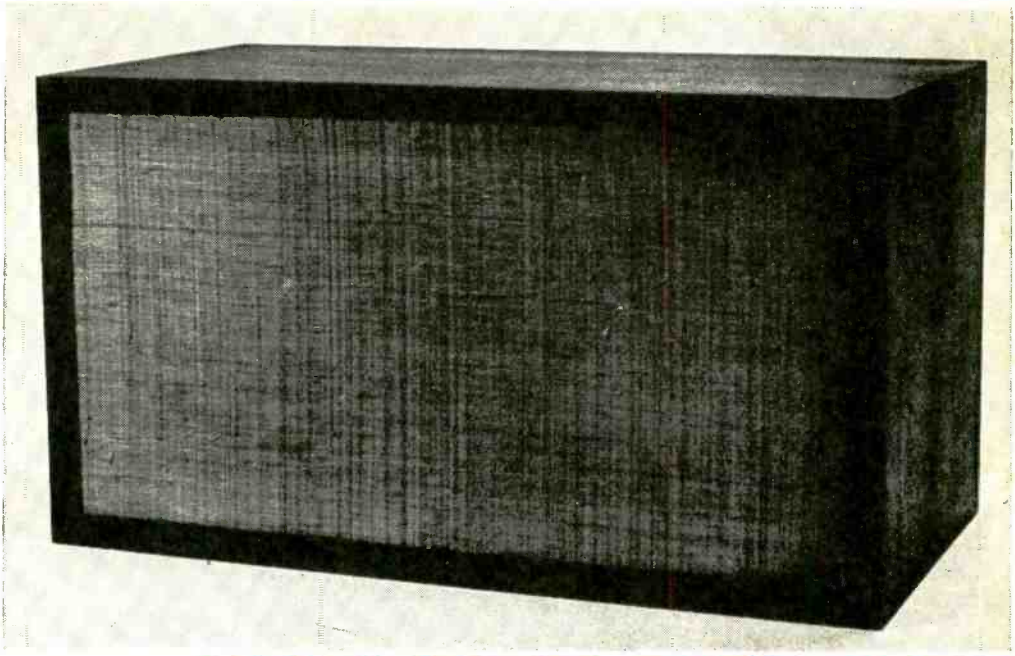
Disliked: Outboard noise silencer (optional, cost extra) for SS-IBS—cranky. *Liked:* Modern functional styling of HQ-225—a very attractive piece of equipment. *Liked:* All band coverage of R-530—gives the SWL a chance to tune something other than broadcasters. *Disliked:* Low frequency coverage of SW-4A—appears to lack the signal punch expected for a receiver of this capability. *Liked:* Instant warm-up of R-530 and HQ-225—a by-product of use of solid-state units. *Liked:* Tuning the ham bands on the R-530, R-4B, and SB-310.

Disliked: Tuning knob on HQ-225—definitely needs fluted edges. *Liked:* AM broadcast-band coverage of the R-530 and SW-4A. *Liked:* Sharp, clean voice quality of SB-310 audio—great on ham bands. *Liked:* Tuning knobs sufficiently free to be spun with a fingertip (HQ-225 and SS-IBS). *Disliked:* Peek-a-boo window for band identification on R-4B. *Liked:* Motor drive on SS-IBS tuning dial—a luxury, but proved itself handy. *Liked:* All receivers with main tuning dial to the right and preselector dial to the left—especially for right-handed people. *Disliked:* Complete lack of band identification on bandswitch of SS-IBS.

The Next Generation. Not too much is missing from this combination of SWL receivers that they shouldn't fail to please the earnest DX'er, or even the casual listener. However, selectivity should be wider than 2.5 or 2.1 kHz—but not as wide as 5 or 6 kHz. To the author, a compromise selectivity of 3.5 or 4.0 kHz would be welcomed—or, if and when the technology permits, a truly variable selectivity function permitting the operator to vary selectivity continuously to suit the frequency and the interference.

Also, since most SWL's use two or three antennas, a front-panel selector switch for antenna changeover would be a very worthwhile addition. —30—

SEALED-REFLEX



SPEAKER SYSTEM

Build something new in hi-fi—a passive radiator that provides better bass, dynamics, and efficiency

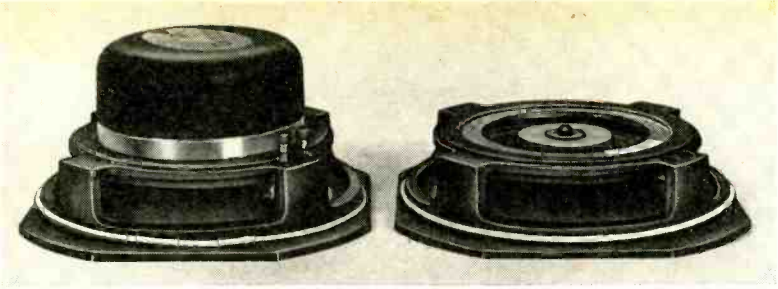
BY DAVID B. WEEMS

IF YOU'VE BEEN PLANNING to build a compact speaker system but can't decide between using a bass reflex or a sealed enclosure, why not build a sealed reflex? By adding an extra "speaker cone" to your enclosure, you can obtain increased bass performance without using ducts or ports.

Experiments to add "free" bass performance have been going on for more than 15 years in projects called by such names as "drone cone," "auxiliary bass radiator," and "passive radiator." The common denominator of each of these projects has been the addition of a freely suspended speaker cone (speaker minus its magnet assembly and voice coil) to a sealed enclosure. Some of the results obtained from these experiments have given rise to the sealed-reflex speaker system described here. The system consists of a full-range 8″ loudspeaker and a complementary cone which the manufacturer, James B. Lansing, terms a "passive radiator."

About the System. The sealed reflex offers several advantages over the conventional compact speaker system. Noticeably improved bass response is possible in the sealed enclosure with the use of a passive radiator. While an ordinary bass reflex will provide approximately the same results, there are a few differences.

The air in the port of a bass-reflex system does not necessarily move in phase with the movement of the speaker cone at all frequencies nor even at all



The PR8 (right) is nothing more than heavy speaker cone without voice coil and magnet. Cone is tuned by adding circular weights.

points across the port. The passive radiator, on the other hand, maintains an in-phase movement of air over its entire surface and throughout its effective range. Thus the possibility of unwanted mid-range reflections through an open port is eliminated. Proponents of the sealed-reflex system claim that it gives a "warmer" tonal quality to the sound than does the bass-reflex system.

Any cone mounted inside a sealed enclosure produces extra bass at some frequencies, but its range and freedom from distortion are determined by the mass and suspension of the cone. The suspension must be linear and compliant because the passive radiator, having no electromagnetic control, moves much farther than a driven speaker's cone. The JBL passive radiator, Model PR8, used in this system, was designed for free movement and is tunable to various enclosure sizes by a change in its mass. When used with the JBL Model LE8T complementary 8″ loudspeaker it is possible to obtain low-distortion wide-range response with greater efficiency and dynamic range than with the usual compact speaker system.

Construction. The enclosure for the passive radiator system features unitized construction; each wall of the enclosure is permanently bonded and sealed to the other walls. This procedure is possible because the speakers are front mounting. The hardware (T-nuts and machine screws) for the speakers is supplied.

To achieve a clean professional appearance when assembling the enclosure, bevel the mating edges of the top, bottom, and two side plates at a 45° angle. Leave the front and rear edges of these plates square. If you have no facilities in

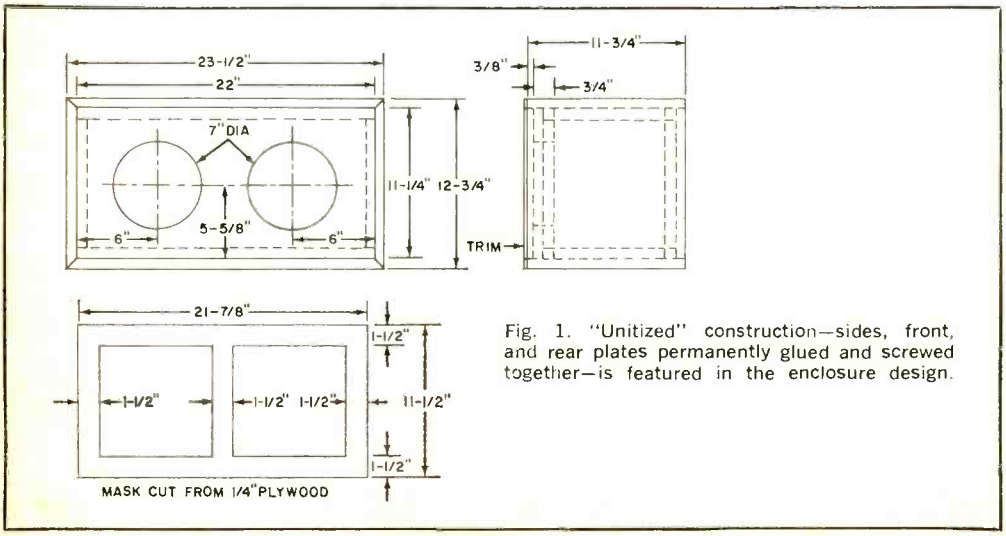


Fig. 1. "Unitized" construction—sides, front, and rear plates permanently glued and screwed together—is featured in the enclosure design.

your workshop for making the beveled edges, be sure to adjust the sizes of the plates used so that the enclosure has the same inside dimensions called out in Fig. 1.

After cutting the lumber to size, prepare the speaker mounting board as follows. First cut the two 7″-diameter speaker holes. Then drill 11/64″ guide holes every 4″ apart and 3/8″ in from the edges of the mounting board. Temporarily set the speakers into the holes from the *front* of the board and mark the location of the mounting holes. Remove the speakers.

Now, carefully drill the mounting holes at 90° angles to the surface of the board (if you have a drill press, use it) with a 7/32″ or 15/64″ drill. Install the T-nuts by driving them into the holes from the *inside* surface of the board.

Replace the speakers into their respective holes, and temporarily screw in the machine screws to check for proper fit. Finally, remove the hardware and speakers and set the speakers aside in a safe place. When handling the speakers, be careful not to touch the cones or aluminum domes.

Prepare the rear plate by drilling 11/64″ guide holes every 4″ around the edges, recessing them 3/8″ in from the edges as done with the speaker mounting board. Drill two small holes near the center of this plate, and insert two tight-fitting bolts to serve as terminals for connection to the speaker. Code the bolts by using one brass and one steel bolt, or by some other method so that you can identify the polarity of the speaker. Connect a 24″ length of twin-lead cable to the screws.

Next, cut the cleats and corner blocks to size, and drill 11/64″ holes, along their center lines, in one direction every 4″ apart. Set the cleats aside, and drill the same size holes through the corner blocks in the other direction every 4″ apart; alternate these new holes with those already drilled. (The 11/64″ guide holes should be used only in a construction member that holds the head of the screw. Use 7/64″ or 1/8″ guide holes for the part receiving the threads. Also, countersink all 11/64″ holes to provide a flush surface over the screw heads.)

The quickest and most efficient way to obtain a good seal is to use glue liberally between all surfaces to be joined. Therefore, glue and screw the long cleats to the long sides, leaving a margin of 3/4″

BILL OF MATERIALS

*1—James B. Lansing Model LE8T 8″ loudspeaker**
*1—James B. Lansing Model PR8 8″ passive radiator**
2—23½″ x 11¾″ x ¾″ pieces of interior-grade plywood for sides
2—12¾″ x 11¾″ x ¾″ pieces of interior-grade plywood for top and bottom plates
2—22″ x 11¼″ x ¾″ pieces of interior-grade plywood for speaker mounting board and rear plate
1—21⅞″ x 11⅛″ x ¼″ piece of plywood for mask; see text
4—22″ x ¾″ x ¾″ pieces of pine for side cleats
4—9¾″ x ¾″ x ¾″ pieces of pine for top and bottom cleats
4—8⅜″ x ¾″ x ¾″ pieces of pine for corner blocks
Misc.—¾″-wide trim cut to size; 6-doz. #8 flathead wood screws; glue; fiberglass wool; carpet tacks; grille cloth; two-conductor cable; stain; etc.
**James B. Lansing loudspeaker and passive radiator are available from most well-stocked hi-fi centers or can be ordered through franchised JBL retailers.*

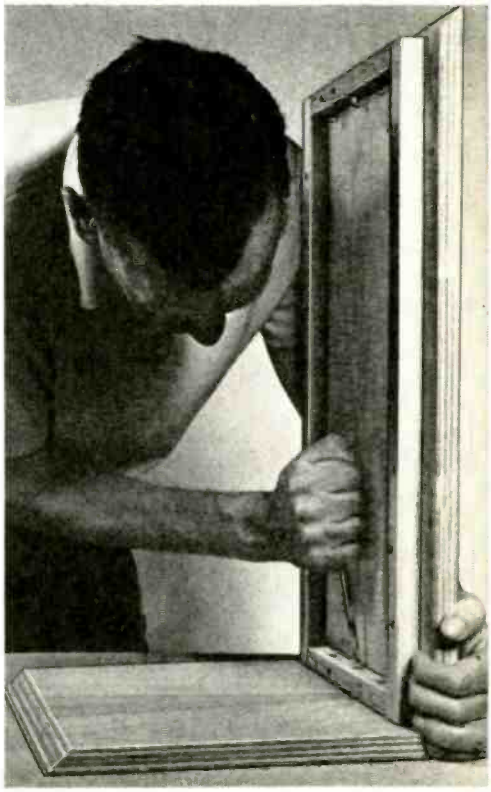


Fig. 2. Corner blocks, drilled in two directions, must be used to anchor sides to top and bottom.

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Fig. 3. Two screws, inserted through rear of enclosure, serve as electrical connections.

at the rear and 1⅛" at the front. Do the same with the corner blocks.

Set up a long side and either the top or bottom plate with the beveled edges matching. Mark the points where the screws from the corner block will enter the top or bottom plate. Drill the small guide holes about ⅜" deep at these locations. Glue and screw the two pieces together (see Fig. 2), and repeat this process until both sides and top and bottom are assembled.

Now glue and screw the 9¾" cleats to the top and bottom plates. These cleats must fit snugly between the longer cleats to prevent air leaks when the enclosure is fully assembled. Glue and screw the rear plate in place as shown in Fig. 3.

PASSIVE RADIATOR TUNING TABLE

0.75-1.0 cu. ft.	use two discs
1.0-1.5 cu. ft.	use one disc
1.5-2.0 cu. ft.	use no discs

Line the top, bottom, sides and rear wall of the enclosure with a 2"-thick layer of acoustical fiberglass. Glue and screw the speaker mounting board to the front of the enclosure. This board should be recessed from the front edges of the enclosure by approximately ⅛" at this time.

Cut four pieces of ¾"-wide wood trim to size, and frame the front edges of the enclosure; use glue to hold the trim in place. Sand and stain all outer surfaces—except speaker mounting board. If you use wider trim, it should be secured as the final step in assembly when the grille cloth is in place.

Before mounting the passive radiator, remove the screw that anchors the discs at the rear of the radiator. Remove one of the discs. Then reassemble one disc, the large washer, the small lock washer, and the screw in proper sequence, and tighten the screw back in place—but don't over tighten. The passive radiator is now tuned to the enclosure.

Connect the speaker cable to the speaker, taking care to note polarity. Mount the passive radiator and speaker in their respective holes as shown in Fig. 4. You will notice that the edges of the speakers protrude about ¼" in front of the speaker mounting board. For this reason it is necessary to fabricate a mask from ¼"-thick plywood, following the dimensions provided in Fig. 1. This mask should be slightly smaller than the speaker mounting board—how much smaller will be determined by the thickness of the grille cloth.

Drive several ⅝" carpet tacks through the front of the mask. Set the side of the mask with the tack heads showing over the grille cloth, fold the edges of the grille cloth over the edges of the mask, and staple. Set the mask over the speakers, pushing the tacks into the speaker mounting board to anchor it solidly. If you are using larger than ¾"-wide trim, now is the time to glue it in place.

Conclusion. This enclosure offers a good compromise between space and performance requirements. The LE8T/PR8 combination can be used in any enclosure from less than one cubic foot to two cubic feet in volume. According to JBL, a two-cubic-foot passive radiator system

Fig. 4. T-nuts and machine screws are provided to facilitate passive radiator and loudspeaker mounting. Note that the LE8T and PR8 are designed for mounting through the front of the speaker mounting board.

HOW DOES IT SOUND?

This is probably the most expensive hi-fi speaker-system construction project published in POPULAR ELECTRONICS. The author and his colleagues all report that the sound from the JBL LE8T-PR8 combination is "pleasing." The bass may be less heavy than in certain other compact systems (selling at about the same price this system costs to build), but it seems natural. Transient response is particularly good and there is little doubt this system has the "edge" in dynamic range. In fact, this combination is thought to be more lively than a well-known system selling for $25 more than construction costs. There is a feeling of "warmth" of tone in the sound—especially in the reproduction of the lower string notes.

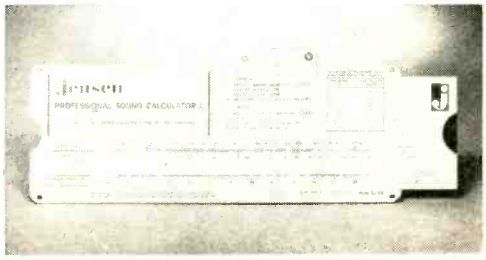
will equal the performance of a four- or five-cubic-foot bass reflex system. If you wish to use a different size enclosure, tune the passive radiator according to the table shown on page 66.

Although the tuning specifications specified are those recommended by JBL, you can vary them to match your own tastes. You might also want to experiment with more or less fiberglass padding. When you obtain the quality of sound you want, you're in business. The sealed reflex system will handle up to 20 watts of power but it is efficient and may be used with a low-power amplifier.

—30—

PROFESSIONAL SOUND CALCULATOR

The Jensen Sound Products "Professional Sound Calculator I" shown in the photo at right can make short work of problem solving when you are designing loudspeaker system installations. The sliderule calculator converts sound pressure in dynes/sq cm to sound pressure level (SPL) in dB and computes SPL, distance, or power input to loudspeakers for known conditions. "Range Expander" and "Summation" tables show SPL changes for large distance and power ratios, and total SPL for two known signal levels, respectively. Detailed procedures on the front and back of the 7½"-long calculator describe how typical computations are performed. Precision in the results obtained from the sound calculator are more than adequate for most problems encountered. To obtain the calculator and instructions describing how to use it, send $1 to Jensen Manufacturing Division, Muter Company, 5655 West 73 St., Chicago, Ill. 60638.

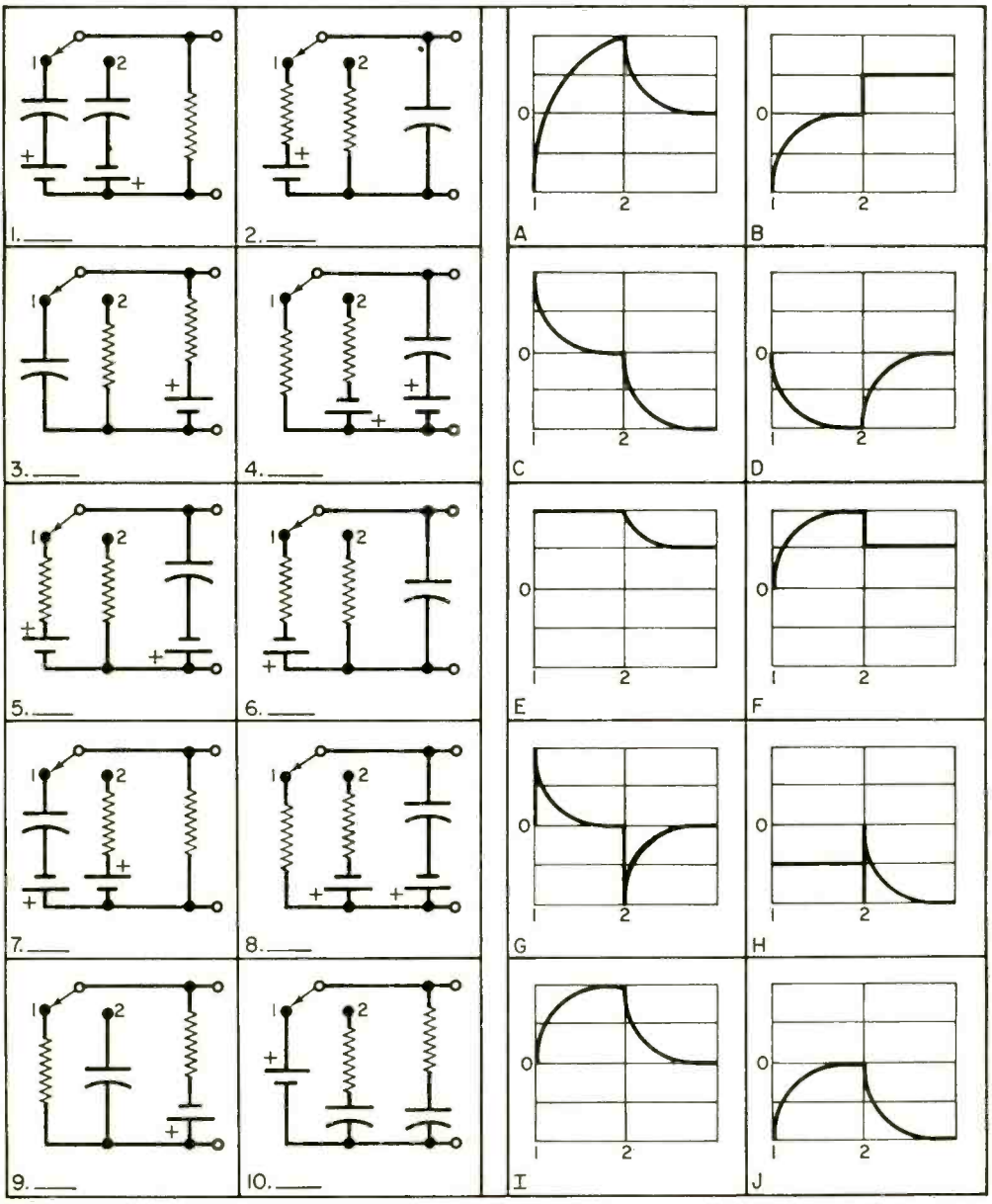


Transient Voltage Quiz

BY ROBERT P. BALIN

Voltages in circuits containing capacitors increase or decrease as the capacitors charge and discharge. These transient voltages may be useful or destructive depending on where or when they occur. To test your knowledge of how transients develop and decay, match the circuits (1-10) to the output voltages (A-J). In each case, the switch is held in position 1 until a steady state is reached, then in position 2 for the same length of time. Don't consider differences in component values.

(Answers on page 104)



MAKING PC BOARDS FROM THE PRINTED PAGE

Low-cost photocopying method can be used by experimenter

DUPLICATING PRINTED-CIRCUIT foil patterns for home-built construction projects has always been a laborious chore. Some experimenters try painfully to duplicate the foil pattern on a PC board using liquid resist and a sharp pen, only to find that it is not as easy as it appears at first glance. Others prefer the trusty razor blade and a set of stick-down strips and dots. Both of these systems are tiresome and seldom produce a pattern that looks like the one in the magazine. By the time a PC board has been redone a couple of times, a lot of project interest goes down the drain. This is why many novice experimenters invest in a commercially etched and drilled printed board usually made available with many projects.

Now, with just a little painting skill, a simple piece of homemade equipment, and a few easily available chemicals, you can fabricate a printed board that will look exactly like the one in the magazine in a very short time.

The heart of this process is a new photo-sensitive resist that comes in a pressurized aerosol can and is simply sprayed on a clean, cut-to-size copperclad board. Because this resist is sensitive to the ultra-violet portion of the spectrum it can be handled in subdued lighting, and it is not necessary to have a photographic darkroom. There are no critical temperatures to worry about.

Equipment Required. The basic chemicals were developed for industrial application by the Dynachem Corp., and you will need their photo resist (in a 16-oz aerosol can, $5), dye (also in a 16-oz aerosol can, $2.50), and developer (in a gallon can, $2.50). These are available from any Dynachem representative shown in the table. The basic kit will suffice for about 25 square feet of PC board—enough for quite a large number of circuits. Also available is a Photo Resist Trial Kit ($5) that includes reduced proportions of photo resist, dye, devel-

by Thomas R. Rosica
Sylvania Entertainment Products

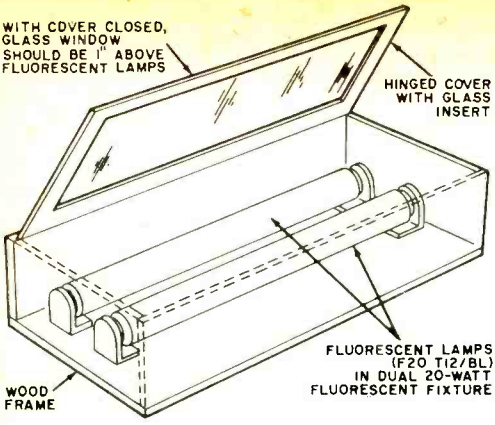


Fig. 1. Suggested printing frame houses the two UV fluorescent lamps and their associated circuitry.

oper, a developing tray, a test negative, three copper-clad boards, and a set of instructions.

You will also need a source rich in ultra-violet light to expose the photo resist. This source can be a high-intensity light source, a mercury-vapor lamp, or a pair of low-cost black-light fluorescent lamps (Sylvania F20 T12/BL) available at most electrical supply houses. A pair of these lamps, mounted side-by-side in a conventional two-lamp 20-watt fluorescent fixture, can properly expose a PC board in three minutes.

Although not essential, a printing frame can be built to simplify the procedure. This consists of a wooden frame housing the dual-lamp fixture, with a window-glass cover that can be set one-inch above the lamps. The basic arrangement is shown in Fig. 1. Otherwise, the negative and the treated PC board can be "sandwiched" between a pair of glass sheets held together with rubber bands.

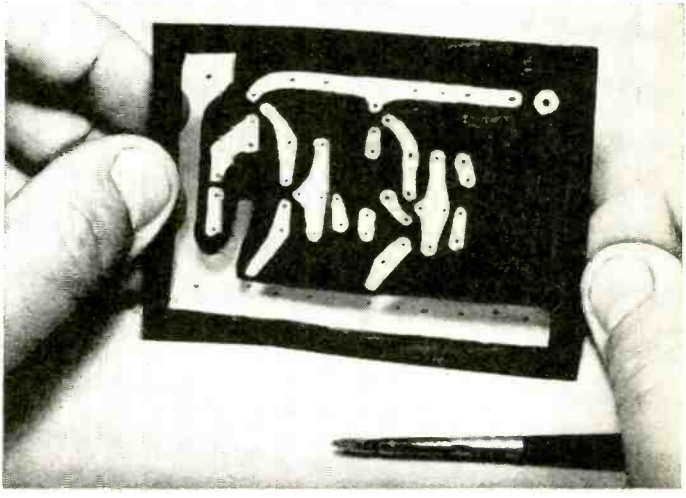
Preparing the Negative. To make a negative of the foil pattern as it appears in the magazine, you can either have a photographer make a negative (on a transparent background), or you can make your own negative using opaque paint on a sheet of thin clear acetate (available at all art stores). If you make your own negative, place the sheet of acetate over the foil pattern as it appears in the article; then using the opaque paint and a fine-pointed brush, carefully cover all the areas in which the copper has to be removed. Always remember, you are making a negative, so the parts to be left copper must be transparent, while the parts to be etched away must be opaque. Because the art work in the magazine is usually black, use a contrasting color of opaque paint for drawing clarity. Don't forget a tiny dot of color where holes will have to be drilled through the foil. A razor blade edge can be used to "clean up" any slight mistakes. India ink is not recommended, as it may bead on most plastics and may not produce a sufficiently opaque coating. A typical sequence is illustrated in Fig. 2. While the paint is drying, prepare the copper-clad board.

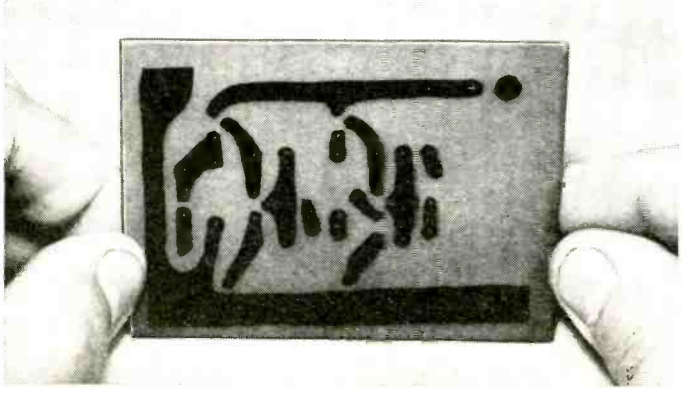
Preparing The Board. Cut the PC board so that the entire circuit, plus a small border, will fit within the area. Thoroughly clean the copper surface using a household abrasive (not a detergent, as the wetting agents in the detergent may form a film which might hinder further applications). You can use a piece of fine steel wool for the cleaning. Once the copper surface has been cleaned, let it dry and from then on handle the copper-clad board only by its edges to avoid contaminating the shiny copper surface with natural body oils. You can lay the cleaned board on a sheet of cardboard if you have to move it around.

The board can now be coated with the photo resist. This should be done in a semi-dark room illuminated by a 40-watt incandescent lamp at least eight feet away. A yellow bug lamp, or a photographic safe lamp is fine. Place a sheet of newspaper behind the board to prevent the aerosol spray from getting on any other surface. Shake the can of photo resist to stir the contents, then spray the copper surface of the board from a distance of 6 to 8 inches. The coating should be as uniform as possible. Try to avoid having any running droplets. After coating, keep the board away from any other light and allow it to dry to a tack-free consistency. To speed up the drying process, place the board in an oven set for 115°F for about 15 minutes. Then remove the board from the oven and allow it to cool. Keep the area reasonably dark during this process and don't allow any light to fall on the board. Remember that the board is now light sensitive.

Fig. 2. If you are making your own negative, the first step in preparing a PC board is to place a piece of transparent plastic over the foil pattern. Using opaque paint, fill in areas where copper is to be removed. When it is completed. . . .

. . . the plastic sheet will look like this. Don't forget to put a small dot of paint at each component mounting hole. Use the method described in the text to expose and dye the PC board. After etching is done. . . .





. . . the finished board will be an exact duplicate of the one in the magazine. The foil will be covered with black resist. Use steel wool to remove the dyed resist from the copper. Drill the required mounting holes and assemble components.

Determining Exposure Time. If a light source other than the F20 T12/BL fluorescent lamps is to be used, the required exposure time will have to be determined. To do this, take a small piece of scrap PC board and spray it with the photo resist. (Don't forget about the safe light!) Then take a spare piece of the transparent acetate, and using the opaque paint, make a small design (cross, circle, etc.) on it. After the board has dried completely, lay the design over it and expose the pair to the light source at some fixed, close distance, for 2 minutes. Then place the exposed board on the developer for about 30 seconds, remove, and spray it with the black dye. Allow the dye to remain for a few seconds, then wash the board in running cold water. This not only stops development, but enables you to see the condition of the pattern on the board in normal room light. At this point, the board is no longer light sensitive. The dyed pattern should be clean and true. If not, dip the board back into the developer and wipe it clean. Reclean and dry the board, go back to the safe light, and repeat the exposure process lengthening the exposure time by one minute, until you get a good, clean pattern of resist. In this way, you will be able to determine the optimum exposure time for the light source and distance you are using. Record the type of light source, distance between the light and the board, and the optimum exposure time required. This will be used whenever you make a printed circuit board using that light source.

Making The Board. With the light source turned off, lay the foil negative on the light-frame window. Remember that the magazine usually shows the foil as seen from the bottom of the PC board, so place the pattern with the painted side up. Place the sensitized surface of the board on top of the negative, aligning it as required. You can place a small weight on top of the board to make sure that the negative and board are lying in close proximity and are flat.

If you are using the fluorescents, turn them on for three minutes. If you are using some other light source, refer to the previously noted exposure time and distance and expose the required time.

After exposure, place the board in a metal or glass tray containing the developer, and allow it to stay there for about 30 seconds. DO NOT use a plastic tray, as the developer is a solvent for certain types of plastics.

After developing, remove the board from the developing tray and using the newspaper again as a backdrop, shake the aerosol can of dye, and spray the wet board. In 5 to 10 seconds, an image of the pattern will appear. At this point, rinse the board in cold water—preferably a water spray—for about half a minute or so. Shake the board clear of water and allow it to dry. DO NOT use a towel or any other cloth to dry the board at this stage, as the plastic forming the resist is soft and can be destroyed by the abrasive action.

Once dry, the board is ready for the etchant. Almost any etchant can be used as directed by its instructions. Incidentally, if you want to speed up the etching process, use a thin-walled plastic or glass tray to hold the required amount of etchant, and place this tray in a sink and run hot tap water around the tray. Lay

(*Continued on page* 117)

COLOR TV- THAT ISN'T

OPTICAL ILLUSION CREATES COLOR IMPRESSION IN VIEWER'S MIND

By LAURENCE R. GRIFFIN

CAN AN ORDINARY black-and-white TV receiver reproduce a color image? "No," you say. Wrong! Believe it or not, the answer is a resounding yes —provided the telecast is in "electronic" color using the Color-Tel subjective color process*.

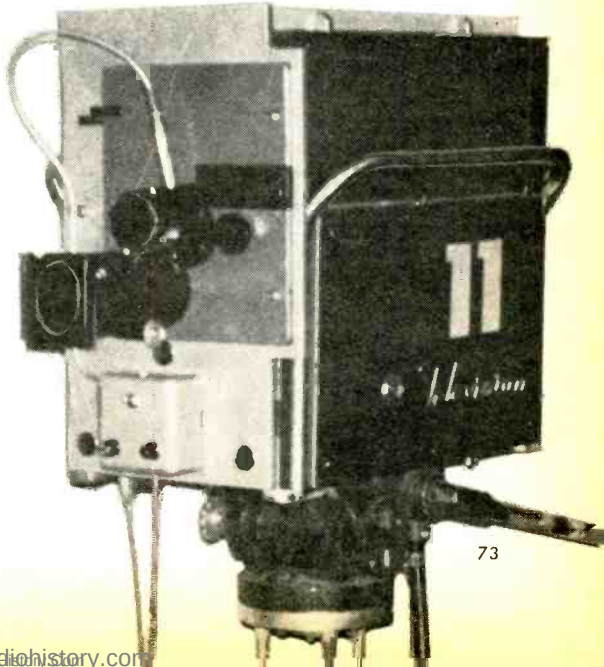
Developed by James F. Butterfield, Sherman Oaks, California, electronic color is a remarkable TV broadcasting technique using relatively unknown optical principles to transmit a monochrome picture that appears to be in color when viewed on an ordinary black-and-white TV receiver. Actually, no color appears on the TV screen—it exists only subjectively in the brain of the viewer. Although most viewers see colors, there are some viewers who do not—for reasons not completely understood. On the other hand, normally color-blind people frequently report being able to see the electronic subjective color display.

Light. Light waves are a form of radiant electromagnetic energy of which the visible spectrum is only a small part spanning the apparent color range from red to violet. Each color has a distinctive wave length, from violet at 16 millionths of an inch, to red at 32 millionths of an inch. Outside of this very narrow band of frequencies lie the optically invisible radiations that include ultraviolet, infrared, X rays, and even radio waves.

Vision begins when light strikes the retina, a light-sensitive nerve membrane covering the hemispherical back wall of the eyeball. Composed of three layers, the retina contains two types of special sensory bodies called rods and cones. These nerve cells respond to light stimulation by "telegraphing" a pulsing sequence of coded information along the optic nerves to the brain's sight center in the occipital lobe of the cerebral cortex. All color perception occurs in the cones and by evaluating the varying frequencies of the neuron impulses, the cortex is able to distinguish what hues are acting on the retina.

Slightly over 15 years ago, Butterfield reasoned that, if the frequencies of the nerve codes for specific colors could be mathematically analyzed, it would be possible to feed the cortex synthetic color data. This could be accomplished by stimulating the cones with flickering pulses of white light, keyed to match the known nerve frequency for a given hue. If the theory was correct, such flickering white light would then appear to the viewer to have color.

Television camera equipped with a Color Translator transmits pictures which appear to the viewer to be in color on a standard black-and-white receiver.



*U.S. Patent 3,311,699, and other patents and patent applications outstanding in the United States and foreign countries.

Subjective Color. Experiments in subjective color have taken place throughout the past one and one-half centuries. The first known experiment appears to have been conducted by the French monk, Benedict Provost, who discovered that when a black-and-white object was moved through a ray of sunlight in a darkened room, a spectrum of colors mysteriously appeared. In 1838, Gustav T. Fechner, a German physicist, using a disc composed of black-and-white areas discovered that, when the disc was rotated, portions of the disc "subjectively" appeared in colors. Fechner advanced a theory to explain the mechanism of the phenomenon. Helmholtz, among others, investigated this strange effect.

At the end of the nineteenth century, C. E. Benham devised a disc which presented these colors in a very striking manner. In appearance, the Benham disc is half black and half white. The white area is subdivided into three equal sections, each containing a black design composed of two closely-spaced parallel curving lines. A facsimile of the Benham disc is shown in Fig. 1. You can cut out this pattern and paste it on a piece of cardboard. Pin the center of the disc to a pencil eraser so that the disc may spin freely. As you spin the disc in a clock-

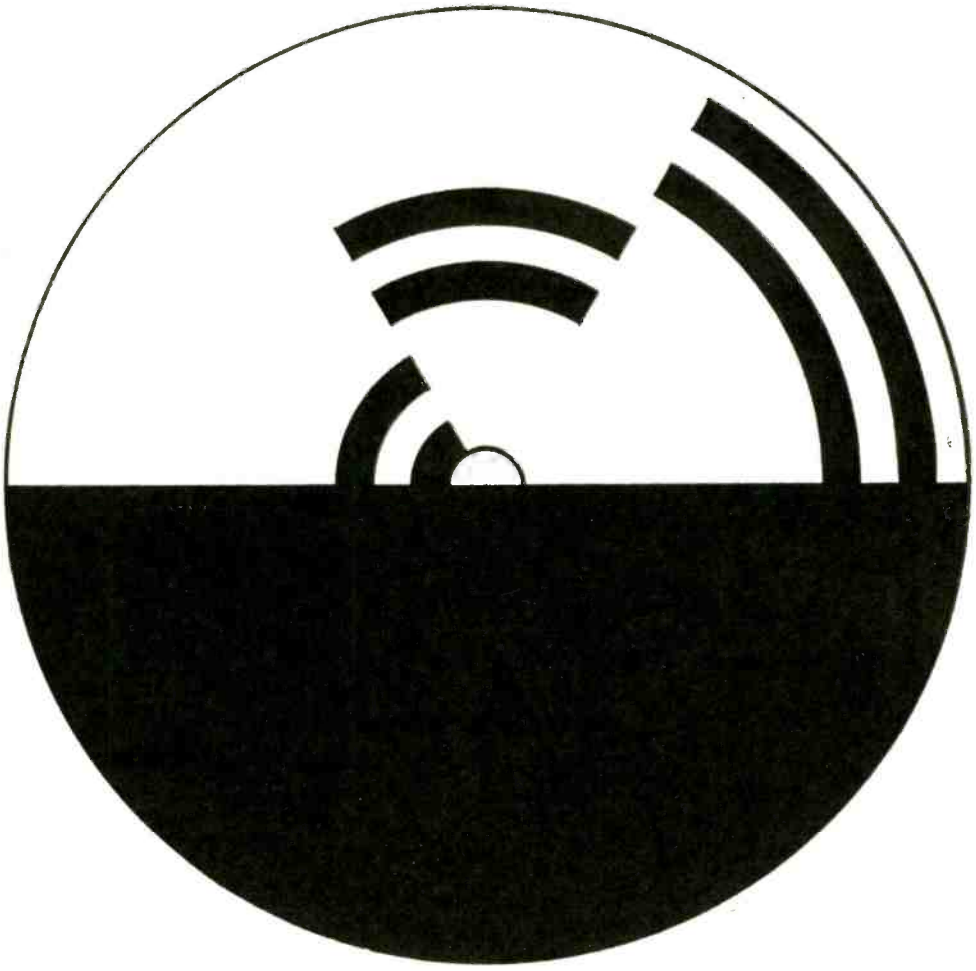


Fig. 1. Cut out or copy this duplicate of the Benham disc. Use rubber cement to adhere disc to a circular piece of cardboard. Punch a hole in the exact center of the disc and support it on a pushpin stuck in the eraser of a lead pencil. Rotate the disc at speeds between 3 and 10 rotations per second. The speed of rotation will affect hue and saturation of the colors. Changing direction of rotation reverses the colors.

wise direction as you face it, you will see subjective color just as Benham saw it 75 years ago.

As the disc rotates, the black lines—almost as if by magic—appear to take on shimmering colors. The lines nearest the hub are reddish, the middle lines appear greenish, and the outer lines are bluish. If this isn't sufficiently surprising, rotate the disc in the opposite direction and watch the display of colors reverse, blue nearest the hub and red on the outside.

In 1953, Butterfield consulted a Dr. Derek H. Fender and asked the famed eye expert to help analyze the Benham disc phenomenon so that it might be used to generate synthetic color codes.

TV Applications. When Butterfield and Fender had completed their tests, the next step was to apply their theory of subjective color to TV broadcasting. This resulted in the development of the Color Translator, a special TV-camera attachment that contains a modified form of the Benham disc. The disc is inserted in the light path between the scene being viewed and the TV camera lens. As shown in Fig. 2 what would have been the white section of the Benham disc is instead comprised of three tinted filter sections. Viewed from the front, the filters are, from right to left, cyan (blue-green), magenta (purple), and yellow, each a complementary color of red, green and blue respectively. When a colored object is seen through a tinted filter of a complementary color, the subject appears black against a pale background.

The Butterfield disc is rotated at 5 rev/m which means that one of the 12 filter elements is between the scene being viewed and the TV camera lens for 60 TV fields. When the cyan filter is in the light path, all red light is blocked out and only green and blue light appears. Therefore, all red areas are transmitted as black. The green, blue, and white areas pass through this filter and correspond to the white spaces of the original Benham disc. The magenta filter blocks out green light (which is transmitted as black), and passes the red and blue light which now acts as the white areas. The yellow filter blocks out the blue light.

Mixed colors are combinations of two or three primary hues and when they appear in the scene, they cause some

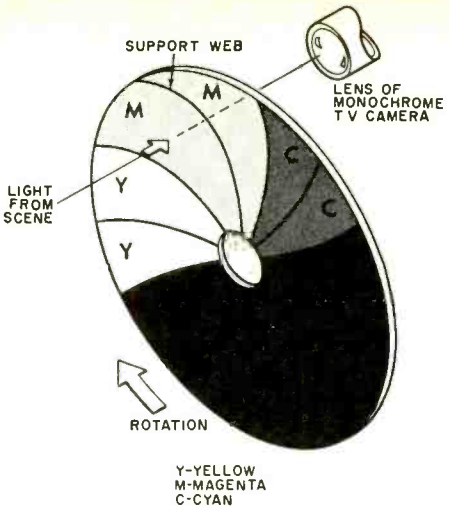


Fig. 2. Disc for use in TV has three sectors in colors that are complements of those seen on reception.

grey or black to be transmitted in the subjective color primaries. When the Color Translator is in operation, a flickering color picture of medium saturation and fidelity can be seen on a black-and-white TV receiver. The flickering is the result of two different effects. First, there is the opaque half of the disc that blocks out all light reaching the TV camera for 50% of the time. This causes a black flicker at 5 Hz (rotational speed of the disc). Secondly, the subjective red, green, and blue colors are each produced during a different sixth of a revolution of the disc. These color areas appear white during the remaining third of the disc revolution. This causes a white flicker in the color area. Mixed colors do not have the latter type of flicker since they are combinations of more than one primary color. Red seems to flicker more than green or blue, but this appears to be a physiological effect.

While Butterfield isn't the first to come up with a workable subjective-color process for black-and-white TV, his method is, by far, the most efficient and flexible system yet devised. The Nagler process, patented in 1958, requires specially prepared film to achieve the desired subjective-color effect. Butterfield's system, on the other hand, needs, no pre-processed material, and can be used to shoot live color sequences, make color

(*Continued on page* 118)

the product gallery

REVIEWS AND COMMENTARY ON ELECTRONIC GEAR AND COMPONENTS

"JAGUAR" COMBO ORGAN KIT (Heathkit Model TO-68)

When rock groups started searching for a "new" sound several years ago, the electronic organ was selected. There was one drawback—electronic organs of that period were as portable as a spinet piano. Because the sound was more important than the furniture, the organ was stripped down to its essentials—a keyboard and a handful of "voices" feeding an outboard high-power amplifier and speaker system. The result is the so-called "combo" organ—an electronic organ in a small package.

Things have changed. The Heath Company, in its inimitable way, has come up with a modern combo organ in low-cost kit form. Its "Jaguar" combo organ, Model TO-68, is a true electronic organ but is only 36″ wide, 22″ deep, and 7½″ thick. It comes with a pair of detachable chrome legs, making it 35½″ high in use. Total weight of organ and legs, each in its own suitcase-size package is only 42 pounds.

The "Jag," at $299, has most of the features of combo organs costing twice as much. Its 49-note keyboard covers four full octaves, with the 12 bass keys playing a dual role. They can be used either as an extension of the regular keyboard, or they can introduce the deep bass tones normally associated with foot pedals.

Four pleasing "voices" are selected by rocker switches—flute, bright, bass, and mellow. One, or any combination of these voices can be used at will, while a vibrato switch introduces a warbling sound normally heard only on the higher-priced organs. An innovation is the use of a "bass/chord" switch. In one position, the lower 12 keys produce a multi-octave chord including a special low bass note. In the other position, the keys only produce deep bass notes. A separate bass note output is provided for either a rhythm or "stereo" effect. Overall organ volume is controlled by a foot-operated potentiometer which is connected between the organ and an external amplifier system.

Construction time should average about 35 hours. The bulk of the electronics consists of the assembly of 11 tone-generator boards and a small power-supply subsystem. Heath supplies one tone generator completely wired and tuned for use as a tune-up standard.

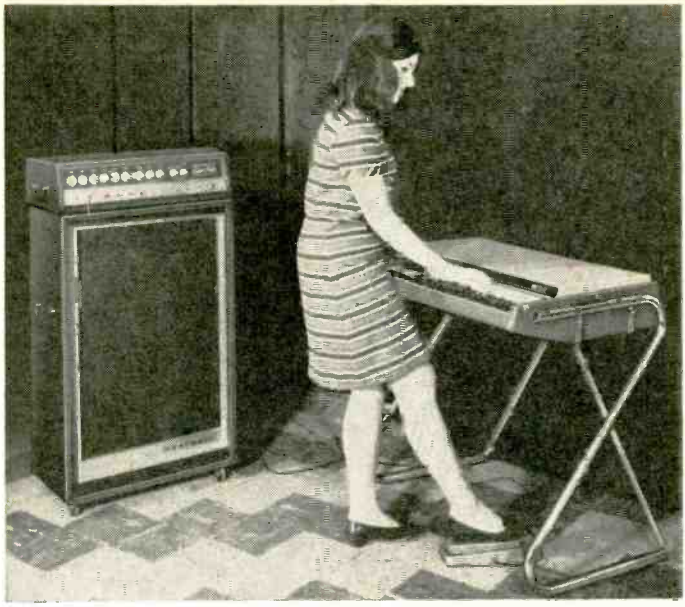
Assembly is far simpler than a scope or amplifier kit, and even an amateur at building kits should have no troubles. The instruction book is very complete and has more than enough illustrations to help make a first-class construction job. Installation of the keyboard calls for a small amount of mechanical skill, but if you follow the instructions carefully and don't run off on your own, there will be no problems. The manual is excellent in this respect.

What does the organ sound like? In one word—great. It's hard to believe that so much versatility can be built into such a small package. Its very light key touch and many voices, plus that extra bass extension, make the "Jag" sound like a mighty Wurlitzer.

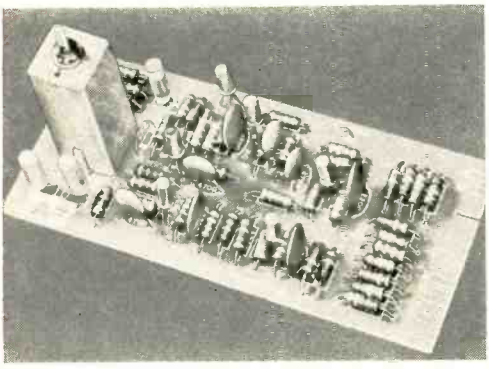
The TA-17 solid-state combo amplifier—the suggested companion for the "Jag"—is a high-quality audio system with a music power rating of 120 watts (240-watts peak) into a 4-ohm load, and 90 watts (180-watts peak) into an 8-ohm load. Construction of the amplifier is in the 20-hour range, and typical of Heath, instructions are simple and complete.

The TA-17 has five independent inputs; one for the organ, one for an electric guitar, one for a bass guitar, one for a mike, and one for a phono pickup. Each input has its own bass, treble, and volume controls (the organ and guitar share a set). The organ/guitar channel also features a tremolo having adjustable rate and depth and a variable reverb system. These channels also include a "brightness" control that really makes the mid-range pop out, while a "fuzz" switch gives you all the distortion you need.

Prices for the individual components in the organ/amplifier system are as follows: Model TO-68 "Jag" available only in kit form—$299.00; TA-17 amplifier kit—$175; TA-17 factory wired—$275; TA-17-1 loudspeaker kit $120; and the TA-17-1 factory wired is $150. Also available are "systems" arranged for price savings. Model TOS-1, consisting of organ, amplifier, and speaker kits, sells for $580. The semi-kit, Model TOS-2, consisting of the organ kit, assembled amplifier and speaker systems, sells for $698. —30—



The combo organ is played standing up, using right or left foot to control volume. Organ must be fed into power amplifier. Legs are detachable and can be carried in their own case. A cover snaps over the keys and the organ becomes a second suitcase. In background is Heathkit TO-17 high-power amplifier featuring variety of inputs and speaker unit.



Each tone-generating board contains a basic audio oscillator and three divider circuits. Resistive matrixing between the circuits give the "Jag" its distinctive tone. Each board is slipped into place behind keyboard (see photo at right). Tuning generators is simple task.

It just looks complicated. Wiring and assembly of the TO-68 is relatively simple, but time consuming. Builder wires 11 tone generator boards and sets in the keys. Rocker arm switches and other controls are at the very far end of the keyboard.

INFORMATION CENTRAL

By CHARLES J. SCHAUERS, W6QLV

RG-65/U Coaxial Cable. *I bought a hundred feet of coaxial cable marked "RG-65/U" at a surplus outlet. The salesman told me it has an impedance of 52 ohms and is similar to RG-8/U. Is this so?*

No, take your cable back. This cable has an impedance of 950 ohms (not 52!) although it has the same outside diameter as RG-8/U (0.405"). RG-65/U is video cable and is used as a delay line.

Ground System. *I live in a second-floor apartment. Is it permissible and desirable to use a hot-water radiator as a ground for my CB equipment?*

In your area it may be permissible, but it is *not* desirable. A cold water pipe should be used, and then with caution, for plastic pipes may be installed in conjunction with the metallic ones. Use an outside ground and connect to it with heavy copper wire (#6 or larger). A good ground will have a resistance of 20 ohms or *less*.

Amplifier Failure. *I have a 10-year-old 20-watt hi-fi amplifier. Recently, when I turned on the set, it would coast along at reduced volume for about five minutes before operating at full volume. Then, after about 30 minutes, distortion and hum appeared. The transformer failed, and I replaced it. I had good operation for a few days, then the old trouble returned. I changed tubes, but that didn't help. What else can I do?*

First, check your power supply electrolytic capacitors. You will probably find them leaky and bad. If not, check the interstage coupling capacitors.

Talk-Back in V MK2. *Some time ago I bought a Galaxy V MK2 transceiver, and I have always received fine reports. However, since I moved to a new location (an apartment house), I get some "talk back" when I load the set on the 21-MHz band. I use a trap antenna. What could be wrong?*

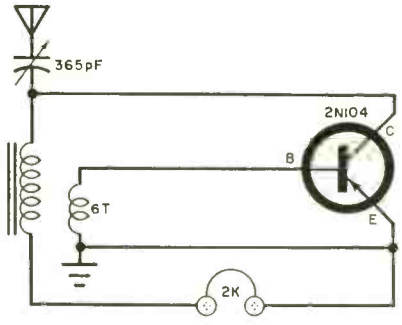
R.f. rectification in the audio output circuits is taking place. Check the SWR of your antenna, and make *sure* you have a good ground. I advocate using a balun with any trap-type antenna, because it saves a lot of mismatch headaches.

Erratic Tube Tester. *After adjusting the line voltage on my tube tester, and I use the tester for a few minutes, the meter readings become erratic. What could be the cause?*

A dirty or bad a.c. line rheostat, or bad or dirty filament tap switch contacts might be the culprits. A bad transformer should be suspected next. If none of these is at fault, check the d.c. power supply components, especially aging resistors.

No Power Receiver. *Because transistors can function on such low voltages and currents, I have heard that it is possible to build a transistorized radio receiver with no batteries. Can you show a schematic?*

Yes, it is possible, as shown by the schematic below. You should use a long wire antenna, 100-feet or more, and a good ground. The tuning coil is a conventional ferrite AM



BCB loopstick with about six turns of #22 wire wound at one end of the coil. You may have to reverse the connections to the secondary winding to get best results.

Power Supply Kit. *I am a new electronics enthusiast who got his start in a fascinating hobby by building kits. I'm hooked! Can you recommend a power supply that I can use with my transistor experiments which I can build from a kit? I want a unit which will supply at least 20 volts and 300 milliamperes. Output voltage must be adjustable.*

Check the catalogs of the major electronics parts distributors. There are many good low-cost power supplies available. —30—

SHORT-WAVE LISTENING

By HANK BENNETT, W2PNA/WPE2FT
Short-Wave Editor

THE DX AWARDS PROGRAM—PHASE FOUR

FOR THE PAST several years POPULAR ELECTRONICS has been conducting an Awards Program for its SWL readers. Working hand-in-hand with our Monitor Registration Program, the DX Awards Program concerns only those who have registered their listening posts with us and who have a Monitor Registration Certificate. If you have not yet registered, consult the 1969 COMMUNICATIONS HANDBOOK which will be available in late November for details.

The Monitor Certificate has five blank spaces for award seals. Each space is for a different category. Three of these categories are already available, a fourth is described below, and the fifth is yet to be determined.

The first phase of the Awards Program is for the number of countries from which the applicant has received bonafide verifications (QSL's). This phase is set up for award seals for 25, 50, 75, 100, and 150 countries verified. Separate Letters of Certification are being issued to those applicants who have more than 150 countries verified, in additional steps of 10 countries. The seals for the country awards are attractively printed in blue on a gold background and show the number of countries verified. Subsequent country award seals are placed over the previous seal thereby showing the greatest total at any time.

Phase two is for individual states verified and is available in steps of 20, 30, 40, and 50 states. This seal is printed in red on a gold background.

The third phase is an All-Canada Award and is available in steps of 6, 8, 10, and 12 Canadian areas verified. This seal is printed in green on a gold background.

At the request of many readers we've decided to make the fourth phase an *All-Zones Award*. In the world of hams and SWL's, there are 40 radio zones, some of which are well populated and easy to hear and verify. Others, being less populated and more distant, are considerably more difficult to get into your logbook as heard and verified. For the newcomers, a 10-zone award; for the experts, a 40-zone seal; and in between, award seals for 20 and 30 zones. The color for the new seal has not yet been determined, but we are sure that they will be attractive.

The 1969 COMMUNICATIONS HANDBOOK will have a completely new and revised Official Country List which will also incorporate the

DX Award Honor Roll

Here are the leaders in the DX Honor Roll. The figures indicate, from left to right, the number of countries, states and Canadian areas verified.

James Young (WPE6ENA) Wrightwood, Calif.	230	50	12
Chuck Edwards (WPE4BNK) Fort Lauderdale, Fla.	190	50	12
Mike Mandrick (WPE2GVF) Rochester, N. Y.	160	50	10
Ed Fellows (WPE7BLN) Seattle, Wash.	200	0	12
Paul Kilroy (WPE3FOB) Washington, D. C.	150	50	12
Charles Matterer (WPE6DXC) Los Angeles, Calif.	150	50	12
Don Jensen (WPE9EZ) Racine, Wis.	190	20	0
L. E. Kuney (WPE8AD) Detroit, Mich.	150	50	10
Bernard Hughes (G2PE6D) Worcester, England	170	40	0

A recent newcomer to short-wave listening is young Charlie Rann, WPE9JFQ, Wheaton, Ill. His receiver is a Knight-Kit Star Roamer. He has nine QSL's now.

DX ALL-CANADA AWARDS PRESENTED

To be eligible for one of the DX All-Canada Awards designed for WPE Monitor Certificate holders, you must have verified stations in 6, 8, 10, or 12 different Canadian areas. The following recently qualified for and have received awards.

6 CANADIAN AREAS VERIFIED

Roy Carroll (WPE2QAA), Neptune, N. J.
Roland Wahlgren (VE7PE1CR), N. Vancouver, B. C.
Richard Spear (WPE3HEI), Baltimore, Md.
Duane Hayes (WPEØFGM), Denver, Colo.
Arnold Rosett (WPE3HIF), Philadelphia, Pa.
Douglas Meyer (WPE2OUS), New Rochelle, N. Y.
Don Zimmerman (WPEØFDR), Madison, S. D.
Warren Bussard (WPE6GTV), Tulare, Cal.
Jon Pearkins, Jr. (VE7PE1CQ), Burnaby, B. C.
Mitchell Hyman (WPE2OPK), Brooklyn, N. Y.
Ken Ascher (WPE8JYA), Detroit, Mich.
Mark Nelson (WPEØFHU), Canton, S. D.
Jerry Heien (WPE9BOD), Berkeley, Ill.
Gary Fredricks (WPE7CGG), Eugene, Oregon
James Bochantin (WPE9JDA), Du Bois, Ill.

8 CANADIAN AREAS VERIFIED

David Conder (WPE9IHV), Centralia, Ill.
Jack Dardes (WPE3EGL), State College, Pa.
Marion Lilienthal (VE3PE2DO), Waterloo, Ont.
David Hagerman (WPE2PWK), Delaware, N. J.
Roy Carroll (WPE2QAA), Neptune, N. J.
David Hailey (WPE4ENX), Nashville, Tenn.
Donald Gross (WPE7CQX), Roseburg, Oregon
Bernard Niderost (WPE6GXR), Mad River, Calif.
Romona Hagerman (WPE2OBV), Delaware, N. J.
Timothy Armstrong (WPE6GGJ), Suisun, Cal.

10 CANADIAN AREAS VERIFIED

Mike Mandrick (WPE2GVF), Rochester, N. Y.
Carl Bruesch (WPE1HJK), New Canaan, Conn.
Robert French (WPE8FGH), Bellaire, Ohio
Thomas Creery (WPE2PHZ), Conklin, N. Y.
Sgt. Robert Combs (WPE2PJU), APO, New York, N. Y.
Bill Wright (VE3PE2HS), Delta, Ont.
Robert Gage (WPE9IXZ), Lafayette, Ind.

12 CANADIAN AREAS VERIFIED

Chuck Edwards (WPE4BNK), Fort Lauderdale, Fla.
Edward Panish (WPE9JAZ), Western Springs, Ill.
Charles Matterer (WPE6DGA), San Leandro, Calif.
Donald Gross (WPE7CQX), Roseburg, Oregon

number of the zone in which each country is located. We suggest that our readers consult the handbook carefully before making applications for zone awards; there will be some specific variations in the zone listings that differ from other zone listings now available. We have adopted, with permission, the Official Country List and Zone List of the Newark News Radio Club. Its country and zone committee has recently completed a thorough and exhaustive overhaul of the zone listings, and we feel that it is by far the most accurate listing now available.

All of the various awards have a few regulations which must be followed by those applying. You must have the required number of verifications in your possession to qualify for the award for which you are applying. You must be registered and have your WPE identification certificate. You must submit a list of stations for the award you desire, including country, state, Canadian area, or zone, call letters or name of the individual stations, their frequencies, dates they were heard, and dates of the verifications. You do NOT have to send your QSL's unless specifically requested for purposes of clarification. These are always returned. Finally, your application and list of stations must be accompanied by a 50¢ fee in coins, unused U.S. stamps, or postal money order. No personal checks or IRC's.

All applications, whether for Monitor Registration, DX Awards, or information on either program should be sent to the Short-Wave Editor at the address which appears at the beginning of "Current Station Reports."

CURRENT STATION REPORTS

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

Abu Dhabi—An overseas source reports that the Abu Dhabi Broadcasting Service is advertising for a senior broadcast engineer to supervise installation and operation of high-power medium- and short-wave xmtrs for the Government of Abu Dhabi. (Editor's note: our atlas shows Abu Dhabi to be on the Persian Gulf, in Oman, rather than a country in itself. Can anyone confirm this report?)

Algeria—Algiers, 11,835 kHz, has an extended schedule until 0000 with mixed pop and Arabic music. There is a complete ID in French at s/off time. For medium-wave DX'ers, the 300 kW outlet on 529 kHz has moved to 575 kHz.

Angola—*Emissora Oficial de Angola,* Luanda, is on 11,925 kHz with a new 100-kW xmtr where it is heard with English and pop records at 1500-1505; this follows a brief newscast in Portuguese.

Argentina—LRX, *R. El Mundo,* Buenos Aires, is good at times on 9710 kHz around 2300. This is now heard rather consistently with Spanish music.

Bolivia—CP88, *R. Amboro,* Santa Cruz de la Sierra, 4900 kHz, was noted recently with a lengthy political talk running past the normal s/off time to 0413. DX'ers are reminded that they have an opportunity to log this country in English. Check 5025 kHz for *R. La Cruz del Sur,* La Paz, around 0230-0245 and again during its bilingual s/off at 0300.

Brazil—PRL8, *R. Nacional do Brasilia,* 11,720 kHz, is noted infrequently around 0013 with an ID in English along with a request for reception reports. Further checks moments later found only the usual Portuguese ID's.

Ceylon—The 0630 xmsn to Europe has been de-

(*Continued on page* 105)

ON THE CITIZENS BAND

By MATT P. SPINELLO, KHC2060, CB Editor

HUNTSVILLE IN THE CB SPOTLIGHT

The Emergency Citizens Band Monitors, Inc., Huntsville, Alabama, was organized in February, 1966 and incorporated as a non-profit, public-service organization in March. In just over 2½ years, the membership has taken giant strides toward living up to its motto, *Pro Bono Publico* (for the good of the public). Since the Huntsville area was already being served by an active rescue squad, the ECBM set its organizational sights on basic communications and participation in civic, public service, and charitable projects.

In May, 1966, ECBM received its REACT charter from national headquarters, and authorization to participate in HELP (Highway Emergency Locator Plan). In August of the same year, the Federal Communications Commission issued a special-condition Class D CB license to ECBM for 80 units under the call letters KOM6753. According to ECBM, this was the first such special-condition license to be issued in the northern Alabama area.

By September, 1966, the growth of the organization made it possible to activate both the REACT and HELP programs on channel 9 on a daily 24-hour basis. The programs have been in effect without interruption for two years. In the interim the ECBM has responded to hundreds of calls for assistance and emergency communications handling.

In addition to its 24-hour monitoring service, the membership participates in charitable activities, and to date has been active in four area-wide telethons. ECBM is also represented on the board of directors of the cerebral palsy and multiple sclerosis health services.

The ECBM is entirely self-supporting, and finances most of its activities through two annual projects. The first involves the compilation and publication of an annual CB call book for the Huntsville area. This project, under a plan developed by the ECBM, produces from $600 to $1000 net income per year. In fact, ECBM feels the plan is so successful that it is offering it to other clubs. You can get a copy of the current call book and the plan by mailing $1.00 to ECBM, P. O. Box 1542, Huntsville, Alabama 35807. The second annual fund raising project undertaken by ECBM is a Fall Festival CB Jamboree. We would imagine their efforts in this area are as successful as their publishing projects, especially since this year's grand prize was a weekend trip for two to Las Vegas.

The ECBM has an active membership of 80, and recently occupied new and larger quarters on the 12th floor of the Times Building in downtown Huntsville. Current officers for the group are: Ken Cowley, Sr., KQM6634, president; Randy Duck, KQM-1025, vice president; Ed Clift, Jr., KON0704, treasurer; Madelyn Schanhoff, KON0529, secretary; and five board members.

ECBM'ers feel they have established a firm foothold as an influential element in the Huntsville-area CB community in a

(*Continued on page* 96)

Ken Cowley, KQM6634, (seated) is the president and Ty Wilkinson, KOM1337, is past-president of Huntsville's ECBM, a group devoted to community service. Obviously, ECBM's equipment, which includes 3 CB transceivers, 2 FM receivers, and an antenna control bay, gives them plenty of gear to work with.

AMATEUR RADIO

By **HERB S. BRIER,** W9EGQ
Amateur Radio Editor

HORIZONTAL "VERTICAL" ANTENNAS

In a recent letter, Gerard, K1STP, asked about the possibility of using two 40-meter, mobile "loaded whip" antennas back-to-back as a horizontal, fixed-station antenna. Gerard's idea seemingly offers no electrical problems. Mount the two whips in line horizontally so that their bottom ends are separated from each other by an inch or so. Feed the two whips with 52-ohm (nominal) coaxial cable by connecting the center conductor of the cable to the base of one antenna and the outer conductor to the other antenna. Adjust the loading coils in the two mobile whips for minimum SWR.

Assuming the mobile whips are of normal length, you will have a loaded antenna with an overall length of slightly under 20 feet. Like all shortened antennas, its radiating efficiency will be inversely related to its length compared to a full-size antenna cut for the same frequency. Consequently, efficiency will be poor on 80 meters, fair on 40 meters, good on 20 meters, and excellent on 10 and 15 meters. Of course, the proper loading coils for the band in question must be used. Also, the antenna height above ground will have an important effect on how well it gets out.

AMATEUR STATION OF THE MONTH

Dr. P. J. Lester, WN9UCM, 204 N. Park St., Streator, Ill., finds amateur radio an ideal relaxation from his dental practice. Doc works CW with an old Heathkit transmitter and receives on a Hammarlund HQ-100. He has made close to 1000 contacts in most states and a handful of foreign countries, so he gets good use out of the low power. He uses a Hallicrafters SR-42A transceiver for local ragchews on 2 meters. A 1-year subscription to POPULAR ELECTRONICS goes to WN9UCM for winning this month's Amateur Station Photo Contest. You can enter the contest by sending a clear photograph of yourself at the controls of your station with some details about your amateur career to: Amateur Station Photo Contest, c/o Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, Box 678, Gary, Ind. 46401.

Operators and Italian visitors at I1DFD, the Amateur Radio Club station of the Southern European Task Force base at Vicenza, Italy. Using Hallicrafters equipment and 300 watts to a 75-foot high rotary beam, the station puts out a walloping signal on the 7- through 29.7-MHz bands. (U.S. Army Photograph.)

Multi-band Vertical Antennas as Horizontals. Some months ago, in the German amateur radio magazine *DL-QTC*, a German ham described his use of a standard, multi-band vertical antenna (Hy-Gain 14-AVQ) in the horizontal position. The antenna was supported horizontally on brackets, and the ground-plane system was replaced by horizontal wires ¼-wavelength long for each band. These wires terminated at an insulator near the base of the antenna. The far ends of the wires were supported by strong, shrink-proof cords far enough apart that they could not touch or twist together in the wind.

The antenna was fed with coaxial cable in the normal manner, with the center conductor going to the base of the "vertical" antenna and the shield to a common terminal of the ¼-wavelength wires. Careful adjustment brought the transmission-line SWR down to a low value on all bands. An impressive list of stations contacted with low power proves that this unusual antenna does perform.

The Horizontal Antenna as a Grounded Vertical. Applying the above idea in reverse, B.A. Watling, G3RNL, used half of a conventional horizontal "trap" dipole as a semi-vertical antenna operated against ground. Reporting in *Radio Communications* (London) for March, 1968, G3RNL concluded that this arrangement was a better all-around 80-, 40-, and 20-meter antenna than four other multi-band antennas with which it was compared.

The antenna consisted of a 32′ 6″ vertical section, the "trap," and a 21′ 6″ horizontal section. The trap consisted of 23 turns of wire on a 1¼″ diameter form paralleled with a 50-pF capacitor. Although not specified, #14 enamelled wire should be satisfactory for the trap, which should be "grid dipped" to the middle of the 40-meter band. In operation, the center conductor of the 52-ohm coaxial feeder (which may lay on the ground) is connected to the bottom of the antenna, and its shield is grounded to a metal stake driven into the earth directly under the antenna.

FCC News. In late June, the Federal Communications Commission reversed a rule that prohibited the connection to a telephone of any device not supplied by the telephone company. The new ruling apparently means that amateur phone patches—devices to connect a transmitter and a receiver to a telephone line—are completely legal as long as they do not interfere with the normal operation of the telephone. As far as the amateur is concerned, the ruling is academic because phone companies have rarely objected to amateur phone patches.

Also in June, Congress sent to the President a bill to authorize the FCC to control devices such as electric motors, automobiles, etc., capable of interfering with radio communications. The bill, which the President will probably have signed when you read this, is the first big step towards reducing the unnecessary electrical noise pollution that plagues all radio services.

Sounds Too Easy. In the July, 1968, *XTRA News Letter* (Bonita, Calif.), Max Adler, ZS1ACD, Capetown, South Africa, says that he learned the code well enough to

(*Continued on page* 98)

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

Prepared by ROGER LEGGE

TO EASTERN AND CENTRAL NORTH AMERICA

TIME—EDT	STATION AND LOCATION	FREQUENCIES (MHz)
7:00 a.m.	Stockholm, Sweden	15.315
7:15 a.m.	Melbourne, Australia	9.58, 11.71
8:15 a.m.	Montreal, Canada	9.625, 11.72
8:45 a.m.	Copenhagen, Denmark	15.165
12 noon	London, England	21.61
7:00 p.m.	Helsinki, Finland	15.185
	London, England	9.58, 11.78, 15.14
	Montreal, Canada	9.625, 11.96, 15.21
7:45 p.m.	Tokyo, Japan	15.135, 17.825
8:00 p.m.	Moscow, U.S.S.R.	9.685, 11.96, 15.21
	Sofia, Bulgaria	9.70
8:30 p.m.	Budapest, Hungary	9.833, 11.91, 15.16
	Johannesburg, South Africa	9.705, 11.875, 15.22
	Kiev, U.S.S.R. (Mon., Thu., Sat.)	9.685, 11.735
	Stockholm, Sweden	11.805
8:50 p.m.	Brussels, Belgium	6.125, 9.615
	Vatican City	9.69, 11.76, 15.285
9:00 p.m.	Berlin, Germany	9.50, 9.73
	Havana, Cuba	9.525, 15.285
	Madrid, Spain	6.13, 9.76
	Peking, China	15.06, 17.675, 17.90
	Prague, Czechoslovakia	7.345, 11.99, 15.365, 17.84
	Rome, Italy	9.575, 11.81
9:30 p.m.	Berne, Switzerland	6.12, 9.535, 11.715
	Bucharest, Rumania	11.885, 11.94
	Cologne, Germany	9.64, 11.945
	Hilversum, Holland	9.59 (Bonaire relay)
	Tirana, Albania	6.20, 9.50
10:00 p.m.	Cairo, Egypt	9.475
	Lisbon, Portugal	6.025, 9.68, 11.935
	London, England	6.11, 9.58, 11.78
	Melbourne, Australia	15.32, 17.84
	Moscow, U.S.S.R.	9.685, 11.96, 15.21
10:30 p.m.	Beirut, Lebanon	15.44

TO WESTERN NORTH AMERICA

TIME—PDT	STATION AND LOCATION	FREQUENCIES (MHz)
8:00 a.m.	Tokyo, Japan	9.505
7:00 p.m.	Melbourne, Australia	15.32, 17.84
	Oslo, Norway (Sun.)	9.55, 11.86
	Quito, Ecuador	9.745, 11.915, 15.115
	Taipei, Taiwan	15.125, 15.345, 17.89
	Tokyo, Japan	15.235, 17.825, 21.64
7:30 p.m.	Johannesburg, South Africa	9.705, 11.875, 15.22
8:00 p.m.	London, England	6.11, 9.58
	Madrid, Spain	6.13, 9.76
	Peking, China	15.095, 17.675, 17.795
	Seoul, Korea	15.43
8:20 p.m.	Yerevan, U.S.S.R. (via Khabarovsk) (Tues., Wed., Fri., Sat.)	15.14, 17.88
8:30 p.m.	Berlin, Germany	9.56, 9.65
	Bonaire, Neth. Antilles	9.695
	Prague, Czechoslovakia	7.345, 9.63, 11.99, 15.365
	Stockholm, Sweden	11.705
9:00 p.m.	Havana, Cuba	9.525, 15.285
	Lisbon, Portugal	6.025, 9.68, 11.935
	Moscow, U.S.S.R. (via Khabarovsk)	15.18, 17.79, 17.88
	Peking, China	15.095, 17.675, 17.795
	Sofia, Bulgaria	9.70
9:15 p.m.	Bangkok, Thailand	11.91
9:30 p.m.	Bucharest, Rumania	11.885, 11.94
	Budapest, Hungary	9.833, 11.91, 15.16
	Kiev, U.S.S.R. (Mon., Thu., Sat.)	9.685, 11.735
9:45 p.m.	Berne, Switzerland	9.72, 11.715
	Cologne, Germany	9.545, 11.945
10:00 p.m.	Havana, Cuba	9.525, 15.285
	Tokyo, Japan	15.105
11:00 p.m.	Moscow, U.S.S.R. (via Khabarovsk)	15.18, 17.79, 17.88
11:30 p.m.	Havana, Cuba	9.655

SOLID STATE

By LOU GARNER, Semiconductor Editor

A RELATIVELY QUIET, but far-reaching, revolution is taking place in the design of electrical products as more and more consumer manufacturers switch to solid-state electronic controls.

Just a few short years ago, it was hard to find a single "electronic" product in the average home or family car that wasn't either an entertainment or communications instrument. True, radio receivers were standard accessories in most cars, and nearly every home had a radio or TV set (or both). Most of them also had record players or elaborate hi-fi systems, but only the well-to-do or the technically inclined hobbyists had anything more elaborate.

Today, inexpensive light fixtures may have triac or SCR dimmers; hobbyist drills, sanders, and electric garden tools have solid-state speed controls; and semiconductor electronic controls are likely to be found in washers, dryers, refrigerators, freezers, etc. Automobiles are equipped with transistorized electronic tachometers and complex automatic cruise (speed) controls. The familiar d.c. generator has been replaced by an a.c. alternator fitted with semiconductor diode rectifiers, and the VW can now be obtained with a computerized electronic fuel control system.

Manufacturers of all these products haven't changed to electronic controls for purely altruistic reasons. Their prime goal is to make profits by delivering reliable, attractive products at reasonable prices. Competition is keen and the changeover to electronic controls became desirable *only* when semiconductor circuits became competitive both in price and reliability with conventional electromechanical controls.

Comparatively few appliance and tool manufacturers maintain their own electronic design staffs or circuit manufacturing facilities. Rather, they rely on modular circuits purchased from electronic specialty suppliers. The original equipment manufacturers buy their circuits as "black boxes" capable of performing specified functions. If the module does the job and the price is right, they don't care what's inside it.

Specialized module suppliers include such well-known firms as Amperex Electronic Corporation, Controls Company of America, GE, Fairchild Semiconductor, RCA, Motorola, and North American Philips (Norelco).

Electronic marketing experts estimate that from 15% to 25% of the major appliances sold during 1968 will incorporate some type of electronic control, with the figure rising to 60% or 75% in 1969.

In the future, the increased use of electronic control and amplifier modules in home appliances and other consumer products may result in a real windfall for the experimenter and do-it-yourselfer. Often, functioning modules can be salvaged from appliances which are damaged mechanically and, in addition, yearly model changes may result in the availability of low-cost surplus modules. Even today, one can purchase fully assembled audio-amplifier modules across-the-counter at prices below the cost of the individual components used in the circuits.

Reader's Circuit. The unusual automatic light-switch circuit shown in Fig. 1 was submitted by reader George L. Garvin (10384 E. Jefferson, Osceola, Ind. 46561), who developed it to satisfy a personal need for a

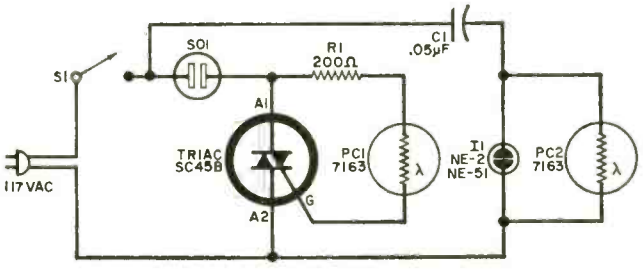


Fig. 1. Automatic light-switch circuit uses medium-power triac and light-sensitive controls to handle loads to 1000 watts.

light switch with a greater power handling capacity than is available in conventional designs or commercial units. Requiring relatively few components, the circuit can be assembled in a single evening, yet, according to George, it is capable of handling loads up to 1000 watts and has more than adequate sensitivity.

George has used a light-coupled control circuit in conjunction with a medium power triac. Capacitor *C1* and photocell *PC2* form a capacitive-resistive voltage divider to supply power to neon lamp *I1* which, in turn, is used to illuminate photocell *PC1*. The gate of the bi-directional triac, which serves as the main power-switching device, is controlled by *PC1* in series with current limiting resistor *R1*. Daylight falling on *PC2* holds it in a low-resistance state in which the voltage drop across it is not sufficient to fire the neon lamp. Photocell *PC1* remains dark and, therefore, in a high-resistance state, limiting the triac's gate current below the level needed to turn it on. As darkness falls, *PC2*'s resistance (and its voltage drop) increases, turning on the neon lamp and illuminating *PC1*. The resulting drop in *PC1*'s resistance permits a corresponding increase in the triac's gate current, switching it to a conducting state and furnishing power to the external lamp load connected to *SO1*.

Standard, readily available parts are used in the control. The triac is a *GE* type SC45B, while *PC1* and *PC2* are both *RCA* type 7163 CdS photocells. A type NE-2 or NE-51 neon bulb is used for *I1*. Resistor *R1* is 1 watt, and *C1* is a 200- to 600-volt paper or ceramic capacitor.

Wiring dress and parts arrangement are not critical, though George recommends that the triac be heat-sinked and that *PC1* and *I1* be mounted close together and shielded to exclude external light. Only *PC2* should be exposed to the ambient light. The circuit may be assembled on a conventional chassis, in a small case, or, for semi-permanent installations, in a standard electrical outlet or switch box.

Manufacturer's Circuit. The sine-to-square-wave converter and audio oscillator circuits illustrated in Figs. 2(a) and (b) respectively, were abstracted from Technical Bulletin 85.15, published by GE's Semiconductor Products Department (Electronics Park, Syracuse, N.Y. 13200). Either or both, may be assembled for use as auxiliary test instruments in the home electronics workshop or laboratory. They each employ a three-stage silicon integrated circuit (*IC1*) which features a two-stage Darlington configuration direct-coupled to a common-emitter amplifier.

In Fig. 2(a), *IC1* is used as a saturated amplifier. The sine-wave drive signal is coupled to the input stage through d.c. blocking capacitor *C1* and limiting resistor *R1*, while the square-wave output signal is developed across load resistor *R2*. Resistor *R3* serves both as a bias source for the first stage and to provide some signal feedback.

According to GE's notes, the sine-to-square-wave converter requires a 1-volt (r.m.s.) drive signal and has a frequency response from 50 Hz to 1 MHz, delivering a square-wave with a 110-nanosecond rise time and a 200-nanosecond fall time.

The sine-wave oscillator circuit shown in Fig. 2(b) utilizes reactive elements *C1* and *L1* in conjunction with load resistor *R3* as part of its output load. The feedback needed to start and maintain oscillation is provided through *C2* and *R2*, while input-stage bias is supplied through *R1*.

A GE type PA113 integrated circuit is used as *IC1* in both cases. All resistors are half-watt types, while the capacitors may be good-quality ceramic or tubular paper types.

(*Continued on page 92*)

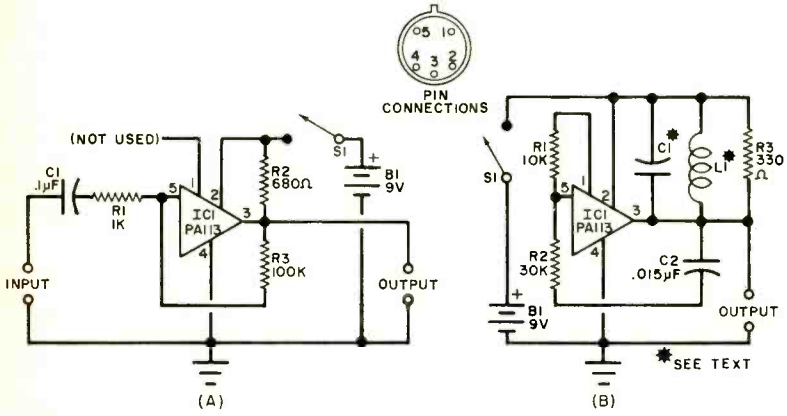


Fig. 2. Integrated-circuit square-wave converter (left) and audio oscillator can be built for auxiliary testing use in the home workshop.

CIRCLE NO. 44 ON READER SERVICE PAGE→

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An FCC License is a legal requirement if you want to become a Broadcast Engineer, or get into servicing any other kind of transmitting equipment—two-way mobile radios, microwave relay links, radar, etc. And even when it's not legally required, a license proves to the world that you understand the principles involved in *any* electronic device. Thus, an FCC "ticket" can open the doors to thousands of exciting, high-paying jobs in communications, radio and broadcasting, the aerospace program, industrial automation, and many other areas.

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Ed Dulaney, Scottsbluff, Nebraska, for example, passed his 1st Class FCC License exam soon after completing his CIE training... and today is the proud owner of his own mobile radio sales and service business. "Now I manufacture my own two-way equipment," he writes, "with dealers who sell it in seven different states, and have seven full-time employees on my payroll."

Daniel J. Smithwick started his CIE training while in the service, and passed his 2nd Class exam soon after his discharge. Four months later, he reports, "I was promoted to manager of Bell Telephone at La Moure, N.D. This was a very fast promotion and a great deal of the credit goes to CIE."

Eugene Frost, Columbus, Ohio, was stuck in low-paying TV repair work before enrolling with CIE and earning his FCC License. Today, he's an inspector of major electronics systems for North American Aviation. "I'm working 8 hours a week less," says Mr. Frost, "and earning $228 a month more."

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CIRCLE NO. 11 ON READER SERVICE PAGE

SOLID STATE

(Continued from page 86)

Components *C1* and *L1* in Fig. 2(b) have values of 0.05-μF and 50 mH respectively, and, with these values, deliver a signal at approximately 2 kHz. Other *LC* combinations can be used for different audio frequencies.

Neither layout nor lead dress are especially critical in the two circuits, and both are well suited to either perf or etched-circuit board construction. Good wiring practice should be observed, of course, with signal-carrying leads kept short and direct. Care should be taken to avoid over-heating the IC leads when soldering this device in place. The completed circuit may be housed conveniently in a small metal or plastic instrument case.

Overseas Developments. Moderately priced 400-Hz servo systems similar to those used in industrial, marine, aircraft, and space applications, have been developed by Feedback, Ltd. (Sussex, England). Designed primarily for educational applications in technical institutes and advanced high schools and colleges, they consist of two basic units—a transistorized power supply and amplifier and an electromechanical servo (see Fig. 3). Full theory and experimental instructions are furnished with the systems, with a minimum of auxiliary test

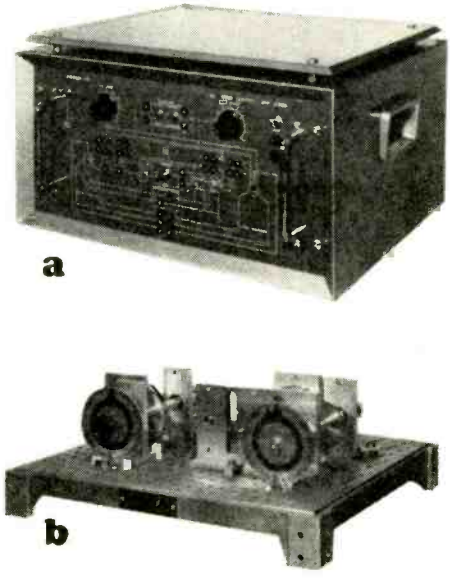

Fig. 3. Transistorized power supply and amplifier (a) and servo board (b) for educational purposes.

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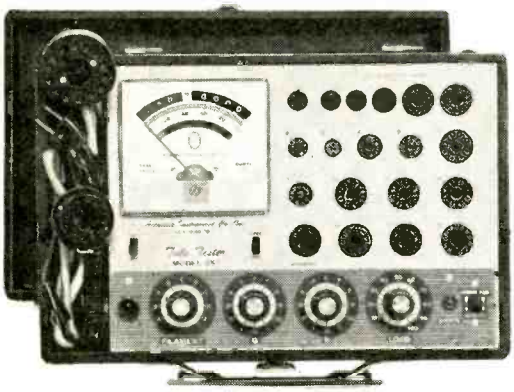

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- The Model 257 tests all Black and White Picture Tubes for emission, inter-element shorts and leakage.

COLOR PICTURE TUBES:

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

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

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

SEND NO MONEY WITH ORDER
PAY POSTMAN NOTHING ON DELIVERY

Try it for 10 days before you buy. If completely satisfied then send $10.00 and pay the balance at the rate of $10.00 per month until the total price of $47.50 (plus P.P., handling and budget charge) is paid. If not completely satisfied, return to us, no explanation necessary.

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Please rush me one Model 257. If satisfactory I agree to pay $10.00 within 10 days and balance at rate of $10.00 per month until total price of $47.50 (plus P.P., handling and budget charge) is paid. If not satisfactory, I may return for cancellation of account.

Name_____

Address_____

City_____ Zone_____ State_____

☐ Save Money! Check here and enclose $47.50 with this coupon and we will pay all shipping charges. You still retain the privilege of returning after 10 day trial for full refund.

CIRCLE NO. 29 ON READER SERVICE PAGE

equipment required for instructional tests and demonstrations. The U.S. distribution of these educational aids is being handled by Feedback, Inc. (438 Springfield Ave., Berkeley Heights, N.J. 07922).

In the Far East, the Nippon Electric Company (Tokyo, Japan) has developed a solid-state, laser-operated instrument for automobiles which can serve both as a distance meter and an alarm control if the car on which it is mounted moves too close to the vehicle immediately ahead. With a range of about 300 feet, the new unit features a gallium-arsenide laser diode and an infrared-sensitive phototransistor detector.

Transitips. As a general rule, a circuit designer is on reasonably safe ground if he uses a semiconductor device with a voltage-breakdown rating at least 50% higher than the d.c. supply voltage of the circuit. A 15-volt transistor, for example, can be used with an ample safety margin in a 9-volt circuit or even, in some circumstances, in a 12-volt circuit. There are exceptions, however, which, if ignored, can lead to disastrous results for the semiconductors involved.

If a switching device—i.e. transistor, bistable diode, tunnel diode, SCR, or triac—is used in a circuit having a highly inductive component, such as a choke, solenoid, or transformer, voltage "spikes" can be developed which may far exceed the device's maximum ratings. With voltage peaks sometimes as high as ten to twenty times the supply voltage, these transient spikes may cause internal arcing or "punch-through," current overloads, or, at the very least, a permanent change in the device's electrical characteristics.

Any of several techniques may be used to minimize possible component damage from transient voltage spikes. The simplest, but not necessarily the best, method is to use a higher-voltage device. While effective in most cases, one may balk at using an expensive 150-volt transistor where a 15-volt unit is adequate as far as basic circuit operation is concerned.

If performance requirements permit, you can sometimes use an alternate circuit design to avoid the need for highly inductive components—a transformerless complementary symmetry amplifier in place of a conventional push-pull circuit, for example.

One popular technique is the use of a small resistive or capacitive "load" across the inductive element. Although this method may not eliminate transient spikes, it tends to limit their maximum amplitude.

Where the inductive component is a transformer, an excellent technique is to design the circuit so that the unit is *never* operated without a nominal load. In audio amplifiers and power inverters, for instance, an internal load resistor may be provided which is automatically disconnected when an external load is used.

Finally, one of the most effective methods is the use of a damping diode and small series resistor across the inductive component. You can use back-to-back rectifier diodes, a zener, or a specially designed transient suppressor.

Regardless of the technique used, however, that old maxim (paraphrased slightly) is still good—a few cents protection is worth more than several dollars "cure."

New Literature. If you are looking for a really good experimenter's handbook, we recommend RCA's latest—the RCA Solid-State Hobby Circuits Manual HM-90. At $1.75, and available wherever electronic manuals are sold (and at all RCA distributors), the HM-90 includes 35 different circuits for the electronics hobbyist with each circuit fully explained and illustrated. The manual even includes construction layouts making each circuit easy to duplicate.

Until next month,

—Lou

ON THE CITIZENS BAND

(*Continued from page 81*)

very short time. The ECBM has been cited by city and county authorities and Civil defense, for its activities during disaster conditions. The association is well-known for its participating support of charitable and civic projects and has been recognized by the federal government as a nonprofit public-service organization.

But, according to its president Ken Cowley, "ECBM is not resting on its laurels. There is still much to do, not only with respect to station equipment and operating procedures, but concerning our basic objective: *Pro Bono Publico*."

An active REACT team on location with its mobile base complete with Zeus portable power generator.

REACT Age-Limit Policy Defined. In response to requests for clarification of the age limits on REACT-team membership, National REACT Director Henry B. Kreer, KPK1386, has replied as follows:

"Every REACT team is required to have among its actual membership at least 3 licensed CB'ers. Beyond that, the membership may include any number of responsible individuals, including teenagers, assuming they are operating legal equipment owned by their parents.

"In other words, REACT would accept membership of . . . teenage group(s) under the *direct supervision* of . . . (an established REACT team) as an integral part of that team. Please be assured that REACT is interested in young people who genuinely wish to perform public service through REACT."

1968 OTCB Club Roster. With this summer's schedule of jamborees and vacations

safely tucked away, CB club activity is increasing and new CB associations are being formed. The following are new additions to our 1968 club roster. If your group was formed recently or if it has not reported to us in the last 12 months, ask your publicity people to furnish us with the statistics. Include current membership totals, club officers, and activities. Send along photos when available (good, clear Polaroids are acceptable). Mail material to Matt P. Spinello, CB Editor, POPULAR ELECTRONICS, One Park Ave., New York, N. Y. 10016.

Indianapolis, Ind. The Indiana Citizens Band Association, Inc., chartered by the State of Indiana, publishes a clean-cut, well-written monthly, *ICBA News*, edited by Floyd Shively, aided by an assistant editor, design and layout personnel, a photographer, and two writers.

Oceanside, Calif. Seacoast Citizens Band Radio Association's Publicity Chairman Jo Cooper, KOX3607, reports club extremely active in public-service functions. Group has sponsored annual "Operation Happiness" since 1964, with special emphasis on helping needy families during the holiday season with drives to collect clothing, food, toys, etc. and donations for the Pala Indian Reservation and needy families in North San Diego county. Group has also handled emergency communications for the San Diego County Fair for the last three annual events.

Decatur, Ga. The Dixie Citation, official voice of the Dixie Communications Club reports that the DCC, the CB Monitor, and the North Atlanta Monitor, have joined to form the DeKalb County CB Association. Since all three clubs have aided authorities in search and rescue operations in the past, often with overlapping communications assignments and activities, they decided to organize an association through which field exercises could be coordinated. Current officers are: Dave Isom, Chairman; Maurice Krugman, vice-chairman; and Allen Copeland, secretary.

Stratford, N.J. Georgianna Weiss, corresponding secretary, KCD0668, reports on the success of the United Citizens Band Radio Club's annual jamboree, at which the proceeds from an attendance of over 1500 made it possible for the club to purchase wheelchairs for the local school for handicapped children. Current officers of the group are: Jerry Lisse, KOG0241, president; Ed Matlack, KKG 2547, first vice-president; Joseph Tulini, KOG0847, second vice-president; Vi Boody, KOG1878, recording secretary; and Walter Mathis, Sr., KKG0366, treasurer.

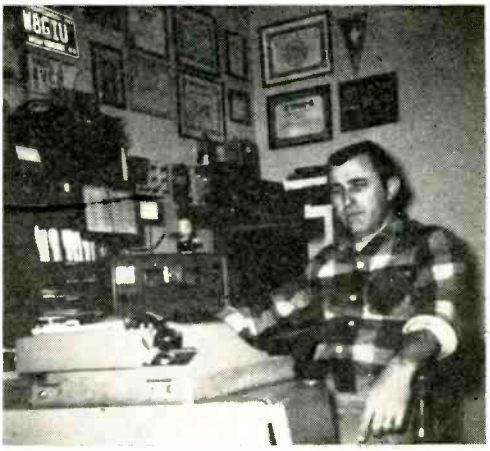
I'll CB'ing you,

—Matt, KHC2060

AMATEUR RADIO

(*Continued from page* 83)

pass the South African 12-wpm code test after two hours of intensive code practice. Max sees nothing unusual about this feat. He is a musician and orchestra leader and since childhood, he has had to learn long and intricate musical sounds by ear, and the code alphabet is nothing more than 26 rhythmic sound patterns.



"GB" Baker, W5QPX, Dalhart, Texas, is QSL manager for FG7XJ, YN4JAB, FM7WI, CR6FW, and FG7XZ. See "News and Views" for his home address and more information about his various amateur activities.

Amateur Radio Correspondence Course. Under the supervision of Byron C. Sharp, W9BE, The Hadley School for the Blind, 700 Elm St., Winnetka, Ill. 60093, offers blind people a free correspondence course in amateur radio leading to a General class amateur license. The taped course is based on the AMECO *Radio Theory Course* and code lessons. The theory lessons will also soon be available in Braille for those who prefer that form. Sharp reports that there are presently 85 students enrolled in the course; although it has been offered for only a short time, several students have already earned their amateur licenses. The Hadley School amateur call letters are WA9WHS. Listen for them Saturdays at 10:00 a.m., CST, on 14290 kHz SSB.

NEWS AND VIEWS

Dave Read (address unknown) after taking the Novice exam disputes our statement that all ama-

(*Continued on page* 102)

OUT OF TUNE

TUNE UP YOUR BASS REFLEX, July, 1968. The "Simplified Design Chart For Bass Reflex Enclosures" as published on the lower half of page 50 might prove a bit difficult to interpret without some additional information. The chart should be divided into two discrete parts as indicated by the shaded and unshaded areas in the chart reproduced below. The shaded portion defines the lower (left figure) and upper (right figure) *length* limits for the 3"-diameter port tube to be used. The blank spaces for the 35- and 40-Hz free-air resonance columns (1 cu. ft. volume) indicate that no port is to be used and the enclosure is to be sealed. The unshaded portion of the chart gives approximate figures for simple port *areas* in square inches. Two or three figures are given for port area. The figure you use depends on the shapes of the enclosure and port.

SIMPLIFIED DESIGN CHART FOR BASS REFLEX ENCLOSURES

VOLUME	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
6 cu. ft.	9	12	25	12	18	32	20	28	36	28	40		56	75							
5 cu. ft.	7	9	20	10	14	28	15	20	24	20	30	40	36	50							
4 cu. ft.	¾		2	7	10	20	11	15	20	14	20	24	26	36		45	80				
3½ cu. ft.	1		3	¾		1½	8	11	16	12	16	20	20	28		32	45				
3 cu. ft.	2		4	¾		2	5	8	12	9	12	18	15	22		26	36		40	80	
2½ cu. ft.	2		5	2		4	¾		2	5	8	12	12	16		20	28		30	40	
2 cu. ft.	4		8	2		5	1		3	¾		2	7	10		12	18		18	25	
1½ cu. ft.	7		10	4		8	3		5	2		4	¾		2	8	11		14	20	
1 cu. ft.							6		8	4		7	2		4	1		2	5	10	
	35			40			45			50			60			70			80		

FREE AIR RESONANCE OF SPEAKER (f_r)

A — *Approximate port area in square inches for rectangular port (length to width ratio—4:1)*

B — *Approximate port area in square inches for square or circular port*

C — *Maximum port area in square inches for increased bass output. This tunes enclosure above speaker resonant frequency, but is permissible if resonance is below 50 Hz*

To use design chart, find fr as described in text, and determine enclosure volume (use inside dimensions). Locate intersection of volume row and fr column, and read lengths of 3"-inner-diameter tubing to try (or port area in sq. in. if intersection is in unshaded portion of chart). Tune enclosure as described in text.

Compact solid-state transceivers, all guaranteed for ten years!

COURIER TR-5
5 channels

A lot of performance for under $100. The top performer for those who don't need 23 channels.

Silicon transistors throughout, just like our finest solid-state rigs. Illuminated channel selector, transmit indicator, auxiliary speaker jack, single-knob tuning, modulation indicator, external channel sockets, RF noise blanker, 100% modulation, triple-plated chrome cabinet. Plus exclusive Courier Safety Circuits® to protect against mismatched antenna, incorrect polarity, and overload. Compact price, compact size: 5¾" x 1⅞" x 6¼".

$99
complete with crystals for Channel 9

COURIER TRAVELLER
23 channels

World's smallest all-channel transceiver—with exclusive Incoming Signal Indicator.

A miracle of miniaturization—all 23 channels in a housing only 5¾" x 1⅞" x 6¼". Exclusive new Incoming Signal Indicator that lights up when receiving S-6 or better signal—lets you mind your driving instead of minding a meter. Silicon transistors throughout. Super-efficient transmitter designed to help pierce "skip". Built-in noise limiter, 100% modulation, true automatic IF noise blanker, triple-plated chrome cabinet. Exclusive Courier Safety Circuits®.

$149
complete with crystals for all 23 channels

COURIER CLASSIC
23 channels

There'll never be anything better until Courier builds it!

Engineered for total reliability, designed to look sharp and work perfectly ten years from now. Silicon transistors throughout. Super-efficient transmitter designed to help pierce "skip". Adjustable noise limiter and noise-cancelling microphone. 100% modulation. Built-in PA system. And more. Everything we know about CB is built into this compact 6½" x 2½" x 8½" unit.

$199
complete with crystals for all 23 channels

COURIER PORT-A-PAK
Makes your Courier TR-5 and Traveller solid-state transceivers completely portable.

$59.95

BASE STATION POWER CHARGER
Model PS-1. Operate your Courier solid-state CB transceiver as a base station.

$29.95

There's a Courier for the pro and the novice, the spender and the saver.

All Courier CB transceivers made in U.S.A.

Rugged heavy-duty tube-type CB with exclusive Modulation Sampler®—boosts your talk power electronically!

COURIER 23
23 channels

America's largest-selling CB rig!

Courier 23 deserves every bit of its popularity. Dollar for dollar, it offers more of what you want in CB: 23 crystal-controlled channels, dual conversion, transistorized power supply, illuminated S-RF meter, illuminated channel selector, PA system, auxiliary speaker jack, modulation indicator, full-time range-expander, triple-plated chrome cabinet. 100% modulation. Ready-to-go—mobile and base.

$189
complete with crystals for all 23 channels

COURIER 23-PLUS
23 channels

Greater sensitivity, more talk-power, less interference than any CB transceiver at its price!

New cascode front end and nuvistor mixer pull in all 23 channels louder and clearer than any other tube rig in its class. Full 5-watt input. Transistorized AC and DC power supply. Illuminated S-RF meter and channel selector. Modulation indicator. Automatic volume control. Floating gate squelch circuit. 100% modulation. PA system. Automatic noise limiter and noise-cancelling microphone. Triple-plated chrome cabinet. Full-time range-expander. Ready-to-go—mobile and base.

$199
complete with crystals for all 23 channels

COURIER ROYALE
23 channels

The dream rig! Finest CB unit you can buy.

Everything hand-wired, hand-soldered. Rugged chassis with 19 tubes (including a Nuvistor) and an over-powered transformer. All 23 channels, with all crystals supplied. Highly efficient ceramic filter for the ultimate in selectivity. Cascode front end for increased sensitivity. Adjustable noise limiter. Enough? There's more! A new, exclusive full-time range-expander and speech compressor. Triple-duty meter. Transmit and Receive Indicators. Every feature for convenience, versatility. 100% modulation. Ready-to-go—mobile and base.

Complete, *very* complete: **$279**

The man who has everything and the CB'er just making a start.

Courier

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☐ Courier TR-5 ☐ Courier Classic ☐ Courier 23-Plus ☐ Port-A-Pak®
☐ Courier Traveller ☐ Courier 23 ☐ Courier Royale ☐ Power Charger

Name _____

PE-810

Address _____

City _____ County _____

State _____ Zip _____

CIRCLE NO. 14 ON READER SERVICE PAGE

AMATEUR RADIO

(*Continued from page 98*)

teur examinations contain questions about transistors. His exam did not, which proves that all examinations for the same class amateur license may not contain exactly the same questions . . . **G. L. "GB" Baker, W5QPX,** 413 Maple Ave., Dalhart, Texas 79022, calls his station the "Fifty Watts of Friendship." He operates all bands, phone and CW, between 3.5 and 39.7 MHz with a Hallicrafters HT-37 transmitter and Hammarlund HQ-170 receiver in conjunction with an assortment of home-built doublet and beam antennas. He likes to DX (has DXCC), rag chew, and handle traffic; and he sends radio parts and technical magazines, etc., to foreign amateurs unable to obtain such things in their own countries . . . **David Cantor, WB4EFE,** 4207 Martha Ave., Louisville, Ky. 40220, has built up quite a record since being licensed in 1966. Running 75 watts to a Johnson Ranger transmitter and receiving on a Drake 2-B, he has all states confirmed and 149 countries worked. A 2-element, 15-meter Quad and a Hy-Gain 18-AVQ vertical antenna do the outside work. Dave is QSL Manager for VP2DAJ and VP2SG, both very active on 15 meters.

Mike Martz, WA8RQA, 804 Foraker Ave., Sidney, Ohio, has worked 41 states and eight countries in nine months as a Novice and six as a General. He transmits using a Hallicrafters HT-40 transmitter, receives on a Hallicrafters S-108, and radiates via a Hy-Gain 18-V vertical . . . **Richard Spritz, WN3IPE,** 7928 Montgomery Ave., Elkins Park, Pa. 19117, has worked 37 states and four countries with his home-brew 50-watt transmitter. He receives on a National NC-60A fitted with Q-multiplier and noise limiter. His antenna is a secret weapon—at least he didn't mention what it was. A 10-watt, home-built 220-MHz transmitter and a helical antenna with theoretical gain of 20 dB (100 times) await the arrival of his next class of license so he can put them on the air . . . **C. Waters, W9JNA,** 3141 N. Julia St., Milwaukee, Wisc., covers 40 through 10 meters with a Mosley TA-31, 1-element "beam" and a Hy-Gain 14-AVQ vertical. The TA-31 is rotated by a Cornell-Dubilier TR-44 rotator. W9JNA uses a Galaxy SSB/CW transceiver to drive four 572B's in a linear amplifier so he is not in the flea-power class; but he has worked all states and all continents in a short time with this setup. He was first licensed as a Novice in "four land" back in 1953.

Patrick Wong, WH6GKC, 2471 Saint Louis Drive, Honolulu, Hawaii, works 15 and 40 meters with a home-built 75-watter driving a Hy-Gain 14-AVS vertical. Pat receives on a Drake 2-B and reports that west-coast signals come into Hawaii with good strength on 40 meters. His best U.S. DX's have been Florida and Michigan on 40 . . . **Gilbert Kunster, Jr., WB2DKZ,** 225 W. 232 St. Bronx, N.Y., spent only five weeks as a Novice. But in that time, he made 110 contacts. Thirteen states and two Canadian provinces were included in the total. A Knight-Kit T-60 transmitter and R-55A receiver, plus an 80-meter doublet antenna, were his tools.

Kirk V. Dahl, WAØRTD, 511 Aldrich Ave. South, Minneapolis, Minn. 55419 practiced the code mentally while simultaneously doing his job as a professional drummer; he just passed his General exam. As a Novice with limited time, Kirk worked 16 states on 40 meters using a Knight-Kit T-60 to excite a "long-wire" antenna. A Hammarlund HQ-129X handles the receiving. A desire to be a traffic (message) handler was one of the things that spurred Kirk on to get his General ticket . . . **Stewart Perry, W1BB,** Winthrop, Mass., worked his 100th country on 160 meters last spring, but three of the countries were worked prior to 1945. Stew.

There has never been a better color-bar generator than the RCA WR-64B...

until now!

The RCA WR-502A CHRO-BAR color-bar generator is all solid-state, battery operated... Provides color bars, dots, crosshatch, vertical lines, horizontal lines, blank raster... has rock-solid stability. It's the greatest yet. The CHRO-BAR. $168.00*.
RCA Electronic Components, Harrison, N.J.

*Optional Distributor resale price. Prices may be slightly higher in Alaska, Hawaii and the West.

RCA

CIRCLE NO. 34 ON READER SERVICE PAGE

therefore, has three countries to go for his 160-meter DXCC certificate. Will he make it this season? . . . **Douglas B. Miller, WN8ANV,** 3748 Northampton Rd., Cleveland Hts., Ohio 44121, has tooled up his Hallicrafters HT-40 transmitter and SX-140 receiver twins to work 31 states and six countries. A Hy-Gain 14-AVQ vertical does the radiating . . . **Larry D. Sweet, WN5TVO,** P. O. Box 51, Hobbs, New Mexico 88240, is the first New Mexico contact for many of the stations he works. If you need New Mexico, Larry spends most of his time on 40 meters, although he can work both 80 and 15 meters. Seventy-five watts to a Heathkit DX-60 transmitter, a Hallicrafters SX-101A receiver, and a Hy-Gain 18-AVQ vertical antenna are Larry's connection with the ionosphere . . . **Rickey D. Hughes, WN4IUA,** 430 TFS. CMR., Box 7425, Homestead AFB, Fla.

Dave Hershberger, WA9QCH, Sycamore, Ill., operates on both CW and SSB with an EICO 753 transceiver. With a Hy-Gain vertical for 40 and doublets for 75 and 20 meters, he had 44 states worked.

33030, celebrated passing his General exam by investing in a new electronic keyer. With his EICO 720 transmitter, Hallicrafters SX-110 receiver, and Hustler vertical antenna, Rickey works 40 and 15 meters. He closed out his Novice career with 40 states and 25 countries worked . . . **Bill Duemling, WN8AEM,** 776 Lakepointe, Grosse Point Park, Mich. 58230, has a common pet peeve: operators who promise to QSL contacts and then never do so. Bill has 38 states and Canada worked; 31 states are confirmed. He uses a Heathkit DX-60A transmitter and a Heathkit HR-10 receiver. A dipole antenna completes the amateur part of his station. But he also SWL's with the aid of a BC/SW/FM receiver and a tape recorder.

If your "News and Views" have not been printed in these pages, the reason might be that you haven't written that letter yet. Include a sharp black and white photo with your letter if possible. Thanks also for continuing to send your club bulletins and club papers. Send all news to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P. O. Box 578, Gary, Indiana 46401.

73, *Herb, W9EGQ*

ANSWERS
Transient Voltage Quiz

1—G	6—D
2—I	7—B
3—F	8—J
4—C	9—H
5—A	10—E

SHORT-WAVE LISTENING

(Continued from page 80)

leted; this 17,815-kHz program will reportedly be on at a later hour. The S.E. Asia xmsn at 1100-1200 on 17.830 kHz and the Commercial Service on 15,230 kHz, heard 1530-1700, are still going strong. Check for "DX Panorama", a new DX series, at 1100-1115 on the second and last Saturdays of each month on 17.830 kHz.

Chile—The tentative listing last month for *R. El Morro* on 9520 kHz is definite; tune for it to as late as 0313-0400 with music and anmts in Spanish. Other Chileans being heard include CE975, *R. Mineria*, Santiago, on 9750 kHz with pop music at 0400, news 0420 and s/off 0430; they have many commercials. CE970, *R. Cooperativa*, Santiago, 9700 kHz, may be identified with their IS of "Pomp And Circumstance"; try around 0210-0230. They verify promptly (send two IRC's).

Congo—*R. Kinshasa* is on 15,245 kHz at 2230-0000 in French to West Africa and Western Europe. Other reports indicate this to be a relay from Paris beamed to the U.S. based on a listing in a recent schedule from Paris.

Dominican Republic—HISD, Santo Domingo, is now identifying as *Radio Christian International* with outlets on 3125, 6090 and 9505 kHz but extensive checking has failed to find any sign of a signal on 3125 kHz. S/off time currently is 0355.

Ecuador—HCJTI, *R. Tulcan*, 3340 kHz, has L.A. pop tunes and a few anmts at 0300-0350. HCJA5, *La Voz del Rio Tarqui*, Cuenca, 3995 kHz, has listener's request music from 0320-0400, or later. Confusion exists on 4772 kHz; HCMX4, *R. Cenit*, Portoviejo, does operate here to 0500 s/off; *R. Cenit de Bahia* in Caraquez is on 4865 kHz. *R. Bolivar*, Venezuela, also operates on 4772 kHz so take care to avoid a misidentification.

Finland—Helsinki is good on 15.185 kHz at 2300-0000 to N.A. with English for first half-hour. English to Europe is at 1800-1830 (Sunday 1600-1630) on 9550, 11,805 and 15.185 kHz.

Holland—A projected xmsn schedule from *R. Nederland* shows English to Eastern N.A. at 2130-2250 on 15.425 and 11,730 kHz. From the Bonaire relay, Dutch at 0030-0150 and English at 0200-0320, both to Eastern N.A. on 9590 kHz. Dutch to Western N.A. at 0330-0450 on 9715 kHz and Spanish to Mexico at the same time on 9590 kHz and, lastly, English to Western N.A. at 0500-0620 on both 9715 and 9590 kHz. This schedule is expected to go into effect next month.

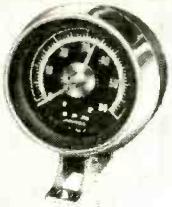
Hong Kong—All short-wave operations have been terminated; the 3925-kHz outlet is no longer in use.

India—*All India Radio*, New Delhi, noted s/off in English on 15,035 kHz at 1100 but a late report shows that the 1000-1100 xmsn has moved to 15,430, 17,705 and 17,870 kHz. The station has begun a "Hindi By Radio" program and they would like to know of those who want to take part; please include your age, profession and education when writing to the station at P. O. Box 500, New Delhi.

SHORT-WAVE ABBREVIATIONS

anmt—Announcement
ID—Identification
IRC—International reply coupon
IS—Interval signal
kHz—Kilohertz
kW—Kilowatts
L.A.—Latin America
N.A.—North America
QRM—Station interference
R—Radio
s/off—Sign-off
xmsn—Transmission
smtr—Transmitter
W—Watts

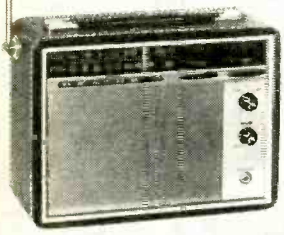
Look What's New In Your



NEW kit MI-18-1
$29.95
NEW kit MI-18-2
$32.95

Heathkit Solid-State Tachometer

The Professional Tach. That's the new Heathkit MI-18. **In Design:** breaker point, "tach" lead or unique inductive pickup connection; use it with any spark-type engine and any ignition system, 2 cycle 1-6 cyl. engines or 4 cycle, 2-8 cyl. engines . . . all electronics are in the tach itself. **In Performance:** 0-6000 & 0-9000 RPM ranges . . . 250° edge-lighted dial . . . temperature-compensated, ±4% accuracy from 0° —120° . . . adjustable red line pointer . . . 10.5 to 17.5 VDC operation. **In Styling:** stainless steel hardware, splash-proof black & chrome case and scratch-proof glass face for use in rugged conditions. The MI-18-1 mounts in your dash — requires only a 3¼" hole & 2¼" depth. The MI-18-2 comes with mounting case & hardware. Put a Professional Tach in your car, boat, dune-buggy, or bike now — the Heathkit MI-18! Shpg. wt. 3 lbs.



NEW kit GR-17
$43.95

Heathkit AM-FM Portable Radio

Here's performance others can't match. The new Heathkit GR-17 portable has 12 transistor, 7 diode circuit with the same front end as Heathkit hi-fi tuners; 3-stage IF; big 4" x 6" speaker; tone control; AFC on FM and amplified AGC on AM; built-in AM rod antenna plus telescoping 34" FM antenna; 350 milliwatt output; and 200-300 hour battery life. Shpg. wt. 5 lbs.

NEW kit AD-27
$169.95

Heathkit FM Stereo COMPONENT-COMPACT

This new Heathkit AD-27 stereo compact has features not found in other units costing twice as much for one very simple reason. It wasn't engineered to meet the usual level of compact performance. Instead, Heath took one of its standard stereo/hi-fi receivers, the AR-14, and re-arranged it physically to fit a compact configuration. The result is performance that is truly high fidelity without compromise. It features 31 transistor, 10 diode circuitry with 15 watts per channel dynamic music power (enough to let you choose most any speaker systems you prefer), full-range tone controls, less than 1% distortion, and 12 to 60,000 Hz response. The pre-assembled FM stereo tuner section with 4-stage IF offers 5 uV sensitivity, excellent selectivity, AFC, and the smoothest inertia tuning. The BSR McDonald "500" turntable offers features usually found only in more expensive units . . . like low mass tubular aluminum tone arm, anti-skate control, cueing and pause control, plus a Shure magnetic cartridge with diamond stylus. It's all housed in a smart oiled walnut cabinet with sliding tambour door that disappears inside the cabinet. For value and performance choose the AD-27, the new leader in stereo compacts. Shpg. wt. 41 lbs.

NOW, THE TUNER AND AMPLIFIER OF THE FAMOUS HEATH AR-15 RECEIVER ARE AVAILABLE AS SEPARATE COMPONENTS

NEW kit AJ-15
$189.95*

HEATHKIT AJ-15 Deluxe Stereo Tuner

For the man who already owns a fine stereo amplifier, and in response to many requests, Heath now offers the superb FM stereo tuner section of the renowned AR-15 receiver as a separate unit. The new AJ-15 FM Stereo Tuner has the exclusive design FET FM tuner for remarkable sensitivity, the exclusive Crystal Filters in the IF strip for perfect response curve and no alignment; Integrated Circuits in the IF for high gain, best limiting; elaborate Noise-Operated Squelch; Stereo-Threshold Switch; Stereo-Only Switch; Adjustable Multiplex Phase, two Tuning Meters; two variable output Stereo Phone jacks; one pair variable outputs plus two fixed outputs for amps., recorders, etc.; front panel mounted controls; "Black Magic" panel lighting; 120/240 VAC operation. 18 lbs. *Walnut cabinet AE-18, $19.95.

NEW kit AA-15
$169.95*

HEATHKIT AA-15 Deluxe Stereo Amplifier

For the man who already owns a fine stereo tuner, Heath now offers the famous amplifier section of the AR-15 receiver as a separate unit. The new AA-15 Stereo Amplifier has the same superb features: 150 watts Music Power; Ultra-Low Harmonic & IM Distortion (less than 0.5% at full output); Ultra-Wide Frequency Response (±1 dB, 8 to 40,000 Hz at 1 watt); Ultra-Wide Dynamic Range Preamp (98 dB); Tone-Flat Switch; Front Panel Input Level Controls; Transformerless Amplifier; Capacitor Coupled Outputs; Massive Power Supply; All-Silicon Transistor Circuit; Positive Circuit Protection; "Black Magic" Panel Lighting; new second system Remote Speaker Switch; 120/240 VAC. 26 lbs. *Walnut cabinet AE-18, $19.95.

Free 1969 Heathkit® Catalog

New Lower Prices On Heathkit Color TV Make Them A Better Buy Than Ever!

Deluxe "295" Color TV...Model GR-295

now only **$449.95** (less cabinet)

New improved phosphors and low voltage supply with boosted B+ for maximum color fidelity and operation • automatic degaussing • exclusive Heath Magna-Shield • ACC and AGC assures color purity, flutter-free pictures under all conditions • preassembled IF with 3 stages instead of the usual 2 • deluxe VHF turret tuner with "memory" fine tuning • choice of installation—wall, custom or optional Heath factory assembled cabinets • Easy to assemble.

Big, Bold, Beautiful . . . With Advanced Features and Exclusive Heathkit Self-Servicing. Top quality, American brand color tube . . . 295 sq. inch viewing area. The built-in dot generator and full color photos and simple instructions let you set-up, converge and maintain the best color pictures at all times. Add to this the detailed trouble-shooting chart in the manual and you put an end to costly TV service calls for periodic picture convergence and minor repairs.

GRA-295-4, Mediterranean cabinet shown $119.50
Other cabinets from $62.95

Deluxe "227" Color TV...Model GR-227

now only **$399.95** (less cabinet)

Has same high performance features and built-in servicing facilities as the GR-295, except for 227 sq. inch viewing area. The vertical swing-out chassis makes for fast, easy servicing and installation. The dynamic convergence control board can be placed so that it is easily accessible anytime you wish to "touch-up" the picture.

GRA-227-1, Walnut cabinet shown $59.95
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Deluxe "180" Color TV...Model GR-180

now only **$349.95** (less cabinet)

Same high performance features and exclusive self-servicing facilities as the GR-295 except for 180 sq. inch viewing area. Feature for feature the Heathkit "180" is your best buy in deluxe color TV viewing . . . tubes alone list for over $245. For extra savings, extra beauty and convenience, add the table model cabinet and mobile cart.

GRA-180-5, table model cabinet and cart $39.95
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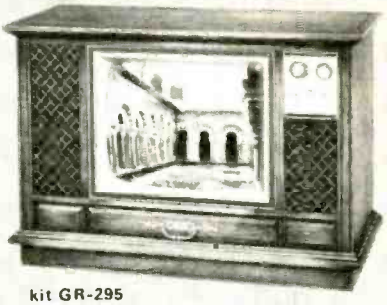

kit GR-295

kit GR-227

kit GR-180

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Indonesia—*R. Angkatan Udara,* operated by the Indonesian Air Force, is being heard in N.A. and reports go to 51 Djalan Tjipinang, Tjempedak I, Djatinegara, Djakarta. They will verify all correct reports. The current schedule is 0430-0730 and 0930-1330 on 2475 kHz (500 W) and 11.940 kHz (actually heard on 11.905 kHz) (7.5 kW).

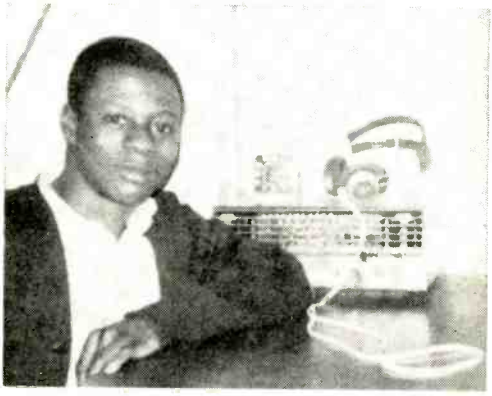
Israel—*Kol Israel,* Jerusalem, has English to Europe at 2115-2130 on 9009 and 9725 kHz. To Africa at 2015-2030 on 9009 kHz, and French to Europe at 2045-2115 and 2145-2215 on 9009 and 9725 kHz.

Italy—Rome has Spanish to L.A. at 0305 on 15,340 kHz and Italian to the same areas at 1840-1905 on 21,560 kHz.

Ivory Coast—*Radiodifusion Television Ivorienne,* Abidjan, was logged on 3242 kHz from 2320-0000 s/off with ID's at 2330, 2345 and 0000; there was some Coast Guard QRM from 3240 kHz. Reports to B. P. 2261, Abidjan.

Japan—The General Service from *R. Japan,* Tokyo, is good at 2200-2215 in English and to 2230 in Japanese on 17.785 kHz to N.A., 15,195 kHz to Asia and 9700 kHz to Europe.

Kuwait—This country is experimenting with what seems to be a new high-power xmtr drifting from 21.475 to 21.525 kHz between 1750 and 0000. Some English has been noted around 1750-1820 and 2250-2315; they are requesting reports. Your Editor has not as yet heard this one but we did hear the ID via telephone from one of our monitors. Reports go to Box 397, Kuwait.



A 19-year-old college student, Edward Pyatt, of Atlanta, GA., uses a Hallicrafters S-120 and has heard 65 countries with 55 of them verified. He is a member of the North American Short Wave Association and the American SWL Club and has Monitor Certificate WPE4IGG, with a 25 Country Award Seal on it.

Maldive Islands—A schedule has been received which shows only the starting time of each xmsn. It reads as follows: transmitter of 2.7 kW on 7150 kHz at 0100 and 0930 and on 6150 kHz at 0300 and 1200; xmtr of 7 kW on 9552 kHz at 0700 and on 3321 kHz at 1330; xmtr of 30 kW on 4740 kHz at 1530 and on Tuesday and Wednesday at 1545.

Nepal—Xmtrs of 100 kW are now being used on 7165 and 9590 kHz with the former listed as operating at 1400-1600; the latter channel, according to a report from India, is being used at 1515-1620 s/off with "some English possible".

New Caledonia—A report from Paris says that the broadcasting center at Noumea will be replaced by a new center at Sainte-Marie. To be in operation in about a year, the center will have three xmtr's of 20 kW each on 1420, 3355, 4913, 7170 and 9510 kHz.

New Zealand—The current schedule from Wellington (P. O. Box 2396) reads: to Pacific Islands at 1700-1945 on 6080 and 9520 kHz, 2000-0545 on 15,110 kHz and 0600-0845 on 6080 and 9540 kHz; to

Australia at 2000-2230 on 11,705 kHz. 2245-0545 on 17,770 kHz and 0900-1145 on 9520 and 11,705 kHz; to Antarctica at 0815-0845 on 6080 kHz. Sunday only; to Niue Island at 0745 on 6080 and 9540 kHz on alternate Fridays.

Nigeria—*R. Nigeria*, Lagos, can be heard at times between 0450-0530 in their Commercial Service on 3986 kHz with pop music and commercials.

Peru—*R. Nacional del Peru* has been found on a new frequency of 17,890 kHz at 0900 with news in Spanish. OAZ4R. *R. San Juan*, Tarma, is the station on 4891 kHz, not *R. Villarica* as claimed by some. It is noted weakly to 0430. *R. Villarica*, Huancavelica, has moved from 4805 to 4876.5 kHz where is has request music from 0500-0600.

Portugal—Lisbon was logged in their Portuguese Service to Brazil from 0050 on 17.760 kHz.

South Africa—*R. South Africa* (not *R. RSA*), Johannesburg, has English at 0500 to past 0530 with news, weather, time annts and pop music on 3965 kHz.

Sweden—French xmsn's from Stockholm: to Europe at 0930-1000 on 9625 kHz. to the Middle East at 0930-1000 on 21.690 kHz. to Africa at 1800-1830 on 15.240 kHz. to Asia at 1500-1530 on 21.585 kHz and 0545-0615 on 17,845 kHz. to Eastern N.A. at 1500-1530 on 17,760 kHz. and to Western N.A. at 0300-0330 on 11,705 kHz.

Switzerland—English xmsn's from Berne: to Australia and New Zealand at 0700-0800 on 9590 and 11,775 kHz, to Europe (weekdays only) at 0700-0800 on 3985, 6165 and 9535 kHz. to Japan and China at 0845-0945 on 17,830 and 21.520 kHz. to Africa at 1000-1100 on 15.305. 17,855 and 21.520 kHz and 1815-1915 on 15,180 and 17,845 kHz. to United Kingdom and Ireland at 1130-1230 and 1930-2030 on 9665 and 11,865 kHz. to S. and S.E. Asia at 1315-1415 on 15,305. 17.845 and 21.520 kHz. to the Near East at 1500-1600 on 15.305. 17.830 and 21.540 kHz. to Eastern N.A. at 0130-0230 on 9535, 11.715 and 15.305 kHz. and to Western N.A. at 0445-0545 on 9720 and 11.715 kHz.

Tunisia—*R. Televisione Tunisienne*, Tunis, has news to Africa in French at 1709 on a new frequency of 21,475 kHz.

Vatican City—A new program from *Vatican Radio* is "Tell Me How You Sing", 30 minutes in length on Sunday evenings: pop music and 'protest' songs and hits are to be presented with an aim of putting this station within the reality of everyday life. We'd appreciate the exact time and frequencies. Spanish in noted at 0030 on a new frequency of 11.895 kHz as well as at 2330 on 21.580 kHz. also new.

Clandestine—*R. Portugal Livre* was noted on 11.508 kHz at 2342 in Portuguese, very weak; it s/off at 2348.

Gaelic Freedom Marchers, said to be located on an island near Scotland, is reportedly operating from 0400 in Gaelic with some English ID's on 7258 kHz and Fridays from 0200-0500 on 8402 kHz.

R. Euzkadi, The Voice of the Basque Underground, is issuing QSL's (with a waiting time of 8 to 23 months!) with a schedule of 2030, 2130 and 2230 on 13,250 and 15.080 kHz. At one time we voiced an opinion that this station was believed to be mobile; their QSL card, with a photo of a permanently installed antenna tower located in tree-covered mountains would seem to indicate otherwise. The exact location, according to the QSL card, is near the west coast of Europe on or near the Spanish-French border. Reports go to B. P. 59, Poste Centrale, 75-Paris (16), France.

73, Hank, WPE2FT/W2PNA

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Mike Manry, Houston, Texas
Kol Israel, Jerusalem, Israel
Radio New York Worldwide, New York, N. Y.
Sweden Calling DX'ers Bulletin, Stockholm, Sweden

SPORTS TIMER

(*Continued from page* 41)

spacers are used, place a non-conducting washer between each spacer and the adjacent foil section to avoid any chance of short circuits. Use 3″-long thin bolts to fasten the boards together. The bolt passing through the bottom portions has a small L bracket at each end to secure the bottom edges of the boards to the base of the chassis. A similar pair of L brackets is used to secure the outer boards at the front. Mount an insulated single-lug terminal strip at the nut end of the upper mounting bolt as shown in Fig. 9 to support resistor *R2*.

Drill suitable holes in the base to mount the fuse holder, power transformer, and power supply as shown in the photo. Mount the power supply using four small standoffs, then secure the transformer and the fuse holder.

Once all components have been mounted, insert the bulbs in the respective plastic holders and wire the components as shown in Fig. 8.

Testing. Once final assembly is complete, turn on the power (*S1*) and note that the decimal point and the colon indicator lamps come on. The various counters will be at some random numerical indication. Depressing the RESET button should cause all readouts to indicate zero.

Being very careful, use a small piece of wire to make an electrical contact between the center contact of the (+) jack *J1* and the similar contact on START jack *J2*. As soon as this is done, the counters will start to operate. The counter on the far right (thousandths of a second) will assume a dim, blurred condition, indicative of very fast counting. The counters to the left of it will operate much slower. The second to the left indicates hundredths of a second and the third indicates tenths of a second. The counter to the left of the decimal point indicates unit seconds, while the next counter to the left is tens of seconds. The latter is the modulo-6 counter that only goes to 5. At the 60th second, all counters to the right of the colon drop

to zero with the minutes counter advancing to the next count. The counters will not stop, and you will see them proceed to 9 minutes, 59.999 seconds and repeat.

To stop the counter at any time, insert the wire jumper between the center contact of *J1* and the similar contact on the STOP jack *J3*. The various counters will stop and the real time can be read on the front-panel indicator lamps. Depressing the RESET button will zero the count. If the RESET button is depressed while the counting is taking place, the indicated time value will drop to zero, but immediately start up again as soon as the RESET button is released. This push-button has no effect on the three fixed indicator lamps. To shut the system down, turn *S1* to OFF.

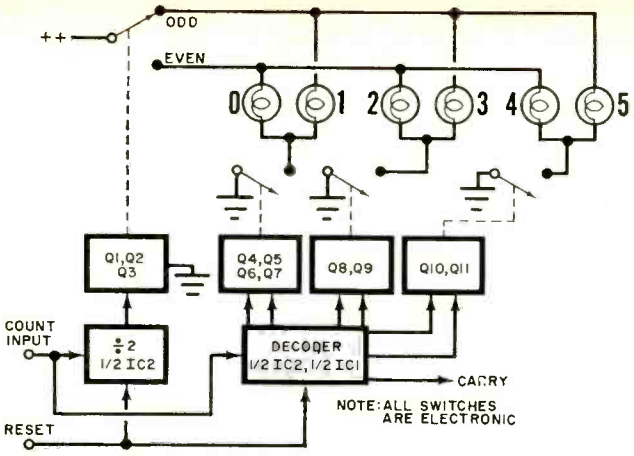
Before assembling the cover on the chassis, use contact-adhesive plastic to give it a finished look.

Starting and Stopping. There are many ways to start the clock, and all depend on providing the START input jack with a positive-going pulse. For races of all types, you can use the photopickoff shown in Fig. 10 at either the start or finish line. Place a light source on one side of the track, focused either by a lens or a length of tubing in front of the lamp so that the light beam strikes the photo-Darlington transistor. A similar lens system, or length of tubing can be placed over the photo transistor to prevent triggering by ambient light. The switch shown in Fig. 10 is used to select either the presence or absence of light as the trigger.

The (+) jack is used to provide 3.6 volts to power any external trigger circuit.

Modifications. The timing unit kit is supplied with a 100-kHz, 0.005% tolerance crystal. With this crystal, the last digit on the right will not be accurate, although it can be used as a relative time indicator. Replacing the 0.005% crystal with one with an accuracy of 0.001% will produce the correct timing in the thousandths column.

If you want to read times up to one hour, add another modulo-6 counter at the left, driven by the "carry" of the minutes counter M8. The clock will now



HOW IT WORKS

Operation of the decimal counting unit was described in the February 1968 issue and the timing unit in March 1968; therefore, only the operation of the modulo-6 counter will be described here.

The input pulse train is fed to a divide-by-two counter (half of *IC2*), a flip-flop which changes state with each input pulse. One state of the flip-flop indicates an odd number, while the other indicates an even number. The odd-even signal is processed by transistors *Q1*, *Q2*, and *Q3* so that, on even numbers, the "even" bus is energized, and on odd numbers, the "odd" bus is energized. The five state-indicating incandescent lamps are connected in pairs to the odd and even buses, and each pair is connected to ground through a set of switching transistors. These transistors act as open switches when they are cut off and closed switches when saturated, thus determining when each bulb is lit.

After passing through the divide-by-two stage, the input signal goes to a decoder consisting of the other half of *IC2* and half of *IC1*. This counter determines whether the number being counted is 0 or 1, 2 or 3, or 4 or 5. The correct switching signals are then passed to three sets of switching transistors which connect the bulbs to ground.

As an example of how the counter works, assume that the count has reached the number 4. The divide-by-two counter has determined that this is an even number and has supplied power to the even bus. The decoder has determined that it is either a 4 or 5, and thus turns on the *Q8-Q9* combination. The other two switches are left open. Under these conditions, only bulb 5 is illuminated.

On each sixth input pulse, the counter automatically cycles back to the zero state, and supplies an output pulse to the "carry" terminal. This pulse is used as the count input for any succeeding counters.

read to 59 minutes, 59.999 seconds. If you want to read up to 10 hours, add both the tens-of-minutes counter and another decade counter driven by the last "carry" output. The clock will now read to 9 hours, 59 minutes, and 59.999 seconds. This should be enough for almost any race. To convert the clock to read only hours, minutes, and seconds, as does a conventional clock, requires a little more logic and may be the subject of another article. —30—

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FREQ-OUT

(*Continued from page 48*)

photocell is small enough to be hidden easily in decorative woodwork and may be separated from the modulator by a considerable distance as long as co-axial line is used to connect the two.

Some applications may require a set of contacts which close when the demodulator is actuated and remain closed until some specific action is taken to reset the relay. This can be done using external circuits, of course, but it is easier to do it by replacing *D5* with a wire jumper. Then the relay will automatically latch in once it has been actuated. A single-pole, normally closed switch placed in the lead between *K1* and point C on the PC board will serve as a reset switch.

There are some applications, such as garage door openers, which require contacts that alternate states on successive activations. This can be accomplished in the Freq-Out by substituting an impulse relay (such as Potter and Brumfield type PC11D) for *K1*. For applications where a stepping relay is required, a Guardian type IR-705-12P-6D is small and relatively inexpensive.

Most intrusion-alarm applications require that the relay be closed under normal conditions because of the light beam falling on the photocell. When the beam is interrupted, the relay opens and an alarm is sounded. It is also desirable to have the relay remain open after the light beam has been restored. The Freq-Out may be made to operate in this way by breaking the connection from point C on the PC board to *K1* and wiring the free ends to one of the normally open contacts on the relay. In addition, a normally open single-pole pushbutton switch should be wired across these contacts to serve as a reset [see Fig. 7(A)].

A more versatile system is shown in Fig. 7(B). With this arrangement, using a three-position switch, the relay may be latched on in the presence of a light signal, latched on in the absence of light, or operated in the normal mode. A common reset for both latching modes is also provided.

Operation. Once you have selected the

type of Freq-Out you want and have built the modulator and demodulator, setting up the system is easy. Simply plug in the demodulator, turn it on and shine the light on the photocell. If you wish, you can use mirrors to bend the light beam and lenses to focus the beam. The Freq-Out is designed to operate in the near-infrared portion of the spectrum so you can make the beam almost invisible by filtering it through several layers of red cellophane. The operation of the unit will not be affected.

Although the circuits in the Freq-Out are insensitive to normal variations in ambient lighting, bright sunlight should not be allowed to fall directly on the photocell. If necessary, a shield of cardboard or plastic should be used to protect the photocell. -30-

PC BOARDS

(*Continued from page 72*)

the panel, copper side up, in the tray and occasionally tip the tray back and forth so that the etchant keeps moving. Use a plastic rod to tilt the tray, as most etchants will discolor skin or clothes they contact. Once etched (all the copper has been removed from the unwanted areas), wash the panel in running cold water for a few minutes.

There are two ways to remove the dyed resist. You can dip the board in the developer then wipe it clean using a towel or other cloth; or, you can use some fine steel wool to remove the dyed resist. If you use the former method, make sure that you go over the copper pattern with fine steel wool to prepare the surface for soldering (after the holes are drilled). If you use the latter process, you can, if desired, use steel wool to remove the black dyed resist from a small area immediately surrounding the soldering holes. In this way, when the board is finished, the pattern will stand out in a distinctive black.

After some use, the developer will develop a "skin". This means that it should be disposed of and a new batch of developer used. -30-

COLOR TV—THAT ISN'T

(*Continued from page 75*)

video-tape recordings, or even, if fitted to a motion-picture camera, turn out full-color movies, on black-and-white film.

What Next? While this optical system will broadcast pictures in natural color, it has a number of inherent flaws that have to date restricted the use of electronic color to certain types of "special effects" commercials.

The slow speed of the filter rotation—necessary for color definition—also makes the picture shimmer, flash and appear generally unsteady. The color quality isn't uniform and some viewers see hues almost as saturated as those of a conventional color TV receiver. Other viewers discern only one or two tints, and a minority of viewers apparently can detect no color whatsoever.

Yet despite its shortcoming, electronic color does seem to be a commercial success, and Color-Tel Corporation, Hollywood, California, is using the Butterfield process to make successful television commercials.

When electronic color was first publicly demonstrated in the Los Angeles area over KNXT, no prior announcement had been made at the request of a soft-drink manufacturer sponsoring the test. The beverage firm wanted its color commercials to be a complete surprise to viewers of black-and-white receivers. And, the telecasts were that, to say the very least. Within hours of the electronic-color broadcast, thousands of viewers began asking the same question, "What happened? Did I really see color on my black-and-white receiver? Or am I having hallucinations?"

Right now, Color-Tel engineers are checking into the possibility of using electronic color for such things as color radar displays, color computer readouts, and perhaps even color sonar pictures. It may be true that, in its present stage of development, Butterfield's process is nothing but a scientific curiosity—however, 25 years ago, so was television. —30—

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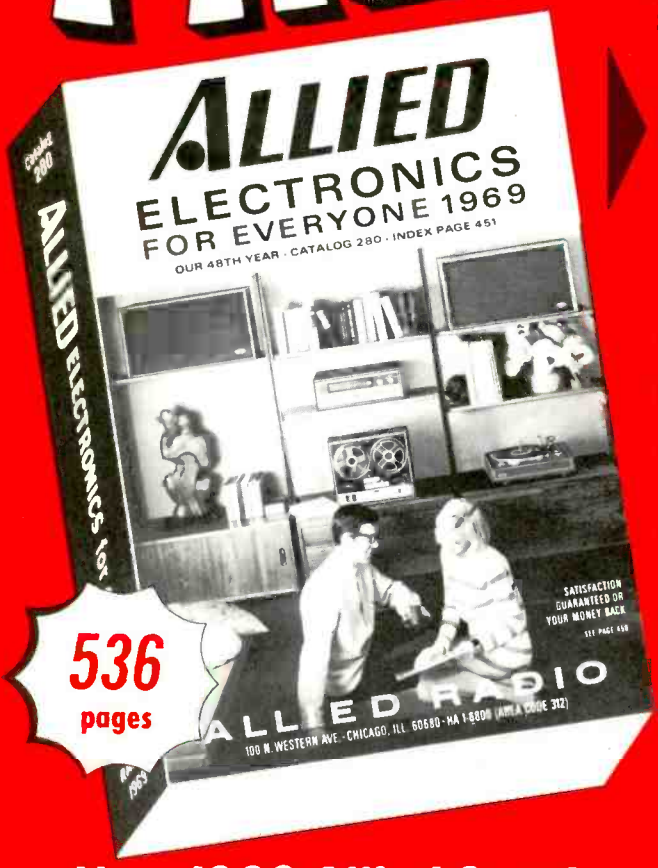

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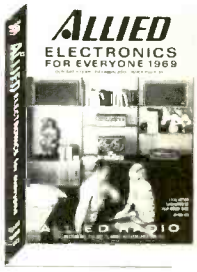

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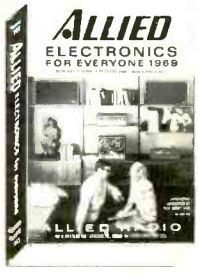

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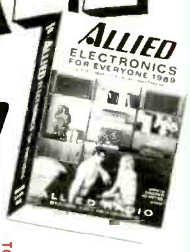

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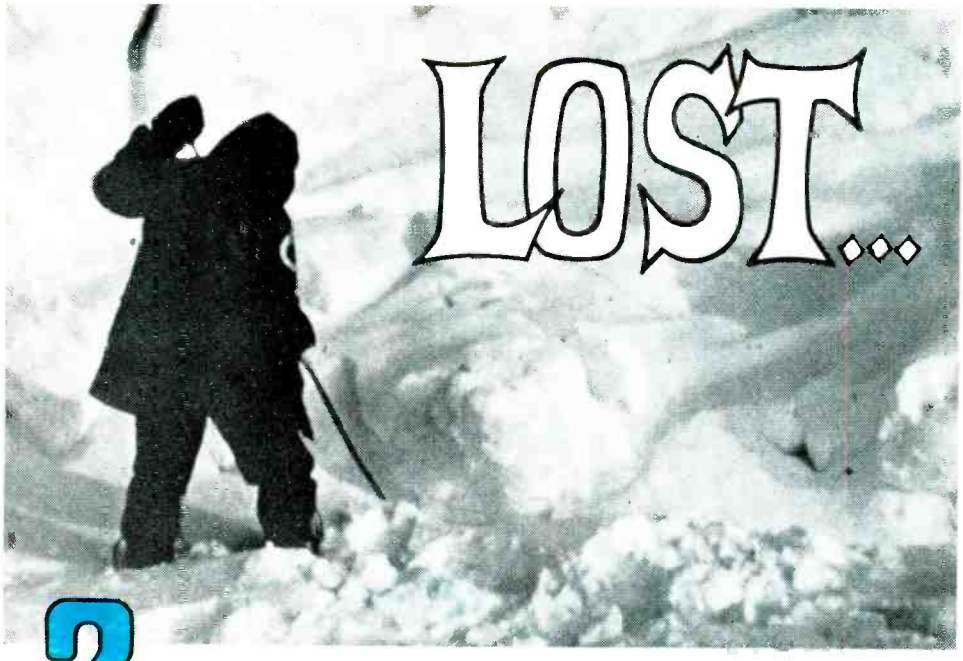
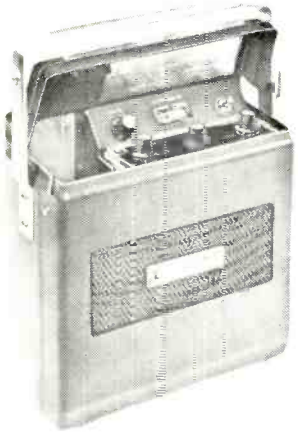


2 JOHNSON MESSENGER III Field Packs at latitude 83° 10′ N



Johnson Messenger III Field Pack

Five Messenger III Field Packs were brought to the Arctic by the 1968 Plaisted Polar Expedition. There, they performed admirably through blizzards, −30° cold, and other Arctic hardships. Even a generator malfunction that blew out all the lights in three base camp buildings did not affect the performance of the Johnson units.

Because of aircraft weight limitations, two had to be left behind when the Plaisted group went home after the first successful assault on the North Pole since Perry. If you'd like two perfectly good Messenger III Field Packs, you can pick these up at Ward Hunt Island . . . 83° 10′ N latitude!

Or you can stop in and see your nearest Johnson Dealer. He'll be glad to tell you all about the *complete Johnson line* . . . including the new 23 channel, tube type Messenger 223, the new 23 channel, solid state Messenger 320 or the new 2 channel, 3 watt Messenger 109 hand-held. Besides, you'll find *his* reception a lot warmer than the one you'd get at Ward Hunt Island!

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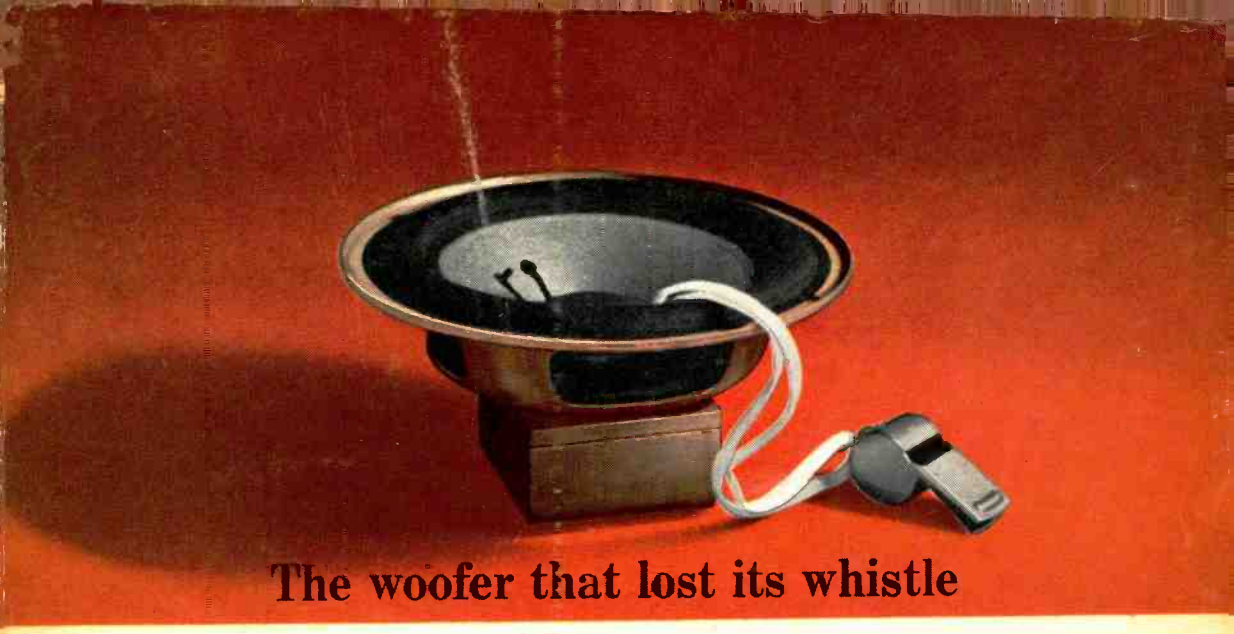

The woofer that lost its whistle

...and other stories.

The woofer cone in a very small enclosure must move a long way to provide all the bass you want to hear. In the new E-V EIGHT, for instance, the 6-inch cone moves back and forth over one-half inch. But in most woofers something strange happens as it moves. It whistles!

You see, the air trapped inside the speaker is literally "pumped" in and out past the voice coil. The whistle is almost inevitable. Except, that is, in the E-V EIGHT.

We did two things almost nobody else bothers to do. First, we vented the woofer. Air can't be trapped inside. Then we punched six big holes in the voice coil form. Air can't be pumped back and forth. And that's how the E-V EIGHT lost its whistle (and gained almost 2 db extra efficiency in the low bass in the bargain)!

The E-V EIGHT tweeter was another story. We aimed to eliminate the "buzz" and "fuzz" so typical of modestly priced speaker systems. What was needed was a better way to control cone motion at very high frequencies. And it literally took years of testing to solve the problem.

The answer looks deceptively simple. We put a ring of short-fiber polyester felt behind the cone, and a precisely measured amount of viscous vinyl damping compound under the edge. Plus a light-weight aluminum voice coil to extend the range to the limits of your hearing. Highs are remarkably uniform and as clean as a (oops!) whistle!

Even the E-V EIGHT enclosure is unusual. examine the walnut grain carefully, especially at the corners. It's a perfect match because we use one long piece of wood, folded to form the cabinet! And we add a clear vinyl shield on every finished surface, to protect the E-V EIGHT from the mars and scratches of day-to-day living.

There are so many good ideas inside the tiny new E-V EIGHT, you may wonder how we found room for them all. Chalk it up to top-notch engineering talent and facilities, plus a very real dedication to the ideal of better value in every product.

Listen to the E-V EIGHT with the whistle-free woofer at your nearby Electro-Voice high fidelity showroom today. Then ask the price. At no more than $44.00 it's the best story of all.

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