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POPULAR ELECTRONICS

APRIL 1969

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(see page 27)

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L. V. Lynch, Louisville, Ky., was a factory worker with American Tobacco Co., now he's an Electronics Technician with the same firm. "I don't see how the NRI way of teaching could be improved."

G. L. Roberts, Champaign, Ill., is Senior Technician at the U. of Illinois Coordinated Science Laboratory. In two years he received five pay raises. Says Roberts, "I attribute my present position to NRI training."

Don House, Lubbock, Tex., went into his own Servicing business six months after completing NRI training. This former clothes salesman just bought a new house and reports, "I look forward to making twice as much money as I would have in my former work."

Ronald L. Ritter of Eatontown, N.J., received a promotion before finishing the NRI Communication course, scoring one of the highest grades in Army proficiency tests. He works with the U.S. Army Electronics Lab, Ft. Monmouth, N.J. "Through NRI, I know I can handle a job of responsibility."

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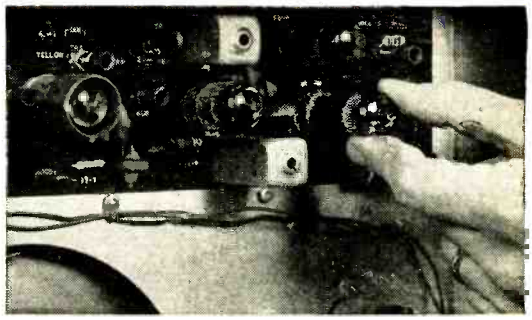

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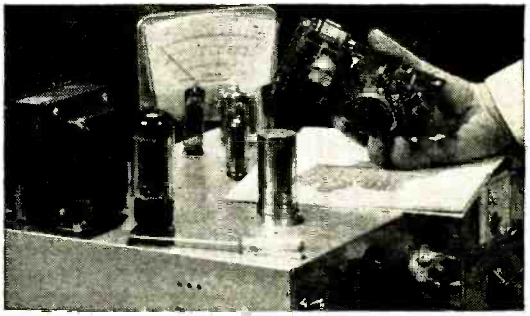

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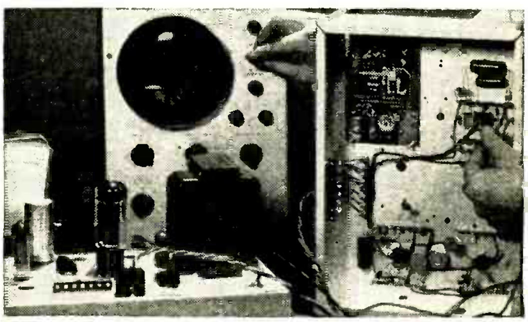
comparable to many months on the job is yours as you build and use a VTVM with solid-state power supply, perform experiments on transmission line and antenna systems and build and work with an operating, phone-cw, 30-watt transmitter suitable for use on the 80-meter amateur band. Again, no other home-study school offers this equipment. You pass your FCC exams—or get your money back.



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POPULAR ELECTRONICS

VOLUME 30 NUMBER 4

APRIL, 1969

WORLD'S LARGEST-SELLING ELECTRONICS MAGAZINE

SPECIAL FEATURE

FEATURE ARTICLES

DEPARTMENTS

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

This month's cover photo by Justin Kerr

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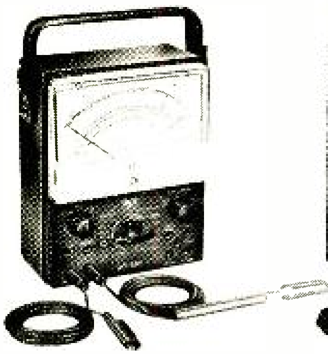

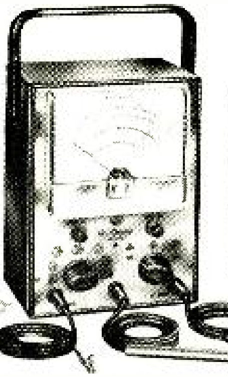

The RCA WV-38A Volt-Ohm Milliammeter is a rugged, accurate, and extremely versatile instrument. We think it's your best buy. Only $52.00.* Also available in easy to assemble kit, WV-38A (K).

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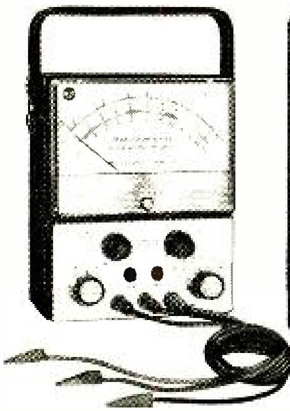

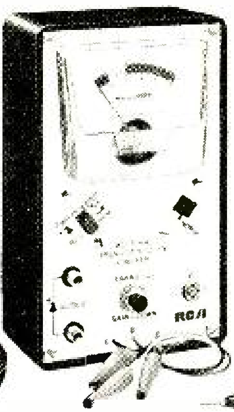

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For a complete catalog with descriptions and specifications for all RCA test instruments, write RCA Electronic Components, Commercial Engineering, Dept. D133W, Harrison, N.J. 07029.

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

RCA

LOOK TO RCA FOR INSTRUMENTS TO TEST/MEASURE/VIEW/MONITOR/GENERATE

CIRCLE NO. 26 ON READER SERVICE PAGE

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Advertising Manager

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ZIFF-DAVIS PUBLISHING COMPANY
Editorial and Executive Offices
One Park Avenue, New York, New York 10016
212 679-7200

Midwestern Office
307 North Michigan Avenue, Chicago, Illinois 60601
312 726-0892
Midwestern Advertising Manager, JAMES WEAKLEY
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9025 Wilshire Boulevard, Beverly Hills, California 90211
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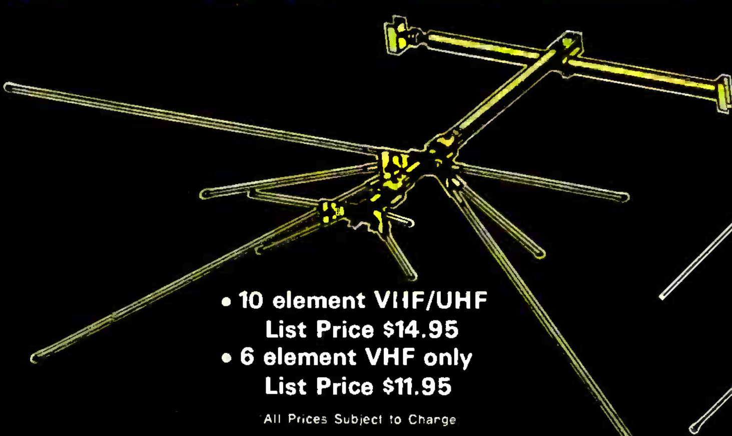

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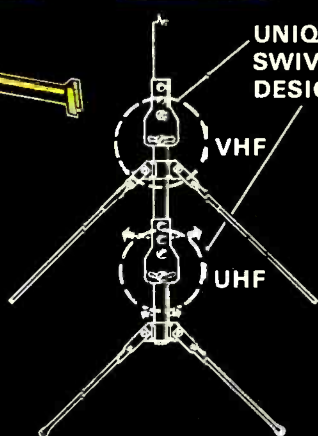

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CIRCLE NO. 14 ON READER SERVICE PAGE

letters FROM OUR READERS

pH METER IS FIRST CHOICE

Although the company I work for already possesses a pH meter which we use to check the condition of the water in our filtration plant near Lake Michigan, it's always a good policy to have a spare handy. It was for this reason that we built the "Solid-State pH Meter" (November, 1968). The purpose of this letter is not to tell you that we built the pH meter, but that our project is so good that it has become the primary instrument, while the old meter is now the spare.

LUDWIG H. KLAUSEGGER
Northbrook, Ill.

MORE ON RESISTANCE SOLDERING

After reading your "Resistance Soldering" article (September, 1968), I wonder whether it would be possible to use two sharpened carbon rods from a dry-cell battery for the electrodes. The rods, at least, won't accumulate solder. Of course, I realize that the rods would have to be insulated.

WILLIAM F. MANGANARO
Portsmouth, N.H.

Although we haven't tried using the carbon rods referred to, there should be no reason why you can't try them if you have an old defunct battery handy. It should be pointed out, however, that these rods are soft and very fragile. In use, they tend to crumble, even if only a slight pressure is applied to them.

WHAT EVER HAPPENED TO . . .?

Hey! What ever happened to your "Tips & Techniques" and "Information Central" columns. I haven't seen them in POPULAR ELECTRONICS in quite a while. Will these columns ever be back?

MARK MELLIS
Glendora, Calif.

Due to the poor health of Charles Schauers, editor of the "Information Central" column, this column has been temporarily discontinued. At the present time we do not know when the column, or one similar to it, will return. As for "Tips & Techniques," we try to publish only new and original ideas, and all indications reveal that we have just about exhausted whatever tips or techniques there were. From time to time we still receive ideas that fit into the T&T category, but they are a rarity. As a result, the column will appear on

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LETTERS (*Continued from page 8*)

an irregular basis. For example the column is in this issue—but don't look for it every month.

"OPERATION ASSIST" HELP

In the past, I have tried to help as many as possible of the readers requesting information through your "Operation Assist" column. I have a large number of manuals for a wide variety of short-wave receivers which I feel can be of help to these readers. So, if anyone needs either a manual or just some information, I can save him a lot of time if he writes to me, describing exactly what he needs. I welcome all inquiries, and if I have the information requested, I'll gladly forward it.

KEN JEFFCOAT
2029 121 Ave., SE
Bellevue, Wash. 98004

Your willingness to provide assistance is commendable. For those readers who wish to take advantage of this magnanimous offer, we urge you to write directly to Ken.

WHAT'S THE CORRECT VALUE?

On page 60 of the "Build the Sound-Signal Thermometer" (January, 1969), Fig. 1 shows C1 with a value of 0.047 μF while the Parts List describes this as a 0.47-μF capacitor. Which value is correct, and what should the capacitor's voltage rating be?

STEVE HIRSH
Hartsdale, N.Y.

Every once in a while our printer drops a zero, and this was one of those rare occasions. The actual value of C1 is 0.047 μF. Since this is a disc capacitor of the ceramic variety, you don't have to worry about voltage rating. The source voltage for the thermometer circuit is only 9 volts, and since the lowest voltage ceramic disc capacitor rating listed in the catalogs is 50 volts, you can use any disc capacitor in this circuit provided that the capacitance value remains the same.

MULTIPATH PROBLEMS WITH DOUBLE ZEPP

I built the "Extended Double Zepp Antenna" (January, 1969) for FM and noticed an increase in signal strength on the meter of my tuner when the antenna was connected. However, I also noticed an annoying multipath problem due to people, metal chairs, and anything else in the room. Tuning the transmission line with aluminum foil was no help at all.

With a little experimenting, I found that if I dropped 20" of each end of the antenna at a 90° angle to the plane of the antenna, I not only eliminated the multipath, I also obtained a tremendous increase in gain. Now my tuning meter pegs even on weak stations.

CARL L. CARTER
Evanston, Ill.

TAKE ONE

new literature

To obtain a copy of any of the catalogs or leaflets described below, simply fill in and mail the coupon on page 15 or 115.

Appearing in the "Heath Scientific Instrumentation" catalog (No. 811/81) are descriptions of a number of research and development instruments suitable for industrial and educational use. The 68-page catalog provides full specifications, illustrations, and many schematic diagrams for such items as the Malmstadt-Enke spectroscopy system, an instrumentation laboratory, chart recorders, pH electrometers, a polarography system, the Berkeley Physics Laboratory, and the Heath/Malmstadt-Enke "Modular Digital System" (a new approach to digital and analog instrumentation). Also included are specifications for oscilloscopes, power supplies, voltmeters, signal generators, testers, bridges, a log/linear recording system, and many more. A copy of catalog No. 811/81 is available free from *Heath Company* simply by writing for it on school or business letterhead stationery. (Heath Co., Benton Harbor, Michigan 49022.)

A new home-study course in systems and procedures for all types of business is now available from *North American Institute of Systems and Procedures.* This 50-lesson course covers a wide range of topics, including automatic data processing, keyboard accounting, punchcard equipment, electronic data processing, digital equipment, and information retreival and systems planning. The course can be a refresher in latest methods and techniques for the practicing systems man and is equally adapted as a teaching organ for new systems men. Complete information pertaining to the "Systems and Procedures" course is available from the Institute.

Circle No. 75 on Reader Service Page 15 or 115

A new *Alsynco* brochure describing an all-new solid-state "Lab-Timer" is now available. The brochure explains how the "Lab-Timer" is designed for accurate timing of photo printing, enlarging, silk screen preparation, and printed circuit exposures for two to 600 seconds in six ranges.

Circle No. 76 on Reader Service Page 15 or 115

READER SERVICE PAGE

free information service:

Here's an easy and convenient way for you to get additional information about products advertised or mentioned editorially (if it has a "Reader Service Number") in this issue. Just follow the directions below...and the material will be sent to you promptly and free of charge.

1. Print or type your name and address on the lines indicated. Circle the number(s) on the coupon below that corresponds to the key number(s) at the bottom of the advertisement or editorial mention(s) that interest you. (Key numbers for advertised products also appear in the Advertisers' Index.)

2. Cut out the coupon and mail it to the address indicated below.

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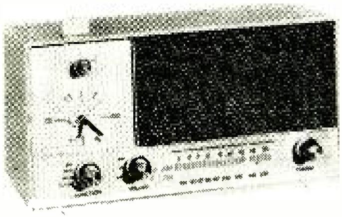
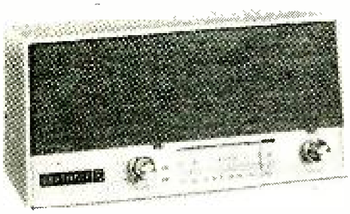


NEW
Kit GR-58
$47.95*

Heathkit GR-58 Solid-State AM/FM Clock Radio

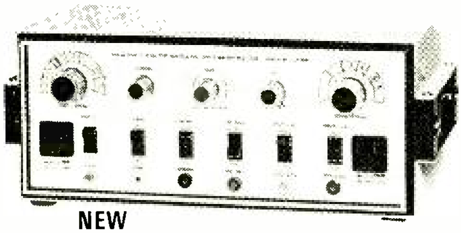
An easy way to get up . . . choose news & weather on AM or the bright sound of FM music. AFC for easy FM tuning. Use "Auto" position for only radio, or the "Alarm" setting for alarm & radio. The clock-controlled accessory AC socket will even perk coffee for you in the morning. The "Snooze" button turns off the alarm for 10 minute periods until you move the function switch . . . lets you wake up gradually. Easy circuit board construction. For an easy way to get up, order yours now. 8 lbs.



NEW
Kit GR-48
$39.95*

Heathkit GR-48 Solid-State AM/FM Table Radio

An ideal table radio for any room in the house. All solid-state circuitry delivers the same excellent sound as the GR-58 above, but without the clock and alarm functions. An Automatic Frequency Control position on the mode switch locks that FM station in and makes tuning easy. Designer-styled avocado green cabinet with matching grille cloth. Fast, simple circuit board construction. 5 lbs.



NEW
Kit IG-28
$79.95*

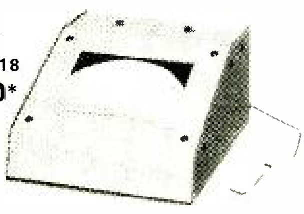
Heathkit IG-28 Solid-State Color-Bar—Dot Generator

The new Heathkit IG-28 is the most advanced instrument of its type available . . . at any price. Computer-type integrated circuitry eliminates divider chain adjustments and instability — no flutter, jitter or bounce . . . ever. Delivers 12 patterns — standard 9x9 dots, cross-hatch, vertical & horizontal lines, color bars & shading bars . . . plus the exclusive Heath "3 x 3" display of all patterns . . . plus a clear raster so necessary for purity adjustments. Also features variable front panel tuning for channels 2 through 6, front panel sync output, two front panel convenience outlets, variable positive or negative video output, built-in gun shorting circuits and grid jacks and vectorscope display capability. 8 lbs.

NEW
kit SB-500
$179.95*

Heathkit SB-500 2-Meter Transverter

The new SB-500 allows owners of Heathkit models SB-101, SB-110A, HW-100 and the SB-301/401 combination to operate on 2-meters without having to buy a complete new rig. It gives complete, reliable SSB & CW facilities from 144 to 148 MHz and features a husky 50 watts output, fast, easy tuning and a 0.2 uV receiver sensitivity. A built-in meter monitors final plate current or relative power. Internal relays eliminate cable changing when switching from LB gear to the SB-500. Step up to "2" now, with the SB-500. 19 lbs.



NEW
Kit PM-18
$62.00*

Heathkit PM-18 Fotoval II Darkroom Computer

A new, low cost way to consistently produce beautiful B & W prints . . . without time, money and paper-wasting test strips. Once programmed, Fotoval II Darkroom Computer eliminates guesswork by accurately determining correct paper grade and exposure time — instantly. Put your negative in enlarger, make two quick readings with the built-in Exposure Probe, adjust enlarging diaphragm, expose for indicated time, and develop. The result is a beautiful print. Quick, easy conversion to color work too, with the accessory Color Probe Kit. 7 lbs.

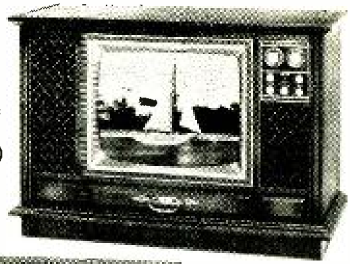
From The Leader

Now There are 4 Heathkit Color TV's...
All With 2-Year Picture Tube Warranty

NEW Deluxe "681" Color TV With Automatic Fine Tuning

The new Heathkit "681" is the most advanced color TV on the market. Compare the GR-681 against any other set available, at any price . . . there isn't one that has all of these advanced features . . . Factory assembled Automatic Fine Tuning on all 83 channels that locks in the best color picture in the industry . . . Push-button Power Channel selection on VHF . . . Built-in cable-type remote control for turning set on and off and changing VHF channels . . . Provision for adding Wireless Remote Control at any time . . . Bridge-type low voltage power supply for superior regulation . . . plus the self-servicing features standard on all Heathkit color TV's . . . plus all the features of the GR-295 below. Compare the "681" against the rest . . . and be convinced. 135 lbs.

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



Kit GR-681
$499⁹⁵*
(less cabinet)

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

The GR-295 is packed with performance . . . a top quality American brand 295 sq. in. color tube with improved phosphors and a boosted B+ supply deliver brighter, livlier color . . . Automatic degaussing . . . Exclusive Heath Magna-Shield . . . Automatic Color Control & AGC for pure, flutter-free pictures under all conditions . . . preassembled 3-stage IF . . . Deluxe VHF tuner with "memory" fine tuning . . . hi-fi sound output . . . 300 & 75 ohm VHF antenna inputs . . . plus exclusive Heath self-servicing features that can save you hundreds of dollars. 131 lbs.

GRA-295-1, Walnut cabinet shown **$62.95***
Other cabinets from $99.95*

Kit GR-295
$449.95*
(less cabinet)

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

Has same high performance & built-in self-servicing features as "295", except for 227 sq. in. screen. And, like the "295", it can be installed three ways — in one of the beautiful Heath factory assembled cabinets, your own custom cabinet or in a wall. 114 lbs.

GRA-227-1, Walnut cabinet shown **$59.95***
Other cabinets from $36.95*

Kit GR-227
$399.95*
(less cabinet)

Deluxe "180" Color TV... Model GR-180

The "180" features the same remarkable performance and built-in self-servicing facilities as the "295" except for 180 sq. in. viewing area. Feature for feature, the "180" is easily your best buy in color TV. 102 lbs.

GRS-180-5, table model cabinet and cart **$39.95***
Other cabinets from $24.95*

Kit GR-180
$349.95*
(less cabinet)

Now, Wireless Remote Control For Heathkit Color TV's

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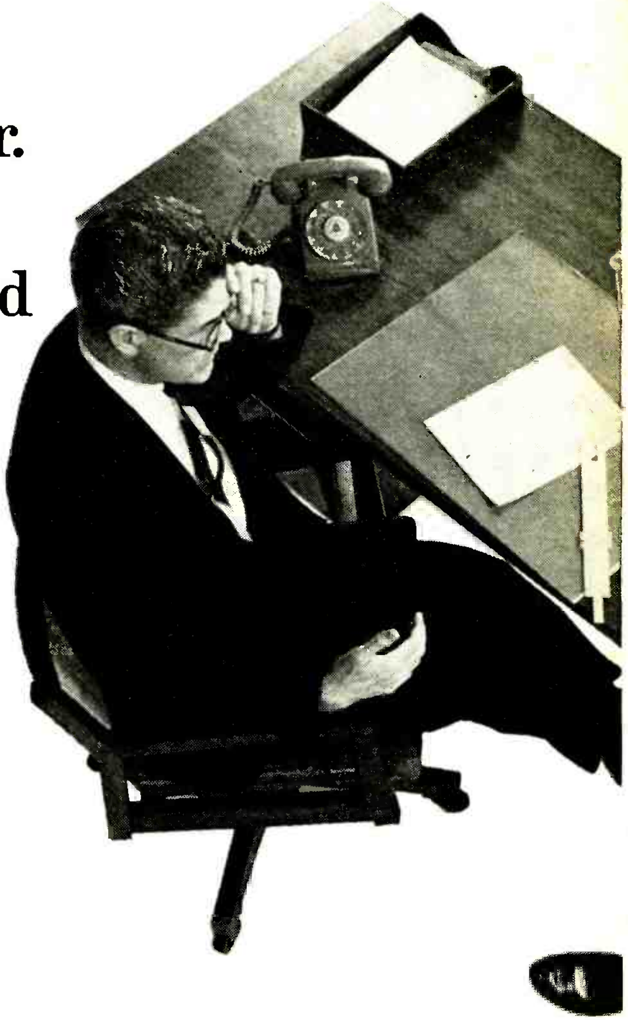
CIRCLE NO. 16 ON READER SERVICE PAGE

"He's a good worker. I'd promote him right now if he had more education in electronics."



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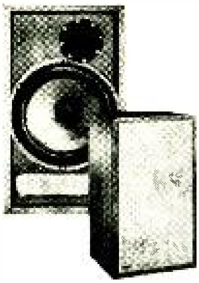
NEW PRODUCTS

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 115.

BOOKSHELF SPEAKER SYSTEM

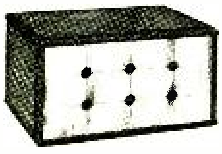
Dynaco, Inc., recently announced the availability of its first speaker system, designated the Model A-25. This bookshelf system employs an aperiodic design, utilizing a novel acoustic impedance system to provide the effect of variable cabinet volume. The aperiodic design is said to improve speaker damping markedly, thus contributing to improved low-frequency transient response and yielding a tighter, better defined bass, with effective cone motion control down to d.c. A smoother impedance curve and essentially resistive load characteristics provide improved coupling between amplifier and speaker system in addition to more efficient power transfer. Technical specifications: 8-ohm impedance; 10" extended excursion woofer and non-rigid hemispherical tweeter with 1500-Hz noninductive crossover network; maximum 3% THD above 50 Hz with constant 25-watt input; five-position tweeter level control.



Circle No. 77 on Reader Service Page 15 or 115

KIT-BUILDER "CUSTOM" CABINETS

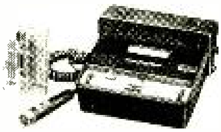
Bell Educational Laboratories has developed a new line of "custom" cabinets that are ideally suited to complement home-brew projects. Trademarked under the name "FLEXICAB," each cabinet consists of six panels and 12 "vise-grip" slides. The panels are rugged 26-gauge vinyl-clad steel plates, available with either walnut wood grain or black leather finishes; front panels are either brushed brass or chrome finish. The FLEXICAB is packaged with a set of pressure-sensitive labels which can be used to identify controls and functions. The cabinets are available in three sizes: 3" × 4" × 4"; 3" × 4" × 6"; and 3" × 6" × 9". Each can be assembled in minutes simply by joining the panels with the sides, thus eliminating the need for special hand tools, screws, and adhesives.



Circle No. 78 on Reader Service Page 15 or 115

CASSETTE STEREO TAPE SYSTEM

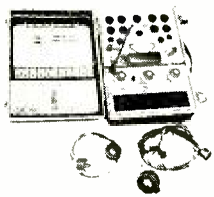
Four-track stereo playback and two-track monaural record features are offered at modest cost in the Model RK-200 mobile cassette stereo tape system now being offered by *Lafayette Radio Electronics*. The system can be operated on any 12-volt d.c. system, whether positive or negative ground. It employs a single lever control for all tape modes, including start, stop, fast forward, and rewind. A stereo balance control is also provided, in addition to a record/safety button and separate volume and tone controls. Maximum record/play time is 120 minutes. The system includes a 60-minute tape cassette, remote-control stop/start microphone with spiral retractable cord, and an adjustable gimbal mounting bracket.



Circle No. 79 on Reader Service Page 15 or 115

TUBE TESTER

Seco Electronics Corporation's Model 88A tube tester will test both color and monochrome TV picture tubes as well as evaluate nuvistors, novars, compactrons, decals, magnovals, and all 7-, 8-, and 9-pin tubes. Test voltages do not exceed 25 volts d.c. or 22 volts a.c., and current is comparatively low. Amplified meter readings of test information detect culls and problem tubes with a sensitivity not otherwise possible with a direct meter circuit and neon lamps. The Model 88A utilizes "grid circuit tests" to make up to eleven simultaneous checks for leakage, shorts, and grid emission or current reversal—not to mention tube merit and filament continuity. Setup data for multiple tests are arranged on handy flip-over cards. The card system is automatically kept current free of charge for registered owners.



Circle No. 80 on Reader Service Page 15 or 115

BATTERY-BOOST REGULATOR FOR CB

The Model BBR-1216 "Battery-Boost Regulator" made by *Mark Products Company* is a d.c. regulator designed to provide constant voltage output for mobile CB and Business Band transceivers. This all-solid-state device is said to provide optimum power output on "transmit" and improved receiver sensitivity. Technical specifications: 11-16 volts input (preset at factory for 15.5 volts but can be field adjusted to provide outputs

PRODUCTS (*Continued from page 22*)

between 12 and 16 volts); 2-ampere maximum output current; 10-transistor, three-diode (one zener) circuitry; fused input and output; ON/OFF switch (when set on OFF position, transceiver is connected directly to car battery).

Circle No. 81 on Reader Service Page 15 or 115

CB PHONE PATCH

Now you can interconnect any CB base transceiver with a telephone and extend a CB call to any telephone in the nation with *Hy-Gain Electronics Corporation's* new Model 402 CB Phone Patch. The Model 402 can be easily connected to any CB transceiver in just a few minutes. Two controls are provided: an ON/OFF switch and a phone patch MODULATION GAIN control. The low-cost Model 402 Phone Patch is supplied with complete instructions for installation and connection to the telephone terminal box, or wall outlet.

Circle No. 82 on Reader Service Page 15 or 115

ADVANCED FM STEREO RECEIVER

Plug-in modular circuitry and IC i.f. strip are just two of the many features you'll find in the *H. H. Scott, Inc.*, Model 342C 100-watt FM stereo receiver. In addition, the 342C has a built-in computer circuit, called the "Perfectune," that tells the user when a station is perfectly tuned in. Other features include a built-in line-cord antenna, silver-plated FET front end, FET tone controls, and plug-in speaker connections that eliminate phasing problems. Technical specifications: 80-watt ±1 dB at 8 ohms IHF, 100-watt ±1 dB at 4 ohms output power; 0.8% distortion at 30 watts, continuous output single channel; 35-dB selectivity; 20-20,000 Hz±1 dB frequency response; −55-dB hum and noise; 80-dB cross modulation rejection; 1.9-μV usable sensitivity; 40-dB tuner stereo separation; 11 FM i.f. stages; 2.5-dB capture ratio; 60-dB S/N ratio; 4-mV phono sensitivity.

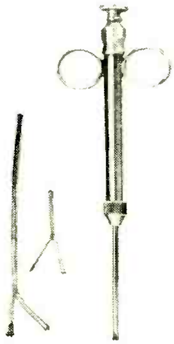
Circle No. 83 on Reader Service Page 15 or 115

TREASURE LOCATOR KIT

The use of three field-effect transistors and two silicon transistors in the *Caringella Electronics, Inc.*, Model TRL-1 treasure locator is guaranteed to provide exceptional operating stability. The TRL-1, available only in kit form can be used for locating buried pipes, lost jewelry, coins, all types of metals, minerals, and other valuables. It is ideal for beachcombing. Assembly of the kit is simplified by the utilization of an etched circuit board and easy-to-follow instructions. A unique feature of the TRL-1 is the 6" etched-circuit "search" coil furnished with the kit; so there are no coils to wind and no need of test equipment for alignment. The handle-mounted search coil is adjustable to any angle.

Circle No. 84 on Reader Service Page 15 or 115

AUTOMATIC PIGTAIL FORMER



The Model G-6 "Lead Ejector" made by *Bailey Company* is a simple syringe-like tool that eliminates most of the time and effort normally required for the preparation of the conductors in shielded cable. The point of the tool is inserted between the braid and inner conductor, parting the shield from the inside without breaking wires. A plunger is then depressed, ejecting the inner conductor through the previously formed exit hole. No trimming of the conductors is needed, so the danger of loose wire "whiskers" is eliminated. The Model G-6 kit consists of the basic syringe device and six interchangeable point/plungers ranging in size from 0.039" to 0.175" to fit a wide range of inner-conductor diameters.

Circle No. 85 on Reader Service Page 15 or 115

TRANSCRIPTION TURNTABLE

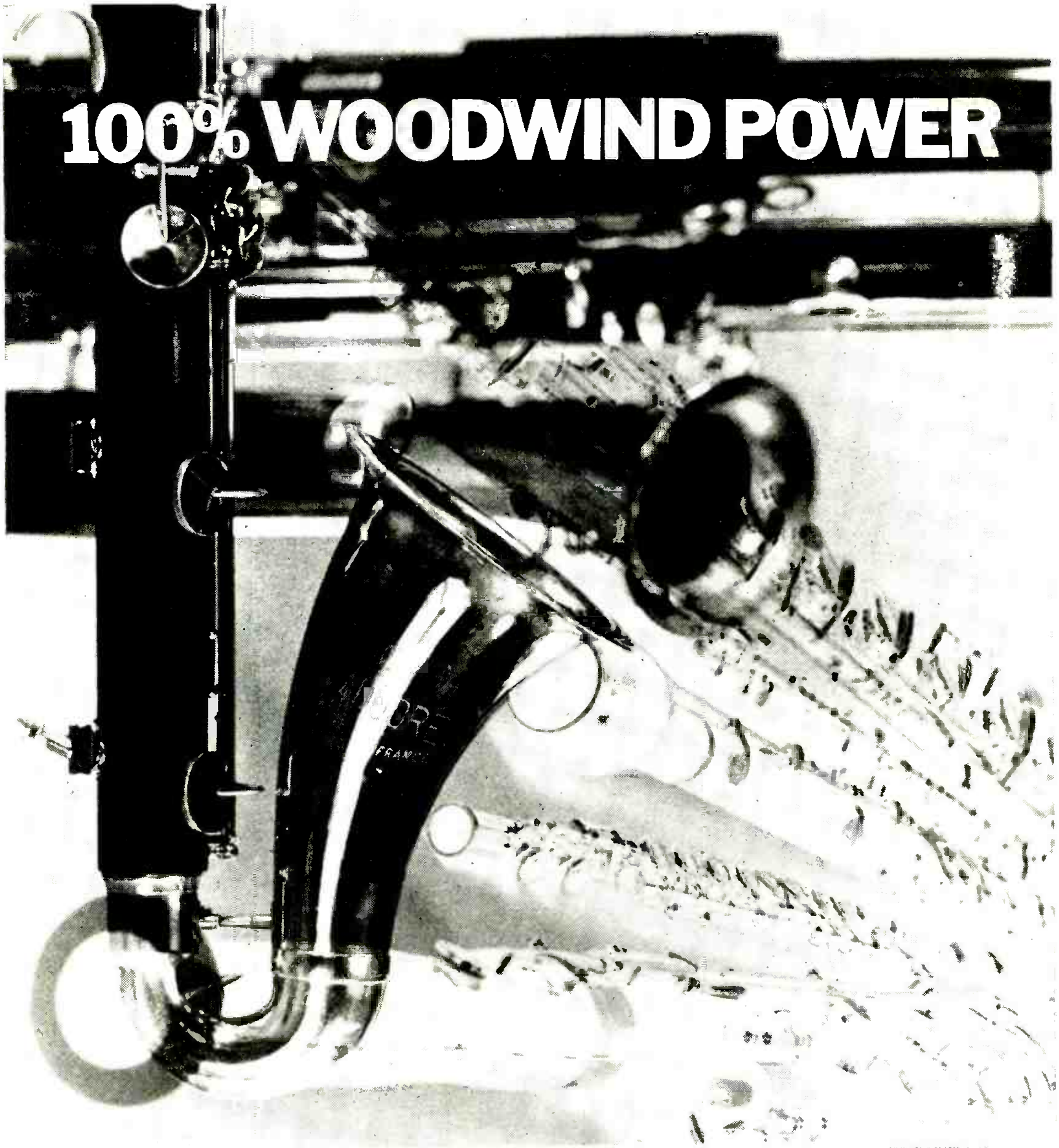
An advanced transcription turntable, Model TD-125, is now available from *Elpa Marketing Industries*. The new Thorens turntable is designed to meet new, more demanding requirements for sound reproduction. It incorporates transistorized drive system that reduces the speed of rotation of the motor to an extremely low value to eliminate audible rumble. Among its many other features, the TD-125 is equipped with electronic speed selector and pitch control, three speeds (16, 33, 45 r/m), dynamically balanced 12" die-cast turntable that guarantees low wow and flutter, and a replaceable tone-arm board.

Circle No. 86 on Reader Service Page 15 or 115

POLICE/FIRE EMERGENCY CALL CONVERTER

A "Piggy-Back" Converter that allows any modern AM receiver to get police, fire, and other emergency calls has been introduced by *Trojan Electronics, Inc.* In operation, the converter is placed in close proximity to the receiver which has been tuned to approximately 535 kHz. The receiver is then fine tuned to a point on the dial where the desired

(*Continued on page* 118)



Words are inherently limited in stimulating the emotions aroused by music. This is especially so in describing how high fidelity components perform.

With cartridges, for example, we speak of flat frequency response, high compliance, low mass, stereo separation. Words like these enlighten the technically minded. But they do little or nothing for those who seek only the sheer pleasure of listening.

We kept both aspects in mind when developing the XV-15 series of cartridges. We made the technical measurements. And we listened.

We listened especially for the ability of these cartridges to reproduce the entire range of every instrument. With no loss of power. In the case of woodwinds, this meant a cartridge that could recreate the exact nuances that distinguish an oboe from an English horn. A clarinet from a bass clarinet. A bassoon in its lower register from a contrabassoon in its higher register.

We call this achievement "100% woodwind power."

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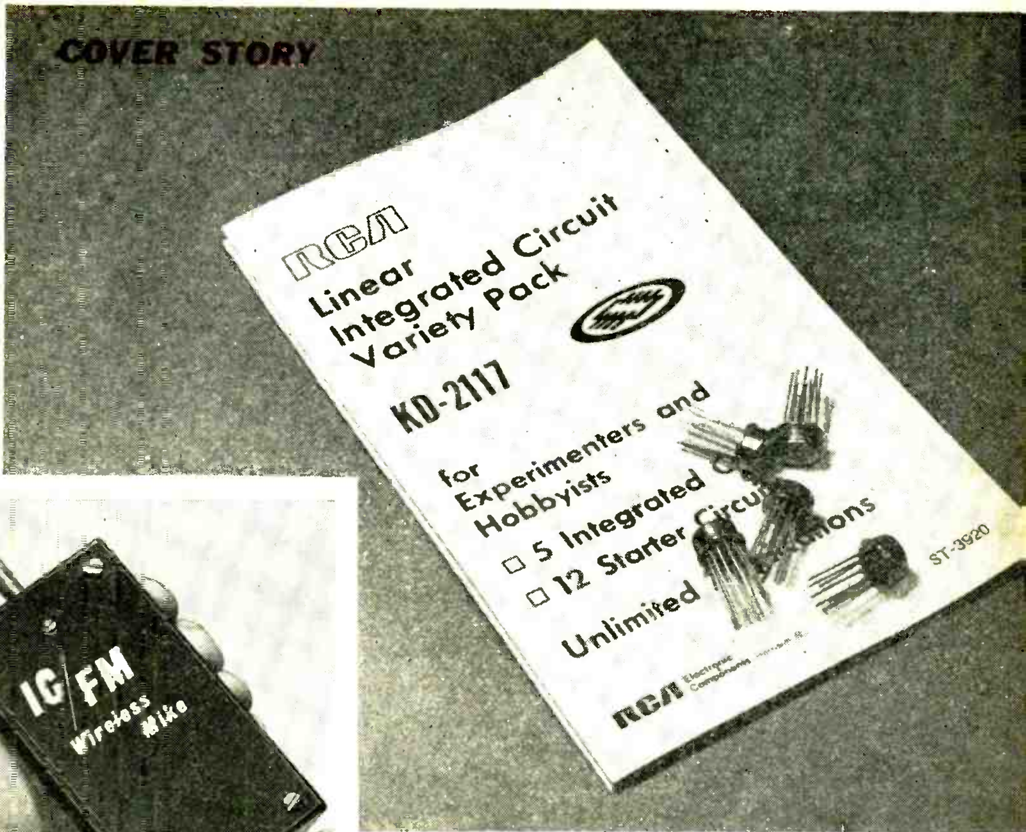
COVER STORY



Linear IC's for the Experimenter

Low-cost package of IC's has many uses—like building an FM wireless mike

By this time, most everybody who has done any electronics experimentation knows what an integrated circuit is, but he may not know how to use one. He knows that many integrated circuits (IC's) can contain a number of transistors, diodes, and resistors in a very small package and that they can be used to form some very complex circuits. Integrated circuits come in a variety of package shapes. Some are about the size of a standard TO-5 transistor case but they have 10 leads instead of the 3 or 4 needed for transistors; others are in flat, rectangular, "in-line" packages with 14 or more pins. Whatever the shape, the uses for IC's are myriad.

This was not always the case. A few years ago, it was very expensive to produce IC's and they were used primarily in digital applications. A large-scale digital computer uses literally thousands of the same IC flip-flop so costs can be spread over high-quantity production. (Digital IC's are of the on-off, two-voltage-level type.)

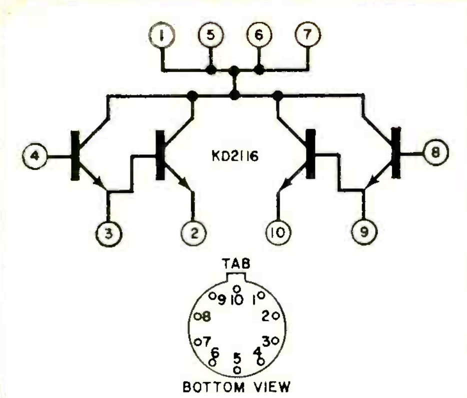


Fig. 1. The KD2116 consists of four closely matched npn transistors arranged in a pair of Darlingtons. All collectors are common.

Production techniques have improved in the last few years, however, and about two years ago semiconductor manufacturers came out with linear IC's (amplifiers, etc.), which, though they were still relatively expensive compared to discrete components, found great favor in the communications industry. Television and FM receiver manufacturers immediately began using IC's in their products. Now IC's are found in CB units and to an increasing extent in standard broadcast receivers.

For the average electronics experimenter, most of the linear IC's available (and they are made by almost all of the semiconductor manufacturers) are still too expensive for wide use—though he appreciates their superior performance characteristics and high reliability. Times are still changing, however, and it is possible that now the experimenter's chance to use IC's is at hand. RCA now has available at its distributors a Linear Integrated Circuit Variety Pack (KD-2117) for just $4.40. The pack contains five TO-5-size linear IC's: two KD2114 transistor arrays, two KD2116 dual-Darlington arrays, and a KD2115 audio amplifier. With the IC's comes a booklet describing 12 basic starter circuits that are not only good in themselves, but will suggest many others.

KD2116. This 10-lead integrated circuit consists of four transistors connected to form two independent Darlington pairs as shown in Fig. 1. The closely matched transistors with emitter-follower outputs provide very low noise and a gain-bandwidth product in excess of 100 MHz. Typical applications for this IC include a stereo phono amplifier, a low-noise differential amplifier, an operational-amplifier driver, and low-level stereo and single-channel stages. In the stereo phono application, the KD2116 can be mounted directly on the phono arm near the cartridge; and, because of the low noise, high input impedance, and low output impedance, minimum shielding is required from the pickup to the amplifier. The buffering action of the KD2116 also substantially reduces losses and decreases hum pickup.

One typical audio circuit is shown in Fig. 2. This two-channel mixer combines two independent inputs into a single output. The input impedance is approximately 4700 ohms, while the output impedance is about 10,000 ohms. Conventional volume controls may be added ahead of the circuit to adjust the required input levels.

KD2115. A multi-purpose, multi-function power amplifier, this 12-lead integrated circuit is designed for use in portable or fixed communication equipment. The circuit, shown in Fig. 3, includes a voltage regulator, a buffer stage, a differential amplifier and phase splitter, a driver, and a power-output, push-pull stage.

Although it can be used for a number of different functions, the typical audio

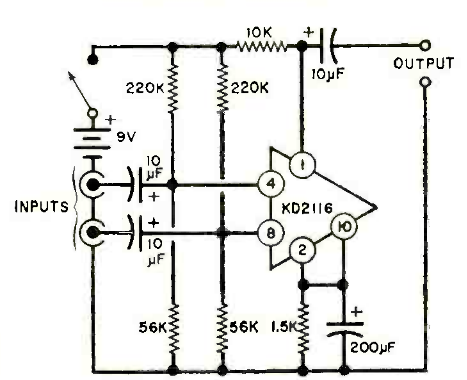


Fig. 2. The KD2116 makes an excellent two-channel mixer useful for audio systems.

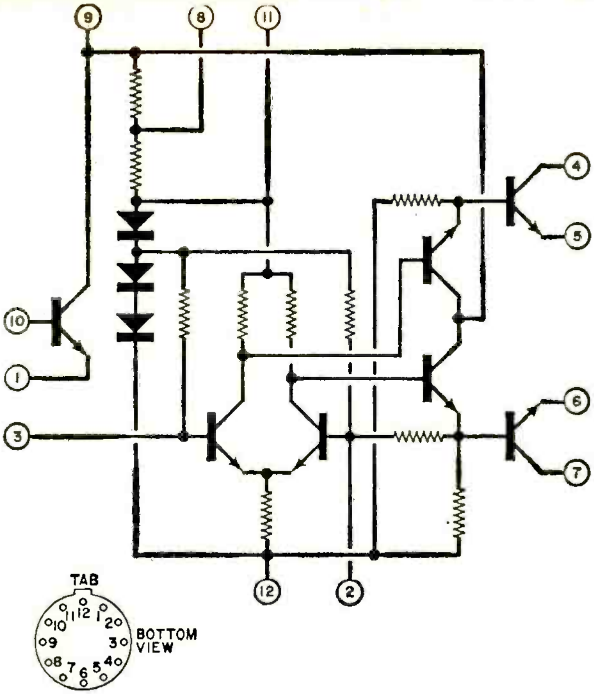


Fig. 3. The KD2115 is complete audio amplifier in a TO-5 can. When driven from a low-level signal, this IC can put about ½ watt to a speaker. Because of its low power requirements, and small size, it makes a good general-utility bench amplifier, as well as a handy amplifier for outdoor (battery) operation.

amplifier circuit shown in Fig. 4 should interest most experimenters. This audio amplifier can be used with a portable PA system, as a phonograph amplifier, or in any application that requires a low-power, portable, lightweight audio amplifier.

With a supply voltage as low as 3 volts, the circuit will deliver 65 milliwatts to a 3.2-ohm speaker, with an idling current of about 7 mA. With a 9-volt supply, the circuit delivers about ½ watt with an idle current of 22 mA. The temperature-tracking voltage regulator in the IC permits it to be used over a very wide range of temperatures, making the KD2115 ideal for outdoor applications. With a supply voltage of 6 volts or more, a heat sink (Wakefield NF209 or similar) for the IC is recommended. This insures maximum power output.

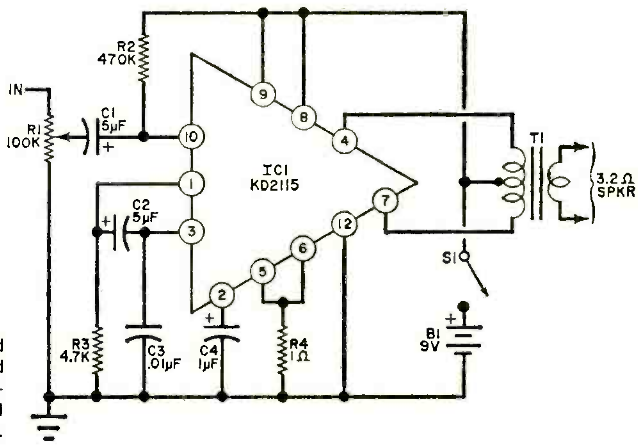


Fig. 4. Add just a few outboard components to the KD2115, and you have an excellent audio amplifier that can be very useful to the electronics experimenter.

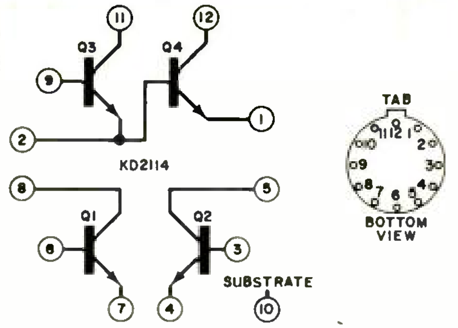


Fig. 5. The KD2114 also contains four npn transistors, arranged as an isolated pair and a Darlington. Each transistor of the Darlington can be used independently when certain external circuit changes are made.

The amplifier requires an input of about 45 millivolts to drive to full output. Frequency response is as good as the output transformer and speaker will allow, and noise is very low.

This amplifier makes an excellent general-purpose audio system for the bench when working with projects that require some form of audio amplification. It can be used to test the front end of a circuit before the regular audio amplifier is built. In strong signal areas, the amplifier can be driven by a crystal set.

KD2114. The four active devices in this integrated circuit (Fig. 5) are two isolated transistors (*Q1* and *Q2*) and two transistors (*Q3* and *Q4*) with a base-emitter common connection. The four transistors can be used almost independently if terminal 2 is at either a.c. or d.c. ground so that *Q3* can be used as a common-emitter amplifier and *Q4* as a common-base amplifier. The presence of *Q3* does not inhibit the use of *Q4* alone in a large number of circuits.

Applications of the KD2114 are many: as a very-wide-bandwidth video amplifier (upper 3-dB point can reach 30 MHz); as an r.f. amplifier for the frequency range between 2 and 100 MHz; as an i.f. amplifier with 30-dB gain at 1 MHz; or as a class B audio amplifier delivering about 40 mW.

A Wireless Microphone. The circuit for a good application of the KD2114 is shown in Fig. 6. The wireless microphone can transmit on any clear spot in the 88-to-108-MHz commercial FM band and has a range between 50 and 150 feet

PARTS LIST

B1—9-volt transistor radio battery
C1—25-µF, 6-volt electrolytic capacitor
C2—200-µF, 6-volt electrolytic capacitor
C3—20-µF, 10-volt electrolytic capacitor
C4—15-pF silver mica capacitor
C5—0.001-µF, 25-volt capacitor
C6—0.1-µF, 25-volt capacitor
C7—3-30-pF trimmer capacitor
IC1—Integrated circuit (RCA KD2114)
J1—Phono jack
L1—See text
R1—270-ohm
R2—150,000-ohm
R3—22,000-ohm
R4—1200-ohm
R6—8200-ohm
R7—68-ohm
R8—330-ohm
R9—6800-ohm
(All resistors ¼- or ½-watt)
R5—10,000-ohm miniature potentiometer
S1—S.p.s.t. switch (see text)
Misc.—Plastic case (Harry Davies 220) with plastic cover; ⅜"-long fiber spacers (2); knob; battery clip; 2½"-long piece of 3/16" brass rod (one end threaded); low-impedance 200-to-600-ohm microphone (RCA HK-99); jack for mike switch (optional); 2½" x 1¾" perf board; metal for chassis; mounting hardware; shielded-pair audio cable; wire; solder; etc.

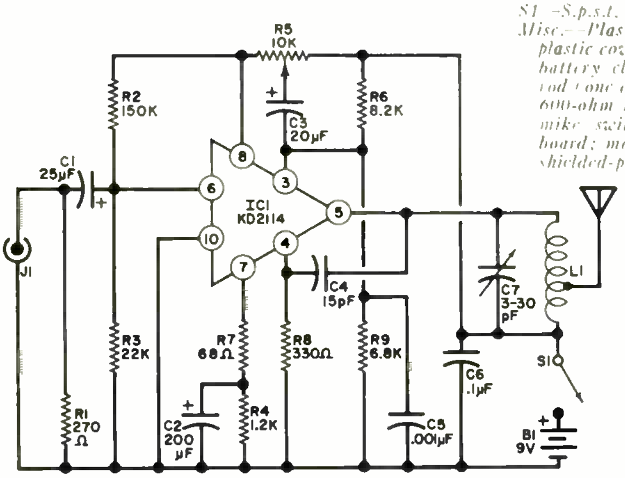


Fig. 6. An excellent wireless microphone can be made using the KD2114. Speech quality is very good (with the microphone suggested), and range is about 50 to 150 feet, depending on receiver used and its antenna.

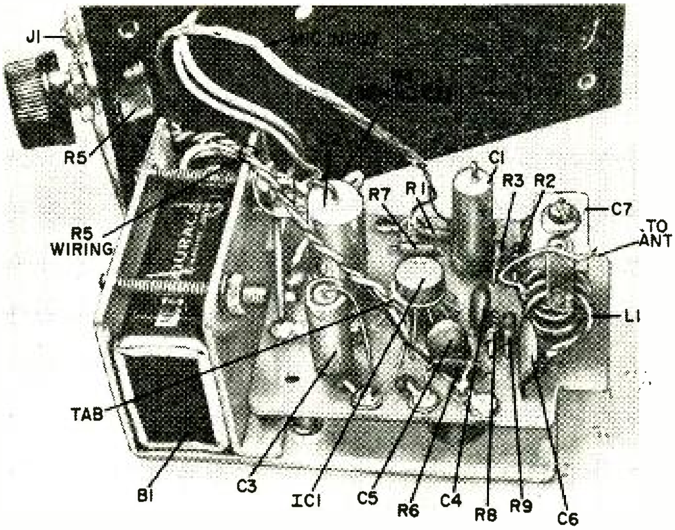


Fig. 7. The wireless microphone is built perf-board style as shown here. Also shown is the suggested component placement. However the circuit is built, observe good r.f. wiring practice for best results. The perf board is notched at the corners to fit the plastic case.

depending on the type and location of receiver antenna used. The unit has high speech quality and low current drain. A conventional 9-volt transistor radio battery provides the power. The antenna length has been limited to keep radiation within the FCC regulations for wireless microphones.

Any type of neat construction can be used to build the wireless microphone, but, if you want to duplicate the author's version, make a perf board like that shown in Fig. 7. The corners of the plastic board are cut so that the completed mike will fit within the case. This figure also shows the location of the various components.

Coil *L1* is made of 6 turns of #12 wire, with an inside diameter of 5/16" and an overall length of 3/4". The antenna tap is 1½ turns from the cold (*C6*) side. Tuning capacitor *C7* is soldered directly to the top side of the first and last coil turns and is physically arranged so that

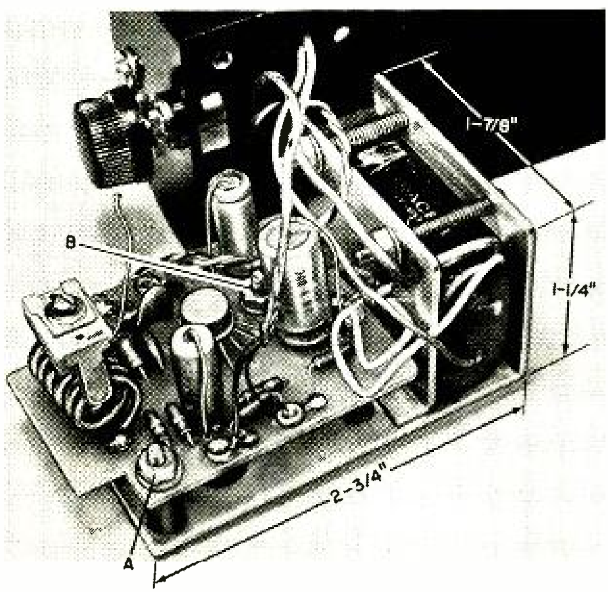
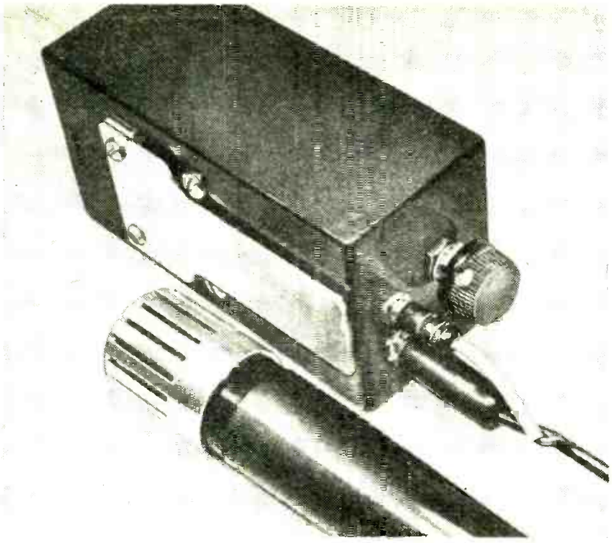
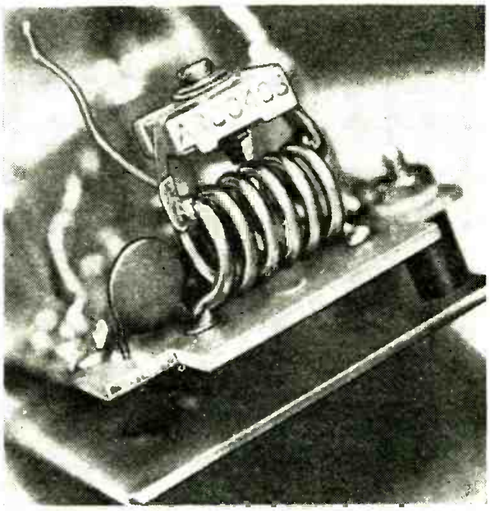


Fig. 8. Overall dimensions of the wireless microphone chassis. The perf board is mounted on standoffs, while battery is secured by a metal clamp at one end. Flexible leads couple the circuit to three case-mounted components.



A metal strap arrangement can be mounted on the rear of the plastic case so that the wireless microphone can be carried on the user's belt. The microphone can be hand carried or mounted on a neck strap for lavelier mike.

Tuning capacitor C7 is soldered directly to the outside turns of coil L1. The loose wire seen is the connection to the antenna.



it can be adjusted through a small hole drilled in the plastic cover.

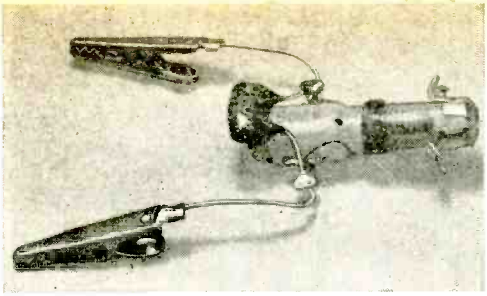
To duplicate the author's mike, make the metal (aluminum) mounting chassis and battery clamp shown in Fig. 8. The two holes marked A and B are used to mount the finished perf board, using 3/8" fiber spacers with suitable mounting hardware. Small threaded nuts are swaged into chassis holes so that the finished metal chassis can be mounted within the plastic case using suitable screws from the rear of the case.

Completed, mounted wireless microphone fits into small plastic case. Tuning capacitor C7 is accessible through a small hole in the plastic cover.

The lip of the 9-volt transistor radio battery mounting clamp is mounted to two more holes. Once the clamp is in place, insert the battery between the two panels and use 1-inch mounting hardware between the upper holes to secure the battery in place.

The antenna is made from a 2½"-long piece of 3/16"-diameter brass rod that has one end threaded. Mount it on one end of the plastic case with a soldering lug between the mounting screw and the plastic case. The lug serves as the antenna connector.

Mount miniature potentiometer *R5*,



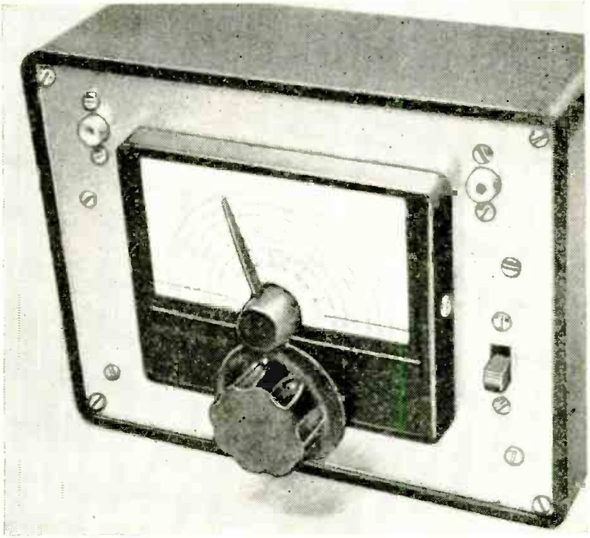
A broadcast-band filter is used with the marine-band converter to eliminate pickup from strong broadcast stations that might cause undesired breakthrough.

microphone jack *J1* and power switch *S1* (if used) at the other end of the plastic case. If you use the microphone called for in the Parts List, mount an appropriate jack beside *J1* for the microphone-switch output plug.

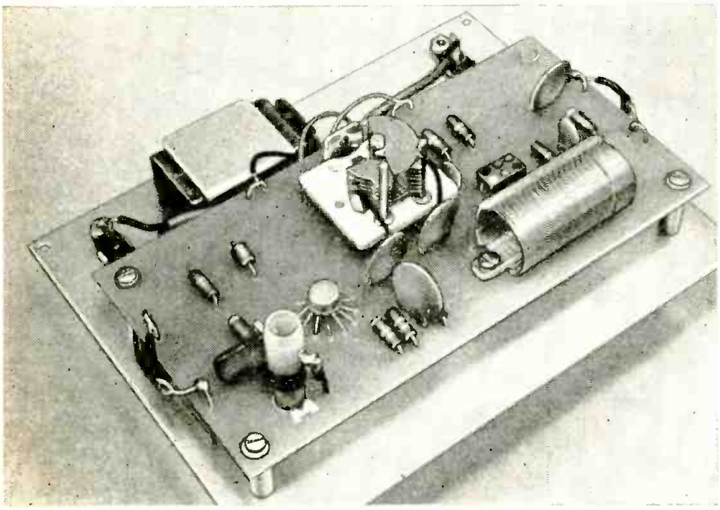
After the perf board is mounted on the metal chassis, connect it to the case-mounted components. Use shielded lead

(*Continued on page* 113)

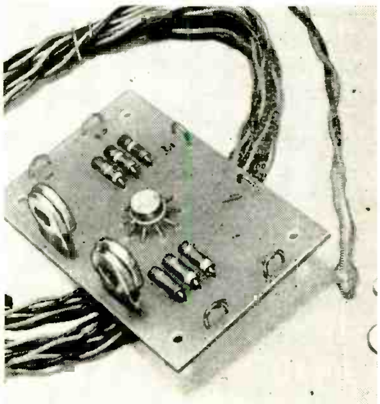
Applications booklet for the KD2117 series gives construction details for 12 projects: ½-W audio amplifier, crystal calibrator, crystal oscillator, 2-channel mixer, flip-flop, power supply, microphone preamplifier, wide-band amplifier, wireless microphone, audio oscillator, electronic thermometer, and marine-band converter. Photos of last two are shown here.



The marine-band converter provides for reception of transmissions on the 2-to-3-MHz band on any conventional AM broadcast-band radio. Coupling is through the antenna input terminals on BCB receiver.



Interior of the marine-band converter shows the neat construction that can be obtained. Although it looks like a PC board, this unit uses perf-board wiring.



The electronic thermometer described in the KD2117 applications booklet measures from −58 to +167°F. Various temperature sensing units can be used.

Build a Pos-Neg Pulse Generator

INDISPENSABLE TRIGGER SOURCE FOR DIGITAL CIRCUITS

BY FRANK H. TOOKER

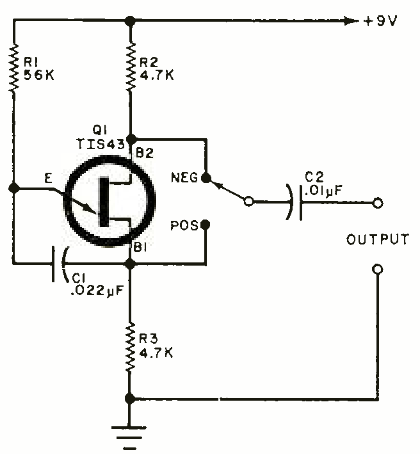


Fig. 1. Simple unijunction transistor circuit generates positive or negative pulses of relatively wide durations.

IN THE COURSE of experimenting with, developing, and testing computer logic and counter circuits, it is useful, if not essential, to have an available source of pulses to supply triggers or actuating signals. Such a source should provide pulses that are quite narrow, of adequate amplitude, and either positive or negative in polarity, selectable at the flick of a switch.

The circuit shown in Fig. 1 is satisfactory for a number of applications. Output amplitude is good, and the setup is quick and easy to breadboard in an emergency. Pulse duration is wide, however.

In the circuit shown in Fig. 2, an inductor, *L1*, with a fairly high Q is used in the B2 circuit of *Q1*, rather than a resistor. Both *B1* and the low end of timing capacitor *C1* are grounded. Each time the UJT fires, a negative pulse and a positive pulse are produced consecutive-

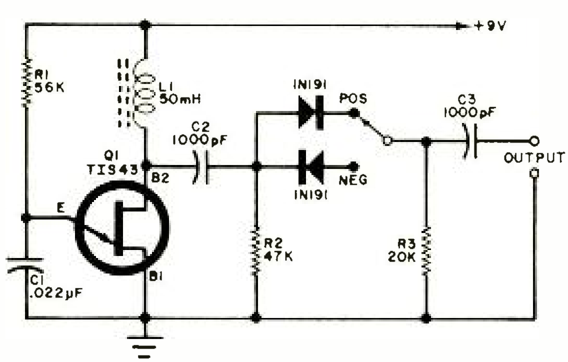


Fig. 2. This circuit generates positive and negative pulses simultaneously with the shape of the pulse sharpened by the inductor in the base 2 circuit.

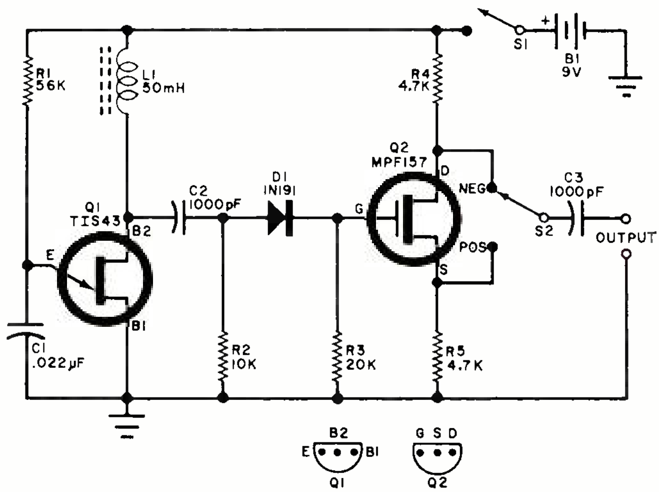


Fig. 3. With the addition of a MOSFET, only positive-going pulses from Q1 are used. Phase splitting then provides a repetition rate of 400 pps of either polarity.

PARTS LIST

B1—9-volt transistor battery
C1—0.022-µF, 100-volt Mylar capacitor
C2, C3—1000-pF silver-mica or polystyrene capacitor
D1—1N191 diode
L1—50mH, high-Q inductor, powdered-iron core
Q1—Unijunction transistor (Texas Instruments type TIS43)
Q2—MOSFET transistor (Motorola type MPF157)*
R1—56,000-ohm
R2—10,000-ohm
R3—20,000-ohm
R4, R5—4700-ohm
} *All resistors ½-watt*
S1—s.p.s.t. switch
S2—s.p.d.t. switch
**Available from Robert A. Glassman, 20 Hampton Rd., Massapequa, N.Y. 11758, $1.30 each, postpaid.*

ly at *B2*. Other than this, ringing is negligible. For the component values given, pulse amplitudes are approximately equal. Because the inductor is effectively in parallel with the output, differentiation occurs, with the result that both of the output pulses are quite narrow. The simple arrangement of two diodes and a s.p.d.t. switch makes it possible to have either positive or negative pulses at the output.

Performance with this circuit is quite good provided it is not too heavily loaded. (That is, it should preferably be used with a fairly high-impedance load.) If resistors *R2* and *R3* are sufficiently high in value, and loading is very light, the amplitude of the output pulse can approach the level of the power-supply potential.

In the circuit shown in Fig. 3, only the positive-going pulses from B2 of *Q1* are used since MOSFET *Q2* is an *n*-channel type. Negative pulses are suppressed by diode *D1*. The type MPF157 MOSFET was chosen for the phase splitter because of its ability to handle the signal level and its excellent high-frequency response, rather than because of its high input impedance. The latter does permit loading of the UJT almost entirely with resistors, however.

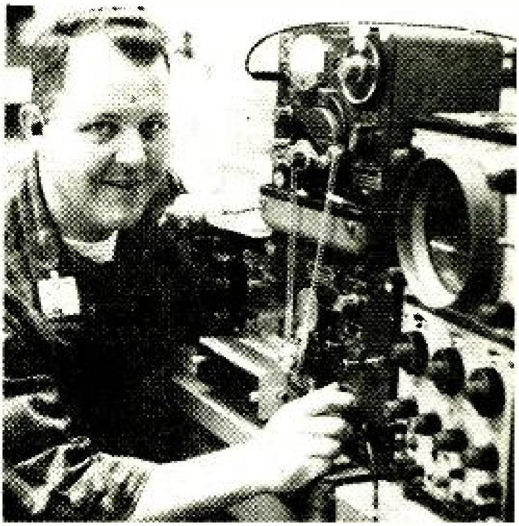
With this circuit, differentiation occurs in the *C2-R2* circuit as well as in *L1*. Repetition rate is about 400 pulses per second, while pulse duration is about 12 µsec and output amplitude is 3 volts. Amplitudes of the positive and negative pulses are equal.

When working with any MOSFET, take care that you do not touch the isolated gate lead since any static charge can destroy the fine gate insulation within the semiconductor. Keep the three leads in direct electrical contact until the MOSFET is soldered into the circuit.

If a slower pulse rate is desired, increase the value of either *R1* or *C1*, in small steps, until the desired rate is obtained. —30—

One of our students wrote this ad!

Harry Remmert decided he needed more electronics training to get ahead. He carefully "shopped around" for the best training he could find. His detailed report on why he chose CIE and how it worked out makes a better "ad" than anything we could tell you. Here's his story, as he wrote it to us in his own words.



Harry Remmert on the job. An Electronics Technician with a promising future, he tells his own story on these pages.

By Harry Remmert

AFTER SEVEN YEARS in my present position, I was made painfully aware of the fact that I had gotten just about all the on-the-job training available. When I asked my supervisor for an increase in pay, he said, "In what way are you a more valuable employee now than when you received your last raise?" Fortunately, I did receive the raise that time, but I realized that my pay was approaching the maximum for a person with my limited training.

Education was the obvious answer, but I had enrolled in three different night school courses over the years and had not completed any of them. I'd be tired, or want to do something else on class night, and would miss so many classes that I'd fall behind, lose interest, and drop out.

The Advantages of Home Study

Therefore, it was easy to decide that home study was the answer for someone like me, who doesn't want to be tied down. With home study there is no schedule. I am the boss, and I set the pace. There is no cramming for exams because I decide when I am ready, and only then do I take the exam. I never miss a point in the lecture because it is right there in print for as many re-readings as I find necessary. If I feel tired, stay late at work, or just feel lazy, I can skip school for a night or two and never fall behind. The total absence of all pressure helps me to learn more than I'd be able to grasp if I were just cramming it in to meet an exam deadline schedule. For me, these points give home study courses an overwhelming advantage over scheduled classroom instruction.

Having decided on home study, why did I choose CIE? I had catalogs from six different schools offering home study courses. The CIE catalog arrived in less than one week (four days before I received any of the other catalogs). This indicated (correctly) that from CIE I could expect fast service on grades, questions, etc. I eliminated those schools which were slow in sending catalogs.

FCC License Warranty Important

The First Class FCC Warranty* was also an attractive point. I had seen "Q" and "A" manuals for the FCC exams,

*CIE backs its FCC License-preparation courses with this famous Warranty: graduates must be able to pass the applicable FCC License exam or their tuition will be refunded in full.

and the material had always seemed just a little beyond my grasp. Score another point for CIE.

Another thing is that CIE offered a complete package: FCC License and technical school diploma. Completion time was reasonably short, and I could attain something definite without dragging it out over an interminable number of years. Here I eliminated those schools which gave college credits instead of graduation diplomas. I work in the R and D department of a large company and it's been my observation that technical school graduates generally hold better positions than men with a few college credits. A college degree is one thing, but I'm 32 years old, and 10 or 15 years of part-time college just isn't for me. No, I wanted to *graduate* in a year or two, not just *start*.

If a school offers both resident and correspondence training, it's my feeling that the correspondence men are sort of on the outside of things. Because I wanted to be a full-fledged student instead of just a tagalong, CIE's exclusively home study program naturally attracted me.

Then, too, it's the men who know their theory who are moving ahead where I work. They can read schematics and understand circuit operation. I want to be a good theory man.

From the foregoing, you can see I did not select CIE in any haphazard fashion. I knew what I was looking for, and only CIE had all the things I wanted.

Two Pay Raises in Less Than a Year

Only eleven months after I enrolled with CIE, I passed the FCC exams for First Class Radiotelephone License with Radar Endorsement. I had a pay increase even before I got my license and *another* only ten months later. I'm getting to be known as a theory man around work, instead of one of the screwdriver mechanics.

These are the tangible results. But just as important are the things I've learned. I am smarter now than I had ever thought I would be. It feels good to know that I know what I know now. Schematics that used to confuse me completely are now easy for me to read and interpret. Yes, it is nice to be smarter, and that's probably the most satisfying result of my CIE experience.

Praise for Student Service

In closing, I'd like to get in a compliment for Mr. Chet Martin, who has faithfully seen to it that my supervisor knows I'm studying. I think Mr. Martin's monthly reports to my supervisor and generally flattering commentary have been in large part responsible for my pay increases. Mr. Martin has given me much more student service than "the contract calls for," and I certainly owe him a sincere debt of gratitude.

And finally, there is Mr. Tom Duffy, my instructor. I don't believe I've ever had the individual attention in any classroom that I've received from Mr. Duffy. He is clear, authoritative, and spared no time or effort to answer my every question. In Mr. Duffy, I've received everything I could have expected from a full-time private tutor.

I'm very, very satisfied with the whole CIE experience. Every penny I spent for my course was returned many times over, both in increased wages and in personal satisfaction.

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But for men like Harry Remmert, who have gotten the training they need in the fundamentals of Electronics, there are no such limitations. As "theory men," they think with their heads, not their hands. For trained technicians like this, the future is bright. Thousands of men are urgently needed in virtually every field of Electronics, from two-way mobile radio to computer testing and trouble-shooting. And with this demand, salaries have skyrocketed. Many technicians earn $8,000, $10,000, $12,000 or more a year.

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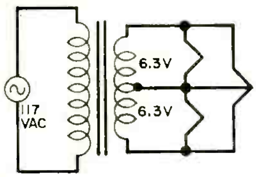
CIRCLE NO. 9 ON READER SERVICE PAGE

Which Transformer Is Which?

BY ROBERT P. BALIN

Transformers are used in electronic circuits to change voltages, couple signals, match impedances, isolate circuits, and split or shift signal phases. To test your knowledge of transformers, match the functions (1-10) to the proper circuits (A-K). Answers will be found on page 117

1. Discriminator
2. Driver
3. Filament
4. Flyback
5. Intermediate frequency
6. Oscillator
7. Output
8. Pulse
9. Quadrature
10. Voltage correction



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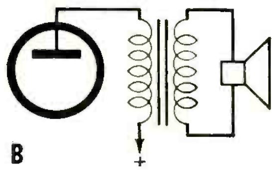

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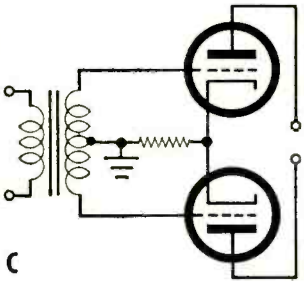
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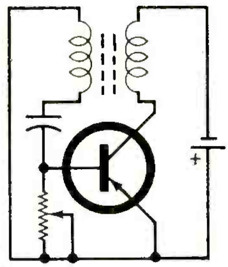

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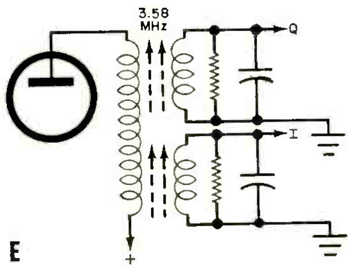

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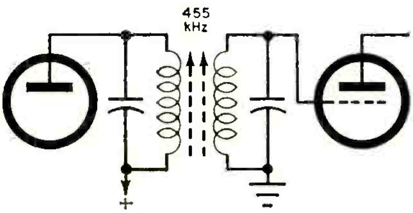

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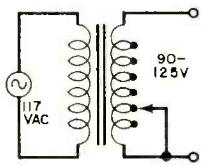

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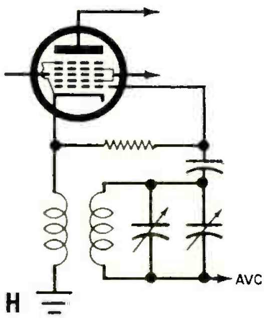

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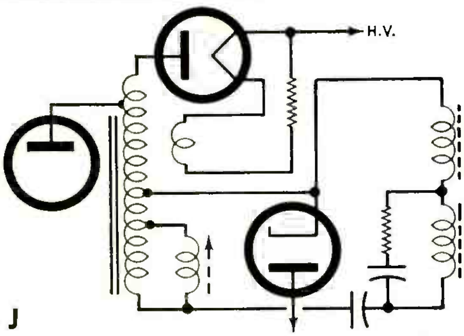

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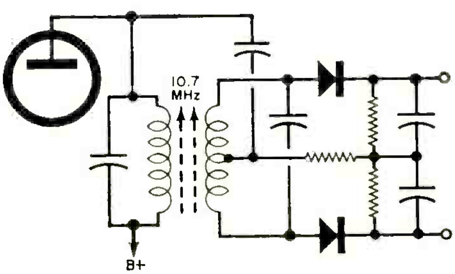

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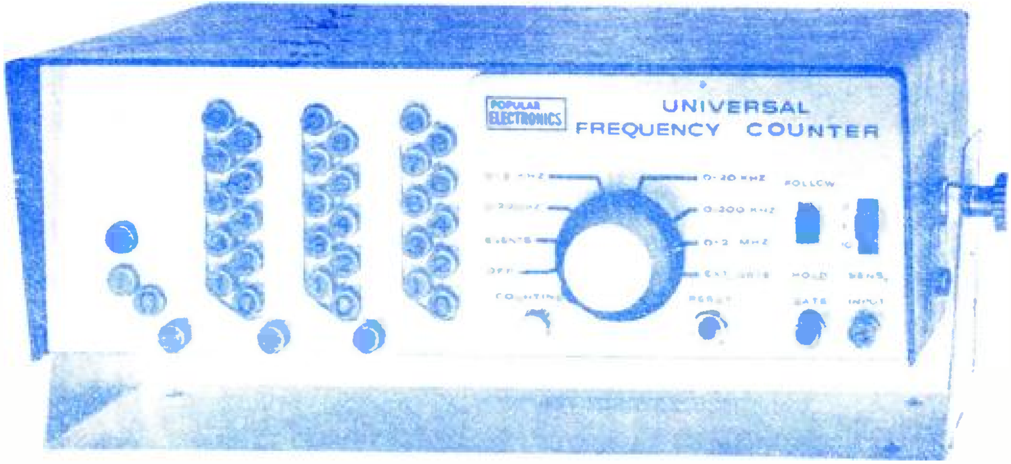


Popular Electronics Universal Frequency Counter

BY DON LANCASTER

Part 2

Note: *Construction of modules for the Counter appeared in the March issue.*

Assembly of Complete Unit. The circuit for the overall counter is shown in Fig. 17, while Fig. 18 shows the interior of the chassis. The vinyl-clad case that comes with the complete kit is punched and machined, and includes assembly instructions. If you select another type of enclosure, use Fig. 18 as a general layout guide. An optional dialplate (see Parts List for Fig. 17) adds a professional touch and also serves as a front-panel layout template.

Modules *M1* through *M6* are arranged in a line along the front of the case, supported by brackets similar to those used on the "Digital Volt-Ohmmeter" (POPULAR ELECTRONICS, December 1968). The three decimal-point indicator lamps are placed between the decade units as shown in the photo, while the Power Supply module (*M7*) mounts on the rear wall of the chassis with spacers and #6 hardware. The fuse (*F1*) and power transformer (*T1*) are mounted on the bottom of the chassis.

Note that the frame of input jack *J2* is isolated (insulated) from chassis ground and has an independent ground lead, called a "guard," running directly to the *M1* board. This lead is very important since it prevents any internally generated ground noise from interfering with the input. Use nylon washers to insulate the jack from the chassis.

Don't forget the individual ground leads from each module to the power

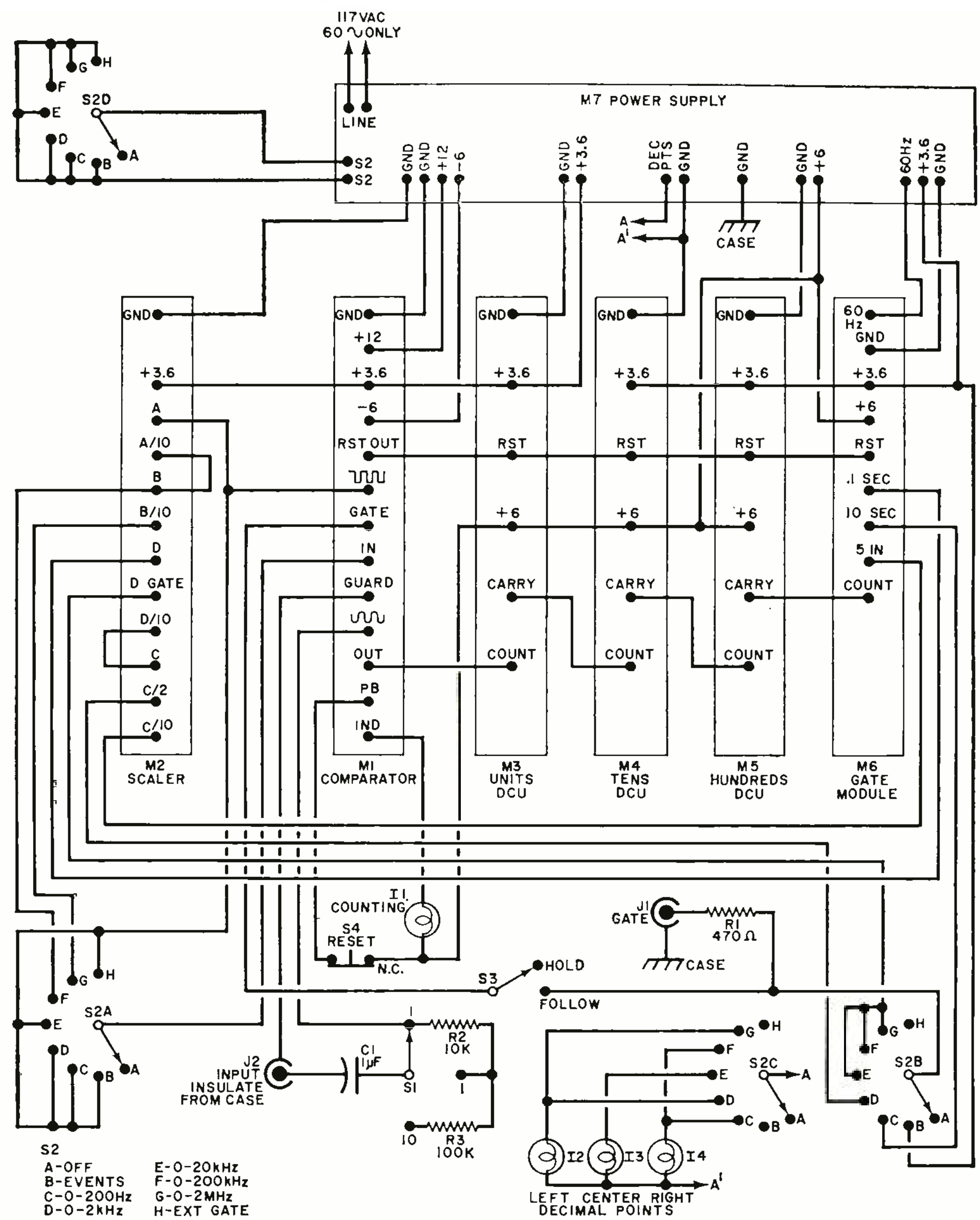


Fig. 17. Interconnections for complete frequency counter. Signal input jack J2 is insulated from chassis to prevent internal noise interference with the input signal.

supply ground buss.

The main selector switch (*S2*) has four decks, one of which is isolated from the other three by spacers. The isolated deck controls the 117-volt, 60-Hz power, while the other three (starting from the front) select the frequency, the timing, and the decimal point.

Preliminary Checkout and Operation. The frequency counter requires no calibration and has no internal adjustments. It is only as accurate as the 117-volt a.c. power-line stability and display resolution permit it to be. The following tests can be performed to check the general assembly for proper operation.

PARTS LIST
COMPLETE COUNTER

C1—1-μF, 400-volt Mylar capacitor
I1-I4—6.3-volt, 50-mA pilot lamp and lens assembly, three green, one white (Southwest Technical G-6.3 and W-6.3, respectively or similar)
J1—Phono jack
J2—Phono jack and nylon insulated mounting kit
M1—Comparator module
M2—Scaler module
M3-M5—DCU module (see text)
M6—Gate module
M7—Power supply module
R1—470-ohm, ¼-watt resistor
R2—10,000-ohm, ¼-watt resistor
R3—100,000-ohm, ¼-watt resistor
S1—Three-position, single-pole slide switch
S2—Four-deck, four-pole, eight-position, non-shorting miniature selector switch. Close space first three decks, isolate fourth with ¼" spacers. (Southwest Technical SW111S1 or equivalent)
S3—S.p.s.t. slide switch
S4—S.p.s.t. normally closed pushbutton switch
Misc.—3" x 5½" x 10" vinyl-clad, prepunched case and support assembly, dialplate, 1½-inch knob, mounting brackets for modules, mechanical hardware, #16 wire for grounds, #22 hookup wire, solder.*
**Anodized dialplate available from Reill's Photo Finishing, 4627 N. 11th St., Phoenix, Arizona 85014: in black and silver $3.00; red, gold, or copper $3.45, postpaid in U.S.A.*
Note:—Complete kit of parts to build counter including case but not dialplate is available from Southwest Technical Products, Box 16297, San Antonio, Texas 78216. Order # 165C, $120, plus postage, 7 lb.

HOW IT WORKS
COMPLETE COUNTER

The frequency to be counted is applied to the sensitivity control, which reduces the input level by 1 or 10 to the approximately 100 millivolts required for normal operation. The signal is then sent to the Comparator module (*M1*) where it is converted from a sine wave to a square wave of the same frequency with sharp rise and fall times. Any noise that might be present in the input is also rejected in the Comparator. The Comparator output is fed directly to the range selector switch *S2* and also to a pair of decade scalers that provides divide-by-ten and divide-by-one-hundred outputs. The latter are also connected to the range selector switch.

The output of the Comparator (f) is selected for the EVENTS function, 0-200 Hz, 0-2 kHz, 0-20 kHz and for the external gate (EXT. GATE) operation. The output from the first decade scaler (f/10) is used for the 0-200 Hz position, and the output of the second scaler (f/100) is used for the 0-2 MHz position.

The time base starts with a 60-Hz reference from the power supply. This signal is filtered, squared, and divided by six (all in module *M6*) to obtain the 0.1-second gating reference. Two divisions by ten produce the 1-second and 10-second time references. These time intervals, along with a positive voltage for EVENTS and no input for EXT. GATE are routed to the range selector switch.

From the selector switch, the time commands go through the HOLD-FOLLOW switch which permits a choice of automatically updating the reading or holding the last reading.

Both the measure command and the selected input frequency go through the synchronizing circuit in the Comparator module. The measure command turns the electronic switch on and off, but it does it in such a way that only whole cycles of the input frequency are counted. This eliminates the one-digit bobble in the counting. The time-base gated frequency then goes to the counting and display circuits.

The counter can be reset to zero at any time by operation of the manual RESET pushbutton, but in normal modes of operation, the counters are automatically reset just before a new count begins.

The operation of the counter is fully automatic. The available measure commands are 10-s measure and 10-s display for 0-200-Hz operation; 1-s measure and 1-s display for 0-2-kHz operation; and 0.1-s measure and 0.9-s display for the other ranges. To keep the display on longer, flip switch S3 to HOLD.

Plug the counter into a source of 117-volt 60-Hz power and place selector switch *S2* on EVENTS and switch *S3* on FOLLOW. One, or possibly two, numerals in each decade should be illuminated. Momentarily depressing the RESET button should immediately produce a 0000 reading.

Check all supply voltages, particularly the +6 and +3.6 volts, to be sure that they are within 0.1 volt of their correct values. The −6 and +12-volt supplies should be checked at their respective terminals on *IC1* of the Comparator module *M1*.

Place the range selector switch on the 0-200 Hz position and observe the COUNTING light on the front panel. It should cycle on for 10 seconds and off for 10 seconds. Place the selector switch on 0-2 kHz. The COUNTING light should now cycle on for 1 second and off for 1 second. With the selector switch on any higher range, the light should flash on for 0.1 second, once each second.

To check the operation of the decimal-point indicators, place the range selector switch on the 0-2 MHz position and note that the left decimal point indicator is illuminated. For other switch positions, lights should be on as follows: 0-200 kHz, right; 0-20 kHz, center; 0-2 kHz, left; 0-200 Hz, right.

With the counter still energized, set the FOLLOW-HOLD switch to FOLLOW, the range switch to 0-2 kHz, and the SENS. (sensitivity) switch to .1. Insert a test lead in the INPUT jack and touch the other end of the test lead. Note that the counter starts operating erratically only when the COUNTING light is lit. The

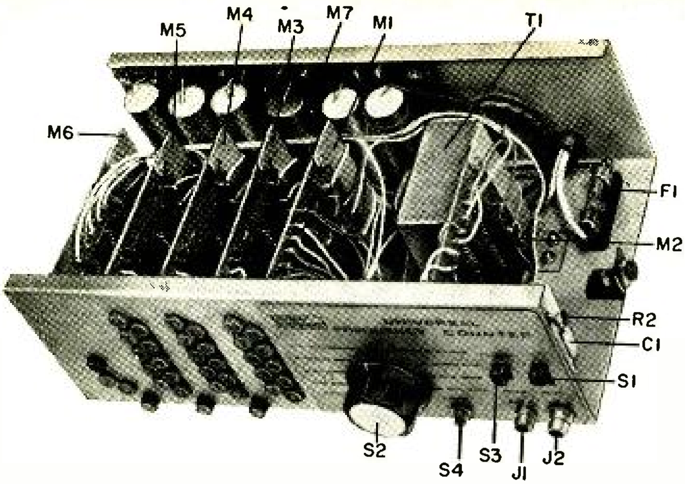


Fig. 18. Author's prototype may be duplicated or used as a guide. Because of the length of M7, the Power Supply module, it is mounted along the rear apron of the chassis. When using a different physical layout, remember that the Power Supply generates some heat and mount it out of the way where it will not affect the heat-sensitive components that are mounted on the other modules.

display should last only as long as the COUNTING light is dark. The counting units should start to count at the same instant that the COUNTING light comes back on. Placing the SENS. switch on either the 1 or 10 position should stop the counting operation.

If the counter passes all of these tests, it is probably working properly and is ready for use. As a final check, and to gain some experience in using the counter, use a bounceless pushbutton circuit (described in "Low-Cost Counting Unit," POPULAR ELECTRONICS, February 1968, or ELECTRONIC EXPERIMENTER'S HANDBOOK, Winter 1969) and a low-frequency audio oscillator. When using the counter, always start with the SENS. switch down to the 1 or .1 position as required to get a stable reading. Also, do not forget that an input lead (whether it is coaxial cable or phono lead) that is too long will attenuate (and load) a high-frequency signal.

Key Waveforms. The following information can be used if trouble is experienced in getting the counter to operate properly. The waveforms at various points in the circuit vary depending on switch settings and the nature of the input. However, there are some critical points at which the waveforms can be checked to determine whether the counter is working properly.

Comparator (M1) When sufficient input signal is applied, the output at the square-wave terminal of this module (connected to *D1* and *R7*) should be either a square or a rectangular wave from 0 to 2.4 volts positive. The output goes positive when the instantaneous input signal drops below +10 mV and drops to zero when the input exceeds +30 mV. The rise and fall times of this waveform should be about 60 nanoseconds.

The feedback to pin 2 of *IC1* should show a steep leading edge that reaches +80 mV, followed by a rapid decay (about 90 ns) to the +30 mV level. The trailing edge of this waveform should have a rapid transition to −40 mV and a rapid decay back to +10 mV. This signal is present only when an input signal is applied to the counter. Because of the very fast switching of this waveform, you will have to use a high-quality, lab-type oscilloscope to make exact measurements although the basic signal can be seen on a conventional service scope.

The synchronizing circuit in the Comparator can be tested by using a bounceless pushbutton and observing the DCU's and the COUNTING indicator light, in the 0-200-Hz range. The first count after the COUNTING light comes on should not be counted, and the first DCU should display starting at the second count. The first count after the COUNTING light goes off should be counted and the display should remain steady after that. Correct operation of this circuit guarantees that the device will only count whole input cycles.

Scaler (M2) The input to the A scaler should be identical to the square-wave output observed on the Comparator.

Output A/10 should be a rectangular

wave with a frequency 1/10 that of the input. It should be about 1.8 volts in amplitude and have a 6:4 duty cycle. This, of course, is also the input to the B scaler.

COUNTER SPECIFICATIONS

Function: Measuring frequency, events, events-per-unit-time, or the ratio of two frequencies. It is also a source of precision 0.1-, 1-, and 10-second timing signals.

Ranges: 0-200 Hz, 0-2 kHz, 0-20 kHz, 0-200 kHz, 0-2 MHz, events, and externally gated events or ratio.

Accuracy: Power-line stability plus or minus one-half count. Typical accuracy is 0.1%.

Resolution: One part in 2000 to full scale. 0.1 Hz on 0-200-Hz scale.

Sensitivity: Switch adjustable from nominal 0.1, 1, or 10 volts. For sine waves—30 mV r.m.s. from 50 Hz to 3 MHz; 300 mV r.m.s. from 5 to 50 Hz. For pulses—symmetric pulse, 100 mV p-p; narrow positive pulse, 50 mV p-p; narrow negative pulse, 700 mV p-p.

Input conditioning: Automatically provided for all but mechanical contacts. High-gain IC comparator provides snap action, 10-mV noise offset, and 20-mV hysteresis. Any reasonable wave shape is acceptable, including sine or square waves, or rectangular pulses of either polarity.

Input protection: D.c. blocking to 200 volts. Combination dual-diode limiter and d.c. restorer allows safe measurement in practically all test situations.

Input impedance: 10-volt range, 112,000 ohms; 1-volt range, 12,500 ohms; 0.1-volt range, 2500 ohms. Typical shunting capacity is less than 30 pF.

Gating: Fully synchronized master gate used to eliminate the one-count ambiguity associated with older counter designs. Last digit is constant rather than bobbling between two values.

Display: Switch selects hold or follow. Infinite display in hold function, automatic updating in follow. For 0-200 Hz, 10-second measure, 10-second display; for 0-2 kHz, 1-second measure, 1-second display; for higher frequencies, 0.1-second measure, 0.9-second display.

Miscellaneous: Automatic overrange indicator comes on when full-scale count is exceeded. Floating decimal points. Manual reset and override. Time gate outputs available at gate terminal during measurement. Modular construction adaptable to crystal time base for higher accuracy. Extendable with input scaling to 0-20 MHz or 0-200 MHz. All solid-state circuit uses 26 IC's, 43 transistors, and 14 diodes.

The frequency of output B/10 should be 1/10 that of A/10 and 1/100 that of the input to the A scaler. Its amplitude depends on the setting of the range selector switch, but it should range between 1.8 and 3.6 volts, positive. It should have a 6:4 duty cycle and rise and fall times of about 50 ns.

The GATE terminal of the D scaler should have a repeating waveform that goes positive about 2 volts for 0.1 second and to ground for 0.9 second.

The output at C/2 should be a repeating signal that is positive for 1 second and ground for 1 second, with an amplitude of about 2 volts.

The output at C/10 should be a repeating symmetrical square wave with a frequency of 0.2 Hz (5-second period), with an amplitude of about 2 volts, positive.

Gate (M6) There should be a clean 60-Hz sine wave at the junction of *D1* and *R3* on this module (terminal 60 Hz). It should be offset with the negative peak at −0.7 volts and the positive at +2.4 volts.

At pin 7 of *IC1* there should be a 60-Hz rectangular wave having 50-ns rise and fall times and an amplitude of about +2 volts. The output at pin 8 of *IC2* should be a 20-Hz rectangular wave with a 1:2 duty cycle and a 2-volt positive amplitude.

The 0.1 SEC output of this module should be a symmetrical, positive-going wave at 0.1 second, with 50-ns rise and fall times. The 10 SEC output should be positive for 10 seconds and ground for 10 seconds.

Reset. The reset buss (RST on all modules except *M2*) is at ground most of the time. Depressing the front panel RESET switch should raise the level of the buss to about 1.6 volts and all DCU's should promptly return to a zero indication. Also during normal operation, there is, on the reset buss, a brief pulse, about 2 microseconds long and 1.6 volts in amplitude, immediately after the leading positive edge of the selected time gate. This waveform erases the old counter indications and drops them to zero the instant a new measurement is to begin. This waveform can be seen best on a lab-type oscilloscope having both triggered sweep and vertical channel delay. —[30]—

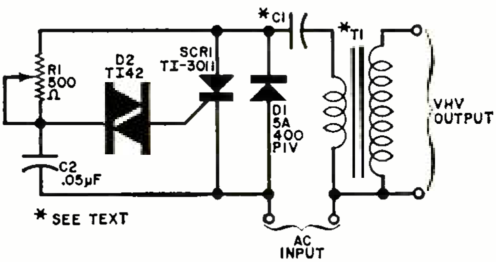
Build VHV Supply

10,000 VOLTS FROM COMMONLY AVAILABLE COMPONENTS

BY PAUL H. FUGE

THERE STILL EXISTS a real need for very-high-voltage power supplies even in this era of low-voltage solid-state electronics—especially in the area of experimenting. A casual look around the various school science fairs will reveal that interest is still high for such projects as air ionizers, Van de Graaff generators, Tesla coils and the like. (One practical use for a VHV supply was given in "The Not Altogether Forgotten Electret" in the March POPULAR ELECTRONICS.)

In most cases, the VHV power supply is required to deliver currents on the order of only a few microamperes. So,



By driving the very-high-voltage power supply with a variable-voltage transformer, output voltage can be made to vary above and below 10,000 volts.

to meet this requirement with maximum economy, the VHV Supply described here consists of an SCR, a capacitor, a common automobile spark coil, and a simple triggering circuit. Operated from any 117-volt a.c. house line, the supply produces an output on the order of 10,000 volts which will jump a ⅜" spark gap and melt an electrode made of solder.

How It Works. Referring to the schematic diagram, when line power is applied to the circuit, *D1* conducts only when it is forward biased, allowing *C1* to charge up. Then, when *D1* becomes reverse biased, *C2* charges up through *R1*. At some point during the charge cycle, the potential across *C2* reaches and exceeds the breakover voltage of trigger diode *D2*. When this happens, *D2* conducts and delivers a triggering pulse to the gate of *SCR1*, turning it on.

The instant *SCR1* fires, it forms a series circuit with *C1* and the primary of spark coil *T1* across the power line. As a result, the charge on *C1* rapidly discharges through the low-resistance *T1* primary, inducing a much higher voltage across the secondary.

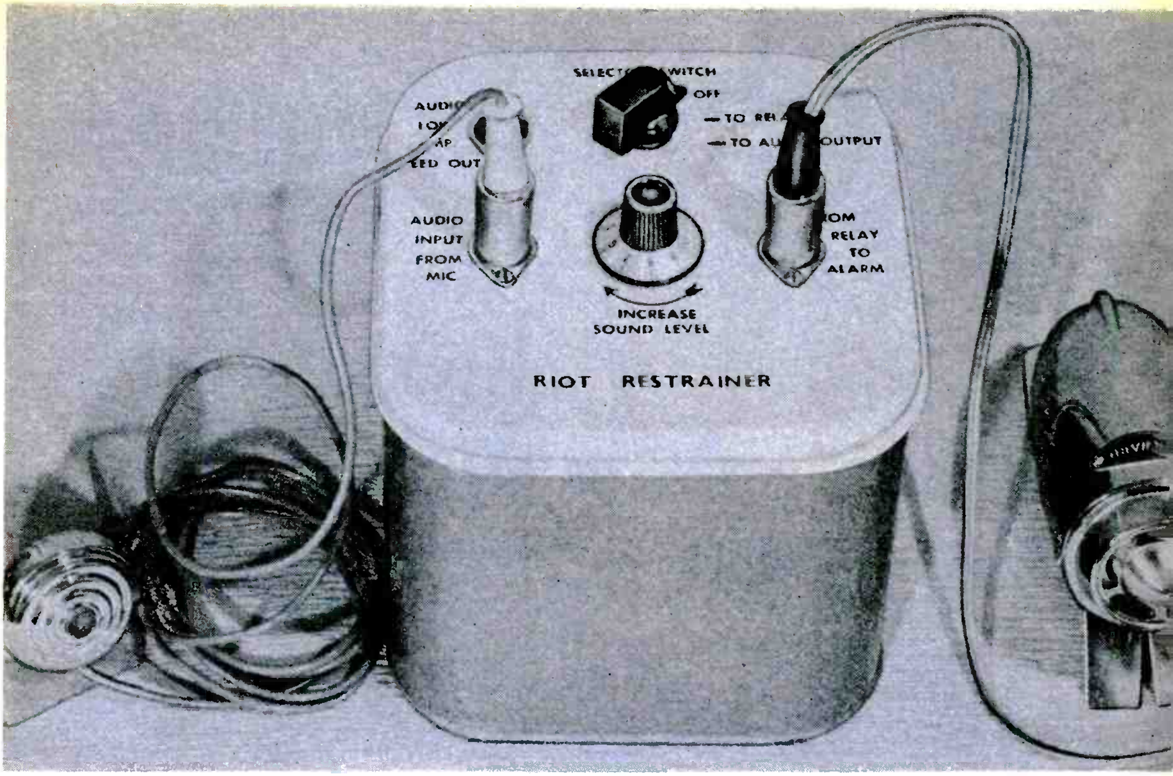
Then when *D1* again becomes forward biased on the next cycle of the applied a.c., *SCR1* cuts off, and the charge-discharge cycle repeats itself until the a.c. power is disconnected.

While the output of the VHV Supply is a.c., it can easily be converted to d.c. by installing a high-voltage TV (silicon) rectifier and filter capacitor across the high-voltage secondary of *T1*. However, if you do this, be careful to limit the value of *C1* to a small figure to prevent damaging the rectifier by high-current spikes when *C1* discharges. If an a.c. output is required, the value of *C1* can be anywhere between 2 and 100 μF, although the larger values will draw more current.

Construction. Parts location and orientation are left to your discretion when assembling the VHV Supply. However, since potentials on the order of 10,000 volts are developed by the supply, fully encapsulate all connections in a silicone potting compound after soldering. Then, for added protection, mount the entire circuit inside a perforated steel or aluminum cabinet.

When the supply is fully assembled, you can adjust the setting of *R1* for maximum output power. Then, if desired, the optimum setting of the potentiometer can be measured and a fixed ½-watt resistor substituted for it in the circuit.

Finally, if you wish to vary the output voltage above or below the designed 10,000-volt level, you can use an adjustable auto-transformer between the a.c. line and input of the supply. —30—



Build the RIOT RESTRAINER

Control Rumpus Room Noise

BY A. J. LOWE

DID YOU EVER wish you knew how to quiet a noisy bunch of youngsters when they are cutting up in the rumpus room? No matter how many times you tell them to keep the racket down, they always claim that they were not making that much noise. With the aid of the "Riot Restrainer," you can predetermine just how loud a racket you'll permit them to make; and, if they exceed it, this simple electronic device will let them know—in no uncertain terms!

Besides helping keep a bunch of youngsters under control, the Riot Restrainer can double as an alarm to signal when the baby is crying, as a noise-sensitive burglar alarm, or as a snore alarm to inform the culprit that he (or she) is keeping even the electronic equipment awake.

The device is a sound-trigger alarm with the circuit shown in Fig. 1. It will turn on an external alarm at any sound level from a footstep to a first-class riot. The alarm is on for a predetermined time; and, if the hubbub has died down when the alarm stops, it remains silent. If the noise is still present after another "sens-

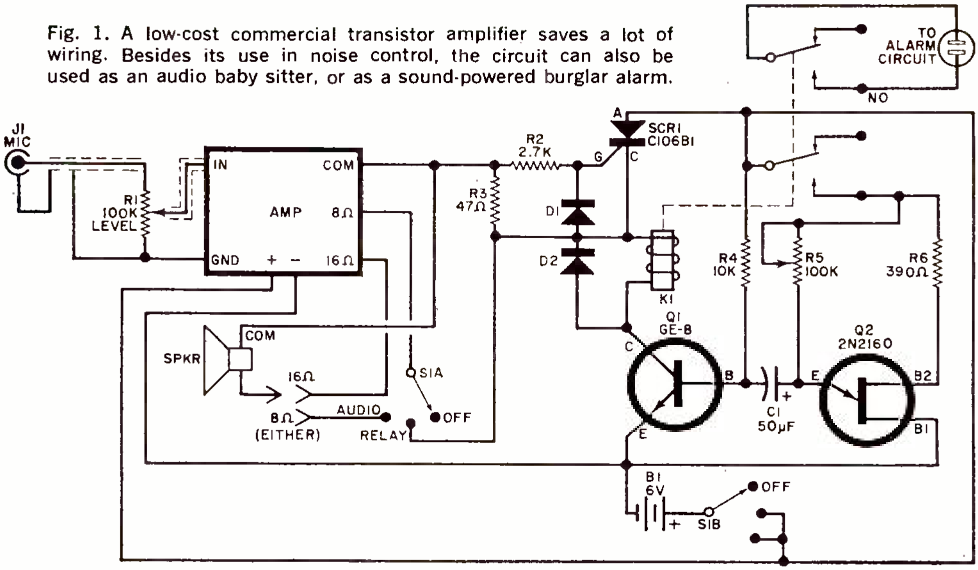


Fig. 1. A low-cost commercial transistor amplifier saves a lot of wiring. Besides its use in noise control, the circuit can also be used as an audio baby sitter, or as a sound-powered burglar alarm.

PARTS LIST

AMP—4-transistor, 3-watt amplifier (Lafayette 99T9132, Burstein-Applebee 49A210, or similar)
B1—6-volt battery (or power supply)
C1—50-μF, 6-volt electrolytic capacitor
D1, D2—1N34 diode, or similar
J1—Microphone connector to suit microphone
K1—Low-current, double-pole, double-throw relay (see text)
Q1—Transistor (GE-8 or similar)
Q2—Unijunction transistor 2N2160
R1—100,000-ohm potentiometer
R2—2700-ohm, ½-watt resistor
R3—47-ohm, ½-watt resistor
R4—10,000-ohm, ½-watt resistor
R5—100,000-ohm miniature potentiometer (see text)
R6—390-ohm, ½-watt resistor
SO1—Socket for alarm
SCR1—Silicon controlled rectifier (GE C106B1)
S1—Two-pole, three-position switch
Misc.—Perf board, metal enclosure, four AA-type penlight cells with holders, crystal microphone, siren, knobs, shielded wire, etc.

ing" period, the alarm continues, intermittently, until the din subsides. The alarm signal *does not* feed back into the circuit.

Construction. The physical layout is not critical and almost any arrangement can be used. As shown in the photographs, the author used a metal container that happened to be handy. Perf-board construction is used to assemble the electronics while LEVEL control *R1*, switch *S1*, alarm-circuit socket *SO1*, and the microphone connector *J1* are mounted on the front panel. If it is desired to hear the audio output, a speaker connector can also be mounted on the front panel.

Check the circuit of the commercially made audio amplifier module to see if the common output terminal is connected to the battery positive lead. If this connection exists, it must be broken so that the secondary of the output transformer is isolated from the remainder of the amplifier. The printed circuit foil can be cut with a razor blade or a very sharp knife, making sure that you don't cut any other leads or chip or break the PC board.

If you happen to have an amplifier whose ratings are less than those specified in the Parts List and it has an output transformer, you can use it if you connect large-value capacitors to each side of the transformer primary and raise the value of R3 to about 1000 ohms. In this way, the audio signal can reach the remainder of the circuit but the d.c. will do no harm.

Once the perf board circuit is built and the front-panel components are mounted, wire the circuit in accordance with Fig. 1. With the audio amplifier energized and the alarm circuit off, current drain is about 15 mA. Although batteries were used in the prototype, a 6-volt d.c. power supply can be used.

Use the microphone suggested for the

particular amplifier in your project. In most cases, this will be a common type of high-impedance microphone. The author used a low-cost lapel-type crystal mike. This type of microphone is mismatched to the amplifier and produces low fidelity; however, all the mike does is pick up room noise so fidelity is not important. For more sensitive operation (such as might be required in using the Riot Restrainer as an intruder alarm), a cheap low-impedance dynamic microphone will be best.

Any type of low-power, two-pole, double-throw relay can be used for *K1* as long as it can be energized by the collector current of *Q1*. The transistor can be almost any *npn* audio type.

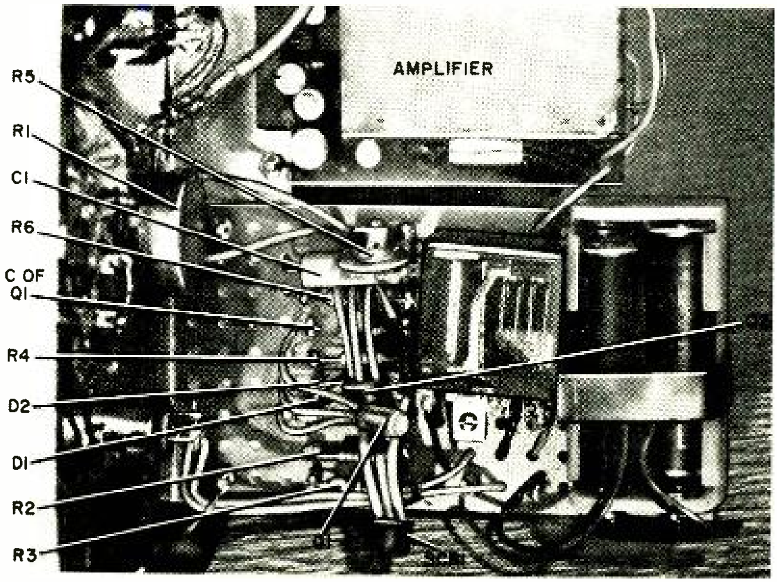
There are many types of alarms available—the author used a conventional electric bicycle horn having its own internal batteries. Be sure that the current required by the alarm does not exceed the contact rating of relay *K1*. The normally open contacts on the relay substitute for the pushbutton on the bicycle horn. For any other type of alarm, make up a series circuit with the alarm, power source, and the normally open contacts of the relay. If you want to use the Riot Restrainer to turn on a 117-volt light or a high-power alarm, you will have to add another relay with heavy-duty contacts. Energize the second relay's coil through the normally open contacts of *K1*.

Testing and Adjusting. Once the project is built, check it carefully for any wiring errors. Connect the microphone to *J1*. Connect a loudspeaker to the audio output leads (loudspeaker common to amplifier common and the other speaker lead to the 8- or 16-ohm output, depending on the speaker) and place *S1* in the AUDIO position. Speak into the microphone and adjust *R1* until the amplified voice can be heard. Audio quality may be poor, but this system is designed for noise pickup, not high fidelity. Reset *R1* for minimum volume.

Plug the alarm selected into *SO1* and place *S1* in the RELAY position. While talking near the microphone, advance *R1* until the alarm sounds. The amount of time that the alarm stays on is determined by the setting of *R5*. If desired, this potentiometer can be replaced by a fixed resistor whose value is selected to keep the alarm on for the desired period.

If the system does not work, first check to make sure that the SCR is firing. To do this, place a short between the emitter and collector of transistor *Q1*,

Layout of the author's version. Since layout is not critical, any physical arrangement will do. Though battery power is called for, you can use a 6-volt power supply. If you want a high-power alarm, use K1 to drive a heavy-duty relay.



HOW IT WORKS

Room sounds are picked up by the microphone and passed through the LEVEL control to the audio amplifier module. The load for the amplifier is *R3*, whose value is selected for a higher-than-normal output *voltage* (not power). This voltage is applied through current-limiting resistor *R2* to the gate and cathode of *SCR1*. Diode *D1* allows only positive-going pulses to reach the gate of *SCR1*.

When the room noise level is sufficiently high, *SCR1* conducts and permits current to flow through the coil of relay *K1* and *npn* transistor *Q1*. This transistor is turned on by the bias provided by resistor *R4*. When the relay is energized, one set of contacts supplies power to the external alarm and the other set applies d.c. to the timing circuit composed of *C1*, *R5*, *R6*, and unijunction transistor *Q2*.

Capacitor *C1* starts to charge through *R5* (the timing control) and when it reaches a certain level, fires *Q2*. With *Q2* conducting, *C1* is discharged, cutting off *Q1*. The series circuit through the relay coil is thus broken and the alarm stops. Because the SCR is operating from a d.c. source, its series circuit must be interrupted to make it turn off. The circuit is then ready to operate again whenever the room sound level reaches the prescribed level. The setting of potentiometer *R5* determines how long the alarm operates after being set off. Diode *D2* suppresses voltage spikes generated when the relay is switched off.

and connect a 20,000-ohms/volt d.c. voltmeter between the battery negative and the cathode of *SCR1*. With *R1* turned fully up, tapping the microphone should produce an indication on the voltmeter. If not, make sure diode *D1* is wired correctly, and increase the value of *R3* while reducing the value of *R2* in small steps.

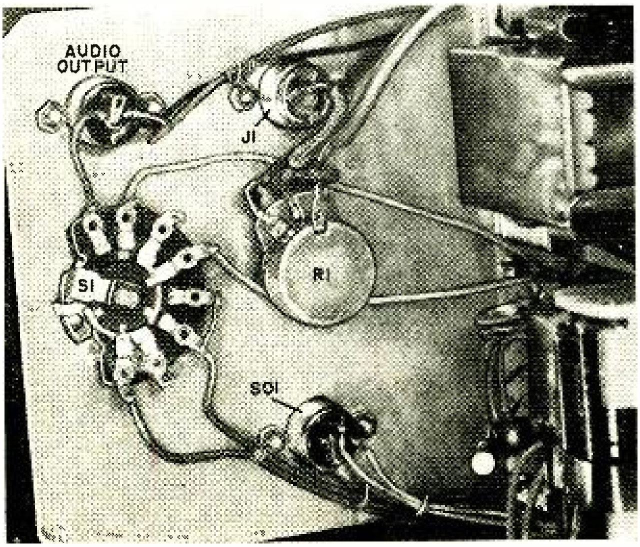
Remove the short on the collector and emitter of *Q1* and again tap the microphone. If the alarm still doesn't sound off, *Q1* may not be turned on. Reduce the value of *R4* in small increments until the alarm sounds when the microphone is tapped.

If the alarm sounds continuously after it once turns on, *Q1* may not be cutting off when *Q2* fires. To check this, connect a high-impedance voltmeter between the battery negative and the emitter of *Q2*. The indicated voltage should rise slowly and then fall rapidly as *Q2* fires. The value of *R5* (with the value of *C1*) determines the rise time.

Calibration. The LEVEL potentiometer, *R1*, can be calibrated in arbitrary values across its range. As examples of calibration, you can use steps such as "someone sick in the house," "birthday party," "Saturday night," "normal riot," etc. or you can calibrate it in hours of the day, with the least amount of noise permitted for the late hours.

Once the microphone has been placed in an out-of-the-way place, and the LEVEL set as desired, the alarm will sound off if the room noise exceeds that for which the Riot Restrainer is set.

To use the device as an intruder detector, place the microphone in the center of the room, and set the LEVEL control as desired. Then tiptoe out. Unfortunately, the barking of a nearby dog, a plane overhead, or the horn of a passing car can set off the alarm. —30—



Front-panel components. As in the internal layout, physical arrangement is not critical, and any packaging approach will do. The audio output jack can be eliminated if the chosen loudspeaker is wired directly to the correct impedance tap of amplifier output transformer through one contact of switch S1.

Medical electronics now measures eye movements caused by that tipsy feeling

BY DEAN WARE

DID YOU KNOW that, when you are dizzy or when you are dreaming, your eyes "beat" involuntarily? (They rotate slowly in one direction and reverse quickly, repeating the cycle rapidly and frequently.) Well, they do. It's a perfectly normal condition called nystagmus and medical electronics technicians have now developed an instrument that records nystagmus for analytical purposes. The machine is called (wouldn't you know?) an electronystagmograph or ENG.

To use the ENG, electrodes are taped to the patient's head near the eyes and the eye movements are sensed, amplified and recorded on strip chart paper. The instrument is all solid-state and the recorder uses heat-sensitive paper with a hot stylus. The ENG can detect even low-intensity nystagmus that might easily escape visual observation.

What's It For? Actually, the ENG is being used more by otologists (ear specialists) than by ophthalmologists (eye specialists). This is because dizziness is associated with the balance system, which is located in the inner ear. The otologist is interested in irregular patterns of nystagmus, spontaneous nystagmus, or its absence to give him an indication of the condition of the ear.

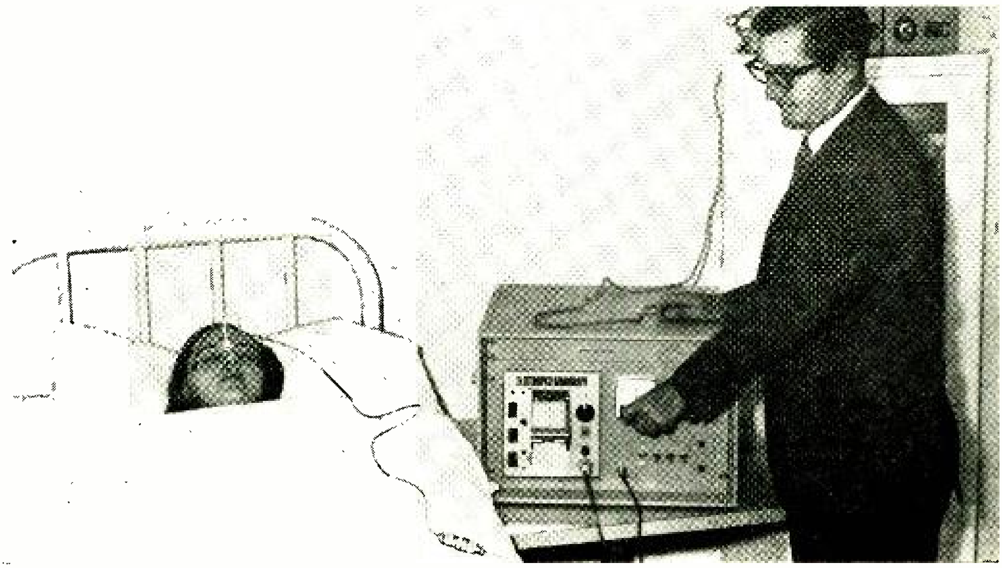
In the clinic, it is often necessary to induce dizziness in order to record the nystagmus. This can be done by securing the patient in a motor-driven chair that spins around—not a very comfortable ride for most people. It is more common, therefore, to use a method called the Fitzgerald-Hallpike technique of caloric irrigation. In this method, the patient's ear is irrigated with warm or cool water. The temperature change upsets the inner ear and makes him tipsy.

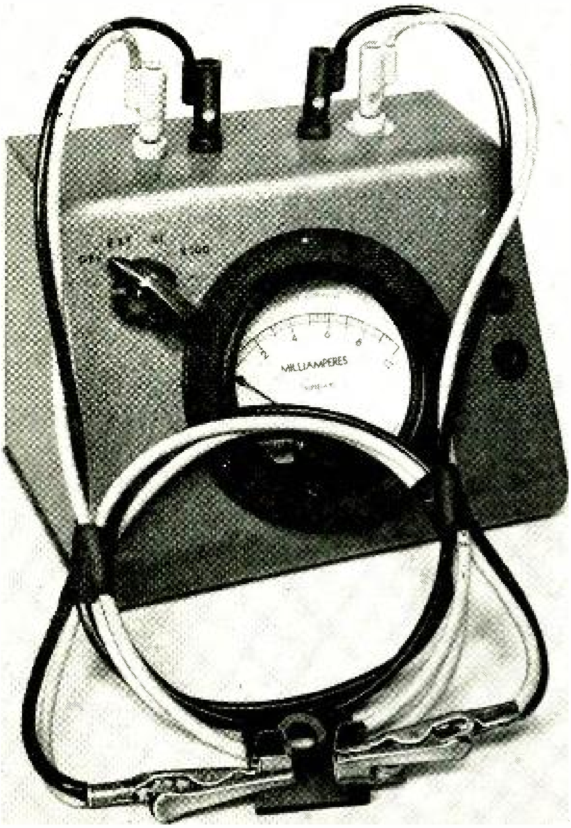
Who Uses It? The ENG is also used as a general eye-movement monitor. By recording eye movements during reading, it is helpful to the teacher of speed-reading courses and to the speech pathologist in providing therapy for children with stuttering problems.

Psychologists use the ENG to determine whether or not a subject is dreaming in ESP research. One subject tries to transmit a thought pattern to a sleeping subject who has the ENG electrodes attached. If the latter starts to dream, which he's not supposed to do if ESP is to work, nystagmus will show up on the ENG and he can be awakened.

Next time you feel a little dizzy, make an appointment with the nearest electronystagmograph—if you're not too far gone to say the word. —30—

The electronystagmograph is used in clinic or hospital to diagnose and record various malfunctions or diseases of the ear or eye. Movements of the eyes are recorded for reference. (Photo by Tracor, Austin, Tex.)





Constant-Current Ohmmeter

BY ALVIN B. KAUFMAN

Build unusual test equipment project

THE UBIQUITOUS VOM is one of the handiest pieces of test equipment available to the electronics experimenter. Although useful in a thousand different ways, there are times when a VOM can be the cause of damage to the equipment being tested—by applying excessive current to low-resistance devices, for instance. This means that you can't use a conventional VOM to test D'Arsonval meter movements, meter fuses, or transistors, to name a few items that are current sensitive.

Another limitation on the use of the VOM, is the poor accuracy obtainable on the lowest resistance range (usually R×1). The VOM range selector switch, battery clips, and test lead terminations often become slightly resistive with time and use and interfere with the readings for very low resistances. Of course you can clean clips and lead ends but it's a little difficult to get at the contacts on the selector switch.

The constant-current ohmmeter described here eliminates these problems and, in addition, does not require a zero adjustment for resistance measurements. Although this new ohmmeter has its own meter, an external d.c. voltmeter can be used if desired.

Construction. The author built his meter in a conventional 4¼″ × 4″ × 4″ metal case with a sloping front, although any other approach can be used. The two external meter jacks (*J1* and *J2*), switch *S1*, and meter *M1* are mounted on the front panel. The two pairs of testlead jacks (*J3-J4* and *J5-J6*) are mounted on the top. The battery is secured in the case by a mounting clip.

The circuit, shown in Fig. 1, is wired point-to-point. When making the connec-

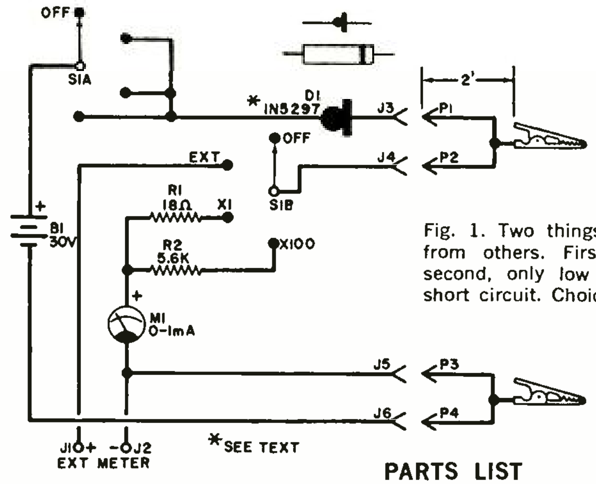
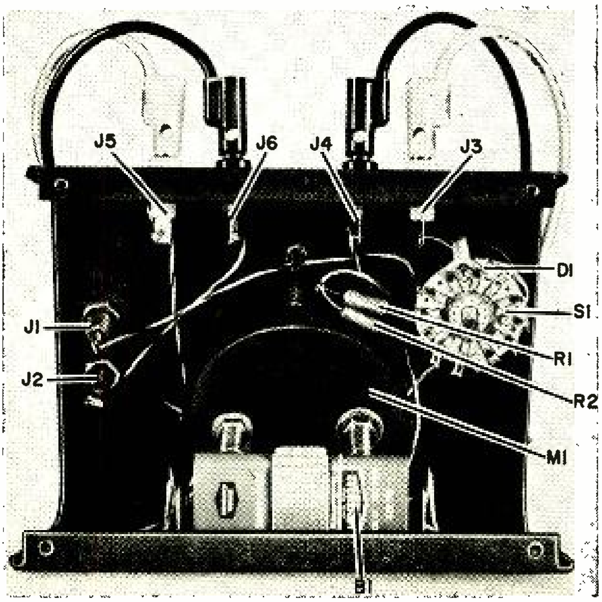


Fig. 1. Two things make this ohmmeter different from others. First it requires no zero control; second, only low current can flow, even with a short circuit. Choice of D1 determines the current.

PARTS LIST

B1—30-volt battery (Eveready 413 or similar)
D1—1N5297 constant-current diode (Allied Electronics #49F261N5297-MOT-$4.45. See How It Works for diode selection.)
J1-J6—Banana jacks (E.F. Johnson 108 series)
M1—0-1-mA meter (Simpson Model 25 or similar)
P1-P4—Plugs to mate with banana jacks
R1—18-ohm, 1-watt, wire-wound 1% resistor
R2—5600-ohm, 1-watt, wire-wound 1% resistor
S1—Two-pole, four-position rotary switch
Misc.—Metal enclosure, battery holder (Keystone 183 or similar), four 2-foot heavy-duty test leads, 2 alligator clips, knobs.

tions to *S1*, be sure that the correct terminals are used on each section. Also be sure that *D1* is wired in correctly. If you use the Motorola diode called for in the parts list, the black band should be toward *J3*. Unlike a conventional diode, if the constant-current diode is installed with the wrong polarity, it will conduct heavily and ruin both itself and the meter.



The circuit and assembly are very simple. The bulk of the components are mounted on the front panel with only the battery on chassis bottom.

CALIBRATION OF OHMMETER

X1 SCALE		X100 SCALE	
Resistance	Meter Reading	Resistance	Meter Reading
10Ω	.16	500Ω	.095
20	.275	1000	.165
30	.365	2000	.29
40	.44	3000	.38
50	.50	4000	.45
60	.54	5000	.51
70	.58	6000	.56
80	.62	7000	.60
90	.65	8000	.64
100	.68	10,000	.695
200	.83	20,000	.84
300	.90	30,000	.91
400	.93	40,000	.95
900	1.00	50,000	.97

HOW IT WORKS

The circuit uses a new semiconductor device—the constant-current diode. This diode maintains a constant current through an unknown resistance regardless of the ohmic value, up to some specified resistance. Since the voltage developed across the unknown resistance is being measured, no balancing or current adjustment controls are required.

The constant-current diode is basically a junction field-effect transistor (JFET) with its gate and source electrodes connected together inside the case. The constant current is accurate provided the applied voltage is between 1 and 100 volts (depending on the diode selected).

There are 32 diode types available with constant currents ranging from 220 microamperes to 4.7 milliamperes (1N5283 through 1N5314). The current value selected determines three other measurement parameters. These are the ohms/volt value, the voltage sensitivity required of the meter, and the high resistance range of the test set.

In the circuit shown in Fig. 1, *D1* is a 1-mA constant-current diode. The ohmmeter range could not exceed 29,000 ohms if the diode pinch-off rating was one volt, because the drop across the unknown resistor would then be 29 volts. If the unknown resistor were zero ohms, the full supply voltage would be placed across the diode. Thus the diode must be selected to withstand the voltage and power dissipation encountered in the operational condition.

If the readout meter is to indicate ohms on a linear scale, it should (for the range selected), have a resistance twenty or more times the value it is to indicate.

The effect of lead-wire resistance is eliminated by the use of a four-wire arrangement. The current carrying leads are connected to the alligator clips at the same points as the voltage measuring leads. Thus the voltage drop is read directly across the unknown resistance.

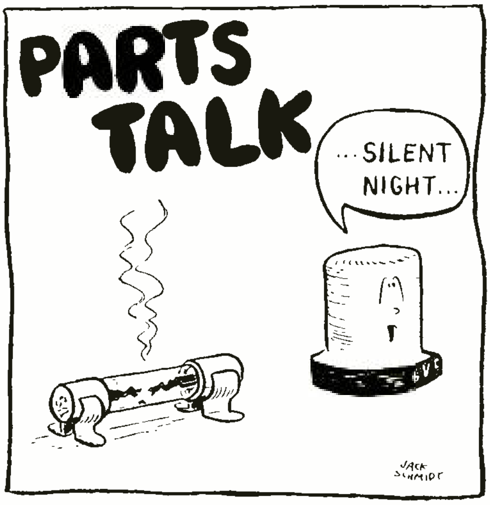
Operation. With switch *S1* on OFF, connect the test clips to an unknown resistance. If the unknown is 900 ohms or less, place *S1* in the ×1 position and determine the resistance by using the calibration table. If the unknown is above 900 ohms, use the ×100 position of *S1*.

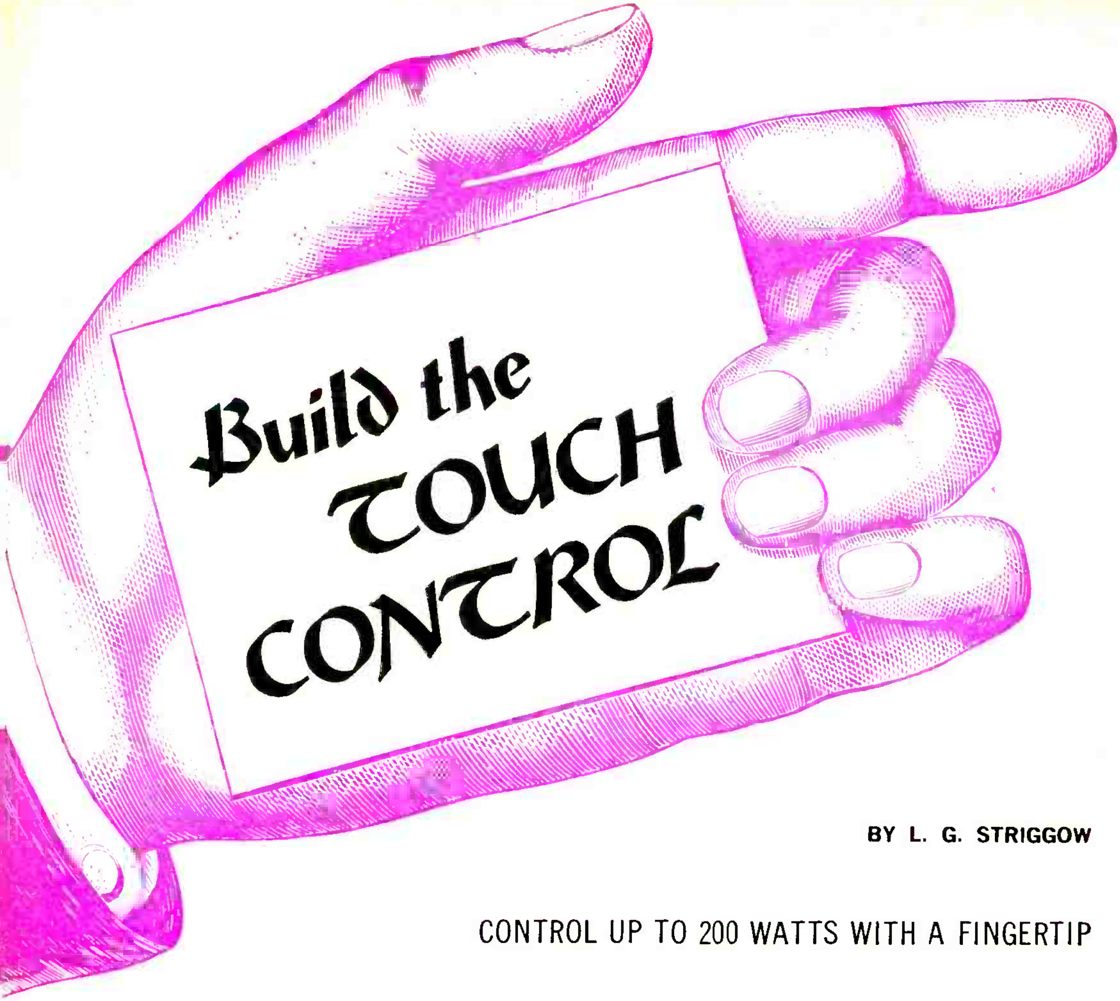
To use an external d.c. meter, be sure that it has at least 20,000 ohms per volt and connect it to *J1* and *J2* with *S1* in the EXT position. Using a 1-mA constant-current diode for *D1*, divide the meter reading by 0.001 to get the value of the unknown resistance in ohms. For example, a 0.1-volt indication would mean 100 ohms, a 1-volt indication, 1000 ohms, etc.

Almost any 0-1-mA meter can be used for *M1*, provided both range resistors (*R1* and *R2*) are adjusted for correct dial reading. You can use an accurate resistor decade box for the unknown resistor and adjust the range resistors to get the proper indications. For maximum accuracy, use 1% resistors and a meter with a comparable tolerance.

In any case, do not turn the constant-current ohmmeter on unless the test leads are connected to a resistor. An open circuit applies the full 30 volts to the meter.

For very high accuracy, a d.c. oscilloscope or a low-range sensitive d.c. voltmeter can be used for the external meter. –30–





Build the TOUCH CONTROL

BY L. G. STRIGGOW

CONTROL UP TO 200 WATTS WITH A FINGERTIP

ELECTRONICS experimenters are always looking for new ways to control the light fixtures in their homes. Here's the latest wrinkle—a light switch that turns on and off with just a touch. You may have seen this type of switch in the call buttons on some new elevator controls. It doesn't provide any dimming control, but the convenience of being able to turn the lights on or off with the touch of a finger, or elbow if your hands are full, is a real plus.

Construction. The circuit for the touch control is shown in Fig. 1. Although any type of construction can be used, the author built his on a small PC board whose foil pattern is shown actual-size in Fig. 2. Note that, instead of etching away copper to produce a network of interconnecting leads, in this case you only etch away relatively thin isolation lines between the copper segments. Once the board is made, assemble the components as shown in Fig. 3.

In this assembly, the SCR's and capacitors are inserted conventionally while the resistors and diodes are mounted vertically. To install the two transistors and the silicon unilateral switch, bend the leads over and mount the units upside down on the board. Use fine solder and a low-wattage soldering iron. Make sure that there are no solder bridges across the isolation lines on the board.

Caution. Because full line voltage is present at various points in the circuit, once the PC board has been built and checked and connections have been made to it, it is suggested that the entire assembly be encapsulated using any com-

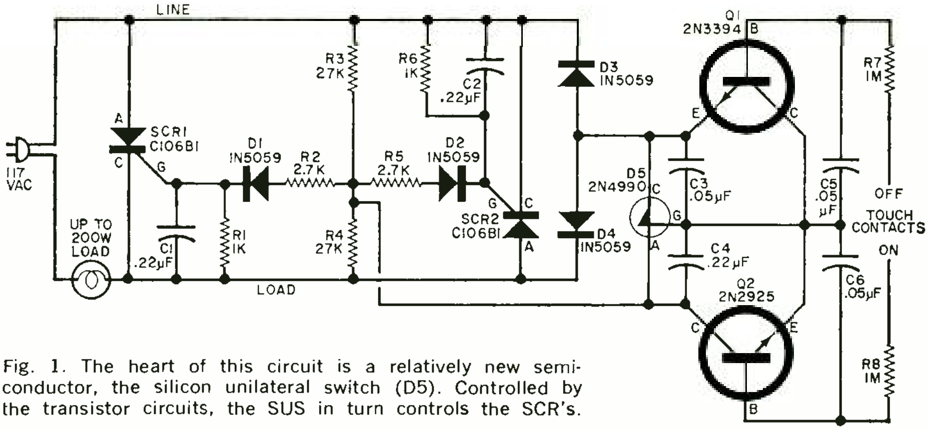


Fig. 1. The heart of this circuit is a relatively new semiconductor, the silicon unilateral switch (D5). Controlled by the transistor circuits, the SUS in turn controls the SCR's.

PARTS LIST

C1, C2, C4—0.22-μF, low-voltage capacitor
C3, C5, C6—0.05-μF, low-voltage capacitor
D1-D4—1N5059 diode
D5—Silicon unilateral switch (GE 2N4990)
R1, R6—1000-ohm, ¼-watt resistor
R2, R5—2700-ohm, ¼-watt resistor
R3, R4—27,000-ohm, ¼-watt resistor
R7, R8—1-megohm resistor
SCR1, SCR2—Silicon controlled rectifier (GE C106-B1)
Q1—2N3394 transistor
Q2—2N2925 transistor
Misc.—One-megohm resistor (optional, see text), line cord, metal for touch contacts, insulated wire.

mercial potting compound. An alternate is to give the complete board several coats of nail polish, preferably transparent, allowing each coat to dry thoroughly before applying the next. To avoid shock, take care not to damage this insulation when handling the board.

Operation. Connect a lamp of 200 watts or less to the load terminal of the board, then connect the other side of the lamp and the line terminal of the board to a source of commercial 117-volt a.c. power. Placing a finger tip on the "touch on" area should make the lamp go on; contacting the "touch off" area should make it go out. A pair of small metal plates can be connected to these terminals, using insulated wire as the connectors, to act as the actual touch plates. If the lamp should only flicker when the "touch on" terminal is contacted, reverse the power-line plug.

If you want to extend the touch plates for some distance, connect a one-megohm resistor to the line terminal and locate the other end of the resistor (by way of an insulated connecting lead) between the two touch plates. Simultaneously touching both the end of the one-megohm resistor and either of the touch plates

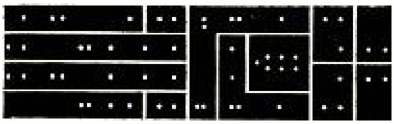
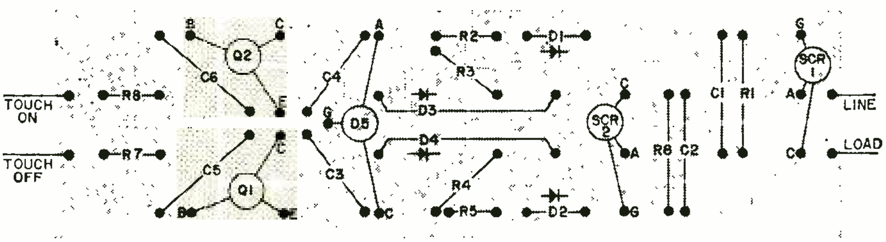
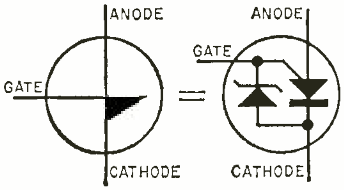


Fig. 2. Actual-size PC board is very small so use care when making it. Unlike conventional boards, this board uses area contact rather than a pattern.

Fig. 3. The components will be tightly packed (see photo at right), so mounting is rather unorthodox. Note that transistors and D5 are "upside down."





HOW IT WORKS

Operation of the touch control circuit depends on *D5*, a silicon unilateral switch (SUS). This semiconductor is essentially a miniature SCR with an anode gate (instead of the usual cathode gate) and a built-in low-voltage avalanche diode between the gate and the cathode. The SUS switches on when its gate is raised to a voltage level in excess of that required to cause the avalanche diode to saturate. When the avalanche diode is forced out of conduction, the SUS cuts off.

When power is applied, transistor *Q1*, across the gate and cathode of *D5*, automatically brings *D5* into conduction. This applies a negative voltage to the gates of the SCR's cutting them off and removing power from the load. When contact is made to the "turn on" terminal, *Q2* conducts to turn *D5* off. This automatically allows both SCR's to turn on, on the next positive-going a.c. alternation, thus providing power to the load. Contacting the "turn off" terminal causes the circuit to revert to its original condition, thus removing power from the load the next time that the a.c. line alternation goes to zero. The gating voltage for both transistors comes from the a.c. field present in the human body when the person is in the presence of commercial a.c. power lines.

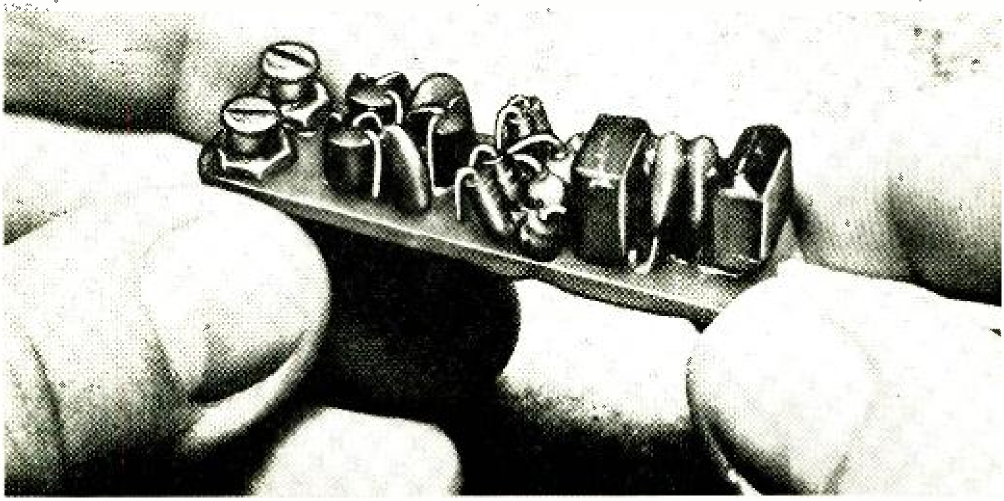
The gates of the SCR's are connected to the power supply (at the junction of *D3* and *D4*) through *D5*. Since the SUS can only turn off at the zero point of the a.c. waveform, the SCR's are turned on only at that point. This characteristic provides minimum distortion to the line current (such as that caused by the opening and closing of mechanical contacts) and therefore prevents electrical interference.

Resistors *R7* and *R8* prevent shock when either of the touch terminals is contacted.

will operate the circuits. One way of doing this is to make two isolated metal contact areas for the on-off operation, with a narrow metal strip for the resistor contact between them. In this way, contact can be made to turn the light either on or off.

Remember at all times that many portions of the circuit board are "hot" to ground and avoid getting a shock.

Besides a lamp, the touch control can be used to turn on any 117-volt a.c. resistive or inductive load whose power requirements are less than 200 watts. -30-



Once the board has been completed and tested, it should be encapsulated with an insulating material to prevent possibility of electrical shock. Only the two screws at left are exposed for external contacts.

"THIS IS RADIO PEKING"

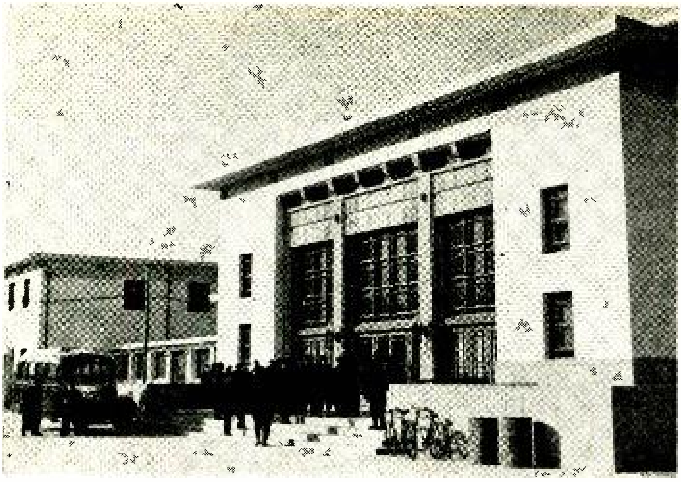
IGNORING INTERNATIONAL RADIO TREATIES IS A FAVORITE TACTIC

BY JOHN KIMBERLEY

A STERN, sometimes harsh female voice comes on the air. "We begin our program," she says, in tones of martial authority, "with a quotation from Chairman Mao. Our great leader Chairman Mao has said: 'We should support whatever the enemy opposes and oppose whatever the enemy supports'." With that or some other extract from the voluminous writings of Chinese Communist Party Chairman Mao Tse-tung, *Radio Peking* begins each international transmission.

At virtually any hour of the day or night, *Radio Peking* is beaming Communist China's propaganda message and Mao Tse-tung's "thoughts" to some part of the world. Today, Red China's shortwave broadcasting activity is among the most extensive in the world and is in the same league with the established broadcasting giants: *BBC, Radio Moscow,* and the *Voice of America.*

At the close of 1968, *Radio Peking* was broadcasting 1400 hours a week, not



This is the new broadcasting building of radio in Peking. (This photo and those on facing page courtesy Eastfoto.)

including simultaneous multi-frequency transmissions. Its international programs were aired in 31 foreign languages, ranging from Tagalog (the native tongue of the Philippines) to Swahili and Hausa, and in five Chinese dialects (Mandarin, Cantonese, Amoy, Chaodhow and Hakka). At peak hours more than 40 different transmitters with power outputs of up to 240,000 watts are in use. These transmitters are only slightly smaller in size than those of the *VOA* and *BBC*.

Rapid Development. Practically all of *Radio Peking*'s broadcasting development has taken place in the last 20 years. When the Communists took control of China in 1949, they were able to broadcast only 56 hours a week in their International Service. By 1959, after the Soviet Union and East Germany had helped the Chinese set up manufacturing plants to produce radio equipment, this figure had increased nearly tenfold—to 512 hours per week. In the next decade, from 1959 to 1969, the figure increased again by more than tenfold.

The Chinese Communists first began broadcasting to the outside world on Sept. 5, 1944, with the establishment in their headquarters at Yenan, Shensi Province, of the *Hsin Hua Kuang Po Tien T'ai* (New China Radio Broadcasting Station). This was, however, a rather small effort since the station operated with only a 300-watt transmitter. It was not until 1953 that *Radio Peking*'s broadcasting hours began to rise at a markedly accelerated rate.

By 1957, Peking had started laying out several 120,000-watt short-wave and a 150,000-watt medium-wave transmitters. The short-wave equipment could be tuned to one of 6 International Broadcasting bands. Audio-frequency response was 50 to 8000 Hz, plus or minus 1.5 dB. Distortion in the audio range of 100 to 5000 Hz was less than 5%.

Since that time, the Chinese have managed to produce and put into operation transmitters with power outputs up to 240,000 watts. The factories believed to be turning out this equipment include the *Peking Radio Factory*, the *Peking Broadcasting Equipment Factory* (both in the Chinese capital), the *Nanking Radio Factory* (in the East China Province of Kiangsu), and the *Harbin Radio Factory* (in Heilungkiang Province in Manchuria).

Broadcasting Patterns. It is generally believed that Albania—China's only true and unwavering supporter in the Communist camp—now uses Chinese-made broadcasting equipment. On the other side of the coin, Albania offers a service of considerable value to Peking's short-wave interests. Some of Radio Peking's broadcasts to Europe, Africa, and both the East and West Coasts of North America are relayed from Chiak, near Durazzo, which is west of Tirana, the capital of Albania.

Following last year's Soviet invasion

Voices of announcers Chi Yeh (left) and Hsu Li are familiar to thousands of listeners who tune in China's "Radio Peking."

of Czechoslovakia. *Radio Peking* started special transmissions in Czech (3 hours weekly), Polish (2 hours weekly) and Rumanian (2 hours weekly). These broadcasts are believed to be relayed by stations in Albania which use equipment built in China.

Radio Peking seems to let political opportunism govern many of its decisions on where to direct its short-wave broadcasts. During the student demonstrations in France last May and June, *Radio Peking* increased its broadcasts in French to Europe from 14 to 56 hours a week and in English to Europe from 10 to 35 hours a week. (These additional hours were discontinued when the demonstrations ceased.)

At the end of 1968 *Radio Peking* was broadcasting 412 hours a week to Northeast Asia (including 300 hours weekly to Taiwan), 319 hours to South and Southeast Asia, 417 to Europe, 105 to Africa (below the Sahara), 70 to South and Central America and 35 to the Near and Middle East and North Africa. About 60 hours a week are transmitted to North America.

The single country receiving the most attention from *Radio Peking,* however, is the Soviet Union. Since the inauguration of Russian-language broadcasts in February 1962, and with the further deterioration of Sino-Soviet relations, Moscow and Peking have steadily expanded the number of programs directed at each other. Peking's Russian-language programs increased to a staggering 302 hours a week in 1968, compared with 98 hours in 1966. There also has been a substantial increase in the number of frequencies used in the radio version of the Sino-Soviet polemics.

(*Continued on page* 116)

These are the modern transmitters used by "Radio Peking." They are made in China.

6 good reasons to get into electronics:

1

2

3

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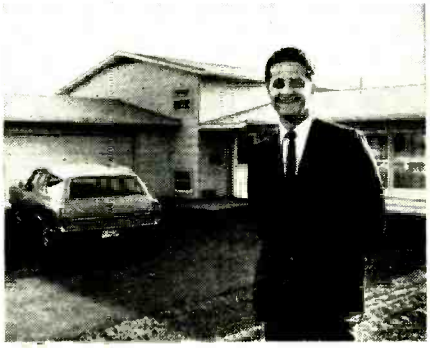

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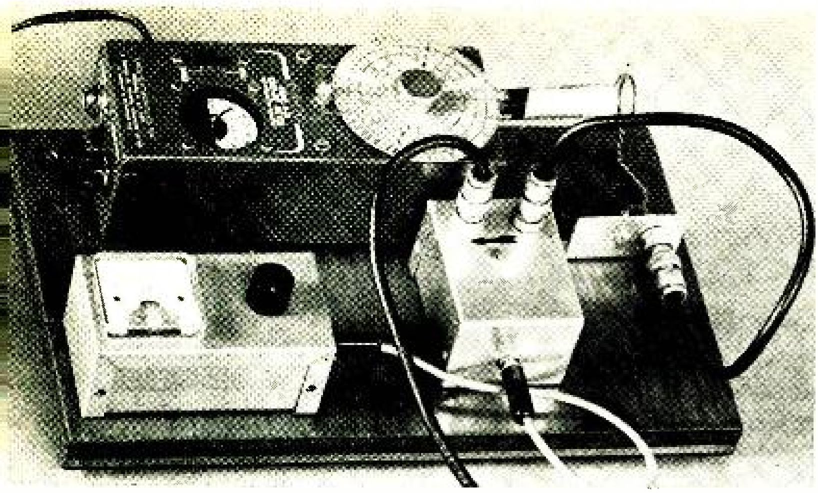


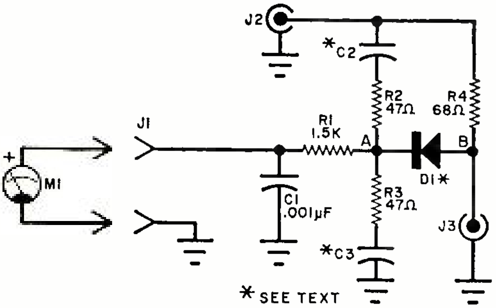
Simplest Antenna Bridge

GET THE MOST OUT OF YOUR SWL ANTENNA SYSTEM

BY JIM ASHE, W2DXH

THE SWL who wants to put up a homemade resonant antenna has two strikes against him to start with. More than likely, he won't have the fancy test equipment that is needed to do a respectable job. As a result, the antenna goes up, and by cutting and pruning, it might just accidentally be tuned to the proper frequencies. However 9 out of 10 SWL antennas are badly mistuned and are nothing more than so much wire strung up in the air.

In a fraction of the time you've spent digging out some of the weaker stations you could have tuned that antenna and possibly gained anything from 3 to 10 dB signal strength on that S-meter. All you need is a grid-dip oscillator (which you can maybe borrow from a friendly ham) or a r.f. signal generator covering the frequencies you want the antenna to tune. Use this signal source in conjunction with a simple little Wheatstone bridge (described below) and you are in the semi-professional antenna testing business.



With system completely set up, reactive imbalances between A and B cause up-scale meter deflection.

How It Works. Resistor *R1* and capacitor *C1* (see schematic diagram) isolate the actual bridge circuit from meter *M1* and prevent stray r.f. from getting into the bridge. In the bridge itself, *C2, C3, R2,* and *R3* function as a voltage divider that splits in half the incoming signal from *J2*. The capacitor values (typically 0.01 µF below 30 MHz and 0.001 µF above 30 MHz) should present low reactance at the operating frequency.

The two voltage dividers in the bridge must balance if a null is to be produced and prevent deflection of *M1*'s pointer. It is evident, therefore, that the load resistance at *J3* must be exactly the same as the resistance of *R4* in the second voltage divider to preserve the null condition. A 68-ohm value was selected for *R4*, but you could as easily substitute one of the more common 52- or 75-ohm values if your antenna is designed for either of these impedances.

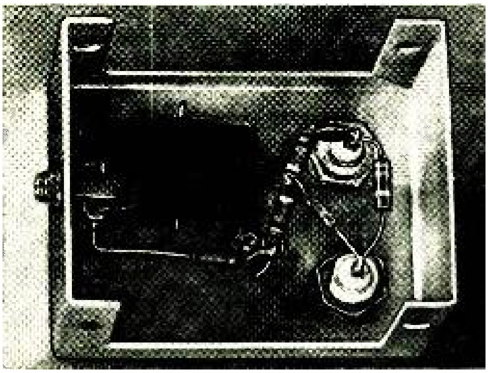
Diode *D1* rectifies r.f. only when a difference of potential or a difference in signal phase exists between points A and B in the schematic. This rectified voltage is then fed to the meter through *J1*.

Construction. Referring to the photo, mount BNC connectors *J2* and *J3* on the top of an appropriate-size metal utility box. Then mount *J1* in any location that is convenient but will not interfere with the components in the circuit. Parts placement is not too critical, but keep component leads as short as possible.

Mount a chassis solder lug as shown, and wire the components together. Be careful to observe the proper polarity when connecting *D1* into the circuit.

You can use a larger utility box than that shown in the photo if you want to mount the meter in the same box with the bridge circuit. In this case you could eliminate the extra utility box and *J1*.

When the Wheatstone Bridge circuit is fully assembled, place an arrow on the top of the utility box, pointing it from *J2* toward *J3* to indicate in which direction the r.f. is supposed to flow. (This arrow shows clearly in the photo at the beginning of this article.)



Spare alternate value resistor is kept handy with strip of electrical tape (upper left of chassis).

How To Use. The bridge is easiest to work with if you mount it, the GDO, and test meter on a board (see photo on page 66). After mounting the instruments, interconnect them with appropriate r.f. cable and connectors, and place the GDO and a pickup loop close enough together to obtain a full-scale deflection of the pointer on *M1* (no connection to *J3*).

Temporarily connect a 68-ohm carbon resistor (a 52- or 75-ohm resistor if either of these values was selected for *R4*) to antenna jack *J3*. The full-scale deflection should drop to zero to indicate the null. And varying the frequency control on the GDO should not disturb the null.

Now, remove the resistor and plug in your antenna lead-in. (This must be single-ended coax; if your lead-in is twin-lead cable, however, install a Balun or other transformer arrangement to convert from balanced to single-ended line.) Vary the frequency control of the GDO; a null indication should appear on *M1* in one and only one position of the control.

There are two signs of trouble you may encounter at the null frequency—an off-frequency null requiring the retuning of the antenna system, and a null that is neither sharp nor complete, an indication that the antenna is reactive to all frequencies.

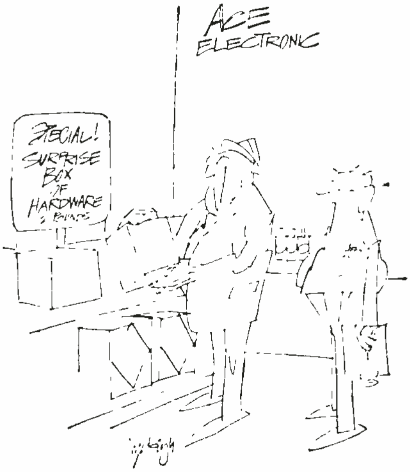
If the null doesn't appear at the expected frequency, tune in the GDO's signal on your receiver. This will give you a closer approximation of the actual output frequency of the GDO than is indicated on the GDO dial. Then, from the receiver's dial, you will be able to determine whether the antenna system nulls at a higher or lower frequency and, consequently, which way to tune the antenna. For a first approximation, increase or decrease the antenna length by the same *percentage* that the frequency is high or low, respectively.

The shallow null may be a more difficult problem to deal with. In this case, first examine the antenna system for poor workmanship, corroded contacts and joints, out-of-parallel open-wire lead-in, and large wire loops that might affect transmission line characteristics. Make certain that neither of the antenna elements is nearer to a large physical object than the other is.

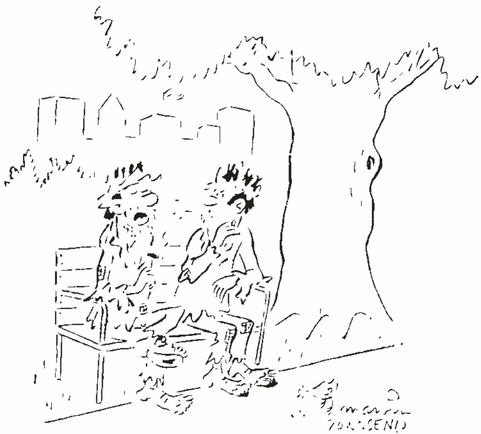
The capacitive or inductive loading of some nearby object might make it necessary to unbalance the antenna physically to obtain an electrical balance. It's all right if one element is shorter than the other when you're finished—just so the antenna system works properly.

Finally, when your antenna system provides you with good readings, take notes on the way you performed your tests and how you set up the test conditions. Then, periodically recheck your antenna system. You'll be surprised how often you discover deterioration. —30—

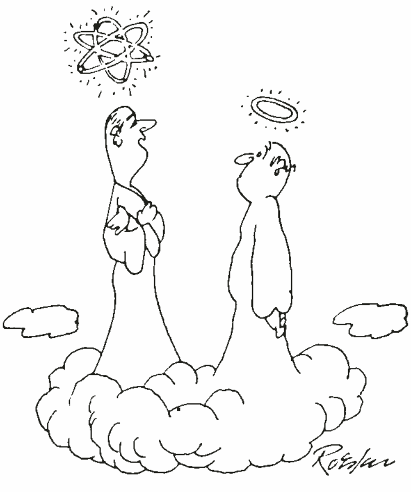
Popular EleComics



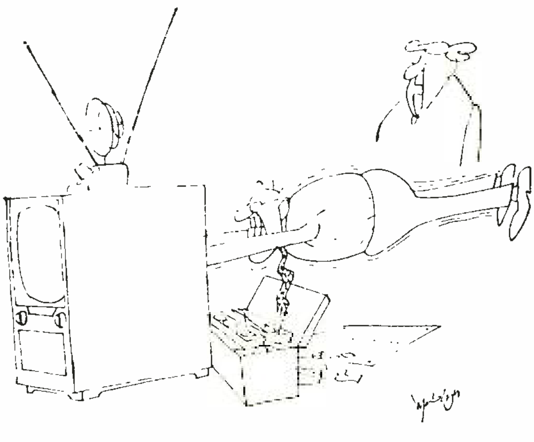
Well, the surprise is the price.
They're 75 dollars.



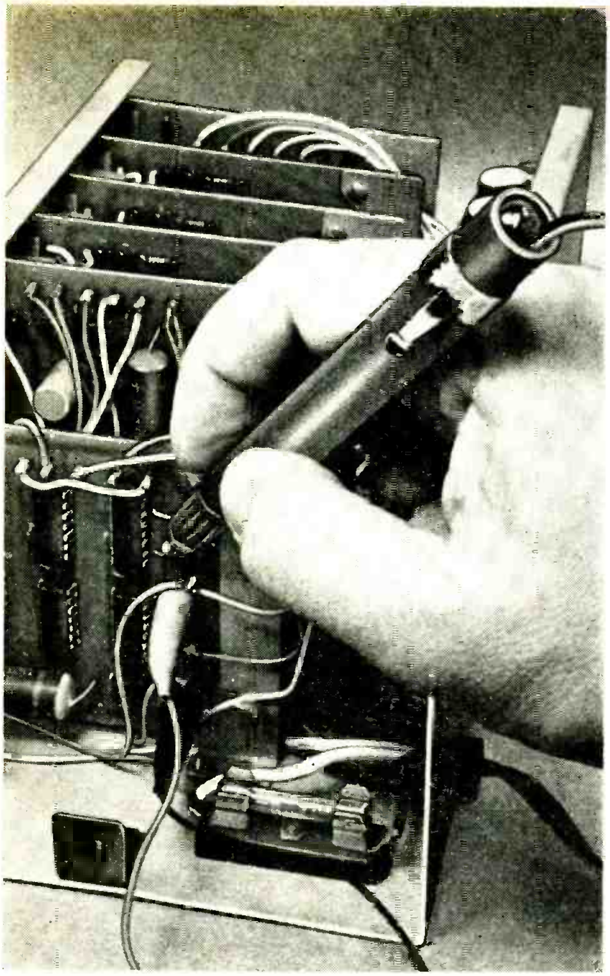
I was aiming to be
a professional amateur ham operator
until I found out there was no profit in it.



Yes sir!
I spent forty years in electronics.



Is that what they call the horizontal hold?



IC Telltale

Two-way system to check digital circuits

BY C. P. TROEMEL

THE INCREASING use of digital IC's in many experimenters' projects has created a need for a low-cost in- or out-of-circuit tester for these complex semiconductor devices. Up to now, most experimenters have done their best using a conventional voltmeter to trace the on-off signal on a circuit board. This is a difficult process at best. Making contact with a narrow foil strip and looking at a meter at the same time is trouble enough, but most of the time the pulses are so short that they don't even register on the meter. It is even more difficult to test IC's that are not connected into known operating circuits.

The "IC Telltale" described here was designed to solve many of these testing problems. It will test, in or out of the circuit, the RTL (resistor-transistor-logic) IC's such as the Motorola MC700P series and the Fairchild μL900 series that are used in a number of POPULAR ELECTRONICS projects.

The IC Telltale consists of two assemblies: a 10,000-ohm input-impedance probe for checking IC's mounted on a circuit board; and a test set with a built-in 2- and 10-Hz trigger pulse generator with 14-pin in-line and 8-pin round IC sockets for out-of-circuit tests. The oscillator circuit in the test set can also be used as a trigger source for finished IC boards, if desired.

The readout is built in the probe and consists of a small pilot lamp that is on when the logic is at, or near, ground level and goes "off" when the logic is at, or near, +3.6 volts. The probe can be used to trace a digital signal through foil patterns and integrated circuit connections.

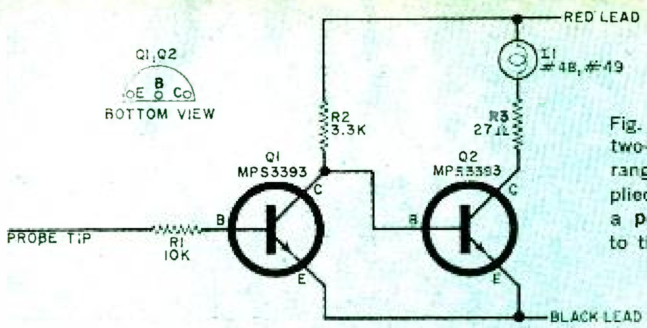


Fig. 1. The probe is a simple two-transistor lamp driver arrangement. With no signal applied, the lamp is lit. When a positive voltage is applied, to the tip, the lamp goes out.

PARTS LIST

I1—2-volt, 50-60-mA pilot lamp (#48, #49, or similar)
Q1,Q2—Transistor (Motorola MPS3393)
R1—10,000-ohm, ½-watt resistor
R2—3300-ohm, ½-watt resistor
R3—27-ohm, ½-watt resistor
Misc.—Plastic tube or felt-tip marker pen ½" inside diameter; 1½"-long brass screw with lockwasher and nut; flexible test leads 18" long (one red, one black); small alligator clips; insulation.

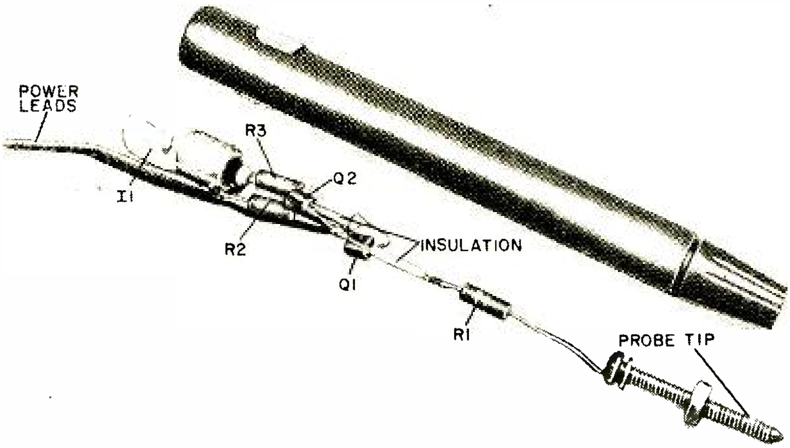
Probe. The electronic part of the probe (Fig. 1) is assembled to fit inside a plastic tube whose inside diameter is just large enough to hold the pilot lamp, *I1*. The author used the empty plastic case of a large cheap felt-tip marking pen.

If you use a similar case, take out the insides and clean it thoroughly. Use a #27 drill to enlarge the hole at the pen tip so that it will pass a 6-32 screw. Place a nut on a 1½" 6-32 brass screw about ¾ of the way down its length. Using a file, make a sharp point of the end of the screw. The nut, which will secure the finished probe within the pen, will clean the threads as it is removed.

Lay all the probe components beside the pen case as shown in Fig. 2. Trim the component leads and assemble the circuit, making sure that you don't exceed the inside diameter of the plastic case. Use insulating tubing on leads where required to prevent accidental shorts. Note that the indicating lamp does not require a socket and the leads are soldered directly to its base.

When you have the components assembled, slide them into the case from the rear until the pointed end of the screw comes out as far as possible. Use a lockwasher and the 6-32 nut to secure the screw to the case. Be sure that you

Fig. 2. The complete probe is housed in a plastic tube, in this case, an old felt-tip marker pen. Assemble the components with care, and gently fit into the housing.



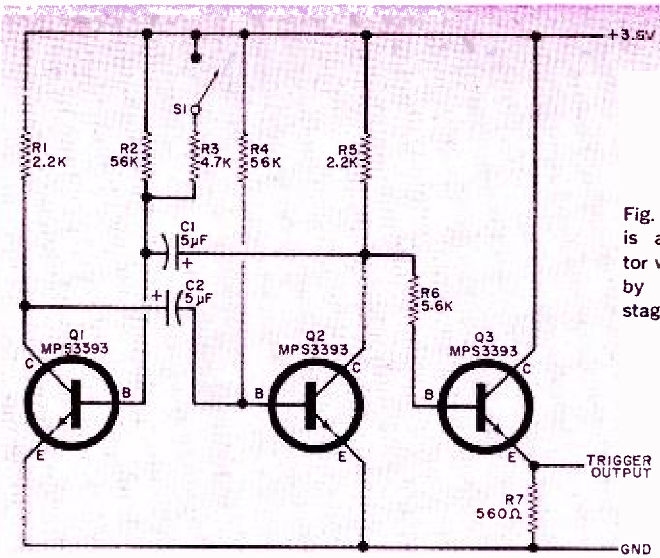


Fig. 3. The trigger generator is a conventional multivibrator whose frequency is changed by resistor variation. Output stage is an emitter follower.

PARTS LIST

C1,C2—5-μF, low-voltage electrolytic capacitor
Q1,Q2,Q3—Transistor (Motorola MPS3393)
R1,R5—2200-ohm, ½-watt resistor
R2,R4—56,000-ohm, ½-watt resistor
R3—4700-ohm, ½-watt resistor
R6—5600-ohm, ½-watt resistor
R7—560-ohm, ½-watt resistor
S1—S.p.s.t. switch
Misc.—5¼" x 3" x 2⅛" enclosed metal box (Bud CU2106-A or similar); 8-pin IC socket (Cinch-Jones 8-ICS, Allied #47F0155 or similar); 14-pin in-line IC socket (Augat 314-AG5D-2, Allied #47F6225 or similar); spring-clip terminals (Vector T30X2, 12 needed); three lengths of color-coded flexible test leads; three small alligator clips; small rubber grommet; 2" bare stiff wire; mounting hardware; etc.

do not rotate the screw as this may break the solder connection to it. The lamp should be slightly recessed within the pen case so that it is protected and yet can still be seen. The two flexible test leads (red for positive and black for ground) can be brought out of the probe beside the lamp. These leads can be a couple of feet long if desired (18" is about ideal) and should be terminated with small alligator clips.

To test the probe, connect the black lead to ground and the red lead to a

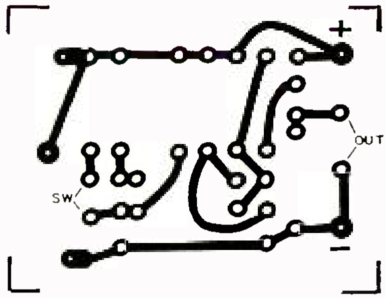


Fig. 4. Actual-size foil pattern for the oscillator.

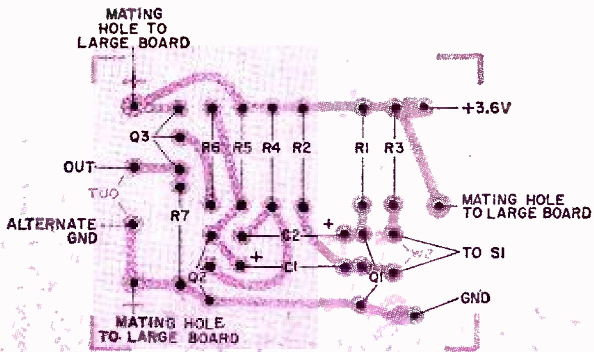


Fig. 5. Component installation on the oscillator board. This board is supported from the large board by three stiff wire leads whose locations are also shown here. Two of these leads carry the power supply.

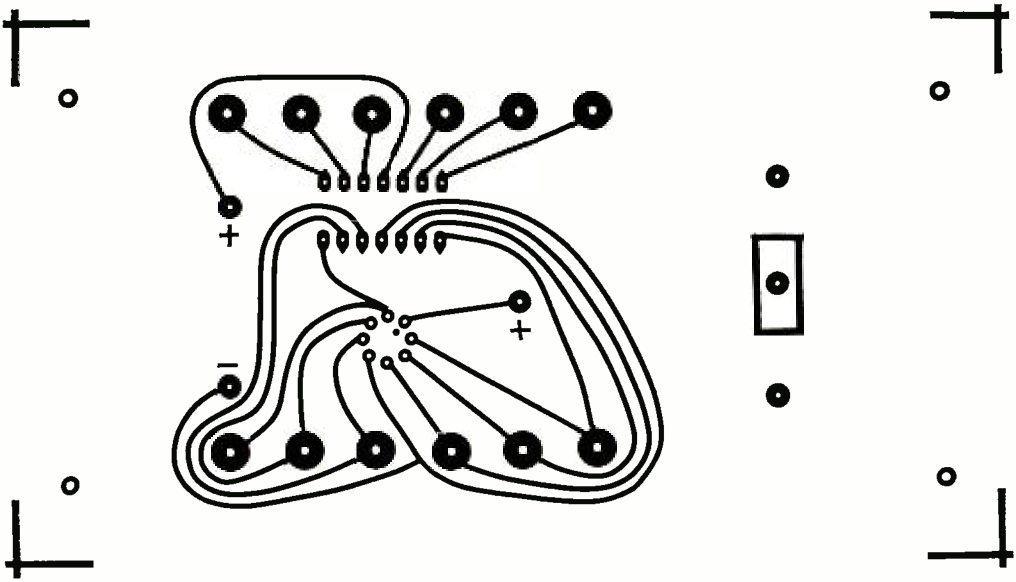


Fig. 6. Actual-size foil pattern for the socket-contact board. Switch S1 cutout and mounting holes are dependent on the particular switch you are using.

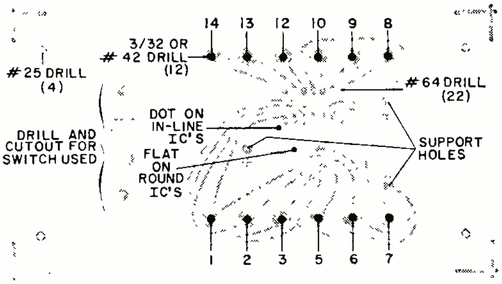


Fig. 7. Parts layout for the socket-contact board. Note the three support holes for oscillator board.

source of 3.6 volts (the same voltage used for the IC circuit). The lamp should glow and be plainly visible at the top of the probe. Touch the probe tip to the 3.6-volt source and note that the lamp goes off. If the lamp either doesn't light or doesn't go off when it is supposed to, remove the circuit from the probe and check for accidental shorts that may have occurred during assembly.

Test Set. There are two circuit boards in the test set: an oscillator and a socket-contact board. The oscillator section, whose schematic is shown in Fig. 3, is assembled on the PC board with the foil pattern shown in Fig. 4. Mount the components on the board as shown in Fig. 5.

To test this circuit, connect the board to ground and +3.6 volts at the indicated places and connect an oscilloscope across the OUT terminals. Depending on the position of *S1*, you should see either a 2-Hz or 10-Hz pulse train.

Make the socket-contact board using the foil pattern shown in Fig. 6. Solder the 12 spring-contact terminals and the two IC sockets in place as shown in Fig. 7. Looking at the top (non-foil) side of the socket-contact board, orient the 8-pin round socket so that pin 8 (identified by a small projection on the socket) is in the position shown in Fig. 7. Make some sort of marks on the board to identify pin 8 and to identify the dot and notch end of the in-line socket. At the same time, mark the LOW and HIGH frequency positions for switch *S1*. The hole for this switch can be cut to fit the switch used.

The oscillator board is mounted on the socket-contact board using three pieces of stiff wire about ½″ long. Insert the three wires in the indicated holes on the smaller board (Fig. 5) and solder them in place. Insert the other ends of these wires in the appropriate holes in the larger board and solder them in place. Clip any excess wire from the top of the board. Connect *S1* to its leads.

On the upper surface of the metal chassis, cut out a rectangle 4″ by 2″ so that the larger board can be mounted within the chassis and secured with appropriate hardware at each corner. Drill a hole in one end of the chassis to accept a small rubber grommet. After tying them in a knot to provide a strain relief, pass the three test leads from the smaller board through this grommet. Attach a small alligator clip to the end of each lead. Use a black lead for ground, red for + and another color for trigger.

Assemble the cover on the metal chassis. Using some type of marker, identify each spring clip on the metal lip adjacent to it, as shown in the photograph. Note that pins 4 and 11 are missing since they are connected internally.

HOW IT WORKS—PROBE

Transistors *Q1* and *Q2* form a high-gain current amplifier using *R1* to limit the input base current to *Q1* and prevent loading of the IC being tested. When *Q1* is cut off, with the input either grounded or left floating, current through *R2* saturates *Q2*. Resistor *R3* reduces the voltage supplied to lamp *I1* when *Q2* saturates.

When the input to *Q1* exceeds about +0.6 volt, *Q1* conducts and removes the base drive from *Q2*, cutting off this stage and extinguishing *I1*.

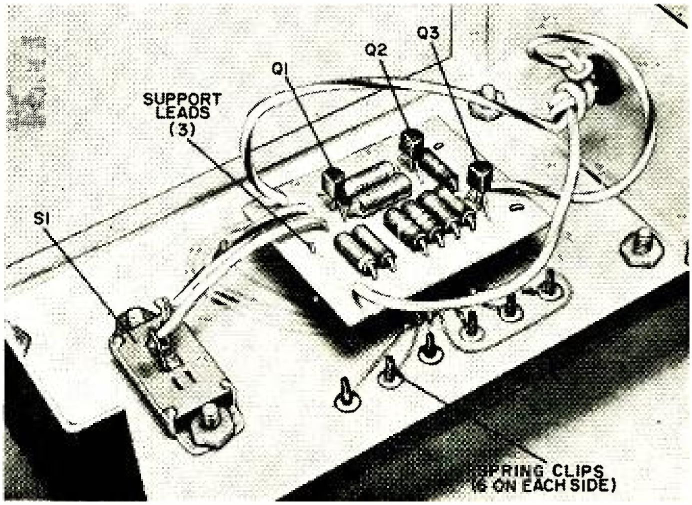
Since most RTL (resistor-transistor-logic) IC's require more than 0.8 volt to guarantee turn on and less than 0.46 volt to turn off, the 0.6-volt threshold of the IC Telltale falls in the correct place to indicate the state of the input or output.

In-Circuit Tests. To check IC's on a finished board, apply the required d.c. power to the board (usually +3.6 volts) and introduce a trigger signal. If you have no trigger source available, connect the black lead of the test fixture to the PC board ground and the red lead to +3.6 volts. Connect the test fixture output lead to the PC board's input terminal. Switch *S1* can be in either the LOW or HIGH frequency position.

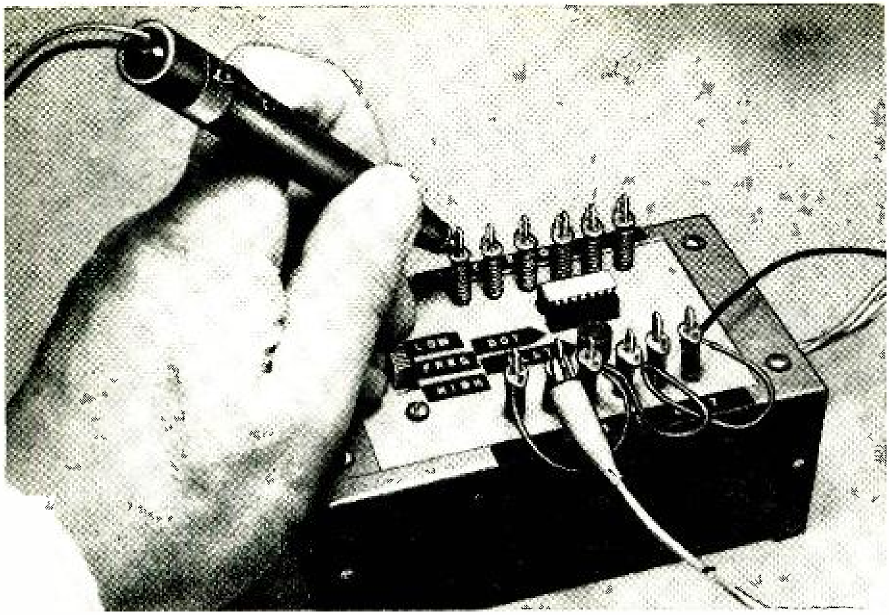
Connect the black lead from the probe to the PC board ground and the red lead to +3.6 volts. The probe lamp should be on. Check for the presence of +3.6 volts at the IC (usually pin 11 of the in-line type and pin 8 of the TO-5 can). When the probe makes contact with +3.6 volts, the lamp should go out. If it doesn't, check back along the foil pattern and locate any break. Note that, when using the probe, it isn't necessary to watch the lamp directly as it is in your line of vision when your attention is on the probe tip. Since the lamp stays on when the probe tip is grounded, it is also possible to check the ground pattern of the foil.

Once it has been determined that the positive d.c. and ground are correct, place the probe tip on the signal input terminal and observe that the lamp blinks on and off in step with the applied trigger signal. It is easier to see the lamp blinking if *S1* is in the LOW frequency position. You can now trace the trigger signal directly to the IC terminal.

When checking flip-flops, observe that the signal at the output (1 or Q, 0 or Q) is usually at a slower rate than the applied trigger. Using the probe and a schematic of the circuit board, it is possible to trace the path of the signal and



Interior of a completed test set. The three leads (one for positive, one for ground, and one for trigger output) are knotted to provide a strain relief, before being passed through the rubber grommet.



When testing an IC out of the circuit, plug it into the proper socket, make the connections called for in the test table, apply power, and use the probe to test device operation.

note where the signal stops (if the board is faulty). If a number of flip-flops are involved (as in a countdown circuit), the probe lamp will blink more slowly as you move down the chain. In this case, place *S1* in the HIGH frequency position to speed up the counting. You can trace the signal through gates or inverters by observing the presence of signals at the inputs and output.

TEST TABLE FOR IC'S* OUT OF CIRCUIT

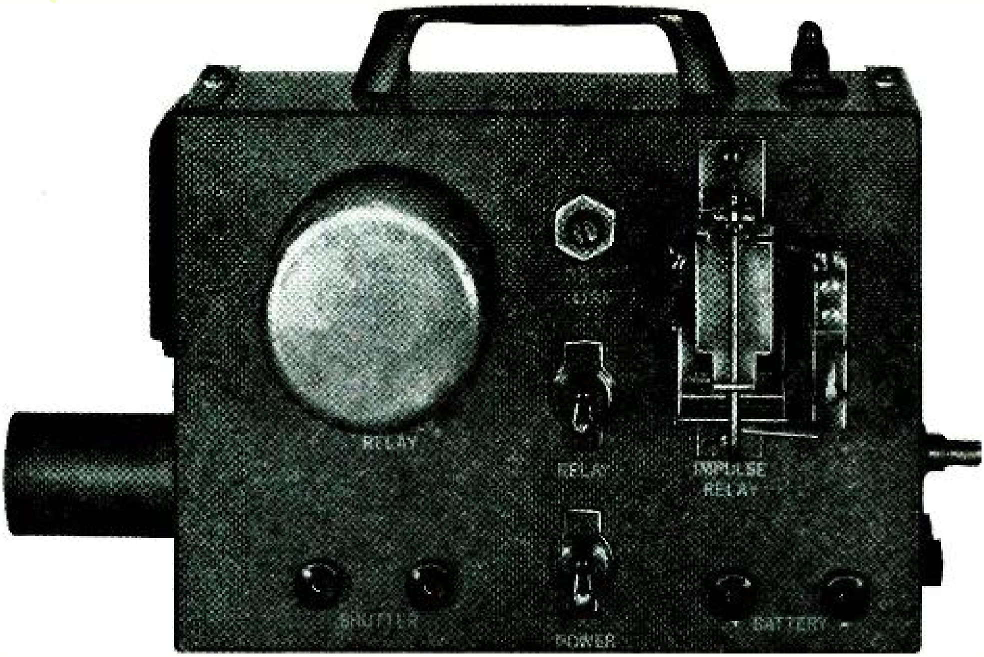
Function	Input				Output**	
Inverter	signal				blinks	
Gate	all gnd				off	
	any +				on	
	one to signal, others to gnd				blinks	
Flip-flop	Reset	S	T	C	1 or Q	0 or $\overline{Q}$
	gnd	gnd	signal	gnd	blinks	blinks
	gnd	+	signal	gnd	off	on
	gnd	gnd	signal	+	on	off
	gnd	+	signal	+	on or off	
	+ then gnd	gnd	gnd	gnd	on	off

**For Motorola MC700P and Fairchild μL900 series IC's.*
***As indicated by probe lamp.*
+Indicates +3.6 volts.

Out of Circuit Tests. To test unmounted (loose) IC's, remove the power from the test fixture and insert the IC in its socket, observing the notch and dot code on in-lines and the flat, tab, or color dot on round IC's.

The only direct connections to the IC's are +3.6 volts to pin 11 of the in-line and pin 8 of the round socket and ground to pin 4 of both types. The rest of the contacts to the IC are made through the 12 spring clips.

Apply power to the test fixture by connecting the black test lead to ground and the red test lead to a source of +3.6 volts. Test the IC using the accompanying table as a guide. Use small lengths of insulated wire with bare ends to make any necessary interconnections. The two-speed oscillator built into the test fixture serves as the signal source. -30-



BUILD AN Electronic Shutter Control

TAKE NIGHTTIME NATURE PHOTOS

BY WALTER B. FORD

ELECTRONICS has always been an important factor in the development of new hobbies and the improvement of old ones. Photography, in particular has benefited tremendously through the use of electronic devices that make photographic equipment and techniques more accurate, more flexible, and easier to use under adverse conditions. As an example, with the aid of a few relays and a solenoid, you can build an "Electronic Shutter Control," that will enable you to get into the fascinating field of nighttime nature photography.

The Shutter Control operates on the electric-eye principle; the subject to be photographed breaks an almost invisible beam of light to a photo-cell, triggering the shutter and taking his own picture. Once the system is tripped, a signal light that can be seen from hundreds of feet away goes on and a relay simultaneously shuts down power to the system. The power disconnect feature is a real battery saver—especially if you plan to leave the system unattended overnight.

How It Works. Power is applied to the Electronic Shutter Control circuit through *J1* and *J2* in Fig. 1. With both *S1* and *S2* closed, the beam from control light *I1* is directed at *PC1*, causing the resistance of the photocell to reduce enough to allow *K1* to be energized. When *K1* picks up, its normally closed contacts open, depriving *K2* and subsequent circuits of power.

Now, when the control light beam to *PC1* is interrupted, *K1* is de-energized and power is applied to *K2*. This results in three simultaneous operations: *K2* is latched in through its lower contacts; a pulse is applied to shutter solenoid *L2*; and power is delivered to the heater of thermal relay *K3* through the upper contacts of *K2*. After a short interval, the contacts of relay *K3* close to complete the circuit through the solenoid of *K4*.

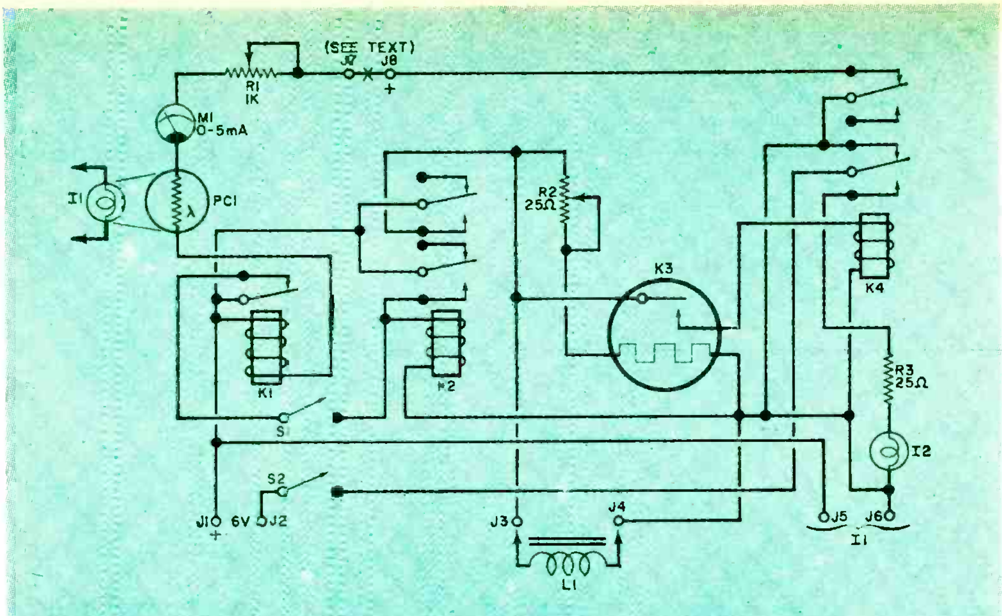


Fig. 1. Once system is tripped, relay operation is in numerical sequence. As K2 closes, it pulses shutter solenoid; K2 provides the power-disconnect feature.

PARTS LIST

I1—6-volt indicator lamp
I2—1.2-volt indicator lamp
J1-J8—Pin or banana jack
K1—2500-ohm d.c. relay (Sigma type 42)
K2—6-volt d.c., d.p.d.t. relay
K3—Thermal relay (Amperite type 6N02T)
K4—6-volt d.c., d.p.d.t. impulse relay (Potter & Brumfield No. PC11D or similar)
L1—6-volt d.c. solenoid (Dormeyer B24-251 A1)
M1—0-5-mA milliammeter
PC1—Photocell (General Electric No. B46)
R1—1000-ohm potentiometer
R2—25-ohm, 5-watt potentiometer
R3—25-ohm, 2-watt resistor
S1,S2—S.p.s.t. switch
Misc.—Flashlight; magnifying lens; 7" x 5" x 3" metal utility box for chassis; camera lens filter; nine-pin miniature tube socket; pin or banana jack (to match J1-J8, 8 needed); eight-pin octal socket; indicator lamp socket; 6-32 x 1½" flat-head brass machine screws; wood screws; epoxy cement; steel band; pine blocks; zip cord; rubber grommet; mailing tube; paint; hookup wire; solder; hardware; etc.

Relay *K4* is then energized, interrupting power to the other relays, turning *I1* off and *I2* on. The latter must be turned off manually.

Construction. It is recommended that you house the Electronic Shutter Control circuit in a sturdy metal chassis to protect it against damage in the field. While component placement (except for *PC1*) is not critical, the author suggests a layout similar to that shown in Fig. 2. Note

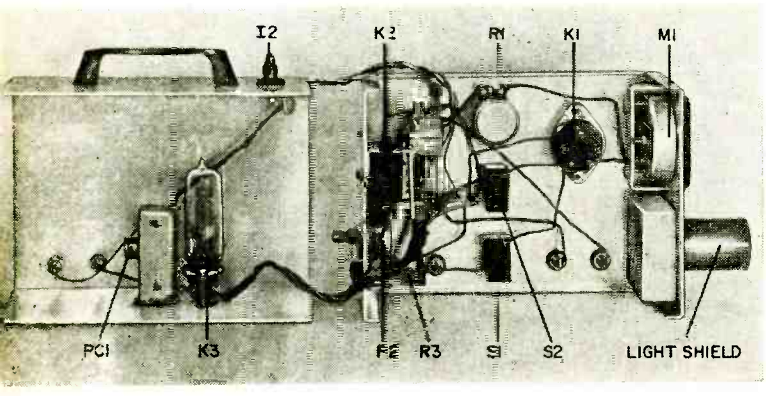


Fig. 2. In this prototype, relays K1 and K4 are mounted on outside of chassis to provide easy access. Interior parts mounting is arranged to avoid obstruction of the photocell.

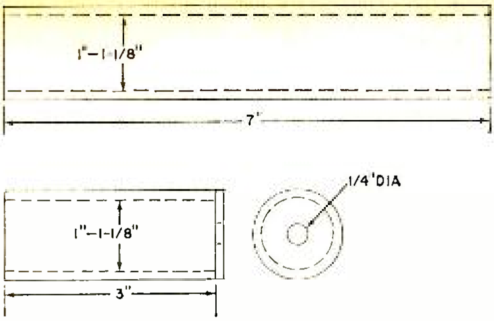


Fig. 3. Fabricate light shields illustrated here from mailing tube; note aperture disc on short tube.

that *K1* and *K4* are mounted on the outside of the chassis for easy access.

Begin construction by laying out and drilling the mounting holes for the various components. Then fabricate one or both of the light shields illustrated in Fig. 3. (The longer light shield is used for large-subject photography, while the shorter shield is best for subjects the size of a tarantula or smaller.) Select cardboard mailing tubes with 1″ to 1 1/8″ *inner* diameter for the shields, and if you make both shields, use the same tube to insure uniform inner and outer diameters. Also, glue a carbdoard disc through the center of which has been punched a 1/4″ aperture over one end of the 3″-long shield. Then apply a coat of flat black paint to all interior surfaces.

Locate the center of the chassis cutout that is to accommodate the light shield 1 1/4″ above the base of the chassis and drill a hole through the chassis to match the outer diameter of the shields. Then drill the same size hole through a 2″-square by 3/4″-thick pine block, and secure the block to the chassis with wood screws as illustrated in Fig. 4.

The magnifying lens which is to be cemented to the wood block as shown serves to concentrate and direct the light from *I1* onto *PC1*. This lens should be slightly larger than the diameter of the cutout in the pine block. The lens selected can be from a small reading glass, or you can order item No. 94,061 for 80 cents from Edmund Scientific Co., 600 Edscorp Bldg., Barrington, N.J. 08007.

When the cement securing the lens to the pine block has set, mount the components (except *PC1*) in place and wire them together. Then place the section of the chassis containing the lens on a flat surface, slip into place the long light shield, and aim the assembly at a light source a few feet away. Now, mount the photocell on a 3/4″-square by 2″-long pine block (see Fig. 4).

Place the photocell-block assembly on a 1/8″ thickness of cardboard, and orient it behind the lens so that the concentrated beam of light from the light source just covers the entire frontal area of the photocell. Measure the distance from the side and front of the chassis to the block to determine where, on the other section of the chassis, *PC1* must be located. Then secure the photocell assembly to the chassis with a wood screw and epoxy cement, and solder the leads of *PC1* into the circuit.

The solenoid specified in the Parts List must be modified to operate the camera shutter. To accomplish this, drill a 5/32″ hole through the flat end of the plunger; then flatten the pointed end of the plunger with a file and drill and tap this end for a 6-32 machine screw (see Fig. 5 for details).

To facilitate mounting the solenoid and camera on a tripod, a bracket as illustrated in Fig. 6 must be fabricated from 1 1/8″ × 1/8″ band steel The leg lengths of the bracket are not provided in the drawing since they will vary depending on the camera. The slots shown in the drawing provide a means for adjusting the solenoid position to apply proper shutter release pressure for a wide variety of cameras.

The control light shown in Fig. 7 is actually a modified two-cell flashlight, equipped with a No. 25 red camera lens filter, mounted on a 7″ × 5″ × 3/4″ pine board. First, remove the batteries from

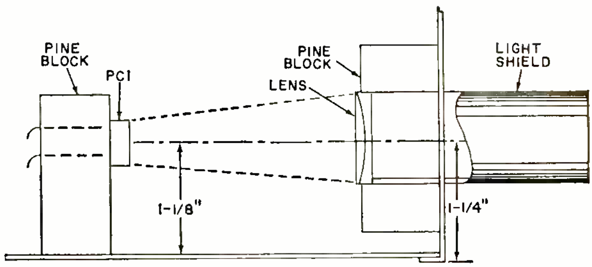


Fig. 4. Light shield, lens, and photocell must share a common axis with control light source.

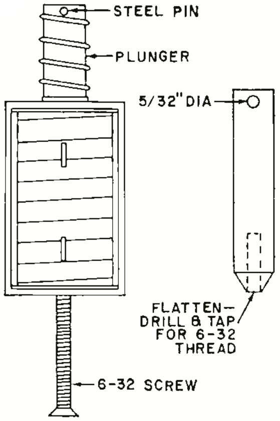


Fig. 5. For proper solenoid operation, plunger must be modified as shown at right.

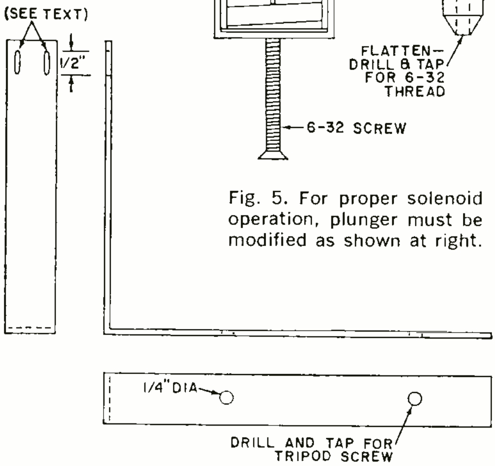


Fig. 6. Lengths of L bracket legs must be calculated for your particular camera; do not omit slots.

the flashlight. Then replace the original lamp with a 6-volt lamp of similar size, shape, and basing. Drill a 3/8" hole through the end of the flashlight body, and place a rubber grommet in it. Now, insert one end of a length of zip cord through the grommet and connect one conductor to the base contact and the other conductor to the thread contact of the lamp.

As for the filter cell assembly, you can use a cardboard tube that fits snugly over the front of the flashlight as shown. The lens filter itself can then be glued to the tube.

How To Use. For the initial tryout, set up the camera, flash attachment, and Electronic Shutter Control in a semi-darkened room. Place *S1* and *S2* in the OFF positions, and connect a heavy-duty 6-volt battery—such as a motorcycle or an automobile battery—through *J1* and *J2*. Next, connect control light *I1* via *J5* and *J6* and shutter solenoid *L1* via *J3* and *J4*. Finally, short-circuit *J7* to *J8*.

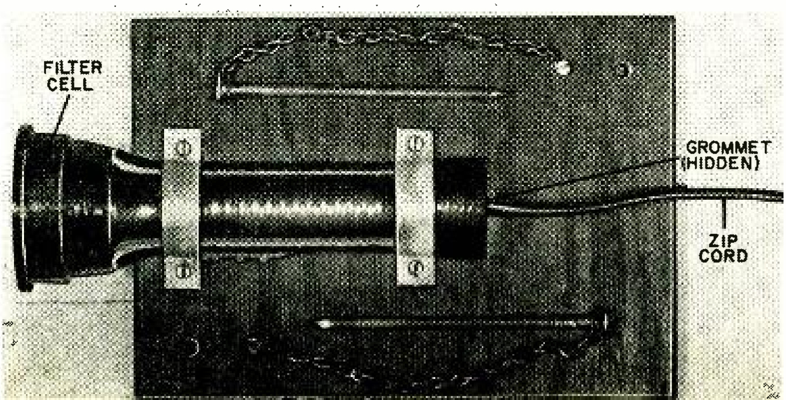
Set *S2* to the ON position (if *I2* comes on, manually reset *K4* until it extinguishes). Place the control light with the filter in place about 4′ away from *PC1*, directing the beam onto the photocell. Meter *M1* should now indicate maximum current flow. Now, without disturbing *R1* from its zero-resistance setting, adjust the armature of *K1* until the contacts just close. Then slowly rotate the shaft of *R1* until the contacts just open, and observe and record the milliammeter reading at this point. Reset *R1* to zero resistance. The minimum meter reading will be helpful in determining the maximum separation between *I1* and *PC1* in future setups.

Should it be desired to separate the control light and photocell by more than about 6′, it is suggested that you remove the short-circuiting jumper from across *J7* and *J8* and connect one or two 1.5-volt D cells in its place.

With the control light directed into the light shield, turn *S1* on and cover the front of the shield with your hand. This interrupts the beam, and if all systems are go, the shutter solenoid should actuate immediately, and about a second later *I2* should turn on.

To reset the control system, first set *S1* to OFF and then depress the armature lever to *K4* to extinguish *I2*. Now close *S1*, and the system is set for another photograph. —30—

Fig. 7. Modified flashlight with filter assembly fitted to lens serves as housing for I1. Zip cord terminates in plugs that match J5 and J6 on main relay chassis.



PARTS/METHODS/IDEAS/GADGETS/DEVICES

tips & techniques

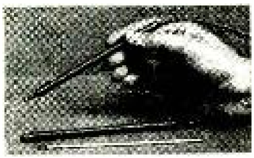
HOMEBREW BATTERY TERMINALS

Where space isn't at a premium, AA battery terminals such as those shown in the photo can be fabricated with the aid of a spring, some stranded wire, and a couple of rubber splice caps. The small compression spring (taken from an old record player or from motor brushes) should be clean and free of rust. Solder a length of the hookup wire to one end of each ¼"-⅜" long spring, and crimp down the other end of each spring to make sure of good electrical contact with the battery's terminals. The splice caps are made by Ideal (#415). To save space, cut off the thumb tabs. Then punch a small hole through the splice caps, and feed the hookup wires through, pulling on them so that the springs fit snugly into the narrow portions of the caps. (To identify the cap polarities, use a red wire for the positive and a black or blue wire for the negative terminals.) Now, fix the AA cell in place.

—*Wendell H. Arthur*

HOMEBREW TEST PRODS FROM OLD BALL-POINT PENS

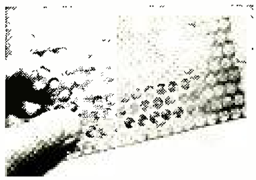
Have you ever wondered what you can do with those old, dried-out ball-point pens you have been throwing away? If you think hard, you will see one possibility: they make handy test prods. Single-piece body pens with brass ink cartridges are ideal for the job (see photo). Using a pointed tool, lift off the top plug and push out the ink cartridge. Then cut off and discard the part of the cartridge just above the dimples in the cartridge tube. Thoroughly clean the remaining piece, and tin the interior of the tube. Now, string the test cable through the pen body, insert the bared end of the cable in the cartridge, and solder in place. Press fit the point back into the pen body, leaving about ½" protruding. Finally, gently squeeze out the steel ball in the pen tip with side cutters, and round off the tip. A bead of epoxy cement at the other end of the pen body serves as a strain relief for the test cable.



—*A. A. Mangieri*

AUTOMOBILE AIR FILTER IS SOURCE OF CHASSIS VENTING MATERIAL

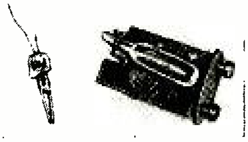
There are still some circuits and equipment in electronics that must be housed inside an enclosed chassis to prevent electrical shock hazard but require conventional ventilation to guard against heat damage. Unfortunately, perforated metal sheets—ideal for fulfilling both needs—are sometimes not readily available in electronic parts stores. However, if you have an old dry-type automobile air filter handy, you have a ready source of this difficult-to-find perforated aluminum stock. This material, which forms the outer wall of the filter, can be cut to size with tin snips or heavy-duty scissors. Then all you have to do is place the cut piece over the chassis cutout, bolt it in place with machine hardware, and you have a functional cooling grille that will provide ventilation while keeping the hands of the user out of danger.



—*James D. Brenner, Jr.*

FLUORESCENT LAMP STARTERS MAKE THERMAL SWITCHES

Need an inexpensive thermal switch in a hurry? Well, if you have a spare fluorescent lamp starter handy, you're in business. These lamp starters contain ideal miniature thermal switches that can be used as they are or modified to suit your needs. First, remove and discard the metal shell of the starter. Then, carefully clip the leads of the glass-enclosed thermal switch (see photo). The switch is normally set for closure at about 150°F. If you want it to close at a higher or lower temperature, you'll have to break the glass envelope carefully, leaving the base intact. Then, for higher temperature action, bend the bimetallic elements farther apart; for lower temperature actuation, bend them closer together. To find the correct distance between the two elements for a given application, you'll have to use a trial-and-error procedure.



—*John Rowe*

BEWARE OF SNAP CONCLUSIONS

Most people—even some professional electricians—assume that the small holes at the ends of the prongs on the common electric plug are for temporary cable splicing. Not so! They were put there for a purpose in the days when we didn't have springy metals for the prongs to hold them in position. The holes engaged dimples in the contacts in the receptacle. The holes are obsolete, but traditional.

—*Henry R. Rosenblatt*

ENGLISH LANGUAGE BROADCASTS FOR THE MONTH OF APRIL

Prepared by ROGER LEGGE

TO EASTERN AND CENTRAL NORTH AMERICA

TIME—EST	STATION AND LOCATION	FREQUENCIES (MHz)
7:15 a.m.	Melbourne, Australia	9.58, 11.71
	Montreal, Canada	9.625, 11.71
7:45 a.m.	Copenhagen, Denmark	15.165
6:00 p.m.	Montreal, Canada	9.625, 11.945, 15.19
6:45 p.m.	Tokyo, Japan	15.135, 17.825
7:00 p.m.	London, England	6.11, 9.58, 11.78
	Peking, China	15.06, 17.675
	Sofia, Bulgaria	9.70
7:30 p.m.	Budapest, Hungary	9.833, 11.91, 15.16
	Stockholm, Sweden	11.805
	Tirana, Albania	6.21, 7.30
7:50 p.m.	Brussels, Belgium	6.125
	Vatican City	9.615, 11.785, 15.285
8:00 p.m.	Havana, Cuba	9.525
	Moscow, U.S.S.R.	9.61, 11.87, 11.96
	Prague, Czechoslovakia	5.93, 7.345, 9.63, 11.99
	Rome, Italy	9.575, 11.81
8:30 p.m.	Berne, Switzerland	6.12, 9.535, 11.715
	Bucharest, Rumania	9.57, 11.94, 15.25
	Cologne, Germany	6.185, 9.64, 11.945
	Hilversum, Holland (via Bonaire)	9.59, 11.73
	Johannesburg, South Africa	6.075, 9.705, 11.875
9:00 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
	Peking, China	15.06, 17.713
	Quito, Ecuador	9.745, 11.765, 15.115
9:30 p.m.	Beirut, Lebanon	11.785
	Berlin, Germany	9.73, 11.89
10:00 p.m.	Moscow, U.S.S.R.	9.61, 9.70, 11.735
11:00 p.m.	Jerusalem, Israel	9.009

TO WESTERN NORTH AMERICA

TIME—PST	STATION AND LOCATION	FREQUENCIES (MHz)
7:00 a.m.	Tokyo, Japan	9.505
8:00 a.m.	Stockholm, Sweden	15.31
6:00 p.m.	Melbourne, Australia	15.32, 17.84, 21.74
	Tokyo, Japan	15.235, 17.825, 21.64
6:30 p.m.	Bonaire, Neth. Antilles	9.695
	Johannesburg, South Africa	6.075, 9.705, 11.875
7:00 p.m.	London, England	9.58, 11.78, 15.26
	Madrid, Spain	6.13, 9.76
	Moscow, U.S.S.R.	9.61, 9.70, 11.735
	Peking, China	15.095, 17.675, 17.795
	Seoul, Korea	15.43
	Taipei, Taiwan	15.125, 15.345, 17.89
7:20 p.m.	Yerevan, USSR (via Khabarovsk) (Tue., Wed., Fri., Sat.)	15.14, 15.18, 17.775
7:30 p.m.	Berlin, Germany	9.73, 11.84, 11.97
	Prague, Czechoslovakia	5.93, 7.345, 9.63, 11.99
	Stockholm, Sweden	11.705
	Tirana, Albania	6.21, 7.30
8:00 p.m.	Havana, Cuba	9.525
	Lisbon, Portugal	6.025, 9.68, 11.935
	Moscow, USSR (via Khabarovsk)	11.87, 15.18, 17.775
	Peking, China	15.095, 17.675, 17.795
	Sofia, Bulgaria	9.70
	Bucharest, Rumania	9.57, 11.94, 15.25
8:30 p.m.	Budapest, Hungary	9.833, 11.91, 15.16
	Kiev, USSR (Mon., Thu., Sat.)	9.61, 11.90
8:45 p.m.	Berne, Switzerland	6.12, 9.72, 11.715
	Cologne, Germany	6.145, 9.545, 11.945
9:00 p.m.	Havana, Cuba	9.525, 11.76
	Quito, Ecuador	11.765
	Tokyo, Japan	15.105
10:00 p.m.	Moscow, USSR (via Khabarovsk)	11.87, 15.18, 17.775
10:30 p.m.	Havana, Cuba	11.93

the product gallery

REVIEWS AND COMMENTARY ON ELECTRONIC GEAR AND COMPONENTS

TERADO TRAV-ELECTRIC (Power Source Model 50-160)

Most inverters (12 volts d. c. to 115 volts a. c.) for emergency, camping or standby use suffer from one major deficiency: What do you do with the cumbersome wet battery? If the inverter is a separate unit and you operate from the battery in your car, there is a natural limitation on portability. Not every occasion when you want to use an inverter is within 10-15 feet of your parked car. Obviously, the answer is a unit with self-contained portability—just like the Terado "Trav-Electric" ($79.50).

Portability of an inverter supply is not new, but Terado has accomplished it in a sensible fashion. About 10 years ago, an Ohio manufacturer put a full-size car battery in a metal case with the necessary electronics to charge the battery and invert the voltage to a. c. The idea was respectable, but it took two men to lift the clumsy case and jockey it to a campsite.

The "Trav-Electric" appears to us to achieve an ideal balance between one man/one hand portability and battery capacity. The secret—if there is one—is in the use of a 25-ampere-hour, 43-plate so-called garden tractor wet battery. It is the result of today's advanced battery technology, which has reached the point where a physically smaller wet battery can practically do the same job that its big brother weighing twice as much did a decade ago.

When you buy the "Trav-Electric" the battery is dry. You fill the battery to the designated fluid levels using electrolyte supplied by the manufacturer. The battery is then brought up to full charge from a 117-volt a. c. line. Charging is at the trickle rate (maximum 4 amperes) and gradually tapers off to a couple of milliamperes. It is impossible to overcharge the battery.

How Much, How Long? As in most inverters, the efficiency of the "Trav-Electric" is inversely proportional to the size of the load. Although your reviewer did not make extensive tests, it appeared that the 100-watt drain efficiency level was about 75% and the 40-watt drain about 60%. In a test using a 75-watt light bulb as the only load, the bulb remained at full brightness (actually somewhat above) for a period of 8 hours. A check of the output voltage showed a drop of only 4 volts during the 8 hours.

We were pleasantly surprised at the performance of the "Trav-Electric" with a black-and-white portable TV receiver. There was no loss of picture size or evidence of instability in a test lasting 10 hours.

Circle No. 90 on Reader Service Page 15 or 115

SQUIRES-SANDERS ULTRA/MONITOR

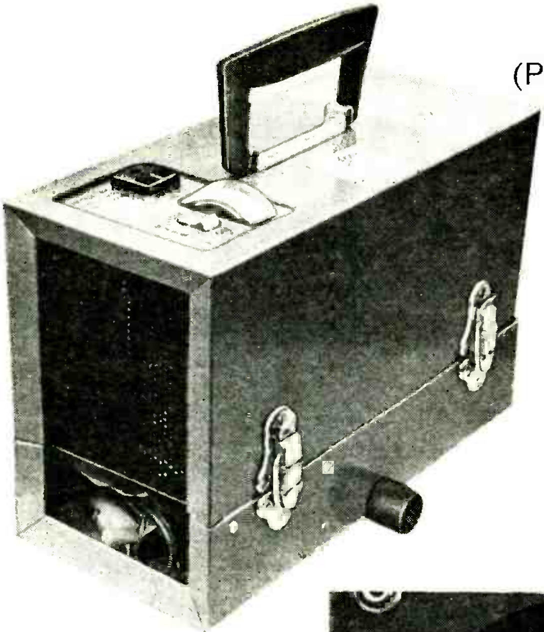
Not everyone who has a police/fire or Business Band receiver is a "knob jockey" easily satisfied with a product of minimal selectivity, dubious sensitivity and near-perfect image-frequency reception. Unfortunately, the marketplace is flooded with low-cost imports that exactly fit those specifications and many citizens with the proper need for VHF receiving equipment have been bilked and are disillusioned.

Testing the new Squires-Sanders Ultra/Monitor was like getting a breath of fresh air. Here is a receiver that behaves like a piece of professional equipment and can do an excellent job for anyone needing 1- to 6-channel crystal-controlled reception in either the high or low VHF bands. A retail price on the Ultra/Monitor has not been set at press time, but it will probably be around $150.00 (with crystal and tuned module for one channel). Each additional channel will require a separate module, which will sell for about $30.00.

Unusual Features. The Ultra/Monitor an all-solid-state, narrow-band FM superhet using appropriate MOSFET's and an IC limiter quadrature detector/first audio amplifier. Selectivity is optimized for VHF re-

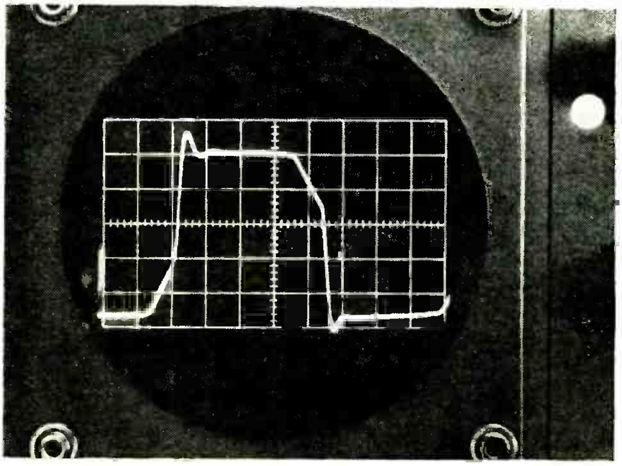
(Continued on page 113)

(See photos of both products on next two pages)

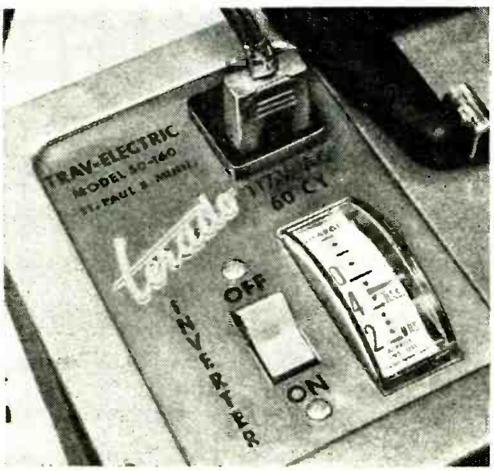


TERADO TRAV-ELECTRIC (Power Source Model 50-160)

Self-contained Trav-Electric inverter weighs about 29 lb. A 43-plate garden tractor wet battery is inside protective metal case. The battery may be recharged from either 117-volt a.c. line or cigarette lighter socket in your car. Both recharging cables are tucked inside case when not in use. Rubber bumpers on sides of case help protect the supply while in transit.

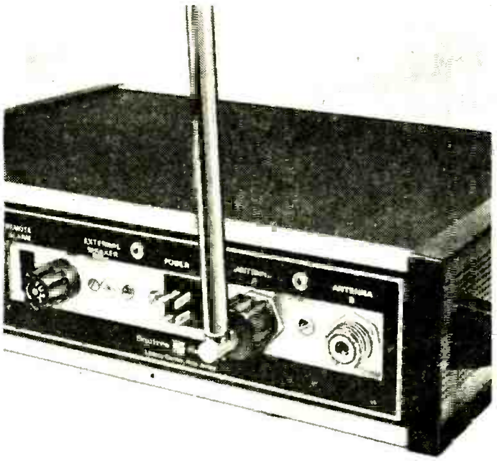


Waveform of the Trav-Electric output shows typical pattern from mechanical vibrator. Stability is excellent over a wide range of loads and battery voltage levels. Output voltage is equivalent to about 122-124 volts a.c. RMS.



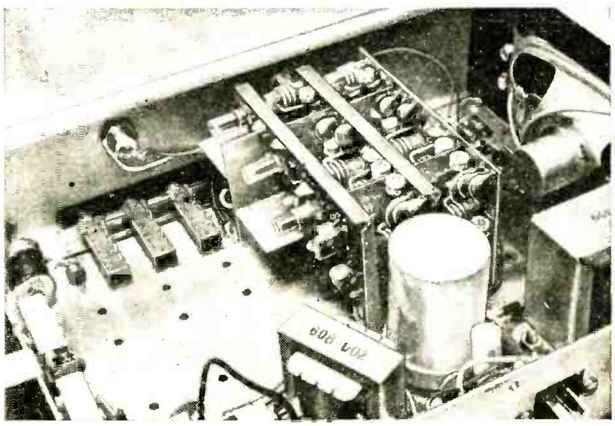
Faceplate contains a dual function meter. When battery is charging, the meter reads approximate charging current. When discharging, the meter reads the approximate time the inverter will operate—if the battery was fully charged to begin with. Your reviewer found the meter readings ambiguous since meter action did not appear linear.

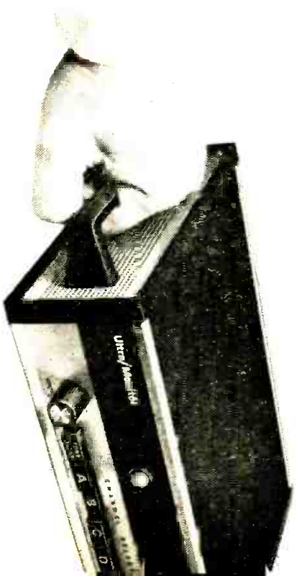
SQUIRES-SANDERS ULTRA/MONITOR



Rear skirt of receiver has two antenna input sockets. Socket "A" should be connected to a high-band VHF antenna and "B" to a low-band antenna. Circuits in the receiver automatically couple proper antenna to appropriate crystal-controlled tuning module.

Crystal-controlled tuning module is actually a whole "front end" featuring fractional microvolt sensitivity and high tolerance stability. User may listen to any of the channels—singly or simultaneously. Pushbuttons select proper channel and extra touch releases circuits from other channels.





Ultra-Monitor has unique functional design and is very light weight. Oval speaker is mounted behind grill under the carrying handle. Receiver contains rechargeable batteries. Pilot lights on front panel indicate whether or not batteries are being recharged and if Tone Alert has been activated.

AMATEUR RADIO

By HERB S. BRIER, W9EGQ
Amateur Radio Editor

NEW NOVICE LICENSE ELIGIBILITY

OPERATION RETREAD has been approved. Effective January 24, 1969, the Federal Communications Commission modified its amateur regulations to permit any U.S. citizen who has not held a valid amateur license within a year to apply for a new 2-year Novice license. Thus, if you have been licensed in the past and would like to get back into amateur radio in easy steps via the Novice route, the way is open.

The procedure, in brief, is to find a volunteer examiner who is over 21 years of age and holds a General, Advanced, or Extra class license. Then, write to the nearest FCC office for a form 610-A. When it arrives, the volunteer examiner will give you the 5-wpm Novice code test and write to the FCC in Gettysburg, Pa. for your written exam which you complete in his presence. He then mails the exam back to the FCC.

More detailed information on Novice licenses is contained in the POPULAR ELECTRONICS COMMUNICATIONS HANDBOOK, 1969, available for $1.35 from many places where POPULAR ELECTRONICS is sold or by mail from Ziff-Davis Service Division, 595 Broadway, N.Y., N.Y. 10012 for $1.60, postpaid. Also, do not depend on any but the latest "License Manual" or other amateur study guide in brushing up for the written exam. Many of the questions are different than they were only six months ago.

Houston, April 1. A scientist who prefers

AMATEUR STATION OF THE MONTH

The father-and-son station of Dr. Otakar Ondra, WA2CCR, and Gordon, WA2CCS, 4645 Arlington Ave., Bronx, N.Y. 10471, has two operating positions. One has a Collins S-line 32S-3 transmitter, 30L-1 amplifier, and 75S-3B receiver; the other a Heathkit DX-60B transmitter and Lafayette HA-500 receiver. They share a 15-meter rotary dipole and a 40-meter dipole. Both Ondras need three states for WAS and are working for their Advanced licenses. We are sending WA2CCR/CCS a 1-year subscription for winning this month's Amateur Station Photo Contest. You can enter the contest by sending a clear photo (preferably black and white) of you at the controls of your station and details about your amateur career to Amateur Station Photo Contest, Herb S. Brier, Amateur Radio, POPULAR ELECTRONICS, P.O. Box 678, Gary, Indiana, 46401.

Richard M. Tavan, K3QDD, receives the John W. Gore Memorial Scholarship from Rosel H. Hyde, Chairman of the FCC. The scholarship, offered by the Foundation for Amateur Radio, Inc., Washington, D.C. is presented for excellence of activities as an amateur operator and high scholastic standing. Tavan is in his third year at Massachusetts Institute of Technology, majoring in Electronics Engineering. Looking on is J. F. DeBardeleben, W4TE, Past President of the Foundation, which is supported by 21 clubs in area.

to remain unidentified, predicted today that the recent spectacular successes in the United States space program may result in more efficient high-frequency receivers and transmitters. He points out that the losses in their coils largely determine the efficiency of high-frequency tuned circuits and that the most efficient coil is of the space-wound type. He has, therefore, proposed that the astronauts in the next space shot spend their spare time in winding coils for critical applications. After volunteering to join the program for this purpose, our informant is presently undergoing an intensive series of tests.

Rochester, April 2. The Rochester Amateur Radio Association's *RaRa Rag* reports that the December, 1968 "Pennython" of Eddie Meath, WHEC radio personality, collected 112,757 pennies in cooperation with the Rochester Amateur Radio Association. When a WHEC listener called Eddie with a pledge, he and other club members verified the address and sent the information by closed-circuit teletype to the amateur control station, WB2MAC. From there, the radio-equipped cars of the club members were dispatched to pick up the pledges. Approximately 67 amateurs and their families participated in the operation, making 208 collections and travelling 1500 miles in doing so. The money raised was used to buy toys for the needy children of Rochester.

Million Dollar Ham/TVI Lawsuit. One of the most unusual lawsuits involving ham radio is taking place in Sarasota, Fla. Several months ago, Ansel "Grid" Gridley, W4GJO, was sued by his neighbor—claiming $1,000,000 damages—for alleged interference to TV reception.

The suit was filed regardless of the efforts of the FCC, Sarasota Amateur Radio Association and Grid to resolve the problem. W4GJO is world-renowned for his interest in UHF-VHF propagation and the equipment in Grid's ham shack meets or surpasses all FCC Standards for interference suppression. However, his neighbor has refused to permit any device or filter to be connected to his TV receiver to increase the receiver's ability to reject radio signals outside the TV channels.

The plaintiff in the lawsuit has also used paid advertisements to literally "damn" the existence of radio hams. This was in addition to other more tangible harassments. When served with a restraining order and injunction, the plaintiff allegedly threatened Grid's life.

The eventual outcome of this lawsuit may have long-standing effects not only on hams but on CB'ers and anyone else using radio transmitting equipment. Should the court find in favor of the plaintiff, it would enable any TV viewer to decide when and how a transmitter might be used.

This lawsuit has cost money to defend and donations are being solicited by the Sarasota Amateur Radio Association, P.O. Box 3326, Sarasota, Fla. 33578. Any contribution will be appreciated. We will keep you informed of developments.

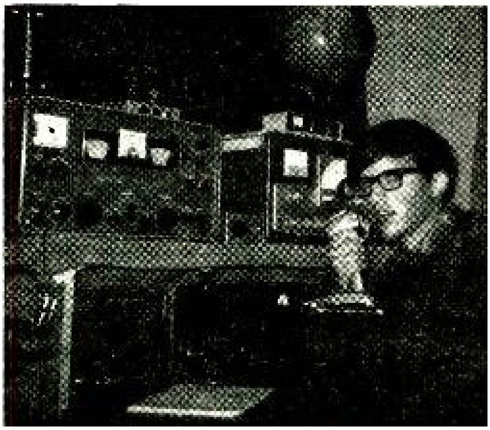
One-Land QSO Party. Between 0000 GMT, April 26, and 2400 GMT, April 27, operate any 24 hours. New England stations work the world and vice versa. Exchange QSO numbers, signal reports and names of counties, states, and operators with each station worked. The same station may be worked once per band and mode (phone and CW). Contacts between U.S. stations count one point, except Novice contacts count five points. Contacts between New England and foreign stations count three points. Stations outside of New England multiply their QSO points by the number of N.E. counties (maximum 67) plus the number of N.E. states (maximum 6) worked. N.E. stations multiply SQO points by sum of states and counties worked and again by the number of countries and continents worked. Suggested frequencies: CW, 3575, 7080, 14,075, 21,090, 28,090 kHz, and all Novice frequencies. Phone: 7290, 14,340, 21,440, and 28,690 kHz.

Logs go to: Thomas D. Walsh, K1VGM, 53 Neponset Rd., Quincy, Mass. 02169. Include stamped return envelope for list of winners if desired. Also, if you plan to go "all out" to win one of the many trophies and certificates offered to various amateur and SWL winners, a stamped envelope to Tom will get you official contest rules.

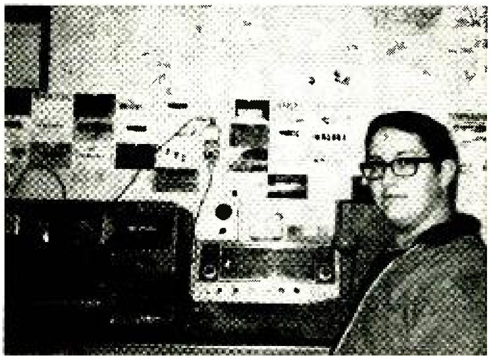
Useful CW Operating Manual. A few years ago, we recommended the booklet, "A Condensed Manual of Radiotelegraph Operating Procedure and Technique for the Amateur Service," published by the Aeronautical Center Amateur Radio Club, Inc., Postal Station 18, Oklahoma City, Ok. 73169, as a good investment for any amateur who wants to be a good CW operator. We repeat the recommendation, and you can hardly beat the price of 30 cents, postpaid.

Another Try at Reciprocity. No sooner had Barry Goldwater, W7UGA, returned to the halls of Congress than he introduced a new resolution to permit certain aliens to have ham stations. Barry proposed an amendment to the Communications Act permitting eligible aliens to operate amateur radio stations in the USA. Chances of passage are not considered too good since there is a Congressional underground movement to scrap the whole Communications Act and start over—rather than continuing to make piecemeal amendments.

It's a shame, since numerous countries permit our duly licensed hams to operate within their borders.



Sid Tryzbiak, WB4HXP (ex-WA1HJM), has worked 36 states and five countries on phone in the short time he has been in Orlando, Fla. His equipment includes Hammarlund HG-170A receiver, Johnson Valiant transmitter, an all-band vertical, 40-meter dipole as well as a rotary 15-meter dipole antenna.



With a Globe Scout 350A transmitter and Lafayette HE-80 receiver, Jack Reece, WNØVLT, Cameron, Mo., has worked 36 states and three Canadian provinces.

NEWS AND VIEWS

Bill Neidlinger WB4EBD, 1924 Ashland Dr., Clearwater, Fla. 33515, remembers hurricane Gladys in October; it blew down his antenna tower! The new tower is a Rohn 60-footer supporting a Mosley Classic 10-, 15-, 20-meter beam and a Hy-Gain DB-62 for 6 and 2 meters. He also has a 40-meter dipole. Inside the shack are Hallicrafters SX-62 and SX-146 receivers and an HT-46 transmitter, plus an AMECO TX-62 transmitter and associated gear. Bill operates CW exclusively, has worked all states, and is active in the Amateur Radio Emergency Corps (AREC) and the Clearwater Amateur Radio Society.

Gregory Ginn, WB6ZNM, 1240 21st St., Hermosa Beach, Calif. 90254, encloses the following note when he sends a QSL card. "Ur QSL will be much appreciated and will be displayed in my shack for all to see and envy." Greg has worked 95 countries and the 50 states, running 100 watts into a 10-, 15-, 20-meter triband beam with a Hallicrafters SX-111 receiver doing the huffing and a Gonset GSB-100 transmitter doing the puffing. Twenty-meter DX chasing is Greg's favorite facet of amateur radio; his big ambition is to become the QSL manager for a DX station. . .**Steve Korn WN2FKE,** 12 Sanderson, West Caldwell, N.J. 07006, worked 35 states and 16 countries in two months as a Novice. He uses a Knight-Kit T-60 transmitter, Lafayette HA-500 receiver, and a Hy-Gain 18-AVQ vertical antenna. Possibly having the antenna mounted 64 feet above the ground on the roof of a building has something to do with how well Steve gets out. Eightly meters followed by 15 meters are his favorite bands.

David Anderson, WN1JXD, 16 Hutchins Ct., E. Greenwich, R.I. 02818, runs 35 watts to a Lysco transmitter—a popular unit about 15 years ago. It, in conjunction with a Hallicrafters S-120 receiver

(Continued on page 101)

SHORT-WAVE LISTENING

By HANK BENNETT, W2PNA/WPE2FT
Short-Wave Editor

A HAM SPEAKS FOR SWL'ING

SOME WEEKS ago our mail contained an interesting letter from Bill Orr, W6SAI, Menlo Park, Calif. Bill needs little introduction to many of our readers. He is a prolific author of books and magazine articles, a world traveller, and a critic of the "appliance operating" radio amateur.

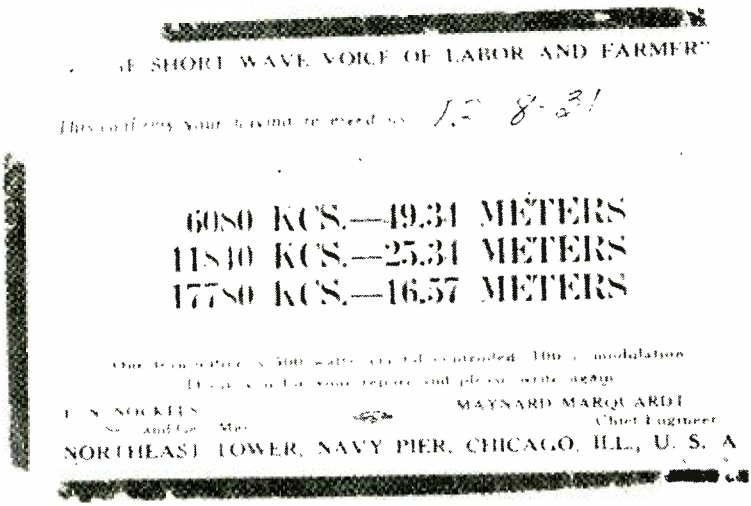
Bill sent along a photo of one of his oldest QSL cards—W9XAA, *The Short Wave Voice of Labor and Farmer*, Chicago, Ill. Dated December 8, 1931, the QSL lists operating frequencies of 6080, 11,840, and 17,780 kHz with a power of 500 watts. That was high power in those days! Mr. Orr asks if our current monitors have any earlier international broadcasting QSL's?

In his letter, Bill goes on to say, "It's too bad that more hams don't indulge in short-wave listening. A lot goes on outside the ends of the ham dial and many fellows who have ham-band-only receivers never get to hear it."

As examples, Bill suggests these items:

- The U.S. Navy single sideband net between McMurdo Sound, South Pole, and Palmer Base on 7995 and 11.256 kHz. They can be heard around 0400 with traffic between the bases and New Zealand.
- RID, a new Soviet time station, has shown up with time ticks on 15,004 kHz, just a shade higher than WWV. Callsign is given in Morse code at 15-minute intervals. Your Editor has heard this one.
- Bill confirms that several 3rd harmonic signals of *Radio Moscow* "regionals" are being heard between 2300 and 0100 in the frequency range of 28.000 to 28,700 kHz. Some are quite strong and all are in the Russian language with music.
- Listen to the Japanese citizens band around 27,500 to 28,000 kHz near 2300. "It sounds just like ours, only more unintelligible!"

Radioteletype. If any of our monitors has equipment to receive RTTY signals, he might try for some of these goodies: BZB85, Peking, China, on 16,138 and 15,865 kHz, every fourth hour starting at 0100; ZEN77, Hong Kong, 16,275 kHz, at 0600 and 1800;



A really "ancient" QSL card received by Bill Orr, W6SAI, Menlo Park, Calif., in 1931 when SWL'ing was just getting on its legs. Bill is an ardent SWL'ing ham.

India News Service, New Delhi, 15.290 kHz, at 1000; and Pyongyang, North Korea (callsign dubiously listed as KCNA) on 16,402 kHz, with no set schedule but on the air six to eight times daily. All of these stations operate at about 60 words per minute. You MAY listen to and copy these stations; you MAY disclose the ID's and times heard; you MAY NOT disclose any of the news items or messages that are received.

Veri Suggestion. As most DX'ers are aware, it is becoming increasingly difficult to get a verification from the point-to-point stations. One that is still sending QSL's, however, is 5BC238, Nicosia, Cyprus, operating on 23,860 kHz. It has been logged at 1600 in a circuit to London. The power is listed as 30 kW. Reports go to Cyprus Telecommunications Authority, Saranta Spilia Transmitting Station, Nicosia, Cyprus.

Utility Loggings. For our readers who can copy Morse Code, here are a few unusual countries that you might like to add to your log.

Canal Zone—NBA, Balboa, 12,883 kHz at 2245 with CQ tapes, V running markers and slow ID's.

Curacao—PJC6, the Dutch Navy at Suffisant on 8565 kHz at 0024 with CQ and V markers.

Malta—A rare catch is GYR at Valletta (Lascaris-?) on 8640 kHz at 0215 but heavy QRM from WCC and KOK.

Martinique—FFP7, Fort-de-France, dual with FFP, on 8675 kHz at 2136 with CQ and V markers and running at an even 20 words per minute.

Copying CW stations, especially the relatively slow-speed coastal stations, such as those listed above, makes a most interesting way to build up your code speed while, at the same time, adding numerous new countries to your log.

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, Canadian areas, and zones verified. Several others have total scores of 200.

James Young (WPE6ENA) Wrightwood, Calif.	230	50	12	40
Chuck Edwards (WPE4BNK) Fort Lauderdale, Fla.	200	50	12	30
Charles Matterer (WPE6DGA) San Leandro, Calif.	180	50	12	
Paul Kilroy (WPE3FOB) Washington, D. C.	170	50	12	
Mike Mandrick (WPE2GVF) Rochester, N. Y.	160	50	10	
Gary Ligon (WPE4JAX) Cliffside, N. C.	150	50	12	
Ed Fellows (WPE7BLN) Seattle, Wash.	200	0	12	
Mark Connelly (WPE1HGI) Arlington, Mass.	160	50	0	
Bernard Hughes (G2PE6D) Worcester, England	170	40	0	
L. E. Kuney (WPE8AD) Detroit, Mich.	150	50	10	
Don Jensen (WPE9EZ) Racine, Wisc.	190	20	0	

CURRENT STATION REPORTS

The following is a roundup 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.

Australia—Melbourne's newest frequency, 21,740 kHz, is producing excellent signals in its N.A. beam at 0100-0300 dual to the older frequencies of 17,840 and 15,320 kHz. Also heard well is 9580 kHz at 1200 with pop music. The 6140 kHz outlet at Perth is heard from 1028-1051 dual with 9610 kHz

DX ALL-ZONE AWARDS PRESENTED

To be eligible for one of the new DX All-Zone Awards designed for WPE Monitor Certificate holders, you must have verified stations in 10, 20, 30, or 40 radio zones of the world. The following recently qualified for and received awards.

40 ZONES VERIFIED

James Young (WPE6ENA), Wrightwood, Calif.

30 ZONES VERIFIED

William P. Kilroy (WPE3FOB), Washington, D. C.
Chuck Edwards (WPE4BNK), Fort Lauderdale, Fla.
Steven Kennedy (WPE4IAX), Sarasota, Fla.
Robert Crowell (WPE4HKO), Mary Esther, Fla.

20 ZONES VERIFIED

Paul Slater (WPE1FRT), Medford, Mass.
Donald Weber (WPE8IPJ), Westlake, Ohio
Clifford Duncan (VE5PE5V), Cut Knife, Sask.

10 ZONES VERIFIED

John Sawhill (WPE1GPN), New Canaan, Conn.
Robert Asbury (WPE2PYT), Williston Park, N. Y.
Thomas Feeney (WPE1GZC), Newport, R. I.

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.

12 CANADIAN AREAS VERIFIED

Robert Baker (WPE2PFM), Pitman, N. J.

10 CANADIAN AREAS VERIFIED

Michael Feinstein (WPE2OAV), Bridgeton, N. J.
Martin Tarnowsky (WPE2PZD), Montvale, N. J.
Jeff Wilson (VE3PE2NL), Sarnia, Ont.

8 CANADIAN AREAS VERIFIED

Bill Migley (WPE8JEL), Lancaster, Ohio
Jack Gladden (WPE5EXI), Fort Worth, Texas
Robert Asbury (WPE2PYT), Williston Park, N. Y.
Richard Vessell (WPE9EIL), Bloomington, Ill.
Robert Downey (WPE4INN), Newport News, Va.

6 CANADIAN AREAS VERIFIED

Montie Fisher (WPE5ESZ), Oklahoma City, Okla.
Steven Kennedy (WPE4IAX), Sarasota, Fla.
Carl Downie (WPE3EGP), West Mifflin, Pa.
Michael Lynch (WPE2QEA), Auburn, N. Y.
David Peters (WPE6HDM), Modesto, Calif.
Kevin Krueger (WPE9JDI), West Allis, Wisc.
Bill Eisinger (WPE7COQ), Gooding, Idaho
Ori Siegel (WPE2QIX), Toronto, Ont.
Gary Rasmussen (WPE7CTI), Sunnyside, Wash.
Michael Forbes (VE3PE2OE), Cornwall, Ont.

with IS, ID, sports, music, weather and shipping reports.

Belgium—Brussels was logged on 6125 kHz with an unscheduled xmsn to N.A. at 0030-0100 with light music, talks and pop European music in English. French and Dutch had been previously scheduled here. A new frequency found recently is 9552 kHz at 2141-2215 with IS, talks and music in all French.

Bolivia—CP58, *R. Progresso*, La Paz, is a new station on 6005 kHz and is heard best around 0200 with usual L.A. programming. CP89, *R. San Rafael*, Cochabamba, 5055 kHz, verified with a mimeographed form after many reports; best time is after 2100 with Spanish religious programs.

Brazil—*R. Visconde do Rio Branco*, 4770 kHz, is audible at times from 2300 with Portuguese language and Brazilian tunes. . . ZYZ36, *R. Globo*, 11,805 kHz, continues to be one of the best heard Brazilians on the West Coast. It is very good from 2300 with news on the hour and music and commercials in the interim. Located in Rio de Janeiro, it will verify reports written in English.

Bulgaria—A new frequency for *R. Sofia* is 9620 kHz, noted 2200-2230 in Italian to Western Europe with news, commentary, light music and a talk. The IS is played on an organola.

Chad—*R. Chad*, Fort Lamy, has been found on 11,800 kHz with native music and a commentary in Arabic at 1445-1515.

China—*R. Peking* has these new frequencies in service: 15,385 kHz from 0100 s/on in Spanish, dual to 17,715 kHz; 15,229 kHz at 0300 in Chinese but weak; 15,185 kHz in English to N.A. at 0100-0158; and 4905 kHz with IS at 2230 and into language. Also noted: 9780 kHz in English at 0100-0155 and 0300-0355 and 15,060 kHz in English at 0205 with many breaks in xmsn.

Colombia—A tentative listing for what seems to be a new station is *Emisora Nueva Mundo* (may also ID as *Transmitte Caracol*) on 4752 kHz around 0200. . . HJZM, *R. Nacional de Colombia*, Bogota, 9635 kHz, was noted at 0400 with a special program of some sort, dual to 4955 and 6180 kHz. The 9635 kHz outlet quickly faded and does not seem to be in regular use.

Costa Rica—The station listed last month on 6150 kHz is not yet confirmed but further monitoring indicates a definite *R. Ateneas* ID. Apparently not on a daily schedule, this San Jose outlet is often noted around 0500.

Dominican Republic—Also listed last month, this 3215 kHz station is definitely giving the ID of *R. Libertad*, Santiago. No clue has been given to clarify the *R. Ventas* ID previously heard. Do not confuse this station with the clandestine station of the same name.

Ecuador—HCJB, Quito, is using two new frequencies: 15,185 kHz at 0520 in English and 0530 in Romanian, and 17,860 kHz at 1940-2000 in English religious programming. . . HCAH3, *R. Trebol*, Zaruma, 4917 kHz, has finally verified after eight reports. They list their power as 2 kW.

Egypt—Cairo noted at 0300 in an Arabic s/on on a new frequency of 15,300 kHz. An outlet on 9550 kHz is also reported with Arabic at 2040 and English at 2045.

England—London has been found on a previously unreported frequency of 7120 kHz with IS at 0700 s/on in the European Service.

France—*ORTF*, Paris, has placed 15,295 kHz into service with English at 1915-1930. An all-French xmsn was noted at 0607-0730 on 9620 kHz with light music and talks; this was a Sunday logging.

Germany (GFR)—Two stations which are very rarely reported by N.A. listeners are *Bayerischer Rundfunk*, Munich, at 0525-0554 with music on 6085 kHz and *Suddeutscher Rundfunk*, Muhlacker, 6030 kHz, at 0710. Both xmsns were in German.

Guatemala—TGCH, *R. Chortis*, Jocotan, 3380 kHz, is fair at 0100 with talks, Guatemalan music and commercials. This station is easy to ID because of its use of the theme from the TV show *"Bonanza"* at closing.

Guyana—ZFY, *R. Demerara*, Georgetown, 3265

(*Continued on page* 103)

David Yetman, PWE1ETK, North Reading, Mass. has, on his right, a modernized National NC-88 receiver and a Zenith receiver for medium-wave DX'ing. The large console at center is for citizen's band use.

SOLID STATE

By LOU GARNER, Semiconductor Editor

BETTER QUALITY semiconductor devices at lower prices may result from the use of a new type of production test instrument developed at Bell Telephone Laboratories. Dubbed the "Profilometer," the new instrument was invented by Bell scientist John A. Copeland (Fig. 1) and is not only capable of much faster and more accurate tests than earlier machines, but costs only a fraction as much to build and operate.

The majority of modern semiconductor devices, whether transistors, FET's, or IC's, are manufactured from thin wafers of silicon, germanium, or special alloys. The electrical properties of these wafers are established by adding exact amounts of such impurity elements as boron or arsenic. The measurement of wafer impurity densities before processing is an essential quality-control step in the fabrication of the final devices.

The needed data was previously obtained by using a costly machine and a tedious discrete measurement technique. Test results then had to be processed by computer to convert the raw figures into meaningful information. These extra time-consuming steps help to increase the price of the final semiconductor. In contrast, the new Bell Labs instrument can make the necessary measurements and plot a "profile" of wafer impurity densities within seconds, thus reducing fabrication cost and eventually the unit cost to the final purchaser.

In operation, the test engineer first deposits tiny metal dots along the surface of the semiconductor wafer. A probe placed on one of the dots passes a low-level 5-MHz current through the dot. At the same time, an increasing d.c. voltage forces mobile charges—electrons or holes—out of an increasingly deep depletion region under the dot. No measurements are made of the d.c. voltage since it functions only to vary the depth in which impurity densities are measured beneath the surface of the wafer. It can do this because no net charge exists within the semiconductor under ordinary conditions. When an increasing d.c. voltage is applied to the metal dot, the free electrons (or holes) near the wafer surface are forced farther down, leaving only a fixed charge due to impurity atoms in the depletion region.

For practical purposes, then, each metal dot acts as one plate of a capacitor, while the depletion region acts as a dielectric. The constant 5-MHz, r.f. drive current causes the edge of the depletion region beneath the dot (acting as the other plate of the capacitor) to oscillate over a short distance, generating a small voltage at the second harmonic of the drive current. This voltage is inversely proportional to the impurity density at the depth of the depletion region in the wafer. The voltage of the fundamental frequency is proportional to the depth inside the wafer.

Thus, two signals are obtained simultaneously—one proportional to depth (beneath the wafer's surface) and another inversely proportional to the impurity density at that depth. In practice, these two sig-

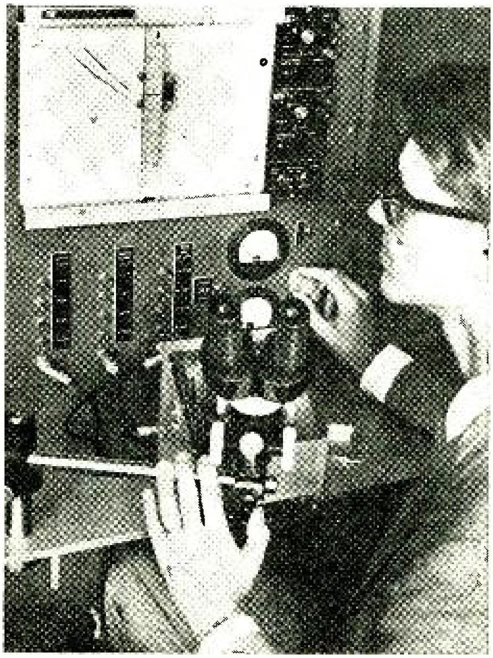


Fig. 1. Inventor John A. Copeland, Bell Telephone Laboratories, uses new Profilometer to plot the densities of impurities in a semiconductor wafer.

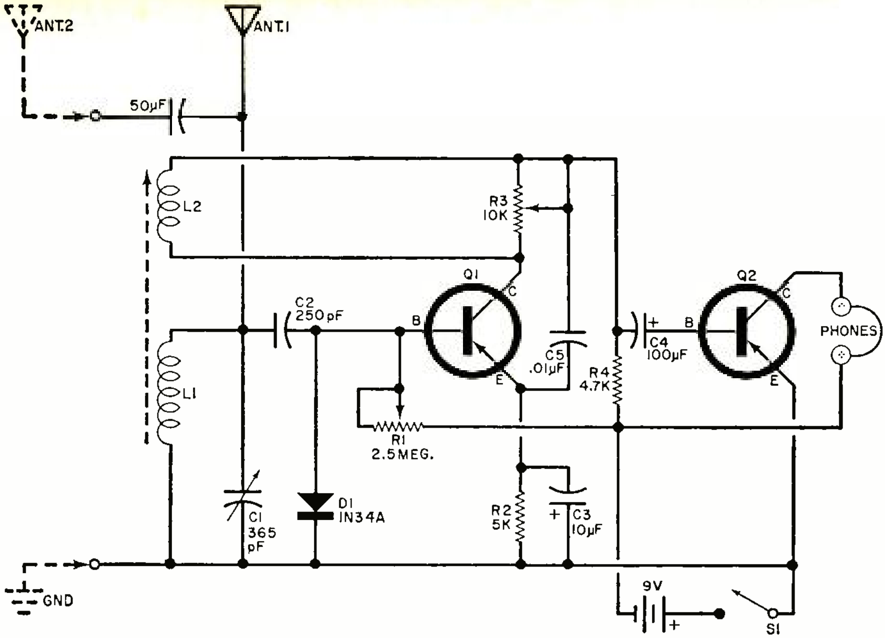


Fig. 2. In this two-transistor receiver circuit, regenerative feedback is used in Q1 portion of the circuit while Q2 serves as a capacitively coupled audio amplifier. Use 2000-ohm phones.

nals are picked up by a pair of modified short-wave receivers and converted, after amplification, into d.c. signals large enough to operate an X-Y recorder. A continuous curve is plotted showing the impurity densities at all depths within the wafer. A typical graph can be seen in Fig. 1. Impurity densities through the wafer can be plotted at each point where a metal dot has been deposited.

The Profilometer can measure impurity densities as low as one atom in one billion over distances as small as one ten-thousandth of an inch, or, for impurity densities as high as ten atoms per million, over distances as small as one millionth of an inch. In coming months, the new instrument may be used by a number of semiconductor manufacturers to insure the quality of their products.

Reader's Circuit. Submitted by reader James F. Kaminski (23 Fairmeadow Road, Wilmington, Mass. 01887), the AM broadcast-band receiver shown in Fig. 2 should make an excellent "one-evening" project for the beginner or student. James writes that he developed the circuit by combining and modifying features found in several other designs. He built the unit as part of his work for a Radio Merit Badge as an Eagle Scout.

Referring to the schematic, diode *D1* and *pnp* transistor *Q1* work together as a regenerative* amplifier/detector stage while a second *pnp* unit, *Q2*, serves as a capacitively coupled audio amplifier. In operation, r.f. signals picked up by the antenna system are selected by tuned circuit *L1-C1* and coupled through capacitor *C2* to *D1* and *Q1*. Detector-stage base bias is supplied through *R1* and stabilized by emitter resistor *R2*, bypassed by *C3*. Regenerative r.f. feedback is furnished by coil *L2*, shunted by regeneration control *R3*. The detected audio signal developed across *Q1*'s collector load resistor, *R4*, is coupled to the audio stage, *Q2*, through *C4*, with *C5* serving as an r.f. bypass to minimize the load's effect on regenerative circuit action. Conventional 2000-ohm magnetic earphones are used for the output.

James has specified inexpensive, readily available parts in his circuit. Transistors *Q1* and *Q2* are general purpose *pnp* units, such as types 2N107, 2N404, or 2N1305. A standard broadcast-band, ferrite coil is used for *L1*, while *L2* consists of 7 turns of any thin insulated wire (size 22 to 30). *L2* is wound directly on, or alongside, *L1*, depending on the latter's size and form.

In common with the majority of simple receiver circuits, neither parts arrangement

**See the Transitips section of Solid State, POPULAR ELECTRONICS, November, 1968 for a discussion of regenerative circuits.*

nor wiring dress should be critical, but, of course, good wiring practice should be followed, with all d.c. polarities observed and signal leads kept short and direct. The receiver may be assembled breadboard fashion or, if desired, on any type of board or chassis.

The receiver's self-contained antenna, *ANT1*, consists of a telescoping "whip" type three to four feet long, but terminals are provided for external antenna (*ANT2*) and ground (GND) connections. James writes that external antennas as long as 30 feet, or more, may be used for maximum sensitivity.

After assembly, check out, and test, two minor adjustments may be needed for optimum performance. Tune to a local station, adjusting *R1* and *R3* as needed; then, with *R3* set in about mid-position, adjust *R1* for maximum gain with minimum distortion. Next, try reversing *L2*'s leads, using the connection which provides maximum sensitivity and readjusting *R1* as needed. If a high-gain transistor is used for *Q1*, the circuit may oscillate with some settings of *R1* and *R3*; this is normal for a regenerative circuit and does not indicate trouble. In use, *R1* generally is left fixed in its pre-adjusted position, while sensitivity is adjusted by means of regeneration control *R3*. With some transistors, you may have to use a resistor of 100,000 to 330,000 ohms between the collector and base of *Q2*.

Manufacturer's Circuit. The versatile "touch control" circuit shown in Fig. 3 may be used in a variety of applications, depending on the needs, interests, and imagination of the user. Typically, it might be employed for special display or stage effects, in magic tricks, in emergency lighting, or as part of a safety alarm or signal system. It is one of a number of related circuits described in "Small Scale Integration in Low

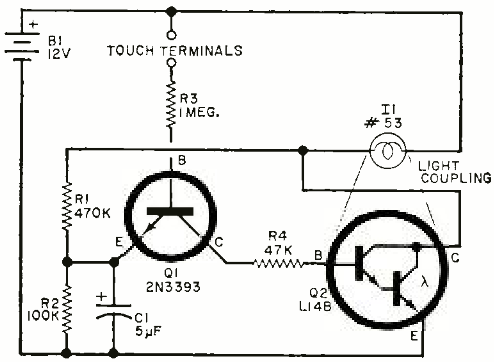


Fig. 3. Touch control circuit uses photo-Darlington transistor, which, once triggered, is held on by I1.

Cost Control Circuits," a section of *Seminar Applications* booklet No. 671.9, published by General Electric's Semiconductor Products Department (Electronics Park, Syracuse, New York 13200).

Referring to Fig. 3, we find that the design features an *npn* photo-Darlington device (*Q2*) controlled by a conventional *npn* bipolar transistor, *Q1*. Resistors *R1* and *R2* form a voltage divider which establishes a net positive charge across *C1* when the circuit is in its off (nonconducting) state. Both *R3* and *R4* serve as base current-limiting resistors. The load is a conventional incandescent lamp while a 12-volt d.c. source furnishes circuit power.

In operation, a momentary high-resistance contact (such as that caused by a person's touch) across the control terminals applies base bias current to *Q1* through resistor *R3*, permitting *Q1* to conduct and apply *C1*'s charge to *Q2*'s base through *R4*. Thus, *Q2* is switched to a conducting state, lighting lamp *I1*. *Q2* is held "on" by light coupled from *I1* to its photo-sensitive surface. Under these conditions, most of the supply voltage is dropped across *I1* so that very little voltage is applied to voltage-divider *R1-R2*. As a result, *C1*'s charge is near zero and its d.c. potential is *less* than that between *Q2*'s base and *B1*'s negative terminal due to internal current flow. If, at this time, another momentary contact is made across the control terminals, *Q1* again conducts, and *C1*, discharged, acts as an effective short across *Q2*'s base and emitter terminals. This switches *Q2* back to a nonconducting (or high-resistance) state and turns off *I1*.

The circuit cycles between its on and off states each time the control terminals are touched. If a steady contact is made, the circuit recycles automatically, flashing the lamp at a rate determined primarily by the bias circuit's R-C time constant in conjunction with *I1*'s thermal lag.

With neither layout nor lead dress critical, the circuit may be assembled breadboard fashion for experimental study or on a small chassis or board. Regardless of construction technique, however, care must be taken to provide adequate light coupling between *I1* and *Q2*'s photo-sensitive electrode (the curved surface). The completed unit may be mounted in a wooden, plastic, or metal cabinet, depending on application needs.

Industry Items. A new series of low-cost complementary silicon power transistors has been introduced by Motorola Semiconductor Products, Inc. (P.O. Box 955, Phoenix, Arizona 85001). Identified as types 2N5190 through 2N5195, the six new units have 4-ampere, 35-watt ratings and are offered in equivalent pairs in 40, 60, and 80-volt versions. Specifically designed for direct-coupled, symmetrical push-pull amplifier applications, the entire series features Motorola's exclusive *Thermopad* plastic package (Fig. 4).

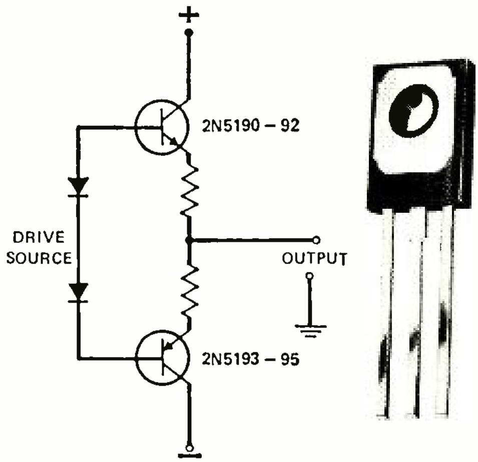


Fig. 4. Complementary silicon transistors have 4-ampere, 35-watt ratings in voltages from 40 to 80.

The Amperex Electronic Corporation (Slatersville, R.I. 02876) has announced the development of a radically new emitter geometry for r.f. power transistors. Illustrated in Fig. 5. the new geometry results in devices with excellent tolerance for the large overloads often encountered in VHF transmitters, thus insuring fail-safe operation while permitting high power outputs. Eight types are available, with voltage ratings of either 12.5 or 28 volts, and power outputs ranging from 3 to 22 watts. Carrying type numbers A270 through A277, the new units are intended for use in transmitters operated in the 175-MHz band.

Solid-state microwave devices utilizing exotic traveling-wave techniques have been developed by two major firms. One device, designed by GE engineers Harold C. Bowers and Thomas A. Midford, is a diode amplifier in the form of a strip transmission line, with the traveling-wave signal amplified as it propagates along the diode's strip-like junction. The other device, announced by Stephen Yando and Dr. C. Fischler of General Telephone and Electronics Laboratories, features a piezoelectric crystal bonded to a semiconductor wafer. In this unit, the input signal is applied to a pair of electrodes at one end of the crystal and converted into a moving acoustic wave. Amplification occurs when the traveling field associated with the acoustic wave penetrates the semiconductor material and provides a transfer of energy.

Diffused silicon planar epitaxial power transistors with 100-watt, 100-volt ratings and f_T specifications up to 40 MHz are now available from Fairchild Semiconductor (313 Fairchild Dr., Mt. View, Ca. 94040). The devices are offered in complementary versions, with the *npn* units identified as types 2N5288 and 2N5289, and the *pnp* units as types 2N5290 and 2N5291.

Engineer's Transistor Guide. One of the biggest problems facing most circuit design engineers is choosing a semiconductor. Making a selection from the over 65,000 "standard" devices now available can tax even the best minds. Texas Instruments Electronic Devices Division decided to put its

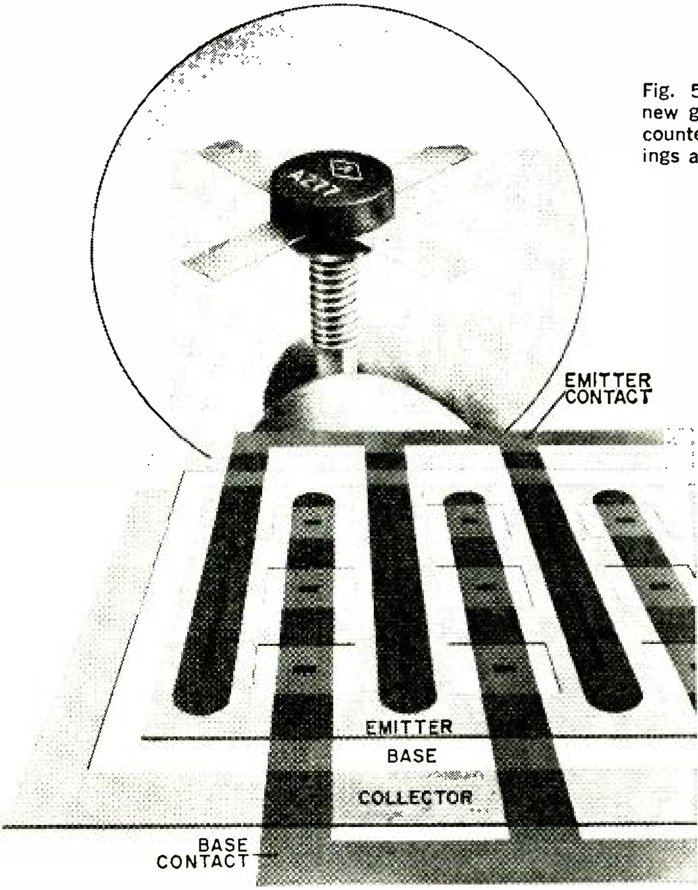


Fig. 5. R.f. power transistors have new geometry to carry overloads encountered in VHF transmitters. Ratings are 12.5 or 28 volts, 3 to 22 W.

computer to work to solve the problem. After reducing the original list to 15,000 "most-popular" types, and supplying performance, cost, and availability information, the computer came up with a selection of 285 small-signal and power transistors (both germanium and silicon), diodes, thyristers, rectifiers, regulators, light sensors and resistors which were then designated as "preferred semiconductors." When the smoke cleared, all this information was bound into a catalog which is being made available to design and standards engineers and purchasing agents, who write in on their company letterhead. The address is Texas Instruments, Inc., Technical Information Services, MS308, P.O. Box 5012, Dallas, Texas 75222.

Transitips. Realizing that excessive heat may destroy semiconductor devices, most hobbyists are careful when installing transistors, diodes, SCR's, and similar pre-tin terminals, and complete each operation as quickly as possible. But circuit disassembly, whether for repair, test, or equipment modification, can pose unique problems, especially if the project is assembled on an etched circuit board.

Quite often, a perfectly good semiconductor device is damaged when it is removed from its circuit board for tests. The worker, finding the unit defective, concludes that he has isolated his circuit defect and is quite puzzled when the equipment continues to malfunction after the "bad" device is replaced with a new unit.

Amateurs, hobbyists, students, and beginners are not the only ones who may encounter this problem. Professional technicians, "old-timers," and even design engineers have been victims from time to time.

The solution, of course, is to avoid possible heat damage by exercising as much care when removing semiconductor components as is used during initial installation of the devices.

Several manufacturers have introduced distinctive tools for solder removal. Ungar, for example, offers a unique device which combines a heating element with a bulb-operated suction tip (*Hot-Vac* De-soldering tool #7800). Another firm manufactures a spring-loaded cylindrical vacuum unit which is operated by pushing an appropriate trigger. Still another firm can supply a small bulb-type rubber syringe equipped with a heat-resistant Teflon tip.

In an emergency—or as an alternative to the purchase of a special "desoldering" tool —one can use an effective, but simple, technique. Impregnate a piece of closely woven copper braid with non-corrosive soldering flux. Hold the end of the copper braid against the soldered terminal and apply the hot tip of your soldering iron against the back of the braid. As the solder melts, capillary action will suck it up into the braid. Remove the iron and braid simultaneously and, when the solder cools, clip off the solder filled braid section and discard.

A special braid for this purpose is manufactured under the trade name "Soder-Wick" by the Solder Removal Company (San Dimas, CA 91733) and distributed by MacDonald & Co. (213 S. Brand Blvd., Glendale, CA 91204). *—Lou*

AMATEUR RADIO

(*Continued from page* 86)

and a multi-band "trap" dipole, has worked 15 states on 40 and 80 meters in three months. Dave likes to "ragchew"—he has a RagChewers' Certificate—and is planning to try his hand at DX chasing on 15 meters. . .Need Nevada? Members of the Sierra Nevada Amateur Radio Society plan to be on hand on the 80-, 40-, and 15-meter Novice bands March 22 and 23 starting at 9:00 a.m., Pacific time, to help those who need a Nevada contact. (I have suggested that the boys repeat the exercise two weeks later on April 5 and 6 for the benefit of readers whose POPULAR ELECTRONICS is slow in arriving.) Calls to look for are WA7HVK, WA7HVN, WA7HVY, WA7HVS, WN7JVO, WA7HVX, WN7HVW, and WN7KQS. Frequencies: 3710, 3735, 7160, 7175, 7190, 21,120, and 21,150 kHz. More information from **David Quest, WN7KQS,** 2255 Riviera St., Reno, Nevada 89502. . . In six months, **Harvey Hnatuik, WB2FWW,** 279 Forest St., Kearney , N.J., has worked all states and 20 countries with his new Swan 500C transceiver and a homebrew 15-meter beam. Next on the agenda

Before getting on the air as BW6TRK, Jim Humphrey used the very old National receiver on the table as a CW short-wave listener and surprised several Novice hams with their first and only SWL cards.

are beams for 10 and 20 meters. Harv rates EP3-AM, Iran, on SSB and KC4USM, Antarctica, on CW as his best catches, by the way.

Vic Muscat, WA1GWS, Sherman Ave., Greenwich, Conn. 06830, reports that the East Coast Teen-age Traffic Net meets Monday through Saturday at 2200 GMT on 7240 kHz. . .**Joseph H. Nicolosi, WN8BME,** 6870 Rushton Dr., Dayton, Ohio 45431, finds that studying Electrical Engineering at the University of Dayton severely limits his time on the air. Nevertheless, he has worked 13 states and Canada on 80 meters using a Knight-Kit T-60 transmitter and R-55A receiver. Joe says that he has learned that listening—not transmitting—is the key to working DX. He further observes that Ham radio is a fraternity, rather than a hobby, which is why they have more fun than people in any other hobby. . .**James Humphrey, WB6TRK,** 1656 E. 33rd St., Los Angeles, Calif. 90011, covers the states on 40 meters with the 20-watt transmitter from his National Radio Institute radio course exciting an end-fed wire. He receives on a 20-year-old National NC-125 receiver. Before getting on the air, Jim

Art Erickson, W1NF, Beverly, Mass., is one of the stalwarts of the "Intruder Watch" described in our December column. In addition, he really puts out a "big" signal on most of the SSB and CW ham bands.

was a CW SWL and really "shook up" Novices when he sent them SWL cards; they never knew that SWL's ever listened to CW stations. (Although rare in the United States, CW SWL'ing is quite common in other parts of the world—behind the "iron curtain," especially.) . . . **Jackie Reece, WNØVLT,** Rural Route #4, Cameron, Mo. 64429, has 30 states and two Canadian provinces confirmed of the 36 and three worked, respectively. In reverse order of their importance, Jackie uses a Globe Scout 350-A transmitter, dipole antenna, and Lafayette HE-80 receiver . . . Thanks to Ray Meyers, W6MLZ, for the nice mention he gave the POPULAR ELECTRONICS COMMUNICATIONS HANDBOOK in his weekly Los Angeles "Examiner" amateur radio column.

Before we can see your picture or "News and Views" in your column, you must take the first step: put them in an envelope and mail to us. Also, we greatly appreciate being put on or kept on the mailing list to receive your club papers and bulletins. Send all mail to Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P.O. Box 678, Gary, Ind. 46401.

73, Herb, W9EGQ.

SHORT-WAVE LISTENING

(*Continued from page 93*)

kHz, is often good in English at 0030-0100; they run until 0345 Sunday with a live dance program from a Georgetown hotel. It is also good from 0520 to as late as 0730.

Iran—*R. Tehran,* while announcing frequencies in use for the English xmsn ending at 2027 as 11,-705 and 15,105 kHz, is actually operating on 11.690 and 15,135 kHz. An ID and IS is given at 2030, then into native language.

Italy—Rome has placed 17,815 kHz in use from 1705 s/on in Italian. An Italian xmsn to N.A. at 2300-0000 is aired on 9710 and 9575 kHz with opera, talks and pop Italian music. English is noted on 9575 kHz at 0100-0120.

Korea (North)—*R. Pyongyang's* English schedule as given over the air: to S.E. Asia at 0800-0900 on 19.3 and 45.9 meters (roughly, 15.520 and 6540 kHz) and at 1100-1200 and 1400-1500 on 39.5 and 46.3 meters (probably 7580 and 6480 kHz); to L.A. at 1800-2100 and to Europe at 0340-0600 on 11,765 and 7580 kHz. A xmsn in Spanish is logged on 16.320 kHz from 2300 s/on to 0000 and in Korean until 0100 s/off. What is thought to be a Home Service xmsn operates on 11.346 kHz from 2220 or earlier to at least 2315 in Korean with excited speech and some native music. Don't confuse with *Radio Peking* operating nearby.

Kuwait—*R. Kuwait* operates on 9520 kHz in Arabic at 0230-0400, 0600-0700, 0900-1600 and 1900-2100. English is at 0400-0600 and 1600-1900 on 9520 and 4967.5 kHz (also on 17,750 kHz at 0400-0600) and at 1600-1730 on 11,920 kHz. Reports to Box 397, Kuwait.

Popular DX program, "Sweden Calling DX'ers," recently broadcast its Edition #1000 in the English language. A special QSL card marked the occasion.

Malagasy—The new International Service from Tananarive, in French and English, is heard on 17,730 kHz at 1330-1430 with pop records and tourist talks. Reports are requested to Box 442, Tananarive. At press time, however, the station is not being heard on a daily basis and is badly QRM'ed by *Radio Moscow.* A QSL card received in two weeks shows a power rating of 10 kW.

Malawi—This country is to have two new xmtrs, one each of 20 kW and 100 kW, on the air by July. No frequencies were given. On medium waves, Mzimba on 674 kHz and Nkhotakota on 908 kHz are to receive new 1-kW units to supplement Bangula's similar xmtr on 1277 kHz.

Malaysia—London's Far East relay at Tebrau is excellent on 11,850 kHz from 0000 s/on with program preview and English news.

Mauretania—Nouakchott, 4850 kHz, was received briefly at 2210 with Arabic chants during a silent period of the ever-present RTTY station on the frequency. (Editor's note—can anyone confirm Mauretania on this frequency? Our listings show only Mauritius here).

Mexico—XEUW, *El Eco de Sotavento*, Vera Cruz, 6020 kHz, is good on the West Coast around 0630 with L.A. music.

Mongolia—*R. Ulan Baton* is presumed to be the station being logged on 7260 kHz to abrupt s/off at 1058 with typical Asian programs and talks. The signal is generally good but the modulation is weak.

Morocco—Long-wave DX'ers, take note of this one: The new 400-kW xmtr on 209 kHz is located at Azilai, Central Morocco. It is—at press time—still testing although the actual schedule lists weekdays 1800-0000, Sundays 0630-0200. The power is to be increased to 800 kW!

SHORT-WAVE CONTRIBUTORS

Stan Mayo *(WPE1GMF)*, Portland, Maine
E. Richard Gombar *(WPE1HBP)*, Shelton, Conn.
David Rose *(WPE1HEF)*, East Hampton, Conn.
William Brechlin *(WPE1HNZ)*, Berlin, Conn.
Dr. Donald Mahler *(WPE1HOK)*, Newton Center, Mass.
Eugene Shiwotsuka *(WPE2NBL)*, New York, N. Y.
Peter Macinta *(WPE2ORB)*, Kearny, N. J.
Anne Karnbach *(WPE2PNR)*, Richmond Hill, N. Y.
Howard Rosenberg *(WPE2PQE)*, Queens Village, N. Y.
Michael Feinstein *(WPE2QAV)*, Bridgeton, N. J.
Gary Chiapola *(WPE2QDU)*, Rockville Centre, N. Y.
Larry Weintraub *(WPE2QHK)*, Cambria Heights, N. Y.
Tom Shultz *(WPE2QJJ)*, Cherry Hill, N. J.
Steven Krane *(WPE2QKT)*, Hewlett, N. Y.
Carter Scholz *(WPE2QLX)*, Tenafly, N. J.
John Karien *(WPE3GOC)*, Franklin, Pa.
Joel Brill *(WPE3HVH)*, Philadelphia, Pa.
Dan Ferguson *(WPE4AUL)*, Coral Gables, Fla.
Grady Ferguson *(WPE4BC)*, Charlotte, N. C.
David Meisel *(WPE4IRS)*, Charlottesville, Va.
Albert Garrou *(WPE4JMG)*, Valdese, N. C.
David Potter *(WPE4JXO)*, Key West, Fla.
Robert Olson *(WPE4JZF)*, Winston-Salem, N. C.
Evan Newlon *(WPE5EZA)*, Albuquerque, N. M.
Charles Bennett *(WPE5SW)*, Sumrall, Miss.
James Young *(WPE6ENA)*, Wrightwood, Calif.
Trevor Clegg *(WPE6FAF)*, Fresno, Calif.
Edward Shaw *(WPE6HCD)*, La Mesa, Calif.
Jim Lacko *(WPE6HCX)*, Los Angeles, Calif.
Jeff Utter *(WPE6HDJ)*, Carlsbad, Calif.
Mary Kohlruss *(WPE7CIG)*, Wallace, Idaho
William Jordan *(WPE8JYI)*, Newberry, Mich.
Gary Smith *(WPE8JZE)*, Toledo, Ohio
Art Mitchell *(WPE8KCL)*, Steubenville, Ohio
Gerry Dexter *(WPE9HDB)*, Lake Geneva, Wisc.
Richard Pistek *(WPE9HOA)*, Chicago, Ill.
Jim Bochantin *(WPE9JDA)*, Du Bois, Ill.
Mark Frisch *(WPE9JGL)*, Brookfield, Wisc.
Benny Loveless *(WPE9JLQ)*, Frankfort, Ind.
A. R. Niblack *(WPE9KM)*, Vincennes, Ind.
John Beaver *(WPEØAE)*, Pueblo, Colo.
C. Vernon Hyson *(WPEØCNF)*, Somerville, N. J.
David Yoder *(WPEØEZU)*, Denton, Kansas
Jack Perolo *(PY2PE1C)*, Sao Paulo, Brazil
Glenn Tamasi *(VE7PE1DY)*, Vernon, B. C.
Neil Bartlett, Verona, Wisc.
Robert Bethune, Saginaw, Mich.
Thomas Fuhrman, Dumont, N. J.
Robert Gorsch, McKinleyville, Calif.
Larry Koltun, Chesterfield, Mo.
Craig Laflin, Indianapolis, Ind.
Daniel Lindley, Florence, S. C.
Marvin McGee, Granite City, Ill.
Bill Owen, Springfield, Ohio
Mike Owen, Glen Arm, Md.
John Patterson, Oswego, Ill.
James Renfrew, New Canaan, Conn.
James Spaar, Jr., Houston, Texas
Gary Steele, Benton Harbor, Mich.
Ivan Waufle, St. Johnsville, N. Y.
David Weronka, Durham, N. C.
Sweden Calling DX'ers Bulletin, Stockholm, Sweden

Mozambique—The "A" Program of *R. Clube do Mozambique* has dropped 3265 kHz and is now scheduled on 4925 kHz at 1630-2100, on 6115 kHz at 0430-1800, on 11.820 kHz at 0430-2100 and on 15.295 kHz at 0600-1600. The "B" Program is on 3218 kHz at 1815-0315, on 1855 kHz at 0300-0730 and 1500-2200, on 6050 kHz at 0415-1745, on 9620 kHz at 0800-1400 and on 11,780 kHz at 0300-1845.

SHORT-WAVE ABBREVIATIONS

anmt—Announcement	N.A.—North America
CW—Morse code	QSL—Verification
ID—Identification	repl—Replacing
IS—Interval Signal	s/off—Sign-off
kHz—Kilohertz	s/on—Sign-on
kW—Kilowatts	xmsn—Transmission
L.A.—Latin America	xmtr—Transmitter

Nigeria—*V. of Nigeria*, Lagos, has English news at 1830 on 21.455 kHz and at 1930 on 15,350 kHz. A monitor in the midwest has logged the Lagos outlet on 3986 kHz at 0600-0619 with news, talk, time check and more music and much QRM from the ham-band operators.

Poland—Warsaw has two new channels in use—11,870 kHz at 0340 in English and 6135 kHz from IS and s/on at 0400 and into Polish; the latter on Sunday.

Qatar—Transmissions from *Idha'at el Qatar min il Douha* are listed as daily except Friday at 0330-0530 and 1400-1835 (Friday only 0430-0700 and 1400-1835) on 9570 kHz. Has anyone heard it?

Senegal—*R. Dakar* is back on 11,900 kHz from 2200-0000 s/off in French; Native music to 2215, news to 2230 and pop native music to 2300; further news at 2355.

Switzerland—According to an anmt by the station, English to Africa at 1000-1100 is now on 17,795 kHz, repl 17,855 kHz. The English xmsn to United Kingdom and Ireland at 1930-2030 on 6015 and 9665 kHz is generally heard well on both frequencies in the east.

Tunisia—*R. Tunis*, measured on 11.898 kHz, s/on at 0600, Arabic news to 0610, anmts and music until 0637 and later; all Arabic. Further Arabic was noted around 1900 and 1955 but always very weak on the west coast.

Vatican—New frequencies in use include 15,210 kHz at 1715 in English and 1725 in French, and 15.254 kHz at 1800 in Arabic.

Vietnam (North)—Hanoi puts a strong carrier on 7286 kHz at 1130 and goes into Vietnamese without any IS. An English ID is given at 1200 followed by times and frequencies, a short selection of classical music and into the usual tirade on Yankee Imperialism.

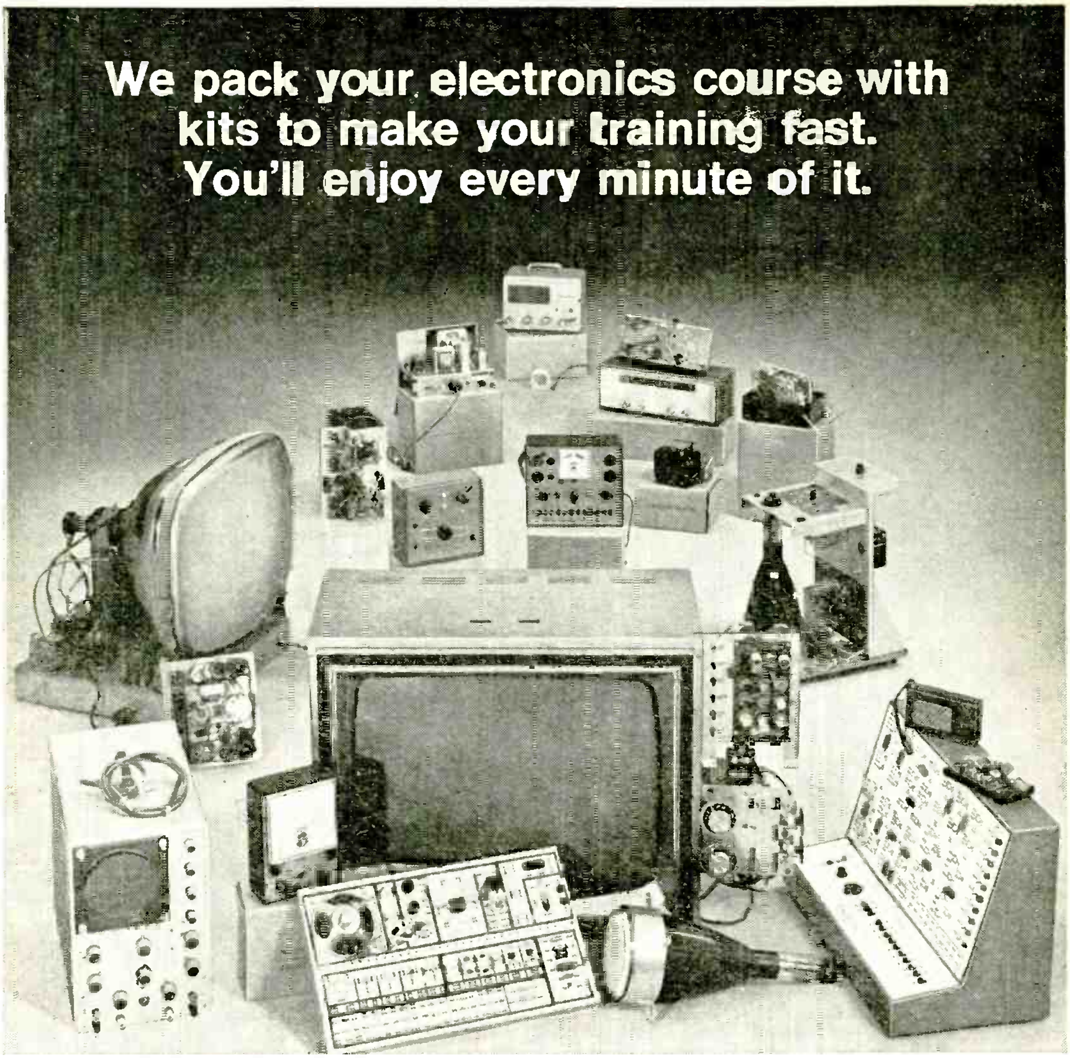
Zambia—A fine logging on the West Coast of *R. Zambia*, Lusaka, 3270 kHz, was made at 0400-0430 with news, musical selections and commercials.

73, Hank

CITIZENS BAND JAMBOREE CALENDAR

May 4, Ohio-Falls CB Club, Clark County, Ind., 4H Fairgrounds, Highway 62, east of Jeffersonville, Ind. Contact: Brad Brooks, P.O. Box 296, Jeffersonville, Ind.

June 1, Rock River Valley CB Club, Winnebago County Fairgrounds, Pecatonica, Ill., 14 miles west of Rockford. Contact: John A. Coffin, 128 N. Burbank, Rockford, Ill. 61103.



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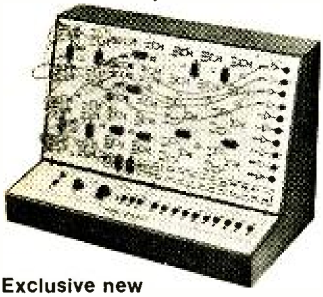

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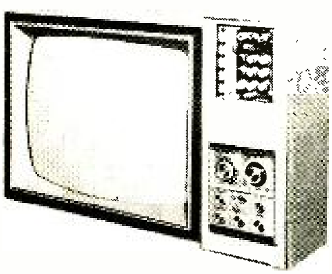

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program designed to make you a complete home-entertainment service technician. Included, at no extra cost, is a 25″ color TV that has more features than any set on the market. You also learn all about stereo, hi-fi, multiplex systems, and become a specialist in Color TV Servicing. Kits also include AM-SW radio, solid-state radio, vacuum tube volt meter, electronic tube tester.

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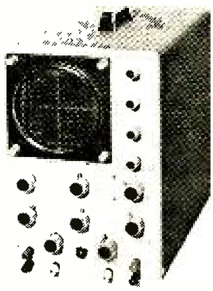

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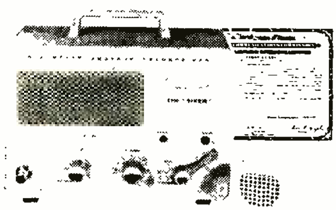

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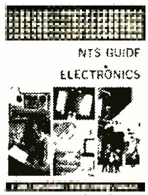

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OPERATION ASSIST

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. Do not send an individual postcard for each request; list all requests on one postcard. 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.*

E.H. Scott Radio Labs Model SLR-12-B receiver. Schematic and instruction manual needed. (Mitchell Kassoff, 252-61 Leith Rd., Little Neck, N.Y. 11362)

Zenith Model 10-S599 receiver. Schematic, parts list, and service information needed. (Bill Brideson, 6821 Duke Dr., Alexandria, Va. 22307)

Slytron service oscilloscope Model 105, Type 405. Manufacturer and address wanted. (E.V. Way, 2317 Treasure St., New Orleans, La. 70122)

Heathkit VTVM Model VI and 5" oscilloscope Model 0-9. Operating instructions and schematics needed. (Robert A. Muylaert, 20728 Lee Court, Crosse Pointe Woods, Mich. 48236)

Radio Craftsman Model CX-17 "Xophonic" time-delay audio amplifier. Schematic and manual needed. (A. Edward Terpening, 838 W. Darlington Rd., Tarpon Springs, Fla. 33589)

Precision Model 660 tube and transistor tester. Schematic and operating instructions for transistor tester portion needed. (Edward L. Robinson, Box 55, Greenwood Sta., Wakefield, Mass. 01880)

Grommes Custom Model 200 PG audio amplifier. Schematic, operating manual, and/or source of parts needed. (Richard G. Brough, Hyde School, Bath, Me. 04530)

Philco Model 10-165 receiver. Schematic and alignment data needed. (J.E. McDaniel, 4317 NW 52, Oklahoma City, Okla. 73112)

Crosley Model 716 BCB/three-band SW receiver (circa 1938-1940). Schematic needed. (Leslie Reeves, 521 Woodlawn Ave., Calhoun, Ga. 30701)

Hallicrafters Model S-38 receiver. Schematic and manual needed. (Gary Nuthals, 1155 Mather St., Green Bay, Wisc. 54303)

Sylvania Model 220 tube tester. Roll chart—any date, any issue—needed. (David H. Lawrence, 603 Thompson St., Charleston, W. Va. 25311)

Boeing Analog computer function generator (custom-made, circa 1956, with 10 generators mounted side-by-side in rack panel with plug-in pot/diode boards, employing six tubes/board). Schematics and operating instructions needed. (Kansas Technical Institute, Computer Dept., Salina, Kan.)

Philco Model 37-620, Code 121 receiver. Alignment data and parts source needed. (Toby Langlois, 7013 St. Francis Ave., Baton Rouge, La. 70811)

Hallicrafters Model S-39 Sky Ranger receiver. Schematic needed. (Karl E. Swenson, Box 72, Humboldt, Ariz. 86329)

Samwell & Hutton (Ilford, England) Type 36 B 1/R television wobbulator. Schematic and operator's manual wanted. (Jim Baker, 9611 Bellevue Dr., Bethesda, Md. 20014)

National Model "One-Ten" receiver, circa 1940. Operator's manual and source of supply of plug-in coils needed. [Ens. S.S. Litchfield, USS Wright (CC-2), FPO New York, N.Y. 09501]

Ninic Model NFM-22 hand-held receiver and charger power supply. Schematics wanted. (J. Kuebler, Jr., P.O. Box 427, Akron, Ohio 44309)

United American Bosch Model 31 BCB receiver. Schematic, tube placement diagram, and instruction manual needed. (David Sitler, 441 West 62 St., Bloomsburg, Pa. 17815)

Philco Model 40-165 receiver. Schematic, alignment instructions, and a 1232 tube needed. (Justin E. De Vault, Jr., 610 Foxx St., Montclair Sub. Div., Johnson City, Tenn. 37601)

Hallicrafters Model SX-110 receiver. Schematic and operator's manual wanted. (Gary Munn, 24 White Birch Ter., Kinnelon, N.J. 07405)

Adams Morgan Type RA10 "Paragon Regenerative Receiver" and Type DA2 amplifier. Operator's manuals and schematics needed. (Basil N. Abbott, Jr., Colonial Forest, Rte. 5, Box 322, Mechanicsville, Va. 23111)

Philco Model 39-55, Code 121 receiver. Schematic wanted. Ken Doty, 343 Navaho Trail, Huntington, W. Va. 25705)

National Model WC-2-40C receiver. Schematic and tube layout needed. (Thomas Verra, Jr., 17 Kendall Ave., Farmingham, Mass. 01701)

Knight-Kit Model KG-670 resistor and capacitor tester. Operator's manual and schematic needed. (Paul Chesloff, 123 Knoll Ter., West Caldwell, N.J. 07006)

National high-frequency receiver Type NC-200. Any information, namely schematic, would be helpful. (Charles C. Nash, 357 N 6th, Laramie, Wyo. 82070)

Stromberg-Carlson No. 140-H receiver. Schematic and instruction manual needed. (Eliot Feldman, 8219 Williams Ave., Philadelphia, Pa. 19150)

Halson radio Model 606 and Cavalier radio Model 1700. Need schematics and parts lists for each. (Dean Frye, TV Sales & Service, 127 W. Elm St., Washington C.H., Ohio 43160)

Montgomery Ward Airline Model 15G-SE-1068A portable receiver. Schematic needed. (Harvey F. Mahnke, Box 1191, Clearlake Highlands, Calif. 95122)

Supreme Instruments Model 385 automatic multitester. Schematic and operator's manual needed. (John H. Kirk, 2800 Zephyr Rd., Orlando, Fla. 32806)

Hallicrafters Model S-38 receiver. Manual, schematic, alignment data, and source of parts needed. (Frank H. Hartl, 4243 N. 84 St., Milwaukee, Wisc. 53222)

RCA Model 816K receiver, circa 1936. Schematic needed; will return original plus one copy. (M.F. Hanna, 1213 Chesney St., Glendora, Calif. 91740)

Delco Model R-1141 AM/SW receiver. Schematic and parts list wanted. (Michael Held, 124 S. Waiola, La Grange, Ill. 60525)

Grunow Model 596 Teledial AM/SW receiver, chassis type 5W manufactured about 1934 by General Household Utilities Co. Schematic and alignment data needed. (C. W. Linden, 4268 N. Carruth, Fresno, Calif. 93705)

Globe Chief Model 90 transmitter (WRL). Schematic and operator's manual needed. (Fred Benson, Box 1795, La Jolla, Calif. 92037)

Knight Model T-50 transmitter. Operator's manual desired. (David Downs, 1101 Stanley Blvd., Calumet City, Ill. 60409)

Morrow Model 5BR mobile converter. Schematic needed. (Al Kaiser, 1331 Dayton St., Camden, N.J. 08104)

Stromberg-Carlson Model 1-A Neutrodyne receiver (uses four 01A and one 12A tubes). Schematic needed. (Robert Avey, Rte. 2, Portland, Ind. 17371)

Webster-Chicago Model 80 wire recorder; **Motorola** Model SP-25-W portable stereo phonograph; **Madison-Fielding** Series 440 stereo receiver and amplifier. Extra spools for Model 80 and schematics and owner's manuals for all models needed. (Alan Boritz, 80 Cheshire Rd., Bethpage, N.Y. 11711)

Telvar Model T60-2 crystal-controlled 80-10 meter transmitter (with plug-in coils). Schematic and parts list needed. (Gary R. Stephany, Rte. #3, Fond du Lac, Wisc. 54935)

Bell Model TRW367 with DK-1 tape deck. Schematics, parts lists, manuals, service center addresses needed. (Fixit Shop, 411 Tripoli St., Pittsburgh, Pa. 15212)

RCA Radiola Models III and III-A receivers. WD-11 tubes needed. (Art Trauffer, 120 Fourth St., Council Bluffs, Iowa 51501)

Atwater-Kent four-tube breadboard, model unknown. Schematic needed. (Harry Carver, 205 Mission Ridge Rd., Rossville, Ga. 30741)

Brunswick Model 15 receiver. Schematic and parts source needed. (James R. Howell, Rte. 1, Todd, N.C. 28684)

Heathkit Model SG-6 signal generator. Operator's manual wanted. (Raymond J. Goodman, 420 Union Ave., Campbell, Calif. 95008)

Polyphase Instrument Model TA-1A transistor analyzer. Schematic and manual needed. (John Jenkins, 1219 College St., Milton-Freewater, Ore. 97862)

Bell Sound System Model PM 10 Pacemaker amplifier. Schematic and any additional information desired. (Bryan Frank, 806 West Locust St., Johnson City, Tenn.)

Philco Model 37-60 receiver. Dial scale, part No. 27-5196, and dial hub, part No. 28-7152 FA-3, needed. (Glen Winger, 504 East Locust St., Robinson, Ill. 62454)

Osborne Model 300 CB radio. Schematic needed. (Major V. H. Arrell, Box 882, Howard AFB, Panama Canal Zone)

Heathkit Model V4 VTVM. Assembly/ operation manual needed. (Larry E. Perry, 142 Vaughan Pl., San Antonio, Texas 78201)

E.H. Scott all-wave receiver. Antenna coupler and type ST-151 impedance-matching transformer needed. (John Mac Jannet, 3650 W. Ridge Rd., Lot 39, Gary, Ind.)

Atwater-Kent Model 46 receiver. Disc-type loudspeaker wanted. (Darcy Brownrigg, Chelsea, Quebec, Canada)

RME Communications receiver model RME-69. Noise silencing circuit schematic diagram needed. (J.P. Sures, 416 S. Marks St., Fort William, Ontario, Canada)

Rock-Ola Model H amplifier. Schematic and parts list needed. (Stanley D. Potopa, 2410 18 St., Altoona, Pa. 16601)

Federal Manufacturing and Engineering Model 47A tape recorder. Main drive motor or name and address of dealer that handles this motor needed. [F.E. Berg, 77 Louisa Ave. (W.E.), Jamestown, N.Y. 14701]

Heathkit Model ES-400 modular analog computer. Assembly manual for most modules needed. (Tim Sharon, 1206 N. Fairlawn, Santa Ana, CA 92703)

Supreme Model 512 multimeter. Operating manual and/or schematic needed. (William Novak, 65 Welles St., Forty Fort, PA 18704)

GE Model 250. Vibrator K57J67 2V, 7 prong, 2¼ x 1⅜ needed. (James Cusick, 1588 Prospect St., Springfield, OH 45503)

Atwater Kent Models 82 and 85. Speakers needed. **Hallicrafters** Model SX42. Tilt base needed. (John A. Schwerbel, RD #1, Box 215, Catskill, NY 12414)

Philco Model 37-116. Dial and magnetic tuning indicator coil needed. (Glenn Lorang, Box 13068, Spokane, WA 99213)

GE TCK-1 transmitter. Manual and circuit needed. (John A. Klingman, 203 Jessie, Manteca, CA 95336)

GE Model J-64 Golden Tone AM/SW receiver. Schematic, operating manual, source of parts, and alignment data needed. (Gary Hart, 1410 N. Salisbury, W. Lafayette, IN 47906)

Hallicrafters SX24. Band spread dial, schematic and alignment information needed. (J. F. Kirk, 1513 Mansion Pl., Pittsburgh, PA 15218)

Atwater-Kent Model 55-C receiver. Schematic and source of parts including speaker needed. (Sidney Morton, 35 Church Lane, Watertown, MA 02172)

Solar Model CE capacitor analyzer. Instruction booklet and schematic needed. (Robert L. Norberg, 347 West St., Hyde Park, MA 02136)

Stromberg-Carlson Model RBM-1 medium-wave receiver. Operating manual needed. (Donald E. Erickson, 6059 Essex St., Riverside, CA 92504)

VM Model 710-A tape recorder. Schematic, manual, and parts source needed. (H. David Kaysen, 83 14th St., Troy, NY 12180)

Hallicrafters Model S-41G receiver. Schematic, operating manual, and alignment data needed. (Joseph Heinen, 771 Cordilleras Ave., San Carlos, CA 94070)

PACO Model S-50 oscilloscope. Source of parts needed. (George Danco, 8863 Bennett Ave., Fontana, CA 92335)

Heath Model DX-100 transmitter. **Hallicrafters** Model S-38B. Schematics needed. (David Tallent, 431 Revere St., Aurora, CO 80010)

Crosley 02CA. Parts needed. (Ronald Propst, 287 W. Paletown Rd., Quakertown, PA 18951)

Sparton Model 667 receiver. **Philco** radio; chassis 44, code 125. Operating instructions, schematics, and alignment data needed. (Steve King, Sandia Park, NM 87047)

Atwater-Kent Model 55. Schematic and source of parts needed. (Mark Hunter, Route 2, Box 140-A, Edinburg, IN 46124)

Madison-Fielding Model HI-503 AM/FM stereo record changer. Schematic and parts list needed. (Milton L. Hoge, 3405 W. 112th St., Chicago, IL 60655)

Webcor Model EP2008-1 tape recorder. Coil #65P125 needed. (Walter C. Barrett, 1808 E. Knollwood St., Tampa, FL 33610)

Truetone 5-band receiver; uses 6D6's, 76's, 45's and single 80. Model unknown. Schematic and service data needed. (Marshall G. Haynes, 364 Roxanna Ave., El Paso, TX 79932)

Firestone S-7393-1 Air Chief receiver, circa 1938-41. Schematic needed. (Robert McQueer, RD #1, Centerville, PA 16104)

Philco Model 38-9 receiver. Schematic, parts list and source of parts needed. (Jeff Wargon, 23050 Sussex, Oak Park, MI 48237)

Heathkit Model DX-100 transmitter. Construction manual and schematic needed. (James Soska, RD 3, Box 271-A, Leechburg, PA 15656)

IC'S FOR THE EXPERIMENTER

(*Continued from page* 33)

between *J1* and the board audio input. Don't forget to solder the *L1* tap to the antenna connector. Before installing the plastic cover, drill the access hole for *C7*.

If the FM receiver to be used is in the same room as the mike, remove any external (rooftop) antenna leads and attach a small vertical length of wire to the antenna terminal. (Or use a rabbit-ear antenna.) Do not try to use the wireless mike with an FM receiver that has an outdoor antenna—the power from the mike won't reach that far.

Using the Wireless Microphone. Tune the FM receiver to a quiet spot on the dial and, if possible, turn off the a.f.c. to prevent the receiver from tuning automatically to a strong adjacent channel.

Operate the talk switch (or turn on *S1* if you are using a discrete switch), speak into the microphone and adjust *C7* through the hole in the cover until your signal is heard on the FM set. Adjust *R5* for the desired volume. If commercial stations in that frequency range are not too closely spaced, the a.f.c. can be used to hold the receiver on the frequency of the wireless mike.

Photos in this article show, in addition to the wireless microphone, other completed projects using IC's. All are described in the RCA booklet. —30—

PRODUCT GALLERY

(*Continued from page* 81)

ception and adjacent channels are screened out by the sharp skirts of the L/C i.f. transformers. Using pushbuttons to select channels, the listener can monitor one frequency or all 6 channels (provided he has the necessary modules installed) simultaneously. And these channels may be in either of the VHF bands or a mix of bands without degrading receiver sensitivity.

The Ultra/Monitor is lightweight (7 lb) and has its own built-in battery supply (rechargeable batteries are optional at extra cost). A handle on the end of the receiver makes it easily portable for field use. One of the new variety of dual-band loaded whip receiving antennas will provide 20-30-mile reception capability. When used at a base station, the receiver can be operated from an a.c. line (automatically recharging the batteries) or from a 12-volt d.c. source.

If you need a really good VHF police/fire or Business Band receiver, you should investigate the Ultra/Monitor. It's functional design is unusual, combining all of the portable-fixed receiving operations you could desire. Squires-Sanders will also provide the receiving components for installing a tone-alerting modification.

Circle No. 91 on Reader Service Page 15 or 115

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QUIET

FET PRINCIPLES, EXPERIMENTS, AND PROJECTS

by Edward M. Noll

This book covers the principles of operation of the field-effect transistor in the first chapter, which serves as a building block for subsequent chapters that review the various applications of the FET. The first chapter also introduces the basic terminology and symbology that is unique to the FET and discusses parameters and specifications. Not only does this book provide a variety of useful experimenter projects (with schematic diagrams), it also provides the mathematical breakdowns required to compute component values to be used in the circuits. The result is a text that is eminently suited to a serious study of FET technology.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, Ind. 46206. Soft cover. 272 pages. $4.95.

104 HAM RADIO PROJECTS FOR NOVICES & TECHNICIANS

by Bert Simon, W2UUN

This book shows how hams can get more fun out of their hobby, while at the same time adding to their knowledge of electronics. As its title proclaims, the book is written around 104 useful ham projects, with the emphasis on transmitting and receiving gear. But accessory equipment, such as mike boosters, mike preamps, CPO's, one-transistor GDO, phone patch, etc., have not been overlooked. Each of the projects presented is accompanied by a schematic diagram, parts list, and construction tips. Careful consideration has been given to the cost factors; in fact, most of the projects can be built for less than $20. And a few are no-cost projects, built from old TV parts. The range of projects covers virtually every ham band.

Published by Tab Books, Blue Ridge Summit, Pa. 17214. 192 pages. $6.95 hard cover; $3.95 soft cover.

PROPO PRIMER
Proportional Control for All

by Howard G. McEntee

The purpose of this book is to provide the powered model airplane, boat, and car enthusiast with a primer on the sophisticated proportional method of remote control. The book starts out by explaining what proportional control is and proceeds to describe the various proportional systems, including simpler ones for independent rudder and elevator control. This is followed by discussions of dual, triple, and "full house" multiproportional systems. Descriptions of transmitters, receivers, servos, and accessories and auxiliaries are included. Finally, a full chapter is devoted to the testing, maintenance, and troubleshooting of proportional radio control systems. As a result, this book is an invaluable aid to both the veteran and rank-beginner modeler.

Published by Kalmbach Publishing Co., 1027 North Seventh St., Milwaukee, Wisc. 53233. Soft cover. 56 pages. $2.00.

ON THE COLOR TV SERVICE BENCH

by Jay F. Shane

This troubleshooting guide, written in down-to-earth language, describes the causes of and cures for almost any color TV receiver trouble you're likely to encounter. It describes how to tackle specific problems in a logical, orderly manner using common-sense service bench approaches. The book starts with a discussion of the techniques to use for unscrambling tough "brightness" problems. Then every type of circuit employed in color TV receivers is covered. Finally, the book finishes with alignment, troubleshooting, and maintenance instructions.

Published by Tab Books, Blue Ridge Summit, Pa. 17614. 192 pages. $6.95 hard cover; $4.95 soft cover.

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4 b

RADIO PEKING

(*Continued from page* 61)

New Frequencies. As Peking steps up its overall broadcasting activities, it is branching out into new frequencies. During the final months of 1968, for example, Peking announced the introduction of new frequencies for five of its English-language services alone. It now transmits on frequencies from 2800 kHz to 17,898 kHz. It lists as many as 320 different frequencies—of which many are outside the recognized broadcasting bands. A check of *Radio Peking*'s use of frequencies shows that it favors transmissions in the 6210-7100, 7310-9500, and 9775-11,700 kHz ranges.

One of the most fascinating, yet difficult to answer, questions regarding *Radio Peking* concerns the locations of its many powerful transmitters. There is little doubt that American and other intelligence agencies have the answer to this question but any attempts to get information out of them are invariably in vain. However, during China's turbulent Cultural Revolution, authorities did determine and let it be known that an allegedly clandestine radio calling itself the *Voice of the Liberation Army* and urging soldiers in Red China to turn against Mao Tse-tung was in fact originating outside China.

It is evident that Peking's transmitters are located throughout the vast geographical expanse of China. At least two of the principal *Radio Peking* transmitters are operating from Canton. Others are located as far west as Urumchi in the remote province of Sinkiang (used principally for broadcasts in Russian) and in Harbin, Manchuria.

According to a number of specialists involved in charting the development of Red China's radio broadcasting activities, it would not be surprising if *Radio Peking* were to become, in the near future, the largest short-wave broadcasting service in the world. It can be safely assumed that Chinese technicians are currently at work on transmitters even larger than the 240,000-watt giants now in use. It is considered only a matter of time before *Radio Peking* fills even more of the world's airways. —30—

WHICH TRANSFORMER QUIZ ANSWERS

(Quiz is on page 40)

1-K An f.m. **discriminator** transformer is tuned to the i.f. frequency and provides two 180° out-of-phase signals which are added to a reference signal. At the resonant frequency, these signals are each 90° out of phase with the reference signal, but shift in phase to change the vector sum as the f.m. carrier varies above and below resonance.

2-C A **driver** transformer is used to couple signals to a following amplifier stage. For push-pull circuits, the driver transformer provides two 180° out-of-phase signals.

3-A A **filament** transformer reduces line voltage to common tube heater voltages such as 12.6, 6.3 and 5.0 volts.

4-J A **flyback** or horizontal output transformer is used in television receivers to simultaneously produce the kinescope second anode high voltage, to match the horizontal output tube to the yoke windings, and to produce a boosted B-plus voltage.

5-F An **intermediate-frequency** transformer uses primary and secondary windings that are individually tuned by a sliding iron core, or by use of compression mica capacitors.

6-H An **oscillator** coil is actually a transformer (if a two-winding coil) or an autotransformer (if a single, tapped coil) used to provide external positive feedback from the output to input circuits of an oscillator.

7-B An **output** transformer couples the signal from a power output tube to a speaker while matching the high impedance of the tube to the low impedance of the voice coil.

8-D A **pulse** transformer has a resonant frequency matched to the rise time for the input pulse in order to couple the signal without distortion.

9-E A **quadrature** transformer in a color television circuit receives a 3.58-MHz signal from a local oscillator and provides two 90° out-of-phase (quadrature) secondary voltages to be used as CW reference signals for the I and Q demodulators.

10-G A **voltage-correction** transformer has a tapped secondary which enables the output voltage to be adjusted to compensate for changes in line voltage.

PRODUCTS

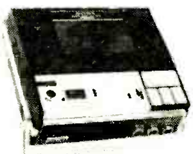
(Continued from page 24)

signal comes in the strongest. No physical wire connections between the cigarette-package-size converter and receiver are required. The converter comes equipped with one or two plug-in crystals that are cut to the frequencies for local police and other emergency broadcast services.

Circle No. 87 on Reader Service Page 15 or 115

PORTABLE SOLID-STATE TAPE RECORDER

For the first time in any portable tape recorder, *Sony's* new "Servocontrol" Model 800-B incorporates a built-in condenser electret microphone with an IC amplifier. Other refinements include a 15/16 in./s speed, built-in speed-tuning control that enables varispeed motor tuning, and switch facilities for a choice between manual and "Sonymatic" recording. The 800-B is also equipped with a cardioid microphone for hand-held and remote stop/start use. The recorder can be operated on line or battery power, has a 5" tape reel capacity, and is equipped with a VU meter and digital tape counter. Technical specifications: from a common low of 30 Hz to 18,000 Hz at 7½ in./s, 13,000 Hz at 3¾ in./s, 7000 Hz at 1⅞ in./s, and 4000 Hz at 15/16 in./s frequency range; 0.2% or less wow and flutter on all speeds except 15/16 in./s; 48-dB signal-to-noise ratio.



Circle No. 88 on Reader Service Page 15 or 115

CB TRANSCEIVER AND VHF FM RECEIVER

Lafayette Radio Electronics' new Model 150 "Telsat" is actually a reliable CB transceiver and a VHF FM police- and fire-band receiver housed in a single unit. To provide top sensitivity (0.7 μV on CB and less than 1 μV on VHF FM) and five-watt input power with 100% modulated output on all 23 CB channels, the Telsat employs a profusion of solid-state devices, including an IC and a FET. The system can be operated on any 12-volt d.c. source—whether positive or negative ground—or from line power with an optional a.c. power supply. The CB section contains a built-in TVI trap and a socket for Lafayette's Priva-Com IIIA Private Tone Caller. The VHF FM (150-174 MHz) receiver section permits manual tuning of the entire band and has two switch-selectable crystal positions for reception of local U.S. Weather Bureau broadcasts. The Telsat is supplied with all CB crystals and a mobile mounting bracket.

Circle No. 89 on Reader Service Page 15 or 115

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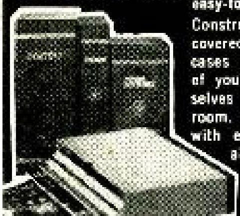

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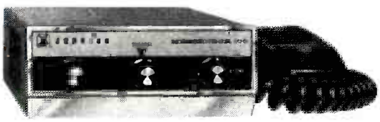

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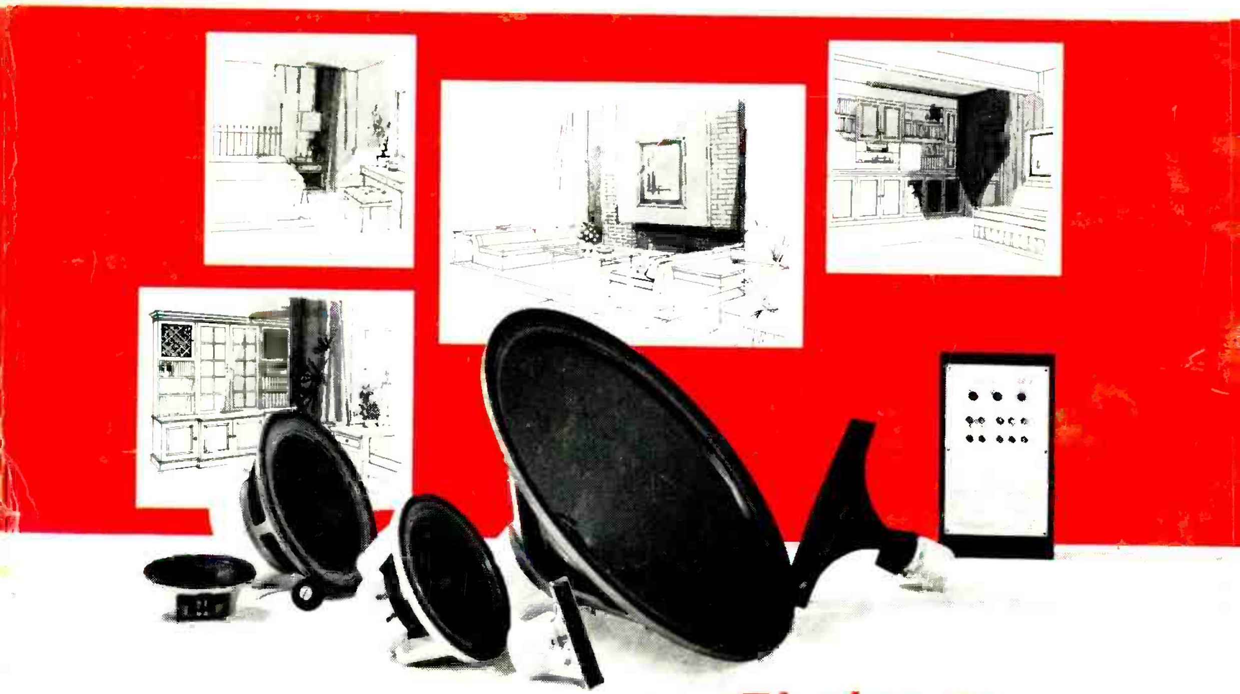

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