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VOLUME 32 NUMBER 6 **JUNE 1970**

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CIRCLE NO. 20 ON READER SERVICE PAGE

letters

FROM OUR READERS

HIGH SCHOOL ELECTRONICS

There is an error in your monthly department, "Opportunity Mirror," (March, 1970) where it is intimated that electronics is not taught in high schools.

Here at the Greater Lawrence Regional Vocational Technical High School, Andover, Mass., a curriculum involving a vocational major is combined with academic courses. These meet regular high school requirements and give the student the benefit of a high school diploma and a vocational or technical certificate for his major subject.

Being a member of the graduating class this year I look forward to the vast number of opportunities available to me as a result of being a student in the electronics program of this school. I will also have the opportunity to continue employment under the terms of our high school's cooperative work programs. It is also possible to continue on in our high school through its post graduate and institute programs, or advance into another popular area of electronics, Computer Programming.

PHILIP MARCELLO
Methuen, Massachusetts

BINGO FOR THE BAMBOO BROADCASTER

Thank you for printing the article, "Bamboo Missionary Broadcaster" (February, 1970, p 61).

R. L. FULLER
San Mateo, Ca.

Congratulations on the foresight and character to print the excellent article on the "Bamboo Missionary Broadcaster." These people have been ignored and neglected too long. How about an article on TransWorld Radio?

R. G. THOMPSON
Milwaukee, Wis.

I enjoyed reading the wonderful story by John Kimberley on the Far East Broadcasting Company. Don't forget some of the other missionary broadcasters such as HCJB and 4VEH.

R. J. ENGEART
Princeton, Iowa

CB LICENSE PLATE

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feel that CB'ers may be able to obtain license plates in the state of Minnesota and have petitioned our legislative representative in this district. We appreciate that there may be an additional cost for this service, but we are confident that most CB'ers will be willing to pay this extra fee.

We would like to have other known and established CB clubs in the state of Minnesota support our efforts in this endeavor.

J. C. MAUSOLF
Twin Ports Citizen's Band Radio Club
2717 East 5th Street
Duluth, Minn. 55812

LOUD, BUT NOT TOO LOUD

To escalate a treble boost for guitar (letter from J. R. Guthrie, March, 1970, page 13) into the urban noise pollution problem is downright silly. Does this mean that POPULAR ELECTRONICS should stop printing speaker designs or hi-fi amplifiers with more than 1 or 2 watts output?

The treble boost can add a whole new world of harmonic content to low and middle register instruments. If Mr. Guthrie is concerned about noise pollution, he should participate in some of the ecological and environmental organizations now springing up to combat this serious problem. Writing to POPULAR ELECTRONICS about the fabled sins of an innocuous device does nothing to lift the cloud of noise and dirt that has settled over us.

CRAIG ANDERTON
Philadelphia, Pa.

TAPE RECORDING, MORE LITERATURE

Your reader, R. Stoddard (April 1970, p 8), should find Skip Athey's book, *Magnetic Tape Recording*, published by NASA in 1966 a valuable addition to his library. I believe it is still available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. It was selling for $1.25. This is a general book, not one devoted to hobbyists, or even sound recording, but a study of it would benefit any tape recorder user.

W. L. SMITH, W3GKP
Spencerville, Md.

OUT OF TUNE

Various gremlins got into the works in our April issue. In the "Micro'Lign Generator" article on page 49, the leads on the transistor case outline for *Q1-Q3*, should be E, C, and B, left to right. On page 40, "Digital Logic Microlab," the figure number should be 8. Parts I, J, and K were omitted due to lack of space. On page 57, "100-kHz Standard," the prices in the parts should be $2.15 for the board, $9.85 for the kit.

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ELECTRONICS library

QUIET

NETWORK THEORY

by J. B. Murdoch

Classroom tested, this book can be considered two different college courses under the same cover. The first part of the book concentrates on steady-state linear networks and the latter part on free and forced behavior of such networks. The detailed material is sufficient for two whole semesters in electrical engineering.

Published by McGraw-Hill Book Co., 330 West 42 St., New York, NY 10036. Hard cover. 525 pages. $16.

BASIC ELECTRICITY/ELECTRONICS, Books 1 and 2

This two-volume set, put together by Training & Retraining, Inc., is a widely used student-tested course. It provides the beginner with a solid grasp of the elements of electricity and electronics and equips the technician-level student with the basic knowledge and preparation to advance into specialized fields. Book 1 is devoted to tube and transistor circuits, test instruments, and motors and generators. Book 2 covers the principles and applications of electricity and electronics and a.c.-d.c. circuits. Both books are written in a programmed-text format. The text is well written and profusely illustrated to show and explain every item discussed.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, IN 46268. Hard covers. 640 pages Book 1, 704 pages Book 2. $9.95 each book.

WAVE GENERATION AND SHAPING Second Edition

by Leonard Strauss

In the decade since the first edition of this book appeared, solid-state technology has revolutionized active circuit design, and IC's have replaced discrete components. Written primarily as a textbook, the objective is to present a logical unified approach to the analysis of those circuits in which the nonlinearity of the active device is the significant factor. A developmental treatment is followed as focus is placed on the essential features of practical wave generating, shaping, and logic circuits. The book is divided into

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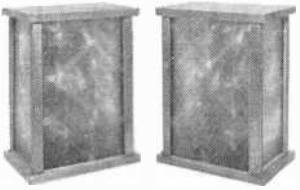

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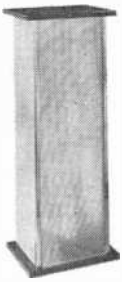

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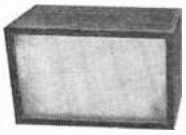

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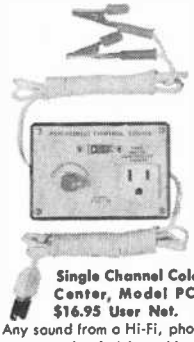

Single Channel Color Control Center, Model PCC-10F — $16.95 User Net.
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five parts: Models and Logic; Timing; Switching; Memory; and Oscillations. The material in the text is on the graduate or advanced undergraduate engineering level.

Published by McGraw-Hill Book Co., 330 West 42 St., New York, NY 10036. Hard cover. 775 pages. $16.50.

LASERS AND HOLOGRAPHY

by Winston E. Kock

Holography, like ordinary photography, is a way of recording a scene on film. But while the photograph displays the scene in only two planes (it has no depth), the hologram is a three-dimensional display of the scene; it actually has depth that changes perspective with the changing angle of view. In this book, the reader is introduced to the holography technique by a careful review of the underlying wave concepts, including coherence, diffraction, and interference. The atomic process by which lasers generate their special coherent light is explained. Also shown is how the unique properties of holography will make the laser a valuable instrument in the future of photography.

Published by Anchor Books, Doubleday & Co., Inc., 501 Franklin Ave., Garden City, NY 11530. Soft cover. 103 pages. $1.25.

1-2-3-4 SERVICING AUTOMOBILE STEREO

by Forest H. Belt & Associates

Anyone who services electronic equipment faces the dilemma of speed versus thoroughness. A simple procedure that gets the job done correctly is the best approach. And that is just what is involved in this book; getting the job done the easy way and the right way. The 1-2-3-4 method of finding troubles, coupled with the Easy-Read format of writing and editing, make even the most complicated discussions easy to understand. The topics are carefully organized and thorough explanations, supported by clear illustrations are provided. Whether you are a student, practicing technician, or curious layman, you will understand automobile stereo systems when you have finished reading this book.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, IN 46268. Soft cover. 192 pages. $3.95.

ELECTRONIC CIRCUIT DESIGN HANDBOOK

Perhaps the most interesting section in most electronics engineering magazines is the one devoted to unique circuit ideas submitted by the readers. Although complete and useful in themselves, such basic circuits may also serve as the kernel of a more complex design idea. The editors of *EEE* magazine have gathered together more than 600 such design ideas, supplemented them with more than 750 diagrams, waveforms, and parts lists, and organized them into 19 sections. Each section is devoted to a specific area, such as amplifiers, oscillators, counting and timing circuits, gat-

(*Continued on page* 100)

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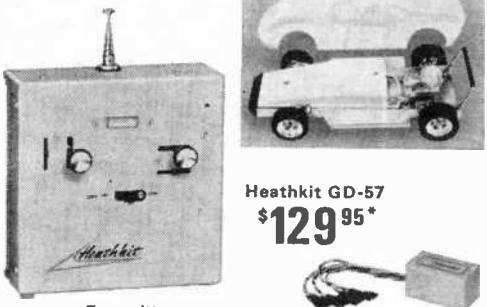

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Join The Most Exciting New Hobby In America...

building and racing radio-controlled Grand Prix cars up to scale speeds of 200 mph. The Heathkit "Spectre" R/C car reaches that speed and has already proven itself a winner. And no wonder; its design is unique. It has a chrome plated steel chassis, adjustable caster and toe-in, specially formulated rubber tires that lock onto the cast nylon wheels, independent front suspension for excellent cornering and a 5.5:1 gear ratio for maximum torque at all speeds. The snap on, ⅛ scale car body (length: 19¾") is of high impact plastic — almost indestructable. Suspension is by real coil springs. The radio equipment compartment is dirt and oil proof. The Heathkit "Spectre" is the only complete car kit available. You get the body, chassis, wheels & tires, 4 oz. fuel tank & tubing, equipment case & protective foam, centrifugal clutch & gears, axles, servo linkages & mounting tape, all hardware, decals, numbers and a comprehensive manual. The "Spectre" accepts any .15 to .23 cubic inch R/C engine and any proportional R/C electronics system. It requires only two servos to operate the steering, brake and throttle. Get in on all the thrills of R/C car racing at the lowest possible price ... order a Heathkit "Spectre".

Kit GD-101, R/C car only, 8 lbs.....$49.95*
Assembled GDA-101-1, Veco .19 R/C engine, 1 lb.....$19.95*

NEW Heathkit 3-Channel Digital Proportional R/C System
For Planes, Gliders, Cars And Boats

Ideal for use with the new Heathkit "Spectre" R/C car to give you total control ... ease of handling. Here's what the Heathkit GD-57 R/C system includes: Transmitter with assembled, factory aligned RF circuitry; new 2 oz. miniature receiver that needs no IF alignment, in a tough nylon case; you also get two servos; all plugs; connectors; cables; charging cord; new flat-pack rechargeable nickel-cadmium transmitter and receiver batteries ... and a special soldering iron. You can have your choice of five operating frequencies in each of three bands ... 27, 53 or 72 MHz. This is the most value ever offered in a 3-channel rig.

Kit GD-57, transmitter, receiver, 2 servos, batteries, charging cord, switches and soldering iron, (specify freq. desired), 11 lbs.....$129.95*
Kit GDA-57-1, transmitter, battery, charging cord, (specify freq. desired), 5 lbs.....$54.95*
Kit GDA-57-2, receiver only, (specify freq.), 1 lb.....$34.95*

NEW Heathkit Siren/PA
For Licensed Emergency Vehicle Only

Hey Chief! Save up to 60% on a new electronic siren/PA system by ordering the low cost Heathkit GD-18. The siren gives both "wail" and "yelp" warnings at 55 watts output power, and you can adjust the pitch. As a public address it will amplify your voice with a full 20 watts of power, and it's practically immune to acoustical feedback. (Either PA or siren can be interrupted to use the other.) Incoming radio calls can be channeled through the GD-18 so you can hear them when away from your vehicle. Use it on any 12-volt auto electrical system with either positive or negative frame ground. It will operate from -20° to 150° F conditions. Control panel is lighted. Comes with gimbal bracket mounting. Take your choice of speakers ... concealed or exposed.

Kit GD-18, Siren/PA Amplifier, 7 lbs.....$54.95*
Assembled GDA-18-1, Exterior Horn, 9 lbs.....$49.95*
Assembled GDA-18-2, Concealed Horn, 4½ x 4½ x 13", 9 lbs.....$49.95*
System GD-18A, (includes GD-18 plus exterior horn), 16 lbs.....$99.95*
System GD-18B, (includes GD-18 plus concealed horn), 16 lbs....$99.95*

NEW Heathkit Solid-State Portable Fish Spotter

Costs half as much as comparable performers. Probes to 200 ft. Doubles as depth sounder. Transducer mounts anywhere on suction cup bracket. Adjustable Sensitivity Control. Exclusive Noise-Rejection Control stops ignition noise. Runs for 80 hrs. on two 6 VDC lantern batteries (not included). Manual explains typical dial readings. Get set for next season; order your Heathkit MI-29 today.

Kit MI-29, 9 lbs.....$84.95*

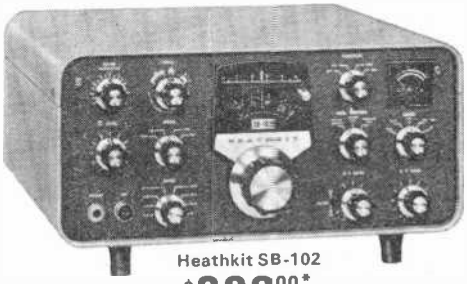
The Value Leader

HEATHKIT®

NEW Heathkit 5-Band SSB Amateur Transceiver

The new Heathkit SB-102 . . . proud successor to the famous "100" & "101". You can expect top performance and value from this rig . . . and you get it. An all solid-state Linear Master Oscillator delivers faster warmup, greater stability and better tracking . . . new receiver circuitry gives better than 0.35 uV sensitivity for real performance under bad band conditions. Plus all the features that made the SB-101 the world's most famous, most popular transceiver . . . 180 watts PEP SSB input . . . 170 watts CW input . . . 80 through 10 meter coverage . . . USB, LSB or CW modes . . . built-in VOX or PTT operation . . . built-in CW sidetone . . . built-in 100 kHz crystal calibrator . . . Triple Action Level Control for reduced clipping & distortion . . . fast, easy bandswitching and tune-up . . . rugged, inexpensive 6146 finals . . . separate headphone level control & front panel jack . . . simple assembly with circuit board-wiring harness construction . . . sharp Heathkit SB-Series styling plus many more features. Order yours now.

Kit SB-102, 23 lbs.....$380.00*
Kit SBA-100-1, mobile mt., 6 lbs.....$14.95*

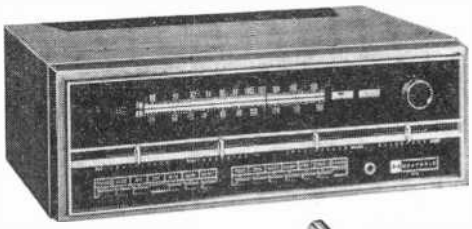


Heathkit SB-102
$380.00*

NEW Heathkit 60-Watt AM-FM-FM Stereo Receiver

Superb stereo performance at budget price, that's the new Heathkit AR-19. A giant, electronically regulated power supply provides 60 watts IHF music power (ideal for all modular and high efficiency speaker systems) . . . frequency response is -1 dB from 6 Hz to 35,000 Hz . . . and Harmonic & IM distortion are less than 0.25% at *any* output. This advanced performance assures you of crisp, clean highs without ringing or breakup . . . solid, clean-cut lows without distortion — just pure, uncolored sound reproduction at all frequencies and power levels. The FM Stereo circuitry is unequalled by any receiver in this price class . . . a factory assembled & aligned FET FM tuners . . . superior overload characteristics & 2.0 uV sensitivity . . . a factory assembled & aligned FM IF circuit board with 4 IC's for superior AM rejection, hard limiting, greater stability and 35 dB selectivity . . . a precision ball-bearing inertia flywheel for smooth, precise tuning . . . two front panel tuning meters for exact station selection. Other features include modular snap-out circuit boards, built-in self-servicing capability, hi-fi AM reception and much more. Make the AR-19 the heart of your stereo system now.

Kit AR-19, 29 lbs.....$225.00*
Assembled AE-19, oiled pecan cabinet, 10 lbs.....$19.95*



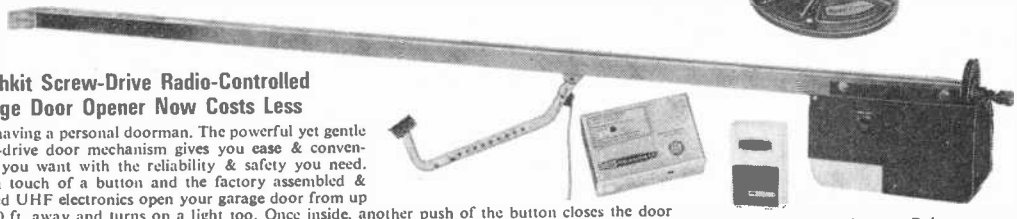
Heathkit AR-19
$225.00*

Heathkit Solid-State Metal Locator

Here's versatile, professional performance in a metal locator at lowest cost. The all solid-state GD-48 uses a unique induction balance detection system that doesn't produce a tone until metal enters the search field . . . eliminates having to listen for a change in tone. The built-in Sensitivity control allows adjustment to detect varying size objects down to 6 feet. A built-in speaker audibly signals presence of metal . . . for higher sensitivity use the accurate front-panel meter. And the front-panel headphone jack lets you use headphones to screen out annoying background noise. Look no further for an excellent metal locator . . . order the GD-48 now.

Kit GD-48, 4 lbs.....$59.95*
GDA-48-1, 9 V battery, 1 lb.....$1.30*

Heathkit GD-48
$59.95*



Heathkit Screw-Drive Radio-Controlled Garage Door Opener Now Costs Less

Like having a personal doorman. The powerful yet gentle screw-drive door mechanism gives you ease & convenience you want with the reliability & safety you need. Just a touch of a button and the factory assembled & aligned UHF electronics open your garage door from up to 150 ft. away and turns on a light too. Once inside, another push of the button closes the door safely behind you, yet the light remains on long enough for you to enter your home. Fast, easy one-night assembly . . . all wires pre-cut with connectors installed . . . no soldering. Fits any 7½' overhead, jamb or pivot single or double size residential doors. Automatic instant reverse feature prevents injury to kids, pets, etc. Send for yours now.

GD-209A, mechanism, receiver & transmitter, 66 lbs.....$139.95*
GD-209B, mechanism, receiver & 2 transmitters, 66 lbs.....$149.95*

New Lower Price
Kit GD-209A
$139.95*

NEW FREE 1970 CATALOG!

Now with more kits, more color. Fully describes these along with over 300 kits for stereo/hi-fi, color TV, electronic organs, guitar amplifiers, amateur radio, marine, educational, CB, home & hobby. Mail coupon or write Heath Company, Benton Harbor, Michigan 49022.

HEATHKIT
a Schlumberger company

HEATH COMPANY, Dept. 10-6
Benton Harbor, Michigan 49022

☐ Enclosed is $_____, plus shipping.

Please send model (s)_____
☐ Please send FREE Heathkit Catalog. ☐ Please send Credit Application.

Name_____

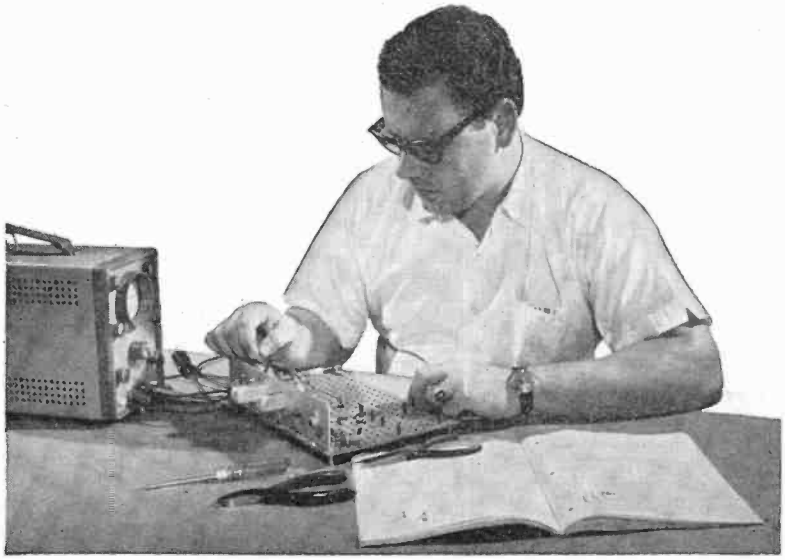
Address_____

City_____ State_____ Zip_____

*Mail order prices; F.O.B. factory. Prices & specifications subject to change without notice. CL-386

CIRCLE NO. 17 ON READER SERVICE PAGE

10 Reasons why RCA Home Training is your best investment for a rewarding career in electronics:



Performing transistor experiments on programmed breadboard—using oscilloscope

1 LEADER IN ELECTRONICS TRAINING

When you think of electronics, you immediately think of RCA...a name that stands for dependability, integrity and pioneering scientific advances. For over a half century, RCA Institutes, Inc., a service of Radio Corporation of America, has been a leader in technical training.

2 RCA AUTOTEXT TEACHES ELECTRONICS FASTER, EASIER, ALMOST AUTOMATICALLY

Beginner or refresher, AUTOTEXT, RCA Institutes' own method of programmed Home Training will help you learn electronics more quickly and with less effort, even if you've had trouble with conventional learning methods in the past.

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

RCA Institutes is doing something positive to help men with an interest in electronics to qualify for rewarding jobs in this fascinating field. Every year, literally thousands of high paying jobs in electronics go unfilled just because not enough men take the opportunity to train themselves for these openings.

4 WIDE CHOICE OF CAREER PROGRAMS

Start today on the electronics career of your choice. On the attached card is a list of "Career Programs", each of which starts with the amazing AUTOTEXT method of programmed instruction. Look the list over, pick the one best suited to you and check it off on the card.

5 SPECIALIZED ADVANCED TRAINING

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

6 PERSONAL SUPERVISION THROUGHOUT

All during your program of home study, your training is supervised by RCA Institutes experts who become personally involved in your efforts and help you over any "rough spots" that may develop.

7 VARIETY OF KITS YOURS TO KEEP

To give practical application to your studies, a variety of valuable RCA Institutes engineered kits are included in your program. Each kit is complete in itself. You never have to take apart one piece to build another. At no extra cost, they're yours to keep and use on the job.

8 FROM RCA INSTITUTES TRANSISTORIZED TV KIT, VALUABLE OSCILLOSCOPE

Those enrolled in RCA's television course or program receive complete transistorized TV Kit. All students receive a valuable oscilloscope—both at no extra cost and only from RCA Institutes.

9 CONVENIENT PAYMENT PLANS

RCA Institutes offers a unique tuition plan that lets you progress at your own pace. You only pay for lessons as you order them. You don't sign a contract obligating you to continue the course. There's no large down-payment to lose if you decide not to continue. However, if you desire, RCA Institutes also offers a convenient monthly payment plan.

10 RCA INSTITUTES GRADUATES GET TOP RECOGNITION

Thousands of graduates of RCA Institutes are now working for leaders in the electronics field; many others have their own profitable businesses. This record is proof of the high quality of RCA Institutes' training.

CLASSROOM TRAINING ALSO AVAILABLE

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

JOB PLACEMENT SERVICE, TOO!

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

SEND ATTACHED POSTAGE PAID CARD TODAY! FREE DESCRIPTIVE BOOK YOURS WITHOUT OBLIGATION! NO SALESMAN WILL CALL!

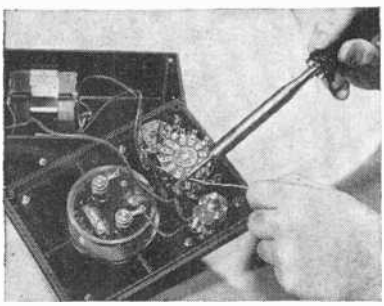
All RCA Institutes courses and programs are approved for veterans under the New G.I. Bill.

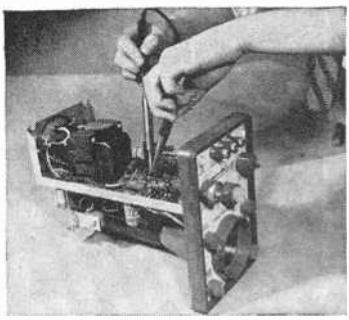
RCA INSTITUTES, DEPT. 694-006-0
320 West 31st Street,
New York, N.Y. 10001

Accredited Member National Home Study Council

RCA

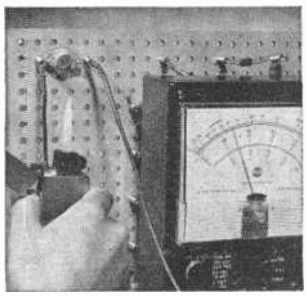
Construction of Multimeter.





Construction of Oscilloscope.

Temperature experiment with transistors.



NEW PRODUCTS

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

COMMUNICATIONS RECEIVER KIT

Armchair adventuring is more fun than ever when you tune in on the world with a receiver you've built yourself. This is the idea behind the new Knight-Kit Model R-195 budget-priced communications receiver kit. The kit features a "modular concept" in which most parts are already soldered to printed circuit boards and all critical adjustments have been made at the factory so that the builder merely interconnects the boards. The assembled R-195 tunes the international and domestic shortwave stations in three bands (1.8-4.8, 4.8-12, and 12-30 MHz), marine weather and navigational beacon stations on long wave (200-420 kHz), and standard AM broadcast band. A specially designed r.f. section features 2 μV sensitivity for 10 dB S+N/N. Selectivity is 4.5 kHz bandwidth at 6 dB. Other features include automatic noise limiting, a.v.c., BFO for CW and SSB reception, remote receiver muting, 4" speaker, and a headphone jack.

Circle No. 78 on Reader Service Page 15 or 95

STEREO CASSETTE DECK

The *Lumistor Products* Model LP-1 stereo record/playback deck is unique in that it is designed to allow for conversion to play four-track "quadrasonic sound" cassettes. The deck was designed to provide the features and operation convenience of quality reel-to-reel decks while retaining the convenience of cassette handling. Featured are interlocking controls, a four-pole synchronous motor, three-digit counter, dual VU meters with separate input level controls, and all interconnecting cables. Present plans are for the four-track converter pack to be made available to those who wish to convert to quadrasonic sound capabilities as soon as prerecorded cassettes for the new sound become available.

Circle No. 79 on Reader Service Page 15 or 95

7-IN-1 BIAS SUPPLY FOR COLOR TV

A new bias supply for color TV alignment has been introduced by *Sencore*. The Model BE156 meets the demands of the TV receiver manufacturers by providing three separate 25-volt supplies that can be switched positive or negative as indicated by alignment instructions provided by the TV receiver manufacturers. Tube operated receivers require negative voltages, while most solid-state receivers use positive voltages. A seventh range of 0-75 volts has been provided to meet the specifications of the manufacturers who use 67.5 volts to bias the chroma amplifiers during alignment. All three supplies are well filtered at 0.1% ripple and have little or no interaction between them.

Circle No. 80 on Reader Service Page 15 or 95

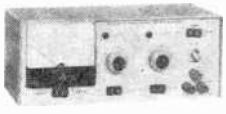
AUTO-REVERSE STEREO TAPE RECORDER

The Sony Model 780 automated tape recorder, available from *Superscope,* is designed for the connoisseur who wants and can afford the best. It features a three-motor drive system that is completely independent of the 60-Hz line power frequency to provide precise speed control. Any external altering circumstance is automatically and instantaneously compensated for by a sophisticated regulating system. Automatic reversing is accomplished through an electronic sensory system; no metal foil or subsonic tones are required to activate the auto-reverse. The 780 is equipped with the Sony Noise Reduction System that provides noise-free playback of all recorded tapes by automatically reducing the gain of the playback amplifier during quiet passages. The Model 780 includes vari-speed tuning, front panel bias switch, and feather touch control buttons. Another new feature is the ferrite Roto-Bilateral Head that allows recording and playback in both directions with simultaneous tape monitoring.

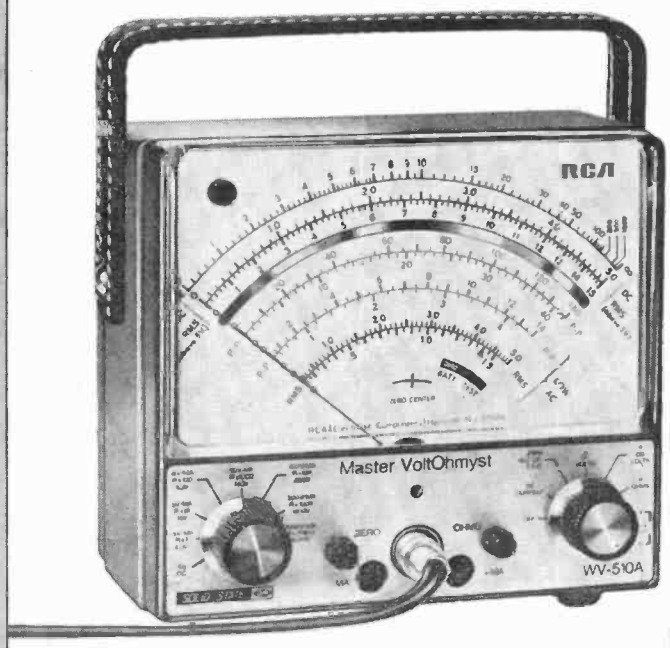
Circle No. 81 on Reader Service Page 15 or 95

REGULATED LOW-VOLTAGE SUPPLY

The new Heathkit Model IP-28 current-limiting regulated lowvoltage supply, available from the *Heath Company,* incorporates a number of features that will make it attractive to servicemen, experimenters, and anyone interested in solid-state circuitry. It is capable of delivering from 1 to 30 volts at 1 ampere maximum load with less than 50-mV variation. For critical circuits where the voltage drop across the supply leads is critical, the



Now it costs less to own the best VOM you need.



The New RCA WV-510A Solid-State Master VoltOhmyst®

*Inexpensive Quality
†Optional Distributor Resale Price

RCA

The best you need is the new solid-state RCA WV-510A Master VoltOhmyst®. The most functional VOM we've ever produced, the 510A has all the features you'll ever need no matter what your requirements may be.

And we've added some extra features you won't find in any competitive VOM, at any price... features designed to make your work easier, help you get the job done faster.

For example: RCA WV-510A operates from batteries or AC. Remove the detachable AC line cord while you're taking a measurement and the batteries take over immediately without a flicker of the pointer. And you'll get maximum life from the batteries because they're always on trickle charge during AC operation. Stability? Switch from range to range and watch a whole series of measurements without constantly zero-adjusting the meter.

Some statistics:

Current:
0.01 milliampere to 1.5 amperes in 8 ranges.

Resistance:
0.02 ohm to 1000 megohms in 7 ranges.

DC Volts:
0.01 volt to 500 volts in 8 ranges.

AC Volts:
0.2 to 1500 rms AC volts in 7 ranges plus peak-to-peak voltages of complex waveforms.
21 megohm resistance on all DC ranges.

And it's only $128,† complete with DC/AC ohms probe and flexible shielded input cable with BNC connector, and removable AC line cord.
Some statistics! For complete details, contact your local RCA Distributor.

RCA|Electronic Components|Harrison, N. J. 07029

CIRCLE NO. 27 ON READER SERVICE PAGE

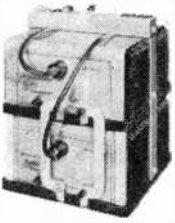
PRODUCTS *(Continued from page 22)*

IP-28 is equipped with a remote sensing feature that reduces the voltage variation to less than 20 mV. A front panel rocker switch selects range of either 1-10 volts d.c. or 1-30 volts d.c., and the output on both is continuously variable. Variable current limiting in two switch-selected ranges from 10-100 mA or 10 mA-1 ampere is also included to protect the load. A 3½" meter can be switched to indicate either voltage or current.

Circle No. 82 on Reader Service Page 15 or 95

MOBILE POWER INVERTER

The new "Quad-Continental" inverter available from *Terado Corp.* converts 12-volt d.c. to 117 volts a.c. at 60 Hz while maintaining the a.c. frequency within 0.25 Hz, regardless of input voltage or load. The Model 50-110 inverter can handle up to 1200 watts of output loading. Hence, it is ideal for powering small-to-medium compressor type refrigerators. The Quad is completely filtered for operation of sound equipment. It comes with a control harness and features solid-state circuitry and forced air cooling.



Circle No. 83 on Reader Service Page 15 or 95

STEREO FM RECEIVER FOR CARS

Stereo Magic recently announced a stereo FM receiver as an add-on accessory to fit all cars. With the Model DFM-888 receiver, any car owner can enjoy stereo FM broadcasts while on the road. The DFM-888 is all solid state in construction, employing 21 transistors, 11 diodes, and 4 thermistors. The result is a powerful circuit with 101dB sensitivity (signal-to-noise ratio of 30 dB), 5 watts r.m.s. of audio output power, and only 3% distortion at 1 watt. The receiver features a.f.c. with a holding range of 600 kHz and a frequency range of 50-10,000 Hz. The DFM-888 operates on 12 volts d.c., negative ground, and fits easily under the dash in most cars.

Circle No. 84 on Reader Service Page 15 or 95

PORTABLE CASSETTE RECORDER

A portable cassette recorder with random function controls and door loading has been made available by the *Ampex Corp.* Designated the "Micro 9," the recorder has positouch controls that allow random switching from one function to another without using the stop control. The door loading feature allows rapid and easy insertion and removal of cassettes. The Micro 9 operates on a built-in battery supply or from 117 volts a.c.; and with an optional adapter, it can even operate from a 12-volt source. Automatic record control, transistor regulated motor, and earphone monitoring during recording are among the extra features of the new recorder.

Circle No. 85 on Reader Service Page 15 or 95

HI/LO BAND MONITOR RECEIVER

A new Hi/Lo Band VHF-FM monitor receiver, Model COP-50HL, from *Courier Communications,* has a built-in 117-volt a.c. power supply for home or office use; yet, it can be operated as a mobile receiver from 12-volt d.c. sources. It has six high-band frequencies between 150 and 175 MHz and six low-band frequencies between 25 and 50 MHz. Other features include exclusive crystal control on all channels (crystals not included) to assure on-frequency monitoring; solid-state design incorporating IC's exclusive r.f. peaking control for obtaining maximum sensitivity; adjustable squelch; and tone control switch for emphasizing highs or lows.

Circle No. 86 on Reader Service Page 15 or 95

PROFESSIONAL VTVM

The *Mercury Electronics Corp.* Model 1700C is an advanced design vacuum-tube voltmeter that will met the demands of the technician's most rigid requirements. It has a large 6" wide-view meter featuring double jeweling at the pivot (with individual side and tail weights), anti-parallax mirrored scale, and easy-to-read scale markings. The highest quality components are said to be used throughout. Wide frequency response is featured in the a.c. voltage mode for compatibility with color TV receiver servicing, FM multiplex troubleshooting, and general industrial applications. Also available in kit form.

Circle No. 87 on Reader Service Page 15 or 95

AM/STEREO FM RECEIVER

Olson Electronics' 85-watt solid-state AM/stereo FM receiver, Model RA-194, has a brushed aluminum front panel with a three-dimensional effect that contrasts strikingly with its oiled walnut enclosure. Contemporary styling is enhanced by an illuminated slide rule dial, FM stereo indicator lamp, and precise tuning meter. Technical specifications: 2-μV FM sensitivity; greater than 30 dB multiplex separation; 30-20,000 Hz audio range; 4-16-ohm output impedance; 22-transistor, 13-diode, 2-IC, and one-FET complement; circuit breaker overload protection; headphone jack; tape output.

Circle No. 88 on Reader Service Page 15 or 95

Grrrrrr.

(The Tiger 23. $149.95)

The Tiger 23. The new untamable radio from Pearce-Simpson, a Division of Gladding Corporation.

The Tiger 23. A radio you'll have to reckon with. Because no other CB in the world can offer all these features at the same price. Only $149.95.

Start with styling. Smart, clean lines. Wood-grain finishing. Brushed chrome. Illuminated dials. Velvet smooth controls.

And more. 23 channels plus PA, modulation light, external speaker jack, plug-in dynamic microphone, and large illuminated combination RF-S meter.

But that's still not all. The Tiger 23 includes an Automatic Noise Limiter *with manual over-ride.* Automatic Modulation Control for ultimate talk power. Television Interference Trap. Receiver Delta Tune Switch that corrects for the other guy's off-frequency transmissions.

And inside, the latest in solid state circuitry including ceramic filter to bring in sharp clear signals, Integrated Circuit, and Field Effect Transistor.

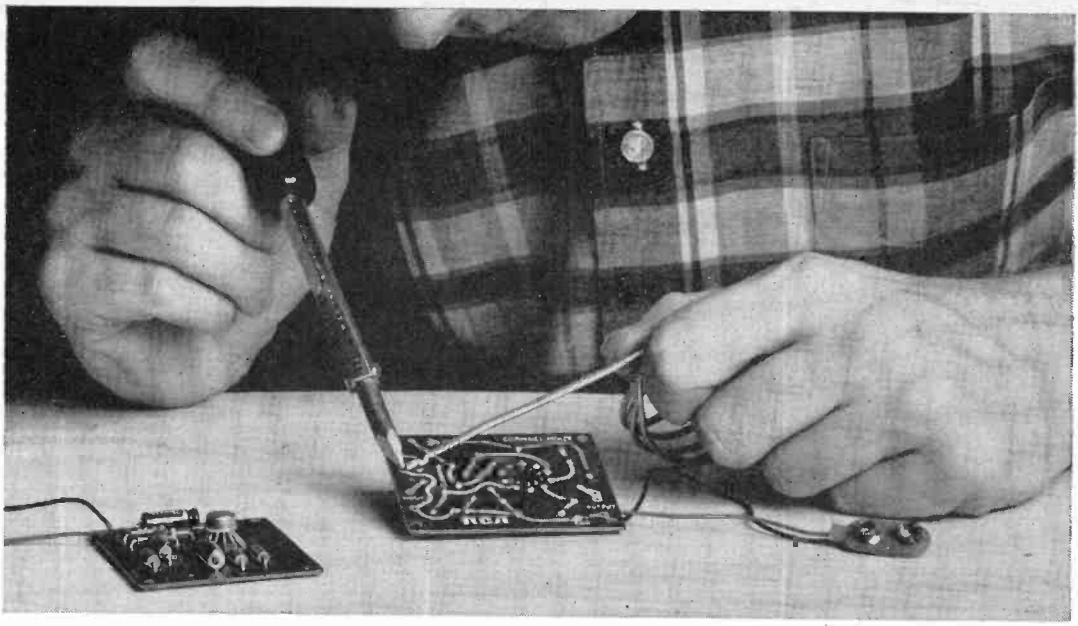
Put it all together and you've got a radio that won't quit. A radio from Pearce-Simpson, the finest name in Marine radios, CB's, antennas, and electronic communication equipment. And backed by Gladding Corporation, first in outdoor recreation since 1816.

The Tiger 23. If you can handle it.

Pearce-Simpson

A Division of Gladding Corporation
First in outdoor recreation since 1816. GLADDING

CIRCLE NO. 24 ON READER SERVICE PAGE



For use at home, on hobby bench, or in classroom

Assemble these new RCA IC Experimenter's Kits quickly and easily. All the active and passive components, the pre-drilled printed circuit boards, and full clear instructions are included. (Add your own preference of alarm indicator to kits KC4005 and KC4006.)

KC4000: Microphone Preamplifier IC Kit—a high-gain, low-noise, wideband preamplifier that accommodates both low- and high-impedance microphones.

KC4001: 2-Channel Mixer IC Kit—combines any two audio inputs, such as microphone, radio, phono, or oscillator, into a single output.

7 NEW IC KITS FROM RCA

KC4002: Audio Oscillator IC Kit—for testing audio, hi-fi equipment, and amateur radio transmitters—also for code practice.

KC4003: Amplifier/Oscillator IC Kit—a 500 mW audio amplifier or a variable tone audio oscillator.

KC4004: 9-V Regulated Power Supply IC Kit—supplies 9 volts DC output with voltage regulation of 3% at a maximum current of 250 mA.

KC4005: Intruder Alarm IC Kit—a circuit that develops a "whooping" signal for a security system.

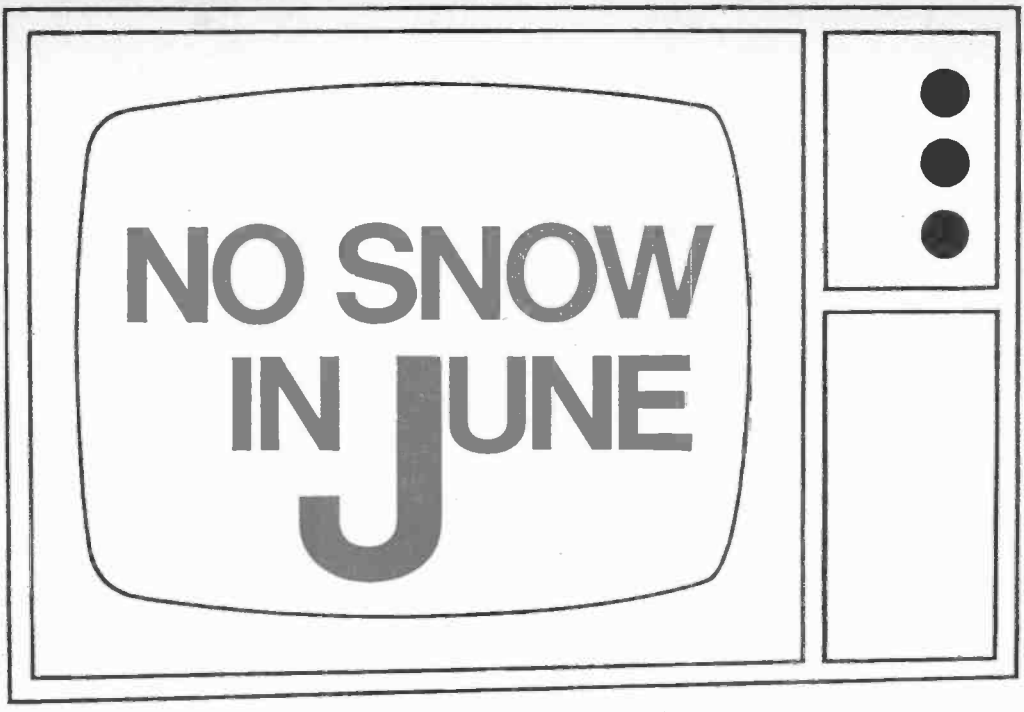
KC4006: Fire Alarm IC Kit—a low-melting-point solder sets off this circuit for a warning device.

KC4500: IC Kit Enclosure and Hardware Pack—optional for KC4000, KC4001, and KC4002—a handsome, sturdy, prepunched case with input and output jacks, switch, and other hardware.

Buy these kits from your RCA Distributor. For information, write: RCA Electronic Components, Commercial Engineering, Section F-133SD/S30R, Harrison, N.J. 07029

(STARTING AT UNDER $5.00*) * Optional distributor resale price

RCA



MATCH YOUR TV ANTENNA TO RECEIVER FOR BEST POSSIBLE PICTURE

BY GEORGE MONSER

GOOD TV RECEPTION is not obtained by accident; it is carefully sought for and designed into your antenna system. You can get the best antenna and lead-in cable money can buy, but if the antenna is not impedance-matched to the cable and/or the cable is not matched to the TV receiver, you might just as well be using outdated "rabbit ears." This is especially true for color TV reception—and not just in the "fringe" reception areas.

Everything in your TV receiving system must be just perfect, and the only way you can make sure that it is is to do the job right—the first time. But do not think that you have to be a TV antenna/transmission line expert to set up a receiving system. With the help of the information provided in this article, you can set up the best possible antenna system.

The Loss Factor. Nothing is perfect. No matter whether it is an automobile engine or an electronic circuit, every system suffers from some type of loss which reduces its efficiency. While you cannot completely eliminate receiving system losses (known as signal attenuation), you can limit them to an acceptable level.

To demonstrate how loss becomes a critical design factor, consider a 300-ohm folded dipole antenna (tuned or cut to any TV channel) connected to a length of 300-ohm twin-lead cable. Very little loss would occur between the antenna and cable for the channel to which the antenna is tuned. But for all other channels in the TV band, the loss might be as high as 3-4 dB; and over the complete band, an average loss of 2 dB would be typical, enough to cancel the characteristic 2-dB gain of the folded dipole (favorably oriented) antenna.

Now, consider a resonant 300-ohm folded dipole, reflector, and several director array (representative of most commercial TV receiving antennas). An estimated 2-dB loss would occur at the

antenna/cable connection due to the lowering of the dipole's impedance. (The effect of placing a reflector and directors in close proximity to the folded dipole is to lower the 300-ohm characteristic impedance of the dipole to about 70-100 ohms). But since this antenna array provides 6-10 dB of gain, a 2-dB loss, severe in our first case, can usually be acceptable, particularly in good reception areas.

For both cases cited above, the cable lead-in loss, assuming about 40′ of twin-lead at VHF, amounts to between 0.6 and 1 dB. Hence, the total loss in antenna signal strength is 3 dB. This means that only 50% of the antenna signal power would be delivered to the TV receiver.

Reducing the Losses. The choice of improving the antenna-to-transmission line match basically involves inserting an impedance-matching transformer between antenna and line. The drawing in Fig. 1 illustrates the makeup of one type of

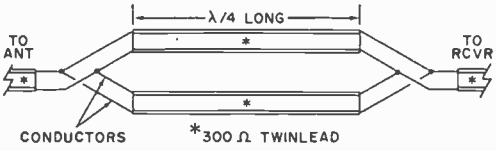


Fig. 1. Transformers are cut to specific lengths for individual channels or for multichannel band.

transformer you can use. It is easy to fabricate and consists of two lengths of 300-ohm twin-lead cable.

The decision of whether to fabricate your own transformer as opposed to buying one that is commercially made should depend on the end results. Tests made with both types show that at the 70-MHz frequency of channel 4, the commercial ferrite-core balun *lowers* the signal level by about 2 dB, while the quarter-wave, twin-lead homebrew transformer *improves* the signal level by 1.5 dB.

Lead-in attenuation, the other loss (amounting to less than 1 dB) can be slightly reduced, but not without considerable effort. Here, two possibilities exist: transition from the antenna to a homebrew 600-ohm open-wire lead-in and back to 300 ohms at the TV receiver; or transition from the antenna to homebrew 1″-diameter, 77-ohm coaxial line and back to 300 ohms at the receiver. Neither of these alternatives will yield a line loss less than 0.3-0.5 dB, which hardly seems worthwhile by itself. However, if a choice were to be made, it would probably be easier to stay with a balanced line and use 600-ohm open line. (Fig. 2 illustrates how this can be accomplished

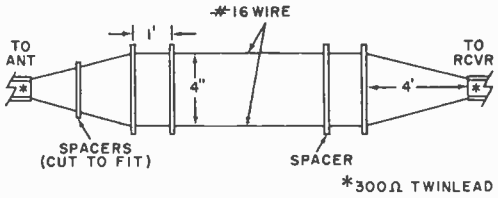


Fig. 2. Insulator spacers support gradual tapers when matching 600-ohm open line to 300-ohm cable.

with #16 wire and a wire separation of 4″ to yield a line loss of about 0.25 dB/100′ at 88 MHz, or less than 0.15 dB for a typical 40′ run.)

You may be wondering when and where it is advantageous to use these methods for improving signal transfer. As a general rule, they should be employed in "fringe" reception areas to improve weak TV channel reception. When making your own transformer or transformers, refer to the Table for the proper quarter-wave transformer lengths to use for each TV channel in the VHF spectrum. The lengths listed were computed assuming standard 300-ohm twin-lead cable with a phase factor of 0.84, which is typical for polyethylene-jacketed twin-lead.

Now, take three practical examples to show how to improve TV reception. In the first example, suppose you have a good quality commercial antenna array and wish to improve reception on Channel 4 by inserting a transformer section between the antenna and a 300-ohm twin-lead line. Select the transformer length section from the Table; in this case, 36″ is indicated. Cut two pieces of twin-lead cable to *exactly* 36″ (plus about ½″ extra at each end). Strip away ½″ of insulation from each end of both cables. Then, connect the lengths of twin-lead in parallel with each other (see Fig. 1).

TRANSFORMER SIZES		
VHF Channel	Transformer Length (inches)	
2	43	
3	40	
4	36	36
5	32	
6	29	
7	14	
8	13.6	
9	13.1	
10	12.8	13
11	12.4	
12	12.0	
13	11.7	

Insert the transformer section between the antenna and twin-lead lead-in cable. This should yield an improvement of 1.5 dB in signal strength and a noticeable improvement in Channel 4 fringe-area reception.

For our second example, suppose you use the same antenna and want the best possible reception. Rather than running 300-ohm twin-lead cable. try using lower loss 600-ohm open line. This can be done fairly easily by following the instructions detailed in Fig. 2. At both the antenna and TV receiver, the line must be tapered gradually to the 600-ohm spacing of the open line. When completed, the installation should yield about a 2-dB improvement in signal reception, slightly better than in the first example.

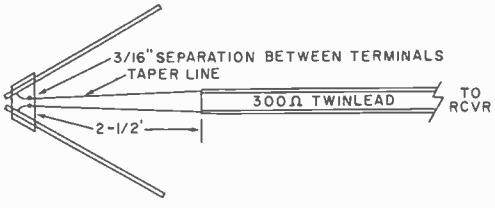


Fig. 3. Gradual taper matches 300-ohm twin-lead cable to 150-ohm impedance of Pyramidal Antenna.

As a final example. assume you are planning to erect the Pyramidal TV/FM Antenna ("Build The 'Pyramidal' TV/FM Antenna," POPULAR ELECTRONICS, July 1969). This antenna's impedance is about 150 ohms, which means that 300-ohm twin-lead cable is reasonably ideal to use. However, for the ultimate match, you should insert a tapered section of line between the antenna connecting terminals and the 300-ohm twin-lead lead-in cable as shown in Fig. 3 to improve reception by about 0.5 dB.

The added complication of tapering the line in the last example might not be

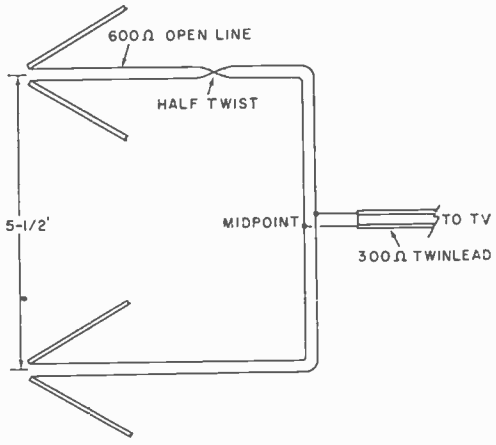


Fig. 4. Open line matches two Pyramidal Antennas to 300-ohm cable. Note half twist in 600-ohm line.

justified, considering that this antenna has a nearly flat gain characteristic of 10 dB for all VHF TV channels.

Finally, suppose that even 10 dB of gain is not enough to provide quality fringe-area reception. You could stack two Pyramidal antennas as shown in Fig. 4 to obtain 13 dB overall gain. Here, the individual antenna connecting point impedances can be tapered to 600 ohms and then paralleled, providing an ideal match to the 300-ohm twin-lead cable line to the receiver. In the illustration, the center-to-center spacing between the antennas is 5'. Of course, the antennas could just as easily be placed side by side to yield the same resultant gain; but erection on a single mast is usually easier to implement.

Now that you have been apprised of good receiving system basics. you can start designing your own system. And with the warm weather here, what better time is there to tackle the job? —30—

VECTOR-CIRCUIT MATCHING QUIZ

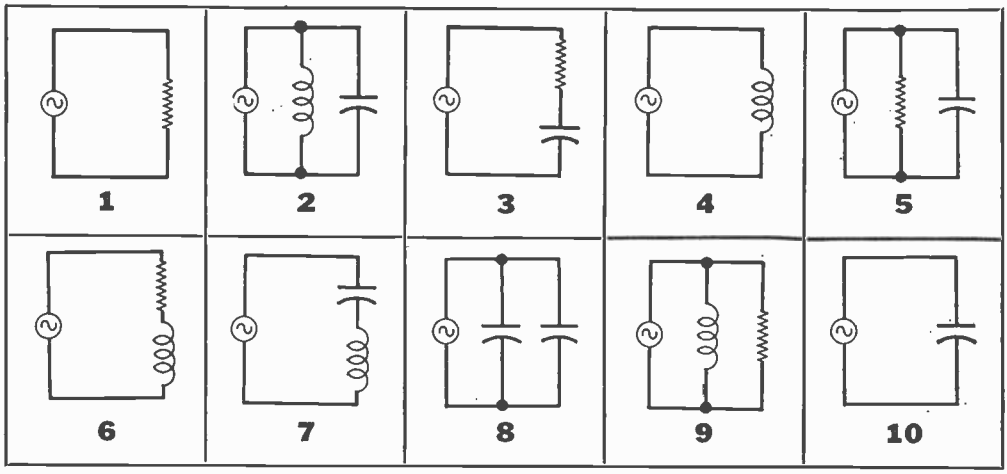
BY ROBERT P. BALIN

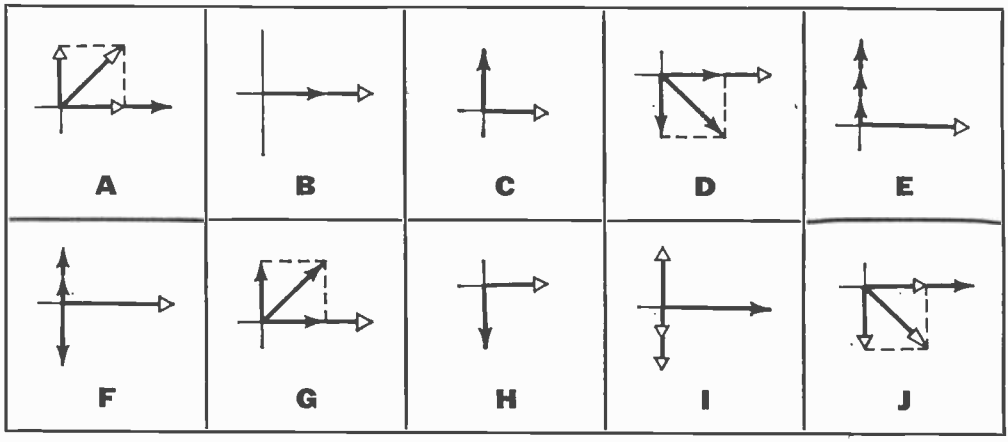
Vector diagrams are widely used to show the magnitude and phase relationships between voltages and currents in an a.c. circuit. A knowledge of vectors is a must for understanding the theory behind frequency modulation and detection, color TV and feedback circuits.

Ten circuits (1-10) are shown below; vector diagrams (A-J) representing the voltages and currents in the circuits are also shown. To test your knowledge of vectors, match the diagrams to the circuits. Note that this is a simple matching quiz—obviously special cases might exist if the effects of resonance were considered. It is also assumed that all elements are pure (that is, capacitors have only capacitance, inductors only inductance, and resistors only resistance).

Standard counterclockwise vector rotation is used to indicate angles of lead and lag. A white arrowhead represents a voltage vector; a black arrowhead is a current vector. In all cases, the reference is the line along the horizontal, extending to the right. Relative vectors are shown for all voltages and currents in each circuit.

(Answers on page 96)





BUILD A TRANSCIPITOR

GIVES YOU GOOD, CLEAN AIR FOR MANY APPLICATIONS

BY WALDO T. BOYD

HAVE YOU EVER painted a very special piece of equipment, only to have it ruined by dust or bugs while drying? Or have you ever had a delicate biological or chemical experiment spoiled by strange gases and smoke in the air? If you have either of these, or any other, needs for a source of truly clean air, the "Transcipitor" is for you.

This clean-air device uses a high-voltage charge in an enclosed column of moving air to remove dust, smoke, and other particulant matter. The column enclosure can be made from a stack of discarded coffee cans (with the ends removed) or from a length of sheet-metal downspout, topped with a small blower. The electronic "heart" of the Transcipitor is a 10-kV d.c. power supply. Power for the device can be obtained either from a 12-volt battery or a transformer/rectifier combination operated from the 117-volt a.c. line.

How It Works. A single isolated conductor, connected to the high-voltage source, is run up through the center of the metal column—the latter being grounded. When air moves through the column all particulants receive a charge from the static field within the column. They immediately fly to the grounded column and cling there where they are joined by millions of other particles until there is actually a visible coat of dust on the inside of the column. When the power is turned off, the dust particles fall slowly to the bottom of the column and can be removed easily.

This system is essentially a miniature version of the type used in factory chimneys to remove residue from the smoke.

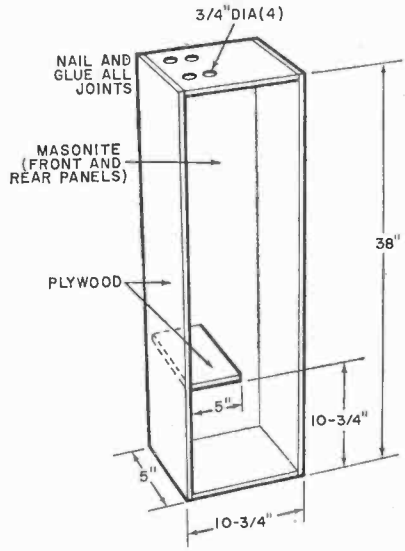


Fig. 1. The cabinet is made from soft pine and Masonite. The front door is not shown.

BILL OF MATERIALS

*2—5" x 38" pieces of ½" pine**
2—5" x 10¾" pieces of ½" pine
1—10¾" x 38" piece of thin hardwood
1—10¾" x 31" piece of thin hardwood
1—5" x 5" piece of ½" pine
Misc.—Plastic-covered vacuum cleaner hose; blower/motor from auto defroster, heater, etc., 12-volt or small 117-volt unit; sealant for motor mounting (RTV-102 or similar); mounting hardware; etc.
**All dimensions may vary. See text.*

Cabinet Construction. Dimensions of the case for the Transcipitor are not critical. A layout of the author's prototype is shown in Fig. 1. Any kind of wood (such as pine) can be used for the sides, top and bottom but the front and back panels are of thin hardwood. A 5" shelf, located 10¾" from the bottom of the cabinet is attached to the side and rear, with another screw inserted through the front panel when it is put into place.

Four ¾" ventilation holes are drilled in the top, while the front panel is cut 6" or 7" short to allow air to enter at the bottom. The height of the column (in this case six 1-lb coffee cans, plus the fan) dictates the height of the cabinet. It is best to assemble the column first and then build the cabinet.

If you are going to use coffee cans for the column cut the bottoms out of five of them, but leave the bottom in the sixth for mounting the fan. Stack five cans together, align them as closely as possible and spot solder them together. Wrap tape around the seams to make them airtight.

The fan is mounted on the sixth (top) can. The fan can be salvaged from an old automobile heater or an evaporative cooler, or you can buy one at a surplus supply house. A small 12-volt type is best, but a fan with a 117-volt motor can be used. The fan and motor assembly should be smaller than the top of the coffee can on which it is to be mounted.

Cut a hole in the bottom of the sixth can to fit the fan intake and mount the fan as shown in Fig. 2. Temporarily set this can (and fan) aside.

Stand the 5-can stack up. In the bottom can, drill a series of 3/16" holes about ⅛" apart around the can about 1½" from the bottom. (Most cans have an indentation ring around the can at about

Fig. 2. The small fan is cemented to its hole in top of can. Make sure that the joint is airtight.

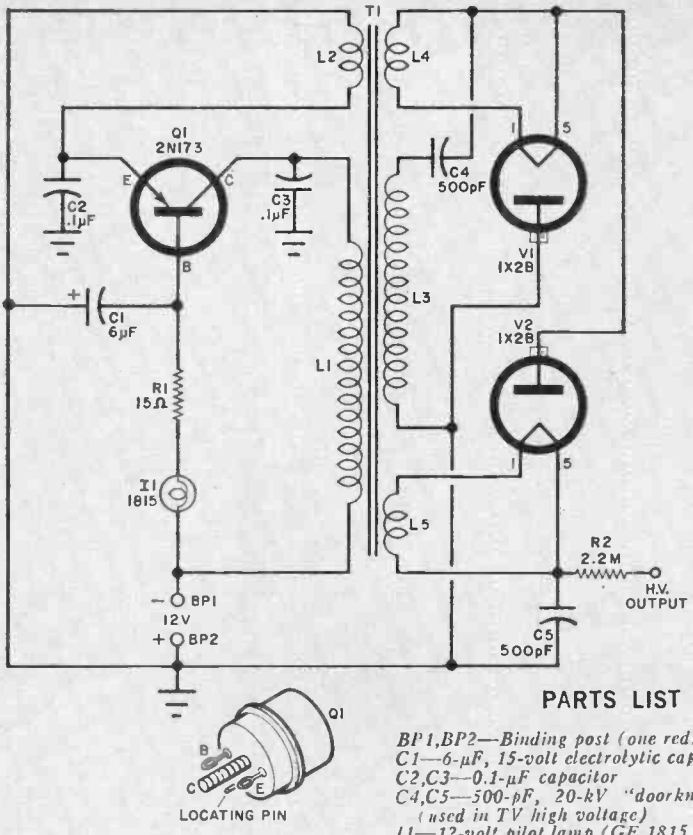


Fig. 3. The circuit is a simple power oscillator driving a voltage-doubler circuit. The two high-voltage capacitors and the flyback transformer can be salvaged from old television set.

PARTS LIST

BP1,BP2—Binding post (one red, one black)
C1—6-μF, 15-volt electrolytic capacitor
C2,C3—0.1-μF capacitor
C4,C5—500-pF, 20-kV "doorknob" capacitors (used in TV high voltage)
I1—12-volt pilot lamp (GE 1815 or similar)
Q1—2N173 or HEP 223 power transistor
R1—15-ohm, 5-watt resistor
R2—2.2-megohm, ½-watt resistor
T1—TV horizontal flyback transformer (Stancor HO-290 or similar)
V1,V2—1X2B high-voltage rectifier tube
Misc.—Heat sink (Wakefield NC621B or similar); insulated mounting hardware for transistor; silicone grease; pilot light holder; 9-pin anti-corona high-voltage rectifier sockets (2); ceramic supports for sockets (2); feedthrough insulator (E.F. Johnson 135-48 or similar); length of ½" high-voltage tubing; length of ⅛" plastic tubing; length of nichrome wire; suitable metal chassis.

that point which you can use as a guide.) Deburr the holes. About 1½" from the top of the can (or in the top indentation ring if it has one), drill four holes 90° apart around the can. Use a thin bit (#43) for these holes. Drill four similar holes in the fifth or top can.

Thread a #6 nylon string through the four holes in the bottom can so that a "crosshair" is created. Make the string tight and apply a little glue on the outside knots to make sure that they hold. Do the same thing on the fifth can. These crosshairs will be used to support and insulate the high-voltage wire in the center of the column. Do not attach permanently the can with the fan at this time.

Place a plastic lid over the open end of the bottom can and stand the stack in the cabinet.

If you use sheet-metal downspout for the column, make the column as high as six coffee cans and drill all holes in approximately the same places. You will have to mount the fan on a piece of metal and secure this to the column later.

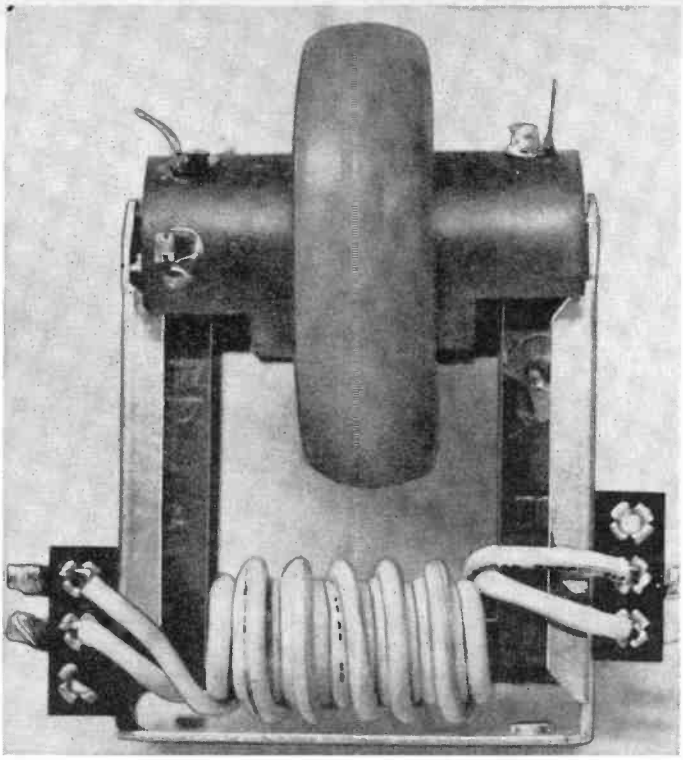


Fig. 4. The two terminal strips are affixed to the side straps of the flyback transformer and support the two ends of new coils (L1 and L2). Wrap layer of insulating tape around the core before winding the coils.

Power Supply. The circuit for the high-voltage power supply is shown in Fig. 3. For safety, the device is enclosed in a grounded metal container and the high-voltage output is taken through a feed-through insulator.

The supply is a simple transistor oscillator using extra windings on a conventional TV high-voltage horizontal output transformer. Two of these extra coils, a primary and a tickler feedback (*L1* and *L2* in Fig. 3), in conjunction with the transistor, form a regenerative feedback network similar to that used in receivers. When the power is turned on, current flows through *L1* and the transistor. The magnetic field set up by this current generates a voltage in *L2* that increases the forward bias on the emitter of *Q1*. The collector current through *L1* then increases. Eventually, the core of the transformer saturates and the magnetic field around *L2* stops building so that the emitter bias is reduced and the collector current drops. The process is then reversed. The magnetic field set up by the decreasing collector current produces a voltage in *L2* that drives the transistor to cutoff. When no current flows through *L1*, there is no voltage across *L2* and the emitter returns to ground potential. The cycle then repeats. The oscillator frequency is near the upper end of the audible range.

The transistor is biased by *R1*, which is bypassed by *C1*. Capacitors *C2* and *C3* protect the transistor from static discharges.

The current through *L1* varies from zero to about 5 amperes. Because of the turns ratio between *L1* and *L3*, about 5000 volts a.c. is developed across *L3*. A voltage-doubler/rectifier combination (*V1* and *V2* with *C4* and *C5*) raises the voltage to about 10,000 volts d.c.

Caution. Although the current is low, voltages at the 10-kV level can be very dangerous. Do not, under any circumstances, turn on this high-voltage generator unless the case is completely closed and the high-voltage feedthrough is well in the clear. When the system is turned off for any reason, always discharge the high-voltage terminal using an insulated cable, with one end secured

to ground and the other end held at the end of an insulated rod to touch the terminal.

Power Supply Construction. Remove the insulated filament winding from the flyback transformer. If there is a sponge-rubber pad between the core and the mounting bracket, remove it. Caution: the core is made of a brittle ferrite material in an epoxy binder. Therefore, do not force or twist it in any way. Gently remove the rectifier plate connector lead from the coil. Make sure that you can identify the high-voltage winding terminals.

Solder a two-lug terminal strip to each side of the mounting bracket as shown in Fig. 4. Wrap a layer of insulating tape on the bare horizontal ferrite core, feeding the tape between the core and the mounting bracket. Wind 12 turns of #18 stranded hookup wire in a close layer around the core. This forms *L1*. Solder the ends to the bottom insulated tie points of the terminal strips. If the winding does not pack tightly, remove it, and rewind with a slightly larger wire.

Wind a five-turn coil, using the same gauge wire, on top of *L1*. This forms *L2*. Solder the two ends to the top lugs on the terminal strips. Wind *L2* in the same direction as *L1* with the windings spaced evenly across *L1*.

Using the same type of wire originally used for the filament winding (removed in an earlier step), wind the two one-turn coils between the turns of *L2*. These form *L4* and *L5* and will be connected to the filaments of the rectifier tubes. Locate one end of the high-voltage winding and connect it to the nearest ground—the transformer mounting bracket will do.

Obtain a metal box, large enough to accommodate the transformer and the rectifier tubes, yet small enough to fit between the metal column and the side of the cabinet. It should be less than 10" high (including the insulator for the high-voltage feedthrough) so that the entire assembly will fit below the shelf in the cabinet.

The transistor is mounted on a heat sink using appropriate hardware and insulating material. Coat both sides of the transistor insulator with silicone heat-conducting grease. The heat sink assembly is mounted at the outside lower end of the rear panel to keep it away from corona discharges set up in the high-voltage section (see Fig. 5). Appropriate holes must be drilled in the rear panel to mount the heat sink and to provide access to the transistor terminals.

The flyback transformer is mounted at one side of the power supply enclosure (see Fig. 6) so that the high-voltage and filament leads face the two rectifier tubes. The tube sockets (of the anti-corona type) for the rectifiers are mounted on ceramic insulators, one on the top and the other on the bottom of the enclosure. Mount the other components as shown in Fig. 6 and wire them, point-to-point, as shown in Fig. 3. Take care to make neat, smooth joints and avoid sharp edges to prevent corona discharges. Resistor *R2* connects from the rectifiers to the feedthrough insulator.

Checkout. Connect a 2- to 3-volt d.c. source to the battery input terminals,

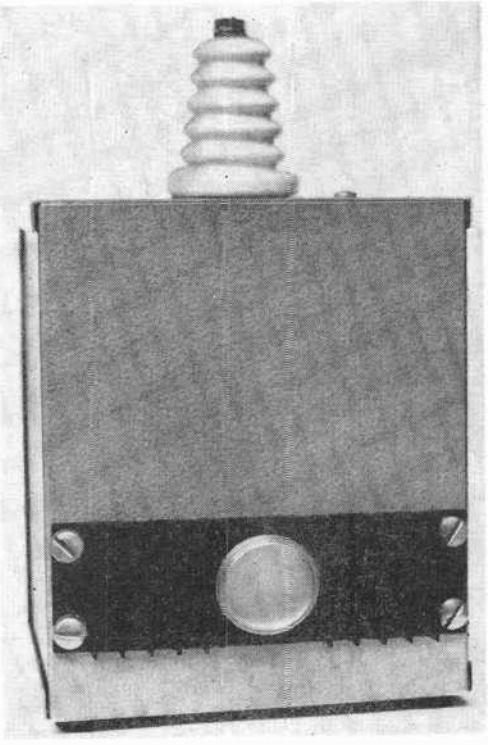
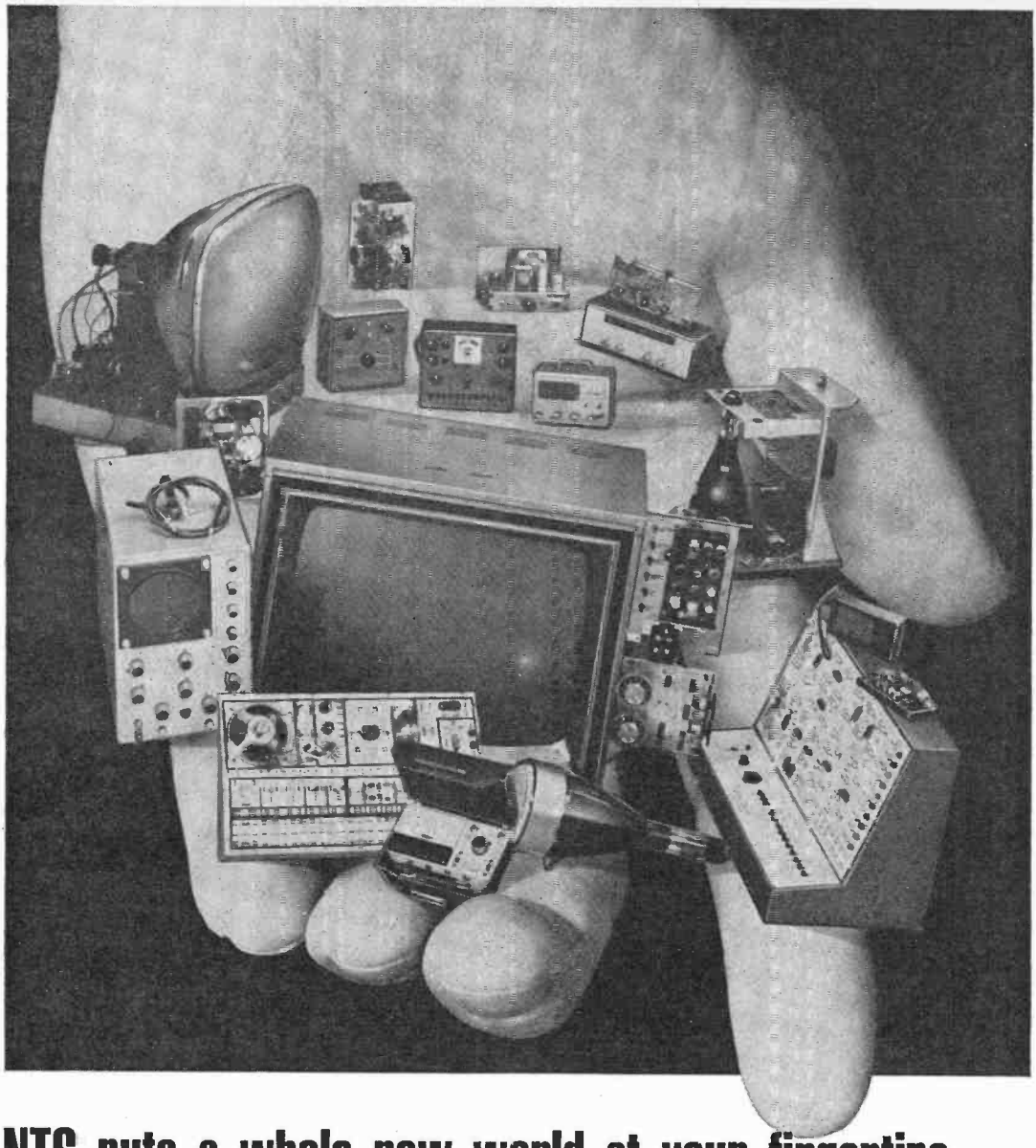


Fig. 5. The transistor is electrically insulated from its heat sink, and the heat sink is attached to the rear of the metal chassis. Make sure that no metal can contact the case (collector) of Q1.



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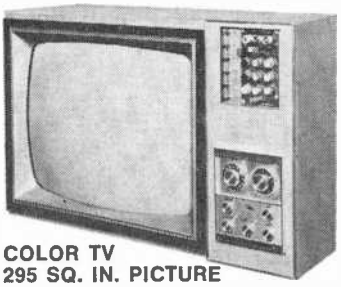

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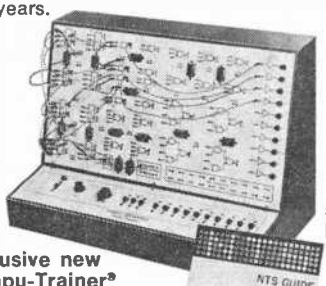

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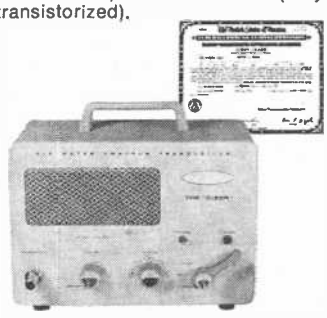

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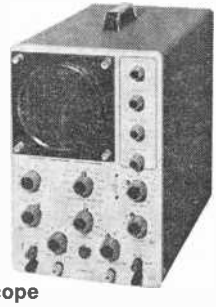

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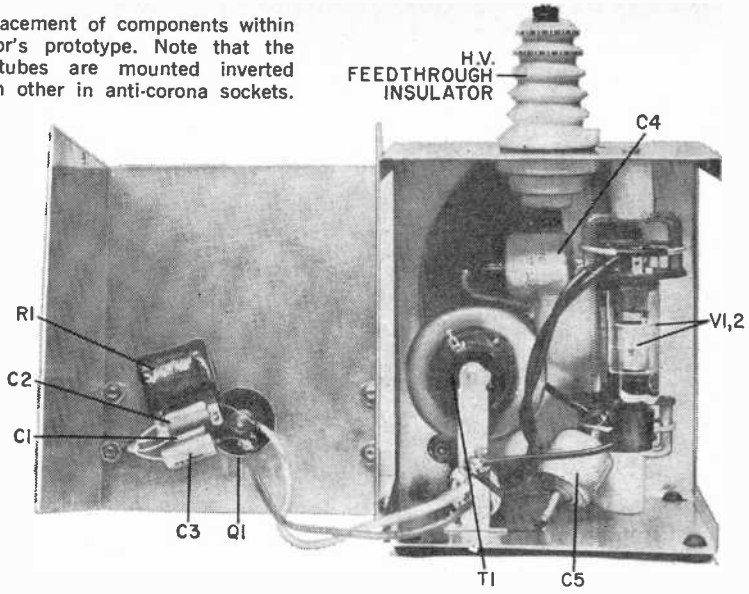


Fig. 6. Placement of components within the author's prototype. Note that the rectifier tubes are mounted inverted from each other in anti-corona sockets.

with positive to ground. A pair of flashlight D cells will do. The circuit will oscillate with this low supply but voltage levels will be down. Try to draw an r.f. arc from the transformer high-voltage terminal using a well-insulated screwdriver. If there is no arc, even a small one, reverse the connections to *L2*. In some cases, it may be necessary to add or remove turns from *L1* to obtain the proper core saturation.

Once you know the oscillator is working, connect 12 volts d.c. to the circuit and, being extremely careful, measure the voltage at the filaments of the rectifiers. It should be between 1.2 and 1.5 volts a.c. Make sure that no part of the voltmeter or your body touches ground when making this measurement! Once filament voltage has been confirmed, shut down the power supply, discharge the high-voltage feedthrough, and assemble the metal enclosure, making sure that it is completely sealed.

As a final check, connect the circuit to a heavy-duty 2- to 12-volt power supply (such as a battery charger) capable of handling 5 amperes. Connect an ammeter in the input lead. With a 2-volt input, the ammeter should indicate about 0.5 ampere. With 12 volts input, current should be about 2 amperes. The reading could go as high as 5 amperes if the circuit is loaded with a high-voltage experiment.

DANGER! There is at least 10,000 volts present on the top of the feedthrough insulator! Treat it with the greatest respect. Don't try to draw arcs with a pencil, and don't short this terminal to ground when the supply is energized. Also, don't touch the transistor case while the supply is operating.

Shut down the power supply, discharge the high-voltage feedthrough, and place the power supply in the cabinet as shown in Fig. 7, with the battery terminals and pilot light facing front.

Mark the point on the metal column that is directly opposite the top of the high-voltage feedthrough. Drill a ¼" hole at this point and deburr it. Obtain a length of high-voltage plastic tubing long enough to go from the top of the feedthrough to the center of the column. For still better insulation, insert another piece of ⅛" tubing inside the first one. Feed a length of #22 or smaller wire through this insulator leaving enough at one end to make a connection to the feedthrough and a small loop at the other (column) end, at the center of the crosshairs.

Attach a length of fine nichrome wire (obtained by dismantling an old wirewound resistor) to the loop of wire at the bottom crosshair (wind the copper wire around the nichrome) and to the crosshair itself for support. Pass the nichrome

wire up through the column and attach the top end to the upper nylon crosshair, making sure that the wire is reasonably straight and does not come near the sides of the metal column. Cut off any loose end.

(Nichrome wire is used here because the high voltage produces a tiny corona which would ruin copper wire but does not harm the nichrome. Steel wire can be used, but it will eventually rust and disintegrate.)

Do not use any mechanical device to connect the nichrome wire to the high-voltage lead since this joint will have to be disassembled occasionally so that the column can be removed for cleaning. Replace the plastic cover on the bottom of the column. Place the blower container on top of the column, making sure that the exhaust is toward the front of the cabinet. Secure this can in place by wrapping tape around the seam. Make a wire connection between the metal column and the metal chassis of the power supply by soldering at both ends.

The appearance of the stack can be improved by spraying it with paint, but don't get paint in the blower mechanism or on the high voltage leads.

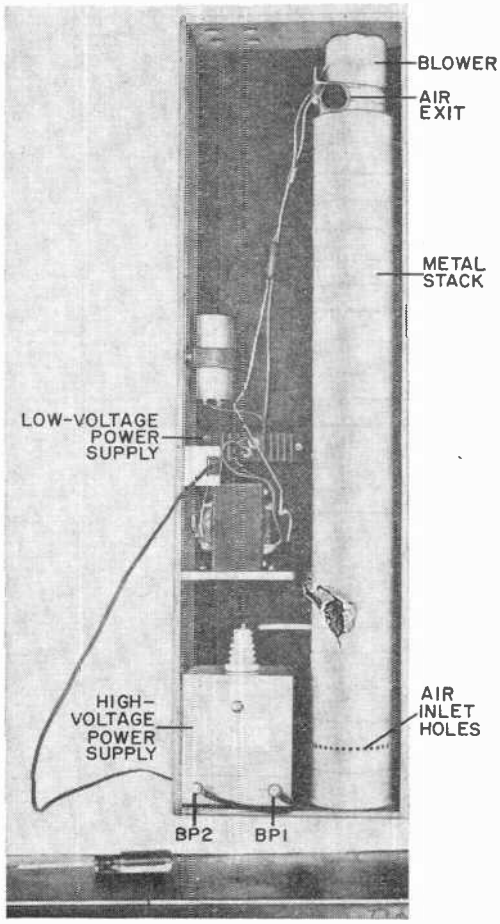
Line Operation. The Transcipitor can be operated from a conventional low-voltage d.c. power supply such as that shown in Fig. 8. Mount the transformer on the small shelf in the cabinet and the filter capacitor on a clamp secured to the cabinet wall. A TV power socket is mounted on a small piece of metal and located on the cabinet wall so that power can be applied to the system only when the front panel is in place. A TV "cheater" supplies power to the socket and is mounted on the front panel aligned with its receptacle. The two rectifier diodes are mounted on a heat sink on the rear wall. Wire the power supply point-to-point as shown in Fig. 8.

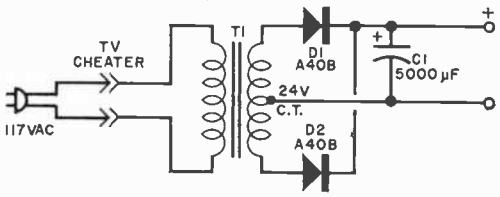
If the fan motor is of the 12-volt variety, wire it to the power supply, observing proper polarity. If the motor is 117 volts a.c., connect it in parallel with the input to the power transformer.

Final Assembly. The finished project should now look like the one in Fig. 7. The column, with the fan at the top should just fit snugly within the cabinet. It may have to be wedged if too loose; or the cabinet top may have to be hollowed out slightly if the fit is too tight. Recheck all wiring, making sure that the metal column is connected to the positive battery input (at ground) on the supply. Make sure that the high-voltage feed is in the clear and that all parts attached to the cabinet walls are on tightly.

Obtain a length of flexible vacuum cleaner hose. The hose should be covered with plastic rather than cloth to make cleaning easier. Wash the hose thoroughly, inside and out, with a good detergent and then rinse thoroughly. Cut a hole in the front of the cabinet so that the end of the hose and the exhaust on the fan can be mated. It may be necessary to make up some type of size-matching device if the two are greatly different in size. Check all dimensions, and then mount the front panel on the cabinet using a few screws to secure it.

Fig. 7. Coffee-can stack was painted before installation to make a more pleasing appearance. The four top vents provide cooling for power supply.





PARTS LIST

C1—5000-μF, 15-volt electrolytic capacitor
D1,D2—Silicon rectifier (GEA40B or similar)
T1—Power transformer, secondary 24 volts, center tapped
Misc.—TV "cheater" cord and receptacle; diode heat sink (Delta NC403K or similar); capacitor clamp; mounting hardware; etc.

Fig. 8. This power supply operates both the air purifier and fan and is mounted on the case wall above the h.v. supply. Use a heat sink for the two rectifiers.

Operation. With the front panel in place and the a.c. supply connected, the blower should start up and moving air should be felt at the outlet. Hold a lighted cigarette or other source of smoke near the ring of holes at the bottom of the column. If everything is working properly, smoke will enter the column, but the air coming out will be clean with no trace of smoke.

For conducting delicate experiments or for drying paint on small items, another cabinet such as that shown in Fig. 9 can be constructed. The vacuum-cleaner hose is coupled to this cabinet; and a small vent in one wall permits the air to escape from the interior. The front door can be constructed with a glass insert and a light bulb can be installed within the cabinet for viewing experiments.

When it comes to removing pollen, dust, etc. from an area as large as a room, the Transcipitor will work—to an extent. It does not have the capacity to handle a very large room; but, in a small room, with windows and doors closed, its effect is quite noticeable.

Every so often, inspect the metal column for dust accumulation. Remove the column from the cabinet, hold it over a paper sack and remove the bottom plastic cover. Shake the column gently to remove dust particles stuck to the sides. Clean the inside walls before reinstalling the column in the cabinet. The stack can be inspected from the outside by shining a flashlight through the bottom array of holes and looking into the other holes. If you can see the dirt, empty the column.

-30-

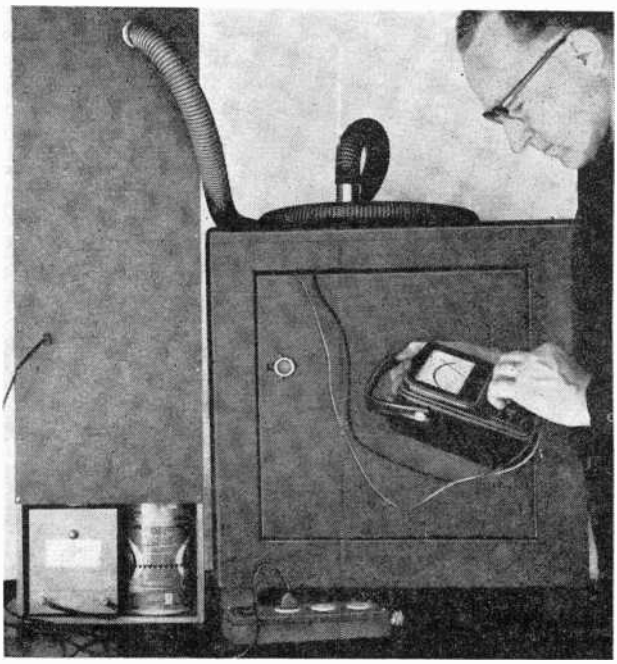
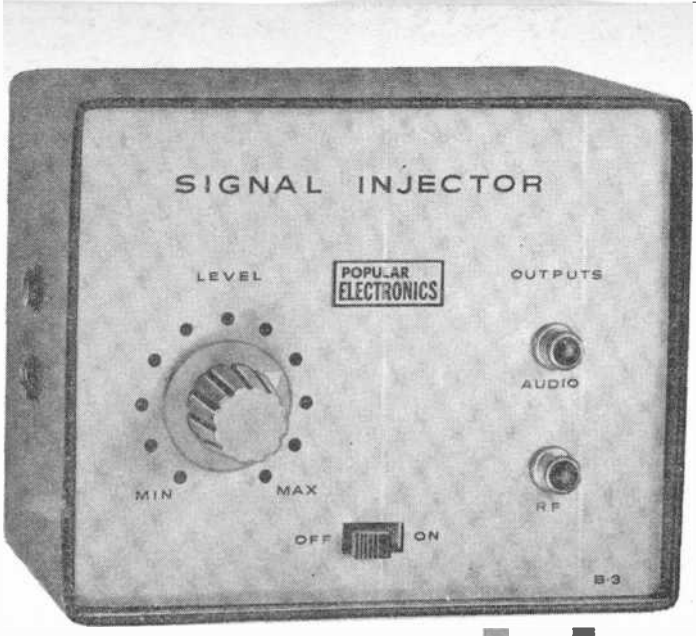


Fig. 9. The front door does not come down to the bottom of the cabinet to allow for air intake and observation of the indicator lamp. To prevent operation when the door is open, a TV "cheater" system is door operated.



Build a Signal Injector

QUICK WAY TO CHECK AUDIO CIRCUITS

BY DON LANCASTER

THE SIGNAL INJECTION technique, most electronics technicians agree, is the quickest way to troubleshoot radio receivers and audio equipment. Using a signal injector, he can check an entire unit with only one hookup—no matter how complex the receiver or amplifier. Time-consuming voltage or ohmmeter checks are required only when the faulty stage is located.

Whether you plan to use it on the job or at home to keep your own equipment in working order, you will find many uses for the "IC Signal Injector" described here. This Injector is basically a battery-powered 1000-Hz multivibrator that generates square waves. The amplitude of the output square waves is continuously variable and is great enough, with the amplitude control wide open, to drive or test a loudspeaker. The Injector also provides a wide band-width r.f. signal which is extremely useful in testing AM receivers.

Construction. As you can see from the schematic diagram in Fig. 1, the circuit of the IC Signal Injector is very simple. However, since it does employ an integrated circuit with closely spaced pin leads, it is essential to use a printed circuit board. You can obtain a prepunched and etched board from the source listed in the Parts List, or you can make your own with the aid of the etching guide provided in Fig. 2.

Install the components on the board as shown in the photo in Fig. 3, paying particular attention to the orientation of the indexing groove on *IC1*. Use a low-wattage, fine-pointed tool when soldering component leads to the foil pattern on

IC EXPERIMENTER'S CORNER

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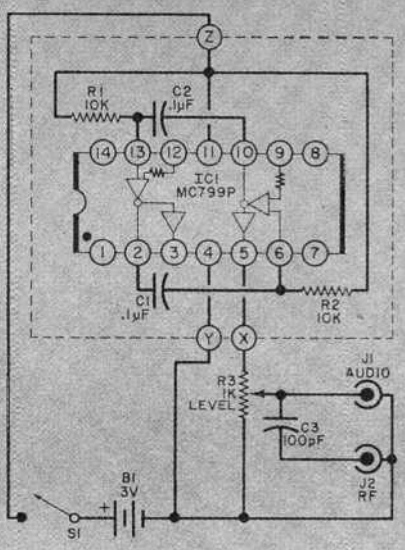


Fig. 1. One-IC circuit provides both audio and r.f. tracing signals; each output signal is continuously variable in amplitude.

PARTS LIST

B1—Two 1.5-volt D cells in series
C1,C2—0.1-μF, 10-volt disc capacitor
C3—100-pF disc capacitor
IC1—MC799P or HEP571 dual-buffer integrated circuit (Motorola)
J1,J2—Phono jack
R1,R2—10,000-ohm, ½-watt resistor
R3—1000-ohm linear-taper potentiometer
S1—S.p.s.t. slide or toggle switch
Misc.—Keystone #176 battery holder; control knob; 5" x 4" x 2½" case; spacers; #6 machine hardware; hookup wire; solder; etc.
Note—The following items are available from Southwest Technical Products Corp., Box 16297, San Antonio, TX 78216: etched and drilled printed circuit board, $1.78; complete kit of parts, including prepunched vinyl-clad case but less batteries, $7.30, postpaid in U.S.A.

the PC board, and apply heat only long enough to allow the solder to flow.

Next, mount *R3*, *C3*, *S1*, and *J1* and *J2* on the front panel. Use ⅜"-long spacers and #6 machine hardware to fasten the circuit board to the front panel in the position shown, and interconnect with hookup wire all components and the circuit board.

Battery *B1*, two 1.5-volt D cells connected in series, can be mounted to the rear panel of the enclosure with a dual-cell holder. However, if you plan to use another type of d.c. supply (see sidebar), make the hookup wires connected to *S1* and ground on the circuit board as long as necessary.

How To Use. To test the IC Signal Injector, close *S1* and connect a small 3.2- or 8-ohm loudspeaker to the AUDIO jack on the front panel. Rotate LEVEL control fully clockwise; you should hear a 1000-Hz tone coming from the speaker. An

HOW IT WORKS

Integrated circuit *IC1* in Fig. 1 is a dual inverting buffer. Each input has two outputs, one low- and the other high-level. The low-level outputs are cross-coupled to each buffer input through capacitors *C1* and *C2* and charging resistors *R1* and *R2* to form an astable multivibrator.

One high-level output is fed to level control *R3* and AUDIO jack *J1* as a 1000-Hz signal. Internal isolation between low- and high-level outputs prevents heavy loads—or even short circuits—from stalling or radically shifting the operating frequency of the multivibrator.

Capacitor *C3* couples only the high-frequency energy (derived from the harmonic-rich leading edges of the square waves generated by the multivibrator) of the audio waveform to RF jack *J2*. At *J2*, there is available a series of impulses that can be used for signal injection and other AM radio receiver work.

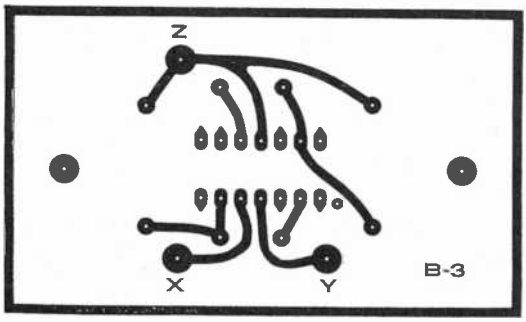
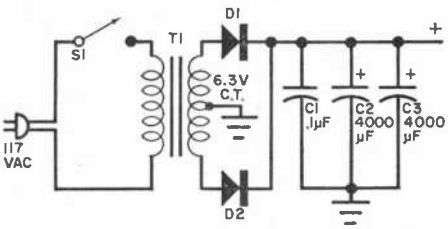


Fig. 2. Actual size circuit board etching guide is designed to accommodate components not mounted on front panel of the project. Isolated dots locate mounting holes.

IC EXPERIMENTER'S POWER SUPPLY

The low-voltage power supply whose schematic is shown here can be used with any and all of the "IC Experimenter's Corner" projects presented in this series. Note that the supply has full-wave rectification and very good filtering to supply a stable d.c. voltage source for the IC projects. Output voltage from the supply is approximately 6.3 volts d.c.

The power supply can be assembled by any conventional method, including point-to-point wiring. Very few components are used and they are relatively small in size. Hence, the supply can be fit inside any of the enclosures suggested for the various projects.



PARTS LIST

C1—0.1-μF disc capacitor
C2,C3—4000-μF, 15-volt electrolytic capacitor
D1,D2—25 PIV, 1.5-ampere silicon diode
S1—S.p.s.t. slide or toggle switch
T1—6.3-volt, center-tapped filament transformer (Stancor No. P-6134 or similar)
1—line cord with plug
Misc.—Hardware, hookup wire, solder, etc.
Note—A kit of parts for the power supply is available at $4.50 postpaid from Southwest Technical Products Corp., 219 W. Rhapsody, San Antonio, TX 78216.

alternate test method would be to connect the audio output of the injector to an audio system, setting the LEVEL control as needed, and listen for the tone.

The output from the RF jack on the injector is rich in harmonics to allow the checkout of the front ends in most receivers, including those that operate in the standard AM broadcast spectrum.

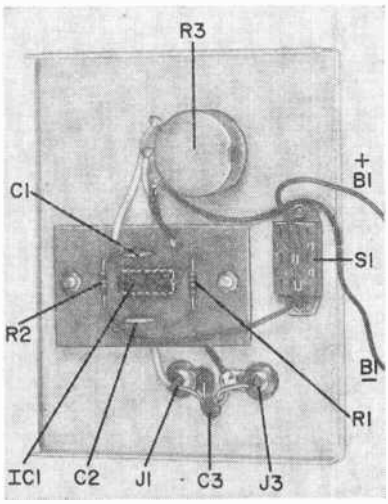


Fig. 3. Pay particular attention to location of notch on IC1 during assembly of project. Mount C3 between J1 and J2.

For example, assume you want to troubleshoot a faulty AM transistor radio receiver. First check the receiver's battery under load with a voltmeter. If it checks out good, proceed to your signal injection tests:

First inject the audio signal into the speaker, directly across the speaker terminals. If you hear the tone, the speaker is in operating order. Then, stage by stage, work back toward the front end of the receiver until the signal ceases to be heard from the receiver, at which time you will have located the faulty stage. (Note: when injecting into the audio circuits, use the audio output; for the i.f. and r.f. stages, use the r.f. output.) You should end up at the antenna input if the receiver is in perfect operating order.

If you wish to change the audio frequency of the tone, you can change the values of *C1* and *C2*. Higher capacitance values decrease the signal frequency, and vice versa.

Current drain for the IC Signal Injector is on the order of 80 mA at 3 volts d.c., assuring long life from a battery supply, especially if you use heavy-duty alkaline cells. If you prefer a built-in power supply, however, you can build your own by referring to the schematic diagram shown in box above. Or, you can use any good bench supply capable of delivering 1.6 to 6 volts d.c. at about 100 mA for full-load operation. -30-

PHOTOCELL MOTOR CONTROL DEMONSTRATOR

Great learning and teaching aid

BY BOB KOVAL

THE MOST EFFECTIVE teaching aids and the most interesting science fair projects are working models of mechanical, electrical, or electromechanical devices. The photocell motor control demonstrator described here falls into this category. Unlike most such projects, however, it offers audience participation. Passersby are invited to turn on and off a motor themselves simply by shining a beam of light on a photocell.

By spreading out the circuit on a large 15¼" × 24" piece of ½"-thick plywood and running the wires on the front surface of the board a twofold objective is achieved. First, the project has eye appeal (an important consideration at science fair judgings). Second, since there is no hidden circuitry on the rear of the board, it is more convenient to explain how the system operates.

How It Works. Photocell *PC1* (see Fig. 1) is connected across the emitter/base junction of transistor *Q1*. Then when light strikes *PC1*, a slight voltage is generated which causes *Q1* to conduct. This, in turn, causes relay *K1* to be energized and power is applied to the motor. Simultaneously, *K3* is energized and latched in since its circuit is completed through the contacts of *K2*. (If the light beam is removed from *PC1*, relay *K1* will drop out.) The entire sequence takes place in just a few milliseconds, so just a quick flash of light on *PC1* is enough to operate the circuit.

To turn off the motor, a beam of light must be directed at *PC2*, which generates a voltage that causes *Q2* to go into conduction. Now, *K2* is energized, opening its normally closed contacts and de-energizing *K3*. When *K3* drops out, the motor circuit is opened, and the motor stops operating. Again, the action is almost instantaneous.

Construction. Begin by selecting a ½"-thick piece of clear plywood measuring 15¼" × 24" (or substitute a close-grained piece of particle board, cut to the same dimensions). If you use plywood, make sure the top lamination is birch so that there will be less of a tendency for the wood to crack after it has been painted. Sand the wood to obtain a smooth, flat finish, remove all wood dust, and apply a thin coat of sealer.

When the sealer has thoroughly dried, sand and clean once more. Now paint the board with thin coats of white or light gray enamel, using as many coats as nec-

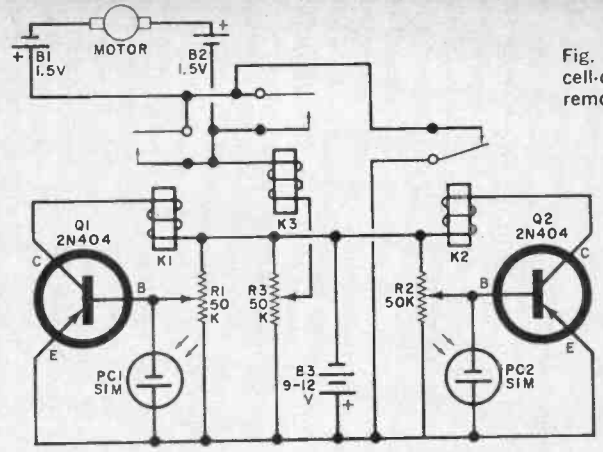


Fig. 1. Relays, operated by photocell-driven amplifiers, apply and remove power from the motor.

PARTS LIST

B1,B2—1.5-volt D cells (see text)
B3—9- or 12-volt power source (see text)
K1-K3—1000-ohm, 7-mA s.p.s.t. relay (Sigma Type 11F-1000-G/SIL)
PC1,PC2—Solar cell (International Rectifier Corp. SIM, or similar)
Q1,Q2—2N404, 2N1191, or SK3006 transistor
R1,R2—50,000-ohm, linear taper potentiometer
R3—50,000-ohm miniature trimmer potentiometer
1—24" x 15¼" piece of ½" birch plywood or close-grained particle board
1—3-volt d.c. hobby motor
Misc.—6-32 brass machine hardware; crimp-on solder lugs; #14 plastic-jacketed solid hook-up wire; sandpaper; sealer; white or light gray paint; battery connectors (2) for B1; etc.

essary to give a hard reflective finish. Remember to sand and clean between each coat and allow sufficient time to dry.

Note that the board is painted before the holes are drilled. The reason for this is to prevent the screws from picking up paint when they are pushed through the holes.

Using the information provided in Fig. 2, drill ⅛" holes for parts mounting on the board. Drill through from the painted side so that as the drill point exits from the wood, any flaking or chipping will be on the unseen side of the board. (Note that holes for the relays are not dimensioned into the drawing since different types of relays require different mounting hole centers.)

Pass a 6-32 × 1" brass machine screw through each hole from the rear of the board, and fasten in place with machine nuts. Next, mount the motor in its appropriate location by any convenient method, and epoxy cement *PC1* and *PC2* in place. The size D flashlight batteries are soldered to #14 solid wire and connected to the appropriate screws with solder lugs, making a neat and sufficiently strong arrangement.

The potentiometers should be made self-supporting by soldering their contacts to solder lugs (see Fig. 3) and fastening them to the screws. The leads of transistors *Q1* and *Q2* are simply connected to the screws directly or via solder lugs.

Wiring is best accomplished by cutting the leads to the appropriate sizes and attaching to each end a solder lug, after which the leads are simply bolted into place with machine nuts. Use #14 solid, plastic insulated wire to obtain the neatest layout and so it can be seen for a considerable distance. Remember, the bold appearance of the wire adds to the success of your project.

The power source for the transistors consists of two 9-volt batteries in parallel. No switch is provided, since the battery connector easily snaps on and off the batteries. (When the demonstrator is to be used for long periods, such as at Science Fairs, two heavy-duty 6-volt lantern batteries can be connected in series and hooked up to the circuit in place of the 9-volt batteries.) Mount the 9-volt batteries as shown, and route their wires behind the board. The dashed lines in Fig. 3 show where the battery leads terminate in the circuit.

No switch is provided in the motor power supply since the D cells supply no

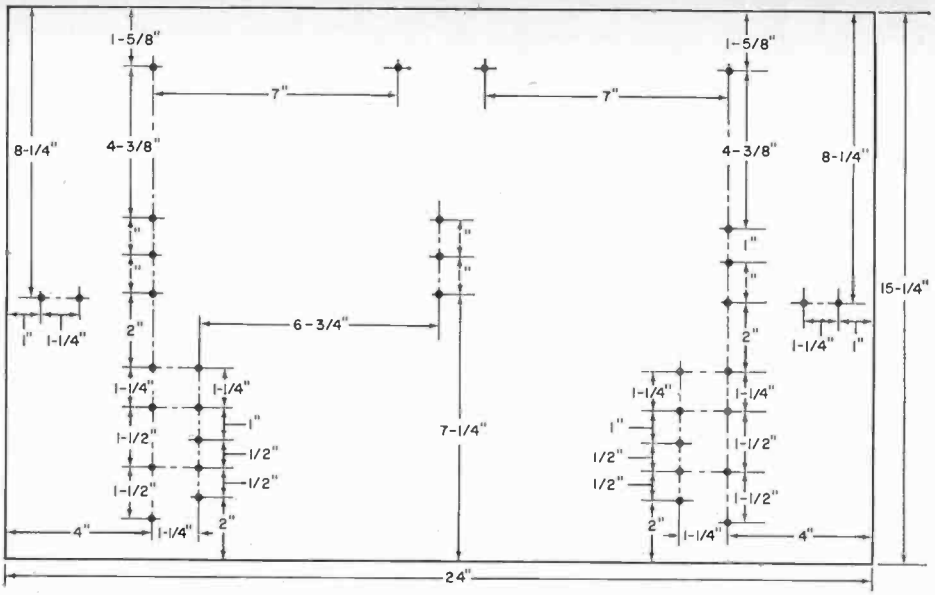


Fig. 2. Holes drilled through demonstrator board are for machine-hardware mounting screws and terminals.

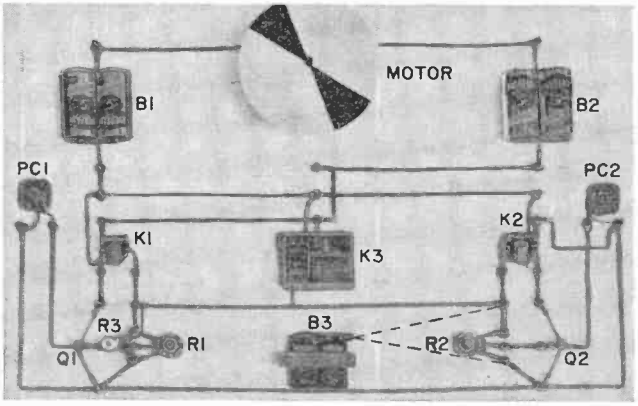


Fig. 3. Neat, symmetrical layout is accomplished with aid of heavy-gauge insulated wire and machine hardware.

power when the circuit is in standby. The D cells are in a series-parallel configuration to provide long life.

Adjustment and Use. After making a complete check of your wiring, cover *PC1* and *PC2*, and set *R1* and *R3* to their mid-range positions. Connect the 9- or 12-volt power source to the circuit, but do *not* install *B1* and *B2* yet.

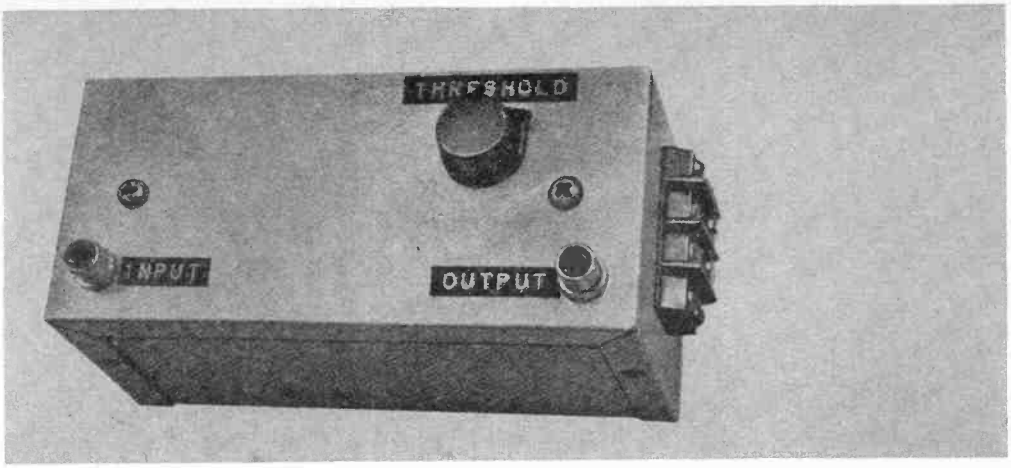
Uncover *PC1* and from about 5′ away, direct a light beam onto it and adjust *R1* so that *K1* is energized when the light strikes *PC1*. Move the beam away from *PC1*; *K1* should be immediately deenergized. Listen for the clicks.

Now, with *PC1* covered and *PC2* exposed, again from about 5′ away direct a beam of light onto *PC2*. Adjust *R2* so that when the beam strikes *PC2*, *K2* is energized. Then, when the beam is moved away from *PC2*, *K2* should immediately drop out.

Uncover both photocells. Now direct the flashlight beam onto *PC1*, and adjust *R3* until *K3* pulls in when the light strikes *PC1*. Check that *K3* remains locked in and is deenergized only when the light beam is directed at *PC2*.

Now install *B1* and *B2* and recheck the operation of the circuit.

Potentiometers *R1* and *R2* are sensitivity controls that can be adjusted for optimum circuit operation under whatever ambient light conditions exist in the vicinity of the demonstration setup. –30–



Simple SCA Adapter

FM MUSIC SANS COMMERCIALS

BY WILLIAM F. SPLICHAL, JR.

MANY FM BROADCAST stations transmit a secondary frequency-modulated subcarrier that is offset from the regular carrier frequency by 67.5 kHz. This sub-carrier channel (called SCA for Subsidiary Communications Authorization) provides the listener with continuous music programming that is uninterrupted by commercials, news, weather, or other reports. The SCA should not be confused with the 38-kHz subcarrier normally used to carry the complementary channel in normal stereo FM broadcasts; it is a separate system which no home entertainment receiver is designed to receive.

Perhaps you are already familiar with the SCA broadcasts. You hear them in such places as restaurants, supermarkets, and other commercial establishments as "background" music. If you would like to receive the SCA subcarrier with your present receiver, all you need is a simple multiplex adapter that can extract the program material without interference from the "normal" program channel transmissions from the FM station.

Adding the SCA Adapter (described in this article) to your FM receiver will in no way interfere with the receiver's normal operation. If anything, it will add to the receiver's versatility by providing an extra source of entertaining music.

How It Works. Referring to Fig. 1, the frequency-modulated SCA subcarrier is introduced into the adapter through input jack *J1* where it encounters a 67.5-kHz parallel-tuned circuit consisting of radio frequency choke *RFC1* and capacitor *C3*. Then it is passed through a high-pass filter made up of *C2*, *C4*, and *RFC2*. From here, the frequency-modulated subcarrier is amplified and limited by *Q1* and *Q2*, respectively. At this point, the frequency modulation will have been converted to a series of pulses whose frequency is the same as that of the original frequency modulation.

Once amplified and limited, the signal is coupled to monostable multivibrator stage *Q3-Q4*. Here, *Q3* is normally conducting, while *Q4* is held in cutoff. Po-

tentiometer *R12* acts as a "threshold" control, allowing only the higher amplitude 67.5-kHz subcarrier signals to trigger the multivibrator. Each time the multivibrator fires, a negative pulse is generated at the collector of *Q4*.

Since the width of the generated pulse is essentially independent of the triggering rate, the average voltage level appearing at the collector of *Q4* will be directly proportional to the triggering frequency (the 67.5-kHz modulation) up

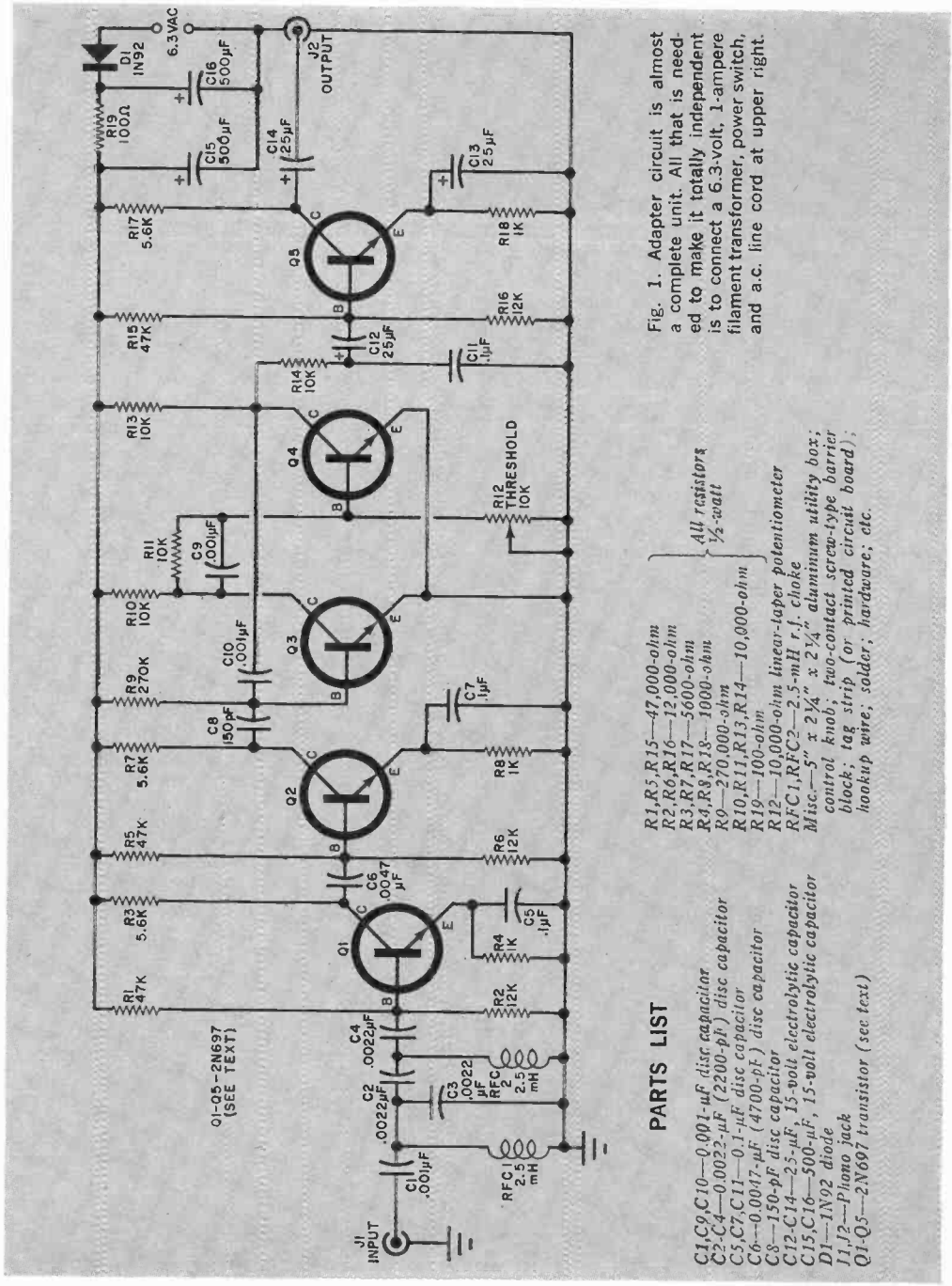


Fig. 1. Adapter circuit is almost a complete unit. All that is needed to make it totally independent is to connect a 6.3-volt, 1-ampere filament transformer, power switch, and a.c. line cord at upper right.

PARTS LIST

C1,C9,C10—0.001-μF disc capacitor
C2-C4—0.0022-μF (2200-pF) disc capacitor
C5,C7,C11—0.1-μF disc capacitor
C6—0.0047-μF (4700-pF) disc capacitor
C8—150-pF disc capacitor
C12-C14—25-μF, 15-volt electrolytic capacitor
C15,C16—500-μF, 15-volt electrolytic capacitor
D1—1N92 diode
J1,J2—Phono jack
Q1-Q5—2N697 transistor (see text)
R1,R5,R15—47,000-ohm
R2,R6,R16—12,000-ohm
R3,R7,R17—5600-ohm
R4,R8,R18—1000-ohm
R9—270,000-ohm
R10,R11,R13,R14—10,000-ohm
R19—100-ohm
R12—10,000-ohm linear-taper potentiometer
RFC1,RFC2—2.5-mH r.f. choke
Misc.—5" x 2¼" aluminum utility box; control knob; two-contact screw-type barrier block; tag strip (or printed circuit board); hookup wire; solder; hardware; etc.

All resistors ½-watt

to the point where *Q4* is cut off completely all the time. This point is slightly above the audio spectrum; therefore, the multivibrator will deliver an output for the full subcarrier modulation range.

Power for the SCA adapter is derived from any 6.3-volt, 60-Hz, source. A built-in half-wave rectifier/filtering circuit, consisting of *D1* and *C15*, *C16* and *R19*, provide the d.c. voltage required for proper operation of the adapter.

Although the SCA Adapter so far described makes use of five commonly available *npn* silicon transistors, germanium or *pnp* transistors can be substituted. Merely change the polarities or values of a few components. The changes that must be made for transistor substitutions are given in the table on the next page.

Construction. The circuit of the SCA Adapter is really very simple, lending itself to just about any type of chassis construction you prefer. While the photos show the original prototype assembled on a double-row solder-terminal tag strip, which is essentially point-to-point wiring, a printed circuit board layout would have been just as appropriate for assembly.

The circuit can be assembled in any enclosure you choose. A 5" × 2¼" × 2¼" aluminum utility box was used for the prototype, with *J1* and *J2* mounted at opposite ends of the top surface. Threshold control *R12* was also mounted to the top, while to one side is located a screw-type barrier block for bringing in the 6.3 volts a.c. for the power supply circuit.

Installation and Use. To operate properly, the SCA adapter must be electrically connected to your receiver. This is a simple process that can be performed in a couple of minutes.

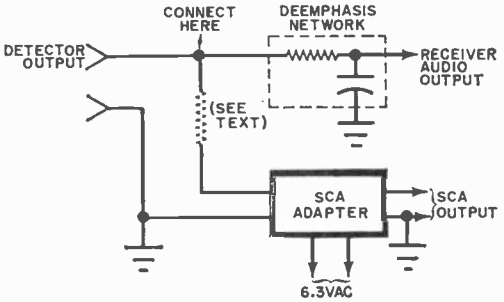
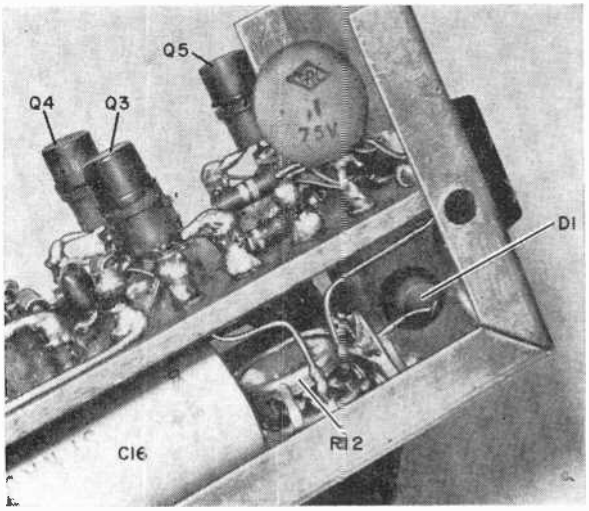


Fig. 2. For proper operation, SCA adapter must be connected between detector and deemphasis net.

A NOTE ABOUT THE LAW

There is no FCC Regulation that prohibits the reception of Subsidiary Communications Authorization broadcasts for private home entertainment purposes. However, there are regulations that do prohibit the use of SCA programs to promote business (or any other reason) by commercial establishments unless such businesses are authorized subscribers and use only the SCA channel to which they subscribe.



Transistors can be installed in sockets or soldered directly to lugs. Locate a.c. filter capacitors on underside of terminal board and the barrier block at end of box.

Before digging into your receiver (or tuner), carefully study its schematic diagram to locate the detector stage and resistor/capacitor de-emphasis network. Then, study the receiver layout to locate the point indicated in Fig. 2. You will notice that the SCA Adapter's input must be connected to a point *between* the detector output and the de-emphasis network. If the connection is made *after* the de-emphasis network, no SCA signal will pass through!

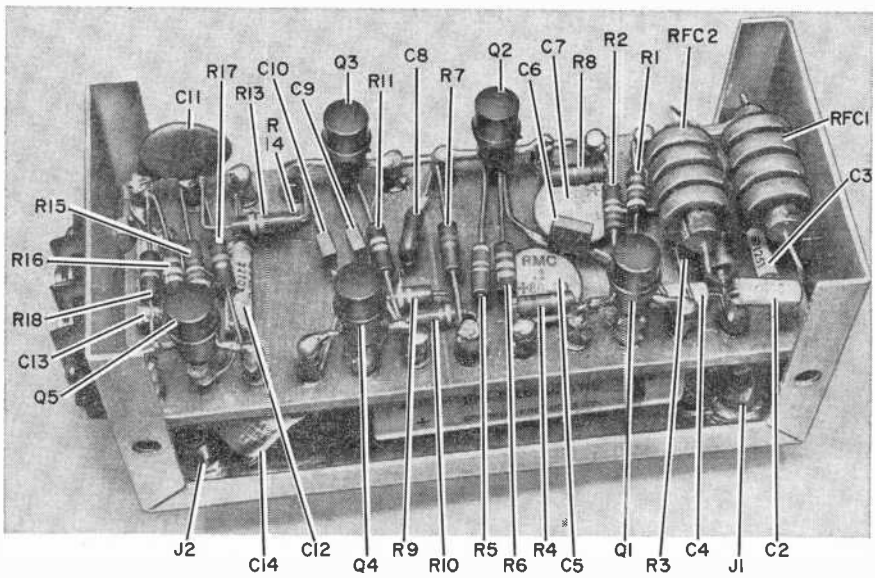
The filter (SCA Adapter) was designed to operate most efficiently with a 3000-ohm load. So, it may be necessary to couple the adapter to the receiver circuit via an isolation resistor with a value of a few thousand ohms, depending on your particular receiver.

Now, connect a twisted-pair cable between the 6.3-volt a.c. winding on your receiver's power transformer and the screw-type barrier block on the adapter. If 6.3 volts a.c. is not available from your receiver, use a separate 6.3-volt filament transformer. Then connect a shielded audio cable from the adapter's output jack to the auxiliary (AUX) input jack on the rear apron of your receiver.

Turn on and tune the receiver to a local FM station known to be broadcasting SCA program material. Set the receiver's source switch to AUX and function switch to MONO, and adjust threshold for the clearest audio. (Note: in some receivers, when the source switch is moved out of the TUNER or FM position, the power is disconnected from the tuner. In this case, connecting the output of the adapter to the receiver's AUX input will not work—a separate amplifier will be required unless you can figure a way of restoring power to the tuner when the source switch is in the AUX position.

Tuning across the dial, you may find that several SCA programs are available. This is true especially in the large cities where different types of background music are required by the subscribers. So much the better for your choice of programs. —30—

Although a printed circuit board or multi-lug terminal strips could be used, wiring is just as simple with a parallel-row terminal board having 13 solder lugs per row as shown here.



TRANSISTOR SUBSTITUTION TABLE

Transistor Type	Changes
PNP silicon	Invert polarities of D1, C12-C16
NPN germanium	Change R2,R6,R16 to 6800 ohms
PNP germanium	Combine both of the above changes

BY JOHN S. SIMONTON, JR.

MODIFY YOUR ELECTRONIC GUITAR SOUND

VARY "ATTACK" TIME WITH THIS DELAY UNIT

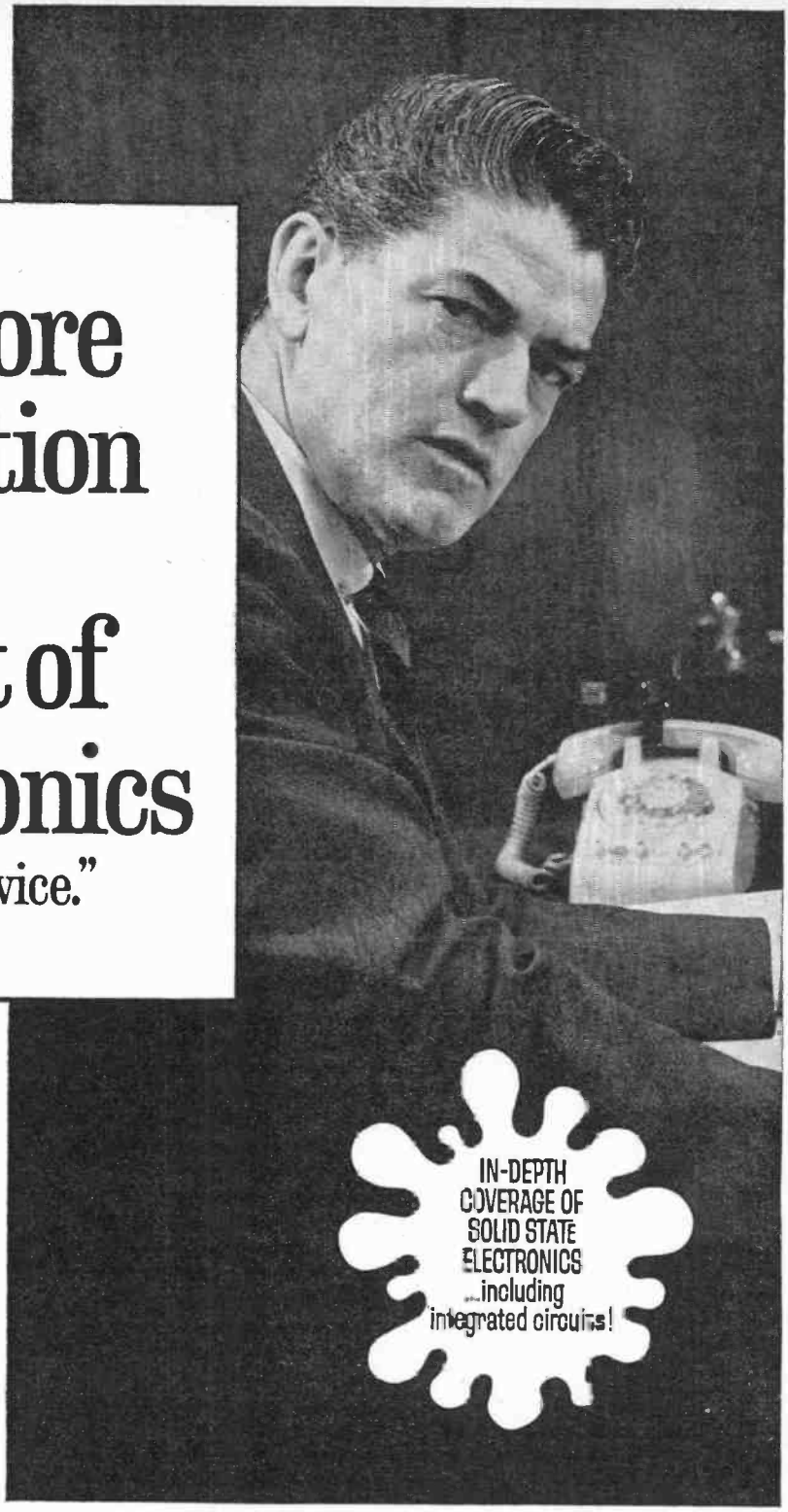
EVERY MUSICAL instrument owes its unique sound to a certain combination of inherent characteristics. For instance, the number of harmonics produced, combined with their magnitudes and phase relationships, play an important role in creating the instrument's distinctive sound.

Another important characteristic is attack time—the speed with which sound is built up after a tone is initiated. Reed instruments such as the clarinet produce sounds which can be described as "soft" because they have a relatively slow attack caused by the time it takes for the reed to build up to its maximum vibration. On the other hand, instruments such as the guitar have a very rapid attack because maximum amplitude vibration is started as soon as the string is plucked or struck.

By changing an instrument's attack, we can make it sound different and, at the same time, not like any other instrument. That is what the "Attack Delay Unit" (ADU) does for the guitar. By slowing down the guitar's attack, a brand new sound can be obtained. The effect can also be produced by recording a guitar passage on tape and then running the tape backwards through the player. Instead of sharp, clean tones, a hard-to-describe "whoop" is heard for each note played. Although the note is on pitch, it doesn't sound like it belongs to any known musical instrument.

Using the ADU, attack can be delayed for a very short period so that only the sound of the pick hitting the string is eliminated or it can be delayed so that the music builds up over the length of a run. A foot control switch makes it easy to delay particular notes selectively.

Construction. The circuit of the ADU, shown in Fig. 1, is fabricated on a printed circuit board whose foil pattern is shown in Fig. 2. Once the board has been made (or purchased), install the components as shown in Fig. 2. Be sure to install the semiconductors and electrolytic capacitors correctly. Use a heat sink (such as long nose pliers) on the transistor and diode leads while soldering to avoid possible thermal damage. Also, use a low-power (35 watts) soldering iron.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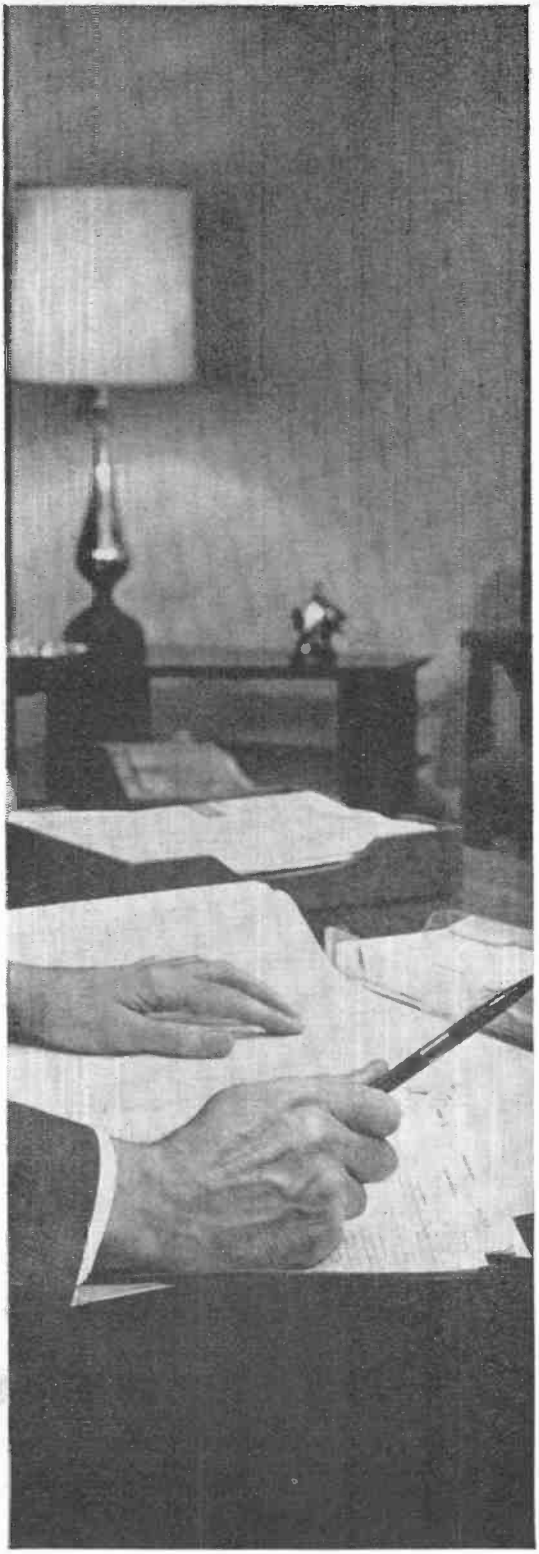

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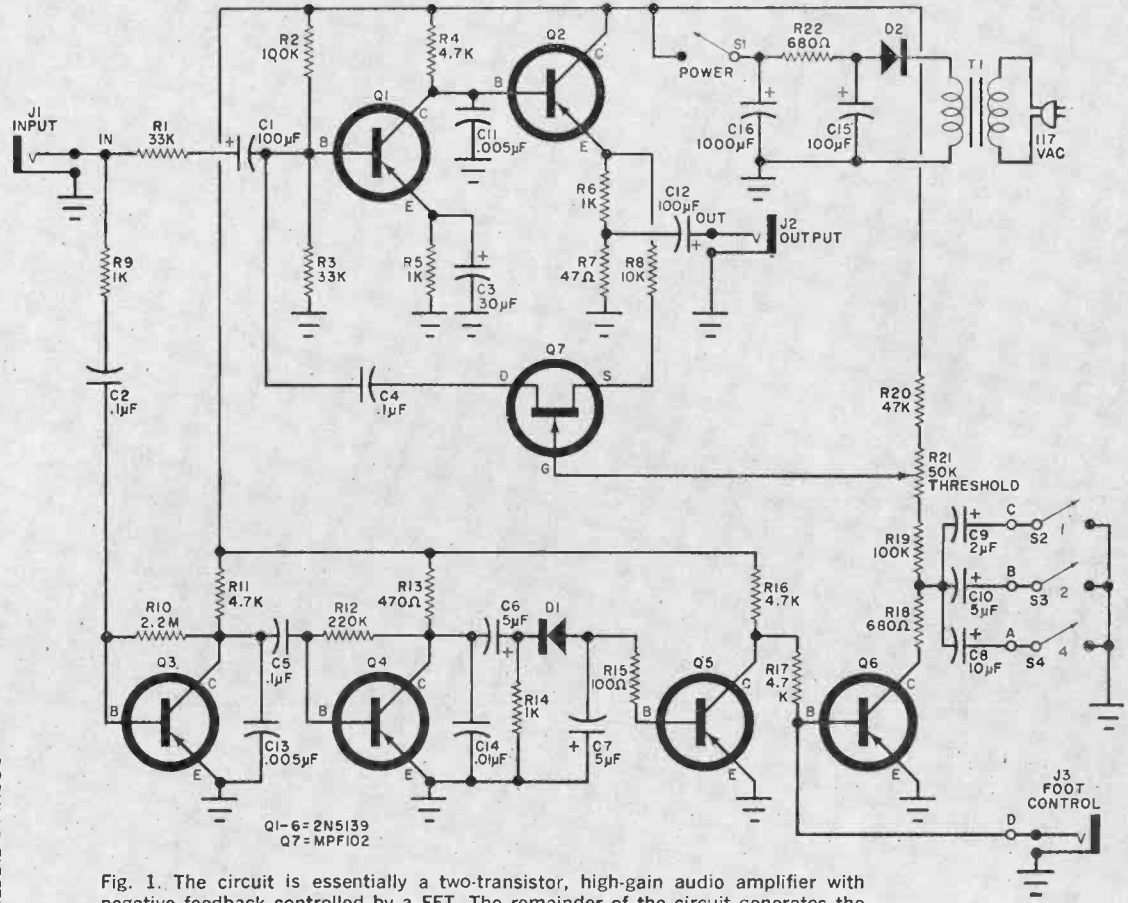


Fig. 1. The circuit is essentially a two-transistor, high-gain audio amplifier with negative feedback controlled by a FET. The remainder of the circuit generates the feedback control signal which is determined by a switch-selected capacitor.

PARTS LIST

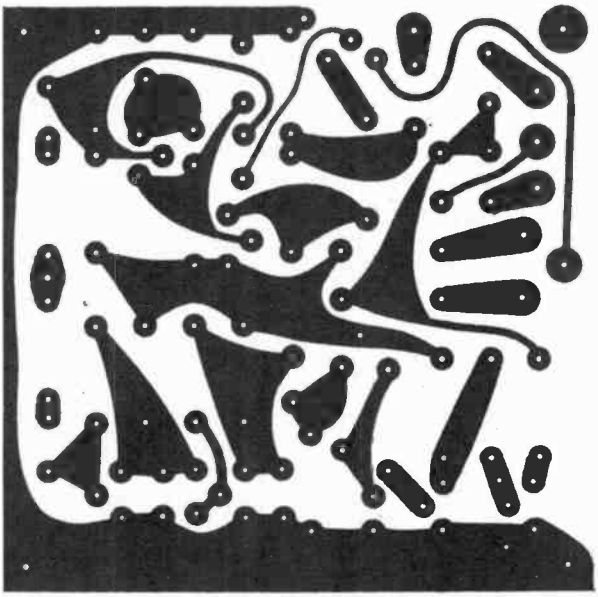
C1,C12—100μF, 6-volt electrolytic capacitor
C2,C4,C5—0.1-μF disc capacitor
C3—30-μF, 6-volt electrolytic capacitor
C6,C7,C10—5-μF, 6-volt electrolytic capacitor
C8—10-μF, 6-volt electrolytic capacitor
C9—2-μF, 6-volt electrolytic capacitor
C11,C13—0.005-μF, disc capacitor
C14—0.01-μF, disc capacitor
C15—100-μF, 15-volt electrolytic capacitor
C16—1000-μF, 10-volt electrolytic capacitor
D1,D2—1N4001 diode
J1-J3—Open-circuit phone jack
Q1-Q6—Transistor, pnp (National 2N5139 or similar)
Q7—Field-effect transistor (Motorola MPF102)
R1,R3—33,000-ohm
R2,R19—100,000-ohm
R4,R11,R16,R17—4700-ohm
R5,R6,R9,R14—1000-ohm
R7—47-ohm
R8—10,000-ohm
R10—2.2-megohm
R12—220,000-ohm
R13—470-ohm
R15—100-ohm
R18,R22—680-ohm
R20—47,000-ohm
All resistors ½-watt
R21—50,000-ohm trimmer potentiometer (PC type)
S1-S4—S.p.s.t. toggle switch (see text)
T1—Power transformer, secondary, 12.6 volts at 300 mA.
Misc.—Chassis, line cord, rubber grommet, 7-lug terminal strip, ¼" insulated spacers (4), rubber feet (4), wire, solder, etc.
Note—The following are available from PAIA Electronics, P.O. Box 14359, Oklahoma City, OK 73114: etched and drilled PC board, $3.00, postpaid continental U.S.A.; complete kit of parts including PC board and case, $19.25, plus postage for 3 lb. Oklahoma residents add 3% sales tax.

Connect sufficiently long leads to the various external connection pads before mounting the board in the chassis.

Almost any type of metal chassis may be used as long as it will hold the PC board, the power transformer, and the associated rectifier and will permit the installation of four switches on the front and three phone jacks on the back.

The choice of switches for *S2, S3,* and *S4* should be made carefully. During use, it may be necessary to manipulate these switches rapidly in various combinations so they should have large paddle-type handles and operate with a light pressure. Any type of s.p.s.t. switch may be used for power switch *S1*.

Mount the power transformer (*T1*) and a seven-lug terminal strip at one end of the chassis and drill a hole in the wall for the line cord. Put a grommet in this hole. Build up the power supply and attach the positive lead to *S1*. Do not ground either side of the a.c. to the chas-



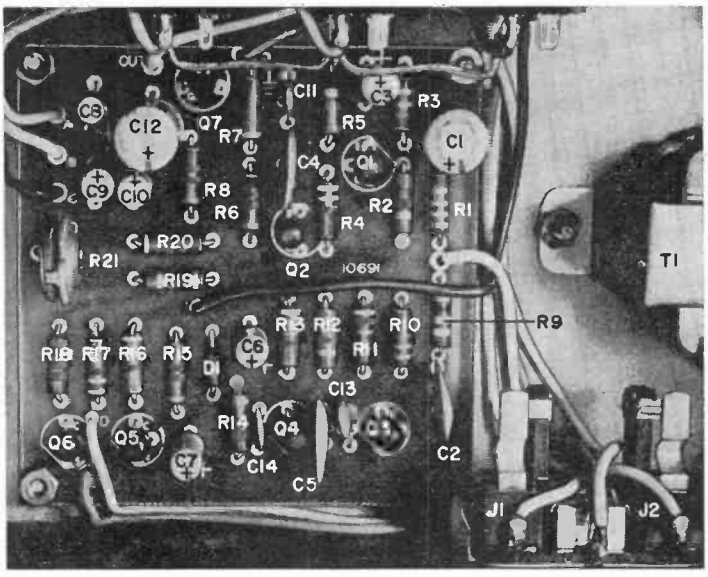
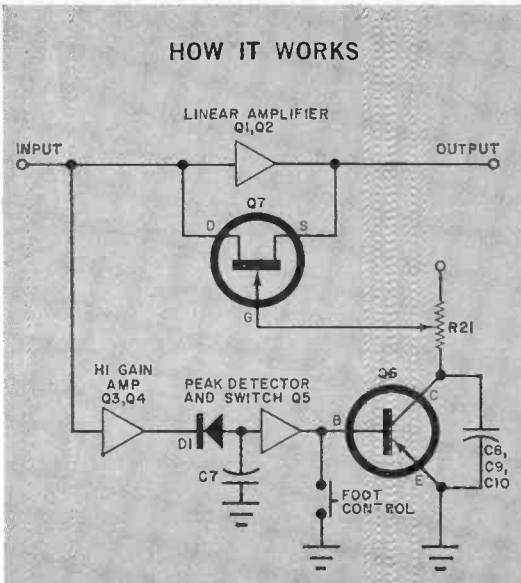


Fig. 2. The actual size foil pattern is shown at the left, while component installation is illustrated below. The PC board is mounted on four spacers, and the power supply is mounted elsewhere in the cabinet. Alternatively, the ADU can be built in an existing amplifier console, with the control switches readily accessible to user.



With no signal input, transistor *Q6* is turned on and acts as a short circuit around the switch-selected capacitors *C8*, *C9*, and *C10*. The gate bias of FET *Q7*, in this case, is such that the FET is turned on and its low source-to-drain resistance results in a large amount of feedback for the linear amplifier formed by *Q1* and *Q2*. Since this amplifier is designed for unity gain with no feedback, for all practical purposes, no input signal passes through it.

When there is an input signal, it is amplified by high-gain amplifier *Q3* and *Q4* and then rectified by peak detector *D1*. The resulting d.c. voltage appearing across *C7* turns on *Q5*, which then turns off *Q6* and allows the selected capacitor to charge. As the capacitor charges, the bias on *Q7*'s gate changes to increase its source-to-drain resistance. The increase in resistance around the linear amplifier loop decreases the feedback and causes the gain to go from nearly zero to approximately unity. The time required for this to take place depends on the capacitance value selected. Trimmer potentiometer *R21* acts as a threshold control and sets the bias on the gate of *Q7* when *Q6* is on.

When the foot control switch is closed, the base of *Q6* is shorted to ground, allowing the selected capacitor to remain charged. This holds the linear amplifier at unity gain and defeats the attack delay.

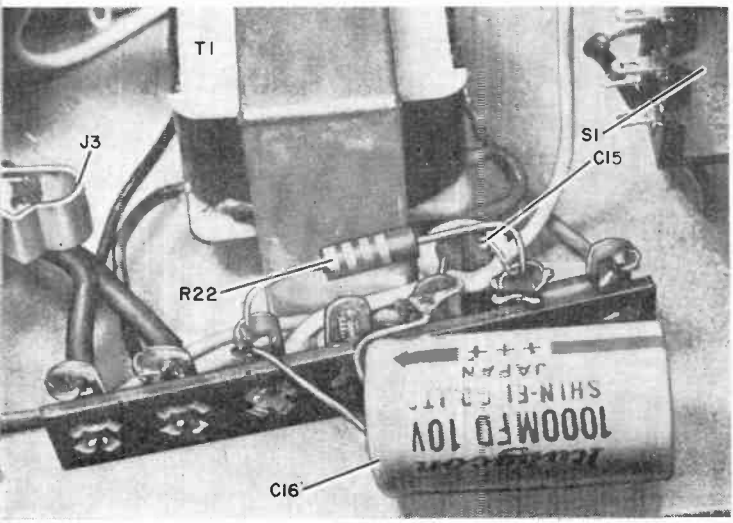
sis. Mount the three capacitor-selector switches (*S2*, *S3*, and *S4*) on the front wall and three phone jacks (*J1*, input; *J2*, foot control; and *J3*, output) on the rear wall.

Mount the PC board on four ¼" insulated spacers so that *R21* will be accessible from the side. Wire the complete circuit as shown in Fig. 1. Put four rubber feet on the chassis bottom to keep it from slipping around when in use.

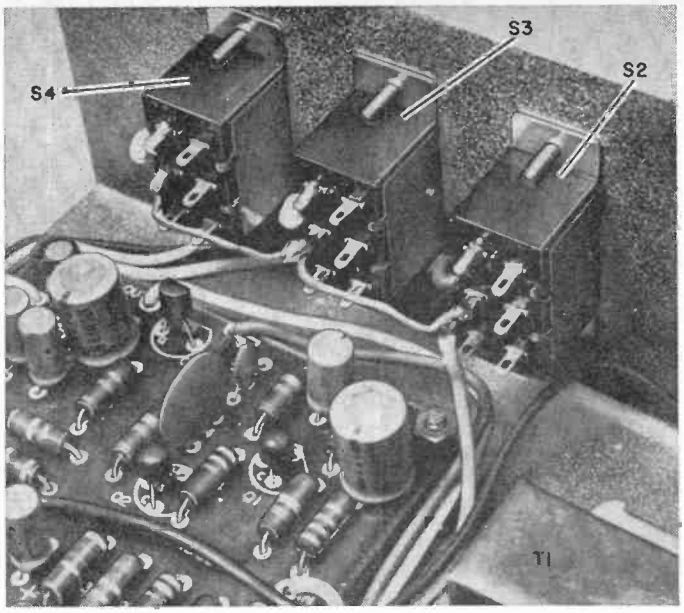
Setup. Prepare the unit for operation by running a short length of cable from the output of the ADU to your amplifier input and plugging the instrument output into the ADU input. For the time being, do not use the foot control switch. Turn the ADU on and set the delay to 4.

Since a certain minimum signal is required to operate the delay unit, the instrument's gain should be turned up almost all the way and the volume adjusted by using the amplifier's control.

The only thing that needs adjustment in the ADU is potentiometer *R21*. At one



The power supply is built up on a seven-lug terminal strip which also carries the input a.c. line cord. The arrangement is not critical, but make sure that neither side of the power line makes electrical contact with the chassis.



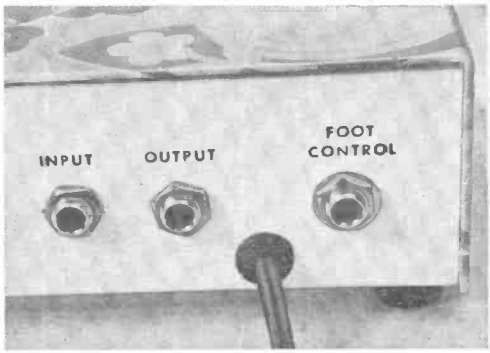
When obtaining switches for the delay selection, remember that they may be operated a considerable number of times, in various orders, and possibly in a hurry. Pick switches with long handles and smooth operation.

end of this pot's rotation, there is little or no delay in the instrument attack; with the opposite setting, there is no sound for an instant and then the volume will come up full. Between these two extremes, are a variety of settings which can be selected strictly as a matter of personal taste. Ideally there should be very little or no sound when the note is first struck, followed immediately by a noticeable increase in volume with a smooth glide to maximum.

Operation. The three delay switches on the ADU can be used singly or in combinations to yield up to seven different delays. The numbers above the switches represent some arbitrary unit of delay (which varies with the setting of *R21*) and may be added together to get the longer delays. For instance, if the "2" and "4" switches are down, the attack delay is 6 times longer than if only the "1" switch is down.

Since the ADU requires a short, no-signal dead time for the circuits to reset, all strings on a guitar must be silenced before the next chord or note is struck. If single notes are being played, just lifting the finger from the finger board will ordinarily accomplish the deadening, but for chords with open strings, it is necessary to deaden the strings with the palm of the strumming hand. The resetting time is actually very short (on the order of a tenth of a second) so very rapid runs can be played with the delay still occuring on each note.

The foot control switch is a single-pole, single-throw type and can be housed in a sturdy case of metal or a block of wood. The switch can be a push-on/push-off type but experience has shown that a spring-loaded, normally closed switch works best. With this arrangement, selective delay can be accomplished by pressing the switch when delay is desired and releasing it to sustain a note. —30—



Phone jacks for input, output, and foot control are located most conveniently on back of chassis. Colorful vinyl cloth was used to cover prototype.

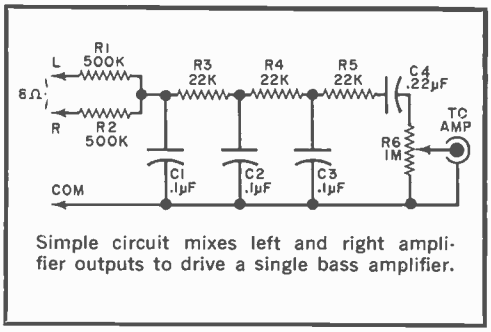
BUCK UP BASS RESPONSE WITH A SUPER WOOFER

BY ERIC PAVLAK

ONE OF THE BEST methods of getting good bass response from your stereo system is to use a super-powerful woofer in addition to your regular speaker systems. Since the very lowest bass notes, those under 100 Hz, are non-directional, a single super woofer setup will serve both stereo channels. Consequently, your regular speaker systems can have less than full bass response and still be quite satisfactory.

A super woofer, for best results, should be powered by a separate amplifier. This provides several distinct advantages over systems connected by an LC crossover network. For one thing, the independent bass amplifier (actually, it can be any amplifier with very good bass response) can be adjusted without interfering with the main amplifier. So, the volume level of the super woofer can be set in relationship to the rest of the system without introducing resistance in series with any of the speakers—a resistance that would prevent good speaker damping.

Also, a separate amplifier allows the lowest bass to be increased without upsetting the balance of the rest of the system. And it permits the use of steep-sloped filters of 18-dB/octave that would otherwise be impractical. One further advantage of using a single super woofer is that no phasing problems exist.



Simple circuit mixes left and right amplifier outputs to drive a single bass amplifier.

The amplifier for the super woofer should be coupled to both the right and left channel outputs of your regular amplifier. For this, you will need a circuit like that shown in the schematic diagram. This circuit is simpler than an electronic crossover network with active elements and it introduces less distortion than a passive filter which uses both capacitive and inductive elements.

Crosstalk introduced by this adapter circuit is minimal. Signal level is adjusted by control *R6*. When assembling the circuit, mount it inside a shielded box. Parts placement is not critical, but be sure to use shielded cable between the circuit output and the input of your super woofer amplifier.

The super woofer itself can be as big as your listening room will allow and as expensive as your budget can take. Several 12″ or 15″ woofers can also be used; or, better yet, you can use one of the horn-type woofers available from Altec or Klipsch.

The best place in a room to set the super woofer is in a corner. And since only the lowest frequency sounds are to be radiated, it matters little if furniture or thin draperies are located between the super woofer and listener. But be wary of standing waves which can result when large, flat surfaces are directly opposite the speaker.

A super woofer is just the thing to improve weak bass systems. Adding one is relatively simple and inexpensive yet it can provide really thunderous lows without mid-bass thumping or booming. —30—

KOOL-KEEPING KWIZ

BY CARL KOHLER

How well do you cope with life's bruises and abrasions?

IT'S A PHILOSOPHICAL fact that into every existence a little pain must crawl. The question is, "How well do you withstand the pain?" To find out, take the following pseudological test, consisting of several theoretical **Life Situations** no electronics enthusiast is likely to encounter. The test does not purport to increase your self-knowledge, but it may add to your confusion. A dubious scoring system, found at the conclusion of the test, is based on whichever of the multiple-choice reactions you instinctively and neurotically selected. No cheating now—and good luck!

Supermouth

✱*While attending a social gathering, you hear a loud-mouthed type bragging that his CB antenna has broken the height regulations for years, and you realize that he is unaware that another guest is the FCC Field Engineer. What would you do?*

A. Whisper a warning.
B. Feel embarrassed for him.
C. Belch nervously.
D. Listen carefully as he prattles on.
E. Ask the lout to repeat his brag to the FCC employee.

Hurry—I'm Double Parked

✱*A neighbor with more gall than most borrows your constant-current ohmmeter. Within an hour he brings it back, asking you to repair it so he can get on with his testing. What would you do?*

A. Graciously comply with his request.
B. Coldly refuse.
C. Feel stunned.
D. Talk real dirty.
E. Brandish a soldering iron at him.

It Is Nobler to Receive

✱*Quite accidentally you learn that your wife is planning to give you a costly set of living-room furniture and drapes for a wedding anniversary present. What would you do?*

A. Feel pleased.
B. Try to talk her out of it.
C. Give her a bound file of POPULAR ELECTRONICS project schematics.
D. Surprise her with a collection of every other Heathkit item on the market.
E. Sulk.

I've Gathered You Here

✱*Having generously agreed to share your vast knowledge of solid-state theory with an electronics club, your lecture is off to an impressive start when your mind goes blank on the whole subject. What would you do?*

A. Admit you can't remember a thing.
B. Ask for help in getting restarted.
C. Smoothly divert their interest to a faked-out history of electronics.
D. Sing and dance.
E. Sprint for the nearest exit.

I Gave at the Office

✱*Having worked long and hard to build your own specially modified Universal Frequency Counter, you find your wife has given it to a shut-in to take apart for the therapeutic fun of having something to do. What would you do?*

A. Consult your attorney about institutionalizing her.
B. Report her to the Westinghouse people.
C. Stamp your foot.
D. Offer the shut-in some tools.
E. Proceed with the next project—from the safety of another country.

Part 95 Violation

✱*You're a bachelor and you've finally succeeded in becoming chummy enough with the curvy little blonde who moved into the next-door apartment to be invited over for a friendly drink. Once there, you discover that the delectable creature is blithely operating a CB rig with a 250-watt linear. What would you do?*

A. Reprimand her sternly.
B. Report her to the FCC.
C. Decide to meet another girl.
D. Drink your drink and say nothing.
E. Teach her how to work skip on channels 24A and 24B.

But I Learned That in School

✱*By sheer accident your cable TV has gone berserk and channel 13 is showing "educational" stag films. What would you do?*

A. Tune to another channel.
B. Have the cable TV send a repairman.
C. Keep the information to yourself.
D. Call the neighbors in for a party.
E. Write a protesting letter to FCC Commissioner Johnson.

Wanted: One Anechoic Chamber

✱*After laboring diligently for weeks you've scratch-built a magnificent hi-fi stereo system with speakers and a beautiful cabinet of your own design. Just as you're ready to try it out, your mother-in-law, who is visiting you and your wife, becomes ill, and the doctor prescribes quietude—bordering on complete silence—for her recovery. What would you do?*

A. Wait with clenched teeth.
B. Have the doctor's credentials checked out.
C. Go on an aspirin diet.
D. Buy her a matched set of earplugs.
E. Write a complaining letter to "Dear Abbey".

You'll Never Get It off the Ground

✱*A slight acquaintance lets you talk him into installing your multi-proportional R/C system in his newly built, highly expensive model airplane—and it crashes into splinters. What would you do?*

A. Offer to replace the airplane.
B. Buy him a cup of consolation coffee.
C. Deride his flight dexterity.
D. Yawn.
E. Bill him for your ruined system.

Of Course They Could

✱*While casually tuning your short-wave receiver, you overhear two stations discussing a plot to kidnap the Statue of Liberty and hold it for ransom. What would you do?*

A. Call President Nixon direct.
B. Mail an anonymous letter to the FBI.
C. Jam their radio frequency.
D. Fly United to Bedloe's Island to see it happen.
E. Offer to sell a statue of Sophia Loren to the Government as a replacement.

CHECK YOUR SCORE HERE

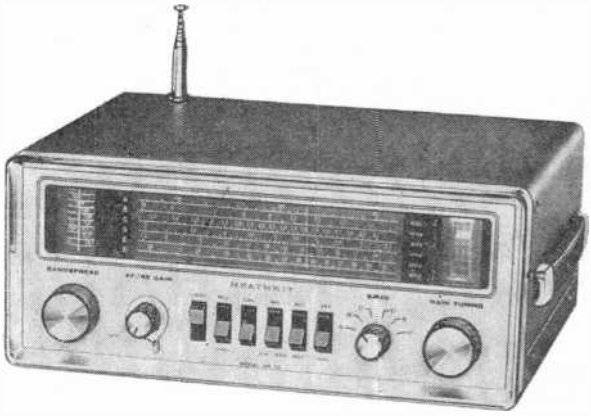
All righty, now that you've checked the various reactions to these dismal *Life Situations*, it's analysis time. If you have mostly A reactions, it could indicate that you *are* Mr. Straight Arrow. Mostly B reactions might mean that you're a flexible individual. Mostly C reactions clearly indicate a warm, human will to survive. Mostly D reactions show that you tend to have an enviable Kool indeed. If you have mostly E reactions, it's a sad hint that you are an accomplished loser. Of course, if you actually bothered to check any choices at all, you're putting *us* on more than we did you with this screwy thing. —30—

the Product Gallery

REVIEWS AND COMMENTARY ON ELECTRONIC GEAR AND COMPONENTS

GENERAL COVERAGE RECEIVER

(Heathkit GR-78)



MAYBE it's hard to believe that a kit which goes together as readily as does Heath's new GR-78 can look so attractive and also perform so well—but it's true. With its low-profile styling, handsome two-tone gray cabinet and polished aluminum bezel, this 190-kHz to 30-MHz solid-state portable receiver matches in appearance what it can do as a top-notch performer.

Within just a little more than 24 hours after its assembly and calibration—and using only the receiver's built-in 39″ whip antenna—this reviewer's GR-78 had logged stations on all six continents!

Let's take a look at what makes such performance possible in a receiver costing only $130. The two factors most important in determining the value of any general-coverage receiver are its selectivity and its useful sensitivity. The term "useful sensitivity" is significant, because the ability of a receiver to bring in weak stations is determined, not by gain alone, but by gain in the presence of a low receiver-noise level. Unless a signal can make it through the hiss or "shot noise" generated in the front end of every receiver, the signal cannot be heard, no matter how high the gain of the stages which follow.

The Important Front End. The tuner in the GR-78 uses the latest in MOSFET's* to maximum advantage, providing high gain, minimum crosstalk, and a low inherent noise level (typically 3.5 dB at 200 MHz for these transistors). It is especially well shielded and, most important of all to the average kit builder, it has short leads for minimum stray capacitance. It is by far the *easiest* tuner to assemble that we have ever seen.

Each of the tuner's four stages is wired as an assembly on a separate PC board and then plugged into its own shielded compartment. The result is a neat, factory-made appearance and high gain with high stability. Six ferrite-core pretuned coils are used in each stage since the receiver covers 190 kHz to 30 MHz in six settings of the band switch instead of the usual four or five.

The GR-78 can be aligned without instruments if necessary; but to peak it for top performance and sensitivity all you need is a calibrated signal generator and the receiver's own built-in S-meter. It isn't mentioned in the Assembly Manual, but you can zero the calibration in very close to the dial legends by zero-beating the built-in 500-kHz crystal calibrator against WWV, then zero-beating your signal generator against the calibrator. We aligned our GR-78 by this method and have found, so far, that calibration has been satisfyingly stable for a receiver in this price range. There is some slight drift for the first few minutes as the receiver "warms up," but even this would not be noticeable were it not for the GR-78's outstanding selectivity.

Latest in I.F. Amplifiers. Sensitivity is of little value without selectivity—especially on

*They are RCA's dual-gate MOSFET'S with built-in gate-protection circuits. Special back-to-back diodes are formed into the transistor pellet and connected between each of the two gates and the source electrode of the FET. These diodes shunt any transient potential exceeding ±10 volts, thereby protecting the gates in the course of general handling and application. Thanks to the dual-gate configuration, feedback capacitance is low (high gain is obtained without neutralization), oscillator pulling is virtually nonexistant and the a.v.c. is as simple as that of a receiver using vacuum tubes.

crowded short-wave bands. An i.f. pass band only 7 kHz wide at 6 dB down, with adequately steep sides, provides this receiver with excellent selectivity. It's done with ceramic filters—four tiny plastic encapsulated units, each no larger than your little fingernail.

Not only do the ceramic filters determine the intermediate frequency and the width of the i.f. pass band, they do away with i.f. alignment forever! There are no i.f. transformers to adjust in the GR-78. The ceramic filters will remain tuned within 0.5% for at least 10 years! Intermediate frequency is 455 kHz except on the highest frequency setting of the bandswitch (18 to 30 MHz), where a double-conversion circuit is used with a first i.f. of 4.034 MHz. The oscillator for the second mixer is crystal controlled.

Other Features. The GR-78 has both a highly stable BFO and CW/SSB product detector. A MOSFET, identical to those used in the front end, is the product detector and there is no significant pulling of the BFO. Also included are a switchable series noise limiter; switchable amplified a.v.c.; a receive-standby switch; manual r.f. and a.f. gain controls; and bandspread with speed reduction tuning and a dial which can be calibrated for either the amateur bands or the international broadcast bands, as you prefer. It's as simple as selecting the appropriate decal for the bandspread dial drum.

The 9.6-volt internal battery is a high-quality nickel-cadmium rechargeable unit with a 500-mA-hr capacity, which means that, beginning with a full charge, you can run the receiver for about eight hours at a reasonable listening level before recharging is needed. A transformer-type 120/240-volt a.c. charger is built into the receiver, and there's a separate circuit for charging from a 12- to 15-volt source—such as the electrical system of a car or boat.

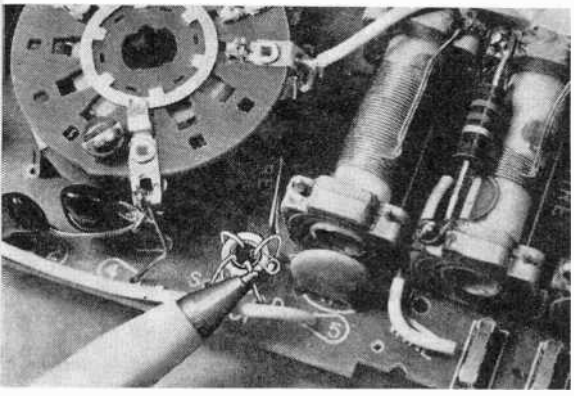
The GR-78 went together more easily than many a kit-type broadcast-band receiver this reviewer has assembled. You don't need the dexterity of a circus performer to build it—there are no hard-to-reach places for either the screwdriver or the soldering iron. Assembly instructions are clear, easily understood, and thoroughly detailed with illustrations. Heath supplies a 120-page Assembly Manual with the kit.

However, take care in soldering the trimmers to the PC boards in the tuner. There is plenty of room to accommodate the solder tabs on the trimmers, but assembly without careful attention to the positioning of the tabs can result in a short circuit to adjacent soldered connections. Look all around the tab for clearance before applying the iron.

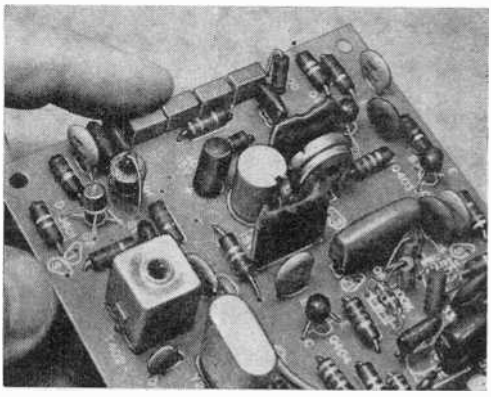
The S-meter is attached to the front subpanel with only one screw. The meter mounting tabs are thick, so probably single-screw mounting is sufficient; but, if you'll feel better about it, you can secure the meter's other mounting tab to the subpanel with a couple of spots of plastic household cement.

The GR-78 is a lot of good receiver for the money. Conservatively designed and ruggedly built, it is a fine performer at home or on the go. (Front-view photo and ceramic-filter i.f. response curve courtesy Heath Co. MOSFET data courtesy RCA.)

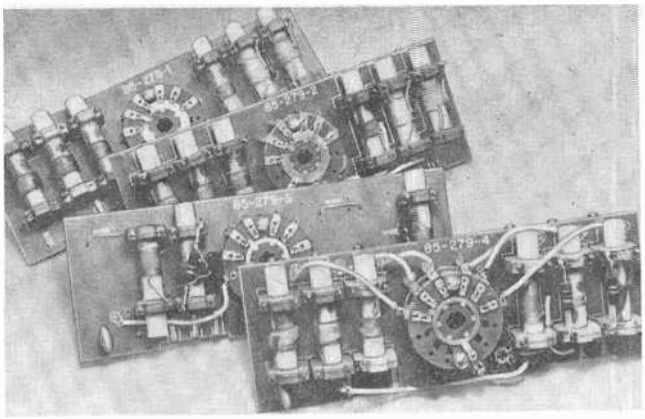
Circle No. 89 on Reader Service Page 15 or 95



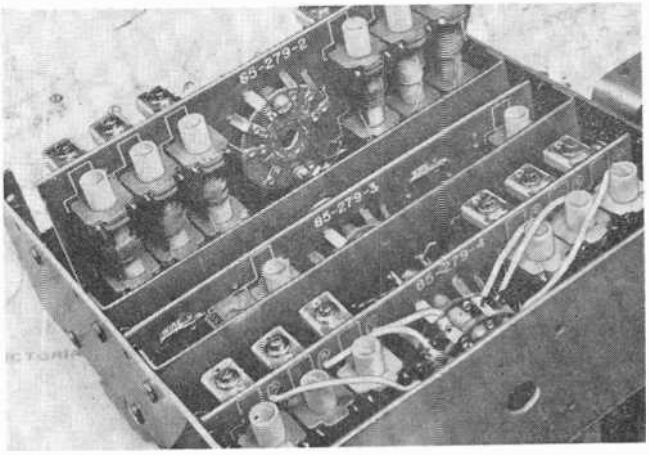
Because of their sensitivity to damage from stray voltages induced by any one of a number of ways, including handling, MOSFET's come with protecting shorting rings. Rings must remain in place until MOSFET's are installed and soldered into circuit.



Four tiny encapsulated ceramic filters provide i.f. bandpass only 7 kHz wide at 6 dB down for excellent receiver selectivity. Capable of remaining tuned within 0.5% accuracy over period of at least ten years, these filters replace i.f. transformers.



These four printed circuit boards actually represent the band switch and tuning components in front end of GR-78. Printed circuit design slashes assembly time and virtually eliminates chances of wiring errors.

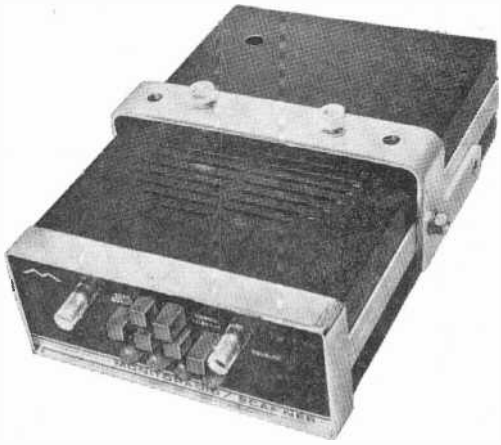


For maximum stability, band switch decks are mounted in chassis with metal shields isolating them from each other. Then shaft is installed.

REGENCY MONITORADIO SCANNER (Model TMR-4)

THE DAY of the blinking red light is upon us. Garage and gasoline service stations, volunteer firemen, newspaper reporters, and hundreds of just plain listeners are buying VHF monitor receivers. The latest innovation is the VHF radio receiver that automatically tunes (or "scans") a certain number of fixed-frequency channels. Usually these channels are set for the local police and fire departments, certain business radio services, the weather broadcaster on 162.55 MHz, etc. The scanning is fully automatic and stops to listen in on the first occupied channel. As soon as that transmission is finished, scanning resumes until another signal is picked up.

Your reviewer recently had the opportunity to set up the new Regency Monitoradio Scanner Model TMR-4. This is a modest-cost version ($129; crystals are available at $4.95 each) of the larger 8-channel model with the



same general characteristics. The four frequencies selected included the 3 police services in the surrounding northern New Jersey area, plus the weather broadcaster KWO-35. The police frequencies were 240 kHz apart and the receiver had been "peaked" around 155-156 MHz.

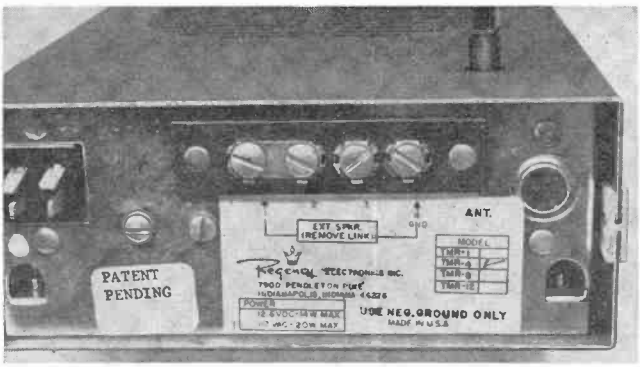
Using the fully extended built-in antenna, we had no difficulty receiving all 3 base stations and all of the mobile units within 5 to 6 miles of our location. Using an outdoor antenna (cut for 155 MHz), all mobile units could be heard, as well as a variety of miscellaneous police services sharing the same frequencies—though some were 50 miles away.

Squelch action is positive and there is no "hang-on" after the received carrier goes off the air. Scanning action in the TMR-4 is rapid and the four channels are scanned about twice a second. Of course, this can be speeded up by locking out the weather station (scanning 3 channels) so that the scanning action is not immobilized by the constant carrier of KWO-35.

Besides the excellent sensitivity, there was no indication of any problems that might arise from inadequate or poor selectivity. Other channels known to be occupied and only 40 kHz away from one of the preset channels could not be heard (splatter or cross-modulation).

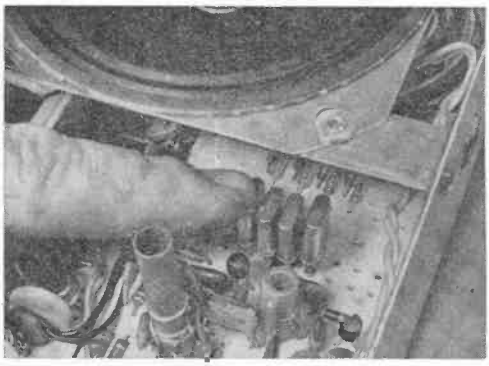
The TMR-4 is usable in the home or office operating from a 117-volt power line and can be installed in a mobile vehicle with a 12-volt negative-ground system.

Circle No. 90 on Reader Service Page 15 or 95



The TMR-4 is a compact solid-state receiver measuring only 7½" x 5½" x 2¼". Use is made of 4 integrated circuits and 23 transistors. Nine transistors and 2 of the IC's are involved in the scanning part of the circuit. A built-in speaker faces upward. An external antenna may be connected to the TMR-4 through a Motorola-type plug (extreme right). An external speaker may be added by following steps given on rear panel.

The front panel of the TMR-4 has two rotary controls (volume and squelch) and 6 pushbuttons. As the face plate indicates, the upper left button places the TMR-4 in either the fully automatic scanning mode of operation or permits the user to select any one of the 4 channels manually. In manual operation, the selector button is repeatedly depressed until the proper channel (indicated by the light) has been tuned in. The four channel pushbutton permits the user to by-pass an undesired signal or channel. When any one of the 4 pushbuttons is depressed, scanning is started; releasing the pushbutton deactivates the channel.



Crystals are plugged into the TMR-4 by removing top cover. Miniature HC-18/u crystals are used with plug-in type pin leads. Crystals are easily obtained by mail order from Shepherd Industries, Overland Park, Kansas, at a price of $4.95 each.

OPPORTUNITY MIRROR

Thoughtful Reflections On Your Future

Fourth in a Monthly Series, BY DAVID L. HEISERMAN

VA-Approved Schools

I am fully qualified for educational benefits under the GI Bill. I like the new electronics school in my home town, but found that it isn't approved for VA training. The school tells me that they can't get VA approval until they have been in operation for two years. Is this true or just a phony excuse?

● It is, indeed, true that a school must be in business at least two years before it can qualify for VA approval. The VA people have told us that even the old, well-established schools are not automatically granted approval for a new branch school until it has been set up and has been in operation for at least two years.

If the school is working toward obtaining VA approval, it would certainly indicate that the courses will meet some of the stiff standards that have been set up by your State Board of Education.

As far as the business end of the school is concerned, you can always check with your local Better Business Bureau. If the BBB has received any complaints about the school and its business operation, they'll tell you to read your contract carefully.

To Relocate, or Not to Relocate

I have just received my diploma in electronics technology from a well-known home study school. I live in a very small town, and there is only one electronics company within five miles of my home. My friends advise me to move to a large city (about 100 miles away), although I am quite reluctant to leave home. Is it true that I can earn a lot more money and will have greater job opportunities in the larger city, as opposed to working only a few miles from my present home?

● There can only be a general answer to this question. It is certainly true that salaries are higher in and around the larger cities than in a small town. However, this in itself is misleading, because the cost of living is also much higher. I suggest that you visit the city, interview for several jobs and compare salaries. Find out where you might live and approximately how much it would cost you each month. In terms of dollar income, you will undoubtedly find it more economical to take a job in the smaller local electronics company.

The notion that people can earn more money by working in a major city does have one real advantage. Electronics firms tend to have a large turnover of employees. This means that you may have more chance to upgrade your career than working for the local manufacturer. If you are in a big hurry to advance your career and salary you should move to the city where you can probably change jobs several times in just as many years. If you are a good technician, you will be able to offset quickly the higher cost of city living by making the appropriate job changes.

If on the other hand you want to wait for opportunities to come your way, perhaps you should stay at home and build up a sound reputation and security with the one local company. Although the opportunities to advance may not come along as often, you will certainly encounter less competition when they do.

Electronics Consulting

For the past 10 years I have been employed in a highly responsible position as an electronics engineering technician. Although I don't have a college E.E. degree, I think that I have enough engineering experience to start my own consulting business. Are there any special pitfalls that I should avoid.

● There certainly are! First, you will find it necessary to clarify the exact nature of

your "consulting" business. It is impossible to call yourself an "engineer" without being duly certified as a Professional Engineer by your state government.

There are different kinds of consulting businesses that you can enter, as long as you do not pretend to be a bona fide Professional Engineer. You could, for example, open a sound system consulting firm. Such consulting firms plan music and intercom systems for homes and offices. Another consulting business might deal with computer programming. In practically every state it is not necessary to be a certified P.E. to write and sell computer programs. However, it is expected that within the near future, an examination program will be established to certify qualified computer programmers. This is being developed by the Council of the Processing Management Association. The first examinations are expected to be given in late 1970.

The problem is in drawing the fine line between "consulting" and engineering. If you want to do real engineering design, you can probably be certified as a Professional Engineer by passing the pertinent examinations in your state.

Throughout most of the country, the P.E. exams take two days to complete. The first day covers general engineering principles while the second deals exclusively with electrical engineering. You can usually take the exams as many times as necessary should you fail one part the first time—although there is a waiting time required between each examination.

Besides passing the state examination, all of your college-level education and work experience must add up to at least eight years. Many engineers take their state examinations right after graduation from a four- or five-year engineering college. Even though they pass the exams, they can not qualify for certification until they have the necessary three or four years of work experience. Your 10 years of electronics technical experience should more than fulfill this part of the P.E. requirement.

We have discussed your problem with a representative from the National Society of Professional Engineers. It is agreed that anyone thinking about stepping into any kind of consulting business should first spend several years in someone else's consulting firm. Like any other profession, there are certain techniques and business problems, plus many unwritten rules of the game, that are not taught in engineering colleges and business schools. The most practical idea is to let someone else pay your salary while you learn the business end.

You can get more information on the consulting business by writing for the free pamphlet, "So You Want to Start a Consulting Firm" from the National Society of Professional Engineers, 2029 K Street, N.W., Washington, DC 20006.

Engineering-Level Home Study

I noticed in the article "Engineering Opportunities For You" (POPULAR ELECTRONICS, *Feb. 1970) that only four schools are listed as offering engineering electronics courses through home study. Are there any other schools you can add to this list?*

● Aside from the four schools mentioned in this article, five more offer engineering-level courses in electronics through home study. These are: Bell & Howell Schools and DeVry Institute of Technology, both of which are based at 4141 W. Belmont Ave., Chicago, IL 60641; Commercial Trades Institute, 1400 W. Greenleaf Ave., Chicago, IL 60626; International Correspondence Schools, Scranton, PA 18515; and National Radio Institute, 3939 Wisconsin Ave., N.W., Washington, DC 20016. The excellence of the material offered by these schools is the same as that of the schools listed in the "Engineering Opportunities For You" article.

Sleep Learning—Real or Hoax?

A friend tells me that "sleep learning" would solve my problems concerning the memorization of formulas used in electronics. I have only read one advertisement about sleep learning and wonder if it isn't a big hoax.

● About 10 years ago, sleep learning was in vogue and a dozen or so "schools" sold tape or disc recordings that repeated certain phrases while the student was asleep. Some people said that sleep learning was very effective—others ridiculed the idea.

Recently two professors of psychiatry at Duke University have established that, although the brain is alert (a mother will awake at her baby's cry), it is in a state of internal communications. Memory and thinking do continue during sleep, but unless the

(*Continued on page* 85)

BY JOHN STAYTON

Build a LOW-COST TIME DELAY RELAY

AN INEXPENSIVE, semi-variable time delay relay is a handy item to have around if you do a lot of experimenting. While solid-state timers give excellent results, they are often more precise than required and prohibitively expensive for simple experimenting and occasional use. However, commonly available and inexpensive thermostatic delay relays can be arranged in a circuit to provide the time delay or delays you would normally require.

Keeping in the low price range, it was found that a maximum of only three minutes could be obtained from any given thermal relay. However, with two thermal relays, as in the schematic diagram, you can obtain anywhere from four seconds to six minutes of delay time.

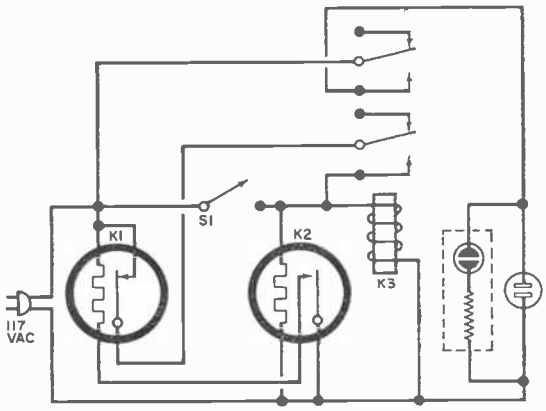
Circuit operation is easy to follow. When pushbutton switch *S1* is momentarily depressed, electromagnetic relay *K3* energizes, simultaneously delivering power to the heating element of thermal relay *K3* and the a.c. outlet. The indicator lamp lights up whenever the a.c. receptacle is "live."

After some specified time, depending on the characteristics of *K2*, the thermal relay's contacts close and supply power to the heater of *K1*. Then, when *K1*'s time delay has elapsed, its contacts open and break the circuit that latches *K3* closed. Relay *K3* deenergizes, and the delay cycle ends. The variable feature is not built in; it is actually a function of a combination of delay times selected for *K1* and *K2*.

Since the circuit is so simple, it can be laid out as desired during construction. The prototype shown here was built on a 5¼" × 3" × 2" metal utility box to conserve space. Although the a.c. outlet is shown mounted to the rear of the box, it could just as easily have been located at the end of any desired length of twin-conductor power cable.

In use, the delay relay's power cord is plugged into an a.c. outlet, and the appliance to be operated connected via the a.c. receptacle. The delay relay is capable of handling up to 1000 watts; so a fairly high load can be safely controlled.

-30-



Thermal relays K1 and K2 are selected to give desired delay time. Depending on the relays, delay can be between 4 seconds and 6 minutes.

PARTS LIST

K1—S.p.s.t. normally closed 117-volt thermostatic relay
K2—S.p.s.t. normally open 117-volt thermostatic relay
K3—D.p.d.t. 117-volt electromagnetic relay with 10-ampere contacts
S1—S.p.s.t. normally open momentary-action push button switch
Misc.—Neon lamp assembly with built-in current-limiting resistor; chassis- or line-cord-mounting a.c. receptacle; sockets for K1 and K2; chassis; line cord and plug; hardware; wire; solder; etc.

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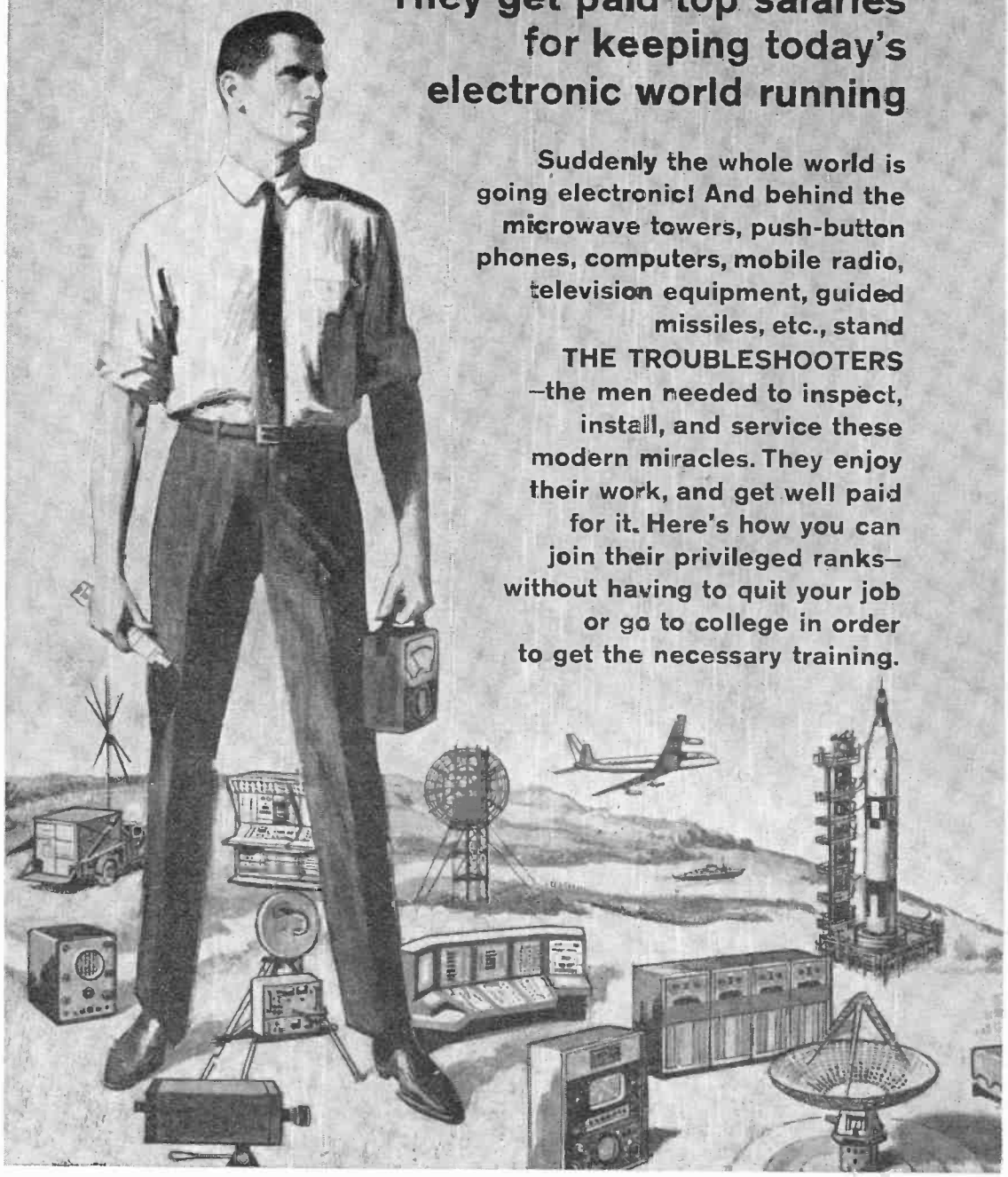

JUST THINK HOW MUCH in demand you would be if you could prevent a TV station from going off the air by repairing a transmitter...keep a whole assembly line moving by fixing automated production controls...prevent a bank, an airline, or your government from making serious mistakes by repairing a computer.

Today, whole industries depend on electronics. When breakdowns or emergencies occur, someone has got to move in, take over, and keep things running. That calls for one of a new breed of technicians—The Troubleshooters.

Because they prevent expensive mistakes or delays, they get top pay—and a title to match. At Xerox and Philco, they're called Technical Representatives. At IBM they're Customer Engineers. In radio or TV, they're the Broadcast Engineers.

What do you need to break into the ranks of The Troubleshooters? You might think you need a college diploma, but you don't. What you need is know-how—the kind a good TV service technician has—only lots more.

Think With Your Head, Not Your Hands

The service technician, you see, "thinks with his hands." He learns his trade by taking apart and putting together, and often can only fix things he's already familiar with.

But as one of The Troubleshooters, you may be called upon to service complicated equipment that you've never seen before or *can't* take apart. This means you have to be able to take things apart "in your head." You have to know enough electronics to understand the engineering specs, read the wiring diagrams, and calculate how a circuit should test at any given point.

Now learning all this can be much simpler than you think. In fact, you can master it without setting foot in a classroom and without giving up your job!

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For over 30 years, the Cleveland Institute of Electronics has specialized in teaching electronics at home. We've developed special techniques that make learning easy, even if you've had trouble studying before.

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To keep up with the latest developments, our courses are constantly being revised. This year CIE students are getting new lessons in Laser Theory and Application, Microminiaturization, Single Sideband Techniques, Pulse Theory and Application, and Boolean Algebra.

In addition, there is complete material on the latest troubleshooting techniques including Tandem System, Localizing through Bracketing, Equal Likelihood and Half-Split Division, and In-circuit Transistor Checking. There are special lessons on servicing two-way mobile equipment, a lucrative field in which many of our students have set up their own businesses.

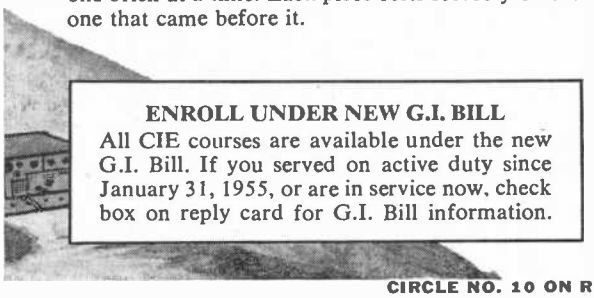
Your FCC License—or Your Money Back!

Two-way mobile work and many other types of troubleshooting call for a Government FCC License, and our training is designed to get it for you. But even if your work doesn't require a license, it's a good idea to get one. Your FCC License will be accepted anywhere as proof of good electronics training.

And no wonder. The licensing exam is so tough that two out of three non-CIE men who take it fail. But CIE training is so effective that 9 out of 10 of our graduates pass. That's why we can offer this warranty with confidence: *If you complete one of our license preparation courses, you'll get your license—or your money back.*

Mail Card for 2 Free Books

Want to know more? Mail the postage-paid reply card bound here. We'll send our 40-page catalog describing our courses and the latest opportunities in Electronics. We'll also send a special book on how to get a Commercial FCC License. Both are free. If the card is missing, just send us your name and address.



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CIRCLE NO. 10 ON READER SERVICE PAGE

SHORT-WAVE LISTENING

By **HANK BENNETT**, W2PNA/WPE2FT
Short-Wave Editor

REPORTING BY TAPE RECORDING

REPORTING to DX stations via tape recordings is a subject that has been discussed at considerable length in various club publications. Tom Meijer of *Radio Nederland*, who took over the duties of Master of Ceremonies for the "Happy Station Program" has listed certain conditions that must be met by the individual reporter who is applying for a QSL.

Foremost is that all tapes submitted must be single-track with a speed of seven and one-half inches per second. (Many reporters send double-track tapes at 3¾ in./sec.)

Tom also reminds listeners that the tape must contain such fundamental items as date, time, frequency, and enough program information in order to qualify for a QSL. In the event that any of the items cannot be included on the tape (date and time, for example) this information should be included in a separate letter enclosed with the tape.

"Happy Station" shows are presently being recorded up to seven days in advance of actual broadcast time. SWL's should not be alarmed at the belated mention of certain requests; simply send your requests earlier than you normally would have in the past.

Guide to Broadcasting Stations. A brand-new edition of this favorite British listing of long-wave, medium, and short-wave stations has just been published. Increased to 224 pages, this station/frequency listing is prepared from information collected by the BBC monitoring facilities. It is a remarkably accurate book—better than the World Radio TV Handbook—and includes a special notation showing the seasonal schedule changes of all short-wave broadcasters. Obviously, the schedule information is based on past history, but at least it gives the user a "fighting" chance of knowing whether or not a particular broadcaster has ever used a certain frequency and when (seasonally) he is likely to be back in operation. The new edition is being sold by Gilfer Associates, Inc., Park Ridge, NJ 07656 for $2.50.

John Leger, WPE4KKK, Louisville, Ky., uses a Hallicrafters S-120A and a Truetone DC3972 receiver. Member of 2 DX clubs, he has logged 37 countries.

CURRENT STATION REPORTS

The following is a resume of current reports. At time of compilation all reports were as accurate as possible, but stations may 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.

Albania—*R. Tirana* has been found on 11,866 kHz with s/on in Portuguese at 2130, and on 7295 kHz from 0700-0726 with English news and commentary.

Angola—CR6RF, *R. Clube de Benguela*, 5042 kHz, has been s/on at 0545 with the schedule for the day, then pop tunes non-stop at 0600. This is in Portuguese.

Antilles—Word is out that *Trans World Radio*, Bonaire, will increase the power of their 800-kHz transmitter from the present 500 kW to a whopping 2 MW. (That's two million watts!). No target date for the new power has been released.

Austria—*R. Osterreich*, Vienna, is now on a new frequency of 11,925 kHz as noted at 2130-2157 in German to northern Europe. Also still well heard is 9770 kHz at 0030-0045 in English.

Belgium—Brussels presents "Belgium Speaking" in English at 2305-2315 on 11,790, 9550 and 9740 kHz and at 0050-0100 on 11,790, 6125 and 9740 kHz.

Bolivia—CP105, *R. Ibare*, Trinidad, continues to

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 of the radio zones of the world. The following recently qualified for and have received awards.

10 ZONES VERIFIED

Dimitur Alipiev (WPE2QXL), Syracuse, N. Y.
Ronald Nawrot (WPE3HUO), Owings Mills, Md.
Mitchell Kassoff (WPE2QTK), Little Neck, N. Y.
Kevin Slater (WPE7CNF), Salem, Ore.
Ivan Waufle (WPE2QVD), St. Johnsville, N. Y.
Arthur Bolduc (WPE1HQU), Biddeford, Maine
Robert Brown (WPE6HKR), Yucaipa, Calif.
Edward Reichard, Jr. (WPE2QZE), Bloomsbury, N. J.
James Jankowski (WPE2QVE), Corfu, N. Y.
Sgt. George Weir (3W8PE1G), APO (South Vietnam)
Charles Clay (WPE2QWE), Climax, N. Y.
Terry Ward (WPE5EZX), El Paso, Texas
Howard Rosenberg (WPE2PQE), Queens Village, N. Y.
Joseph Perge (WPE8JKD), Newark, Ohio
John Griffin (VE6PE7V), Calgary, Alta.
John Karien (WPE3GOC), Franklin, Pa.
Tom Frisz (WPE9JRU), South Bend, Ind.
G. Shadwell (VE3PE2QZ), Ottawa, Ont.
Tom Kennedy (WPE8KKE), Battle Creek, Mich.
William Castellani (WPE8KGE), Detroit, Mich.
Philip Scribani (WPE2QSY), Maspeth, N. Y.
Sheldon Carson (WPE6HMF), Glendale, Calif.
David Larrabee (WPE1HRB), Bucksport, Maine
Alan Faustner (WPE3HYK), Northampton, Pa.
Robert Rattner (WPE2RBL), Forest Hills, N. Y.
Peter Thomas (WPE9JQT), Michigan City, Ind.
Jim Townsend (WPE8KJT), Painesville, Ohio
David Porter (WPE2QSU), Cherry Hill, N. J.
Steven Fix (WPE2RAS), Rochester, N. Y.
Robert Fruehwald (WPE4KHQ), Jeffersontown, Ky.
Scott Fruehwald (WPE4KIH), Jeffersontown, Ky.
Steven Brewer (WPE1HSX), Westminster, Mass.
Steve Nack (WPE3HTU), Conshohocken, Pa.
Jim Miles, III (WPE7CXI), Seattle, Wash.
Jon Love (VE6PE8D), Edmonton, Alta.
Robert Rose (VE4PE7M), Fort Garry, Man.
Angelo Casella (WPE2RAH), Staten Island, N. Y.
Todd Basche (WPE2RAR), Nutley, N. J.
Stephen Kennedy (WPE3HZT), Newville, Pa.
Philip Creasy, Jr. (WPE3HWT), Bloomsburg, Pa.
Sam Fulp (WPE4KIM), Lexington, N. C.
Richard Niles (WPE2QRB), Fort Lee, N. J.
Robert Lurie (WPE2QVQ), Howard Beach, N. Y.
James Sanders (WPE4KCH), Savannah, Ga.
Anthony Toscani (WPE3HVN), Philadelphia, Pa.
Roger Horie (WPE7COV), Mountain Home Air Force Base, Idaho
Wayne Gentry (WPE6HMR), Foster City, Calif.
Ken Brookner (WPE5EWM), Memphis, Tenn.
Maury Weiner (WPE6HPC), Palm Desert, Calif.
Jim Fox (WPE9JVS), Indianapolis, Ind.
Richard Eddie (WPEØFFT), St. Louis, Mo.
Kevin Kleman (WPE9JQV), Tigerton, Wisc.
Jack Graham (WPE2QNT), New Milford, N. J.
Michael Caditz (WPE6HOA), Los Angeles, Calif.
Michael Zyda (WPE6HJL), Northridge, Calif.
Ronald Dudinski (WPE3IAF), Plymouth, Pa.
Frank Harris (WPE8JRG), Edison, Ohio
Dave Schoeller (WPE9IQQ), Springfield, Mo.
Robert McLarnon (WPE1HQL), Natick, Mass.
Tom Smith (WPE4KCP), Daytona Beach, Fla.
Robert Walker (WPEØFPO), Wichita, Kansas
Mike Witkowski (WPE9JFT), Stevens Point, Wisc.
Roy Neese (WPE7CWZ), Kent, Wash.
James Kobus (WPE7CGW), Ferndale, Wash.
Chuch Nobles (WPE4KIG), Winter Haven, Fla.
Mike Carrick (WPEØFLX), Omaha, Nebr.
Brian Hajder (WPEØFPI), Crystal, Minn.
Robert Keller (WPE7CND), Brigham City, Utah
Philip Thibodaux (WPE5FEB), Morgan City, La.
Peter Vegter (VE5PE6G), Regina, Sask.
Bill Buckley (WPE2RDI), New York, N. Y.
Roland Hamel (WPE1HEE), Waterbury, Conn.
Ted Romanow (WPE1HQH), Waban, Mass.
Tommy Buchanan (WPE4KGA), Darlington, S. C.
James Murray (WPE2RFR), Troy, N. Y.
Carroll Patterson (WPE4KHW), Decatur, Ga.
Gary Hubbard (WPE6HQA), Northridge, Calif.
Robert Galka (WPE8HWS), Tallahassee, Fla.
James Haberman (WPE9JWS), Indianapolis, Ind.
Donald Jones (WPE8KLV), Parma, Ohio
Tony D'Agostino (VE3PE2SD), Hamilton, Ont.
Marvin Van Sickle (WPEØFPD), Dubuque, Iowa
Joseph Ulrich (WPE6HGA), Los Angeles, Calif.
Henry Seidner (WPE2REP), Pearl River, N. Y.
Bradley Krohn (WPE2REA), Amherst, N. Y.
Robert Haase (WPE4KHT), Brunswick, Ga.
Wayne Randall (WPE1HFA), Danbury, Conn.
Daniel Lindley (WPE4KEA), Florence, S. C.

20 ZONES VERIFIED

Mitchell Stern (WPE2QIA), Brooklyn, N. Y.
Martin Miron (WPE8JTN), Warren, Mich.
Stefan Lai (VS6PE1H), Causeway Bay, Hong Kong
Thomas Alleman (WPE2QFR), Rochester, N. Y.
Loren Davis (WPE6HMA), Hayward, Calif.
Tom Christian (WPE7CXG), Seattle, Wash.
James Ziegler (WPE9JOW), Milwaukee, Wisc.
Joseph Breton (WPE1HKW), Methuen, Mass.
Michael Dopson (WPE4KCF), Enterprise, Ala.
Brian Heller (WPE2OVP), Lawrenceville, N. J.
Gary Kromer (WPE2PIH), Auburn, N. Y.
Lawrence Plummer (WPE7CRV), Bellevue, Wash.
Peter Macinta (WPE2ORB), Kearny, N. J.
J. H. Mac Neill (WPE6GWX), Redwood City, Calif.
Dean Frey (VE6PE7N), Fort Saskatchewan, Alta.
Daniel Polansky (WPE2QFH), Rochester, N. Y.
Michael Lynch (WPE2QEA), Auburn, N. Y.
Lance Kimmel (WPE2QQY), Forest Hills, N. Y.
Robert Hagerman (WPE8INH), Hemlock, Mich.
Charles Loftis (WPE4KEF), Landrum, S. C.
Everett Slosman (WPE2QZB), Endicott, N. Y.
Steve Sox (WPE4KEU), Asheboro, N. C.
Charles Clay (WPE2QWE), Climax, N. Y.
Robert Scott (WPE4HHX), Kingsport, Tenn.
Nick Chinn (WPE6HKB), San Leandro, Calif.
John Adams (WPE3HXT), Beltsville, Md.
Mrs. Mildred Marshall (WPEØFIR), Devils Lake, N. D.
Donald Appling (WPE7CNG), Spokane, Wash.
Steven D'Adolf (KX6PE1B), APO (Marshall Islands)
Delbert Fant (WPE6HMY), San Luis Obispo, Calif.
Tim Ohrman (WPE3HHA), Monroeville, Pa.
Frank Swanberg III (WPE9JVD), Dolton, Ill.
Paul Metro (WPE2QZM), Colonia, N. J.
G. W. Fisher (WPE7CXZ), Longview, Wash.
Robert Fleck (WPE3DXZ), Schiller Park, Ill.
Ken Piper (WPE6GVB), Stockton, Calif.
Douglas Stark (VE3PE2OY), London, Ont.
Carroll Patterson (WPE4KHW), Decatur, Ga.
Bruce McCoy (WPE9JMY), La Porte, Ind.
Bill Potorti (WPE2QYH), Ithaca, N. Y.
Jack Dashper (WPE4KCJ), Camden, Tenn.
Marvin Robbins (WPEØMW), Omaha, Nebr.
Gregory Kelley (WPE4JGI), Staunton, Va.
Kurt Leonhardt (WPE9FLI), Blue Island, Ill.

30 ZONES VERIFIED

Everett MacLeod, II (WPE1HTG), Gloucester, Mass.
Mark Connelly (WPE1HGI), Arlington, Mass.
Jeff Wilson (VE3PE2NL), Sarnia, Ont.
Tom Christian (WPE7CXG), Seattle, Wash.
Thomas Creery (WPE2PHZ), Conklin, N. Y.
Vincent Geraci (WPE1HMP), Shelton, Conn.
Richard Shawyer (WPE6CFL), San Francisco, Calif.
John Sgrulletta (WPE2MFX), Bedford Hills, N. Y.
Steve Kamp (WPE5EUT), Irving, Texas
Marvin Robbins (WPEØMW), Omaha, Nebr.
Clifford McKinstry (WPE6CXS), Hampton, Va.

be heard on 4958 kHz at fair level until s/off at 0200 in all Spanish programming.

Brazil—ZYW25, *Radiodifusora Jatai,* Jatai (Goias), is on 2470 kHz and verified after five reports; no schedule or power was stated. It's audible at times around 2300 in Portuguese but does not seem to be on any definite schedule. . . ZY023, *R. Vitoria,* Vitoria, has settled down on 5053 kHz and is heard daily in Portuguese until s/off between 0200-0230. . . *R. Braganca,* Braganca Paulista (Sao Paulo), is on 2480 kHz but with a strong harmonic at times on 4960 kHz; it's been logged there after 2200 in Portuguese.

Chile—*R. Sociedade Nacional de Mineria* is noted daily on 9750 kHz from 0100 with many talks and ID's in Spanish.

Columbia—Reports are being received on a superpowered station operating on 810 kHz, mediumwave. Heard evenings (local time) causing heavy QRM to WGY, Schenectady, N. Y., we have not as yet obtained a definite ID. Listed for the channel is *R. Sutatenza,* Bogota; the power is said to be 250 kW. This is undoubtedly strong competition to the Antilles station on 800 kHz.

Czechoslovakia—*R. Prague* is on 5930 kHz with IS and time ticks at 0058-0100 and opens with this schedule: to US and Canada at 0100 and 0400 on 5930, 7345, 9540, 9630 and 11,900 kHz, rebroadcast to Europe at 0700 on 6055 and 9505 kHz; to Australia and New Zealand at 0700 on 9575, 11,800, 15,310, 21,485 and 21,700 kHz; Sundays to N.A. at 1400 on 15.445, 17.840 and 21,735 kHz.

Dominican Republic—HIBB, *Voz de Papagayo,* La Romana, 5030 kHz, has a most elaborate s/off at 0400 with a sad-voiced announcer, playing of "Taps", then a stirring march. A station that we've been hearing on 2500 kHz from 0000-0200 is thought in some quarters to be a second harmonic of HIBC, *La Voz del Progreso,* 1250 kHz.

Ecuador—HCJB, Quito, is good on 11,740 kHz with English religious programs heard at 0805 and 0410; "DX Party Line" was logged at 0230-0300. . . *R. Vision,* Manta, long inactive, is again on the air on 6141 kHz and heard from 0400-0430 with music, commercials and time checks in Spanish. . . HCAK2, *Cadena Radiodifusora Ecuatoriana,* Guayaquil, was heard from 2355-0105 on 4655 kHz with L.A. music and radio drama.

Egypt—Cairo is testing numerous channels in the 31-meter band. English news is noted on 9550 kHz at 2200; Arabic with chanting can be heard at 0000-0040 on 9860 kHz. The 9475 kHz channel is still heard well at 0230-0245 with English news and music as is 9740 kHz at 1830-2300 in Italian, French, German and English. Reports go to P.O. Box 566, Cairo, United Arab Republic.

El Salvador—YSS, San Salvador, 5980 kHz, is reportedly planning more extensive English and French programs to be aired Monday to Saturday at 0300-0330 and Sunday at 0030-0100. This will be dual to 9555 kHz.

Ethiopia—ETLF, Addis Ababa, opens at 0330 in Swahili to E. Africa on 9725 kHz, a new frequency.

Germany (East)—*R. Berlin International* is on 15.145 kHz in English to Africa until 1900 closing and requesting reports.

Gilbert and Ellice Islands—VSZ1, Betio, Tarawa, 844 kHz, seems to now be using 10 kW as indicated by increasingly better signals on the West Coast at 0600.

Guantanamo Bay—If you need this country for DX Awards, look for KG4AA in the 20-meter ham radio band; he often operates around 0000-0100 weekdays on single sideband.

Guatemala—Possibly a new frequency for *R. Nacional-La Voz de Quezaltenango* is 9680 kHz as noted from 0305 with marimba music.

Guiana (French)—Cayenne, 3385 kHz, has French from 0915 s/on; news is given at 0930. This one often fades out by about 1000.

International Waters—A good catch was that of the New Zealand Navy Survey Ship "Lachlan", callsign ZMCU. On 8236 kHz with 250 watts, it was noted at 0911 in contact with ZLW, Wellington. It verified in nine days by letter and by signing a prepared card.

Italy—Rome was heard in Italian to N.A. at 2300-0000 on 6010 and 9710 kHz, both unlisted channels, then shortly afterward, on 5990 and 9575 kHz, in a dual frequency move.

Mexico—XEVJ, Chilpancingo, a 250-watt station, has been heard on 2160 kHz at 1347 in Spanish. . . . *R. Mexico* is on a new frequency of 9745 kHz, dual to 11,718 kHz at 0500 but with heavy QRM on the lower channel.

Monaco—The English test transmissions to Great Britain over *R. Andorra* on 701 kHz have been moved to *R. Monte Carlo* on 1466 kHz and are aired at 2300-0100 every Saturday-Sunday night under the name of *Radio 205.* Reports go to Geoffrey Bass, 1 Harley Street, London W1, England.

Nigeria—*Voice of Nigeria,* Lagos, was heard at 2130-2300 and at 0450-0525 with mostly English programs of music, news, commercials and time checks on 3986 kHz. Some African chanting was noted around 0450-0455.

Norway—"Norway This Week" in English is aired on Sundays to East Coast N.A. at 2000-2030 on 21,655 kHz and 2200-2230 on 11,860 kHz, at 1600-1630 to East Coast on 25,900 kHz and to West Coast on 21,730 kHz, and on Mondays to West Coast at 0200-0230 on 9610 kHz and at 0400-0430 on 9610 and 11,735 kHz.

Paraguay—An overseas source reports that this country is planning an international service with a transmitter of 100 kW. Further details as they become available.

Peru—OBX10, *R. Atlanta,* Chulucanas, 4990 kHz, can be occasionally logged under severe QRM from a Venezuelan on the same channel from 0200 with the usual L.A. format.

Portugal—A new frequency for Lisbon is 15,340 kHz as noted in Portuguese from 0445 s/on. Other frequencies reported recently include 11,870 kHz at 0200 to N.A., 11,840 kHz with English around 0245-0305, and 11,935 kHz at 0020 with "Radio Safari" using the facilities on the second Monday in each month.

Seychelles—*R. Seychelles,* Victoria, was logged on 15,265 kHz from 1536-1630 s/off with light music at 1550, "Back to the Bible" at 1600, ID, frequency, and time, in an all-English xmsn.

South Africa—*R. RSA,* Johannesburg, is now operating to N.A. at 2330-0020, 0030-0120, 0130-0220 and 0230-0320 on 9695, 9705, 11,875 and 15,220 kHz, and to Africa in English and Afrikaans at 1100-1450 on 25,790 kHz. Two other new frequencies noted include 15,249 kHz at 1805 with English news, and 15,320 kHz at 0150 with an interview-type program, also in English.

Sudan—*R. Omdurman* broadcasts at 0700-0900 and 1600-1900 on 4994 and 11,835 kHz with English usually at 1715-1800.

Switzerland—New frequencies in use by Berne include 6055 kHz in French with s/off at 2245, and 11,720 kHz at 2310-0000 s/off in Portuguese.

USSR—Two of the time stations listed last month, RID and RKM, are being noted by Your Editor. RID is usually audible around 2300-0200 and RKM around 1100-1300, both on 15,004 kHz. ID's are given every 10 minutes in slow Morse starting with "VVV CQ CQ CQ" and sounds like it is being handsent. So far we have not yet located RTA on 14,996 kHz . . . Vladivostok, 5015 kHz, was noted in the clear at 1045 in Russian with two bars of organ music and an ID at 1100, then man and woman alternating in Russian news . . . A report to *R. Moscow* for reception of Kalinin, listed in this column last October on 15.470 kHz, brought a fast reply to one of our readers that the Soviet Union has no xmtr's on that frequency!

Vatican City—A new frequency in use by *R. Vaticano* is 6135 kHz as noted at 2358-0015 in Spanish to L.A. dual to 11,845 kHz and a third channel which we could not copy. English news is given

(*Continued on page* 91)

SOLID STATE

By LOU GARNER, Semiconductor Editor

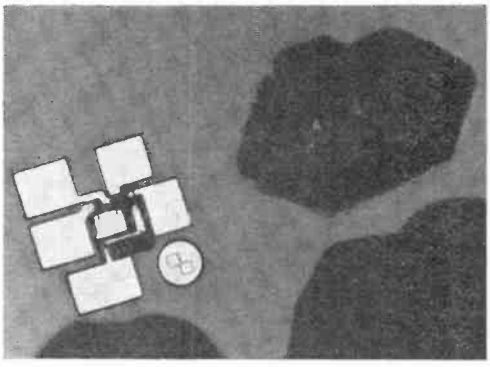
NEW PROCESS MAY REDUCE IC COSTS

INTEGRATED CIRCUITS may be less costly in the future as a result of a new manufacturing process developed by the Bell Telephone Laboratories (BTL). Requiring fewer production steps than previous methods, the new IC fabrication technique can produce reliable, high-quality devices which are smaller than a grain of sugar.

Conventional bipolar integrated circuits require from five to seven photolithographic masking steps before the contacts to the silicon are formed. In contrast, the new circuit configuration needs only three such steps and, appropriately, is called a "Tri-Mask" (TRIM) structure. In both techniques, of course, additional processing is required to make contacts to other circuits and to protect the device from the environment.

As illustrated in Fig. 1, the new TRIM structure is based on the use of lateral transistors—devices in which injected carriers flow parallel to the surface rather than perpendicular to it. The collectors and emitters are diffused simultaneously and, therefore, need only one masking operation. Thus, all of the important transistor properties are determined by this one step.

The TRIM process starts with a silicon substrate lightly doped with boron to provide general *p*-type characteristics. A shallow *p*-plus base layer is diffused into the substrate. Next, silicon oxide is grown over the entire surface, then etched away selectively using the first photolithographic mask to establish the emitter and collector areas. Phosphorous-doped emitter and collector regions (*n*-type) are diffused through the *p*-type base and then all of the exposed silicon oxide is removed. Another silicon oxide layer is now grown on the surface with a second mask defining the emitter, collector, base, and surface contact holes. Metal is



TRIM technique produces high-quality IC chips that are smaller than grains of sugar (black objects).

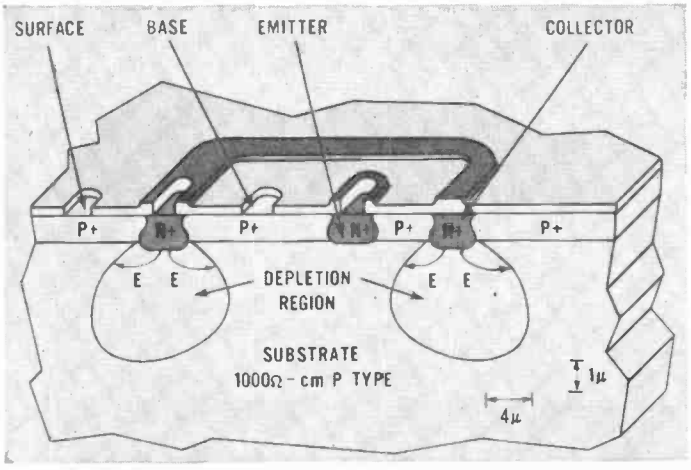


Fig. 1. TRIM structure, based on use of lateral transistors, has collectors and emitters diffused simultaneously. It requires only one masking operation. One step determines all of transistor properties.

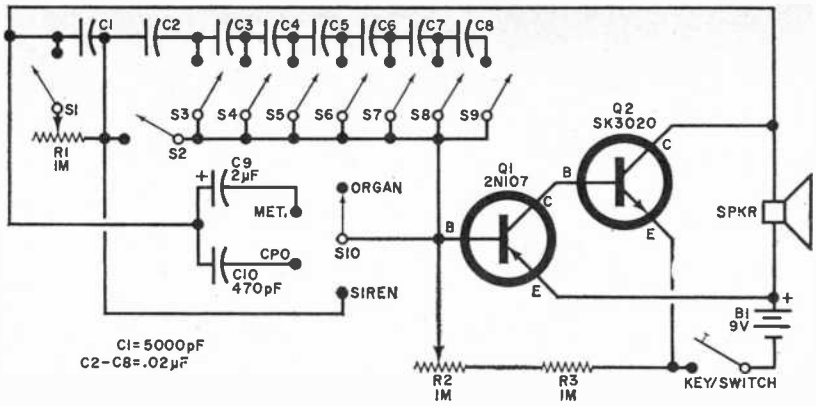


Fig. 2. Switching arrangement allows wide-range relaxation oscillator to operate as an electronic organ, metronome (and thermometer), code practice oscillator, or siren.

evaporated over the entire surface and etched away except where the third mask defines the metal conductor paths. The final contacts to external circuits are provided through beam leads, with a layer of silicon nitride providing environmental protection.

Thus far, the TRIM method has been used primarily for the fabrication of integrated circuit logic gates of the type used in computers and telephone switching system; but, conceivably, it could be used in linear devices as well. A transistor in such circuits occupies less than one millionth of a square inch.

Reader's Circuit. In developing a Science Fair project, reader Paul Serafin, WN4OEG (707 Cathy Ct., Murfreesboro, TN 37130) first selected a reader's circuit described here in March 1969. Encountering minor difficulties, he modified the design using a circuit we described in February 1966. Additional modifications and adpatations resulted in the multi-purpose project whose schematic is shown in Fig. 2. Operating, variously, as an electronic organ, a metronome (and electronic thermometer), CPO, or siren, his final design won an Honorable Mention Award at the 1969 Vanderbilt University Regional Science Fair.

Essentially a wide-range relaxation oscillator, Paul's circuit features a two-stage, direct-coupled complementary amplifier using *pnp* (*Q1*) and *npn* (*Q2*) transistors to drive a PM loudspeaker. The circuit's operational mode and basic repetition rate (frequency range) are determined by the feedback arrangement chosen by function switch *S10*, while its exact operating frequency can be adjusted by bias control *R2*, in series with current limiting resistor *R3*. Switches *S2* through *S9* serve as the organ "keys," while *S1* is used as the siren switch. Circuit power is furnished by *B1*, controlled by a familiar handkey or switch.

Standard, readily available, parts are used in the project. Transistor *Q1* is a general purpose *pnp* transistor such as RCA's SK3020. Capacitors *C1* through *C8* and *C10* are low-voltage ceramic or tubular paper types; *C9* is a metallized paper or electrolytic unit; and switches *S1* through *S9* are s.p.s.t. normally open momentary push-buttons. Almost any PM loudspeaker may be used; but better results generally will be obtained with units having high-impedance voice coils (8, 16, or 45 ohms).

Neither layout nor lead dress is critical and the circuit can be assembled using any preferred construction technique. Paul assembled his display model on a three-section poster, with the schematic diagram and actual circuit in the center and an explanation of the project operation on the sides.

The circuit's performance as an electronic organ, metronome or CPO is fairly straightforward. In its "siren" mode, however, *R1* must be adjusted for optimum signal with *S1* closed. Finally, the circuit may be used as an electronic therometer" by switching to the metronome mode and physically varying *Q1*'s temperature. The output beat rate will change as *Q1* is heated or cooled.

Manufacturer's Circuit. With a variety of potential applications in experimental projects as well as in commercial and industrial systems, RCA's TA5371B is a unique integrated circuit which combines light-sensitive elements and an amplifier in a single device. Two typical circuits using this unit are shown in Fig. 3. Both were abstracted from the engineering bulletin/specification brochure published by RCA describing the new device.

(*Continued on page* 88)

AMATEUR RADIO

By HERB S. BRIER, W9EGQ
Amateur Radio Editor

FIELD DAY, 1970

MOST IMPARTIAL observers agree that amateur radio's ability and willingness to supply emergency communications are two of its most valuable functions. This was demonstrated dramatically when Hurricane Camille struck the Gulf Coast in the fall of 1969 and in other less publicized disasters.

On the fourth weekend of each June, "Field Day," sponsored by the American Radio Relay League, Inc., gives amateurs a chance to show and test their abilities at supplying communications under emergency conditions. Between 1900 GMT, Saturday, June 27, and 2200 GMT, Sunday, June 28, amateurs all over the United States and Canada will set up temporary, self-powered stations in forest preserves, parking lots, athletic stadiums, etc., to contact other amateurs. Each contact made on each code or phone sub-band earns a number of points determined by the power source and the amount of transmitter power used.

Large groups may operate 20 or more transmitters simultaneously during the event; although the greatest number of entries is usually in the one-, two-, three-, four-, and five-transmitter groups. And of course there are always a few "iron-man" entries in which a single operator attempts to keep his field day station in operation during the entire period. Undoubtedly, however, the most enjoyable and valuable Field Day operations are the co-operative ven-

AMATEUR STATION OF THE MONTH

Jim Rafferty, WA9UCE, 529 Buckingham, Libertyville, IL 60048, became a Novice in 1967 and was a General in three more months. His Collins KWM-1 SSB/CW transceiver is older than he, but its 175 watts fed into a Mosley TA-33-Jr., tri-band beam, 30 ft high, has worked all states and 97 countries. Jim attends Western Illinois U., where he is president of the radio club, W9YOL, and lives at the fire station, where he signs WB9AZW. We are sending WA9UCE a 1-year free subscription to POPULAR ELECTRONICS for sending this month's Amateur Station Photo. You can enter by sending a clear (black and white preferably) photo of yourself at the controls of your stations and some details about your amateur career to Herb S. Brier, W9EGQ, P.O. Box 678, Gary, IN 46401.

tures in which amateurs from the newest Novice to the hoariest old timer (and their families) work to make Field Day a success.

Collecting equipment, erecting antennas, installing the equipment, and keeping a number of transmitters going around the clock under conditions that simulate an actual emergency present real challenges to any amateur club. So, starting Saturday afternoon, June 27, you can expect many bosky glens and other likely (and unlikely) spots to echo with the call "CQ Field Day" from approximately 12,000 throats and keys until the affair ends Sunday evening. Drop a request (with a stamped, business size envelope) to Communications Dept., ARRL, 225 Main St., Newington, Conn., 06111, for full Field Day rules and score sheets.

Gilbert Kunster, Jr., WB2DKZ, 225 W. 232 St., Bronx, NY 10463 needs Montana and Hawaii for his WAS certificate. His Heath "S" line and Hustler vertical antenna worked 62 countries in 6 months.

FCC and Related News. Amateur license fees are going up! In an attempt to obtain its entire budget from fees charged for license processing, the FCC proposes in Docket 18,802 to increase basic amateur license fees from $4.00 to $9.00 and for applications for special callsigns from $20.00 to $25.00. The CB fee will jump from $8.00 to $19.00.

While April 20, the date set by the Commission for filing original comments on the docket, will have passed before you read this, we assume that the Commissioners will consider any well-reasoned "late" comments from interested parties. Most comments that we have heard claim that the increases are inflationary. We strongly suspect that the protests will not prevent the increases, but enough protests might delay the effective date.

The Commission also issued its proposals to formalize the regulations governing amateur repeater operation on the frequencies above 50 MHz. Such repeaters receive signals on one frequency and simultaneously retransmit them on another frequency. The most important part of the new proposals limits the repeaters to 200-kHz segments in the 50-, 144-, 220-, and 430-MHz bands and also specifies the frequencies to be used to transmit to the repeater. The rest of the proposal clarifies and consolidates the informal rules that have been put into effect since repeaters became so popular.

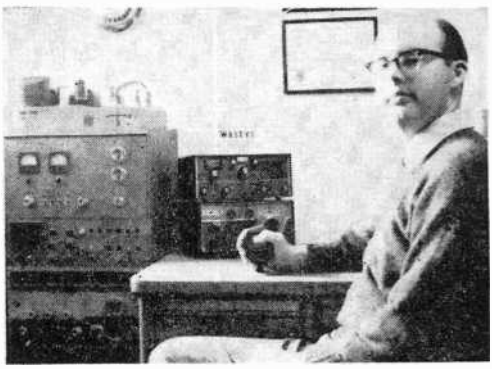
In a recent speech, Everett G. Henry, W3BG, Chief, Amateur and Citizens Radio Division, FCC, stated that surveys of the Advanced and Extra class segments of the amateur bands show that they are not the deserted wastelands that some opponents of incentive licensing claim. Rather, they are well occupied during the popular operating hours. Some of them are rather sparsely occupied at other times, but the other parts of the bands are not overly crowded then, either.

W3BG also stated that 85% of the applicants for the Advanced license who must take the code test (Novices, Technicians, Conditionals, and brand new applicants) pass it. Also, 81% of all who take the Advanced class written exam pass it. Similarly, 80% of the applicants pass the Extra class code test; and 77% of those that get by the code also get by the Extra class written examination.

Thoughts on Silver Plating. It is common practice to silver plate UHF/VHF coils, cavities, etc., to reduce "skin effect," which increases the r.f. resistance of conductors above their d.c. values. But many UHF/VHF workers say that the results do not justify the effort.

R. S. Stone, VK5PB, reports in *Amateur*

(*Continued on page* 86)



Jim Labo, WA5ZVI, Enid, OK 73701, uses an SBE-34 transceiver and Drake R4 for the "d.c." bands. His main interests are in the frequencies above 50 MHz, however, as demonstrated by VHF/UHF gear.

ENGLISH LANGUAGE NEWS BROADCASTS FOR THE MONTH OF JUNE

Prepared by ROGER LEGGE

TO EASTERN AND CENTRAL NORTH AMERICA

TIME-EDT	STATION AND LOCATION	FREQUENCIES (MHz)
7:00 a.m.	Stockholm, Sweden	15.315
7:30 a.m.	Melbourne, Australia	9.58, 11.71
8:00 a.m.	Peking, China	11.685, 15.095
8:15 a.m.	Montreal, Canada	9.625, 11.72
12 Noon	London, England	21.61
5:30 p.m.	Hilversum, Holland	11.73, 15.425
6:00 p.m.	Ankara, Turkey	15.16
7:00 p.m.	Montreal, Canada	9.625, 11.945, 15.19
7:45 p.m.	Tokyo, Japan	15.445, 17.825
8:00 p.m.	London, England	6.11, 9.58, 11.78, 15.14
	Moscow, U.S.S.R.	11.87, 11.96, 15.15
	Sofia, Bulgaria	9.70
	Tirana, Albania	7.30, 9.50
8:30 p.m.	Johannesburg, South Africa	5.98, 9.695, 11.875
	Stockholm, Sweden	11.95
8:50 p.m.	Brussels, Belgium	6.125
	Vatican City	11.725, 15.285, 17.80
9:00 p.m.	Berlin, Germany	11.89, 15.17
	Budapest, Hungary	9.833, 11.91, 15.16
	Havana, Cuba	9.525
	Madrid, Spain	6.14, 9.76
	Peking, China	15.06, 17.715
	Prague, Czechoslovakia	7.345, 9.54, 11.99, 15.365
	Rome, Italy	11.81, 15.41
9:30 p.m.	Berne, Switzerland	9.535, 11.715, 15.305
	Cologne, Germany	6.075, 9.735
	Melbourne, Australia	15.32, 17.82
10:00 p.m.	Cairo, Egypt	9.475
	Hilversum, Holland (via Bonaire)	11.73
	Lisbon, Portugal	6.025, 11.935, 15.34
	London, England	6.11, 9.58, 11.78
	Moscow, U.S.S.R.	9.70, 11.87, 15.15

TO WESTERN NORTH AMERICA

TIME-PDT	STATION AND LOCATION	FREQUENCIES (MHz)
8:00 a.m.	Tokyo, Japan	9.505
6:30 p.m.	Melbourne, Australia	15.32, 17.82, 21.74
	Tokyo, Japan	15.235, 17.825, 21.64
7:00 p.m.	Oslo, Norway (Sun.)	11.86
7:30 p.m.	Johannesburg, South Africa	5.98, 9.695, 11.875
8:00 p.m.	Madrid, Spain	6.14, 9.76
	Moscow, U.S.S.R.	9.70, 11.96, 15.15
	Peking, China	15.095, 17.673, 21.735
	Prague, Czechoslovakia	7.345, 9.54, 11.99, 15.365
	Seoul, Korea	15.43
	Tokyo, Japan	17.785
8:30 p.m.	Berlin, Germany	9.73, 11.84, 15.45
	Stockholm, Sweden	11.705
	Tirana, Albania	6.20, 7.30
9:00 p.m.	Budapest, Hungary	9.833, 11.91, 15.16
	Havana, Cuba	9.525, 11.76
	Lisbon, Portugal	6.025, 11.935, 15.34
	London, England	6.11, 9.58, 11.78
	Moscow, USSR (via Khabarovsk)	15.14, 17.865, 17.88
	Sofia, Bulgaria	9.70
	Tokyo, Japan	17.785
9:30 p.m.	Kiev, USSR (Mon., Thu., Sat.)	11.96, 15.15
9:45 p.m.	Berne, Switzerland	11.715, 15.305
	Cologne, Germany	9.545, 11.945
10:00 p.m.	Havana, Cuba	11.76
	Hilversum, Holland (via Bonaire)	9.715, 11.73
11:00 p.m.	Moscow, USSR (via Khabarovsk)	15.14, 17.865, 17.88
	Tokyo, Japan	15.105
11:30 p.m.	Havana, Cuba	11.93

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BEETHOVEN: Wellington's Victory (Battle Symphony) (excerpt from the first movement) Westminster Records.
MASSAINO: Canzona XXXV à 16 (complete) DGG Archive.
CORRETTE: Concerto Comique Op. 8, No. 6, "Le Plaisir des Dames" (third movement) Connoisseur Society.
KHAN: Raga Chandranandan (excerpt) Connoisseur Society.
RODRIGO: Concert—Serenade for Harp and Orchestra (excerpt from the first movement) DGG.
MANITAS DE PLATA: Gypsy Rhumba (complete) Conn. Soc.
MARCELLO: (arr. King): Psalm XVII "The Heavens are Telling" (complete) Connoisseur Society.
PRAETORIUS: Terpsichore: La Bourrée XXXII (complete) DGG Archive.
BERG: Wozzeck (excerpt from Act III) DGG.
BARTOK: Sonata for two pianos and Percussion (excerpt from the first movement) Cambridge Records.
BEETHOVEN: Wellington's Victory (Battle Victory) (excerpt from the last movement) Westminster.

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State _____ Zip _____

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OPPORTUNITY MIRROR

(*Continued from page 70*)

subject under study was in danger or might be rewarded (the mother example again), it is not possible to impress "new" material or learn while sleeping.

Jobs for "First Phone" Holders

I have a First-Class Radiotelephone license, but my interest is not in commercial AM or FM broadcasting. What other kinds of jobs can I get to take advantage of my First-Class FCC license?

● The non-broadcasting jobs that you can get will depend upon the amount of training that you have above and beyond that required to get the First-Class license. If your training covered only the material necessary to pass the examination, you can only get a job that involves operating, maintaining and troubleshooting communications gear. There are a lot of governmental jobs of this kind currently available. Law enforcement agencies ranging from the local police to the FBI all report a shortage of qualified radio operators and troubleshooters. And, all branches of the Armed Forces also hire "first phone" men for their civilian repair facilities.

There are some private business openings and I would suggest trying taxicab companies, the local telephone company, and any other outfit that uses a lot of mobile radio gear. Put an application in with a reputable, nationwide employment agency. Many jobs for men with a "first phone" license are fee-paid.

The best jobs go to the men who have both a "first-phone" license and a solid background in general electronics technology. Almost every electronics company that designs and builds communication gear is looking for men who have an FCC license and at the same time can design solid-state logic and control circuits.

Keep your eye on the classified employment ads in your local newspaper. Visit any major airport and you'll probably find a cluster of small companies that specialize in airborne radio communications equipment. However, you'll find that the engineering electronics technician job is a lot more exciting than the plain and simple "first phone" maintenance and operation job. If you don't have the training to let you design communications *and* control circuits, I suggest you enroll in a home study course in electronics.

AMATEUR RADIO

(*Continued from page 82*)

Radio, Melbourne, Australia, that work done by Alan Fowler of the Australian Post Office Research Department, indicates that these "doubting Thomases" may be right. He says that, unless that silver plating is nearly 100% pure, its resistance becomes excessively high. Furthermore, not only is it difficult to keep the plating solution clean; but commercial platers usually add contaminants called "silver brites" to obtain a bright finish. Compounding the difficulty, many silver-plated electronic components are also gold plated to inhibit corrosion. Gold brighteners also increase the resistance of gold plating sharply—and its resistance is greater than copper or silver.

VK5PB (who is a professional plater) recommends skipping silver plating entirely. Instead, buff the material to a smooth, shiny surface; electroplate it with copper (even if the material is copper to begin with); polish again; and lightly flash with pure gold to inhibit corrosion.

Gary Kent, WNØSZY, Eddyville, IA, 52553, is waiting for his General license. His Heathkit DX-60B, Drake 2B, Hy-Gain 18-AVQ have worked 34 states.

$1,000,000 TVI Suit—Final Report. As we reported previously, the $1,000,000 TVI suit against "Grid" Gridley, W4GJO, has been withdrawn. Legal costs were $6,500, of which $5,200 were covered by contributions. Further contributions may be sent to the Sarasota Amateur Radio Association, P.O. Box 3323, Sarasota, Fla. (Tnx *Florida Skip*)

NEWS AND VIEWS

Ron Del Buono, WA2JUI, 415 41 St., Union City, NJ 07087, collected over 450 QSL cards as a Novice! His best Novice DX was Spain, but he is most proud of his card from WA6UIL at the San Diego Naval Base. Ron used a Hallicrafters S-120 receiver and a Heathkit DX-20 as a Novice. He is

now using a Heathkit Sixer on 6 meters . . . **Ken Sobel, WN2MQI,** 1560 E 102 St., Apt. 3-G, Brooklyn, NY 11236, worked 22 states his first three weeks on the air and expected to pass the General exam during Easter vacation. He uses a DPZ "Vacationer" window-mounted antenna in conjunction with a Heathkit DX-60B transmitter and HR-10B receiver on 15 meters. The antenna is 4½ feet long and 30 feet high . . . Across country. **Dave Wetherbee, WN6GTE,** uses an Ameco AC-1 transmitter and R-5A receiver in conjunction with a Gotham V-80 vertical antenna. Dave has three states confirmed after a few days on the air and is studying hard for his General ticket.

The Medical Amateur Radio Council, Ltd., will hold its 4th Annual meeting in Chicago at the Sheraton-Blackstone Hotel on June 25 at the time of the American Medical Association Meeting. Reservations at $7.50 can be obtained from Joseph J. Boris, P.O. Box 229, Manchester, CT 06040. The MARCO nets meet on 14,280 kHz at 0200 GMT and on 7260 kHz at 0100 GMT. Last September, the MARCO net, with help from the International Missionary Radio Net, obtained 10 ampoules of Dilantin needed for a 3-year-old ill with encephalitus in Lima, Peru, and put them on a plane in Miami. The drugs arrived in time, and the child was relearning how to use her muscles in February.

Ray Ilich, WN8FMZ, 446 Alameda Ave., Youngstown, OH 44504, was so excited when his license arrived that he fell down the stairs getting to his radio shack. Picking himself up, it took him a month to work 16 states and Canada on 40 meters.

Don Babcock, WB4KUZ, Titusville, FL 32780, likes to ragchew and he is also a member of the local Radio Amateur Civil Emergency Service (RACES).

A Heathkit HW-16 transceiver drives Ray's 40-meter vertical antenna, and he has plans for a 15-meter beam . . . **R. H. Mattox, W9ADT/MM,** *SS Green Bay* (5457 Hatch Lane, West Palm Beach, FL 33406, when he's home) has been a ham for over 35 years. He has also been a disc jockey and engineer for AM and FM BC stations, teacher of code and radio engineering, seaman, etc. The shipboard equipment includes a Heathkit SB-300 receiver, SB-400 transmitter driving an SB-200 linear amplifier to 1000 watts input into a Hy-Gain 14-AVQ vertical antenna. On shore, Bob signs WB4IPP. Get him to tell you how he was blown 100 miles out to sea on his honeymoon, spending 35 hours lashed to the tiller of the 34-ft ketch. By the way, the captain of the *Green Bay* is WA5TKV, thanks to Bob's tutoring . . . **Faris Howat, WN2GJM,** 115 Ocean Ave., Brooklyn, NY 11225, alternates between a homebrew 10 watter and a Heathkit DX-60V transmitter. His antenna is a Hy-Gain 14-AVQ vertical, and his receiver is a Drake 2C. It all adds up to 41 states and 10 countries. When Faris gets his code speed built up a little more, he will go for his Advanced ticket. As he already holds 2nd class Commercial Radiophone license with Radar endorsement, he isn't too worried about the theory. Being in the U.S. Navy may explain the radar endorsement . . . **C. D. Anandasegar, VU2AI/W2,** Box 253, Manasquan, NJ 08736, first got on the air in Madras, India, using a 25-watt, homebuilt transmitter to feed a folded dipole antenna. He received on a BC-342 and worked over 80 countries. Anand is in the United States for electronics training and has been operating under the Indian/USA reciprocal operating agreement through the cooperation of Charles, W2AIW. The best time to catch Anand is on weekends on 20 meters . . . **James W. Andrews, WN8FRQ,** 4240 Otis Dr., Dayton, OH 45416, feeds his 40-meter dipole with a Drake 2-NT transmitter and receives on a Drake 2C. Jim has worked 11 states and is president of the Miami Valley SWL Association . . . **Daniel Ray, WN1MJC,** 19 Standard Ave., West Warwick, RI 02893, has separate dipoles for the 80-, 40-, and 15-meter Novice bands. He operates them in conjunction with a Heathkit DX-60B transmitter and a Realistic DX-150 receiver. Dan wants to start an amateur radio club at his high school and would appreciate advice from officials or members of established clubs.

Jim Labo, WA5ZVI, 1700 Mosher Dr., Enid, OK 73701, was KH6FKB in Hawaii for six months before becoming WA5ZVI. He was thrilled at working 45 Novices in 12 states on 15 meters, but his big frustration was being unable to convince many of them that his call was KH6FKB, *not* K6FKB. Jim uses an SBE-34 transceiver on 15 meters, but he is now a VHF man with homebrew or kit gear for 50, 144, 220, and 432 MHz.

Good luck on Field Day. Keep your "News and Views," pictures, and club bulletins coming to P.O. Box 678, Gary, Ind. 46401. *73, Herb, W9EGQ*

SOLID STATE

(*Continued from page 80*)

The TA5371B is a developmental IC consisting of a photosensitive section and a power amplifier on a single monolithic silicon chip assembled in a modified TO-5 package fitted with a transparent window. The light-detector portion includes two photosensitive Darlington pairs connected in parallel, while the amplifier is a direct-coupled multi-stage circuit using seven *npn* transistors, four diodes, and ten fixed resistors.

Depending on external connections, the TA5371B can be used either as an amplifier providing a linear output signal or as a sensitive light-actuated switch with two outputs. One output (terminal 6) supplies power to the load when the photosensitive elements are illuminated, while the other (terminal 2) furnishes current in the absence

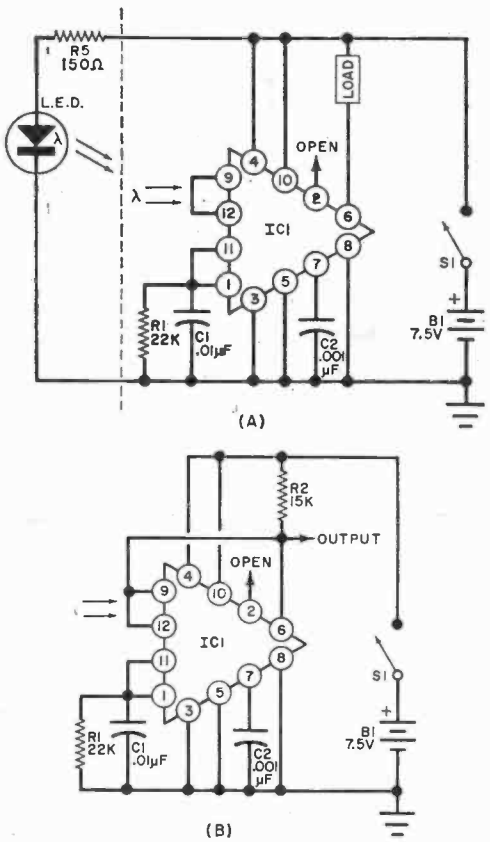


Fig. 3. New RCA TA5371B IC is shown in circuit (A) connected as light-actuated on/off switch. In circuit (B), same IC is used as a linear amplifier.

of light. Designed for operation on a 7.5-volt d.c. power source, the device can furnish up to 100 mA output. Its peak sensitivity is to infrared light at 7250 Angstroms, but it responds to visible light as well.

An on/off switching action is provided by the circuit shown in Fig. 3A. In operation, the load is energized when light strikes the sensitive elements located between pins 9 and 12. A reverse action—load energization in the absence of light—can be obtained by connecting the load to pin 2 with 6 open. A gallium-arsenide light-emitter diode (LED). RCA type 40598A, may be used as the controlling infrared source, and will provide greater sensitivity than an incandescent source.

The linear amplifier arrangement (Fig. 3B) may be used in test equipment or communications applications. In practice, the output signal developed across load resistor *R2* can be coupled to a high-impedance voltmeter, to an output amplifier and speaker system, to an oscilloscope, or to other instrumentation, depending on system requirements.

In both circuits, all resistors are half-watt types and the capacitors low-voltage ceramic or tubular paper units. The switching circuit's load can be a tone source, such as a Mallory Sonalert, or a moderately sensitive 6-volt electromagnetic relay. If a relay is used, however, a small diode should be connected across its coil to absorb the transient pulse voltages generated during switching (anode to pin 6).

While conventional construction and wiring techniques may be used for assembling either of the two circuits, reasonable care in regard to layout and lead dress is necessary to prevent feedback and instability due to the amplifier's inherently high gain. Signal leads must be kept short and direct. RCA, in fact, suggests that the external components (*R1*, *R2*, *C1*, *C2*, etc.) be connected directly to the appropriate IC terminals.

Device News. Motorola Semiconductor Products Inc. (P.O. Box 10912, Phoenix, AZ 85036) has announced the production of an integrated circuit UFH duplexer. Identified as type MCH5890, the unit is essentially a solid-state s.p.d.t. switch designed to operate at frequencies between 400 and 500 MHz with inputs of up to 40 watts.

Although primarily a transmit/receive switch, the new device also can be used as a monitor network in a transmitter, as a sampling unit in an a.f.c. or a.g.c. circuit, or in similar communications applications. With a typical 0.1-dB transmit-mode insertion loss and 25-dB transmit-mode isolation figure, the MCH5890 is supplied in a

SOLID STATE

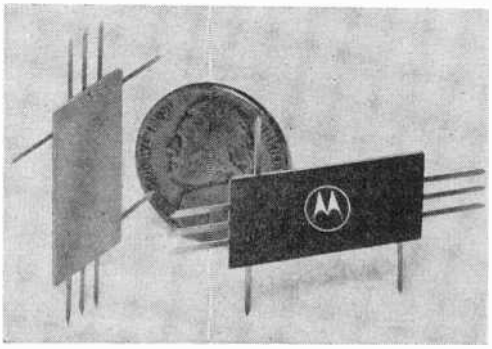
(*Continued from page* 89)

thin plastic-ceramic package measuring ½" by 1" overall.

An interesting solid-state "relay" has been developed by Ebeko of Urloffen, West Germany. Featuring an integral four-transistor direct-coupled amplifier, the unit employs a conventional electromagnetic input coil. Instead of operating a mechanical armature, however, the coil acts to control the resistance of a Hall-effect indium-antimonide element. The Hall-effect resistor, in turn, adjusts the amplifier's bias to provide output switching, with one driver transistor used as the normally off and another as the normally on contact. Suitable for use in d.c. as well as pulsed a.c. circuits, the new relay has the advantages of virtually unlimited life, fast, bounceless, arcless operation, and excellent input/output isolation.

Field-effect transistors capable of handling 10 to 12 watts at 2 GHz have been developed by Siliconix, Inc. (1140 W. Evelyn Ave., Sunnyvale, CA 94086) as the first products in a planned line of microwave semiconductor devices. Future products will include additional special purpose FET's and bipolar devices as well as both multiplier and tuning varactors.

A line of "Magnistors" at prices within the reach of the serious experimenter is being offered by the Hudson Corp. (Box 867, Manchester, NH 03105). A Magnistor is a silicon planar transistor which has two collectors and a single emitter, with its construction so arranged that an external magnetic field gives a lateral motion to the charge flow from the emitter, causing a differential change in the relative collector currents. Used as magnetic sensors, these devices can be employed in test and control applications. Unit prices range from $3.50 for the HM 111 B to $5.00 for the HM 111 G, although there is a minimum order requirement of $30.



The Motorola MCH5890 is a UHF duplexer integrated circuit for the frequencies from 400 to 500 MHz.

Transitips. Engineer Bob Botos of Motorola Semiconductor Products Inc., has passed along some very worthwhile tips for anyone concerned with minimizing feedback and oscillation problems when working with linear integrated circuits. He points out that linear monolithic IC's, even if specified for audio applications, are potential r.f. amplifiers and, therefore, must be treated with respect and care.

Good r.f. breadboard techniques must be observed, with both signal carrying and power supply leads kept short and direct to minimize distributed inductances and feedback capacities. In addition, bypass and frequency compensation capacitors, where used, should be connected directly to the device's leads (or socket terminals). Naturally, ground loops must be avoided.

According to Bob, improper breadboard techniques can result not only in frustration but in a tendency to blame the IC's manufacturer for producing poor-quality merchandise. —*Lou*

SHORT-WAVE LISTENING

(*Continued from page 78*)

SHORT-WAVE CONTRIBUTORS

Bill Jarvis *(WPE1GEP)*, Wakefield, Mass.
Richard Pendleton *(WPE1HMV)*, E. Braintree, Mass.
Bob Raymond *(WPE1HOE)*, Bradford, Mass.
Joseph Smith, Jr. *(WPE1HRA)*, Saugus, Mass.
Rick Mills *(WPE1HSA)*, Berwick, Maine
Andy Emars *(WPE1HVQ)*, Willimantic, Conn.
Bill Feidt *(WPE2AM)*, Lanham, Md.
John Banta *(WPE2PHU)*, Bay Shore, N. Y.
Bob Arnold *(WPE2QPR)*, Canastota, N. Y.
Paul Wolcott, Jr. *(WPE2QVL)*, Linwood, N. J.
T. R. Dieber *(WPE2QVT)*, Summit, N. J.
Bradley Krohn *(WPE2REA)*, Amherst, N. Y.
John Brandt *(WPE2REL)*, Brooklyn, N. Y.
Bennett Pine *(WPE2REK)*, Brooklyn, N. Y.
Michael Fallarino *(WPE2RFC)*, Catskill, N. Y.
Neil Berman *(WPE2RGC)*, Brooklyn, N. Y.
George Sprout *(WPE3GMW)*, Reading, Pa.
Larry Gilboy *(WPE3HVL)*, Pittston, Pa.
Bill Martin *(WPE3HZI)*, Wilmington, Del.
Fred Heutte *(WPE3IBI)*, Brookland, Md.
Grady Ferguson *(WPE4BC)*, Charlotte, N. C.
John Carson *(WPE4IZB)*, Durham, N. C.
Bruce Roberts *(WPE4KAH)*, Waynesboro, Va.
M. F. Dressler *(WPE4KHJ)*, Jacksonville, Fla.
Guy Fisher *(WPE4KIK)*, Cape Coral, Fla.
Sam Fulp *(WPE4KIM)*, Lexington, N. C.
John Leger *(WPE4KKK)*, Louisville, Ky.
Alan Parker *(WPE5FFF)*, New Orleans, La.
John Wheeler *(WPE5FFS)*, San Angelo, Texas
Charles Bennett *(WPE5SIW)*, Sumrall, Miss.
Walter Schivo *(WPE6AFN)*, San Francisco, Calif.
Jim Young *(WPE6ENA)*, Wrightwood, Calif.
Wallace Glavich *(WPE6EPX)*, Eureka, Calif.
Richard Loustau *(WPE6HPS)*, Woodland Hills, Calif.
Robert Hymes *(WPE6HRW)*, Palo Alto, Calif.
David Williams *(WPE7CWW)*, Astoria, Ore.
Anthony Marks *(WPE7CYO)*, La Grande, Ore.
Wayne Benkinney *(WPE8EEI)*, Flint, Mich.
R. D. Bolling *(WPE8EJX)*, APO (Qui Nhon, Vietnam)
George Smith *(WPE8KJJ)*, Grand Rapids, Mich.
Tom Kennedy *(WPE8KKE)*, Battle Creek, Mich.
Bruce Call *(WPE8KKR)*, Akron, Ohio
Bob Smith *(WPE8KKY)*, Grand Rapids, Mich.
Bill Brown *(WPE8KNI)*, Corunna, Mich.
Ben Mancine *(WPE8KNJ)*, S. Euclid, Ohio
Gerry Dexter *(WPE9HDB)*, Lake Geneva, Wisc.
Robert Zilmer *(WPE9IJV)*, Milwaukee, Wisc.
Jim Siers *(WPE9INS)*, Franklin Park, Ill.
Jerry Reichman *(WPE9IPG)*, Chicago, Ill.
John Hedstrom *(WPE9ITQ)*, Wheaton, Ill.
David Speegle *(WPE9IUH)*, Plymouth, Ind.
Mike Rogers *(WPE9IWC)*, Glencoe, Ill.
Robert French *(WPE9IXA)*, Fort Wayne, Ind.
Robert Mackey *(WPE9IXS)*, Rockford, Ill.
Arthur Nelson *(WPE9IYG)*, Rockford, Ill.
A. R. Niblack *(WPE9KM)*, Vincennes, Ind.
John Beaver *(WPEØAE)*, Pueblo, Colo.
Gary Lovegren *(WPEØFAN)*, St. Paul, Minn.
Art Burke *(WPEØFOJ)*, Topeka, Kan.
Carl Larson *(WPEØGA)*, Mount Ayr, Iowa
Jack Perolo *(PY2PE1C)*, Sao Paulo, Brazil
Mark Paull *(VE2PE1OG)*, Chomedey, Que.
Jeff Wilson *(VE3PE2NL)*, Sarnia, Ont.
Paul Cau *(VE3PE2OZ)*, St. Catharines, Ont.
Anthony D'Agostine *(VE3PE2SD)*, Hamilton, Ont.
Leo Cellini *(VE3PE2SK)*, Hamilton, Ont.
Ken Asmus *(VE4PE7W)*, Winnipeg, Man.
Les Hughes *(VE7PE1EH)*, S. Burnaby, B. C.
Shawn Daniels, St. Louis, Mo.
Homer Fort, Midland, Texas
Bruno Haineault, Montreal, Que.
Harold Honnold, Modesto, Calif.
Jon Jayroe, Baltimore, Md.
Kirk Kolpitcke, Wausau, Wisc.
Capt. P. Lefevre, Carcavelos, Portugal
Cass Lewart, Holmdel, N. J.
William Milus, Plymouth Meeting, Pa.
Garry Murch, Tewksbury, Mass.
Jim Sight, Kansas City, Mo.
Robert Tomaine, Jermyn, Pa.
Dan Tschopp, Humble, Texas

(*Continued on page 92*)

SHORT-WAVE LISTENING

(*Continued from page* 91)

on 9645 kHz at 2055-2105 and around 0055 on 6175 and 11,725 kHz. Numerous reports received within the past few days also list 9615, 9690 and 15.285 kHz as having English church news during that 0050 xmsn.

Vietnam (North)—*V. of Vietnam*, Hanoi, now runs an English time slot on 10.042 kHz at 2300-2330 for American Forces in South Vietnam with usual slanted propaganda, some old American pop records and the voice of "Hanoi Hattie".

Clandestine—*Radio Nordsee International* is being reported on 6210 kHz at 2120-2300 with rock music and anmt's in English and German.

DX COUNTRY AWARDS PRESENTED

To be eligible for one of the DX Countries Awards designed for WPE Monitor Certificate holders, you must have verified stations in 25, 50, 75, 100, 125, or 150 different countries. ("Letters of Certification" will be issued to those who have over 150 countries verified in steps of 10.) The following DX'ers recently received their awards for 25 countries.

25 COUNTRIES VERIFIED

Howard Rosenberg (WPE2PQE), Queens Village, N. Y.
Lewis West, Jr. (WPE4JYL), Charlotte, N. C.
David Perry (WPE2QFK), Pleasant Valley, N. Y.
Dennis Davenport (WPE9JLT), Edwardsville, Ill.
Edward Sue (WPE1HMA), Brookline, Mass.
John Ward (WPE1HJH), Springfield, Mass.
Horace Steinhaeusser (VE3PE2JO), Kenora, Ont.
Jack Dashper (WPE4KCJ), Camden, Tenn.
E. F. P. Lloyd (VE7PE1ED), N. Vancouver, B. C.
David Galletly (WPE2QHG), Sound Beach, N. Y.
T. R. Wieber (WPE2QVT), Summit, N. J.
Richard Moore (VE3PE2NZ), London, Ont.
Michael Dopson (WPE4KCF), Enterprise, Ala.
Steve Swift (WPE7CVV), Olympia, Wash.
Barry Lavine (WPE2QHM), Elmira, N. Y.
James Ziegler (WPE9JOW), Milwaukee, Wisc.
Robert Olszewski (WPE8KFW), Toledo, Ohio
Loren Davis (WPE6HMA), Hayward, Calif.
Fred Parkinson (WPE2QTW), Hewlett, N. Y.
Charles Loftis (WPE4KEF), Landrum, S. C.
John Burda, Jr. (WPE8KAO), Willard, Ohio
Joseph Cooper (WPE9JRT), Milwaukee, Wisc.
David Yoder (WPEØEZU), Denton, Kansas
Everett Slosman (WPE2QZB), Endicott, N. Y.
Craig Seufert (WPE1HNS), Newtown, Conn.
Gregory Martin (WPE8KFL), Wyoming, Mich.
Walter Robison (WPE2RAK), Bellmawr, N. J.
Daniel Laurier (WPE2QHP), Walton, N. Y.
Glenn Tamasi (VE7PE1DY), Vernon, B. C.
Ron Taylor (WPE9JSA), Benton, Ill.
Richard Lewis (WPE5BST), Blackfoot, Idaho
David Lubar (WPE9JFD), Elmwood, Ill.
Donald Asp (WPE6HGY), Tustin, Calif.
Willie Martin (WPE5FBJ), Blytheville Air Force Base, Ark.
Thomas Gongaware (WPE5HWU), Latrobe, Pa.
Joel Bahl (WPE9JFY), Worth, Ill.
Charles Albertson (WPE7CWI), Spokane, Wash.
Clayton Ruth (WPE9JGY), Munster, Ind.
Michael Schackner (WPE1HSJ), Pawcatuck, Conn.
John Limbach (WPE4KCV), Fayetteville, N. C.
David Winfree (WPE4KBA), Jupiter, Fla.
Curtis Philips (WPE3HNS), Hellertown, Pa.
James Maker (WPE4HB), Tampa, Fla.
David Weinberger (WPE3HVV), Philadelphia, Pa.
Mrs. Mildred Marshall (WPEØFIR), Devils Lake, N. D.
Robert Byers (VE3PE2PX), Gananoque, Ont.
Ronald Richmond (WPE9JIH), Alexandria, Ind.
Alan Macnaughton (VE3PE2PP), Kitchener, Ont.
Warren Flack (WPE4KEL), Atlanta, Ga.
Stanley Starks (WPE8KDR), Midland, Mich.
Thomas Blossom (WPE9FHQ), Fort Wayne, Ind.
Kim Stenson (WPE1HPU), Wilmington, Vt.
John Adams (WPE3HXT), Beltsville, Md.
Dennis Sheppard (WPE4JTH), Stone Mountain, Ga.
Dimitur Alipiev (WPE2QXL), Syracuse, N. Y.
Mitchell Kassoff (WPE2QTK), Little Neck, N. Y.
Ivan Waufle (WPE2QVD), St. Johnsville, N. Y.
Gary Marks (WPE2QZK), Tonawanda, N. Y.
James Jankowski (WPE2QVE), Corfu, N. Y.
Timothy Gjenvick (WPE9ILO), Brookfield, Wisc.
Charles Clay (WPE2QWE), Climax, N. Y.
Anthony Baleno (WPE3HWY), Verona, Pa.
Bruce McCoy (WPE9JMY), La Porte, Ind.
Keith Fritzinger (WPE3HSW), Shillington, Pa.
Brian Heller (WPE2QVP), Lawrenceville, N. J.
Michael Garrett (WPE8KBA), Grosse Pointe Park, Mich.
Joseph Perge (WPE8JKD), Newark, Ohio
Lawrence Plummer (WPE7CRV), Bellevue, Wash.
Thomas Porzio (WPE2PXI), Butley, N. J.
Randy Curtis (WPEØFKE), Omaha, Nebr.
Ken Piper (WPE6GVB), Stockton, Calif.
James Hurst (WPE3HWP), Vienna, Md.
Dave Denbow (WPE6HJT), Claremont, Calif.
Ronald Del Buono (WPE2PYJ), Union City, N. J.
Steve Smith (WPE5FAU), El Dorado, Ark.
Ronald Nawrot (WPE3HUO), Owings Mills, Md.
Tom Frisz (WPE9JRU), South Bend, Ind.
Christopher Martin (WPE1HRG), Naugatuck, Conn.
George Shadwell (VE3PE2QZ), Ottawa, Ont.
Robert Rattner (WPE2RBL), Forest Hills, N. Y.

Edes Matsukado (KH6PE3Z), Honolulu, Hawaii
Robert Frieden (WPE4KIA), Norfolk, Va.
Thomas Phillips (WPE1HQE), Rutland, Vt.
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Joseph Williams (WPE9JKD), Milwaukee, Wisc.
Tom Felton (VE7PE1EA), Vancouver, B. C.
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William McGraw (WPE3HRM), Burgettstown, Pa.
Joseph Molon (WPE1HSC), Torrington, Conn.
Frank Swanberg III (WPE9JVD), Dolton, Ill.
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Bill Potorti (WPE2QYH), Ithaca, N. Y.
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Matthew Shifman (WPE2RAZ), E. Brunswick, N. J.
Alan Carpenter (WPE8JXS), Fairmont, W. Va.
Donald Appling (WPE7CNG), Spokane, Wash.
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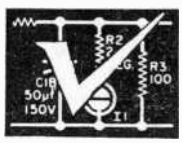
Andrew Finick, Jr. (WPE9JPF), Highland, Ind.
Mark Androw (WPE9JUZ), Lincolnwood, Ill.



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.

Crosley Model 51 Receiver. Schematic and tubes needed. (John Von Dollen, 820 Ambrose Dr., Salinas, CA 93901)

National NC-183D receiver. Operating manual needed. (A. G. Barry, 538 E. Samford Ave., Auburn, AL 36830)

MusiCraft Model MS 30-30 stereo basic amplifier. Schematic needed. (Wm. Jachim, 8338 Baker Ave., Chicago, IL 60617)

Scott Marine Radio Model SLRM receiver. Schematic needed. (Joseph Talley, 163 Charles Circle, Seaford, VA 23428)

Montgomery Ward Model 62-297 "Airline" receiver. Schematic needed. **Heathkit** Model 0-9 oscilloscope. Schematic and calibration info needed. (Peter Rebuzzini, 78 Tanners Marsh Rd., Guilford, CT 06437)

RCA Model RC-6108 AM-FM radio, circa '34. Schematic and operation manual needed. (Eric Urscher, 620 10th Ave., Huntington, WV 25701)

Triumph Model 841 oscillograph. Instruction book and schematic needed. (Leo Bellarts, 1920 State St., Everett, WA 98201)

Norelco Model EL 3541/54B tape recorder. Instruction manual needed. (Donald Rubin, 3919 Bancroft Rd., Baltimore, MD 21215)

Motorola Model LO3-F3 FM receiver. Manual needed. (R. Bell, 20146 Beachcliff, Rocky River, OH 44116)

Realtone Model VT-2466 TV. Operating manual and schematic needed. (Bruce Friedman, 21 Stuyvesant Oval, New York, NY 10009)

Atwater Kent Model 60. Speaker needed. **Philco** radio chassis type 89 (or 19 series). Schematic needed. (Delmar Pond, 11 Stevens Court, Exeter, NH 03833)

Precision Apparatus Model 920 tube and set tester. Instruction manual and schematics needed. (Mike Morrow, 506 Manchester Dr., Chattanooga, TN 37415)

Lysco Model 600 CW transmitter. Schematic and parts list needed. (Stephen Smith, 2011 Broad St., New Castle, IN 47362)

Revere Model T-100 tape recorder. Schematic needed. (George Dewey, 512 N. Shore Dr., Crystal Lake, IL 60014)

Precise Model 300 oscilloscope. Schematic needed. (R. Arguin, 8595 Blvd., Levesque, Laval, P.Q. Canada)

Motorola Model KM 202R vibrasonic. Schematic needed. (Cris Holmes, 1723 Orchard, Fresno, CA 93703)

Kadette Model 36 by International Radio Corp. Schematic needed. (Terry Shotts, 18009 Marden Ln., Sandy Spring, MD 20860)

Brunswick Model 5KR. Schematic and 1-UX71A, 2-UX226 tubes needed. (Larry Fahr, 1103 Hampton Circle, Elmira, NY 14904)

Dynatron Radio Model 1000 monitor oscilloscope, manufactured in 1949. Schematic needed. (T. Felton, 3697 W. 15th Ave., Vancouver 8, B.C. Canada)

Zenith Model 55119 shortwave receiver. Source for parts needed. (Bob Patton, 2S00 Elm, Parsons, KS 67357)

Globe Scout Model 680 transmitter. Schematic and instruction manual needed. (Ken Countess, 110 Sycamore Circle, Stony Brook, NY 11790)

Hallicrafters Model S-76. Alignment data and operating manual needed. (John Davis, 2607 Colgate Ln., Lake Worth, FL 33460)

Heathkit AR-2 receiver **Setchell Carlson** Model 416 radio-intercom. Schematics needed. (John Moran, 605 N. Maple Ave., Cookeville, TN 38501)

E. H. Scott Model 800 5761 console receiver. Schematic and operating manual needed. (S. Petrie, 1925 Newell Ave., Walnut Creek, CA 94598)

RCA Model T4-8 receiver. Schematic, manual and source of tubes needed. (Gary Lueck, 692 4th Ave., Newport, MN 55055)

Eico Model 315 signal generator kit. Manual, operating instructions and schematic needed. **Sentinel (RCA)** Model 1U622C TV receiver. Schematic, alignment data needed. (Dan Houser, 3393 Greenwich Rd., Norton, OH 44203)

Satellite FM receiver (channel A) to match FM-10T transmitter. Schematic needed. (Bruce Weinel, Box 691, 5115 Margaret Morrison St., Pittsburgh, PA 15213)

Temco Model RA-150 amateur transmitter. Schematic, operating manual, and source for plug in coils needed. (Stephen Farkaly, 2653 S. St. Louis Ave., Chicago, IL 60623)

POPULAR ELECTRONICS READER SERVICE PAGE

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ABOUT YOUR SUBSCRIPTION

Your subscription to POPULAR ELECTRONICS is maintained on one of the world's most modern, efficient computer systems, and if you're like 99% of our subscribers, you'll never have any reason to complain about your subscription service.

We have found that when complaints do arise, the majority of them occur because people have written their names or addresses differently at different times. For example, if your subscription were listed under "William Jones, Cedar Lane, Middletown, Arizona," and you were to renew it as "Bill Jones, Cedar Lane, Middletown, Arizona," our computer would think that two separate subscriptions were involved, and it would start sending you two copies of POPULAR ELECTRONICS each month. Other examples of combinations of names that would confuse the computer would include: John Henry Smith and Henry Smith; and Mrs. Joseph Jones and Mary Jones. Minor differences in addresses can also lead to difficulties. For example, to the computer, 100 Second St. is not the same as 100 2nd St.

So, please, when you write us about your subscription, be sure to enclose the mailing label from the cover of the magazine—or else copy your name and address exactly as they appear on the mailing label. This will greatly reduce any chance of error, and we will be able to service your request much more quickly.

VECTOR-CIRCUIT QUIZ ANSWERS

(Quiz appears on page 30)

1-B In a series circuit containing only resistance, the current is in phase with the applied voltage.

2-F In a parallel circuit, there are three currents and a single voltage, which is used as the reference vector (directed horizontally to the right). The current in an inductor lags the voltage across the inductor by 90 degrees. The current into a capacitor leads the voltage across the capacitor by 90 degrees. The total circuit current is the difference between the branch currents.

3-J The current is used as the reference vector. The voltage drops across the capacitor and resistor add vectorially to equal the applied voltage.

4-H The applied voltage is the reference vector. The current in the circuit lags the voltage by 90 degrees.

5-G The applied voltage is the reference vector. The two branch currents add vectorially to equal the circuit current.

6-A The current is used as the reference vector. The voltage drops across the resistor and inductor add vectorially to equal the applied voltage.

7-I The current is the reference vector. The voltage drops across the inductor and capacitor are 180 degrees out of phase, and the difference between them is equal to the applied voltage.

8-E The applied voltage is the reference. The leading currents in each branch are in phase and add to equal total circuit current.

9-D The applied voltage is the reference. The two branch currents add vectorially to equal total circuit current.

10-C The applied voltage is the reference. The current in the inductor leads the applied voltage by 90 degrees.

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 95.

A new leaflet, Form No. 7260, recently issued by *Nortronics Co., Inc.*, is written to show the owner of a tape recorder how to determine whether or not his tape head is worn enough to warrant replacement. The leaflet describes the company's "Look-Touch-Listen" test, which gives the visible, aural, and tactile indicators on tape head wear. Worn heads, or heads where the gap has widened, tend to lose their effectiveness in reproducing high frequency sound clarity; worst of all, the deterioration takes place so gradually that the listener is usually unconscious of the change. In view of this, the leaflet recommends periodic head examination even if there is no active dissatisfaction with the performance of the tape recorder.

Circle No. 75 on Reader Service Page 15 or 95

A new company, *Antenna Corporation of America,* is offering to distributors a complete line of TV and FM receiving antennas that are suitable for color and monochrome TV. The antenna line will be marketed under the name "Citation." The VHF-UHF-FM antennas include a number of features, such as tetrapole collector elements, dual-action director/reflector screen, and die-cut impedance collators. Also being offered are electronic accessories, including set couplers, solid-state preamplifiers, booster couplers, and matching transformers. A complete-line brochure is available from ACA.

Circle No. 76 on Reader Service Page 15 or 95

An easy-reference brochure featuring the company's entire line of home entertainment products is available from *Koss Electronics, Inc.*, manufacturer of stereo headphones and accessories. The catalog, P/N11-1351, lists and describes Koss' exclusive electrostatic line of three stereo headphones and six dynamic models. Included also is a listing of accessories, encompassing remote control stations, connector box, monitoring adapter, extension cables and cords, and a high-impact plastic stereophone carrying case with sponge liner.

Circle No. 77 on Reader Service Page 15 or 95

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ing and logic circuits, etc. And each circuit illustrated is complete, accompanied by at least one schematic diagram and parts list.

Published by TAB Books, Blue Ridge Summit, PA 17214. Hard cover. 384 pages. $17.95.

BIOLOGICAL ENGINEERING

edited by Herman P. Schwan

With the emergence of biological engineering programs both here and abroad, the need for a comprehensive textbook in this area has become great. Fortunately, this need is now met by this compilation of recent outstanding contributions to bioengineering by eminent authorities in the field. Some of the contributions include hemodynamics, electrocardiography, absorption of ultrasound data, biological control mechanisms, and mathematical models of excitation and propagation in nerves. Throughout the book, the emphasis is on fundamentals.

Published by McGraw-Hill Book Co., 330 West 42 St., New York, NY 10036. Hard cover. 556 pages. $18.50.

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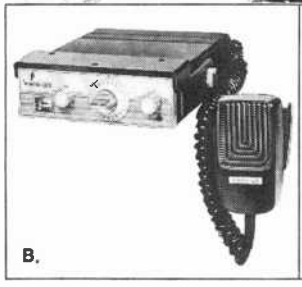

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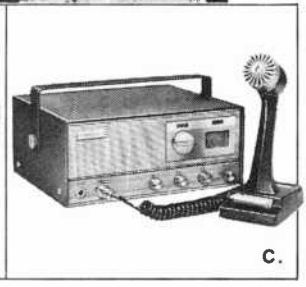

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