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September, 1959

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If you're confused about the new four-track stereo tape systems, you'll want to read "Stereo Tape Is Back—To Stay." A complete report on the tape cartridge and four-track reel-to-reel systems, it also shows how they stack up against stereo records.

Ever consider joining a record club? If so, you'll be interested in an article which tells exactly how they operate, and points out their pro's and con's. Look for "The Low-Down on Record Clubs."
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STORY OF A STORY. The big problem in putting together any article is to organize the individual bits of information into an overall picture. For example, in the preparation of this issue's color TV article, so much information was accumulated that when it came time to put the story together, the raw material would have filled a good-sized book. Some of the areas researched included: color TV picture quality and circuitry, the history of color TV, the economic factors complicating its growth, consumer and service technician reaction, new types of color systems in development, and more.

Due to space considerations, it was impossible to include everything. But the problem of deciding what to put in and what to leave out presented an interesting challenge. How well this challenge was met you can determine by reading our 'Special Report on Color TV Today' which begins on page 41.

READER MAIL. One of the best ways in which we can keep our fingers on the pulse of our readers' interests is through a careful reading of the letters which come in to our office every day—in almost fantastic quantity. If you have written in either to commend us or criticize us, we greatly appreciate your comments. Be assured that the points made by our readers are carefully considered and discussed at our editorial meetings.

Unfortunately, due to the sheer volume of mail, we are not always able to answer each letter individually. If you have written to make some suggestion and haven't received a direct answer, please try to understand our problem. One thing for sure, your letters are a tremendous help in planning future issues; so keep them coming!

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Letters from our readers

"Nifty Novice"

- I built the "Nifty Novice" 15-meter transmitter described in the April 1959 issue, and have found it to be trouble-free and without the "chirp" which plagues other low-priced kits. My buddy, Bill Loveless, W7OWQ/5, made the following con-

- tacts with the transmitter loading a dipole anten-
na: El Paso, Texas; Detroit, Mich., KNSOCCO.
RST 579; Chicago, Ill., KN9RP, RST 589; Somerhill, Mass., KN1JOV, RST 479.

I have passed my Novice exam and have been waiting 51 days so far for my ticket. I am very pleased with the "Nifty Novice" transmitter, as it will load anything including a 12" coax cable.

JOE GABUS
El Paso, Texas

- I wish to call your attention to an error on page 149 of your April 1959 issue which describes a 21-mc. antenna. According to your pictorial, the over-all dimensions of the antenna are 10' 11". This should be 10' 11" for each leg, or 21' 10" over-all. Anyone who uses the original dimensions will have heap big headache.

M. J. BILLINGS, D.D.S., W2BJV
Brooklyn, N. Y.

You're right, Dr. Billings. We hope they don't write to us for aspirins.

VTVM User

- I want to take this opportunity to express my appreciation to you and your staff for the interesting and helpful articles in the March issue. The one that helped me in particular was the article by Larry Klein on "Radio Repair with the VOM." It just so happened that I purchased an RCA WV77 Junior Voltomhyt (kit form) and was trouble-shooting an a.c.-d.c. "All-American Five" receiver when your article appeared. Although

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Letters

(Continued from page 10)

the instructions accompanying this kit were helpful with respect to putting the VTM in operation and calibrating it; they were not complete in "how-to-use-it" data. Just when I needed it most, along came this article with a step-by-step troubleshooting method, and now the a.c.-d.c. set really blasts out with the music.

ALBERT C. BALKEMA, KN4ZFU
Maxwell Air Force Base, Ala.

Sound Level Meter Change

After building the transistorized sound level meter described in your April issue, I found that it became much more sensitive with transformer T1 wired with the red lead going to the mike and the yellow going to the capacitor. Could it be that there was a mistake in the diagram?

GEORGE TILICH
Los Angeles, Calif.

You're right, we're wrong. The color coding indicated in the schematic is incorrect. The red transformer lead is the input and the yellow one is the output.

Praise from Afar

Just a note to tell you that you have loyal readers in far-off Cambodia. Here, Americans and Cambodians alike peruse each issue of Popular Electronics with great interest.

I thought you might be interested in seeing a picture of Josephine, our pet elephant. Josephine belongs to Mr. Basil D.D. McIntyre, who brought her here half dead at the age of three months and has nursed her back to health. She is now the fattest little girl elephant in all of Indo-China. The picture shows Josephine giving a kiss to one of her close friends.

Keep up the good work in your magazine and best regards to our friends back in the States.

RALPH NAVARRO
Phnom Penh, Cambodia

"Police Special" Correction

In looking over the article "Police Special Receiver" in the July ’59 issue of Popular Electronics, I noted something confusing in the parts designations. The pictorial diagram of the sub-

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September, 1959

13
chassis indicates that L1 should be connected to (B) of TB1. According to the schematic diagram, L2—not L1—is connected to TB1.

DANIEL MERSEL
Frenchtown, N. J.

In the pictorial diagram on page 51, change coil L1 to read L2, and coil L2 to read L1. Also, on the pictorial diagram on page 53, the wiring instructions of TB1 (B) should be changed to read "To center tap L2." Potentiometer R5 and capacitor C8 can have the values shown in the parts list or in the schematic diagram.

Crystals for Citizens Band

Your article entitled "Build a Citizens Band Transceiver" in the June issue specified an International Crystal FO-150 in the transmitter parts list. This unit has a frequency tolerance of 0.1%—not within the .005% required for CB equipment. Only the Model FO-200 meets the requirement. You may want to bring this fact to the attention of your readers to prevent them from violating the FCC rules.

THOMAS J. MADDEN
Des Plaines, Ill.

Make a Mike Mixer

The story called "Maze of Mikes" in your July issue answered some of the questions I have had concerning the possibility of putting our little theatre productions on audio tape. However, I now find that I need a schematic for an audio console which will handle eight to ten mikes. Could you possibly publish one or advise me where one may be obtained?

B. E. JOLLEY
West Hartford, Conn.

Our March '59 issue carried plans for building a multiple-input mike mixer. See "One-Transistor Microphone Mixer" by I.J. Cohen.

DX Anyone?

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That's High Enough

The frequency range of the square-wave generator described in your March '58 issue was described as being from 100 to 2000 cps. Would it be possible to extend the range to 15,000 cps?

C. R. HINDLE
Baltimore, Md.

This particular generator does not produce useful output much above 4000 cps. However, the square-wave generator in our June '59 issue ("Q-Square Transistor Generator") offers outputs at 100, 1000 and 10,000 cps.

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Street: ____________________________ Zone: ______ State: ______
City: ____________________________

CHECK: ☐ Home Study ☐ Residence School ☐ Korean Veteran

To obtain fast, immediate service and to avoid delay, it is necessary that the following information be filled in:

EMPLOYED BY: ____________________________
TYPE OF PRESENT WORK: ____________________________
EDUCATION: YEARS HIGH SCHOOL: ____________
OTHER: ____________________________
ELECTRONICS EXPERIENCE: ____________________________
"SERVICING HI-FI—VOLUME 3 (AM-FM TUNERS)," published by Howard W. Sams & Co., Inc., 2201 E. 46th St., Indianapolis 6, Ind. 160 pages. Soft cover. $2.95.

Volume 3 of this series contains an editorial section titled "Highlights on FM," which covers the FM signal, a.f.c. circuits in FM receivers, and alignment techniques using a sweep generator. A second section provides complete photofact service data on 18 selected models of 1957-58 AM-FM tuners.


This basic radio primer has been revised and brought up to date to include recent developments in the field. The subject matter falls into three general categories: electronic theory, radio transmitters, and radio receivers. At the end of each of the 42 chapters is a summary of the chapter, a glossary of new terms, and problems for self-testing. This book is recommended as a text for beginners in electronics and as a reference source for the advanced student or technician.

"CONCISE DICTIONARY OF SCIENCE" by Frank Gaynor. Published by Philosophical Library, 15 East 40th St., New York 16, N.Y. 546 pages. $10.00.

Here is an up-to-date dictionary which provides concise definitions of terms and concepts pertaining to the many branches of the scientific field. The author, well known as a contributor to the Encyclopedia Britannica, has included the newer sciences (Continued on page 20)
Do you WISH you were EMPLOYED in ELECTRONICS?

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Write for the 1960 ALLIED Catalog featuring the complete KNIGHT-KIT line—see the big news in electronic kits—get this leading Buying Guide for everything in Electronics. Send for your FREE copy.
Bookshelf  (Continued from page 16)
such as virology, enzymology, cylogenics, radio-chemistry, etc. This should be a useful reference tool for those who are interested in modern-day science.

"EXPERIMENTAL MUSIC" by Hiller and Isaacson. Published by McGraw-Hill Book Co., 330 West 42nd St., New York 36, N. Y. 196 pages. $6.00.
This is the "first book dealing with the application of scientific method to musical composition." It explains techniques used to produce music by means of electronic computers. It is not a "light" or popular treatment of the subject, but rather a scholarly exposition of the problems involved. Written by a musician and a mathematician, the book is authoritative; however, its contents can be understood fully only by a person with a solid background in both music and mathematics. If you qualify, you should find it very interesting and a worthwhile addition to your library.

"ELECTRONIC CIRCUIT THEORY" by Zimmerman and Mason. Published by John Wiley and Sons, 440 Fourth Ave., New York 16, N. Y. 564 pages. $10.75.
An excellent guide to the understanding of the theory of circuit design, this book is very comprehensive in its scope and is generously illustrated. Since it relies heavily on mathematical equations, including calculus, it is recommended only to the engineer or the engineering student.

"THE SOUND OF HIGH FIDELITY" by Jordan and Cunningham. Published by the Windsor Press, 200 East Ontario St., Chicago 11, Ill. 208 pages. $3.95.
Of all the many books that have been published about high fidelity, this is one of the very best. It is interestingly and authoritatively written, attractively designed, and surprisingly comprehensive in view of its necessarily limited size. Included are clear explanations of almost every facet of hi-fi. It is an especially good choice for the beginner because it also includes clear and concise explanations of the principles of...
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Bookshelf (Continued from page 20)

basic electronics that underlie top-grade hi-fi performance. This book is very highly recommended both to the neophyte and the expert.

"SERVICING TRANSISTOR RADIOS: Vol. 3" published by Howard W. Sams and Co., Inc., 2201 East 46th St., Indianapolis 6, Ind. 160 pages. Soft cover. $2.95.

An informative volume on the repair of transistor radios, this book covers the late models of 23 manufacturers. Use of the well-known "Photofact" technique—photographs, schematics, parts lists and alignment instructions—makes the presentation crystal-clear. Included is a brief but helpful section on transistor circuit theory. Highly recommended.

Free Literature Roundup

Two new catalogs are available from Electro-Voice, Inc., Buchanan, Mich. Catalog 134 is a colorful and attractive 26-page guide to hi-fi equipment; it also contains an introduction to stereophonic sound and illustrates proper placement of stereo speaker systems. Catalogue 120A is a descriptive guide to E-V professional microphones and contains photographs, response curves, polar patterns, wiring diagrams, and other specifications for the complete E-V microphone line.

An entire series of science materials for use in teaching science to the younger set is described in an attractive 36-page catalog available from Science Materials Center, 59 Fourth Ave., Dept. M-4, New York 3, N. Y. The educational and instructional material covers such fields as electronics, electricity, physics, mechanics, engineering, radiation detection, and others.

"Facts About Storage Batteries" is the title of an interesting and informative 32-page booklet published by Exide Automotive Division, P. O. Box 6266, Cleveland 1, Ohio. It covers car, tractor and boat batteries, with explanations of how they work and how to get the maximum amount of service from them.

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Amazing Little Machine With Spinning Wheels and Trip Mechanism Adds Up To 9,999,999... Automatically!

Not a flat, rent pocket adder—not a gadget—no bewilferring instructions to follow. Here for the first time is a real cash-register-type desk office adding machine even the most arithmetically inclined are sure to enjoy. It is the only real adding machine with spinning wheels and trip mechanism that anyone can learn to operate in seconds. Its beauty, ease and simplicity reduces general adding to just a few seconds of work. It adds & subtracts figures instantly. A wheels slam to the answer window and the answer is read. No thinking, no addition, no correction—just the answer on the answer window.

Incredible! Yet you can easily see why this unique adding machine was called the World's First Personal Size Desk Adding Machine. It adds and subtracts numbers with ease, accuracy and speed, and you operate it in seconds just by a few simple basic steps. It's so simple even a child can learn to operate it...

NEW MENTAL ADDING—FOREVER!

No more adding figures in your head! No more swaying numbers on paper, making mistakes that cost you time...and make you money. Simply press the answer buttons added in seconds, or just compare your answers with the answer window while you're doing your figuring. Yes, you can learn to operate it in seconds for the first time.

AN INVENTION

An ancient invention in Italy discovered the secret of the fool-proof, fast and accurate adding machine. The answer window and the answer window. It operates on the same principle of adding and subtracting numbers, the answer window and the answer window. It is the only real adding machine with spinning wheels and trip mechanism that anyone can learn to operate in seconds, and in seconds! No adding, no subtracting, no correction—just the answer on the answer window.

FREE TRIAL OFFER

How would you like to try this amazing new adding machine? You can add your name to the long list of customers who have already purchased the ADDIPRESTO machine? You can double your speed and accuracy by adding and subtracting numbers, adding and subtracting numbers. There is no other machine like it. It's the first wheel automatically spins the next wheel on the answer window just like $2000.00 electro-mechanical adding machine! However, the ADDIPRESTO machine has made it possible to add and subtract numbers in no time at all. It operates on the same principle of adding and subtracting numbers, the answer window and the answer window. It is the only real adding machine with spinning wheels and trip mechanism that anyone can learn to operate in seconds, and in seconds! No adding, no subtracting, no correction—just the answer on the answer window.

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products

FM TUNER KIT
Heath's Model FM-4 high-fidelity FM tuner kit features 2.5-microvolt sensitivity, automatic frequency control with defeat switch, and flywheel tuning. In addition to the normal audio output, a multiplex output is provided for use with a multiplex adapter. Ease of construction is assured by prealigned i.f. transformers and a prewired, prealigned tuning unit. $34.95. (Heath Company, Benton Harbor, Mich.)

PROMOTIONAL TAPE OFFER
For the price of two 7" reels of unrecorded Audiotape #1251 plus $1.00, you receive a duo-pack which includes one reel of blank Audiotape plus one 7" reel of "Blood and Thunder Classics." This special stereo tape offer is being made by Audio Devices, Inc., 444 Madison Ave., New York 22, N. Y. The prerecorded stereo reel includes Tchaikovsky's "Russian Dance" from the Nutcracker Suite, Sibelius' Finlandia, de Falla's "Dance of Terror" and "Ritual Fire Dance" from El Amor Brujo, Katchaturian's "Saber Dance," Stravinski's Fire Bird Suite, and other selections. The stereo program time is 30 minutes. A mono version, with one hour of music, is also available.

CITIZENS BAND TRANSCEIVER
The CD-5 "Citi-fone" five-channel transceiver for operation on the new Class "D" Citizens Band has been announced by Multi-Products Co., 21470 Coolidge Highway, Oak Park 37, Mich. The transmitter section is rated at 5 watts input, is AM-modulated, and comes complete with Always say you saw it in—POPULAR ELECTRONICS
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Oversized platter and bearing assembly

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DEPT. P, 16 ARBOR ST., HARTFORD 1, CONN.

products

(Continued from page 24)

crystals for one channel. Features include a squelch control and noise limiter. A ceramic-type crystal microphone is provided as well as license application Form 505. Price, $124.50.

MAGNETIC STEREO CARTRIDGES

Two additions to the G.E. line of stereo cartridges have been announced recently. The VR-225 is a variable reluctance design with a 0.5-mil diamond stylus for use with professional turntable systems. Frequency response is from 20 to 20,000 cps ±3 db, and channel separation is up to 30 db. Lateral compliance is $4 \times 10^{-4}$ cm/dyne, vertical compliance $2.5 \times 10^{-4}$ cm/dyne. Price, $27.95.

The VR-227 is similar to the VR-225 but has a 0.7-mil diamond stylus and is for use with record changers. Frequency response is from 20 to 17,000 cps ±3 db. Lateral compliance is $3 \times 10^{-4}$ cm/dyne, vertical compliance $2 \times 10^{-4}$ cm/dyne. Price, $24.95. (General Electric Specialty Electronic Components Dept., West Genesee St., Auburn, N. Y.)

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products

(Continued from page 26)

383. Glenbrook Station, Stamford, Conn., is easy to use, reaches into tight spots, and doubles as a pick-up pincers. It cuts steel wire in the smaller gauges and copper up to #12. The "Little Snipper" comes in standard lengths ranging from 2 to 18 inches; most popular are the 4" model at $4.25 and the 6" model at $4.50. For prices on other lengths and further information, write to the manufacturer.

STEREO AMP/PREAMP

Sherwood Electronic Laboratories, Inc., 4300 N. California Ave., Chicago 18, Ill., has announced a 36-watt add-on basic amplifier and stereo preamp to convert monophonic systems to stereo. Among the controls on the S-4400 are a presence-rise switch, phono scratch and rumble filter switch, "center-set" loudness control, tape monitor switch, and an output tube balance control. Control features essential to stereo operation include the dual loudness control, stereo normal/reverse switch, and phase-reversal switch. Frequency response at 36 cps is 20 cps to 20 kc. ± 1 1/2 db. Price, $159.50.

WALL-HUNG FOLDING TABLE

Do-it-yourselfers can now make a convenient wall-hung table that folds flat against the wall when not in use. It can be done in minutes simply by attaching any counter top material to a pair of "Droptop" folding wall brackets. These

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September, 1959
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SONIC CUSTOM-CRAFT S-200 12 watt stereo, master control center and dual amplifiers. 6 watts per channel develops 24 watts of peak power. Frequency response, ± 1.5 db from 30 to 15,000 cps. Total harmonic distortion, less than 2% at full rated output. Stereo or monophonic inputs. Internal audible stereo test signal for channel and speaker balance adjustment. 9 separate front-panel controls. 4, 8 and 16 ohm outputs for single, double, or triple channel operation.

SONIC CUSTOM-CRAFT S-100 low-priced hi-fi 10 watt stereo, master control center, and dual amplifiers. 5 watts per channel develops 20 watts of peak power. 50 to 17,000 cps. Total harmonic distortion at full rated power. Hum and noise, 45 db below maximum rated power. 4 stereo or monophonic inputs. 8 ohm outputs for single or double operation. audiophi le net with enclosure $49.95

SONIC CUSTOM-CRAFT MODEL 19 FM-AM TUNER Super-sensitive tuner features drift-free automatic frequency control performance and 3-gang tuning capacitor for optimum selectivity. Sensitivity: FM 5 µv for 30 db quieting. Total harmonic distortion at rated output, less than 1.5%. Selectivity bandwidth at 6 db point: FM 200 kc, AM 9 kc. Frequency response, FM ± 2 db of standard de-emphasis curve, AM 20 to 9,000 cps. Function switch AM, FM or FM-AFC. audiophile net no cabinet $79.95

MODEL 19C with handsom e genuine mahogany cabinet, audiophile net $99.95

SONIC CUSTOM-CRAFT S-400 (pictured above) Quality combination 40 watt stereo amplifier, master control center, and transistorized preamplifier. 20 watts per channel delivers 80 watts of peak power. Frequency response, flat from 20 to 20,000 cps ± 0.5 db. Less than 1% total harmonic distortion at full rated output. Built-in stereo test signal to adjust channel and speaker balance as well as speaker phasing. Sonic Stereo Monitor, a precision meter shows when both channels are properly balanced. 8 inputs and 9 front panel controls handle any program source. 4, 8, and 16 ohm outputs for single, double or triple channel operation, audiophile net with enclosure $99.95

at your local hi-fi dealer, or write
SONIC INDUSTRIES, INC. 19 Wilbur Street, Lynbrook, N. Y.

products

(Continued from page 28)

brackets come packaged in a kit which contains two of the steel brackets, mounting hardware, and a wrench. Cost, $9.95 per kit, postpaid. (Sturdilite Products, 2501 Peterson Ave., Chicago 45, Ill.)

STEREO TONE-ARM KIT

Components Corporation of Denville, N. J., has announced a new stereo tone arm in kit form. The Model AS "Auto-Set" tone arm features a single pivot bearing which is made of special heat-treated and polished alloy material. Unique mounting arrangements allow positioning of the arm for maximum tracking accuracy and all standard stereo and mono cartridges can be accommodated. Price, $19.50.

TOOL HOLDER

Holding up to 12 items, the "Lifetime Holder" ends clutter in workshop, garage, and kitchen. No item is too small to be held in place. Three tension adjustments are available. The holder is 11" long and comes with screws for wall mounting. Price, $1.69. (The Callahan Co., 5101 S. E. 17th Ave., Portland 2, Ore.)

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- **Clutch-Opperated Volume Control**
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A completely new stereo high fidelity amplifier with a high quality of reproduction, remarkable flexibility and new distinctive styling. Full range of controls include the unique "blend" control for continuously variable channel separation—from full monaural to full stereo, 4-position Selector, Mode, Loudness and Phasing switches plus outputs for 4, 8 or 16 ohm speakers. Harmonic distortion less than 0.25%, THD distortion less than 1%. Hum and Noise 74 db below full output. Assembly is simple—no special skills or tools needed. Complete with deluxe cabinet and legs, all parts, tubes and detailed instruction manual. Shop. wt. 26 lbs.

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- **LA-250 Stereo Amplifier, wired & tested**: 8.95 down Net 89.50

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- **KT-600 Stereo Preamplifier Kit**: 7.95 down Net 79.50
- **LA-600 Stereo Preamplifier, wired and tested**: 13.45 down Net 134.50

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- **Employ 4 Premium-Type 7189 Tubes**
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- **Less than 1% Harmonic or IM Distortion**

A superb basic stereo amplifier in easy-to-build kit form. Unit may be used with a stereo preamplifier to provide two 18 watt stereo channels, or, at the flick of a switch, as a fine 36 watt monaural amplifier. Controls include 2 input volume controls, Channel Reverse switch and Monoaural Stereo switch. Dual outputs for 4, 8, 16 or 32 ohm speakers. Input sensitivity .45 volts per channel for full output. Tubes are 2-6AN8, 4-7189, 2-24 rectifier. Size 10 9/16" x 6 5/8" x 13 3/4" w. Complete kit with cage, all parts, tubes and detailed instruction manual. Shop. wt., 22 lbs.

- **KT-310 Stereo Power Amplifier Kit**: 4.75 down Net 47.50
- **LA-310 Stereo Power Amplifier, wired and tested**: 6.95 down Net 69.50

#### FM-AM Stereo Tuner Kit

- **11 Tubes (4 dual-purpose)**
- **Tuning Eye**
- **Selenium rectifier**
- **Multiplex Output for new Stereo FM**
- **Armstrong Circuit with Dual Limiters and Foster-Seeley Discriminator**
- **Extreme Sensitivity and Wide Frequency Response**

A precision engineered, highly stable tuner—perfect for life-like stereo FM-AM broadcast reception, FM reception and/or AM reception. Features separate tuning and volume controls for AM and FM. Mag ic eye on AM and FM, plus automatic frequency control on FM for accurate tuning—stations are "locked" in. Other deluxe features include cathode follower outputs and 5-position Function Selector. Efficient, broadband circuitry on AM with built-in antenna. FM section features includes 2 microvolts sensitivity for 30 db quieting, frequency response 20-20,000 cps ± 1 db and full 200 KC bandwidth. Two printed circuit boards make wiring simple—even for such a complex unit. Complete kit includes all parts, deluxe cabinet and detailed instruction manual. Size is 13" W x 10 1/2" D x 4 1/2" H. Shop. wt., 22 lbs.

- **KT-500 FM-AM Stereo Tuner Kit**: 7.45 down Net 74.50
- **KT-50 Same as above, wired & tested**: 12.45 down Net 124.50

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New! LORENZ S-988
HP-1 HIGH PASS CROSSOVER

Tips and Techniques

EXTRA EXTENSION AT LOW COST

Ordinarily a droplight comes with 25 to 50 feet of electrical cord. To acquire an extra extension cord for use around the home, cut the cord about a foot from the lamp socket and attach an a.c. plug. Fit a multi-outlet female receptacle to the open end of the a.c. cord. Actually the benefits derived are two-fold: not only have you gained a handy extension at little cost, but the droplight can be neatly and easily stored when not in use.—Peter Barna, Wilmington, Calif.

MOUNTING VARIABLE CAPACITORS

When hooking up experimental circuits on a "breadboard," it isn't necessary to make brackets or panels to hold variable capacitors to the board—simply stick the capacitors down with Duco cement! Spread the cement on the edge of the capacitor frame, press the capacitor onto the board,
Coming in October POPULAR ELECTRONICS:

SPECIAL HI-FI
STEREO ISSUE!

What's new in Stereo—the fascinating field that's changed the entire complexion of the hi-fi industry? You'll find out in next month's POPULAR ELECTRONICS—which features special articles on Stereo such as:

- **BUILD the PERFECTIONIST'S "DUAL-60" STEREO AMPLIFIER**
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- **BUILD a TOP QUALITY STEREO SPEAKER SYSTEM**
  Why move two speakers around the room looking for the best "stereo effect"! Build this one-cabinet stereo speaker system which "places" the speakers anywhere in the room by the use of acoustic reflectors. This could be an inexpensive solution to your stereo speaker system problem!

- **PLUS SUCH STEREO FEATURES AS:**
  - What's Happening to Stereo Tape?
  - How Hi-Fi Loudspeakers are Designed
  - Report on Stereo Tonearm Kits
  YOU'LL ALSO ENJOY THESE INFORMATIVE POPULAR ELECTRONICS FEATURES IN THE OCTOBER ISSUE:
  - **ELECTRONICS IN AVIATION**—A fascinating historical study
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POPULAR ELECTRONICS  •  434 South Wabash Avenue  •  Chicago 5, Illinois

September, 1959
Tips (Continued from page 34)
and allow the cement to set. When you want to remove the capacitor, simply pry it off the board and scrape off the dried cement. Quick and easy connections to the capacitors can be made with a pair of Fahnestock clips soldered on each capacitor.—Art Trauffer, Council Bluffs, Iowa.

**LOW-COST INDICATOR LAMP**

Small plastic containers with red tops which are used by dime stores to retail screws, nails, etc., make good indicator lamp holders. The lamp is mounted inside the container by a screw and nut through the lamp socket bracket and the container wall. The completed lamp holder is mounted to the equipment by sandwiching the equipment panel between the red cap and a plastic ring cemented around the outside of the lamp holder.—D. B. Tansley, Oshawa, Canada.

**IMPROVE PORTABLE RECEPTION**

To improve the signal pickup and output volume of your transistor or tube portable, install the loopstick antenna on the outside of the set. In effect, you will be increasing the distance between the chassis and the antenna and thereby eliminating the signal-robbing effect of capacitance between the
The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics technicians, making use of the most modern methods by fundamentals training in practice and servicing. This IS A COMPLETE COURSE IN EVERY DETAIL. You learn practical schematics, how to wire and solder in a professional manner, how to test radios. You will work with the standard type of professional equipment as well as the latest development of Printed Circuit chassis.

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Tips  (Continued from page 36)

two. Not only will you notice a marked improvement in reception, but the life of the batteries will be extended since they will continue to provide sufficient volume when they begin to weaken.—Charles Lang, San Francisco, Calif.

CHASSIS POSITIONER

In soldering electronic equipment, it is often necessary to hold the chassis at odd angles to control the flow of the molten solder. A good third hand for such work is the woodworker’s adjustable screw clamp. An edge of the chassis is clamped in the jaws at the desired angle. The weight and broad base of the clamp easily supports a chassis of average size.—Louis Golden, East Peoria, Ill.

HAIR DRIER CLEANS RADIO

A small hair drier will blow away the dust from electronic equipment in quick order. Most driers have “hot” and “cold” positions, allowing cold air to be used for dust and hot air for coils which may have absorbed moisture.—H. Leeper, Canton, Ohio

CARDBOARD-BOX CHASSIS “CRADLE”

When you have to turn the chassis of a radio, audio amplifier, or hi-fi component upside down for servicing, a large cardboard box makes a handy “cradle.” It’s better to rest the chassis in the opening of the
USES FOR TRAIN TRANSFORMERS
A toy train transformer makes a handy variable low-voltage a.c. supply. It can be used with selenium rectifiers to power transistor circuits, and the higher-wattage models can be used as battery eliminators. Another trick is to connect the secondary in series with the line to buck or boost the line voltage, depending on phase, and you have a cheap autoformer! Some of these transformers even have a built-in circuit breaker.—Mark H. Wirth, K8IVJ, St. Joe-
seph, Mich.

"FLOAT" YOUR RECORDS
In these days of lightweight records and phono pickups, records can be "floated" to reduce dust pickup from the turntable and vibration from the motor. I cemented three 1"-diameter soft rubber discs cut from a scrap of "Non-Skid" material onto the top of my turntable. The tripod arrangement of the rubber discs spaces the records away from the turntable and keeps them from slipping.—Art Trauffer, Council Bluffs, Iowa.

SPICE WITH SQUARE KNOTS
When you splice thin stranded wire, skin the ends back sufficiently so that you can tie a square knot in the splice, then wrap any remaining bare wire around the splice. Such splices require no soldering for strength as they will withstand parting up to the breaking point of the wire. The tighter the splice is pulled, the better will be the connection.—Harry J. Miller, Sarasota, Fla.

September, 1959
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**STEREO and MONO HI-FI**

<table>
<thead>
<tr>
<th>Product</th>
<th>Model</th>
<th>Price</th>
<th>Description</th>
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<tbody>
<tr>
<td>Stereo Dual Amplifier/Preamplifier</td>
<td>HF81</td>
<td>$59.95</td>
<td>Wired $62.95, new; SATURDAY REVIEW: HI-FI MUSIC AT HOME.</td>
</tr>
<tr>
<td>Mono Preamplifier</td>
<td>HF65A</td>
<td>$39.95</td>
<td>Kit $33.95, Wired $39.95.</td>
</tr>
<tr>
<td>Mono Power Amplifiers (50, 60)</td>
<td>Kit $37.95</td>
<td>Wired $43.95.</td>
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<tr>
<td>Mono Integrated Amplifiers (50, 60, 12 Watt)</td>
<td>Kit $34.95</td>
<td>Wired $40.95.</td>
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<tr>
<td>Mono Power Amplifiers (60, 50, 30, 22)</td>
<td>14 Watt use</td>
<td>Kit $32.95</td>
<td>Wired $40.95.</td>
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<tr>
<td>Stereo Dual Power Amplifier</td>
<td>HF56</td>
<td>$43.95</td>
<td>Wired $49.95.</td>
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**TEST INSTRUMENTS**

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<th>Product</th>
<th>Model</th>
<th>Price</th>
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<tbody>
<tr>
<td>New Tube &amp; CRT Fil. Tester</td>
<td>Kit $3.95</td>
<td>Wired $5.95.</td>
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<tr>
<td>RF Signal Generator</td>
<td>Kit $32.95</td>
<td>Wired $37.95.</td>
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<tr>
<td>Vacuum Tube Voltmeter</td>
<td>Kit $25.95</td>
<td>Wired $32.95.</td>
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<tr>
<td>Miniaturized Multi-Signal Tracer</td>
<td>Kit $19.95</td>
<td>Wired $23.95.</td>
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<tr>
<td>Series/Parallel R.C. Combination Box 2</td>
<td>Kit $19.95</td>
<td>Wired $23.95.</td>
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<tr>
<td>Series/Parallel R.C. Combination Box 3</td>
<td>Kit $19.95</td>
<td>Wired $23.95.</td>
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<tr>
<td>6V &amp; 12V Battery Eliminator &amp; Charger</td>
<td>Kit $19.95</td>
<td>Wired $23.95.</td>
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<tr>
<td>2-Way Bookshelf Speaker System</td>
<td>Kit $39.95</td>
<td>Wired $45.95.</td>
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<tr>
<td>5&quot; Push-Pull Scope, EICO</td>
<td>Kit $44.95</td>
<td>Wired $49.95.</td>
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<tr>
<td>DC-5 MC 5&quot; Scope</td>
<td>Kit $49.95</td>
<td>Wired $54.95.</td>
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<tr>
<td>Tube Tester</td>
<td>Kit $34.95</td>
<td>Wired $40.95.</td>
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<tr>
<td>Peak-to-Peak VTVM</td>
<td>Kit $29.95</td>
<td>Wired $34.95.</td>
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<tr>
<td>R-C Bridge &amp; R-C-L Comptator</td>
<td>Kit $950</td>
<td>Wired $1000.</td>
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See Page 38 for EICO'S BEST BUYS in "HAM" GEAR.

Always say you saw it in—POPULAR ELECTRONICS
What's the truth about color TV? Is it everything it's claimed to be? Here are the facts.

In 1954, when color television first became a commercial reality, the experts all foresaw a rosy future for it. John Q. Public was supposed to march right down to his local appliance store and lay his money on the line for one of the new multi-hued models.

But this John Q. Public did not do, and five years and 130 million dollars later (RCA's estimated investment), what has been color TV's lot? Judged by any business man's standards, it has gone over like a
Musical and variety shows are naturals for color TV. The Dinah Shore show is particularly "colorgenic." Perry Como and Steve Allen are also color favorites. Note the color background possibilities.

lead balloon. Out of a total of 45 million TV sets now in use, less than 500,000, or only about 1%, are color sets.

Ask the man on the street what he thinks of color TV, and chances are he hasn't even seen it yet. If he has seen it, he will probably say: (1) the quality is poor, (2) it's too expensive, (3) it's too difficult to tune, (4) there aren't enough color programs, and (5) color sets break down too often.

Facts About Color TV. Despite the fact that RCA has spent millions of dollars advertising and promoting color TV, the foregoing impressions are strongly implanted in the minds of a great many people. The awful pity of the situation is that, for the most part, these impressions do not reflect the true facts.

After having surveyed a number of color TV set owners and service technicians all over the country, and after having lived with a color set for a period of four months, the writer has come to the following conclusions: (1) the visual quality of color TV usually varies from good to very good and is often truly superb, (2) the sets are not difficult to tune, (3) there is still not a wide choice of programs, but color programing appears to be getting stronger with each new season, (4) the service problem is not significantly more important than it is with a black-and-white set (excluding one major consideration which we'll get to later), and (5) as far as price is concerned, although color sets are undeniably expensive, the results of our survey of color set owners indicate that the great majority feel they have received full value from their sets.

Color Set Owners. To find out exactly what people who own color sets think of color TV, a number of owners were surveyed by mail. These people hailed from such diverse areas as: Lansing, Mich.; Elizabeth, N. J.; York, Pa.; Whittier, Calif.; Fishkill, N. Y.; Portsmouth, Ohio; Chicago; and Milwaukee.

Typical replies to the question, "What is your over-all impression of color TV?" were: "Beautiful," "Great," "Magnificent," "Exciting," and so on.

"Just one good color program a week offsets any additional cost of a color TV set," one enthusiastic fan wrote. "Color TV is far more natural than color movies."

Another commented, "After two years with a color TV set, we cannot contemplate any other means of home TV enter-
Special outstanding programs have been presented in color. The award-winning "An Evening with Fred Astaire" was one. Others included the Old Vic presentation of "Hamlet," and "The Green Pastures."

The Owners.

Entertainment. We seldom miss a color program. Only rarely do we go to movies because color TV is so satisfying."

The clincher was added by another fan. "We even enjoy commercials in color."

Almost unanimously, the owners reported that their sets have been easy to operate and have performed reliably. None had encountered problems in getting his set serviced. Most have found occasional adjustments of the controls necessary, but none considered these adjustments difficult to make.

When asked how well their color sets received black-and-white programs, the set owners generally agreed that a monochrome image is less sharp on a color set than on an ordinary set. In addition, most color set owners reported a slight color tint (usually a light bluish-green) on black-and-white programs. However, few people objected to either the "soft" monochrome image or the color tint on the screen. In general, the color set owners felt that black-and-white reception on their color sets was as good as on their monochrome sets.

Although antenna requirements are more demanding for color than black-and-white reception, the great majority of the color owners surveyed use their old antennas with their color sets. Some, indeed, located near TV transmitters, report that they use only an indoor "rabbit ears" antenna.

The concluding question on the questionnaire was, "Do you think the enjoyment made possible by your color TV set has been worth the money you paid for it?" To this most important question, the answer was a unanimous "Yes."

Service Technicians. In order to get opinions on color TV from the technical point of view, it was decided to quiz the men who service color sets. The service technicians surveyed were scattered from St. Louis to Sacramento, Chicago to Fort Worth, and from New Orleans to Garfield Heights, Ohio. They have been handling color TV set repairs for an average period of four years, and each turns out about 57
color repairs a month. They indicated that, although in their experience color sets require slightly more repair than black-and-white models, breakdowns of color sets are usually caused, not by defects in the color circuitry, but by failures which are common to both color and black-and-white sets—such as loss of sound, no vertical deflection, power supply failure, etc.

It was generally agreed that it is slightly more difficult to repair a color set than a black-and-white set. The average repair cost reflected this; whereas the average repair bill for a black-and-white set was reported to be about $25.00, the average color set repair amounted to about $30.00.

Of the technicians surveyed, half already own color sets and the remaining half indicated that they plan to buy color sets. In general, they feel that color TV is "very good" and they would be very optimistic about its future if the number of color shows were to increase.

**Tough Row to Hoe.** Any discussion of color TV should point out that two closely linked corporations, RCA and its affiliate NBC, in truth, are color TV. These two colossi of the electronics world together have produced well over 90% of all the color programs transmitted and over 90% of the sets to receive them on. With very little support from the rest of the industry, they have taken on the task of selling color TV to the American public. At this time, with over 130 million dollars sunk into polychrome TV, it is most unlikely that they will slacken their efforts.

But RCA and NBC, in their efforts to popularize color TV, are confronted by a double-headed monster: price and programing. If these two problems could be solved, there is no doubt that color TV would fulfill every optimistic speculation of five years ago.

Obviously if there were a wider choice of color programs, a person would have a much greater incentive to buy a color set than he has presently. However, color programing will never be what it can be until...
more color sets are in use. NBC’s biggest competitors, ABC and CBS, have made it quite clear that they will start doing a bang-up color programming job only when “the people want it”—meaning, of course, when enough people have color sets to make it economically attractive to sell color shows to sponsors. In the meantime, NBC has to keep color programming going practically single-handedly; ABC hasn’t done anything in color and CBS makes only a token contribution to color programming.

Looking at things from a TV set manufacturer’s viewpoint, you can’t really blame him for being hesitant about going into the business of turning out high-priced color sets at a time when many people would refuse to buy them because of the lack of more color programming. Consequently, with both the networks and the TV manufacturers waiting for the others to make the first move, color TV is caught in the middle of a game of “let’s-wait-and-see.” The question is: Which will come first, the chicken (in the form of lower priced color sets) or the egg (more and better color programs)?

Quality of Color. As far as the visual quality of the finished product is concerned, as indicated earlier, it is variable—but rarely less than acceptable. Good color TV is a color experience as exciting and beautiful as any you’ll ever run across—and this includes the results of any printing process and the highest quality color film.

If you have seen color TV in a store or in a bar and haven’t been impressed, there can be two explanations: first, the set might not have been properly adjusted, and secondly, the level of illumination in the room may have been too high. In order for color TV to look its best, it must be shown in a considerably darker room than is suitable for black-and-white TV. If the room lighting is too bright, the picture will look weak and washed out; if the color control is turned up excessively in an attempt to give the picture more pep, it is almost impossible to achieve the correct color balance.

Live shows which originate under studio conditions generally provide the best color quality. The “Dinah Shore Chevy Show” comes live from California and is undoubt-
edly the top color show on the air. On the other hand, the “Steve Allen Show,” which is also live, is less consistent in its color quality. This just proves it's not only the process, but the man behind the process, that counts. Dinah apparently has better technicians.

Filmed color, if expertly done, is almost as good as live color. “Northwest Passage,” a filmed adventure series, generally has very good color, especially in the outdoor sequences.

To date, color-taped shows have been less satisfactory than either of the other two methods, with the color frequently appearing unsaturated and weak. Perhaps as the recorders and the tape are improved, color video tape will rival the other two processes. This would be very important economically, since color tape is about 15% cheaper than color film.

Truly poor color quality is almost always caused in the studio rather than in the receiver. Getting the light evenly distributed over the stage is a very ticklish problem. Occasionally a performer who is off-center falls into an area of illumination which is either “hot” or “cold.” When this happens, his face may go out of color balance and turn either greenish or bluish-red. In severe cases, the unlucky actor may look as if he came from another planet. Improper color balance can be corrected in the studio, and distortions of this type will probably disappear as technicians become more skilled and as the equipment is made more self-correcting.

**Depth and Realism.** The most frequent words you'll find applied to color TV in the advertisements are “depth” and “realism.” Now these don't mean much when you read them. They're just words. But the truth of the matter is that color does bring a genuine feeling of depth to the TV screen. When objects and people appear in their natural colors, you seem to see them inside the picture tube, rather than on the screen of the tube. It's not a true “3-D” effect, of course, but sometimes it comes remarkably close.

This feeling of depth accounts for part of the “realism” of color TV. But the different colors themselves add interest and realism. In color TV, as in painting, it is possible for the most banal subject to become a visually interesting experience by virtue of its color values alone. No matter what the subject matter, if color is handled skillfully, it can be enormously exciting.

**The Sets Themselves.** The first color sets had 15" screens, four controls for color alone, and were priced at a cozy $1000. In addition, the four controls worked together something like a combination lock. Each had to be set in just the right position before a good color picture could be received.

Color sets today have 21" screens, use only two extra “color” controls, and are priced as low as $495.00. This isn't exactly cheap, of course, but from time to time special offers bring the price down more.

From the user's point of view, the greatest improvement in today's color sets over earlier models is the ease of tuning. There is no longer just one correct “combination.” If you misadjust one control, it is usually possible to compensate with either the other color control or the fine tuning, or by a slight re-orientation of the antenna (if it's handy).

The two color controls are: (1) Color, which acts as a volume control, adjusting the intensity of the color, and (2) Tint, which varies the color balance. After the set is adjusted for normal black-and-white reception, when a color program comes on all you do is set the Color control for the minimum amount of color required to saturate the screen satisfactorily and then adjust the Tint, or color balance control, for natural flesh tones. If this is done, all colors will automatically come in with the correct balance.

**The Servicing Problem.** When the first color sets came on the market, the price for an RCA one-year service contract was $149.50. Today, the price has come down to $69.50. Included in the $69.50 is installation and one year's service, with all parts being factory-guaranteed for the first year. However, since the parts guarantee expires after the first year, the price of a service contract jumps up in following years.

For these succeeding years, RCA offers two types of service contracts: a complete-coverage plan for $119.50 per year; or a “Preferred Rate” plan for $79.50 a year. The latter contract covers all parts and “limited” service—meaning that a flat fee of $5.95 is charged for each service call after the first one.

Now, do you really need a service contract? It boils down to how much of a gambler you are. Look at it this way: since

(Continued on page 120)
SINCE THE DEVELOPMENT of the transistor, there has been an enormous rebirth of interest in the "odd-ball" receiver circuits dating from the early days of radio. Electronic hobbyists are regularly rediscovering the reflex, regen, and superregen-

Trans-3
Pocket Radio

Easy constructed unit
offers loudspeaker operation
with built-in antenna

By HARRY KOLBE
in ferrite rod antenna, and 2½" speaker, should run under $15.

**Construction.** Because a large number of components is placed in a relatively small plastic cabinet (Lafayette MS-302), extreme care in the layout and selection of the miniature components is required. Unless the constructor is familiar with miniature construction techniques, a slightly larger cabinet should be used.

Winding the antenna coil is the first construction step. Cut a 3¾" length of flat ¾"-wide ferrite strip. Then cover the strip with four layers of masking tape. The complete coil consists of 80 turns of No. 26 enamel-covered wire with a tap brought out at the 18th turn. Start the winding ½" from one end of the form and wind each turn so that a space the thickness of the wire exists between it and the next turn. Then coat the coil with coil dope and allow it to dry.

The cabinet and chassis are prepared next. If the MS-302 case is used, the raised rim surrounding the large tuning capacitor hole must be trimmed away. Drill about 20 ¼" holes in the grilled front panel of the case. In the back panel drill three ½" holes approximately where the center of the speaker will be. Additional speaker and phone jack mounting holes are required.

Cut the chassis from perforated phenolic board as shown. Flea clips are used for mounting the three transistors. Make the underchassis wiring and solder joints as flat to the chassis as possible. Mount the tuning capacitor in the hole provided using a large washer. The chassis is held in the case at one end by a washer and a bolt which screw into the nut imbedded in the case. The top end of the chassis is secured by the volume control mounting.

Construction is now complete except for the mounting of the antenna coil and speaker. Position the coil along the side of the case so that the tapped end of the coil is at the bottom end of the case. Secure the coil by cementing it to the side of the case with Duco cement.

The speaker is cemented or bolted to the back panel. It should be mounted with its cone facing three ½" back panel holes. This
technique "front loads" the speaker and improves its tone quality.

Install the battery, slip on the back cover, and the radio is ready for use.

**Operation.** Volume control $R_2$ controls the amount of detected audio signal fed back to the detector input. As the feedback audio signal is increased, a point of instability is reached and oscillation (squealing or a rushing sound) starts. The sensitivity is greatest just before oscillation.

To use the receiver, advance $R_2$ to the point where oscillation begins and then back it off until oscillation just stops. Now just tune in the desired station. If volume is too loud, simply decrease the sensitivity. A phone jack is provided for earphone operation when desired.

**In wiring the receiver,** be sure to use enough wire between the speaker and the output transformer. This will allow you to remove the speaker from the case for repairs or adjustments. If larger components are used than those suggested, rearrange the parts accordingly; a slightly larger cabinet than the one specified will be necessary.

September, 1959
The Magic of Cross-Country

Here's how telephone calls and TV programs are sent from coast to coast

By ART ZUCKERMAN

If you've been reading your mail lately, you may recall a letter from your local telephone company. This letter was about the new system of direct long-distance dialing which makes it possible for you to call Aunt Minnie in Minneapolis just by dialing 612, the area code number, plus her phone number.

Ingenious new switching circuits make such long-distance dialing possible. But these fancy new techniques wouldn't be worth a nickel without a way of getting messages across the country quickly and economically. At the present time, we have two efficient carriers of the cross-country electronic mailbag. These are the coaxial cable and the radio relay systems.

Some 16,000 miles of American real estate are covered by the radio relay towers of the American Telephone & Telegraph Co., while another 10,000 miles hold A T & T's buried coaxial cables.

Through Earth and Air. Although one sends its messages through underground tubes and the other goes through the air, radio relay and coaxial cable use the same basic techniques to handle thousands of telephone calls at the same time. Network television programs are routed around the country on these same carriers, right along with your phone call.

Actually, a coaxial cable and a relay antenna carry a broad band of frequencies. Some of the latest equipment covers eight
times the frequency span of the entire broadcast radio band. An individual telephone conversation occupies only a narrow channel of the band, much as a single radio program represents only a part of the total signal picked up by your receiving antenna.

In the same way that your radio receives and separates many stations, so coaxial cables and radio relay can carry an enormous composite signal and separate the many individual voice channels at the receiving stations and cable terminals.

Why are there two systems? There are several reasons. First of all, the type of terrain to be covered can determine whether coaxial cable or radio relay should be used. In a mountainous area, radio relay is almost always called for, while coaxial cable is favored in open country.

Another factor is local needs. Other things being equal, the system which best suits local traffic requirements at a given time will receive the nod. At one point

The two carriers of the cross-country electronic mailbag are the coaxial cable and radio relay systems. Above is an inside view of a coax cable. At right is an antenna tower at a radio relay station.
Coaxial cable is made up of eight coaxial tubes plus a number of standard wire conductors. Spacers made of polyethylene position the center wires inside the hollow copper outer tubes.

in the game, radio relay may offer the greatest message-handling capacity; at another time, cable equipment may forge ahead.

The costs of the two systems tend to average out. While radio relay is cheaper to install, cable is cheaper to maintain and operate.

The Cable System. Coaxial cable is a marvel of design. About as big around as a man's wrist, it's really a collection of eight copper tubes, together with a number of standard wire conductors for maintenance and short-haul telephone purposes. These are all encased in a gas-filled lead sheath.

Each copper tube is roughly the diameter of a fountain pen. A copper wire runs down the center of each tube, held in place by polyethylene insulating discs spaced about an inch apart. Because the tube and the wire have the same axis, the tubes are called "coaxial." This design offers unusually good shielding properties. It prevents interference with other conductors in the same cable and protects against outside electrical disturbances.

For telephone purposes, the tubes are used in pairs—each transmitting in one direction. When equipped with the latest design of related apparatus, some 1860 simultaneous conversations can be handled by each pair of coaxials.

Since signals carried by the cable weaken rapidly, a chain of booster amplifiers spaced four to eight miles apart is necessary to refresh them. Depending on the particular system, these repeater stations are mostly small, unattended units that draw their power from the cable itself. A series of main stations supplies this power and also provides over-all maintenance.

Automatic Trouble-Shooters. The cable has an amazing ability to look out for itself. Not so long ago, for instance, a farm hand in the South was digging post holes when he hit something. The man was startled when the mysterious object started hissing at him. He was almost as surprised when a Bell System maintenance man showed up in short order.

The object our farm hand struck was, of course, a "coax." The hissing came from gas—either nitrogen or dehumidified air—escaping through a break in the casing. The gas serves two purposes. First, by escaping under pressure, it keeps moisture from entering the break. Second, it sets
A radio relay chain is made up of a number of stations about 30 miles apart. Each one must be within the line of sight of the station in front and behind, because the microwaves they handle are highly directional and are focused into extremely sharp beams. The relay stations are placed in a zigzag path rather than in a straight line, so that there is no danger of a station's overshotting its mark and being picked up by the next station down the line. Because it uses such tightly focused beams, microwave relay employs power very sparingly. It takes less than a watt—about enough to light up a pocket flashlight bulb—to span the gap between stations. The tight focusing arrangement also conserves frequencies at a station that feeds two or more relay chains. The station can send out the same frequency in different directions without danger of interference.

In regular practice, however, a relay station receives a transmission on one frequency band and then converts it to another frequency for relaying to the next site. Here, the transmission is again sent out on the original frequency, and the alternation of frequencies continues right on down the line. This practice eliminates the possibility of part of a station's transmission feeding back into its own receiving antenna.

The amplifiers that give the relay stations their punch really pack a wallop. They can take a weakened signal and send it on with a millionfold gain in strength.

As with coaxial cable, the radio relay system contains a number of built-in safeguards.

(Continued on page 130)
LAUNCH HOUR

Space-age engineers take time out for relaxation by sailing radio-controlled boats during lunch hour at International Telephone and Telegraph's Guided Missile and Space Laboratory in Nutley, N. J. During working hours, these lunch-time skippers design "electronic brains" for guided missiles such as "Lacrosse," "Talos," and "Bomarc." In their spare time, they take things easy by designing and building souped-up remote control equipment for their boats. (UPI photo)

ATOM SMASHER

The tiny technician at right gives you an idea of the size of the new particle accelerator at Britain's Atomic Weapons Research Establishment in Aldermaston. This low-energy 12-million-electron-volt van de Graaff generator is the largest of its kind in the world. By firing billions of atomic particles into a metal "target," the 100'-high generator makes its contribution to mankind's knowledge of the atom. It is expected to provide data which will lead to more peaceful applications for atomic power.

HEART MONITOR

A new "heart monitor" is expected to reduce surgical risks by signaling physicians when emergency measures are necessary. The instrument translates electrical impulses from the heart into audible "beeps." When the monitor is strapped to the patient's forearm, an electrode attached to the other arm completes the sensing circuit. This device is being distributed by the National Cylinder Gas Division of the Chemetron Corporation.
Multi-Purpose Pulser

A HIGH-POWER transistor pulse generator has many interesting applications for the experimenter. For example, it can be used as a portable neon communicator, or marker light, an emergency flasher, an electronic fence charger, and a dog-and-thief discourager. Other possibilities that can be investigated include its use as a worm digger, a portable electronic fish guide, etc.

The pulse generator to be described here is very simple. It has a peak power output of 10-30 watts, depending on the load resistance. Battery drain is low, and the output voltage can be changed for different applications with a different output transformer. Seven type "D" flashlight cells are employed as these cells have a large current capacity and are available everywhere at low cost. They should last several weeks with normal use.

Construction. Since the pulse generator was designed for portable use, it is housed in a durable aluminum case with a con-
venient carrying handle. Total weight including batteries is about 4½ pounds. All components except the batteries are mounted in the top half of the case, with the case itself serving as the chassis.

There is plenty of space available, but take care to keep the parts from shorting out to the batteries when the case is closed. Mount the battery clips low on the sides of the case, as shown. Keep T2 close to the top but low enough to allow room for the handle mounting screws.

Transistors Q1 and Q2 are soldered to the terminal strips, with the usual precautions, and Q3 is mounted to the chassis by means of two machine screws. Q1's collector is the shell and must be insulated from the chassis with fiber washers or a power transistor insulating mounting kit.

The collector connection is made with a flat solder lug under one of the fiber washers. Use a lock washer between this washer and the nut for a positive contact. After you mount Q3, check with an ohmmeter between its collector (shell) and chassis to be sure that the insulation job is effective.

Connectors for the Q3 base and emitter are taken from a miniature 7-pin tube socket. Put a small piece of mica or paper between these connectors and the transistor body to prevent accidental contact.

Heavy peak currents flow in the Q1 output circuit and in the battery circuit, so be sure that all connections are good and that the battery holders contact the batteries firmly. Bend in the terminal ends of the holders to increase contact pressure.

To avoid damage to the transistors by

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**How It Works**

Transistor Q1 is a blocking-oscillator-type pulse generator which develops stable, short, high-level pulses. A low pulse rate is preferred normally because it keeps battery drain low, but the rate can be changed by varying the values of R1, R2, and C2. The width of the pulse can be changed by C2.

Pulses generated by Q1 are applied to Q2 by the secondary of T1, which also supplies feedback to make (Q1-oscillate. Transistor Q2 amplifies the pulses without inverting them. Q3 further amplifies them and T2 reverse-connected steps up the voltage before applying it to the output receptacle (Q1).

The secondary of T2 is isolated from the metal case to reduce the chance of shock. Neon pilot lamp PL1, connected across the output, shows that the pulse is working properly.

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**Parts List**

- **B1**—10.5-volt battery (seven series-connected type "D" flashlight cells)
- **C1, C2**—100-µf., 15-volt electrolytic capacitor
- **C3**—500-µf., 15-volt electrolytic capacitor
- **D1**—Panel-mounting a.c. receptacle
- **PL1**—Neon pilot light assembly (Dialco 5408X or equivalent)
- **Q1**—2N217 transistor
- **Q2**—2N270 transistor
- **Q3**—2N301 transistor
- **R1**—33,000 ohms
- **R2**—4700 ohms
- **R3**—1200 ohms
- **R4**—1000 ohms
- **R5**—1 ohm, 1 watt
- **S1**—S.p.s.t. toggle switch
- **T1**—Transistor audio transformer, 500 ohms CT to 500 ohms CT (Hordarson TR-1 or equivalent)
- **T2**—Filament transformer, 117-volt primary, 6.3-volt, 3-amp, secondary
- **1**—4" x 5" x 6" aluminum cabinet (Bud 29442 or equivalent)

2—Holders for two "D" cells (Acme #12)
3—Holders for single "D" cell (Acme #11)
1—Four terminal tie strip (1 lug grounded)
1—Five-terminal tie strip (1 lug grounded)
2—Pin connectors for Q3
2—Fiber shoulder washers and sleeves
Misc. handle, screws, nuts, solder lugs, wire, lock washer, rosin core solder
reverse battery polarity, put a small dab of red paint or nail polish on the positive terminal of each battery holder.

Applications. With the parts listed, the pulse rate is about 90 per minute, the open-circuit voltage is over 600, and 125-volt pulses are obtained across a 500-ohm load. This is suitable for medium loads such as a large neon lamp in a portable marker light or an emergency flasher.

When the pulse generator is used as a fence charger or dog-and-thief discourager, larger open-circuit pulses will be needed—which means that T2 must have a larger turns ratio. Try using the center-tap and one filament lead of a 2.5-volt filament transformer as the "primary." The d.c. resistance of the low-voltage "primary" winding connecting to Q3 should be no more than 1 ohm for best results. You'll find that almost any well-insulated transformer with the proper turns ratio will serve nicely as T2.

For light communication work, use a 3-watt neon lamp and change R1 to 1000 ohms and C2 to 20 μF, to obtain about 60 pulses per second. The telegraph key can be placed in the Q1 emitter return just below the R2-R3 junction, in the Q1 collector return between T1's brown lead and ground, or across R2.

The battery holders should be located carefully on the chassis lid, or the lid will not close properly.

The output power is somewhat low for best worm "turning" and fish guiding, but some interesting results are still possible. For these and other loads below 500 ohms, use the full 6.3-volt winding of T2 as the primary instead of using the center-tap as shown in the schematic diagram.

Two fork-like probes, each consisting of three or four ½" rods about 12" long, will be needed for worm digging. The upper ends of the rods can be mounted about three inches apart in a strip of metal, or in wood with the upper ends soldered together. Attach a wooden handle to each probe to avoid shock. The separation between the two probes will generally be about two to four feet depending on how wet the earth is. A few trials will show which is best in each case. (See "Don't Dig Those Crazy Worms" in the May 1957 issue of Popular Electronics.)

For electronic fish guiding (see the November 1956 issue), one probe can be a metal boat bottom or a sheet of metal foil tacked to the hull, and the other a sheet of foil tacked to a wooden pole. The second probe can be held by the operator or suspended in the water from the side of the boat. The heavy load placed on the pulser by the water will limit the electric field between the probes to a small area, but any fish entering the field will be attracted to the positive electrode. Experiments should be limited to fresh water because the resistance of salt water is too low for the pulser to work properly.
WHENEVER a science fiction movie or TV show wants to appear ultra-scientific, chances are that an oscilloscope will be shown with some interesting-appearing trace fluttering across the face of its cathode-ray tube. With its profusion of control knobs and input facilities, the oscilloscope is probably the most impressive-looking instrument on the technician's test bench. But the very diversity of functions of this multi-talented instrument also makes it one of the most difficult to understand and use to full advantage.

On the Beam. Since the heart of the modern oscilloscope is the cathode-ray tube or CRT, let's see how it works first. A type of CRT familiar to most people is the picture tube in their television sets.

In the neck of the picture tube, the designers have placed an electron gun (Fig. 1) which shoots, not bullets, but electrons—about six billion of them per second—in a
concentrated high-velocity beam toward the phosphor-coated face of the tube. This thin coating fluoresces under the electron bombardment. A TV set with its yoke disconnected or an oscilloscope with its horizontal and vertical gain controls turned down would let you see the small luminous dot caused by the electron stream hitting a single point.

How do we cause this dot to form a TV picture or oscilloscope trace? The answer lies in making use of the particular properties of an electron beam. It seems that a stream of electrons can be deflected (or bent) by either a magnetic field (such as is produced by the yoke in a TV set) or an electrostatic field. The internal design of the CRT determines which type of deflection system should be used with the tube. In general, TV sets are designed to use the magnetic system and oscilloscopes to use the electrostatic system.

**Designed for Deflection.** Electrostatic deflection, which is the type that concerns us here, is not at all mysterious. If you've ever noticed the way a hair comb can pick up lint on a dry day, you've seen electrostatic attraction at work.

Figure 2 is the schematic diagram of the inside of a typical 5" oscilloscope tube showing the arrangement of the tube elements and how the operating voltages are applied. If all the elements are doing their jobs correctly, a focused beam of electrons is shot out from the electron gun to the tube face.

In its travels, this beam passes between two separate pairs of deflection plates—H1, H2 and V1, V2. These plates will bend the beam either right or left, or up or down, or any combination of horizontal or vertical, depending upon the voltages present on the pairs of plates.

The action which takes place is illustrated in Fig. 3. With zero difference in potential between the two plates, the beam is centered. If 50 volts d.c. are applied across the horizontal plates in the manner shown, the spot will move about 1" right or left. (The actual distance moved depends on the CRT's sensitivity.) Applying 100 volts d.c. will move the spot about 2", etc.

A reversal of the polarities shown in Fig. 3 will move the spot an equal distance in the opposite direction. The same story, of course, applies to the vertical plates for up and down motion of the spot.

Once we understand the basic operation of the CRT, we are equipped to examine the rest of the oscilloscope and find out how the deflection voltages are developed and what role they play in the final presentation of a trace on the scope face. Next month we'll look at some saw-tooth waveforms and check out the vertical and horizontal amplifiers used with scopes.
1 Chris Tal found this circuit in a notebook he had saved since his school days. At a glance he knew what the voltage across points X should be. What was once a tough problem for him is now a snap. How about you?  
—Dale F. Betz

2 Needing a 150 to 300 ohm impedance-matching transformer, a ham friend of ours turned up a transformer with two 150-ohm secondary windings. He connected the windings as shown but the results were unexpected. Why?  
—Garbis Saatjian

Electronic Sticklers

(Answers on page 126)

3 Here is a "black box" problem that could trip even the experts. With the circuit connected as shown, the ammeter reads 1 ampere, the voltmeter reads 10 volts, but the wattmeter shows zero. What is in the black box?  
—A. G. Swan

4 Ed Surplus found this black box having four numbered terminals. In an attempt to figure out the contents, he applied 1 volt a.c. to terminals 1 and 2. His VTVM showed 1 volt a.c. at terminals 3 and 4. But to his dismay, he measured 1 volt a.c. at any two terminals when he applied 1 volt a.c. to the other two. Ed gave up in disgust. Would you?  
—Cesar E. Marestaing
2W4116 Unit 2 calling 2W4116 Unit 1. Come in, please.
2W4116 Unit 1 to 2W4116 Unit 2. Hi, Hon. Hurry home. Supper is almost ready. Over.
I'm on the way. Coming down U. S. 4 now. Will keep tuned to Channel 12 in case you call. 2W4116 Unit 2 over and out.

18W3325 calling 2W4116, Unit 2. Do you read me, OM? I'm calling you from downtown Chicago. Over.
2W4116 Unit 2 to 18W3325. Hear you 5-by-5. I am in New Jersey near the George Washington Bridge. Hon, we must be 750 miles apart.

Suddenly inhabited only by hams, the 11-meter band is now known officially as the Citizen's Radio Band. The man-in-the-street having no technical know-how can now enjoy two-way radio with endless possibilities for pleasure and business.

One of the first transceiver kits for this new band is produced by the Heath Company (Benton Harbor, Mich.). Moderately priced at $42.95, the Model CB-1 is as easy to build as it is to operate.

The complete transceiver is housed in a handsome, lightweight 8" x 6" x 9½" cabinet. Its small size makes it convenient not only for home use but for cars where under-the-dashboard space is at a premium.

**Mobile Operation.** Although the Model CB-1 can be operated from a.c. house current, a handy power plug on the rear apron of the unit permits a quick disconnect for other power sources. All that is needed for mobile operation is a standard 6- or 12-volt vibrator supply with an output of 260 volts at 60 ma. Transceiver filaments are also operated directly from either a 6- or 12-volt auto power system.

Front panel controls include receiver "Volume," "Tuning," and a "Transmit-Receive" switch. A neon power-on indicator operates with any power source used, and another neon indicator flashes when the unit is transmitting. A ceramic handheld mike plugs into a front panel jack.

Several types of antennas are available.
from Heath. We chose the whip, which can be mounted on the rear of the cabinet.

Circuit Features. The r.f. section of the transmitter consists of a single 6AU8 dual triode-pentode tube. The triode section operates as a crystal-controlled oscillator and drives the pentode final amplifier to the 5-watt maximum permitted by FCC regulations. All the coils are of the slug-tuned type and are easy to adjust.

The r.f. from the final tank coil is link-coupled to the antenna jack and resultant harmonics that might interfere with your neighbor's TV are minimized by a series r.f. trap. The trap also keeps strong local TV signals out of the receiver portion.

Receiver design is simplified by the use of a single 6AN8, which functions as a broad-tuned r.f. stage and a tuned supergenerative detector. The transceiver's audio section consists of a 12AX7 and a 6AQ5 and provides a healthy 1 watt of power to the 3½" speaker. This same section also is used as a modulator for the transmitter.

Silicon diodes featured in the power supply are in a voltage doubler circuit, thus eliminating the usual heat-producing rectifier tube.

Construction Hints. The Heath instruction manual lets you build directly from pictorial diagrams without referring to the very large schematic diagram which is included. But read the whole manual before you lift a soldering iron. And don't try to finish the kit in a single evening, or you may find yourself getting too tired to do a good construction job.

One thing to watch is the installation of the transmitter power neon indicator. Do not clip off one lead as instructed. Instead, leave about %" of lead. Touch a screwdriver or insulated wire to this lead while tuning the transmitter final. The added capacity to ground will allow the neon indicator to strike quickly and make adjustment easier.

On Trial. When the CB-1 was hooked up and tried out, stations from several time zones throughout the country were received loud and clear. With the transmitter operating from a car, a station a few miles away reported a strong signal with high modulation.

Parts placement at transmitter tube socket is critical. Slug-tuned oscillator and final coils are mounted near socket. Switch is shown partly wired.
Many radio amateurs and short-wave listeners operating near commercial areas are plagued with high background noise and local interference from neon signs, fluorescent lights, motors, etc. One way to make weak voice stations intelligible under these conditions is to attenuate the frequencies below 500 cycles and above 3000 cycles. Part of the audio signal is lost, of course, but the remaining portion has high intelligibility, and power line noise and adjacent station heterodyning will no longer tend to swamp out the signal.

This filter inserts a variable bandpass circuit in series with the receiver’s speaker voice coil. By switching in various values for L and C, a series-resonant circuit with a desired bandpass can be selected while you are listening to a station.

Coil L1 is wound on a wooden dowel ¾” in diameter and about 1 ½” long. Glue and tack stiff cardboard or Masonite retainers on the ends of the dowel to support the coil tap connections. Wind about 160 turns of enameled or Formvar-covered copper wire (#18-#20) on the coil form with taps at the 100-, 120- and 140-turn points.

Connect coil L1 to a five-position rotary switch and the capacitors to a 12-position switch of the same type. On both, the “Out” (off) position bypasses the filter if
high or low frequency cutoff is not needed. Note that there will normally be a drop in loudspeaker volume as the degree of frequency attenuation is increased, but in most cases the very great improvement obtained in the signal-to-noise ratio will more than compensate for the volume loss.

The speaker impedance, receiver characteristics, acoustical conditions, and your own ears will determine the coil taps and capacitor values used. Remember, you're listening for intelligibility and not fidelity, so don't expect too much in the way of natural-sounding speech reproduction. Proper setting of the controls will limit the noise frequencies reaching the speaker to such an extent that good copy will be possible under conditions that formerly made even partial copy impossible.

Versatile Electrical Connector

IN EXPERIMENTAL and repair work, when it is necessary to join temporary wire leads having various types of terminations, this easily made connector can save you much time and trouble. It is simply a 1½” length of brass, iron, or copper tubing, having a bore of the right diameter to accept standard banana plugs. Two or three ¾”-long Fahnestock clips are soldered onto the tubing. If you have any trouble finding metal tubing with the right size bore, you can make your own as shown.

You can join two banana plugs by pushing one into each end of the connector. Two phone-cord-tips can be joined by placing one in each clip. Or, you can join two spade lugs, or two plain wire leads, by putting them in the clips. There are many possible combinations of quick connections that can be made. Since the connector costs only a few cents to make, you will probably want several of them.
Build a Power Footswitch

... for your ham shack, darkroom, or workshop

A FOOTSWITCH is a useful device for operating a drill press, bench saw or other piece of machinery when it is desirable to have both hands free. Also, it is a great convenience in the darkroom; you can switch from safelight to enlarger and back in two easy "steps."

A snap-action s.p.d.t. switch with a 10 to 20 amp. rating is used. For darkroom work, both the enlarger and safelight are plugged into the footswitch receptacles. One step takes the power off one receptacle and puts it on the other. A second step reverses the situation.

If the footswitch is to be used for operating machinery alone, either power receptacle can be used, or the footswitch can be designed for a single receptacle.

Note that the entire footswitch box is fabricated from a single piece of 16-gauge sheet metal. You'll find aluminum easiest to work.

First, cut the metal to shape with a pair of tinsnips, and drill and punch all the required holes. The box is then formed by bending the metal in

By HENRY SEVCIK

September, 1959
a vise or a homemade bending brake fabricated from a couple of blocks of wood and a pair of hinges.

Secure the sides of the box with rivets, self-tapping sheet metal screws, or with solder. Then cut a bottom cover from a piece of ¼" plywood or fiberboard, being careful to drill and countersink the holes where the mounting tabs are located.

Mount all parts and wire the unit as shown in the dimensional drawing. Receptacle mounting straps must be bent slightly for true flush mounting. The bottom cover can be secured to the box with 6-32 flat-head machine screws; or you can use longer screws fitted with rubber feet.

The footswitch is now ready for use. Plug in the power cord and insert the enlarger and safelight cords in the outlets. If the footswitch is used for power tools, remember not to exceed the current rating of the switch.

---

**BILL OF MATERIALS**

1—9" x 9" piece of 16-gauge galvanized steel or other metal
1—7" x 4" x 18" piece of plywood or fiberboard
1—¼" rubber grommet
2—Single, flush, power receptacles
1—A.c. extension cord and plug of suitable length
4—Rubber mounting feet (if desired)
8—Self-tapping sheet metal screws
1—Snap-action s.p.d.t. switch (Acro-Robertshaw-Fulton MPB-312 or equivalent)

---

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Many crystal-controlled converters are available to the v.h.f. enthusiast and to the satellite listener, but most of them require external filament and B+ voltage supplies. Some converters, such as the Tape-tone XC-51, need voltage-regulated supplies. The VR supply to be described here will furnish power to most popular converters, including the satellite types.

In working with several different types of crystal converters, it was found that 150 volts d.c. was most often required. The noise figure was improved in some converters by using 150 volts when the manufacturer called for 150 to 250 volts. In fact, a regulated power supply will improve the results with any converter, whether recommended or not.

**Substitutions.** This VR supply will furnish 150 volts, d.c., with loads between 10 and 70 ma., plus 6.3 volts, a.c., at 3 amperes. Transformer T1 must have at least 175 volts each side of center-tap on the high-voltage winding, at 90 ma. or more.

If a different power transformer is used, the value for resistor R1 will vary depending on the value of the high-voltage winding on T1. It is not hard to calculate the resistance of R1, however. Simply take the power at 150 volts from Table 1, divide by the load in milliamps, and you will have the proper value of R1.

By DONALD A. SMITH, W3UZN

September, 1959
**HOW IT WORKS**

The VR supply uses a SY3 full-wave rectifier (V1) and two VR-150/0D3's (I2 and I3) in parallel as voltage stabilizers. All the rectifier plate current is returned through the center-tap of the high-voltage winding via jumpers inside each VR-150 to protect the powered equipment. Resistor R1 serves to limit the output current passing through the voltage regulator tubes to a safe value. Resistors R2 and R3 help balance tube current. Tubes I2 and I3 can each regulate loads from 5 to 35 ma. The two tube-to-terminal handle 10 to 70 ma. In spite of large variations in current through I2 and I3, the voltage across them remains constant. These tubes drain more or less current depending on the output voltage at the p.i-filter and changes in the load.

**PARTS LIST**

- C1a/C1b—20/20-mf., 450-volt dual electrolytic can capacitor
- CH1—5-henry, 100-ma. choke
- F1—2-ampere fuse and mounting assembly
- PL1—6.3-volt pilot lamp and assembly
- R1—Sliding-tap variable resistor (see text and diagram)
- R2, R3—68-ohm, 1-watt resistor
- S1—S.p.s.t. toggle switch
- T1—Power transformer, 520 volts CT., 90 ma.; 6.3 volts, 3 amp.; 5 volts, 2 amp. (Stancor PC-8404 or equivalent)
- TSI—Four-screw terminal strip
- V1—SY3 tube
- V2, V3—VR-150/DD3 tube
- 3—Octal tube sockets
- Misc. hardware and 3/8" grommet

**Layout** is not critical. However, leave enough space between tubes for heat dissipation.

High-voltage potential between the center-tap and one side and subtract 170 from it. Then divide the answer by one-half the load current. For example, if your converter drains 70 ma., divide by 35 ma. (.035).

Typical values for R1 using the specified power transformer are shown in the schematic diagram.

**Construction.** A 7" x 7" x 2" chassis was used although other sizes are suitable. A four-terminal strip is mounted on the back of the chassis with the wires coming through a 3/8" grommet from inside the chassis. Make up a cable with the type of power supply connector which your converter uses and connect the other end of the cable to the supply.

One side of the 6.3-volt a.c. filament line is left ungrounded. See the instructions accompanying your converter regarding filament grounding.

This supply is used regularly with a Tapetone XC-51 and International Crystal Company's FCV-1 and FCV-2 converters, as well as a home-brew converter draining 65 milliamperes.

**Adjustments.** The exact value for R1 should be determined experimentally. After R1 has been set to its approximate value using the formula outlined above, insert a 0-100 ma. meter at test point "X" on the schematic diagram. With no load connected, adjust R1 for a meter reading equal to one-half the load current. Make sure you don't set R1 to zero resistance—you might ruin T1 or the regulator tubes.
Listening on the 27-mc. Citizens Band

We aren't ones for whooping it up in the prediction department, but every now and then something so terrific pops up that we can't help but venture a peek into the future. We'll make the prediction that the new 27-mc. ("Class D") Citizens Band will be the hottest thing since the Chicago Fire, and within a very short time!

What does this mean to Joe DX'er? It means that there will be scads of new stations on the air for him to monitor; and not only that, they will be low-powered stations, offering a bit of a challenge.

The 27-mc. stations are allowed to have a maximum of 5 watts input to the final stage; and, as many of you know, the adjacent 10-meter ham band (28 mc.) often comes up with some pretty healthy DX stations using power just as low, or even lower. These Class D stations may operate on 23 frequencies, each designated by a channel number (see Table 1) like TV channels. Most stations, however, are equipped for operation on just one or two of the available frequencies.

Citizens Net. We were most fortunate in being able to take a close-up look at this band, using one of the many inexpensive transceivers now on the market. We went up on the roof of the house here in New York, flipped on the set, and found ourselves listening to a local "net" which meets on this band most nights to discuss everything from new radio equipment to Casey Stengel.

We sat patiently absorbing the conversation for a while; then it occurred to us that it took only the press of the mike button for us to become part of the net. Well, we
Table 1. Citizens Band channels are numbered like TV channels. Channel 4 is generally used as the calling frequency by stations with more than one transmitting channel.

Table 2. Prefixes and locations of Citizens Band stations. There are 27 call areas as compared to only 10 for amateur stations.

<table>
<thead>
<tr>
<th>Prefix No.</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Northern N.J., Southeastern N.Y.</td>
</tr>
<tr>
<td>4</td>
<td>Southern Del., Eastern W.Va., Md. &amp; N.Va. (except D.C. areas)</td>
</tr>
<tr>
<td>5</td>
<td>Eastern N.C., Southern Va.</td>
</tr>
<tr>
<td>6</td>
<td>Georgia, Western N.C., Ala. (except Mobile area)</td>
</tr>
<tr>
<td>7</td>
<td>Fla. (exc. Pensacola, West-Central areas)</td>
</tr>
<tr>
<td>8</td>
<td>Ark., La., Miss., areas of Mobile, Ala., Pensacola, Fla. &amp; Texarkana, Tex.</td>
</tr>
<tr>
<td>9</td>
<td>Southeast Tex. (except Beaumont area)</td>
</tr>
<tr>
<td>10</td>
<td>Okla., Northern &amp; Western Tex. (except Texarkana area)</td>
</tr>
<tr>
<td>11</td>
<td>Ariz., Southern Calif. (except San Diego area), Las Vegas, Nev., area</td>
</tr>
<tr>
<td>12</td>
<td>N. Calif., Nev. (except Las Vegas area)</td>
</tr>
<tr>
<td>13</td>
<td>Oreg., S. Idaho, S.W. Wash.</td>
</tr>
<tr>
<td>14</td>
<td>Mont., N. Idaho, Wash. (exc. S.W. area)</td>
</tr>
<tr>
<td>15</td>
<td>Colo., Utah, Wyo., N.M., Northwestern Nebr., Southwestern S.D.</td>
</tr>
<tr>
<td>16</td>
<td>Minn., N.D., S.D. (except S.W. area), N. Peninsula of Mich., Northern Wis.</td>
</tr>
<tr>
<td>17</td>
<td>Kans., Mo., Nebr. (except N.W. area), Western Iowa</td>
</tr>
<tr>
<td>18</td>
<td>Ill., E. Iowa, S. Wis., W. Ky.</td>
</tr>
<tr>
<td>19</td>
<td>Ohio, Eastern Ky., S. Peninsula of Mich., W.Va. (except Eastern area)</td>
</tr>
<tr>
<td>20</td>
<td>N.Y. (except S.E. area), Western Pa</td>
</tr>
<tr>
<td>21</td>
<td>Hawaii &amp; Pacific Islands</td>
</tr>
<tr>
<td>22</td>
<td>Puerto Rico, Virgin Islands</td>
</tr>
<tr>
<td>23</td>
<td>Alaska</td>
</tr>
<tr>
<td>24</td>
<td>D.C. areas of Md. &amp; Va. near D.C.</td>
</tr>
<tr>
<td>25</td>
<td>Area of West-Central Fla.</td>
</tr>
<tr>
<td>26</td>
<td>Area of Beaumont, Tex.</td>
</tr>
<tr>
<td>27</td>
<td>Area of San Diego, Calif.</td>
</tr>
</tbody>
</table>

A QSL from a distant station worked by a Citizens Band operator. QSL'ing between Citizens Band stations is the latest sideline to this new hobby.

The band when "skip" conditions are right, and that New York-Texas contacts are not uncommon.

Call Signs. When you hear a Citizens Band station, you'll note that it is assigned a pretty odd-ball call sign. First there are one or two numbers, designating the geographic area where the station is located (see Table 2). Following the geographic numbers, there is a "W," and then four numbers (2W1377, 2W0305, 19W3118).

You space-crammed city dwellers will be happy to hear that a 96" vertical doublet or whip will give good results when you are monitoring on 27 mc. It should be placed as high as possible.

But why just monitor the Citizens Band when you can easily join in the swim yourself. You can if you are at least 18 years of age, a U.S. citizen, and are willing to make a nominal investment in a transceiver (see the various advertisements in Popular Electronics for some pretty hot rigs). Or if you have an itchy soldering iron, you can whip together the set described on page 48 of the June issue of POP'tronics.

Stick to the Rules. Unless you are anxious to try Alcatraz as a DX site, you must ask the FCC for their Form 505, fill it in, send it to Washington, and wait for your (Continued on page 131)
FISH LURES come in practically all shapes and sizes. Whether it be a simple spinning reflector or the weirdest creation of an artistic angler, the fish lure's job is to attract fish to the hook. While conventional fish lures sometimes successfully employ light reflectors and motion to gain the attention of the fish, they fail to take advantage of the extreme sensitivity of the fish to the faintest underwater sounds. If a sound is not loud enough to frighten fish, experiments have shown that they may be attracted to it.

For some time now, a few cunning fishermen have sealed tiny electric buzzers in watertight jars and lowered them into the water at their favorite fishing spot. The

**Flashing lights**

**and buzzer**

**attract fish**

By

**JAMES G. BUSSE**
faint steady vibration from the buzzer seems to create the illusion among the fish that a large tasty insect has fallen into the water. They swim around the jar until their disappointment is forgotten among all the other tempting bait offered by the fishermen.

This buzzer-in-the-jar idea has been expanded into an electronic fish lure. And, as an extra attraction, a dual neon flasher circuit has been added. The completed unit is entirely self-contained. The buzzer and neon flasher are on separate circuits so that one or the other or both can be used, as desired.

**Assembly.** Putting an electronic fish lure together is quite simple since placement of parts is not critical. Battery voltages from 90 to 135 volts can be used. The rate at which the bulbs fire depends upon the values of the resistors, capacitors, and battery voltage. The rate can be slowed down by using larger value capacitors and resistors or a lower battery voltage. To conserve space, no switch was used in the neon flasher circuit. And even if the batteries operate continuously, they will outlast the fishing season, as power consumption for the blinker is only a fraction of a milliampere.

The buzzer shown is powered by a single flashlight battery. A somewhat more expensive buzzer, sold by the electronic supply houses, can be adjusted to operate at a number of different frequencies. If this type is used, adjust the control to the highest available frequency. A s.p.s.t. switch is employed in the buzzer circuit to silence the buzzer when the lure is not in use. To save space the buzzer circuit as well as the neon flasher circuit could be activated simply by connecting and disconnecting a couple of pairs of leads.

Size of the power pack and the other components used in the electronic fish lure will determine the size of the jar required. Choose the smallest size possible with a tight-fitting, screw-type cover. The individual cells of the battery pack are taped together and placed in the bottom of the jar for ballast.

The buzzer is mounted to the inside of the cover, which acts as a diaphragm to radiate the sound through the water. If the mounted buzzer makes a very tinny sound, try inserting a thin piece of rubber between it and the cover. Remember, too loud a vibration will most likely scare away the fish, not attract them. It may even be necessary to add a small resistance in series with the buzzer to produce the desired faint buzzing. In air, the buzz from the sealed jar should be hardly audible. Sound travels much better in water, and fish can hear sounds too weak to be heard by the human ear.

A small metal eye is attached to the top of the cover, through which a length of heavy fishing line is threaded. Be sure to seal every hole made in the cover with some type of waterproof cement.

**Operation.** Almost anyone can use an electronic fish lure successfully. Simply activate the buzzer and neon flasher circuits and screw on the cover tightly. Check for possible leaks. Then lower the electronic lure into the water, keeping it at least four feet from your fishing lines. If you are fishing in shallow water, let it lie on the bottom. Otherwise, keep it a foot or two above the level of your baited hooks. Now get set for action! If your electronic lure has a tendency to move about, weigh it down with some lead sinkers or a heavy stone.

The fun of fishing with an electronic fish lure comes from the fact that you never know what the thing will attract! Although no state prohibits the use of sound to attract fish, some forbid any use of light for this purpose. To be on the safe side, check with your state conservation commission. If the lights are out, the buzzer part of the circuit can still be used with success on your next fishing trip.

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POPULAR ELECTRONICS
SHOPPING for magnetic recording tape 12 years ago must have been a cinch—there was only one type commercially available: "Scotch" Brand No. 100, a black oxide product on a paper backing.

Today if you are in the market for recording tape you have decisions to make. Do you want tape with acetate or polyester backing? With 1½-mil, 1-mil, or ½-mil thickness? With standard, high-output, low-print, or perhaps even tensilized characteristics?

Confusing though it may be, such a variety of recording tape has become necessary to meet the diversified uses found for tape since its embryo days of 1947. Perhaps you are a recording engineer and require a special tape for long-term storage. If so, you have needs quite different from

HOW TO CHOOSE A RECORDING TAPE

By DICK ENGER

September, 1959
The basic ingredient of recording tape’s magnetic coating is iron oxide. Interestingly enough, the oxide is not magnetizable before being processed.

Photographs courtesy of Minnesota Mining and Manufacturing Company

Treated oxide and the binding agents are mixed together in ball mills. As the drum rotates, steel balls pulverize the oxide. Here, men are shown pumping the finished coating material into storage tanks.

Those of a geophysicist who uses tape to help locate pools of oil far beneath the ground.

Similarly, a tool control technician who uses tape to direct automatic milling machine operations has different tape requirements than does a TV producer who puts his production on video tape. Then, too, the missile-man who uses tape to record outer space data doesn’t use the same tape as the home recordist who wants to make high-fidelity audio recordings for his own personal use and enjoyment.

Whatever your game, though, the tape you are using is basically the same as that used for every other purpose—whether it be sound or electronic signal recording. Magnetic tape is nothing more complicated than plastic “ribbon” coated with finely powdered iron oxide.

All tape would be alike if various uses didn’t demand differences in:
- Kind of material used for backing
- Thickness of backing
- Formulation of oxide and binder.

Backing Materials. Two plastic materials are commonly used for magnetic tape backing—cellulose acetate and polyester film. Unless otherwise specified, the word “plastic” on a box of recording tape means that the backing is made of cellulose acetate. This tape is very popular because it meets all normal recording requirements and costs the least per foot of tape.

Under conditions of excessive heat or humidity, polyester backing—better known as Mylar—is worth its extra cost. Mylar is actually a film form of Dacron and has greater resistance to heat and humidity and greater strength than does acetate. It is
Hundreds of thousands of listening hours could be recorded on the tape in this storage area. "Jumbo rolls" are kept here before being cut and wound onto separate reels.

especially useful for long-term storage because it contains no plasticizers. In acetate tape, these plasticizing agents may eventually evaporate, leaving the tape brittle.

However, Mylar has a disadvantage. Under extreme tension, it may stretch. Although the likelihood of this happening is the exception rather than the rule, it is troublesome if the stretched tape contains critical information. Acetate tape will stretch only slightly before it breaks and any breaks can be repaired by splicing. For this reason, most of the major record companies make their master recordings on acetate-backed tape.

Thick or Thin. Tape is commonly available in three backing thicknesses. For greatest strength, it is produced with the 1½-mil backing which provides 1200 feet of tape on a standard 7" reel. To obtain half again as much playing time, manufacturers put out 1-mil tapes, thus obtaining 1800 feet of tape on the same diameter reel. This reduction in thickness reduces the strength of the tape, but 1-mil Mylar is actually stronger than 1½-mil acetate tape. However, it is more prone to stretching than is 1½-mil acetate.

Decreasing backing thickness even further to ½-mil makes it possible to put twice as much tape on the same reel, providing twice as much playing time. However, paring the thickness of the backing to ½ mil cuts its strength still further. To compensate for this loss of strength and the stretching problem, polyester-backed tape has been developed which is pre-stretched (usually referred to as "tensilized" or "tempered" tape). This tape is twice as strong as 1-mil Mylar. It is also roughly about 40% more expensive per foot than 1-mil Mylar.

The big advantage of double-length (½-mil) tape is that a full hour may be recorded on a standard 7" reel at the speed of 7½ ips—as opposed to the half hour possible with a reel of 1½-mil tape.

Special Tapes. As tapes became thinner and thinner, recording engineers discovered (Continued on page 127)
How NOT to Use Transistors

Twist and yank the leads excessively when you install the transistor. If you listen closely you will hear the snap.

Ignore the published ratings and exceed them. You'll have a real "hot" transistor — for a moment or two.

Insert the transistor into the test equipment while the power is on, making sure the order in which the leads make contact is switched around. This may cause immediate ruin.

We've all heard how sturdy and indestructible the transistor is . . . but nothing is perfect. Any qualified engineer, equipped with the proper educational background can, with a little ingenuity, reduce the transistor to a midget jellyfish. The accompanying quips are by no means all-inclusive, but they will start you on your way to becoming a big transistor user.

If the transistor does not fit into the equipment properly, put a screwdriver on the case and hammer it into place.

In order to burn out the transistor thoroughly, be sure there is leakage to the power line in the soldering iron.

Overheat the leads with a big soldering iron. Leads are going out of style anyway.
Transistorized
Two-Way
Power Trumpet

Special "talk-back"
feature enables
two-way communication for
p.a. or boating use

By R. L. WINKLEPLECK

PORTABLE voice amplifiers of the
type used to direct crowds, instruct
groups of workers and supervise
games are a real convenience, and
more and more are being used. The
advent of power transistors has made possible size reductions and eco-
nomical battery operation not previously attainable.

After using one of these handy devices for a while, you recognize that
they have one weakness: the man with the horn can make his wishes
known over a large area, but it's seldom that a reply is loud enough to
be intelligible. What's needed is a "talk-back" or intercom type of power
trumpet so that you can hear as well as talk.
Mounting plate of the high-gain, low-power "listen" amplifier is box's back panel. The grommet hole immediately below gain control R7 is for the handset cable.
Relatively inexpensive, and compact, the unit presented here combines a ten-watt power trumpet with a second high-gain amplifier that can convert the sound of an approaching automobile into that of a roaring avalanche. It's completely transistorized and, except for the flaring horn and the telephone handset, is contained complete with batteries in a 5" x 6" x 7" aluminum cabinet.

To use the trumpet, simply turn on the "listen" amplifier and adjust the volume knob at the back of the case. Pick up the handset and hear everything going on around you, with special emphasis on sounds originating in the 90° pickup and dispersion angle of the trumpet. When you want to talk, push the button on the top of the box next to the handle. This disconnects the "listen" amplifier from the trumpet, and turns on and connects the "talk" amplifier.

The box can be constructed of sheet aluminum, aluminum angle stock and self-tapping screws, or a commercial cabinet can be used. The entire circuit is wired and mounted to the box panels before the box is assembled. In this way you avoid the problem of working in tight corners.

The "talk" amplifier mounts on the underside of the top pane; and the "listen" amplifier is fastened to the inside of the back panel. Two six-volt batteries are housed in the bottom of the box. All interconnecting wires terminate at a tie strip mounted near the battery.

The "talk" amplifier parts placement and lead dress are not critical. But it's im-

HOW IT WORKS

The "talk" amplifier employs two CBS 2N256 power transistors in a class 'B' push-pull circuit using the common-emitter configuration. These are driven, through driver transformer T4, by the F-1 car-bon button microphone in the Western Electric E-1 handset. The output rating of the amplifier is a powerful ten audio watts—adequate for virtually every need.

The driver and output transformers specified in the parts list provide good impedance matching. Note that the d.p.d.t. push-button switch S1 when depressed, both supplies power to the amplifier and connects the trumpet to the amplifier output. Thus, this amplifier, which may draw an ampere or a bit more when hard-driven, consumes battery current only when the "push-to-talk" switch is actuated.

The "listen" amplifier is a four-stage RC-coupled transistor unit using 2N35 n-p-n transistors. With a maximum over-all voltage gain of approximately 2500, current drain from the battery is about 5 ma. Potentiometer R7 adjusts sensitivity for good intelligibility and a low level of background noise. Degeneration, provided by the 1000-ohm resistors in the emitter circuits, produces an input impedance of approximately 40,000 ohms and increases stability.

The input transformer specified offers a good impedance match between the amplifier input and the 8-ohm trumpet which substitutes as a dynamic microphone for "talk-back." The output transformer T2 closely matches the receiver in the E-1 handset. If some other handset is used, another transformer may be required for good matching.

PARTS LIST

- B1—Two 6-volt batteries (Burgess F4P1)
- C1, C3, C4, C5—1 µf. All capacitors
- C2, C6, C7—10 µf. 12-volt
- C8—100 µf. electrolytics
- Q1, Q2, Q3—2N35 transistor (Sylvania)
- Q5, Q6—2N256 power transistor (CBS)
- R1, R5, R8, R11—1 megohm
- R2, R6, R9, R12—1000 ohms 1/2-watt
- R3, R10—10,000 ohms composition
- R4—22,000 ohms
- R7—10,000-ohm audio taper potentiometer
- R13—150 ohms
- R14—100-ohm resistor or Veco 21W1 thermistor
- (see text)
- R15—100 ohms
- R16—3.3 ohms
- R17—470 ohms (see text)
- S1—D.p.d.t. push-button switch
- S2—S.p.s.t. switch (on R7)
- T1—Thordarson TR-36 transformer (or equivalent)
- T2—Stancor TA-34 transformer (or equivalent)
- T3—Triad TV-64x transformer (or equivalent)
- T4—Triad TV-6lx transformer (or equivalent)
- Sprk.—University Model 1B-8 trumpet
- 1—Western Electric E-1 handset (or equivalent)
possible with the arrangement illustrated to keep the input and output well separated; so transformers \( T3 \) and \( T4 \) must be placed at right angles to each other. This reduces the possibility of magnetic coupling and feedback.

The shells of the power transistors \( Q5 \) and \( Q6 \) are their collector connections and must be insulated when they are mounted on the top panel. Thin fiberglass, mica or composition sheets provide good electrical insulation and still let the heat generated flow into the chassis. Be very careful to remove all burrs from around holes in the insulation before mounting the transistors. With the new fiberglass insulation, even a small projection may punch through when the power transistor is tightened in place.

Output volume may be fairly well controlled by varying the level of the speaking voice. If a volume control is desired, and one will be necessary if the unit is used in a restricted area, current limiting resistor \( R17 \) can be replaced with a 1000-1500 ohm pot hooked up as a rheostat. If the unit will be exposed for hours to the hot summer sun, resistor \( R14 \) should be replaced by a Veco 21W1 thermistor to prevent thermal runaway.

Some of the older carbon buttons tend to develop quite a bit of hiss. If this is loud enough to be objectionable, it can be eliminated by connecting a .01-.04 \( \mu \)f. capacitor across the red and blue leads of transformer \( T4 \).

The “listen” amplifier, its input and output transformers, and the volume control may be assembled on a 3" x 4" phenolic board with metal clips at the points where the components are interconnected. The circuit board is then mounted on the rear (Continued on page 128)
AFTER a Novice goes General, the phone bug bites him. The key is tossed aside and is replaced by a mike. Unfortunately, most Novice c.w. transmitters do not have a built-in modulator. So, the next item to add to the ham shack is a modulator unit.

POPULAR ELECTRONICS built and operated the EICO 720 Modulator-Driver and found it to be a suitable unit for modulating most 100-watt transmitters. The modulator output transformer is tapped to match final r.f. amplifier loads from 500 to 10,000 ohms.

Assembly. If you ever assembled a hi-fi power amplifier, you will have absolutely no problems with this modulator-driver. Just follow the instruction book carefully, using standard audio practices when wiring.

If tight corners cause difficulty in wiring the indicator tube socket, loosen the socket bracket mounting screws and tilt the socket bracket forward. One other gripe which is common in building kits, concerns the connection of too many wires to a grounding lug. Fortunately, in this case an extra
Except for the power supply, this schematic diagram of the EICO Model 720 is complete.

An optional steel cover dresses up the modulator-driver for desktop use. Front and rear screens provide ample ventilation.

ground lug was packed in the kit, and two of them were used where only one was called for.

How It Operates. Dual-triode tube \( V1 \) is used as the microphone preamplifier, with the gain control \( R4 \) in the grid circuit of the second stage. A phone patch jack \( J2 \) is also located at a low-impedance point in the second stage. If the gain control is not set at minimum, mixing with the microphone is possible. An r.f. filter \( (R1, C1) \) is employed at the input of the first stage to reduce any possible tendency towards r.f. feedback.

A 6AL5 dual-diode \( (V2) \) is employed as a series-type clipper, with the clipping level controlled by potentiometer \( R9 \) in a voltage divider circuit. The clipper output is fed through a low-pass filter \( (L1, C5 \) and \( C6) \) to suppress high-order harmonics generated by peak clipping. The clipper prevents over-modulation and raises the effective speech level of the signal 8-12 db for added "punch" under QRM conditions.

A 6AN8 pentode triode \( (V3) \) is used as a pentode voltage amplifier direct-coupled to a triode split-load phase inverter; negative feedback from the secondary of the modulation transformer is introduced at the cathode of the voltage amplifier. And a pair of EL34 audio power amplifier tubes \( (V4 \) and \( V5) \), are operated in push-pull, class AB1, with fixed bias.

Visual indication of over-modulation is provided by an EM84 electron-ray tube \( (V6) \) when the Model 730 is employed as a plate modulator. Potentiometer \( R9 \) should be set so that the indicator bars approach each other closely but do not overlap. This indication corresponds to 100% modulation.

Getting on the Air. Following the instruction manual closely, the modulator-driver was connected to the EICO 720 transmitter. A crystal mike was used, with favorable results. QSA5 reports are still coming in.

If operation with a transmit-receive switch is desired, most receiver and transmitter manuals will give the necessary schematic diagram required. If you have any problems interconnecting the modulator-driver with a transmitter, just drop a line to EICO (Electronic Instrument Co., Inc., 33-00 Northern Boulevard, Long Island City 1, N. Y.)
IN MANY AREAS of the country the availability of good music from FM and AM stations has made the hi-fi tuner the cheapest and most convenient source of high-fidelity program material. Some 100 stations are today broadcasting AM-FM stereo simulcasts or experimental multiplex. The Federal Communications Commission has under consideration several proposals for multiplex transmissions—not only on FM stations but also on AM. All of this has greatly increased interest in hi-fi tuners.

Basically, a hi-fi tuner is a refined and specialized radio receiver. The big difference is that the tuner has no audio amplifier or speaker. It amplifies the radio signal, demodulates it, equalizes it (if necessary) and then delivers the audio component at a level of about 1 to 5 volts to the control unit of a hi-fi system.

Basic Principles. All commercial hi-fi tuners today are superheterodynes. The principle of the superheterodyne is no doubt familiar to most of our readers.

Figure 1 (A) is the block diagram of a superheterodyne AM tuner. The incoming radio signal, after being induced into the antenna, goes into the radio frequency amplifier where it is amplified at the original station frequency. The converter, consisting of a mixer stage and an oscillator, converts the incoming signal to a lower frequency. This conversion is also accompanied by additional amplification. The signal is further amplified by the i.f. (inter-
mediate frequency) amplifier at the new, lower frequency.

Next, the demodulator or detector separates the audio from the carrier. Sometimes a stage of audio amplification is employed to give the signal one last boost and then it is sent on to a cathode-follower output stage. This circuit couples the tuner to a hi-fi amplifier with little interaction and modification of the audio signal.

Only in specific particulars does FM circuitry differ from the AM circuitry outlined above. There may be an automatic frequency control circuit, and the i.f. amplifiers are usually followed by one or two stages of limiting. The FM demodulator or detector is also different from an AM detector. A block diagram of a typical FM tuner is shown in Fig. 1 (B).

Front Ends. The r.f. stage is one of the most important elements of a tuner because it determines how weak a signal the tuner can receive satisfactorily. Any electrical element, including a tube, generates some noise when a current flows through it. Thus, a signal that is introduced into a tube faces the competition of noise from the tube and its circuitry. Once noise gets into a circuit, it is amplified right along with the signal at every step of the way. Consequently, it is of utmost importance to keep noise to a minimum in the r.f. amplifier, the very first circuit.

The two most widely used types of r.f. amplifier circuits are the grounded-grid triode and the dual-triode cascode circuit. See Fig. 2. Triodes are favored over pentodes in FM r.f. stages because of their low-noise characteristics. However, the conventional grounded-cathode triode is not suitable for use in r.f. amplifiers due to problems of oscillation. Consequently, the grounded-grid circuit of Fig. 2 (A) was evolved. This circuit is very stable and, in addition, has excellent noise characteristics. Unfortunately, however, it is not capable of very high gain.

The cascode circuit of Fig. 2 (B) is capable of both high gain and low noise. This interesting circuit uses two triodes wired in series, with the plate of the left triode connected to the cathode of the right one. The left portion is a normal grounded-cathode stage; it does not oscillate because the right tube loads it too heavily to sustain oscillation. The right section is a grounded-grid amplifier; because its input is ideally loaded by the output impedance of the left tube, it produces much more gain than if it were used directly at the input and loaded by the antenna. The result is an r.f. stage which has the gain of a pentode but the noise figure of a triode. In addition to being used in hi-fi tuners, the cascode r.f. circuit is also commonly employed in TV receivers.

Automatic Frequency Control. The local oscillator of an FM tuner presents some big problems in stability. Ideally, once the tuner is tuned to a given station, the oscillator should maintain the exact same frequency. If it shifts frequency, distortion will result. If the oscillator frequency shifts as much as 200 kc.—and this is easily pos-

Fig. 2. Grounded-grid r.f. amplifier circuit shown in (A) is used in the Harman-Kardon FM-100 tuner. The cascode r.f. circuit of (B) is employed in the new Fisher FM-100.
sible at FM frequencies—the i.f. frequency produced by the converter may be completely outside the bandpass of the i.f. amplifier and the signal will not be heard at all. Constant adjustment would be necessary to keep the station in tune and to minimize distortion.

There are a few tuners using temperature compensation, permeability tuning and another special precautions that maintain oscillator stability within 25 kc. At least one tuner, the Karg, employs a crystal-controlled oscillator and thus achieves even greater stability, but this requires an individual crystal for each station to be received. Many manufacturers feel it is easier and much cheaper to solve the problem with an automatic frequency control circuit.

The principle of a.f.c. is not hard to understand. A tube can be circuitted so its input or output capacitance will vary in step with the bias on its grid. By varying the bias on such a tube, we have in effect an electronic variable capacitor. If we connect this electronic variable capacitor, or "reactance tube," across the frequency-determining tank of the oscillator, we can vary the frequency of the oscillator over a narrow range by varying the bias on the reactance tube.

Most happily for the operation of a.f.c. circuits, at the output of an FM detector we have not only demodulated audio but also a d.c. voltage which can be used to "key" the a.f.c. tube. When the station is exactly tuned in, this voltage is zero. But when the station is detuned one way, the voltage becomes positive; when it is detuned the other way the voltage swings negative. All we have to do is use this voltage as bias for our reactance tube.

When the oscillator tube starts drifting in frequency, the resultant change of bias applied to the reactance tube causes a change in the reactance tube's output capacitance. This capacitance is applied to the oscillator tank circuit and results in the retuning of the oscillator to its proper frequency. See Fig. 3. By proper design we can obtain correction in this way to take care of as much as 500-kc. drift, and thus automatically maintain the stability we need for proper reception.

Automatic frequency control is not all peaches and cream, however. Weak stations close to strong ones may be completely blanked out by stronger ones. Con-

**Fig. 3.** Automatic frequency control circuit used in the Sherwood S-2000 tuner. Triode on left is "keyed" by the d.c. voltage from the discriminator and presents a varying capacitive load to the oscillator tube at right. This keeps the oscillator circuit tuned to the proper output frequency.

**Fig. 4.** A limiter amplifies a signal to a point, then chops it off, thereby eliminating noise (in the form of amplitude modulations) superimposed on the signal.
sequently, many FM tuners provide a switch for switching out the a.f.c. when desired. Some have adjustable a.f.c. controls to allow variable amounts of a.f.c. action. And a.f.c. is not a "cure-all" for oscillator drift. For maximum sensitivity and lowest distortion, the oscillator should be designed to be as stable as possible before the addition of the automatic frequency control.

Some manufacturers of high-quality FM tuners, led by H. H. Scott, have gotten away from a.f.c. altogether by the use of extremely wide i.f. stages and detectors in their tuners. Should the oscillator drift slightly, the wide bandwidth will still pass the errant i.f. signal without distortion.

**The I.F. Amplifier.** In AM tuners a single i.f. stage, when added to an r.f. stage and a converter, can produce enough gain for hi-fi reception. Sometimes, however, two i.f. stages are used to increase the gain and to control the bandwidth more exactly. FM tuners usually have at least two i.f. stages, plus one or two limiters which also provide gain on weak signals.

In AM, the audio response depends on the i.f. bandwidth—the wider the bandwidth, the better the high-frequency response. Unfortunately, under present allocations in the AM band, with stations only 10-ke apart, the modulation of stations on adjacent channels causes the 10-ke. space to be shared between them. Thus, only when there is no station on either of the adjacent channels is it possible to receive anything resembling the full audio range without interference. In addition, the tuner's bandwidth would have to be from 20 to 40 kc. But, with such a broad bandwidth, the tuner could not separate stations on adjacent channels.

For this reason, more and more de luxe AM tuners are incorporating some type of variable i.f. bandwidth control. This allows the tuner to be adjusted for sharp tuning when there are adjacent stations, or broad tuning when there are no adjacent stations. "Narrow-band" operation usually provides a frequency response to about

(Continued on page 122)
Transistor Topics

By LOU GARNER

As of the latest count, well over a thousand different types of transistors have been introduced by semiconductor manufacturers, with new types announced almost on a month-to-month basis by nearly every major producer. If we add to this the several thousand types of diodes and rectifiers available, we find that the total number of types of semiconductor devices in current production far exceeds the total number of vacuum tube types. Unless some move is taken towards standardization, the day is not far distant when a several-hundred-page book will be needed simply to list available semiconductor devices.

This brings up a question which plagues the engineer, experimenter, factory technician, serviceman, and parts distributor alike: why so many types of semiconductor devices? As you might expect, there are several answers.

First, there is a definite tendency on the part of manufacturers to use type numbers peculiar to their own products. Transistors with very similar—if not identical—characteristics produced by different manufacturers are likely to carry different type numbers; this is in contrast to vacuum-tube manufacturing, where several firms may produce a single tube type.

In addition, most manufacturers tend to use different type numbers for even slightly modified versions of a specific component. Thus, a transistor may carry one type number if it comes in a conventional “flat” case, another in a round JETEC-30 case or a subminiature case, another if it is equipped with long flexible leads instead of short pins, another if its basting arrangement is changed, and perhaps still another if it is selected for low noise... even though its basic electrical characteristics remain the same.

A third important factor is the rate at which new developments are made. Semiconductor devices which are “impossible” today may become commonplace within a few short months as new design and production techniques are developed. This alone could lead to the introduction of scores of new types each year; it is offset,
In many instances, low-cost "experimenter's" transistors are units culled from various production runs after more expensive types have been selected. While all the transistors of a given experimenter's type will meet the basic specifications of the type, they may have widely varying individual characteristics; in a given batch, you may find some that work well at r.f. (even though listed as "audio"), some that have exceptionally high gain, and some that have very low noise.

If you have several transistors of a given type available, and are working with an especially critical circuit, you'll find it worthwhile to try each of your units... finally installing the one which gives best over-all performance.

**Readers' Circuits.** About 70% of the circuits submitted by readers are of simple broadcast-band receivers, and about 20% are of simple "earphone" amplifiers. The remaining 10% are of more complex receivers, audio amplifiers, instruments, and "gadgets." This month we are featuring three circuits from the latter group.

Reader Robert Bari (207 N. Washington Ave., Bergenfield, N. J.) sent in the circuit shown in Fig. 1. Combining a thermistor (Th1) with two transistors, this circuit offers a number of experimental possibilities and can be easily modified to meet special requirements.

Bob used the arrangement shown as an electronic thermometer, but indicates that it can be used as a temperature control device if the meter is replaced with an appropriate sensitive relay (one requiring less than 5 ma. at 1.0 volt for operation). The unit may be assembled quite easily in a single evening using standard, readily available components. Neither layout nor lead dress should be critical.

Referring to the schematic diagram, the thermistor is a Veco Type 31D7 unit. Battery B1 is a penlight cell and S1 is a push-button switch. In operation, the current passing through the meter is dependent on the bias current applied to the two transistors (Q1 and Q2). This, in turn, depends on B1's voltage, potentiometer B1's setting, and the thermistor's value.

Since the thermistor's resistance varies with temperature, the current through the meter (or relay, if one is used) varies also. As the thermistor's resistance is lowered, meter current increases, and vice-versa. The Type 31D7 thermistor has a negative

(Continued on page 114)
HOW would you like to work Australia, and Arabia, and many other foreign countries on the Novice bands? Well, they are there to be worked, and DX conditions are already improving after the usual summer letdown. In previous years, several Novices have worked over 100 different countries, and many have worked 50 or more. You can work your share if you are on the ball and do not have too much trouble making run-of-the-mill contacts.

To Whet Your Appetite. Ivor Strafford, VK3XB, 16 Byron St., Box Hill South E-11, Victoria, Australia, may have already called you if you do much early-morning operating on 40 meters. Ivor's ambition is to work Novices in all the states on 40 meters—as of this writing he has worked over 100 Novices in 15 states.

The sad part of this tale is that, although VK3XB calls Novices by the dozens in all call areas, they usually come back to a Novice in a neighboring state or call CQ again. But once Ivor raises a Novice and alerts him to the fact that his signal is traveling 9000 miles, they usually have little trouble working each other on subsequent mornings, proving that the first contact was no accident.

With two exceptions, the Novices that VK3XB has worked recently know it. But it will be news to KN4ZUC that he did not work K3XRV on May 14; he did work VK3XB! The same goes for KN5RVU on May 17!

September, 1959
Nasir will QSL promptly upon the receipt of your card.

**DX'ing All Countries.** Before we discuss how to work DX, it might be well to decide how far away a station should be before it can be considered DX. Most General Class DX-chasers classify any station over 2000 miles away and in a different country as DX. Most Novices, however, would probably rate any station over 1000 miles away as DX on 80 and 40 meters. On 15 meters, any station in another country, with the possible exception of Canada, is DX to most Novices. You might govern yourself accordingly when answering a "CQ DX."

The following discussion refers specifically to working foreign DX, but there is really no difference between working a new country and a new state, except that the competition is usually less for the new state.

Fifteen meters has been the Novice DX band up to now, and it will probably continue to retain the title. Nevertheless, as the present sunspot cycle continues its downward trend, the periods of good 15-meter DX conditions will be somewhat fewer, and of shorter duration, compared to last year. On the other hand, DX conditions on 80 and 40 meters are definitely improving. This is good news for night owls. For while DX is usually best when at least part of the signal path is through daylight on 15 meters, DX is an all-darkness proposition on 80 and 40 meters.

Let me emphasize that you do not need super equipment to work DX. Reading "News and Views" and observing the equipment used by the fellows who report working DX will prove this. Naturally, the better your equipment is, the easier it is to work DX—or locals. But more important than equipment in establishing a good record will be your operating.

Get a good map. You can use the country list in the back of the ARRL logbook to identify the countries you hear. But you will need a special world DX map centered on the United States to determine their distance and true great-circle direction from you. The multi-colored 30" x 40" DX Map, available from amateur supply houses, is excellent for the purpose. Smaller maps of this type are printed in the Call Book. It may be enlightening to compare one of these maps with a conventional world map.

**Listen!** Over half your success in working DX will depend on how well you listen. Naturally, you should concentrate on the weaker signals. But this does not mean (Continued on page 133)
BUILD a

Noise-Free Transistorized
Stereo Tape Preamp

DESIGNED for the stereo tape fan, this fully transistorized preamplifier can be used directly between a stereo tape deck and two basic or integrated amplifiers to form a complete professional-quality NARTB-equalized playback system. As for noise and hum pickup, it will outperform any vacuum-tube device anywhere near its price range.

Hum is inaudible, even with the gain full up. With no "moving parts" in the transistor, microphonics are nonexistent. At 2.5-millivolts tape head input, "hiss" is about 68 db below full output (1.5 volts or higher), barely audible with the volume control(s) wide open.

Construction. The two identical amplifier circuits are contained in a 2" x 3" x 5" aluminum chassis box. Most of the components are secured on lug-type terminal strips mounted on the bottom of the chassis. Two volume controls and a voltage adjustment potentiometer are...
mounted on the front apron. The input jacks, output leads, and battery are installed on the rear apron. Since parts layout is not too critical, the preamp can be built in a larger box, for example, a 5" x 7" x 2" box.

**PARTS LIST**

B1—8-volt battery (RCA VS309)
C1, C2, C3, C7, C8, C9—25-µF, 25-volt capacitor
C4, C10—0.022-µF, 200-volt paper capacitor
C5, C11—0.047-µF, 200-volt paper capacitor
C6—100-µF, 15-volt miniature electrolytic capacitor
J1, J2—Phono jack (RCA type)
PL1, PL2—Phone plug (RCA type)
Q1, Q2—2N1010 transistor (RCA—new type available at most supply houses)
R1, R4, R11, R14—560,000 ohms
R2, R12—15,000 ohms
R3, R13—1500 ohms
R5, R15—220 ohms
R6, R16—10,000 ohms
R7, R17—33,000 ohms
R8, R18—500,000-ohm audio taper potentiometer
All resistors
R9—100 ohms
R10—500-ohm linear taper potentiometer
S1—See text
I—2"x3"x5" chassis box (L. M. Bender #136)
Misc. knobs, hardware, terminal strips, grommet, and shielded wire

Drill the chassis as shown in the photographs. Note that one end lug is cut from each terminal strip so that it will fit between the edges of the chassis box. Mount the four strips so the lugs “face” the nearest open end of the chassis. The mounting feet of the tie lugs should “face” toward the center of the chassis.

Following the photos, install the capacitors first and then the resistors. Components R7, R17, C4, and C10 control equalization and their leads should not be wrapped around the terminal lugs if equalization adjustment is desired. Note also that a common tie-point is made at the junction of R5, R9, R15, and C6, halfway between the amplifier channels.

The jacks and potentiometers should be mounted and wired next. Pots R8 and R18 can be omitted if volume can be controlled at the amplifiers. In this case, output phono jacks (similar to J1 and J2) can be used with C5 and C11 connected directly to the “hot” terminals of the jacks. Output lead length is not critical.
Install a 9-volt battery (B1) and holder on the rear apron of the box. Include a power switch in series with the battery. This switch may be external or ganged with either of the input level pots. If the potentiometer-mounting switch is used, mark the panel so the control knob can be reset easily when the preamp is switched on.

When you install the transistors, make sure to protect them from heat by grasping each lead with long-nose pliers, between the solder point and the transistor body, to conduct away the heat.

**Testing.** Wire a 0-10 ma. d.c. meter in series with the negative battery lead to chassis ground. When the preamp is turned on, the meter should "pop up" (as the capacitors charge) and then drop to about 2 ma. (between 1.5 and 2.5 ma. is okay). If the meter reads higher or lower, there is probably something wrong you can tell which half of the preamp is at fault by separating the circuits at R5 and R15.

If the test circuit reading is correct, disconnect the meter. Set pot R11 to maximum resistance. With a VTVM or 20,000 ohms/voltmeter connected across C6, adjust R10 for an 8-volt reading (± 1/2 volt). This completes the adjustment.

**Setting Equalization.** The values shown for R7 and C4, and R17 and C10 provide NARTB equalization for the Viking Model "85" tape deck. If you use the preamp with a different tape head or prefer more bass (Continued on page 121)
He Did It
With Mirrors

DILIGENTLY studying the final plans for the best tracking route that would allow my latest project—a solar battery plant—to follow the sun around our yard, I failed to hear friend wife approaching the workshack until, too late, she was through the doorway and upon the scene. Naturally, she carried a coffee pot and a pair of cups.

“What’s with all the mirrors?” she demanded, indicating the large, parabolic mirrors and the small, flat mirrors littering the workshack. “You gone nuts over the sight of your own face or something? I always thought it was your alleged mind you were in love with.”

“Spare me the witty dialog,” I said. “You don’t know it, of course, but you are literally surrounded by the components of a plan which, put into effect, will free us forever from the clutches of the public utilities people. Can your domestic mind grasp the vastness of that concept, hey? No more electric bills! No more gas bills! I may even install a water pump and power it with juice from my own solar power plant!”

I laughed triumphantly, but it came out mildly hysterical. “Can’t you see their faces when I order them to disconnect our utility service! We’ll be free! FREE! As free as the sunlight pouring abundantly down from the open skies!”

Friend wife studied me closely.

“Come to think of it, you have been out in that hot sunshine an awful lot, lately. Maybe I better get you a couple of aspirins to go with the coffee.”

“Oh, I can hardly wait, I... tell... you!” I babbled, rubbing my hands together briskly. “Perhaps my brave stand will constitute a veritable social revolution, a mass exodus away from the current dependency upon those greedy public utilities. Naturally, I’ll charge a pretty penny for the use of my schematics, my tower-design blueprints—and we’ll live in utter luxury, utter luxury...”

“Look... Mac...” she jabbed an emphatic finger into my brisket. “If this utter luxury you’re yakking about don’t include hot water, gas for cooking and electric lights—start looking for another helpmeet right now. I don’t mind achieving weekly miracles with that miserly pit- tance you call a household budget, and I can stand watching other girls wear ermine and mink while I gab about in good, sensible woolens—but I either live in a pad that has the utilities turned on or you can mail my alimony checks to mother’s address!”

“Ahhhh, fret not!” I told her, an impish grin playing about my mouth. “You shall have all the light, all the heat, all the power to run a household—in fact, enough to run a hundred such households—that your avaricious little heart desires! What I’m pleading with you to understand is that none of it will cost us one, red cent beyond the sum necessary to build the tower, install the mirror system and energy-converter, and bring all that gorgeous, free power into the house!”

“You’re gonna get electricity from sunshine?”

“Sure am!”

She backed off toward the door, a wary step at a time. “Why,” she whined, “can’t...
you just ruin the electrical appliances and short out the TV set like other husbands?"

Six Weekends of consecrated thought and labor later, I stood in the back-yard gazing hopefully up to the top of the 20' steel tower where I had just finished installing the most brilliantly conceived and constructed solar battery plant ever to be modified from standard, unimaginative plans sold anywhere.

Suddenly, the wife stepped onto the porch behind me.

"How come it's not doing anything?"

"Mainly," I said patiently, between molars already ground to the gums from patience, "because I haven't thrown the switch that will activate the motor which will, in turn, start the heliostat on its journey."

She didn't even bother to muffle her snicker.

"This . . . uh . . . heliomajig—what's the bit, anyway?"

"By an ingeniously modified tracking mechanism, I have set up the heliostat to follow the sun's direct rays and simultaneously direct them to the larger mirror—the parabolically ground one—which, in turn, will transfer the energy-laden rays into the storage cells located in that housing just below the whole works."

"And how're ya gonna keep this gismo running if the electric company turns off the power? Answer me that! You just finished saying you had to—"

I crossed my arms over my chest and leered.

"Yes, we must depend upon outside current—for a brief time until the solar plant has absorbed enough natural energy to allow us to run it, from its own batteries, upon solar converted electricity which it obtained itself."

"I don't dig the explanation, but leave me out of that 'we' business," she said.

"Whatever happens, I'm just an innocent bystander who is entitled to alimony if you alienate the power people. Personally, though, I think this gimmick is . . ."

Quietly, I threw the switch which fed juice to the tracking motors. Smoothly, silently, the entire tracking mechanism began its rotation cycle—barely perceptible to the eye. I made a notation of position for checking later in the day.

"Well?" demanded the wife.

"It's working. It's simply a matter of an occasional position check for the next couple of days—to make certain the mirror is staying in proper reference to the direct rays of the sun."

"I have a premonition," she murmured darkly.

"You've got a million of them," I observed sourly.

"Something's wrong, somewhere," she persisted. "That gismo should be hissing or sparking or burning—or doing something goofy and unexpected."

"It's doing precisely what it was built to do," I gloated. And I went off to enjoy a nap during the heat of a triumphant Saturday afternoon.

Some hours afterward—just as I was in the middle of a superb, technicolor

(Continued on page 132)
Transistor Amplifier for Toy Telephones

By J. E. PUGH, Jr.

Toy Telephone Sets found in most department stores usually have one major defect —low volume. The addition of a simple one-transistor amplifier not only "soups up" the volume but improves intelligibility.

The telephone set used in this conversion was a Zimphone, with each hand unit in the set consisting of a carbon microphone, a magnetic earphone, and a single flashlight cell. Any similar set—including conventional telephones now available on the surplus market—should work just as well. "Before" and "After" diagrams show the simple electrical modification on the Zimphone.

Identify all the wires in your set, both internal and external, and compare them with the wire color code in the "Before" diagram. If your color code is different, change the coding on the diagram to conform.

After soldering the transistor and resistor in place, tape all connections and gently press all internal wires and parts down into the back of the telephone handle. Be careful when you solder inside the handle because it is made of meltable plastic. And apply solder to the negative battery terminal quickly as this terminal is anchored in the plastic.

Put a dab of red paint on the positive battery terminal to aid in placing the battery in correctly. Reversed polarity can ruin the transistor.

**HOW IT WORKS**

In the original circuit, switch S1 connects the microphone to the battery and to the two parallel-connected phones (its own and that in the second telephone unit). The signal from the microphone is applied direct to the earphones without amplification. In the modified circuit a simple transistor amplifier is placed between the mike and two phones to boost the signal before it reaches the phones.

A medium-power transistor is used to give good power transfer as its input and output impedances are a reasonably close match for the mike and phones. The carbon microphone and a 1000-ohm resistor are used to bias the transistor base.

When the amplifier is in use, the mike resistance changes, and thus changes the base bias. The amplified collector output current flows through the load (the two magnetic earphones in parallel) to give a comfortable listening level. An identical amplifier in the second telephone unit sends an amplified signal back to the first earphone.

The original buzzer circuit is satisfactory and does not need to be modified.

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**BEFORE ▲**

**AFTER ▼**

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POPULAR ELECTRONICS
Mention the word distortion to a hi-fi enthusiast or a broadcast engineer and his emotional response will be about the same as that of a forest ranger at the sound of the word fire. But distortion does not always play the role of a villain; sometimes it is both intentional and helpful.

Many radar, computer and industrial electronic circuits use intentional distortion as a means to an end. Most such circuits fall into the general category of wave shaping circuits which are useful for changing one waveform into another—a sine wave to a square wave, a square wave to a pulse, a pulse to a saw-tooth waveform, etc.

Top Chopping. The grid limiter squaring circuit shown in Fig. 1 converts a sine-wave input to a square-wave output. The cathode of the tube is operated at ground potential and, as a result, the grid is more positive than the cathode during the positive half-cycle of the sine-wave input. So, grid current flows, and produces a voltage drop across resistor R as in Fig. 1.

Since the positive half-cycle of the sine-wave input is dropped across R, it is effectively eliminated. An oscilloscope connected to the grid side of resistor R would show a half-wave pattern with the positive alternations missing.

The peak of the negative half-cycle of sine-wave input drives the grid below cutoff and is therefore clipped. Since the positive alternation and the peak of the negative alternation are eliminated, all that remains of the original sine-wave is a "slice" out of the center. As shown in Fig. 1, this slice is essentially a square wave.

Such a circuit is operated with large-amplitude input signals and with low values of B voltage so that the tube can be more easily driven to cutoff. For the same reason, a sharp cutoff tube is commonly used. Because the tube is driven into saturation during the positive half cycle and into cutoff during the negative peaks, the circuit is often referred to as an overdriven or a distortion amplifier.

It's a Pip! The differentiator circuit, familiar to the TV technician, is shown in Fig. 2. This circuit converts a square-wave input to a series of positive and negative "pips." As the voltage rises during the leading edge of the square-wave input, capacitor C charges through resistor R. This charging current produces a voltage drop across R which constitutes the positive pip of the output.

The time constant of the circuit is very short as compared to the period of the square-wave input, so C becomes fully charged in a very short time. It is for this reason that the output pip is narrow.
During the trailing edge of the square wave, the input voltage drops rapidly from its positive level to zero and then increases in the negative direction. This causes capacitor \( C \) to discharge and then recharge in the opposite direction. Since the current flow through \( R \) is now in the opposite direction, the voltage drop across it produces a negative output pulse.

**Taking a Pulse.** In the circuit shown in Fig. 3, distortion is employed to change a square-wave input to a series of narrow pulses. The coupling capacitor and grid resistor are chosen to have a very short time constant as compared to the period of the square-wave input. Consequently, these components act as a differentiator and a series of positive and negative pips appear at the grid.

A negative potential, applied to the grid, biases the tube below cutoff so that only the positive pips bring the tube up into its conducting region. Each positive pip on the grid therefore produces a flow of plate current, and the plate voltage decreases because of the drop across the plate load resistor. Thus, the plate waveform consists of negative-going pulses.

The positive pips on the grid not only bring the tube above cutoff but drive it all the way to saturation. As a result, the sharp tip of the input is clipped off. Because it produces narrow output pulses, this circuit is often referred to as a pulse-narrowing stage.

**One-Shot Saw.** The single-sweep circuit shown in Fig. 4 produces a saw-tooth output each time a negative pulse is applied to the input. Because the tube is operated without bias, it draws considerable plate current and most of the supply voltage is dropped across the plate load resistor.

Capacitor \( C \) charges to the low voltage at the plate of the tube. If a negative pulse is now applied to the input, the grid of the tube will be driven below cutoff. Since the plate current is now reduced to zero, the plate voltage of the tube rises and capacitor \( C \) charges to a higher level. It is this increasing charge that produces the rise of the saw-tooth waveform.

Capacitor \( C \) continues to charge for the duration of the negative input pulse. When this pulse is completed, the tube is no longer cut off and the plate voltage decreases to its initial low value. Capacitor \( C \) now discharges rapidly through the conducting tube, producing the back edge of the saw-tooth waveform.

As the foregoing circuits illustrate, distortion is a useful method of wave shaping. Because of the increasing use of pulse circuitry in all phases of the electronic art, the technician should learn to think of distortion as a tool.
Our featured DX'er this month is Lloyd Alford of 811 Riverside Drive, London, Ontario. He is a business merchant and, with his son, Graham, deals in retail auto accessories and sporting goods.

A fairly recent newcomer to the ranks of DX'ing, Lloyd started about three years ago. He has consistently kept your Short-Wave Editor informed of his DX'ing activities, and a short time ago he became the proud owner of Canadian amateur license VE3CRG.

Besides DX'ing, Lloyd's hobbies include photography, tapesponding, and building equipment. So, while his listening post features a Hallicrafter SX-100—connected to a WRL doublet antenna with wave traps—and a Bach-Simpson wave meter, you will also find there two tape recorders, a complete stereo setup, and numerous pieces of test equipment that he built from kits. In all, Lloyd has assembled 28 Heath-kits, ranging from a crystal receiver to a DX-100 transmitter. His latest project is the Apache kit.

Lloyd does very little reporting to the short-wave stations, but he is a member of the Newark News Radio Club and the International Shortwave League. His favorite band is 20 meters and his preferred frequency range for amateur transmissions is the 80-meter band. Watch for him operating around 3600 kc.

VE3CRG will be glad to work anyone on the air, but requests that you hold your code to about 13 words per minute until he is able to build up his speed.

(Continued on page 138)
It was a beautiful morning in late August, and Carl and Jerry, with Carl's dog, Bosco, perched between them, were sitting on Jerry's front steps trying desperately to think of something interesting to do. After all, school started in another week, and time was a-wastin'!

"Hey, Joe, what you got in the basket?" Carl called to a boy who was walking along the sidewalk with a market basket on his arm.

"Pups," Joe answered, and he walked over and tilted the basket to reveal two tiny squirming little fellows with tightly closed eyes. "I'm taking them down to the veterinarian to have them chloroformed."

"How come?" Jerry asked as he stroked one of the whimpering little dogs with his finger. "They look kind of cute to me."

"Yeah," Joe said with a voice suddenly gone hoarse; "they do to me, too. But their mother was killed by a car last night, and they're too young to get along without a mother. Dad says putting them to sleep is the only humane thing to do. We men know things like that have to be done sometimes, but he's going to have a tough job selling the idea to my kid brother, Davey. Davey's only five, and he's talked of nothing but those pups since they were born a couple of days ago. He's going to take it real large when he learns what happened to them."

For a few moments the three boys were silent, remembering how they would have felt at Davey's age. It was obvious from the way Carl's arm tightened about Bosco's neck that he wasn't feeling much different right now.

"Let us have them!" Jerry suddenly blurted.

"Why? What will you do with them?" Joe asked with a puzzled frown.

"I've got an idea I want to try. If it works, we'll save the pups for Davey. If not—well, Carl and I can still do what you were planning."

"Buddy, you've got yourself a deal!" Joe exclaimed, setting the basket on the step and straightening up as though he had rid himself of a tremendous burden. "I'll just tell Davey the pups are in a kind of hospital where maybe they can be saved. At the worst, that will let him down easy. I'll go right home now and give him the word before Dad tells him they're dead."

"Are you planning for us to spend all the time left before school starts baby-sitting with those pups?" Carl asked Jerry.

"Nope, I intend to turn that job over to a surrogate mother."

"To a what kind of mother?"

"Surrogate. That's a fancy scientific word meaning 'substitute.' A while back I was reading where the American Psychological Association has been experimenting..."
with surrogate mothers for little monkeys. A block of wood was covered with sponge rubber; terry cloth was stretched over this; and a light bulb was placed behind the arrangement to radiate heat. The result was a monkey mother that was always warm and soft and tender. Once the infant monkey was accustomed to the substitute, he ran to it for protection and showed as much affection for it as for a real mother. My idea is for us to make a surrogate mother for the pups; and from that whimpering they’re doing, we’d better be about it. I’ll bet they’re getting plenty hungry. Bring them down to the lab."

IN THEIR basement laboratory the boys began assembling parts for the "mother," improvising as they went along. A stout cardboard carton about two feet square and a foot deep was selected. A piece of heavy, coarse screen was bent in a U-shape and arranged so that the open end of the U could be fastened against one side of the box. The outside of the U was covered with an inch-thick layer of soft foam rubber. Matching holes were cut in the side of the box, the screen, and the foam rubber, so that two nursing bottles could be inserted in openings in the sides of the box and the nipples would protrude through the foam rubber. The bottles slanted downward at about a 45° angle.

Next, a 40-watt lamp bulb and an old thermostat of the mercury-switch type were installed in the hollow space of the U and connected to the light line, so that the thermostat turned the light bulb on and off with changes in temperature and kept the temperature inside the hollow nearly constant.

"Now we’ve got to know the skin temperature of a dog," Jerry announced. "I suppose I better scamper upstairs and see if I can find it in the encyclopedia."

"Perish the thought!" Carl exclaimed as one long arm picked a small thermometer off the wall and the other grabbed the dog, Bosco, by a hind leg. "A true scientist never relies on other sources of information when he can make his own observation."

The wild-eyed, apprehensive Bosco was flapped over on his back, and the thermometer was tucked firmly between an upper foreleg and his body. There it stayed for a couple of minutes in spite of his squirming, growling protest. Then Carl removed the thermometer and read it quickly.

"A dog’s skin temperature is about ninety-two degrees," he announced.

With the thermometer placed against the foam rubber, the thermostat was adjusted to hold the temperature constant at this figure. Next, the boys filled the bottles with milk and put them in position. The pups were transferred from the basket to the box and were coaxed and cajoled into nursing from the bottles. This took a little patience and doing, but once the little dogs got the idea, they took the milk warmed by the light bulb hungrily and noisily.

"Well, now," Jerry said proudly as he watched the puppies; "I’d say Alma Mam-

ma was a huge, it not a ‘howling,’ success; wouldn’t you?"

"Almost perfect," Carl agreed.

"What do you mean, ‘almost’?" Jerry demanded. "What could a real mother do for the pups that Alma Mamma can’t?"

"Well," Carl said slowly, looking at one of the puppies that had wandered blindly into a far corner of the box and was whimpering disconsolately, "a real mother would hear that little dog crying and comfort him by nuzzling and licking him; but of course we can’t make Alma Mamma do that."

"Why-y-y-y not?" Jerry demanded with a rising, challenging inflection made famous by a TV comedian. "Go over and get your voice-control unit while I see if I can find that geared-down little motor of ours. Bring your lapel mike, too."

WHEN Carl returned, Jerry was already busy fastening slabs of sponge rubber to a section of broom-handle so as to form a four-bladed paddle wheel. Each sponge blade was just wide enough to fit inside the box; and when the broom-handle shaft
was arranged in a couple of bearings across the top of the box, the blades brushed the bottom of the box as the shaft was revolved. A belt went from a pulley on the end of the broom-handle to a smaller pulley on the slow-speed shaft of the gear-box of the little motor. When the motor was running, the rubber blades moved across the bottom of the box at the rate of one every five seconds.

The voice control, or VOX, unit was an electronic device that permitted sounds picked up by a microphone to close the contacts of a relay and hold them closed for two or three seconds. Such a unit is often used with a transmitter, especially a single-sideband suppressed-carrier type, to turn on the transmitter when the mike is spoken into and to turn it off when the operator stops speaking.

They fastened the lapel mike inside the top of the box and connected it to the VOX unit. The relay contacts of the unit turned on the motor when they closed, and a cam on the broom-handle operated a microswitch in parallel with the contacts. The cam was arranged so that once the VOX unit started the shaft turning, the cam-operated switch took over and kept it going for a complete revolution. Then it stopped until a sound striking the microphone started it again.

Jerry dampened the sponge blades, and the boys watched in silence to see how the Rube Goldberg device would work. Soon one of the little dogs gave another whimper. Instantly the motor started, and the yielding, soft rubber blades moved caressingly over the tiny body, nudging it gently back toward the milk supply and leaving its hair slightly damp as though it had been licked. The puppy stopped whimpering, and at the same time the paddle wheel stopped.

Carl and Jerry shook hands in a gesture of mutual congratulation and then tiptoed out of the basement. Several times during the day, though, they checked on the pups and their surrogate mother; and each time they found things just fine. Before going to bed, Jerry replenished the bottles with clean, fresh, sweet milk and dampened the sponges of the “nuzzling and licking” device again.

SOMETIME during the night, Jerry awakened at the sound of a violent thunderstorm roaring about the house. As he lay there in the darkness, he was aware of a disturbing sound that was not part of the growling thunder or pouring rain. It was a rhythmic and muffled “thump, thump, thump” and seemed to be coming from the furnace register.

He slipped out of bed and went to investigate. As he turned on the basement light, he saw a stream of water as thick as his arm pouring in through an open basement window, and the floor was already covered with an inch or so of water. The water was coming from a downspout that had broken just above the window, and the drain in the floor had clogged.

Jerry called his father, and the two of them quickly cleared the drain and diverted the water from the broken downspout away from the window. It was not until then that Jerry had time to think of the pups and their surrogate mother. The box was gone!

As he searched wildly about the wet basement, Jerry heard the same thumping sound that had awakened him. Then he saw the cardboard carton wedged against the side of the gas furnace with its paddle wheel turning.

Water had floated the two-by-four platform on which the carton was placed to keep it up off the damp floor and to provide (Continued on page 110)
get a real head start in work you like!
choosequalifyknow...beforeenlistment

It’s up to you! The Army’s new “Choose-it-Yourself” System lets you choose your vocational training before you enlist! Here’s how it works:

1. CHOOSE ... before enlistment!
Choose your training from fields like Metal Working, Electronics, Motor Maintenance, Guided Missiles, Radar & TV Repair—and many more.

2. QUALIFY ... before enlistment!
Next you take aptitude and physical examinations to qualify for the training you’ve chosen.

3. KNOW ... before enlistment!
If you qualify, you know you’ll get the training you like. Your choice is written into your future Army record—guaranteed before you enlist.

AND THERE’S NO OBLIGATION! Choose, qualify and know—without the slightest obligation to enlist. You get the Army training you like—guaranteed in writing—or you don’t enlist! This week, see your Army recruiter and choose from his complete list of available fields.

CHOOSE IT YOURSELF VOCATIONAL TRAINING SYSTEM US ARMY

September, 1959
do-it-yourself kits put top quality within easy reach

With absolutely no previous experience or knowledge of electronics you can assemble your own HEATHKIT hi-fi system, Ham station, test equipment or marine gear. Easy to understand step-by-step instructions, along with large pictorial diagrams, guarantee your success—and you save 10% or more on the highest quality equipment available today at any price!

STEREO EQUIPMENT CABINET KIT

A thing of beauty as well as utility, this stereo equipment cabinet ensemble houses your complete stereo hi-fi system. It consists of a stereo equipment center flanked by two stereo speaker enclosures. The kit is supplied with mounting panels pre-cut to accommodate Heathkits and interchangeable blank panels are also furnished. The pre-cut panels accommodate the Heathkit AM-FM Tuner (PT-1), Stereo Preamplifier (SP-2), and Stereo Record Changer (RP-3-S). The changer slides out smoothly for easy record loading. Convenient record and tape storage space is provided. Ample room is provided in the rear of the center cabinet for a pair of matching Heathkit amplifiers from 12 to 70 watts. The stereo wing speaker enclosures are open-backed, cloth-grilled cabinets designed to hold the Heathkit SS-3 or similar speaker enclosures. The cabinets are available in beautifully grained 3/4" solid core Philippine mahogany or select birch plywood suitable for the finish of your choice. Entire top features a shaped edge. Hardware and trim are of brushed brass and gold finish.

DIAMOND STYLUS HI-FI PICKUP CARTRIDGE

Get the most from your LP microgroove records. Designed to Heath specifications by Fairchild Recording Equipment Corporation, the MF-1 is one of the finest pickup cartridges on the market today. Shpg. Wt. 1 lb.

ENJOY A HOME HI-FI SYSTEM NOW... PAY LATER...

Heath's convenient Time Payment Plan allows you to buy all of your hi-fi components right away... and pay for them in easy installments. Only 10% down on purchases of $35 or more. Send coupon today for FREE Heathkit catalog with full time-pay details.

CHAIRSIDE ENCLOSURE KIT

Put your entire hi-fi system right at your fingertips with this handsome enclosure. Available in either traditional or contemporary models and constructed of beautiful veneer-surfaced plywood suitable for the finish of your choice. It is designed to house the Heathkit AM and FM Tuners (BC-1A and FM-3A), the WA-P2 Preamplifier, the RP-3 Record Changer, and adequate space is provided for any Heathkit amplifier designed to operate with the WA-P2. All parts precut and predrilled for easy assembly. Shpg. Wt. 46 lbs.
NEW! 14-WATT HI-FI ECONOMY AMPLIFIER (EA-3)
From HEATHKIT audio labs comes an exciting new kit... New Styling, New Features, Brilliant Performance! Designed to function as the "heart" of your hi-fi system, the EA-3 combines the preamplifier and amplifier into one compact package. Providing a full 14 watts of high fidelity power, more than adequate for operating the average system, the EA-3 provides all the controls necessary for precise blending of musical reproduction to your individual taste.

NEW HEATHKIT EA-3
$29.95

"BASIC RANGE" HI-SPEAKER SYSTEM KIT
With performance comparable to speakers costing many times more, the SS-2 employs a Jensen 8" woofer and compression-type tweeter to provide total frequency response of 50 to 12,000 CPS. Shpg. Wt. 26 lbs.

ATTRACTIVE BRASS TIP ACCESSORY LEGS: convert the SS-2 into handsome console. Shpg. Wt. 3 lbs. No. 91-26. $4.95.

BASIC FIR MODEL: same as SS-2 except constructed of non-premium plywood without trim or grille cloth. Shpg. Wt. 26 lbs. Model SS-3. $34.95.

BUILD IT IN ONE EVENING
HEATHKIT SS-2
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HIGH FIDELITY FM TUNER KIT
The thrills of FM entertainment are yours at budget cost with this handsomely styled tuner. Featuring broad-banded circuits for full fidelity and better than 10 microvolt sensitivity for 20 db of quieting, the FM-3A pulls in stations with clarity and full volume. Shpg. Wt. 8 lbs.

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"EXTRA PERFORMANCE" HI-FI 55 WATT AMPLIFIER KIT
Offering full fidelity at less than a dollar per watt, the power output of this remarkable amplifier is conservatively rated at 35 watts from 20 CPS to 20 kc with less than 2% total harmonic distortion throughout this entire range. Shpg. Wt. 28 lbs.

HEATHKIT W-7M
$54.95

MONAURAL-Stereo AM-FM TUNER KIT
This professional quality 16-tube tuner offers you outstanding AM, FM or stereo AM/FM performance at minimum expense. Features include individual flywheel tuning and automatic frequency control. A multiple jack is also provided. Shpg. Wt. 24 lbs.

HEATHKIT PT-1
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MONAURAL-Stereo (two channel mixer) PREAMPLIFIER KIT
Control your entire stereo system with this 2-channel preamplifier. A remote balance control with 20' of cable allows balancing the stereo system from listening position. Shpg. Wt. 15 lbs.

HEATHKIT SP-2
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HIGH FIDELITY TAPE RECORDER KIT
Whether making your own recordings or playing pre-recorded tapes you'll enjoy the many fine features of this tape recorder kit. Included are fast forward and rewind functions and choice of 7½ or 3¼ IPS tape speeds. Printed circuit boards simplify assembly. Shpg. Wt. 24 lbs.

HEATHKIT TR-1A
$99.95

Includes tape deck, tape recorder electronics, microphone and roll of blank tape.

AUTOMATIC HI-FI RECORD CHANGER KIT
Combining the convenience of an automatic record changer with true turntable quality the RP-3 obtains full fidelity from your hi-fi and stereo records while treating them with the care they demand. A "turntable pause" feature prevents records from dropping on moving turntable or disk. Plays at 33⅓, 45, 78 and 16 RPM. Shpg. Wt. 19 lbs.

HEATHKIT RP-3
$64.95

(stereo model RP-3S $74.95)
Mobile Fun! With all New Heathkit Mobile Ham Gear

HEATHKIT TX-1  $234.95

"APACHE" HAM TRANSMITTER KIT
Features 150 watt phone input and 180 watt CW input. Provision for single-sideband transmission using the SB-10 External Adapter. Shpg. Wt. 110 lbs.

HEATHKIT RX-1  $274.95

"MOHAWK" HAM RECEIVER KIT
Covers from 160 through 10 meters on 7 bands with an extra band calibrated to cover 6 and 2 meters using a converter. Outstanding SSB reception. Shpg. Wt. 66 lbs.

HEATHKIT SB-10  $89.95

SINGLE SIDEBAND ADAPTER KIT
A compatible plug-in adapter unit for the "Apache" Transmitter, the SB-10 covers 80, 40, 20, 15 and 10 meter bands. Produces USB, LSB or DSB signals, with or without carrier insertion. Shpg. Wt. 12 lbs.

HEATHKIT DX-40  $64.95

PHONE AND CW TRANSMITTER KIT
Providing phone and CW operation on 80, 40, 20, 15, and 10 meters, the DX-40 features built-in modulator and power supplies. Shpg. Wt. 25 lbs.

HEATHKIT MP-1  $44.95

MOBILE POWER SUPPLY KIT
Furnishes all power required to operate both MT-1 Transmitter and MR-1 Receiver from 12-14 volt battery. Delivers full 120 watts continuously or 150 watts intermittently. Kit includes 12' battery cable, tap-in studs for battery posts, power plug and 15' connecting cable. Shpg. Wt. 8 lbs.

HEATHKIT MR-1  $119.95

"COMANCHE" MOBILE HAM RECEIVER KIT
Handsome styling, rugged construction, top quality components and economy are all wrapped up in the "Comanche". It is an 8-tube superheterodyne receiver operating AM, CW and SSB on the 80, 40, 20, 15 and 10 meter amateur bands. Operates from 12 volt car battery through the MP-1 Mobile Power Supply. Can be converted in minutes to a fixed station unit by using an AC power supply. Shpg. Wt. 19 lbs.

MOBILE ACCESSORIES
Quality 5" PM speaker in rugged steel case with mounting brackets. Heathkit AK-7. $5.95. Shpg. Wt. 4 lbs.

Mobile base mount holds both transmitter and receiver. Universal floor mounting bracket. Heathkit AK-6. $4.95. Shpg. Wt. 5 lbs.

HEATHKIT TX-1  $234.95

"CHEYENNE" MOBILE HAM TRANSMITTER KIT
The fun and convenience of mobile operation are yours with the compact and efficient "Cheyenne" Transmitter. Featuring high power with minimum battery drain, the unit provides up to 90 watts phone input and covers 80, 40, 20, 15 and 10 meters. Featured are a built-in VFO, modulator, 4 RF stages with a 6146 final amplifier pi network (coaxial) output coupling. The "Cheyenne" is designed as a companion to the "Comanche" receiver and is powered by the MP-1 Power Supply. Shpg. Wt. 19 lbs.

HEATHKIT TX-1  $234.95

"SENeca" VHF HAM TRANSMITTER KIT
General, technician or novice class hams wishing to extend transmission into the VHF region will find the "Seneca" ideal. A completely self-contained 6 and 2 meter transmitter, the VHF-1 features up to 120 watts input on phone and 140 watts input on CW in the 6 meter band. Included are controlled carrier phone operation, built-in VFO for both 6 and 2 meters, and four switch-selected crystal positions. Shpg. Wt. 56 lbs.

Always say you saw it in—POPULAR ELECTRONICS
ETCHED CIRCUIT VTVM KIT

World's largest selling VTVM, the V7-A measures AC voltage (RMS), AC voltage (Peak-to-peak), DC voltage and resistance. Features 7 AC (RMS) and DC voltage ranges of 0-1.5, 5, 15, 50, 150, 500 and 1500. In addition there are 7 peak-to-peak AC ranges of 0-4, 14, 40, 1', 400, 1400 and 4000. Seven e:cmeter ranges are provided. Battery and test leads are included with kit. Shpg. Wt. 7 lbs.

TUBE CHECKER KIT

An invaluable aid to servicemen, the TC-3 tests for open, short, leakage, heater continuity and quality of all tube types commonly encountered in radio and TV servicing. Checks 4, 5, 6 and 7-pin large, 7 and 9-pin miniature, 7-pin sub-miniature, octal and loctal tubes and pilot lamps. A blank socket provides for future tube types. Shpg. Wt. 12 lbs.

TV PICTURE TUBE TEST ADAPTER

For use with TC-3 or earlier model TC-2. Includes 12-pin TV tube socket, 4' cable. Octal connector and data. No. 355. Shpg. Wt. 1 lb. $4.50.

“PROFESSIONAL" 5" DC OSCILLOSCOPE KIT

Offering complete versatility, the OP-1 features DC coupled amplifiers and also DC coupled CR tube unblanking. Triggered sweep circuit operates on internal or external signals and may be either AC or DC coupled. Transformer operated power supply has silicon diode rectifiers. Shpg. Wt. 34 lbs.

“GENERAL PURPOSE" 5" OSCILLOSCOPE

Ideal in servicing as well as routine laboratory work, the OM-3 features wide vertical amplifier frequency response, extended sweep generator operation and improved stability. Vertical response is within ±3 db from 4 CPS to 1.2 mc. Sweep range covers 20 CPS to over 150 kc. Shpg. Wt. 22 lbs.

VISUAL-AURAL SIGNAL TRACER KIT

Doubling as a utility amplifier, test speaker, or substitution transformer, the T-4 represents an outstanding buy. Traces RF, IF and audio signals in AM, FM and transistor-type radios. Shpg. Wt. 5 lbs.

RF SIGNAL GENERATOR KIT

Aligns RF, IF and tuned circuits of all kinds. Provides extended frequency coverage in five bands from 100 kc to 110 mc on fundamentals and up to 220 mc on calibrated harmonics of the fundamental frequencies. Shpg. Wt. 8 lbs.

IN-CIRCUIT CAPACITANCE-TESTER KIT

Check capacitors for "open" or "short" right in the circuit. Detects open capacitors from 50 mfd up and checks shorted capacitors up to 20 mfd. Checks all bypass, blocking and coupling capacitors of the paper, mica and ceramic types. Shpg. Wt. 5 lbs.

TEST OSCILLATOR KIT

Provides fast and accurate selection of test frequencies most used by servicemen in repairing and aligning modern broadcast receivers. Five fixed-tuned frequencies are quickly selected for trouble-shooting. Shpg. Wt. 4 lbs.
HEATHKIT US-1
$7.50

12" UTILITY SPEAKER
This high quality auxiliary speaker offers many possibilities in audio, radio and TV work and will handle up to 12 watts with a frequency response from 50 to 9,000 CPS ± 5 db. Speaker impedance is 8 ohms and employs a 6 1/2 ounce magnet. Shpg. Wt. 7 lbs.

HEATHKIT BR-2
$18.95

BROADCAST BAND RADIO KIT
Fun to build, and a fine receiver for your home. Covers complete broadcast band from 550 to 1600 kc. Built-in 5½” PM speaker and rod-type antenna. Transformer operated power supply. Excellent sensitivity and selectivity. Shpg. Wt. 10 lbs.

Cabinet optional extra: No. 91-9A. Shpg. Wt. 5 lbs. $4.95.

HEATHKIT AK-1
$9.95

MICROPHONE ACCESSORY KIT
Useful in countless applications, this kit consists of a rugged high fidelity crystal mike and three holders; a mike stand adapter, a lavaliere neckband and desk stand. An 8’ cable with phone plug is included. Shpg. Wt. 1 lb.

HEATHKIT TI-1
$25.95

ELECTRONIC TACHOMETER KIT
Easy-to-build and simple to install. Operates directly from the spark impulse of any 2 or 4 cycle engine with any number of cylinders. Operates on 6, 8, 12, 24 or 32 volt DC systems and is completely transistorized. The easy-to-read indicator shows RPM from 500 to 6,000. A calibration control is also provided. Shpg. Wt. 4 lbs.

HEATHKIT XR-1P
$29.95

6 TRANSISTOR PORTABLE RADIO KIT
This easy-to-build portable radio offers fun and enjoyment for the whole family. Features 6 transistors, large 4” x 6” PM speaker for “big-set” tone quality, and built-in rod-type antenna. Uses standard size “D” flashlight cells for extremely long battery life (between 500 and 1,000 hours). The modern molded plastic case with pull-out carrying handle is two-tone blue with gold inlay and measures 9” L x 7” H x 3½” D. Shpg. Wt. 6 lbs.

Complete Engine "Tune-Up" Facilities!

Let your boy learn radio

HEATHKIT CR-1
$7.95

CRYSTAL RADIO KIT
Any youngster interested in radio or electronics will enjoy building and using this fine little crystal receiver. Frequency coverage is from 540 to 1600 kc. A scaled germanium diode is used for detection —no critical "cats whisker" adjustment. Headphones included. Measures 6” L x 3” W x 2½” D. Shpg. Wt. 3 lbs.

COMPLETE TOOL SET
This handy tool kit provides all the basic tools required for building any Heathkit. Includes pliers, diagonal sidecutters, screwdrivers, and soldering iron with holder. Pliers and sidecutters are equipped with insulated rubber handles that provide protection from electrical shock. All of the tools are of top quality case hardened steel for rugged duty and long life. Shpg. Wt. 3 lbs.

Always say you saw it in—POPULAR ELECTRONICS
**2-BAND TRANSISTOR RADIO DIRECTION FINDER KIT**

Economically powered by 6 standard flashlight cells, the DF-2 provides you with a completely portable 6-transistor standard and beacon band receiver of unusual quality and performance. Covers the beacon band from 200 to 400 kc and broadcast band from 540 to 1620 kc. A tuning dial light is provided for night operation. Large 4" x 6" speaker provides superb tone reproduction. Shpg. Wt. 9 lbs.

**12 VOLT POWER CONVERTER KIT**

Household electricity right on your boat or in your automobile is yours with this 12-volt power converter kit. Operate your radio, electric razor, lights, etc., directly from your 12-volt boat or car battery. Power rating is 125 watts continuously and 175 to 200 watts intermittently. Note: not recommended for record players, tape decks, power tools or radio transmitters. Shpg. Wt. 8 lbs.

**MARINE CONVERTER KIT**

Charge your 6 or 12 volt batteries at dockside even while your boat's electrical system is in use. Provides up to 20 amperes continuously for charging 6-volt batteries or 10 amperes continuously for charging 12-volt batteries, regardless of type. Charging current is continuously monitored by a 25 ampere meter. Shpg. Wt. 16 lbs.

**MARINE BATTERY CHARGE INDICATOR KIT**

See at a glance the exact percentage of charge in your boat batteries. Checks from 1 to 8 storage batteries instantly. Operates on 6, 8, 12 or 32 volt systems. Note: for mounting on non-ferrous metals or wood only. Shpg. Wt. 3 lbs.

**FUEL VAPOR DETECTOR KIT**

Protecting against fire and explosion on your boat, the FD-1 indicates the presence of explosive fumes and shows immediately if it is safe to start the engine. The kit is complete including spare detector unit. Shpg. Wt. 4 lbs.

Free Send now for latest Heathkit Catalog describing in detail over 100 easy-to-assemble kits for the Hi-Fi fan, radio ham, boat owner and technician.

**HEATH COMPANY BENTON HARBOR 10, MICH.**

a subsidiary of Daystrom, Inc.

Send latest Free Heathkit Catalog.

<table>
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September, 1959
Carl and Jerry

(Continued from page 102)

a place to mount the paddle wheel bearings and the motor. As the box was pushed against the side of the furnace, it slewed slightly on this base. This caused the rubber blades to catch on the side of the box as they went around. As each one flipped free, it slammed into the thin metal side of the furnace.

One of the thumps produced by this action came at just the right time each revolution to trip the VOX unit and keep the shaft turning. The pups were safe, and the carton wasn’t even damp.

MR. BISHOP shook his head in admiring wonder as Jerry explained the chain of events. “Well, you boys certainly built a dandy surrogate mother there,” he said with a chuckle. “No real mother could have done better. When her babies were in danger, she took care of them and summoned help. Not only did she save her puppies, but she kept us from having a flooded basement as well. I feel as though I want to pat her or give her a bone or something!”

And about three weeks later, when Joe brought Davey over to get his pups, and Carl and Jerry watched the small boy gather the plump, frisky little dogs lovingly into his arms, the boys felt exactly the same way.

Does your stereo have three sounds?

New stereo owners often hear a third sound: ugly turntable rumble. Here’s why:

Most standard phonos were designed so that vibration was aimed in a vertical direction. The up-and-down movement is O.K. for monophonic cartridges. But in stereo, this vertical bucking makes your records sound as if they had acid indigestion.

What to do? You could purchase a very expensive turntable. Or, for a modest sum, you can get a Sonotone “ST” ceramic stereo cartridge. It has an exclusive vertical rumble suppressor...acts like the springs on your car to absorb vertical motion...and greatly reduce turntable noise.

You’ll hear the difference when you get Sonotone and prices of Sonotone stereo cartridges start at only $6.45 (including mounting brackets).

FREE! “Stereo Simplified” booklet—tells you how stereo operates. Write to:

Sonotone
Electronic Appliances Division, Dept. CG 99
ELMSFORD, NEW YORK

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ANNOUNCING

TRU-VAC

REMARKABLE TUBE VALUES AT 1950 PRICES
ALL TUBES INDIVIDUALLY BOXED, CODE DATED
AND BRANDED "TRU-VAC"
Typical TRU-VAC® Bargains!

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Thousands More Always In Stock

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6W4GT .......... ALWAYS 30c

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16GQ 2BN6 6AC7 6BC5 6CMA 65AY 7A6 12AC6 13287 29/44
13GQ 2BN6 6AF4 6BC6 6CNY 45DGT 7S7 12A07 13SN7T G 41
1C5 2CR 6AG3 6DLB 6CNY 45S5 78X 12AS4 13310 41
1C7 6AQ 6AHGT 6B6E 6C0B 65F7 7C4 12AV7 13V4GT 43
1A4 6A9UH 6B5P 6ACB 65C5 7C5 13A45G 12W6GT 45
135 2V1 6A9S 6AG5 6CS 65NH 7C9 12AF7 13J4 39/45
1G4 4ZP7A G4L 6N6E 6GUS 65C7 7C7 12427 1477/1280 5985
1Q4 4ZP7A G4L 6N6E 6C0B 65F7 7C8 12716 1308 50C
114 8477 6ANB 65X 400 65L7 716 12586 1450 50/46
13C5 4AC 64G5 650S 6F57 717 12716 79 36
1Q5G 5AMH 6AQB 6B7GT 6DGATG 656P7 717 19606 194U7G 37
13S 6AMF 6ANF 6DGBG 40M4 7A6 12886 19864G 58
155 4ABT 6ABS 6DGATG 6M5 48B 707 12986 1936 71A
13T 6AYB 6AS 6D6G 416 65G6 717 12306 1918 73
144 6ATB 6A8B 6E8B 6M6 65WGT 717 12306 245 74
15S 5AS8 6AUGT 66J 64 6X4 707 12987 354AZT 77
193 6AU 6ATIG 6ATG 415 65G6 717 12307 36 78
182 5SA 6AUS 6BST 6B 64X 746 12AC5 37 80
24A4 5SM6 6AUS 6BST 6M7 682 717 12AC5 35 84/84Z
24A4 5SM6 6AUS 6BST 6M7 682 717 12AC5 35 84/84Z
2BN6 6AYGT 64C 6DGGT 7A4XZ 742 1204 35AS 11723
2CS 5S4G 6AV6 6C6B 617 7A5 724 1256 3583
34N 5S4G 6AV6 6C6B 617 7A5 724 1256 3583
2AS 6AXGT 64G7 6C0 607 7A7 17465 2126 30W4
2AS 6AXGT 64G7 6C0 607 7A7 17465 2126 30W4
2AS 6AXGT 64G7 6C0 607 7A7 17465 2126 30W4

1 YEAR GUARANTEE PICTURE TUBES
Brand New* All 11 Tubes Brand New
Below Listed Prices do not include dud. Add Additional $5.00 Deposit on tube sizes to 20"; on 21" and 24" tubes - $7.50. Deposit refunded immediately when due is returned prepaid. Aluminized tubes - $4.00 extra.

Picture tubes shipped only to continental USA and Canada - All tubes F.O.B. Harrison, N. J.

SEN SATIONAL
$100,000 GIVE-AWAY
We want 100,000 new customers by Nov. 1st. For every new order of $25 or more received by that date, we will send you a crisp, new dollar bill.

FACTORY SECOND TUBE!

GUARANTEE
Only TRU-VAC guarantees to replace free any tube which becomes defective in use within one year of date of purchase.

USED TV CONSOLES
GUARANTEED TO WORK
When You Receive Them
10" & 12" $ 9.99
14" & 16" $ 14.99
19" $ 35.99
20" & 21" $ 39.99
All sets shipped in two cartons to avoid breakage. Ships shipped express to cont. U.S.A. and Canada only. F.O.B. Harrison, New Jersey.

FREE BONUS—RABBIT EARS
$7.95 Value
FREE with each set purchased

WRITE Dept. L For FREE LIST Of Other Tube Types and Products Sold By TRU-VAC®

ATTENTION QUANTITY USERS!
Big Discounts Are Yours . . . Call or Write For Your 1000 Tube "Private Label" Special! Attention Branding Dept. MGR.

MONEY CHEERFULLY REFUNDED WITHIN FIVE (5) DAYS, 1951! COMPLETELY SATISFIED!

TRU-VAC PAYS YOUR POSTAGE
On orders of $5 or more in U.S.A. and Territories. Send approximate postage on Canadian and foreign orders. Any order less than $5 requires 25c handling charge. Send 25c on C.O.D.'s. All orders subject to prior sale.

Complying with Federal regulations, the following statement appears in all TRU-VAC advertising: Tubes appearing in this ad may be FACTORY SECONDS or used tubes and are clearly marked.

TRU-VAC Electric Company
Harrison Avenue Box 107 Harrison, New Jersey
Humboldt 4-9770

Visit Our Huge Testing Dept. In The Heart
Of Harrison N. J.'s Electronics Industry

September, 1959
Shipped on Approval

An In-Circuit Condenser Tester That Does the Whole Job!

In-Circuit Condenser Tester  Model CT-1

The CT-1 actually tests in and takes over where all other in-circuit condensers fail. The ingenious application of a dual bridge principle gives the CT-1 a tremendous range of operation...and makes it an absolute 'must' for every serviceman.

In-circuit checks:
- Quality of over 80% of all condensers even with circuit short resistance. (This includes shorts, opens, intermittents)
- Value of all condensers from 200 mfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge).
- Transformer, socket and wiring leakage capacity.

Outstanding Features:
- Ultra-sensitive 2 tube drift-free circuitry.
- Multi-color direct scale readings for both quality and value...in-circuit or out-of-circuit.
- Simultaneous readings of circuit capacity and circuit resistance.
- Built-in hi-leakage indicator sensitive to over 300 megohms.
- Cannot damage circuit components.
- Electronic eye balance indicator for even greater accuracy.
- Isolated power line.

Out-of-circuit checks:
- Quality of 100% of all condensers...This includes shorts, opens, intermittents.
- Value of all condensers from 50 mfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge).
- High leakage resistance up to 200 megohms.
- New or unknown condensers...transformer, socket, component and wiring leakage capacity.

Why the CT-1 Surpasses All Others in the Field

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In-Circuit Rectifier Tester  Model SRT-1

SRT-1 housed in sturdy hammer tone finish steel case complete with test leads...

Specifications:
- Checks all power rectifiers in-circuit whether selenium, germanium, siliccon, etc.
- With the growing trend towards compactness, simplicity and low price, TV and manufacturers are resorting more and more to producing series-stringing TV sets and eliminating selenium, germanium or silicon employed selenium, germanium or siliccon...now the need for an in-circuit rectifier tester is greater than ever.
- The SRT-1 checks all power rectifiers in-circuit and out-of-circuit with 100% effective ness for:
  - Quality
  - Fading
  - Shorts
  - Open
  - Arcing
  - Life Expectancy

Size: W-6"  H-7"  D-3/4"

Price: $29.50

In-Circuit Transformer Tester  Model TT-2

An Inexpensive Quality Instrument Designed for Accurate and Dependable Tests of All Transformers and Diodes Quickly and Accurately.

Every day more and more manufacturers are using transformers in home appliances, inductors, in heating devices, etc. Since this new in-circuit testing is very simple and does not require a special rear compartment, any technician can easily use this instrument...and make the most of it. As an example, it can be employed in any small appliance, or a home heating device, to check the transformer...or even the diodes...in the circuit. ...and make it a part of every serviceman's tool kit.

Specifications:
- Checks all transformers, including all types of power rectifiers, and all inductors for current gain, leakage, shorts, cut-off current. Checks all diodes for forward to reverse. It is capable of identifying all types of transformers and diodes. It is also capable of identifying both polarities of all diodes. It can be used to check the transformer or diodes of any device, even in a circuit with other transformers or diodes.
- The TT-2 is housed in sturdy hammer tone finish steel case complete with test leads.

Size: W-6"  H-7"  D-3/4"

Price: $24.50

EASY TO BUY IF SATISFIED

See order form on facing page.

Always say you saw it in—POPULAR ELECTRONICS
CONVENIENT TIME PAYMENT PLAN — NO FINANCING CHARGES

CEN'TURY ELECTRONICS CO., INC.

FOR 10 DAY FREE TRIAL

Convince yourself at no risk that CENTURY instruments are indispensable in every every-day work. Send for instruments of your choice without obligation... try them for 10 days before you buy... only then, when satisfied, pay in easy-to-buy monthly installments — without any financing or carrying charges added.

NEW Battery Operated Peak-to-Peak VACUUM TUBE VOLT METER Model VT-1

with LARGE EASY-TO-READ 6” METER — featuring the sensational new MULTI-PROBE

No extra probes to buy! The versatile MULTI-PROBE does the work of 4 probes

1) DC Probe 2) AC, RMS Probe 3) Lo-Cap Probe 4) RF Probe

The VT-1 is a tremendous achievement in test equipment. With its unique MULTI-PROBE it will do all the jobs a V.T.V.M. should do with the expenditure of buying additional probes. No longer do you place probes, with just a twist of the MULTI-PROBE you can set it to do any one of many time-saving jobs. A special holder on side of case keeps MULTI-PROBE firmly in place ready for use.

OUTSTANDING FEATURES

- Completely portable — self powered with long life batteries — permits use everywhere — new advanced mode simplifies circuit assures amazing low battery drain — a huge 100-milliampere meter, more sensitive than meters used in most V.T.V.M.’s. Laboratory accuracy performance — 90% of full scale bias readings with no AC. Simplified multi-cigar circuitry — easy setup, operation and adjustment, plus troubleshooting. Amplifier rectifier circuit with frequency compensated AGC. Laboratory instruments — meter completely self contained, can be used for balancing. Complete AC, DC, auto range, range switching. All service heads of printed circuitry, 2% of scale, cut down time alternating cables. RF generator included for low law RF measurement. Microphone type earphone connector. Matching cover protects instrument face. Neatly snaps on and off instantly.

SPECIFICATIONS

DC Voltmeter — Will measure 0.0 to 1 to 1 5 volts full scale with minimum circuit loading, give accurate readings, scale divisions as low as 0.025 volts. Will measure the AC and oscillator bias volts from 10 volts or more to 500 volts with consistent laboratory accuracy on all ranges. Zener tube provides for all balancing voltages, such as discriminator, ratio detector alignment and RF, amplifier balancing.

AC Voltmeter — True Peak-to-Peak measures all AC wave forms including TV sync, deflection voltages, video pulses, audio or high frequencies, AC wave output. All ranges are easily read down to 1 volt. Measures full 0 to 1 volt, 1000 volts without overloading. VCM: the V.T.V.M. has no loss in accuracy on the lower side of ranges.

Electronic Ohmmeter — Measures 0.01 to 3 ohms. Scale divisions are easily read down to 3 ohms. Will measure all ranges with high resistance leakage in electrolytic and by-standers.

RF and Lo-Cap Measurements — With these extra VT-1 functions you can measure voltages in extremely high impedance inputs, volts in TV tubes, TV bias tubes, driving saw tooth voltages, color TV gathering, mixer, output levels, I-F stage bias gain and detector inputs.

PITCURE TUBE TESTADAPTER INCLUDING WITH FAST-CHECK Enables you to test picture tubes (including the new shows-com 110 degree type) for cathode emission, shorts and life expectancy. Also to reject weak picture tubes.


Model FC-2 — housed in hang-ribboned oak carrying case complete with QM adapter.

FAST-CHECK TUBE TESTER Model FC-2

Simply set two controls ... insert tube... and press quality button to test any of 700 tube types completely, accurately... IN JUST SECONDS!

Over 20,000 servicemen are now using the FAST-CHECK in their every day work and are cutting by selling more parts, reducing call backs and increasing their profits. Save for yourself at no risk why so many servicemen chose the FAST-CHECK above all other tube testers.

RANGE OF OPERATION

- Checks quality of over 700 tube types, employing the time proven dynamic cathode emission test. Tests more than 99% of all tubes in use today, including the newest color-strung TV tubes, auto 12 plate valve, tubes. D2A, gas tube, argon filled tube, special purpose full tube, and special tubes, gas rectifiers, special purpose full tube and even foreign tubes.

- Checks for inter-entirement shorts and leakage.
- Checks for gas content.
- Checks for life expectancy.

SPECIALS

- No time consuming multiple switching... only two settings are required instead of banks of switches located inside cover. New listings are added without costly roll chart changing ...
- Large roll chart listing over 700 tube types is included.
- All phosphor bronze tubes, tube sockets never need replacement... 1-pin and 9-pin straighteners protected against accidental shortening. Special scale on meter for low current tubes. Compensation for all tubes. Extra long life lithium batteries ensure long lasting operation. Safe operating manual trouble free aluminum panel.

NOTE: The Fast-Chek positively cannot become obsolete... circuitry is engineered to accommodate all future tube types as they come out. New tube listings are furnished periodically at no cost.

September, 1959

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Transistor Topics

(Continued from page 88)

temperature coefficient, with the resistance decreasing as temperature increases; thus, meter current increases with increasing temperature.

The simple “transformerless” code practice oscillator circuit given in Fig. 2 was submitted by reader Ronald Remmel (2221 W. Raleigh Ave., Milwaukee 9, Wis.). Needing relatively few components, the unit may be wired “breadboard” fashion or put in a small plastic or metal box, whichever you prefer.

Ronald used a CK722 transistor for Q1, but almost any transistor should work in his circuit if R1 and R2 are adjusted experimentally until proper operation is obtained. Generally, R1 will have a value between 1000 and 10,000 ohms and R2 a value between 100,000 ohms and 1 megohm.

Basically a modified shunt-fed Colpitts oscillator, Ronald’s circuit uses the inductance of the headphones as part of its tuned circuit. C1 and C2 serve both to “tune” the headphones and as a capacitive voltage divider. Resistor R1 serves as Q1’s collector load, with base bias current furnished through R2. C2 provides signal feedback from Q1’s collector to the tuned circuit.

Reader Jock F. McTavish (75 Heston St., Calgary, Alberta, Canada) designed the “booster” amplifier circuit in Fig. 3. Using a single p-n-p transistor (Q1) as a common-emitter audio amplifier, this instrument is employed with small transistor radios in place of standard headphones, providing moderate loudspeaker volume. Use as large a PM loudspeaker as you can; “Mac” put a 5” speaker in his model but the larger the speaker, the more efficient the amplifier’s operation.

Mac suggests trying different output transformers from your junk box for T1, finally installing the one which gives best performance; if you prefer, you can install an Argonne Type AR-167 here. And you may wish to experiment with R1’s value; try from 500 to 5000 ohms, using as large a value as you can before “clipping” and distortion occurs.

Note that Q1 is operated without separate base bias. Mac has relied on the transistor’s internal leakage to provide the small bias needed for operation. In a few cases, it may be necessary to connect an external bias resistor. If so, use a 1/2-watt
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September, 1959

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resistor between Q1's base and B1's negative terminal—try values from 100,000 ohms to 2.2 megohms.

New Semiconductor Devices. From Bell Telephone Laboratories comes news of a "field-effect" tetrode device which can be used as a transformer, impedance-changing device, modulator, or as a stable negative resistance. This unit (Fig 4) is made up of a disc-shaped semi-conductor having a diffused n-p junction. A circular trench is etched in each face of the disc to within a thousandth of an inch of the junction. Leads are then attached to each face, both inside and outside the trench. In operation, various bias currents are applied to each of the four electrodes, with the unit's mode of operation determined by the polarity and amplitude of each bias.

RCA (Semiconductor Division, Somerville, N. J.) has announced what may be the first of a whole family of dual-purpose semiconductor devices—a diode-triode transistors. It consists of an alloyed p-n junction diode and a p-n-p triode built up on a single germanium pellet so that the n-type base is common to both units. The construction thus provides a direct connection between the diode and triode, permitting the device to serve both as a detector and as an audio amplifier, while requiring a minimum of external components. This dual device is also very well suited for amplified a.g.c. circuits.

A controlled rectifier has been introduced by the International Rectifier Corporation (1521 E. Grand Ave., El Segundo, Calif.). Electrically the solid-state equivalent of a gas thyratron, the new unit can handle load currents up to 10 amperes at PIV ratings of up to 200 volts. In operation, it combines some of the basic characteristics of the rectifier and the power transistor, and can be used to switch relatively large currents when a signal is applied to its "gate" electrode. It can also be employed for motor and generator control, static switching, cur-
Rent regulation, and industrial control applications.

Transistorized Ignition. Our discussion of transistorized automobile ignition systems in the June column brought forth a small flood of inquiries for "construction details." Unfortunately, your columnist has no construction plans available. However, we understand that Technical Services Institute, 5234 Fourth St., N.E., Washington 11, D. C., is offering detailed plans and instructions at $2.50 per set, postpaid.

Product News. Lafayette Radio (165-08 Liberty Ave., Jamaica 33, N. Y.) has just introduced one of the cleverest items we've seen in some time ... a pair of sunglasses with a transistorized radio built in the frame! Operating power is supplied by a self-contained button-sized nickel cadmium battery. Stock No. is F-436.

From Allied Radio (100 N. Western Ave., Chicago 80, Ill.) comes news of a fully transistorized mobile p.a. amplifier. With a rated output of 25 watts, this unit can operate on any 12-volt d.c. source, and has both low and high impedance input jacks. A separate battery-powered record player is available as an accessory item.

The Delco Radio Division (General Motors) has developed a new transistorized garage door opener which operates on frequencies between 5 and 10 kc. The receiver uses five transistors, two diodes, and a rectifier. The transmitter, mounted in the car, uses two transistors ... one as an oscillator and another as a power amplifier. By limiting each channel to a bandwidth of 100 cycles, Delco has squeezed 50 operating channels in the 5 to 10 kc. band.

That covers the news for now, fellows. See you next month ...

Lou

"I'm working on some pretty big projects."

September, 1959

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Color TV Today

(Continued from page 46)

a color set has more tubes than a comparable black-and-white set, it's common sense to expect more breakdowns from a color set. For some reason, though, the incidence of color set repair has not been nearly as high as some people expected.

Anyway, let's assume you'll have just a little more trouble with a color set than a black-and-white set. Let's say, for example, that instead of calling a service man three times every two years, you call him twice a year. If the average cost of a color set repair were $30.00, you would pay only $60.00 a year as opposed to either $119.50 or $85.45 ($79.50 plus one free call and one $5.95 call) in service contracts.

If a color set didn't have a hidden "joker," it would seem to be a pretty safe risk to go without a service contract. But there's one little item in a color set that isn't found in a black-and-white set—the color picture tube. If your color picture tube burns out, you will suffer the ultimate disaster. You can figure on paying about $150.00 for color picture tube replacement plus service.

So, when you buy a service contract, to a great extent you are paying insurance on the picture tube. While there has been no unusual amount of difficulty with color picture tubes (replacements are currently running in about the same ratio as black-and-white picture tubes), you can see why it takes quite a gambler to operate a color set without a service contract.

Future of Color TV. There are several indications that color TV may really get going either this year or next year. First of all, NBC has announced a very attractive schedule for the fall which outlines 250 hours of color programming, 30% more than was presented during the same period last year. The NBC line-up will include all the NBC color regulars such as Dinah Shore, Perry Como, Steve Allen, etc., and will feature numerous color "specials"—musicals, plays, educational programs, comedy and sports. Included in the sports coverage will be the World Series and 11 major football games. Accompanying this truly excellent color schedule will quite likely be a full-scale advertising campaign for color TV.

Also, news that the Admiral Corporation is plunging into the production of a complete line of color sets points to a new confidence in the future of color TV. Admiral...
envisages a mass market opening up in 1961.

As mentioned earlier, the two things holding up color TV are price and programming. With NBC's increase of color programming this fall, at least part of the problem is being solved. It is doubtful, however, that any tremendous breakthrough will come until the price of the sets comes down. When color sets are priced within $100 of comparable black-and-white models, then color TV will come into its own. Until that time it seems probable that it will make steady but unspectacular progress.

**Color TV and You.** Now for the $64 question—or more exactly, the $495 question: Should you buy color TV now?

Very frankly, it all depends on how much money you have. If you can afford a boat, or an extra car, or an automatic dishwasher, then the enjoyment you will get from a color TV set should be well worth what you pay for it. And even if you can't really "afford" a set, it might still be worth $495 to you.

One word of warning, though, if you get a color set, don't tell your friends—unless you're prepared to spend your evenings demonstrating it. And don't forget to order the beer and pretzels! —90—

### Stereo Tape Preamp

(Continued from page 93)

or treble, you may want to change these values.

Increasing the size of the capacitor will reduce the bass, while reducing the size of the capacitor will have the opposite effect. If the resistor is made larger, the highs will be boosted; decreasing the resistor will cut the highs. Do not change values more than 200%, however, because they interact and will affect the gain.

If the preamp is not grounded properly, it is possible to get a considerable amount of hum. In addition to the shielded output cables, separate ground wires from the tape deck to the preamp—and then on to the main amplifier—may be necessary.

You can also use this preamp with monaural tape systems. If you wish to do so, build only half of the circuit, and double the size of R9 and R10. The battery voltage adjustment procedure remains the same.

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Inside the Hi-Fi Tuner

(Continued from page 86)

4000 cps and some of the wide-band circuits go up to 10,000 cps.

Tuners with broad i.f. bandwidths usually have a 10-kc. or "whistle" filter to attenuate the 10-kc. beat note between carriers of adjacent channel stations.

In FM tuners the tendency is also toward wide bandwidths. Whereas 150-kc. bandwidths used to be the rule, at present bandwidths of 200 kc. are not uncommon.

FM Limiters. One of the great virtues of FM is its ability to minimize static. This is possible since noise amplitude-modulates the radio signal. In AM, the audio is also amplitude-modulated, so we cannot remove the noise without damaging the audio. But in FM the audio signal is frequency-modulated, and it is possible to remove the amplitude-modulated noise without affecting the audio information.

In the FM tuner, most noise reduction takes place in the limiters, which follow the i.f. amplifiers and are a special type of amplifier themselves. They amplify a weak signal, but after the signal reaches a certain level, they saturate and in effect chop off the rest of the signal. See Fig. 4. The noise superimposed on the FM signal is removed while the "intelligence" carried by the signal—the frequency variations—is not affected by the limiting process.

Detectors. The most popular FM detector circuits employed today are the discriminator, shown in Fig. 5 (A), and the ratio detector, shown in Fig. 5 (B). Though each of these circuits has its advantages, both are capable of good results. They both

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operate more or less as specialized forms of slope detectors, and their output curve is, or should be, a straight line inclined as in Fig. 6. The FM carrier frequency should lie at the center of the straight portion of the curve; one set of sidebands will then produce negative voltages, the other side positive voltages.

The straight portion of the curve must cover at least 150 kc. to handle the combined deviation of both sides of the transmitted signal. However, if the straight portion is only 150-kc. long, the tuner must be precisely tuned to avoid distortion on either of the two sidebands. Thus, the detector bandwidth is usually designed to be considerably greater than 150 kilocycles. In fact, some of today's best FM tuners have detector bandwidths up to 2 megacycles. Wide-band detectors minimize distortion and make tuning less critical.

Squelch Circuits. As tuners are made more sensitive for fringe-area reception, they become noisier between stations. There is a trend to include a squelch or muting circuit in very sensitive tuners. This circuit functions like an electronic switch which mutes or squelches the audio portion of the tuner when no station signal above a certain threshold is present, but opens it when a station is tuned in.

As we have already seen, at the detector output we have not only the audio component but a d.c. component. At one point of the output network this d.c. component will be greatest when a signal is tuned in, and lowest when there is no signal. If this voltage is used to bias a tube which is connected into the circuit of the audio amplifier, this "squelch" tube will be biased to cutoff when a station is tuned in and it will not cut off the audio tube. When the tuner is tuned off a station, the bias on the squelch tube changes and it then cuts off the audio tube.

Tuners today—especially the FM portions—are far superior to those of the past. One or two have sensitivities below 1 microvolt. With a good antenna, high-fidelity FM reception is possible over ranges previously considered impossible—up to 200 miles, and even more, where the receiving and transmitting antenna heights are favorable.

Next month we will take a look at the design considerations necessary for the production of a high-fidelity loudspeaker.

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On the Citizens Band

By TOM KNEITEL, 2A0305

Each week sees more and more stations on 11 meters, the Class D Citizens Band; and each week we seem to hear of a new and novel use for Citizens Radio.

Among the clever tasks that CB has been asked to take on is one put to it by a smart service-station operator in the West, whose station is located along a desolate stretch of highway. There are signs along the road for 15 miles in each direction which read: "Need help? For prompt road service call Harrington's Service Station via Citizens Radio on channel 1 or 4" (the popular channels in the area).

This station uses an International Crystal 2-channel rig. So that both receiving channels can be monitored simultaneously, a Kuhn Electronics 315A converter is used in conjunction with another receiver. Aside from just selling gas, Harrington's sells crystals for, you guessed it, channels 1 and 4.

This is a perfect example of what the FCC intended CB to be used for. As a matter of fact, it has been reported that recently issued CB licenses are coming through with a little note attached stating that CB was not intended to be a replacement for ham radio, and that "CQ'ing" is frowned upon. However, the FCC Rules (Paragraph 19.61a) state that a CB station is authorized to work other stations in the same service. Do you follow the FCC Rules as they are written in Part 19, or do you take their subtle hint pinned on your license? We don't know.

Speaking of the FCC, waiting for your license to come through can be a pretty long and drawn-out business. The latest word is that you shouldn't hold your breath for the time you are going to have to wait over the FCC's announced 60-day period (Paragraph 19.13c of the Rules). Just be patient, and don't think you've been forgotten. They have been swamped with applications for CB licenses and their staff is

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working on the applications as fast as possible.

By the way, when you get your license, you will receive a set of call letters. Don't forget to announce them at the beginning and end of each contact, and at least once every ten minutes during a long-winded session.

Signals are improving on 11 meters, and even some of the formerly weak stations seem to have picked up. This is a result of better antennas.

Many stations started out using horizontal antennas, and most have now been changed to the more effective vertical types. Also, a number of high-gain ground plane antennas have started popping up on the band. There are a few really "scooky" stations using something called a "Dual Ground Plane" antenna, which makes men out of boys.

One manufacturer has been using his noggin and has come up with a little gizmo that plugs into the crystal socket of a fixed channel receiver and makes it tunable; it’ll be on the market soon for about $20. Also planned are a low-cost phone patch and an automatic signaling device that enables you to signal one specific CB station in your area to let the operator know you want to talk.

Station activities in the New York area are still on the upswing, with Al, 2W1369, giving Fred, 2W1352, a run for his money with his new antenna. Even so, during a recent band opening, 2W1352 was called by an 11-meter ham in The Union of South Africa who heard Fred and couldn’t resist giving him a shout. Fred is still wiping the tears from his eyes about not being allowed to reply because of regulations.

Channel 11 is pretty busy these days, being inhabited by scores of mobile units using Gonset rigs. It appears that Gonset transceivers are furnished with the channel 11 crystal. Gonset has a popular set, and no wonder, as it is well made and attractive in appearance.

The Heathkit CB sets have been given some nice references by the boys now using them. We hear that they are easy on the nerves when you are putting them together.

Please keep us posted regarding your 11-meter activities, and we’d like to receive any suggestions you may have for pepping up CB equipment and signals. Anybody know of unusual applications for CB which are now in use?

---

September, 1959
Answers to Electronic Sticklers
on page 60

1. The voltage across points X is 100 volts, neglecting the small forward voltage drop across diode CR1. Both diodes are biased for forward conduction, but when CR1 conducts, CR2 is biased for reverse conduction and effectively becomes an open circuit.

2. If our ham friend had recalled his transformer theory, he would have used the following formula:

\[
\frac{Z_{in}}{Z_{out}} = \left( \frac{\text{Primary turns}}{\text{Secondary turns}} \right)^2
\]

and figured out that he’d end up with an output impedance of 600 ohms instead of the 300 ohms he wanted.

3. The black box contains a set of contacts which are continually opening and closing at 100 cycles per second. When the contacts are open, there is a voltage across them which can be measured by the voltmeter, but no current flows. When the contacts are closed, the voltage drop across the contacts is zero and a current flows through the ammeter. The ammeter and voltmeter needles cannot follow the contact switching rate, so they indicate an average reading. The wattmeter indicates zero because the current and voltage required to cause a reading do not occur at the same time. The current is limited by the internal resistance of the power supply.

4. The box contained a one-to-one ratio transformer. Because the VTVM has a very high input impedance, the voltage drop across the relatively low resistance windings is practically zero. The box acts as a transformer with power applied to terminals 1-3 or 2-4, and as coils in series with power applied to terminals 1-2 or 1-3.

If you know of a tricky Electronic Stickler, send it in with the solution to the editors of POPULAR ELECTRONICS. If it is accepted, we will send you a $5 check. Write each Stickler you would like to submit on the back of a postcard. Submit as many postcards as you like but, please, just one Stickler per postcard. Send to: POPULAR ELECTRONICS STICKLERS, One Park Ave., New York 16, N. Y. Sorry, but we will not be able to return unused Sticklers.
How to Choose a Recording Tape

(Continued from page 75)

a new problem—“print-through,” the transfer of a signal from one layer of tape to another when the tape is stored for long periods of time. Only the backing of the tape prevents the magnetic field on one layer from magnetizing the next layer.

Special types of “low-print” tape have been developed to reduce print-through. By using a modified form of oxide dispersion, the print-through is cut by about 8 db, enough to make it a minor problem. Of course, print-through can also be minimized by keeping the recording volume low. If you want to keep recorded tape for an extremely long period of time, however, the extra 15% you pay for low-print tape will be money well-invested.

Another tape headache is oxide rub-off. This is especially bothersome in computer applications where every “bit” of information is vital. Recently “sandwich” tape has been developed to reduce this problem. This tape’s oxide coating is protected by a 50 micro-inch plastic layer which prevents the oxide from contacting any part of the recording system, thereby eliminating wear on the oxide itself.

Practically all magnetic tapes, however, feature some type of built-in “anti-wear” system. Silicon lubricants are frequently used to fill in the spaces between the oxide particles and the resin. This reduces wear on the tape heads, eliminates squeal, and increases tape life by allowing the tape to glide smoothly past the heads without causing distortion. Similar to lifetime anti-friction bearings, the lubricant lasts the life of the tape.

So-called “high-output” tapes provide extra output for increasing the dynamic range in sensitive recording applications. Such tapes achieve signal-to-noise ratios from 6 to 12 db greater than conventional tapes and prevent “overloading” in passages where the dynamic range varies widely. Because of its greater potency, high-output tape has made possible narrower magnetic tracks without sacrificing output level.

Pick a Tape—Any Tape. If you are just starting to use magnetic tape, you are probably somewhat puzzled by the profusion of tape types from which to choose. To make things simpler, here are some tips.

If your recording needs are about normal, start off by using 1½-mil acetate...

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September, 1959
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Two-Way Power Trumpet

(Continued from page 80)

panel of the aluminum box with the shaft of the volume control protruding through the back.

When you wire the "listen" amplifier, save the transistors for last since they are easily damaged by heat. Be careful to hold each transistor lead with long-nose pliers while it is being soldered, and for a moment afterward, until the lead has cooled.

Final assembly of the box is done after the "talk" and "listen" amplifiers and batteries are wired and assembled on their respective panels. Leave one side of the box off while attaching handset, handset, and amplifier leads to the terminal tie strip just above the batteries.

The batteries can be secured in place with cardboard if desired since they last for an unbelievably long time. When necessary, they may be quickly and easily replaced by removing a side or bottom panel.

Aside from the very practical advantages of a two-way power trumpet, it has side benefits which may be amusing or confusing. Many people in the crowd you're addressing simply never realize that you can listen in on their private comments.
Short-Wave Monitor Registration

The Popular Electronics short-wave fraternity is growing by leaps and bounds each month. Tom Kneitel, WPE2AB, Director of Monitor Station Registration, has been swamped with registration forms, but his loving XYL pitched in and now the certificates are really moving. To get yours, just fill out the form below and mail to: Monitor Registration, Popular Electronics, One Park Ave., New York 16, N.Y. Please include ten cents to help cover cost of mailing and processing the certificate.

(Please Print)

Name

Address

City State

Receiver Make Model

Make Model

Principal SW Bands Monitored

Number of QSL Cards Received

Type of Antenna Used

Signature Date

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Self-Contained 90W Transmitter, Bandswitching 10-80 Meters

The Globe Chief Deluxe truly lives up to its name! Gracefully styled with the new "low look" cabinet of pleasing proportions and a tastefully designed panel, its smart, modern appearance is second to none. Improved circuitry and new components provide outstanding performance for the advanced amateur or the novice. Appearance and performance add up to value that cannot be matched anywhere. Improvements include a new 1500 µfd loading capacitor for continuous variable loading on all bands and for improved TVI and harmonic suppression, selectable keying (grid-block or cathode); all Globe Accessories such as a VFO, screen or plate modulator may be plugged in without modification; internal control for antenna relay; all switching functions performed by rotary switches — no unsightly or hard-to-use slide switches. Standard coaxial antenna fittings. This adds up to unsurpassed quality and value. Kit contains pre-punched chassis, all parts and tubes, and complete manual for easy assembly. Compact: 15 3/8 x 11 1/4". Shipping weight: 31 lbs.

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September, 1959
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Now—you can build a record library of hi-fi classics from the steadily growing catalogue of $1.98 releases! More than half a dozen big record companies are re-issuing great performances on the new $1.98 labels. You can have a guide to the best of these for 15¢—by ordering this reprint of a recent article in HI FI REVIEW. Complete with catalogue number, artist, orchestra information—it’s a fabulous guide to building up a high fidelity library of basic classics!

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If you’ve been thinking of starting a record collection or adding to the one you have—this reprint is your best guide! Order your copy today—simply mail 15¢ in coin or stamps with the coupon below. But the supply is limited, so order now!

Cross-Country Communications
(Continued from page 53)

guards. It, too, has spare emergency channels for use in case of trouble. Storage batteries and motor-driven generators are ready to supply emergency power. An alarm system spells out any trouble on a coded diagram at the nearest control office.

Multi-Purpose “Highway.” Television and telephone traffic are carried together on both radio relay and coaxial cable. The average TV circuit ties up the equivalent of 600 telephone circuits. But, unlike telephone, it only goes one way, and thus uses only half the two-way circuits involved.

Interestingly enough, the television picture and the audio portion of the show are normally carried on separate channels. This means that technicians in the control centers must coordinate the two sections of the program at the end of the line.

Since the audio is carried on lower-priced lines, network television doesn’t offer too much for the hi-fi enthusiast. Bell Telephone can supply circuits with a top audio frequency response of either 5000, 8000, or 15,000 cps. The higher the response, the higher the price of the service. For this reason, though some TV circuits are occasionally rigged for the higher frequencies, the networks generally content themselves with a 5000-cycle audio cutoff. Regular telephone frequency response, incidentally, ranges from about 300 to 3000 cycles.

Ground Work. A lot of planning goes into the construction of either system. For radio relay, topographical maps are used to locate clear paths between sites and to avoid reflective surfaces, such as flat land or lakes, that might harm the signal. Portable transmitters, receivers, and antennas are spotted for field tests of prospective sites. Borings and soil samples tell what kinds of foundations are in order.

Cables are laid in open country by tractor-drawn plow trains. A 27-ton job, tagged the “Mickey Mouse,” is the most powerful type in use. This monster’s hydraulically controlled plowshare can cut through almost any kind of terrain, feeding cable into the ground and filling in the trench as it moves ahead.

In cities, on the other hand, or under highways and railroads, the cable is generally placed in a conduit or pipe. Sometimes it must be run over bridges. Or, at river crossings where there are no bridges,
The cable may be laid by barges and dredges using high-pressure water jets to trench it in the stream bed.

Aside from consideration of local problems, the telephone companies think it is just plain good sense to use both radio relay and coaxial cable, instead of putting all their eggs in one basket, since a disaster that affects one system isn't likely to harm the other. This way, there is a good chance that an alternate route will always be available should something go wrong with the prime channel.

And if this belt-and-suspenders approach is important under everyday conditions, from the viewpoint of national defense it could be a matter of life and death. 

The 27-mc. Citizens Band  
(Continued from page 70)

license to be sent to you by the FCC before you transmit. If you are building your own transceiver you must be very careful not to exceed the FCC's maximum power input limitation, or the allowable transmitting crystal tolerance, which is .005% or less. Citizens frequencies, like all others, are monitored by the FCC, and if you don't stick to the rules you'll bite off a big chunk of trouble with your Uncle Sam.

A copy of Part 19 of the FCC Rules will give you complete information on Citizens Band do's and don't's, and you are required to have a copy of Part 19 before you apply for your license. It's available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for 10 cents in coin. Specify that you want the edition which became effective on September 11, 1958. (See the article entitled "Tips for Citizens Band Applicants" in the August issue for the complete story.)

You may want to put a transceiver in your car and one in the house, store, or office. The rigs are darn handy for use between buildings on a farm, on hunting or fishing trips, for just chewing the fat with your cronies, or 1001 other uses.

Most of the available equipment is designed to work from 6 or 12 volts d.c., in addition to 110 volts a.c. In other words, the Class D Citizens Radio Service covers a satchel-full of communications needs, and offers the DX'er some choice morsels. Why not get on the air yourself in time for the coming DX season?
dream wherein tons of green, green money were being shoveled to me by the buyers of The Kohler Home Solar Power System—I awoke to find a wife gone mad with fear, hysterically mouthing tiny sounds of terror and clawing at my shoulder.  

“What is it?” I hollered, leaping to my feet. “What’s WRONG?”  

She jibbered, pointing spiritedly to the window. I glanced out to see a cherry-red steel tower atop which a metal housing glowed incandescently white! The Solar Power System was melting itself! Worse, it was taking a utility company’s transformer—also glowing a beautiful, horrible orangeish—right along with it.  

“Quick!” I shrieked, hurling myself through the doorway and sprinting into the yard. “We’ve got to break those heliostat mirrors and cut off the destructive power of the sun’s rays! Throw rocks, throw rocks!” I scooped up a handful of stones and began feverishly pelting them at the parabolic mirror high above.  

“Try killing it with a stick!” howled the wife, whose terror had—at the sight of anguished me destroying my own device—vanished into pure, sadistic good humor. “I knew something had to be wrong!”  

I was too busy, lobbing rocks, to attempt any kind of reply. . . .  

After all the fire department trucks, the police cars and the horde of several hundred morbidly curious bystanders had departed, I stood beside the wife and sadly contemplated the twisted remains of the steel tower. Frequently, I glanced at the fire-citation slip clutched in my hand. Finally, I risked a glance up to the charred, badly melted utility company’s transformer. The thought of what the replacement charges would be chilled the marrow and stunned the mind. I shuddered, and turned my eyes away.  

“Got any notion what happened?” inquired the most callous-minded wife in the world.  

“Somehow . . . in some way, that whole mechanism managed to become what amounted to a solar furnace. Maybe it was the tracking mechanism that failed to function. Or maybe I went, unknowingly, into error when I courageously made the mirror modifications. Either way—“ I broke off, fighting back a strange urge to beat my head against the bricks of the barbecue pit.  

“Some furn-ace, eh, kid!” jibed the cruelest wife in the whole, wide world. “Well, it’s back to blowing fuses with the garden variety electricity supplied by those villains down at the power company!”  

I ventured another horrified glance at the maimed transformer upon which temporary repairs had been made until a new one could be installed.  

“What a bill,” I whispered hoarsely, “that’s going to be!”  

POPULAR ELECTRONICS
Among the Novice Hams

(Continued from page 90)

that DX is always weak. A better clue is
the fluttery sounds that carry many DX signals
acquire in their long journey through the
ionsphere.

A good DX man hears far more DX than
he calls. For example, if he hears a strong
"G" (England), and he has already worked
England, he may pass it by to listen for
new countries from that area. He knows
that they should be coming through, too,
and he could miss a new country while
working an old one.

He also knows that a strong DX signal
will attract many DX'ers, and while they
are busy with it, he may be able to locate
and call a rarer station. This can be a big
advantage, because it is usually competition,
rather than the inability to put a signal
on the DX station's receiving antenna,
that prevents you from getting through.

Keep an ear on what other Novices are
working. By doing so, you can frequently
locate DX they are working when they
stand by.

Calling DX. No matter how you locate a
DX station, you will be lucky to raise it
on your first call. More often than not, you
will have to call, wait for the DX'er to sign
with the station he answers, and call again.

JAMBOREE-ON-THE-AIR

The Boy Scouts International Bureau in Ot-
tawa, Canada, has announced the Second An-
nual Jamboree-on-the-Air, from 0001 GMT
October 23 to 2400 GMT October 25, 1959.

Members of the Boy Scouts who are radio
amateurs are invited to participate, exchang-
ing Scouting greetings and messages. This is
not a contest and there is no prescribed ex-
change. Operations will be on authorized
amateur bands.

The International Bureau will operate a sta-
tion and will QSL all contacts with a special
K2BFW... }

card. The "Boys' Life" Radio Club station,
K2BFW, will also send special QSL's to all sta-
tions worked and to SWL's submitting reports.

September, 1959

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Here, for the first time, is an AM-FM STEREO Tuner within the reach of every audiophile. Unmatched by units costing twice the price, the
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Wired and tested $74.50 Easy-to-build Kit $49.95

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Advanced design and precision features make the VS-10 a truly sensational buy, unmatched at this price. You get exclusive larger 6-INCH 400 uA meter movement, within 2% accuracy, and edge-lighted for easier reading. Precision multipler resistors are used throughout the range switch. There are 7 AC (RMS) and 9 DC (peak-to-peak) ranges, Resistance, dB and other essential ranges. Durable plastic case.

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ARKAY CAP-40 6-INCH DIRECT READING CAPACITY METER

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See and hear completely wired ARKAY Kits at your dealer.
Write for detailed specifications & catalog, Dept. PE.

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Complete as shown length 109 ft. with 87 ft. of 72 ohm balanced feeder. Installation involved is simple and avoids automatic frequency changing circuits. Will not affect the frequency in any way. No need for destroy the law of balanced feed system. NOVICE and ALL AMATEURS! NO EXTRA TUNER OR GUARD. NO HAYWIRE MESS! EASY INSTALLATION! EASY INSTALLATION!

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serves as a common tie point for several B+ connections. To use the S-meter with it, I moved these connections to the B+ terminal of the accessory socket. I then connected the Y terminal of the S-meter circuit to this point and its X terminal to the i.f. transformer terminal. I also bypassed the transformer terminal to chassis with an additional 0.005-µf. capacitor.

To adjust the meter, short the receiver antenna terminal to ground, advance the sensitivity control to maximum, and turn the BFO off. Adjust R1 for zero meter reading. Unshort the antenna and adjust R2 so that only the very strongest signals will "pin" the meter. R2 may be omitted if desired. Opening S1 removes the meter from the circuit.

News and Views

Bob Mindell, WV6DIQ, 11235 Covello St., Sun Valley, Calif., excites a "Demo-Quad" antenna (described in POPULAR ELECTRONICS, January, 1958) on 15 meters with a WRL Globe Chief transmitter, and he receives with a Hallicrafter SX-99. He has worked 18 states; Massachusetts is his best DX. Bob offers to help prospective amateurs get their licenses. . . . In five weeks, Bob Myers, KN3HWL, Meadville, Pa., has made 150 contacts in 15 states on 80 and 40 meters. He uses a Heathkit DX-20 transmitter to feed an all-band "trap" antenna about 30' high. He receives with a Hallicrafter SX-99, to which he has added a Q-Multiplier for additional selectivity. KN3HWL would like to arrange a contact with a member of the Rag Chewer's Club, so that he can earn an RCC certificate for himself. . . . James Crouse, K4SET, 10 East Parrish, Statesboro, Ga., now has his General Class license. His WRL Globe Chief 90A transmitter and his Hallicrasters S-53A have accounted for some good DX recently, too, including England, Yugoslavia, Germany, Japan, and Scotland. Jim operates some on 20 meters, but 40 meters is still his favorite band.

Don Maase, KN55UO, 9433 Parsifal Place N.E., Albuquerque, N. M., has made three contacts a day spread over nine states in his 21 days on the air. He uses a Heathkit DX-20 transmitter to feed a Mosley 40-through-10-meter vertical antenna mounted on the house roof. Don is proud of his home-built receiver. His pet peeve is hams who neglect to put any spacing between letters and words in their sending. He requests a little help with General Class theory. . . . Tommy Murphy, KN5UKH, Route 1, Kosciusko, Miss., has worked 22 states on 40 meters in his first two weeks on the air. He feeds a dipole antenna about 35' high with a 50-watt transmitter of his own design, and receives with a SX-99. See Tom if you need a Mississippi card. . . . Benny "Chip" Thomas, KN4ZEP, 313 North Sterling St., Morganton,
HELP US OBTAIN OUR HAM LICENSES

K1/W1 CALL AREA
Dave Waycie, 57 Newington Rd., Elmwood 10, Conn. Phone: AD 3-1670. (Code, theory and regulations)
Philip Brady, Jr., 60 Park Ave., Needham Heights 94, Mass. (Code, theory and regulations)
Lorraine Chauik, 617 E. 7th St., South Boston, Mass. (Code and theory)

K2/W2 CALL AREA
Jim McLeilian, 29 Ridgewood Pkwy. W., Den- ville, N. J. Phone: OA 7-7132. (Code and theory)
Erwin P. Cohen, 3802 Walkow Ave., Seafood, N. Y. Phone: SU 5-9231. (Code)
Thomas Doollittle, Sharon Springs, N. Y. (Code and theory)
Robert W. Myers, 25 Harding St., Coplague, N. Y. Phone: AM 4-5622. (Code and theory)
Ronald J. Kuhl, 121 Kramer Dr., Linden- hurst, N. Y. Phone: TU 8-9274. (Code and theory)
James B. White, 2275 First Ave., New York 35, N. Y. (Code and theory)
Kenneth Fee (12), 848 Elizabeth Ave., Eliz- abeth 4, N. J. Phone: EL 3-0762. (Code, theory and regulations)
Richard C. Factor, 115 Central Park West, New York 23, N. Y. Phone: SU 4-5673. (Code)
Thomas A. Gundlach, 2 Hopes Ave., Holte- ville, N. Y. (Code, theory and selection of equipment)
Jim Tweedle, 501 Oxford St., Vineland, N. J. Phone: OX 1-4571. (Code)
Paul Adler, 2232 Brigham St., Brooklyn 29, N. Y. Phone: NI 6-1101. (Code)
Richard W. Reynolds, 14 Longview Rd., Liv- ington, N. J. (Code, theory and selection of equipment)

K3/W3 CALL AREA
Carl Sacherich, Jr. (16), 418 Seddon Ave., N. Braddock, Pa. Phone: BR 1-7330. (Code and selection of equipment)
Joseph Zeleziak (15), 1034 Sixth St., N. Braddock, Pa. Phone: BR 1-2087. (Code and selection of equipment)
Mickey Kirkell, 181 N. Spring St., Blairsville, Pa. (Code and theory)

K4/W4 CALL AREA
L. L. Womack, Jr., 39 Park Ave., Brevard, N. C. (Code and theory)
Moran Graham, Tifton, Ky. (General Class theory)
Philip Walker, 1501 Waverly Ave., Charlotte 3, N. C. (Code, theory and regulations)
Horace Monroe, 400 N. 33rd St., Richmond 22, Va. (Code and theory)
Sam S. Wright, 514 N. Monroe St., Arlington 1, Va. (Code, theory, regulations and selection of equipment)
David H. Butler, Rippon Lodge, Woodbridge, Va. Phone: GY 4-4004. (Code, theory and selection of equipment)
Kenneth Heiton, Route #1, Vinemont, Ala. (Code, theory, regulations and selection of equipment)
Andre Hansen, 1594 Peachtree Circle, Jack- sonville 7, Fla. (Code and theory)
Craig Littlejohn, 4564 Rosewood Ave., Jack- sonville 7, Fla. (Code and theory)

K5/W5 CALL AREA
Lynn Dale Brooks, 2500 37th St., Snyder, Tex. (Code, theory and selection of equipment)

David F. Tyndell, 513 E. Layton St., Kilgore, Tex. (Code, regulations and selection of equipment)
Clarence Perry, Route #2, Madill, Okla. (Code, theory and regulations)
John W. Daut, Route #2, Box 1061, Humble, Tex. (Code and regulations)
Alex Galbraith, 1710 McCall Rd., Austin 3, Tex. (Code, theory and selection of equipment)

K6/W6 CALL AREA
Joseph Yelda, 2257 Holly Dr., Hollywood 28, Calif. Phone: HO 9-4239. (Code)
Michael J. P. Dooley, 454 65th St., Oakland 9, Calif. (Code, theory, regulations and selection of equipment)
Michael Flynn, 2836 Harmony Place, La Cres- centa, Calif. Phone: CH 8-2549. (Code and theory)
Dan Scanlan (16), 4579 W. 171st St., Lawn- dale, Calif. (Code, theory and selection of equipment)

K7/W7 CALL AREA
Pete Almada, 1328 E. 13thth, Tucson, Ariz. Phone: MA 2-2466. (Code and theory)
Eric Lundberg (14), 2216 E. 110th St., Seattle 55, Wash. (Code and selection of equipment)

K8/W8 CALL AREA
Robert Morgan (14), 6317 Stratford Dr., Parma Heights 30, Ohio. (Theory and selection of equipment)
Ken Kozel (16), 13466 Eureka, Detroit 12, Mich. Phone: TW 2-5662. (Code and selection of equipment)
Mike Bockoff, 666 W. Maplehurst, Ferndale 20, Mich. Phone: LI 2-6307. (General code, theory, regulations, and selection of equipment)

K9/W9 CALL AREA
John Walasewich, 4029 W. Warwick Ave., Chicago 41, Ill. (Code, theory, regulations and selection of equipment)
Jerry Kelley (16), R. R. 3, Box 103-B Apple- gate Lane, Jeffersonville, Ind. Phone: BU 2- 3137. (Code)
Tom Lanham, 765 Indiana St., Gary, Ind. (Code, theory and selection of equipment)

K0/W0 CALL AREA
James Crooks, 6606 Hoffman, St. Louis 39, Mo. (Theory and selection of equipment)
Robert J. Nobis, Jr. (16), 1316 13th St., N. Moorhead, Minn. Phone: CE 3-5348. (Code and theory)

VE AND OTHERS
Melville C. Coffin, P. O. Box 882, Mission City, B. C., Canada. (Code, theory and regulations)
Dennis Madokoro, 209 10th Ave., No. Port Aberni, B. C., Canada. (Code, theory and selection of equipment)
Louis Bouvier, Cote Noir Rd., St. Hubert, Quebec, Canada. Phone: CR 6-2482. (Code and theory)
Donald Drueck (13), 261 Sheraton Dr., Mon- treal 28, Quebec, Canada. (Theory, regulations and selection of equipment)
Ian Hodgson, 64 Malcolm Circle, Dorval, Que- bec, Canada. (Code, theory, regulations and selection of equipment)
N. C., has made 20 watts input to his Heathkit AT-1 “antenna heater” and a single 40-meter crystal sufficient for over 100 contacts. His receiver is a National NC-183D, which works excellently except that the BFO jumps around a bit at times; he will welcome any suggestions on how to find the trouble.

Mike Eilers, KN8OOK, 2533 Leahy St., Muskegon Heights, Mich., worked three Generals for his first three contacts. Now, after a week on the air, he has become a DX-chaser. Mike runs 40 watts to a home-built transmitter and listens with a Hallicrafters receiver, model not specified. He does both with the aid of a 40-meter dipole antenna. From the rare state of Delaware, Tom H. Weslager, KN3GKD, 601 South Maryland Ave., Wilmington, offers to schedule anyone needing his card for WAS (worked all states). Tom operates on 7199.5 kc., using a Heathkit DX-20 transmitter to feed a 40-meter dipole through a pair of balun coils. He receives with a Hallicrafters S-53A. In seven months on the air, Tom has worked 37 states, all confirmed, and three WP4’s (Puerto Rico).

Bruce “Butch” Wizorek, KN9QPA, 3404 N. Keeler Ave., Chicago 41, III., runs 75 watts to a WRL Globe Chief 90 transmitter. He has two antennas, a WRL 12AV vertical and a 40-meter dipole. In a month on the air, Butch has worked Australia, England, Switzerland, and Poland, plus many U.S. stations. He is also an avid SWL’er, having heard both Sputnik I and the U.S. Army’s “Moon-Bounce” signals.

Marilyn J. Boer, KN4FLW, P. O. Box 553, Andrews, N. C., had had her license for exactly three weeks when she wrote us. In that time, she had made 48 contacts in 30 states, 13 states already confirmed! In setting this record, Marilyn called only two CQ’s! She says, “I have a lot of patience, and I do a lot of listening.” Marilyn operates on 40 meters only, running 65 watts to a WRL Globe Scout transmitter, which feeds a Windom antenna. She listens on a Hammarlund HQ-160 receiver. Incidentally, her husband is K4YBQ.

Nasir, 9K2AN, Kuwait, Arabia, mentioned earlier, has worked 33 states and 88 countries on c.w. and 66 countries on phone in 15 months on the air. During 1958 he used a Heathkit DX-35 transmitter running 50 watts and an AR-3 receiver. In January he switched to a Harvey-Wells T-90 transmitter at 90 watts input and a Hallicrafters SX-101 receiver. He uses dipole antennas.

Mark, WY2CYZ, 53-31 Marathon Parkway, Little Neck 62, N. Y., calls his antenna a “76-foot mess,” which may explain why he has worked only three states in a month on 40 meters. R. M. Saltzman, WV2BWC/WA2BWC, 1 Vista Drive, Great Neck, N. Y., claims that it is grammatically correct for him to say, “We at WV2BWC use a National NC-109 receiver and a WRL Globe Scout transmitter at 65 watts feeding a long-wire antenna or a 15-meter dipole,” because his brother Rick (11) passed his Novice exam 55 days ago. Bob’s record is 40 states and 20 countries confirmed.

Until next month, when I hope to hear from you, 73,

Herb, W9EGQ
Short-Wave Report

(Continued from page 99)

The following is a resume of the current reports. All times are Eastern Standard. Stations may change frequency and/or schedule with little or no advance notice; however, all reports given here are correct at the time of compilation.

Please remember to send all your reports to P.O. Box 254, Haddonfield, N. J., from now on.

Andorra—R. Andorra has definitely moved from 5979 kc. to 5991 kc. and is noted at 1640 with classical music and Spanish. The ID is Aqui Radio Andorra. [WPE3NF]

A new outlet, known as Andorrradio was noted on 6306 kc., close/down at 1700 with French and Spanish ID. Another report lists this station as being noted from 0500 to 0700. However, according to the World Radio Handbook, it operates only on 3145 kc. [WPE3NF, WPE4FB, WRH]

Angola—According to a verification, the correct call for the Emisora Official outlet on 17,795 kc. is CR6RZ, not CR6SF. This Luanda xmr operates with 10-kw. power to a rhombic antenna. [URD/KC]

Argentina—LRA32, R. Nacional, Buenos Aires, carries ENG to Europe at 1800-1900 on 15,345 kc. Portuguese begins at 1900. [WPE4EB, WPE8FW, WPEOJ]

The R. Nacional Mendoza outlet on 6180 kc. LRA34, 10 kw., is scheduled from 0700 to 2300. [WRH]

Australia—Changes have been made recently in the R. Australia xmrns to S. Asia and N. E. Asia. Broadcasts now go to S., S. E., & S. W. Asia at 1714-1830 on 15,310 kc., 1714-0415 on

21,540 kc., 1815-0230 on 17,840 kc., 0129-0445 and 1915-1930 on 15,160 kc., 0459-1230 on 9580 kc., 0800-0830 and 0930-1230 on 7220 kc., 0800-1230 on 11,710 kc., and 0930-1000 on 11,740 kc.; to N. E. Asia and N. Pacific Islands at 1559-1800 on 15,240 kc. 0244-0700 on 11,740 kc., 0459-0900 on 15,160 kc. All of these xmrns are in English. [WPE8DN, HB]

VLX15, Perth, 15,425 kc. (new frequency), is heard weakly at 2228 with dance music. [WPE3NF]

Brazil—R. Marajoara, Belem, 15,245 kc., is a new station that has been testing around 1600. PRG3, R. Nacional de Sao Paulo, Sao Paulo, has moved from 6125 kc. to 6115 kc. and is heard well at 1930-2030. [WPE4FI, WPE8KM]

PRG3, R. Tupi, Rio de Janeiro, 15,370 kc., will make special tests in Spanish, French, and English with 100-kw. power. [AR]

The call-signs for the R. Rural Brasileira

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outlets are ZYZ31 (6062 kc.) and ZYZ32 (15,-105 kc.). R. Progresso, Sao Paulo, 4775 kc. (reported on 4755 kc.), is now ZYR81. There are two stations reportedly operating as R. Guarujá: one on 5975 kc., Florianópolis; the other on 5985 kc. giving the ID R. Guarujá Paulista. The former is ZYJ7, and the latter is ZYTT. (WRH)

Cameron—R. Douala, formerly on 6115 kc., has moved to 6194 kc. and is tuned at 0100 with French and a very poor signal. (WPE3NF)

Canada—CKFX, Vancouver, 6080 kc., listed as 10 watts, is a real challenge for DXers. Try for it around 0300 with news, 0305 with pop records, 0320 with CKWX Headlines. (DXRA)

CFVP, Voice of the Prairies, Calgary, 6030 kc., is another rarely reported station. It carries Eng. to the N. W. Territory from 0830 to 1200. (DG)

Radio Canada offers a program guide monthly. Send your request to the International Service, P. O. Box 6000, Montreal, Canada. (DH)

Ceylon—The Commercial Service of R. Ceylon, 15,265 kc., continues to be well reported in its S. Asian “Early-Morning” show at 2030. Catch the tuning signal from 2025 and “Strike Up The Band” at 2030. (DK)

Radio Ceylon relays the VOA on 6075 kc. at 0700-1300. (DW)

China—Chinghail, 9457 kc., is heard in native language at 0700-0900. Other Peking stations have been noted on 11,820, 11,975, and 9064 kc. at the same time, and on 9620 kc. at 0905. (WPE6AA)

Congo Republic—R. Brazzaville, 21,500 kc. (new), is noted at 0830-1015, dual to 17,720 kc. English news is given at 0930. (WPE4FI, WPE6AA)

The 11,725-kc. outlet can be heard in Eng. at 1730-1755 for Africa and Asia and at 2015-2100 for N. & S. America, dual to 11,970 kc. They are reportedly doing their verifying with new cards. (PB)

Costa Rica—TIDCR (reported also as TIRICA), San Jose, 9620 kc., is using two slogans: La Voz de la Victor y. R. Internaciona de Costa Rica. It was checked around 2110. (WPE4EB, WPE6KM)

TIQ, R. Casino, Puerto Limon, 5960 kc., is noted with Latin and American music at 0300-0102. (WPE04JJ)

Cuba—CO7Z, R. Salas, Havana, has been varying from 9025 kc. to 9030 kc. and as high as 9068 kc. It is audible from 1830 to 0000 with good signals. Programs are mostly music,
commercial, and announcements in Spanish. The medium-wave outlet on 830 kc. is often heard during the evenings in northern states. (WPE9DK, WPE0(AE))

COCY, R. Rebelde, Havana, has moved from 11,750 kc. to 0450 kc. and is heard at 1900-0000. (WPE4FI)

Dominican Republic—H18Z, R. Santiago, Santiago de los Caballeros, has moved from 6140 to 6075 kc. and is noted around 2000 with music and commercials. (WPE0JJ)

Ecuador—ONDAS DEL VOLANTE, Azogues, 6140 kc., has been monitored at 2200-2230 with non-stop Latin and old American jazz, and to 2259 with Andean music. Two ascending chimes were noted at 2259 followed by a brief vocal selection. The s/off was at 2302. (DXRA)

Germany—DEUTSCHE WELLE, Cologne, 11,795 and 9640 kc., has Eng. at 2130-2150 daily. Eng.

lich/German lessons begin at 2140. (WPE2AIQ)

India—Madras is operating on 15,385 kc. (new) at 1845-1915 with programs in Tamil. (WPE4FI)

Israel—Israel B/C Service, Jerusalem, has been tested on 11,945 kc. at 1600 and urgently requests reports. (WPE8GB, WPE9FM)

Ivory Coast—Abidjan has been found on 7215 kc., dual to 4940 kc., at 1730 with final ID in French. This one is only 1 kHz, but the signal is good. The schedule has apparently been extended. (WPE3NF)

Malaya—BBC Far East Station, Singapore, 9690 kc., is tuned from 1115 to 1147 s/off with program details, commentary, and forum. (WPE0AE)

Netherlands—R. NEDERLAND, Hilversum, operates in Eng. to N. A. at 1615-1655 (except Sundays) on 17,775, 15,220, and 11,730 kc., and at 2130-2210 (except Sundays when "Happy Station Program" is broadcast) on 11,730, 9590, 6025 kc. (WPE2AIQ, WPE9DN, WPE9LF, WP)

New Zealand—ZL2, Wellington, 9540 kc., is heard well at 0100-0300 with music and news in English. (WPE5CN)

Panama—HPSJ, LA VOZ DE PANAMA, Panama City, 9608 kc., has returned to the air after a long absence. It was noted at 0700 and from 2000 to 2205/close. Announcements are all Spanish. (WPE3HP, WPE4EB, WPE4FI)

HOLA, Colon, 9505 kc., can be tuned at 2115-2215 with music programs and many commercial. (MS)

Peru—OAX4T, R. NACIONAL DEL PERU, Lima, has moved from 15,130 to 15,152 kc. and is noted at 1900-0000. (WPE4FI)

Portugal—R. LISBOA, Lisbon, 17,895 kc., has Eng. news at 1248-1255; music follows to 1300 close in English. (DXRA)

Portuguese Guinea—CQM, Bissau, has been noted on 7948 kc. with male and female vocals at 1751-1759. The ID followed and the anthem was presented from 1800 to 1802 s/off. The 3974-kc. channel is inactive. Present schedule: 1600-1800 daily; 0800-0900 Sundays only. (WPE1BM)

Solomon Islands—VQO2, Honiara, Yavaya Ridge, 5960 kc., is being heard well from 0259 s/on to 0355 s/off; children's show at 0330, BBC news at 0415, local news at 0430. (WPE7AT, WPE0JJ, MK)

Tibet—According to information from two broadcasting operators living in Northern India, no regular broadcasting service exists in Tibet. Only a Chinese Army xmt is active from time to time near Lhasa, and that station varies between 9210 and 9245 kc. (WRH)

Tunisia—Tunis is not currently operating on the short waves. An Arabic station noted at 7110 kc. at 0145-0300 may be Rabat, Morocco, 7111 kc., actually scheduled to operate to 0400. Another Arabic station noted on 4810 kc. is the fifth harmonic of Tunis on 962 kc. (URDXC)

USA—The Dept. of Commerce, National Bureau of Standards, is conducting a survey of users of the technical radio broadcast services of WWV and WWVH. For a questionnaire, write to P. W. Brown, Director of Boulder Laboratories, Boulder, Colorado. (DH)

Vatican City—VATICAN RADIO can be heard on 15,120 kc. from 1315 s/on to 1330 s/off, dual to 9646 and 11,685 kc. (WPE9AE)

Venezuela—YVXX, LA VOZ DE LA PATRIA, Caracas, is heard well in English on 3305 kc. at 2130-2230 with "Night Beat." The news is read at 2200. Jim Davission, announcer, requests that reports be sent to Apt. 2797, Caracas. (AR)

Utility—Standard frequency station BPV is presumed to be located in China, in or near Shanghai. Although it has been heard on 5000, 10,000, and 15,000 kc. for over a year, few details are actually known about this particular station. (WRH)
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Part 12, Section 12.231(a) of the FCC Rules is being amended as follows:

(a) The following tabulation indicates the frequencies and frequency bands, within the regularly allocated amateur frequency bands, which are made available for use by stations in the Radio Amateur Civil Emergency Service. These frequencies and frequency bands may be used, on a non-exclusive basis (stations authorized in the Amateur Radio Service may also, pursuant to the provisions of Section 12.111, use these frequencies or frequency bands until such time as national conditions require discontinuance of regular amateur operations), by the classes of radio amateur civil emergency stations or units of such stations indicated, and only with the types of emission shown in the right-hand column.

(1) For use only by authorized stations or units of such stations which are operated under the direct supervision of duly designated and responsible officials of the civil defense organization:

Frequency band Authorized emission
1800-1825 kc. (Note 1) 0.1AI, 1.1FI, 6A3
1750-2000 kc. (Note 1) 0.1AI, 1.1FI, 6A3
3500-3510 kc. (Note 1) 0.1AI, 1.1FI, 6A3, 6F3
3990-4000 kc. (Note 1) 0.1AI, 1.1FI, 6A3, 6F3

NOTE 1. Use of frequencies in the band 1800-2000 kc. is subject to the priority of the Loran system of radionavigation in this band and to the geographical, frequency, emission, and power limitations contained in Section 12.111 of the rules governing amateur radio stations and operators (Subpart A of this part). The use of these frequencies by stations authorized to be operated in the Radio Amateur Civil Emergency Service shall not be a bar to expansion of the radionavigation (Loran) service, and such use shall be considered temporary in the sense that it shall remain subject to cancellation or to revision, in whole or in part, without hearing, whenever the Commission shall deem such cancellation or revision to be necessary or desirable in the light of the priority within this band of the Loran system of radionavigation.

(2) For use by all authorized stations in the continental United States only: (Not available in Alaska, Hawaii, the territories or possessions of the United States):

Frequency band Authorized emission
3510-3516 kc. 0.1AI, 1.1FI
3516-3550 kc. (Note 2) 0.1AI, 1.1FI
3994-3999 kc. 0.1AI, 1.1FI, 6A3, 6F3
7097-7103 kc. (Note 2) 0.1AI, 1.1FI
7103-7125 kc. (Note 2) 0.1AI, 1.1FI
7245-7255 kc. (Note 2) 0.1AI, 1.1FI, 6A3, 6F3
14,047-14,053 kc. (Note 2) 0.1AI, 1.1FI, 6A3, 6F3
14,220-14,230 kc. (Note 2) 0.1AI, 1.1FI, 6A3, 6F3
21,047-21,053 kc. (Note 2) 0.1AI, 1.1FI

NOTE 2. The availability of the frequency bands 3516-3550 kc., 7103-7125 kc., 7245-7255 kc., 14,220-14,222 kc. and 14,228-14,230 kc. for use during periods of actual civil defense emergency is limited to the initial 30 days of such emergency unless otherwise ordered.

(3) For use by all authorized stations:

Frequency or Frequency bands Authorized emission
3997 kc. (Note 3) 0.1AI, 6A3
26.55-28.75 mc. 0.1AI, 1.1FI, 6F3, 6A4
29.45-29.65 mc. 0.1AI, 1.1FI, 6A3, 6A4, 40F3
50.35-50.75 mc. 0.1AI, 1.1AI, 6A2, 6F2, 6F3, 6A4
51.30 mc. (Note 3) 0.1AI, 40F3
51.35-53.75 mc. 0.1AI, 1.1FI, 6A2, 6F2, 6A3, 6A4, 40F3
145.17-145.71 mc. 0.1AI, 1.1FI, 6A2, 6F2, 6A3, 6A4, 40F3
146.79-147.33 mc. 0.1AI, 1.1AI, 6A2, 6F2, 6A3, 6A4, 40F3
220-225 mc. 0.1AI, 1.1FI, 6A2, 6F2, 6A3, 6A4, 40F3

NOTE 3. For use in emergency areas when required to make initial contact with military stations for communication with military stations on matters requiring coordination.

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