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JULY 1969 • 50¢

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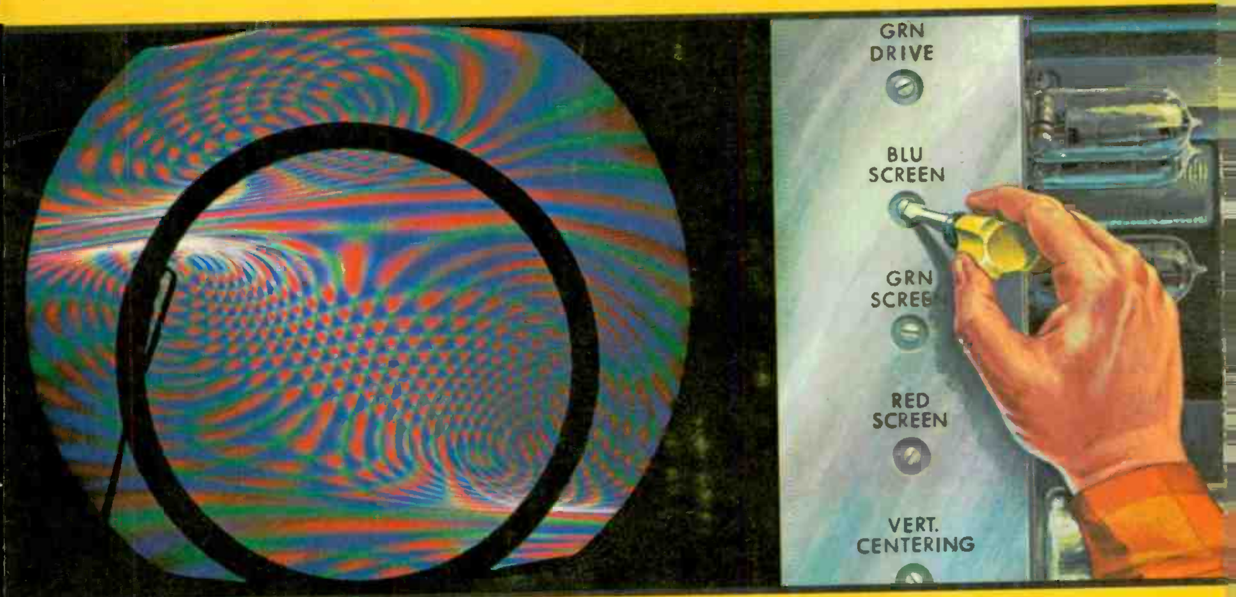

Starting in This Issue!

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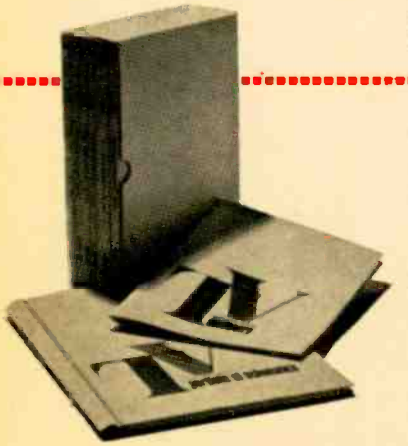

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ELECTRONICS ILLUSTRATED

A Fawcett Publication

July 1969 Vol. 12 No. 4

Member Institute of High Fidelity, Inc.

COVER: Illustration by Eugene Thompson
Color Transparency by RCA

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All channel color TV WINDOW ANTENNA outperforms any indoor antenna!

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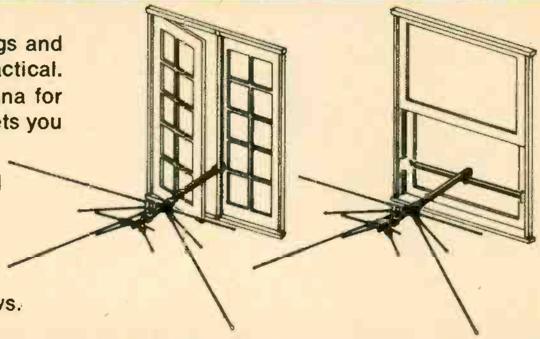

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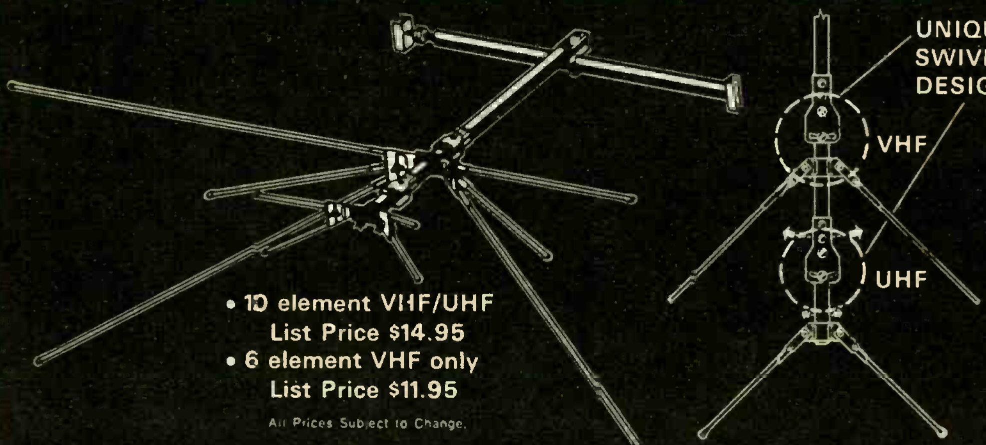

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CIRCLE NUMBER 11 ON PAGE 15

ELECTRONICS ILLUSTRATED

By the Publishers of MECHANIX ILLUSTRATED

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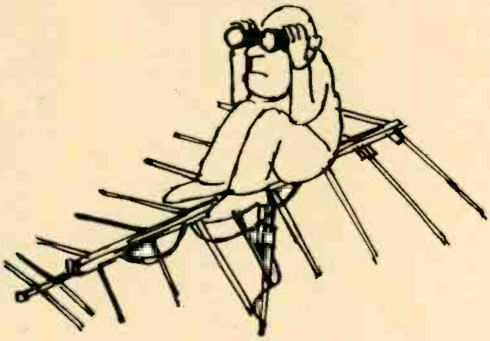
Feedback from Our Readers

Write to: Letters Editor, Electronics Illustrated, 67 West 44th St., New York, N.Y. 10036

● AIMING LONG DISTANCE



I enjoyed your article on getting a good color TV picture with an antenna in the May issue but what gives? Several times now I've lined up my antenna visually with NYC and I still can't get channel 98.

Peter Perkins
Ridgewood, N.J.

We can't, either, Pete. Maybe it's because the FCC stopped at 83.

● ELEGANT DEFINITIONS?

I don't usually do this but I must take exception to the report on the new edition of our Dictionary of Electronic Terms (Good Reading, January '69 EI). This book at $1 is probably the best value in electronics publications and that isn't just my opinion.

I don't know what an *elegant* definition is, but ours have been phrased to be as accurate and understandable as possible. It is not the number of terms that's important but those which are in greatest use and most often looked up. We think that our selections cover over 95 per cent of these.

I think this publication merits more than the half-hearted, negative description your reviewer dashed off.

J. W. Rubin
Allied Radio Corp.
Chicago, Ill.

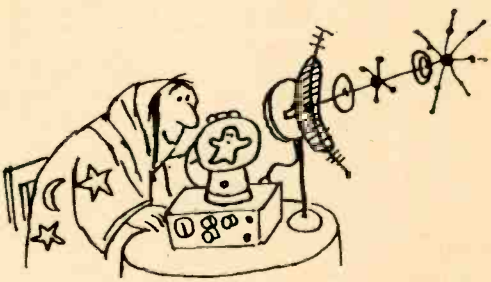
● WHO'S THAT TOOL?

The article on tools in the May 1969 EI (AMAZING NEW TOOLS FOR ELECTRONIC HOBBYISTS) was helpful. However, you didn't mention the name of that trim looking soldering iron in the photo at the bottom of page 30. I need one that size and would like to know what to ask for at my parts distributor.

J. Herman Horwowitz
Bronx, N.Y.

Sorry about that, JHH. It's a 60-watt temperature-controlled iron made by Weller. The model number is W-60.

● WAVE OUT WAVES



Dear EI, could you please tell me how to build a receiver that can pick up the occult frequencies referred to in Uncle Tom's column?

Marcy Utpenskia
Melloville, Ind.

Uncle Tom is now involved with a sit-in at his spacious office. When we reach him we'll see if he has plans.

● RHYTHM

Is there a way to determine the frequency of the human body? I know about eye and ear vibrations but what about the other parts?

Miss Betty F.
Kingston, Ont.

All depends on what you're doing, Betty.

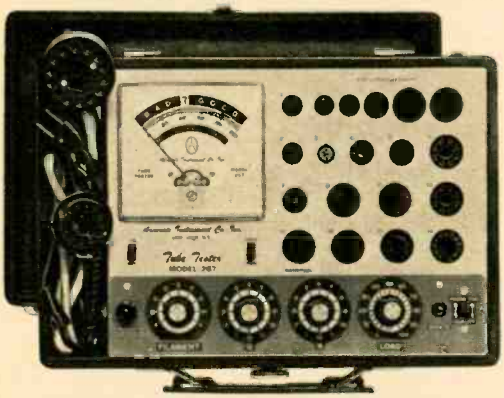
● DIRTY DEALERS

I've become very interested in people's reactions to the radar traps used by police. I

[*Continued on page* 8]

The New 1969 Improved Model 257 **A REVOLUTIONARY NEW**

TUBE TESTING OUTFIT



COMPLETE WITH ALL ADAPTERS AND ACCESSORIES, NO "EXTRAS"

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ANNOUNCING...for the first time

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STANDARD TUBES:

- ✔ Tests the new Novars, Nuvistors, 10 Pins, Magnovals, Compactrons and Decals.
- ✔ More than 2,500 tube listings.
- ✔ Tests each section of multi-section tubes individually for shorts, leakage and Cathode emission.
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- ✔ Employs new improved 4½" dual scale meter with a unique sealed damping chamber to assure accurate, vibration-less readings.
- ✔ Complete set of tube straighteners mounted on front panel.

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- ✔ Single cable used for testing all Black and White Picture Tubes with deflection angles 50 to 114 degrees.
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COLOR PICTURE TUBES:

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

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

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

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

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CIRCLE NUMBER 7 ON PAGE 15

Feedback from Our Readers

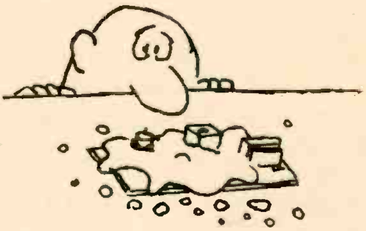
Continued from page 6

think we've all had enough of it. An ultrasonic device that would jam radar would be much in order. How about it, fellas?

N. A. Perkins
Miami Beach, Fla.

We've also been through some of the small towns you're talking about. The only ultrasonic device we can think of is a gun—don't recommend it, but be our guest.

● HOME ON THE RANGE



Can't tell you how pleased I was with your piece on new tools (May '69 EI). To get to the point, I was at my wit's end with my old range-top soldering iron. Please keep up the good work.

Bill Richey
Atlanta, Ga.

Don't throw that antique away, Bill. You may have something—an IC melter for your broiler, for instance.

● FOREIGN TRADE?

The scarcity of electronic parts in our country is too great for an experimenter like me. Sometimes even more common parts are not available in our markets; and thinking of buying FETs or zener diodes is absurd. I wish to have correspondence with some of your American readers who could help me overcome this difficulty. I don't know how many of your readers would endeavor to help me but surely some will respond.

Faheem Akram
28 Main Bazar
Gahri Shahu, Lahore
West Pakistan

Guess the marketplaces aren't what they used to be, Faheem.

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23 Channel Crystal Controlled Channels . . .
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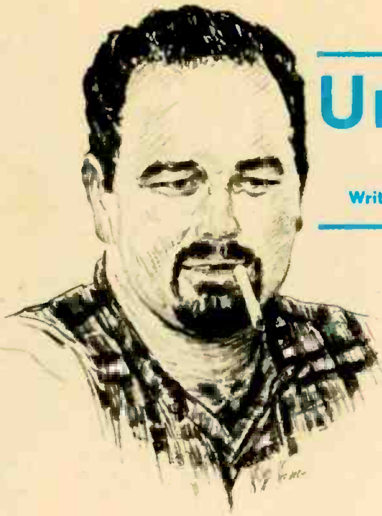


Uncle Tom's Corner

By Tom Kneitel, K2AES/KQD4552

Uncle Tom answers his most interesting letters in this column.
Write him at Electronics Illustrated, 67 West 44th St., New York, N.Y. 10036.

★ *After all of the hullabaloo about Radio Americas/Swan leaving the air, it now looks like they're back. I can hear a weak carrier (no audio) near their old broadcast channel (1,165 kc) each evening. Are they testing again?*

Harold Merriwell
Lafayette, La.

Possibly, but I doubt it. If they were back on the air you'd hear them with a signal that would peel the paint off the walls. My guess is that you're picking up a harmonic from a TV set's oscillator. There are more than 60 such harmonic frequencies in the broadcast band and one of them is 1165.5 kc. Tell your XYL to turn off the video box the next time you hear the carrier and I'll wager you'll find your Radio Americas test signal gone.

★ *Several times you've referred to the troublesome Hammarlund SP-600 receiver. I have one of these sets; it is reasonably troublesome but I thought it was a unique problem. What's the usual story?*

George F. Brockman
Greenville, Ky.

The most serious problem. and one that seems to be contagious from one SP-600 to another, is a badly slipping dial train. It's a killer to repair. I understand that Hammarlund now is manufacturing SP-600s again and I hope they've found a way to patch up this problem. Otherwise, it's a good general-coverage receiver.

★ *Late in the evenings I sometimes hear a chirpy CW signal on 3805 kc. It's not a ham station but sometimes the signal is strong enough to chop up a contact for me. What can be done to get these bootleggers off the bands?*

Sam Wells, WA5KTW
Colfax, La.

Probably isn't a bootlegger, Sam. The ham bands are loaded to the edges with all manner of licensed stations operating in a galaxy of non-ham radio services ranging from broadcast to marine. On the frequency you mention there are almost 100 commercial stations. The closest one to you with enough zonk to give QRM would be HJV35 in El Banco, Colombia. He runs a CW circuit to Bogota with 500 watts going into an omnidirectional antenna. Hams have been bothered by such antics for years but nobody seems to care. Ever hear the powerhouse broadcasters on 40 meters?

★ *Please give me the frequencies of the police stations in Bayonne and North Bergen, N.J.*

Ben Moskowitz
Bayonne, N.J.

Bayonne is on 155.49 mc, while North Bergen holds down the fort on 159.09 mc.

★ *I recently purchased a book entitled 103 Simple Transistor Projects. There's a photo of you on the back of the book which shows you minus the peach fuzz. Why doesn't my book have you with a beard?*

David Cavallaro
Hayward, Calif.

The director made me take it off while we were shooting.

★ *I need the name and address of that fellow I once read about who builds all the really good bugging equipment.*

E. E. Price
Marion, Mass.

Write to Central Intelligence Agency, Langley, Va. 23365. And be sure to mention my name.

New Kits For Home And Hobby...

NEW
Kit GR-58
47^{95}*

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

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

NEW
Kit GR-48
39^{95}*

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

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

NEW
Kit IG-28
79^{95}*

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

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

NEW
kit SB-500
179^{95}*

Heathkit SB-500 2-Meter Transverter

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

NEW
Kit GD-28
59^{95}*

Heathkit GD-28 8-Track Cartridge Tape Player

The new GD-28 is an ideal addition to any home music system. Plays pre-recorded tapes through any system with a Tape Recorder, Tuner or Auxiliary input. Just push in the 8-track stereo cartridge . . . it starts and changes tracks automatically . . . even shows which track is playing. Changes tracks instantly with the front panel switch too. Goes together quickly on one circuit board, and the playing mechanism is preassembled & adjusted. Attractive wood-grained polyurethane cabinet included. Order yours now. 10 lbs.

CIRCLE NUMBER 3 ON PAGE 15

CIRCLE NUMBER 3 ON PAGE 15

Broadsides

Pamphlets, booklets, flyers, application notes and bulletins available free or at low cost.

SUMMER is nigh but the 1969 catalogs keep piling up. A big surprise is a new **home entertainment** electronics catalog from Sears. It runs to 68 pages and covers the firm's own line of stereo equipment plus that of other manufacturers as well. You'll also find radios, TV sets, records and musical instruments. It's available free as catalog 39A 7166 from Sears, Roebuck & Co., Dept. 139, 925 S. Homan, Chicago, Ill. 60607.

Talk about **instruments,** Conar has a 53-page catalog that lists a wide range of kits, test equipment, ham and CB rigs and hi-fi components. Of special interest are their own kits, which are developed for use in NRI courses on electronics and amateur radio. For your copy write Conar, Div. of National Radio Institute, 3939 Wisconsin Ave. N.W., Washington, D.C. 20016.

For advanced electronic types is a Scientific Instrumentation catalog from Heath Co., Benton Harbor, Mich. 49022. Here are 64 value-packed pages illustrating both Heathkit and Malmstadt-Enke precision instruments. If you're interested in computer modules, chart recorders, test equipment and laboratory instruments this is the brochure for you. It's free if you write on an official letterhead.

Turning to **high-fidelity** components, James B. Lansing offers two manuals that can make life easier if you're about to build your own speaker enclosure. Manuals CF802, Enclosure Construction, and CF706, Enclosure Construction for JBL Series F Musical Instruments, can both be had for 50¢ from JBL, 3249 Casitas Ave., Los Angeles, Calif. 90039.

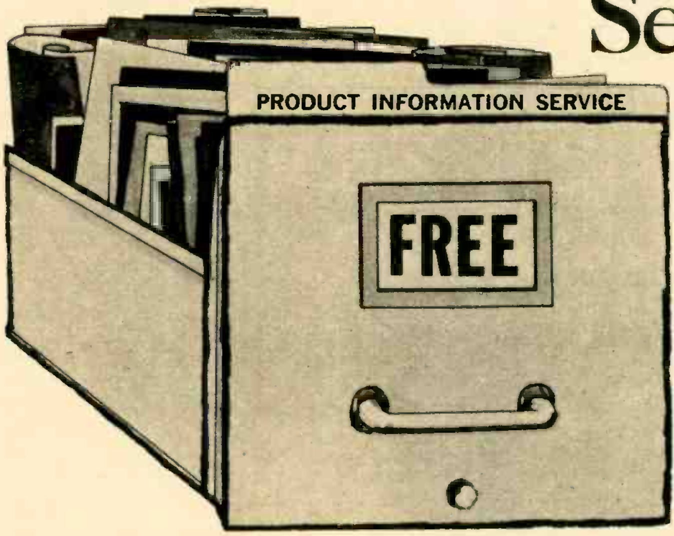
Tape recorders are the subject of a 16-page catalog available free from Concord Electronics Corp., 1935 Armacost Ave., Los Angeles, Calif. 90025. You get all specifications for their line of cassette recorders, tape decks and stereo tape systems.

An 8-page brochure describes **headphones** for communications, dictation and private listening. Whatever your interest, you'll find a handy earphone for any application. Catalog BI-2166 is yours free from Telex Communications, 9600 Aldrich Ave. S., Minneapolis, Minn. 55420.

Have a 1960 through 1969 model car? You may want the automotive **speaker replacement** guide that's available free from Jensen Manufacturing Div., Muter Co., 5655 West 73rd St., Chicago, Ill. 60638; it covers both domestic and foreign autos.

Also make note of a 64-page catalog from Hy-Gain that details their line of antennas. Write to Hy-Gain Electronics Corp., Box 868, Lincoln, Neb. 68501.

ELECTRONICS ILLUSTRATED Product Information Service



If you want more information about one or more of the products advertised in ELECTRONICS ILLUSTRATED, this service is for your convenience. The product information you request will be sent to you promptly free of charge.

Just complete the name and address portion of the handy coupon below and circle the PRODUCT INFORMATION SERVICE number or numbers you find beneath the advertisements in this issue.

Mail the completed coupon to ELECTRONICS ILLUSTRATED at the address shown—We'll take care of the rest.

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7/69

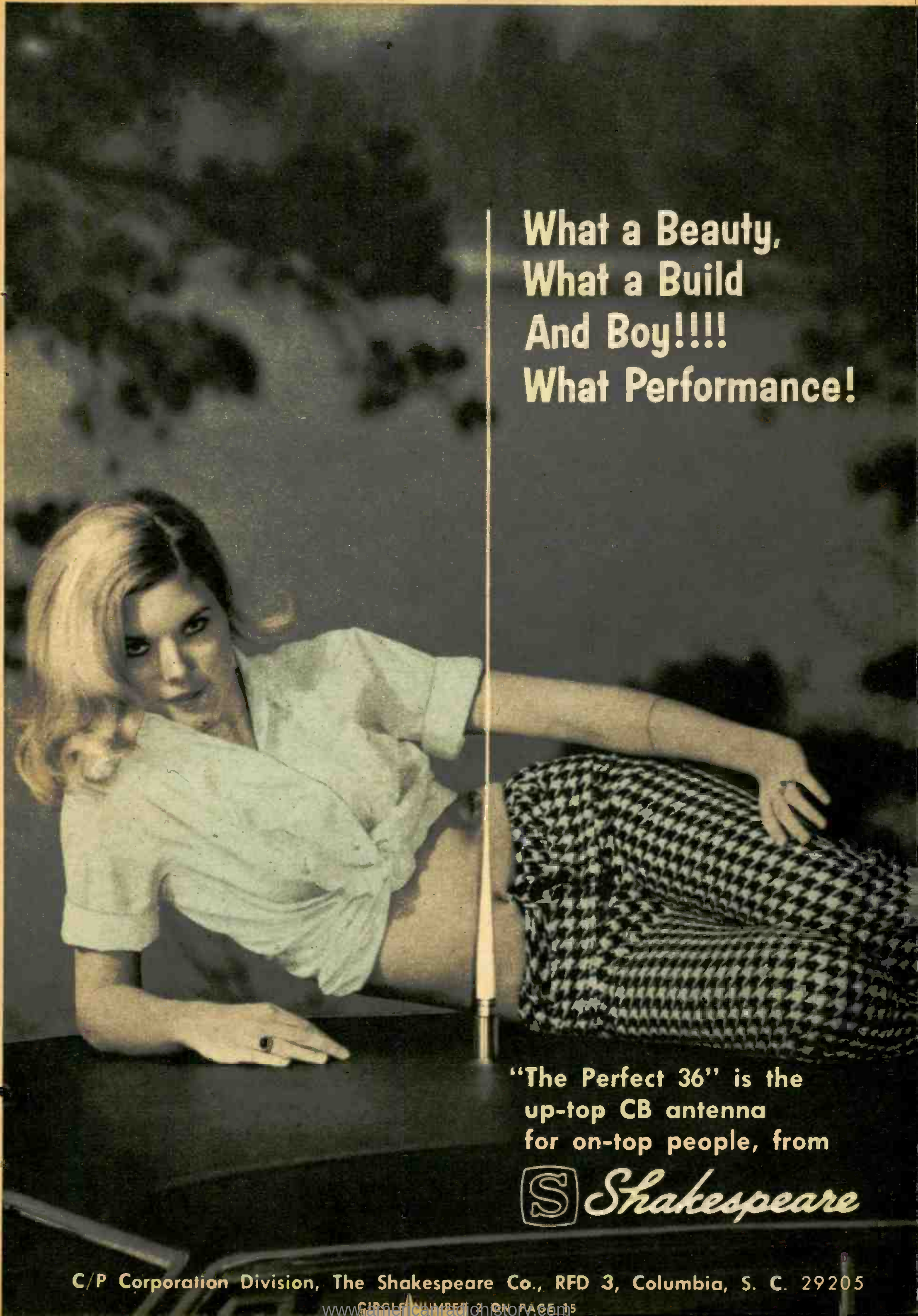
July 1969 Elec. Illus

CENTURY CELL. A new line of alkaline batteries can be charged up to 100 times, according to the manufacturer. Batteries come in D, C and AA sizes. Companion battery charger, Model BC-15, is designed for use with the Duracells. It operates off 117-VAC line and can charge either two or four batteries simultaneously in any pair combination. Charger: $9; batteries (per pair): D size, $3.50—C size, $2—AA size, $1.32. Mallory Battery Co., Tarrytown, N.Y.

Sharp Look. Model SA660 integrated amplifier offers 60 watts rms per channel. THD is said to be less than 0.2 per cent from 20 to 20,000 cps with IM distortion less than 0.2 per cent at 100 watts. Noise is 72db down for low-level inputs. $435. James B. Lansing, Inc., Los Angeles, Calif. 90039.

Electronic Marketplace

Novice Station. Model 400 transmitter and Model 500 communications receiver operate on 80, 40 and 15 meters. Each has been available separately (kit or wired) and they are now part of new NRI courses on amateur radio. Transmitter $39.90 kit, $55.50 wired; receiver: $44.75 kit, $74.95 wired. Courses: $75 to $195. National Radio Institute, 3939 Wisconsin Ave., Washington, D.C. 20016.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What a Build
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What Performance!
"The Perfect 36" is the
up-top CB antenna
for on-top people, from
Shakespeare
C/P Corporation Division, The Shakespeare Co., RFD 3, Columbia, S. C. 29205
CIRCLE NUMBER 2 ON PAGE 15

Electronic Marketplace

Portable Recorder. Servocontrol 800-B portable tape recorder has built-in condenser electret microphone with IC amplifier. Unit is also equipped with cardioid mike for handheld and

remote use. Switch allows selection of either internal mike, external mike or simultaneous use of both. Tape speeds: 1⅞ ips, 3¾ ips, 7½ ips and 15/16 ips for extra-long playing time. $229.50. Superscope Inc., 8150 Vineland Ave., Sun Valley, Calif. 91352.

Around You Go. Model AR-22 Autorotor is latest addition to Bell Series of rotors and controls for TV/FM antennas. Bell Series heavy-duty equipment is designed for large arrays. The AR-33 is solid-state control having PC board

construction. Full 360° sweep is possible and accuracy is ± 1°, according to manufacturer. Five push buttons allow automatic control of rotor so that regularly tuned FM stations and TV channels may be preset for immediate tracking; set uses five-wire cable. $79.95 for AR-33 and Bell rotor. Cornell-Dubilier Electronics, Div. of Federal Pacific Co., 50 Paris St., Newark, N.J. 07101

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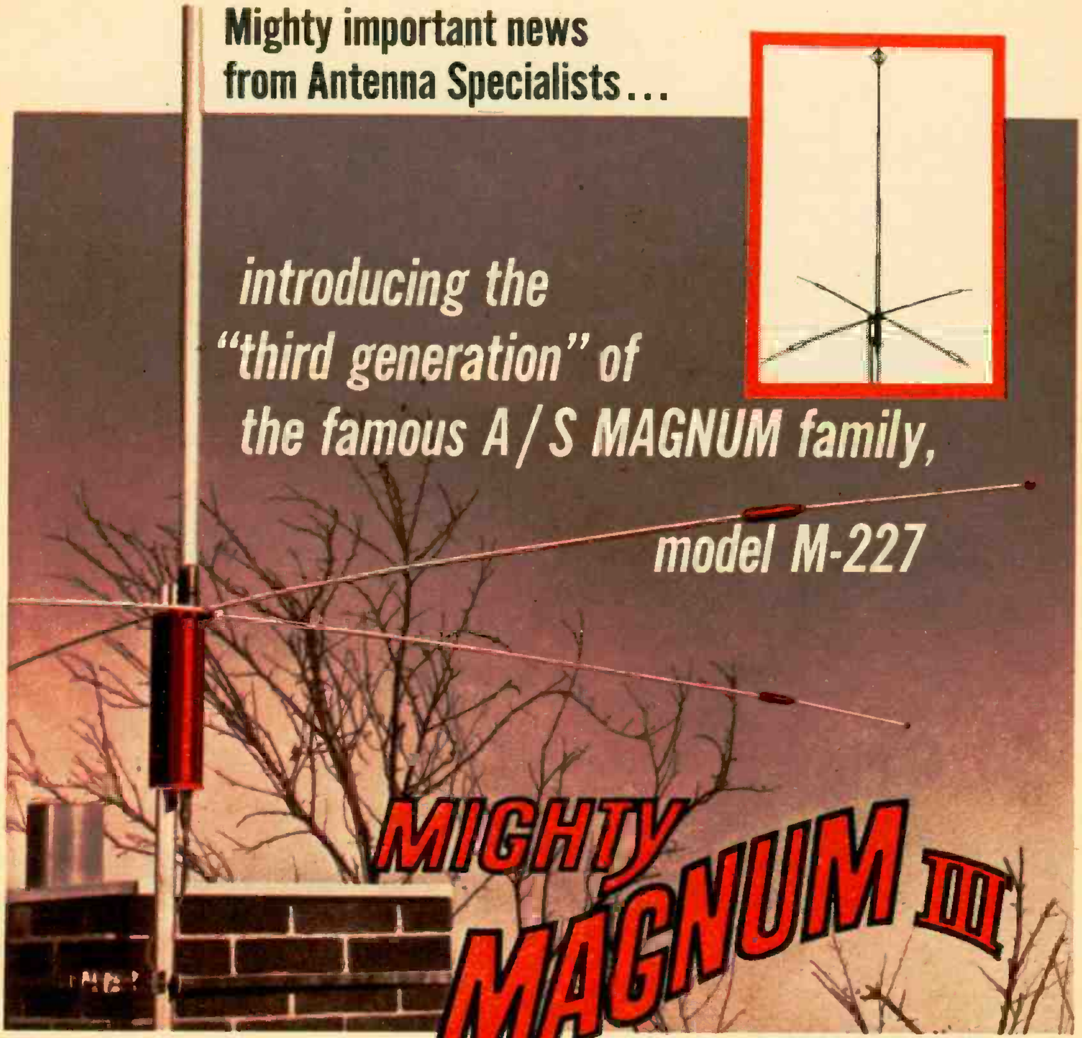

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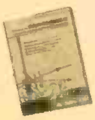

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CIRCLE NUMBER 21 ON PAGE 15

Is Johnson's new 23-channel Messenger 123 at $169.95 . . . Legal?

FCC Type Accepted

You be the Judge.

Is it unfair competition for Johnson to produce a 23-channel solid state unit with the incomparable Johnson "talk-power" for less money than you had to pay yesterday for a 12-channel unit with crystals?

Is there a law against operating a rig whose specifications are close to theoretical perfection—such as 0.4 microvolt sensitivity . . . and sharply filtered 7 kHz selectivity?

Is it a crime to build in a special speech compression circuit for unsurpassed voice intelligence? Or the famous Johnson high-efficiency noise limiter that virtually wipes out ignition and other extraneous radiated interference?

We think you'll agree: For sheer value, Messenger 123 is the exception to the rule.

E. F. JOHNSON COMPANY
WASECA, MINNESOTA 56093

CIRCLE NUMBER 15 ON PAGE 15

Build Your Own Legal Broadcast Station

. . . and turn on the neighborhood with programming that swings.

By HERB FRIEDMAN, W2ZLF

TIRED of the same old radio programs with their screaming disc jockeys, crummy music and irritating commercials that jab at you every minute or two? We don't blame you. A lot of the time radio resembles the vast wasteland that TV was once called. It doesn't take much imagination to come up with programming that could be a good deal better. But how do *you* get it on the air? Best way is with your own *legal* and license-free broadcast station.

As long as a transmitter's input power is less than 100 milliwatts and the antenna length is no greater than to 10 ft., you're legal. The FCC permits you to operate an unlicensed broadcast station as long as you don't interfere with a licensed station. You won't get across town by staying within the FCC regulations but you can give your neighbors new and imaginative programming.

Legal Broadcast Station

The transmitter portion of the station is a snap. It's a wireless broadcaster such as the Lafayette 19 T 0903 (kit) or 19 T 0908 (wired). The Lafayette has inputs for a microphone, magnetic cartridge or high-level program source. Because this gives you almost nothing in the way of programming flexibility you'll need our control center—a professional console that has all the conveniences found in a broadcast station.

The console can mix four inputs: two high level such as a tape deck or ceramic cartridge, and two low level such as dynamic microphones. Each input has its own gain control, and a master-gain control affects all inputs simultaneously. The high-level gain controls have cue switches on them which allow the turntables or recorders to be cued (listened to) through an external monitor speaker while other inputs are live.

The internal monitor amplifier lets you monitor either the output to the wireless broadcaster or the cueing bus from the high-level inputs. To avoid acoustic feedback a relay automatically cuts out the monitor-amplifier speaker when either mike input is turned on. A front-panel phone jack, which is not disabled, allows constant monitoring of the program. (The speaker is disconnected when the phones are plugged in.)

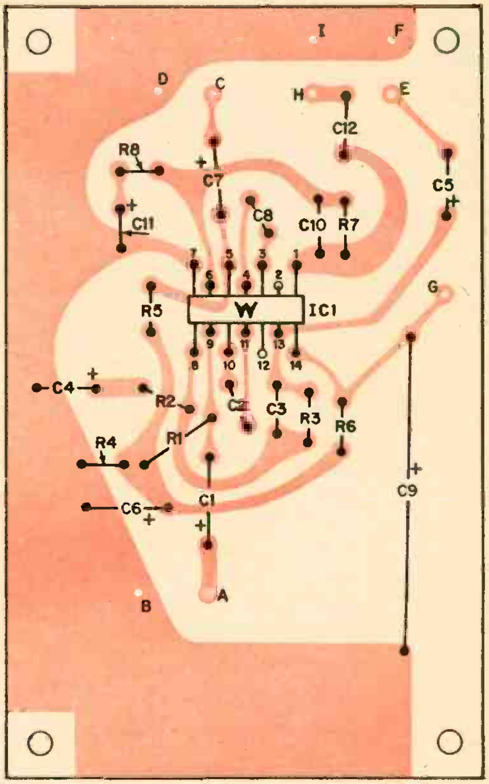
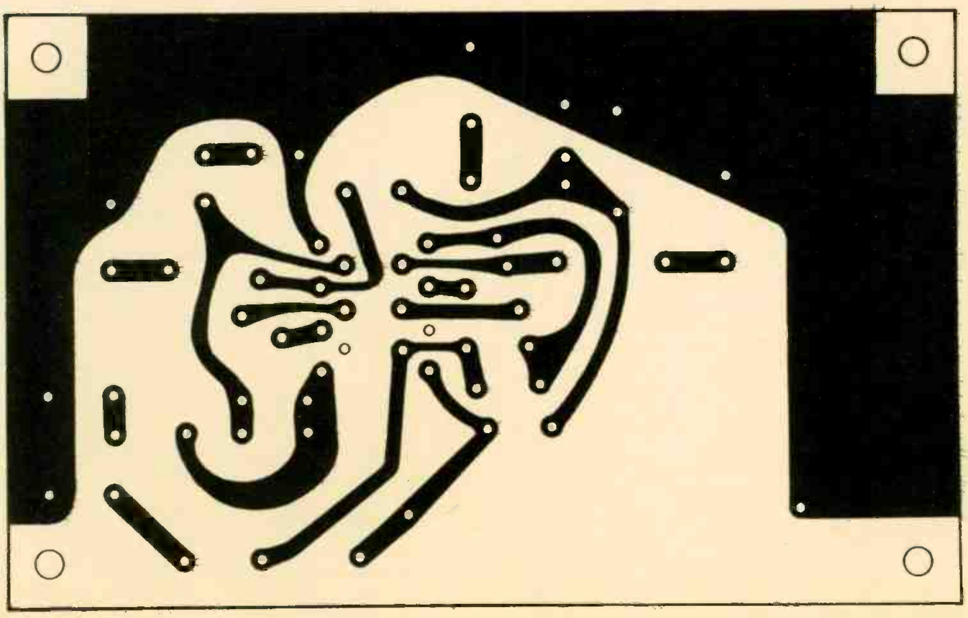


Fig. 1—Below is template for mic.-preamps and program/VU-amp. boards. Trace outline of black areas with carbon paper on foil side of two boards. Part numbers and location for mic.-preamps board is above. Fig. 8 has program/VU-amp. board nos.



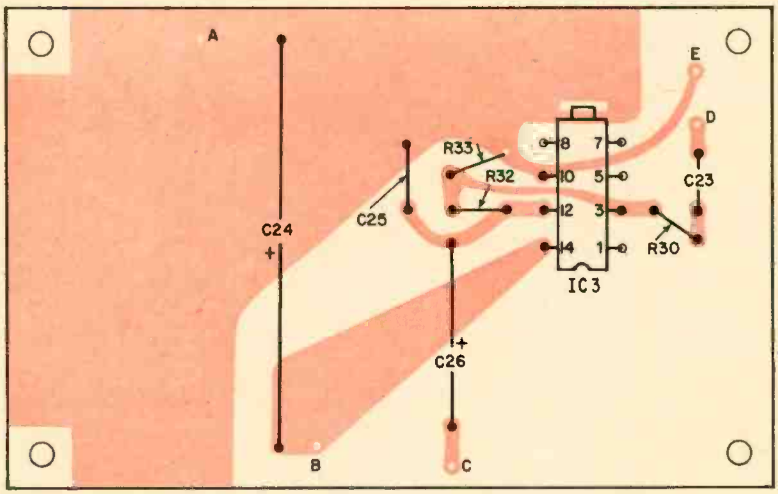
The Program Sources. The console's output level is variable from full off to about 1 V (rms)—enough to drive any wireless broadcaster.

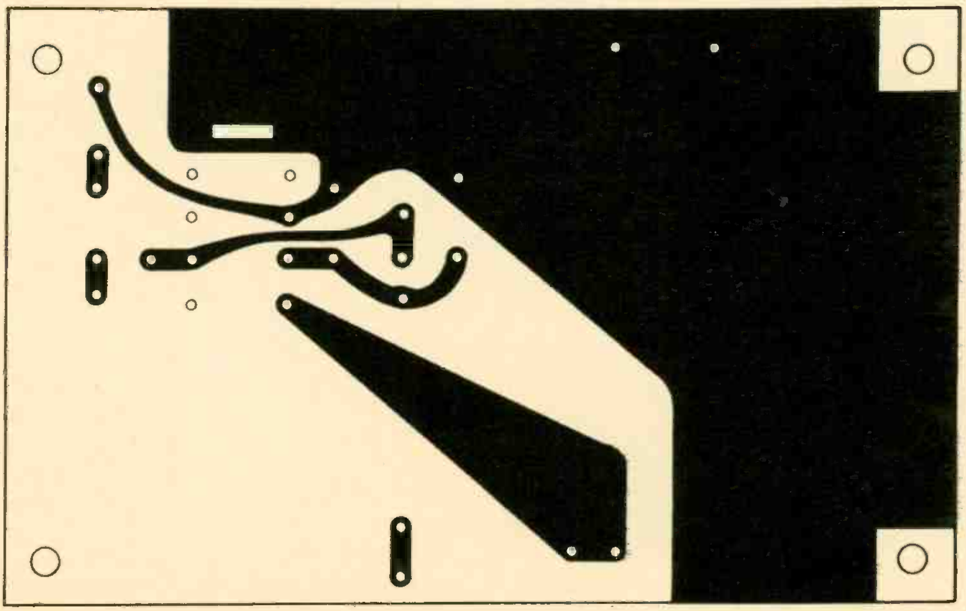
Integrated circuits are used throughout; IC1 is a dual preamp and provides two separate mike preamps. Integrated circuit IC2 is the same type as IC1: one half of it is used as a program amplifier and the other half is the VU-meter drive amplifier. Integrated circuit IC3 is a preamp/1-watt audio amplifier and must be used with a 16-ohm (or higher) speaker. A 10-20-40-ohm transistor replacement speaker is suitable. While the 1-watt output will not produce a thundering monitoring level, it will be adequate in almost all applications.

Except for the power-supply components, all circuits are built on printed-circuit boards that you make. The mike preamps are one board, the program amplifier and VU-meter amplifier are on a second board. The monitor amplifier is on a third board.

Construction. The printed-circuit boards are made on 3 x 4½-in. pieces of copper-clad XXXP Bakelite (Lafayette 19 T 7103).

Fig. 2—Below is template for monitor-amp. board. Again, transfer outline of black areas on foil side of board with carbon paper. Location of the parts on the board is at right.





Legal Broadcast Station

Cover the board with a piece of carbon paper (carbon toward the foil) and slip the board under the full-scale templates in Figs. 1 and 2. Make two boards from the template in Fig. 1 for the *mic.-preamps* and the *program/VU-amp.* boards, which have the same layout. Using a ball point pen, trace the *outline* of the copper-foil areas. Using an ice pick or similar pointed tool, indent the copper through the template at the center of each circle to indicate where to drill a hole for a component lead.

Remove the carbon paper and using a

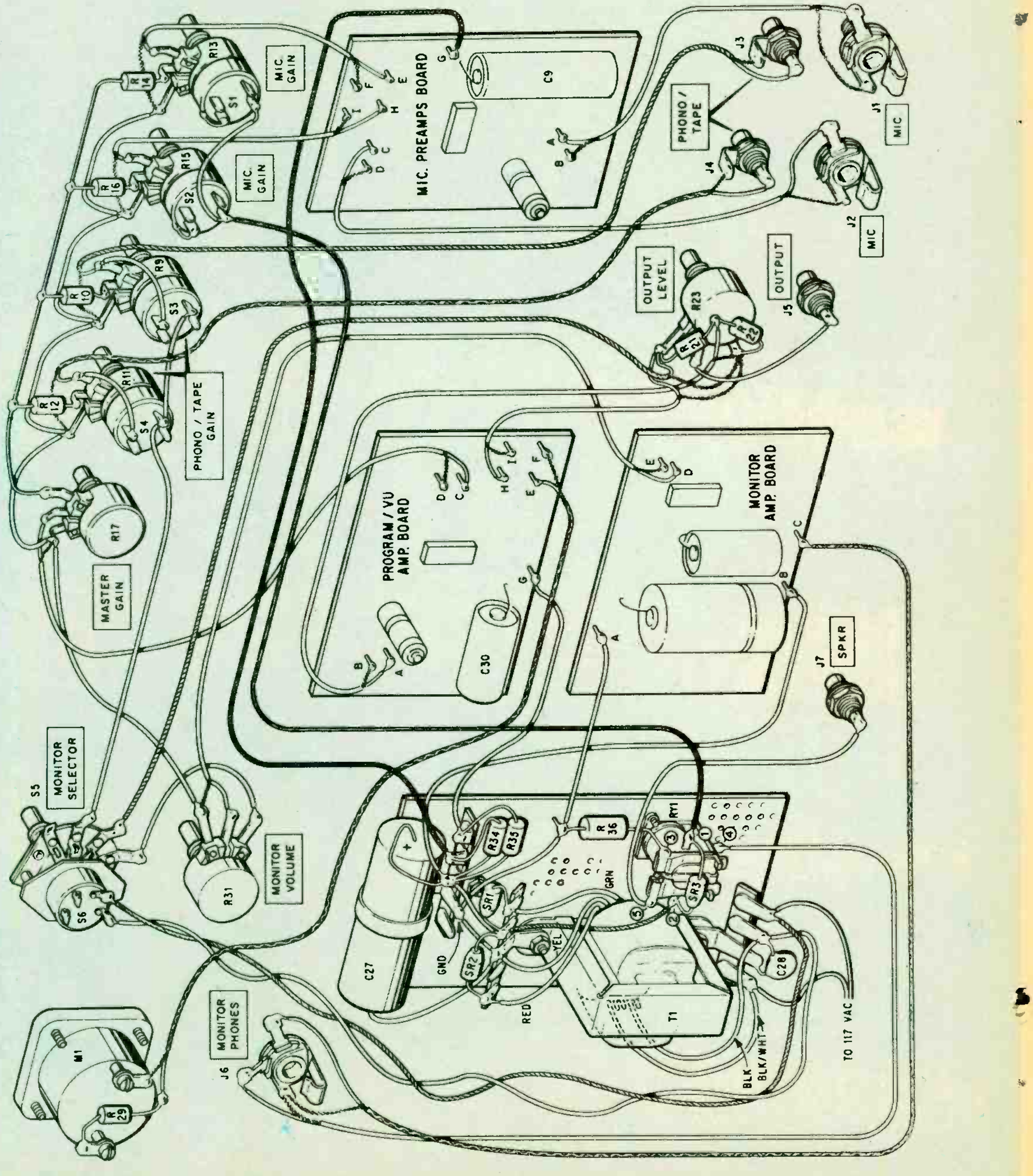


Fig. 3—Pictorial shows connections of cabinet parts to boards. Photo in Fig. 4 shows location of parts.

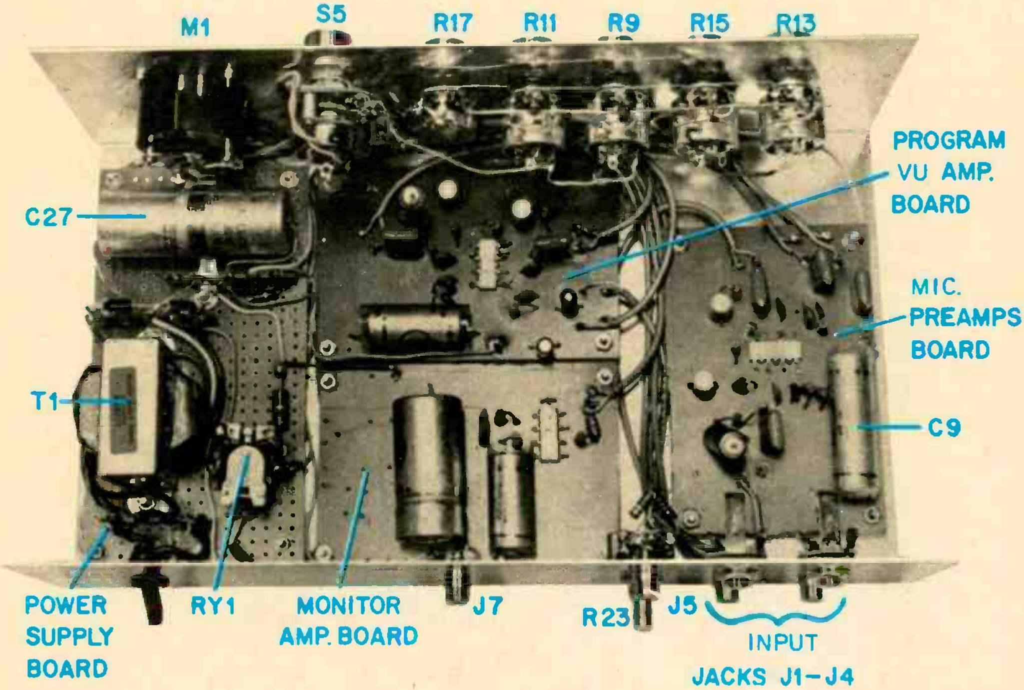


Fig. 4—Photo of inside of console shows part locations. Mount cabinet parts before installing boards.

PARTS LIST

Capacitors: 25 V unless otherwise indicated
C1,C5,C7,C12,C13,C29—.25 μf or 1 μf (see text)
C2,C8,C14,C19—680 μμf ceramic disc
C3,C10,C16,C21—33 μμf ceramic disc
C4,C11,C17,C22—30 μf, 15 V electrolytic
C6,C18,C26,C30—250 μf electrolytic
C9—500 μf electrolytic
C15,C20—6 μf, 15 V electrolytic
C23,C25—.05 μf ceramic disc
C24—1,000 μf electrolytic
C27—2,000 μf electrolytic
C28—.005 μf, 500 V ceramic disc
IC1,IC2—MC1303L dual-stereo-preamp integrated circuit (Motorola)
IC3—PA234 1-watt audio-amplifier integrated circuit (GE)
J1,J2—Open-circuit phone jack
J3,J4,J5,J7—Phono jack
J6—Closed-circuit phone jack
M1—VU meter (Radio Shack 22-019)
Resistors: ½ watt, 10% unless otherwise indicated
R1,R3,R5,R7,R18,R20,R26,R27,R30,R33—100,000 ohms
R2,R8,R19,R28—1,000 ohms
R4,R6,R24,R25—4,700 ohms
R9,R11—1 megohm audio-taper potentiometer (CTS type PQ or equiv.)
R10,R12,R14,R16—470,000 ohms
R13,R15—50,000 ohm audio-taper potentiometer (CTS type PQ or equiv.)
R17,R31—100,000 ohm audio-taper potentiometer
R21—560,000 ohms
R22—15,000 ohms
R23—10,000 ohm audio-taper potentiometer
R29—8,200 ohms
R32—1 megohm
R34,R35—150 ohms
R36—22 ohms, 1 watt
RY1—SPDT 2,500-ohm relay (Potter & Brumfield RS5D, Allied 41 C 5897)
S1,S2,S3,S4—SPDT potentiometer switch (CTS type 76-4)
S5—Single-pole, 4-position rotary switch with AC line switch (Centralab 1465, Allied 56 C 4073)
S6—On S5
SR1,SR2,SR3—Silicon rectifier; minimum ratings: 500 ma, 50 PIV
T1—Low-voltage rectifier transformer; secondary: 10, 20 V center tapped: 40 V center tapped; 100 ma (Allied 54 C 4732)
Misc.—12 x 7 x 4-in. Minibox, printed-circuit material, perforated circuit board, shielded audio cable (RG-174/U or equiv.)
Note: The Motorola MC1303L integrated circuit ($5.10) and the GE PA234 integrated circuit ($2.50) are available from Custom Components, Box 352 Alden Manor, Elmont, N.Y. 11003. Add 75¢ for postage and handling. N.Y. State residents add sales tax. Canada add $1. No foreign orders.

resist pen, such as the Allied 47 C 1102 (page 385, catalog No. 280) trace the outlines on the copper foil. Note that even though some IC leads are not connected they require a hole in the board. Place a drop of resist over the matching indent in the foil so you'll know where to drill. Then using the pen, fill in all areas to be protected with resist.

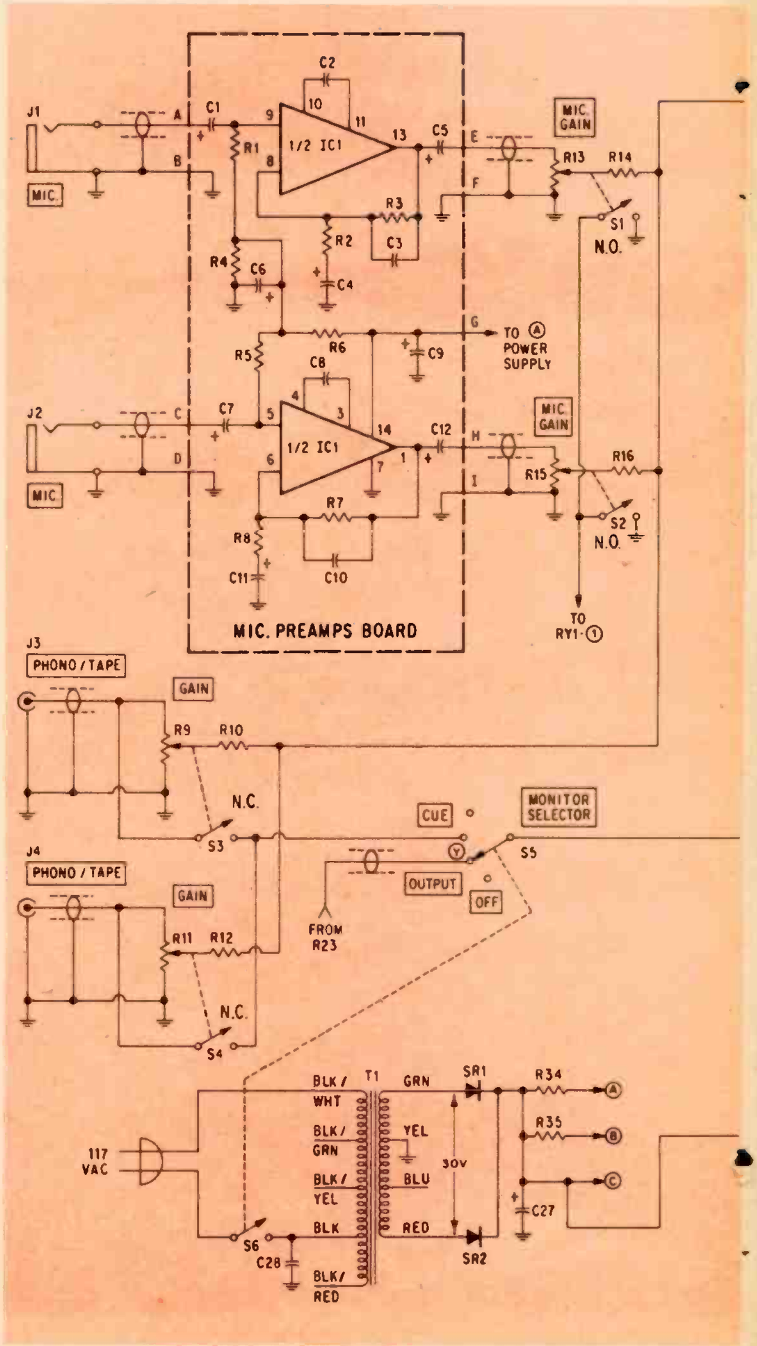
Prepare the *monitor amp.* board in a similar manner. The circles in the corners of all boards indicate the mounting holes and should be marked with an indent and a drop of resist.

Place the boards in a plastic tray and cover with about 1 in. of etchant solution. Gently agitate the tray for about 20 minutes and then, using tweezers or pliers, lift out the boards and check that all unwanted copper foil has been *completely* removed. If there is the *slightest trace* of unwanted foil, immerse the boards for one-minute intervals until the copper is completely removed. Then rinse the boards thoroughly in running warm water for at least two minutes to remove the etchant.

Using non-soaped steel wool scrub off the resist from the remaining copper areas. At each indent in the copper foil drill a hole with a No. 58 bit (.042-in. dia). Assemble the *mic.-preamps* board first. To attenuate bass below 100 cps C1 and C7 should be .25 μf. For full low-frequency response C1 and C7 should be 1 μf. The same is true for C5, C12 and C13. Observe polarity when using 1-μf capacitors.

Take extreme care when inserting the IC leads through the holes in the board. If the spacing between the holes is too great, do not try to bend the IC's leads. Instead, slip a small piece of solid wire through the hole to the foil side and solder. Then bend the wire over the IC lead and solder the wire very quickly and with as little heat as possible.

Legal Broadcast Station



The *program/VU-amp.* board is assembled in the same manner except that C15 and C20 (same physical position on the board as C12, C5) must be 6 μf.

In a similar manner assemble the *monitor-amp.* board. Note that the small tab on the end of IC3 must pass through the board and be soldered to the copper foil which acts as a heat sink. The tab passes through to the foil through a slot which can be drilled with

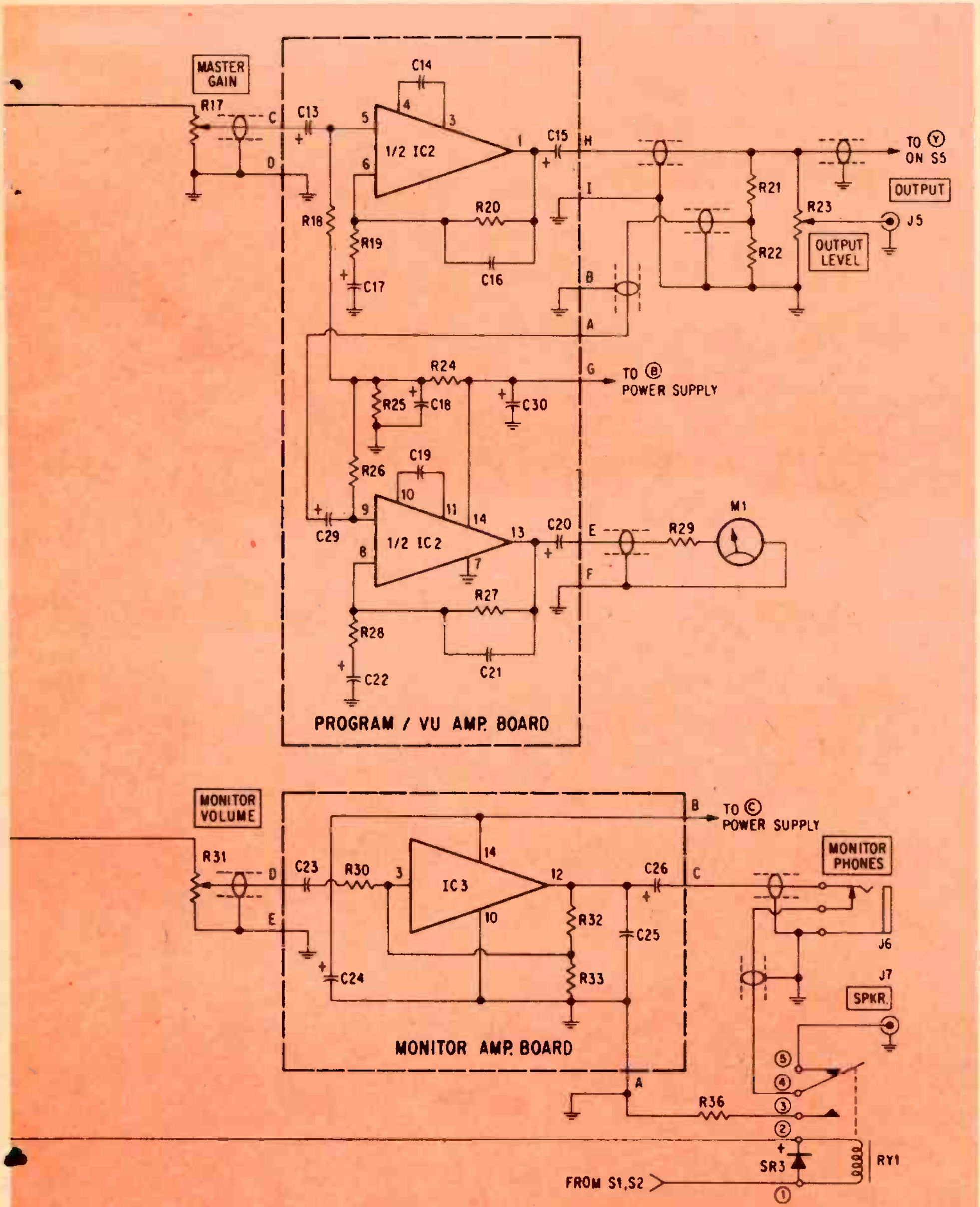


Fig. 5—Console schematic. When cueing a record or tape, switches S3 and S4 are closed and signal is fed via S5 to monitor amp. whose output drives speaker so you cue record or tape. When you turn up either mike gain control, S1 or S2 closes and energizes RY1 to cut out speaker and prevent feedback. Set S5 to the output position and you monitor signal going to wireless broadcaster at J5.

four or five passes of a No. 58 bit.

The power supply is assembled on a 3 x 6-in. piece of perforated board; Vector type T-28 terminals are used for tie points. The front of the board will have to be notched (1 in. square) to provide clearance for jack J6. Note that speaker-cutout relay RY1 must be mounted on the board because its mounting frame is also the wiper connection.

Once the boards are mounted it will be impossible to solder the connecting wires to the foil; therefore, install solder pins at the proper holes. (Note that the *mic.-preamps and program/VU-amp.* boards have an extra ground terminal which is only used in the event of ground loop instability.) Make the terminals from No. 20 or No. 22 wire as shown in Fig 9. Insert the pin from the top of the board, fold the end over on the foil side and solder.

When the boards are completed, but before any components are mounted, position the boards on the base of the U-section of the cabinet as shown in Fig. 4 and mark the mounting holes. Mount the *mic.-preamps* and power-supply boards almost flush with the sides of the U-section. Mount the *monitor-amp.* and *program/VU-amp.* boards about ¼ in. from the power-supply board. The edge of the *monitor-amp.* board should be about ¼ in. from the back of the cabinet. The *program/VU-amp.* board should be close to the *monitor-amp.* board. If everything is arranged properly there should be about at least ⅝ in. between the inside edge of the *mic.-preamps* board and the other two boards.

Remove the boards from the inside of the cabinet and install the front- and rear-panel cabinet components. Jacks J1 through J4 are directly behind the *mic.-preamps* board. Mount *output* jack J5 and *output-level* control R23 on the back panel. *Spkr.* jack J7 is located behind the monitor board away from *output* jack J5.

Gain-Control Switches. Switches S1, S2, S3 and S4 mounted on the back of gain controls R13, R15, R9 and R11 are somewhat unusual. While they are catalog listed as SPDT there are actually four lugs on them. Two lugs are supposed to be connected together for SPDT operation. However, one set of lugs is normally closed (N.C.) and the other set is normally open (N.O.). Make certain you connect to the correct lugs as indicated in the schematic in Fig. 5. When *phono/tape*-gain controls R9 and R11 are clicked to the off position, the closed switch terminals are the ones to use to provide the cueing connection to the monitor amplifier. When *mic.-gain* controls R13 and R15 are clicked to the off position the open switch connections are the ones to use. When either *mic.-gain* control is advanced, the closed terminals will energize RY1 which will disable the speaker.

Note that isolation resistors R10, R12, R14 and R16 are connected to a solid bus which connects to the top of *master-gain* control R17. Keep the resistors and the bus wire away from the controls and switch wires.

Power switch S6 is on the back of *monitor-*

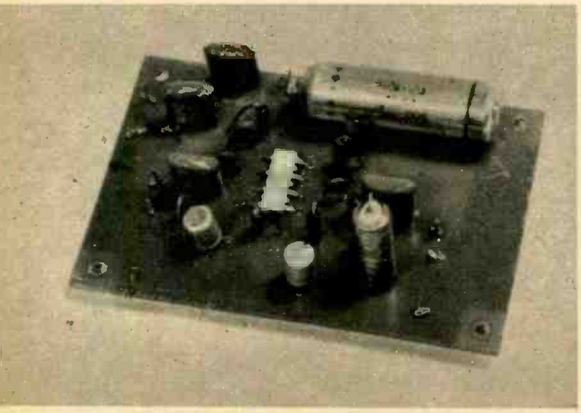


Fig. 6—Mic.-preamps board. Program/VU-amp. board looks same except capacitors in upper left corner are electrolytics. Wires connect to small pins.

Fig. 7—Ready to go on the air. Wireless broadcaster can be near console. For best range put it in attic near antenna and feed audio up to it.

CORRESPONDING PARTS ON CIRCUIT BOARDS																				
	Resistors (R)								Capacitors (C)											
Mic. Preamps	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	9	10	11	12
Program/VU Amp.	26	28	27	25	18	24	20	19	29	19	21	22	20	18	13	14	30	16	17	15

Fig. 8—Part nos. in Fig. 1 (top) are for mic.-preamps board. This table has nos. for program/VU-amp. board.

selector switch S5. Switch S6 has two sets of lugs (four connections) and normally switches both sides of the power line. Make certain you select a pair of lugs that are open (off) when S5 is in the *off* position, and closed (on) when S5 is in the *output* or *cue* position.

The meter specified for M1 is recommended in preference to other low-cost VU meters because its damping is similar to that of professional VU meters. Meter M1 mounts in a hole made with a standard 1½-in. chassis punch.

Get as much front panel wiring done as possible, then install the amplifiers and power-supply boards using a ¼ spacer or a stack of washers between the board and the cabinet at each mounting screw.

Proper Grounds. To avoid ground-loop instability the system ground must be installed as follows: Do not connect the ground lugs on potentiometers R9, R11, R13 and R15 to the control's cover. The lugs are grounded through shielded cable to the circuit-board grounds or the input-jack grounds. All shielded cables have a shield connection on both ends except the lead from R23 to *monitor-selector* switch S5. It is connected at R23's ground lug only.

If upon completion there appears to be oscillation caused by a ground loop, try connecting the ground terminals on the *mic.-preamps* and *program/VU-amp.* boards to cabinet. Ground-loop oscillation will occur if you try to replace C24 and C27 with a single capacitor of larger value. Though the two capacitors are in parallel, C24 must be on the *monitor-amp.* board.

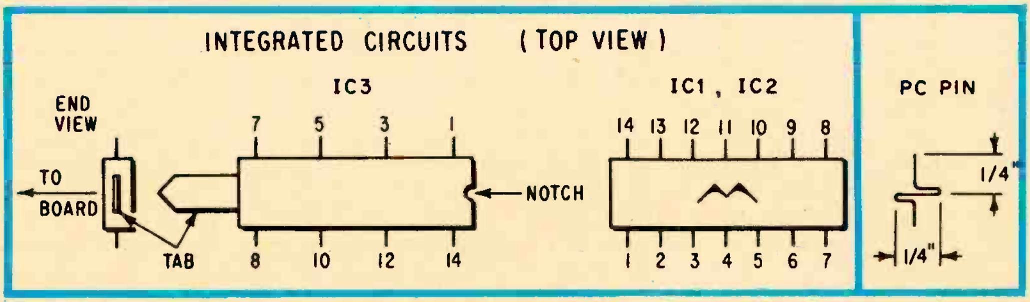
Preliminary Checks. Plug a 16-ohm speaker in J7, set S5 to *off* and plug in the line cord. Connect a VOM or a VTVM (set to at least 25 VDC) across C27. While observing the meter, set S5 (S6) to on. If the voltage does anything other than rise to between 22 and 24 VDC quickly turn off power and check for a wiring error.

If the B+ voltage checks out, set gain controls R9, R11, R13 and R15 full counterclockwise (switch must click) then observe relay RY1. The armature (wiper contact) should be *up*—connecting the *monitor amp.* output to *spkr.* jack J7. Advancing either of the *mic.-gain* pots should cause RY1's armature to pull down—opening the monitor-to-speaker connection. If the wiper stays down permanently even when the controls are full counterclockwise, you have used the wrong switch terminals. If the armature does not pull down when the *mic.-gain* controls are advanced, either incorrect switch terminals have been used or SR3's polarity is reversed. If all preliminary checks indicate normal operation proceed with the audio checks.

Audio Checkout. Connect a high-level program source such as a tape deck or ceramic cartridge to J3 or J4. Set the matching gain control to mid-position and the *master-gain*

[*Continued on page* 108]

Fig. 9—Sketches show pin numbers of integrated circuits and dimensions of circuit-board connecting pins.



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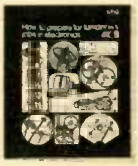
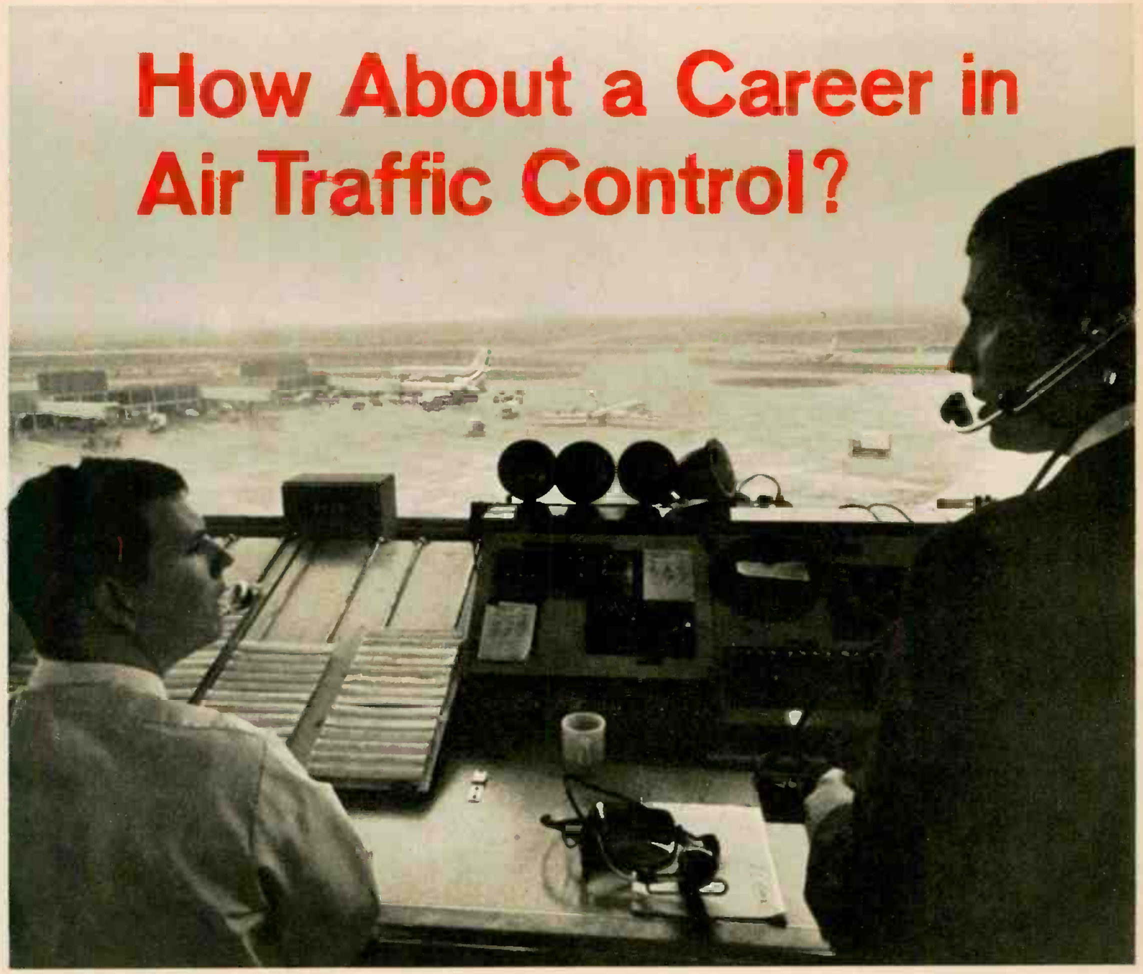


How About a Career in Air Traffic Control?



. . . just one of many exciting jobs in FAA electronics

By FOREST H. BELT

LAST SUMMER commercial aircraft were stacked up in holding patterns around large metropolitan airports as far as radar's eye could see. A rash of airplane accidents also claimed dozens of lives and many of the crashes occurred only minutes before a landing was scheduled.

Congested air lanes and bad-weather flying are just part of the overall picture. Even normal operations during good visibility can be potentially dangerous because all flights boil down to men and equipment. Making our skies safer has become a knotty problem for government and industry alike.

Today's high-performance aircraft ride safely on invisible electronic lines that guide them through the skies and bring them down to earth. If one of the lines should break or shift from its assigned position disaster may follow.

The equipment that projects these lines and the instruments that detect them are under the jurisdiction of the Federal Aviation Agency—one of the tightest-knit organizations in the government. The FAA (once known as CAA or Civil

Aeronautics Administration) is in fact responsible for almost everything that pertains to flying. It influences aviation electronics chiefly through two services: *Flight Standards*, which polices the accuracy of instruments used by airliners, and *Systems Maintenance*, which installs airway and airport electronic equipment and keeps it functioning accurately.

Systems Maintenance offers an especially meaningful career in electronics. Pride of responsibility runs high because thousands of lives rest on the thoroughness of an FAA technician's work; there is little margin for error. The men who qualify for this critical work actually become an elite so they really like their work.

You can understand some of the challenge when you know more about the fantastic equipment that an FAA man works with. Vortac, for example, is an acronym for VHF OmniRange with Tacan. The Tacan in this strange lingo means Tactical Air Navigation. Vortac is a navigation system that helps a pilot determine his direction and distance from a Vortac station or facility. The Vor gives him the direction and Tacan gives him the distance.

An ILS (instrument landing system) uses a *localizer* to line a pilot up with the runway as he approaches and a *glide slope* to keep him from coming in too low or too high. Inaccurate and inoperative glide slopes have been blamed for some accidents. Both ILS and Vortac are classified as navigation aids, or *navaids*. Vortac is an airways navaid and ILS is a terminal navaid.

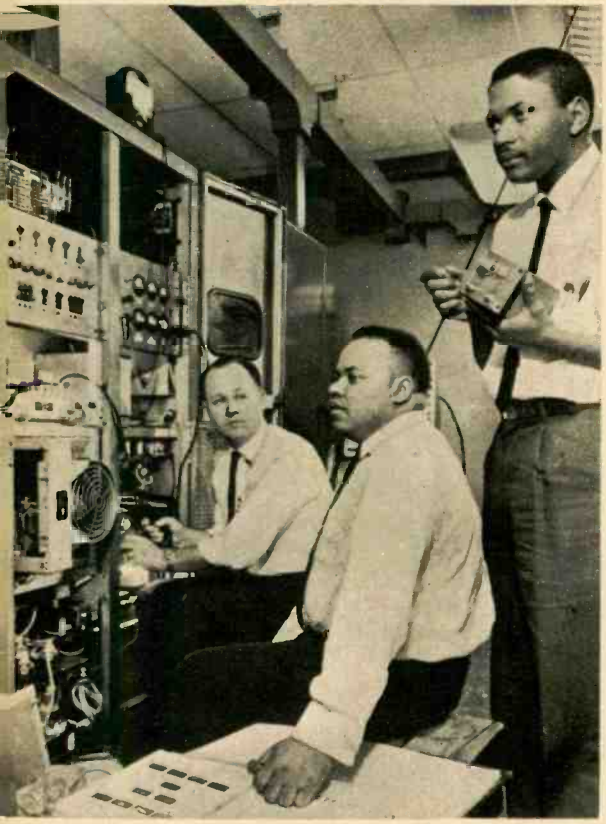
Radar also is an aid to navigation and probably the best known. With regard to maintenance, FAA technicians classify radars separately. Widely scattered air-route surveillance radars help air-traffic controllers keep airliners separated as they travel the airlanes laid out by Vortac facilities. Terminal radars (at airports) include GCA, or ground-controlled approach, and PAR, or precision-approach radar. PAR gives tower operators both the position and altitude of incoming aircraft; GCA shows their position only.

Another classification is *comaid* (communications aid). This is the conversation network. Air-route facility operators and air-traffic controllers must communicate with pilots. So must Flight Service Stations (FSS) which handle flight clearances and weather briefings. Control-tower operators talk to pilots and so do ground-control experts at larger airports. So a tremendous amount of FAA equipment is involved in the comaid system.

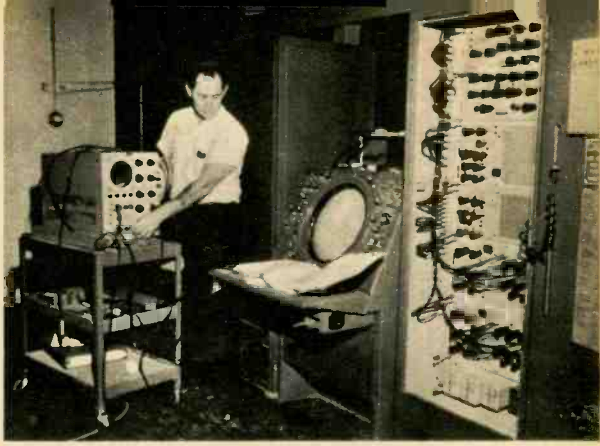
The fourth and newest classification of FAA equipment has an ordinary-sounding name. It's called *data* and refers to computers. Data is information about every plane that's in the air and for which a flight plan has been filed. (That's all scheduled airliners, many private and business flights and all flights in bad weather.)

A computer at each major air-traffic-control center keeps track of the progress of every flight being handled by controllers in that center. When a plane enters another section of the country and is handed off to a controller in the next center, the flight progress report is transferred to the computer at that next center. This is why a lost pilot is discovered quickly. The computer has passed him along automatically, taking into account his normal speed. If he doesn't show up where the computer says he should on the controller's radar screen (or if he doesn't check in by radio) a full-scale air/sea rescue search may be the end result.

FAA technicians and supervisors are dedicated people. Morale is high and turnover is low. A lot of time and effort go into training these men for their specific jobs. As a new man, you spend several weeks learning about the equipment and how the FAA operates. Then come more weeks of schooling on how

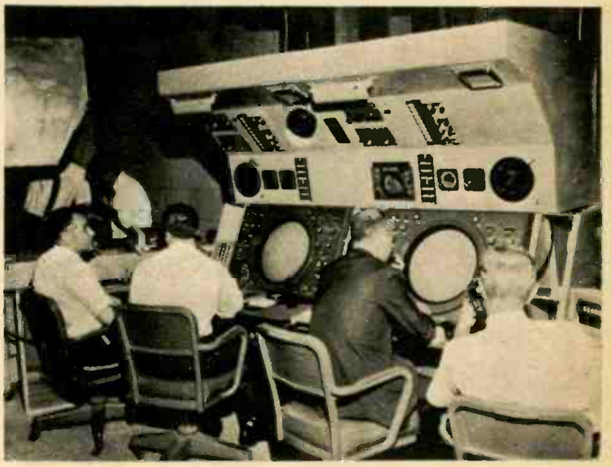


FAA maintenance experts such as these keep this nation's navigation and communications equipment running smoothly. All jobs are under Civil Service.



Technician is using some of the most advanced test equipment to align and adjust a critical radar installation. Everything is state-of-the-art.

Air-route surveillance radar helps keep en route flights safe distances apart. These sets will soon be replaced by computerized, digital displays.



Air Traffic Control

to service and maintain the equipment. After this you get a lot of closely supervised field experience where you actually work on gear. Before you're on your own you have the confidence that you know what you're doing.

The work isn't monotonous, either. No sooner do you master comaid equipment than you're off to school again to learn navaid maintenance. If you stick with the Agency you eventually become an expert in the entire range of FAA electronics.

Job security attracts and holds some men. FAA technicians are hired through the Civil Service Commission. A good man with a few years' tenure has a job that's dependable, with pay increases almost guaranteed and attractive retirement benefits. Even the fellow who doesn't care to acquire a whole range of skills can do well so long as he's competent in his specialties.

If you like to travel, opportunities come up regularly for new assignments—some in exotic places like Hawaii or Alaska, or in many U.S. Possessions. Admittedly choice spots go to the men who earn them, but everyone has a chance.

A supervisor in the O'Hare Sector Office at Chicago, James T. O'Brien, gave us some clues as to what kind of man gets an FAA technician job and what his advancement pattern can be. Mr. O'Brien is a 22-year man with the FAA and does the hiring for his office.

You need at least 3½ years of electronics repair training. Experienced men often come from the military—some Air Force veterans

At FAA air-traffic control centers computers keep constant track of scheduled flights as they move from one section of the country to another.

may have even worked on related equipment. Next best background, as far as Mr. O'Brien is concerned, is 4 or 5 years in commercial TV, radio, or communications servicing . . . but he adds, "provided they know their theory." That means you'd better have at least 2 years training in a top-rated electronics school.

You usually start with the FAA at a GS-7 rating. That gives you about $7000 a year, with a chance to advance beyond $9000. A really sharp technician (with good training in theory and several years of servicing experience) may be able to qualify for GS-9 at the start. He has to meet Civil Service standards for the grade and also get the approval of the FAA Chief who is hiring him. Minimum pay at GS-9 is above $8400, while the maximum is $11,000.

No matter what grade you start in or the level of your previous experience, you must go through a year of training. The FAA has a well-equipped training school in Oklahoma City where you go for weeks at a time. You learn preventive maintenance, how to repair failures quickly, how to calibrate delicate, critical systems, and become familiar with all kinds of FAA instruments. You can also expect to be sent back once or twice a year to learn new techniques, study new equipment and brush up your skills on older equipment.

Advancement depends both on merit and demand. You have to be in your grade a year before you can be considered for advancement. Then, if you feel qualified you can take the exam. Once you pass it you wait until there's an opening somewhere in the new grade. If you want that assignment you let it be known. This is called *bidding*. The supervisor at that facility checks the qualifications of all bidders and picks the one he thinks is best. Thus, performance on your present job is an important factor.

It takes three to five years to reach GS-11, the most common grade; it can take longer if you're slow. A GS-11 technician earns from $10,200 to well over $13,000. That's about as high as you'll go unless you show some inclination to supervise. Then, after a few years, you can move on up to GS-13 and a secure supervisory spot. At this grade you can make as much as $18,729 a year.

Up to now low turnover has been a problem. The fellows who have the jobs keep them. And budgets have been so slim for the last few years there's been almost no expansion in FAA maintenance staffs.

However, a whole new picture is taking shape. A growing aviation industry is creating airlane congestion and more and better electronic gear is needed. More equipment means more men to install it and keep it operating. Inadequate facilities are just as dangerous as faulty components.

Other things have been happening that spotlight airlane maintenance needs. An air-route surveillance radar in the East broke down 25 times in 28 days. The New York traffic-control center—busiest in the country—lost several communications channels 22 times in one month. And after the terminal radars at John F. Kennedy and LaGuardia airports were combined into one new control room, air traffic on the entire Eastern seaboard was paralyzed for hours when the twin system failed to operate on at least two different occasions.

[*Continued on page* 117]

The Ham Shack

By Wayne Green
W2NSD/1

A GROWING NUMBER of amateurs, concerned about the lack of growth of their hobby during the last few years, are becoming critical of the Morse code requirements for the different licenses. They feel that if these requirements could be dropped then amateur radio would be more attractive to newcomers. Quite possibly.

But how did this get started? Where have we been and where are we going? It may be helpful to put the code into perspective. The first radio amateurs had no choice other than code since spark transmitters (which were all that had been invented at the time) were incapable of being modulated. The leading scientists of the time said that radio-telephone communication would never be possible since there was no way that damped waves could be modulated.

At about the same time Nicola Tesla was hard at work building his power and radio broadcasting station out on Long Island east of New York City. Unfortunately, he was prevented from finishing his project by manufacturers of electric power equipment who did not want unlimited amounts of power made available for free. Tesla's secrets of broadcasting power died with him but his ideas on radio broadcasting bore fruit. Continuous waves (CW) were discovered eventually and modulation become possible. Diehards continued to use spark transmitters until the government forced them to quit.

Early amateur radiotelephone transmitters were expensive and difficult to adjust. A special class of license was announced for those who wanted to use phone on our two best amateur bands, 20 and 80 meters. This was the Class A license. Apparently a lot of amateurs wanted to talk rather than beep-beep at each other because despite cost and other drawbacks phone operations continued to grow and CW to diminish.

CW enthusiasts gave three reasons why code should be continued as part of the amateur license requirement. First of all, CW transmitters were simpler than phone rigs and many amateurs could not afford phone. Secondly, CW copied easily when signals were too weak for phone contact or when the interference was too great for phone. Thirdly, CW is much faster and better for sending messages in times of emergency.

All these things were true—a few years ago. Are they still valid? Take a look at the transmitters available on the market and see how many are CW-only. They are few and far between because there is little demand for them. And they are not much cheaper than complete sideband transceivers. Practically no one can say today that he cannot afford a sideband transceiver. Unfortunately, the day when we built our own transmitters is over and never coming back.

How about getting signals through during poor conditions? One of the big reasons for the massive rush to sideband was that tens of thousands of CW operators found that SSB was able to get through just about as well as CW. AM required powerful signals to get through and was a monster at creating QRM, while SSB was much cleaner and more efficient. CW no longer has much advantage over phone from this viewpoint. CW is still better than phone for handling traffic, alpha bravos or no. However, CW looks pretty sick alongside RTTY. Radioteletype putts along at 60 wpm, hour after hour.

The defenders of the code for amateur licenses have lost most of their arguments and now are holding out mostly on the basis of tradition. In the thirties about 90 per cent of all amateurs used CW as their means of communications. This dropped to about 50 per cent in the forties and 30 per cent in the fifties. Today it is about 20 per cent, with a great deal of that being Novice activity.

CW fans point out that they enjoy using code and prefer it to phone operation. This is fine and I think that they should be permitted to continue to enjoy it. But is there really any reason to force every newcomer to learn code? Why not let those who enjoy it use it and those who are more interested in phone, TV. Fax or RTTY use these modes?

The FCC regulations require that you demonstrate the ability to send and receive code at 5 wpm for the Novice or Technician license. Once you have memorized all the letters and numbers you should be able to do

[Continued on page 110]

The ABCs of Color Television Servicing

By Forest H. Belt

Part I: Review & Procedures

COLOR TELEVISION service work by people who aren't full-time professionals is becoming widespread, largely because color sets now are so numerous. Whether you want to work on your own set, help out a friend in need or go into part-time servicing for money, if you know only black-and-white TV you won't make the grade. You *must* move up to color.

Color television always conjures up images of complex circuit boards

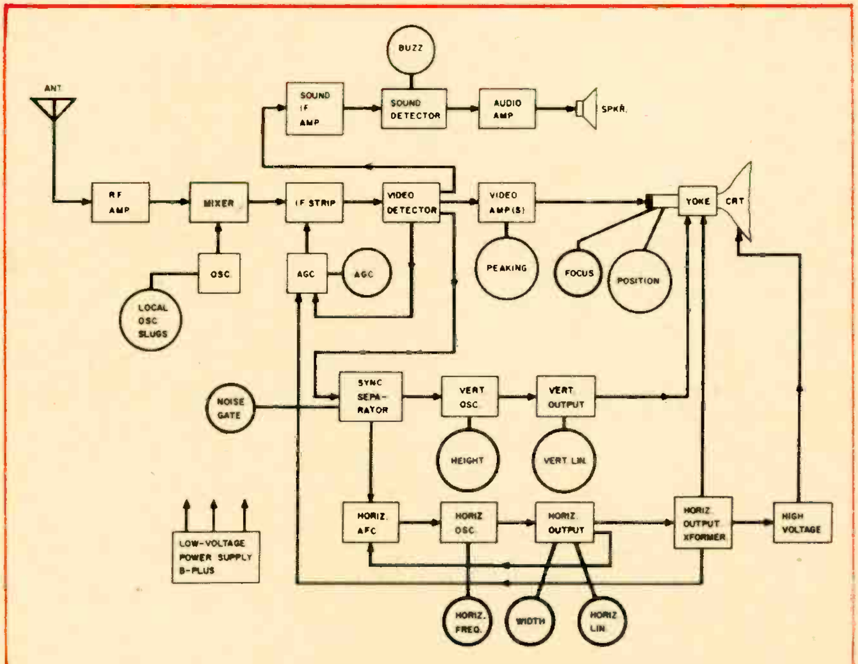


FIG. I-1

Block diagram of basic circuits found in b&w and color receivers. Signals consisting of picture information, sync, blanking pulses and FM sound are distributed at video-detector.

First in a six-part series based on Television Servicing/Repair, a new home study course available from and copyright by International Correspondence Schools, Scranton, Pa. 18515.

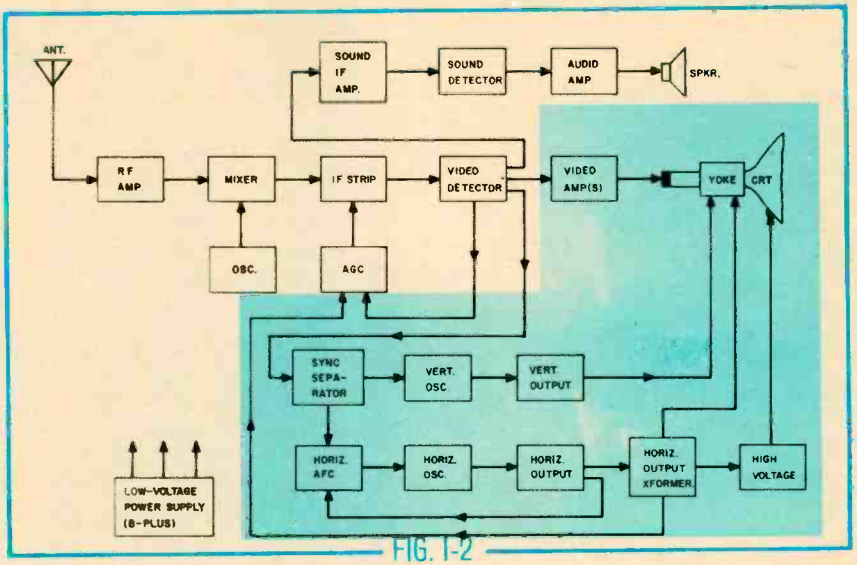


FIG. 1-2

and unreadable schematics. Not so! If you understand the basics of b&w receivers, have some practical bench experience and are familiar with color-TV fundamentals (as presented, for instance, in EI's THE ABCs OF COLOR TV, January-September, 1967), you can get your feet wet without doing any damage at all. By applying equal doses of patience and careful observation to your work, you'll be on the road to fun and profit in a part of the industry that is about to burst at the seams.

For more than a dozen years, color-TV servicing problems have bothered manufacturers, technicians and set owners. More than 33 per cent of the nation's TV sets are color. This trend is continuing full speed and yet the technician shortage of the last few years has not improved in the slightest. That old bugaboo, color TV complexity, still seems to frighten away many a frustrated participant in the great color struggle.

No one becomes expert at a skill merely by reading about it. To understand color sets you have to work on them. Nevertheless, a quick tour beforehand will show you what to look for once you've got the chassis in front of you. This course, divided into six parts (the rest will appear in the next five issues of EI) will do just this. You'll study how color works, how to adjust controls and find tube troubles and how to align and troubleshoot the set. The whole series comes in a handy cutout format which you can save and put into a loose-leaf notebook.

Troubleshooting is a key word because developing a good servicing method is half the battle. Four simple steps are all you'll have to remember. They are as logical as they are helpful and a real must if you want to get the job done fast. *First*, analyze the symptoms; *second*, inspect the equipment carefully; *third*, isolate the section or stage that is causing the trouble; and *fourth*, pinpoint the faulty component and replace it.

Remember, time spent troubleshooting is money—real money! Concentrate at first on the similarities between color and black and white and don't worry about problems that will become simpler later on. Fig. 1-1 will help you get your bearings; without these basic circuits, color (which also must be compatible with b&w reception) is unthinkable.

Quick Review. Normally sound comes on before the picture. In vacuum-tube sets the picture (or raster, illumination on the face of a CRT produced by scanning lines) follows the sound by 15 seconds or so, unless the tubes have an instant-on circuit that keeps them warmed up all the time. The sound may have a buzz at first but that will be eliminated by the AGC circuit; this usually operates only after the horizontal-sweep stages have warmed up.

If you can hear the sound okay (i.e., there are no unnatural noises) and if the volume is very loud when you turn the control wide open, you know immediately that the tuner—front-end—and IF strip (unshaded area of Fig. 1-2) are functioning normally. Only some very unusual front-end troubles will let sound through while blocking the picture. And since a diode detector develops the intercarrier sound IF it must also be working. (Remember that the sound and picture carriers are always 4.5 mc apart. At the video detector stage the two carriers beat together to produce a 4.5 mc sound IF which must be picked off by a wave trap.) Looking again at the unshaded area, it's obvious the sound stages are okay as well as the power supply which feeds the audio section, IF strip and tuner.

Note that one other stage is in the unshaded area in Fig. 1-2. This is the AGC circuit. Since it prevents the IF and RF amplifiers from being overloaded by strong signals, it also controls the audio. Most modern AGC systems depend on a pulsed voltage from the horizontal-sweep circuit. Unless this 15,750-cps pulsed voltage is present the AGC can't work and the RF and IF stages will overload easily. That's what causes the buzz you hear while the tubes are warming up. If the sound becomes normal after the horizontal sweep begins and the raster appears, the AGC circuit is probably okay. (The picture is not viewable, but you see that only after there is a raster). Should the overload continue, the buzz will be audible.

Next question to be asked: Is there a raster? Not necessarily a picture, but a raster. If so, this tells you that the stages in the unshaded area of Fig. 1-3 are working. If any of them were inoperative, there wouldn't be a raster. The picture tube needs a high voltage to get the beam onto the screen. Without the high voltage, there's no beam. There won't be high voltage unless the horizontal-

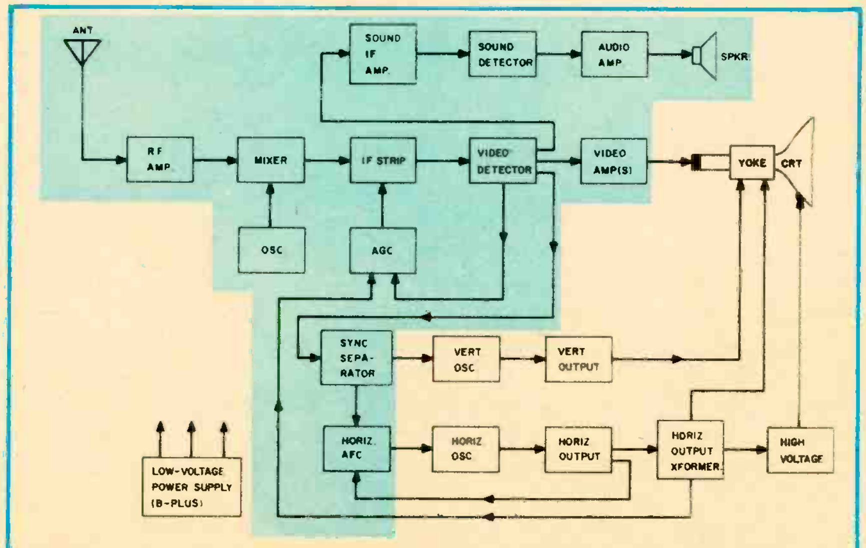


FIG. 1-3

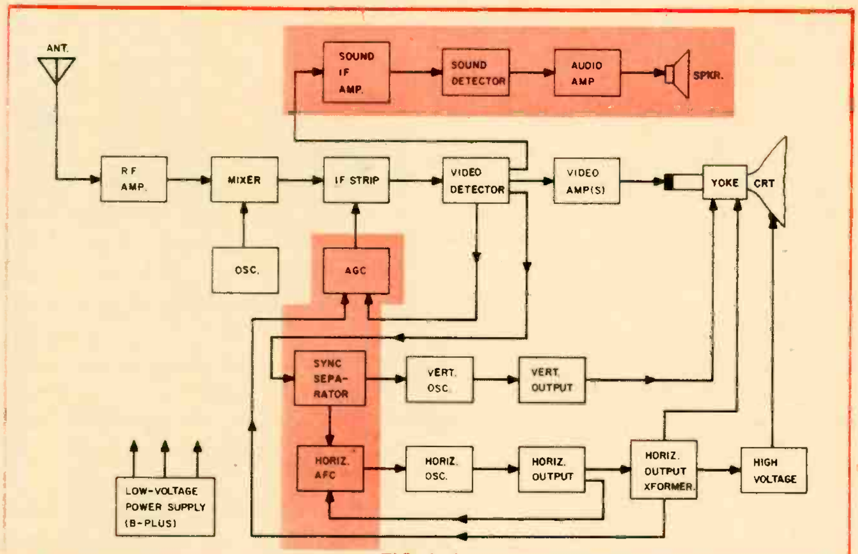


FIG. 1-4

sweep circuit is operating. Even if the high voltage is present, there cannot be a raster unless both horizontal and vertical sweeps are working. Should only the horizontal sweep and high voltage function, the beam is just swept from side to side to form a single horizontal line (i.e. the vertical sweep is not sweeping the beam from top to bottom).

The power-supply section is shown in Fig. 1-3 to be operating normally. It always is whenever one or more stages in the set are operating. Since power is essential to almost every circuit in a television set, you can be sure that if any stage is functioning the power supply must be working. Certain symptoms do suggest problems in the power supply. Nevertheless, if the supply is working even reasonably well it can be ruled out as a source of trouble until you're further along in your troubleshooting.

Now that you have a raster, is there *video* on the screen? The word video is used instead of picture for a special reason. You can have video signals modulating the electron beams in the picture tube and still not be able to get a normal picture. For example, the picture may tear, smear, wash out, develop a herringbone pattern, etc. In every case the video is reaching the picture tube even though there is no picture you can watch.

So if there is video on the screen you know the stages in the unshaded portion of Fig. 1-4 are operating normally or nearly so. You verify that several stages are working by the fact that you see video on the screen; both the horizontal and vertical sweep circuits are operating or else there'd be no raster to display the video, and the presence of video and raster also implies the power supply is working. The tuner, IF strip, video detector and amplifier must also be okay.

You can see that the AGC and sync-separator stages are blocked out in Fig. 1-4. This means they might be faulty and you could still see video on the screen. Herringbones and wavy lines are examples of video reaching the picture tube and providing no picture. This is because the inoperative AGC circuit is letting the IF section overload. Pictures which roll or tear may be caused by trouble in the sync-separator.

The conclusion to be drawn from Fig. 1-4 should be this: Seeing video on the screen, in whatever shape or form, is an indication that the power supply, tuner, IF strip, sweep and video circuits and picture tube are all functioning. By breaking down a receiver in the way we have just done, you can come to conclusions by a process of *elimination*. If you can see which stages are operating you are closer to knowing which ones are not operating.

Controls Normal? Once you know you have sound, raster and video, a fast way to check for other possible symptoms is to manipulate all the operating controls and note their effect on the picture, and then go through some of the screwdriver adjustments. Up to now you've been using your eyes and ears as tools for diagnosis; now you must utilize first the operating controls and then the servicing controls.

Start with the brightness control. Turn it all the way down and then all the way up. As it goes down it should extinguish the raster completely (except on a few color receivers). When you turn it all the way up the raster should be very bright (yet without getting larger, going out of focus, or changing color). Next try the contrast control, the horizontal and vertical hold, the channel selector and the fine-tuning control. Also try the color and tint (hue) controls. If they don't work be sure there's a color program on before you decide the set is at fault.

We want to analyze the effect of these operating controls on the picture. If one of them doesn't do what it should, that indicates trouble in the stage associated with that control. The block diagram in Fig. 1-5 includes most servicing controls (circles). If manipulating a control reveals a malfunction it may not be the control itself that is faulty but some part of its associated circuit. You may even find the trouble in a circuit that is secondary to the one the control is in. For example, suppose the horizontal-hold control doesn't straighten up the picture as it should. The fault could lie in the horizontal oscillator. However, this oscillator depends on the horizontal AFC circuit which in turn

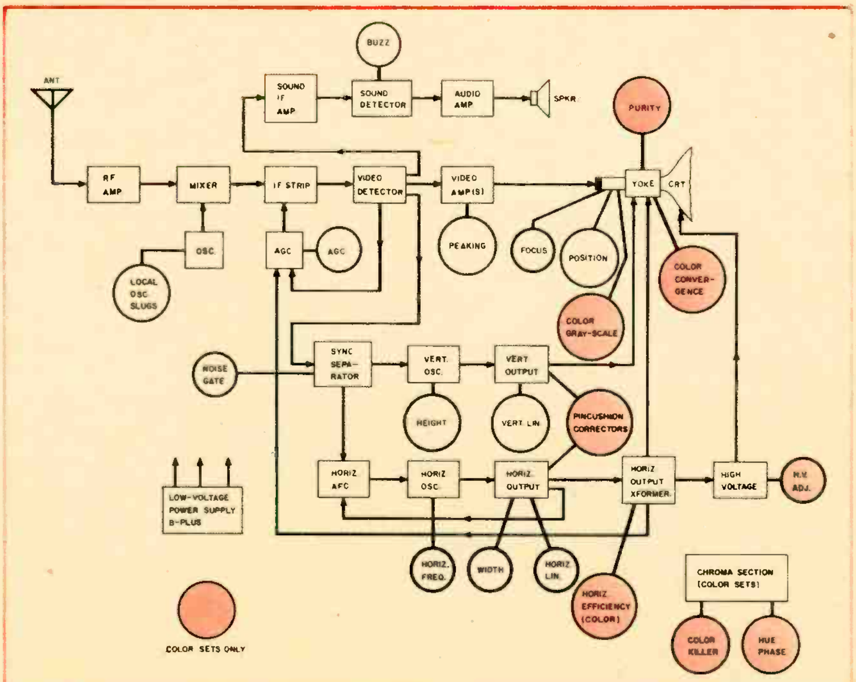


FIG. 1-5

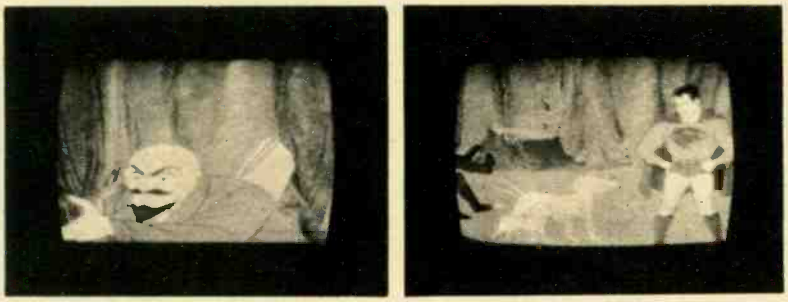


FIG. 1-6

depends on the sync-separator stage. Trouble anywhere along this chain could cause the horizontal-oscillator frequency to be wrong; and the hold control might not have enough range to correct the problem.

Color Controls. Fig. 1-5 also shows the servicing controls for color sets (shaded circles). At this point in our course, a brief description is all that's necessary. You will learn to adjust them later on.

- The *horizontal-efficiency* control is a color-receiver's equivalent of a horizontal-linearity control. Linearity of the horizontal sweep is closely allied with the tuning of the horizontal-output transformer. The horizontal-efficiency coil actually fine tunes the horizontal-output transformer.
- The *pincushion corrector* takes care of a condition inherent in rectangular-screen color receivers. Take a look at the color raster in Fig. 1-6 (left). The bowing of lines at the top of the raster is called pincushioning because of the rounded appearance of the lines. You will learn to adjust the corrector circuit to eliminate this bowing as shown in Fig. 1-6 (right).
- *Convergence* is the word used to describe the way the three rasters in a color set—red, green and blue—are superimposed. The convergence adjustments make sure all three are superimposed precisely at all points on the screen. Without these adjustments the rasters could coincide perfectly in one area of the CRT face and not in other areas. The result of poor convergence is color fringing around figures.
- *Purity* also involves superimposing the three rasters but on a larger scale than with the convergence circuits. Purity is controlled by the position of the deflection yoke and the two small, magnetic purity rings on the neck of the picture tube.
- The *gray-scale* of a color set affects the picture mainly during b&w operation and controls the gradations of gray between solid black and white. There are five and sometimes six adjustments that control how well the raster tracks its gray scale; i.e., they make sure the raster retains some shade of gray throughout the white-to-black range instead of becoming brown or some other incorrect hue. You'll learn the exact order of adjusting these controls later.
- The *high-voltage* adjustment sets the high-voltage DC applied to the second anode of the CRT. This control will be explained later because certain other adjustments must be made at the same time.
- The *color killer* control prevents the color (chroma) circuitry from operating unless a color program is being received.
- The *hue phase* control (found only in some models) is a coarse adjustment for the hue (tint) control at the front of the set. If the main hue control doesn't

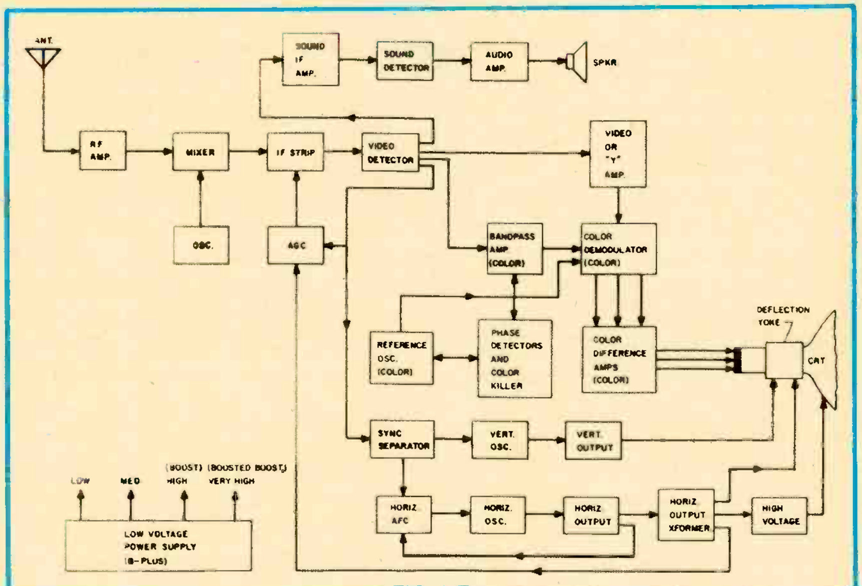


FIG. 1-7

have the proper range (from green faces at one end to purple faces at the other), the phase control can correct it.

Amplifiers, Oscillators and Detectors. Troubleshooting is easier if you take certain vantage points. And there is one that simplifies the analysis of most every stage in a color TV set: learn to look upon most stages in a TV receiver as being a variety of amplifier! The function diagram of Fig. 1-7 shows the main stages of a typical color receiver. Count how many amplifiers there are and you'll probably miss some. (This is a vacuum-tube set but transistor sets are similar.)

Coming from the antenna, the picture and sound RF carriers go through an RF amplifier, then on to the mixer. (The mixer is a special form of low-gain amplifier.) After three stages of IF amplification the signals are strong enough for detection. The video detector is the first stage that does not amplify the picture and sound signals. In this color receiver, the video detector recovers three signals from the IF carrier. These are the video (Y) signal, the chroma (R, G and B) signal and the composite sync (horizontal and vertical). A separate diode picks off the 4.5-mc sound intercarrier IF. Trace the signal path for each of the three signals, and you can see that two of them go to amplifiers before anything else is done to them.

The third signal (composite sync plus video) goes to a pair of unusual amplifiers—the sync separator and the AGC. While most amplifiers build up signal strength without changing or altering the signals in any way, the AGC and sync-separator stages do alter the signal considerably. The sync separator is called a clipper (i.e., it's a special type of amplifier). The stage sometimes uses an ordinary amplifier tube but more often one designed especially for this service. The composite sync signal (composed of vertical and horizontal sync and still containing video) is fed to the sync-separator amplifier. The tube is operated (biased) so that the signal appearing at its plate consists of only horizontal and vertical sync pulses. Thus, the video has been eliminated and the sync has been separated.

Both the vertical and horizontal output stages are power amplifiers. They develop pulses from the signals fed to their grids. Of course, the FM sound circuits use audio amplifiers and they are identical to those found in any FM broadcast receiver.

In the color circuits, the chroma signal goes through a bandpass amplifier. This is another amplifier that strengthens the chroma signal, video signal and burst (color sync) signal at the same time. The *demodulators* accept the chroma subcarrier sidebands and mix them with a signal from the reference oscillator. They develop from this mixture, the R, G and B signals that originated in the color camera at the TV studio. Most chroma demodulators are a keyed (gated) form of amplifier, although some recent sets use diodes for color demodulation. You can see from the arrows that the three outputs from the color-demodulators are fed to amplifiers which make the R, G and B signals strong enough to drive the color picture tube.

Oscillators, too. In its simplest form an oscillator is an amplifier chasing its own tail. Part of the output from the plate is fed through a frequency-determining network and returned to the grid. There may also be an input signal at the grid (some form of synchronizing signal) that controls the oscillating frequency precisely. The vertical oscillator in a TV set is an example. It operates at 60 cps because the feedback circuit is responsive to that frequency only. A signal sample is taken from the plate of the tube, fed through the frequency-control network (a resonant circuit) and applied to the grid. This might seem comparable to perpetual motion but it isn't—the tube supplies amplification to keep oscillation going. Since the vertical oscillator needs something more accurate than its own resonant circuit to make its output signal coincide exactly with the vertical sweep signal at the TV camera, vertical-sync pulses are applied at the grids of the tube to keep its oscillations timed precisely.

Detectors, sometimes! Several different tubes are used as detectors in color-TV sets. Inspect Fig. 1-7 again and you should see seven detectors of one kind or another. The mixer in the tuner can be considered a detector (as well as a low-gain amplifier) because it transfers the picture and sound modulation to a secondary carrier—the IF signal. The video and sound detectors are obvious. though they do use different systems (AM for video and FM for sound).

There are several kinds of detectors for the FM sound. Discriminators and ratio detectors make use of diodes—usually semiconductors. These stages are not amplifiers, however. *Gated-beam* and *quadrature* detectors have become more popular in recent years because of their greater efficiency.

The color demodulator is another special form of detector. Two other detectors are also in the color circuits. Both use diodes and are part of a stage called a phase detector (or differential detector). One detector compares the color-sync burst with the color-reference oscillator. If the oscillator is even slightly out of phase, the phase detector puts it back on frequency. The other phase detector operates the color killer stage that turns off the chroma circuitry if a color program isn't being received. Even the horizontal AFC circuit is a phase detector.

Next Issue: **Color Servicing Fundamentals**

Plus Examination on Part I

Hi-Fi Today * *Crystal-Clear FM*

By John Milder

TO MY MIND, the most important improvement in audio gear over the past three or four years has been in FM tuners (or, more accurately considering the way people buy these days, in the FM sections of stereo receivers). Today's FM circuits pull in far more stations than those built a few years back, sound clearer both on weak and strong signals and stay in tune, if you'll pardon the expression, far longer—some of them indefinitely.

Many audiophiles have been confused about the factors that determine tuner performance and have tended to compare competing tuners strictly in terms of rated sensitivity. For that reason, there has been little recognition in audio circles of the really striking improvements in tuner performance over the past few years. After all, the IHF sensitivity of most new tuners is hardly a tenth of a microvolt better than the older tuner generation, if that.

Rated sensitivity has never been that important, and today less than ever. The first real breakthrough (somewhere between 1964 and 1965) was in the ability of transistor tuner circuitry, done even halfway decently, to produce a fairly sharp limiting curve. That is, the difference in signal strength between acceptable (IHF) reception quality (with audible background noise) and full limiting began to be slight. Previously it was perfectly normal for a tuner with an IHF sensitivity of 3 microvolts not to produce really first-class reception quality (with full quieting of background noise) until something like 50 to 100 microvolts of signal appeared.

With the appearance of transistors the difference dropped suddenly to under 10 microvolts. For the first time, the chances were that if you got a signal at all in a fringe area, you got it pretty decently instead of with the expected veil of noise. In all the discussions about problems in transistor tuner circuitry—including the much-discussed (and never really significant) problem of cross-modulation—nobody talked much about this improvement. But what an improvement it was!

Then came the small, low-mass IF transformers that resisted having their slugs shaken out of alignment during shipment. They complemented the transistor's ability to maintain tuned-circuit parameters far longer than tubes; and for the first time, a tuner was likely to arrive at your home in decent alignment and stay that way for years instead of months.

Next, the arrival of the FET (field-effect transistor) improved matters considerably and the use of ICs in IF strips produced a further improvement in limiting characteristics, particularly by rejecting troublesome noise impulses like those from auto ignition. Finally, the crystal filter has started to replace the conventional IF transformer, thereby bringing (in some cases) a fantastic improvement in selectivity and a further promise that, with just a bit of luck, a tuner may never need alignment.

Thanks to the crystal filter and other developments we are right on the edge of what could be—for typical metropolitan listeners with typical reception conditions—the end of multipath distortion. Multipath, the FM equivalent of TV ghosts, usually has been attacked by using a directional antenna that can be oriented to zero in on a station's primary signal in order to reject multiple reflections.

But getting rid of multipath also has been a function (almost ignored) of a tuner's selectivity characteristic known as capture ratio. This expresses—in decibels—the differ-

[*Continued on page* 118]

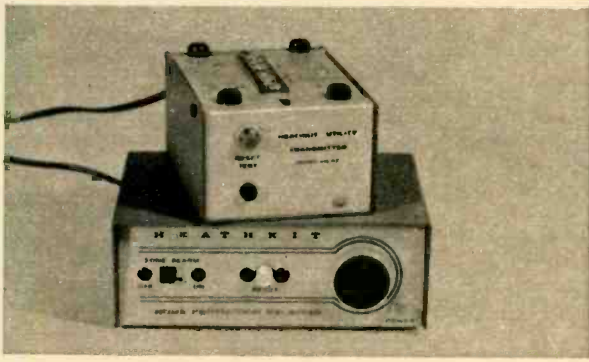
Scott model 342C 100-watt stereo FM receiver is latest component to feature quartz-crystal lattice filter. Factory alignment is said to be permanent. The check mark was put there by factory.

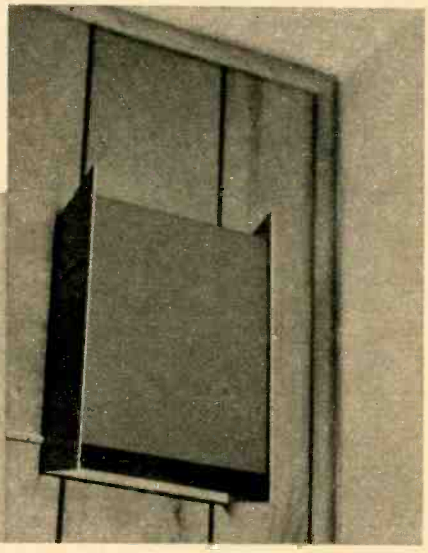
EI Kit Report

Three-Armed Home Protector

Heathkit

GD-87 Smoke/Heat Detector
GD-97 Utility Transmitter
GD-77 Receiver Alarm





BESIDES worrying about soaring prices, taxes and welfare expenditures, people nowadays are developing concern about their security. The idea of the house being broken into sometimes disturbs sleep, as does the old worry about having a fire.

Protecting your home electronically is not always a simple job because you must tie together several sensing and alarm devices. And installing the equipment can be a problem, too, if you don't like wires strung or stapled all over the place.

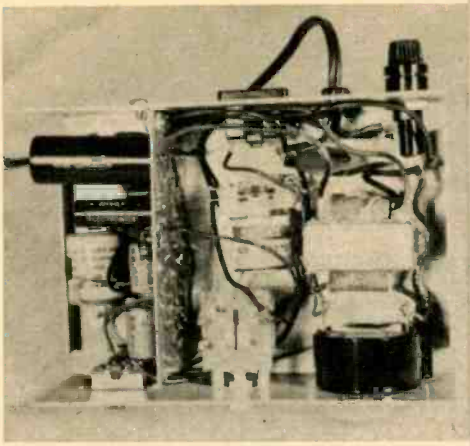
The Heathkit home-protection system solves both problems. It will warn you of smoke, fire, excessively high or low temperature, power failure, break-in through a window or door, rising or falling water levels, thawing and rain. You couldn't do better with a full-time watchman. The Heath rig has three basic alarm inputs: thermal (heat), visual (smoke) and open/closed circuit (contacts disturbed by the opening of a window). Thus, we call it a three-armed protector.

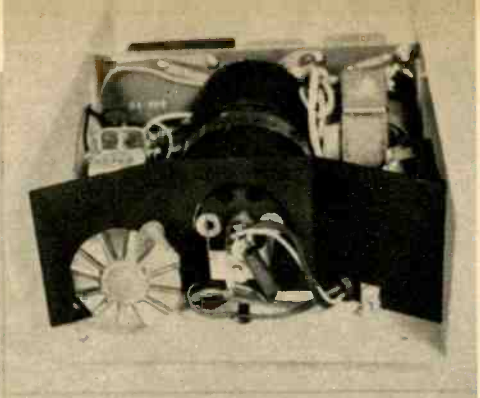
The beauty of the system is that you do not have to connect the sensing transmitters to the receiver with wires. When a transmitter is activated by smoke, heat or whatever, it feeds a 50-kc signal to the receiver via your home's AC wiring. The system consists of three units.

The $39.95 Receiver Alarm audibly warns you of trouble with its Mallory Sonalert tone generator (2,800 cps). Fail-safe circuitry powered by a constantly-charged nickel-cadmium battery sounds the alarm to warn you of a power failure or if the receiver is accidentally unplugged. On the back of the receiver there's an AC outlet in which another warning device can be plugged.

The $34.95 Utility Transmitter sends a signal to the receiver alarm when a sensing device (a switch) connected to it opens or closes. Such sensors could be a microswitch or a magnetic-reed switch installed on a window or a door. Both normally-open and normally-closed switches simultaneously can be connected to it.

The $49.95 Smoke/Heat Detector Transmitter activates the receiver alarm when the temperature reaches about 133°, or if the air becomes dense with smoke. On the back there's a terminal strip to which additional heat sensors or a normally-closed sensor can be connected. For example, if the detector is located in a laundry/furnace room, you could connect to the terminal strip a micro-





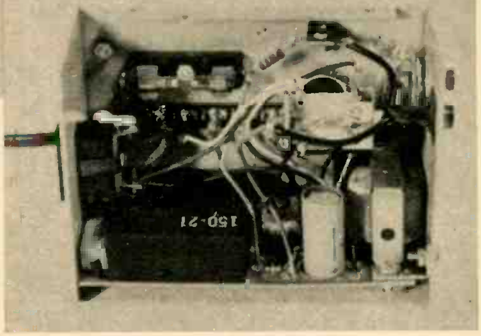


Photo at extreme left is of utility transmitter on top of receiver. To right is smoke/heat detector mounted on wall. Photo above is of receiver. In photo at upper right of bottom of smoke/heat detector, round object at left is heat sensor. Black can is smoke detector. Note pilot lamp at bottom and holes through which smoke enters. Photo at lower right is of utility transmitter. The black object at the bottom is the 50-kc epoxy transmitter module.

switch on the room's window.

How does the smoke/heat detector transmitter work? Inside it there's a smoke-detector, a cylinder about 2 in. in dia, and 5 in. long. Inside the detector (interior is painted a dull black) there are several compartments formed by discs (the diameter of the cylinder and painted black) each of which has a hole in the center.

At the edge of a compartment near the top there's a light-dependent resistor (solid-state photocell); at the bottom there's a pilot lamp whose light shines up through the holes in the discs. Normally the light-dependent resistor is in total darkness and its resistance is high.

When smoke goes up through the detector's discs light is reflected by the smoke onto the light-dependent resistor. This causes its resistance to drop and the transmitter to feed a 50-kc signal into the power line. A fail-safe feature is the balanced-bridge circuit of which the pilot lamp is a part. If the lamp burns out, the bridge will be unbalanced and it will turn on the transmitter to warn you of trouble.

The construction of the transmitters and the receivers was not at all difficult; we completed the job in just under seven hours. One thing that took time was the adjustment of the smoke detector. Initial adjustment is made using a radio tuned to a quiet spot on the dial around 600 kc. After blowing smoke in the bottom, a sensitivity control must be adjusted so a buzz comes from the radio after about 5 to 30 seconds. Then you blow the smoke out of the detector. The buzzing should stop after about 30 seconds. If it doesn't you readjust the sensitivity control to stop the buzzing.

Next, you just let the thing sit for 12 hours to make sure it doesn't trigger the receiver alarm. If it does you touch up the sensitivity control and wait five or six hours to see if the alarm goes off again. If it does again, you repeat the procedure once more. Our transmitter worked satisfactorily after the 12-hour wait. The transmitter comes on about 20 seconds after smoke is blown into it and goes off about 35 seconds after the smoke is blown out.

Fortunately we haven't had the opportunity to see if the system works under real conditions—a flashback or fire in the furnace room or a burglary attempt. To be sure the system is always in a *go* condition, we regularly light a match under the temperature sensor, blow cigarette smoke into the smoke detector and sneak in through the protected patio door. The system hasn't failed yet.

[*Continued on page* 118]

The Listener

By C. M. Stanbury II

DXing the Duplicates

ONE OF the more interesting challenges for the avid DXer is to log two unrelated stations which through some fluke have been assigned the same call letters. If you count beacon identifiers as call letters (which they technically aren't) the feat is not terribly rare because beacon IDs often duplicate the calls of other stations. For example, CBM is a beacon at Columbus, Miss., on 320 kc and also a BCB station at Montreal on 940 kc. SWA is a beacon at Swan Island as well as the call assigned to Athens Aeradio.

But if you stick to a strict definition of call letters, duplications are extremely rare. In fact, we know of only one pair currently operative—TGY. This call covers both a TRT station at Barcenas, Guatemala, and a BCB station at Guatemala City—R. Progreso on 580 kc. Although it's an SW station using CW, TGY will be by far the easiest to log. A marker tape is run often for long periods which can be decoded by anyone no matter how little Morse code he understands. This marker will consist of a long series of dots followed by QRA DE TGY TGY TGY. Most of the QRM on 4860 will come from R. Maracaibo down in Venezuela (it shouldn't be too much of a problem). However, it will be difficult to log the other TGY on 580 because many U.S. and Canadian stations also operate there. But then bagging both TGYs is a matter of pure DX and if you're a pure DXer the bigger the challenge the better, right?

Asian Democracies . . . Switching from a difficult logging to two comparatively easy ones, R. Japan (NHK) and All-India Radio should provide some interesting reception for the beginner. They are the official voices of Asia's two most important democratic governments. Japan is a strong and thriving democracy while India has many problems and stands in precarious balance between East and West.

R. Japan not only represents a stronger government but has by far the stronger signals. The powerful 17825-kc transmitter can be spotted easily on the 16-meter band with English to North America at 1845-1945 and 2100-2200 EST. On 19 meters, 15445 also is used for the first transmission and 15235 for the second. AIR has no programs beamed our way but their 15080-kc outlet at Bombay, just below the edge of 19 meters, is not too difficult to locate on your dial when conditions are good around 1300 EST.

Homebrew QSLs? . . A controversial topic among DXers for many years has been the validity and/or desirability of stamped, self-addressed cards which some listeners include with reports and which a station merely has to sign and mail back to the listener. Arguments for this approach are that a good deal of time and postage is saved if the station turns out to be a non-verifier; also, a perfectly worded verification is obtained and, finally, many utility stations don't know how to answer a reception report.

The arguments against this, however, are equally impressive. If the practice became widespread many stations would dispense with their own individual and unique QSLs and many undeserved verifications might be issued because radio stations would sign these cards just to avoid being bothered by DXers.

There is something to be said for both points of view so a final decision is pretty much up to each DXer. The following guidelines do, however, seem reasonable: except for utility stations, never send a prepared card with your first report. And if you know a utility station does issue its own QSL, don't send it a card, either. Also, never send a prepared card to any station without making certain you have in fact heard it.

Club News . . . While few Americans and Canadians with DX listening interests belong to DX clubs, such organizations do have some effect on the national scene and, therefore, their activities occasionally are worth noting.

This past winter has been especially eventful. To start with, the Canadian International DX Club came up with a first—a regular news column devoted exclusively to clandestine radio research and related matters. CIDXC dues are $4 and the SWBC editor is

[*Continued on page* 109]

Tape-Head Analyst

By HARRY KOLBE

THINK you are making really professional tape recordings at home? It's not terribly likely—even if your recorder has seen only a couple of months of service. Optimum performance from a tape recorder depends on the accuracy of the alignment of the heads and the amount of bias current. Even if your recorder was aligned perfectly when it left the factory and wasn't jarred during shipping, tape abrasion and pressure during normal use will change head alignment in a relatively short time.

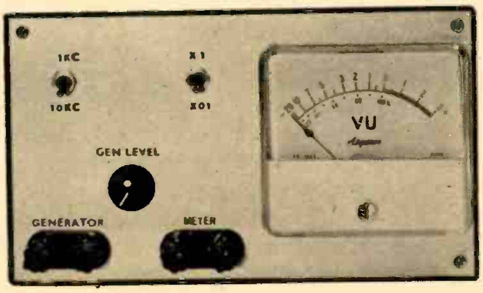
Improperly aligned heads result in poor high-frequency response, crosstalk between channels and a deterioration of the signal-to-noise ratio. Maximum high-frequency response, signal-to-noise ratio, lowest distortion and greatest dynamic range are also dependent upon the correct record bias current. Unfortunately, there is no single correct bias current for all types of tape. The correct bias depends on the tape's characteristics. And the variation among the many brands of tape can be quite large. The special recording tapes—low noise, high output, extended range—usually require different bias currents. Most manufacturers set the bias on their machines for a specific brand and type of tape that they feel will more or less represent the average tape likely to be used.

If you are serious about making the best recordings your machine is capable of, you must carefully select a specific tape, adjust the bias current for that tape and stick to the same brand of tape.

By now you should be ready to admit that the heads on your machine may be out of alignment and the bias-current setting is probably incorrect. But what do you do about it? The machine could be brought to a service shop, but that will cost money. A better solution is to service the machine yourself. All it takes is a couple of test tapes, an audio voltmeter, an audio signal generator and know-how. But because an audio voltmeter and signal generator are very expensive, we suggest our Tape-Head Analyst.

It can be built for much less than the cost of one professional alignment job at a service shop. A little practice will result in perfect alignment of your recorder's heads and will also allow you easily to check the alignment to determine when your machine is in need of service.

How it Works. The Analyst is a battery-operated audio generator and high-impedance AC voltmeter. Transistors Q1 and Q2 form a twin-tee oscillator with a low output impedance. The generator section puts out a 0-1.5 V 1,000- or 10,000-cps signal. Switch S1 connects one or the other of the twin-tee networks in the feedback path between the collector and base of Q1. Transistor Q2, an emitter follower, prevents loading of the oscillator and provides a very low output impedance at BP1 and BP2. The low output impedance can feed a low- or high-impedance tape recorder input. The 1,000-cps signal is used to calibrate your recorder's record-level meters (or indicators) and to set the record bias. The 10,000-cps signal is used for record-head alignment.



The voltmeter section consists of field-effect transistor Q3, transistor Q4, VU meter M1 and associated circuitry. Field-effect transistor Q3 provides an input impedance of over a half megohm. With such an input impedance, the voltmeter will not cause significant loading of recorders with a high output impedance.

And the high impedance will enable you to use the voltmeter to troubleshoot the electronics in your recorder. If the voltmeter is to be used in this way, we suggest that a 25-μf, 100-V DC-isolation capacitor be installed between BP3 and S2. Two sensitivity ranges are provided by S2. When S2 is set to the highest range, Odb (X1), the meter will indicate OVU when the input voltage is about 0.245 V.

The second range, X10, will produce a meter indication of OVU when the input voltage is about 0.77 V. (The N.A.B. standard for OVU is 0.77 V.)

Construction of the analyst is straightforward. The unit is built in a 7¾ x 4-7/16

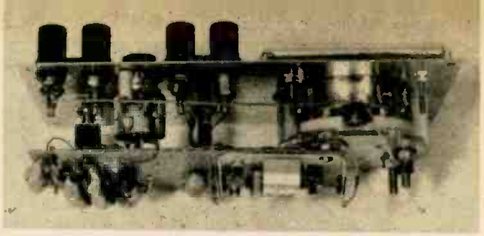
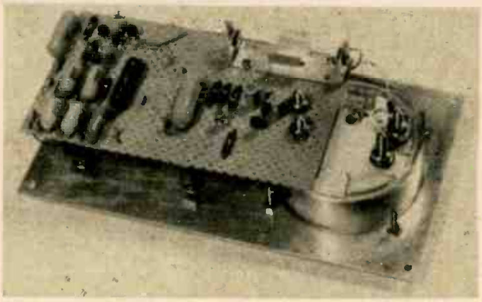
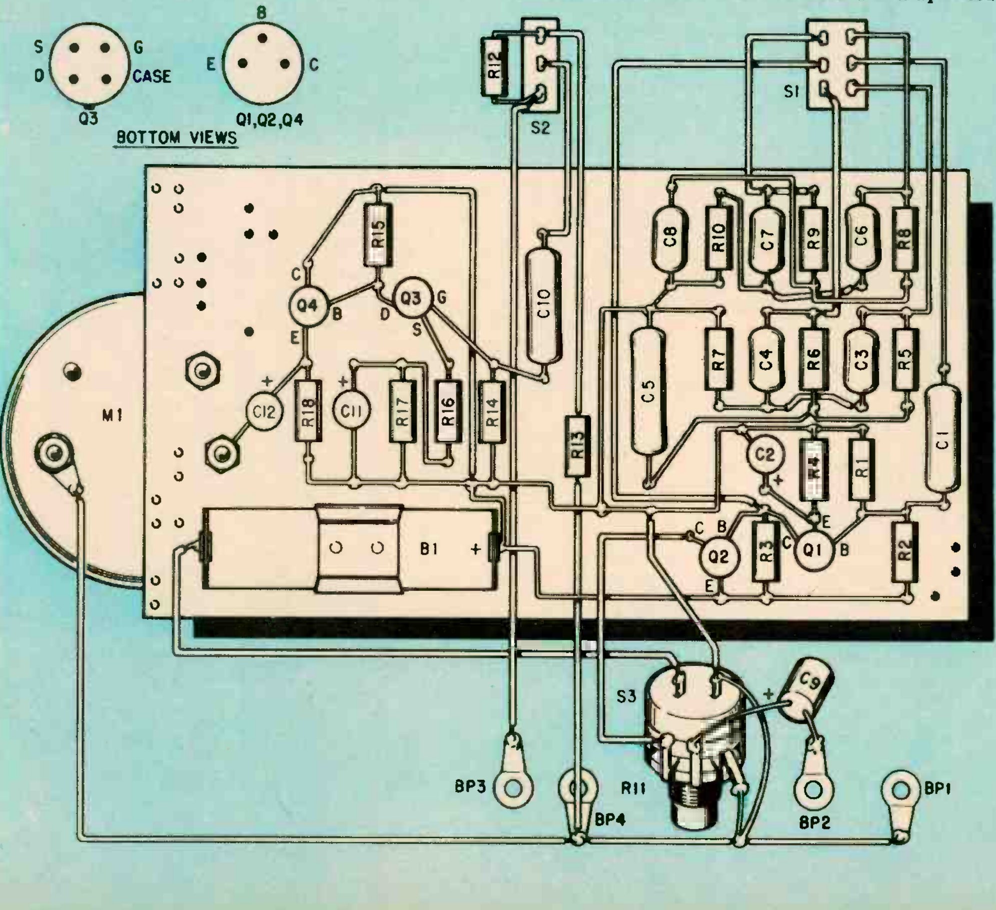


Fig. 1—Note how perforated circuit board is mounted on back of the meter and spaced 1¼ in. from the panel. Directly behind binding posts is the ground bus which connects to the negative terminal on the meter. Holder is for battery.



Tape-Head Analyst

Fig. 2—View of rear of board (above). Author's wiring is on back of board; however, we show it in the pictorial (below) as if it were on top with connections made to flea clips. Use spaghetti insulation on leads that cross and may short.



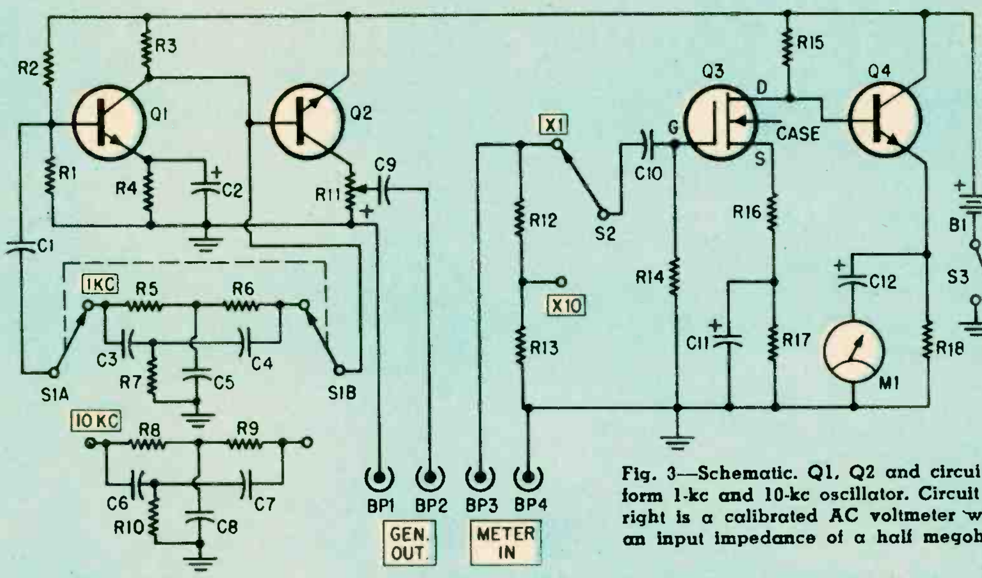


Fig. 3—Schematic. Q1, Q2 and circuitry form 1-kc and 10-kc oscillator. Circuit at right is a calibrated AC voltmeter with an input impedance of a half megohm.

PARTS LIST

B1—9 V battery
BP1-BP4—Insulated binding post
Capacitors: 100-V mylar unless otherwise indicated
C1,C10—.1 μf
C2,C9,C11,C12—10 μf, 15 V electrolytic
C3,C4—.02 μf
C5—.04 μf
C6,C7—.022 μf
C8—.004 μf
M1—VU meter (Lafayette 99 T 5043)
Q1,Q2,Q4—40232 transistor (RCA)
Q3—2N4220 transistor (Motorola, Allied Stock No. 49 F 26 2N4220MOT. $2.85 plus postage. Not listed in catalog)
Resistors: ½ watt 10% unless otherwise indicated
R1—22,000 ohms
R2—120,000 ohms
R3,R18—2,200 ohms
R4—220,000 ohms
R5,R6,R8,R9—15,000 ohms, 5%
R7,R10—1,500 ohms
R11—2,000 ohm, audio-taper potentiometer
R12—330,000 ohms, 5%
R13—220,000 ohms, 5%
R14—5.6 megohms
R15—27,000 ohms, 5%
R16—5,600 ohms, 5%
R17—2,400 ohms, 5%
S1—DPDT miniature toggle switch
S2—SPDT miniature toggle switch
S3—SPST switch on R11
Misc.—7¾ x 4 7/16 x 2⅜-in. Bakelite utility case with aluminum panel (Lafayette 99 T 8076 or equiv.), perforated circuit board, flea clips, battery holder

x 2⅜-in. Bakelite utility case with an aluminum front panel. Drill and punch the front panel for the meter, output-level control R11 frequency-selector switch S1, voltmeter range switch S2 and binding parts BP1-BP4. The remaining components and battery holder are mounted on a 3 x 6-in. piece of perforated phenolic board. The board is held in place by bolting it to M1's terminal screws.

Preliminaries are a Must. Dispense with them and you are wasting your time trying to align a tape recorder and what's worse, you stand a good chance of degrating expensive test tapes to the point where they are worthless. To check and align a tape recorder, you will need Q-tips, a tape-head demagnetizer and a new reel of the recording tape you have decided to use for all of your recordings.

First thing to do is clean the heads. Swab away bits of dirt and tape oxide with a Q-tip moistened in head cleaner. Scrub oxide deposits away from the erase, record and playback heads as well as the tape guides and rollers. Heavy deposits on the capstan pinch roller can be removed easily by scrubbing with a soft cloth moistened in head cleaner.

After the machine is cleaned, all of the metal parts that contact the tape must be demagnetized. Detailed instructions for doing this are supplied with your head demagnetizer. Take your time and be thorough when demagnetizing because the quality of your recordings and the preservation of test tapes depend upon it. The machine is now ready for alignment.

Test Tapes. For a complete recorder alignment a test tape is required. The tape provides a series of constant-level signals from 50 to 15,000 cps recorded at standard (N.A.B.) recording levels. The tape for this purpose is the Ampex No. 01-31321-01. It is a full-track tape and is available from Harvey Radio Co., Inc., 2 W. 45th St., N.Y., N.Y. 10036. The price is $21.95 plus postage for 1 lb. (It is also available from other distributors of professional audio equipment.)

Head alignment establishes the proper position of the head with respect to the recording tape. There are four head-tape relationships: they are azimuth angle (Fig. 4), track registration (Fig. 5) and contact angle and tilt (Fig. 6 left and right). Azimuth angle (Fig. 4) is the angle between the edge of the tape and the head gaps; it must be 90°. Track registration (Fig. 5), refers to the height of the head gaps with respect to the tape. If height of the head is incorrect, the gap will pick up information from two tracks instead of one. Tilt (Fig. 6, right, is an exaggeration of this condition for purpose of illustration) refers to the angle between the face of the head, and surface of the tape. The angle must be 0° to insure equal head-to-tape contact across the tape. Contact angle (Fig. 6, left) is the tangent angle at which the tape contact the head, it must be 90°.

Heads are adjusted by the screws on the tape-head mounting plate. Depending upon the head mounting arrangement in your machine, there may be two, three or four screws. Consult your machine's service manual to find out which screws do what. In most cases, one adjustment will affect another. *Important*: all tools used to make head adjustments must be demagnetized.

Visual checks. Sighting through the tape guides and along the tape path, check that the guides and the heads' faces are perpendicular to the plate of the recorder. Correct any tilt by turning the appropriate adjustment screws. Thread a reel of tape on the machine. Keeping the tape taut across the heads, check the contact angle by viewing the heads from above and noting the angle between the tape and the face of the head at the center of the gap. Still keeping the tape taut, view the heads from the front to check the height of the heads. (Figs. 4 & 5). Adjust the playback and record head height so that the top edge of the tape just covers the upper-track pole pieces. Recheck head tilt; you may have to repeat the tilt and height adjustments a few times to get them both correct.

Playback Head. Put the azimuth alignment tape on the machine carefully and connect the output of the recorder to the Analyst. Start the tape, the first recorded tone is a 1,000-cps reference signal. Set the recorder's playback-level controls for a convenient reading on the Analyst's meter. Set both left and right channel levels on the recorder to give the same indication. The next tone on the test tape will be 10,000 or 15,000 cps. Adjust the azimuth adjusting screws on the playback head for maximum and equal output from both channels.

An Ampex 01-31321-04 four-track alignment tape (same price as other tape) has a steady tone recorded on tracks 1 and 3. While playing tape, adjust the playback head's position for *minimum* output from tracks 2 and 4. Check the playback-head tilt and recheck

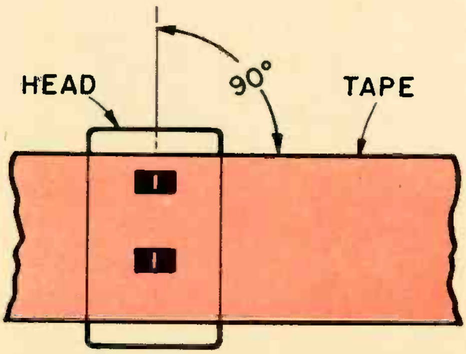


Fig. 4—The azimuth adjustment of the head is correct when the angle between the gap in the head and the edge of the tape is exactly 90°.

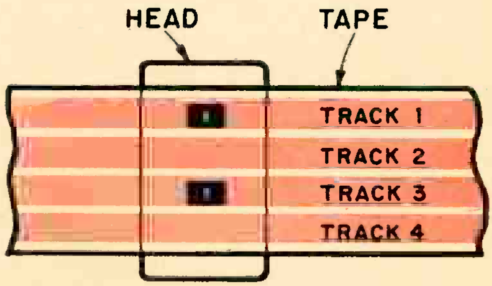


Fig. 5—To prevent crosstalk between tracks, head height must be correct. For example, if head is too low, tracks 1 and 2 will pass over upper gap.

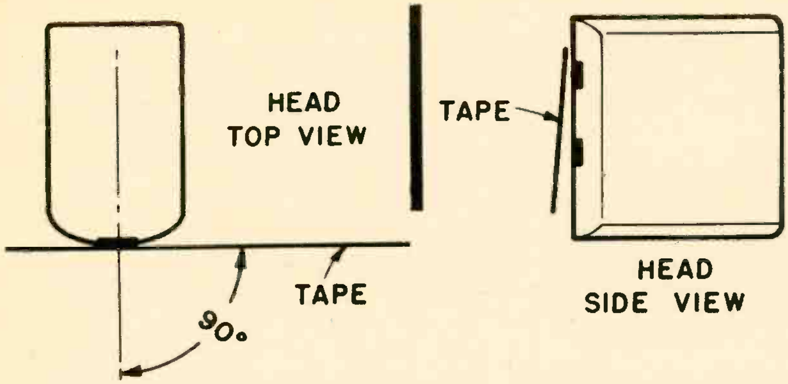


Fig. 6—Contact angle (left) is tangent at which tape contacts head. It should be 90° to head's centerline. Tilt (right) is deviation from parallel between surfaces of tape head and tape. Tape and head should be exactly parallel at contact (it's shown away from head here for illustration purposes).

azimuth alignment. You may have to repeat azimuth, height and tilt alignment a few times before all three are correct.

Playback frequency response may now be checked with the test tape. The first tone on the test tape is a 1,000 cps signal recorded at a OVU reference level. Set the playback-level controls so that the Analyst's meter indicates OVU. Do not disturb these control settings until after you have finished the record-head alignment. Remove the test tape, load the recorder with a reel of fresh tape and connect the output of the Analyst (BP1 and BP2) to the high-level input of the recorder.

Record a 1,000-cps signal on the tape. Without disturbing the previously set playback-level controls, adjust record-level controls and the Analyst's level control (R11) for a meter indication of OVU. If possible, keep the record-level controls about ½- to ¾ open. Reduce the Analyst's output with R11 until the meter indication drops 15db and switch the Analyst to 10,000 cps. Adjust the record-head azimuth and height screws for maximum output. Check and adjust the tilt of the record head if necessary. Record a 1,000-cps signal at +3VU on tracks 1 and 3.

Turn the tape over and play back channels 2 and 4. The output from both channels should be low but equal. If the output on track 2 is significantly higher than track 4, the record head is too high. Repeat the record-head alignment until the azimuth, height and tilt are correct.

Bias Current Adjustment. Record a 1,000-cps signal at about OVU. While the recorder is running, adjust the left- and right-channel bias-current controls for maximum output from both channels. On two-head machines you will have to make a number of recordings at various settings of bias current and play them back to find the setting that results in maximum output.

Recorder Meter Calibration: Check the

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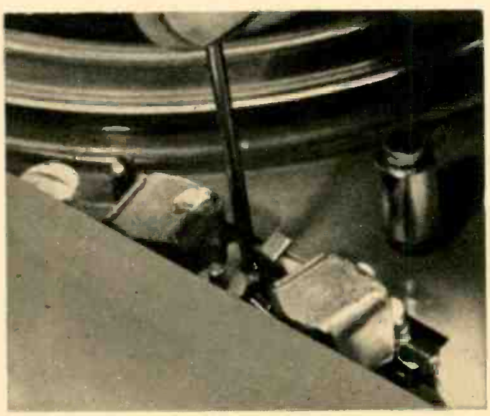

Fig. 7—On this two-head (erase and record/play) recorder, tilt-adjustment screw is on side of head. Refer to recorder's manual for location.

Fig. 8—On same machine azimuth-adjustment screw is at rear of head on the mounting plate. Use demagnetized tools when working around head.

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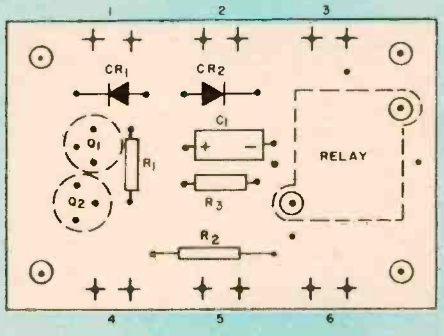
G. O. Allen

Dr. G. O. Allen
President

Making It With Minikits

By DAVID WALKER

Kits in a bubble are just the thing to fill out stages in projects you want to build. They're fast, too!



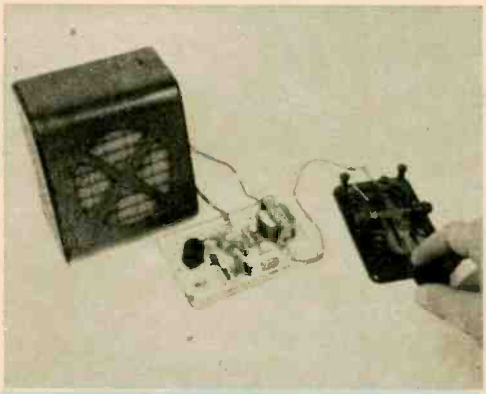
Blister packages and pegboards are trademarks of minikits. Parts placement diagram above for RCA kit is typical aid included for builder.

FALLING SOMEWHERE between slick kits that resemble commercial equipment and surplus transistor packs is a new item for experimenters. It's called the *minikit*. You'll see it as a collection of parts jumbled inside a blister card that swings from a pegboard at your parts distributor. If you assemble one according to instructions it forms a circuit chunk that will slip into a larger electronic scheme. You can bring a phono cartridge to life, produce sound from a tape head or test a mike by feeding the audio signal to a minikit amplifier. Just add a loudspeaker and power source and the job's complete.

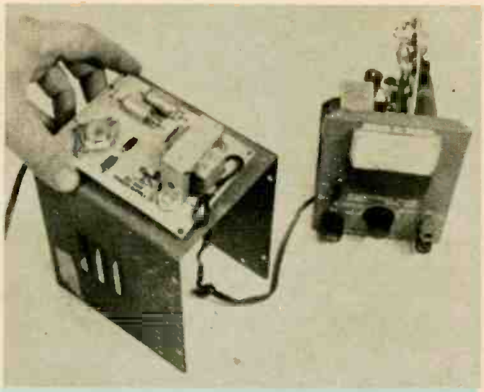
We're not including in this article *ice-cube* circuits sealed in epoxy or printed-circuit modules prefabricated at the factory. These are items of another ilk because you don't assemble them from individual components. They're fine for many tasks but the minikits described here may prove more flexible in some applications; their parts are easier to change or modify at a later time. The *ice cubes* can't be opened and modules are too miniaturized for tampering.

Minikits come in different packages but have certain features in common. They contain a package of parts, a circuit diagram and adequate instructions for easy assembly. They'll tell you if additional components are needed to make the circuit work. In almost all cases this means a battery or DC supply, a speaker (if it's an audio amplifier), a special switch or sensor if the circuit triggers an alarm. Some kits call for additional controls; possibly a power switch. To know about these extras read the fine print on the back of the minikit's card.

Can you save hard cash with a minikit? We figured the parts cost on several kits and arrived at a total that's about the same as what you'd pay when buying individual components over the counter. What you buy in most minikits is the *convenience* of having your parts in one package together with a circuit diagram that should work. A shrewd experimenter, it must be added, could buy more cheaply on his own, especially if he can handle risky surplus parts with confidence. In fact, minikit makers seem to do just that. Many components in their packages (notably semiconductors) are fallout items that couldn't make the grade in more rigor-



IC minikit from RCA serves as code practice oscillator. Missing items (like key and speaker) must be supplied by experimenter.



Minikits can often improve existing equipment. Here, Eicocraft power supply is added to power supply for another fixed voltage.

ous applications. The kit manufacturer has removed the guesswork and markets the benefit of his sorting, testing and applications ability. That's worth something. At least four manufacturers now produce minikits.

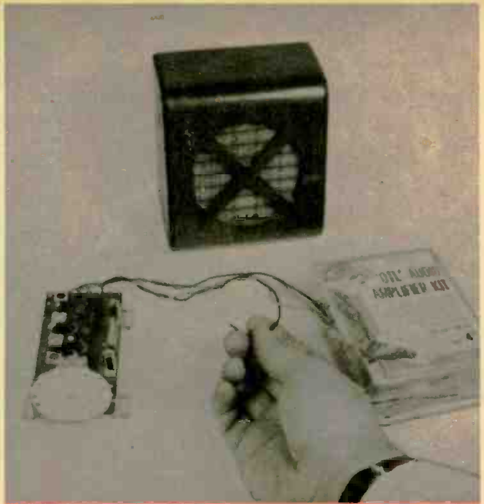
Science Fair is the name Radio Shack uses for its line. Though certain non-minikits are included (a 10-in-1 projects board, a 5-tube superhet), the line contains plenty of goodies for an experimenter needing slices of circuitry. One useful module is called an OTL (output-transformerless) Audio Amplifier (#28-106, $4.95). It's an amplifier that can be used in innumerable ways. It will take the low-voltage audio output of a tuner, phono, tape or mike and boost it to loudspeaker volume.

Building the Science Fair series requires the participation of the builder. You'll get a perf board that isn't marked and perhaps is in need of a drill hole or two. The step-by-step instructions, though, are easy to follow and their assembly shouldn't challenge anyone's skill. The instruction sheet tells how to interconnect the device with other components. One handy feature, the assembled board fits into the plastic case which originally swung on the peg.

Mod-U-Kits by Bowman Electronics are also widely distributed. They use a variety of construction techniques—circuit boards or point-to-point wiring—depending on the project. The builder is expected to do detailed drilling in some kits. The 5-watt Universal Amplifier kit, for example, requires you to obtain aluminum scrap and use a template (supplied) to drill several holes for the transistors.

Radio Shack's Science Fair minikits come in nicely prepared package. Components are in plastic bag; perf board is chassis.

One of handiest Science Fair kits is general-purpose amplifier which has transformerless output. You only add speaker and battery.



Once Science Fair OTL amplifier kit is wired, components fit back into plastic case. Here, low-level signal from AM tuner is amplified.

Mod-U-Kits manufactured by Bowman Electronics include amplifiers, receivers, power supplies, alarm systems and other circuits.

Making It With Minikits

One Mod-U-Kit, the Siren (HPS-2), sells for only $2.95. By adding a speaker, some flashlight batteries and a heat sensor, you have a simple fire alarm. The device can even be wired to a float switch to signal when your bathtub is about to overflow.

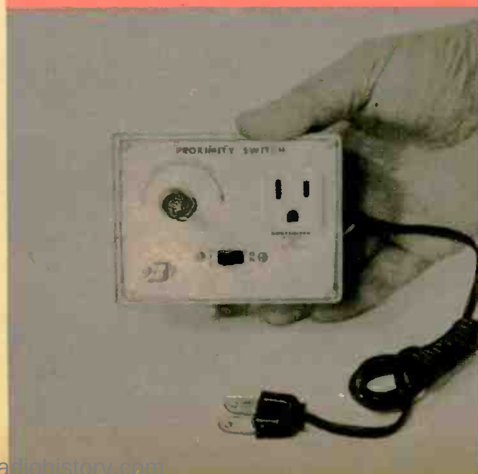
The instructions provided with Mod-U-Kits appear to be adequate. We did find a small variation in components, however, which could confuse a rank beginner. One terminal strip, for example, couldn't fit into the position shown on the diagram without causing a short-circuit. We also had to snip a jutting metal tab from a potentiometer before it would mount squarely on a panel. These are petty problems, but remember that you may have to make minor corrections.

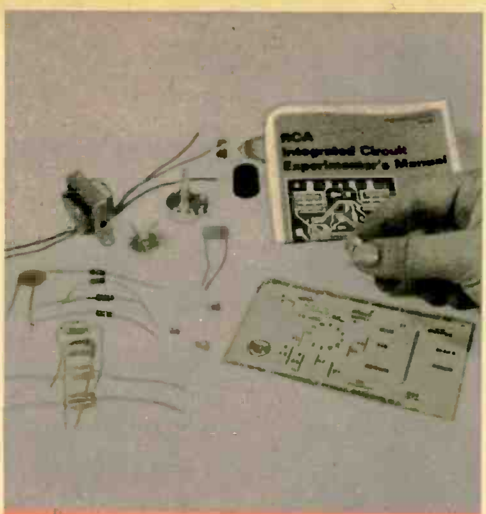
The Eicocraft line includes nearly two dozen devices—ranging from a flasher, metronome or alarm, to receivers and amplifiers. Produced by the Eico Electronic Instrument Co., these minikits generally use PC-board construction. You plug in the parts on one side and solder them to copper foil on the other. Good illustrations and instructions accompany these models.

We built several units and found each to perform well. The Light Flasher (EC-600, $3.95), for example, and also the Photocell Nite Lite (EC-800, $4.95) that triggers a small pilot lamp when evening approaches. This circuit also can be modified to operate a relay in high-powered applications (like turning on an outdoor floodlight). The in-

Bowman's Proximity Switch breaks down like so. Drilling and parts adjustments sometimes require a bit of extra effort.

Proximity Switch makes nifty looking package. Markings on front panel are on sheet of paper pasted on panel by builder.





In RCA's IC kit, practically all parts are supplied. Manual discusses both theory and construction in detail. PC board is used.

Detailed view of PC board for RCA's IC kit. Circuit operates as audio amplifier or oscillator. You add speaker and batteries.

struction sheet suggests several applications but the builder has to work out additional circuitry for himself.

Supplied with many Eicocraft boards is helpful mounting and spacer hardware. Though a minor item it's essential for preventing shorts if the board is mounted inside a metal cabinet. The Eicocraft line is slowly becoming more exotic. You can now build a voice-operated relay, AM and FM wireless mikes, a treasure locator and even electronic bongos.

RCA's Experimenter Kits are slanted toward the hobbyist who wants to learn by building and then end up with a practical, working circuit. This is offered in two ways. In the Integrated-Circuit Kit (KD2112, $10.98) the experimenter receives a fairly complete package of parts. In another kit, there are only a few basic parts so the builder has to supply resistors, capacitors, chassis, etc.

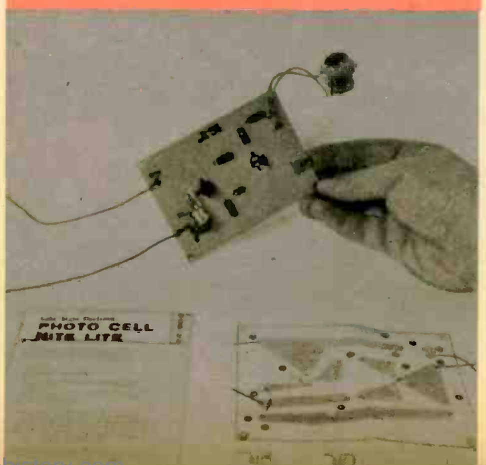
The IC kit is supplied with a well-marked circuit board which is assembled by inserting components and then soldering. Near the end of the project you decide whether it's to be used as an oscillator or amplifier and then install the appropriate parts in final steps. (The circuit is convertible at any time.)

The educational value is mostly in the RCA manual which accompanies the IC kit. It contains a good description of IC technology and how the circuit operates. (The project itself, however, with a spacious board and conventional parts doesn't exactly

[*Continued on page* 118]

Eicocraft line of minikits includes alarms, oscillators for musical effects, etc. PC boards are used; cabinet is sometimes included.

Eicocraft Photocell Nite Lite turns on lamp when illumination on cell dims. Sensitivity control is located at right side of board.



Community Radio Watch

This program to combat crime isn't new but it's the wave of the future.

By ALAN LEVESQUE

SOME people are afraid to walk in their own neighborhoods at night for fear of attack. At the heart of the matter is what has become known as crime in the streets, a phenomenon hiding many problems to which we have few solutions.

Now one of the grand old ladies of two-way radio, Motorola Communications & Electronics, has put forth the newest idea for a partial answer to the problem. The Motorola plan is to give law-enforcement agencies thousands of extra eyes and ears by uniting communications services from CB to the Business Band in a kind of giant police auxiliary, all without additional expense to the communities involved. The name of the program: Community Radio Watch.

The idea is simple. There are no clubs, no so-called volunteer emergency teams to risk either life or limb. There are no expenses, meetings or dues. The premise is that the driver of a vehicle equipped with two-way radio moves about his daily route with more freedom than most folks; he doesn't have to plan his stops so as to be near telephones or call boxes at regular intervals. This mobility means that he will always have more exposure to emergencies, suspicious acts and actual crimes that are a threat to life and property. Vandalism, robberies, fires, accidents, faulty traffic lights, fallen trees, even downed power lines—you name it, he sees it.

When the driver sees such a threat, according to the Motorola plan, he immediately radios in to his base station (not one operated by Community Radio Watch or the police) and reports to his regular dispatcher at home, store or office. The dispatcher takes the report along with all pertinent facts and then calls the proper agency (police, fire, utility, etc.) by telephone. The agency involved can decide which of their units is in the area and dispatch the necessary personnel via their own radio communications system. Within minutes after the initial sighting, if the lines of communication have held up, help should be at the scene. Thus, trained professionals with all necessary knowledge and equipment can handle the situation quickly and efficiently.

Try to imagine how this system would work when you multiply one mobile observer by the several thousands of persons participating in an organized CRW effort. Think about the pool of mobile two-way radios to be found in any community and you've got CBers, the electric company, taxis, bus companies, repair trucks, delivery trucks, the telephone company, service stations and businesses from gravel companies to pizza parlors. If all their drivers were alert to what was happening around them the community would be under constant surveillance.

When the program was announced in late 1966 there were many locales in dire need of such a program, but unfortunately it was no more than a plan on paper. It sounded fine, but would any city accept the observations of private citizens as an adjunct to their law enforcement and fire agencies? Would business and individual operators want to participate? Would participating observers assume unauthorized police powers? In other words, would CRW work?

City fathers in Cincinnati, Ohio, were the first to sense that CRW had the potential to augment their battle against crime. CRW officials also were encouraged that an important city (with more than 500,000 popula-

Community Radio Watch is based on the premise that drivers using two-way radios have more mobility than most people and can be on the scene when crimes take place. When radio operator (first photo) sees suspicious event he calls in to his own dispatcher (second photo), who in turn telephones authorities (third photo); help then is sent as quickly as possible as illustrated in photo below.

tion) should take an interest in their virtually hypothetical plan. Working together, CRW and Cincinnati officials decided to contact certain radio operators in the area to present the CRW concept to them. To say that the response was overwhelming would be an understatement.

As soon as the first feelers went out CRW was promised the cooperation of 447 vehicles belonging to the Cincinnati Gas & Electric Co. plus another 150 vehicles from the Cincinnati Suburban Bell Telephone Co. During the first month hundreds of CBers and nearly every business-radio user in the city had flocked to CRW.

City officials were delighted. Mayor Walton Bachrach credited the success of the program to the fact the project "appealed to the public because it had given these citizens an opportunity to personally combat crime and accidents." Cincinnati's Safety Director, Henry Sandman, stated that it "would take $100,000 to buy the communications equipment alone that is being placed on watch for police departments in the area. We couldn't afford to buy this equipment, much less hire the men and buy the vehicles to operate it."

Cincinnati continues to use CRW but is now no longer alone. Today almost 700

CRW has gone over big in Cincinnati. Here, Col. Jacob Schott, Chief of Police, presents first CRW kit to Jerry Hurter of Gas & Electric Co.

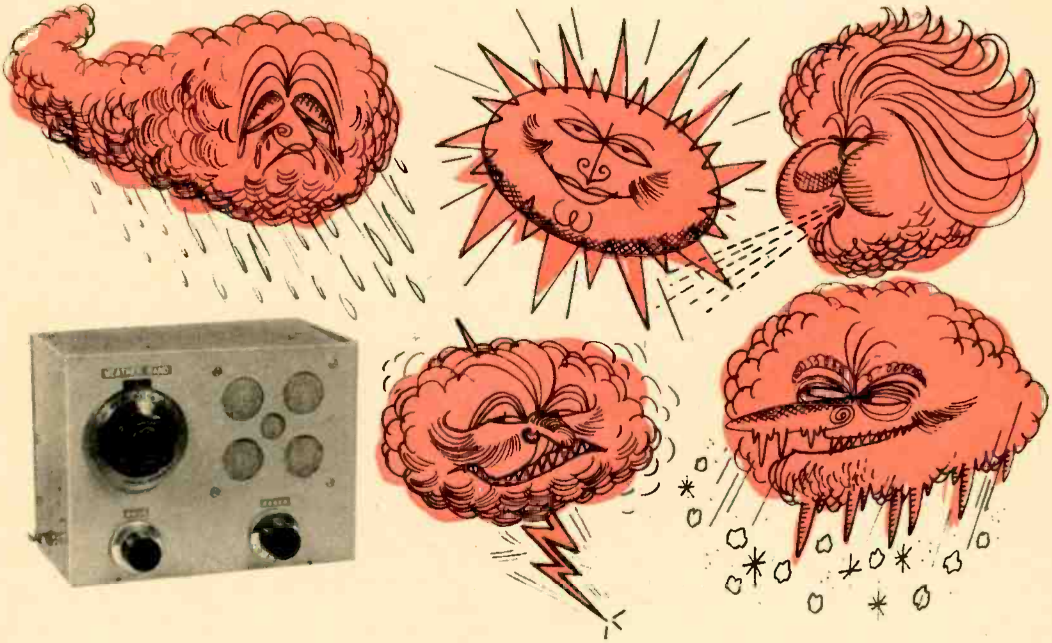
San Francisco's Chief of Police Thomas Cahill presents a charter membership in CRW to a veteran driver for Yellow Cabs, Antonio Norcie.

American cities, both large and small, are participating. This includes Detroit, Pittsburgh, Charlotte, Baltimore, Chicago, Los Angeles, Dallas and Ft. Worth. In fact, most of our cities with populations over 100,000 now have an operational CRW program. On a national basis, some 46,000 business and personal radio systems are participating to the tune of 500,000 mobile units. This is the equivalent of mutiplying the total number of police officers in patrol cars by five to ten times.

CRW is starting to gain momentum. In 1967 the program won the George Washington Honor Medal from the Freedom Foundation at Valley Forge. But perhaps the most important awards are the ones uttered by officials of the cities in which CRW is operating. Spokane is "extremely gratified." San Francisco said that CRW "has managed to make many San Franciscans aware of the stake they have in a lawful society." Charlotte's police greeted CRW "with enthusiasm," and Atlanta hailed CRW as "doubling the eyes and ears of the Atlanta Police Dept."

Motorola is helping to promote CRW with a series of awards which are given to a participant who has made an "extraordinary contribution to his fellow man through the use of two-way radio." Winners of the Distinguished Service Award receive a distinctive plaque and a $200 U.S. Savings Bond. Motorola already has tapped 28 participants for this award. They come from such di-

[*Continued on page* 114]



Low-Band Weather Receiver

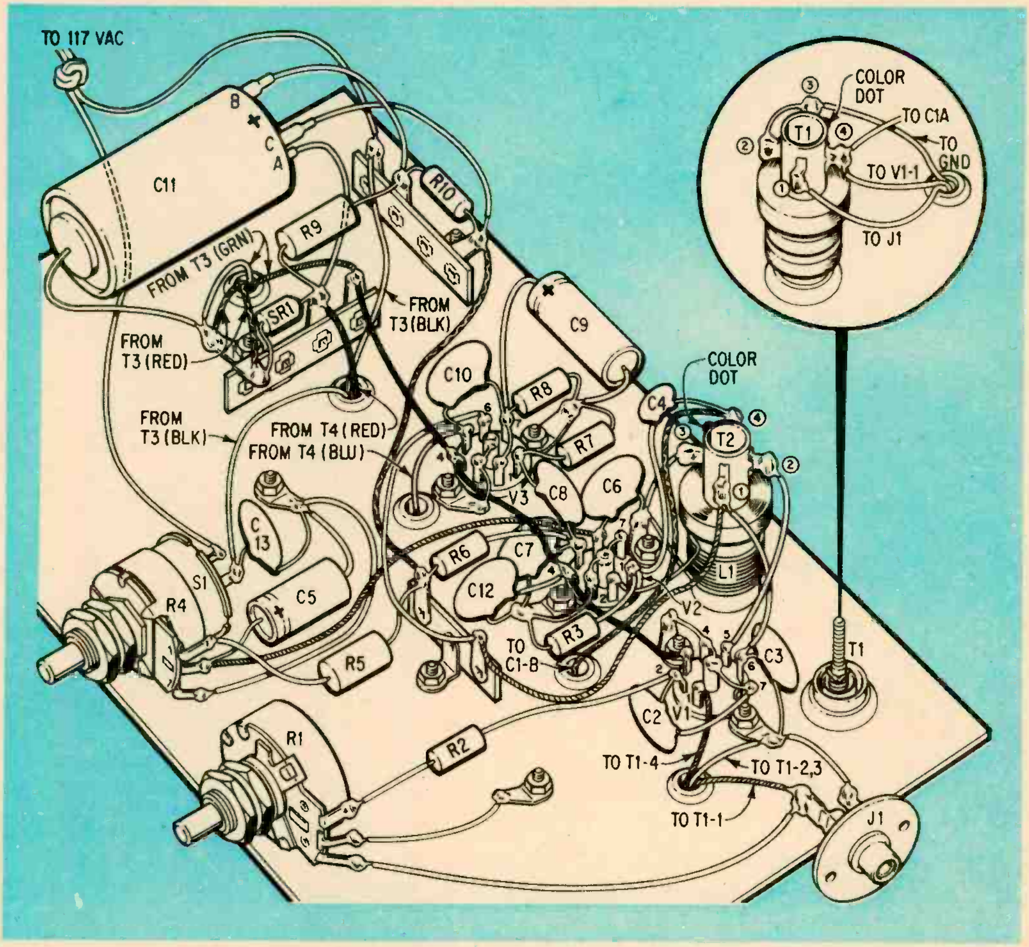
By CLARE GREEN, W6FFS

THERE are some people who wouldn't set foot out of the house in the morning without dialing weather information, staring into a crystal ball, checking at least two radio reports, flexing an arthritic knee, scanning the sky and reading the forecast in the paper. And, to be doubly sure, they'll even go so far as to take an umbrella and stow a pair of rubbers in their briefcase. For such skeptics there is yet another source of information: the Federal Aviation Agency (FAA). An FAA weather report will sound something like this:

This is Los Angeles area radio transcribed weather broadcasts . . . aviation weather coastal area from Santa Barbara to Mexican border . . . surface winds along coast will be 15 knots with 25-knot gusts . . . Bakersfield measured ceiling 2,500 broken . . . surface winds 25 knots . . . San Francisco clear.

The FAA broadcasts reports like that from about 600 locations throughout the United States. The reports are updated each hour or more often and are broadcast 24 hours a day on frequencies between 200 and 415 kc. The broadcast at 15 minutes after the hour is an *area* broadcast of the weather within about 150 mi. of the station.

The broadcast 45 minutes after the hour is called an *airway* broadcast and it gives the weather from major terminals on airways within a radius of about 400 mi. of the station. The broadcasts identify the station, give general weather conditions in the area, pilot reports, radar reports and winds-aloft data.



Underside of chassis. Wiring is tight around V1, V2 and V3. Note 12-turn winding (L1) wound over T2. Input transformer T1 is mounted on top of chassis and is shown in detail in inset drawing at the upper right.

Weather Receiver

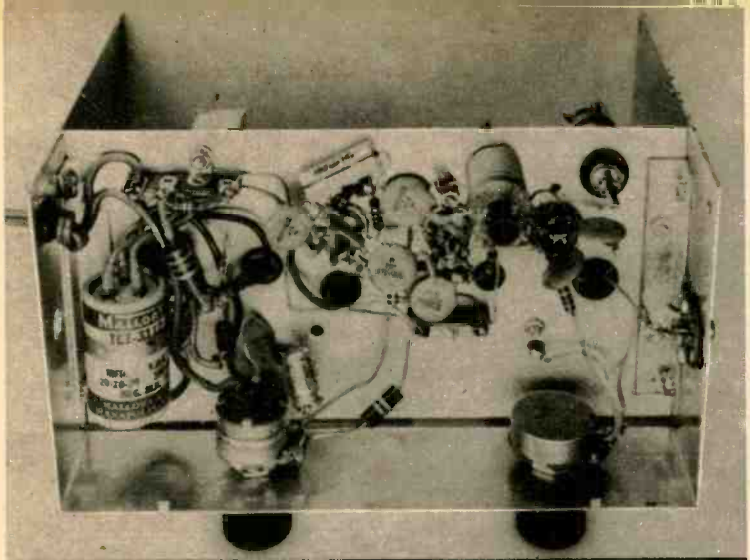
Look at the partial list of weather radio stations at the end of this article. The stations are located near airports and along air routes in most of the states. The radio beacons provide weather information for local and cross-country fliers.

Each announcement begins with the station name, the starting time of the broadcast (beginning with two digits or two digits and a fraction) and the words *aviation weather.*

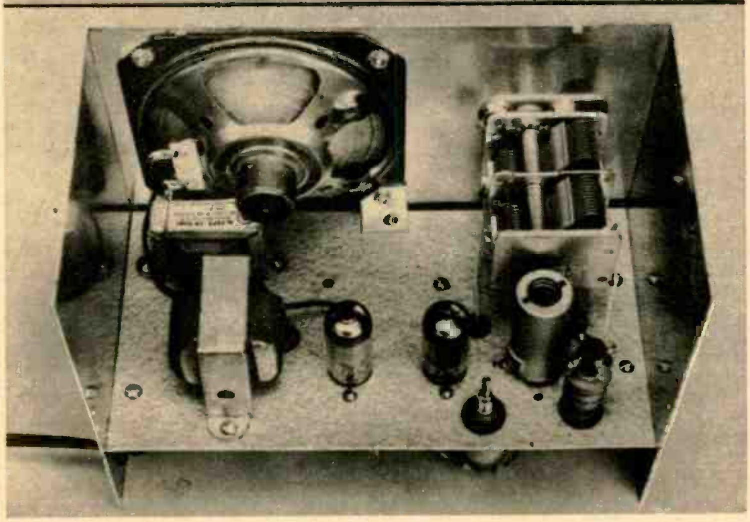
You can obtain more detailed information about FAA weather broadcasts (stations, location and frequency) from the Airman's Information manual, Parts 1, 2, 3 and 3A. The manuals are updated several times during the year and are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The annual subscription prices: Part 1, $2.50; Part 2, $4; Parts 3 and 3A, $18.

You can listen to these weather broadcasts, radio beacons (and even marine CW transmissions) with our three-tube receiver. The receiver has a tuned-RF stage, a regenerative detector and an audio stage which drives a built-in speaker. The receiver is easy to build and uses standard commercially-available coils.

How it Works. Signals from the antenna connected to J1 are tuned by T1/C1A and then are amplified by V1. *RF-gain* potentiometer R1 controls the gain of V1 and prevents overloading of the regenerative-detector stage. The amplified signals from V1 are fed to T2 and tuned by C1B (which is ganged to C1A). The signals are detected by



Underside of chassis. Note how the chassis in our model is held in the cabinet with angle strips. If this material is not available, use four angle brackets. Antenna jack (J1) is at right.



Top of chassis. Output transformer is near speaker. Mount power transformer (with core turned 90 degrees with respect to output transformer) behind it. Transformer T1 is at lower right corner of chassis.

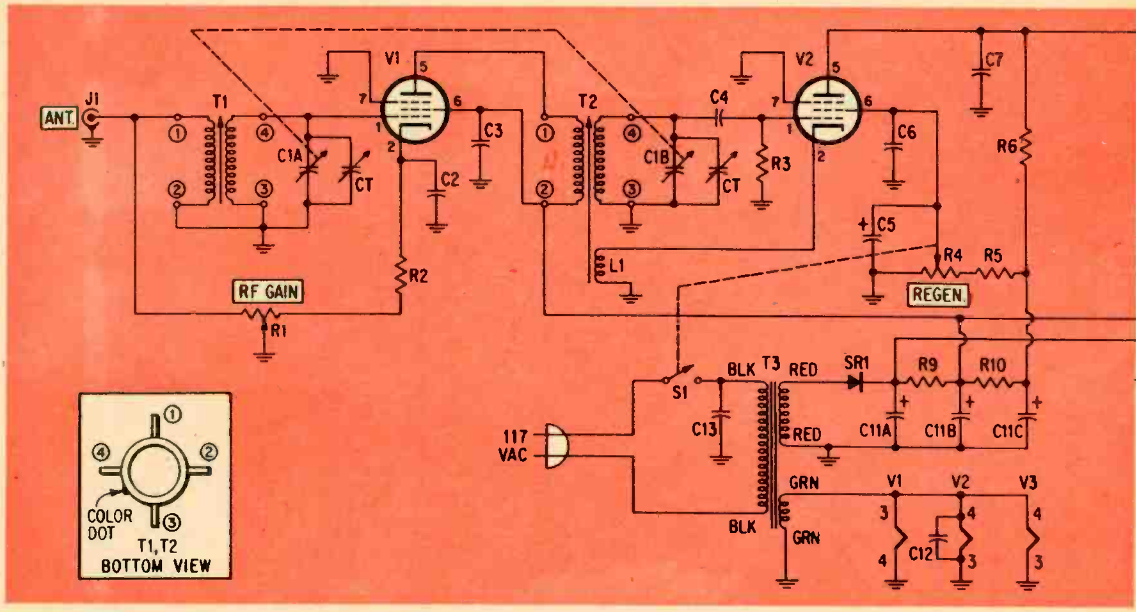
the regenerative detector, V2. RF feedback for regeneration is via a 12-turn coil, L1. *Regen.* control R4 varies the screen voltage of V2 and thus the regeneration of the stage. The detected signals (audio) are coupled via C8 to V3 and amplified. The amplified audio is coupled via T4 to the speaker. Power for the receiver is supplied by T3, SR1, filter C11A, B, C, R8 and R9.

Construction. Cut an 8 x 4¼-in. section of sheet aluminum for the chassis plate and mount it 2-in. above the bottom of the box with aluminum angle or angle brackets. Even though the receiver is tuned to low frequencies, the wiring and component layout in the RF and detector stages are critical. Follow the layout of our receiver.

Before installing T1 and T2, remove the small ceramic capacitors on them and wind 12 turns of number 22 hookup wire on T2. It will be easier to wind coil L1 if you wrap a sheet of heavy paper over T2's secondary before winding on the wire. Make sure T2's terminals are kept away from the cover. Mount transformers T1 and T2 in rubber grommets inserted in oversize chassis holes.

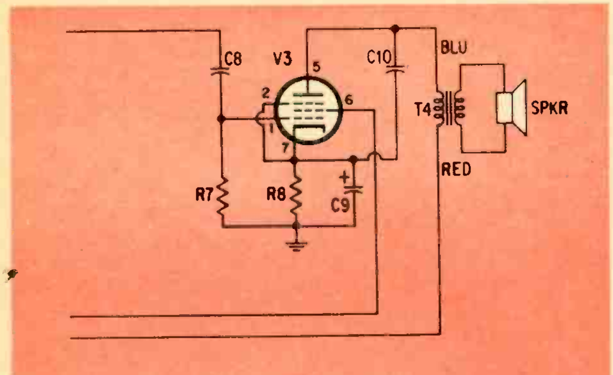
An easy way to make the speaker cutout is to punch holes in the front of the cabinet with octal or 7-pin tube-socket punches. We used large washers for spacing C1's frame away from the panel. Run the lead from T2 to C1B close to the chassis feed-through holes. Install the speaker using a small bracket between the bottom mounting screw of the speaker and the chassis. This bracket will add rigidity to the chassis plate.

Alignment. We used a dial with a logging scale for our receiver, but a cardboard scale with the frequencies marked directly on it can be made. Connect a signal generator to J1 and allow it and the receiver to warm up for a few minutes. Set C1 to full capacitance



WEATHER BEACON TRANSMITTERS

Facility	Freq. (kc)	Call	Facility	Freq. (kc)	Call	Facility	Freq. (kc)	Call
ALABAMA			Salisbury		SBY	Portland	332	PDX
Birmingham	224	BHM	MASSACHUSETTS			Redmond	368	RDM
ARIZONA			Boston	382	BOS	PENNSYLVANIA		
Tucson	338	TUS	MICHIGAN			Allentown		ABE
ARKANSAS			Detroit	358	DET	Harrisburg		HAR
Little Rock	353	LIT	Houghton	227	CMX	Pittsburgh		AGC
Pine Bluff		PBF	Traverse City	365	TVC	RHODE ISLAND		
CALIFORNIA			MINNESOTA			Providence		PVD
Fresno	344	FAT	Duluth	379	DL	SOUTH CAROLINA		
Los Angeles	332	LAX	Minneapolis	266	MSP	Charleston	329	CHS
Oakland	362	OAK	MISSISSIPPI			Greer		GSP
COLORADO			Jackson	260	JAN	SOUTH DAKOTA		
Denver		DEN	MISSOURI			Rapid City	254	RAP
Trinidad	329	TAD	Kansas City	359	MKC	TENNESSEE		
CONNECTICUT			St. Louis	338	STL	Knoxville	281	TYS
Windsor Locks		BDL	Springfield	254	SGF	Memphis	371	MEM
FLORIDA			MONTANA			Nashville	281	BNA
Jacksonville	344	JAX	Billings	400	BIL	TEXAS		
Miami	365	MIA	Great Falls	371	GTF	Amarillo	251	AMA
Tallahassee	379	TLH	Missoula	308	MSO	Austin		AUS
GEORGIA			NEBRASKA			El Paso	242	ELP
Atlanta	266	ATL	North Platte	224	LBF	Fort Worth	365	FTW
IDAHO			Omaha	320	OMA	Galveston	206	GLS
Boise	359	BOI	NEVADA			UTAH		
Idaho Falls	350	IDA	Las Vegas	206	LAS	Delta	212	DTA
ILLINOIS			NEW JERSEY			Salt Lake City		SLC
Chicago		MDW	Newark	379	EWR	VERMONT		
INDIANA			NEW MEXICO			Burlington	323	BTV
Indianapolis	266	IND	Albuquerque	379	ABQ	VIRGINIA		
KANSAS			Roswell	305	ROW	Roanoke	371	ROA
Garden City	257	GCK	NEW YORK			WASHINGTON		
Wichita	332	ICT	Elmira	375	ELM	Spokane	365	SFF
KENTUCKY			NORTH CAROLINA			WEST VIRGINIA		
Louisville		LOU	Raleigh	350	RDU	Charleston		CRW
LOUISIANA			OHIO			WISCONSIN		
New Orleans		NEW	Cleveland	344	CLE	Milwaukee	242	MKE
Shreveport	230	SHV	OKLAHOMA			WYOMING		
MAINE			Tulsa	245	TUL	Casper	269	CPR
Millionocket	344	MLT	OREGON			Rock Springs	290	RKS
MARYLAND			Pendleton	341	PDT			



Incoming signals are tuned by T1/C1A and fed to RF amplifier V1. Amplified signal is tuned by T2/C1B and fed to regenerative detector V2. Detected signal (audio) is fed to output stage V3. RF gain control R1 determines volume.

Weather Receiver

(plates closed) and set the signal generator for a 150-KC modulated output.

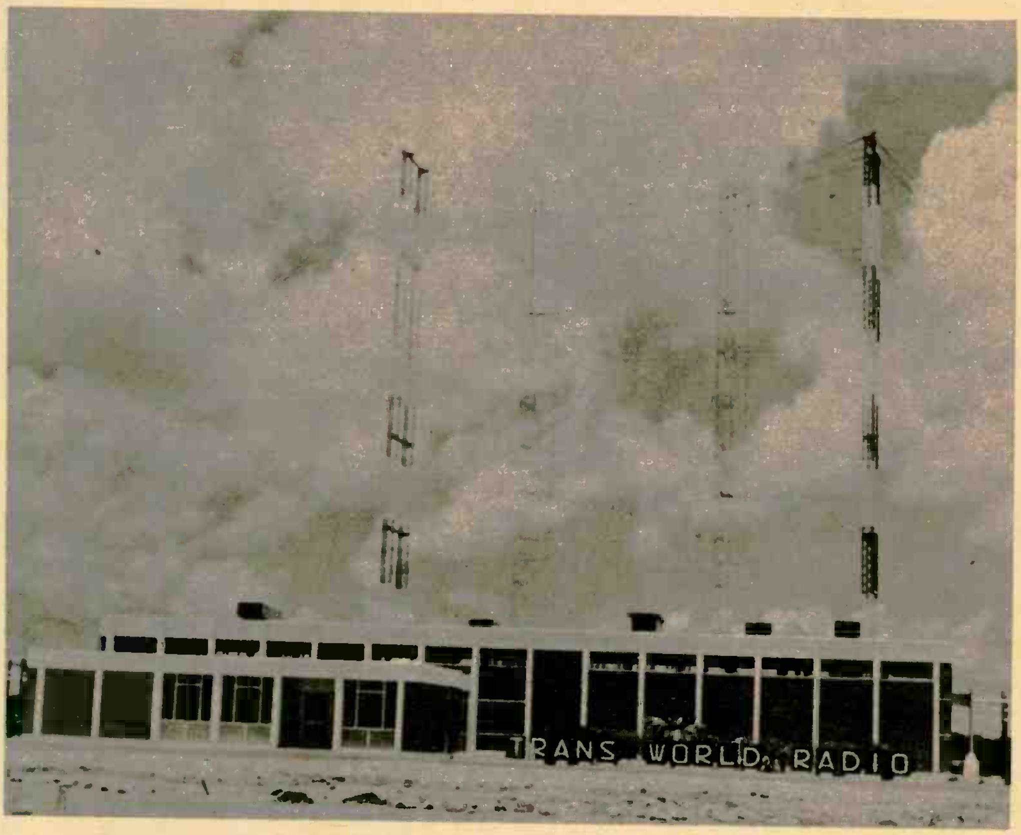
Adjust the *regen.* and *gain* controls to mid-range, and adjust the tuning screws of T1 and T2 until you hear the signal. Then adjust the *regen.* control to the point just below oscillation and repeak T1 and T2 for best reception. Set the signal generator for a 500-kc modulated output and adjust the

[*Continued on page* 108]

PARTS LIST

Capacitors: 1,000 V ceramic disc unless otherwise indicated
C1A,B—10.3-365.7 μμf two-gang variable capacitor (Lafayette 32 T 1102 or equiv.)
C2,C3,C6,C8,C10,C12,C13—.01 μf
C4—470 μμf
C5—5 μf, 150 V electrolytic
C8—100 μμf
C9—100 μf, 15 V electrolytic
C11A,B,C—20/20/20 μf, 150 V electrolytic
CT—Trimmer capacitor on C1A,B
J1—Phono jack
L1—12-turn winding on T2 (see text)
Resistors: ½ watt, 10% unless otherwise indicated
R1—200,000 ohm audio- or linear-taper potentiometer
R2—470 ohms
R3—1.5 megohms
R4—100,000 ohm audio- or linear-taper potentiometer
R5—150,000 ohms, 1 watt
R6—470,000 ohms
R7—1.2 megohms
R8—330 ohms
R9—1,800 ohms, 2 watts
R10—10,000 ohms
S1—SPST Switch (on R4)
SPKR.—3-4 ohm speaker
SR1—Silicon rectifier; minimum ratings: 500 ma, 400 PIV
T1—140-420 kc antenna coil (J. W. Miller X-5495-A, Lafayette 34 T 8706)
T2—140-420 kc RF coil (J. W. Miller X-5495-RF, Lafayette 34 T 8707) with 12-turn tickler winding (L1), see text
T3—Power transformer; secondaries: 125 V @ 15 ma and 6.3 V @ 0.6 A (Allied 54 C 1410 or equiv.)
T4—Output transformer; primary: 10,000 ohms, secondary: 4 ohms (Allied 54 C 1448 or equiv.)
V1—6BJ6 tube
V2—6BH6 tube
V3—6AK6 tube
Misc.—8 x 6 x 4½-in. cabinet (LMB 146, Newark Electronics Corp., 500 N. Pulaski Rd., Chicago, Ill. 60624. Stock No. 91F1014, $2.99 plus postage, $2.50 minimum order), sheet aluminum for chassis plate, aluminum angle, two 7-pin tube sockets, one shielded-type 7-pin tube socket

Completed receiver. Four large holes for speaker were made with 1¼-in. socket punch. Small hole was made with ¾-in. socket punch. Instead of calibrating a dial, we used a standard 0-100 dial and prepared a chart showing corresponding frequencies. RF gain control is at left, regen control is located at the right side.



DXing the Relays

By ALEX BOWER

UNTIL a few years ago the only SWBC stations that could boast international relay networks were the Voice of America and the BBC. With QRM on high-frequency bands on the upswing many other stations now have (or are building) relay stations. As a result, numerous islands and small countries which formerly were difficult to hear and QSL are now within reach of all North American DXers. At the same time, serious SWLs have more opportunities to keep tabs on the changing scene in international politics.

Among the new relays the best known is R. Nederland's operation in the Netherlands Antilles on the island of Bonaire. However, the transmitters originally used didn't belong to RN but instead were leased from Trans World Radio (station is shown above), a religious organization based on the island. This was an interim arrangement while R. Nederland built its own station. As of this spring, two new transmitters have been put into operation and RN has modified its schedule to take advantage of the new equipment.

The Bonaire relay transmits English for North America at 2030 EST and reception is in the cinch category. Medium-wave transmissions from R. Nederland can often be logged on 800 kc via this station. Between 1830 and 2030 EST there are programs in Spanish, English and Dutch; broadcasts generally are non-political. MW broadcasts still make use of TWR facilities.

A station which made a drastic change in the DX picture is Deutsche Welle's (Voice of Germany) relay at Kigali, Rwanda. Before DW appeared on the African scene this tiny nation was one of the most difficult in the world for DXers to bag. Now it is comparatively easy; try 17765 until 1515 EST.

The relay plans of West Germany are considerably more ambitious than R. Nederland's. In addition to Rwanda, Deutsche Welle also plans to set up a relay station in El Salvador (for Latin America) and Portugal. The Portuguese site seems an odd choice at first but this location offers two advantages. It will permit the use of higher frequencies to Eastern Europe (thereby providing DW with a wider choice of channels to avoid QRM); also, because Portugal is located to the south of German territory, reception throughout the world will be generally improved. The further any station is from the poles, the better its coverage.

DW's Portuguese transmitters were to be operating by the end of 1968. The El Salvador project (also to include a MW station) is probably further in the future so this tiny Central American republic will remain fair DX for some time. However, R. Portugal is already operating its own relay at Sao Tome off the West Coast of Africa. Lisbon is attempting desperately to hold on to a fading African empire and the Sao Tome station is a major weapon in this struggle. It operates with 10 kw on 4807 kc and English is scheduled from 1645 until 1730 EST. In North America this station can be received east of the Mississippi only; 4807 kc was formerly the property of a privately owned station, R. Clube de Sao Tome, which now seems to be wandering around 60 meters looking for a new channel. (Late reports, however, say the Sao Tome Relay may be off the air. Reason is unknown.)

Portugal's neighbor, Spain, has also entered the relay race. Both are right-wing dictatorships but while R. Portugal is noted for its aggressive propaganda, Spanish National Radio (RNE) sticks pretty much to a soft sell by emphasizing such things as tourism, trade and Spanish culture. Like Portugal, RNE's relay is off the West Coast of Africa at Tenerife in the Canary Islands (previously semi-rare DX country). Broadcasts are entirely in Spanish for Latin America and Africa at 1500-2300 EST on 11800 and 15365 kc. [*Continued on page* 109]

RELAY NETWORKS AT A GLANCE

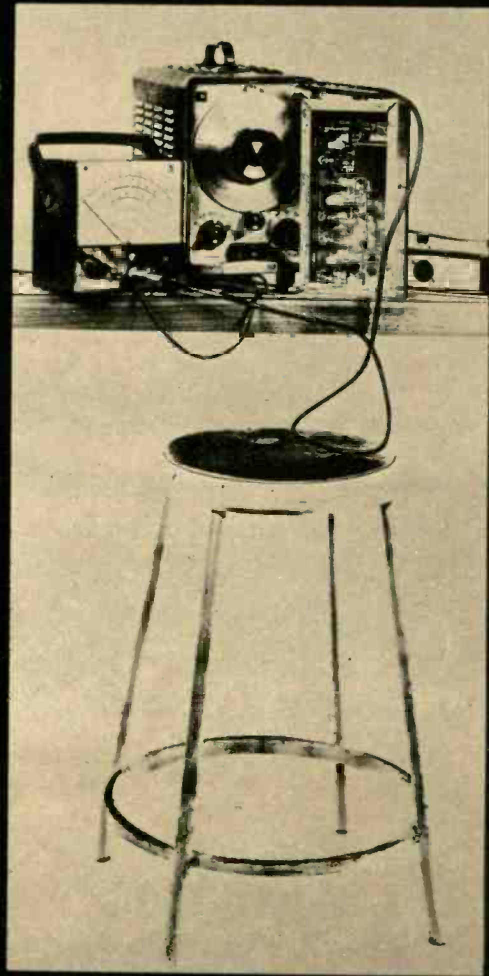
FREQ. (KC)	STATION	COUNTRY	TIME (EST)
800	R. Nederland	Neth. Antilles	1830-2030
4807	R. Portugal	Sao Tome	until 1730 S/Off
9590	R. Nederland	Neth. Antilles	2030
11753	R. Pyongyang	North Vietnam	1030 (Tue & Fri)
11800	RNE	Canary Islands	1500-2300
15245	ORTF	Congo Republic	1415 (to be replaced)
15365	RNE	Canary Islands	1500-2300
17765	Deutsche Welle	Rwanda	early afternoons

LOGGING FUTURE RELAY SITES NOW

FREQ. (KC)	STATION	COUNTRY	TIME (EST)
655	R. Nacional	San Salvador, El Salvador	evenings
3385	ORTF	Cayenne, Fr. Guiana	until 2000 (Sat until 2100)
4780	ORTF	Djibouti, Fr. Somaliland	2200 S/on (rare)
6010	R. Nacional	San Salvador, El Salvador	evenings
7170	ORTF	Noumea, New Caledonia	0100-0400

Someone should develop an easy way to learn electronics at home

RCA Institutes did!



Here is a whole new approach to learning electronics at home! RCA Institutes, one of the nation's largest schools devoted to electronics, has developed a faster, easier way for you to gain the skills and the knowledge you need for the career of your choice. Here for the first time is a student-proved, scientifically designed way to learn. If you have had any doubts in the past about home training in electronics—if you have hesitated because you thought you might not be able to keep up—or that electronics was too complicated to learn—here is your answer! Read how RCA Institutes has revolutionized its home training ideas!

Good Reading

By Tim Cartwright

REFERENCE DATA FOR RADIO ENGINEERS, Fifth Edition. Howard W. Sams, New York. 1150 pages. $20

The International Telephone & Telegraph Co. (now owner of Howard Sams) has been producing this massive handbook of radio engineering data for 25 years and this fifth edition unquestionably is as complete a reference work as I've ever seen on any subject. Since I can't conceive of anyone who works regularly in radio not knowing of this tome (either owning or having regular access to it), I'll address this review to those who don't work in the field but whose hobby or general interests call for basic information ranging from frequency data and properties of materials to microminiature electronics and Fourier waveform analysis. This is one reference you really ought to own and keep on your desk.

INTERPRETING FCC BROADCAST RULES & REGULATIONS. By the Editors of BM/E Magazine. Tab Books, Blue Ridge Summit, Pa. 192 pages. $6.95

I must admit that I don't really know just who reads the long series brought out by Tab Books on radio-station management, programming and promotion, but occasionally one of the series coincides with an interest of my own. That's the case here. I have always been interested in how the whole broadcast industry operates and presumably is allowed to operate in our society. And as of right now there are a whole bunch of issues, such as the future of CATV, that have awfully important implications for us all. This series of interpretations of various FCC decisions covers everything from socio-political matters like CATV to new rules for test hours for FM stations. Of course, this little spiral-bound volume isn't the best organized or produced I've seen, but it does provide a lot of information that interests me. Maybe you will find some topics of interest, too.

HANDBOOK OF OSCILLOSCOPES, THEORY AND APPLICATION. By John D. Lenk. Prentice-Hall, Englewood Cliffs, N.J. 206 pages. $7.95

Most books on this subject are of the 11 Strange Things You Can Do With Your Oscilloscope variety. This one is a good cut above that and quite professional, but still should have some real interest for the serious hobbyist—at least the advanced one. It begins with a long section (some five chapters) on the basics of oscilloscope theory, along with a discussion of controls, performance and accessories. The author then proceeds to talk about measuring electrical phenomena and about checking components and equipment. This is a nice, obvious enough way to do things and both the language and illustrations are clear and non-redundant. If you're beyond the 11 Strange Things level, try this.

HANDBOOK OF TRANSISTORS, SEMICONDUCTORS, INSTRUMENTS, AND MICROELECTRONICS. By Harry E. Thomas. Prentice-Hall, Englewood Cliffs, N.J. 449 pages. $20

Here's another massive and expensive reference book (this is our month for them). This one, while reasonably complete, is really more of a well-ordered text, covering semiconductor operation, fabrication, ratings, characteristics and so on. This type of book falls in with some pretty fast and furious company, which makes it kind of hard to call the work an indispensable kind of reference. But it is a good one by any standards, well-organized, crisply presented and well illustrated.

HOW TO SELECT AND INSTALL ANTENNAS. By Lon Cantor. Hayden Books Co. (Rider Series), New York. 112 pages. $3.95

We've seen far too much color TV and heard a lot of poor stereo FM that was due simply to a bad antenna system. But a week with this book and you can be sure of a professional installation. Covering VHF/UHF-TV and FM antennas, the book goes into such other important topics as types of antennas, gain, masts, mounts, stacking, leadin, preamps, noise, interference, impedance matching, transformers and master-antenna systems.

And Make Note Of . . .

CIRCUIT DESIGN FOR INTEGRATED ELECTRONICS. By Hans R. Camenzind. Addison-Wesley, Reading, Mass. 266 pages. $7.95

A Mho Tester for FETs

By CHARLES GREEN, W6FFQ

Now you can determine an FET's health in an instant! It's easy with our bridge-type tester, but impossible with anything else.

ALTHOUGH it has been around for quite a while, the field-effect transistor (FET) was at first used only in industrial and military electronic equipment. Because of its high price, it was out of reach of the consumer and hobby-electronics market.

But now the FET finally has made the low-price scene and is being used almost everywhere. Its price has really dropped—to $1 or less. Another reason for its wider use is that it combines the high input impedance of a vacuum tube with the physical package and power requirements of a conventional (bipolar) transistor. And, like bipolar transistors, FETs also die. Unfortunately, conventional transistor testers cannot test an FET.

No problem. You can check FETs with our mho tester (a transconductance bridge). The tester uses a lab technique to determine the transconductance (gm) of an FET at a particular bias and drain voltage. The tester measures gm up to 12,000 μmhos.

To simplify design, external batteries supply the drain (B+) and bias voltages to the FET being tested. An internal AC (60 cps) signal is the bridge's input. An integrated-circuit null amplifier, whose output goes to an external detector (VOM or earphones), provides a null output. Clip leads are used for easy connection to the FET leads.

Theory. The gm of an FET is determined the same way as the gm of

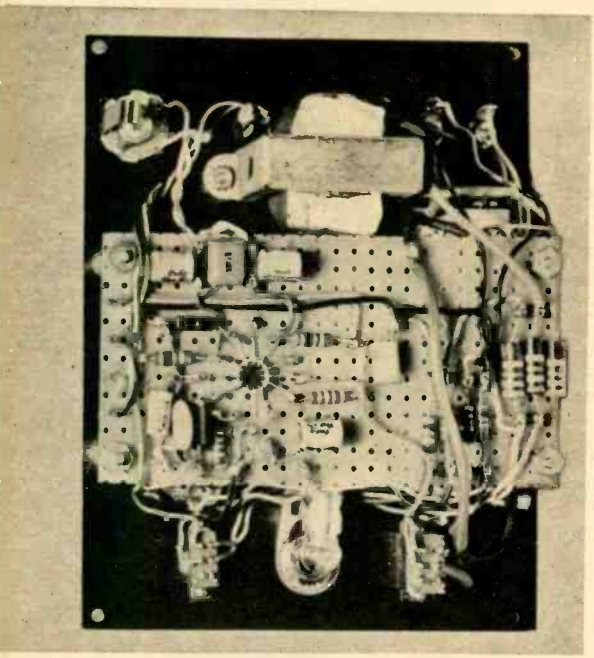


Fig. 1—Mount parts on panel with long leads, then wire board. Install board with 1-in. spacers so back of board doesn't touch panel parts.

A Mho Tester for FETs

PARTS LIST

B1—9 V battery
C1—.001 μf, 50 V or higher ceramic disc capacitor
C2,C8,C9—10 μf, 25 V electrolytic capacitor
C3,C6—5 μf, 15 V electrolytic capacitor
C4—.005 μf, 25 V or higher ceramic disc capacitor
C5—30 μf, 10 V electrolytic capacitor
C7—.1 μf, 25 V or higher ceramic or paper capacitor
IC1—CA3020 integrated circuit (RCA, Allied 50 C 1 CA3020-RCA. $2.56 plus postage)
J1,J2,J3,J4—Fahnestock clip
J5—Phone jack
P1—No. 51 pilot light and holder
R1,R4—2,500 ohm, linear-taper potentiometer (Lafayette 30 T 8072 or equiv.)
R2,R13,R15—1,000 ohm, ½ watt, 10% resistor
R3—2,000 ohm, 1 watt, 5% resistor
R5,R6,R7—3.3 ohm, 1 watt, 5% resistor
R8—510 ohm, ½ watt, 5% resistor
R9—100 ohm, ½ watt, 5% resistor
R10—100,000 ohm, linear-taper potentiometer (Lafayette 33 T 1140 or equiv.)
R11—4,700 ohm, ½ watt, 10% resistor
R12—470,000 ohm, ½ watt, 10% resistor
R14—12 ohm, ½ watt, 10% resistor
S1,S2—DPST slide switch
T1—Filament transformer; secondary: 6.3 V @ 0.6 A (Allied 54 C 1416 or equiv.)
Misc.—6¾ x 5¼ x 2¼-in. Bakelite box and panel (Lafayette 19 T 2002 and 19 T 3702), perforated circuit board, miniature insulated alligator clips (4), flea clips

a tube. The gm in μmhos equals the *change* in FET drain current divided by the *change* in the gate voltage.

For example, if the AC drain current (I_D) is 0.0005 A, and the AC gate voltage (E_G) is 0.1 V: $I_D/E_G = 0.0005/0.1 = 0.005$ mhos or 5,000 μmhos.

Construction. The tester is built in a 6¾ x 5¼ x 2¼-in. Bakelite box but the size is not critical. Best way to start construction is to lay out and mount the front-panel components as shown in Fig. 2. Before mounting T1, cut off the secondary center-tap lead. Keep T1's leads away from the J1-to-J4 terminals; we used fahnestock clips for J1-J4 but other terminals can be used.

Most of the components in our model are mounted on a 2¾ x 4⅞-in. perforated board on which flea clips are used for tie points. The board is spaced approximately 1 in. away from the panel with metal spacers. For easier construction, mount the components on the board before mounting the board on the panel. Cut off the ends of the flea clips to prevent shorts and connect the leads to the panel components before mounting the board.

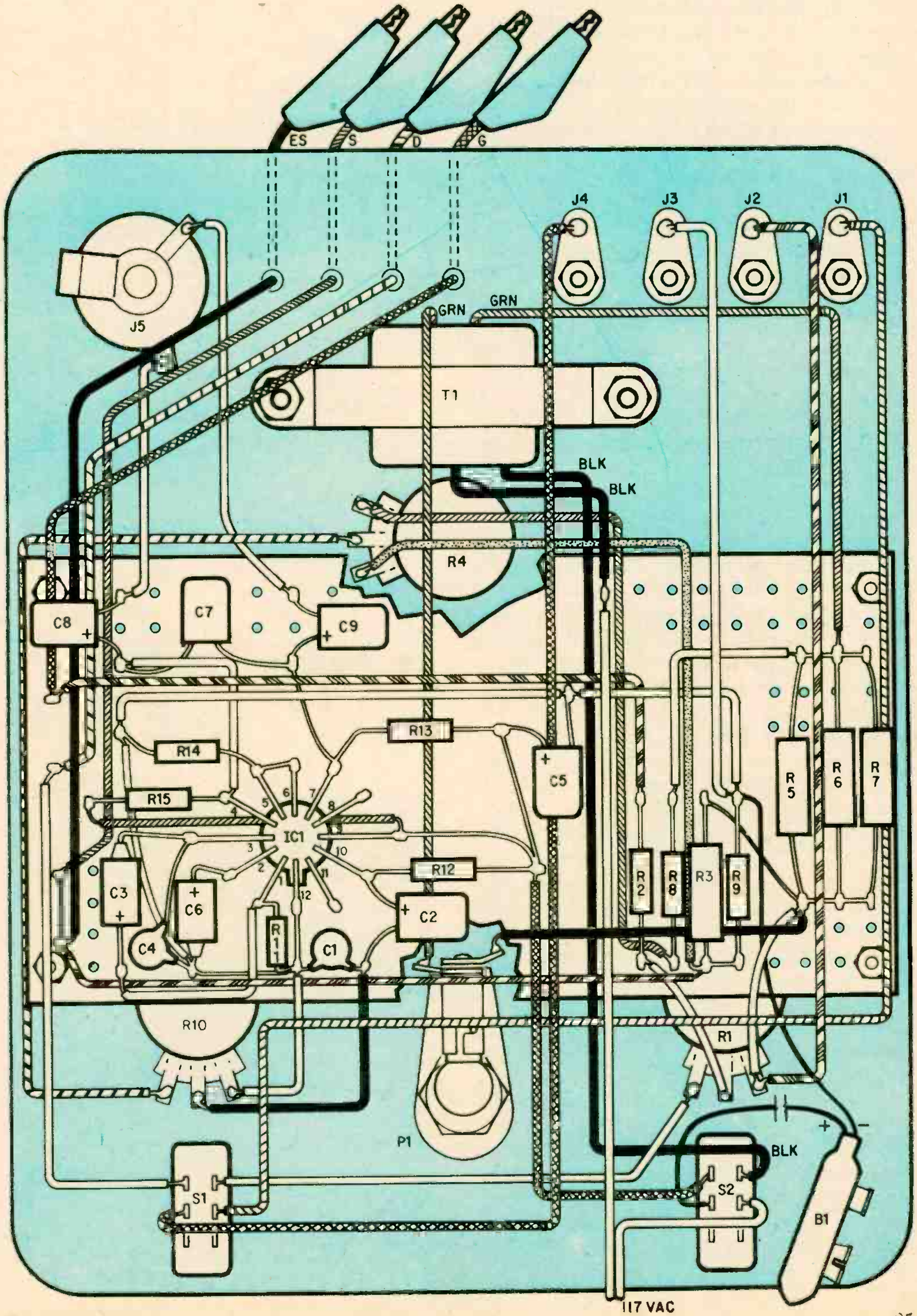
Mount battery B1 with an aluminum strap held between a spacer and the panel. We used a small bracket under another spacer to hold the AC line cord. Wire the components as shown in Figs. 1 and 2.

The gate, drain, source and shield clip leads stick approximately 3 in. out of the panel holes. Knot the wires inside the panel to prevent them from being pulled out; we put a small rubber grommet in each of the holes. Make sure that the alligator clips have snug-fitting insulation over them to prevent shorts.

Cut a notch in the side of the box for the AC line cord and position the line cord away from the IC1 and circuit components. Do not connect the battery yet.

Calibration. You will need a VOM to calibrate the tester. Set S1 and S2 to *off* and set

Fig. 2—Rear view shows panel slightly larger than actual size (perforated board really is 2½ x 4⅞ in.). Battery in our model is mounted under upper right corner of circuit board. For purposes of clarity, wires going from parts on bottom of panel to top are shown going over board; in reality they go under the board.



R1, R4 and R10 full counterclockwise. Disconnect the lead from R4 going to the junction of R3 and R9. Set the VOM to measure resistance and connect its test leads to R4's wiper lug and disconnected lead.

Adjust R4 until the VOM indicates 100 ohms, then mark R4's scale 500 μmhos. Then adjust R4 until the VOM indicates 200 ohms and mark the scale 1,000 μmhos. Calibrate the remainder of R4's scale in the same way. Mark the scale for every 200 ohms for multiples of 1,000 μmhos to 12,000 μmhos (2,400 ohms). Mark the scale for every 100 ohms for the half-division points representing multiples of 500 μmhos. We calibrated our scale with marks 0 to 12 and put an X-1,000 notation at the bottom of the scale. Disconnect the VOM and reconnect the lead to R4.

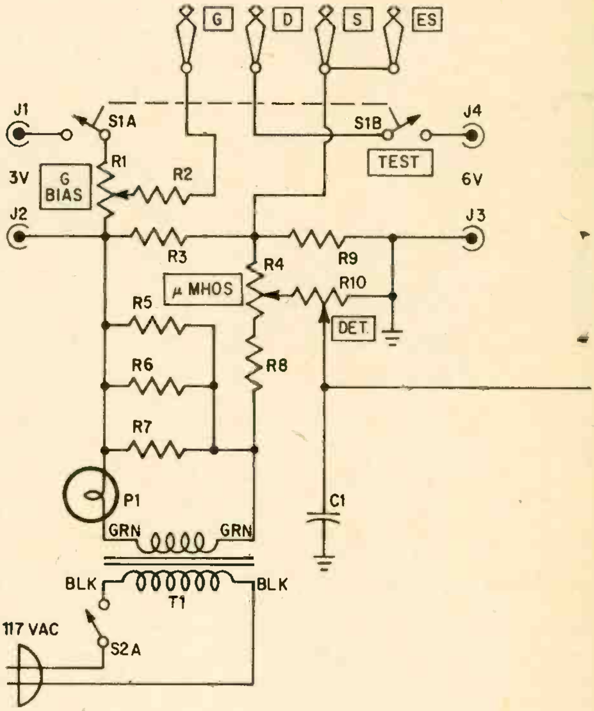
Connect the VOM's test leads to J2 and the wiper of R1. Mark R1's scale every 200 ohms representing 0.25-V points. At 800 ohms, mark the dial to indicate 1 V. Calibrate the remainder of the scale in the same way, with 2 V marked at the 1,600-ohm point and 3 V marked at the 2,400-ohm point. Disconnect the VOM.

Plug in the AC line cord and set S2 to *on*. Set the VOM to measure AC volts and connect the test leads across R5, R6 and R7. The VOM should indicate exactly 0.25 V. If it does not, use other value resistors to get the voltage to 0.25 V. Disconnect the VOM and the AC line cord. Set S2 to *off* and connect battery B1.

The tester is designed to be used with data supplied by the manufacturer of the FET (the RCA Transistor Manual, for example). On an FET's data sheet you will find the gate, source and drain leads identified, as well as the FET's gm. Usually, minimum and maximum gm ratings are given at zero gate bias and a high drain voltage. Checking the FET at these voltages may cause the maximum power dissipation rating to be exceeded and the FET to be destroyed.

Inasmuch as an FET is not usually operated at zero bias and a high drain voltage, a good indication of the FET operating condition can be made safely at lower gate bias drain voltages. Our tester normally checks the FET at a 6-V drain voltage and an 0.5-V gate bias. The FET gm measurement may be lower than that given on the data sheet, but will be satisfactory to evaluate FETs, for most projects.

Using the Tester. Set a VOM to its lowest AC range, and connect it to J5. Set S1 and



A Mho Tester for FETs

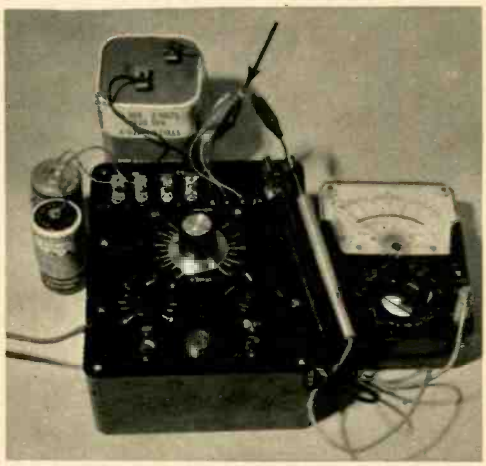


Fig. 3—Alligators hold test FET (arrow). D cells are for gate bias voltage, lantern battery supplies FET's drain voltage; VOM indicates the null.

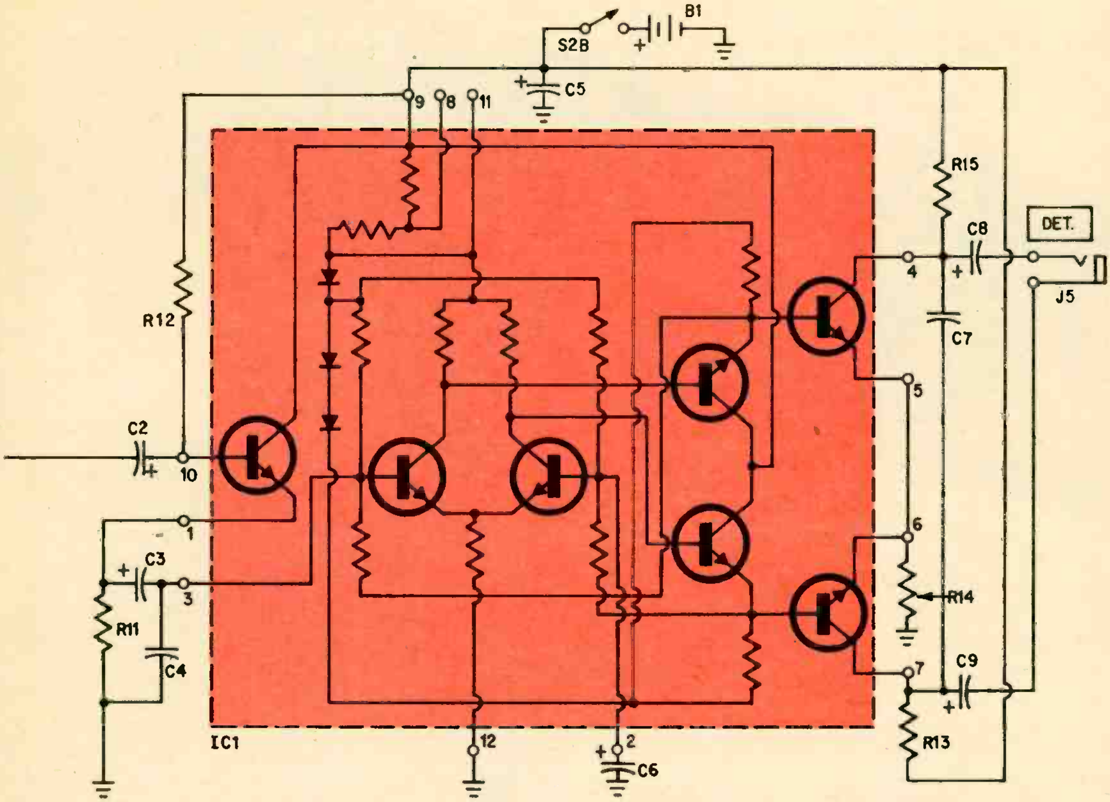


Fig. 4—Bridge part of tester (left schematic) compares gate voltage (across R3) to voltage drop (across R9) produced by drain current. R4 is adjusted to null out voltage difference and transconductance is read from its scale. Circuit above amplifies bridge output to drive meter. Insulate J5 if you use metal cabinet.

S2 to *off* and plug in the AC cord. Set R1, R4, and R10 full counterclockwise. Connect the + lead of a 6-V battery to J4 and the — lead to J3. Note: Reverse these connections for a P-channel FET.

Connect the FET's leads to the tester using the base diagram on the data sheet. Connect the *D* clip to the FET drain lead, the *S* clip to the source lead, and the *G* clip to the gate lead. To minimize the chance of damage to the FET, do not connect the gate lead first. If there is an external shield or case lead, connect it first to the lead marked *ES*.

Set R1 *(bias)* for 0.5 V and set S2 to *on*. Allow a minute for the bridge unit to stabilize and set S1 to *test*. Adjust R10 (*det*) for a convenient VOM indication (about mid-scale) and slowly adjust R4 (*μmhos*) for a null indication on the VOM. Adjust R10 (*det*) to keep the gain as low as possible for a good null.

The scale of R4 will then indicate the FET's gm at the particular gate bias and B+ voltage used. If desired, the bias setting can be changed to another value and R4 adjusted for a null on the VOM, to get another gm reading.

The Circuit. When S2A is closed, 0.25 VAC is developed across R5, R6, and R7 (which are in series with P1). The 0.25 VAC is divided across R3 and R4/R8. When a FET is connected to the test clips, the 0.1 VAC across R3 is fed through the *G* and *S* test leads to the gate and source of the FET. When S1 is set to test, DC from the 6-V external battery connected to J3 and J4 is fed to the FET's source and drain. The AC in the FET drain/source circuit flows through R9 causing a voltage drop across R9.

The difference in voltage drops across R4 and R9 is amplified by IC1 and fed via J5 to the external null indicator (VOM or earphones). Potentiometer R4 is then adjusted for a null. At this point the AC voltage drop across R4 equals the AC voltage drop across R9. Potentiometer R4 is calibrated in μmhos to 12,000 and the FET's gm is indicated by R4's pointer.

UPI Cablephotos

The 20 Incredible Days of Free Czech Radio

For 20 days, from August 21 to September 9, 1968, a network of secret radio stations inside Czechoslovakia kept the channels of free speech alive to spite Russian might.

By RUSSELL ROBERTS

In Prague, on August 22, two young people hold a blood-covered Czech flag in front of burning tank. Flag had covered the bodies of slain Czechs.

ON AUGUST 21, 1968, after a respite of five years, the jamming of Voice of America broadcasts and BBC Russian language programs was resumed by the Soviets to prevent the Russian people from hearing the Western version of the invasion of Czechoslovakia. This jamming continues even at this writing.

A shocked world first learned of the occupation from Radio Prague. It was announced at 0050 GMT on August 21 that Russian and other Warsaw Pact troops had crossed their borders into Czechoslovakia. Shortly after this a woman announcer said: "We are still here but when you hear our Czechoslovak National Anthem it will be the end." Then the station fell silent.

The Czechoslovak news agency CTK continued to operate until 2300 GMT on August 21, when it was occupied by invading troops. Before signing off staff members sent two flash messages. The first read: "The CTK news agency has just been invaded by foreign troops," while the final one said: "At this moment the free news activity of CTK is at an end. If additional news is transmitted it will no longer be from the ed. . . ." Then the teletype machine began to race and there were no further messages.

But the unbelievable story of clandestine Czech and Slovak radio operations was just beginning. For within hours after the closing-down of Radio Prague, transmitters identifying themselves as *free and legal* Czechoslovakian stations began to broadcast accounts of the invasion without interruption. The broadcasts originated from Prague as well as other parts of the country and in open defiance of the Russians. Our map shows the locations of some of the known transmitter sites and the frequencies on which they operated during the early days of the invasion.

Despite the fact that occupation forces took control of some studio and transmitter

Map shows locations and frequencies of some Czech Freedom Radio stations which operated during early days of Russian invasion of Czechoslovakia. Some other frequencies used by Free Czech Radio are in box.

facilities and destroyed or damaged others, Czech and Slovak Freedom Radio networks continued to function. They broadcast on the long-, medium- and short-wave bands, as well as on FM and TV.

The frustrated Russians tried to jam these broadcasts by superimposing other transmissions on Czech frequencies but the jamming was relatively ineffective and the *free and legal* stations continued to tell the Czech people and the rest of the world about what was happening within the beleaguered little country.

The Czechoslovak Freedom Radio began to operate from numerous locations within the country. Each regional station would transmit about 15 minutes with prearranged broadcasting times allocated to local studios to report happenings in their areas. At first there were delays of five minutes or more between transmissions from different locations but as the Czechs and Slovaks became more adept at running a clandestine network the broadcasts became smoother.

One remarkable aspect of the whole operation was that many of the transmitters were operated from makeshift facilities and their operators were almost constantly on the run from Russian security forces. The Freedom Radio network was instrumental in the overall resistance to the Soviet secret police and as the Czechs and Slovaks continued their programming the broadcasts took on more imaginative and useful forms.

For example, at the direction of Czech Free Radio, street signs were changed and bogus detours were put up at critical road junctions throughout the country. Polish troops who crossed their border into the Tesin area travelled some sixty kilometers before finding themselves back at the border area where they originally crossed.

Street names in all major cities were either changed or completely obliterated in order to confuse the invaders. Names of towns and villages were also changed to further confuse unwelcome guests.

Anyone found giving information to Russian intelligence agents was reported and pedestrians were warned when spies and informers stood nearby on the street to locate troublemakers. Three days after the invasion Freedom Radio broadcasts carried the license numbers of unmarked secret-police cars. More than one such vehicle was later observed with its tires punctured and swastikas painted all over the body.

By August 24th the radio stations were broadcasting regularly the names and addresses of Czech and Slovak citizens who were collaborating with the Russians. Actually, broadcasts of the names of individual collaborators had begun earlier. Bratislava Radio, for example, had started this on August 22, but temporarily abandoned the project when it was found that in some cases the information was incorrect and possibly hurting the cause.

Of course, the Soviets did not sit idly by while the resistance radio grew in importance and effectiveness. Direction-finding equipment was used in some instances to locate and destroy clandestine operations and finally a call went out to the Soviet Union to send additional, urgently needed direction-finding and jamming equipment by rail. Ivan was starting to worry!

Quick to respond, Free Czech Radio called upon railway workers to slow or derail the train carrying the Russian equipment. The call was heeded. Signal lights were sabotaged and the train was stalled for almost a week near Prerov, Moravia—about 180 miles from its destination, Prague.

The frustrated Russians snatched transistor radios from the hands of Czech and Slovak citizens in the streets in order to hinder further cooperation. But these measures were of limited effectiveness because the Russians couldn't confiscate every radio nor could the occupation armies get at the millions of radios in the homes of Czechoslovak citizens.

On August 21, outside Radio Prague, defiant Czechs carry their flag past a burning Soviet tank. Citizens blockaded Russian approach for hours.

Who ran the Freedom Radio Stations? In most instances it was the technicians, commentators and reporters who worked for Radio Prague and other regional stations. When the Russians shut their stations down they moved to other locations to set up clandestine stations. When these secret stations were discovered they fled to still other locations. Time and again, the words, "We are nearing the end of our transmission—Russian soldiers are at the door," could be heard. Frequently such announcements were followed by the sound of gunfire; then the station would go silent. However, new stations would usually replace the one that had been shut down on the same frequency and within minutes after the first had gone silent.

One such station taken over by the Russians tried to broadcast the false announcement that the President of Czechoslovakia had asked the citizens of the country to cooperate fully with the Russians. Within seconds after the announcement had been read, a Czech voice (on the same wavelength) shouted, "Collaboration station." The seized transmitter then went off the air.

There is evidence to indicate that the Czechoslovak army (which remained loyal to the Dubcek regime throughout the occupation) contributed significantly to the Freedom Radio effort. The army provided transmitters and broadcast facilities, as well as technical personnel to help operate them. It is also believed that they provided transportation so station personnel could reach new transmitter locations after the old ones had been located and seized by the Russians. The entire nation supported the efforts of the Freedom Radio and it was evident even early in the occupation that the invaders had no idea of the resistance they would meet.

By early September, after the return from Moscow of the Czechoslovak delegation led by Dubcek, Cernik and Swoboda, radio operations began to return to normal. In the face of increasing Government restrictions on the type of material that the *free and legal* stations had been carrying, many stations began to alter their identification calls by deleting the word *free* from their signature. Some stations—in defiance of the government edict—carried music or poetry or failed to broadcast entirely. One station which suspended operations claimed it could not function properly because military forces had occupied its studios.

By September 9, normal broadcasting had been resumed as a result of persistent efforts on the part of the Czech broadcasting authorities. Two networks—one calling Radio Prague, the other Radio Czechoslovakia—were heard and shortly afterward the international service of Radio Prague was resumed on regular frequencies. On the very same day CTK, the Czech news agency, resumed operations. The lead item in English to Europe was a statement to subscribers apologizing for the interruption in service "due to circumstances beyond our control."

The propaganda battle was by no means one-sided. Numerous pro-Soviet stations began to operate shortly after the invasion. Most prominent among these were Radio Vltava, operating on 1430 kc from a location presumed to be in East Germany, and The Workers Voice of the Republic, which operated until September 3rd on 1061, 1178, 7125 and 9540 kc. These are Polish frequencies and it is believed the broadcasts originated in Poland. Another pro-Soviet station operated on 1250 kc. This channel is normally used by Hungary and though the station did not identify its location it almost certainly operated from that country.

The Soviet Union increased significantly its programming in Czech and Slovak on August 21. Beginning at 1700 GMT on the day of the invasion a 24-hour service was inaugurated. More than a dozen short- and medium-wave frequencies were used. Prior to the Soviet intervention, the total daily program output to Czechoslovakia was two hours and 30 minutes.

On August 25, Radio Warsaw resumed broadcasts after an 18-year lapse in programming to Czechoslovakia using a 500-kw medium-wave transmitter operating on 1502 kc. The programs, consisting of three hours of broadcasts initially, increased to 20 hours per day by September 6, utilizing five short-wave transmitters in addition to the long- and medium-wave equipment.

In Karlovy Vary, Bohemia, youths with national colors pinned on demonstrate against occupation. Banner reads: "Never again with the Soviet Union."

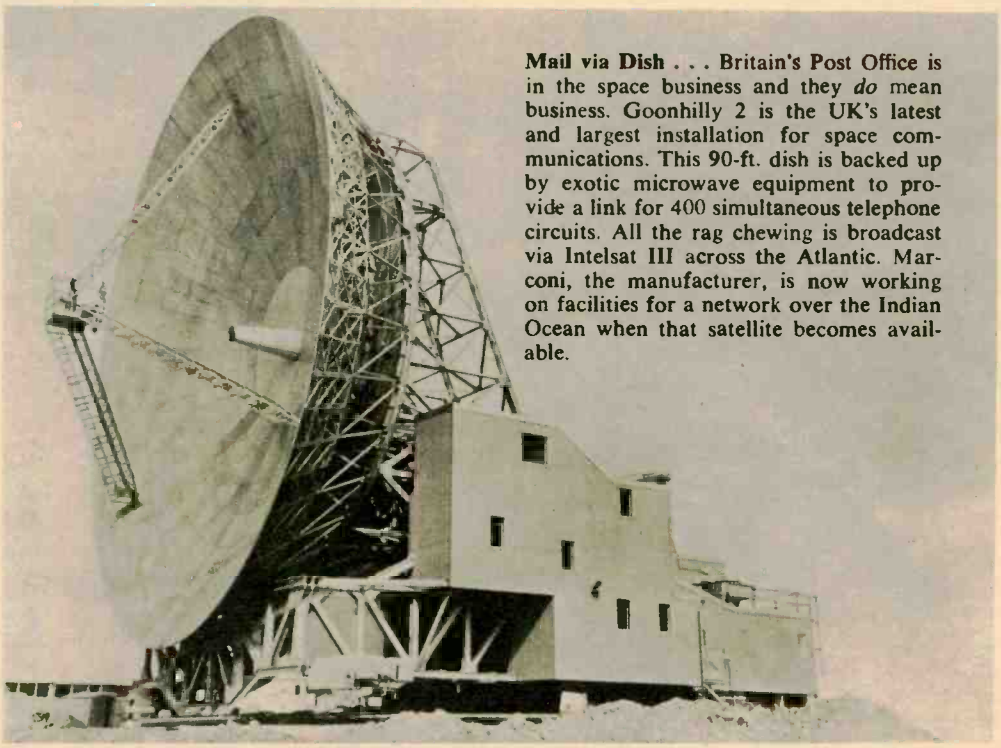
Aside from the activities of Free Czech Radio it is interesting to note that pro-Czechoslovak transmissions were heard from Radio Novisad in Yugoslavia on 1268 kc. By September 11, however, this station resumed its normal operating schedule.

It is obvious that the Russians could not cope with the Freedom Radio stations. Never in the annals of radio broadcasting has so large a nation been unable to suppress the clandestine broadcasts of an occupied smaller nation. It must give the powers that be in Moscow an uncomfortable feeling to know that they couldn't silence Free Czech Radio. Perhaps in the future, should the situation warrant, these stations will come back on the air to haunt the enemy.

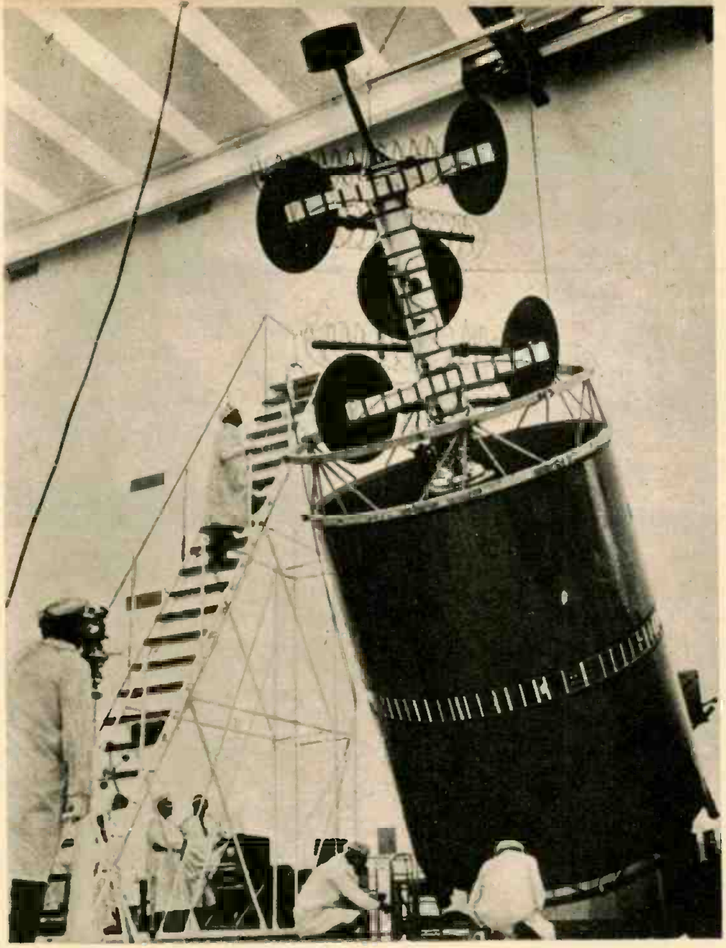
Since all this took place, Jan Palach (a young Czech student who set himself on fire and thereby achieved martyrdom) has been laid to rest, and the officials who worried about a possible uprising at the time of his death have returned to espousing the Soviet line—feeling safe in the assumption that nearby Warsaw Pact divisions will continue to prevail over the liberal reform movement and the flame of Czechoslovakia's desire for freedom.

TIGHT SECURITY . . . Would this gal want to cut a fella's leg off? Probably not, but the device she's holding spells trouble for intruders. It's a laser detection system developed by RCA for the Air Force. An invisible light beam is transmitted by a gallium arsenide laser pulser to an optical receiver. If the beam is tripped an alarm signal indicates trouble afoot.

Electronics in the News



Mail via Dish . . . Britain's Post Office is in the space business and they *do* mean business. Goonhilly 2 is the UK's latest and largest installation for space communications. This 90-ft. dish is backed up by exotic microwave equipment to provide a link for 400 simultaneous telephone circuits. All the rag chewing is broadcast via Intelsat III across the Atlantic. Marconi, the manufacturer, is now working on facilities for a network over the Indian Ocean when that satellite becomes available.



Tactical Satellite? . . . The Air Force Space and Missile Systems Organization now has a new baby to play with. It's an experimental communications satellite—the largest and most powerful ever—built by Hughes Aircraft. The monster is as tall as a two-story building and will be launched from Cape Kennedy into a synchronous orbit aboard a Titan-3 booster. This rotund fellow can handle 10,000 telephone channels and pop them into dish antennas only 1 ft. in diameter.

Buried Treasure . . . If traffic signs are the bane of your existence help could be on the way. An Experimental Route Guidance System is being developed with help from the Kollsman Instrument Corp. It's now being tested by the Bureau of Public Roads. Antenna loops buried under a roadway trigger a computer-decoder in your car so that a read-out is projected on the windshield. A set of 16 directional signals are focused at infinity; you concentrate on driving and make your maneuver. A national computer network would allow a driver to select a code for his particular destination; he would then be directed automatically to this point by the network.

Best of the

UNTIL about two years ago, a budget short-wave receiver was at best classed as junk. For a hundred or so hard pre-inflation dollars you got fair-to-middling performance to about 14 mc and next to nothing in the way of sensitivity above. Added to this was an unstable oscillator that virtually walked the tuning up and down the band, making sideband reception a nerve-jangling chore.

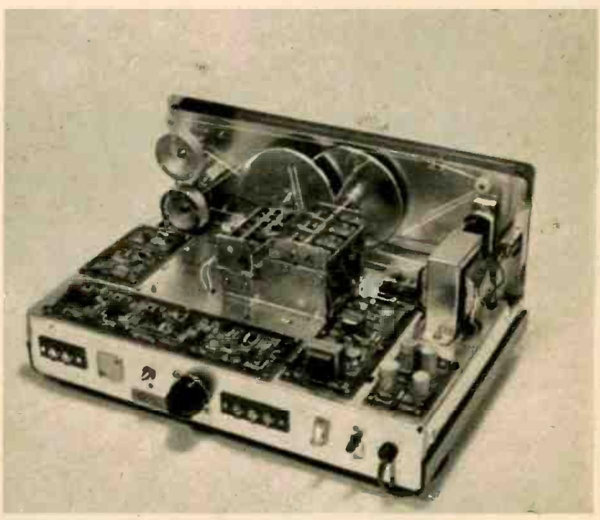
For the same hundred dollars now, a beginning ham and SWL can have a solid-state receiver that delivers the performance found just a few years back in tube receivers priced between $200 and $300. No longer need a budget receiver be an interim affair until a more costly model can be obtained. A new-breed solid-state receiver can be the first and last ever purchased.

One of the secrets to the hot (or perhaps you should say cool) performance of solid-state receivers is the transistor. The elimination of the heat generated by tube filaments virtually assures both VFO and BFO stability, thereby eliminating drift. Also, because transistors are not microphonic, performance above 14 mc is almost the equal of low-frequency performance. Finally, a lot more solid-state circuitry can be delivered for $100 than can be with tubes.

To date there are three solid-state receivers worth serious consideration: the Allied A-2515, the Lafayette HA-600T, and the Radio Shack DX-150. Each receiver has both an AM (diode) and a product detector for CW and SSB reception. All have antenna trimmers for tuning the RF amplifier and all have variable BFOs and calibrated bandspread for the 80—10-meter ham bands. The Radio Shack has a calibrated bandspread for the 27-mc Citizen's Band. All three models can be operated on 12 VDC or 117 VAC.

Both the Lafayette and Allied have speaker terminals on the rear apron in addition to a panel-mounted headphone jack. The Radio Shack has an internal speaker; either headphones or a speaker can easily be plugged into the front-panel headphone jack. The Lafayette also has a 500-ohm output for feeding a phone or radio line, and also has a tape recorder output jack.

All three receivers are equipped with automatic noise limiters. We found the Radio Shack's to be more effective than that of the other two models. However, because of



The Allied Model A-2515 receiver has four printed-circuit boards on chassis. Note the three-gang main-tuning and bandspread variable capacitors.

Budget Receivers

By HERB FRIEDMAN
W2ZLF

the heavier noise limiting, the Radio Shack's has greater audio distortion because a limiter is an audio clipper.

Though each receiver has an S-meter, it is little more than a relative signal-strength meter. Only Allied's S-meter indication has a relationship between an S-unit and measurable, meaningful signal strength. Allied's S-meter units represent 3db below S-9 and are relative above S-9. The Lafayette meter indications are entirely relative. The Radio Shack's S-meter is not only relative but extremely hot. Any signal strong enough to be 100 per cent readable is strong enough to pin the S-meter.

Once you get beyond the common operating features and conveniences, the three receivers take different roads in both circuitry and performance. While our chart compares the three in terms of sensitivity, image rejection and 27 mc (Citizen's Band) selectivity, there are different aspects of performance about each which might make one or the other especially suited to your particular requirements.

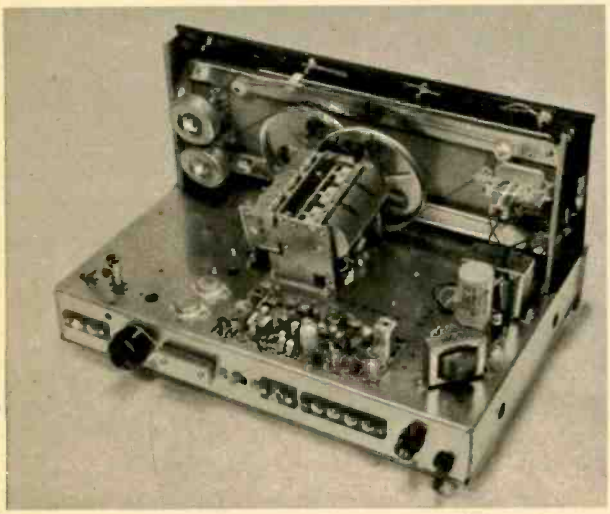
The Radio Shack DX-150 is about two years old and incorporates little in the way of new semiconductor technology. It was designed for phenomenal stability and its superb AVC (automatic volume control) system makes it excellent for SSB and CW reception.

The DX-150 tunes from 535 kc to 30 mc in four bands. A logging scale is provided for the main tuning dial. As with the other receivers, the front end is diode protected against excessively strong signals and is overload resistant up to a 1,000 μv. signal at the antenna terminals.

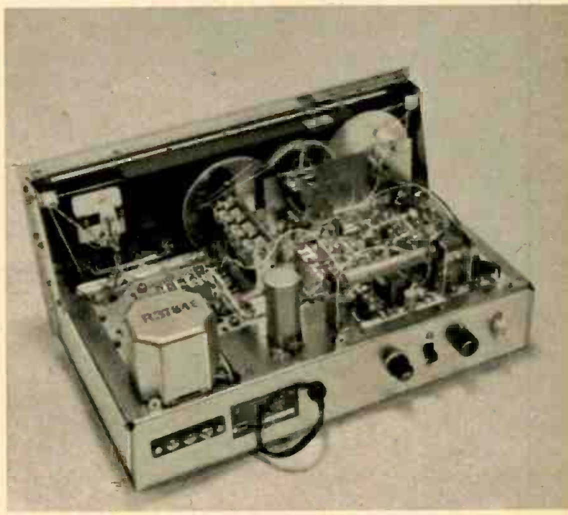
The circuitry is almost out of the book and consists of an RF amplifier, VFO, mixer, two IF amplifiers, product and AM detectors, BFO and AF amplifier. A big feature is the buffer amplifiers between the VFO and the mixer and between the BFO and the product detector. Overall receiver stability is so good that 28-mc SSB signals can be tuned and received for longer than 20 minutes without need to retune the receiver or BFO. Adjustment of RF gain has no effect on VFO stability.

The amplified AVC system is very effective and works particularly well on SSB and CW. Audio was very clean, even with extremely strong input signals (limiter out).

As shown in the chart, the DX-150's sensitivity is about average (but darn good compared to the old budget tube-type re-



The Lafayette HA-600T receiver has a good deal of circuitry packed on one printed-circuit board. Output transistors are to the left of the board.



Radio Shack DX-150 has three-gang tuning capacitor and smaller bandspread capacitor to right of it. Power transformer is in lower left corner.

Budget Receivers

ceivers). The image rejection, except above 21 mc, is good while the selectivity is just about sufficient for a communications receiver. Because the DX-150 does not have extra sharp selectivity, broadcast-band reception is notably good, particularly because of unusually good broadcast-band noise rejection. The DX-150 is well made, having a heavier-than-usual chassis and cabinet that adds considerably to its stability when tuning.

The Allied A-2515 was the second budget solid-state receiver to become available. It tunes from 150 to 400 kc and 550 kc to 30 mc in a total of five bands. For those who prefer fully-shielded antenna transmission lines the rear chassis apron is drilled for a coax connector. Completely modularized on printed circuits, the Allied Receiver uses a dual-gate FET RF amplifier, dual-gate FET mixer, and three stages of IF amplification coupled with mechanical filters rather than IF transformers. The rest is the usual AM and product detectors and AF amplifiers.

A voltage-doubling AVC detector is employed and in the AM mode its output is fed to the second gate of the RF amplifier. In effect, the A-2515 has two independent AVC systems plus front-end diode protection to provide both slow and fast AVC and strong signal overload protection.

The Allied's big feature is the mechanical-filter IF amplifier which (as shown in the chart) provides an extreme degree of selectivity. In fact, the selectivity is sharp enough to literally split a CB channel in two. For example, if one signal is slightly above center frequency and one slightly below, the receiver will tune one or the other.

While the selectivity is notably effective for communications use it does result in sideband cutting on the broadcast band, and stations end up sounding muddy (bassy) due to the clipping of sidebands.

The Allied's image rejection is quite good for a single-conversion receiver, except from 21 to 30 mc. (A common failing of most single-conversion receivers.) The receiver is well constructed though pressure on the front panel tends to shift slightly the tuned frequency when you are on the highest band.

The Lafayette HA-600T is the latest entry in the solid-state receiver sweepstakes. Tuning 150 kc to 30 mc in five bands, the HA-600T can be easily used to feed remote audio or telephone lines or remote speakers as the wiring and connectors are factory installed.

Touted as an FET receiver, the FETs are used for the oscillator and mixer. The RF input is a standard bipolar transistor that is diode protected against overload. The IF amplifiers utilize mechanical filters for both coupling and bypass, driving both AM and product detectors which feed the AF amplifier. As shown in the chart, the HA-600T is the most sensitive, though the image rejection is just about equal to that of budget tube receivers.

Though the selectivity is not the greatest it provides a good balance between more than enough selectivity for good communications use yet not so much as to adversely affect standard broadcast reception.

The HA-600T has a rather simple AVC system that produces some distortion on very strong signals, though the distortion can be sharply reduced by backing off on the RF-gain control. Construction is generally sturdy, though the oversize, lightly supported front panel can cause a slight tuning shift when operating the controls.

AVC Action. As shown in the chart, the effectiveness of the AVC systems in the three receivers is quite different. AVC action is the ability of the receiver to equalize (compress) in the audio stage the signal-strength variation at the antenna terminals. The smaller the change in audio output the

[Continued on page 119]

SOLID-STATE RECEIVER SPECIFICATIONS

Freq. (mc)	Sensitivity (μv) Allied	Sensitivity (μv) Laf.	Sensitivity (μv) Radio Shack	Image Rejection (db) Allied	Image Rejection (db) Laf.	Image Rejection (db) Radio Shack
2	1.1	0.8	2.0	60	38	44
4	1.3	1.0	1.3	38	22	40
5	1.3	0.9	1.0	50	15	44
7	1.0	0.9	1.3	37	18	39
14	0.9	0.8	1.4	20	16	35
21	1.0	1.0	1.0	17	21	20
28	0.9	1.0	3.8	15	17	6

		Allied	Laf.	Radio Shack
AM AVC Action	1.0-3.2 μv	10db	4db	5db
	3.2-100k μv	12db	15db	7db
Signal at input for S-9 indication.		80 μv	63 μv	3.2 μv
27-mc selectivity		77db	66db	30db
Price (less speaker)		$99.95	$99.95	$119.95

IT'S A BUSY night on 80 meters. You're trying to listen to a CW message in a very crowded spot on the band but the constant grind of QRM and QRN (signal interference and atmospheric noise) makes you just about walk up the wall.

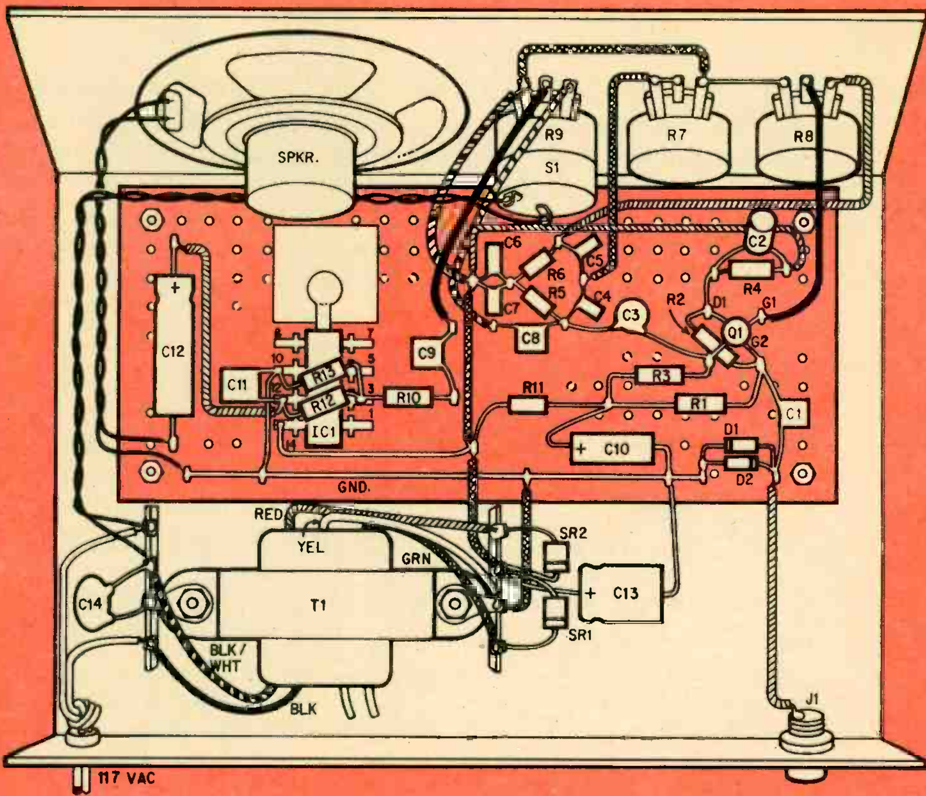
Before you swing an ax at the receiver, consider our Audio Q-Multiplier. Connected to your receiver's output it will give you interference-free CW reception of the quality you would get from a high-priced gold-plated receiver.

Instead of requiring an internal receiver connection, as does the usual IF Q-multiplier, the Audio Q-Multiplier connects to the receiver's speaker or headphone output. Just as the IF Q-multiplier narrows the bandpass of the IF amplifier by putting the stage on the verge of oscillation, the Audio Q-multiplier increases the Q of an external audio stage by putting it at the verge of oscillation. The result is that the IC amplifier which follows the audio stage receives primarily the desired tone frequency. All other background noise is sharply attenuated.

How it Works. Transistor Q1 is a dual-gate FET that provides a slight amount of AF amplification via input gate G2 and output drain D2. The signal at D2 is divided after capacitor C3 and is then fed to both IC1—an integrated-circuit amplifier—and to the bridged-T filter network consisting of C4, C5, C6, C7, R5, R6 and R7. The values of parts used in the bridged-T have been chosen to provide a voltage across R8 which is in phase (positive) with gate G2's input signal at one specific frequency. The positive feedback is applied via R8's wiper to Q1's other gate, G1,

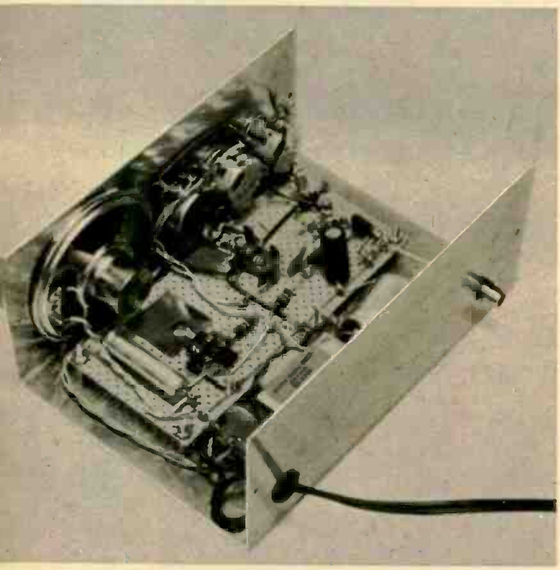
An Audio Q-Multiplier for SWLs and Hams

By VICTOR KELL



Except for power supply, Q-multiplier is built on a piece of perforated board. Tab on IC1 is heat sink.

Audio Q-Multiplier



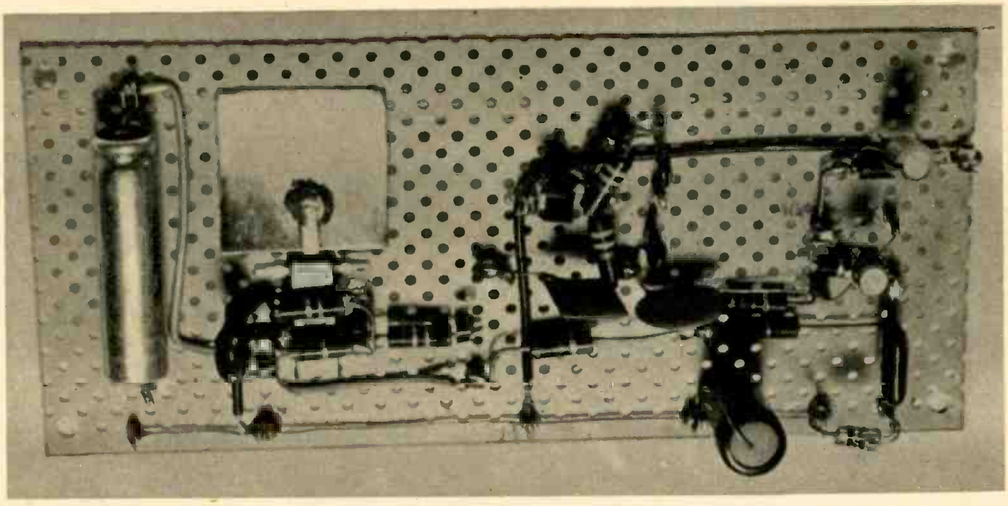
To allow room for installation of perforated board, mount power transformer against the rear of cabinet. Speaker is cemented to panel with epoxy.

where it combines in the drain circuit with the input signal. (If too much feedback is applied through R8 the stage will break into oscillation.)

The total signal at drain D2—which is fed to the IC amplifier—is, therefore, peaked at the resonant frequency. Because R7 is variable, the circuit shown tunes a range of about 800 to 2,000 cps. If you prefer your CW tones at other frequencies, substitute the bridged-T part values given in the Table.

In addition to suppressing tones other than the one peaked, background noise is sharply reduced because of the narrow audio bandpass. Diodes D1 and D2, which provide overload protection for Q1, also act as audio noise limiters to further reduced background inpulse noise.

In this circuit the IC amplifier has a maximum output of ½ watt but the audio output while sufficient, may not be loud enough unless fed into headphones. While the amplifier can be overdriven to a higher volume (by removing diodes D1 and D2), Q1 will be damaged. Hence, do not attempt to get



Metal tab is IC's tin heat sink. Note long leads on diodes (lower right) to prevent soldering-heat damage.

BRIDGED-T COMPONENT VALUES		
Approx. freq. (cps)	C4,C5	Combined (parallel) value of C6, C7
600	.0013 μf	.003 μf
1,500	620 $\mu\mu f$	.0015 μf
2,500	330 $\mu\mu f$	750 $\mu\mu f$
R5,R6 each always 240,000 ohms		

more output volume by eliminating D1 and D2. If you desire more volume, add an amplifier stage between C8 and R9.

Construction. FET Q1 is extremely sensitive to a static charge, and if its leads are not kept shorted during installation it can be instantly destroyed by the charge at the tip of a soldering iron. FET Q1 is supplied with its leads shorted together by a hollow rivet. Before removing the rivet, wrap several turns of a single strand of wire, removed from about 3 in. of lamp wire (zip cord) around Q1's leads just below the case. Then remove the rivet and fan out the leads so you are certain all leads touch the shorting wire. Keep the wire on until the project is completed.

Our model is built in the U-section of a 7 x 5 x 3-in. Minibox. The circuit is wired on a 2½ x 5½-in. piece of Keystone G-pattern perforated-board. Push-in terminals are used for tie points.

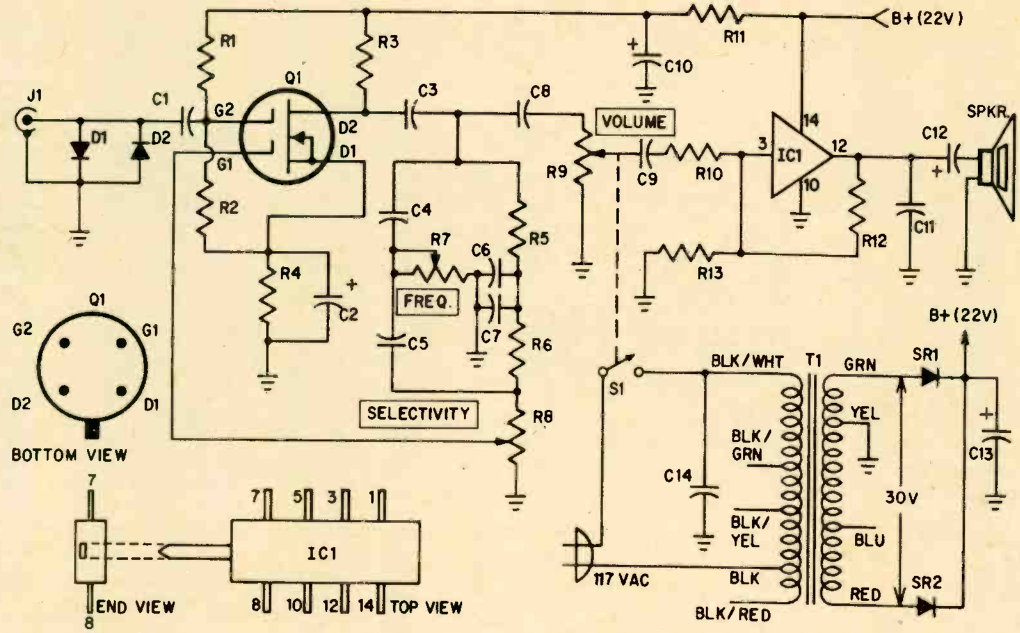
Keep the components about ½ in. back from the front edge of the board so they will not interfere with mounting of the cabinet components. Get all parts soldered in before installing Q1. To avoid the possibility of soldering heat damage, Q1 must be the last component installed.

The IC's terminals will exactly match the G-pattern holes. Insert three push-in terminals for pins 10, 12 and 14, and a single terminal on the other side for pin 3. There is no need to secure the remaining pins. If you have positioned the terminals correctly, the IC's pins will drop right into the terminals.

Note carefully how the IC's pins are oriented to avoid incorrect installation. The pins and the heat sink tab on one end, are positioned slightly off center on a line drawn through the IC package. The IC must be installed so the pins are closer to the board than to the top of the IC. Then, solder a ¾-in. square tin heat sink to the IC's tab. (The heat sink can be cut from a tin can.) Make certain the heat sink does not touch other components or wires.

Capacitor C11 suppresses high-frequency oscillation of IC1 and must not be eliminated, nor must any substitution be made for R12, and R13. Capacitor C12 can be 100 μf for use in the 800 to 2,000 cps. range. If you use bridge-T values for tones below 800 cps, change C12 to 250 μf.

The speaker is a 2¾-in. 22-45-ohm type. (Any speaker rated from 22 to 45 ohms can be used.) Do not substitute a 3.2-, 8- or 16-ohm speaker as it will cause IC1's output waveform to become a sharp spike which will destroy IC1.



Audio Q-Multiplier

Signal from receiver's output is fed to gate G2 of dual-gate FET, Q1. Bridged-T network (C4-C7, R5-R7) applies feedback at particular frequency to G1. IC1 amplifies combined signals from D2.

PARTS LIST

Capacitors: 25 V or higher unless otherwise indicated
C1,C8,C11—.05 µf ceramic disc
C2—10 µf, 6 V electrolytic
C3—.1 µf ceramic disc
C4,C5—See table
C6—.001 µf ceramic disc (see table)
C7—.002 µf ceramic disc (see table)
C9—.01 µf ceramic disc
C10—50 µf electrolytic
C12—250 µf electrolytic (see text)
C13—500 µf electrolytic
C14—.005 µf, 500 V ceramic disc
D1,D2—1N60 diode
IC1—1-watt audio amplifier integrated circuit (GE-type PA-234)
J1—Phono jack
Q1—3N141 field-effect transistor (RCA)
Resistors: ½ watt, 10% unless otherwise indicated
R1,R12—1 megohm
R2,R10,R13—100,000 ohms
R3—6,800 ohms
R4—1,200 ohms
R5,R6—240,000 ohms
R7—250,000 ohm, linear-taper potentiometer
R8—1 megohm linear-taper potentiometer
R9—500,000 ohm audio-taper potentiometer
R11—1,000 ohms
S1—SPST switch on R9
SPKR.—22-45-ohm, 2¾-in. speaker (see text)
SR1,SR2—Silicon rectifier; minimum ratings: 100 ma, 50 PIV
T1—Low-voltage rectifier transformer; secondary: 10-20 V CT, 40 V CT @ 35 ma (Allied 54 C 4731)
Misc.—7 x 5 x 3-in. Minibox, perforated board
Note: Both IC1 ($2.45), and the speaker ($1.45) are available from Custom Components, Box 352, Alden Manor, Elmont, N.Y. 11003. Add 80¢ for postage and handling. N.Y. State residents add sales tax. Canadians add $1. No foreign orders

Capacitors C6 and C7 can be replaced with a single .003 µf capacitor. However we have shown two parallel-connected capacitors to allow for trimming to the desired value. With C6 .001 µf and C7 .002 µf the circuit should break into oscillation when *selectivity* control R8 is advanced almost full clockwise. If the unit does not oscillate try a different .001 µf capacitor for C6.

When the board assembly is completed, set it aside until the cabinet components are mounted. If the speaker has no mounting holes cement it to the inside of the cabinet with epoxy. Similarly, cement a section of perforated-board to the front of the cabinet to protect the speaker cone.

Power transformer T1 should be posi-

[*Continued on page* 111]

CB Corner

By Len Buckwalter, KQA5012

Probing Your Car's Ignition

IGNITION NOISE in a mobile rig usually is cured by a standard procedure: silence the spark plugs with suppressors, add a filter to a whining generator and install bypass capacitors to ignition wiring. But should the chitty chitty bang bang persist in your receiver, try an RF Sniffer. It's a handy probe you can make in minutes from a 25-ft. length of RG58/U coaxial cable. Strip one end of the cable and install a PL-259 connector to the other end as shown in the drawing.

Stubborn noisemakers often are the result of poor electrical contact between a car's metal surfaces. The hood, for example, can float electrically and act as a pickup for ignition noise; then it showers your CB antenna with radiated Rice Krispies. And that's where the Sniffer comes in. You can use it to pinpoint and subdue the noisy offender.

To track down noise, plug the probe into the CB set, start the car's engine, turn the receiver squelch off and turn up the volume. Now search with the sniffer end, holding the probe about an inch from various metal surfaces. When you hear the noise level rise in the receiver you've discovered an area that probably needs bonding.

In this technique, a short length of copper braid (which even can be some shield braid from your coax) should be used to ground the floating metal. Parts that most commonly need bonding are: hood to firewall, bumper to body, light fixtures to body, tailpipe to body, front or rear end of muffler to chassis, chassis to body in several places and the ignition coil's case to the firewall. The Sniffer indicates which of these regions is acting up. One precaution, however. While probing under the hood, avoid catching the probe tip in the spinning fan blades or drive belts. Unlike the Cougar, you don't have eight remaining lives.

Since some noises may occur at different engine speeds it's helpful to have a friend sit behind the wheel. He can operate the accelerator pedal while you probe around for tell-tale sounds. He also can listen critically to the CB rig's speaker and report to you when interference is rising. This can help you zero in on trouble generated in a small area, from the ungrounded case of a voltage regulator, for example.

CB Seesaw . . . Some pessimists say CB isn't growing. They support that contention by pointing to the total number of licenses; it seems to be stuck somewhere near the million mark. They also estimate that only about one out of every five CBers renews his expiring license (after the five-year term.)

Optimists, though, say CB is hardly ready for pasture. They point out that converts to CB are just as lively as ever. It is estimated that 15,000 to 20,000 new applications pour into FCC offices every month—about the same as always. What's more, new applicants face a deterrent the old-timers never had, an $8 license fee. So CB boosters and blasters alike can have their say. The medium has about as many joiners as dropouts.

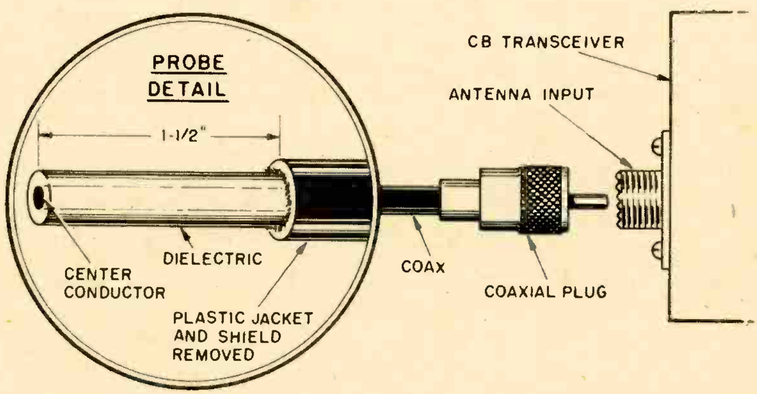


Diagram shows home-brew RF probe used to search for ignition noise that can disturb reception capabilities of mobile CB rigs. A 25-ft. length of RG58/U coaxial cable is prepared by stripping off plastic jacket and shield at one end of the cable only.

Notes from El's DX Club

LEE William Cook, WA8WMK (Ohio), has QSLed a rare European DX country in the person of DL7LB, West Berlin, which counts as being separate from West Germany under EIDXC criteria. Lee worked him on 20 meters around 0740 EST.

Regular Bob LaRose (N.Y.) reports an odd one—a Russian-language SSB station on 20003 kc (normally a Soviet space frequency) at 1245 EST on Dec. 22, during the flight of Apollo 8.

What seems to be a popular Outpost catch is VP5CB at the USCG Loran station on S. Caicos Island. Among those sporting QSLs are members James F. Barry, WA3JAT (Pa.) and Alvin Rothe, WAØQQS (Colo.). Both worked the station on 15 meters.

Gerry Dexter (Wis.) has logged the Nigerian Broadcasting Corp. station at Benin City; it boasts powerful signals on 4932 kc around 2350 EST. This territory formerly was an ally of breakaway Biafra. Meanwhile a new frequency for the Voice of Biafra is 6099 kc.

Again from Bob LaRose we learn that the Voice of Germany is experimenting with transmissions beamed to North America from its Kigali, Rwanda relay base. Look for this on 11795 kc at 1900-2200 EST (1600-1900 PST).

Watch for R. Luxembourg's early-morning (their time) transmission on 6090 kc between 2300 EST (when HISD in Santo Domingo signs off) and 2330 when R. Luxembourg itself goes off. Gerry Dexter reports that they sometimes put good signals into the Midwest.

EIDXCer Father Jack Pejza (Calif.) has taken over as foreign editor for the International Radio Club of America, currently the hottest BCB organization on this continent. A sample copy of their bulletin can be had by sending 25¢ to them at 6059 Essex St., Riverside, Calif. 92504.

And also from IRCA, we learn of R. Progreso, a new and powerful station at La Paz, Bolivia, which is being heard Monday mornings on 1090 kc roughly between 0400 and 0500 EST (0100-0200 PST) when this channel is relatively clear. R. Progreso reportedly has a transmitter on 6005 kc also.

HIDB, R. Libertad at Santiago, Dominican Republic (no relation to the clandestine RL), has returned to the SW wars on a frequency of 3215 kc with sign-off heard at 2245 EST. A couple of weeks before HIDB's reappearance, a Santo Domingo station calling itself R. Ventas was noted on this same channel.

Member Bill Migley (Ohio) reports that HRVC, R. Evangelica at Tegucigalpa, Honduras, is still asking for reports at the conclusion of their 2200 EST (1900 PST) English program on 4820 kc.

Chris Lobdell (Mass.) reports East Coast reception of the clandestine Laotian station La Voz de La Pathet Lao on 6199 kc around 0630 EST.

Propagation: Throughout the spring the hours of daylight continue to lengthen in the Northern Hemisphere. As a result, the higher frequencies are useful for DX for longer periods of time. This means 19 meters will be useful for DX around the clock, while 16 meters should be good from Europe until past sunset (local time) and for considerably longer periods from other continents. However, 13 meters will be weak from Europe due to lower sunspot numbers and the higher absorption that occurs in this band; but 13 meters should open from Africa and Latin America during the daylight hours. At night, all bands from 49 to 16 meters should be good for DX. Radio Germany (Deutsche Welle) on 6100 kc and the BBC on 6110 kc will provide strong signals from 7 p.m. to midnight (local time) throughout eastern North America.

Seasonal increases in noise levels during the nighttime hours will interfere with BCB DX, making reception somewhat more difficult than it has been during the past several months.

Now... Golden-Ear Stereo for Cars and Boats!

AMERICA IS on the move! And now the H.H. Scott Co. has made its own contribution to the American dream of total mobility. For whether you're escaping from your problems via waves or asphalt this clever hi-fi manufacturer has just the components to insure that your trip will be faithful to the Sounds of the Sixties.

The trick they've come up with is a compact stereo system, the Scottie, that operates off a 12-volt battery for use in your car or boat. Two shoe-box speaker systems and an optional turntable come with an AM/FM stereo receiver that features the latest in Scott circuitry. Yes, the FETs and ICs are in there—even at 85 mph on the pike. Another item to remember—the whole mini package will operate on 117 VAC for those who decide to stay at home and forget it. Can you think of a better way to turn on?

Swap Shop

Individual readers (not commercial concerns) may swap electronic gear by sending one listing, name and address to Swap Shop, ELECTRONICS ILLUSTRATED, 67 West 44th Street, New York, N.Y. 10036. Space is limited; only most interesting offers are published.

AUDIO & HI-FI

CRAFTSMAN AM/FM tuner and assorted parts, including ICs, etc. Interested in Heath 10-18 scope or similar. Steve Barrett, 30856 Via La Cresta, Palos Verdes, Pennisula, Calif. 90274.

MAGNAVOX mono amplifier. Want Heathkit GR-64 SW receiver or best offer. Mike Zabreski, 11148 Sunburst, Warren, Michigan 48089.

MOTOROLA stereo car-tape player with speakers and three cartridges. Want 30-40 watt stereo amplifier (tube). Lonnie Smathers, P.O. Box 2675, Harris, Greenwood, S.C. 29646.

AMPRO tape recorder, model 731. Want amateur radio equipment or best offer. A. Richard Bergeron, 616 North 11th St., Carlsbad, N.M. 88220.

VM COURIER tape recorder and accessories. Want CB transceiver or ham gear. Dwight Weidman, RR 1, Hedgesville, W. Va. 25427.

AIWA portable tape recorder, power supply and parts. Want small tape deck. Mark Silva, 33 Marla La., Reading, Mass. 01867.

WOLLENSAK mono tape recorder. Will swap for oscilloscope or best offer. Robert N. Allen, 4053 Florida St., Zachary, La. 70791.

RHYTHMASTER amplification system (rhythm section). Will swap for ham gear. C. E. Spitz, Box 4095, Arlington, Va. 22204.

ELECTRIC GUITAR. Want CB transceiver or guitar amplifier with reverb. Brian Dunn, 226 Montair Dr., Danville, Calif. 94526.

PORTABLE TAPE RECORDERS (2) and other equipment. Will swap for Knight Star Roamer. David Cornell, Box 135, Yellow Springs, Ohio 45387.

CITIZENS BAND

ALLIED C-540. Will swap for scope, signal generator or best offer. Jan Bechtel, 3722 So. 16, Omaha, Neb. 68107.

LAFAYETTE Comstat 23 transceiver. Want Lafayette HA-225, -230, -600 or -700. Joseph Smith, Jr., 27 Johnson Road, Saugus, Mass. 01906.

TRANSCEIVER, Allied C-540 plus equipment. Want tube tester or best offer. Tom Schwartz, 319 South St., Rockville, Conn. 06066.

LAFAYETTE HE-20T transceiver, base antenna and accessories. Want Allied TD-1030 or similar tape deck. Larry Stafford, 553 Victor Ave., Lebanon, Tenn. 37087.

RCA Fleetfone 30-50 mc mobile receiver. Swap for short-wave receiver. Richard Dore, 55 Union St., Brewer, Me. 04412.

ROSS Walkie-Talkie, 8-mile range. Want any model Dyna-Com of Lafayette or best offer. Martin Haga, 812 North Main St., Mishawaka, Ind. 46544.

GONSET G-12 transceiver. Want 30-50 or 145-175 mc police/fire monitor. Bob Langdon, 6 Sussex Place, Deer Park, N.Y. 11729.

MOTOROLA AM or FM mobile transmitter. Want Heath, Eico, other equipment. Richard M. Jacobs, WA0AIY, 4941 Tarcy Ave., Kansas City, Mo. 64110.

HY-GAIN 473 CB antenna. Will swap for Lafayette PRO-540 cassette tape deck, RK-820 tape deck or Heath FM tuner. Samuel C. Chase, 1135 E. 7 (#3), Long Beach, Calif. 90813.

LAFAYETTE HA-711A 1-watt, 3-channel walkie-talkie. Will swap for base or mobile transceiver. Kevin Pek, 15034 Brest Rd., Southgate, Mich. 48192.

SHORT-WAVE LISTENING

FM RECEIVERS (418-462 mc) and large selection of radio tubes. Want Hallicrafters S-20R receiver. Mike Bruski, 1039 W. 7th Ave., Oshkosh, Wis. 54901.

KNIGHT R-55A receiver. Will swap for 2-meter transmitter or best offer. David Burks, P.O. Box 2029, Auburn, Ala. 36830.

HALLICRAFTERS S-120, Hy-Gain antenna. Want CB transceiver or best offer. Peter Ordower, 534 Stratford Pl., Chicago, Ill. 60657.

6 good reasons to get into electronics:

1

2

3

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5

6

Want more reasons? Read on...

A future? Electronics *is* the future. Build your career in a field that's growing this fast, and you should grow fast.

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119R

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ONE OF THE
BELL & HOWELL SCHOOLS

Low-Band Weather Receiver

Continued from page 75

tuning capacitor to a point where the capacitor blades are slightly more than minimum capacitance. Adjust the trimmer capacitors on C1A and C1B for best reception of the signal.

If your tuning capacitor has its trimmers mounted on the side closest to cabinet's side (as ours are) use the side of a small screwdriver blade or an offset screwdriver to adjust the trimmers. Repeat the 150-kc and 500-kc adjustments. Now calibrate the dial, or make a logging sheet of the dial frequencies.

Disconnect the signal generator from the receiver and connect a good outdoor antenna to the receiver for best reception. A ground should also be tried as well. Keep the gain control low as possible to prevent overloading the detector. The detector is most sensitive for CW when it is weakly oscillating and is most sensitive to AM just below the point of oscillation.

If desired you can connect a pair of low-impedance earphones in place of the speaker. If you plan to use high-impedance phones, connect them in series with a .005-μf, 500-V capacitor to the plate of V3.

If you still have doubts about the weather, don't leave the house. Just stay home and listen to the reports on your new receiver.

Tape Head Analyst

Continued from page 59

settings of the playback-level controls. The O-level reference tone on the azimuth-alignment test tape should give a OVU reading on the Analyst's meter. Record a 1,000-cps signal on the tape. Set the record-level controls for an indication on the Analyst's meter of OVU. Adjust the record-level meters' calibration controls for an indication of O level on the recorder's meters. On machines that incorporate magic-eye indicators, O level is the point at which the eye just closes.

Your recorder is now perfectly aligned, calibrated and matched to the type or recording tape you use. Once the machine is completely aligned only minor checks and slight adjustment of azimuth angle need to be made at fairly regular intervals. The complete alignment procedure and checks can be made after every 500 or 1,000 hours of use.

Legal Broadcast Station

Continued from page 33

control to its 2 o'clock position. Connect a speaker to J7. Turn the console on by setting switch S5 to the *output* position. Feed in the signal; you should hear something in the speaker and get an indication on the VU meter. If you don't, check for a wiring error.

Set S5 to the *cue* position and turn the appropriate gain control counterclockwise till it clicks into the cue position; you should hear the signal in the speaker. If you don't, check the wiring of the switches on the back of the *mic.-gain* controls R13 and R15.

Next, connect a mike to J1 or J2 and advance the appropriate gain control. The speaker should cut off and you should be able to read the level on the VU meter. And you should be able to monitor the signal at the phone jack (phones with an impedance greater than 16 ohms).

When using the console take care not to run the monitor amplifier level too high. To keep costs down we have not used a regulated power supply. The class B stage of the monitor amplifier IC pulls enough current at very high output levels to vary the B+ about 4 V—enough to affect the IC and cause a signal drop. At comfortable volume levels the monitor amplifier does not affect the B+ voltage. There is no problem at any monitor volume level when using headphones with an impedance greater than 250 ohms.

Getting On The Air. Connect *output* jack J5 to the wireless broadcaster's high-level input jack with shielded cable. Do not attempt to use the magnetic-cartridge input as this will result in high bass boost. Similarly, do not use the broadcaster's mike input as you will probably get hum and distortion. The broadcaster's high-level (flat) input will often be specified for *ceramic cartridge*—that's the input to use.

Set *output level* control R23 full counterclockwise (off) then feed a phono or tape signal into the console. With the *master gain* control at about the 2 o'clock position, adjust the input gain control until the VU meter peaks at the 100 per cent (O VU) on the loudest sound. Place a radio no closer than 10 ft. from the broadcaster, tune in the broadcaster's *carrier* and then advance R23 until the broadcaster is modulated as much as it can be without causing distortion. Push too much signal into the broadcaster and you just get distortion. If you make the adjustment correctly a 100 per cent meter indication will coincide with the maximum undistorted modulation of the broadcaster.

Getting Maximum Range. Since the power output and antenna length of the broadcaster are limited by FCC regulation, optimum range can be obtained by careful positioning of the broadcaster. Since up to 50 ft. of connecting cable can be used between the console and the broadcaster, try to locate the broadcaster in the attic or near a window.

The Listener

Continued from page 54

Bob Hagerman of Hemlock, Mich. Next, we were saddened to learn of the death of the Newark News Radio Club's utility editor, C.E. McCormick, Jr. Charles was one of a handful of DXers who in the late fifties made utility DXing popular. He will be missed.

Since I am unable to cover club news on a regular basis it might be worthwhile to list nine of the current contenders in this ever-changing scene. Two I've already mentioned and I will have more news on the rest in later columns:

- American SWL Club
16182 Ballad La.
Huntington Beach, Calif. 92647
- Canadian International DX Club
44 Carmen Ave.
Winnipeg 5, Manit.
- International Radio Club of America
Box 605
Beaverton, Ore. 97005
- International Utility Hunters
2180 Bolton St., Apt. 1F
Bronx, N.Y. 10462
- National Radio Club
Box 99
Cambridge, Mass. 02138
- Newark News Radio Club
215 Market St.
Newark, N.J. 07101
- North American SW Association
Box 989
Altoona, Pa. 16603
- Radio Listeners of America
Box 2162
Tallahassee, Fla. 32304
- Worldwide TV-FM DX Association
Box 5001
Harbor Station
Milwaukee, Wis. 53204

DXing the Relays

Continued from page 77

Another West European nation with ambitious plans is France. ORTF plans to add powerful new transmitters in French Somaliland, New Caledonia and French Guiana—all supposedly linked to Paris via satellite. Just when these facilities will actually go on the air is anybody's guess. However, ORTF already boasts one of the oldest relays at Brazzaville, Congo Republic. This one is heard easily in North America, and their English broadcast at 1415 EST is a particularly good bet on 15245 kc. You'd better log the Brazzaville relay while you can because when the French Somaliland station replaces it, Congo Republic will become a difficult country to log.

The first Communist station to boast an overseas relay base is R. Peking. After many false reports and wild rumors, this one finally appeared on the scene near Tirana, Albania early in 1968 with good signals on several frequencies (this included English to North America at 2100-2300 EST on 9780 kc). While the existence of the relay has been definitely established by several expert SWLs, no mention of this comparatively striking development in international power politics has appeared in the press—at least as far as we can determine.

During December, 1966, R. Hanoi announced that it would relay R. Pyongyang (North Korea) twice a week (Tuesdays and Fridays) at 1030 EST. This transmission is currently heard in North America on 11753 kc. While Hanoi's southerly location is more favorable for international broadcasting than Pyongyang, the present arrangement amounts to little more than a program exchange—similar to those which various Communist stations have with R. Liberacion in Cuba (640 kc and other frequencies for domestic consumption)—except that in this Pyongyang-Hanoi deal programs are in English rather than Vietnamese.

Also, in the spring of 1967, Peking and Pyongyang signed a broadcast cooperation treaty which will presumably make available to the North Korean government one of R. Peking's southern sites. Exactly when this treaty will be implemented is uncertain.

Despite these Asian developments, the Communists still have a long way to go before they catch up in the relay race.

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Ham Shack

Continued from page 42

this. For most of us this takes anywhere from a few hours to a few days. General and Advanced licenses require 13 wpm. This is a *lot* tougher. Along about 10 wpm you have to stop translating the dots and dashes into letters and shift over to an automatic recognition of the characters. This can take weeks of hard work and some people never make it, as the Army found out when they taught the code during the war. For the Extra Class license 20 wpm is required. This is really tough for you are expected to copy this by hand and few have pens that fast. You have to learn to type and this can take a year all by itself—never mind the code— if you are going to copy 20 wpm with any comfort.

International regulations (ITU) call for the demonstrated ability to send and receive code, with no speed whatever named. Thus our basic 5 wpm satisfies the international agreements and anything further than that is between us and our FCC.

What other arguments are there for continuing code requirements for amateur licenses? One sentiment held by those already licensed is that, "since we had to suffer the code to get our license we don't see any reason why someone else should come along later and not have to suffer similarly." I guess I don't have any answer for that type of reasoning. Others feel that the CW requirement keeps out the riff-raff. It obviously hasn't—if we can judge by the growing obscenity and deliberate QRM on our bands.

Perhaps these abuses would be even worse if we did not place the tough hurdle of the code in the path of aspirants. It's true that you tend to treasure things more when you have to work hard for them. If we make ham licenses easier to obtain then they may be of little value and things might get a lot worse on our bands. We have only to listen in to the Citizens Band to get an earful of how awful it could be.

Perhaps we can keep the amateur license relatively difficult to obtain, thus retaining its value, but substitute technical knowledge for the skill of sending and receiving code. This, too, would change the fabric of the hobby, tending to turn it over to the professionals and engineers. At present, only about half of the amateurs are working in electronics, the others being spread out through various professions.

Do you have any ideas on a solution to the code dilemma? Should we cut back to 5 wpm for all grades of license? Should we perhaps have a CW class of license for those who enjoy CW and eliminate code from the phone license?

Audio Q-Multiplier

Continued from page 100

tioned against the rear of the cabinet to leave room for the board. Finally, mount the board in the bottom of the cabinet using ¼-in. standoffs (or a stack of washers) between the board and the cabinet at each mounting screw.

Checkout and Operation. Input jack J1 connects to your receiver's speaker or headphone output. Apply power to the circuit and turn *volume* control R9 full clockwise. Advance *selectivity* control R8 to the point where the unit breaks into oscillation, as evidenced by a tone in the speaker. If you cannot get the oscillation, adjust *frequency* control R7 until the unit oscillates. If you still cannot obtain the oscillation frequency, there is a wiring error. (Did you remember to remove Q1's short?)

If you get the oscillation the project is ready for use. Back off on *selectivity* control R8 till the oscillation just stops. Then turn on the receiver and tune in any CW station. As you tune across the signal, or adjust the BFO, there will be one tone that suddenly peaks up, while tones on either side of this frequency are attenuated. The frequency to which the Q-multiplier is tuned can be changed by adjusting R7. But remember to readjust *selectivity* control R8 just below the point of oscillation whenever you change R7's setting.

Use the minimum amount of receiver signal necessary to obtain a clean output tone. Excessive receiver output will cause the circuit to generate noise bursts. If you want to connect headphones at the circuit's output, connect a 20- to 24-ohm 1-watt resistor from the output (negative end of C12) to ground.

Keep in mind that the Q-Multiplier cannot eliminate all QRM. If you are monitoring a CW signal with a tone of say 1,000 cps and the interfering signal has a tone say 800 cps there will be little suppression of the interfering signal. The Q-multiplier works best at suppressing a signal that is least double the frequency of desired tone.

A Final Report on Apollo

CAN an electronics hobbyist build a receiver to pick up Apollo signals directly from space or the moon? EI discussed such a receiver in July 1967 and January 1968. We thought it could be done. Alas, we've decided it can't—for two main reasons: complexity and cost.

The first circuit designer we turned loose on the project put together a block diagram showing the system (converter) he planned to build. He did succeed in assembling a 2400-mc crystal-controlled oscillator, a mixer stage and another transistor oscillator module. That was as far as he got. An increasing work load at his job took up most of his free time that might have been used for the project and one other factor came up.

The cost of the components for the converter and a required parabolic antenna, he discovered, was quite steep. Further, he realized, it would have been impossible to check the receiver until an Apollo mission was in progress. If redesign was necessary, it would have meant further checks could not be made until there was another mission. His project slowed and stopped.

In November 1968 we received a letter (and new hope) from a reader in California offering us plans for an Apollo receiver he had built. Anxious to know more about it, we sent a West Coast contributor to look at the installation. The report he gave us made interesting reading but turned out to be discouraging. The installation he saw was designed and built by the members of a high school radio and rocketry club. The equipment cost more than our writer's house.

There were two receivers. One, a 296.8-mc surplus job, was fed by a corner-reflector antenna built by the students. It was intended to receive transmissions from the Apollo command module when in earth orbit. The 2287.5-mc receiver system was made with commercial gear borrowed from local electronics firms. Feeding the receiver was a surplus 6-ft.-dia. radar antenna mounted on a barber-chair pedestal so it could be rotated.

Since neither of these projects could have led to practical receivers, and because of the limited time for further work before the flight to the moon this summer, we have decided to abandon the program.

Community Radio Watch

Continued from page 70

versified fields as taxi companies, utilities, bus transportation and TV repair.

While business and industrial radio operators usually have been contacted first by CRW coordinators, CBers are welcomed and now play a key role in most CRW programs. In St. Louis, for instance, CRW is affiliated with the HELP (Highway Emergency Locating Plan) program, and CBers have worked well with police and Civil Defense agencies. CRW patrols are operating round-the-clock in St. Louis. In neighboring Florissant, a group of 22 teen-age CB operators have a walkie-talkie CRW program operating under the supervision of an adult group and the police.

All participants in CRW receive a packet of instructional material from CRW headquarters. This includes detailed information on how to radio in valid reports. Members also receive a certificate for the station wall and a distinctive decal for mobile units. If CRW is already established in your community why not see if your own CB or business communications system can play a part? Check with local public-safety officials and they'll let you know how you can fit in.

If you're not certain whether CRW has been established in your area, ask at your nearest police station or sheriff's office: In areas where CRW is not a going thing, we suggest that you show this story on the program to local officials and business organizations. It's possible that these people may have heard of the CRW program but need someone to bring their varied interests into common focus. Motorola says that they are ready in every way possible to "help every American city inaugurate and maintain a CRW program, in order to roll back the tide of crime and lawlessness, and to relieve the burden of law-enforcement officers."

Community Radio Watch must be the wave of the future. With continued efforts on behalf of its public relations campaign and a better understanding on the part of citizens everywhere, success is assured.

Interested civic officials, trade associations and service clubs who want details on implementing the CRW program in their areas should write to Community Radio Watch, 1301 East Algonquin Road, Schaumburg, Ill. 60172.

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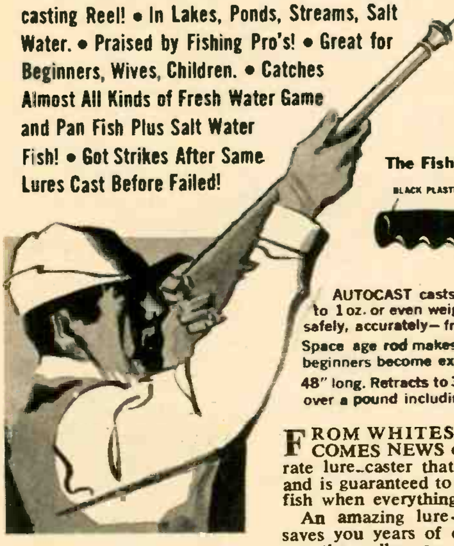

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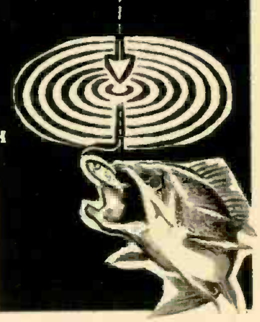

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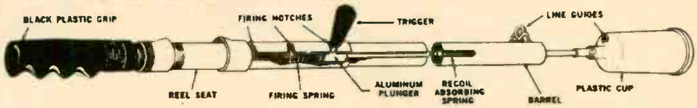

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American Legion Reported: "AUTOCAST great for kids and beginners, for experienced anglers."

Argosy Magazine recommended AUTOCAST.

Parade Magazine Reported: "Even an inexperienced youngster in your family can toss a line where he wants it after only a few minutes practice."

The Fort Worth Press Reported: AUTOCAST looks like a bazooka – it's a show stopper – wherever it's used."

The Pittsburgh Post Gazette Reported: "AUTOCAST a Bonanza for the lazy angler – just aim it, push a button and watch a lure shoot across the water to the spot."

The Angler's Digest Reported: "Easily pops a ¼ oz. plug into a bucket three times out of four at 30 yards."

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Over and Out

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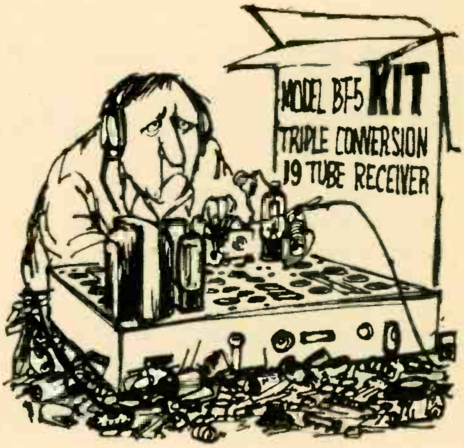

"His is a very strange story. He was building a color TV from a kit. It comes out wrong. He tries to find out where he goofed. He's disgusted. He takes a drink, then another and another. . . ."

Career In Air Traffic Control?

Continued from page 41

Events such as these can't escape notice. Important people began to ask questions and what surfaced was the fact that the FAA was understaffed and had 10 per cent fewer technicians than were needed for normal operations. Also, maintenance people were being pulled off regular assignments to install badly needed equipment. As maintenance was neglected, more and more failures occurred and they took longer to repair. Thus, the FAA is now hiring again.

But that's only the short-term picture. What about next year, and thereafter? FAA personnel don't see any letup for some time in the FAA's growing need for electronics experts. Today's FAA computer system is already outmoded. A new system is going in, using IBM 9020 computer hardware that will make traffic control quicker and safer. Soon it will be hooked up with digital radar equipment and a new electronic plane-identification system. Traffic controllers will see each flight as an alphanumeric display right on their radar screen. The display will show altitude as well as distance and direction. The magnitude of this system should create hundreds of additional maintenance jobs.

Congress is now alerted to the dangers of an inadequate system of air transportation. Additional funds are flowing into the new traffic-control system and are aimed at providing more radars, more navaids and more communications channels. Within a few years there'll be several hundred more airports and three or four times as many control towers, ILS systems and so on. The introduction of jumbo jets should further these needs.

If you're interested and qualified, now's a good time to get your application in at any Civil Service Commission office. Pass the exam and your turn will come. If you're not qualified get as thorough an electronics education as you can. An EE degree can move you up the ladder quickly if you have anything on the ball. It may even start you at a higher level.

However, two solid years of electronics school and some full-time servicing experience will get your foot in the door. After that it's up to you to show the hiring Chief that you're the kind of highly motivated and dedicated individual who can make a career in FAA electronics

Home Protection System

Continued from page 53

And the system works from our house to a neighbor's. During the winter when we were on vacation we connected a thermostat (set to 55°) with normally-open contacts to the utility transmitter and put the receiver in our neighbor's house. We put the thermostat out a window and in a few minutes the receiver alarm sounded. This assured us that if the furnace conked out there wouldn't be a freeze-up because our alerted neighbor would call the oil company for service.

Hi-Fi Today

Continued from page 51

ence in signal strength required for a tuner to latch onto one of two signals on the same frequency and reject the other. Capture ratio always has been talked about as an important factor for people living in a reception area where two stations of different geographic origin might show up at the same place on the dial. That's a pretty esoteric consideration. But capture ratio also indicates how much extra signal a tuner needs to accept the primary signal from a station and reject the ghost reflection.

We now are at a point where tuners will soon be able to boast capture ratios of ldb or less. This means that the city dweller in a prime ghost area finally may get to hear FM the way he once heard it was supposed to sound.

Making It With Minikits

Continued from page 67

dramatize the benefits of the micromin IC). This kit is at the higher end of the price scale bnt it does operate at fairly high power levels (a half-watt of audio output) to produce good speaker volume.

RCA's other packaging idea is exemplified by the Silicon Controlled Rectifier Kit (KD2105, $9.95). This package includes one SCR, two transistors and five rectifiers. With the schematic printed on the card you can build a universal motor speed control or a lamp-dimmer circuit. You have to add about 11 resistors, two capacitors, a switch and some hardware. This kit, though, can serve as the basis for about a dozen more projects, including a battery charger, heat control, flasher and others. The extra circuit information is contained in RCA's *Hobby Circuits Manual* ($1.75)—found in the same racks as the kits.

Chances are, more minikits are on the way. Big semiconductor manufacturers are taking more notice of the hobbyist. He is proving to be a good market for components that can't fly with Apollo.

Best of the Budget Receivers

Continued from page 96

less the possibility of the receiver blasting when tuning from a weak to strong station. We broke the input signal levels into two ranges: 1 to 3.2 (10db change) μv (representing weak signals) and 3.2 to 100,000 (90db change) μv (representing tuning from a weak to a very strong signal). As shown, the Allied has no AVC action in the weak-signal range and a normal AVC action on weak to strong signals. The Lafayette compresses the weak-signal range into a 4db change in audio output with a slightly greater than normal change in the weak to strong signal range. The Radio Shack provides 5db change for weak signals with a very good 7db change for weak to strong signals.

Which Receiver For You. There is sufficient difference between the performance of the receivers that a particular model might be more suited to your special needs. For example, if you require the highest frequency stability you'll get it in the Radio Shack. Razor-sharp selectivity, such as for CB or 20-meter reception, would be found in the Allied. If you need good selectivity and maximum sensitivity, the Lafayette might be the best choice. It should be noted that all receivers are capable or receiving signals well below the sensitivities indicated in the chart, because the 10db signal-plus-noise to noise test represents the sensitivity for AM reception. CW signals down to as low as 0.1 μv can be received on all three receivers, with SSB reception of acceptable quality as low as 0.5 μv.

The important thing to bear in mind regardless which receiver you select is that any of the three will deliver a standard of performance considerably greater than obtainable from the old tube-type budget receivers—and at a considerable saving in money, too.

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START YOUR Own Mailorder Business! Beginner's catalog. "Mailorder Success" letter. Home profit plans. "Home Business Digest." Six mailorder magazines. $1.00. Sullins, Box 2067-X, Forsyth, Georgia. 31029.

VENDING MACHINES—No selling. Operate a route of coin machines and earn high profits. 32-page catalog free! Parkway Machine Corp., 715EI Ensor St., Baltimore 2, Md.

MAKE THOUSANDS Yearly sparetime, with home Mailorder Business using tested, proven plan! Complete details Free! Service Products, P. O. Box 17276-D, San Diego, Calif. 92117.

EASY-TO-START RUBBER stamp business at home in spare time. Make up to $16.50 an hour without experience. Facts free. Write to: Roberts, 1512 Jarvis, Room CR-120-B, Chicago, Ill. 60626.

JOIN THE High Income Group! Earn fantastic profits in Mail Order. Information write, Fairfield, Box 98, Toronto 14, Ont. Canada.

• • • EMPLOYMENT OPPORTUNITIES

BOOMING AUSTRALIA Wants You! Good jobs, Adventure. Forms and Australian Handbook (1969) describing Australian assisted passage, passport-visa, advantages, opportunities $1.00. Buckeye, Box 1032PD, Fairborn, Ohio 45324.

PRINTING — ADVERTISING Salesmen. Excellent moneymaking sideline selling Decalcomania Name Plates. Advertising Specialties. Sign Letters, Automobile initials. Free Samples. Ralco-EI, Box L, Boston, Mass. 02119.

• • • EDUCATION AND INSTRUCTION

BOOKS CATALOG Free. E. K. Heffner, 3500 E. Colorado Blvd., Pasadena, Calif. 91107.

• • • BUILD-IT-YOURSELF (OR DO-IT-YOURSELF)

LASER CONSTRUCTION Plans: Visible beam, operational in pulsed mode. $2.00. Build F.M. Bugging Devices, two transmitter schematics $1.00. Hobbyists Catalogue 10¢. Howard, 20174 Ward, Detroit, Michigan 48235.

PSYCHEDELIC LIGHTING Manual! Make light-machines, strobes, organs, slides, etc. Send $2.00. Lightrays, 713 Pine, Philadelphia, Pa. 19106.

KITS GALORE! Free catalog subscription. Alsynco, EI-89, 171 S. Main, Natick, Mass. 01760.

• • • TAPE RECORDERS

LEARN WHILE Asleep with your recorder, phonograph or amazing new "Electronic Educator" endless tape recorder. Details free. Sleep-Learning Research Association, Box 24-EI, Olympia, Washington.

RENT 4-TRACT open reel tapes—all major labels—3,000 different—free brochure. Stereo-Parti, 55 St. James Drive, Santa Rosa, CA. 95401.

TAPE RECORDER, $16.50 ppd., send $1.00 For Information. Bill Carroll, Tuskegee, Alabama 36083.

• • • RADIO & TV

POLICE—FIRE—Aircraft—Marine—Amateur Calls on your Broadcast Radio with Tunaverter! Tunable—Crystal control! Free catalog! Salch Company, Woodsboro EI, Texas 78393.

FREE! GIANT bargain catalog on transistors, diodes, rectifiers, SCR's, zeners, parts. Poly Paks, P. O. Box 942EI, Lynnfield, Mass.

ELECTRONICS ILLUSTRATED Classified Advertising Order Form

For information on terms, closing dates, etc., see heading at top of Classified Section.

INSTRUCTIONS:

50¢ a word
Minimum Ad
10 Words

WORD COUNT: Zip code free. Figure one word for name of state (New Jersey); name of city (Little Falls); sets of characters as in key (M-14); abbreviation of Northwest (NW); but note separate initials as in a name (M. D. Brown), 3 words counted as a word each.

DEADLINE FOR ADS: Copy must be in by the 20th day of the fourth preceding month for the issue in which the ad is to appear.

BLANKLINE: May be placed both above and below the ad, if desired. Each blank line is charged as 5 words.

TO: ELECTRONICS ILLUSTRATED • 67 W. 44th St., New York, N.Y. 10036 • Att.: Classified Advertising Dept.

Gentlemen: Here's our copy for the Classified Section of ELECTRONICS ILLUSTRATED. Remittance of $________ is enclosed to cover ______ insertion(s) in the ______ issue(s).

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35

YOUR NAME ________ (PLEASE PRINT) PHONE ________

FIRM ________

ADDRESS ________

CITY ________ STATE ________ ZIP ________

DATE ________ YOUR SIGNATURE ________

(PLEASE PRINT OR TYPE COPY • FOR ADDITIONAL WORDS ATTACH SEPARATE SHEET) 7

BUILD 20 RADIO
CIRCUITS AT HOME
with the New Improved PROGRESSIVE RADIO "EDU-KIT"®

only **$26.95**

Reg. U. S. Pat. Off.

Training Electronics Technicians Since 1946

A Practical Home Radio Course

Now Includes
- ★ 12 RECEIVERS
- ★ 3 TRANSMITTERS
- ★ SQ. WAVE GENERATOR
- ★ SIGNAL TRACER
- ★ AMPLIFIER
- ★ SIGNAL INJECTOR
- ★ CODE OSCILLATOR

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ EXCELLENT BACKGROUND FOR TV
- ★ SCHOOL INQUIRIES INVITED
- ★ Sold in 79 Countries

YOU DON'T HAVE TO SPEND HUNDREDS OF DOLLARS FOR A RADIO COURSE

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL.

You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice troubleshooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build Receiver, Transmitter, Square Wave Generator, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the low price you pay. The Signal Tracer alone is worth more than the price of the kit.

THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment.

Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice troubleshooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and troubleshooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector Circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build twenty different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, coils, volume controls and switches, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C. Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

Progressive "Edu-Kits" Inc., 1186 Broadway, Dept. 602AE, Hewlett, N. Y. 11557

FREE EXTRAS

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

SERVICING LESSONS

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

FROM OUR MAIL BAG

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

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

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

UNCONDITIONAL MONEY-BACK GUARANTEE

Please rush my Progressive Radio "Edu-Kit" to me, as indicated below:
Check one box to indicate choice of model

- ☐ Regular model $26.95.
- ☐ Deluxe model $31.95 (same as regular model except with superior parts and tools plus valuable Radio & TV Tube Checker).

Check one box to indicate manner of payment

- ☐ I enclose full payment. Ship "Edu-Kit" post paid.
- ☐ I enclose $5 deposit. Ship "Edu-Kit" C.O.D. for balance plus postage.
- ☐ Send me FREE additional information describing "Edu-Kit."

Name ______________________________

Address ______________________________

City & State ______________________ Zip ________

PROGRESSIVE "EDU-KITS" INC.
1186 Broadway, Dept. 602AE, Hewlett, N. Y. 11557

PRINTED CIRCUITRY

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

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

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

CIRCLE NUMBER 10 ON PAGE 15

Now you may earn double-time pay without working over-time.

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National Technical Schools makes it easier to double your income. All you need is your own ambition. The NTS Project Method simplifies your training... makes it easy for you to enter Electronics... a whole new world of opportunity.

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