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SEPTEMBER 1968 • 50¢

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Roof-to-Basement CB

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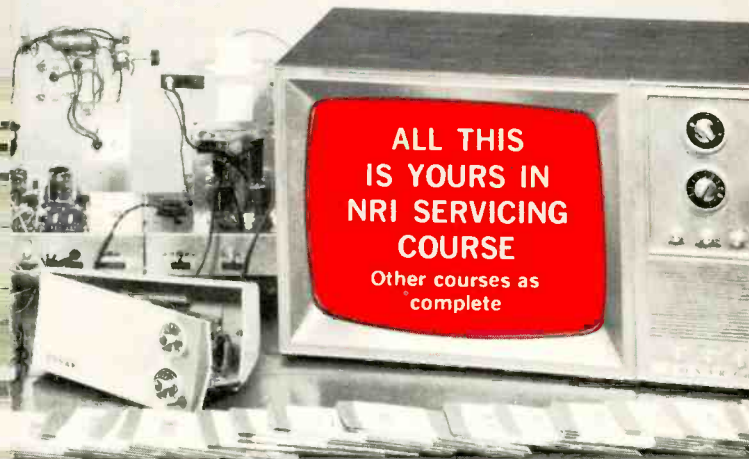
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*RANDY ACERMAN, Camden, N.J., has his own TV service business. He is the official TV repair center for the Radio Shack store and Goodyear Tire Co. in his area. He says, "I have seen other schools' texts and most can't hold a candle to NRI lessons."*

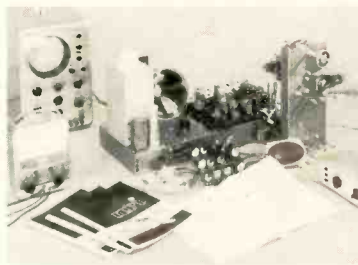


*BERNARD SMOLKOVICH, Ft. Knox, Kentucky, is a Staff Sgt. with the U.S.A. Armor & Engineering Board. "Thanks largely to the NRI diploma I hold, I am a very successful and upcoming Communications Technician. My thanks to your fine staff for their unfailing assistance during my course."*

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A Fawcett Publication  
September 1968

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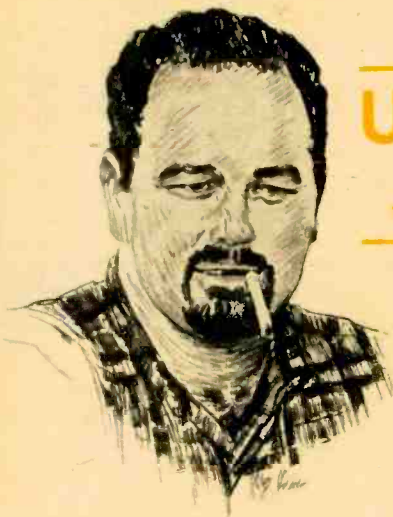
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# Uncle Tom's Corner

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.

★ *I have a transistor multimeter that pegs the movement on all ranges in all functions. It's driving me batty since the circuits all seem to check out. What do you think?*

Thomas M. Butts  
Detroit, Mich.

The meter usually is in a bridge circuit which measures the difference in balance between the emitters or collectors of the two transistors in the bridge. My guess is that one of the bridge transistors is bad and is unbalancing the circuit.

★ *Every time someone starts a national CB organization you're quick to criticize it. Don't you believe in clubs for the improvement of CB?*

Richard Hagerman  
Moline, Ill.

Clubs, spears, dynamite—anything to silence the loudmouths on the band who are ruining it for everyone else.

★ *Can you identify stations on about 6725 kc calling themselves Raspberry Moffett and Raspberry Alameda? They were calling Gray Eagle.*

Alan Traganza  
Citrus Heights, Calif.

Raspberry Moffett is at Moffett Naval Air Station and Raspberry Alameda at Alameda NAS (both in California). I'm more interested in Gray Eagle. It obviously is a Navy aircraft—possibly another airborne broadcaster like the Blue Eagle that had everybody shoo up a few years ago.

★ *Do you know if a CB rig can prevent you from getting picked up by a police radar*

*unit? I heard that if you hold down the mike button as you pass the radar, it won't indicate that you're speeding.*

Terry D. Hall  
Mulkeytown, Ill.

Sure, but only if you're not driving above the speed limit.

★ *We pick up CB on my brother's guitar amplifier. How can we stop that racket?*

Richard Lewis  
Osawatomie, Kan.

Which racket—the guitar or the CB?

★ *In looking over the FCC's table of frequency allocations I noticed the band between 490 and 510 kc is for maritime distress and calling. Sounds interesting but my receiver won't tune to this band and I don't see any that will listed in catalogs. What's the story here? Where can I get a receiver?*

Ben L. Seeber  
Irving, Tex.

The band isn't really a band at all—only the 500-kc international calling and distress frequency for ships with a 10-kc barrier on each side for interference protection. If you can copy CW at a respectable speed the frequency really swings day and night, with some spectacular DX available during winter months. Voice isn't used at all. The military surplus market abounds with suitable receivers such as the DZ-2, RAK, RBH, RBL, DAE, RAX/CG-46115, ARC-5/R-148, BC-314 and BC-453.

★ *I have a 1963 VHF-only Philco color TV set. Using rabbit ears for an antenna, I can pick up my two local UHF stations! Nobody can tell me why this is happening—even servicemen. Why can't they?*

Robert Gangi  
Revere, Mass.

Probably because they don't know.

★ *Okay, Big Daddy, I know the fuzz busts people for turning on in the usual ways.*

[Continued on page 8]



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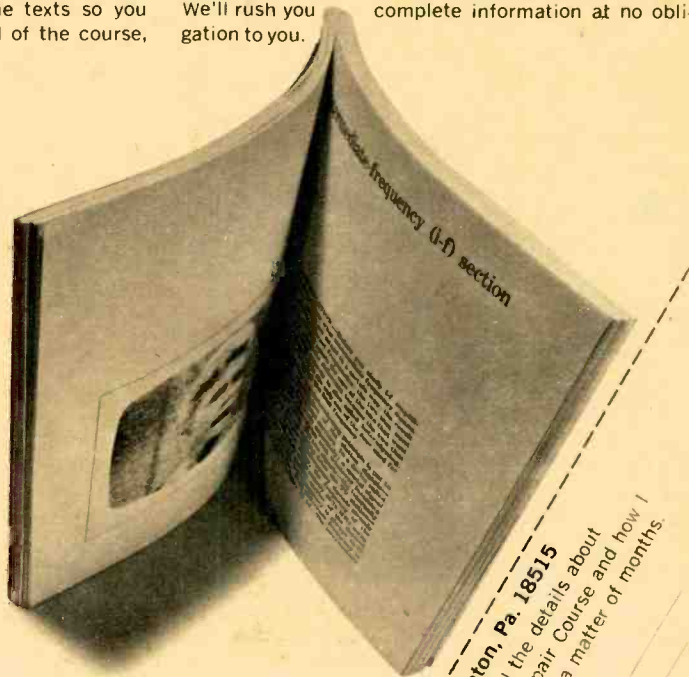
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## Uncle Tom's Corner

Continued from page 6

*How about suggestions for doing this legally via electronics?*

David Plant, K9LAJ/2  
New York, N.Y.

Easy! Get LSD (large silicon diode) and clip a lead to each ear. If you stand next to a broadcasting antenna and can find a way to tune in you should have no trouble turning on.

★ **Fun & Games Dept.** If your CB and ham communications become a little more confusing than usual in the near future you can thank the U.S. Army Electronics Command at Ft. Monmouth, N.J. They're working out plans to launch an artificial radio-reflecting ionosphere. The layer would be produced by rocketing a kettle-full of cesium-aluminum to a height of about 60 miles (near the ionosphere's E layer). Bouncing signals will skip up to 1,400 miles. Only 30 pounds of the stuff will create two hours of whoopee for all CB stations in an 800-mi. area. So if CB skip has earned you an FCC violation notice, try blaming the Army. (It won't work but it's better than most excuses the FCC hears.)

★ *What ever happened to pay TV? It's been on the way for about 15 years now.*

Larry Orr  
Texarkana, Ark.

Don't look now but pay TV is just about dead. Main reason is that Zenith Radio Corp. is the only outfit that wants the system; broadcasters and advertisers are against it. Original idea was that pay-as-you-watch TV would result in more diversified programming. Now TV stations allegedly are covering this need with more specials and feature films. Also, cable TV (CATV) systems (which already are serving subscribers from coast to coast) soon will be equipped to send programs on 20 different TV channels. This will offer viewers more choice than ever.

★ *Is it possible to use a buried antenna for radio communications? Seems like this might bear some experimentation.*

David Coloway  
Bismarck, N.D.  
*[Continued on page 10]*



# Learn I.C.'s... Build this new RCA Audio Amplifier Kit

RCA's new Integrated Circuit Experimenter's Kit, KD2112, is the first of its kind. You get a "short course" in integrated circuits, and you can build a 500-milliwatt audio amplifier or a variable-tone audio oscillator.

The heart of this new "all-parts-included kit" is an RCA linear integrated circuit — a multipurpose wide-band audio amplifier — containing the equivalent of 7 transistors, 11 resistors, and 3 diodes.

Each kit comes with a 20-page manual which gives complete step-by-step kit construction details. An extra I.C. "chip," with case removed, is also supplied so that its circuitry can be examined.

RCA's new Integrated Circuit Experimenter's Kit KD2112 is available from your RCA Distributor. Ask him for it, and learn more about I.C.'s.

RCA Electronic Components, Harrison, N. J. 07029



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CIRCLE NUMBER 16 ON PAGE 11

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CIRCLE NUMBER 9 ON PAGE 11

## Uncle Tom's Corner

Continued from page 8

Buried antennas have been tried for years but the main problem with them is that most of the signal goes underground and therefore only a short distance. Attempts at overcoming this problem by placing the antenna horizontally result in the signal going straight up into the air, making it useless. Northrop Corp.'s Page Communications Div. developed a way around these hitches with an underground antenna buried in the side of a hill at a 20° angle. The antenna is buried beneath a layer of rock equal to 1/10 of the wavelength (or more) of the transmitting frequency. It works well from the VLF range up to 50 mc. Northrop hopes the government will adopt the system for ICBM sites.

★ **The Bells Are Ringing Dept.** That bootleg telephone you have in your bedroom (you know—the one you disconnect when the repairman shows up) someday may be legal. A few months ago the Justice Dept. asked the FCC to revoke phone company regulations prohibiting the use of non-company-supplied gadgets attached to phone lines. It all started with a squabble over the mobile telephone service. If the FCC wipes the slate clean it will clear the way for all privately-owned attachments. The FCC probably will sit on this for a while (one FCC hearing examiner already has said the regulations are illegal) and if they ultimately act against the phone companies the whole thing probably will end up in court.

★ *Our high-school class would like to buy a Weather Bureau type radiosonde transmitter but we can't seem to find out who makes them or how much they cost. Can you tell us?*

*Mitchell Wagner  
 Medford, Ore.*

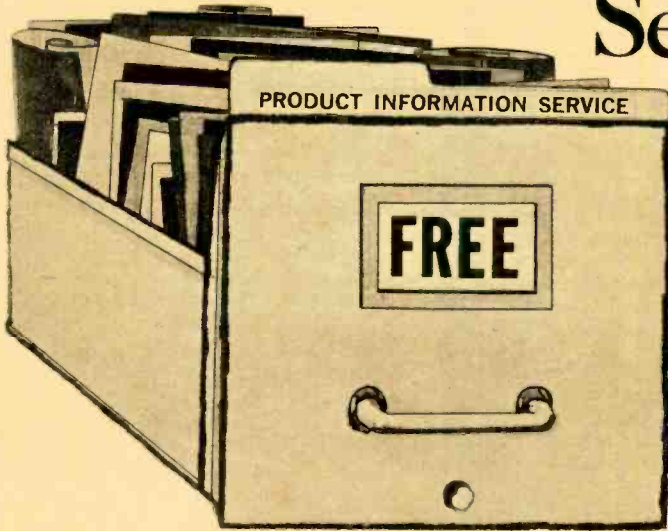
The weatherman buys them in large lots from VIZ Mfg. Co., 335 E. Prince St., Philadelphia, Pa. 19144. Uncle Sam spends from \$15 to \$30 each, depending on the number of telemetry functions in the particular unit. VIZ normally doesn't sell radiosondes on a single-unit basis to individuals. Ask your teacher to write on a school letterhead to Mr. Strasburger at VIZ. Maybe they have a government-reject unit kicking around that they might sell individually.



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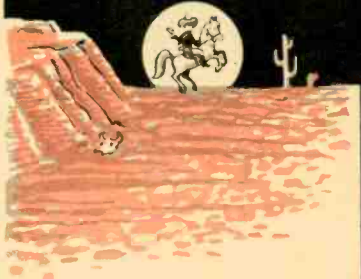
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MASKED MAN?



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CIRCLE NUMBER 2 ON PAGE 11

## Broadsides

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

**T**HE Tape Recording Handbook contains a collection of tips, including five simple tests you can perform to determine the quality of a tape sample. The tests can be useful in evaluating a reel of unknown origin you have around the house or in deciding how good a buy the latest tape sale represents. You'll also find hints on such tape-recorder uses as recording short-wave broadcasts or adding sound to home movies and on editing and maintenance. Available at 25¢ per copy from Pofe Electronics, 1716 Northfield, Muncie, Ind. 47304.

A catalog describing a variety of precision resistors—carbon-film, wire-wound and network types—includes information on how they're constructed and circuit applications. For a free copy, write Resistance Products Co., 914 South 13th St., Harrisburg, Pa. 17104.

A 24-page short-form catalog features a wide range of audio accessories, such as phono jacks and plugs, patch cords, connectors, adaptors and annunciators. You'll also find microphone mixers, miniature microphone amplifiers, switches and control devices for audio gear and other applications. Free from Switchcraft, Inc., 5555 N. Elston Ave., Chicago, Ill. 60630.

Many well-known manufacturers are represented in a catalog of electromechanical components—including pressure transducers, generating plants, AC and DC motors, blowers, transformers, meters, counters, solenoids, switches, relays, timers and many more. A free copy is available from American Relays, Electronics Div., 39 Lispenard St., New York, N.Y. 10013.

A catalog describing specifications for a wide variety of potentiometers, power rheostats and resistors also lists rotary switches and accessories. Free from Clarostat Mfg. Co., Dover, N.H. 03820.

For experimenters who like to take a peek into the world of industrial tube design and applications, a booklet titled Photomultiplier Tubes (PIT-703) details specifications and uses. Copy, 35¢. Write RCA Electronic Components & Devices, Harrison, N.J. 07029.

Home-study courses designed to prepare you for a career as a power engineer—stationary system steam engineer and fireman, power plant and industrial building engineer, boiler inspector, diesel engine and industrial instrument specialist—are described in a free catalog available from International Correspondence Schools, Scranton, Pa. 18515.



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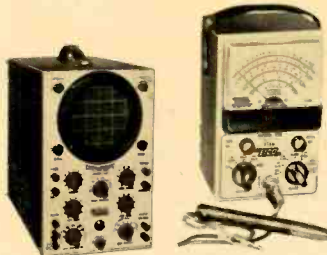


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# Look What's New

## NEW HEATHKIT In-Circuit Transistor Tester

At last, a realistic price for in-circuit testing of transistors! The new Heathkit IT-18 Tester has the facilities you need and it costs a lot less. It measures DC Beta in-or-out-of-circuit in 2 ranges from 2 to 1000 (the spec. commonly used by mftrs. and schematics to determine transistor gain). It tests diodes in-or-out-of-circuit for forward and reverse current to indicate opens or shorts. Measures transistors out-of-circuit for ICEO and ICBO leakage on leakage current scale of 0 to 5,000 uA. Identifies NPN or PNP devices, anode and cathode of unmarked diodes; matches transistors of the same type or opposite types. Cannot damage device or circuit even if connected incorrectly. Big 4 1/2" 200 uA meter. 10-turn calibrate control. Completely portable, powered by "D" cell (long battery life). Front panel socket for lower power devices. Attached 3' test leads. Rugged polypropylene case with attached cover. Build in 2 hours. 4 lbs.



**NEW**  
Kit  
IT-18  
\$24<sup>95</sup>

## NEW HEATHKIT 1-15 VDC Regulated Power Supply

Labs, service shops, hams, home experimenters . . . anybody working with transistor circuitry can use this handy new Heathkit All-Silicon Transistor Power Supply. Voltage regulated (less than 40 mV variation no-load to full-load; less than 0.05% change in output with input change from 105-125 VAC). Current limiting; adjustable from 10-500 mA. Ripple and noise less than 0.1 mV. Transient response 25 uS. Output impedance 0.5 ohm or less to 100 kHz. AC or DC programming (3 mA driving current on DC). Circuit board construction. Operates 105-125 or 210-250 VAC. 50/60 Hz. 6 lbs.



**NEW**  
Kit  
IP-18  
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## NEW HEATHKIT Low-Cost 5 MHz 3" Scope

Here is the wideband response, extra sensitivity and utility you need, all at low cost. The Heathkit IO-17 features vertical response of 5 Hz to 5 MHz; 30 mv Peak-to-Peak sensitivity; vertical gain control with pull-out X50 attenuator; front panel 1 volt Peak-to-Peak reference voltage; horizontal sweep from internal generator, 60 Hz line, or external source; wide range automatic sync; plastic graticule with 4 major vertical divisions & 6 major horizontal; front mounted controls; completely nickel-alloy shielded 3" CRT; solid-state high & low voltage power supplies for 115/230 VAC, 50-60 Hz; Zener diode regulators minimize trace bounce from line voltage variations; new professional Heath instrument styling with removable cabinet shells; beige & black color; just 9 1/2" H. x 5 1/2" W. x 14 1/2" L.; circuit board construction, shipping wt. 17 lbs.



**NEW**  
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IO-17  
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## NEW HEATHKIT Solid-State Portable Volt-Ohm Meter

There's never been a better buy in meters. Solid-state circuit has FET input, 4 silicon transistors (2 used as diodes), and 1 silicon diode. 11 megohm input on DC, 1 megohm on AC. 4 DC volt ranges, 0-1000 v, with  $\pm 3\%$  accuracy; 4 AC volt ranges, 0-1000 v, with  $\pm 5\%$  accuracy. 4 resistance ranges, 10 ohms center scale x1, x100, x10K, x1M, measures from 0.1 ohm to 1000 megohms. 4 1/2", 200 uA meter with multicolored scales. Operates on "C" cell and 8.4 v. mercury cell (not included). Housed in rugged black polypropylene case with molded-in cover and handle and plenty of space for the three built-in test leads. An extra jack is provided for connecting accessory probes to extend basic ranges. Controls include zero-adjust, ohms-adjust, DC polarity reversing switch, continuous rotation 12-position function switch. Easy-to-build circuit board construction completes in 3-4 hours. 4 lbs.



**NEW**  
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## NEW HEATHKIT/Kraft 5-Channel Digital

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CIRCLE NUMBER 3 ON PAGE 11

Electronics Illustrated



# From Heath

## NEW HEATHKIT AJ-15 Deluxe Stereo Tuner

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

## NEW HEATHKIT AA-15 Deluxe Stereo Amplifier

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

## NEW HEATHKIT 2-Meter AM Amateur Transceiver

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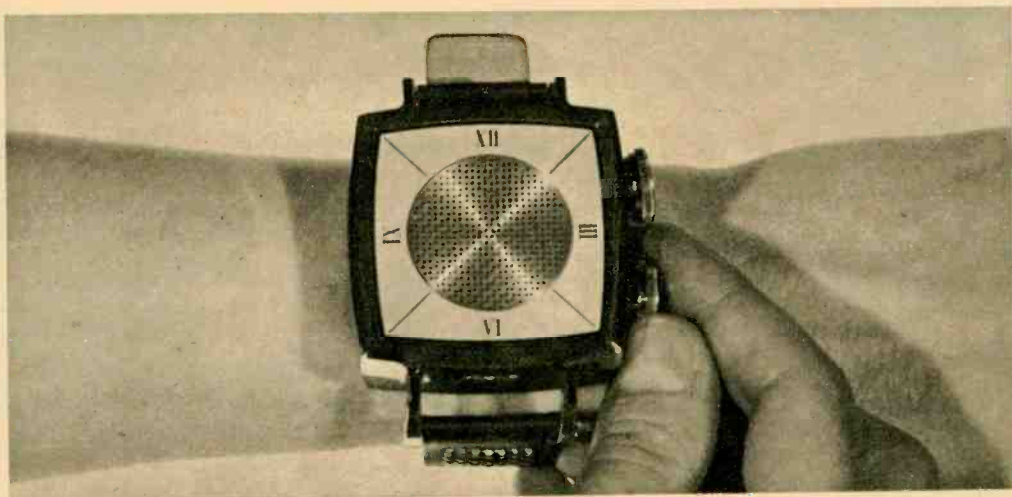
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**RCA**





September, 1958



**MUSIC TIME.** . . Look, Ma, no hands—because it's not a watch, it's a radio. If the Super Micro 7 gives you the time of day it will be in words, on the broadcast band. Seven transistors and a speaker fit in the 2-in.-square case. The finish is gold with a leather wrist strap. Power is supplied by two mercury cells. \$29.50. Partners, Ltd., 205 Third Ave., New York, N.Y. 10003.

## Electronic Marketplace



**Plus VHF.** . . So you want a portable radio with some special goodies? A handsome unit called the Jetflight (Model RLM-74) offers both AM and FM plus the police (152-174 mc) and aircraft (108-136 mc) VHF bands. A ferrite rod antenna is provided for AM; FM and VHF use the telescoping, pivoted monopole. There's an AFC switch for FM, a tuning meter for VHF. An oval 6-in. speaker is built in but an earphone also is included for private listening. Four D cells power the rig away from home; AC adaptor is built-in. \$79.95 including D cells. RCA Home Instrument Div., 600 N. Sherman, Indianapolis, Ind. 46201.

**Charge Up.** . . At last someone is mounting a campaign to make nickel-cadmium rechargeable batteries a household product, rather than specialty item or a built-in. Using the trade name Perma-Cell, GE is turning out the three most popular sizes, AA, C and D cells—plus a charger that will handle any of them. Recharge requires 14 hours. Charger \$9.95; cells \$3.15 to \$3.95 a pair. General Electric Co., Schenectady, N.Y. 12305.





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CIRCLE NUMBER 8 ON PAGE 11

Signal Power On Top Means  
More Distance—No Dead Spots...

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The Avanti Astro Plane's big signal power on top assures full omni-directional communications. No more dead spots or loss of mobile contact in areas where nearby buildings block signals from ordinary antennas—ASTRO PLANE gets its signal over these obstacles. Performance tests have proven Astro Plane superior to  $\frac{5}{8}$  wave length antennas when installed at the same tip height. The short, sturdy radials at the tip of the Astro Plane direct an extremely low angle signal take off for maximum distance in all directions.

Ordinary collinear or ground plane antenna signals are blocked . . . they radiate from the bottom.




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CIRCLE NUMBER 19 ON PAGE 11

## Electronic Marketplace

**Sixty Watts Per. . .** The Model 388B solid-state AM/FM stereo receiver features such state-of-the-art items as three FETs in the front-end and an integrated-circuit IF strip. IHF power rating is 120 watts (both channels) with a claimed frequency response of 15 to 30,000 cps. FM tuner specs include 1.7- $\mu$ v sensitivity, 90db cross-



modulation rejection, 46db selectivity. The 388B has facilities for tape monitoring, microphone jacks, headphone jack, multi-speaker switching, muting control, rumble and hiss filters, as well as more commonplace controls. A back-panel switch permits mono operation of extension speakers while the main system is in the stereo mode. \$539.95. (Model 348B, FM only. \$499.95.) H. H. Scott, Inc., 111 Powdermill Rd., Maynard, Mass. 01754.

**Hand CB. . .** The Messenger 109 is a lightweight, compact (30-oz., 8½ x 3 5/16 x 1 13/16-in.) 2-channel CB transceiver with 3 watts of power. The solid-state walkie-talkie, which boasts 14



transistors, 9 diodes and a thermistor is equipped with a rechargeable nickel-cadmium battery providing up to 8 hrs. use without recharging. To recharge the battery pack you either can remove it and insert its built-in prongs into an AC outlet or connect a line cord directly to the rig. In that case, you need not take the transceiver out of service while the batteries are being charged. The Messenger 109 has a squelch control, extension-speaker jack and rated sensitivity of 0.5  $\mu$ v for a 10db S/N ratio. FCC type accepted and DOT (Canadian) approved. \$149.95. E. F. Johnson Co., Waseca, Minn. 56093.

# We took our WA-44C Audio Generator, transistorized it, made it smaller, lighter, more portable, made it easier to use... and lowered the price!

## **RCA WA-504A only \$95\*.**

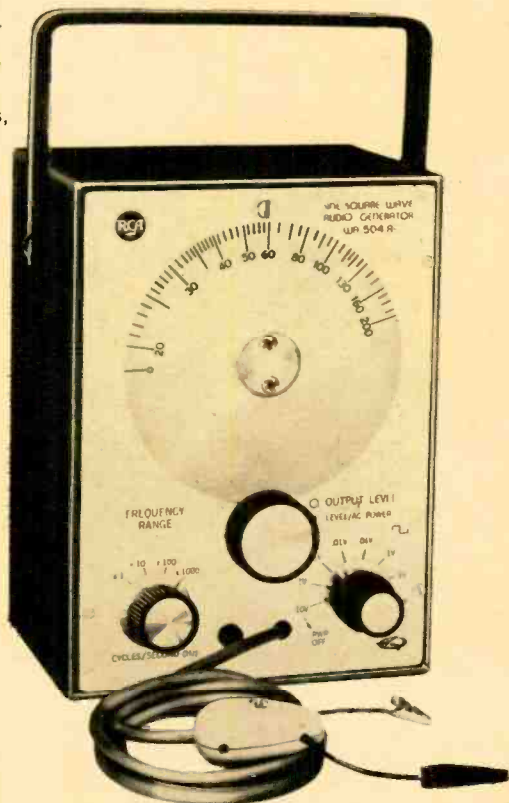
The RCA WA-504A Sine/Square Wave Audio Generator—transistorized for stability and dependability—provides a tuneable AF signal that's ideally-suited for service, industrial, laboratory, education and hobby use. Frequency range extends from 20 Hz to 200 kHz. New solid state circuit design uses 6 transistors—including MOS FET oscillator circuit—and 2 diodes... assures stability (Amplitude variation  $\pm 1.5$  dB, total harmonic distortion of sine wave less than 0.25%).

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Ask to see WA-504A at your Authorized RCA Test Equipment Distributor, or write RCA Electronic Components, Commercial Engineering Department 1-134-W, 415 South Fifth Street, Harrison, N.J.

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

# **RCA**



CIRCLE NUMBER 29 ON PAGE 11

September, 1968

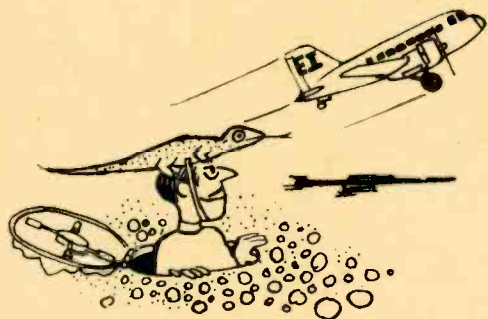
23



# Feedback from Our Readers

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

## ● HI, SPY!



Congratulations on your in-person report on Radio Americas and Swan Island [July '68 EI]. I wonder whether you really looked hard enough for snakes among the iguanas, though. I mean, if the CIA would let you see that much, how much more there must be to see!

(unsigned)  
Miami, Fla.

One thing the R. Americas people did hold back was the fact that they were going to cease operations on May 15th. Curiously, that also is the date our issue was due to hit the newsstands. More of a shock was the picture of the BCB antenna towers on page 46. Someone drew a weird, sagging line between them that was not on the original

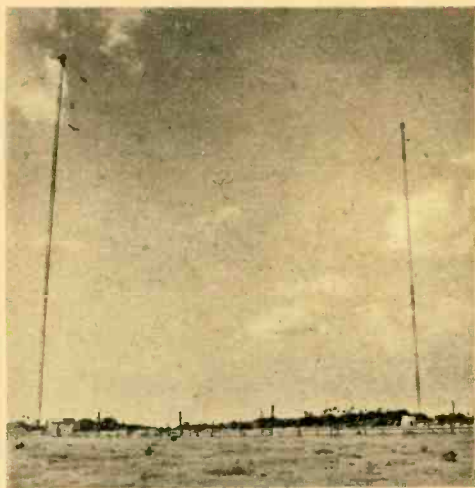


photo. reproduced here, making it look like an obvious fake. Apparently, it was a misguided printer, trying to be helpful. But we're keeping an eye out for Rolex wrist-watches in our production department.

## ● MAKING DO

I recently built your Pinch-Penny Strobe [Jan. '68 EI]. I built it mainly because it was easy and I had all the parts. I substituted a few parts, using a pot having too much resistance. I ended up with the circuit oscillating at much too high a frequency. Instead of using a light I attached a speaker to the output terminals and used a telegraph key as an on-off switch. It really made a handy-dandy code practice oscillator.

Richard K. Shipman, Jr.  
Edison, N.J.

*Why don't you try building a color TV? You may end up with a garage-door opener.*

## ● WEATHER WATCH



Your article on weather satellites [July '68 EI] makes them sound terribly complicated. Since I still get more reliable forecasts from the little Swiss barometer on my mantel than I do from the so-called official forecasts on TV I can't help wondering whether all that hardware is really worth the cost.

Myron Morgenthaler  
Madison, Wis.







## ● FOR THE DOGS?

Do you have any information on how to transpose low-frequency sounds into frequencies above normal hearing?

W. Feschuk  
Lindsay, Ont.

*How about a radio transmitter?*

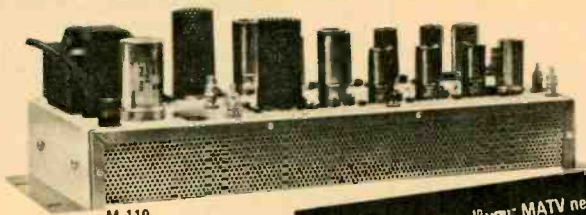
[Continued on page 27]

<b>M-11</b>  Solid State Units All Silicon Transistor VHF-FM Pre-amplifier — 20 dB, 300 ohm In — 75 ohm Out	<b>M-19</b>  Solid State Units All Silicon Transistor FM Pre-amplifier — 20 dB, 75 ohm In — 75 ohm Out	<b>M-116</b>  Solid State Units 82-channel solid state — 25 dB Dist. Amplifier. Separate UHF and VHF 75 ohm inputs.	<b>M-118</b>  Solid State Units All Silicon Transistor VHF-UHF Home Amplifier — Four 75 ohm Outputs	<b>M-108</b>  Solid State Units All Silicon Transistor VHF 40 dB Distribution Amplifier	<b>M-403</b>  Solid State Units UHF to VHF Crystal Controlled Converter
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## Feedback from Our Readers

Continued from page 24

### ● CALL FOR HELP

I have a rather unusual request. I am a Peace Corps volunteer teaching English here in Saipan. Saipan is one of the more advanced islands in the U.S. Trust Territory of the Pacific Islands but it has a great need for people with vocational training. For instance, there isn't one full-time radio-TV repair shop on the island.

The population is about 10,000 and growing. And practically every home has a radio. Battery-powered radios are used in the homes without electricity and in homes with power there usually is a radio-phonograph. But there is no place to get them repaired when they fail.

I have been trying to interest some of the people here in learning about electronics in the hope that they will start a business. Ultimately, I'd like to see them take a correspondence course but the cost is almost unattainable for people who earn 40¢ an hour and must feed, clothe and house a family. Hence, my appeal.

We need books (correspondence-course texts, tube and transistor manuals, how-to books), used but usable test instruments and learning kits (like Allied's 21-in-1 kit). There must be a lot of reading material, test instruments and kits around that still are useful but have been shoved aside in favor of something new and more advanced. Perhaps some of your readers would be willing to help us get started by sending appropriate materials that they don't use.

There is no problem in sending things here, incidentally, as we are served by the U.S. Post Office. No duties are involved.

John Leekley  
Peace Corps Hq.  
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Glenn Nelson  
New Hyde Park, N.Y.

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CIRCLE NUMBER 40 ON PAGE 11



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**CIRCLE NUMBER 31 ON PAGE 11**

# WHAT'S NEW IN

# DIODES

## EI'S GUIDE TO DIODE SYMBOLS



Signal, Mixer, Detector,  
Switching, Noise,  
P-I-N, Light-emitting



Zener



Varactor



Tunnel



Double Anode



Photodiode



Constant Current



LSA (Limited Space-charge Accumulation)

Many of these symbols can be found in several variations. We have chosen the versions that are normally used in our schematics.

By **LEN BUCKWALTER**, AFTER 50 years of fox-trotting around, the diode is shucking its spectacles and earhorn, letting down its hair and swinging out as the latest glamorpuss of electronics. Grandpa remembers the diode as a crystal (with cat whiskers) for receiving radio. Today the whisker is growing into Methuselah's beard. Mention to an engineer the diode's old functions—to detect and rectify—and you're likely to get a ho-hum. A sampling of what's happening shows why.

Relatively inexpensive home sound movies are one goodie promised for an early debut, thanks to the *light-emitting* diode. It scraps both fancy soundtrack optics and expensive magnetic striping. The unwieldy, mechanical tuning capacitor in your receiver also is tagged for extinction with the decreasing cost of *varactors*, diodes that pack a huge dose of variable capacitance in a mite-size plastic blob. The Rube Goldberg dial cord, pulley and pointer should disappear, too.

Recently, an exotic diode generated the highest frequency ever achieved by a semiconductor. Named *LSA*, it oscillated at 88,000 mc. And that's the first step to pocket-size radar or creation of communications channels with enormous message capacity.

The *hot-carrier* diode is another new one latching onto super-high frequencies. It can operate so rapidly engineers don't yet have instruments to make measurements. This diode will raise vastly switching rates demanded by all manner of speed-hungry logic circuits.

Another late development is the *constant-current* diode. It joins the zener as a slick and simple way of taming a power source. Operating in opposite fashion from a zener, the constant-current diode pegs current (not voltage) at a steady value. It hands the circuit designer another tool for fighting the old problem of varying power sources.

Diode and transistor are such kissin' cousins that students of electronics often are told a transistor really is a pair of diodes placed back-to-back. So progress in tran-



# WHAT'S NEW IN DIODES

sistor technology compelled the professors to take a second look at diodes. Diodes, old or new, start out with striking similarities. Two chips of silicon (or other semiconductor raw material) are refined to an incredibly pure state. Then each is contaminated with a trace of impurity. The impurity in one chip will capture electrons floating through the silicon, leaving it dotted with holes (or areas of positive charge), making it P-type material. The impurity selected for the other chip frees electrons and the silicon is considered negative, or N-type. The diode is born when the two chips are brought together and a boundary, or junction, forms between them.

In a regular rectifier an outside voltage can force P and N charges against the junction to form a bridge that will conduct current. But reverse the external voltage and P and N charges flee the junction. The diode then opens into a high resistance.

The varactor is a good example of the diode's transformation. It had been known that any diode displays a mite of capacitance across its junction because charges in P and N materials act like metal plates of a capacitor. And the capacitance can be varied by an external voltage that shoves charges toward or away from the junction. Trouble was that total capacitance had been too small to be of value except in very-high-frequency circuits. But a new varactor diode greatly multiplies the capacitance to the several-hundred  $\mu\text{f}$  needed for tuning the BCB. Its resistance and leakage are low enough to prevent poor tuning selectivity and losses. Tuning ratio (ratio of minimum to maximum capacitance), once measured at about 1:3, is extended to 10:1. These specs lend weight to pronouncements that radio's mechanical tuning capacitors soon will be replaced by so-called solid state tuning—a tiny varactor tuned by a simple potentiometer and a DC voltage source.

The light-emitting diode began not long ago as a laboratory curiosity. By feeding current into the diode it was found that visible

light or infrared radiation could be obtained from the semiconductor material. Theoretical explanation is for the quantum physicists but here's roughly what they say: when a voltage is applied to the diode, electrons are kicked up to a higher energy level. As they fall back to former state they wobble fast enough to produce frequencies in the neighborhood of light.

Recent news is that light-emitting diodes are about to become practical hardware. Makers have licked production problems once considered colossal. To create sufficient light, the diode must be fashioned of diamond-hard material at searing temperature. The material must be polished like a jewel. Specially-designed windows must keep generated light from being wasted inside the diode case. But one maker, Norton, believes it has the secret of cheap sound movies for the home.

Norton's diode emits a needle-thin beam of cold yellow light. The device is smaller than a match head and operates on tiny batteries. Inside your movie camera, the diode would aim a point of light near the edge of the film. You'd pick up sound on a microphone, amplify it and feed the audio voltage to the diode. Variations in light from the diode would be recorded on film like a regular variable-density optical soundtrack. But the diode is far simpler than conventional apparatus. It needs no lamp, mirrors or lenses. What's more, after the film is developed at the corner drugstore it will play back through standard sound projectors like those used for decades to show 16mm educational films. Models for home use could appear on the market in about two years.

Diodes not only turn current into light but work in opposite fashion: converting light into current. This is the old photocell idea. But a sweeping development in this area is bringing the Picturephone closer to everyday reality. Thanks to integrated-circuit techniques, engineers have managed to carve about 700,000 silicon diodes, each a separate photocell, into a half-in.-sq. space. This becomes the light-sensitive screen, or target, of a new TV pickup element. It's upstaging the vidicon tube often used in TV cameras. The new diode screen is not only more sensitive to light but won't suffer damage when exposed to over-strong light.

The idea of exciting electrons in a diode, then capturing some new effect as charges

fritter back to normal also is applied in other novel diodes. There's one that even produces *more* output energy than is fed in by the power supply. The diode pulls the extra energy (heat) from the surrounding environment, making it a thermoelectric refrigerator or air conditioner that operates without moving parts.

And the idea is reversible. Build a fire under a bank of thermoelectric diodes and they generate electrical power. The operator of an unmanned TV relay station in Utah frequently had to climb a 10,000-ft. mountain to repair a balky diesel generator. He replaced it with a thermoelectric power supply and now makes one trip a year to fill the fuel tank with a little propane gas.

One of the most dramatic assaults on the state-of-the-art by new diodes is in microwave communications. On super-high frequencies experts expect to find solutions to the communications explosion. One authority says the spectrum from 30,000 to 300,000 mc offers about nine times the communications capacity of all lower frequencies *combined*. But, until recently, only hefty tubes operating at hundreds of volts could penetrate these regions. Now it can

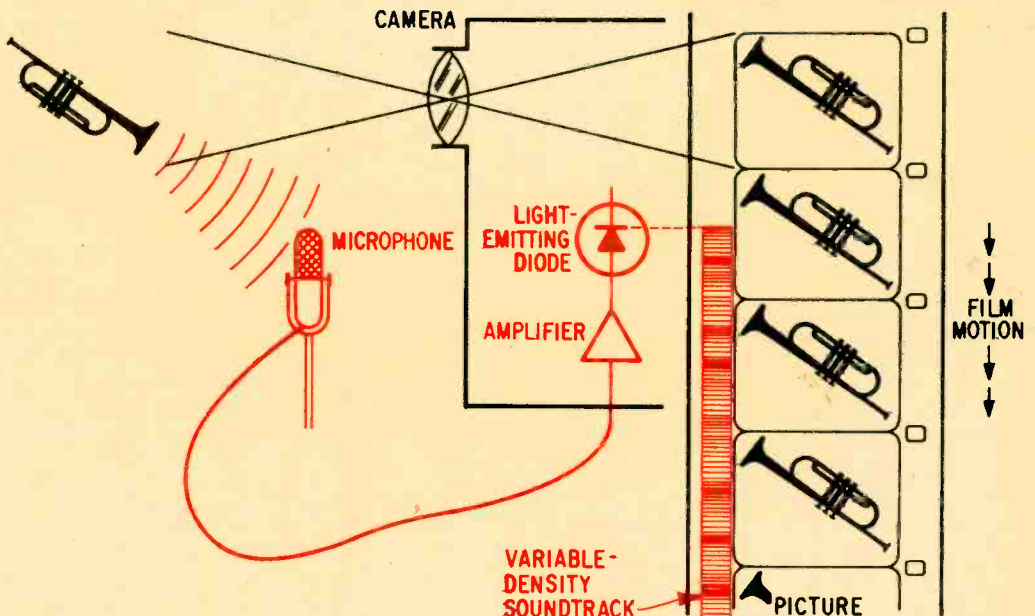
be done with a solid-state oscillator—using a diode.

The big problem always had been transit time. A conventional diode or transistor is limited by the time it takes an electrical charge to move across the semiconductor material. It had been possible to reduce transit time by making the device smaller but that also steals output power. The barrier is broken by a new generation of diodes typified by LSA (limited space-charge accumulation). Unlike regular semiconductors, the LSA's space charge (electrons and holes) is not permitted to build up to any significant degree during each cycle so the diode operates independent of transit time.

Another diode launched into microwave orbit is P-I-N (positive-intrinsic-negative). It's solving the problem of controlling fragile microwave signals which easily deteriorate in a switching system. The P-I-N diode behaves like a variable resistance when its charges are controlled by an external bias voltage.

Yes, the diode has strayed far from home. Most of its new uses—heat, light, tuning, microwave, switching—are remarkably unrectifierish. ●

## HOW A DIODE RECORDS A SOUNDTRACK



Announced system for making home and industrial 16mm sound films uses light-emitting diode to record sound directly on film. Diode requires less power and parts than standard optical systems. is processed automatically along with picture. avoids special equipment normally used to sync magnetic track to picture.





## Dust-Cover for Tape Recorder

*Dirt-free heads and transport keep repair bills down and performance up.*

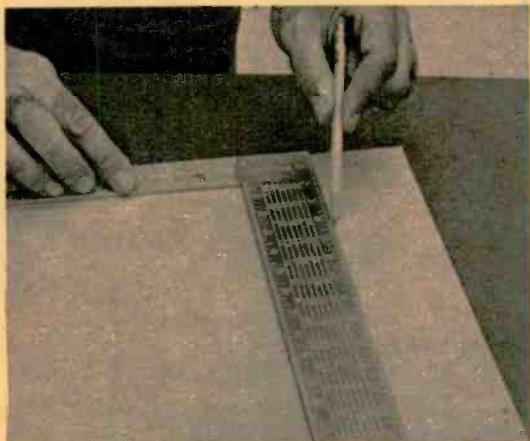
**B**IGGEST scourge to a tape recorder is dust. Because it's abrasive it grinds away the precision-ground faces of the erase, record and playback heads. As it accumulates elsewhere, it gums up bearings and moving parts in the transport mechanism.

Such damage can be prevented with a cover like the one shown here. It takes about two hours to build and costs less than \$5. The cover is made of  $\frac{1}{8}$ -in. thick Plexiglas, which is supplied covered with protective paper on which you lay out the four sides and top pieces. Dimensions depend on the size of your recorder. But add at least  $\frac{1}{16}$ -in. to the length and width to prevent the cover from binding on the cabinet.

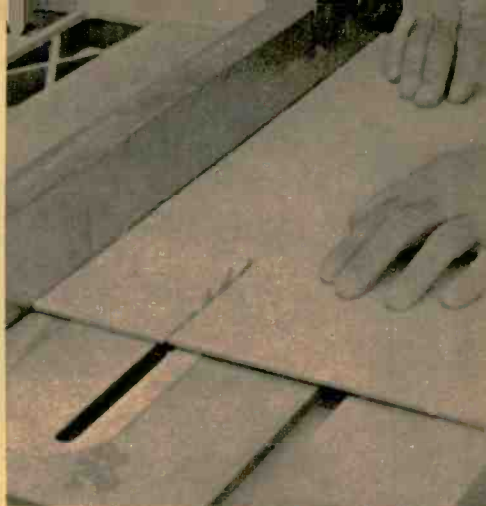
To cut the Plexiglas, run a scribe along the line you've drawn on the protective paper. Put the line over the edge of a table, press down and the piece will break off with a clean edge. Using masking tape, put all pieces together (butted joints) and apply Cadco CD-125 solvent. (\$1.85 a pint) to the seams with a medicine dropper. Add height-positioning tabs at each corner to keep the cover from dropping down on the recorder. The tabs are right triangles with  $\frac{1}{2}$ -in. sides. Cement them  $\frac{1}{8}$  in. up from the cover's bottom edge.

A half hour later, remove the tape and smooth the edges with a fine file or sandpaper. Polish the edges with a polishing wheel and compound or else use a cleansing powder, such as Bon-Ami, and a wet cloth.

*John Capotosto* —



Use pencil to lay out cutting lines on paper coating. To cut Plexiglas, run scribe along lines as pencil. Put line over table edge and apply pressure to break.



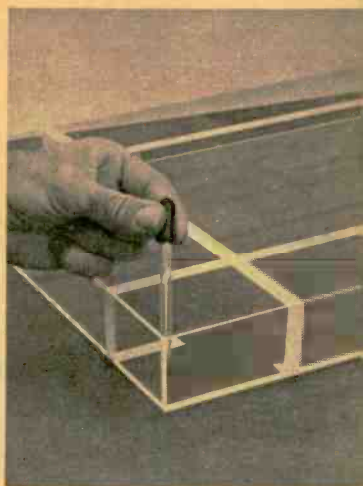
Although best way to cut plastic is to scribe lines and break off pieces, a bench saw will also work. Use hollow-ground blade, smooth edges with fine sandpaper.

Plexiglas comes with protective paper coating on both sides. This protects its surface from scratches and shouldn't be removed until pieces are cut and ready for assembly. Peel off paper as shown. Plexiglas (\$1.20/sq. ft.) and solvent are available from Cadillac Plastic Co., 35-21 Vernon Blvd., Long Island City, N.Y. 11106. Minimum C.O.D. order is \$2.00.



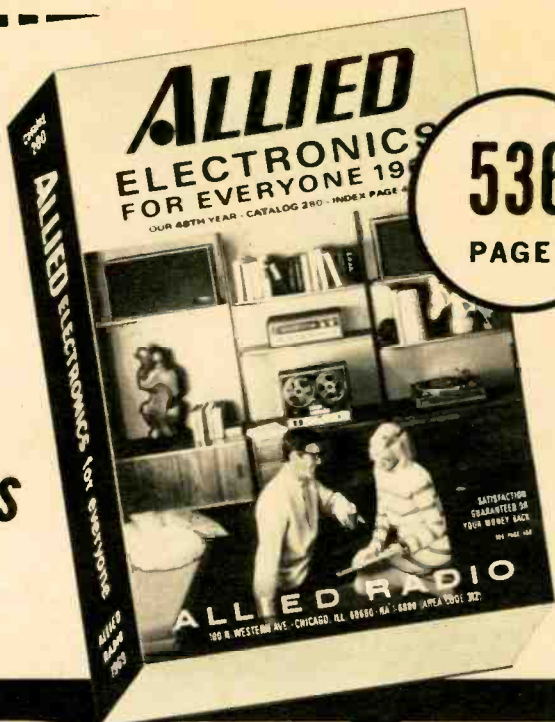
After you've removed paper, temporarily assemble cover with masking tape. Cut thin strips of tape and put on outside corners to indicate position of four height-positioning tabs— $\frac{1}{8}$  in. from bottom.

Use medicine dropper to apply solvent to seams. High viscosity of liquid causes it to travel along full length of seam—even uphill. To be on safe side, wait a half hour for the solvent to dry before removing tape.





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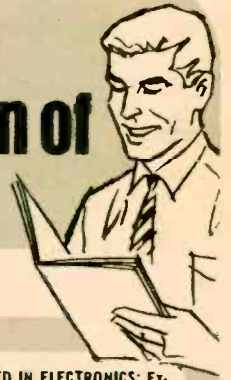
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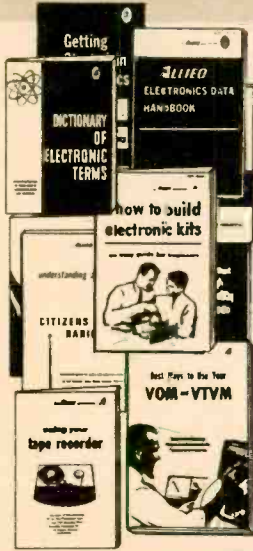
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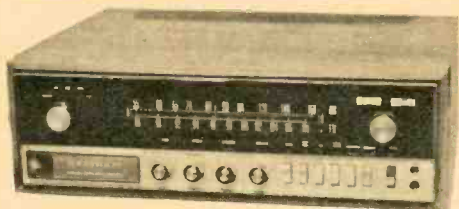
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## El Kit Report



FOR January, it was a mild day in New York. As we strolled up to the Barbizon-Plaza Hotel and to the Heath suite we wondered what the occasion was because this was the only press show Heath had ever given. After arriving we learned the purpose of the luncheon affair was to announce the new AR-15 AM/FM-Stereo Receiver kit. There was a large turnout, which included all the members of the electronics press. We examined and listened to the display of receivers and sat through speeches describing design and performance. When the price came out at \$329.95 we saw eyeballs roll and heard gasps and whispered negativism from Fourth Estate skeptics.

Who, we asked ourselves (being amongst the skeptics), would want to tackle this expensive and complex kit with its 69 transistors and 43 diodes, its pair of integrated circuits and brace of IF crystal filters—who would?—when it is possible to buy some factory-wired receiver with comparable specs for only a few more clams? (The AR-15 was not available assembled then but is now for \$499.50.) In short, we wondered whether the AR-15 could get off the runway.

That was 1967. Time has passed and when we look at the AR-15 today we see it not only got off the ground but has gone into orbit.

The AR-15 is an outstanding receiver whose features and performance leave little to be desired. As a matter of fact, Consumer Reports magazine once said on its cover that the AR-15 was "the best we've tested yet."

One of the AR-15's import features is what we consider a state-of-the-art IF strip. Unlike other receivers, the AR-15's FM IF strip uses two crystal filters and two integrated circuits. The design means no IF transformers and, consequently, no IF alignment or misalignment. In terms of performance, this results in a selectivity curve which is almost rectangular—flat top and almost vertical sides.

# A First-Rate Stereo Receiver

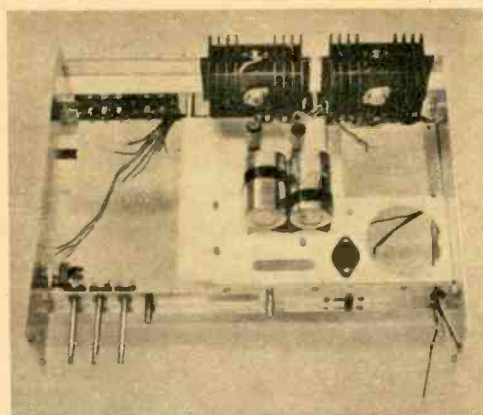
## Heathkit AR-15

As you tune across the dial stations pop in. You're either on the station or off it. (A zero-center tuning meter gives you an indication of the exact tuning point.)

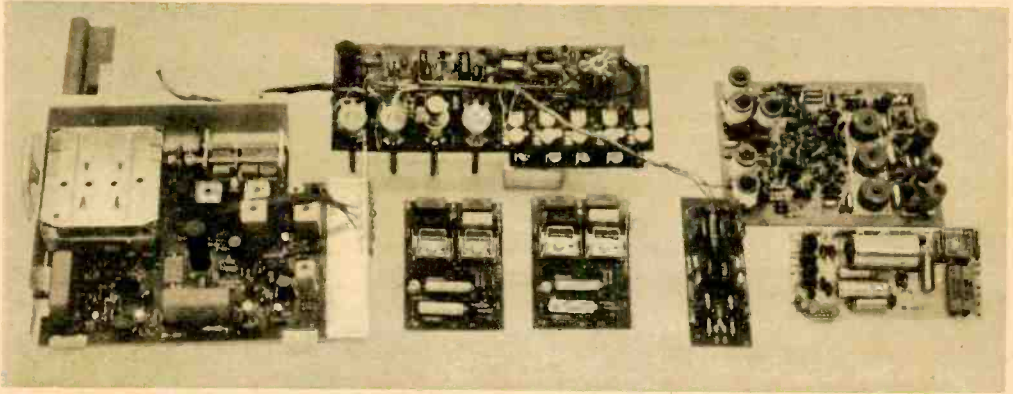
Then there's the *norm/stereo-only* front-panel rocker switch. Set it to the *stereo-only* position and you hear only those stations which are broadcasting in stereo. A *stereo threshold* control hidden behind a hinged plate on the left side of the front panel controls the noise level at which the receiver will switch from stereo to mono. You set the control for the minimum-quality stereo signal you can tolerate. Signals which don't come up to this level cause the receiver to operate mono. There's also a squelch control, which you use to eliminate inter-station noise.

Another control behind the panel is marked *phase*. After you tune a stereo station you pull the control and turn it for minimum volume. Push it in and you get maximum stereo separation.

In addition, there are ten screwdriver-adjust controls for setting the levels of all inputs



Chassis. Wires come from one of three pre-wired cable harnesses. Large holes at right are for power transformer and power-supply filter capacitor.



Board at left contains AM and FM front-ends and IF strips. At top center is control preamp; at top right is multiplex board. Boards at bottom center are power preamps. To right are phono preamp, power supply.

so you won't get blasted when you switch from, say, tuner to record player.

A signal meter indicates the relative strength of AM, FM and FM-stereo signals and is used to make voltage and resistance measurements after construction. A *tune* meter indicates the precise FM tuning point when the needle is center-scale. When power is off the dial is not visible—you see a black panel on the front.

One front-panel light marked *hi temp* comes on when the output transistors overheat (simultaneously the power amplifier stages are shut off). When you tune a station transmitting in stereo, another indicator lamp comes on and the receiver is switched to stereo. There are two jacks on the front panel for pairs of headphones.

So much for the operating features and

conveniences. What kind of a job is it to put the AR-15 together and what are the chances of its working after you complete it?

Knowing it would be a colossal task to troubleshoot the receiver to find a wiring error or to track down a defective or incorrect component, our kit builder (who has a large number of complex kits under his belt, including the Heath GD-983 organ) took his time, reading every step twice and checking every board after it was completed.

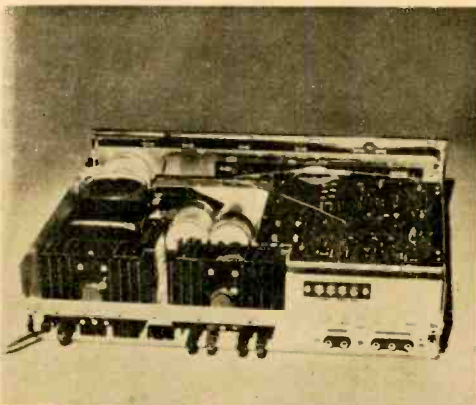
It took 34 hours over a two-month period to complete the job. We found no errors in the manual but we did have two defective components. After we installed one deck of the two-deck rotary function switch in the printed-circuit board we discovered that the switch had been assembled with rear deck turned 180° with respect to the front deck. We replaced it with a new switch.

During the check-out procedure we found nothing happened when we touched the left-channel input jacks with the volume control wide open. We found that the jack strip (five RCA phono jacks on one phenolic strip) had been punched inaccurately when manufactured. This caused the shell contacts (ground) to touch all the center (hot) contacts, grounding them all. A replacement cured this.

Following assembly, you make a series of voltage and resistance checks, using the built-in signal meter as an indicator. Then you make a few connections and turn on power. To our delight and relief the receiver worked in all modes.

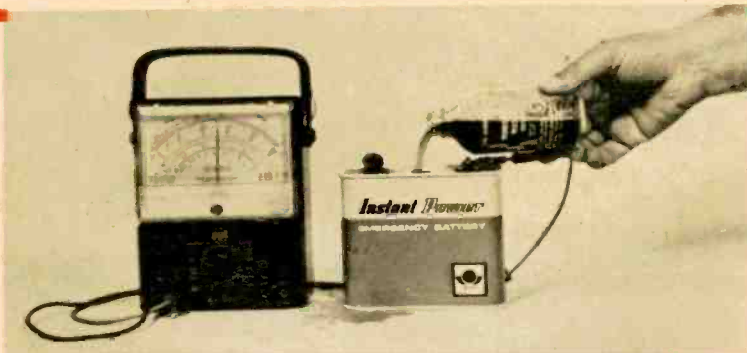
Next, was the alignment or tune-up. This consists of touching up the ratio-detector

[Continued on page 110]



Output-transistor heat sinks are at left. At top right is back of front-end/IF circuit board which swings up on hinges for access to other boards.





# Instant Battery

**T**HE scene is common. There's 50 miles of dark road in front and 100 in back when suddenly your car stops. You dig for the flashlight and find the batteries are dead.

But if your light just happened to be a lantern powered by a Globe-Union IP-3 Instant Power Battery you'd be able to light up the area in a minute.

Normally the battery has no output voltage. In this dormant condition it can be stored up to five years (guaranteed by the manufacturer) without your worrying about it going dead. Add any water-base liquid and the battery delivers a nominal 4.5 V.

In the top photograph we show an IP-3 being activated by a car's window-washer solution. And you can activate it with everything from soda to second-hand beer.

Once energized, the battery life is only 72 hours during which time it will deliver its rated 1 ampere-hour capacity either continuously or intermittently. It will deliver approximately two hours of lantern-light service. Because the output voltage is approximately 4.5 V, the light output is less than that of a fresh 6-V lantern battery.

Presently, the Instant Power Battery is available only in the IP-3 lantern size. It is priced at \$5.59 and is available directly from the manufacturer, The Globe Battery Division, Globe-Union, Inc., Box 591, Milwaukee, Wisconsin 53201. A kit containing a two-way lantern with red flasher, a standard lantern battery and the IP-3 Instant Power Battery is available for \$10.95. Prices include postage and handling.



The pointer indicates the filler plug which you remove to fill the battery. After activation you re-install the plug to make the battery leakproof.

The complete battery/lantern kit consists of the two-way lamp, a standard lantern battery and an Instant Power Battery. Current kit price is \$10.95.



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# Notes from EI's DX Club

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**B**Y THE time you read this R. Americas will be off the air. That most controversial of all Western Hemisphere broadcasters closed down on May 15th—not long after receiving an EI reporting team with unexpected cordiality. We can't help wondering whether RA would have been so cordial if they had not been planning to quit.

As we go to press, R. Libertad has been silent for more than two months—which could mean either that the clandestine broadcaster is defunct or that its facilities are being revamped.

Timothy C. Armstrong (California) reports reception of R. Pakistan's station at Dacca in rare East Pakistan. Time was 0700 PST and the frequency 7080 kc.

Larry B. LeBoeuf, VE3GHL (Ontario), has worked VP8IU in Antarctica on 14153 kc at 0912 EST. Antarctica usually is bagged via the KC4 prefix.

Despite the anti-American feeling generated by the 1967 Mideast war, R. Cairo still is verifying some reports from U.S. listeners. Barry Babaj (Pennsylvania) is one of several to have received a card.

Terry R. Boles (Georgia) has received an enthusiastic QSL letter from the Maldives Islands Broadcasting Service confirming reception at 0415 EST on 9552 kc. There has been some dispute as to whether the station on 9552 at this hour actually is MIBS or R. Tanzania's transmitter on the island of Zanzibar. Unfortunately, MIBS's letter to Terry didn't specify frequency so the battle probably will continue.

The U.S. government has placed on the air at Bangkok, Thailand, a 1-megawatt BCB transmitter. Frequency is 1580 kc and while the station calls itself R. Free Asia it carries VOA programs at 0330-0830 PST.

Reports have been circulating that R. Luxembourg had moved its 19-meter transmitter (used for French-language programs) to

15245 kc. Whether or not they did move to that frequency for a while, the station now is back on 15350.

Don Jensen (Wisconsin) notes that the Voice of the Patriotic Militiamen's Front, a U.S.-backed clandestine operation aimed at North Vietnam, occasionally is heard in the Midwest on 7216.5 kc with weak signals around 0800 EST.

Saudi Arabia Broadcasting's 19-meter outlet definitely is on the move but you should be able to hear it at various times of the day around 15160 kc.

A new frequency for R. Abidjan in the Ivory Coast (properly known as Cote d'Ivoire) is 11920 kc. Watch for it here with potent signals around 1430 EST.

R. Beirut (Lebanon) is now using new 15440-kc frequency for transmissions to North America. Most DXers should have no trouble logging it around 2030 EST.

The Far East Broadcasting Co. has announced that its British branch will build and operate an international SWBC station in the Seychelle Islands with transmissions beamed primarily to India.

*Propagation:* Although it is too soon to know for certain, it appears that the maximum of the present sunspot cycle has passed. This means that the usefulness of the higher bands, particularly 11 and 13 meters during daylight hours, will begin to decrease—slowly at first, then more rapidly as sunspot numbers continue to decline.

During the fall of 1968, 11 and 13 meters will remain useful with good to excellent DX during the daylight hours. At night, everything from 49 to 19 meters will be good at one period or another over circuits from the east. Even higher frequencies will be useful from the west during the evening and early night hours.

Seasonal decreases in local noise levels will result in better broadcast-band DX than at any time since March. ☺





## 20 Watts for 40 and 80

By JIM WHITE, W5LET

**B**EGINNING hams usually start off slowly. First place it shows up is in code speed. Second place you'll notice it is in the simplicity and low cost of equipment.

Take the transmitter, for example. Ready-made CW gear often contains all manner of frills. The beginner avoids frills because they simply jack up the price and don't necessarily do anything for performance. But, unfortunately, he won't find many commercially-made gutless-wonder transmitters on dealer shelves.

Then again, perhaps the beginner doesn't want to put much money in a first transmitter, which will eventually be replaced by a larger job after he acquires more operating confidence and money. Or maybe he feels the whole ham bit is a fad which will pass in time. With this thought in mind, he'd naturally be reluctant to spend big money at the start.

The most economical way to get on the air is with a one-tube rig. Now most one-tube transmitters are simple affairs which are small and easy to construct but lack the power necessary to punch a hole in QRM-loaded hands.

Although our 20-watt transmitter is compact and easy to build, it runs enough power to put out a good strong signal.

The transmitter operates on both 40 and 80 meters and can be built in a few hours for about \$20. There are no unnecessary frills, yet everything is included to make operating uncomplicated.

The transmitter is designed around a 6L6 tube. This bottle has been around a long, long time but still is unsurpassed for ruggedness and reliable performance. The crystal-controlled circuit is standard, easy to tune-up and will withstand heavy antenna loading before it stops oscillating. You change bands with plug-in coils. By using such coils you eliminate complicated and expensive hand-switching.

The power supply is a full-wave transformer type. Six silicon rectifier diodes are connected in series—three in each high-voltage secondary lead. A resistor across each of the diodes equalizes the voltage drop. Using this many rectifiers means breakdown at this point is prevented. A single 40- $\mu$ f electrolytic capacitor provides ample filtering of

the power supply's output.

A neon lamp connected to the plate of the 6L6 indicates RF. Not only is it used to tune up the rig, it also will give visual indication of your keying.

### Construction

The transmitter is built on a 5 x 4 x 3-in. aluminum Minibox. The location of each part is not critical, but try to duplicate our general layout to get everything in place and to minimize problems.

After all holes have been drilled or punched, deburr them and proceed with the mounting of the parts in this order: power transformer, coil socket, tube socket and crystal socket. Orient the tube socket so that pins 1 and 8 are facing the front apron of the Minibox. Mount the coil socket so that pins 2 and 3 are near the transformer.

After these parts are mounted install jack J1 and antenna connector SO1. Variable capacitor C6 is installed later. Part of the wiring can be started at this point. First install C1 and R1 across the crystal socket. Capacitors C3 and C4, along with L1, are connected directly to V1's socket. The end of L1 which

goes to J1 is soldered to pin 6 of V1's socket, which is an unused pin.

Bypass capacitors C4 and C5 should now be installed. Pin 2 on V1's socket gets soldered to one of the ground lugs on the socket. Install C6 now and be sure that none of the rotor plates touches a stator plate. After C6 is installed and the wire from pin 3 of the coil socket is connected to C6's rotor lug, mount neon lamp NL1 in a 3/8-in. rubber grommet and connect NL1's leads together and solder them to C6's stator lug.

With the foregoing completed and checked, install power switch S1, a 6-lug terminal strip and resistor R9. The silicon diodes and their shunting resistors, along with filter capacitor C7, are left until last. The three unused transformer leads should be cut short and taped together. Be sure the wires at the ends don't touch each other or the chassis.

The silicon diodes, along with their resistors, can be connected before being installed. Be sure to observe polarities. After you have the diodes connected properly, mount them on the terminal strip, one (SR1 and SR4) to each high-voltage lead already connected to the strip. Now carefully recheck the con-

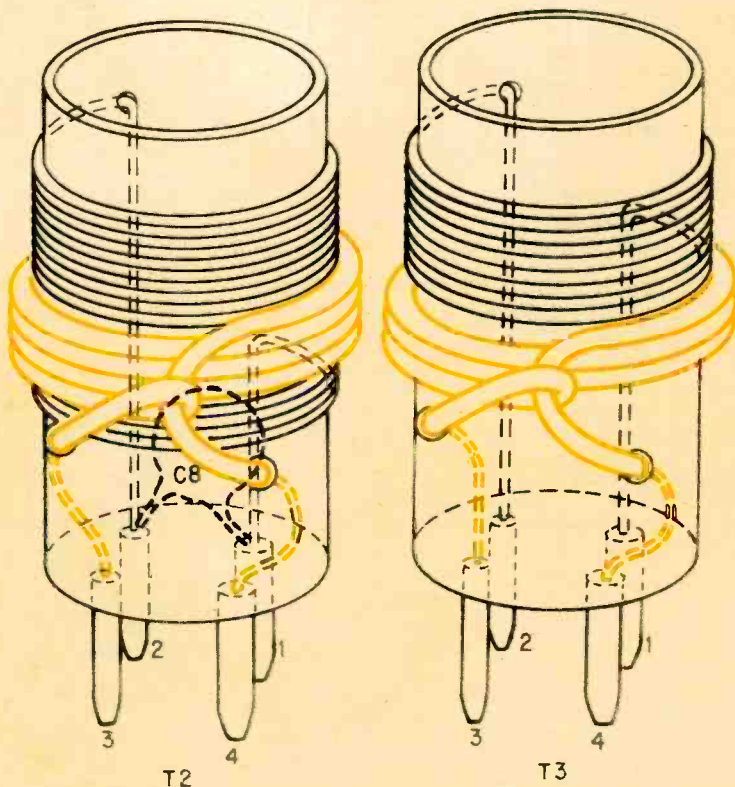


Fig. 1—Primary of 80-meter coil (left) is 25 closewound turns of No. 20 enameled wire connected to pins 1 and 2. Before soldering wire in pins, install C8, a 75  $\mu$ F, 1,000 V ceramic disc capacitor. Secondary is 4 turns of No. 22 solid hookup wire. Primary of 40-meter coil is 17 closewound turns of No. 20 enameled wire. Secondary is 3 turns of No. 22 solid hookup wire. Wind secondaries over bottom turns of primary.



# 20 Watts for 40 and 80

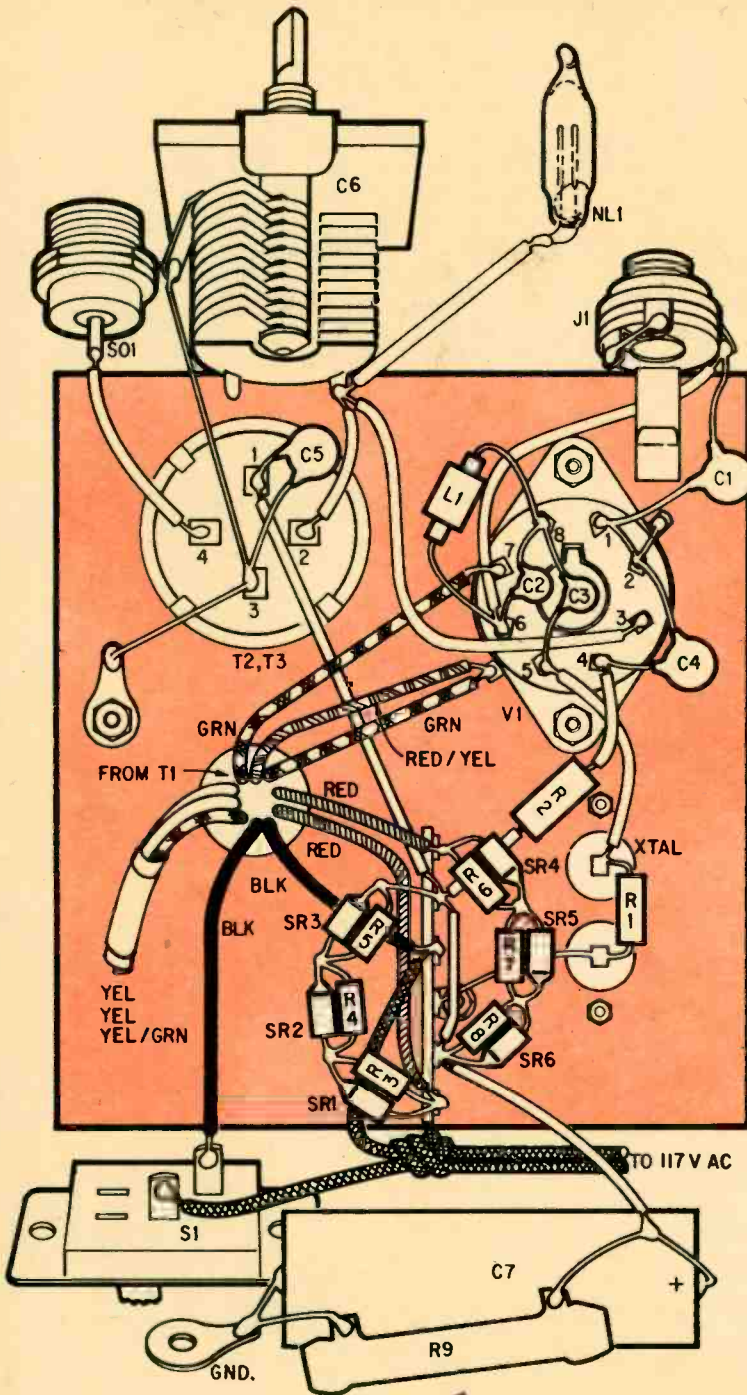
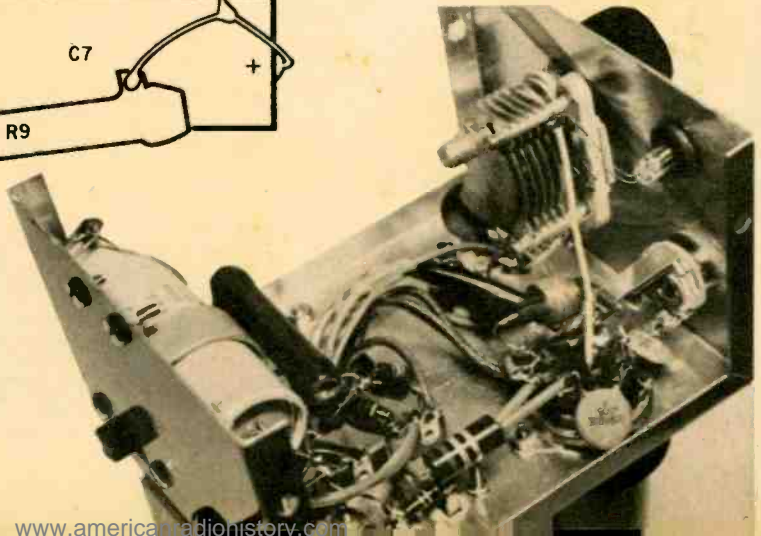


Fig. 3—Note how neon lamp NL1 is installed in grommet in upper right corner. Keep all parts close to chassis, double check your wiring and there should be no trouble. Electrolytic capacitor C7 and 10-watt resistor (R9) go on rear apron.

Fig. 2—Underside of transmitter. Parts C6, J1, NL1 and SO1 are mounted on front apron of Minibox. C7, R9 and S1 are mounted on rear apron. When installing the octal socket for V1, be sure the keyway between pins 1 and 8 is facing the front of the box. The unused yel, yel and yel/grn leads from the 5-V winding of T1 should be cut and taped.







# Hi-Fi Today

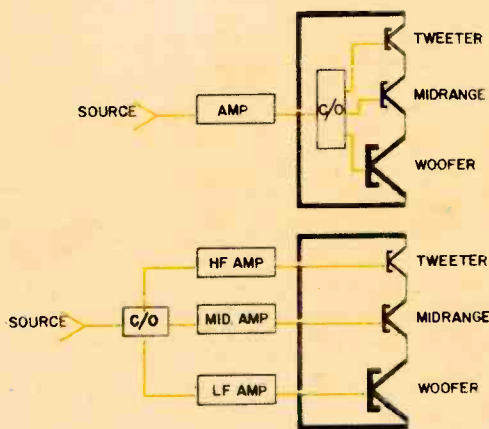
By John Milder

## \* Crossovers—Stop, Look, Listen!

EVERY so often the hi-fi business takes a side road and everybody marches off noisily into the distance following the band-leaders. I'm convinced that's what's happening with a newly refurbished idea: the electronic crossover and multi-channel amplification.

If you haven't heard of these systems before, let me make it clear right now that I'm not talking about the separate channels necessary to reproduce stereo. This idea goes back to mono days. Even then some hi-fi systems had more than one amplifier—perhaps one for high frequencies, one for the mid-range and a third for the bass—each with its output transformer directly connected to the appropriate speaker, and only that speaker.

The theoretical advantages of the electronic crossover sound fairly persuasive. By splitting the frequency range between two or three separate power amplifiers you dispense with the conventional crossover at the loud-speaker system. You also reduce IM distortion by relieving an amplifier of the usual chore of handling the entire frequency range (in general, a narrow range of frequencies means less chance for interaction between them).



Conventional hi-fi system (top) has single amplifier for each channel, crossover (C/O) in enclosure with speakers. Electronic crossover system (bottom) separates frequency bands first, amplifies them individually, drives speakers directly from amps.

The trouble with the arguments for electronic crossover is that they overlook disadvantages that, to my mind, are even more important. The most obvious one is cost. With a minimum of two power amplifiers per channel (four for stereo) it's got to be expensive. And remember that, for this whopping investment, you're getting improvements that you *might* be able to hear—with distortionless loudspeakers.

But speaker design is, as we all know, one of the weaker links in the hi-fi chain. Designers of speaker systems must trade off one non-linearity against another. One place they do this is the crossover network. And a fine speaker system is a carefully-tuned combination of speakers, crossover and enclosure.

What happens when you use it with an electronic-crossover system? Well, first off, you rip the crossover out of the speaker system and all that careful design goes down the drain. If you start from scratch with raw speakers you're no better off. The job of making the finished system turn out really superb sound is one that requires a professional. And if they're not going to turn out superb sound, why spend all that money in the first place?

There are other problems, too. What happens, for instance, when the amplifier that drives your tweeter develops a 60-cycle hum? In a standard system, you'd hear it in the woofer and fix it. The speaker system's crossover would prevent it from reaching the tweeter. With electronic crossover *before* the amplifier, there may be nothing to stop it. And—since, for the same apparent loudness, low frequencies require more energy than high frequencies and small speakers generally can handle less power than large ones—you easily could end up with a ruined tweeter.

Some fine companies have put their names on electronic-crossover equipment (Marantz, Sony, Pioneer and Kenwood among them). But before you head off in a new direction I'd suggest you stop and check your objectives, look at the price tag and listen to the sound. Anyway, I'm sticking to the main road.



# Sonic Switch

By JOSEPH RITCHIE

Ali Baba had it made. He clapped his hands and the genie carried out all his commands. Unfortunately, the genie got trapped in the bottle and no one figured a way to get him out. EI has uncorked the bottle with an electronic genie to carry out your wishes. And all you have to do is clap your hands.

The Sonic Switch genie will turn power and TV or radio sound on and off, control lights and, well, just about anything else that has an on-off function. For example, our model is wired to control 117-VAC power. Depending on how relay RY1's contacts are

used, the switch can shift power from one appliance to another—say turn off the hi-fi and turn on the TV. Or RY1 can be used to control a speaker or low-voltage circuit. Whichever way you connect RY1, operation is still controlled by two hand claps, finger snaps, whistles or taps within one second.

A single clap or sound, such as that of a dropped book or ash try, will not trip the switch, nor will two sounds spaced more than 1 second apart. Speech and music? Normally they won't affect the switch.

The switch is sensitive to loud hand claps at 30 ft., soft claps at 20 ft. and finger snaps at 10 ft. Loud two-syllable words such as *mag-ic* and *stu-pid* will trip it up to about 10 ft. A lamp could be turned off by saying *light-off*. As you can imagine, an ingenious bit of circuit design makes possible the Sonic Switch's genie abilities. A full explanation appears at the end of this article.

**Construction.** The Sonic Switch is built in the U-section of a 7 x 5 x 3-in. Minibox. Under no circumstances attempt to mount the microphone in or on the box. The Sonic Switch has been designed for high sensitivity and the sounds of the relay tripping may



Fig. 1—Electronics is in box but crystal or ceramic mike must be external to prevent sound of tripping relay from reactivating the circuit.



cause continued cycling or chatter. While the design incorporates some spread to accommodate normal variations between transistors of the same number, it most likely will not work if you substitute other transistors. Do not change component values other than C7 and C8. In case of difficulty, the voltages shown in the schematic (in ovals) will help you get around variations in transistor characteristics (more on this later).

The parts are mounted on a 4½-in.-square piece of perforated board on which Vector T28 terminals are used for tie points. To make certain relay RY1 does not interfere with T1, mount the cabinet components before installing the board. Jack J1 is 1 in. up from the bottom and ¾ in. from the right side of the panel (see Fig. 1). Position transformer T1 so its windings are almost flush

with the edge of the U-section of the box. Power socket SO1 (if used) goes directly behind T1. Before

## Sonic Switch

mounting T1, cut off its unused leads. Mark RY1's mounting holes, making certain its contacts do not touch T1. Do not install RY1 until the rest of the wiring is completed.

Follow the pictorial of the board in Fig. 4 closely. Note that components are mounted on-end to conserve space. Don't cut the transistor leads short—use them full length. The diode leads should not be shorter than ¾ in. and use a heat sink on the transistor and diode leads when soldering.

Since there are many connections to the push-in terminals, install the diodes and transistors *after* all other components (except R10). Solder all components before installing the transistors and diodes; then spot-solder (don't wrap) the transistors and diodes to the tie points.

Take particular care of the polarity of the diodes when installing them. Be sure that R10 is installed so it can be removed without damage to other components. If possible, leave at least ¾-in. leads on R10 because it may have to be changed if you don't get the voltages indicated in the schematic.

After the board is complete install it on the bottom of the cabinet with a ¼-in. spacer or stack of washers between the board and chassis at each mounting screw.

**Checkout.** The proper circuit voltages are shown in the schematic inside ovals. Voltages are measured with a VTVM and may be

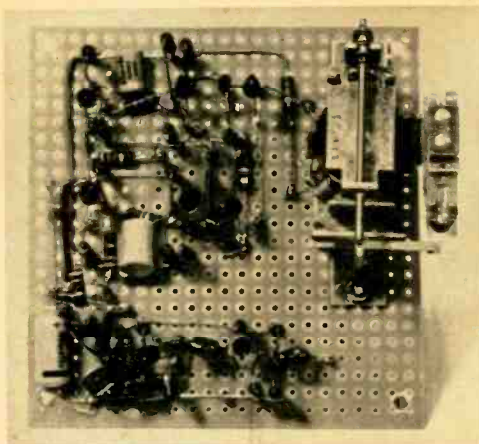


Fig. 2—Completely wired board. To conserve space, mount resistors on end. Drill holes in four corners of 4½-in.-sq. board for mounting purposes.

within 20 per cent of the indicated values. Plug PL1 in an AC outlet. The voltage at the junction of SR1 and C10 should be 21 VDC. If it is higher or lower check to see if you have used the correct wires from T1.

Next, check the voltage at the junction of R16 and R19. If it is zero, or substantially lower than 13 V, check for a short. Similarly, if the voltage at the junction of R8 and R10 is zero or substantially less than 7.5 V check for a short. If the R8/R10 voltage is higher or lower by 1 to 1.5 V change R10's value until you get the correct voltage.

The voltage at Q1's collector should be 5 V. However, due to variations in transistor characteristics it may be 1 or 2 V higher or lower. Change R1's value to get the voltage close to 5 V. Since Q1 has high gain, change R1's value in small increments (30,000 ohms), say from 150,000 to 120,000 ohms.

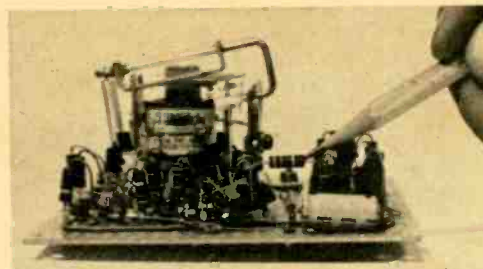


Fig. 3—Side view of board. Pencil points to R10, which should be mounted in clear because it may have to be replaced with different value after test.

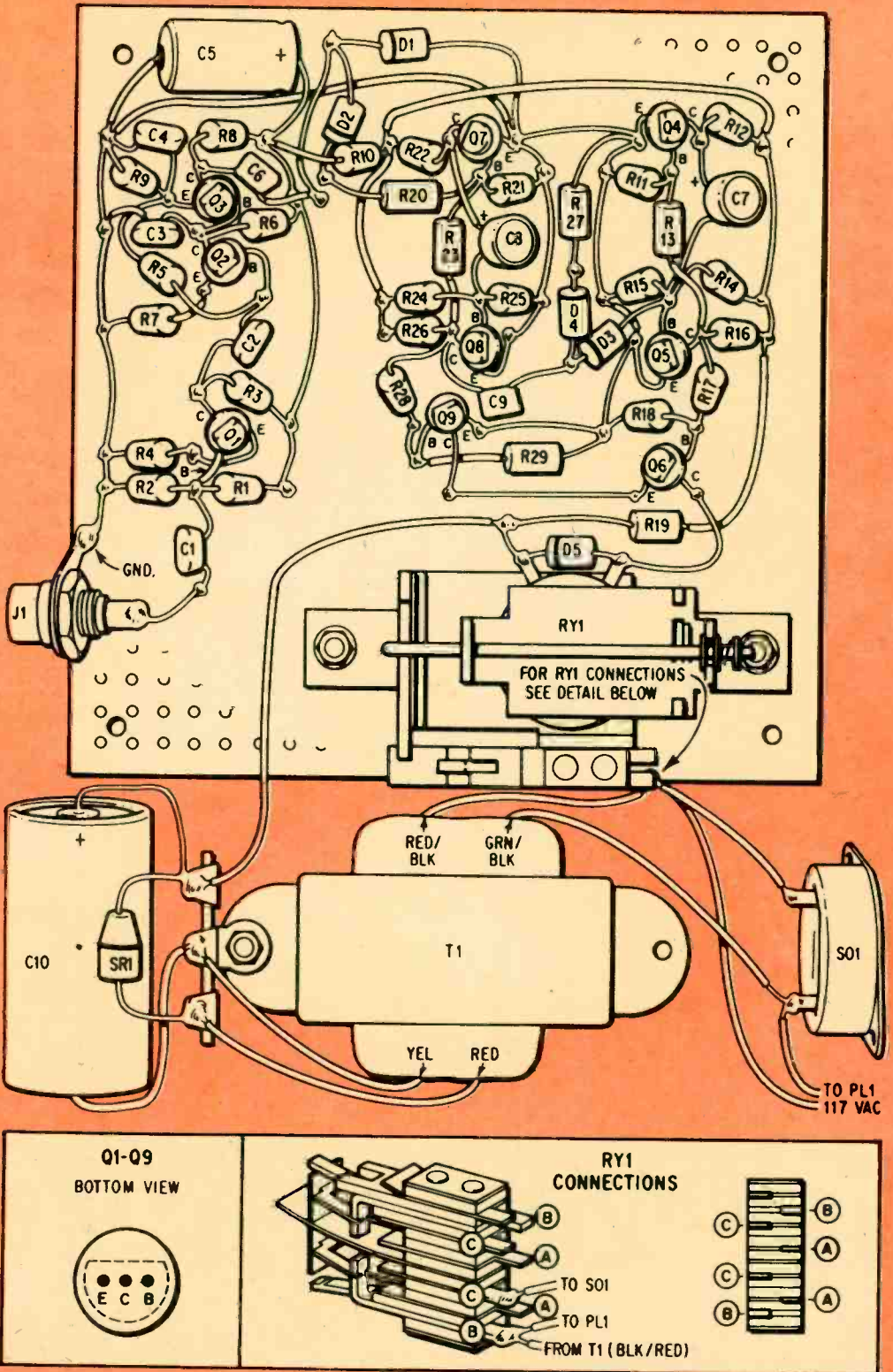


Fig. 4—Wiring is tight in upper half of board so go slowly and carefully. Cathode end of diodes D1 through D5 is indicated with the heavy black band above. It may be a color band on diode. RY1's lugs are below.



# Sonic Switch

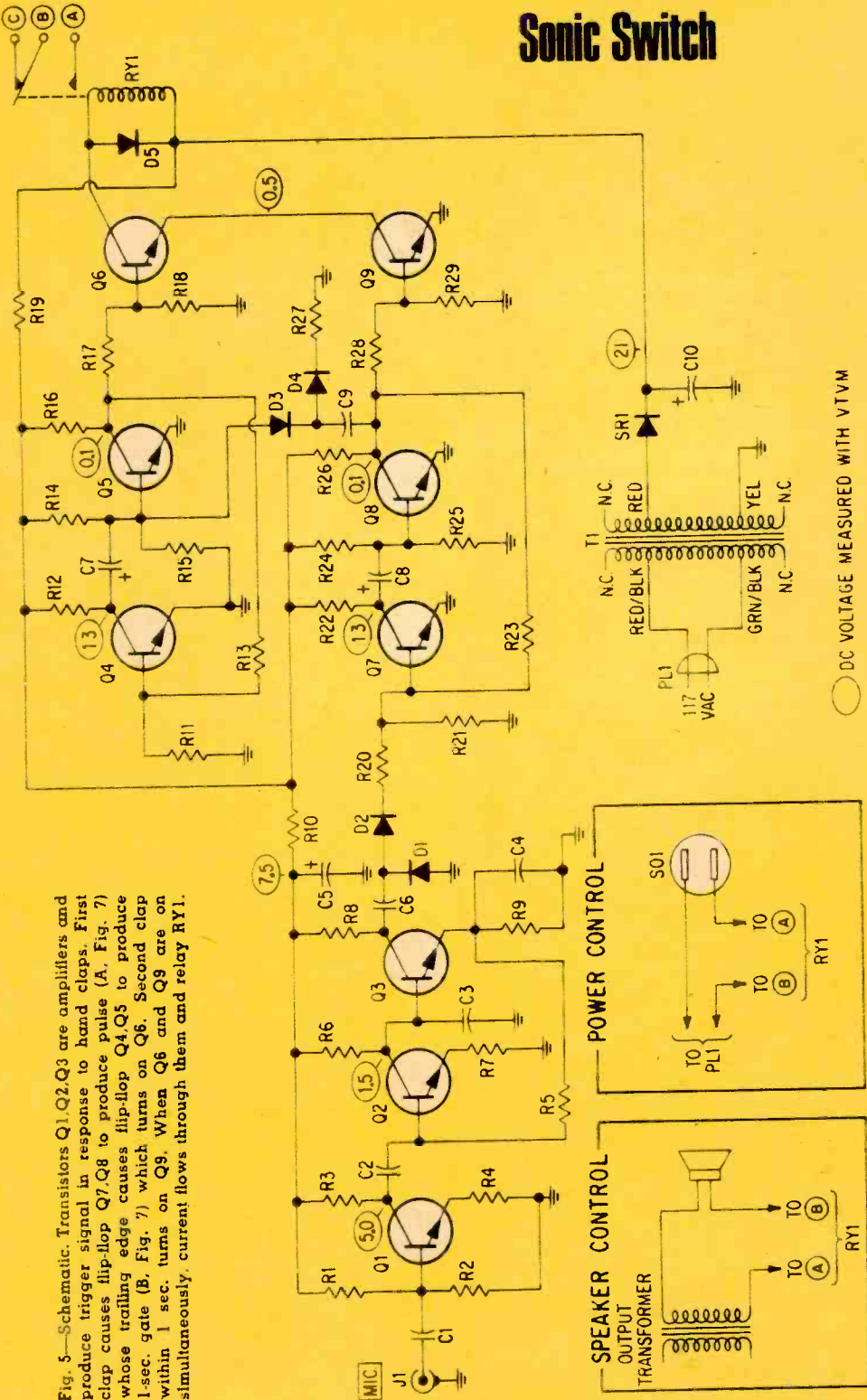
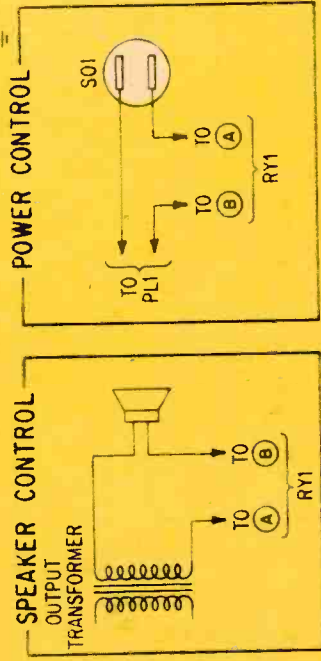


Fig. 5—Schematic. Transistors Q1, Q2, Q3 are amplifiers and produce trigger signal in response to hand claps. First clap causes flip-flop Q7, Q8 to produce pulse (A, Fig. 7) whose trailing edge causes flip-flop Q4, Q5 to produce 1-sec. gate (B, Fig. 7) which turns on Q6. Second clap within 1 sec. turns on Q9. When Q6 and Q9 are on simultaneously, current flows through them and relay RY1.

○ DC VOLTAGE MEASURED WITH VTVM



The collector voltage of Q2 should be close to 1.5 V. Change R5 in small increments to get the voltage close to 1.5 V but keep in mind that you're allowed a 20 per cent variation.

The voltage shown at the collectors of transistors Q4, Q5, Q7 and Q8 will appear only during stand by. If you get a low voltage when it should be high, and vice versa, check the diode polarities and polarities of C7 and C8.

If the voltages check out the Sonic Switch is ready to go. Apply power. Quickly touch J1's hot terminal twice. The hum pulses will cause RY1 to trip. If RY1 doesn't trip, measure the voltage at the collectors of Q5 and Q8. If the voltages don't rise, check the connections of D1 and D2. Each finger pulse (remember, a quick touch) should produce about a 1-VDC indication at the junction

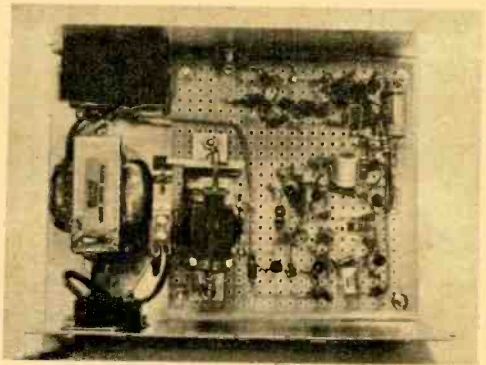


Fig. 6—Completed unit. Input jack is mounted 3½-in. in from left side of the U-section of Mini-Box (top). Transformer T1 goes at extreme left.

#### PARTS LIST

Capacitors: 15 V or higher unless otherwise indicated

- C1, C2, C3, C4, C6—.05  $\mu$ f
- C5—100  $\mu$ f electrolytic
- C7—50  $\mu$ f electrolytic
- C8—20  $\mu$ f electrolytic
- C9—.2  $\mu$ f
- C10—500  $\mu$ f, 50 V electrolytic
- D1 through D5—1N60 diode
- J1—Phono jack
- PL1—AC plug
- Q1, Q2—2N3391 transistor (GE)
- Q3—2N3392 transistor (GE)
- Q4, Q5, Q7, Q8—2N3393 transistor (GE)
- Q6, Q9—2N3415 transistor (GE)
- Resistors: ½ watt, 10 %
- R1—150,000 ohms
- R2, R3, R18, R29—10,000 ohms
- R4—68 ohms
- R5—220,000 ohms
- R6—18,000 ohms
- R7—150 ohms
- R8, R10, R11, R15, R17, R21, R25, R27, R28—4,700 ohms
- R9—1,000 ohms
- R12, R16, R26—2,200 ohms
- R13, R23—22,000 ohms
- R14, R24—15,000 ohms
- R19—560 ohms
- R20—3,300 ohms
- R22—2,700 ohms
- RY1—DPDT impulse relay, 24 VDC (Potter & Brumfield PC11D-24VDC, Allied 41 B 6506)
- SO1—AC receptacle
- SR1—Silicon rectifier; minimum ratings: 400 ma, 50 PIV
- T1—Low-voltage rectifier transformer; secondary: 10-20 c.t., 40 c.t. @ 100 ma (Allied 54 B 4732)
- Misc.—7 x 5 x 3-in. Mini-Box, crystal or ceramic microphone, perforated circuit board, push-in terminals

of diode D2 and resistor R20.

If the unit checks out, connect a crystal or ceramic mike (not dynamic) to J1, make your wish, clap twice and let the switch take over.

**How It Works.** The switch's secret of operation is a pair of flip-flops: Q4, Q5 and Q7, Q8. The signal picked up by a mike plugged into J1 is amplified by Q1, Q2 and Q3. The use of small-value coupling capacitors for C1, C2 and C6 attenuates the low frequencies predominant in speech and music or heavy footsteps. Maximum gain is given high frequencies such as are produced by impulse sounds like claps. The amplifier output is fed to voltage-doubler rectifiers D1 and D2.

Normally Q7's base voltage is low and its  
[Continued on page 113]

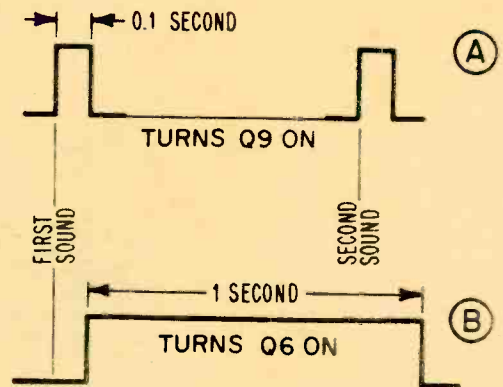
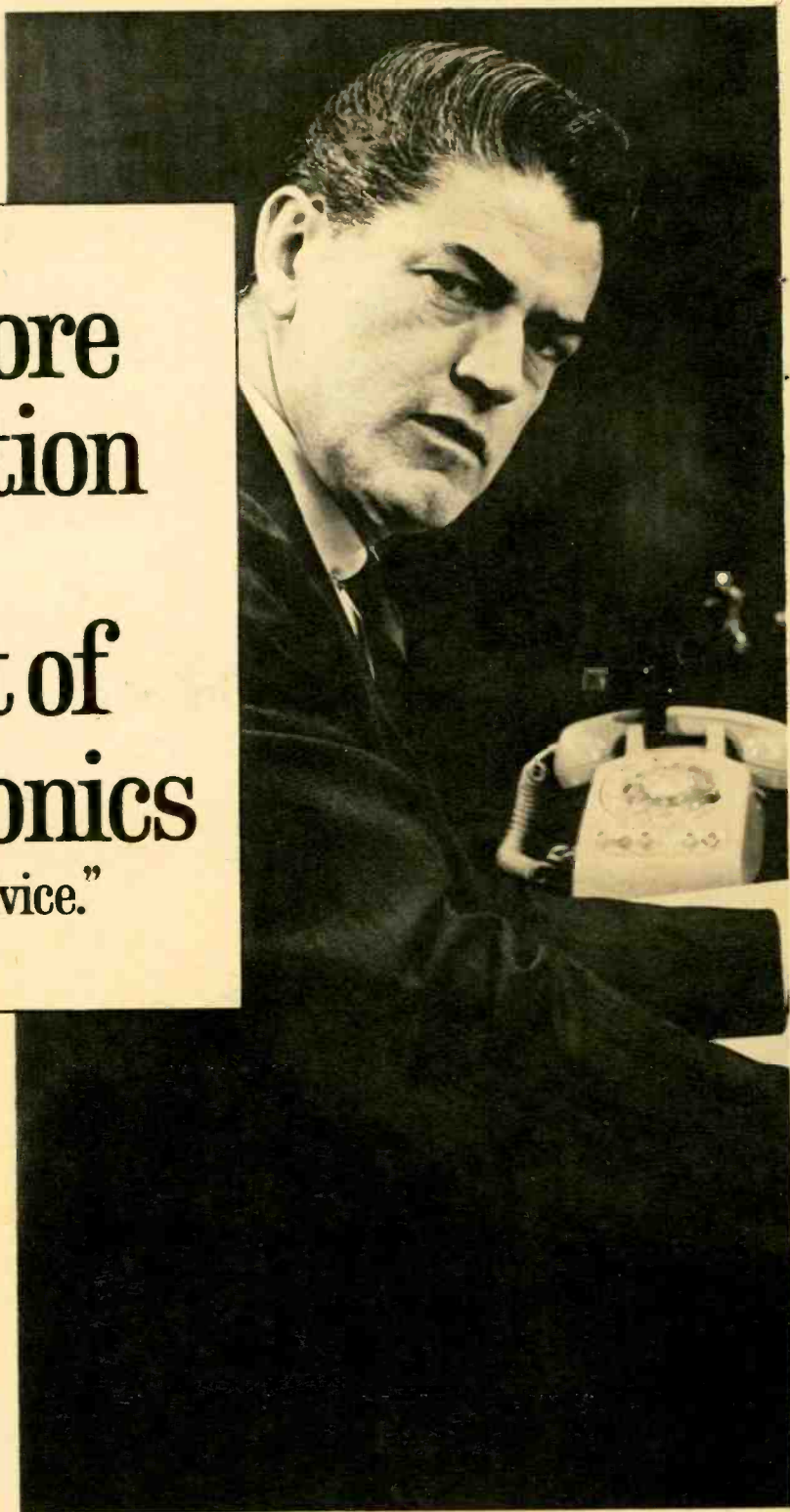
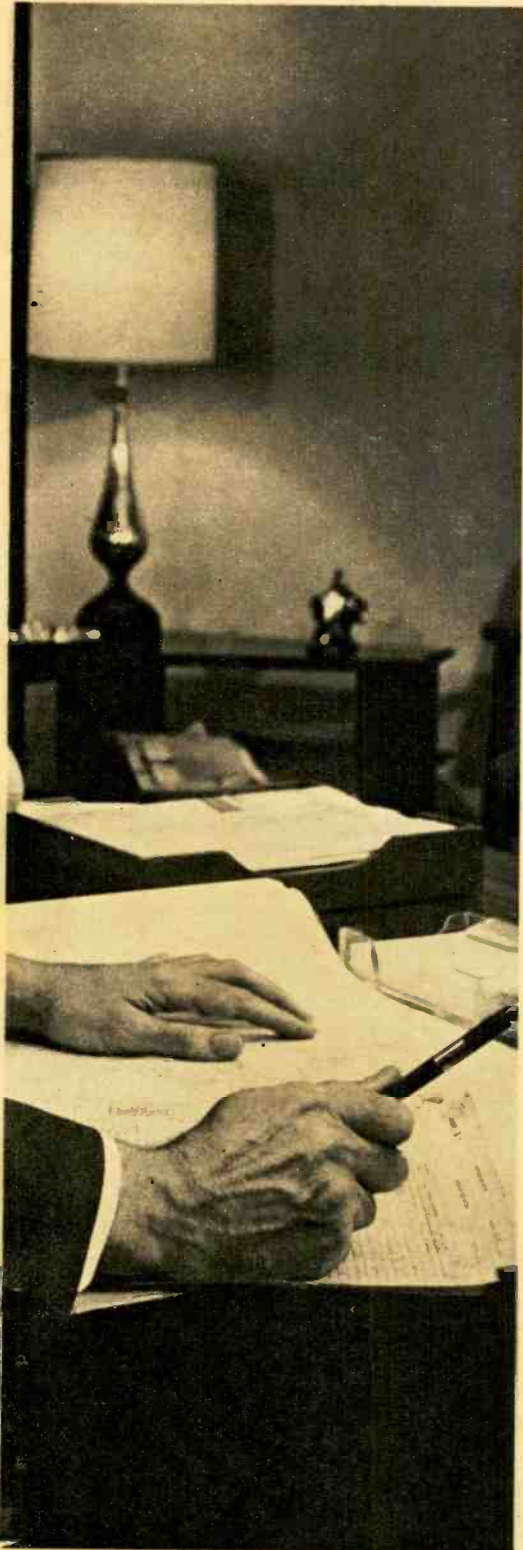


Fig. 7—First clap causes flip-flop Q7, Q8 to produce left pulse (A) whose trailing (right) edge causes flip-flop Q4, Q5 to produce 1-sec. gate (B). Second clap in 1 sec. turns on Q9 and RY1 trips.



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# The Listener

By C. M. Stanbury II

## Airlanes on the Airwaves

**A**IRBORNE radio transmitters represent a unique situation for DXers. They are quite different from ground stations and satellites because they're located in the lower part of the troposphere, below the ionosphere. And, so far as we know, little research has been done on distant reception of VHF airborne signals because such signals normally are intended for short-distance communications.

But with the great antenna height of airborne transmitters, seemingly spectacular VHF loggings are possible even under normal conditions. For example, a jetliner flying at 30,000 ft. can be heard, without help from the troposphere or ionosphere, 250 mi. away, though the receiving antenna may be located at sea level. The aircraft's signal will strike both the ionosphere and lower troposphere at angles not possible from a ground-base station, probably increasing scatter-wave effects.

There also is the matter of ducting, the phenomenon responsible for most FM broadcast DX. Most ducting takes place between air layers of different temperature in the lower 1,500 ft. of the troposphere (Raytheon and the Air Force have experimented with similar ducting in the ionosphere) and normally both transmitting and receiving antennas must be within the duct. But if the signal from an airliner happens to strike the beginning of a duct area might it not travel even farther than it would with normal ionospheric or tropospheric propagation? Maybe DXers with pioneering spirit can help supply answers. And, unlike the crowded FM and TV channels, the aircraft band seldom is haunted by QRM.

The VHF aeronautical band runs from 118 to 136 mc. There are several inexpensive receivers available for adequate DX reception, including the Allied 2671, which also can be used for limited satellite reception on the 136-138 mc band. We have experienced excellent VHF DX results with only the 2671's built-in telescoping rod.

Considerable patience is required to determine the aircraft's location because many reporting points appear only on aeronautical

charts. The ground station being worked provides a clue. Depending on altitude of the aircraft, however, it can be anywhere up to 250 mi. from that location. Incidentally, any change in altitude reported via radio usually is minus the last two digits—if you hear a pilot report reaching 2-3-0 he is at 23,000 ft.

Address your reception report to the Communications Supervisor of the appropriate airline at the location (airport) the aircraft was working. It should be accompanied by a self-prepared QSL card, stamped and self-addressed so that someone with the airline merely has to sign and mail it back to you. Don't report aircraft less than 300 mi. from your location. They cannot be considered DX and you'd simply be making a nuisance of yourself.

[Continued on page 119]

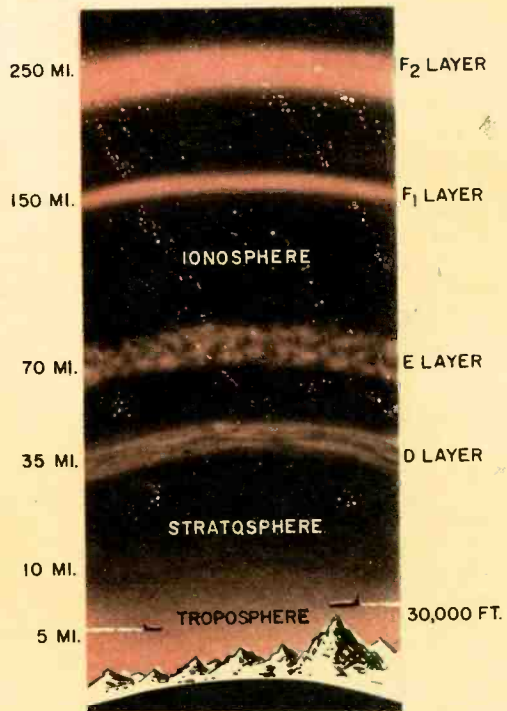


Diagram of factors affecting propagation (not to scale) illustrates how airborne signals can be carried beyond the 250-mi. radius to which they are limited in normal direct radiation (see text).

By VINCE DANIELS



# Portable PA

**T**HE PTA meeting has been called to order. The speaker is introduced and starts talking. Two minutes later there's a voice from the back, "LOUDER, Charlie, I can't HEAR you!" Then giggling and foot-scrapping. And the speaker loses his place. And you'd just as soon go home, especially if you happen to be the speaker.

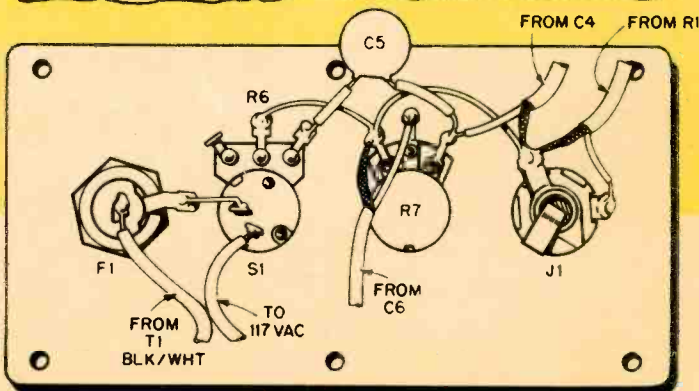
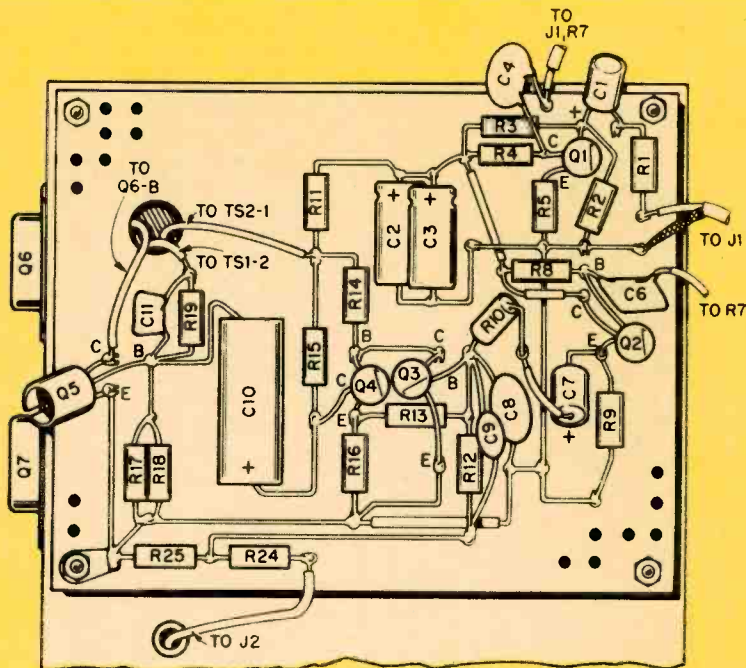
It need not happen again. The solution is our Portable PA system, which provides sound-reinforcement amplification and then some. As a two-speaker sound column (right photo, above), it becomes a lectern with a fold-out shelf for your notes. If the room is wide and a table available, the speakers can be separated and placed on each side of the room (center photo, above). After the meeting is over the speakers can be latched together side by side for easy carrying (left photo, above).

Before we go further let's look at the difference between a public-address and a sound-reinforcement system. With a PA system the speaker may be out of sight but his voice is brought to the audience via an amplifier and loudspeakers. The voice may be distorted but the listeners get the message. A sound-reinforcement system adds enough wide-response amplification to make the speaker sound as though he has a strong voice. The effect is that there appears to be no amplification.

The Portable PA is a sound-reinforcement system whose amplifier



Fig. 1—Amplifier board is shown mounted on top of upper part of chassis. Put ¼-in. spacers or nuts between board and chassis; ½-in.-dia. hole in upper left corner is through board and chassis. Controls, input jack and fuse holder are mounted on 3 x 5½-in. piece of aluminum. Connecting leads are about 20 in. long.



## Portable PA

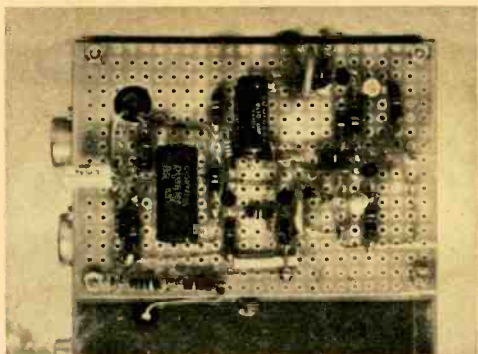


Fig. 2—Photo of top of chassis. Objects sticking out at left side are transistors Q6 and Q7. Between them is Q5, which is pushed toward board.

is almost ruler-flat from 100 to 15,000 cps. It has an IHF power rating of 15 watts at less than 1 per cent distortion. When used with a good-quality microphone, speech reproduction is almost perfect. (Response is attenuated below 100 cps to prevent speaker overload at high volume levels.) The amplifier and its controls and jacks are mounted in the bottom of the lower speaker cabinet to provide extra stability to the column. The note holder is a hinged shelf with a locking bracket that folds out from the top of the upper speaker. The mike is mounted on a flexible gooseneck which attaches to a small mounting flange on top of the column. The AC cord is stored in a compartment in the

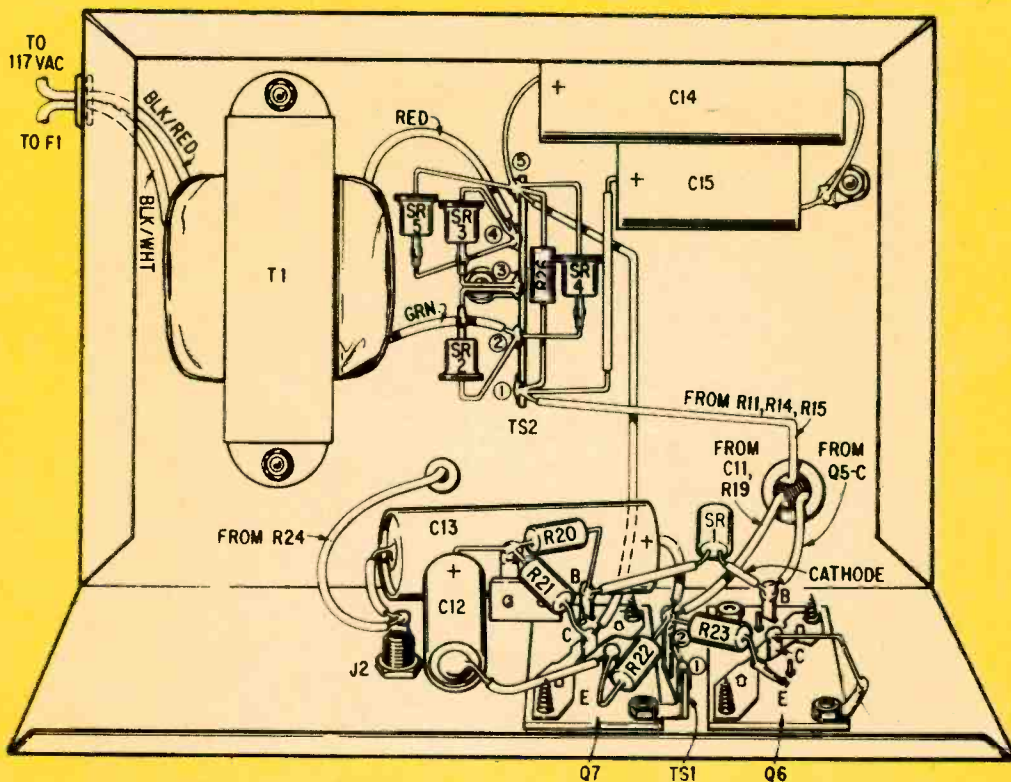
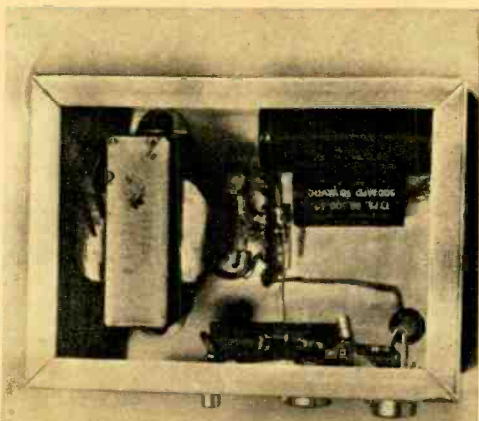


Fig. 3—Underside of chassis. Note how transformer T1 is mounted in upper left corner to keep it away from board, which is on other side of chassis at right. There's a red dot near SR1's cathode lead. Use mica washers between Q6, Q7 and chassis and plastic bushings in mounting holes so screws don't touch chassis.

bottom of the lower speaker cabinet (Fig. 6).

**Construction.** You'll have no trouble if you follow our construction sequence. The amplifier is built on a 7 x 5 x 3-in. aluminum chassis. Before drilling any holes, cut a 3½ x 4¾-in. piece of perforated board and drill

Fig. 4—Best place to start construction is underside of chassis in area around Q6 and Q7 at bottom. Continue with power supply, then board.



a mounting hole in each corner for a No. 6 screw. Position the perforated board on top of the chassis with one edge almost flush with the upper chassis edge and mark and drill four mounting holes in the chassis.

Temporarily mount the board to the chassis and drill a ½-in.-dia. hole through the perforated board and the chassis at a point approximately 1 in. down from upper edge and ¾ in. in from the left side as in Fig. 1. Remove the board and set aside.

Mount power transformer T1 under the chassis away from the board area. Next, drill a ⅜-in.-dia. hole for the power cord and the holes for the output-transistor sockets (Q6 and Q7). The template supplied with the transistors indicates specific hole size for the base, emitter and collector leads. To avoid heartaches later, drill ¼-in.-dia. holes for the collector-mounting screws. The specified holes are so close to tolerance that Q7's collector will short to the chassis if the socket



### PARTS LIST

**Capacitors:** rated at indicated voltage or higher  
 C1—10  $\mu$ f, 6 V electrolytic  
 C2,C3—50  $\mu$ f, 25 V electrolytic

C4,C8—.1  $\mu$ f, 50 V disc  
 C5—.02  $\mu$ f, 50 V disc  
 C6—.25  $\mu$ f, 50 V disc  
 C7—6  $\mu$ f, 15 V electrolytic  
 C9—33  $\mu$ f, 500 V disc  
 C10,C12—250  $\mu$ f, 15 V electrolytic

C11—.001  $\mu$ f, 50 V disc  
 C13—1,000  $\mu$ f, 25 V electrolytic  
 C14—2,000  $\mu$ f, 50 V electrolytic  
 C15—500  $\mu$ f, 50 V electrolytic

F1—1-A fuse and holder  
 J1—Phone jack  
 J2—Phono jack  
 PL1—Phono plug

#### Transistors

Q1—2N3391 (GE)  
 Q2—2N3394 (GE)  
 Q3—2N3393 (GE)  
 Q4—2N3416 (GE)  
 Q5—40452 (RCA)  
 Q6—2N2148 (RCA)  
 Q7—40465 (RCA)

**Resistors:**  $\frac{1}{2}$  watt, 10% unless otherwise indicated

R1—22,000 ohms  
 R2,R11—10,000 ohms  
 R3—220,000 ohms  
 R4—6,800 ohms  
 R5—47 ohms  
 R6—25,000 ohm audio-taper potentiometer with SPST switch

R7—10,000 ohm audio-taper potentiometer  
 R8—1 megohm  
 R9,R15—1,000 ohms  
 R10—220 ohms  
 R12,R13—100,000 ohms  
 R14—33,000 ohms  
 R16,R17—100 ohms  
 R18—200 ohms  
 R19—2,200 ohms  
 R20,R21—150 ohms, 1 watt  
 R22,R23—0.82 ohms, 1 watt  
 R24,R25—560 ohms  
 R26—330 ohms

S1—SPST switch on R6  
 SR1—1N3754 silicon rectifier (RCA)  
 SR2,SR3,SR4,SR5—1N1763A silicon rectifier (RCA or equiv.)

SPKR 1,SPKR 2—8-ohm speaker and cabinet (Olson S-580)

T1—Low-voltage rectifier transformer; secondaries: 10-20 V c.t., 40 V c.t. @ 750 ma (Allied 54 B 4734)

**Misc.**—transistor sockets, uni-directional mike (Lafayette 99 H 4545 or equiv.), 13-in. gooseneck (Lafayette 44 H 1026 or equiv.), male mike flange (Atlas AD-12), terminal strips, transistor mounting kit (see text).

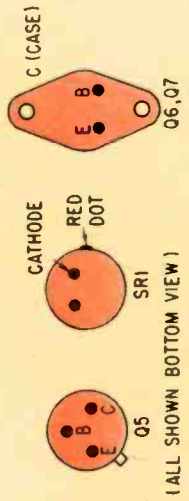
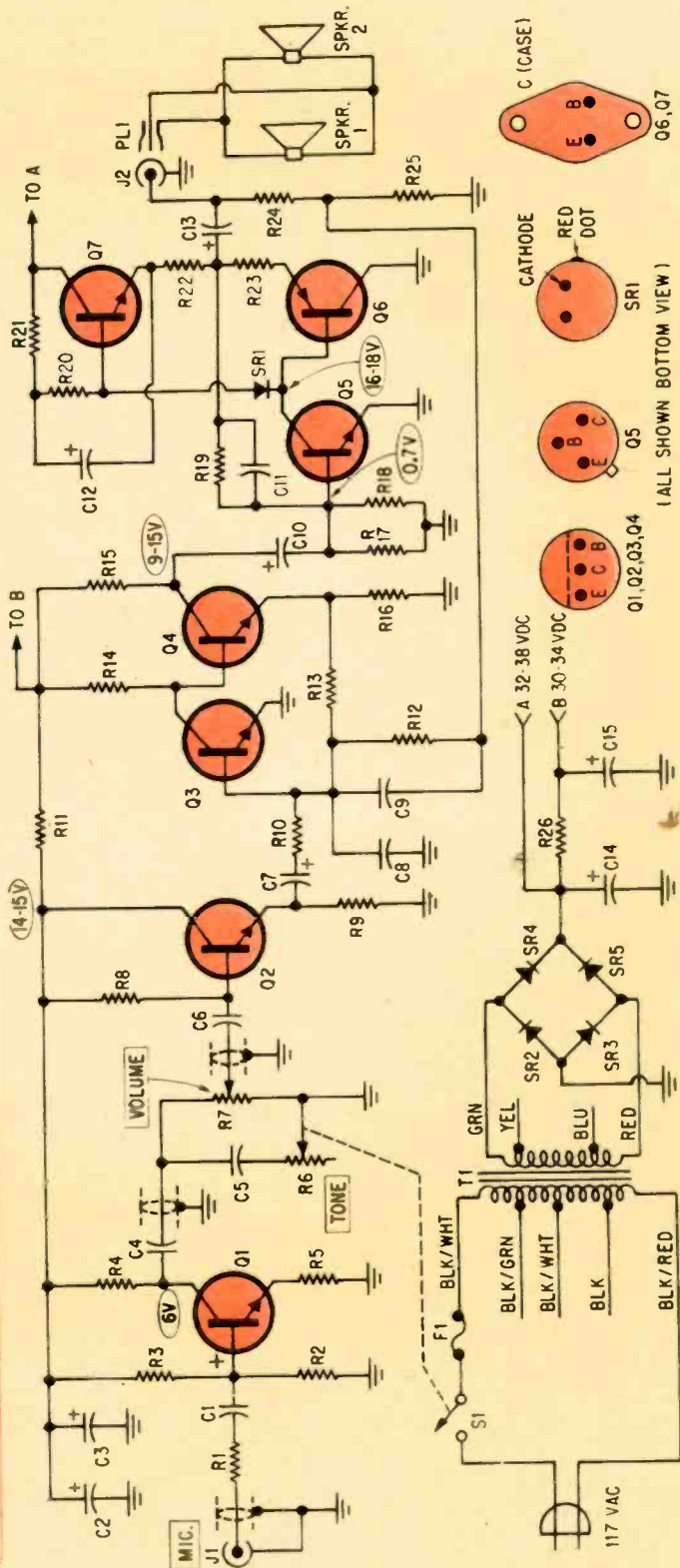


Fig. 5—Schematic. Voltages in ovals are measured with VTVM and may be within range specified. Q6, Q7 are in complementary-symmetry configuration.

# Portable PA

is slightly out of line (which it probably will be).

Finally, drill the remaining holes for output jack J2, terminal strip TS2 and the C14, C15 ground lug. Mount all under-chassis components and the transistor sockets, then install Q6 and Q7. The mounting kit for Q6 and Q7 (Lafayette 19 H 1531) provides a thin mica washer to be placed between the transistor and the chassis; make certain it is used. We suggest that you apply silicon grease to both sides of the mica washer to insure proper heat sinking of Q6 and Q7.

Take extra care when installing diode SR1. Make certain the lead near the red dot on the side of the case—the cathode—connects to Q6's base. Use insulation on both of SR1's leads and do not cut them short. When all chassis components are installed set the chassis aside and start the board.

Use Vector T28 terminals for tie points. Note that a single ground bus is used. It is connected to the chassis with a solder lug at the lower left mounting screw. Follow the layout closely. Because the amplifier has high gain, crossed input and output leads may result in oscillation.

Transistor Q5 comes with an attached heat sink. Under no circumstances substitute some other transistor for Q5. While even RCA has a so-called direct replacement for Q5, the replacement does not have the heat sink. And

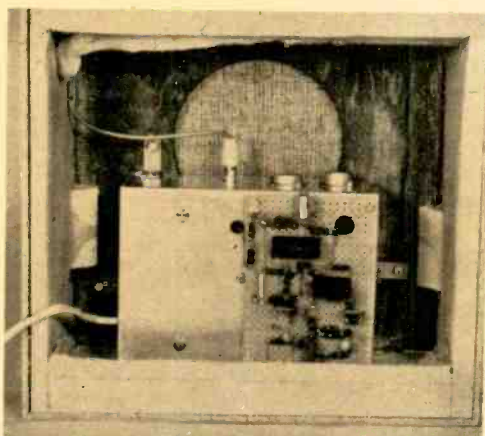
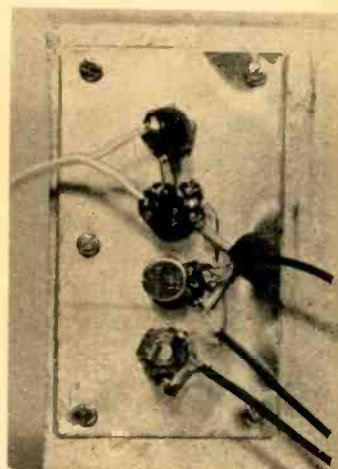


Fig. 6—Amplifier is mounted with three brackets in bottom of lower speaker cabinet; see Fig. 9 for cutting dimensions. Hole is the existing port.

Fig. 7—Input jack, controls and fuse holder are mounted on piece of aluminum in removed section of back panel as shown in detail in Figs. 8 and 9. Six screws hold plate to the panel.



Q5 normally runs *hot*. Don't worry about it, though. If you can't melt solder on the heat sink everything's safe. After Q5 is installed fold it over to provide a little extra space in the cabinet.

The transistor leads should not be cut short and use a heat sink, such as an alligator clip, on each lead when soldering. Complete the board but do not install R18 because it might not be needed. It is installed only if final checkout indicates it's required.

Insert four 3/4-in.-long No. 6 screws from the chassis underside up through the chassis and the board mounting holes. Then mount the board, using four 1/4-in. spacers, and a ground lug under the lower left mounting nut. Connect the ground lug to the amplifier's ground bus. Directly opposite R25 drill a 1/4-in. hole and insert a rubber grommet. Complete the amplifier wiring and attach a temporary line cord.

**Checkout.** Connect the negative lead of a DC voltmeter set to indicate higher than 40 VDC to the chassis and connect the positive lead to the junction of C14 and R26. Turn on power and watch the meter. If the meter doesn't rise almost instantly to the voltage shown in the schematic (Fig. 5), pull the plug and check for a wiring error. If the voltage checks out move the meter's positive probe to Q5's collector. The voltage at this point with no signal into the amplifier should be 16 to 18 V—preferably 18. If it is lower, say 12 to 15 V, install R18 and check again. If the voltage is still below 16 V reduce the value of R18 until the voltage is at least 16 V—better to get it up to 18 V.



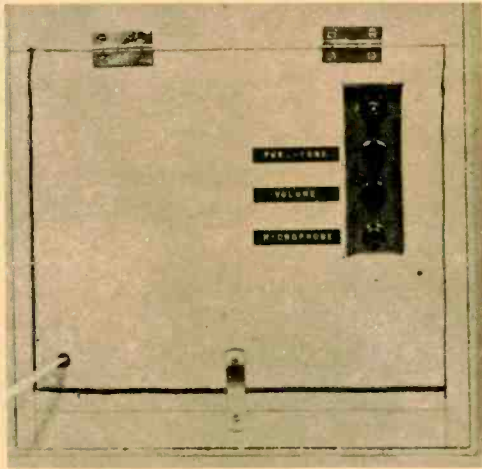


Fig. 8—Section of back panel can be removed with saber saw and should be hinged to allow access to amplifier and storage space for mike, cable.

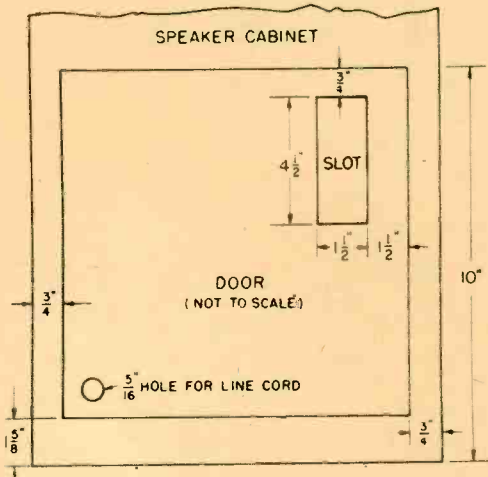


Fig. 9—Use these dimensions to cut rear panel of bottom speaker. Latch (Fig. 8) permits quick access to the amplifier and cable-storage space.

## Portable PA

The voltage at Q4's collector will be between 9 and 15 V, depending on the gain of Q3 and Q4—there is a natural gain variation in transistor production. If the voltage is outside the range try different transistors of the same numbers. The voltage at the junction of R8 and R11 must be in the range of 14 to 15 V. If it is not, change the value of R11 accordingly. In most cases the voltages will check out; we detail the test procedure only because it is possible your transistors will not match ours exactly.

If the amplifier checks out set it aside and cut the back panel of one speaker as shown in Figs. 8 and 9. Use a saber saw to get a clean cut. Then cut the slot in the door for the control panel.

The control panel is a 3 x 5 1/2-in. piece of aluminum held to the door with six screws. Prewire the entire panel and note that all panel-lead shields connect to the panel ground points but that the shield of only the wire from J1 is connected to amplifier ground. Cut off the remaining two shields at the amplifier end and tape them so that a shield strand does not touch an amplifier part. Mount the amplifier in the bottom of the cabinet with angle brackets—on three sides of the amplifier.

Using a shielded wire, connect the am-

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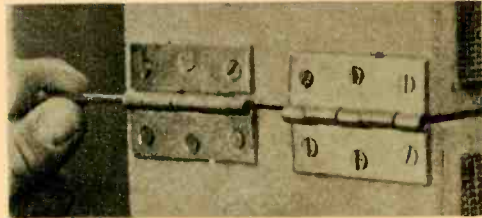
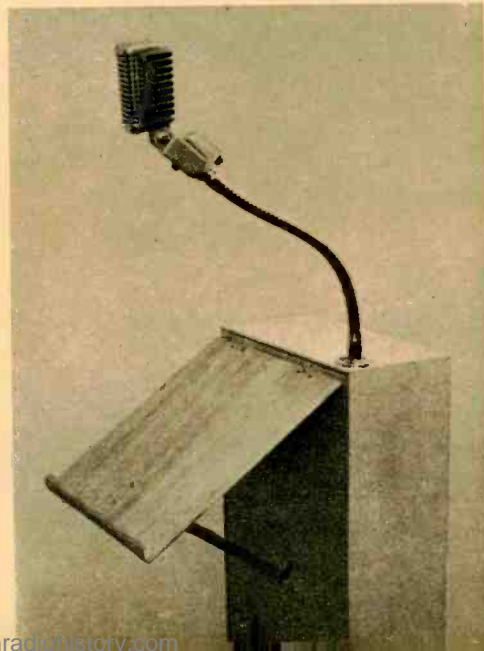


Fig. 10—Use hinges with removable pins so speaker cabinets can be separated quickly or attached for carrying and for sound-column setup.

Fig. 11—The mike mounting flange is located on the lower right corner of the top speaker and the mike gooseneck is screwed into the flange.



By SCOTT ROBERTS ABOUT a year ago EI announced: "FM, once called the good-music medium, is becoming something else . . . the kind of radio broadcasting that turns people off." When the issue came out, we received a request for permission to reprint from two other magazines and letters from disgruntled readers suggested general agreement with what we had printed.

Not that there was anything particularly new in the point of view. The last few years have produced many complaints about how FM—and stereo FM, in particular—was betraying its early promise to be *the* quality radio medium, in both programming and technical quality.

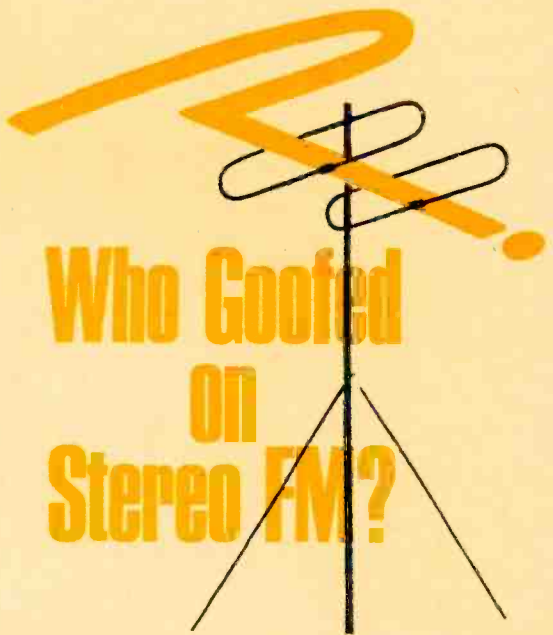
"One barrier to the sale of better FM stereo receivers is the lack of really good programming," says the sales manager of a leading receiver manufacturer. "Too many stations don't care what they put out over the air. Some automated stations may let a tape play at the wrong speed for half an hour without doing anything about it. I know one station that regularly drops its stereo-carrier signal without warning."

Then there is the axiom about stereo reception. Stereo FM (as opposed to mono) underlines the effects of poor reception in much the same way and for the same reasons as color (as opposed to B&W) TV. It figures, then, that many listeners are satisfied with their FM reception until they get a stereo receiver. Anyway, that line of reasoning has been used to sell a lot of super-directional antennas and rotators.

Well, how bad *is* stereo FM—and why? EI decided to find out. But the surprising result of our survey of readers is that, in their opinion, FM stereo is not bad at all. They like it! They listen to it! They're glad they spent money on it! But let's take it one step at a time.

For one thing, although FM traditionally has been a local medium (there are no significant FM networks, for example) and has been hidden in the shadow of television, EI readers seem to find it of fairly uniform quality across the country. Listeners rate programming excellent or good by a wide margin (23% called it excellent, 55% called it good) while 19% said programs were only fair and only 2% classified programming within range of their receivers as poor.

More than half feel that stereo is much



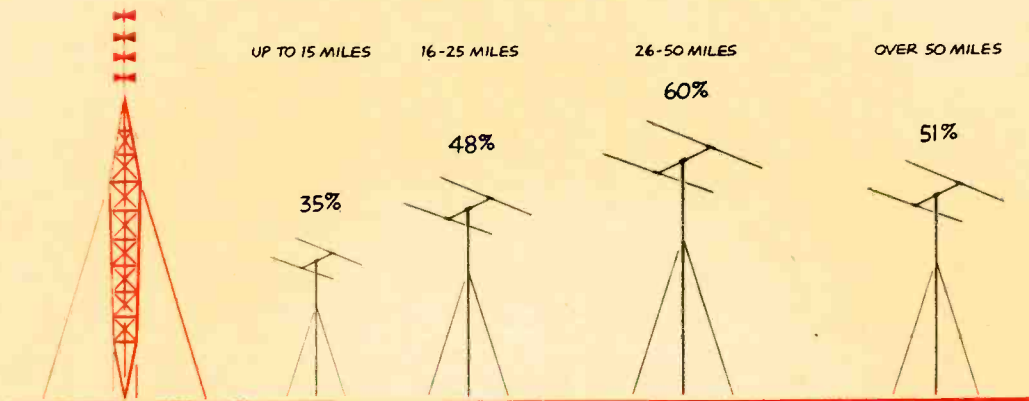
more enjoyable than mono, while an additional 21% have a slight preference for stereo. About 24% of the readers we asked said they have no preference between stereo and mono. None expressed a preference for mono. Similarly, the overwhelming opinion of our readers is that their investment in stereo FM equipment has not been wasted.

Few people concentrate their attention on radio whenever they have it turned on, of course. And if you don't *listen* to radio how can you tell whether it's good or bad? As the results started to come in we were surprised to find that the answers to one question showed our average stereo-owner listens a little over 2½ hours at a sitting—rather long for full-time attention. The answers to another question clarified that figure. Most (64%) gave the expected answer—that they used stereo FM sometimes for attentive listening, sometimes as background music; the remainder were precisely divided between those who usually listen attentively and those who seldom do. So we might say that our average listener spends about half of his 2½ hours in attentive listening—enough to get a pretty good idea of what's there to be heard.

Indications are that EI readers are well above the national average in FM listenership. For example, better than 60% had listened to FM stereo within 24 hours of our survey. And more than 25% said they had listened for four hours or more the last time



## DO YOU USE AN OUTDOOR ANTENNA?



the set was on. But more dramatic, still, was another fact that has emerged from the survey: Those who listen most closely to stereo FM are heartiest in praise of it. Of those who say they usually listen attentively, over 90% called their investment in equipment well worth it, while only about 75% of the rest were so enthusiastic.

Returning to our average listener, we find that he can pick up anywhere from one to more than 20 stereo FM signals (the median is 6.5 and over 60% of our sampling were able to get at least five stereo signals well).

To do so, less than half depended on an outdoor antenna. Not surprisingly, those living within 15 mi. of stations they listen to relied least (35%) on roof-top jobs (see Fig. 1). As distance from the transmitters increases, so does the tendency to choose an outdoor antenna—until you reach 50 mi. Beyond that point, for reasons we haven't been able to pin down, the figure drops once again.

Distance also affected listeners' evaluation of stereo FM quality. In Fig. 3, you will see that with greater distance the difference between stereo and mono was judged to be less dramatic. But comparing stereo FM with discs and tapes (which sound the same anywhere) showed FM to least advantage *closer* to the transmitters than 15 mi. Urban multi-path and overload of tuner front ends by strong local signals probably account for this.

The comparison between stereo FM and stereo tapes is particularly interesting. Only 35% of our listeners said they have a tape

Fig. 1—Our survey determined how our readers respond to the rule-of-thumb that the farther you are from a stereo-FM station the more you need an outdoor antenna for good reception. Predictably, percentages using outdoor rigs rise, area by area, with the distance—but only until you get 50 mi. from the transmitters. Readers were less impressed with the quality of FM stereo in the under-15-mi. zone than they were in areas farther away.

## IS STEREO FM WORTH WHAT YOU PAID FOR YOUR EQUIPMENT?

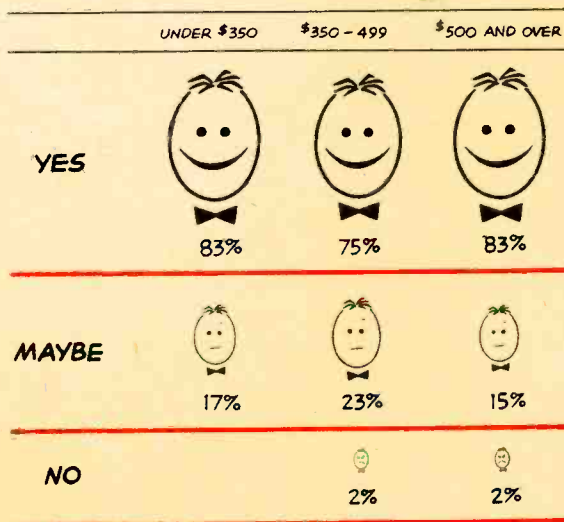


Fig. 2—Most of our readers owning stereo FM equipment are pleased with their investment in spite of loud complaints from FM's critics. Curiously, those with a moderate investment were somewhat less pleased than those who had spent either more or less. Reason appears to be that, while rock-bottom stereo FM is a good buy these days, only the finest equipment is capable of satisfying the fastidious. Prices include an allowance for adding tape and disc playback equipment to all systems.



recorder in their system—yet about 70% had an opinion on the FM-vs-tape question. So we must take their opinion with a grain of salt. If we did not, we would have to assume that stereo tapes are better than stereo discs since only about half of those expressing an opinion found FM as satisfactory as tapes while well over half found it as good as records. All we can say under the circumstances, however, is that our readers seem to *believe* tapes to be better.

Another surprise came when we compared the satisfaction of our readers in their investment in stereo FM equipment with the size of that investment (Fig. 2). As it turns out, the most pleased were those who had paid minimum prices and those who had shelled out a good deal.

“The reason for a drop in the middle group,” a component dealer explained, “is that for very little money these days you can get excellent FM stereo equipment. The sur-

vey figures are a comment on the excellent value that table FM radios, budget kits and components represent. They pull in enough stations to satisfy the average listener. But you can't tell as much difference between a \$100 and \$200 tuner as you can between ones costing \$50 and \$100. It isn't until you get to the upper reaches—\$400, \$500 and more—that quality improvements again become dramatic.” And those with champagne tastes probably will consider it all worthwhile only when they can afford that kind of equipment.

Because so many EI readers have a technical background we believe our sampling was particularly qualified to judge the performance of the nation's broadcasters. That stereo FM comes away with such high marks would seem to be a tribute to the local broadcaster's desire to provide the kind of service most listeners want—whatever our so-called experts may have to say.

### IS STEREO FM QUALITY AS GOOD AS . . .

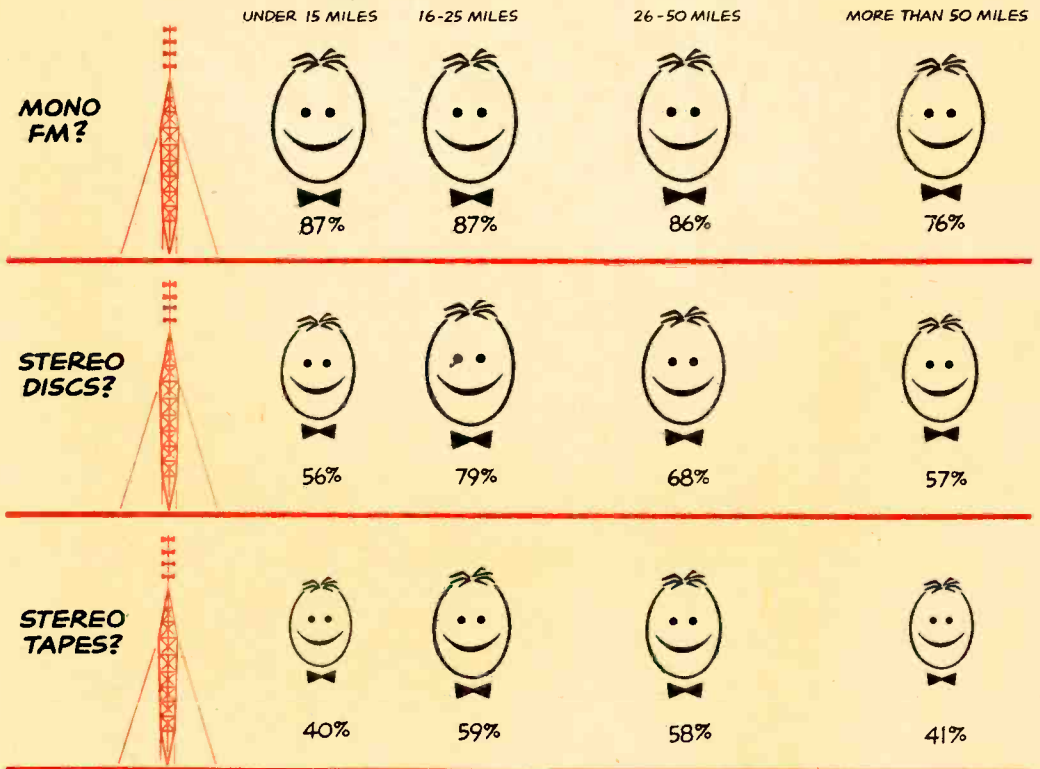


Fig. 3—Smiling faces represent yes votes among those in each zone giving us an opinion on relative merits of stereo FM. In addition, some expressed no opinion—particularly on stereo FM vs stereo tapes. But many who said they had no stereo recorder still had an opinion on this question, making replies dubious.



**T**HE FIVE million transmitters operating in the U.S. are oozing into every corner of the radio spectrum. Television sprawls on UHF through channels 14 to 83, yachtsmen steer toward a new marine band up near 150 mc, the country's cops just received 20 additional channels, commercial two-way radio soon will expand to 145 new frequencies. If everybody else is doing it, why doesn't CB get its share of the spectrum strudel? The ironic answer: CB already owns more than double the number of channels it exploits. Trouble is, the frequencies are up-up-and-awayyy.

CB's big brash band, as a million operators know, is Class D. It's the 23-channel slice of 27 mc that made it on a winning combination of easy licensing and inexpensive equipment. But also woven into FCC rules are three other CB classes—A, B and C. What ever happened to them? Well, one is dying, another is marked for extinction, the third recently needed a transplant.

**Class A.** On the face of it, Class A sounds like the dream of every power-starved, interference-ridden CBer. The band permits 60 watts—a dozen times more than the 5-watt limit of Class D. And Class A offers 48 channels—more than double that of Class D. But before you turn in your rig to the Salvation Army Signal Corps, consider Class A's downfall.

Its frequency range is 462-467 mc, which makes it UHF. To reach any reasonable distance, equipment must boast sophisticated circuits, many stages, high power and a 6-in. antenna mounted at skyscraper height. That antenna's not the only thing that's high. An inquiry to a major manufacturer on Class A prices brought the reply: "... available in the price range from \$600 to \$900 per mobile unit." Actually, the company markets this unit for commercial and government stations that operate on other UHF channels. It converts the set to Class A merely by plugging in the proper crystals.

That's only part of Class A economics. To obtain a license, you have to hire a professional surveyor to measure map coordinates of the antenna location. Then you'll

need help in choosing a channel from a Frequency Advisory Committee. You'll call an FCC-licensed technician to make periodic measurements of power, frequency and modulation.

No wonder that, according to a recent report, there are only about 6,000 licenses in Class A. Final twist happened a few years ago when the FCC yanked Class A from the regular Citizens Band application (Form 505). Now it's on Form 400, where police, fire, taxi, industry and other two-way professionals do their filing.

**Class B.** The second band, the granddaddy of CB, now is nearly 20 years old. Like Class A, it is assigned to UHF—with basically one channel on 465 mc. The huge difference is that Class B equipment needs nowhere near the sophistication demanded of Class A. Frequency accuracy must be held to within 0.001 per cent on Class A; Class B may be 500 times sloppier at 0.5 per cent, opening the way for cheap Class B equipment. At least two manufacturers entered the market with low-cost transceivers. Despite a 5-watt power limit and an operating range barely more than shouting distance the sets enjoyed some success. Then came 1958 and Class D, and the old 465-mc sets vanished.

At last count there were only 6,250 licenses on the band and practically all were tagged for garage-door openers (the band also may be used for control). But even this is on its way out. There now is a proposal before the FCC to kill Class B.

[Continued on page 116]

EI's GUIDE TO THE CB BANDS				
Class	Freq. (mc)	Chan.	Power (watts)	Remarks
A	462-467	48	60	Primarily voice, AM and FM. Equipment cost high.
B	465	1	5	Voice and R/C.
C	27	6	5	R/C only. One channel (27.255 mc) may operate 30 watts.
	72-76	5	1	Model aircraft R/C only.
D	27	23	5	Voice. Most popular band.

# COPING WITH TV's No. 2 BAD GUY

By ART MARGOLIS



**W**HEN a TV set is on the blink, chances are good that a tube is to blame. If not, it probably is a power-supply capacitor—whether the TV is color or B&W, tubed or transistorized. So if you're quick on the draw at troubleshooting filter capacitors you'll be able to knock off a large percentage of TV repairs.

The only service equipment you need is a spare filter capacitor or two. Let me show you how simple it really is with four case histories from my notebook.

**The first victim** seemed to be in pretty bad shape. It had no sound or picture although the heaters of the tubes lit up. Its owner wrung his hands fretfully as I looked over the tubes.

Since there was no action in the TV at all the trouble had to be in a circuit common to all the others. Since the heaters were working, it looked like the culprit was in the B+ line from the power supply (Fig. 1). If the B+ voltage is not present at the plates of the tubes they will not operate even though the heaters are lit.

In transformerless TVs like this, the 60-cycle, 117-VAC house current is rectified and doubled to positive, rippling DC. Then the DC is passed through a filter network to remove the ripple. In order to get the high B+ voltage without a transformer, this type of supply relies on a large capacitor—say 150  $\mu\text{f}$ , 150 V—in series with one side of the line.

Should it open, the B+ is stopped dead and all activity ceases. This is such a common occurrence that I carry a spare capacitor with me in addition to tubes.

The fix is easy. I locate the oversize troublemaker and snip the wires, making sure to note which one went to the plus end and

which one to the minus end. Then, leaving the old capacitor in place, I mount the replacement nearby and attach the leads, taking care to observe polarity.

In this case, the TV resumed normal operation. The owner gave me that "Oh, thank you, dear Dr. Gillespie" look and I wrote out the bill.

**Another case** concerned a shrunken picture. All four sides had pulled in from the edges of the screen and the sides of the picture were not straight but curved. In addition, there was a loud hum in the sound.

Weak B+ will reduce the horizontal and vertical deflections and shrink the picture. Unadulterated weak B+ will do this evenly—the sides of the picture remain straight and there is no distortion in the sound. When open filter capacitors lower the B+ voltage they also allow DC ripple into the B+ line. The ripple appears as bending in the picture and hum in the sound.

The cure is fairly easy. Locate the filter capacitors and bridge them one by one with a spare. When you bridge the defective capacitor the condition will improve somewhat even if the replacement value is not exact. I took the one I carry with me (50  $\mu\text{f}$ , 450 V) and, being careful to observe polarity, started testing.

The culprit (the third one I tried) turned out to be a 120  $\mu\text{f}$ , 150 V. When I replaced it with a new one of the same value, picture and sound popped back to normal.

**The next case** involved one of those barely portable portables with a transformer power supply. The transformer makes B+ by stepping up the 117 VAC to about 350 VAC which is then rectified to DC and filtered to take out the ripple. In this type, the rectifier



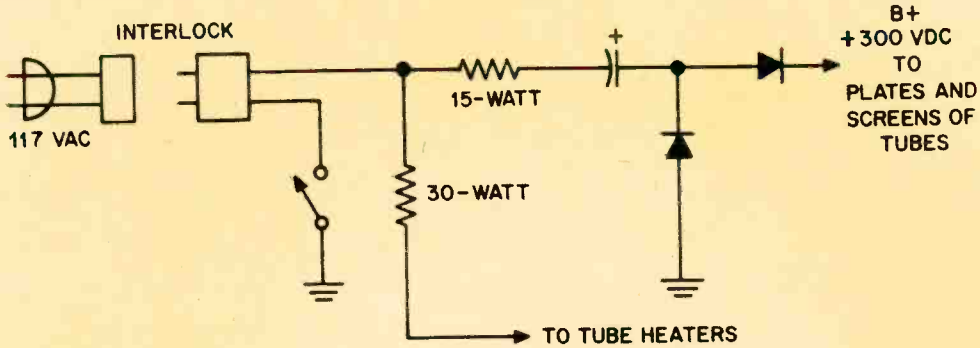


FIG. 1-POWER SUPPLY

## TV's No. 2 BAD GUY

usually is full-wave, changing the 60-cycle input to DC with a 120-cycle ripple. When the filters do not do their job the 120-cycle ripple gets into the B+ line. That puts a 120-cycle component into the picture and the sound.

I turned on the portable. The screen had two thick black bars going horizontally through the picture. They were 120-cycle bars. If they had been caused by 60-cycle ripple there would have been only one.

I took a 50  $\mu$ f, 450 V filter capacitor and

attached the negative end to the chassis. When I turned on the TV again the hum bars returned and I began touching the plus end of the filter methodically to the plus end of each of the TV's various filters. Nothing happened, except a bunch of loud pops as the filter charged and discharged. Still, it had to be a filter. Filaments in these circuits receive 60-cycle AC so a heater-to-cathode short in one of the tubes would have produced a single bar in the picture.

I began another tack. Bridging works only when a filter opens or has a high-resistance short. A capacitor with a low-resistance short must be disconnected to relieve the short be-

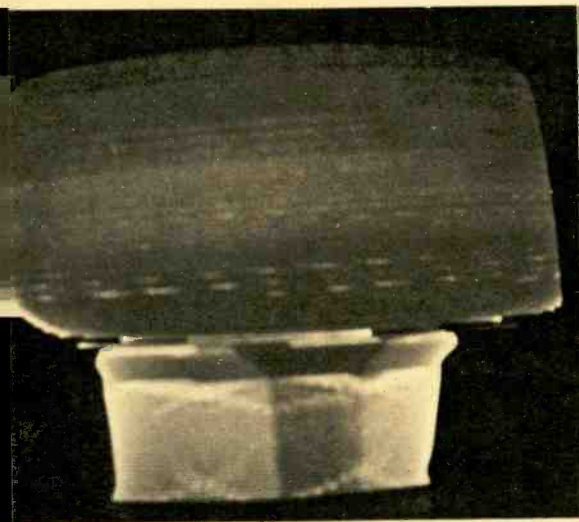


Fig. 3—This weird mushroom-cloud effect in picture is caused by open filter in the power supply.



Fig. 4—Commonest TV filter-capacitor breakdown makes picture shrink, pull and develop hum bars.

Simplified diagram of a transformerless power supply in Fig. 1 relies on capacitor for voltage doubling. Full schematic would show additional filter capacitors following diodes. Where multiple-capacitor cans are used, code markings at terminals may not look exactly as they do in the listing on side of can (Fig. 2). Positive connections are keyed with these symbols: common negative (ground) is unmarked.

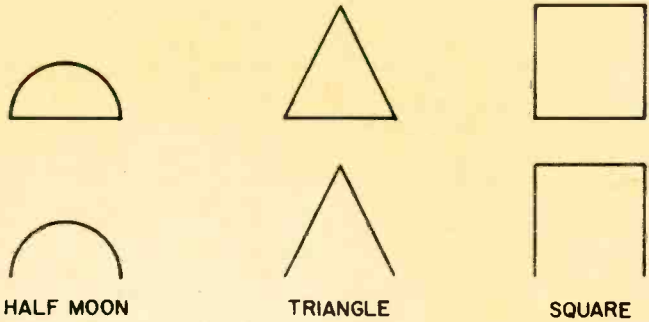


FIG. 2—MULTIPLE FILTER MARKINGS

fore you bridge in a new capacitor. It's tedious, but it's the only way.

The fourth one I bridged did the trick. The 120-cycle hum disappeared. The bad capacitor was a 50  $\mu$ f, 375 V. I installed a 50  $\mu$ f, 450 V to give the replacement a little better safety tolerance.

I once took a service call from a boxing promoter. His trouble looked something like 60-cycle hum except that it was turned 90° and appeared as a vertical band (Fig. 6 shows the reverse effect, with a faulty filter in the vertical output). As he demonstrated his problem to me the promoter gave the set a sharp left hook to its side. The trouble

cleared. Then he walked around and gave the set a right cross. Back came the banding.

This, too, was a filtering problem. The B+ to the horizontal circuits was not being filtered and each horizontal line was affected.

I began bridging the filters one by one. Some of the filter capacitors were in cans. You'll find two, three or four separate filters all in one can. Their positive terminals are separate but they share a single negative terminal—the can itself. You must be careful of this type.

Inside the can, the capacitors are separated by insulators. If the insulation should de-

[Continued on page 110]

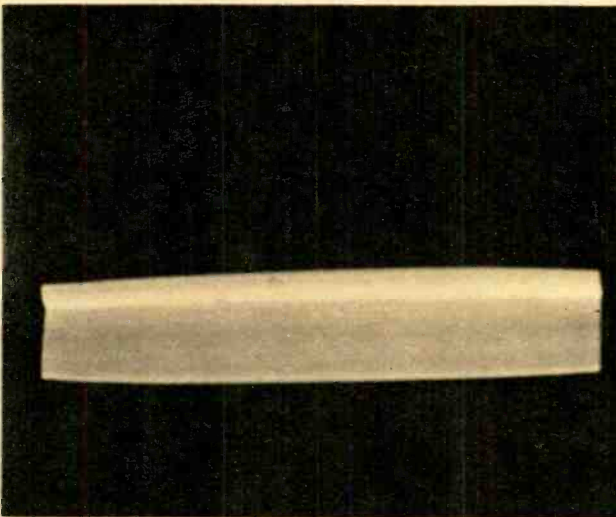


Fig. 5—The classic 60-cycle hum bar that you can hear as well as see is caused by a shorted filter.



Fig. 6—Banding is across screen for filter short in vertical output (up and down if in horizontal).





## How Long Do Stereo Records Last?

By BOB SWATHMORE

Grooves between arrows were played repeatedly in test, show wear under microscope.

**I**F you take your phonograph records at all seriously it's likely you feel a little uncomfortable every time someone digs up those statistics about how many tons per square inch a stylus exerts on the groove walls of a record. You can't help wondering how on earth your records manage to survive—particularly if you don't own the latest, fanciest equipment.

Long-time readers of EI will remember that in our November 1959 issue we published results of what has been called the most exhaustive test yet made by anyone of the factors that affect record wear. But how well do those results stand up today? Re-examination of the subject provides a startling conclusion: most of what we said in that article remains true today. Only the names, the model numbers and the details have changed.

In 1959 the stereo record was celebrating its first birthday. Best of the changers then available were the Garrard RC-88, the Collaro TC-99 and the Glaser-Steers GS-77. The first round of stereo cartridges had proved a bust. But new ones introduced a month earlier at the New York High Fidelity Show—the Shure M3D, the Pickering 380 Flux-valve, the Weathers Ceramic and Fairchild SM-1—promised better results.

The 1959 tests were made with a battery of Glaser-Steers GS-77 changers (shown on the opposite page). A solenoid was attached to each changer so the change cycle could be tripped with the pickup at a point on the record where a wire projecting back from the pickup arm met a movable upright contact bar. By setting the index screw on the changer the point at which the play cycle would begin could be adjusted. Usually about 35 sec. of playing time was allowed between the two points. Evaluation of the completed tests involved an elaborate system of book-keeping and classification. Variables like stylus force, record cleanliness and interval between plays were evaluated along with the stereo cartridges.

Rule No. 1, laid down on the basis of test results, went as follows: Use a high-compliance, low-mass pickup. In 1959, high compliance meant  $4.0 \times 10^{-6}$  cm/dyne (the rating for the Shure M3D). Today, it may mean as much as  $25 \times 10^{-6}$  cm/dyne (for the Shure V-15 Type II). Low mass in 1959 meant a cartridge that weighed at least  $\frac{1}{2}$  oz. (like the GE VR-22), while today's best weigh no more than  $\frac{1}{4}$  oz. (Pickering's XV-15, for example).

Rule 2: Set the stylus force correctly and check it from time to time. In 1959, the best



Exhaustive wear tests by EI used a battery of modified changers with various cartridges to play small portion of records over 1,000 times in some cases. Here stylus tracking force is being double-checked.

you could hope for in tracking force with a good stereo cartridge in a quality changer was 3 to 7 grams. Optimum results usually were reached at about 4.5 grams. If you wanted to track at a lower force you'd have to use your cartridge with a turntable and a separate tone arm. Then you could track at 2 to 4 grams.

Today record changers like the Garrard SL-95, the Dual 1009-SK or 1019 or the Miracord with any of the leading cartridges will allow you to track records at 0.75 to 2 grams, with optimum results at about 1.75 grams. These automatic turntables also have built-in tracking-force scales—much more accurate than the spring scales, levers and other gadgets of 1959. A major shift in tone-arm design from spring-loaded pick-up models to dynamically balanced ones has been a big improvement. But the principle EI laid down in 1959 still stands.

Our findings nine years ago proved that record wear increased much more rapidly as tracking force fell below optimum than it did as the force was raised. (If tracking force is too low, the stylus goes careening around like a car out of control on a winding road.) In other words, low tracking force is desirable only if you don't push it too far. This certainly is still true. If the cartridge manu-

facturer suggests 1.5 grams, for instance, you'll be better off at 1.75 grams than you will at 1 gram. Probably much better off.

Likewise with Rules 3 and 4: Cleanliness is equal to godliness when it comes to making stereo records live. And the stereo cartridge must be installed with great care to insure long record life. Following these two rules to the letter can net an astounding number of plays for a stereo record. Under ultra-fussy conditions, the 1959 setup netted 1,150 plays with no appreciable wear except for impact noise where the stylus landed at the beginning of each cycle. Dispensing with the frills still allowed upward of 800 plays with the best cartridge (at 3 grams) before really serious damage had been inflicted. Life expectancy today should run about double the 1959 figures.

At what point does record wear become serious? That, of course, depends on who's doing the listening—what wear effects he can tolerate, and to what degree, before he finds them objectionable.

One new development is the elliptical or bi-radial stylus tip. There seems to be no doubt that it will track today's stereo groove more precisely than will its standard (conical) counterpart. How it will affect record wear.

[Continued on page 110]



Ameco R-5



# Extended-Coverage Receiver

**R**EMEMBER the old budget communications receiver? You know, the \$40 to \$50 five-tube job which suffered from miserable sensitivity at lower frequencies, practically no sensitivity above 15 mc, terrible stability and a fixed-frequency BFO which was a shade better than worthless.

Fortunately that set is going the way of the vacuum tube and is being replaced by better-performing transistor receivers. Such a receiver is the Ameco R-5, a 12-transistor set whose performance is several cuts above that of its five-tube counterparts. The R-5 kit sells for \$64.95. Assembled it's \$79.95.

Although the R-5 still feeds the antenna directly into the mixer stage (no RF amplifier), there are two IF amplifiers, variable BFO and an oscillator voltage regulator. The R-5 tunes .54 to 54 mc continuously in five bands. A logging-type bandspread dial can be used at all frequencies. Front-panel con-

trols include BFO tuning, volume, RF gain as well as noise limiter on-off, AM-CW, power on-off and band-selector switches. The headphone jack, which disables the internal speaker, is also on the front panel. The rear apron contains the antenna terminals and muting terminals. The latter enable the receiver to be muted by a transmitter's T/R relay. A battery kit is available to permit the receiver to be operated from a 12-V battery supply.

The receiver's sensitivity at several frequencies is shown in the chart at the end of this report. These are for the standard 10db S+N/N ratio. While the figures may not be as good as those of more expensive receivers, they are good when compared to the old five-tube budget receivers.

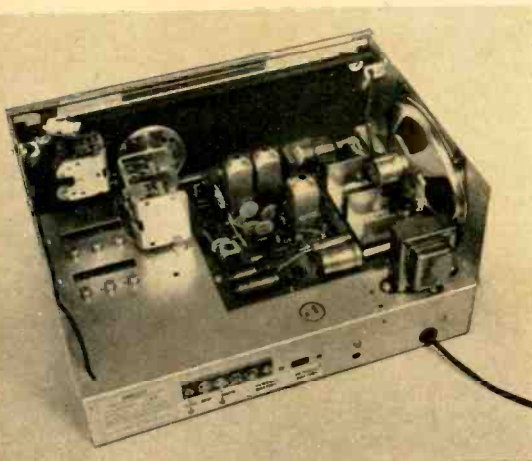
Similarly, the figures shown for image rejection, the receiver's sensitivity to image frequencies, are quite good compared to five-tube receivers, and even the poor image performance of 7db at 27 mc compares favorably with the image rejection of some \$100 to \$150 CB transceivers.

The R-5's front-end coils and capacitors are supplied factory mounted and aligned, and the sensitivity and image figures are based on factory alignment. The builder peaks IF transformers on a received signal. Instrument alignment produced no noticeable improvement in performance.

Except at 7 mc where it was slightly rough, the BFO stability was notably good. Oscillator stability was good even at 52 mc. However, microphonic howling on the highest band (23 to 54 mc) was unusually severe. It was caused by feedback from the speaker through the chassis to the front end. Use of an external speaker or headphones eliminated this.

The AGC action was good. A 36db input-

[Continued on page 117]



With exception of front-end at left, almost all parts are mounted on board at right. The antenna, mute, and battery connectors are on rear apron.

5 MV

15 MV

50 MV

150 MV

.5 V

15 V



5V

15V

50V

150V

500V

OFF

# An FET Millivoltmeter

By WALT HENRY

**A**NY experimenter who knows his onions will tell you that the most useful measuring instruments to have on a bench are a VOM and a VTVM. He'll also quickly admit that when it comes to making measurements of extremely low AC voltages, the instruments are next to useless.

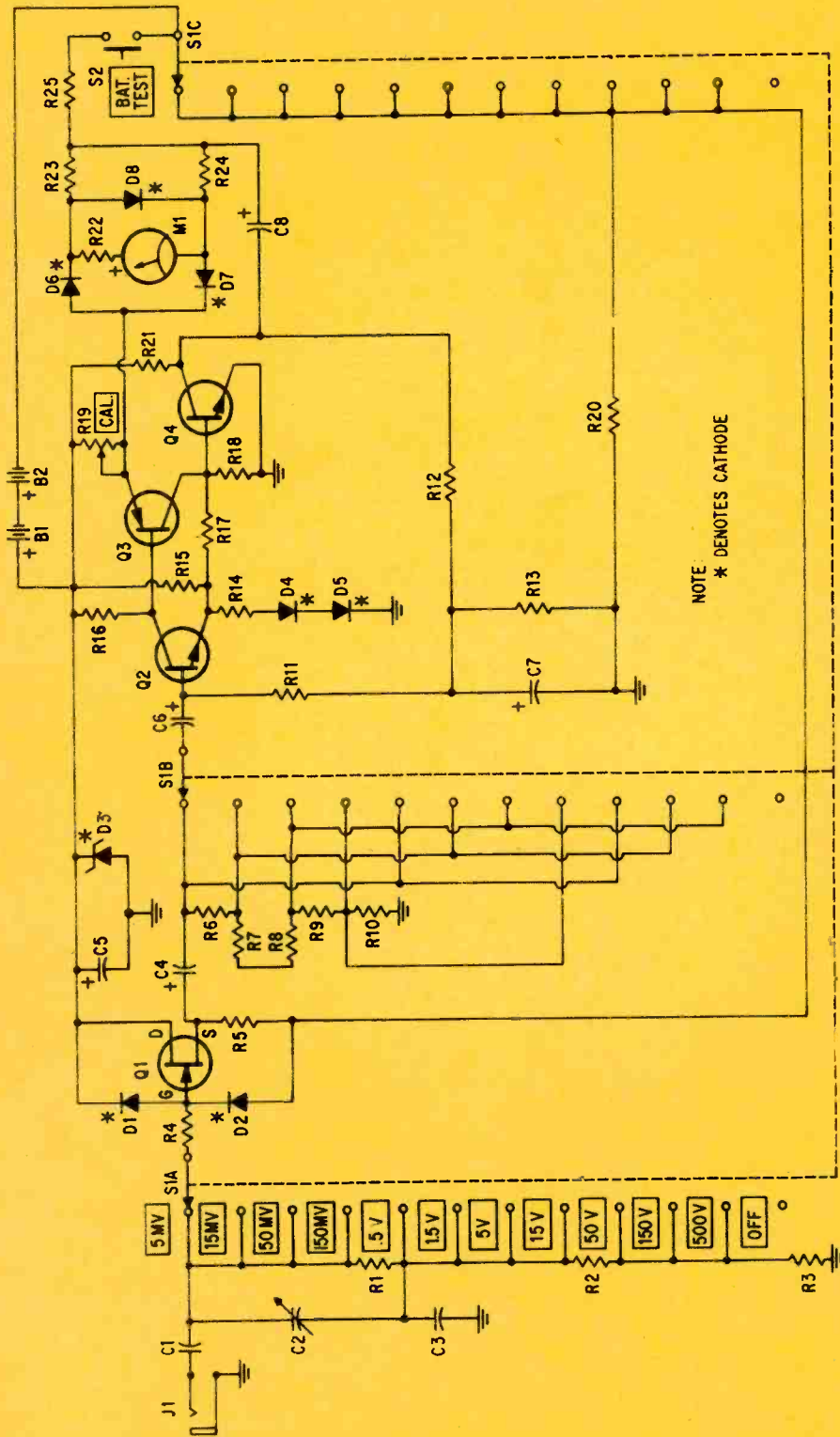
For example, to measure the gain of the low-level input stage of a stereo amplifier you need a VTVM that can measure AC down in the millivolt region. Do you know of any conventional VTVM's that can go that far down into the basement? And the instrument must have a high input impedance and wide frequency response.

Our FET Millivoltmeter fills these requirements and then some. Its full-scale AC (rms) ranges go from 5 millivolts to 500 V. It has a flat frequency response from 10 cps to beyond 1 mc and has an input impedance of 1 megohm on all ranges. As an added bonus it boasts the reliability of silicon solid-state circuitry and is battery powered. It is small and light, yet has a generous-size meter face which makes it easy to read. All it takes to own it is about \$25 for parts and a few evenings of construction time.

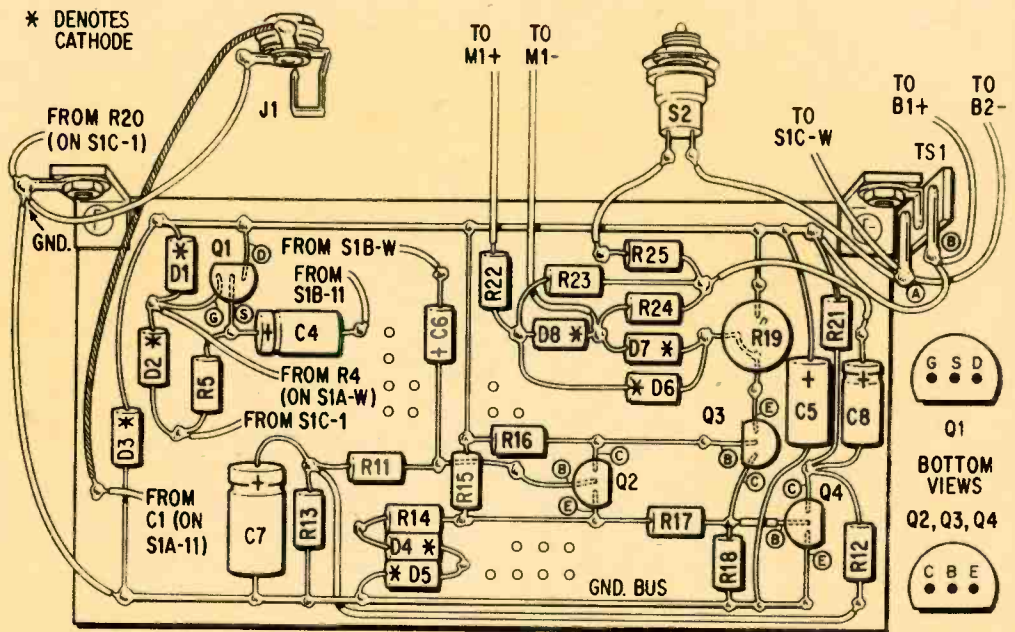
**Construction.** The amplifier should be laid out carefully on a  $5\frac{1}{8} \times 2\frac{7}{8}$ -in. piece of perforated circuit board. Be sure to duplicate our layout to prevent high-frequency oscillation.

Make sure all connections have good clean solder joints. Use the usual heat-sink precaution when soldering transistors and diodes. Do not





FET Q1 is connected as source follower. Input signal is applied through DC blocking capacitor C1 to frequency-compensated attenuator consisting of C2,C3,R1, R2,R3 and S1A. Input impedance is equal to sum of R1,R2 and R3. D1 and D2 protect Q1 against very high input voltages. Q1's output is coupled through C4 to second switch attenuator formed by R6 through R10 and S1B. Signal is then coupled by C6 to high-gain meter amplifier which consists of Q2, Q3 and Q4.



Input and amplifier stages are built on  $5\frac{1}{8} \times 2\frac{7}{8}$  in. piece of perforated board. Input jack J1 and battery-test switch mount on front panel below board. Note in photo at right the positioning of range switch S1 with respect to the board and how the two 9-V batteries are mounted on front panel.

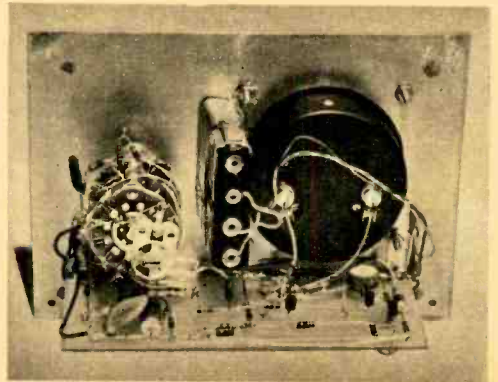
## An FET Millivoltmeter

overcrowd the amplifier components but at the same time keep all component leads as short as practical.

Note that the range resistors and frequency-compensation capacitors are mounted on range switch S1. We obtained good accuracy using 5 per cent resistors. The accuracy can be improved somewhat by using 1 per cent resistors for R1, R2, R3 and R8 through R12.

The FET (Q1) is a Motorola plastic-encapsulated semiconductor, it is a high-quality silicon unit and at \$1 is a bargain. Most N-Channel FET's with comparable specifications may be substituted. However, if you want to make a substitution here be sure you know what you are doing.

Many silicon transistors can be substituted for the 2N4124 and 2N4126. Make sure the type you want to use has a high beta at low collector currents. Be careful of diode polarities. D1, D2, D4, D5 and D8 should be silicon



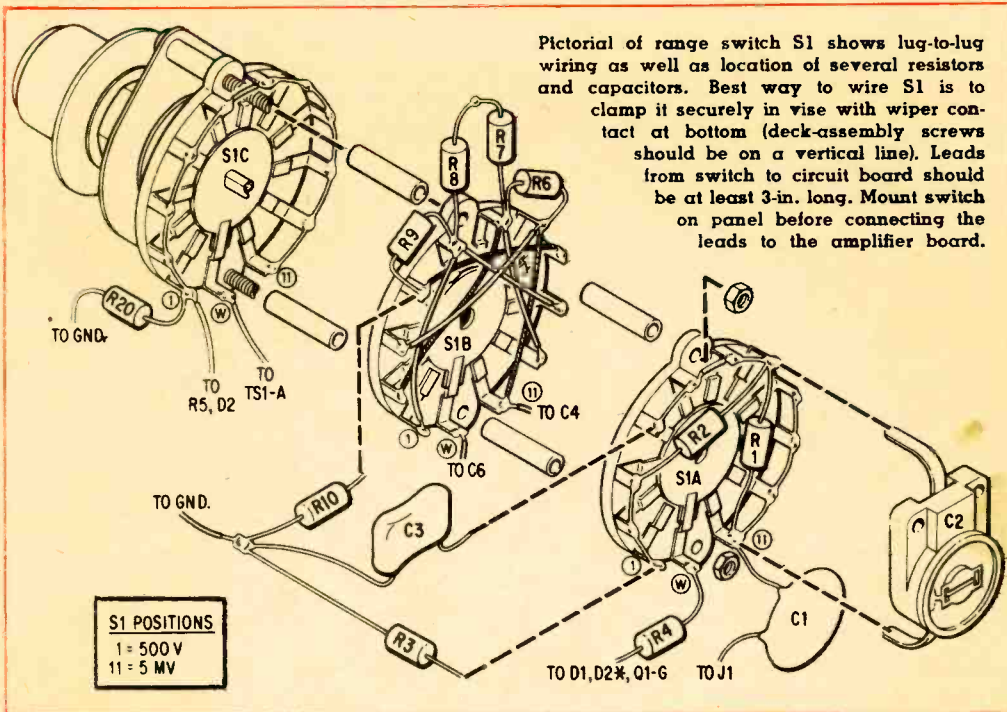
diodes similar to the 1N914. For best accuracy D6 and D7 should be germanium diodes such as 1N270.

The electrolytic capacitor values are not critical but should be kept reasonably close to those specified. Do not make C6 greater than  $1 \mu\text{f}$ .

Remove the adjustable stop on range switch S1; leave the fixed stop intact. Wire the switch so that it will turn from the *off* position to the 500-V position but will not turn to the 5-mv position. This will prevent severe meter overload if an input signal is being fed into the meter when the unit is turned on.

Make the battery holder from a couple of pieces of a tin can. Just bend it to shape





## An FET Millivoltmeter

around the batteries and solder together. Salvage battery clips from a dead 9-V battery.

An all-metal case must be used to shield the circuitry. Without it, noise and 60-cps hum will be a problem because of the tremendously high gain of the amplifier. Use a miniature phone jack for input jack J1. Note that the circuit ground is connected to the case *only* at the input jack.

**Checkout and Calibration.** After you have double-checked your wiring a few checks need to be made before calibration. First, turn S1 to the off position and install the batteries. Press *Bat. Test* pushbutton switch S2. The meter should indicate about 5.0 (full scale) with fresh batteries. Now turn S1 to the 500-V position. The meter may deflect momentarily but should quickly settle back to zero. If it does not return to zero check for a wiring error or shorted or leaky C8. Also check for leads that may be too close together and might cause oscillation in the amplifier.

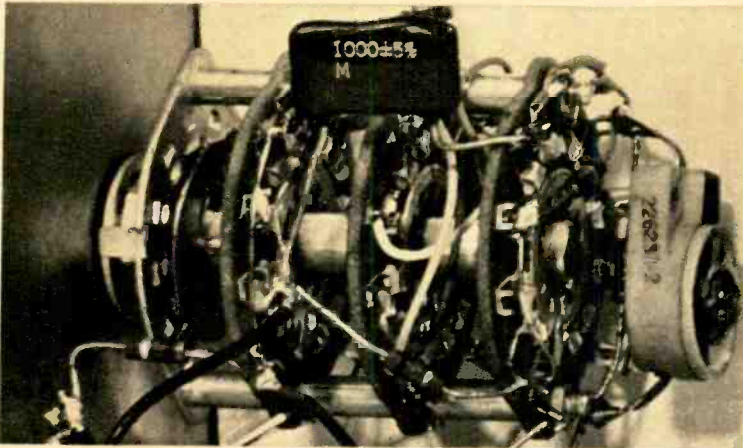
Connect the negative lead of a voltmeter to case ground. Measure the DC voltage at

the drain lead of Q1. This should be between 7.5 and 9.0 V. If it does not fall within this range a wiring error or faulty component is probably the cause of the trouble. If the first measurement is okay, check the voltage on the source lead of Q1. This should be between 0.5 and 3.0 V. Next, check the voltage at the collector of Q4. It should be between 3.0 and 5.0 V. If it should fall slightly out of this range a small change in the value of R13 should bring it in. An indication way out of this range means there is a wiring error or bad component.

When you have satisfactorily completed the above checks rotate S1 to each position. The meter may jump slightly between positions but should always quickly settle to zero. You are now ready to calibrate the instrument.

A quick way to get the basic calibration is to measure the 60-cps line voltage with a VOM or VTVM whose calibration you know to be accurate. Turn the range switch of the millivoltmeter to 150 V and connect it across the line. Turn R19 to obtain an indication identical to that on the reference meter.

The frequency-compensation adjustment requires a sine-wave oscillator and an oscilloscope. Connect both the meter and the oscillo-



Closeup of range switch S1. Deck A is at the right, deck B is in the middle and deck C is at the left. Trimmer capacitor C2 is at right. The rectangular object at top is capacitor C3.

scope to the oscillator output terminals. Adjust the frequency to 1,000 cps and set signal amplitude to get a 1-V indication on the millivoltmeter. Note the signal amplitude on the oscilloscope very carefully. Change the oscillator frequency to 100 kc and readjust the amplitude to the previous level on the oscilloscope. Adjust C2 in the millivoltmeter for a 1-V indication as before.

If you don't have access to an oscilloscope a wide-band VTVM can be used as the reference; just substitute it directly for the scope. If you don't need the wide-frequency response and don't want to fool with the compensation adjustment, C2 and C3 can be left out. The upper-response limit in this case will be about 50 kc, depending on parts layout.

Once you have completed the calibration it is a good idea to check the accuracy of each range if you have access to the necessary instruments. A calibrated oscilloscope or a comparable millivoltmeter that is known to be accurately calibrated will do.

Batteries should be replaced when the *Bat. Test* indication falls below about 3.5 with the power on but with no input signal. If batteries are used too long the calibration may be affected. In normal use batteries will last several months. If you will have the meter turned on for fairly long periods of time it is a good idea to use alkaline or mercury batteries. Or, you could use 12 penlite or C cells in series if you need to keep it in operation long periods of time each day.

The existing meter scale can be used for the 5 mv, 50 mv, .5 V, 5 V, 50 V and 500-V ranges. The 15 mv, 150 mv, 1.5 V, 15 V and 150-V ranges correspond to the 10, 20, 30, 40 and 50 markings on the meter's scale.

#### PARTS LIST

- B1,B2—9 V battery
- C1—.1  $\mu$ f, 600 V tubular capacitor
- C2—2.5-13  $\mu$ f trimmer capacitor (Centralab 822-BZ, Lafayette 33 H 2512 or equiv.)
- C3—.001  $\mu$ f, 500 V dipped silvered-mica capacitor
- C4—68  $\mu$ f, 15 V electrolytic capacitor (Sprague 150 D-686X0015R2, Allied 43 B 3280 or equiv.)
- C5,C7—100  $\mu$ f, 10 V electrolytic capacitor
- C6—1  $\mu$ f, 10 V electrolytic capacitor
- C8—10  $\mu$ f, 10 V electrolytic capacitor
- D1,D2,D4,D5,D8—1N914 diode
- D3—1N4738 zener diode (8.2 V, 1 watt. Motorola)
- D6,D7—1N270 diode
- J1—Miniature phone jack
- M1—0-50  $\mu$ a DC microammeter (Lafayette 99 H 5042)
- Q1—MPF103 transistor (Motorola)
- Q2,Q4—2N4124 transistor
- Q3—2N4126 transistor
- Resistors:  $\frac{1}{4}$  watt, 5% unless otherwise indicated
- R1—1 megohm
- R2,R5,R23,R24—10,000 ohms
- R3,R10—100 ohms
- R4,R16,R20,R22—1,000 ohms
- R6—2,000 ohms
- R7—20 ohms
- R8—680 ohms
- R9—200 ohms
- R11—22,000 ohms
- R12—15,000 ohms
- R13—12,000 ohms
- R14—39 ohms
- R15—8,200 ohms
- R16,R21—3,300 ohms
- R17—4,700 ohms
- R19—1,000 ohm, linear-taper potentiometer (Mallory MTC-4-1000, Lafayette 33 H 1671 or equiv.)
- R25—150,000 ohms
- S1A,S1B,S1C—3-pole, 11-position, shorting-type miniature rotary switch (Mallory 4M11311, Lafayette 30 H 4159)
- S2—Normally-open pushbutton switch
- Misc.—5 x 7 x 3-in. aluminum chassis (Premier ACH-428), 5 x 7-in. aluminum bottom plate (Premier ABP-423), perforated circuit board, flea clips, miniature phone plug to match J1, shielded wire (for test lead)

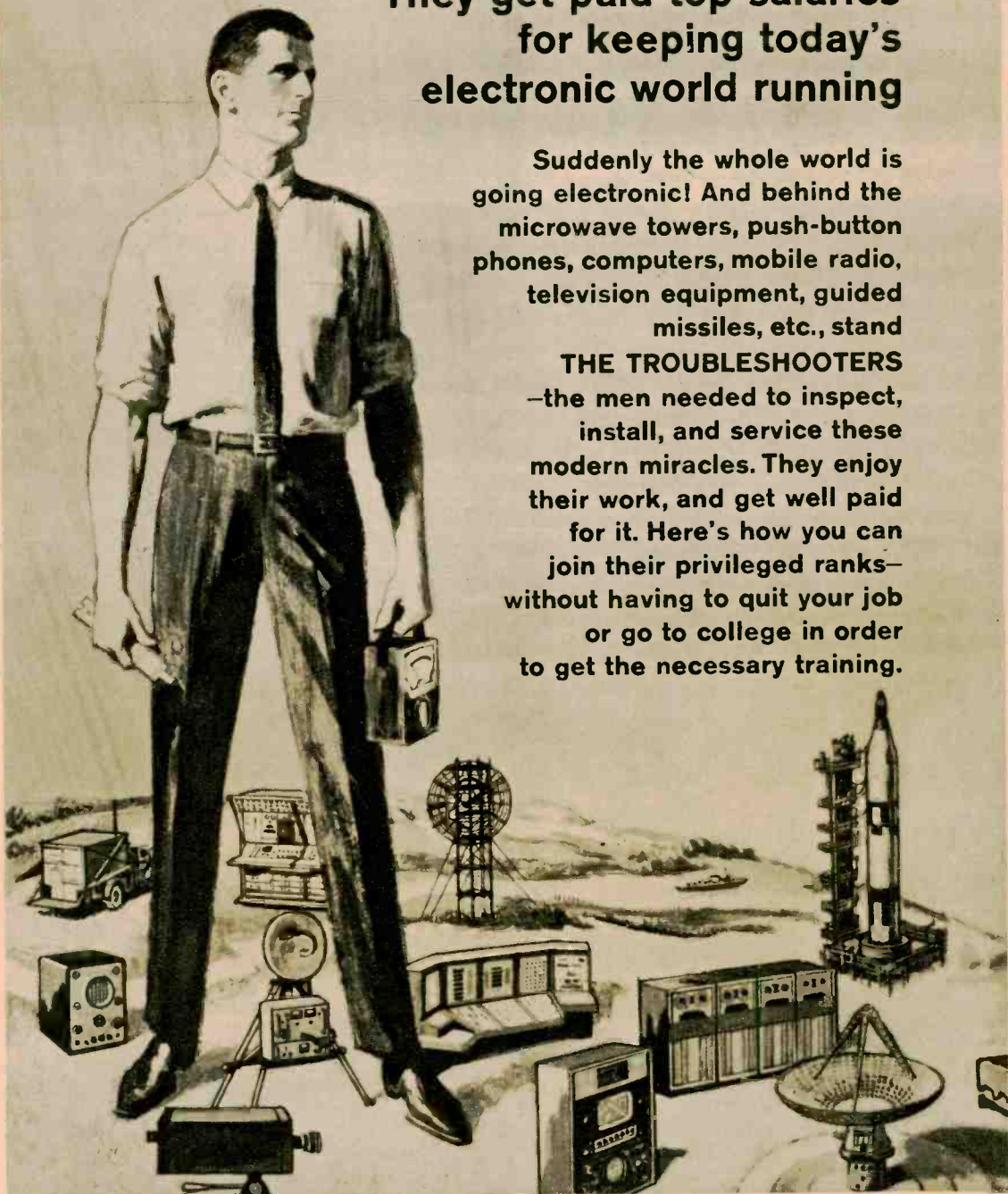


# Join "THE TROUBLESHOOTERS"

They get paid top salaries  
for keeping today's  
electronic world running

Suddenly the whole world is going electronic! And behind the microwave towers, push-button phones, computers, mobile radio, television equipment, guided missiles, etc., stand

**THE TROUBLESHOOTERS**  
—the men needed to inspect, install, and service these modern miracles. They enjoy their work, and get well paid for it. Here's how you can join their privileged ranks—without having to quit your job or go to college in order to get the necessary training.



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

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

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

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

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

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# CBing Canadian Style



*Citizens Band and General Radio Service—the unidentical twins.*

By ALAN LEVESQUE TO the vast majority of U.S. CBers, the Canadian version of the CB service (known officially as the General Radio Service but usually referred to as CB by its users) is just another chapter of the same old story. As it turns out, though, while CB and GRS are kissin' cousins they don't smooch as often as you might imagine.

Canadians are only too aware of the differences in the two services and sometimes are angered at the thought that Americans easily can get permission to operate their rigs in Canada while Canadian operators aren't given the same accommodation in the States. But almost all Canadians (and most Americans, too) are unaware that there are special circumstances under which Canadians are permitted to operate south of the border—but we'll come back to that.

The GRS came into being in 1962 at the insistence of Canadians who had witnessed the rapid growth of the CB service since its feeble beginnings in 1958. The Canadian Department of Transport (DOT—the Canadian counterpart of the FCC), was happy to work up a set of rules for the new GRS. They did it with a wary eye, however, attempting to avoid some of the problems of CB by working protective clauses into the GRS rules. The intention was to have a radio service where the licensees would communicate only with their own stations. To keep pandemonium at a minimum, the DOT requires that each individual transceiver be licensed separately at a cost of \$3 for a 3-year license. (In the U.S., \$8 covers a 5-year term and all of the transceivers owned by the licensee. Further, no set may be licensed unless it has type approval from DOT engineers.

American CB gear that passed the DOT hurdles still must go through Canadian Customs at a high import duty. There are, however, some Canadian manufacturers of approved GRS equipment—Benco, Chisholm, Lindsey, Hofstetter and Bailey Bros. among them.

There are other differences in licensing regulations as well. The applicant must be at least 18 years old in both countries. In the U.S. he also must be a citizen while Canada will license citizens, landed immigrants—permanent residents who do not have citizenship—and British subjects—which includes citizens of most British Commonwealth countries. An Australian tourist, for example, can take out a GRS license even though he is not a permanent resident. And Canada will allow a transceiver to be operated (under control of the licensee, of course) by an even larger group. Minimum age for users drops to 12 and non-resident U.S. citizens qualify.





Otherwise, operating rules are similar. Businesses in both countries may apply for licenses but, since there is less 27-mc traffic in Canada, business users tend to encounter less interference there and find the band more satisfactory for low-cost business use.

DOT regulations are quite specific about licensees not being permitted to work skip or broadcast music and entertainment. As an all-encompassing damper, they even include a statute that no transmission may be "of a frivolous nature." GRS rule 73(1)(b) does permit communications between stations of different licensees "where the business or personal activities of the licensees are of mutual interest." If this suggests communications relating to equipment performance or QSL cards and general chit-chat, forget it! That's just what the DOT means by frivolous.

**On the technical side, GRS channels are basically identical to CB channels with the exception that the Canadians are not allowed to use American CB channels 1, 2, 3 and 23.** (The first three remain 11-meter ham frequencies in Canada; the channel-23 frequency is used for low-power municipal stations and private radio paging.) Channels are specified in the GRS rules only in terms of frequency: 27.005, 27.015, 27.025 mc, etc. Canadians usually refer to the channels by their U.S. numbers, however, partly because it's simpler and partly because much of their gear is designed in the States. If it is, it probably will include the forbidden channels. GRS type approval does not require the manufacturer to disable them.

Class D CB stations at present may use either standard AM or SSB with an 8-kc bandwidth. GRS stations are authorized to use AM or FM with a 12-kc bandwidth. Rules to allow SSB equipment in Canada are now being formulated.

**The DOT's special service for the U.S. CBer-tourist** is called, logically, the Tourist Radio Service. It allows a CBer to operate his transceivers (which must meet DOT standards) on the GRS channels under a special TRS license, valid for the period he plans to stay in Canada—up to one year on the original license which may be renewed for up to one more year. No distinctive TRS call-signs are issued to its licensees. The American station merely adds the letters XM (which is the Canadian prefix) to the end of the regular CB call (KXX2345 becomes KXX2345XM, etc.).

Tourist information transmissions are specifically allowed between TRS and GRS stations. Canadian GRS clubs (a sampling of whose insignias is shown on these pages) have established no single frequency for national use as a calling channel. Nor is there pending in Canada any plan similar to the HELP proposal in the U.S. (although if the FCC were to approve HELP the DOT might follow suit).

To get a TRS license, Americans must apply to the Regional Superintendent, Radio Regulations, Department of Transport, nearest to his port of entry into Canada. This must be done at least 30 days in advance of his visit. (See the table at the end of this article.) The DOT will then furnish the CBer with all necessary forms and data required. The license is issued





# CBing, Canadian Style

free but 25¢ (in Canadian currency) is charged for a copy of the TRS rules.

Unfortunately, while Canada welcomes American CBers with their own customized radio service, the U.S. government does not offer GRS users a particularly inviting prospect when visiting the States. This seemingly unfair and confusing business isn't the result of any anti-Canadian hostility on the part of the FCC. The hang-up lies in international communications treaties which can be modified only after considerable hearings, haggling, and horse-trading in the United States Senate. While most observers believe that such things eventually will take place, it probably will not be in the immediate future.

Canadians can operate unlicensed 100-mw (Part 15) walkie-talkies in the U.S. without fear of FCC wrath, of course. But there is a little-known FCC CB regulation that permits Canadian GRS licensees to operate their 5-watt rigs in the States under present regulations! Rule 95.87 (B7) (iii) permits Canadians visiting the States to operate temporarily as a unit of a licensed American CB station.

To take advantage of this regulation the American CBer must write to the FCC in Washington and request such authority, showing the need for the operation (for instance, if the Canadian will be included in a CB-equipped hunting caravan or accompany a CB-equipped camping expedition). The CBer also must tell the FCC how he will maintain control over the visitor's equipment so that violations will not occur. And he must explain that, being a Canadian, the visitor is not eligible to apply for a CB license of his own. Specific dates of intended use must be given, as well as the names of the operators who will be using the equipment.

Perhaps the governments involved will someday unravel the complex strings that tie the hands of those of us who would like to cross a friendly border dragging along the comforts of home. Perhaps! —

TRS LICENSES ARE ISSUED TO U.S. CBers BY THESE CANADIAN REGIONAL SUPERINTENDENTS OF RADIO REGULATIONS	
PORT OF ENTRY	NEAREST SUPERINTENDENT
British Columbia	739 W. Hastings St. Vancouver 1, B. C.
Alberta	Federal Building 9820 107th St. Edmonton, Alta.
Saskatchewan, Manitoba, and Ontario from the Manitoba border east to and including Pt. Arthur	Winnipeg GPO Bldg. 266 Graham Avenue Winnipeg 1, Man.
Ontario (except Pt. Arthur and points west)	25 St. Clair Avenue East Toronto, Ont.
Quebec	Regional Adm. Bldg. Dorval, Que.
New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland	Federal Bldg. P.O. Box 42 1081 Main St. Moncton, N. B.

# Good Reading

By Tim Cartwright

**SO YOU WANT TO BE A HAM** (Fourth Edition). By Robert Hertzberg. Howard W. Sams, New York & Indianapolis. 189 pages. \$3.95

Lots of people write books about their hobbies. A few even manage to be articulate about it. But very few can convey the flavor of their interest and give you a real notion of what it's like to be involved. Bob Hertzberg, W2DJJ, can and does in his informative and flavorful little book—now in its fourth edition. And, with the exception of a few photos, everything is pertinent and up to date.

**MUSIC, SOUND AND SENSATION.** By Fritz Winckel (translated from German by Thomas Binkley). Dover Books, New York. 189 pages. \$2.25

If you're interested in sound reproduction and would like to go beyond the usual treat-

tises on hi-fi and music ("This is the oboe. It has a frequency range of . . ."), the above is a genuinely fascinating book on acoustics, psychoacoustics and music. The kinds of things discussed include the relation of so-called stationary sound (the sine-wave combinations of fundamental and overtones that give an instrument its characteristic sound) to the actual dynamics of music. Among them are attack and decay of instrumental sounds, combinations of sounds and perception of sound in space and time. If it sounds a bit esoteric, it is. But it's also challenging and accessible. This is a fine addition to Dover's excellent paperback series on music and sound.

**ANATOMY OF LOCAL RADIO-TV COPY.** By William A. Peck. Tab Books, Blue Ridge Summit, Pa. 93 pages. \$5.95—and **RADIO NEWS HANDBOOK.** By David Dary. Tab Books. 173 pages. \$7.95

Both of these books seem to be part of a continuing series on the day-to-day operations of radio stations in small towns. If the series can do anything to upgrade those operations it may do everybody some good. Neither book aims at the sky but both are full of information that seems eminently sensible and useful for anyone interested.

**THE RADIO AMATEUR'S HANDBOOK** (45th Edition). The American Radio Relay League, Newington, Conn. 612 pages. \$4.00

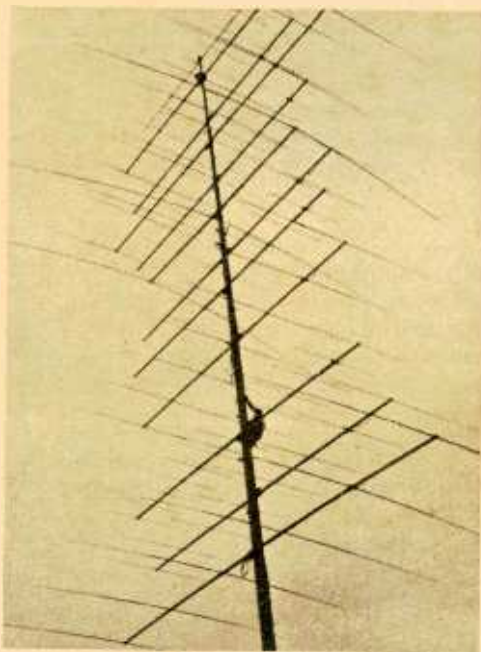
It gets harder and harder to refer to the ham's bible as new and improved. Even if it weren't you'd buy it. But it really is improved. And more readable than ever before, with up-to-date semiconductor information that hams just won't find anywhere else. Still as good a bargain as I know of anywhere.

And Make Note of . . .

**ELECTRONIC CIRCUIT DESIGN HANDBOOK.** By The Editors of EEE Magazine. Tab Books. 318 pages. \$12.96

**UNDERSTANDING AND USING YOUR OSCILLOSCOPE.** Edited by William A. Stocklin. Allied Radio, Corp. Chicago. 128 pages. 75¢

**CARE AND FEEDING OF POWER GRID TUBES.** EIMAC, San Carlos, Calif. 158 pages. \$3.95

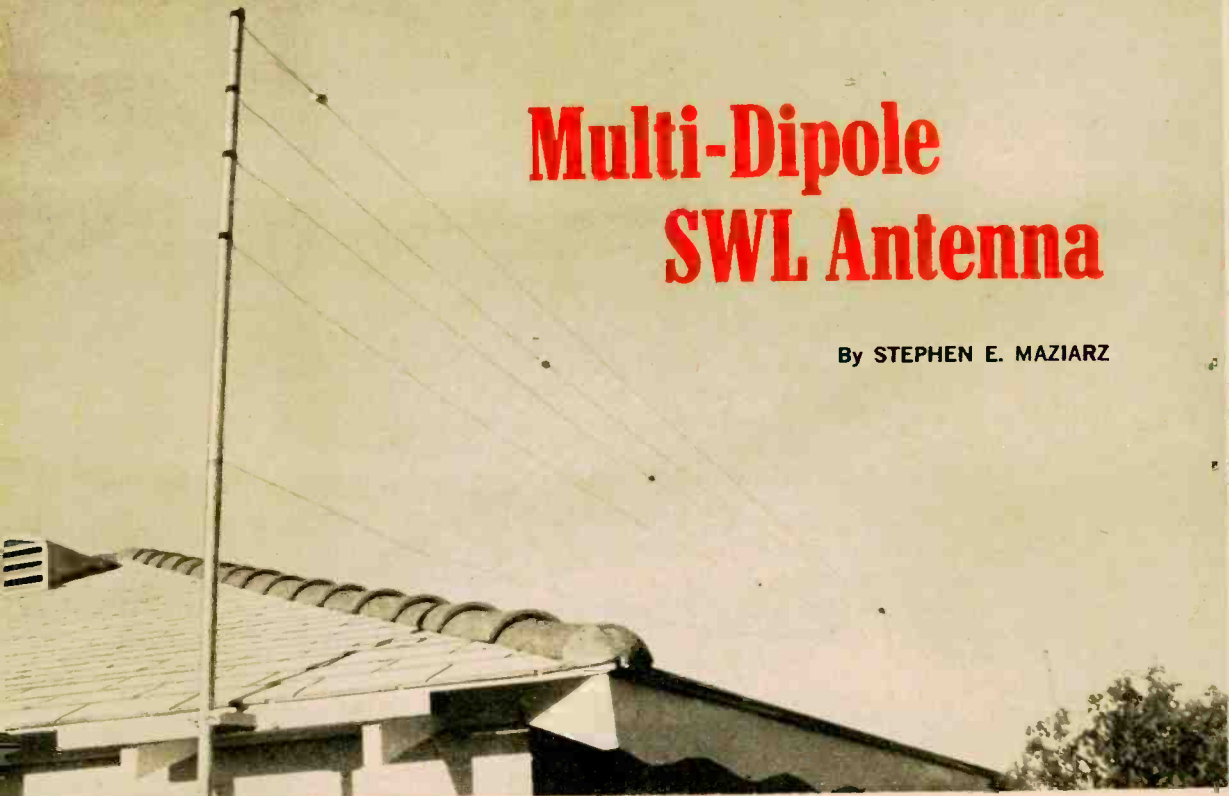


Up, up and away—on a 100-ft. antenna mast. A photo from Hertzberg's *So You Want to Be a Ham*.



# Multi-Dipole SWL Antenna

By STEPHEN E. MAZIARZ



*Double your QSOs with this easy-to-erect cluster of tuned dipole antennas.*

**O**NE of the perennial problems of short-wave listeners is deciding which antenna to use. On the one hand there's the long-wire for general coverage. But it generally is resonant at only a few spots on the bands and as a result gives compromise performance.

Then there's the dipole antenna which is resonant (and; therefore, gives best performance) only at the frequency to which it is cut. To cover all the short-wave bands you should have an antenna which performs on all bands as well as an antenna designed specifically for one band. Such an antenna is our Multi-Dipole. Construction is simple and can be completed in an afternoon.

## How It Works

Take a look at the diagram at the top of the right page. Notice that the antenna actually is five dipoles connected together and fed to the receiver via one coax feedline.

The longer elements are resonant on the low-frequency bands and vice versa. At frequencies other than that to which a particular dipole is cut, that dipole is electrically disconnected from the line.

Our Multi-Dipole covers any five bands without the use of tuners or traps. The antenna has the same characteristics as a single dipole; therefore, it should be oriented so it is broadside to the source of the signals you wish to receive.

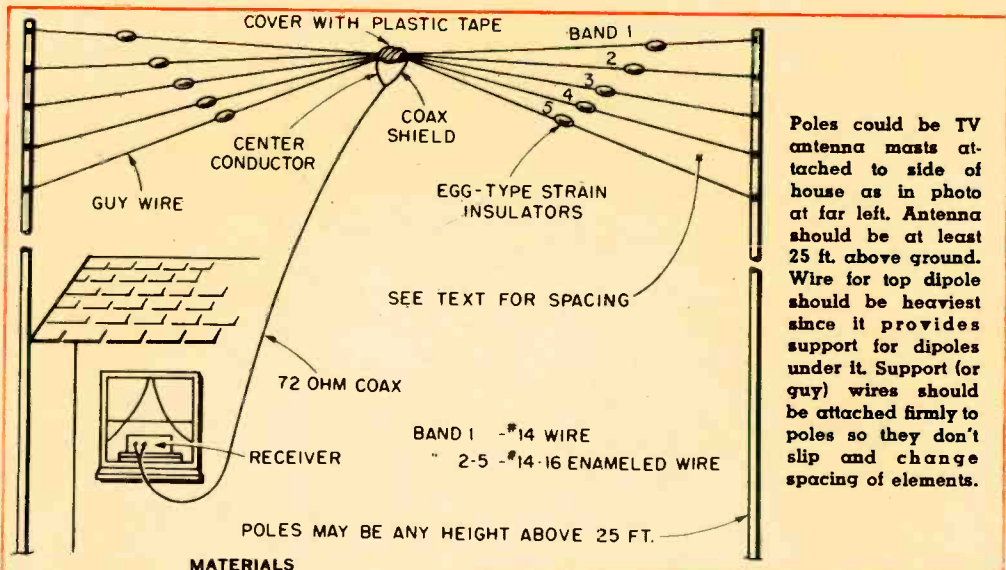
## Construction

With the size limitations of your back yard or roof in mind, look at the pictorial, then check the table for the dipole lengths for any five bands you desire. If you want a particular band or frequency not covered in the table, just divide the mid-frequency of the band (in megacycles) into 468. Your answer will be the total length of the antenna in feet.

Since you'll have to use up a few inches of wire to tie the antenna to the insulators at each end, it's a good idea to add about another foot of wire for this purpose.

Number 14 copper wire can be used for all five dipoles or the cost can be cut by using No. 14 wire for the longest dipole and No. 18 wire for the remaining dipoles.

Cut each dipole to the length given in our table or derived with the formula. Now cut

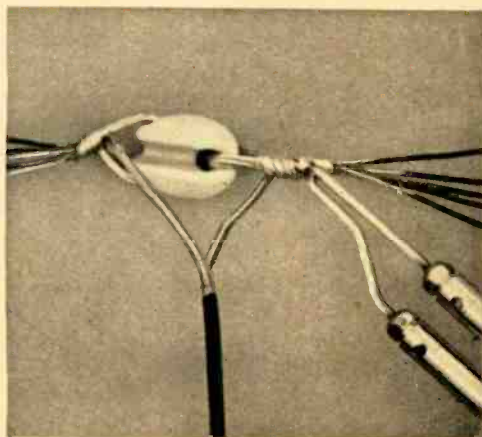


Poles could be TV antenna masts attached to side of house as in photo at far left. Antenna should be at least 25 ft. above ground. Wire for top dipole should be heaviest since it provides support for dipoles under it. Support (or guy) wires should be attached firmly to poles so they don't slip and change spacing of elements.

- MATERIALS**
- No. 14 enameled copper wire
  - No. 18 enameled copper wire
  - RG59/U coaxial cable
  - TV antenna masts
  - Porcelain strain insulator (egg-type insulator Allied 47 B 6052 or equiv.)

each length of wire in half. Wrap the wires through the insulator, twist them and apply solder liberally. Solder the braid of the RG59/U coax feedline to one side and the inner conductor to the other side, as shown. A good solder joint is important so scrape all the enamel insulation and dirt off the end of each wire to be soldered.

Wrap the solder joint with tape to keep out moisture and to provide mechanical strength. The antenna now can be mounted



Pour on the solder when connecting the coax to dipole elements at center porcelain insulator. Then cover both connections with electrical tape.

ANTENNA LENGTH vs. FREQUENCY *		
Band (meters)	Frequency (mc)	Length (ft., in.)
80	3.5	133-8
49	6.0	78-0.
40	7.0	66-10
31	9.0	52-0
25	11.0	42-6
20	14.0	33-5
19	15.0	31-2
16	17.0	27-6
13	20.0	23-4
11	27.0	17-4
10	28.0	16-9
6	52.0	9-0

\* Length (ft.) = 468/Frequency (mc)

between two poles or any convenient structures. Mount the longest dipole at the top, pulling it fairly taut, using insulators to separate the dipoles with a 6- to 12-in. drop between each (at the masts). Twist the guy wire around the pole and wrap with plastic tape to keep from sliding down.

Connect the coax to the SW receiver as you would a regular dipole antenna. Fire up the receiver and tune across the bands. You'll discover that the antenna does an excellent job on the bands it was cut for and a fairly decent job on the frequencies in between. —



# The Ham Shack

By Wayne Green  
W2NSD/1



**T**HOSE CBers who like to chew the rag are beginning to find that the FCC inspector is not the only thing they have to worry about. The current high level of sunspot activity is filling their channels with screaming signals from as much as a thousand miles away. This has put quite a damper on local rag chewing.

But just a megacycle away on the 10-meter amateur band, where rag chewing is legal, there's all sorts of elbow room in the 1200-kc-wide phone band. Hams are using converted CB transceivers and talking with skip stations not only in the U.S. but all over the world. Many newcomers to the band report contacting over a hundred countries in a single week.

It's not difficult to get a ham license. One week of serious work and you should be able to get a Novice ticket. Code at five words per minute amounts just to memorizing the letters and numbers. And the technical part of the exam is about as tough. Just drop in at the next ham-club meeting in your town and ask for help. You'll get plenty.

The Novice license permits you operate on 15 meters, one of the best DX bands. You'll use code, which is a lot more fun learning if you're talking with someone in Helsinki or Nairobi.

If your technical ability gets ahead of your code speed you can take the Technician license exam and get in on the fun on 6 meters. With the current high level of sunspots, 6 meters is opening up for DX.

On 2 meters, Technicians are finding that the aurora makes possible contacts up to 600 mi. This occurs only during sunspot peaks. Aurora contacts are via CW and until you hear one you won't believe it. The Doppler shift is so rapid that the received signal sounds like a hiss or rushing noise, rather than a whistle. Sideband gets through on aurora and sounds like someone whispering. AM signals normally don't get through.

This probably is one of the best times to get going in amateur radio. Not only are conditions at a peak for almost any activity, but equipment is available today at prices that would have seemed beyond belief a few years ago. You can buy a complete sideband kit for about \$100. I used one a while ago and contacted 50 countries in two days.

**The UFO reporting net** on 20 and 80 meters that I proposed in my last column is beginning to gain support. Both the National Investigation Committee on Aerial Phenomena (NICAP) and the Aerial Phenomena Research Organization (APRO)—the two major civilian UFO investigation organizations—seem enthusiastic about an amateur radio net. Both have promised cooperation and are interested in being plugged into the net. The group at the University of Colorado studying UFO reports under an Air Force contract also was interested. But their inquiry is over and their report (unpublished at this writing) is expected to be controversial instead of conclusive.

I have been expecting static from the Air Force. In the past they have attempted to discourage UFO reports and research. Once they move in there's little you can do. A few years back I stepped on their toes by writing an editorial about their virtual take-over of the amateur UHF bands. They asked me to be nice and not write about this, suggesting in detail how they might hurt my business if I didn't cooperate.

But before they have a chance to lean on me again, let's set up on-the-air meetings for Wednesdays at 2100 EST on 14300 kc and Thursdays at the same time on 3900 kc. This way we can see who's interested, establish an organization and talk about UFOs.

Members of the net will set up communications in their areas with other users of mobile radio, police, radio and television stations and so on. If something is sighted anywhere in the country we'll be able to notify nearby areas so it can be tracked and perhaps photographed. As we get set up we should find many groups of UFO investigators wanting to tie in and be warned of approaching objects. Some of these groups have sophisticated equipment that could tell us a lot about what we've been seeing.

Of course, if UFOs are just a giant hallucination the net should reveal that, too—which in itself would be historic. —



As a singer looks out at the audience in the new Metropolitan Opera House (above) he may well wonder how many microphones are trained on him, feeding concealed tape recorders for black-market reproduction. Major musical events are a prime target of bootleg recordists who have even produced stereo recordings by smuggling FM wireless mikes into two seats carefully chosen on opposite sides of the auditorium. Mike signals are picked up and recorded by confederate parked outside the concert hall.

## The Boom in Bootleg Tapes

By ROBERT ANGUS      MURDER on tape? Gruesome as it may seem, it's literally true—you can buy the sounds of a man (Malcolm X) being murdered. And hundreds of less macabre items that won't (or can't) appear in the record catalogs. They're all available on the tape black market.

A list of tapes from a dealer handling these under-the-counter specialties might include the Malcolm X tape (at \$10), the complete proceedings of the gala that marked the closing of the old Metropolitan Opera House (in stereo hi-fi at \$75), Black Power speeches by Stokeley Carmichael or a sermon against Communism by Dr. Fred Schwarz (\$3.50 each), an interview with the late Lee Harvey Oswald, nightclub routines by Lenny Bruce, the Orson Welles production of *The War of the Worlds* (a science-fiction dramatization that—on network radio in 1938—convinced thousands of listeners that earth was under attack by Mar-

tians) and countless performances of the Metropolitan Opera back as far as 1929.

True, not all of these tapes are up to audiophile standards and most are recorded in mono only. But, for the collector who wants to hear Bruno Walter conduct Mozart's *Don Giovanni* or relive two hours of Fred Allen radio broadcasts, a charge of \$10 really doesn't seem exorbitant.

**By definition, a bootleg tape** generally is a recording made without the performer's knowledge or permission. In practice, the term also may apply to dubbings of records once commercially released but long-since withdrawn, propaganda materials that have the blessing of the performer but lack sufficient commercial backing for regular issue and recordings of so-called blue material that might earn the frowns of police or censors.

Where they come from is almost as interesting as what they contain. Bootleg recordings go all the way back to Edison cyl-



Radio shows of the '30s figure prominently among bootleg tapes. Fred Allen is shown with violin-playing guest Jack Benny. Other favorite shows include Fibber McGee and Molly, Charlie McCarthy, Eddie Cantor, Easy Aces, I Love a Mystery, The Shadow and so on.



## The Boom in Bootleg Tapes

inders cut backstage at opera performances. But the first harbingers of the boom in black-market recording came with radio and the home disc recorder.

Among the first to realize the possibilities of this combination were opera lovers. When the old Blue Network of NBC began broadcasting Saturday matinee performances from the stage of the Metropolitan Opera back in 1931, amateur recordists started salting away otherwise unavailable arias by Rosa Ponselle, Beniamino Gigli and Ezio Pinza. One 12-in. disc lasted only four or five minutes. So the few buffs who attempted complete operas had breaks at regular—and frequently inconvenient—intervals. Eventually the wealthiest (and most dedicated) recordists began using two disc recorders, alternating them during the broadcast to achieve true continuity. It is their work that forms the backbone of today's bootleg record and tape catalogs.

By the time World War II broke out, popular music was supplying its own set of bootleg recordings. These emanated from the major recording and broadcast studios where it was not uncommon for a recording artist to make a blooper during a take. Some bloopers were funny; other definitely were

not for the ears of children. And here and there a performer would do for his own amusement a parody of the song he had just recorded. These out-takes (recordings that were to be discarded) were cut on separate acetate discs. At the end of the session, a recording engineer, the performer, his manager or anybody else might smuggle some out of the studio to play for friends. In short order, copies of the original acetate could be had in New York record shops for \$5 or so.

During World War II, bootlegging consisted largely of efforts by amateurs to record off the air—anything from Edward R. Murrow's broadcasts describing the blitz in London through the radio dramas of Norman Corwin and the comedy of Fred Allen to *The Shadow* and *Inner Sanctum*. Many of these recordings were poor in quality; most were incomplete. Yet, today, taped copies bring moderate prices on the black market and such archives as the National Association of Broadcasters and the Library of Congress are searching for any material they can get.

When the first wire and tape recorders hit the home market in the late 1940s the bootleg catalogs began to bulge. From the college campuses came tapes of concerts by folksingers and opera stars; from radio and television came more comedy, drama and





Out takes—unusable portions of a radio or record session—are often valued for the humor or unprintability of its content. Lionel Barrymore (right, with his brother John) was famous for following a fluff with a string of invective that would do a sea captain proud.

music; from private parties came a host of interesting and intriguing recordings.

During the early 1950s, for example, it was common for folksingers to perform at informal parties for friends. Sometimes, they got around to bawdy ballads—the kind you couldn't then record for a commercial record firm. And occasionally there would be a tape recorder capturing it all. In fact, a tape consisting of a number of favorites by such performers as Paul Clayton, Pete Seeger, Josh White, Ed McCurdy and Ewan MacColl eventually wound up in the archives of the Kinsey Sex Institute at Indiana University—but not before copies of it had gone into the black market tape catalogs.

The coming of the battery recorder opened the doors of the opera house, concert hall, theatre and assembly hall to the purveyors of bootleg recordings. On Sunday, February 21, 1965, a white college girl entered the Audubon Ballroom on Manhattan's Upper West Side. In her roomy handbag was a small battery-power tape recorder and microphone. The purpose of the meeting was to discuss Black Nationalism and the featured speaker was to be Malcolm X. When he stepped to the podium shortly after 2 p.m. the girl started her recorder. Malcolm spoke a few words of greeting to the assembly; then there was a scuffle in the aisle. Before anyone knew what had happened several

shots rang out and Malcolm fell to the stage, mortally wounded. The tape captured it all.

Eight years earlier, a bespectacled gentleman took his seat at Carnegie Hall. His companion that evening was a battery recorder. The singer featured was Maria Callas, appearing with the American Opera Society, and the recorder captured every note. Insiders always look on this evening with wry humor. For it was one of the first cases where the battery recorder was used to pirate a performance at Carnegie Hall. And what did Mme. Callas sing? A little-known Donizetti opera entitled *The Pirate*.

It was around 1959 that a young man experienced the QT-recorderist's nightmare. He had tickets for a Dave Brubeck concert—once again at Carnegie Hall. For a time, the taping went along perfectly, the young man's microphone picking up every note from his third-row seat. Then, suddenly and unaccountably, the recorder began to play back at full volume a previous and very loud passage. As the musicians stared down from the stage he struggled to turn off his recorder. He describes it as one of the worst moments of his life—even though he didn't actually get thrown out of the hall.

Today, battery-power recorders are used freely in Carnegie Hall and elsewhere. While most concert halls and theatres print a no-

## The Boom in Bootleg Tapes

tice in the program warning patrons not to take pictures during performances, they say nothing about recording. It is common practice, however for ushers who spot recordists at work in the audience to request they put away their recorders. When one recordist refused to do so in Cleveland a few years ago the usher reported him to the manager. The manager, in turn, asked the doorman to seize the recorder. The next day, the recordist's lawyer called the manager to demand return of the unit. He pointed out that his client had violated no law and no published rule of the house and hinted at legal action unless the recorder was returned immediately with an apology. The client got both.

Most nights at the Metropolitan Opera, there's a stocky, bespectacled, intense young man to be seen in the Family Circle carrying a bulky overcoat on his arm. Hidden under the overcoat is a Norelco Carry-Corder, which he uses to record more than 50 complete operas each season under an agreement with a bootleg-tape dealer. All of the operas and all of the stars are to be heard on commercial recordings, usually in stereo and always in true high fidelity. But the Met can schedule a tenor who is under contract to Angel with an RCA-Victor soprano or a London mezzo or, perhaps, a Columbia bass. If you want to hear them

together you have to buy the pirate recording, coughs and all.

Perhaps the most elaborate of operatic souvenirs—and one of the most expensive—is the stereo recording of closing night at the old Met in April, 1966. Orchestra tickets to the gala event, which featured virtually every singer of any importance on the Met roster, cost \$75 each. So a specialist in underground recordings bought two—one on the left aisle, the other on the right. On the night of the big event, two young men attended the concert—each with a wireless microphone in his jacket pocket.

Outside on 39th Street, a third man sat in a car with a stereo tape recorder and two FM receivers. One receiver was connected to each tape input and tuned to the output of the corresponding wireless mike. The recorder itself operated on a converter running off the car battery. The concert finally broke up in the wee hours of the following morning. But when the dealer opened his store at 9:30, he had edited copies of the tape for anyone willing to plunk down the original cost of one orchestra seat.

These days, virtually any tape recorder is suitable for making black-market tapes. The recording a Peter Sellers fan in Britain makes from the BBC and swaps with a friend in New York; the broadcast by the Radiotelevisione Italiana Opera that's traded for a recording of one of Leonard Bernstein's Young People's Concerts may be recorded

*[Continued on page 115]*



Most grim of all subject matter in the bootleg catalogs, perhaps, is the murder of Black Power advocate Malcolm X in New York's Audubon Ballroom, where he had come to make a speech. Recorder in the audience, already running and prepared to catch every word, immortalized the entire event.





# Junior Guitar Amp

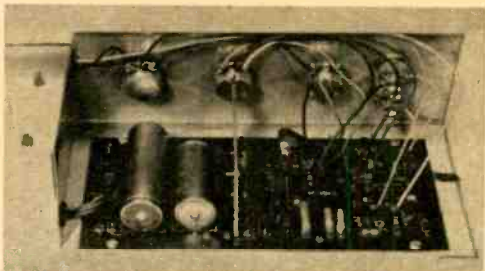
## Heathkit JK-37

**I**NTEREST in the electric guitar has been growing at a phenomenal rate. And while sales have been soaring so has the number of instruments that end up in closets after interest wanes.

If you have been toying with the idea of getting an outfit but are somewhat uncertain about how long your enthusiasm will last, the \$29.95 Heathkit JK-37 amplifier is an inexpensive way to try yourself out. Referred to by Heath as a *Heathkit Jr.* kit, the JK-37 is designed for a rank beginner—builder or performer.

It's a small (13½ x 5¾ x 14-in.) lightweight (11 lbs.) amplifier but is able to fill the average-size living room or playroom with a moderately-high sound level. Though single channel, two parallel-connected inputs are provided as well as a tone control. There is full tremolo with rate and depth controls. The speaker is an 8-in. 16-ohm music type (high efficiency and power handling capacity).

The four-stage transistor amplifier plus



Amplifier, assembled on printed-circuit board, is at right and power-supply filter capacitors are at left. Box at left covers the power transformer.

two-stage tremolo oscillator and amplifier and power-supply filter are assembled on a printed-circuit board. The board in turn is mounted on a metal frame which serves as the front-panel and amplifier frame. The complete amplifier assembly slides into the top section of the cabinet and the speaker and front baffle are mounted as the front part of the case. Our construction time was 10 hours.

**Performance.** The JK-37 will not provide the sound quality of an expensive high-power amplifier. The overall sound is about what you'd expect for the price. Distortion is less than in many other beginner and practice amplifiers.

You might have some difficulty correlating the performance with Heath's specs. This is because Heath's specs are generally conservative while in the music field anything goes and Heath, to be competitive, used standard music-power specs rather than the more common IHF standards. For example, the JK-37 is rated at 18 watts peak power, 9 watts music power and 7 watts EIA power—with not a word about distortion. But these are typical of git-amp specs. Fact is, peak power is meaningless. Music power is the power delivered for a fraction of a second and 7 watts EIA has a 5 per cent distortion reference. At the more typical 1 per cent distortion reference (hi-fi equipment) the JK-37 delivered 4 watts into 16 ohms.

So forget the specs. In low-price amplifiers they tell you nothing about performance. When used with a low-cost electric guitar the JK-37 delivered a somewhat loud, reasonably-low-distortion sound in an average-size living room. Sound quality was good, with

*[Continued on page 118]*



## Low-Cost Telephone Answerer

**W**HEN you're near the phone and it rings you answer it. If you can afford a secretary, she will. If you can't pay her salary, a telephone answering service will do the job. If that's too expensive you can shell out about \$30 a month to Ma Bell for an automatic answerer. Or, in the past, you could have bought an answerer from one of several sources for \$200 to \$600.

But prices for electronic secretaries have fallen to the basement. You can now purchase an answerer and message deliverer for \$99.95. It's the Crown Model CTA-4000 Telephone Valet and is available from many electronics distributors, including McGee Radio Co. and Lafayette Radio.

The CTA-4000 is 8½ in. wide, 10½ in. deep and 3 in. high. It weighs less than 7 lbs., is solid-state and draws only 4 watts of power in the standby mode. Your telephone is placed on it in such a way that the phone

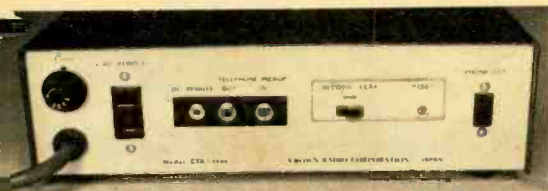
can be used in the normal manner; there are no electrical connections to the phone.

The CTA-4000 uses a small tape cartridge which contains the message to the caller. To record the caller's messages, you use virtually any AC or battery-operated recorder with it. The lifter, which raises the handset from the telephone cradle, can be attached to the phone without even a screwdriver.

When the telephone rings, the lifter raises the handset from the cradle to energize (answer) the telephone and starts the external recorder. The previously recorded answering message is played through a small built-in speaker under the handset's mouthpiece. The caller's message is picked up by a small coil adjacent to the handset's earpiece. At the end of 60 seconds, metal foil on the tape returns the unit to the standby mode. The operation may be stopped by pushing a tape-release button and removing the cartridge.

The heart of the answerer is the tape cartridge, which contains 18¾ ft. of special magnetic tape wound in an endless loop. The cartridge performs the following functions: 1) it controls the timing sequence, 2) it closes the energizing microswitch when fully inserted, 3) it contains the answering message. A built-in microphone and record switch allow you to make your own answering message. You can record several answering messages using different cartridges.

—Fred Blechman, K6UGT



Rear of unit. Jacks are for connections to external recorder which tapes messages, handset lifting mechanism and pickup coil on handset earpiece.



# THE SHORT, TREACHEROUS LIFE OF RADIO 1212

By JACK ALTHOUSE



"RADIO 1212 sending, Radio 1212 sending," the raspy German voice said. It was 2 a.m., a strange time for a radio station to start its broadcast day. But Night Radio 1212 was strange in many ways.

Busts of Hitler adorned its offices. Swastikas and Nazi flags hung on the walls. Its programs were in German and it was known as the Voice of the Rhineland. In reality 1212 was not in the Rhineland—it wasn't even in Germany.

Radio 1212 had a short life, a short broadcast day and worked only the graveyard shift. Its schedule of broadcasts from 2 to 6:30 a.m. continued for a little more than four months. Yet it had listeners by the thousands in towns in Germany and in field camps of the German Army from Switzerland to Holland. They listened because 1212 brought something new to wartime radio broadcasting — Radio 1212 told the truth.

1212 told the truth to gain an audience who believed. Then, at the last minute, it switched to lies and deception and in so doing trapped thousands of German troops—350,000 from Army Group B surrendered in a single day, April 18, 1945.

It had almost been

From their transmitter in Luxembourg, the men of Operation Annie went on the air as a radio station in the German homeland. In one of the most brilliant propaganda efforts ever staged they promoted surrender on the home front while leading troops into Allied traps.

## THE SHORT, TREACHEROUS LIFE OF RADIO 1212

the other way about. The Psychological Warfare arm of the U.S. Army had embarked on Operation Annie in late 1944. Almost at once the station was threatened by the German breakthrough we have come to know as the Battle of the Bulge. But Allied lines held and Radio 1212 settled down to the job of getting the biggest possible audience in Germany and making it believe what it heard.

A staff of announcers, writers and technicians was assembled at studios in a secluded old house in the Grand Duchy of Luxembourg, just a few miles from the German border. CBS's Brewster Morgan was program director but 1212's announcers were German-born. The chief announcer was Sgt. (eventually Lt. Col.) Benno Frank, a former German national. His unmistakable Rhine-Hessian accent and his experience as an actor combined to make him the real voice of Radio 1212. As captured German soldiers said, you *had* to believe what he was saying.

It was characteristic of this strange station that its business of telling the truth started with a fairy tale—an elaborate yarn about its location and purpose. 1212 claimed to be in the Rhineland and operated by Germans loyal to their country but not to its Nazi government. Hitler's radio wasn't telling the truth about the war, they said. Radio 1212, as its patriotic duty, would tell the facts.

1212's method was to give eyewitness accounts, from the German viewpoint, of military operations. The stories were told in great detail. For example, after an Allied air raid on a German town Radio 1212 named the factories and shops that were wrecked and gave the names of people whose homes were destroyed.

This was information German soldiers wanted and they became avid listeners. Unknown to them, the reports were put together after study of reconnaissance photographs, city directories, telephone books, captured letters and prisoner-interrogation reports.

The German field commanders did know that Radio 1212 was not German. But they listened, anyway, because it was sometimes their only source of accurate information on the fortunes of their fellow commanders and their armies. The official reports they received

often were so vague that they were worthless. But 1212 was always there with accurate, detailed information.

1212 was also entertaining. Its music came from records that were authentically German: folk songs, Viennese waltzes and ribald beer-garden songs.

1212's sports coverage was unique. The important football games were played on Sunday but the results were never broadcast by German radio stations until they had appeared in the Monday newspapers. So 1212, which didn't have to wait, had a sports scoop.

Of course 1212 had its own brand of sly propaganda. The German radio often failed to report bombing raids on German towns. As a matter of fact, the government asked civilians not to tell of these raids in their letters going to the front. It might hurt morale. When the German soldier heard



The late Brewster Morgan, director of Operation Annie, was a successful radio producer before the war. He is shown in 1939 when he was with CBS. Having joined the Office of War Information, he set up a complex VOA relay program with the BBC, went on to the Psychological Warfare Group, the American Broadcasting Station in Europe and Radio 1212. He later received Army commendation for leading a small task force to capture Radio Leipzig under combat conditions. Back in the U.S., he turned to television, produced pioneer spot commercials and Fireside Theater for Ivory Soap.



about the raids over Radio 1212 and realized that he was not being told the truth from home his morale was given a double blow.

As morale depressors Radio 1212's reports of speeches by local dignitaries were good. After hearing pompous phrases about fighting to the last man the soldier was likely to wish that the supreme patriot who spoke so well was at the front himself.

Night Radio 1212 was dramatic, too, and sometimes it bent the truth a little to improve its impact. At 2 o'clock one morning it reported that an enemy drive was being made in the direction of a German town. The town was important but, 1212 assured, it was practically impregnable. Later that night news flashes announced that the impossible was happening. The enemy was drawing closer to the impregnable town. Fighting was reported in the suburbs. Then, at 4 a.m., the town



**Benno Frank, the main voice of Radio 1212, was born in Germany and lived for a time in the home of Gen. von Kleist. His authentic accent, his intimate knowledge of the Rhineland and his experience in the theater all were of incalculable value to Operation Annie. As an officer in the U.S. military government, he was responsible for the re-establishment of German cultural institutions and in 1960 he was decorated by the West German government for his contributions to peaceful relations between Germany and the rest of the world. Since 1948 he has lived in Cleveland, Ohio.**

was taken by the enemy.

1212 squeezed every ounce of drama from the story that so conveniently unfolded during its broadcasting hours. But the fact was that the town had been taken at 9 o'clock the previous evening and the action carefully restaged for the delayed broadcast.

Operation Annie's best propaganda writer was Field Marshall Model, a favorite of Hitler. He had commanded the Army Group Ukraine-North on the Russian front. But when the Allies started pushing the Germans back in France Hitler personally selected him to lead German forces in the West. During Annie's lifetime he commanded Army Group B under the Supreme Commander of the Western Front, Karl von Rundstedt, and his successor, Field Marshal Kesselring.

As a commanding general Model was competent but when he sat down to write he turned out pure corn. At a time when his soldiers were engaged in a futile last-ditch fight to save Germany, Model issued fatherly advice in his orders of the day—advice on how to wash woolen underwear without soap, a recipe for a ragout made of sawdust-and-potato sausages, reminders of a soldier's duty to worship Hitler and so on.

German officers thought his helpful hints so inappropriate that they conveniently lost them instead of passing them on to their troops. Radio 1212's announcers read them straight. No rewriting could have improved them or their effect on German morale.

One of 1212's most significant successes was its apparently single-handed establishment of anti-Nazi groups within Germany. Radio 1212 told tales about how Nazi party posters which bore the official party initials, N.S.D.A.P., were being altered to leave only N.D.—standing for Neues Deutschland, or New Germany. Those who did these deeds, said Radio 1212, were seeking to preserve Germany by surrender before it could be destroyed by Nazi fanaticism. It told of patriotic civilians who circumvented the military to save their towns, mixing enough facts with the fabrication to be convincing.

When Germans heard what others were doing they organized Neues Deutschland groups to make it the reality they assumed it already was. In fact, when Allied forces finally reached Germany they found posters altered just as 1212 had described.

In April 1945 the time arrived for Radio 1212 to spring the trap it had so carefully



Field Marshal Model (far left and far right) was, unintentionally, one of Radio 1212's most effective propaganda writers. His fatuous directives to German troops were read verbatim over the air. When German defenses began to crumble, Von Rundstedt (with Model above) was removed as Supreme Commander. Model remained, was surrounded—partly through the success of 1212. His last order urged troops to keep a stiff upper lip. He then took his own life.

## THE SHORT, TREACHEROUS LIFE OF RADIO 1212

baited. Allied armies were closing in rapidly on German forces in the Rhineland from both flanks. The German armies had but one way to get out of the trap. That was to retreat east of the Rhine River.

The battle reports from Radio 1212 did not appear to change. Weary German commanders, whose own communications were breaking down, couldn't tell that 1212 was selling the Allies short. When the Allied Seventh Army broke through German lines in the south, 1212 reported that the German army was holding firm. To the north, the U.S. Third Army under Patton was reported to be 20 mi. behind its actual location.

Meanwhile, the First Army moved across the Cologne plain and discovered the undestroyed bridge across the Rhine at Remagen. Fifteen miles of river bank separated it from Patton's left flank at Andernach—15 mi. through which the remaining German troops in the Eifel Mountains could have rushed to safety if they had known. But other escape routes were open, according to 1212. When German troops acted on this information they walked directly into Allied traps. The

same thing happened farther south on the Saar.

As the war passed the Rhineland and moved on toward Berlin, 1212's usefulness was over and its supposed location overrun by the enemy. It would have been easy just to pull the switch at the Luxembourg transmitter but it seemed a shame to let the myth of Rhineland Night Radio 1212 die in such a drab manner.

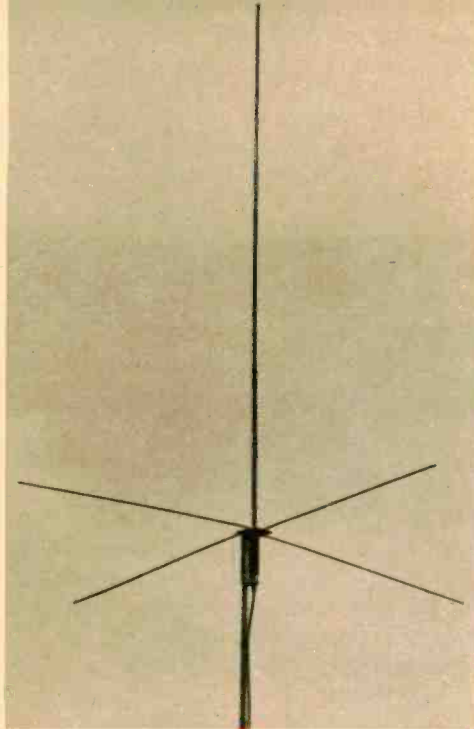
The build-up took several days. The announcers threw in hints that the Allies were closing in on them. But, they insisted, Radio 1212 would not give up until the bitter end.

April 25, 1945, was the final morning. Messages about the imminent approach of the enemy became more frequent. Suddenly a newscast was interrupted by excited voices, shouts and the splintering of wood. The enemy was taking over the transmitter.

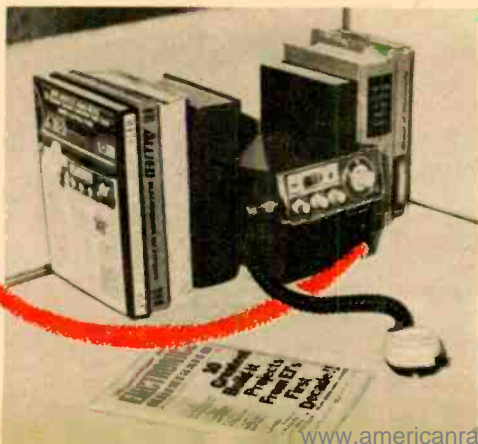
Above the din, Benno Frank could be heard yelling, "Put on the record!" 1212's theme, an old Rhenish tune, came on for the last time. In the middle of the record 1212 died and was never heard again.

When, a short while later, the men of Operation Annie gathered for a quiet toast to Radio 1212, they ended it by singing an old American song: Annie Doesn't Live Here Anymore. —





## Roof-to-Basement CB Installation Guide



By **LAWRENCE GLENN** It's always a shock to discover after a heavy rain storm that your CB antenna has gone with the wind. And after you spend a few hours installing a new skyhook it can be mighty discouraging to find your antenna system's SWR is high, also.

Such problems can be avoided easily by making a proper installation the first time. By firmly mounting the mast, antenna and transmission line, you'll never have to worry about the antenna blowing away or a high SWR preventing your power from being radiated.

Because a CB installation is so easy, over-confidence sets in and many jobs end up being quick-and-dirty lash-ups. At first they're great but after a few months of rain and some heavy pedestrian traffic across the coax feed-line it would be a miracle if half the transceiver's output got to the antenna.

Take a little extra time to do a proper job with permanence in mind and your installation will give years of trouble-free service.

### Preliminaries

First step is to select a location for the transceiver and then figure out a way to get the transmission line out of the house. The idea is that you should not walk on the coax, nor should it be squeezed under a threshold. Each time someone steps on the threshold the coax is flattened. Although you might have a proper match at the antenna you can end up with a system SWR of 5:1 because the cable is crimped.

Best way to route coax is around the baseboard and corners and, if needed, all around the room to get to the other side of the door. Contrary to popular belief, an extra 50 ft. of transmission line is not going to cause a noticeable loss of RF output.

### Getting Started

How do you get the coax out of the house? The utility servicemen have already found the most convenient way, so follow the phone or electric lines to the outside of the building. (If you live in an apartment route the coax to the outside through the windowsill nearest the antenna.) Drill the hole close to the phone-line hole but try to stay at least 6 in. away from electric lines. Drill the hole from the outside at a slight upward angle

# Roof-to-Basement CB Installation Guide

so water running down the transmission line won't run into the house. Such an installation is shown in Fig. 1.

Do not staple the coax to anything yet; simply run it along the inside route to the hole in the wall and then pull it through from the outside.

Select the desired antenna location and mount the antenna with wall brackets. Chimney and vent-pipe mounts should not be used. Even the lightest CB antenna (the ground plane) develops a lot of angular torque in a high wind and many are the loose chimney bricks and broken vent pipes because of this.

If possible mount the antenna on a 10-ft. steel mast—not aluminum. Keep the wall brackets as far apart as is possible, with one bracket at the bottom of the mast, as shown in Fig. 2. The farther apart the brackets the more rigid the antenna installation. Try for at least a 4-ft. separation or, if possible, 6 ft.

Just because the bracket is clamped to the antenna mast with screws, don't depend on a screwdriver for a tight fit. Hold the screw and tighten the nut with a wrench until all play in the bracket is removed. Don't forget lockwashers. Use them under both the screw head and the nut.

Decide how you will route the transmission line and place standoff insulators along the route about 3 ft. to 4 ft. apart. Coax shield

will be cut through when wind causes the coax to rub against the side of the building. Run the coax through the standoffs and up to the antenna mast and tape the coax to the mast.

Mount the antenna and connect the coax to it. Whether the coax connects to an antenna connector or to screw terminals, seal the entire head-end against moisture with a silicon rubber adhesive such as Silastic. Don't skimp on the adhesive and make certain water cannot get into the connector or under the coax shield because one or two good rains are all it takes to jack the SWR up to 3 or 5 to 1.

Tape slack coax to the mast and then work back through the standoff insulators, stretching the coax and tightening the insulators as you go back to the point where the coax enters the house. When you're finished, the transmission line should be taut so it will not move in the wind.

Form a U-shape bend at the point where the coax enters the house, as shown in Fig. 1, and seal the hole with caulking. The purpose of the bend is to cause water which runs down the coax to drip off outside the house. If you run the wire straight into the hole the water will flow under caulking (when it cracks with age) and into the house.

## Indoors

Back inside, staple the coax to the baseboards with round staples and a staple gun. This gun, which can be rented, shoots a half-round staple that secures but doesn't pinch  $\frac{1}{4}$ -in.-dia. cable. Route the coax to the CB rig and you're almost ready to go on the air.

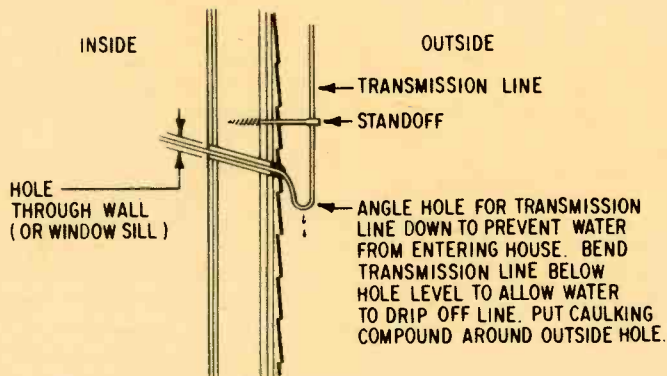


Fig. 1—Drill hole for the coax at an upward angle from the outside. Wire through standoff is short-wave antenna lead-in and has loop to prevent water from entering house. Other wire is for phone.





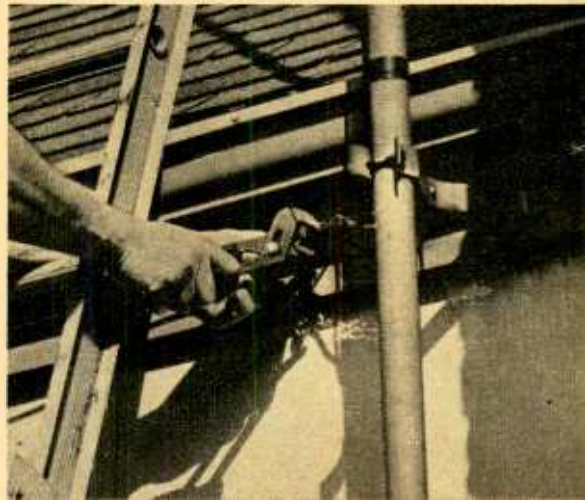
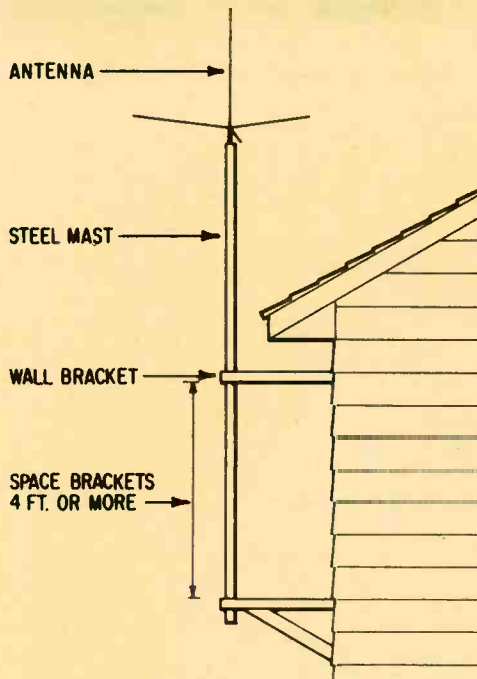


Fig. 2—Most rugged installation is made with a 10-ft. steel mast. Secure it to house with wall brackets separated 4 ft. or more. Be sure to use lockwashers under the bracket screws and nuts.

### Check-Out

First, measure the antenna system's SWR. Unless you have been extremely lucky you will not have a 1:1 SWR since the coax connectors and the antenna terminals themselves increase SWR. If your SWR meter (the one we show in Fig. 3 is a Seco Model 520 Antenna Tester) indicates even as high as 1.5:1 you have a fine installation which is essentially loss-free. If the SWR is higher than 1.5:1 check the antenna specs. Some CB antennas can have an SWR up to 2:1. If the SWR is greater than 2:1 check your entire installation for cold-solder joints at the connectors or antenna connecting lugs and for pinches in the coax.

If you find a pinch in the coax you've had it. It cannot be straightened by rolling the coax until it's straight. To fix this, cut out the section with the pinch, install connectors on the free ends, then seal the connectors with Silastic. If the ends can't be pulled together, make a short patch cord with coax. Do not try to solder in a new section of coax unless you're an expert. A sloppy splice can be even worse than the pinch.

Finally, connect a power/SWR meter between the antenna and transceiver and measure the output power delivered to the antenna. (Some SWR meters are calibrated in forward output power.) If you read about 3 watts (or whatever the output power should be) everything is okay.

### Lightning

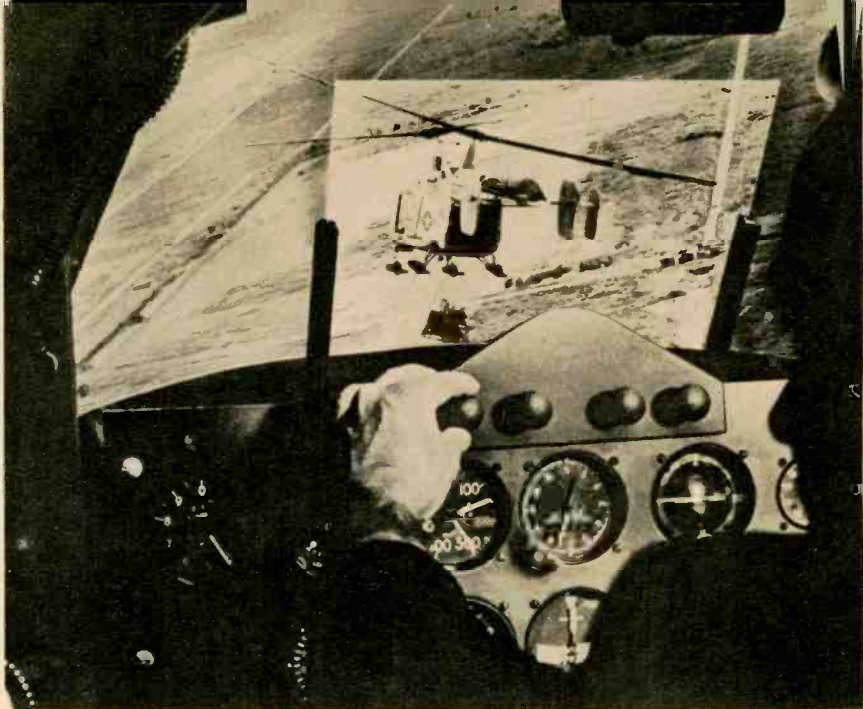
You must protect the system against lightning. Ground the transceiver to a cold-water pipe through the shortest possible length of No. 10 wire. This also provides protection against the transceiver case being hot with respect to the AC line. Then drive a 4-ft. rod into the ground near the antenna and connect the mast to the rod with No. 10 wire.

It may sound complicated and expensive but it's not. It takes at most an extra 30 minutes to install the transmission line and ground wire properly. And less than \$5 will cover the cost of the extra standoff insulators and ground wire. But you'll be guaranteed years of trouble-free CBing.



Fig. 3—After installation of antenna and coax, connect an in-line power/SWR meter between coax and transceiver to measure SWR and output power.

**WATCH OUT...**  
A windshield that permits pilots to see at night has been developed by Standard Kollsman Industries. The Night Window, as they call it, is based on image-intensifier techniques but produces no flat-screen image. Instead, a virtual image is formed so objects appear at true distances. The effect is simulated in this photographic mockup. Image is reflected toward the pilot from equipment behind the instrument panel by angled glass screen. In daylight, pilot looks through the screen.



## Electronics in the News



**Doctor-Patient.** . . Seldom have telephone circuit boards been brought to a hospital to receive surgery. But the doctor—in this case, Western Electric technician Frank Curtis—is, himself, confined to a hospital as a result of an accident ten years ago that deprived him of the use of his legs. Frank's own troubleshooting routine for the boards (used to control circuits in push-button phones) has worked so well that WE has adopted it in its regular repair shops. By the way—who's your friend, Frank?

*Electronics Illustrated*





**Burning Beacon.** . . A piece of equipment adapted from the space program has helped put the Plaisted Polar Expedition over the top—the top of the world, that is. Deputy expedition leader Donald Powelleck poses with the special equipment—a radio beacon run on a 3M propane-power thermoelectric generator putting out 5 watts at 12 V. The beacon guided snowmobiles and supply planes to a fuel cache about 200 mi. from the North Pole. The only other recorded polar round trip on the Arctic ice was made by Admiral Robert Peary in 1909.

**Instant Antenna.** . . Troops in Vietnam were bending down the antennas on their transceivers to keep them out of sight of snipers. Avco Electronics had a better idea (below): make the antenna out of a long strip of stainless-steel foil and use a motor drive to coil it into a tubular monopole or roll it up again on a spool inside the transceiver, out of sight until it's needed.



**Lethal Glance.** . . The helmet worn by this combat pilot actually doubles as a gunsight. Honeywell, which makes the device for the Army's Cheyenne helicopters, won't reveal details—only that a beam of what they call invisible light comes from a source behind the pilot and is tracked by gear in the helmet to determine direction pilot is looking. Information can be used for automatic aiming of guns, cameras or other reconnaissance equipment.

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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.

## AMATEUR RADIO

HEATH Twoer. Want Knight T-60, Heath DX-60B or similar. Randy Bell, 7725 Pontiac Dr., Pensacola, Fla. 32506.

TUBES—4X150Ds and 4CX250Bs. Will swap for CW transmitter or best offer. Mark Lundstrom, WN0TQC, 1022 Lake St., Alexandria, Minn. 56308.

NAVY CTS-13 receiver and transmitter. Will swap for Heath HR-10 and DX-60A or Swan 350, Galaxy V or Collins KWM-21. Harold Stancil, 1303 Langford, College Station, Tex. 77840.

GENERAL ELECTRIC BC-191F transmitter with TU5B, TU6B tuning unit. Will swap for guitar, VHF receiver or best offer. Wait Trepanier, 178 Intervale Ave., Burlington, Vt. 05401.

SURPLUS ART-13 transmitter, dynamotor, plugs. Will trade for 12-VDC CB transceiver or best offer. Thomas A. Berry, 209 N. Travis St., Wichita Falls, Tex. 76304.

HALLICRAFTERS HT-40 transmitter. Want VHF gear or best offer. F. Struebing, 977 Nash Rd., North Tonawanda, N.Y. 14120.

HEATH HG-10 VFO, other gear. Will swap for CB base or mobile transceiver or best offer. Kenneth V. Vickery, 1716 Jordan Dr., Rockledge, Fla. 32955.

TWO-METER BEAM A-144-11, T-45 manual rotor system. Will swap for 6-in. reflecting telescope or best offer. David Rose, Long Crossing Rd., East Hampton, Conn. 06424.

AMATEUR STATION for 80 meters. Will swap for CB gear or stereo tape recorder. Steve Armeros, 1019 S. Weadock, Saginaw, Mich. 48601.

LAFAYETTE HE-45B transceiver. Want HX-50A or Invader 200. K. N. Massie, 115 Woodlawn Dr., Ironton, Ohio 45638.

HEATH Twoer. Will swap for Heath Sixer or similar. Steve Lucius, WABJXW/3, Box B-741, Bucknell University, Lewisburg, Pa. 17837.

NAVY TDE-1 transmitter with power supply. Want 10-in. radial arm or table saw and 12- to 16-in. band saw. S. Fedor, 792 N. Shore Rd., Revere, Mass. 02151.

HEATH Twoer. Will swap for Heath Sixer or similar. William Goble, K3UEM, 330 Wood St., Clarion, Pa. 16214.

HEATH DX-40 transmitter, HR-10 receiver. Will swap for Lafayette HA-460 transceiver or best offer. Gus Lucus, WN5RYN, 414 Durango St., El Paso, Tex. 79901.

## AUDIO & HI-FI

KNIGHT KG-320 amplifier. Want stereo tape deck or dual-impedance microphones. R. VanderGoten, 7939 S. Marquette Ave., Chicago, Ill. 60617.

LAFAYETTE LT-99 AM/FM tuner. Want portable cassette tape recorder or best offer. F. C. Filippone, 543 Joralemon St., Belleville, N.J. 07109.

BALDWIN type C polarized headphones. Want VOM or short-wave receiver. D. Landesberg, 179 Marcy Ave., Brooklyn, N.Y. 11211.

STROMBERG-CARLSON AV-29 amplifier. Want Garrard SL-55 or similar turntable. C. M. Anderson, 133 Delaware Dr., Clarksville, Tenn. 37040.

VIKING RA-72 recording amplifier. Want RCA 45-rpm changer. D. L. Schermerhorn, Box 699, Seroe Colorado, Aruba, Netherlands Antilles.

WBCOR Microcorder II portable tape recorder. Will swap for CB transceiver, aircraft receiver or best offer. Jack Rosenbach, 1001 W. 79th Pl., Denver, Colorado 80221.

HEATH WA-P2 preamplifier. Want transistorized CB transceiver. Steve Peterson, 382 W. 870 N., Sunset, Utah 84015.

NORTH AMERICAN tape recorder, tape. Want Montgomery Ward 62C8453M mandolin. Rick Bennehoff, Rt. 3, Box 19A, Deer Park, Wash. 99006.

HEATH/GARRARD hi-fi system plus stereo records. Make swap offer. Ray Gasiorowski, 107 Warner Ave., Jersey City, N.J. 07305.

OLSON AM-229 35-watt stereo amplifier. Make offer. C. L. Thomason, 1162 Eastern Pkwy., Louisville, Ky. 40217.

## CITIZEN BAND

GONSET 12 transceiver. Will swap for short-wave receiver or best offer. Paul H. Gorrell, Box 228, Mashpee, Mass. 02649.

KNIGHT Safari III transceiver, KN-2572 antenna. Will swap for TR-106, TR-108 or similar 6- or 2-meter amateur transceiver. WA9TRV, 4530 S. Laporte Ave., Chicago, Ill. 60638.

CRYSTALS for channels 11, 17, 21, 23. Will swap for ham crystals for 80, 40, 20 meters. Mike Morris, 635 E. Bedford, Marshfield, Mo. 65706.

LLOYDS 7A08 walkie-talkie. Want ham gear or best offer. Ricky Miller, RR #3, Sumner, Iowa 50674.

HEATH GW-10 transceiver converted for 12-VDC. Will swap for Johnson Citiphone II or similar. Ernest Scavinsky Jr., 1127 Kirkpatrick Ave., North Braddock, Pa. 15104.

LAFAYETTE HE-100A walkie-talkies, power supplies. Will swap for Knight R-100A short-wave receiver or Hammerlund HQ-100A. D. McCrary, 1109 Ewing Blvd., Murfreesboro, Tenn. 37130.

EICO 772 transceiver with S-meter. Will swap for amateur receiver. Russ Quisenberry, 15454 Vintage St., Sepulveda, Calif. 91343.

MIDLAND 13-116 walkie-talkie, AC adapter, crystals for channels 11 and 16. Want Lafayette DynaCom II or Lafayette Echo-Verb reverberator and foot switch. James Briggs, 1306 W. Main, Russellville, Ark. 72801.

LAFAYETTE HE-20T transceiver. Will swap for technical microscope or best offer. Steven Pollack, 1215 Grand Concourse, New York, N.Y. 10452.

HEATH GW-22 transceiver. Want ham gear. Mark Cheek, Box 212, Canon, Ga. 30520.

LAFAYETTE 2-channel, 300-mw walkie-talkie with AC power supply. Make swap offer. Wendell H. Waites, 1634 N. 55th St., Philadelphia, Pa. 19131.

## SHORT-WAVE LISTENING

KNIGHT R-55A receiver. Will swap for ham or surplus gear. W. E. Francisco, 1171 W. Eldorado, Decatur, Ill. 62522.

HALLICRAFTERS S-120. Will swap for 4-track tape recorder. Mitchell D. Herbach, 2957 Ave. W, Brooklyn, N.Y. 11229.

HEATH AR-3. Make offer. Larry Miller, 4903 Wythe Ave., Richmond, Va. 23226.

KNIGHT Star Roamer. Swap CB base transceiver. Paul Roberts, 1520 E. 37th, Spokane, Wash. 99203.

HEATH GR-91. Want Knight R-100A or best offer. Ian Hyland, 34 Westhead Rd., Toronto 14, Ont., Canada.

HALLICRAFTERS SX-62A, 550 kc to 108 mc. Will swap for CB gear or best offer. R. Smucker, RD #3, Huntingdon, Pa. 16652.

KNIGHT Star Roamer. Will swap for Knight KG-250 stereo amplifier or similar. P. J. Yudell, 1428 N. Curson, Hollywood, Calif. 90046.

HEATH GR-91, HD-11 Q-multiplier. Want oscilloscope. Kent Wilson, 5767 W. Jewell, Denver, Colo. 80226.

HARVEY-WELLS R-9A receiver. Will swap for Heath Twoer or other ham gear. Marshall Keyes, K3YOF, 4912 Midline Rd., Baltimore, Md. 21206.

HOMEBREW all-band receiver. Make swap offer. Darrell Patton, 33483 Fernwood, Westland, Mich.

KNIGHT Star Roamer. Will swap for best offer. Larry Slayman, 12 Hoffman Dr., Williamsport, Md. 21795.

HALLICRAFTERS S-120. Want Heath GR-54, Ameco R-5 or similar. Peter Ordower, 534 Stratford Pl., Chicago, Ill. 60657.

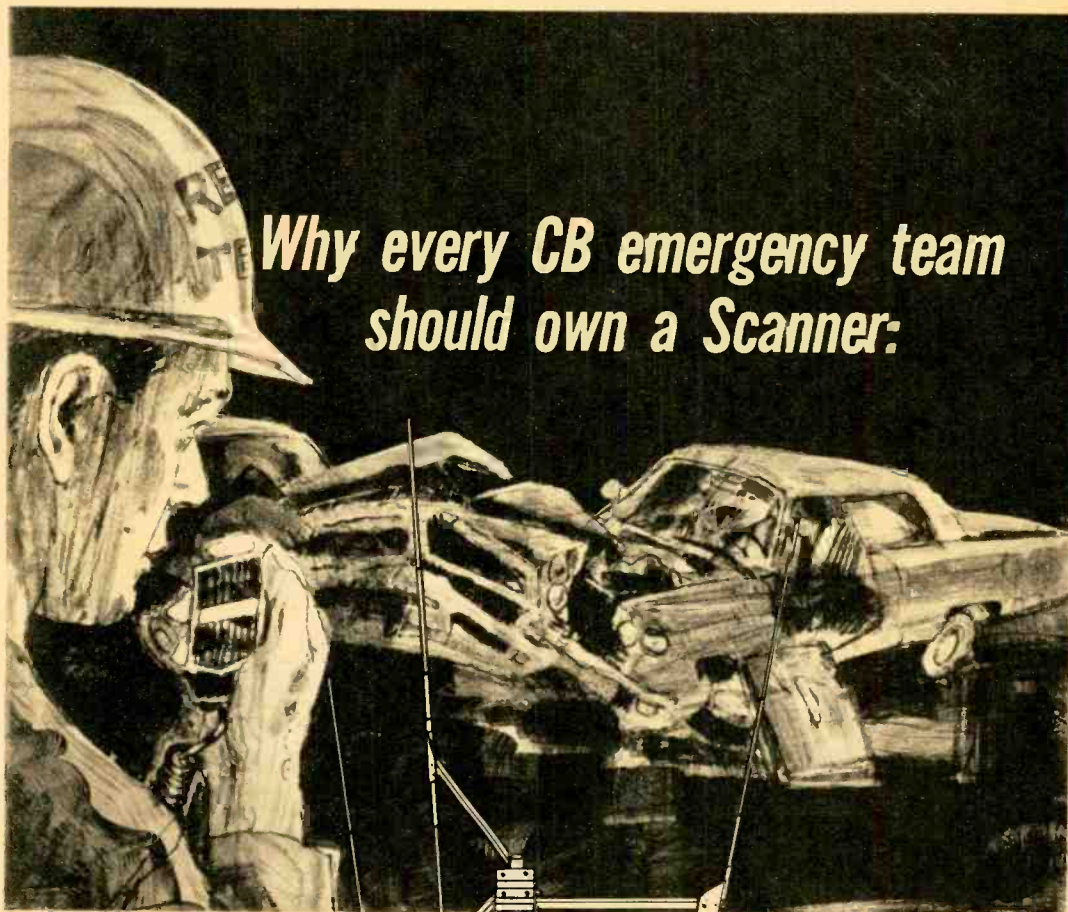
SURPLUS BC-348R receiver, 950 kc to 18 mc. Will swap for CB transceiver, antique radios or best offer. William E. Lee, 1980 Clinton Ave., Oroville, Calif. 95965.

REGENCY Model 3 12-VDC/AC all-band converter. Will swap for CB transceiver. Robert H. Langdon, 6 Sussex Pl., Deer Park, N.Y. 11729.

HALLICRAFTERS SX-101A, matching speaker. Will swap for amateur gear or best offer. William H. Commerford, 713 Fecet St., Goldsboro, N.C. 27530.

KNIGHT Star Roamer. Will swap for VTVM or transceiver. Robert Hall Jr., 51 Bridge St., Monson, Mass. 01057.





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CIRCLE NUMBER 21 ON PAGE 11

September, 1968

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## Kit Report

Continued from page 39

transformer using a station as a signal source, and aligning the multiplex circuit with a stereo station as the signal source. No hitches here but we found that instrument alignment of the ratio detector later did lower distortion slightly.

Here are some of our measurements of the tuner portion of the receiver. IHF sensitivity: better than 2  $\mu$ v (this met Heath's specs). 1-kc stereo separation: better than 35db. 15-kc stereo separation: better than 15db. (Separation figures were limited by our instruments.) Mono total harmonic distortion: 0.4 per cent. Stereo total harmonic distortion: 0.9 per cent. Mono signal-to-noise ratio: 60db. Stereo signal-to-noise ratio: 55db. The mono frequency response was down 1.5db at 20 cps, flat from 40 cps to 5 kc, down 1db at 8 kc and down 3db at 15 kc. The stereo response was down 1.5db at 20 cps, flat to 8 kc, then dropped 3.5db at 15 kc. AM performance met Heath's specs.

The amplifier portion of the receiver performed just as well. In all measurements both channels were driven. This is what we found: total harmonic distortion at 50 watts (rms) output was never greater than 0.2 per cent in either channel from 20 cps to 20 kc. Clipping level for each channel was 55 watts.

The frequency response at 1 watt (both channels) was down 0.5db at 10 cps and virtually flat out to 50 kc, where it dropped only 2.5db. The signal-to-noise ratio was 69db at the *aux* inputs, 68db at *phono*.

But enough of figures. Let's take a look at how the AR-15 performed. Our builder is located 50 mi. from New York City, out on Long Island. Simply touching antenna terminals pulled in almost every major FM station in New York. After we attached an 11-element VHF-TV/FM antenna, stations came in all over the dial from Connecticut, Poughkeepsie, N. Y. and New Jersey. The AR-15's sharp selectivity meant no difficulty tuning closely spaced stations.

## TV's No. 2 Bad Guy

Continued from page 69

teriorate, the capacitors will short to each other. Bridging won't help in these cases because the short is internal and you won't be

able to bridge out the short. Disconnecting the filters one at a time also won't help. You must disconnect all of the filters at the same time and substitute new filters for them. This is tedious but purely mechanical.

That's what I did with the filter cans when I found my routine bridging didn't help. Being careful to keep the wires together I labeled each with the appropriate symbol from the filter can (Fig. 2). I connected test filters to see if the trouble would clear. It did. So I replaced the entire can.

When I brought back the set I told the promoter it was fixed.

"I'll tell you when it's fixed," he growled, giving it a jab on the right side. The TV wobbled on its stand but the picture held.

"Okay, it's fixed," he said.

## Do Stereo Records Last?

Continued from page 71

however, still is a subject of argument. Under optimum conditions, with tracking force precisely adjusted, it might create somewhat less wear than a conical stylus tip. When the adjustment is off it might do more harm.

Another point affecting record wear was raised by a recent letter from W. L. Ferrigno, Manager of Product Planning and Market Research at General Electric's Consumer Electronics Division. He says, "In extensive laboratory tests it was found that polyvinyl chloride and polyvinyl acetate, the materials used in making LP records, suffer from a lack of resiliency. It takes about 16 hours for a record groove to recover from the expansion force generated by the stylus and until it returns to its normal configuration the walls are extremely brittle and subject to chipping if the record is played."

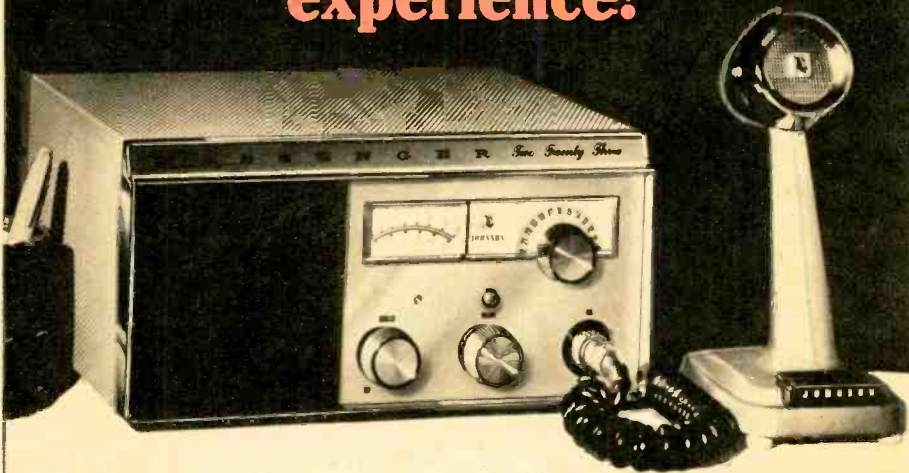
Findings of the 1959 test pointed to the same conclusion. Recovery of groove walls was demonstrated several times when a record was evaluated immediately after a test run and then again some time later. Conclusion then, as now: A record played once and put away for a day will last longer than one played over and over, even though total number of plays is the same.

All of which goes to show that no matter how the equipment changes the rules of record care remain the same. And if discs don't seem to last longer maybe it just proves your ear has improved with the gear.



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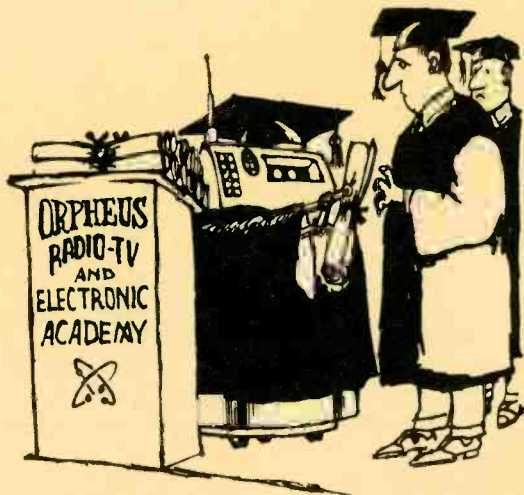
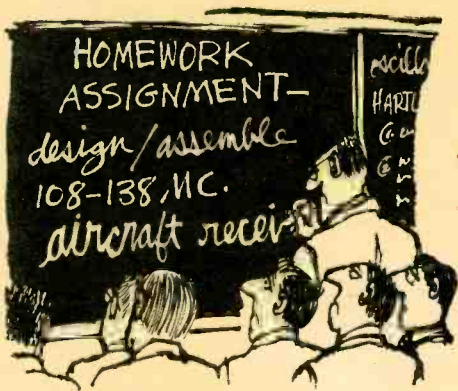
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CIRCLE NUMBER 34 ON PAGE 11

# Over and Out *rodriguez*





## Sonic Switch


Continued from page 51

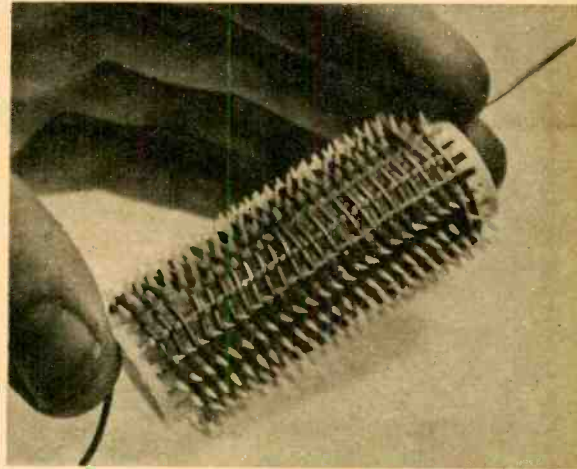
collector voltage is high Transistor Q8's collector voltage is low. When the DC at D2's cathode is applied to Q7's base, Q7's collector voltage falls. Capacitor C8 discharges through R25 and Q8. This reduces the bias on Q8's base and causes Q8's collector voltage to rise. After C8 has discharged it allows Q8's base voltage to rise. This causes Q8 to conduct and its collector voltage falls. Thus, a rectangular pulse is produced as in Fig. 7A. Essentially a square wave, this voltage is applied to Q9's base, turning Q9 on. Since Q9 is in series with Q6 and RY1, RY1 cannot close because Q6 is still off.

The square wave also is applied via C9, D3 and D4 to flip-flop Q4, Q5. The circuit constants of C9, D3, D4 and R27 are such that a spike voltage is applied to Q5's base at the trailing edge of Q8's pulse. The spike causes the Q4, Q5 flip-flop to trigger, but its time period, as shown in Fig. 7B, is much longer than that of Q7, Q8. The waveform at Q5's collector now turns Q6 on.

But note that the Q4, Q5 waveform is turned on after the Q7, Q8 output has returned to normal. Q6 is turned on, Q9 is now off, and RY1 still cannot close. Effectively, the first impulse (clap) has left Q6 turned on and Q9 turned off. If a second impulse is applied to D2 (the second hand clap) while Q6 is on, Q7, Q8 flips again turning on Q9. Since Q6 and Q9 now are both on, current flows through RY1's coil and RY1 closes. Since RY1 is an impulse relay, each pulse causes its contacts to close and stay closed even after the current through the coil stops. It takes two more impulses to open RY1's contacts. The impulses may be two sharp sounds, as we said before, such as claps, finger snaps or even two loud words like *light on* or *light off*.

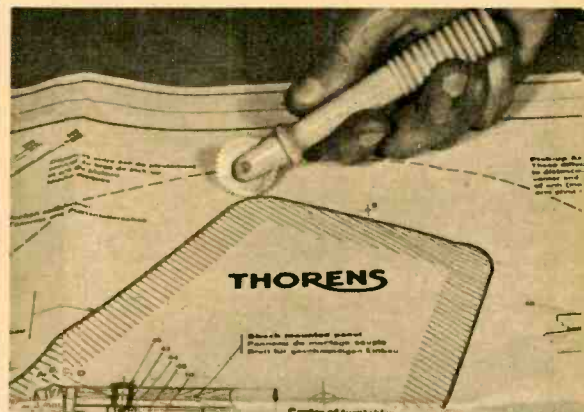
Remember that the second clap must come while Q4, Q5 is flipped (Q6 on). After about 1 second Q4, Q5 flops back to normal, Q6 is turned off and a second clap would have no effect on RY1.

The timing is determined by the values of C7 and C8. By maintaining the same ratio between the capacitor values but increasing their capacitance the time necessary for two claps can be lengthened. Similarly, decreasing their value shortens the required two-clap timing. 



Next time milady goes out to buy hair curlers ask her to get you a few—not for your hair, for coil forms. They're cheap, low-loss and will keep coil windings from touching each other. By winding the coil between the many tiny projections you can keep the windings about 1/8 in. apart.

## TIPS



A dressmaker's fabric-marking guide is an excellent tool for transferring the cutout pattern from a record-changer mounting template to a baseboard. Sold in most variety stores for less than \$1, the gadget also will serve in other wood-working projects which have full-size templates.

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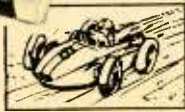
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## The Boom In Bootleg Tapes

Continued from page 92

on anything from a \$69.95 monaural recorder to a \$600 Ampex or Magnecord.

A good battery-power portable can catch virtually anything that plays live at a local theatre. Because fidelity and reliability are at a premium here, dealers favor tapes made on such recorders as the Nagra and the Uher 4000. But both are bulky and expensive—\$400 for the Uher, \$1049 for the Nagra. Neither records in stereo (Nagra's stereo model is due this summer and Uher's Stereo 4400 is only beginning to appear) but both are capable of excellent mono quality and anyway stereo miking presents a major problem within the confines of a theatre seat.

Most recordists resort to units small enough to fit an overcoat pocket. Cassette models are favorites because they can provide acceptable fidelity and it's much easier to flip over a cassette in the dark than to thread a tape reel. Then there is the whole new generation of reliable recorders small enough to fit comfortably in a jacket pocket or moderate-size handbag. The EDI M60 (at \$345) even records in stereo for 60 minutes without interruption. (See Consumer Report on Pocket Tape Recorders, July '67 EI.)

The trouble with all of this is that it's illegal. At present, the artist, who frequently suffers the most damage from unauthorized recordings, has no legal protection against bootleg recordings. When the Copyright Act was passed in 1909 Congress didn't take the phonograph very seriously. Composers could copyright their music and manufacturers could patent a process. But Enrico Caruso couldn't protect his own performances and vaudevillians weren't immune from others who copied their style and costume.

Artists argue that unauthorized recordings damage their professional reputations since bootleg tapes—particularly those made live—never are made under conditions as favorable as those in the studio. Besides, if you pay a bootlegger \$10 for some Charlie Parker or Lenny Bruce the performer sees none of the money. And you're less likely to buy a commercial recording on which the performer *does* receive a royalty.

So far, record companies and other vested interests have managed to keep the bootleg

[Continued on page 116]

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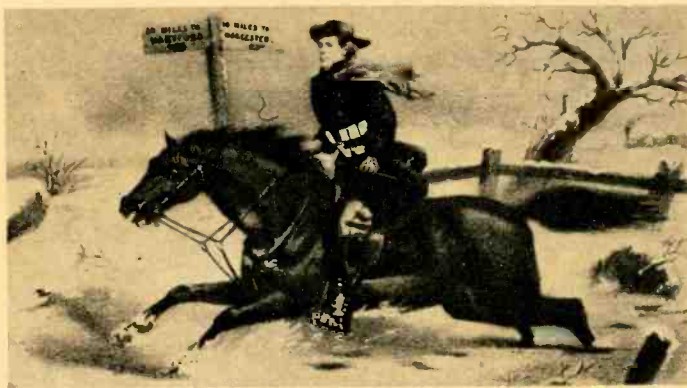
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tape business under the counter by threatening possible action. You can come and go in most of the stores that sell underground tapes without seeing or hearing anything out of the ordinary—unless you're a regular customer.

"I know we're not going to drive them out of business and I know they're doing a good business with our artists," one agent told *EI*. "But the cost of prosecuting each and every individual would be prohibitive." A lawyer, he believes that bootleggers can argue with some justice that they're performing a worthwhile service. "After all, there wouldn't be any Fred Allen comedy around if it weren't for those people."

### CB Corner

*Continued from page 66*

**Class C.** As the major band for radio control, Class C enjoyed considerable popularity

among the model-airplane crowd. But even their hobby couldn't escape the upheavals that periodically plague the Citizens Band.

Class C originally was issued as six channels for radio control on 27 mc. The model fliers, with little more than a one-tube receiver, could fly anything from an outside loop to an Immelmann Turn—until the birth of Class D. Then the airplane hobbyist with primitive equipment had his control beeps bopped as the air grew heavy with Class D carriers on the same or nearby channels.

So the modelers formed their own strategic air command. First, they went to more sophisticated equipment to filter out the ubiquitous Class D CBers. Then they petitioned the FCC for Class C channels far removed from the communications explosion on Class D. They won their case. The FCC has created five more CB channels between 72 and 76 mc exclusively for model aircraft.

And all that brings our discussion to **Class D**, CB's most unabandoned band.



## Ameco R-5 Kit Report

Continued from page 72

signal increase from 15 to 1,000  $\mu\text{v}$  caused only a 2db output-level change at the speaker. Somewhat unusual for such a low-cost receiver, the front end was immune to objectionable overload with signal input levels ranging as high as 20,000  $\mu\text{v}$ .

Only two things bothered us. First, the circuit board, which contains most of the parts, has very closely-spaced solder pads. This requires a very small soldering-iron tip and some previous experience in close-quarter soldering. For this reason we would not recommend the R-5 as a beginner's project.

Second, should you have some difficulty getting the kit to work at the first try you will find the service notes are poorly organized. The material is there (there are excellent X-ray views of the circuit board) but you'll have to dig out the information. Also, two schematics were supplied—revision A and C—and it was some time before we realized we were using the wrong schematic. Our builder had the receiver working 15 hours after he opened the box.

For the money, R-5 offers amazingly good performance. We would recommend it for a rock-bottom priced ham station and as a general-coverage receiver from the bottom of the broadcast band to 54 mc.

AMECO R-5 PERFORMANCE			
Freq. (mc)	Sensitivity in $\mu\text{v}$ for 10db S+N/N	Minimum CW Sensitivity*	Image Rejection (db)
1.0	13.0	—	—
2.5	8.9	2.2	27
7.0	10.0	3.0	12
14.0	7.1	1.8	20
28.0	10.0	5.0	7
52.0	5.6	1.0	3

\*Minimum RF signal required to produce usable audio level

## Portable PA System

Continued from page 62

plifier output, J2, to the speaker terminal strip on the rear of the cabinet. You do this by removing the two screws which hold the strip in place, then lift out strip. Slip the shielded wire into the hole, connect one end of the wire to the lugs and reinstall the strip. Fish the shielded wire through the cabinet,

(Continued on page 118)

## El at Large

### Ah So! Return of Return of Turcan!

VERY clever, these English electronics brokes! Have designed splendid video recorder to cost ah, so few yen—now to be made in Rand of Rising Sun.

In fact, in plain English, the British have designed two low-cost home video recorders. First came Telcan (which folded before it could deliver). Then came Wesgrove (with a rig that sounded curiously like Telcan and a company that had several of the same officers). Telcan's deck was supposed to have sold for \$170. Wesgrove's, in kit form, went for \$392. We got our hands on one but never could get it working in acceptable fashion. Nor could anyone else, so far as we know.

Wesgrove faded into the woodwork almost as fast as Telcan. Well, not into the woodwork. In 1966 (three years after Telcan's first murmurings about a VTR) Wesgrove disposed of its patents and parts to the Maruwa Electrical Chemical Co. of Japan. (Ah, so! Explains ridiculous pidgin English above.)

Then, late in 1967, a small U.S. importer of radios and tape recorders, Master-Craft Electronics Corp., announced it would handle a \$695 VTR (with camera and monitor) using ordinary audio tape (like Telcan and Wesgrove) and it would be made by Maruwa.

We asked Master-Craft president Jim Farnell whether his VTR was Telcan reincarnate. His answer: "I don't know. We recently merged with First Standard Corp. and it was one of their assets"—meaning, presumably, Wesgrove's U.S. patents. He also said that last year Master-Craft acquired the assets of Starlite Electronics, a company that had been importing inexpensive radios and tape recorders from (you guessed it) Maruwa.

Whatever its precise pedigree, Playback (the name of the Master-Craft VTR) appears to be a distinct improvement over Wesgrove. Appearance is more stylish and the picture we saw was free of Wesgrove's worst defects.

"It uses ordinary tape that goes for \$1.88 a reel," plugged Farnell. But he also said Master-Craft recommends Crolyn and that he was using it for the demonstration. (Crolyn is Du Pont's new super-low-noise tape, not yet commercially available and made only in 1/2-in. width. Indications are that it will cost considerably more than \$1.88 for a 10 1/2-in. reel of 1/4-in. tape for use on Playback's transport.)

Later this year you may see Playback for yourself, according to Farnell. And maybe this one will bear watching.—Bob Angus

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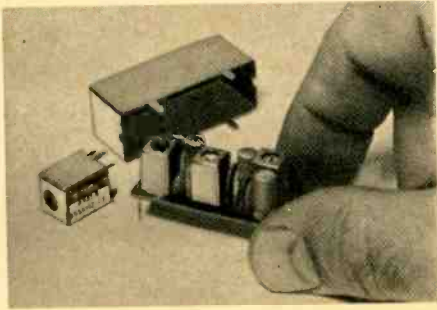
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CIRCLE NUMBER 1 ON PAGE 11

## Portable PA System

Continued from page 117

staple it to the side of the cabinet—to keep it away from the input leads—and attach plug PL1. Plug PL1 into J2.

Install the door with two hinges and connect the control-panel leads to the amplifier. Connect the power leads from the front panel to the power cord. Swing the door down and install a locking bracket at the bottom.

**Two Speakers Into One.** Place the second speaker on top of the amplifier speaker and install two luggage-type catches on each side. When the catches are snapped the speakers will be locked together into rigid column assembly. Connect the terminals of each speaker together, making certain the positive terminal of one speaker connects to the positive terminal of the other speaker.

The shelf is made from a piece of ¼- or ⅜-in.-thick plywood and is 11 in. wide x 12½ in. deep. Cement a strip of ½-in. quarter-round moulding to the bottom edge to provide a support for paper.

**Using the Portable PA.** Connect the mike and turn power on. Advance volume control R7 to the point just below which the system breaks into howl or for the desired sound level. If the system howls at low levels cut the high frequencies by turning tone control R6 clockwise.

## Junior Guitar Amp

Continued from page 93

some low-frequency loss due to a slight roll-off below 200 cps. When the tone control was in the center position there was a slight high-frequency roll-off of 5db at 10 kc. The tone control produced a 6db boost at 10 kc.

Tremolo was very effective. Its rate is adjustable from roughly 3 to 15 cps. Depth is very deep—almost 100 per cent pulsation. Both the rate and depth are adjustable. Unlike amplifiers which have a foot switch to key the tremolo on and off, the JK-37's tremolo is turned on and off by rotating the depth control.

While the JK-37 is adequate for anyone desiring a budget or practice guitar, it is especially attractive for those who enjoy rolling their own.



## The Listener

Continued from page 56

**Harmonic DX . . .** Since 1966 there has been considerable debate about the merits of logging SW harmonics. Are such signals legitimate DX or not? One difficulty is that many rookie DXers can't distinguish between a harmonic and an image. A harmonic is a real signal produced by the transmitter and can appear at any whole multiple of the fundamental frequency. For example, R. Americas' former SW operation on 6 mc could radiate harmonics on 12, 18, 24 mc, etc. And the 18-mc harmonic, having traveled from transmitter to receiver on that frequency, behaves like an 18-mc signal—not like 6 mc.

An image, on the other hand is an unreal signal produced in the receiver, itself, by poor front-end selectivity. An image of RA's 6-mc outlet, no matter where it appeared on your dial, always would behave like 6 mc since it was transmitted to your receiver on 6 mc.

The current debate has been sparked by the high sunspot count and accompanying live conditions on the upper frequencies. But, so far, a lot of would-be DXperts have missed the point. A harmonic is verifiable DX only when reception of the fundamental is poor or impossible. For example, if you received La Voz de Suyapa (San Pedro Sula, Honduras—fundamental, 6125 kc) on 30625 at noon EST you would have bagged yourself an indisputably great catch. Similarly, BBC's 7170-kc VOA Russian relay at noon is a good catch when its harmonic is logged on 28680 kc. 📻



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