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- How to Set Up a Neighborhood Antenna TV System
- Easy One-IC Project Mixes 4 Mikes
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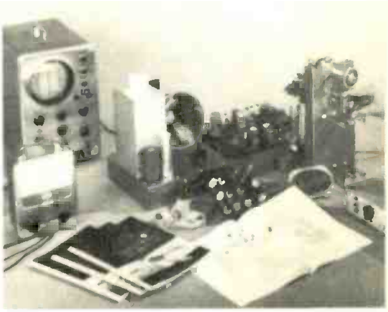

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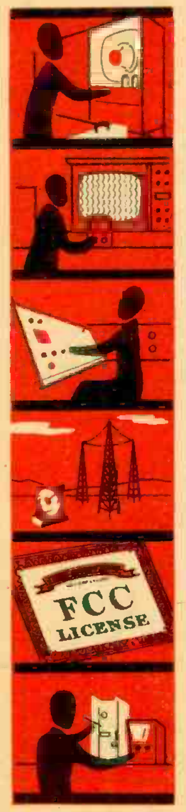

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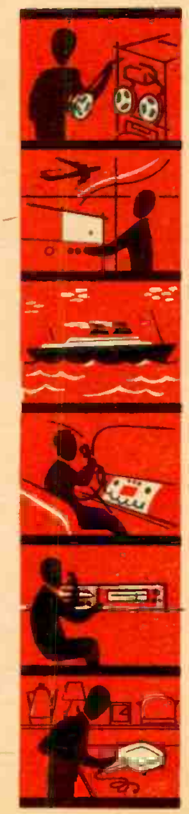

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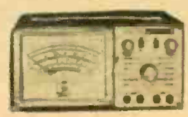

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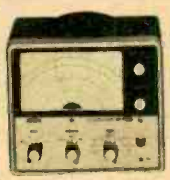

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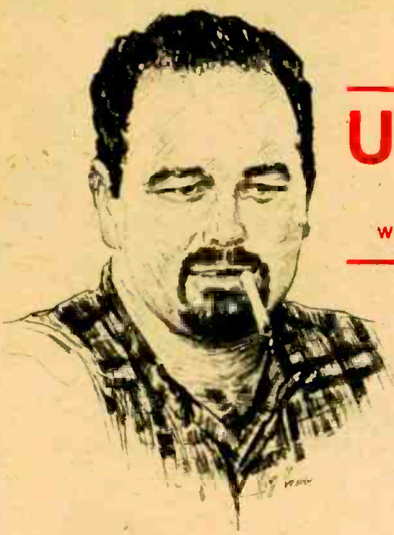

Uncle Tom's Corner

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.

★ *Recently you and a couple of other EI authors presented an article on the mysterious Radio Libertad. Since I liked the way you previously had got to the bottom of the Radio Americas affair, I think EI should finance an expedition to locate Radio Libertad. Not only would it put an end to the controversy about the station, but it would give EI some more editorial material.*

Kark W. Bullock
Falkner, Mass.

Latest news on the location of Radio Libertad comes from a radio engineer friend of mine who took the trouble of running through the wilds of South America with a DF receiver. One time he traced the BCB signal to an antenna which was strung between two buildings in the Mariperez section of Caracas. One building happened to be police headquarters and the other was the INOS (Institute Nacional de Obras Sanitarias) building.

A few days later he traced BCB signals (which were, this time, accompanied by several SW frequencies) to a place called Colinas de Bello Monte, also in Caracas. This is another INOS installation (a reservoir) surrounded by a high barbed-wire fence. Inside the fence exists a huge antenna farm connected to transmitters which seemingly operate by remote control from another location.

At other times he heard the same channels buzzing away with Radio Libertad signals not coming from either of these locations, and probably not from anywhere in Venezuela. His sources have advised him that the Venezuelan Ministry of Communications is fully aware of the operation but conveniently overlooks it, just as our FCC never seemed to be aware of little old 50,000-watt Radio Swan/Americas. . . Hey, did I just talk my way out of a trip to South America?

★ **Radar Department.** Here's an inside memo to all those companies shelling out fancy fees to rent or buy radar intruder (burglar) alarm systems. The word has already gone out that: 1) Many of them can be foiled easily by a small T-99/CRT-2 military surplus radar jammer which can be purchased for less than $20; and 2) the detection signals from most of these alarms can be received on a $30 radar speed detector, available at most auto supply shops and electronics mail-order houses.

★ *I understand that the human brain emits minute electromagnetic signals, sort of like radio waves. Couldn't someone design a receiver which would pick up these signals and convert them into written or aural messages? It might be a step towards explaining ESP or even so-called communications with the spirits.*

W. S. Ecklund, Sr.
Broken Arrow, Okla.

It's an interesting theory, the possibilities of which were rather thoroughly explored by Boris Karloff and a group of Hollywood writers in the movie *The Devil Commands* back about 30 years ago. At any rate, electrochemical activity cannot be equated with electromagnetic energy, and the latter is necessary for radio propagation.

★ *I purchased a Heathkit AR-3 general-coverage receiver and noticed that at the 30 mc spot on the dial it was marked with the letters WWV. So far as I can determine, WWV doesn't operate on 30 mc, so don't you think it's kind of funny that the set is marked that way?*

Terry Price, KCL6766
Chattanooga, Tenn.

No, not particularly funny.

This is 30,000 solid state replacement parts.

Feedback from Our Readers

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

● DON'T DIDDLE!

Regarding your ABCs OF COLOR TV SERVICING, I hope no beginner pays any attention to the first paragraph on p. 88 of the Jan. '70 issue. For a beginner—even if he has a diddle stick—all coils and transformers in the chroma section should be off-limits. Even experienced technicians stay out of chroma coils unless they have the proper alignment equipment. Anyway, diddling with most chroma coils will tell you next to nothing. For example, what good will playing with the reactance coil do unless the serviceman knows where to short out the correction voltage?

Incidentally, you should have mentioned to your readers that the photo of the Knight-Kit color-bar generator on p. 83 appears reversed—your layout man flipped the neg.

Robert Schaefer
Racine, Wisc.

● A BIT FISHY

I realize inflation is galloping along at a wild rate, but you guys are pushing a bit hard, aren't you? On page 48 of the Mar. '70 EI, your article HOW TO CHOOSE ELECTRONIC GEAR FOR YOUR BOAT (in a caption) quotes the price of the Heathkit MI-29 Fish Spotter as $79.95. On page 37 of the same issue, the Heath Co. gives the price as $84.95. What happened, fellas?

Joe Krasmire
Hauppauge, N.Y.

Sorry. Our author was apparently given a price that was only tentative.

● ELECTRET PUZZLE

I found your article THE AMAZING GIZMO NOBODY KNOWS (Jan. '70 EI) very interesting. In the early '40s I owned a Bruno velocity mike. It was a self-polarized capacity microphone. Puzzled about its operation I wrote to the company, but received no additional information, except that they warned against applying any sort of external voltage.

I opened up the mike myself and found what appeared to be a sandwich type construction, with two outer perforated plates riveted together; some kind of foil was inside. The foil appeared to be insulated and separated from the plates by something like a thick layer of rubber.

The mike had a high impedance and exhibited the usual figure-8 pickup. I used it for a number of years until the high frequency response dropped off. I now feel that it must have been an early form of electret microphone. Do you agree?

Alfred Luisser, W3EUD
Northampton, Pa.

● STAY IN SCHOOL

Wayne Green's piece in HAM SHACK in the Jan. '70 EI really disturbed me. I am convinced that he sold short the role of the college man in the electronics industry. First of all, the electronics schools he mentions produce technicians and not engineers. There is a big difference between the two. Technicians possess a practical knowledge of electronics which enables them to build the hardware of the industry. Invention, design and development remain the province of the engineer, the four-year college man who has the theoretical knowledge needed to carry on research to advance the state of the art.

It may well be that large corporations swallow up technicians. However, a talented electrical engineer is a valuable asset to the company. He is also well paid. Further, not all engineers immediately flock to large companies. Many work for small outfits and many form companies of their own. Yes, college men do these things.

[*Continued on page* 12]

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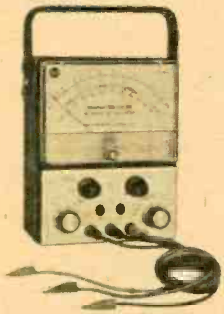

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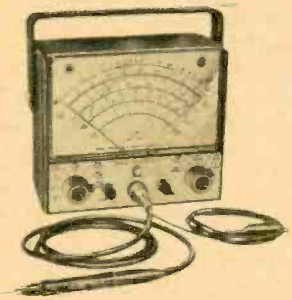

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CIRCLE NUMBER 25 ON PAGE 13

Feedback from Our Readers

Continued from page 10

I have a BS in electrical engineering and am working for both the Master's and Doctorate. I wouldn't trade my education for anything. Don't discourage the aspiring college man, and don't sell college short!

Charles Patisaul, WA4ARQ
Georgia Inst. of Technology
Atlanta, Ga.

We have received a good deal of mail on this subject and will publish more letters as space permits.

● MARINE BANDAGE

Enjoyed working on your Marine-Band Converter (Mar. '70 EI), but the reception was a bit too much. It's the first time I've ventured into this area, but I never expected to hear such language. Have you ever heard what goes out over the marine band? What I want to know is—can you show me how to add an obscenity filter to my rig?

Hyram Forsyth
Bangor, Me.

● STOP SHOUTING

While reading FEEDBACK in your January '70 issue I noticed a fellow ham fighting to keep the code test. I feel anyone who is really interested in amateur radio should know the code and any person can master it because it is a fascinating aspect of radio. I work it most of the time. So keep those letters rolling in, fellow hams!

Clarence Jewell, WA2GFF
New York, N.Y.

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Swap Shop

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

CITIZENS BAND

GONSET G-12 transceiver and Hy-Gain base antenna. Want Lafayette RK-810A tape recorder or 3-watt, 3-channel walkie-talkie. Clair Weaver, 627 Lake Holloway Blvd., Lakeland, Fla. 33801.

GENERAL RADIO TELEPHONE VS-4 CB rigs (2), two Hallicrafters CB-11 walkie-talkies, Wollensac 4-track recorder. Want turntable, speakers or cash. Charles Dickinson, 220 Phillippine, Taft, Calif. 93268.

PACER CB rig, Nova Tech Pilot II, back issue of electronics and aviation mags. Want tape recorder or telescope. John Martin, Box 116, Leeton, Mo. 64761.

ANTIQUE ELECTRONICS

PHILCO console TRF receiver (model 96), in working order. Swap for 5-watt CB rig or best offer. Edward Perkins, Star Rt., Mt. Washington, Ky. 40047.

PACKARD car radio (circa 1936), in perfect condition. Will swap for Ameco R-5 or best offer. Ron Layton, R.D. 2, Box 14, Connellsville, Pa. 15425.

RCA Model 18 (circa 1926) receiver, old tubes and radio parts. Want University 6201 coax speaker ('55 or '56). B. N. Abbott, Jr., Rt. 5, Box 322, Mechanicsville, Va. 23111.

MIDGET SUPREME Model 1-01A (1923) radio. Swap for best offer. Roy Pederson, K9FHI, 510 Park St., Juneau, Wis. 53039.

FREED-EISEMAN NR-7 (1924) and other equipment. Want Swan 250/W power supply, SX-43, HA-10, HW-17, HG-10 or best offer. Robert Hummel, 104 E. Oak Grove St., Juneau, Wis. 53039.

WESTINGHOUSE Model DA with tubes, Grebe CR-9 with tubes and Thorala speaker, Sparton 301, Atwater Kent Models 36, 53 and 60C. Swap for SW receiver or best offer. E. V. Wills, 1249 Kansas Ave. S.E., Huron, S.D. 57350.

RADIOLA Model IIIA, AR-812 and 5-vol. auto engineering course dated 1919. Want ham equipment. Charles Shwartz, WN3LGS, 44 Prospect St., Susquehanna, Pa. 18847.

ATWATER KENT model 20 battery radio, set of Rider service manuals (copyright 1931). Swap for best offer. Steve Fox, WA7EDK, 4439 Fuleda, Klamath Falls, Ore. 97601.

ASSORTED ANTIQUE TUBES. Will trade for APR-2 or -4, or UHF/VHF equipment and parts. Peter Murricane, 200 E. 63 St., N.Y., N.Y. 10021.

RCA RADIOLA III-A and 17LP4 picture tube. Want Heath Twoer, GDO or 10-17 scope, or 10-meter linear amplifier. Keith Frank, 555 E. Franklin St., Berne, Ind. 46711.

ZENITH receiver (circa 1940), BCB and SW bands. Want Lafayette Explor-Air Mark V or similar SW rig. Glenn Campbell, 1017 Military St., Florence, Ala. 35630.

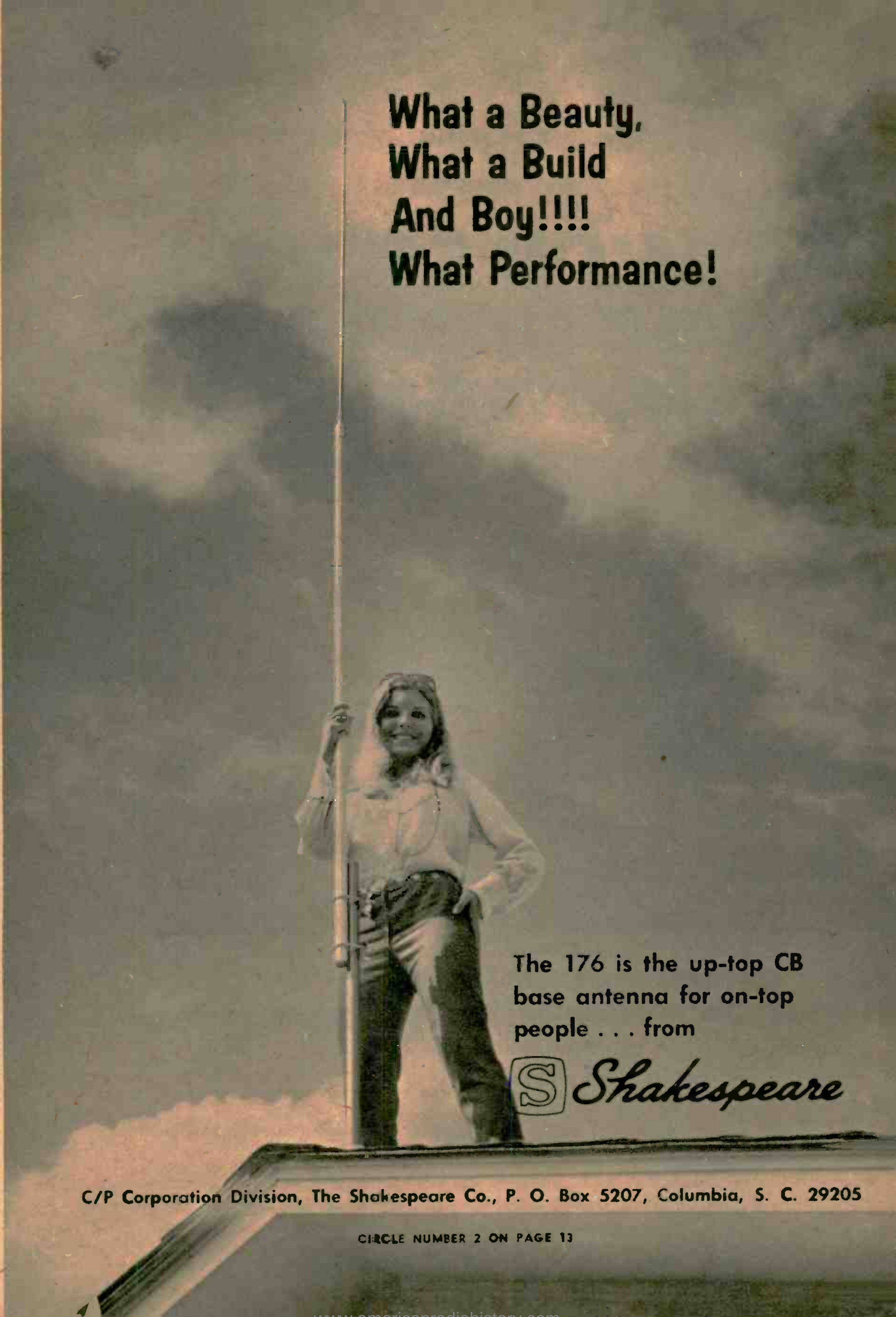
ANTIQUE RCA 9-tube FM tuner, Bogen AM tuner. Want government surplus receiver, signal generator or test equipment. Philip Corby, Box 730, Helena, Ark. 72342.

MAJESTIC-7, model 70; also Pentron 9T-3 mono tape recorder. Will swap for photo equipment or best offer. Tom Jackson, 15813 Andover Dr., Dearborn, Mich. 48120.

OTHER EQUIPMENT

HEATH EK-1 VOM. Will trade for seven 15-meter novice crystals. Mark Dubay, WN6MMX, 500 S. Gilbert, Fullerton, Calif. 92633.

ELECTRIC GUITAR, double pickup, 10-W amplifier, case. Will swap for new Knight R-100A receiver kit. Chris Hendricks, 443 S. 93 Place East, Tulsa, Okla. 74112. [Continued on page 24]


What a Beauty,
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And Boy!!!!
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The 176 is the up-top CB base antenna for on-top people . . . from
Shakespeare
C/P Corporation Division, The Shakespeare Co., P. O. Box 5207, Columbia, S. C. 29205
CIRCLE NUMBER 2 ON PAGE 13

Broadsides

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

TALK may be cheap but sometimes it can be important that what you say be faithfully reproduced. With this in mind, the Brothers Shure offer you a catalog which describes their line of **microphones**, mixers and other products related to public-address and tape-recording applications. If fidelity and audio gear are your interest, be sure to write for your free copy of catalog No. AL314D from Shure Bros. Inc., 222 Hartrey Ave., Evanston, Ill. 60204.

More equipment from the audio scene appears in a catalog of **stereo headphones** available from Superex, 4-6 Radford Pl., Yonkers, N.Y. 10701. Included are detailed descriptions of Stereophones for hi-fi listening and phones designed for amateur-radio, CB, electronic-music appreciation, marine and aviation, short-wave listening, etc. Write for free catalog No. 5727.

If professional **test equipment**—including some at reasonable cost—is your thing, make sure you write for a copy of Sencore's new 1970 catalog. You'll find VOMs, VTVMs, color-bar generators, tube, transistor and FET testers, scopes and sweep generators. For a free copy, write to Sencore, Dept. EI-5, 426 S. Westgate Dr. Addison, Ill. 60101.

A Quick Reference Guide for **solid-state devices** available from RCA turns out to be a handy 48-page catalog which lists more than 1,000 devices according to application or function. Devices include ICs, transistors, silicon rectifiers, thyristors, diodes and photocells. At a glance, you can see what is available in a specific group. Catalog SPG-201F has a suggested price of 35¢ and is obtainable from your local dealer or from RCA Electronic Components, Harrison, N.J. 07029.

If public-service, industrial or business communications are your concern you'll want to take a look at brochure No. S-528 offered free by the Hallicrafters Co., 600 Hicks Rd., Rolling Meadows, Ill. 60008. This four-page product information guide discusses their line of Hand Command FM **transceivers**, which operate in the frequency range of 148 to 173 mc.

Anyone involved in tape recorder servicing won't want to be without a short-form **Tape-Head Replacement and Conversion Guide** available from Nortronics. The guide covers 218 manufacturers and over 2,100 recorder models, both popular and professional, imported and domestic. The guide is designed for shop use wherever tape heads are serviced or sold. Free copies are available from distributors or from Nortronics Distributor Div., 6140 Wayzata Blvd., Minneapolis, Minn. 55427.

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Comes with crystals for 3 channels (9, 13 and 19), but its unique frequency-synthesis circuit makes all 23 channels available at low cost. Each time you buy one of the 10 optional plug-in crystals you add 2 more channels . . . . **lets you add your choice of extra channels at any time, economically!**

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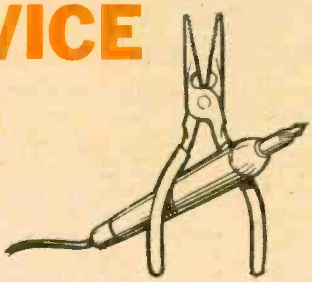
CIRCLE NUMBER 8 ON PAGE 13

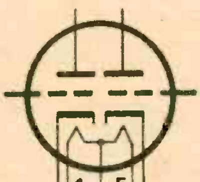
SERVICE TIPS



By ART MARGOLIS

THERE are three things to remember when you service transistor equipment: (1) Electron flow is always in the direction opposite to the arrow which appears in the emitter circuit; (2) NPN transistors usually are made of silicon and have a 0.6 V emitter-to-base bias; (3) PNP transistors usually are made of germanium and have a 0.2 V emitter-to-base bias.

One mysterious electronic malady occurs when 12-V twin-triode tubes—like the 12AX7A whose schematic is shown on the left—burn up as quickly as you put them in their sockets. It turns out that one of the three heater connections in the tube socket has opened up, putting 12 V across a 6-V winding. A new socket or pin is the cure.



Most common danger that exists when you repair appliances is the possibility of a plugged-in unit coming into physical contact with a nearby radiator or water pipe. A large voltage difference will be present, so upon contact a large amount of current can flow. Moral: keep all such items apart.

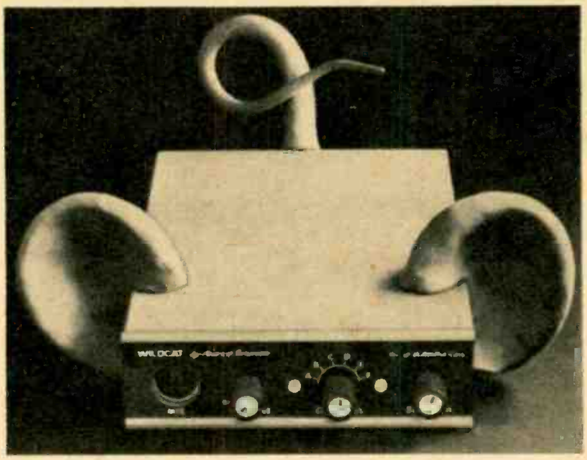
When testing tubes in a drug store tester, don't leave the tube in the test position any longer than necessary. Most people hope the needle will go higher the longer they leave the tube in! Emission testers tie the control grid to the plate; triodes and pentodes are tested as diodes. So too long a test could burn out the tube.

Heating elements in those small, hand-held electric massage units are the familiar 10-watt resistor found in radios and TVs—value is a few thousand ohms. If the heat loses its effect or disappears altogether, the resistor has either increased in value or opened up. Just test it and replace it.

Ever feel a slight vibration as you rub your fingertips over a plugged-in chassis? You're getting a slight shock from a non-polarized line cord insertion. Just reverse the plug in the wall socket and the sensation will disappear.

If you should happen to wear smooth the slot in a ferrite tuning slug by using a metal screwdriver instead of a plastic one, remove the slug and turn it around. Quite often there is an identical slot at the other end.

MIGHTY MOUTH



Sure it's small. It measures merely $1\frac{3}{8}$ inches high, $4\frac{3}{4}$ inches across, and $6\frac{1}{4}$ inches deep. It weighs less than two pounds. With all the extras.

In fact, it's the smallest mobile CB in the world.

Do not be deceived.

Its real name is Wildcat. And it lives up to the name.

The Wildcat gives you as much power as *any* CB...including the great big ones. It has six full channels. Including crystals for channel 9. It comes equipped with mounting bracket and quick power disconnect.

The Wildcat is all solid state. It's completely warranted by Pearce-Simpson, the finest name in marine radios, depth finders, hailers, and CB radios and antennas. And backed by Gladding Corporation, first in outdoor recreation since 1816.

It's even got a wood grain finish in the front.

And what a mouth. This little radio will fit inconspicuously into any car, but turn it on and you've got pure talk power.

And ears? Well, you can see for yourself. We've got the biggest in the business. So sensitive, they can pick up even the weakest signal.

Oh, yes. One other very small thing. The price. Only $69.95.

So, please. See your Pearce-Simpson dealer. He'll introduce you to Mighty Mouth. And any of our other fine CB radios and antennas.

Or write for complete literature to Pearce-Simpson, P.O. Box 800. Biscayne Avenue Annex, Miami, Florida 33152.

Wildcat. By Pearce-Simpson. Good things come in small packages.

Pearce-Simpson GLADDING

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CIRCLE NUMBER 18 ON PAGE 13

UTAH WD-66 speaker system, less woofer. Want hi-fi reverb or strobe lite. Dave Felix, 1741 Thames St., Clearwater, Fla. 33515.

PHILCO (Waterman) scope (2-in.) and EchoPhone recorder. Want Heath 3-in. scope or CRL lever switches. J. Leach, 406 Federal, Milton, Del. 19968.

RCA SV-1 hi-fi preamplifier. Want SW preselector or best offer. John Kusek, 821 E. Hector St., Conshohocken, Pa. 19428.

TEST RITE B-45 RF signal generator. Want recent books on any phase of electronics. Eugene Fleming, WØHMK, 328 Gunison, Grand Junction, Colo. 81501.

MOTOBIKE, 60cc displacement. Will swap for general-coverage receiver. R. Wilson, 330 S. Capitol St., Iowa City, Iowa 52240.

HICKOK model 455A VOM. Will swap for best offer or sell for cash. Jack Lewis, 680 Dockery La., Cleveland, Tenn. 37311.

EICO VTVM and signal generator. Want factory-wired Color-daptor chassis, A-1 condition. Darcy Brownrigg, Chelsea, Que., Canada.

SCIENCE & INVENTION magazines (1920-1925), 60 copies in fair shape, a few covers missing. Swap for best offer. Lyman E. Greenlee, Box 1036, Anderson, Ind. 46015.

TRANSFORMERS, three power and six audio models. Swap for best offer. David Lavin, WN5JCQ, 910 Virgil Dr., Corpus Christi, Tex. 78412.

TIC TAC TOE machine with 15 28-VDC (3PDT) relays. Want DX-60B or other equipment. Larry Smith, 4056 Suada Circle, Salt Lake City, Utah 84117.

QST MAGAZINES (240), complete from 1923 to 1943 (5 1941 issues missing). Want Heath HW-16 receiver. S. L. Bird, Mapleknoll, Windsor, Mass. 01270.

MISCELLANEOUS tubes (70), transformers, coils, other components. Want surplus gear or best offer. Alan Kozakiewicz, 34 Shirely Dr., Schenectady, N.Y. 12304.

MOTOROLA SK-9800 6-V crystal oven conversion kits (7), with instructions. Exchange for best offer. Tim Gieseler, 336 Hihn Rd., Ben Lomond, Calif. 95005.

IMAGE ORTHICON 7198 tube. Swap for parts and Menotron tube for Monoscope 104. Mark James, 1521 Vine St., Belmont, Calif. 94002.

EMERSON 705 and 850 portable radios. Will swap for tape recording accessories. Bruce Friedman, 21 Stuyvesant Oval, N.Y., N.Y. 10009.

POLAROID camera. Will swap for CB base station or Heath Twoer. Rob Schmitt, Box 279, Payson, Ariz. 85541.

BRAUN strobe, battery/ACPRO model. Swap for CB rig, SW receiver or best offer. Jack Rosenbach, 1001 W. 79th Place, Denver, Colo. 80221.

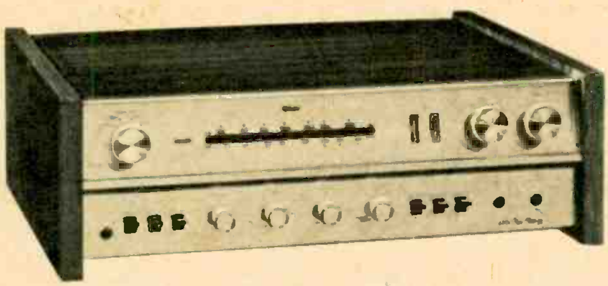
INDUSTRIAL TUBES. Nine NL710/6011/WL730 and three NL5557/EG-17/715. Swap for CB rig or walkie-talkie. D. Galarneau, 3177 Levesque Blvd., Chomedy Laval, Que., Canada.

QST Magazines wanted, first issue to 1959. Will pay cash, pick up within 150 mi. Don Trayes, B443924, Momaulant Naval Base, Charleston, S.C. 29408.

CTI television course, complete. Want Knight R100A, test equipment or best offer. J. Davis, 924 Exchange St., Alden, N.Y. 14004

RAINBOW. Model CG153 color-bar generator supersedes an earlier version, Model CG141. New features include increased circuit stability, less current drainage, plus two additional patterns—both a movable cross and movable dot. Unit also provides color bars, crosshatch, adjustable dots, vertical and horizontal lines. Temp Control feature automatically preheats circuits to above 80°F. and maintains temperature in cold or hot weather. All circuits are voltage regulated and tuning covers channels 2 through 6. $169.95. Sencore, Addison, Ill. 60101.

Electronic Marketplace



Sounding Board. Model RA-195 AM/FM/FM-Multiplex receiver has power output of 85 watts (IHF) per channel; frequency response is ±3db from 30 to 20,000 cps. FM sensitivity is 1.5 μV for 30db quieting; stereo separation, better than 30db. Receiver features solid-state front end and dual tuning meters $249.98. Olson Electronics, Akron, Ohio 44308.

Flashing Eyes. Electra Bearcat VHF-FM monitor receiver comes in three models, each having a different frequency range. Ranges available include: 30-50 mc, 150-174 mc and 450-470 mc. Each receiver automatically scans up to eight fixed-frequency channels while presenting continuous display. Units scan at rate of 12 channels per second and lock onto first active channel. Scan continues when transmission ends. Stations may be selected manually. Sensitivity: better than 1 mv for 20db quieting. Prices start at $139.95, plus crystals. Electra Corp., Cumberland, Ind. 46229.

CIRCLE NUMBER 20 ON PAGE 13

Four-Channel Mixer Uses Just One IC

By LESLIE POWELL

WHEN making live recordings the only way to be sure of capturing all the sound correctly is by using several mikes whose levels can be independently set. This is because it might be necessary to boost the level of a band's guitar during a solo. You would have to do the same thing for a member of a discussion group who has a soft voice. Balance is always crucial.

The only way to accomplish this is with a mixer. And the more inputs and gain controls the greater your flexibility and the better the recording.

Using only one integrated circuit you can build a four-channel mixer with a whopping 0.5-V output—enough to really sock it to any high-level amplifier input. Heart of our mixer is RCA's CA3048 IC amplifier array. It's an in-line package that contains four separate amplifiers each with a gain of about 53db.

Our mixer has four independent amplified inputs (each of which has a gain control) and a master-gain control that allows the gain of all channels to be adjusted simultaneously. Unlike a passive mixer, which uses resistors to mix the inputs and then an amplifier to boost the mixer output, adjusting one or more level controls on our mixer does not affect the other inputs. The mixer has been designed to accommodate low-impedance microphones supplied with the latest solid-state recorders. It will work well with any mike whose impedance is from 50 to 10,000 ohms. You can even intermix with a typical 50,000-ohm (high impedance) dynamic mike because the 10,000-ohm loading caused by level controls R1 through R4 will not materially affect the mikes' performance. If you want to use only 50,000-ohm dynamic mikes, simply change R1 through R4 to 100,000-ohm potentio-

Four-Channel Mixer Uses Just One IC

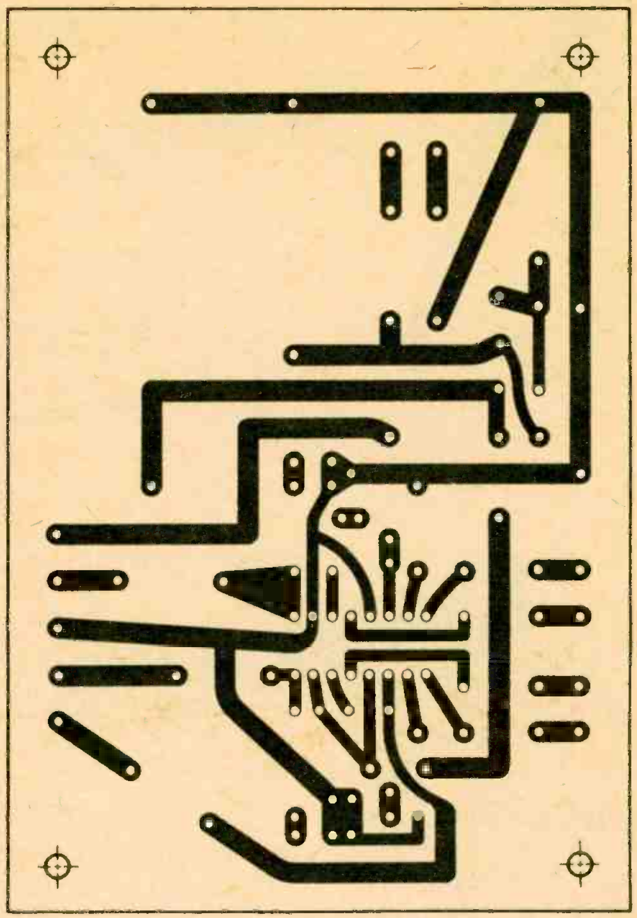


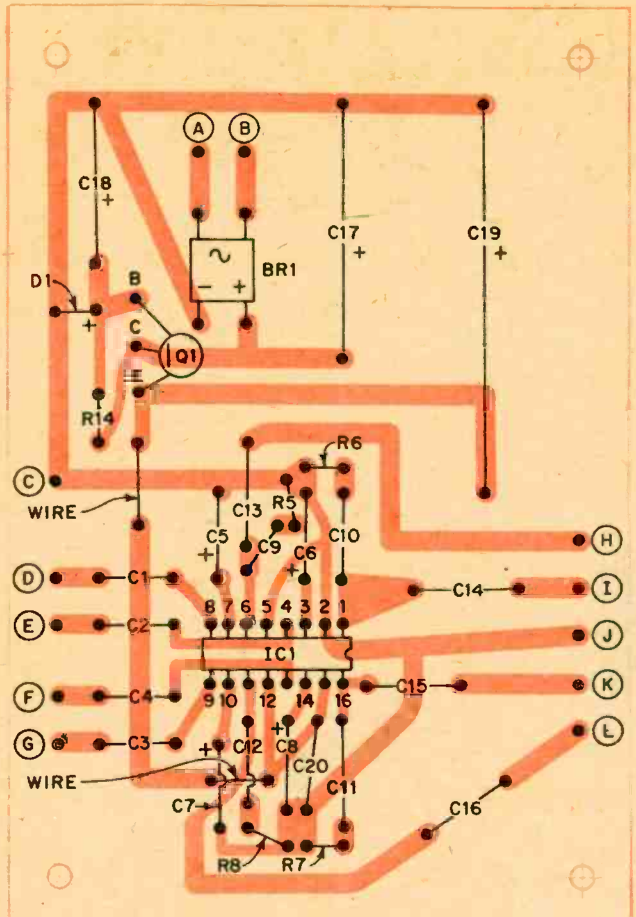
Fig. 1—Use this full-scale template to make your printed-circuit board. On the foil side of a 4¾ x 3¼-in. piece of copper-clad board place a piece of carbon paper. Lay this template over the carbon paper and using a pointed tool, make indents in all circles. Then trace all strips with a ball-point pen. The succeeding steps are described in detail in the text.

meters. However, if you use 100,000-ohm pots you may have to install a small metal shield between power transformer T1 and the input jacks to avoid possible hum pickup.

Except for T1 and output-isolation resistors R9 through R12 all components are mounted on a printed-circuit board, which must be used to insure the proper layout. If the layout is changed even slightly, the amplifiers can break into sustained or intermittent oscillation.

To avoid power-supply hum, a capacitance-amplifier voltage regulator (Q1) is employed. Transistor Q1 must have very high gain to obtain sufficient capacitance amplification. We suggest you use the specified 2N3391 or a similar transistor with a minimum beta of 250. Also, use the largest capacitance values for C17, C18 and C19 that will fit on the board. Capacitor C18 is specified as 50 μf but if you have a miniature type of higher capacitance use it.

Construction. First step is to prepare the 4¾ x 3¼-in. circuit board, for which we provide a full scale template in Fig. 1. Scrub the copper foil with a household cleanser such as Ajax and rinse thoroughly. Place a piece of carbon paper face down on the foil and place the template in position on top of the carbon. Using a sharp pointed tool, such as an ice pick, push through to the foil at each template circle and the four corner mounting holes. The pick will indent the foil, indicating where the component holes are to be drilled. Using a ball-point pen, trace the foil using but a single line between holes. Where several holes are indicated in a foil pad, draw the outline around the holes. Remove the template and the carbon paper, and using a Kepro RMP-700 resist pen (Allied 47 A 1102) place a drop of resist on each indent and connect the indents together with a single line of resist. If the line is too thin (less than 1/16 in.), use two strokes to



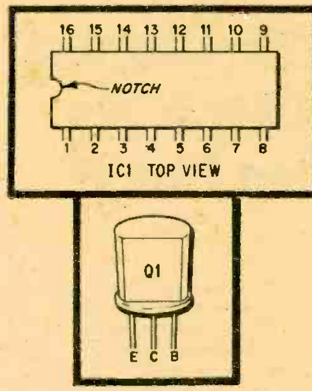


Fig. 3—Diagrams at the top identify the leads of the IC and of transistor Q1. The diagram at the left is an X-ray view of the top of the board and shows the location of all the parts. All resistors should be mounted vertically. Electrolytics C5, C6, C7 and C8 are type whose leads come out of the same end to facilitate their being mounted vertically on the board.

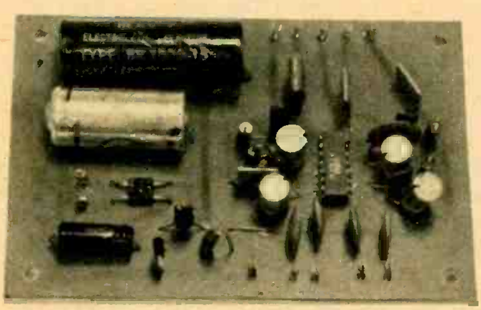


Fig. 2—Completed board. Push-in terminals are used for input and output connections. Inputs are at the bottom and the outputs are at the top.

thicken the resist line. Immerse the board under at least ¼ in. of Kepro E-1PT etchant solution (Allied 47 A 1159) for at least 20 minutes, agitating frequently. Then inspect the board. If all undesired copper has not been etched away immerse the board again for five minute intervals until the excess copper is completely removed. Then rinse the board thoroughly under running water and remove the resist with steel wool or Kepro Type T-2 resist thinner (Allied 47 A 1106).

Next, drill the component holes at each indent in the foil. Use a No. 50 drill for rectifier BR1's terminals. Use a No. 57 drill for the component holes. Connections to the board are made through Vector T-28 type terminals; use a No. 53 drill for these terminal holes.

Install the board components (Fig. 3) leaving IC1 for last. Rectifier BR1 is a diode bridge rectifier whose AC input terminals are indicated with a ∿ symbol. The DC output is indicated with + and − symbols. When properly mounted the symbols face down against the board.

To mount BR1, first clip off the small tabs on each lead. Then position BR1 with the

Four-Channel Mixer Uses Just One IC

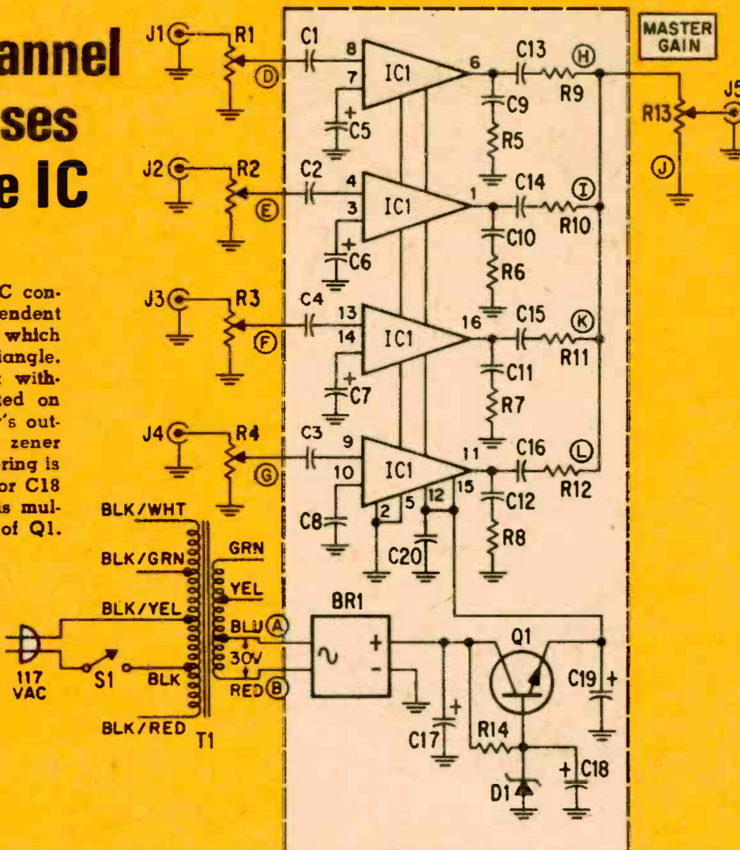


Fig. 4—Schematic. IC consists of four independent amplifiers each of which is shown as a triangle. Components in area without color are mounted on board. Power supply's output is regulated by zener diode D1. Heavy filtering is provided by capacitor C18 whose capacitance is multiplied by the gain of Q1.

PARTS LIST

BR1—Full-wave bridge rectifier; minimum ratings: 1 A, 50 PIV (Motorola HEP-175)
Capacitors: 15 V unless otherwise indicated
C1,C2,C3,C4—.05 µf disc
C5,C6,C7,C8—30 µf, 6 V electrolytic
C9,C10,C11,C12—.01 µf disc
C13,C14,C15,C16—.47 µf disc (see text)
C17—2,000 µf, 30 V electrolytic
C18—50 µf electrolytic (see text)
C19—1,000 µf electrolytic
C20—.1 µf disc
D1—12 V zener diode (Motorola HEP-105)
IC1—CA3048 integrated circuit (RCA)
J1-J5—Phono or phone jack
Q1—2N3391 transistor (GE, see text)
Resistors: ½ watt, 10% unless otherwise indicated
R1,R2,R3,R4,R13—10,000 ohm audio-taper potentiometer (see text)
R5,R6,R7,R8—47 ohms
R9,R10,R11,R12—10,000 ohms
R14—270 ohms
S1—SPST
T1—Low-voltage rectifier transformer; secondaries: 10-20 V center tapped, 40 V center tapped @ 35 ma (Allied 54 A 4731)
Misc.—3 x 8 x 6-in. cowl-type Minibox, printed circuit supplies

symbols facing up and the leads facing the edge of the board, then flip BR1 over and insert the leads in the matching holes. Zener diode D1 should be mounted above the board with at least ½-in.-long leads.

Except for the power-supply filter capacitors, all capacitors are the end-mounted type (both leads come out the same end) and all resistors should be mounted vertically. Be careful no component leads short to the jumper lead, which runs under capacitors C7, C8 and C12. For a 10,000-ohm output termination, capacitors C13, C14, C15 and C16 should be .47 µf. If you use a larger resistance the capacitors can be made smaller. The frequency response of each amplifier with the .47-µf output capacitors is +0, −3db from 40 to 15,000 cps. Using smaller capacitors with the specified load resistors will increase the low-frequency attenuation.

To mount IC1 correctly, hold the case as shown in Fig. 3 then push the terminals into the matching holes in the board. If installed

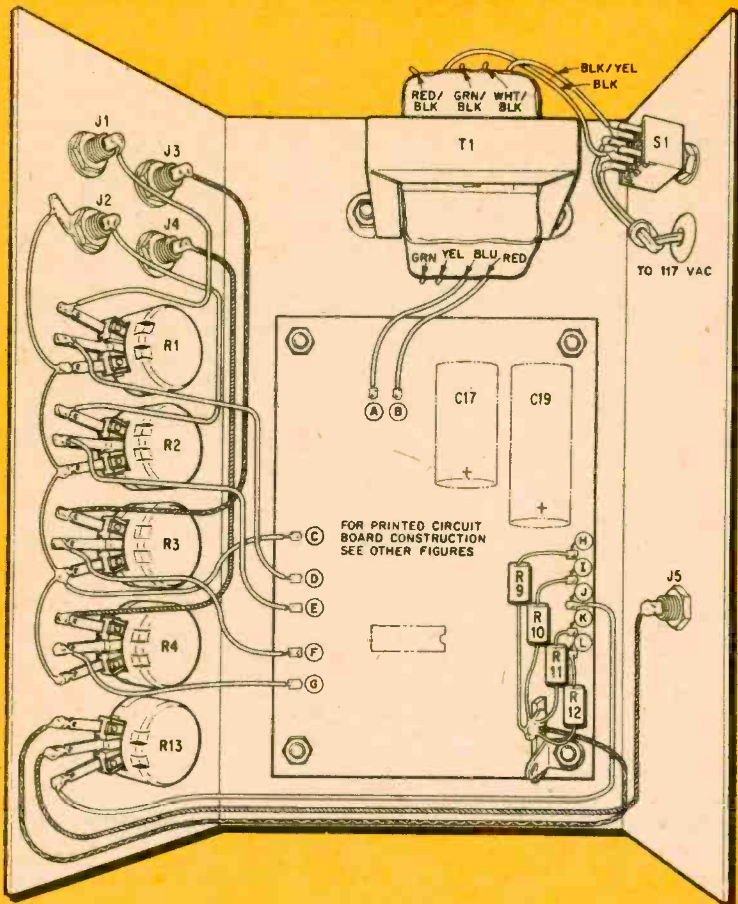


Fig. 5—Photo above shows inside of mixer. Power switch is mounted on rear panel to keep AC away from inputs. Note in pictorial at left the ground connections of J2 and all pots to board at lug G. Be sure to scrape all paint from inside of cabinet around each input jack and output jack. Also note ground connection from lug on pot R13 to lug J at right side of board. Cut short all unused leads from the power transformer.

correctly the notch in IC1's case will face C15.

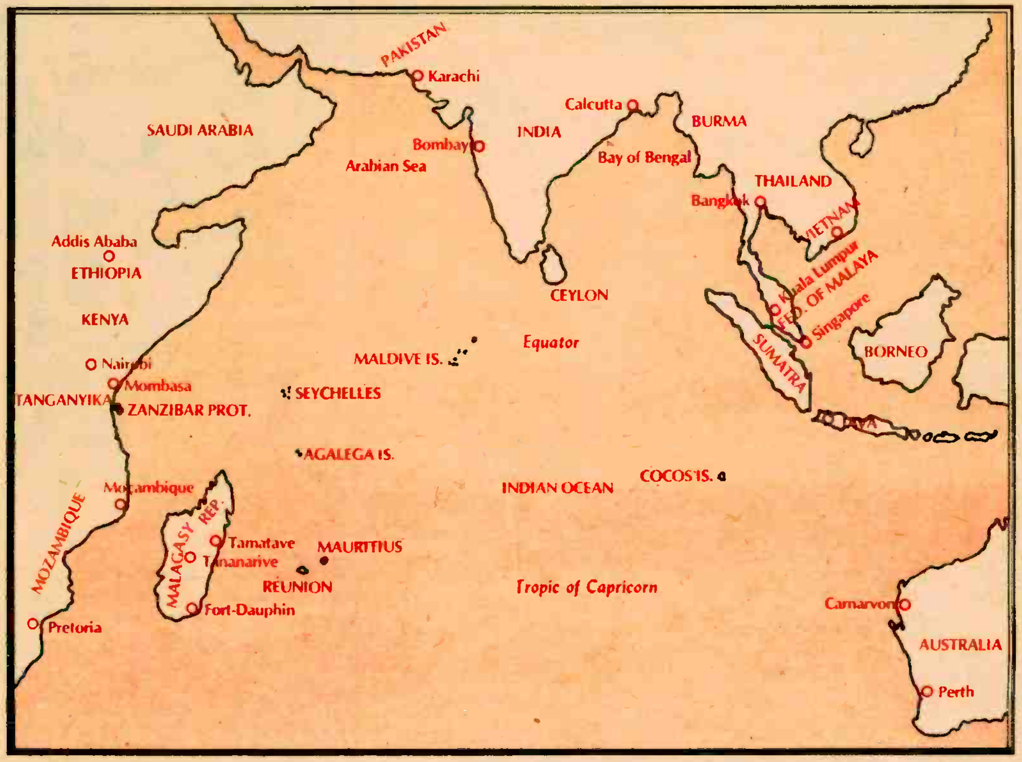
When the board is completed mark its four mounting holes in the bottom of a 3 x 8 x 6 in. cowl-type Minibox, or similar cabinet. Make certain the board and T1 will clear the cabinet cover's mounting flange. Drill all the holes for the cabinet components and then install the board using a ¼ in. spacer between board and cabinet at each mounting screw.

Note in the pictorial that there is only one single cabinet ground connection at input jack J2. The ground lugs from pots R1 through R4 connect to the J2 ground lug. Resistor R13's ground connection returns to the board output ground located between the output terminals.

Using the Mixer. A normal-level mike signal applied directly to the IC with no attenuation will overload the IC's input. Try to keep gain controls R1 through R4 at approximately their mid position when the mike is in close. Naturally, if the performer moves off-mike you can advance the gain control.

An easy way to establish the correct setting of the *master-gain* control is to connect the mixer to an amplifier or recorder's high-level input and set the amplifier's or recorder's volume control to its normal position. Speak into a mike with the gain control set at mid-position and adjust the *master-gain* control for the proper recording level (or amplifier volume). Control the mike level(s) only with the mixer's controls. The master gain, which should normally be full or ¾ open, simultaneously adjusts all four inputs.

To get the highest signal-to-noise ratio from your recorder do not use so much output from the mixer that the recorder's gain control is run almost closed—just cracked open. Internal noise from the recorder will be lowest if the mixer's output is such that the recorder's level control is between 12 and 3 o'clock.



The Longest DX

If you live in North America and want to DX the long way around, zero in on the exotic stations scattered around the Indian Ocean.

By ALEX BOWER

EXCLUDING signals from outer space, short-wave stations located around the Indian Ocean—on the opposite side of this planet when you're in North America—represent maximum possible DX mileage. And to make things tough, stations on islands in the Indian Ocean are either low-power or their activities are shrowded by conflicting reports.

Probably the biggest DX tangle of all time in the Indian Ocean centered around the Reunion Islands, which are under French control. According to a report circulated early in '68, the remote ORTF relay there not only had installed a new high-power BCB transmitter (which may or may not be true) but had suddenly begun all-night broadcasting, suggesting perhaps that Reunion (noted for hurricanes and tidal waves) was mysteriously involved in one of President DeGaulle's grand designs.

Though the all-night operation was fiction and, in fact, based on a simple translation error, several prominent DXers went to great lengths to maintain the myth. In any event, ORTF Reunion signs on at 2130 EST; the station has been heard in North America on 4807 and 2446 kc. Its BCB transmitter, whatever its power, broadcasts on 665 kc. As Reunion has no native (i.e. indiginous) population, all programs are in French. The station is a slow but consistent verifier.

Switching to the northern edge of the Indian Ocean we encounter the Maldive Islands Broadcasting Service, about which there also has been some controversy. MIBS definitely operates a 15-kw transmitter on 9552 kc starting at 0200 EST. But for some unknown reason, R. Tanzania's relay on the island of Zanzibar (also in the Indian Ocean and only a few miles off the African coast) apparently uses 9552 kc at about the same time. DXers have found it difficult to determine which station they are listening to.

However, these two stations do not use the same languages. MIBS broadcasts in English and in Hindi, Tamil and Sinhalese (three languages of India), while R. Tanzania's programs are in Kiswahili, possibly along with some Arabic.

By carefully deciphering their signals you should be able to determine which of the two stations you are logging. Of course, you might log them both. MIBS is an enthusiastic verifier. If you report reception of Zanzibar correctly to R. Tanzania's headquarters at Dar-es-Salaam they most likely will send a QSL. Incidentally, Zanzibar counts as part of Tanzania, not as a separate country—but it's still an excellent catch.

The island of Mauritius recently gained independence but was promptly engulfed by racial strife. The Mauritius Broadcasting Corp. has also been the cause of some minor DX problems. Though MBC has been assigned a frequency on the 31-meter band (9710 kc), few DXers have heard it. However, some DXers have claimed remarkably good reception on 9710. We recommend that EI readers try for Mauritius on their 60-meter channel—4850 kc at 2130 EST sign-on. If you can hear Reunion on 4807 at that hour, try for Mauritius and vice versa. MBS transmits in English, French, Hindi and Chinese; their QSL policies can be erratic.

In the Malagasy Republic—a new name for the former French island of Madagascar—Radiodiffusion Nationale Malagache operates an international service on 15265 kc using English and French at 1100-1200 EST (0800-0900 PST), but reception is difficult. This is due both to QRM and the fact that broadcasts are irregular. When on the air, broadcasts are best received west of the Mississippi.

Meanwhile, the frantic race to set up new relays (see DXing THE RELAYS, July '69 EI) will shortly reach the Indian Ocean. The Dutch government (R. Nederland) has pursuaded the Malagasy Republic to let it build a station on their island for both African and Asian coverage. While it will be several years before this RN relay is ready to begin broadcasting, don't be surprised if in the interim R. Nederland programs should suddenly appear on 15265 kc.

Another international relay slated for this part of the world will belong to

[*Continued on page* 100]

LONGEST DX AT A GLANCE

FREQ. (kc)	STATION	LOCATION	TIME (EST)
2446	ORTF	St. Denis, Reunion	2130 S/On
4807	ORTF	St. Denis, Reunion	2130 S/On
4850	MBC	Forest Side, Mauritius	2130 S/On
9552	MIBS	Male Sinico, Maldive Islands	0200 S/On
	R. Tanzania	Zanzibar (Tanzania)	??
9610	ABC (VLX9)	Perth, Australia	0600-1000
9710	MBC	Forest Side, Mauritius	??
15265	RNM	Tananarive, Malagasy Rep.	1100-1200

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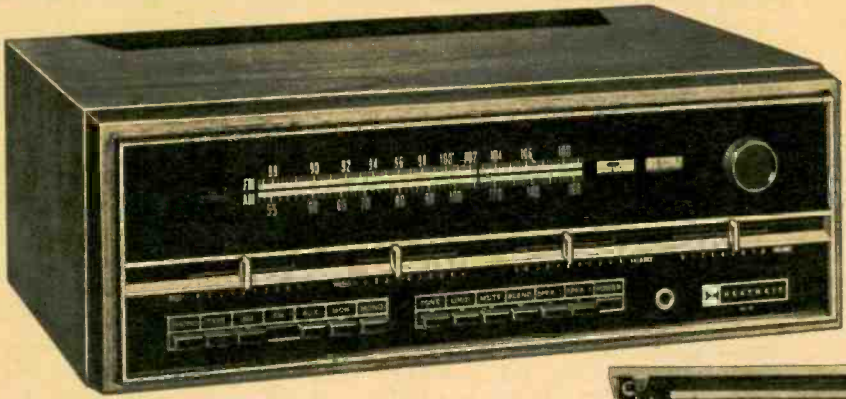
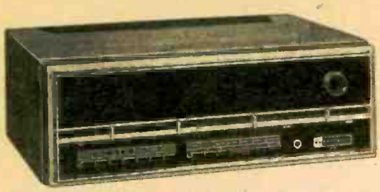
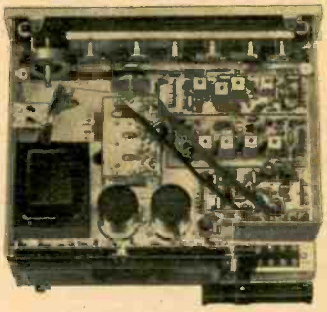




Heathkit AR-19

$225.00*



Third In The New Generation Of Superb Solid-State Receivers From Heath . . . And Low In Cost

• Advanced solid-state circuitry with 108 transistors. 45 diodes and 5 integrated circuits • 60 watts music power output at 8 ohms • Less than 0.25% Harmonic & IM Distortion at any power level • Frequency response from 6 to 35,000 Hz • Direct-coupled, transformerless outputs for lowest distortion and phase shift • Dissipation-limiting circuitry protects outputs from damage even with a short circuit • Assembled, aligned FET FM tuner has 2.0 uV sensitivity to give you more listenable stations • Ball-bearing inertia flywheel tuning for smooth, accurate station selection • Preassembled, factory aligned FM IF circuit board speeds assembly and eliminates IF alignment, gives 35 dB selectivity • Multiplex IC circuit provides inherent SCA rejection • Pushbutton Mute control attenuates between-station FM noise • Blend control reduces on-station FM noise with a push of a button • Tone-flat pushbutton disables bass & treble controls for perfectly "flat" response • New linear motion controls for volume, balance, bass & treble • Individually adjustable level controls for each input including tape monitor eliminate annoying volume changes when switching sources • Switches for two separate stereo speaker systems for stereo sound in two different locations • Center channel speaker capability • Two front panel tuning meters give exact station selection • Stereo indicator light • Front panel stereo headphone jack • 300 & 75 ohm FM antenna inputs • High fidelity AM reception • Built-in AM rod antenna swivels for best reception • Massive power supply includes section of electronically regulated power • New Heath modular plug-in circuit board design speeds assembly, aids servicing • Built-in Testing facilities aids construction, simplifies servicing • Circuit board & wiring harness construction for easy, enjoyable 25 hour assembly

Ahead of its time . . . those who want to hear stereo high-fidelity as it will sound in the 70's can begin right now, at a modest price, with the Heathkit AR-19. Its design is an extension of the advanced circuitry concepts first introduced in the AR-15. These receivers are truly of a new generation . . . they've expanded audio engineering horizons and set the pace for the 70's.

Field Effect Transistor And Integrated Circuit Design. The AR-19 uses advanced semi-conductor circuitry . . . including five integrated circuits, with a total of 108 transistors and 45 diodes. The preassembled FM tuning unit uses an RF field effect transistor to provide high sensitivity and low cross modulation with no overloading on strong local stations. In the AM RF circuit also, field effect transistors give superior sensitivity and large signal handling capacity.

Ideal For Most Home Stereo Installations. The AR-19 is just right for the medium and high efficiency speaker systems that are so popular today. It can form the nucleus of a fine stereo system . . . and will probably be the most attractive part, thanks to its rich oiled pecan wood cabinet and to the "Black Magic" front panel. The scale and dial readings appear only when the power is on.

Features To Aid The Kit Builder. All 8 circuits of the AR-19 snap in and out in seconds. Think of the resulting convenience and ease of assembly! In addition, the AR-19 has built-in test circuitry . . . two test probes with the front panel meter for indications. With it, the user can check out circuit parts without the need for expensive external test equipment. Proper use of this feature is fully covered in the manual.

Don't Wait For Something Better To Come Along . . . it'll be a long wait. Up-grade your stereo system now, with this outstanding receiver value.

Kit AR-19, 29 lbs. **$225.00***

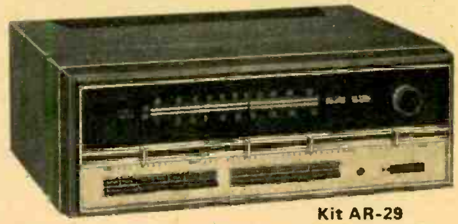
Assembled AE-19, cabinet, 10 lbs. **$19.95***

PARTIAL AR-19 SPECIFICATIONS — AMPLIFIER: Continuous power output per channel: 20 watts, 8 ohms. **IHF Power output per channel:** 30 watts, 8 ohms. **Frequency response:** (1 watt level) —1 dB, 6 Hz —35 kHz. **Power bandwidth for constant 0.25% THD:** Less than 5 Hz to greater than 30 kHz. **Harmonic distortion:** Less than 0.25% from 5 Hz to 20 kHz at 20 watts rms output. Less than 0.1% at 1000 Hz at 1 watt output. **IM Distortion:** Less than 0.25% with 20 watts output. Less than 0.1% at 1 watt output. **Hum and noise:** Phono input, —65 dB. **Phono input sensitivity:** 2.4 millivolts; overload, 155 millivolts. **FM: Sensitivity:** 2.0 uV, IHF. **Volume sensitivity:** Below measurable level. **Selectivity:** 35 dB. **Image rejection:** 90 dB. **IF Rejection:** 90 dB. **Capture ratio:** 2.5 dB. **Total harmonic distortion:** 1% or less. **IM Distortion:** 0.5% or less. **Spurious rejection:** —90 dB. **FM STEREO: Separation:** 35 dB at midfrequencies; 30 dB at 50 Hz; 25 dB at 10 kHz; 20 dB at 15 kHz. **Frequency response:** ±1 dB from 20-15,000 Hz. **Harmonic distortion:** 1.5% or less @ 1000 Hz with 100% modulation. 19 kHz & 38 kHz. **Suppression:** 50 dB. **SCA Suppression:** 50 dB. **AM SECTION: Sensitivity:** Using a radiating loop, 130 uV/M @ 1000 kHz. **Selectivity:** 25 dB at 10 kHz. **Image rejection:** 60 dB @ 600 kHz. 60 dB @ 1400 kHz. **IF Rejection:** 60 dB @ 1000 kHz. **Harmonic distortion:** Less than 2%. **Hum & noise:** —40 dB.

CIRCLE NUMBER 3 ON PAGE 13

The Leader HEATHKIT

New Heathkit 100-Watt AM/FM/FM-Stereo Receiver



Kit AR-29

$285.00*

World's finest medium power stereo receiver . . , designed in the tradition of the famous Heathkit AR-15. All Solid-State . . . 65 transistors, 42 diodes plus 4 integrated circuits containing another 56 transistors and 24 diodes. 100 watts music power output at 8 ohms — 7 to 60,000 Hz response. Less than 0.25% distortion at full output. Direct coupled outputs protected by dissipation-limiting circuitry. Massive power supply. Four individually heat sinked output transistors. Linear motion bass, treble, balances and volume controls. Push-button selected inputs. Outputs for 2 separate stereo speaker systems. Center speaker capability. Stereo headphone jack. Assembled, aligned FET FM tuner has 1.8 uV sensitivity. Two tuning meters. Computer designed 9-pole L-C filter plus 3 IC's in IF gives ideally shaped bandpass with greater than 70 dB selectivity and eliminates alignment. IC multiplex section. Three FET's in AM tuner. AM rod antenna swivels for best pickup. Kit Exclusive: Modular Plug-In Circuit Boards . . . easy to build & service. Kit Exclusive: Built-In Test Circuitry lets you assemble, test and service your AR-29 without external test equipment. The AR-29 will please even the most discriminating stereo listener.

Kit AR-29, (less cabinet), 33 lbs. **$285.00***

AE-19, Assembled oiled pecan cabinet, 10 lbs. **$19.95***

New Heathkit Deluxe 18-Watt Solid-State Stereo Phono

Kit GD-109

$74.95*

Looks and sounds like it should cost much more. Here's why: 16-transistor, 8-diode circuit delivers 9 watts music power per channel to each 4½" high-compliance speaker. Speaker cabinets swing out or lift off . . . can be placed up to 10' apart for better stereo. Has Maestro's best automatic, 4-speed changer — 16, 33-1/3, 45 & 78 rpm. It plays 6 records, shuts off automatically. Ceramic stereo cartridge with diamond/sapphire stylus. Has volume, balance & tone controls. Changer, cabinet & speaker enclosures come factory built . . . you build just one circuit board . . . one evening project. Wood cabinet has yellow-gold & brown durable plastic coated covering. This is a portable stereo you can take pride in.

Kit GD-109, 38 lbs. **$74.95***

New Heathkit 80-10 Meter 2 KW Linear Amplifier

Kit SB-220

$349.95*

Incomparable performance and value. The new SB-220 has 2000 watts PEP input on SSB & 1000 watts on CW and RTTY. Uses a pair of Eimac 3-500Z's. Pretuned broad band pi input coils. Requires only 100 watts PEP drive. Solid-state power supply operates from 120 or 240 VAC. Circuit breaker protected. Safety interlocked cover. Zener diode regulated operating bias. Double shielded for max. TVI protection. Quiet fan — fast, high volume air flow. Also includes ALC to prevent over-driving. Two meters: one monitors plate current; the other is switched for relative power, plate voltage and grid current. Styled to match Heath SB series. Assembles in about 15 hours.

Kit SB-220, 55 lbs. **$349.95***

New Heathkit Solid-State Portable Fish-Spotter

Kit MI-29

$84.95*

Costs half as much as comparable performers. Probes to 200 ft. Spots individual fish and schools . . . can also be used as depth sounder. Manual explains typical dial readings. Transducer mounts anywhere on suction cup bracket. Adjustable Sensitivity Control. Exclusive Heath Noise-Reject Control stops motor ignition noise. Runs for 80 hrs. on two 6 VDC lantern batteries (not included). Stop guessing — fish electronically.

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

Kit MI-19

$69.95*

New Heathkit Solid-State Depth Sounders

Let its flashing indicator light guide you through strange waters . . . day or night. Sounds to 200 ft. Has Noise Rejection and Sensitivity controls. Operates from your 12 VDC boat battery. Sun-shielded dial. All solid-state.

Kit MI-19 1, (with thru-hull transducer), 7 lbs. **$69.95***

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CIRCLE NUMBER 3 ON PAGE 13

Good Reading

By Tim Cartwright

TAPE RECORDING FOR FUN AND PROFIT. By Walter G. Salm. Tab Books, Blue Ridge Summit, Pa. 224 pages. $7.95

With a title like that, this sounds like one of those little tomes that tell you how to take your old Webcor recorder to church to tape that wedding. But it turns out to be an informative and up-to-date working guide that could be of great use to many hobbyists, including hams and CBers.

Of particular usefulness are the chapters on microphones, mike techniques, special effects and maintenance. There is also a good (if short) section on the addition of sound to movies and slides. The coverage of cartridges and cassettes gives a pretty stiff back-of-the-hand to the former, but perhaps with reason. Included is the first coverage I've seen in a book of this kind of the Dolby audio-noise reduction system. All in all, a pleasant surprise and worthwhile.

CBers' HOW-TO BOOK. By Leo G. Sands. Hayden Books (Rider Series), New York. 120 pages. $3.50

Leo Sands can (and does) claim credit for the first book on CB back in 1958 and this newest effort should prove useful to those just getting their feet wet. The *how to buy* section is pertinent to today's Citizens Band equipment and the kind of information supplied on installation and operation leaves little for the imagination of the beginner. There is an extensive final chapter on modifying equipment for your particular needs.

INTRODUCTION TO SOLID-STATE TELEVISION SYSTEMS. By Gerald L. Hansen. Prentice-Hall, Englewood Cliffs, N.J. 449 pages. $15

Here is a comprehensive guide to the state of solid-state devices in black-and-white and color television. Except for specific transmitter practice, it covers every aspect of transmission and reception, including optics, cameras and TV applications ranging from schools to space travel. It doesn't get into the specifics of present TV sets for the home but it does provide a thorough description of reception theory and circuitry. Aimed at professionals and engineering students, it is decidedly not an introduction for those who would just like to know more about television, but it is an impressive treatment for its intended audience. And it just might fill the bill for the man who just has to know everything about everything whether he needs to or not.

HANDBOOK OF PRACTICAL ELECTRONIC TESTS AND MEASUREMENTS. By John D. Lenk. Prentice-Hall. 303 pages. $15

HANDBOOK OF ELECTRONIC METERS, THEORY AND APPLICATION. By John D. Lenk. Prentice-Hall. 176 pages. $10.95

This pair of basic reference texts deserves to be bracketed since so much of the coverage is complementary. I suspect the first, which covers almost every conceivable area and application of electronic measurements, will be useful to a wider range of knowledgeable students and technicians. But both are thorough and well-illustrated guides that probably are musts for the well-stocked reference shelf.

HOW TO FIX TRANSISTOR RADIOS AND PRINTED CIRCUITS. By Leonard C. Lane. Tab Books, Blue Ridge Summit, Pa. 256 pages. $7.95

The word *fix* really tells all. This little book is jam-packed with working information for service people and is much concerned with everyday details of relatively simple transistor circuits in radios. That isn't to say, though, that it's all how and no why. There are abundant descriptions of circuit theory, certainly more than enough to keep a repairman from coming up with a cure that's worse than the disease.

AUDIO SYSTEMS HANDBOOK. By Norman Crowhurst. Tab Books, Blue Ridge Summit, Pa. 192 pages. $7.95

My own Pavlovian conditioning is to think automatically of hi-fi and stereo systems when I see the word audio. It took quite a few pages of Norman Crowhurst's treatise for me to acknowldge to myself that he really was writing about public-address equipment and associated techniques. So he is, and rather usefully for readers who work (or want to work) in industrial sound. There are some sections on home audio, but the real thrust is toward information for the *sound man.*

Build the Micro Oscilloscope for Your Test Bench

Part II: Calibration and Operation

By WALT HENRY

IN our January '70 issue we described features and construction of the Micro Oscilloscope. In case you missed that article, here is what the 'scope is all about. It's a really compact instrument with a 1⅛-in. screen-dia. CRT. The vertical amplifier is DC coupled and its response is flat out to 1 mc. Except for the CRT, it is completely solid state and includes four integrated circuits. It has triggered sweep, a calibrated vertical attenuator and measures 2 x 7 x 9 in. (The separate power supply is the same size.) This article covers checkout and calibration procedures and includes the theory of operation.

After you are satisfied your wiring is correct you can adjust and calibrate the 'scope. The following step-by-step procedure should be followed in sequence. If a voltage is out of range or an adjustment will not give the proper result the trouble should be located and corrected before proceeding. You will need a 20,000 ohms-per-volt VOM and a signal generator to properly adjust and calibrate the 'scope.

Initial Turn-On

1) Turn all controls including the screwdriver-adjust trimpots to the center of their rotation. Set S1 and S2 to *AC* (open) and close S3 (non-*auto*. position). Set S4 to 100 V/div., S5 to 0.5 ms/div. and S6 to *hor./trig. in.*

2) Turn on power switch S7 and look

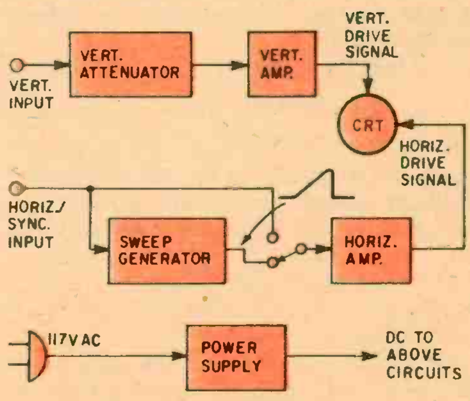


Fig. 1—Block diagram of the 'scope shows the six major sections. The schematics of each are shown in this article and are decribed in complete detail.

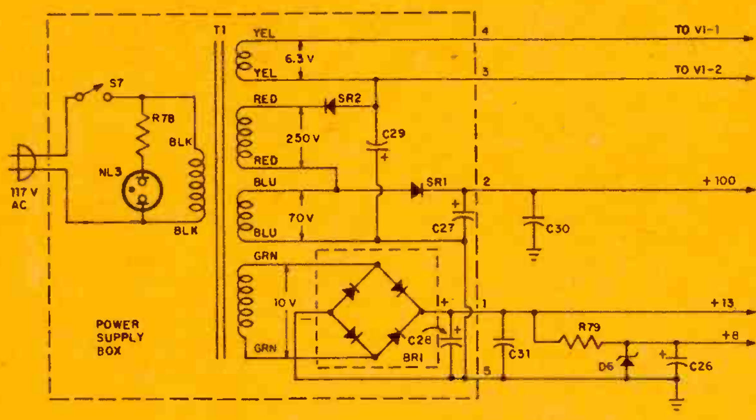


Fig. 2—Power supply furnishes operating voltages to all circuits. —450 VDC for CRT is produced by series connection of 250-V and 70-V windings. If voltage at junction of C29, SR2 is considerably less than —450 V, interchange red leads. Numbers at right of box are the pin numbers of SO1.

Micro Oscilloscope for Your Test Bench

to see if NL3 is on and if heater of the CRT is glowing.

Power-Supply Check

3) Check the DC voltage from the positive end of C28 to ground. It should be between 13 and 16 V.

4) The voltage from C26 to ground should be between 7.8 and 8.6 V.

5) The voltage from C27 to ground should be 90 to 100 V.

6) The voltage from the negative terminal of C29 to ground should be between —420 and —480 V. If the voltage is only about —200 V. the transformer phase is incorrect. Reverse the two red leads and the voltage should be in range.

7) *Power on* lamp NL1 should be on.

Horizontal Amplifier

8) Connect the voltmeter between the collectors of Q11 and Q12. Turning R68 should make the voltage go through zero and reverse polarity. Set it as close to zero as you can.

9) Check the voltage from source lead of Q13 to ground. It should be between 3.5 and 5.5 V.

10) Connect the meter from collector of Q11 to ground. Adjust R66 to get an indication of 45 to 50 V.

11) Recheck the voltage between collector of Q11 and Q12 and readjust R68 to get within 2 V of zero. It may be necessary to alternately adjust R66 and R68 two or three times to get both indications within range.

Vertical Amplifier

12) Remove Q4, Q5, Q6 and Q7 from their sockets. Turn R26 to maximum resistance and R15 to maximum gain (wiper to Q1 end). Make sure R15 stays set this way and that R13 remains centered until step 22. The voltage from the source lead of Q1 to ground should be 1.7 to 2.4 V.

13) Now connect the meter between the source lead of Q1 and the wiper of R14 and adjust R14 to get a zero indication.

14) The voltage from the source lead of Q2 to ground should be 3.4 to 5 V.

15) Connect the meter between the source leads of Q2 and Q3 and adjust R19 for zero volts.

16) Connect the meter between pins 6 and 8 of IC1. Readjust R19 for a zero indication. This is a sensitive adjustment. Get the indication as close to zero as you can with R19, then bring it as close as possible with *vert. pos.* control R18.

17) The voltage from IC1 pin 6 to ground should be from 5.5 to 6.5 V. If it is not in this range select a new value of R21 to bring it in. A further adjustment of the value of R21 may be necessary in step 20.

18) Plug Q4 and Q5 into their sockets. The voltages from each emitter to ground should be identical, and should be between 5 and 6 V.

19) Plug in Q6 and Q7. Connect the meter between their collectors and adjust R18 for a zero indication.

20) The voltage from collectors of Q6

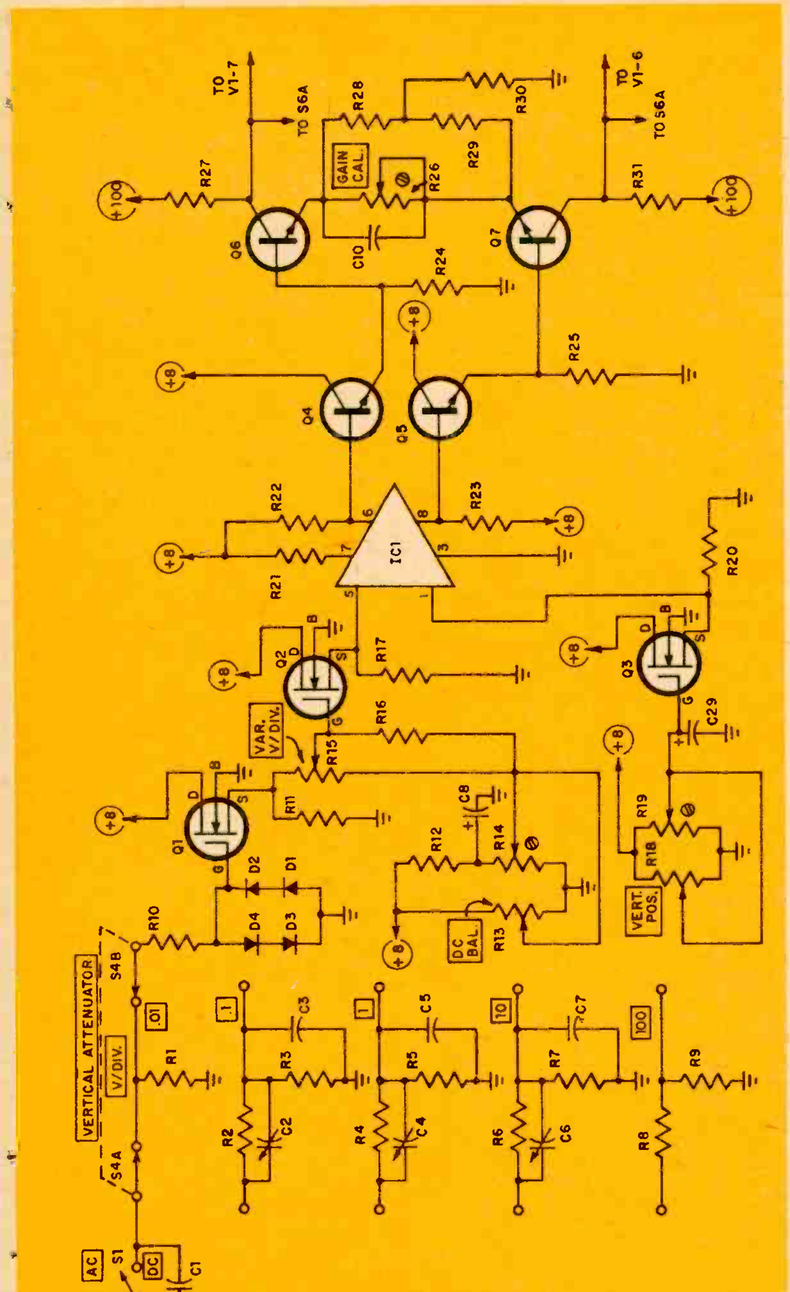


Fig. 3—Schematic of vertical attenuator and vertical amplifier. Vertical attenuator circuit attenuates input signal by multiples of 10. All ranges except 100 V/div. are frequency compensated. Amplifier is balanced differential type and is DC coupled throughout. Diodes D1-D4 protect input against overload. Amplifier output goes to CRT.

and Q7 to ground should be between 45 and 55 V. If it falls outside this range select a new value of R21 to set the voltage near 50 V.

CRT Check

21) Make sure *hor.-pos.* control R69 and *vert.-pos.* control R18 are set so that voltages between collectors of Q11 and Q12, and between collectors of Q6 and Q7 are zero. By adjusting *intensity* control R75 and *focus* control R73 you should get a small sharp dot on the CRT. *Vert.-pos.* control R18 should make the dot move up and down and R68 should make it move left and right. You will probably have to rotate the CRT to get it oriented properly. Don't leave a small extremely bright dot in one spot on the CRT face for a length of time as the phosphor coating may become burned at that spot, permanently damaging the CRT.

22) Set the dot to the center of the CRT with R18 and R69. Now turn *var. V/div.* control R15 and the dot will move up and down. With R13 centered, set R14 to get as little movement of the dot as possible. Adjustment of *DC-bal.* control R13 should then yield a stationary dot when R15 is turned.

23) Turn *vertical-attenuator* switch S4 to each position and make sure the dot remains stationary. Note at this point if you touch *vert. in.* terminal BP1 when S4 is on the sensitive ranges a vertical line will appear on the CRT. Rotate *hor./sync.* control R33

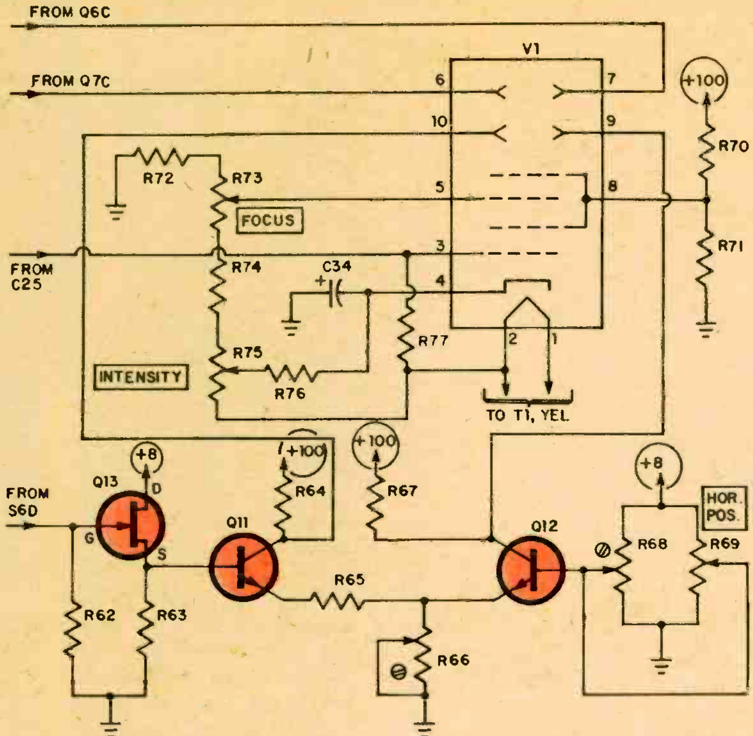


Fig. 4—Schematic of horizontal amplifier. Inputs at top come from vertical amplifier and go directly to CRT's vertical plates. Other inputs are from sweep generator and function selector switch S6. Pots whose names are in boxes are front-panel controls.

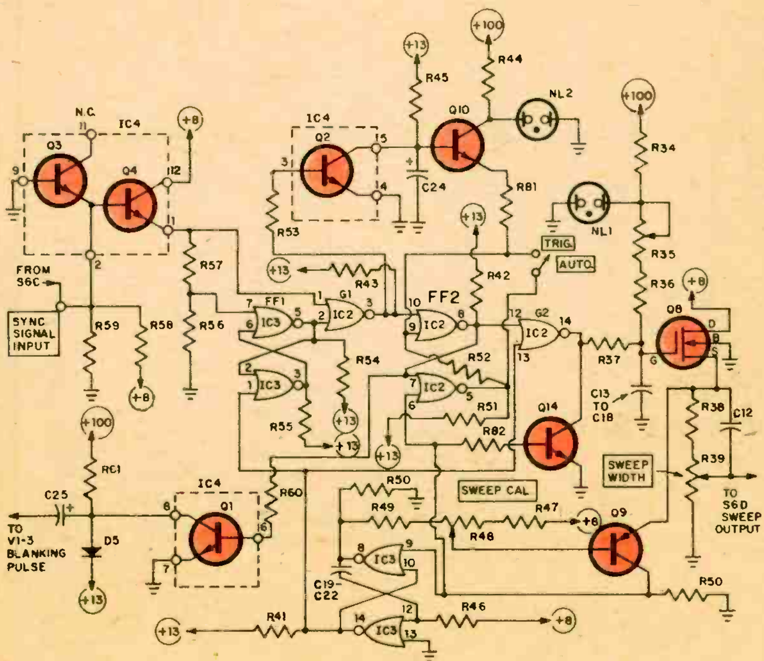
through its range and note if the dot stays stationary. Touching the *hor./trig. in.* input terminal (BP3) will cause a horizontal line to appear on the CRT.

Sweep Generator

24) Make sure horizontal-selector switch S6 is in the *hor. in.* position and S3 is closed. From each of the points in the Table measure the voltage to ground. An incorrect voltage means a wiring error or a defective part. Any discrepancies in step 24 should be corrected before going on to step 25. Before making the voltage checks momentarily ground IC2 pin 5 and IC3 pin 3. Don't leave them tied to ground—just touch to ground and then

Micro Oscilloscope for Your Test Bench

Fig. 5—Sweep generator. This schematic is an expansion of schematic in Fig. 6. Here, ICs are opened up to show functions of different sections. Configurations of FF1, FF2, G1, G2, and one shot (two IC3s at bottom) are shown in further detail in Fig. 7.



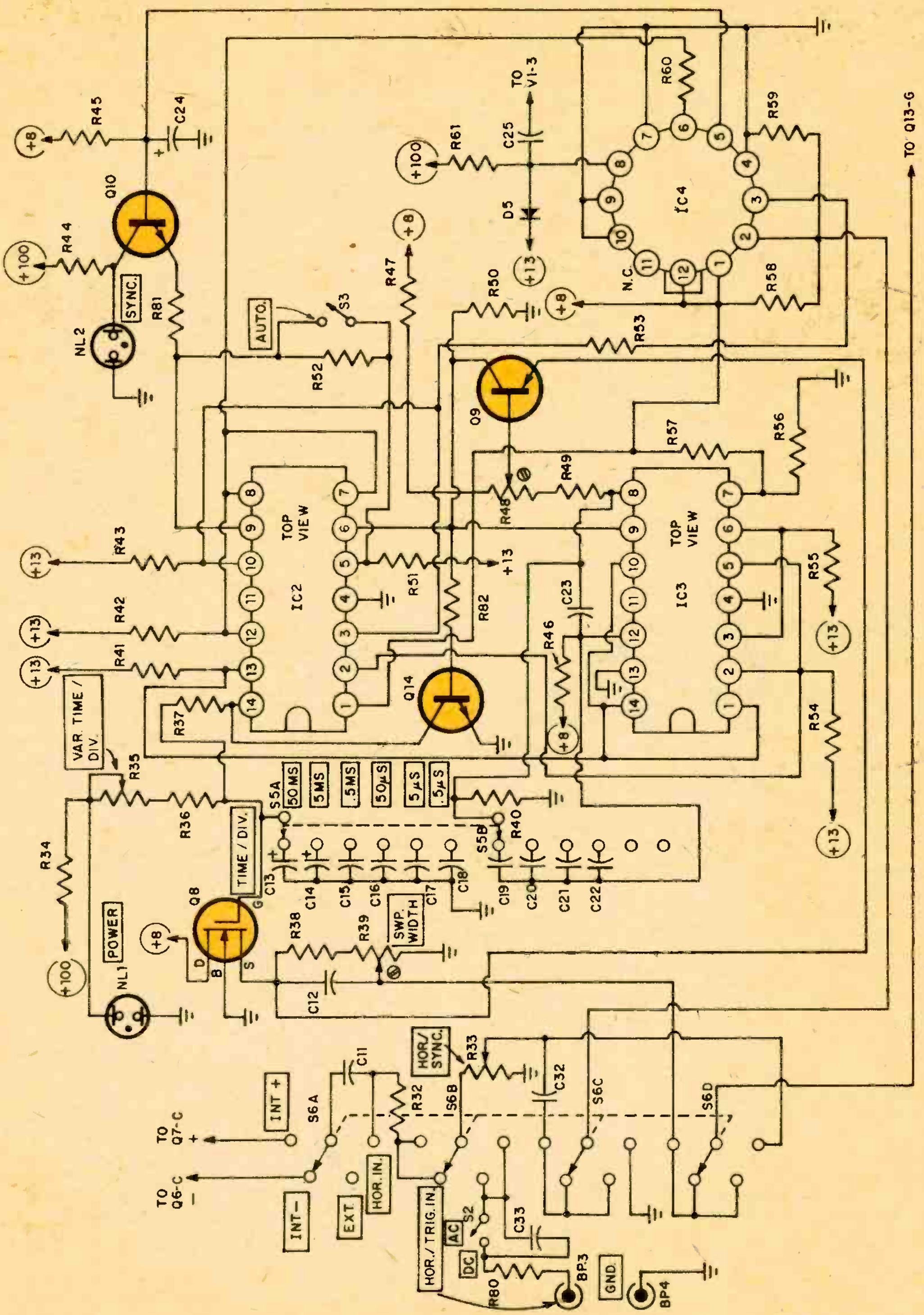


Fig. 6—Sweep generator. IC2 and IC3 are identical digital ICs used in computer-type sequential logic circuit. Sync-lock indicator NL2 is always off when there's no input signal to 'scope. When circuit is properly triggered, NL2 comes on. When S3 is in auto. position the sweep generator will run continuously.

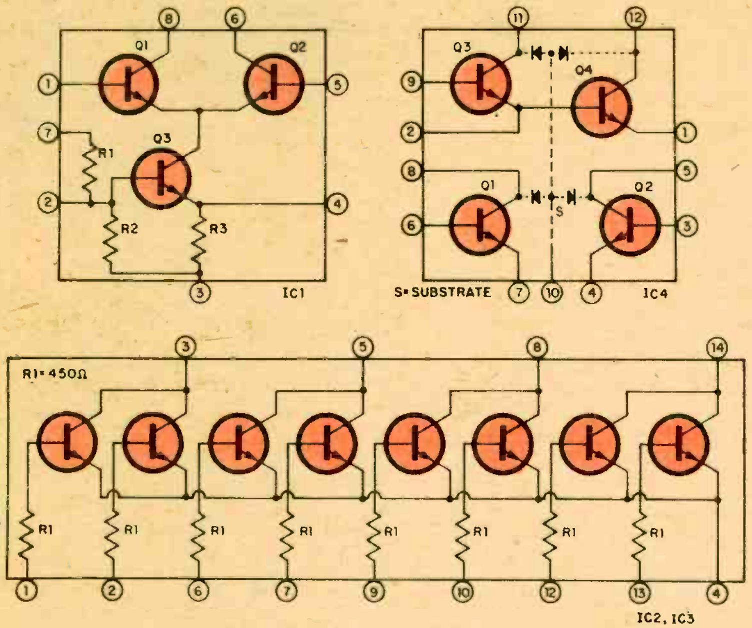


Fig. 7—Schematic of ICs used in 'scope. IC1 is in vertical amplifier. IC2, IC3 and IC4 are in sweep generator. Circled numbers at edges are IC's pin numbers.

Micro Oscilloscope for Your Test Bench

take away the wire.

25) Turn S6 to the *ext.* position. Temporarily connect a 10,000-ohm resistor between IC4 pin 2 and the 8-V supply. Temporarily connect a grounded clip-lead to IC2 pin 14. Momentarily ground IC2 pin 5 and IC3 pin 3 again and then make the voltage checks indicated in the Table. (FF1 has now changed states.)

26) With the same temporary connections as in step 25, again momentarily ground IC2 pin 5 and IC3 pin 3. Then connect a ground lead to IC4 pin 2 and leave it on. Now make the voltage checks in the Table. (FF2 has now changed states.)

27) Remove all temporary grounds and the 10,000-ohm resistor. Turn R33 fully counterclockwise (wiper to ground). There

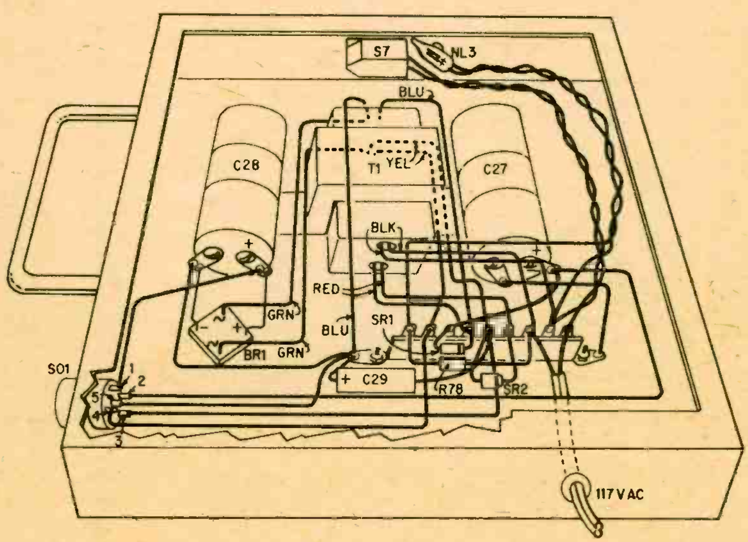


Fig. 8—Pictorial of power supply. Layout is wide open and there's plenty of room to spare as you can see in photo in Fig. 10. It is even possible to build supply in a smaller cabinet.

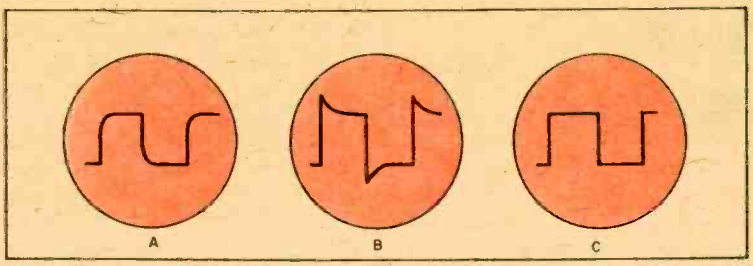


Fig. 9—'Scope patterns reveal adjustment of vertical-attenuator-compensation trimmer capacitors C2, C4, C6. A indicates undercompensation. B shows overcompensation. C shows correct compensation.

should be no sweep on the CRT. Now set S3 to the *auto.* (open) position. A trace should now appear on the CRT. Adjust *swp.-width* pot R39 to get the proper length trace. Turn S5 to each position and see that the trace stays put. On each range turn R35 through its full range and make sure the trace stays put and that NL1 remains on. If NL1 goes off when R35 is turned, the value of R34 should be lowered slightly.

TEST	STEP 24	STEP 25	STEP 26
Sync. lamp NL2	off	off	on
IC2-1, IC4-1	0	4.5-6.7	4.5-6.7
IC2-2, IC3-2, 5	0.9-1.3	LT 0.2	LT 0.2
IC2-3, 10	LT 0.2	LT 0.2	0.9-1.3
IC2-4	gnd.	gnd.	gnd.
IC2-5	LT 0.2	LT 0.2	1.3-1.7
IC2-6, IC3-9	0	0	0
IC2-7, 8, 12	0.8-1.1	0.8-1.1	LT 0.2
IC2-9	LT 0.2	LT 0.2	1.3-1.7
IC2-13, IC3-1, 10, 14	LT 0.2	LT 0.2	LT 0.2
IC2-14	0	gnd.	gnd.
IC3-3, 6	LT 0.2	1.3-1.7	1.3-1.7
IC3-4	gnd.	gnd.	gnd.
IC3-7	0	2.0-3.3	2.0-3.3
IC3-8	3.5-4.5	3.5-4.5	3.5-4.5
IC3-12	0.6-0.8	0.6-0.8	0.6-0.8
IC3-13	gnd.	gnd.	gnd.
IC4-2	gnd.	6-8	gnd.
IC4-3	LT 0.2	LT 0.2	0.6-0.8
IC4-4, 7, 9, 10	gnd.	gnd.	gnd.
IC4-5	0.5-1	0.5-1	LT 0.2
IC4-6	0.6-0.8	0.6-0.8	LT 0.2
IC4-8	LT 0.2	LT 0.2	+13 supply plus 0.7
IC4-12	+8 supply	+8 suppl	+8 supply
Q8-S	1.5-2.5	1.5-2.5	1.5-2.5

Notes: 1) LT means less than
2) 1.5-2.5 means voltage is between 1.5 and 2.5 V
3) Number after IC designation is pin no.

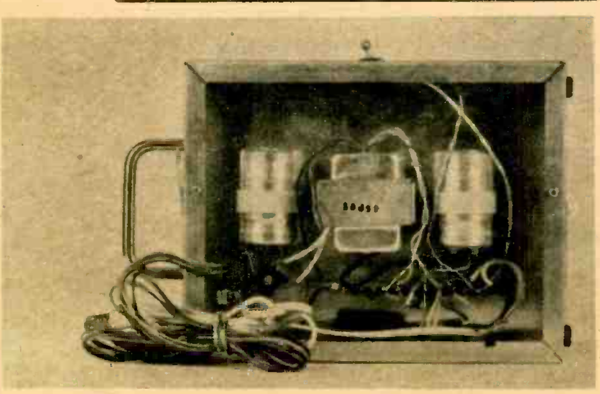


Fig. 10—Inside of power supply. Electrolytics at right and left are mounted with large cable clamps. Our model had cable which connected to 'scope.

28) Set S3 to the closed position. Connect a signal generator to the *hor. in.* and *vert. in.* terminals and adjust for 2 or 3 V amplitude at 1,000 cps. Set S4 to an appropriate range. Turn R33 clockwise until a trace appears on the CRT and locks in as indicated by NL2. Set S5 to an appropriate range and note if turning R35 simply expands or contracts the waveform. Changing the frequency of the signal generator has the same effect.

Sweep Generator Calibration

29) Set the signal generator to 2,000 cps. Set S5 to 0.5 ms/div. and turn R35 full clockwise. Adjust trimmer pot R48 so that one cycle on the CRT occupies exactly one division. Readjust trimmer pot R39 for the proper sweep length. You may also have to readjust the horizontal position. Check calibration of the other sweep ranges using the signal generator.

Vertical-Amplifier Calibration

30) Set S5 to 10 V/div. and connect the signal generator. Set it for about 500 cps and using the voltmeter set the generator amplitude to 7.07 VAC. Make sure R15 is set for maximum gain. Adjust R26 for a two division (peak-to-peak) sine wave on the CRT.

Vertical-Attenuator Calibration

31) Connect a 5,000-ohm carbon potentiometer between IC2 pin 3 and ground, and connect the wiper to *vert. in.* terminal BP1. Connect a signal generator to the *hor. in.* terminal and set it for about a 1,000 cps square-wave output at about a 2-V amplitude. Set S6 to *ext.* and adjust R33 for a stable sweep with NL2 on. Adjust S5 and R35 to get about 1½ cycles of the square wave on the CRT. Set R15 to maximum and

Micro Oscilloscope for Your Test Bench

S4 to 10 V/div. Turn the potentiometer for maximum amplitude. Referring to Fig. 9, adjust compensating capacitor (trimmer) C6 to obtain the properly compensated waveform of Fig. 9C.

32) Repeat the process for the 1 V/div. and 0.1 V/div. ranges adjusting C4 and C2 respectively. Adjust the potentiometer for a convenient amplitude on the CRT for each trimmer adjustment. The 0.01 and 100 V/div. ranges require no compensating adjustment. Frequency response on the 100 V/div. range is somewhat less than the other ranges.

Operating Hints

The 'scope has all necessary controls to serve as a very versatile service or lab instrument. The DC amplifier coupling and triggered sweep are features usually found on 'scopes in the several-hundred-dollar price range. Learning to use these features effectively will greatly enhance the usefulness of your 'scope.

The vertical and horizontal amplifiers are both DC coupled. In general, DC coupling is used only when you wish to view low-frequency waveforms or complex waveforms where you need to know the DC level as well as the amplitude of the AC component of it. Experience is the best teacher and with some practice you will find the DC coupling is often very handy in circuit measurements. *DC bal.* control R13 may need occasional readjustment to keep the CRT trace from moving when R15 is turned.

The most important feature of this 'scope is the triggered sweep. Triggered sweep is locked to the input signal and will not go out of sync if the input frequency changes. Choose the desired sync source, *int.+*, *int.—*, or *ext.* and set R33 for a locked sweep as indicated by *sync.* lamp NL2.

A continuous trace will appear on the CRT even with no trigger signal if S3 is in the *auto.* position. When S3 is closed a trace will not appear on the CRT until there's an input signal. When viewing low-frequency waveforms S3 should be in the closed (non-auto) position for the most stable display on the face of the CRT.

How It Works

To help explain the circuit operation of the 'scope we will describe its six sections: the power supply, vertical attenuator, vertical amplifier, horizontal amplifier, sweep generator and CRT (cathode ray tube). These sections are shown in the diagram in Fig. 1.

Power Supply. The power supply (Fig. 2) delivers rectified and filtered DC power to the circuits. Refer to bridge rectifier BR1 and filter capacitor C28 provide +13 V to power the logic circuits in the sweep generator. The +13 V is regulated down to about 8 V by zener diode D6 to power low-level amplifier stages and other parts requiring a stable DC voltage. Capacitor C26 provides further filtering.

The +100 V supply derived from SR1 and C27 is necessary for the transistor stages that drive the CRT and which require large voltage swings for full-scale deflection. A negative high-voltage DC is required for the CRT. Two windings of power transformer T1 are series connected to SR2 and C29 to develop —450 V. One side of the 6.3-V filament winding is connected to —450 V to keep the CRT heater near the cathode potential.

Vertical Amplifier. This amplifier (Fig. 3) is a balanced differential type and is DC coupled throughout. Transistor Q1, an MOS field-effect transistor, provides the amplifier with an extremely high input impedance. Diodes D1 through D4 protect Q1 from overload. The high input impedance of Q2 prevents amplifier bias change when vertical gain control R15 is turned. Transistor Q3 gives the necessary low impedance to the differential input of IC1 and also reduces circuit drift caused by temperature changes.

Amplifier IC1 has two outputs which are 180° out of phase. These signals go to emitter followers (Q4, Q5) that increase high-frequency response.

Gain cal. Potentiometer R26 varies the amplifier gain for calibration. Capacitor C10 increases the frequency response of the output stages. *DC bal.* control R13 is for occasional front panel adjustment of amplifier balance. Proper adjustment keeps the CRT trace from moving up or down when vertical gain control R15 is turned.

Vertical Attenuator. Switch S4 and associated components attenuate the input signal by factors of 10 for sensitivities of 0.01, 0.1, 1, 10 and 100 V per division on the CRT,

[*Continued on page* 98]

Totable Stereo

RADIO designers may be long on circuitry but when it comes to cabinet appearance sometimes you figure they should stick to integrated circuits. Take a look at several sets on dealer shelves and you see the same basic layouts: speaker at the left and controls at the right; controls at the left and right and speaker between; controls at the top or bottom and speaker below or above. How dull.

But Hitachi has come up with an AM/FM/stereo-FM portable whose rather striking design makes good sense and is esthetically pleasing to the eye. The Model KS-1810H's dial is on the end of the cabinet and the controls are right at the side. The speakers are each attached with hinges at the sides and are detachable. When they're opened out, the set looks more like a bird in flight than the usual radio. There are headphone jacks and a tuner output for connection to a stereo amplifier. The suggested price is $99.95.

The KS-1810H's size is about 7 x 3 x 13 in. In addition to its swing-out speakers it has a telescoping FM antenna, ferrite-rod AM antenna, operates on AC or batteries, an AM, FM-AFC and stereo FM-AFC mode switch, tuning, volume and tone controls as well as stereo-indicator lamp. Battery power is provided by four C cells; a folding handle is located on the top.

The speakers are normally folded into the case and can be used in this position. For stereo reception the speakers can be swung out on their hinges or disconnected and spread apart 50 in. Though the speaker enclosures measure 7 x 7¾ in. the speakers are 4 in. and produce a sound quality just about equal to a good table radio.

AM reception is about equal to any other good transistor radio. FM sensitivity is about the same as most good telescopic-antenna-equipped FM portables. Similar to other transistor portables, the FM receiver overloads if you're too close to FM transmitters. Selectivity was average. In the New York City area there was considerable overlapping of stations in the crowded 100-mc portion of the dial.

The FM-AFC was very good; there was no discernible shift in tuning even when the radio was moved from indoors into the sustained heat of direct sunlight. Best of all, stereo reception and separation were quite good.

Unfortunately, the switch-operated (to reduce battery drain) stereo-beacon lamp was defective and would not operate. We can't report on whether it really does indicate stereo reception.

While the Hitachi is by no means a substitute for or the equal of a table-model stereo radio, it is a good choice for someone who wants stereo on vacation. It will fit in a picnic basket or briefcase easily. And it does double as a reasonably good FM tuner for a small hi-fi system.

Photo at top shows speakers detached; their wires are stored in each speaker — 600-mw amplifier is built in each speaker. Controls (top to bottom) are tuning, mode, volume, tone. At left is radio with speakers folded back in carrying position. Set may be played with them this way.

4-CHANNEL STEREO...
Pleasure Squared or Square Hi-Fi?

By ROBERT ANGUS

CALL it four-channel stereo, surround stereo, quadriphonic sound, quadrasonic sound or what have you, if you want to be the first in your neighborhood with the latest in audio gear—and price is no object—then you'll want to make the scene with four-channel listening.

Four-channel stereo is so new that even its most enthusiastic supporters are not agreed on how it's supposed to work. One thing is certain, however, and that's the need for *four* independent sound systems to reproduce four channels of audio material. The aim of the combined system is to provide the dimensional spread of a real concert hall. Not only are you supposed to be conscious of the left and right sides of the stage, but also of the echo or reverberation inside the hall.

The most common form of four-channel stereo at the moment (see Fig. 1) consists of four pickup points in the recording studio and four corresponding loudspeaker positions for playback at home. There are the normal right and left front channels, but these are supplemented by right and left rear channels as well. Thus, the total acoustics of the studio or hall are supposed to be reproduced accurately.

Obviously, four-track recording tape easily adapts to the needs of four-chanel stereo. Fig. 2 shows a strip of conventional quarter-track tape with the tracks arranged for four-channel playback. Vanguard Records is now preparing a catalog of prerecorded four-channel tapes and at least one other major record company is expected to follow suit this year.

Experimental four-channel stereocasts are already under way in New York and Boston, and FM stations in other cities may begin their own broadcasts shortly. So far, about the only hi-fi medium which hasn't felt the hot breath of four-channel programming is discs—but some engineers say that's only a matter of time.

From a listener's point of view, the interesting thing about four-channel stereo is that whether you listen to only the two front speakers, the two rear speakers, or the front and rear speaker on either side, you hear genuine stereo. In the first example, you hear the same kind of stereo most people listen to now. When you listen to only the two rear speakers the orchestra seems turned around and there's a good deal of ambience, but the music (at least on the samples we've heard) is clear and the sound is of good quality.

Listening only to the left rear and left front speakers provides a peculiar kind of sensation where instruments seem to lose their directionality. Yet, because one speaker has room acoustics in its makeup and because the perspective of each microphone on the orchestra is slightly different, the resulting effect is genuine stereo. This effect is most satisfying with solo instruments, or with classical music, where directionality is not important. (The same holds true for the speakers on the right side, too.)

Tape-head manufacturers like Michigan Magnetics and Nortronics have been experimenting with four-channel heads for special-purpose recorders for some time, while companies like Teac and Crown International already had built recorders capable of four-channel recording and playback. However, these were intended for educational or industrial use, and nobody thought much about four-channel stereo for the consumer market until Seymour Solomon of the Vanguard Recording Society demonstrated some four-channel tapes for reporters. Vanguard, it seems, had been quietly experimenting with four-channel pickup.

One of their tapes, made in Salt Lake

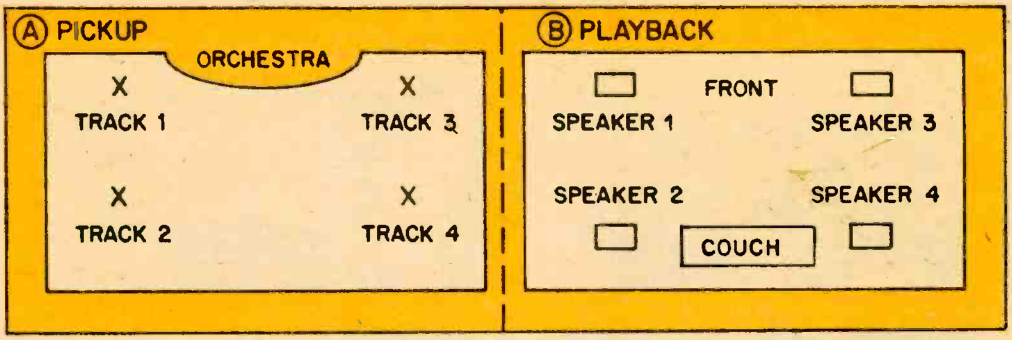


Fig. 1—Four-corner system above is championed by Vanguard and is early favorite. Other alternatives include: (1) three speakers in front and one behind (favored by Teac), where third front speaker fills hole in middle and rear unit provides ambience; (2) all four speakers in front for a curtain of sound as heard in control room, and (3) Scott arranges four speakers in a square at front of the room.

City's Mormon Tabernacle, featured an excerpt from the Berlioz *Requiem* scored by the composer for four-channel stereo, with a separate brass choir emanating from each speaker. Another tape arranged a baroque ensemble between the two front microphones, while those in the rear merely reproduced the sounds of the hall.

The effect provided not only a more natural sound, but it lent depth as well as breadth to the stereo effect. Another tape presented Joan Baez in the middle of the listener's head (something like listening to stereo with earphones) and instruments grouped around each of the four speakers. It was something like finding yourself in the middle of a performing group with instrumentalists surrounding you.

Within weeks of the Vanguard demonstration, Acoustic Research, with the aid of Telex, was demonstrating four-channel stereo at its listening room in Grand Central Station in New York and at hi-fi shows in Los Angeles and Montreal.

The next step was taken by the Boston Symphony Orchestra, which added four-channel stereo to the live pickup of its broadcasts in October of 1969. If you live in the Boston area and have two stereo FM receivers, you can pick up the stereocasts any Saturday evening during the season (on nights when the Symphony isn't broadcasting live, FM stations WCRB and WGBH fill in with four-channel tapes of earlier broadcasts). For the Boston stereocasts, WGBH-FM is carrying the left rear signal on its normal left channel and the left front signal on its normal right channel. WCRB-FM carries the right front on its normal left channel, and right rear on its normal right channel.

In New York, radio stations WNYC and WKCR have presented similar broadcasts using Vanguard tapes. Technically speaking, the stereocasts violate the FCC requirement (1961) that broadcast signals must present a balanced or complete signal (a mono FM signal containing the sum of the left and right channels is balanced, according to the FCC, while a broadcast of either left or right channel is unbalanced). The mono listener to WGBH hears only the sum of left front and left rear signals, and even the average two-channel stereo listener hears only the *left side* of the symphony orchestra. So far, the FCC has had nothing to say about the new stereocasts.

Listeners to a recent demonstration by San Francisco stations KSAN and KPFA, who tuned in either station in mono got only one side of the stereo stage (KPFA handled left rear and left front, while KSAN broadcast the two right channels), a practice followed by the other broadcasters in New York and Boston.

The mono signal emphasized instruments on one side of the orchestra at the expense of those on the other side, but it included some-

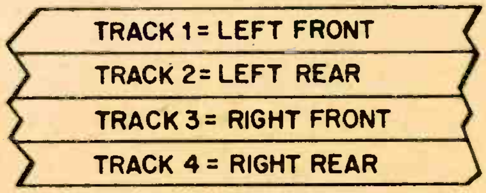


Fig. 2—Quarter-track tape arranged for four-channel system of Vanguard. Tracks 1 and 3 are compatible with two-channel playback equipment.

4-CHANNEL STEREO...

Wollensak Model 6154 Quad/Stereo tape deck costs $500, offers three in-line heads and three speeds, four playback and two record preamps.

Crown International Model SX824-P4ch recorder costs $1,825 plus $59 for the carrying case. Deluxe quarter-track unit is fitted with in-line heads.

what more reverb or studio ambience than is usual in a stereo broadcast. Listening to either station in conventional stereo, the audiophile heard the rear, or ambient, channel from one loudspeaker; the front channel from the other. While this kind of stereo is not unpleasant, it is unnatural and not compatible within the meaning of the FCC regulations. Instead of getting the normal stereo spread, with violins on the left, violas on the right and the basses arranged somewhere in between, the listener has heard the orchestra crammed into one loudspeaker, with room ambience existing between the speakers.

You can't have a new four-channel system unless you have the right equipment. It is possible to use two conventional stereo receivers and four loudspeakers to receive four-channel broadcasts. But to play (or record) four-channel tapes, you'll need a four-channel recorder (see photos). A four-channel amplifier with ganged controls is also available now.

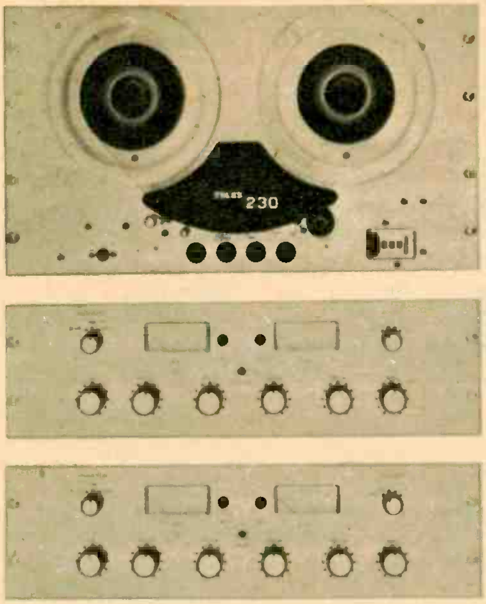
So far, there's no four-channel FM tuner—and for a good reason. Everyone agrees that the Boston and New York stereocasts are experimental; that they are unsatisfactory in the same way that the first AM-FM two-channel stereocasts were unsatisfactory. Most of the experts expect four-channel stereocasts to originate from a single station once it proves technically and commercial feasible.

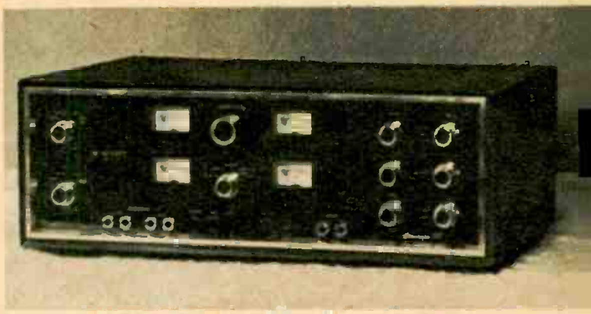
A stereo FM authority, William Halstead, believes that every commercial FM station has the capability of broadcasting not only two-channel stereo, but four-channel as well. "Instead of having one subchannel, as we do in two-channel stereo," Halstead said recently, "it's just as easy to put two separate and distinct subchannels in the upper part of the spectrum available to the station which would complement the two channels we already have in the presently-approved two-channel stereo system."

Under Halstead's plan, an additional channel, carrying programming for, say, the left rear signal, could start at 67 kc. Another, carrying the right rear signal, might start at 89 kc. These two subchannels can accommodate a frequency response up to 8,000 cps.

"Many people would say this is not hi-fi," Halstead explains. "The basic two stereo channels that we have now produce the full audio range up to 15,000 cps. Still, if two supplementary channels are added which are limited to 8,000 cps, all the localization effects produced by these new channels will be there because the bulk of the power in all the musical instruments is below 8,000 cps. They are the formants that produce the clues to the ear, determining the localization effect. When we go up to very high overtones, then the ear will detect all the overtones coming from the two front speakers normally used in stereophonic broadcasting, and it will associate these overtones with the other instruments that may be coming from the rear speakers."

Halstead's proposal is only one of a series aimed at single-station transmissions. Until the FCC authorizes one or another, how-





Scott Model 499 Quadrant four-channel amplifier costs $600, offers master volume control, left to right and front to rear balancing and meters.

Telex Model 230 Quad/Sonic four-channel units range in price from $550 to $1,544. Model 230-QQRM offers four-channel record and playback.

ever, manufacturers of tuners and receivers won't dare rush into production.

The problems of synchronizing and phasing the signals of two FM stations carrying a single four-channel program—particularly when their studios and transmitters may be located miles apart (as are those of WKCR and WNYC in New York, for example)—might seem to be great. Not so, says Walter Salm, editor of Broadcast Management/Engineering: "You're dealing with two out-of-phase signals whenever you pick up sounds from the front and back of a hall. The reverb signal obviously has to be out of phase. So if one station is picking up the front left and right while a second picks up rear left and right, there is no problem."

Harry Maynard, the man responsible for New York's experiment, explains that 15,000-cps telephone lines were used to connect the studios of WKCR and WNYC, some seven mi. apart. To synchronize the signals, Maynard explains, the telephone engineers simply transmitted a test tone which permitted station engineers to make the necessary adjustments.

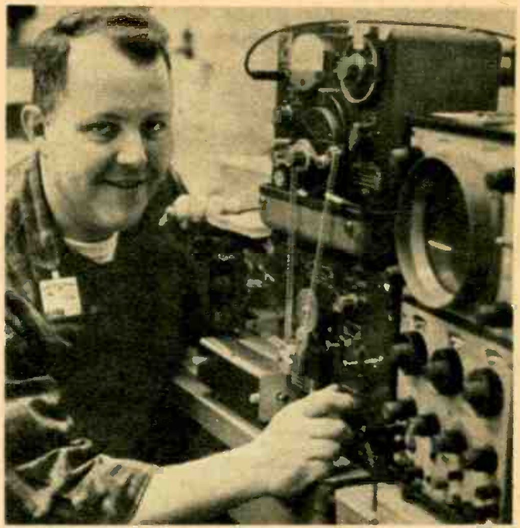
Can you put four-channel stereo on a disc? "Technically, I don't see why not," says the chief engineer for a major manufacturer of stereo pickups. "It could be done, for example, by adding a matrixing signal (A-B) to the left and right components of the record groove. This technique would require a signal outside the normal audio spectrum—up to about 25 kc or so. The problem is that ordinary cartridges would have to be much more compliant than they are today, or they'd wipe the multiplex carrier out of the groove with

[*Continued on page* 98]

Teac Model A-4010SRA tape deck costs $700 and offers two speeds and four heads, along with four record preamps, four playback preamps and four VU meters for monitoring.

One of our students wrote this ad!

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



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

By Harry Remmert

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

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

The Advantages of Home Study

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

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

FCC License Warranty Important

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

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

Hi-Fi Today * Economical Luxury

By John Milder

FOR quite awhile now, it has looked as though the trend in audio electronics was to increasingly complex and expensive gear, with the many excellent receivers in the $300-$400 range getting less emphasis than a newer generation of ambitious preamps and amplifiers. However, something else has been happening recently that promises to make life far more beautiful for the man whose eyes and ears are bigger than his budget. That something is the emergence of the $200 receiver.

Practically everybody—at least among the Japanese manufacturers—seems to have had the idea at about the same time, which makes it look at first like just a pricing expedient. But it's far more than that.

The new generation includes gear like the Marantz 26, Pioneer SX-440, Sansui 2000 and Sony STR-6040. I've now had a chance to do some extended listening to the Pioneer and the Sony and I'm impressed. These receivers represent a point where most of us with far more expensive equipment would have stopped a few years back if they had only been available. And with design practice being what it is these days, there's reason to believe that the ones I haven't heard are in the same class.

What do they really have to offer? Well, a combination of low-to-medium power and really first-rate FM tuner performance. The FM performance will come as a jolt to many who own far more expensive receivers and tuners bought only a couple of years ago. This new performance is probably the equivalent in really *useful* reception to the characteristics of many current tuners of equal or greater price. It combines excellent sensitivity, steep limiting curves and good selectivity characteristics complemented by capture ratios of 2db or less. (As I pointed out a few columns back, capture ratio has a lot to do with how well a tuner performs in metropolitan areas where reflected signals tend to produce multi-path distortion.)

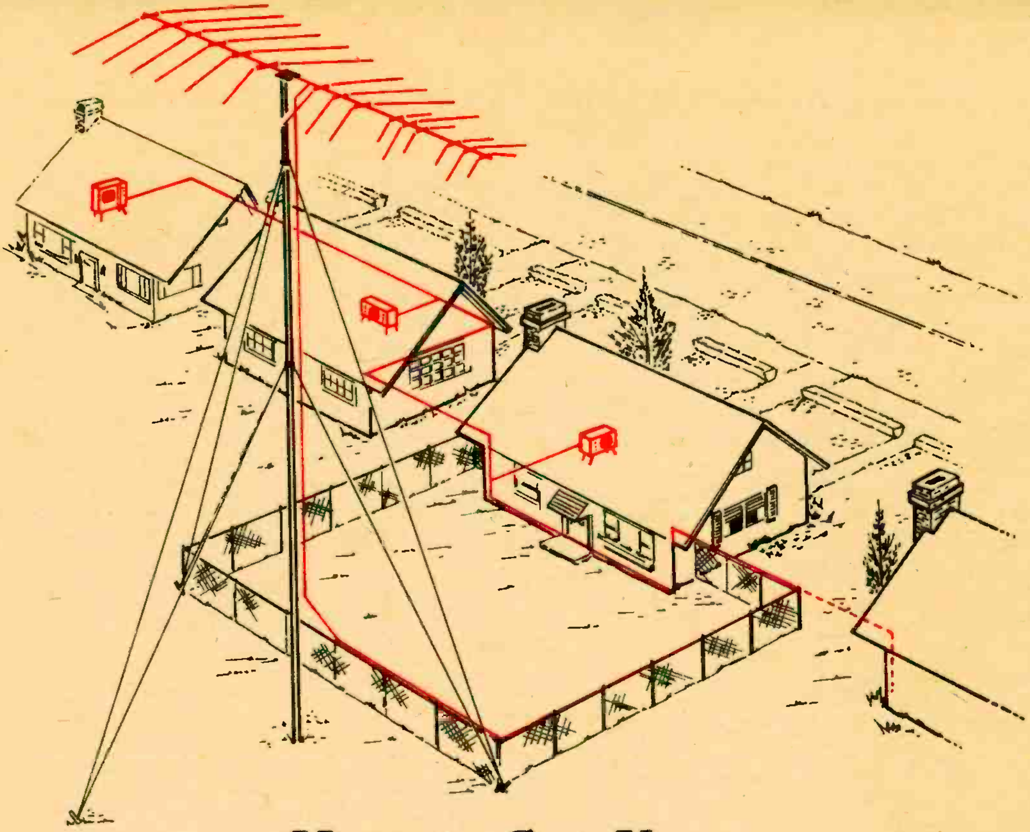
Pioneer SX-440 stereo receiver offers FM sensitivity of 2.5 μV, channel separation of 35db at 1 kc and 40-watt (IHF) power output—all this costs $189.95.

The power rating of these new receivers is in the 12-15 watt per channel (rms) area, which doesn't encourage their use with low-efficiency speakers. But unlike older vacuum-tube models, this generation will produce rated power at the extremes of the frequency range. (No cheap transformers to limit response.) You can listen at a reasonably healthy volume in an average living room without hearing a hint of the skinny sound of older low-power units. Things can get sticky if you want to play hard rock very loud with 40 or 50 people in the room for a party, or if you like to listen consistently to organ pedals and marching bands at room-rattling levels. But for most music under most conditions, everything is pretty fine.

All of the foregoing has a particular irony for me these days, because I recently decided to replace my own receiver and have been doing some close looking and listening. My own speakers are just not efficient enough for the new breed of low-price receivers, so I've been poking around in the $300-$450 price range. And I've been turned off—despite the really superb performance that's available—by the damned-near-incredible knobbiness and complexity of most of the units I've seen.

I can think of at least three of four that I would defy an experienced audiophile who isn't familiar with them to turn on in less than a couple of minutes. At least half of the flittering knobs on some of these monsters are of marginal (to put it kindly) usefulness. Even when they are useful, their physical layout is so cluttered that it would worry an airline pilot.

Come on, gentlemen. You can do a lot better than this. And you don't need knobbiness to zonk the consumer.



How to Set Up a Neighborhood Antenna TV System

By LEN BUCKWALTER, K1ODH

FIRST there was MATV, the Master Antenna TV system for apartment houses and motels. Then came CATV, the Community Antenna TV system that picks up signals on a mountain top and cables them to homes in a valley. Now there's NATV, a Neighborhood Antenna TV system. It's a hybrid of master- and community-antenna system plus the likes of an oldtime barn raising. To set up such a system neighbors get together and share the cost and effort of erecting one super antenna system for themselves. It could be the cure for ghosts and snow which plague pictures picked up by individual mediocre antennas in a fringe area. Consider an NATV system's advantages and disadvantages.

A better installation and more sophisticated equipment are two benefits. In the NATV system we installed, cost of equipment was about $175. Though it sounds expensive, remember that it can feed high-quality signals to four or five homes. Each of those homes might pay up to $100 for an individual antenna installation whose performance might not be satisfactory. In our system we erected a 50-ft. mast—about twice the height of the average antenna. Divide $175 by three homes and each installation costs about $60. (More homes are going to tie in later which will reduce the cost per home).

An NATV system also boasts electronic amplification at two points—the antenna and in the first home. This means that a long length of coax won't lose signal or pick up salt-and-pepper spots of ignition interference. Each homeowner gets one tapoff, or outlet, to replace the line from his old antenna. He connects to it like any antenna lead-in; for example, he can connect a two- or three-set coupler to the tapoff and split the signal among several TV sets, or a TV set and an FM tuner. What happens to the neighbors if one home shorts the line? Nothing. Because the tapoffs also isolate each home from the main line, no one is disturbed.

Now for the limitations of an NATV system. First, all homes should lie on adjacent lots as shown in the sketch on the first page of this article and in Fig. 11. This allows the coax to go from home to home without crossing a street. If you hop over a road the town fathers may consider it a CATV operation and subject to franchise. Then there's the matter of cooperation among neighbors. If they feud like the Jukes and Kallikaks, forget about NATV and learn to live with the snow.

If you plan to go ahead, consider what we used in our system. It can be used as a model for almost any group of homes that can be linked by 400 to 500 ft. of coax.

Antenna. Since NATV pays off only in moderate to deep-fringe areas (about 50 miles or more from TV stations), don't skimp on antenna size. We chose a 15-element model (Finco CS-V15, about $40) designed for VHF (channels 2-13) and FM reception. Many elements mean high gain and good rejection of ghosts and interfering stations because of a sharp pickup pattern. Sensitivity (or gain) is important, too, because no

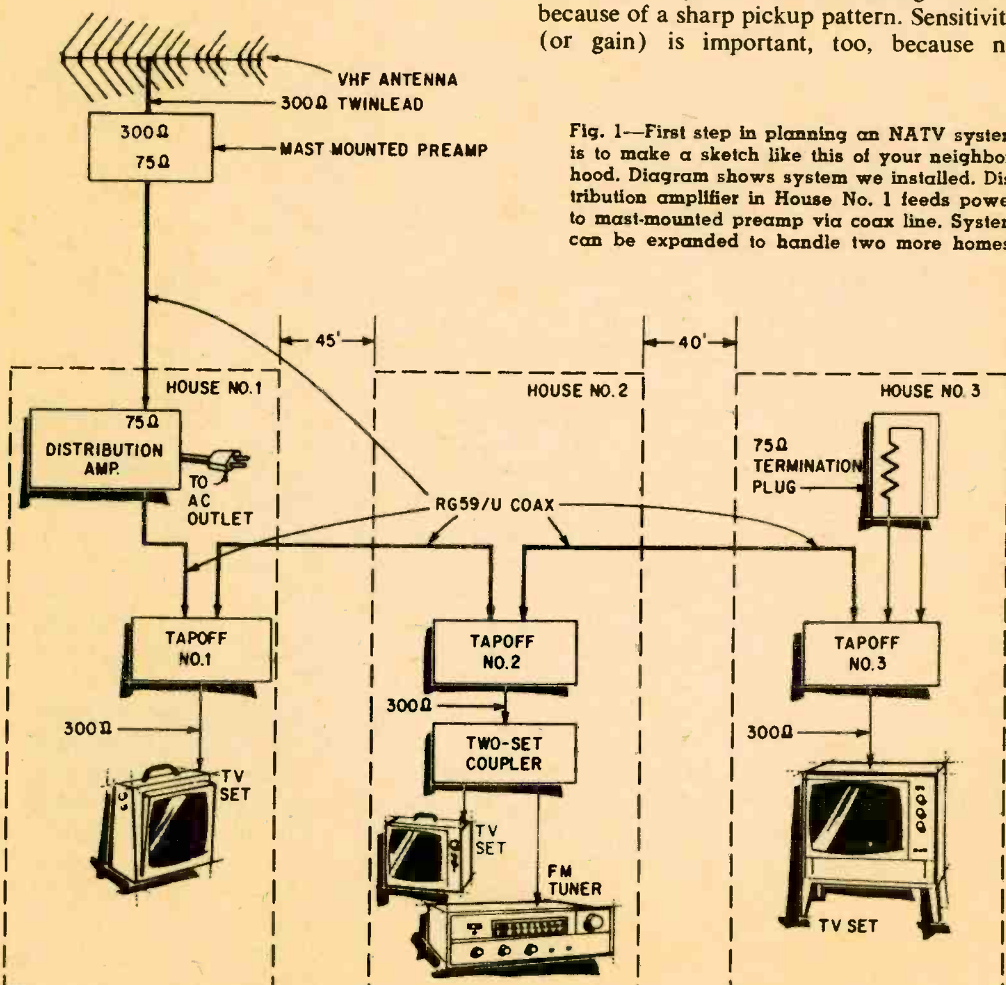


Fig. 1—First step in planning an NATV system is to make a sketch like this of your neighborhood. Diagram shows system we installed. Distribution amplifier in House No. 1 feeds power to mast-mounted preamp via coax line. System can be expanded to handle two more homes.

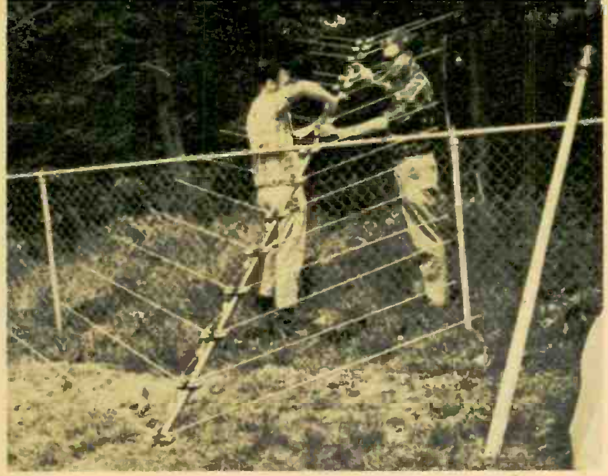


Fig. 2—First assemble the antenna on the ground. Next step is to mount antenna on the telescoping mast which is leaning on fence at the right.

Fig. 4—Attach guy wires to rings on mast. Eyebolt (right) holds sections during erection. Cotter pin (not visible) through mast locks sections.

amount of amplification can reduce snow induced in an antenna with low gain. The preamp and distribution amplifier are for restoring losses after the antenna—losses caused by long lines and splitting signals among many receivers.

Some systems (like ours) are strictly for VHF-TV and FM reception. If you are interested in UHF, the antenna and amplifier must be the VHF/UHF/FM type. Another consideration is antenna direction. As you may well imagine, a rotator isn't practical when one antenna feeds several homes. This can be solved by mounting two antennas on the mast, orienting them in different directions and using a *combiner* on the mast so they feed one line. This enables you to pick up stations in different locations without turning the antenna.

The Tower. Go as high as you can so the antenna will see farther over the horizon. Self-supporting towers are expensive, but you can get up 50 ft. with a telescoping mast, (Lafayette 18 T 5609WX, Allied 11 C 2103W) as we did, for about $20.

The Electronics. It's advisable to use two boosters in the system to make up for losses caused by long lines and by splitting. First is a preamp mounted directly under the antenna (see Fig. 3). If it's a typical one- or two-transistor preamp designed for home use it can feed a lead-in of a few hundred ft. with no difficulty. Cost is usually under $30, like the Blonder Tongue Vamp 2-75A used in our system.

Second point where signals get a boost is the distribution amplifier. Installed indoors (Fig. 10) it boosts the level of signals prior

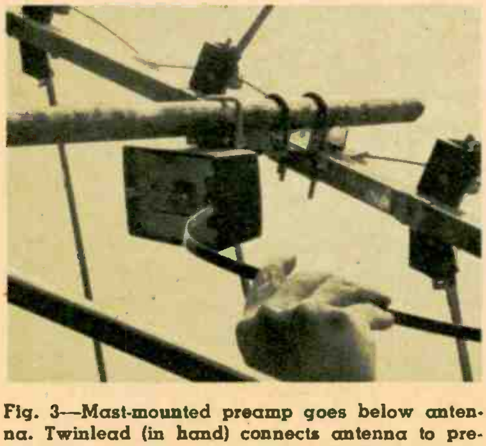


Fig. 3—Mast-mounted preamp goes below antenna. Twinlead (in hand) connects antenna to preamp; coax connects preamp to distribution amp.

Fig. 5—Mast must rest on firm base. Here, hole is dug for ready-mix concrete (bag, left). Broken block or bricks reduce amount of concrete needed.

Fig. 6—Man at right uses clamp to grip mast section and lifts. Man at left uses Stillson wrench to stop downsliding. Guy wires are on first section.

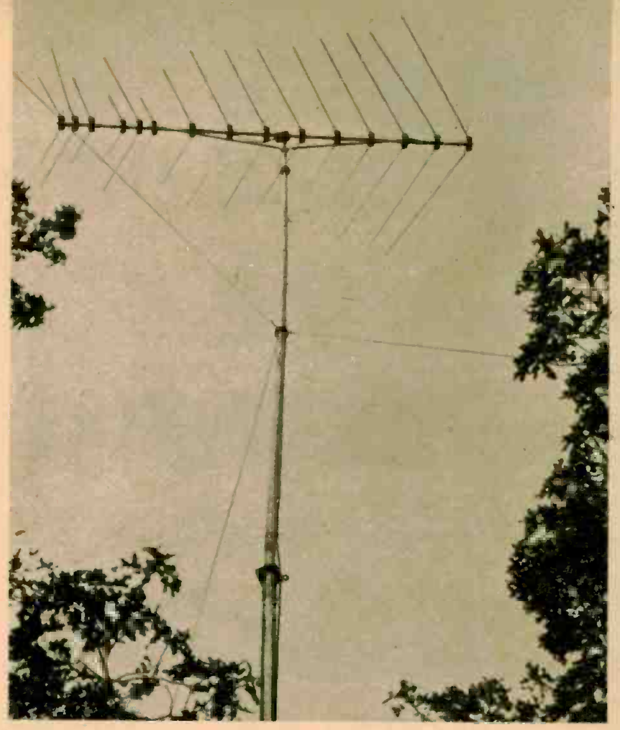


Fig. 7—Erected antenna. Note guy wires just under antenna and 30-ft. below. Orient antenna in proper direction before tightening guy wires.

Neighborhood Antenna TV System

to splitting them at each home. For this you might select a model designed for a small MATV system. (Ours is a Blonder Tongue CVB-30P priced about $60. Its gain is 30db.) Ours has adjustments for controlling gain of high and low channels, and it is the power source for the preamp on the mast.

The Cable. Most professional systems use 75-ohm RG59/U coaxial cable. With a plastic jacket and shielded conductor, coax is extremely easy to use. You won't need stand-offs to hold it away from metal and you can even run it underground. This is especially convenient for running cable outdoors and between homes. The components in our system, with certain exceptions, are rated at 75 ohms to match the coax. Only the antenna and TV input are the standard 300 ohms. The matching job, as we'll show, is simple.

Tapoffs. These devices (ours are Blonder Tongue TS-731B) solve the problem of feeding signals to several receivers and preventing interaction between them. You can insert tapoffs anywhere along the line. Tapoffs are used like AC wall outlets in that you take power from them without disturbing other outlets tied to the same line. There is, of course, a limit to how many tapoffs you can use. It depends on a relationship between signal level, length of cable runs and gain of the distribution amplifier. But you can avoid engineering calculations by modeling your system after ours. Just use the same general type of equipment, stay within a cable length of about 500 ft. and feed no more than about five homes.

Rough Plan. Before ordering the components, make a rough pencil sketch showing the homes and distances. This tells how much cable you'll need, where to run lines and where to locate the distribution amplifier. The sketch on the first page of this article and Fig. 1 show our installation. Notice how the coax from the antenna to *House 1*, for example, circles around the rear lawn. This route allows the cable to run along a fence and gain some protection. Use your sketch to plot the best path between houses. It's usually easier to keep most of the cable outdoors, even if it means longer runs. That way you avoid the difficult job of snaking cable through inside walls.

Complete System. The sketch should tell what impedance ratings you'll need for each item (300 or 75 ohms), plus other essentials. For example, the antenna is a standard 300-ohm model. This calls for a preamp with a 300-ohm input so it can connect directly to the antenna with a short piece of twinlead. Preamp output, however, must be 75 ohms so it can connect directly to the coax down-

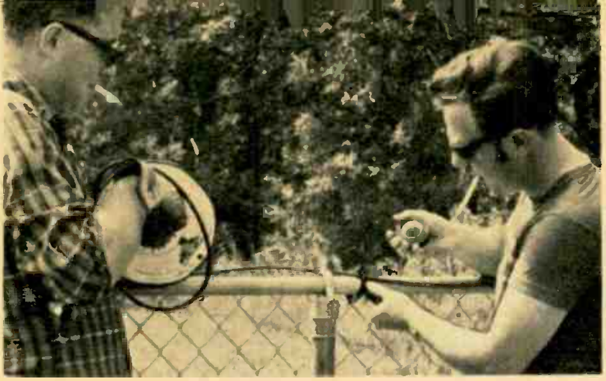


Fig. 8—Coax is being run from mast to House No. 1. The cable may be taped directly to metal (a fence in this case) or it may be buried underground.

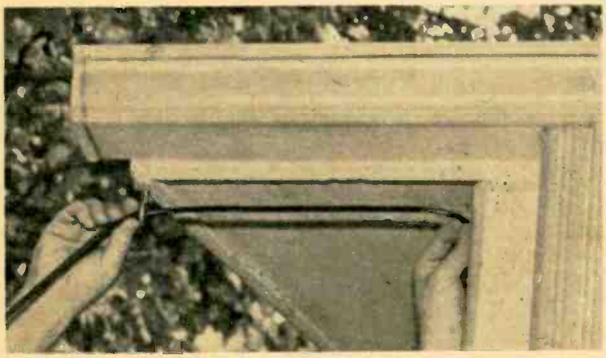


Fig. 9—Coax cable from first house is brought outdoors and fastened under eaves. It is then strung to house next door and attached in same way.

Manufacturers of TV Antennas and Amplifiers

Blonder Tongue Labs, Inc.
9 Alling St.
Newark, N.J. 07102

Channel Master Corp.
Ellenville, N.Y. 12428

The Finney Co.
34 W. Interstate St.
Bedford, Ohio 44146

Gavin Instruments, Inc.
1450 U.S. Route 22
Somerville, N.J. 08876

Jerrold Electronics Corp.
401 Walnut St.
Philadelphia, Pa. 19105

JFD Electronics Corp.
15th Ave. at 62 St.
Brooklyn, N.Y. 11219

Mosley Electronics, Inc.
4610 N. Lindbergh Blvd.
Bridgeton, Mo. 63042

Winegard Co.
3000 Kirkwood St.
Burlington, Iowa 52601

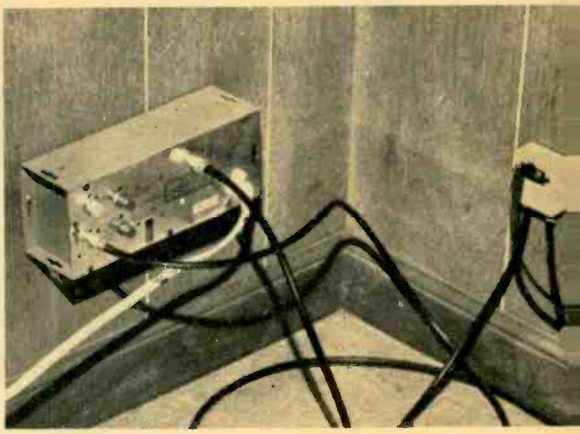


Fig. 10—Distribution amplifier (left). Tapoff is at right. Twinlead from tapoff goes to TV set or splitter; coax from it goes to the next house.

lead going to the first home.

Next major item is the distribution amplifier, rated at 75 ohms at input and output for coax connections. The amplifier can be located in a closet or basement since it doesn't have to be immediately accessible. Be sure to locate it near an AC outlet, and away from any heat source.

Next is the first tapoff (at *House 1*). Note that its input is 75 ohms so it can connect to the coax. The tapoff has a 300-ohm output to allow a twinlead connection to the TV set. To show what else can be done with a tapoff a variation is given at *House 2*. Note that a two-set coupler is connected to the tapoff to split the signal to go to both an FM tuner and a TV set. You might even install a four-set coupler here for added outlets.

Besides impedance, tapoffs are also rated in terms of *isolation* which ranges from about 8 to 30db. Since our system is fairly simple we avoided fancy computations by using tapoffs rated at about 17db. Another approach is to buy adjustable tapoffs that let you vary the amount of isolation. They allow you to balance experimentally the signal through the system.

Another item you'll need is a 75-ohm terminator. Notice that it is used at *House 3* to seal the output of the last tapoff. This electrically terminates the line with a load and prevents signal reflections (which cause ghosts). If the coax is extended in the future, you remove the terminator and lengthen the line

Fig. 11—Everyone on this block is now satisfied with TV reception. House at left (only garage is visible) is at head of system. Antenna is in the backyard and distribution amplifier is in den. Houses in center and right are presently tied to system. Two more at right (out of photo) will join later.

from that point. The terminator would then be moved to the tapoff at the new last location.

In our system there's a 50-ft. mast with its base at ground level. If you intend to erect a mast that high here are some rules to follow: Guy the mast at at least two levels; near the top (several ft. below the antenna) and about half-way up. Use three guy wires at each level and space them equally (120° intervals) around the mast. The guys are anchored to the ground about 25 to 30 ft. from the mast. Anchors may be pieces of iron pipe (5 ft.) driven into the ground at an angle.

You'll need plenty of help to raise a telescoping mast. As Fig. 6 shows, a section is grasped and raised inches at a time by one person, while a helper prevents the mast from slipping down. Each succeeding section is raised, then locked into position. Three helpers are needed to hold and let out on the guy wires as the antenna rises. When the guy wires are ready for tightening use turnbuckles and don't draw them too taut. After the wires are adjusted in length to make the mast vertical, tighten them but leave a slight amount of slack.

A tall antenna is a good target for lightning so install some protection. The mast should be grounded by a No. 8 aluminum wire connected to a water pipe or an 8-ft. copper rod driven into the ground. The shield of the coax, just before it enters the home, should also connect to that ground system.

Balance the System. After installation, check the signal level in each home. Observe a TV set at each outlet in the system while a helper turns up the gain controls at the distribution amplifier. You'll want to use the greatest gain without producing cross-modulation or overload at any receiver. These conditions will show up as an interference pattern on the screen or possibly a picture turning negative. If it's impossible to obtain good balance in the system, you may have to play with the tapoffs. A problem might be that sets near the amplifier are overloaded, while those near the end of the line are snowy. This is where an adjustable tapoff is handy because it lets you reduce signal to cure overload.

In a stereo system a good speaker system can expose a poor amplifier. The same thing happens when the NATV system sends strong signals to an old TV set. The set may have performed reasonably well on weak signals, but suffers from reversed pictures, jittery sync, or total overload after connection to an NATV system. The reason for this is a weak tube in the tuner or IF amplifier that clips or saturates on strong signals. Another possibility is that a set's AGC control may be adjusted for weak-signal reception. Check the adjustment to see if you can cure the overload condition. TV sets on the line should be working satisfactorily before you reduce gain on the distribution amplifier or try different tapoffs. Write to the manufacturers listed in this article to obtain literature on their antennas and amplifiers.

The Audio Scene, Careerwise

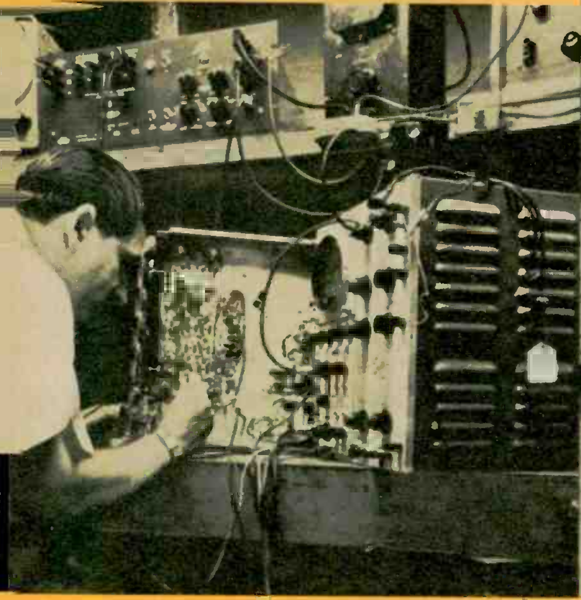
Stop—look—and really listen, because you may be missing out on an exciting career in hi-fi servicing and sound reinforcement.

By FOREST H. BELT

NOT too long ago the President of the United States walked up to a microphone at an important electronics-industry gathering. What happened was most embarrassing—the sound system went dead. Technicians scurried to change mikes and patch in another amplifier at the console; it took a bit longer, however, for convention officials to get over red faces.

This could happen to anyone, anywhere. Equipment just isn't that predictable. Still, the incident dramatizes how important good technicians are, men who can spot and fix audio problems quickly. Therein lies a story—about careers in this broadly diversified branch of electronics.

People tend to lump several segments of the electronics industry under the word *audio*. Specifically, an audio technician works on sound reinforcement for public gatherings; on stereo hi-fi systems located in homes or theaters; on studio equipment in FM or AM radio stations; on auto, boat and airplane sound systems; on industrial paging and interoffice communication systems; even on guitar amplifiers, electronic musical instruments and small phonographs. Depending on his specialty, the man will be called either a *sound technician* or *hi-fi technician*. Whatever the



Bench technician checks out frequency response of stereo receiver with oscilloscope.

Technicians on inspection line in large plant use large-screen scopes to make final tests on amplifiers.

name, he installs, repairs and maintains audio equipment.

To get an idea how diversified a career this can be, let's spend a day with Philip Royal. He's been in audio for almost 30 years. He started in high school, worked 12 years for an RCA distributor, spent seven years with his city's largest TV/sound dealer and now runs his own company.

Royal Sound has two technicians. This morning, one of them is sent out on repair calls—an office intercom has a loud buzz on three stations; a factory paging system is weak; the police department has two portable hailers and one electronic siren to be fixed; the yacht club has two members with bad dockside hailers on cabin cruisers; a grade-school PA system is dead and is needed for an assembly this afternoon; a rented sound system has to be set up for a horse show tonight.

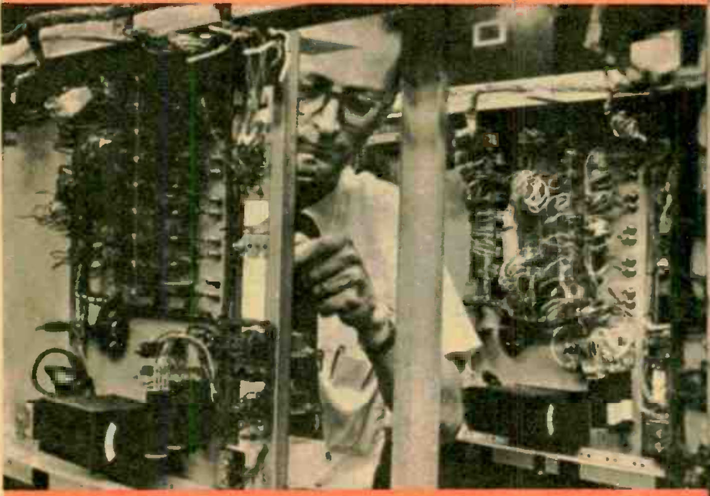
The other technician has his work to do: go to the high school and find out what's wrong in 12 cubicles in the language lab (and pick up three tape machines which have quit working); pick up some portable hi-fi sets at three department stores and deliver some finished ones; spend the rest of the day at the bench troubleshooting high-price stereo and some hi-fi players picked up the day before; and, this evening, help finish the horse-show setup and stay with it to make sure it keeps working.

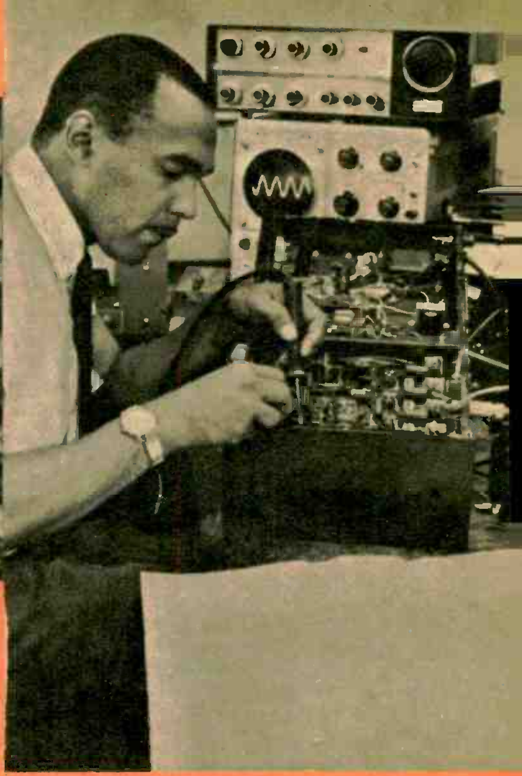
With both technicians dispatched, Phil Royal starts his own rounds. A local FM station has a bad turntable, a faulty modulation compressor and a noisy remote amplifier—he fixes them all on the spot. The sister AM station wants a new console modified for special effects so he stops by the studio to plan the job—one of his technicians will do the work later. Two schools want language laboratories and another is planning a 57-station paging-intercom system. Phil stops to check these out before he prepares his bid for the school board.

In the afternoon, Phil makes four service calls on home stereo systems. Then he stops at the newspaper office to place a want-ad in hopes of hiring another sound technician. He finishes up at another radio station where his company cleans all the tape machines and turntables once a month and runs tests to make sure the studio equipment is up-to-snuff. Later in the evening, he'll work out the school bids and then drop by the horse show to make sure the equipment is okay.

Some work went undone. There just isn't

Photos courtesy of Bogen Division/Lear Siegler, Inc.





Equipment racks belonging to single PA system are checked out by a representative of Custom Engineering Sound Dept.

At right, engineering sample of solid-state PA amplifier is checked out against a schematic diagram by technician.

enough help. Phil Royal doubts his ad will attract anyone, unless a technician at some other shop wants to change. But he needs at least one other man—and has for seven months—so he'll keep trying.

Besides a company like Royal Sound, you might want to consider a shop that does home and car stereo installations and repairs. Josh Bacon runs such a place in a large Midwest town. Until recently, his shop sold, installed and repaired only automobile cartridge-tape machines—probably the fastest-growing area in audio. With more of these units being sold for home use, Bacon's technicians now service other home-entertainment equipment, too. This includes reel-to-reel tape machines, cassette tape players, automatic turntables and amplifiers. They work on receivers, too, since so many car tape rigs include them. Bacon *doesn't* make home service calls because he can't find enough qualified technicians to do the work.

The fellow who becomes a hi-fi or sound technician often isn't college trained. If he knows audio electronics and acoustics well enough, he can hold a good-paying job with a firm like Royal Sound. He also can work in a shop which specializes in hi-fi, in a factory that builds hi-fi and sound gear or on the maintenance staff of a radio station.

If you have an engineering degree even more doors are open—as a design engineer for a manufacturer; planning and installation engineer for a building contractor; auditorium planner or consultant; or troubleshooter of faulty music and sound-reinforcement systems. These are just some of the possibilities.

If you want to crack this field, a key word to remember is *ability*. If you're not competent, even though you may land a job you won't keep it for long. There's so much to be done that companies have no time for slipshod work.

If you love audio work and are experienced, but perhaps have been away from it for awhile, you can buy some recent books about the field and read recent issues of relevant magazines. You also might sign up for the audio and acoustics courses of a correspondence school (information about schools can be obtained from the National Home Study Council, 1601 18th St. N.W., Washington, D.C. 20009). Of course, if you're in an associated electronics field already, the transition should be easy.

If you're a beginner in hi-fi and sound technology you must get a thorough grounding

The Audio Scene, Careerwise

in both the electronic and acoustic sides of the business. Then pick out a shop in your locality that has a good reputation and get a few years' experience. Your local newspaper's want-ad section may yield a company that wants a trained, inexperienced man. (It isn't likely you'll find anyone who will bother with you until you've got the basic training you need.)

Whether you study by correspondence, in a resident electronic school or at a public vocational school, your emphasis should be on audio equipment. But don't neglect radio. Since the arrival of stereo FM, there's no divorcing receivers from audio systems. And be sure the school you choose offers some practical training in servicing as well as theory. Remember that most people take three to four years to accumulate enough experience at the bench to become really good.

Once you become a journeyman technician many avenues open up. You may want to start your own business. That takes several thousand dollars and a lot of hard work. You need expensive test instruments, a proper business location, a stock of parts, money to pay expenses for a year or so while you get established and—most important—savings to live on until the business starts paying off.

You will need special training in business management. This last item is often neglected; that's why several thousand service shops went broke last year. Don't be fooled into thinking you'll be able to get by without business training; you won't.

You may prefer a regular paycheck and the fringe benefits gained by working for an established shop. When day is done, you can go home and relax instead of battling the many headaches associated with running a business. Also, you'll draw extra pay when you do extra work. Conditions are usually pleasant; messy, hole-in-the-wall audio shops have been replaced by modern well-lighted, air-conditioned establishments.

The pay in hi-fi/sound shops is usually somewhat better than in TV servicing. A beginner, even with technical schooling, may get as little as a $3,500 annual. But if you're good, you'll soon get substantially more or a more appreciative shop will snap you up and pay from $4,500 to $5,500 a year. As a journeyman technician you can expect anything

Technician in engineering lab at Bogen Communications checks out relays for a paging system.

from $6,500 to $10,000 a year. It depends on how capable you are, where you're located, and how well the shop is managed.

A tip-top technician who knows the sound business thoroughly and is a quick and willing worker often makes up to $15,000. That's the pay range you can expect to work into if you're a sound engineer with a degree.

Engineers usually work for manufacturers—but not in the factory jobs technicians are often hired for. Quality inspection, troubleshooting faulty sets off the line, jobs like that are usually for technicians. Pay in these plants is about the same as in the better repair shops, although overtime pay in factories sometimes swells up yearly wages. Fringe benefits are sometimes attractive: company-paid insurance, pension plans, three- and four-week vacations for workers with tenure, sick leave with pay, etc.

Wages are better than they were two years ago. That's due to the serious shortage of competent technicians and the fantastic increase in the number of music systems and sound installations. Hardly any shop can do the work that it's asked to do.

Pinchpenny Skyhook for 6 and 2

By RONALD LUMACHI, WB2CQM

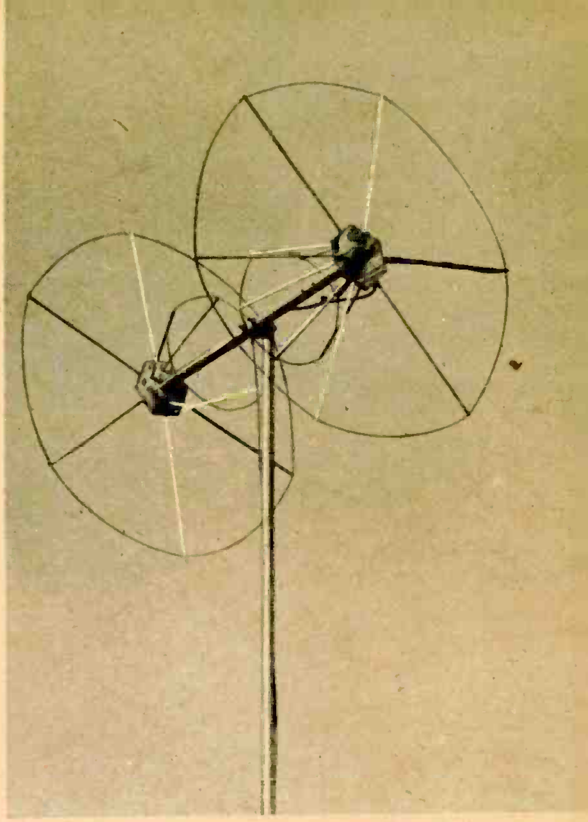


Fig. 1—Antenna in operating position. Round elements are for 6 meters; conical elements are for 2 meters. Tape coax to boom and mast and attach mast to center of the boom with a U clamp.

SOME hefty wire, a few dowels and a bit of aluminum tubing can be turned into an exceptionally lightweight and efficient antenna for operation on the 6- and 2-meter ham bands. With no trouble you can bring the project in under $3. Our bill for materials came to exactly $2.35, but we're semi-professionals at the game of pinching pennies.

Our Pinchpenny rig makes a quite-satisfactory permanent installation at home but also has special features as an antenna for the road. The light weight is one. Another is small size. Lastly, it solves the problem of nondirectivity, the affliction that besets halos, which long have been popular for travel. A halo can't compete in directivity with a good beam, which is the type of performance offered by our 6/2-meter antenna.

In many respects, our rig closely resembles a cubical quad and, like a two-element quad, has performance approximately equal to that of a three-element beam. In addition, it offers a lower angle of radiation than does a beam.

A quad owes its good performance to the fact that it has a large peripheral area which intercepts a relatively large portion of signal. Our circular design improves on this point with an even-larger periphery and more signal pickup (and radiation on transmit).

We compute our Pinchpenny's peripheral area to be about 20 per cent greater than that of a comparable quad. So one can figure on performance figures roughly 20 per cent on the light side.

Summing up our bit of sales talk, we'll say that our little rig will perform alongside any three- or even four-element yagi.

Construction. Our skyhook is two separate antennas mounted on a common boom, each antenna being fed from a common feed point. A standard aluminum TV mast cut to 3 ft. makes a good boom because it is lightweight, strong and readily available. The circular radiator and director elements, made from No. 14 copper wire, are held in place by ¼-in.-dia. wooden dowels. The dowels are mounted on six-sided hubs made from two pieces of ½-in.-thick exterior-grade plywood, cut to the dimensions shown in Fig. 5 and glued and nailed together. The dowel holes must be drilled in the center of each side of the hub.

The dowel holes for the 6-meter portion of the antenna are drilled perpendicular to the edges of the hubs. To provide the proper angle for the dowels for the 2-meter antenna, the holes for the dowels must be drilled at an angle of 20°. To drill the holes accurately, make a triangular jig as shown in Fig. 2; the holes should be ½ in. deep.

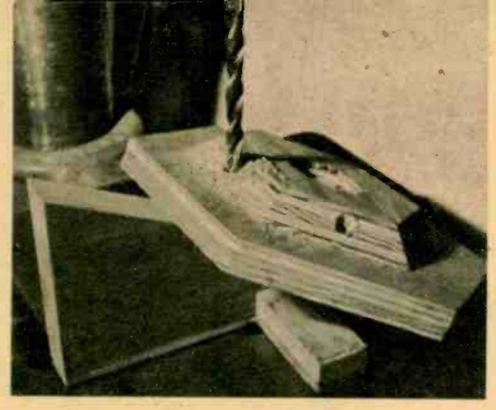


Fig. 2—To drill the angled holes for the 2-meter-antenna dowels, use a wedge with a 20° angle. Holes should be drilled to ½-in. depth.

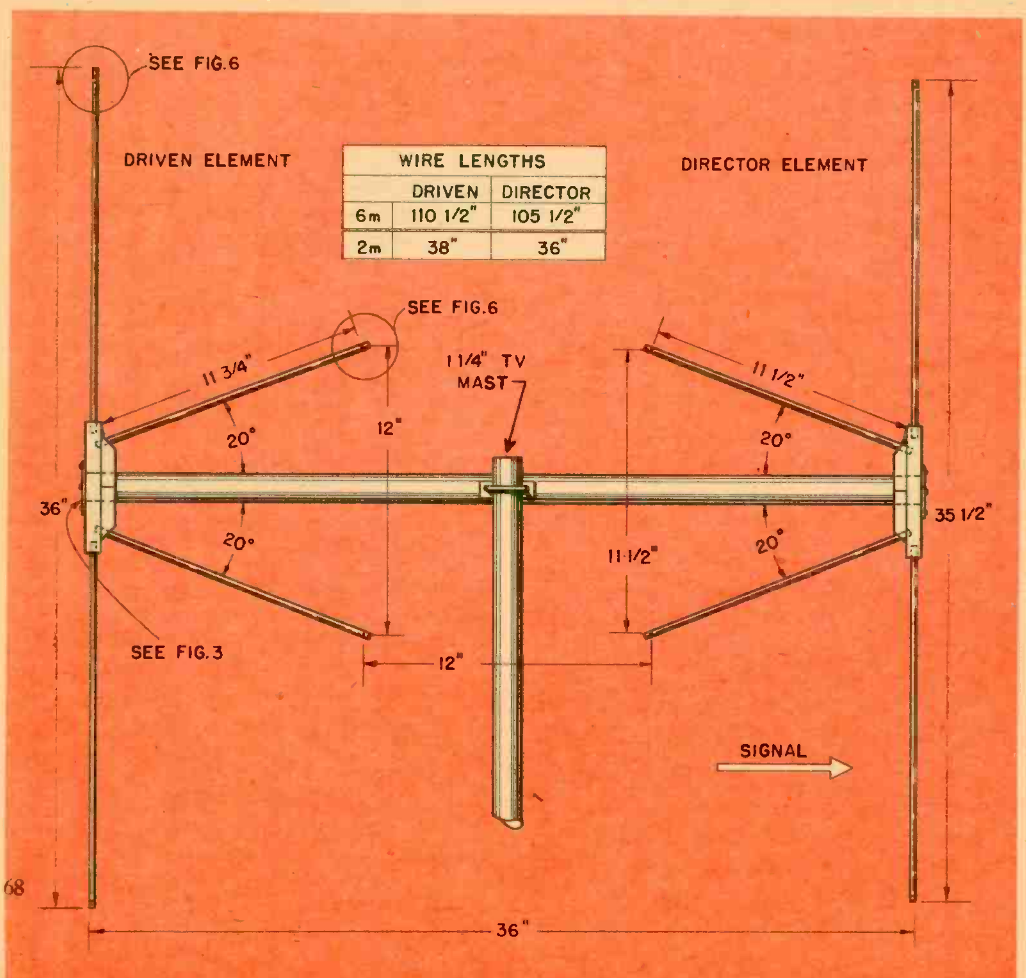
Fig. 3—Back of hub. Force fit short lengths of 1⅛-in.-dia. dowels in each end of boom. Attach hubs firmly to boom with 3-in.-long pieces of metal.

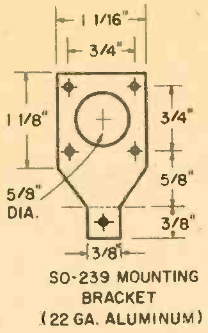
The 6-meter-element dowels are 15½ in. long. The length of the 2-meter dowels in the diagram in Fig. 4 is from the wire hole to the hub; add another ½ in. to go in the hub.

At the far end of each dowel drill ⅛-in.-dia. holes ½ in. from the end for the wire. The six dowels for each element form and support the wire and keep it rigid. The dowels may be glued if you don't plan to disassemble the antenna.

Before measuring and installing the No. 14 wire, put one end in a vise and stretch the

Fig. 4—Dimensions. Boom may be a TV mast or of wood. Driven and director wire lengths are critical.





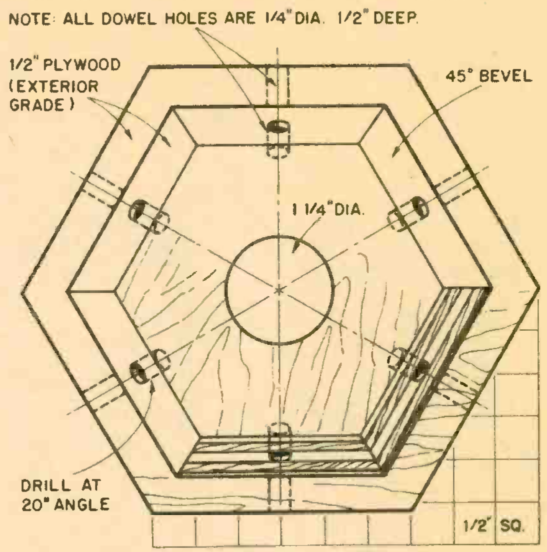


Fig. 5—Diagram above is of bracket used to support SO-239 connector shown in Fig. 7. Diagram at right is of hub (make two). Outer holes are for dowels for 6-meter element. Holes drilled at 20-degree angle are for the 2-meter element.

Pinchpenny Skyhook

wire by pulling it. This takes out all the small bends and kinks and will help in forming a circle.

Solder the two ends of the 6- and 2-meter director wires to form a closed loop. On one dowel of each driven element (for 6 and the 2 meters) drill a second hole then tape on a length of RG58/U coax.

Orient the 6-meter dowels so they are in a vertical plane with the feed-point dowel at the highest or side position. Solder the center conductor of the coax to one end of the antenna wire and the braid to the other as shown in Fig. 6. To keep the wires in place while soldering, form a right-angle bend in the coax after passing it through the dowel.

Install an SO-239 connector on a small homebrew racket (Fig. 5). Twist the center conductors of the coax together and solder to the center post of the connector. Install a solder lug on the shell of the connector and solder the braids to it as shown in Fig. 7.

The antenna may be rotated manually or with a rotator. The wind load is light and almost any rotator will be suitable. The antenna is sufficiently broadband on both bands to make tuning unnecessary. And switching is unnecessary even though both elements are tied together.

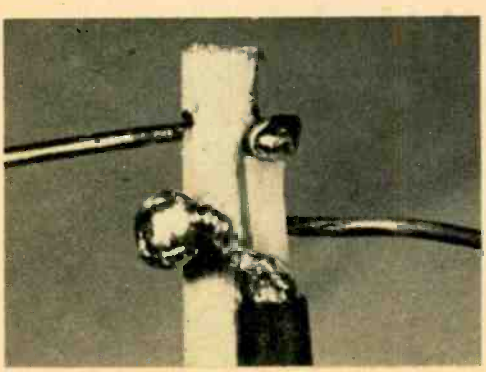


Fig. 6—On one dowel (far end) of 6- and 2-meter elements, drill two holes ½-in. apart. Solder coax to each end of antenna wire as shown.

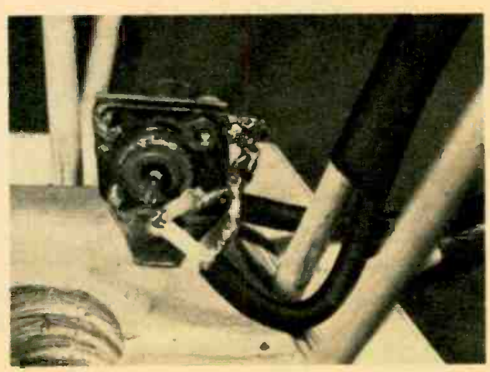
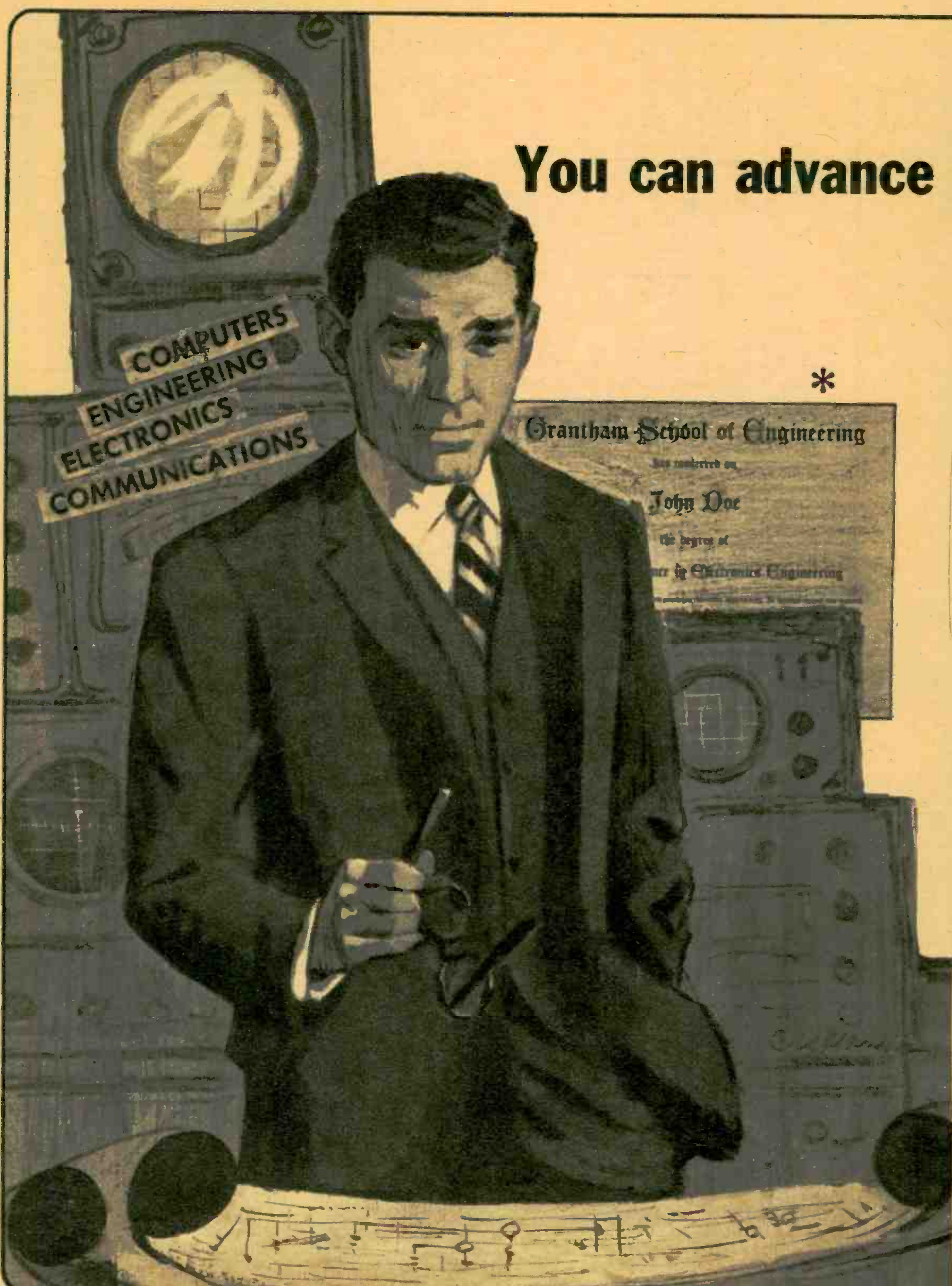


Fig. 7—Photo shows SO-239 coax connector mounted on hub of driven element. Solder coax from both 6- and 2-meter elements to the connector.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Notes from EI's DX Club

MEMBER Frank C. Kollins, WA9CWX (Illinois) can boast a bit of newsworthy African DX in the person of 9J2HZ at Lusaka, Zambia. He worked him at 2000 EST on 20 meters.

From EIDXCer Bob Smith (Michigan) we learn that R. Nacional de El Salvador is airing transmissions in English and French at 2200-2230 EST. Frequencies are 5980 and 9555 kc.

Radio-TV Algerienne currently is using the 19-meter channel of 15200 kc. If you own a 100-kc' frequency marker, as every SWL should, this spot will be a cinch to locate.

From Dan Ferguson (Florida) we learn that ORTF Brazzaville (whose days in the Congo Rep. supposedly are numbered) is using 11718 kc for their English transmission at 1415 EST (1115 PST).

If you're becoming frustrated trying to log that tricky Costa Rican powerhouse La Voz de la Victor (9615 and 625 kc), you might try instead for TIFC which has an English broadcast prior to their 2300 sign-off on 6037 and 1075 kc.

A new frequency for the government-owned Voice of Ethiopia is 9610 kc. Watch for their East African music around 2230 EST.

One station operating well above the edge of the 60-meter tropical band is R. Centinela del Sur. Gerry Dexter (Wisconsin) reports reception of a broadcast from Loja, Ecuador on 5120 kc around 1950 EST. Another station that's even further off the band is R. Atlantida at Iquitos, Peru (currently on 5180 kc).

R. Iran currently has a multilingual newscast (in English, French and German) around 1450 EST on 17735 kc. This technique allows a smaller station to reach several target audiences simultaneously.

Reception reports for KDD telephone transmitters should be addressed to: Kokusia Denshin Denwa Co. Ltd., Kasumigaseki Bldg. No. 2-5, 3 Chome, Kasumigaseki, Chiyoda-Ku, Tokyo, Japan. This mouthful from California's Pat St. Denis.

Latest frequency for Beirut's English transmission to North America at 2130 EST (1830 PST) is 15170 kc. Considering what what has happened recently in Lebanon this transmission might merit special attention.

Cable & Wireless, on super-rare St. Helena island, has a transmission (upper sideband) for Ascension Monday thru Saturday at 0600-0800 EST on 11092 kc. Beam width is 300 deg. so the broadcast should be loggable in North America. But getting a QSL will be something else again.

Still another newcomer to the international SWBC wars is R. Mexico. The station has been heard evenings on 11718 and 9535 kc.

Don't look for station WDSI—formerly carrying VOA programs from Wayne, N.J.—to ever come back on the air again. Its transmitter house has been turned into an environmental testing center for electronic components, and all that's left of the antenna farm are some huge cement pylons jutting up out of the ground. Remember that there was also another WDSI on Long Island?

Propagation: During daylight hours the 16- and 19-meter bands will be optimum for short-wave DX. In general, signal levels in the 13-meter BCB will be relatively weak over long paths because of decreasing sunspot numbers and seasonally higher absorption on higher frequencies.

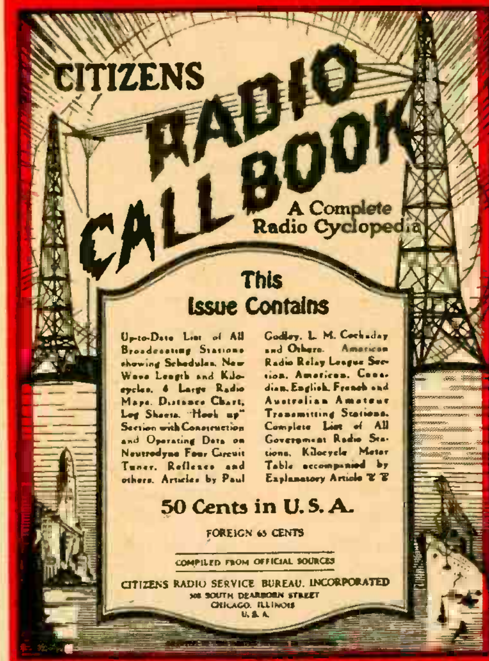
Daylight short-skip openings in the 10- and 11-meter bands will be numerous over circuits up to 800 mi. distant. This is due to the usual summertime increase in sporadic-E activity in the ionosphere.

During nighttime hours, openings from 49 to 19 meters will occur, with round-the-clock DX to one part of the world or another possible in the 19-meter band.

Because of high summertime noise levels, BCB DX will be restricted to relatively nearby stations during the hours of darkness.

CB Special Section

How the FCC Stole CB



A short tale reveals the facts about who really got the CB ball rolling.

By ALAN LEVESQUE

As with most things which issue forth from the halls of Washington, CB was a long time brewing in the pot before the first 27-mc signal was flung out into the ether. Governmental agencies like the FCC have been begging, borrowing and stealing ideas ever since our Constitution was written and the annals of CB now seem to verify this age-old tradition.

One of the most amazing predictions about CB we've seen this side of Nostradamus was an accurate description (right down to the use of the words Citizens Radio) which appeared in 1938, a full seven years before the creation of the service. It would be hard to believe the Commission failed to exercise its rights and didn't take notice of this unique proposal!

It turned up in a short letter written to the Editor of the amateur radio magazine, *QST*, which appeared in the November 1938 issue. Under the bold heading Citizens Radio appeared the thoughts of Herbert Brooks, W9SDG, of Port Wing, Wisc.

In the letter, Brooks said that the "Federal Government should . . . permit non-licensed operators to use sealed, fixed-tuned transmitters." Further, he says that this is desirable because there is a public need for low-power, portable rigs which "is not filled by commercial, experimental, or amateur licenses, especially . . . intercommunication between salesmen and truck drivers and the home office, and between small-town fire and police departments that cannot afford an operator, plus many other uses."

However, Mr. Brooks was ahead of his time. Technology had not yet advanced to the point where W9SDG's low-power, portable rig could be designed and then be produced commercially. Besides that, there wasn't any suitable spectrum space for the service to operate in—in 1938, all frequencies above 25 mc were strictly experimental.

Actually, one could say our story begins back in 1920 with the first known use of the term Citizens Radio. This was in the title of a semi-annual publication known as *The Citizens Radio Call Book* (see photo), which was published by the Citizens Radio Service Bureau, Inc., 580 South Dearborn St., Chicago, Ill. The book was a directory containing callsigns, names and addresses of ham operators. Why they chose to use the title Citizens Radio instead of Amateur Radio is lost in the dust of 50 years. Most likely, the expression Amateur Radio hadn't taken hold at the time and the name Citizens Radio was still in the running for public approval. In any event, the name Citizens Radio has a genealogy which dates it back even 18 years before the proposal of W9SDG that appeared in QST.

World War II changed practically everything but it wasn't until 1944, as the end of the war was in sight, that someone trotted out the old Citizens Radio idea again for another lap around the track. Reasons? The needs of the war had propelled radio technology toward the new frontiers of UHF and even microwaves, and the war had created thousands of veterans who were familiar with radio communications. Besides, there was now all that wartime radio gear which would soon be surplus.

Those were some of the reasons behind the first draft of CB ever to be presented officially to the government. It was an obscure project bearing the ornate title of The World War II Veterans Amateur Mobile Service Band. The originator of the proposal was former Director of Naval Communications, Rear Admiral Stanford C. Hooper (Ret.).

Speaking at the FCC frequency allocation hearings held during late 1944, Admiral Hooper said that the FCC "assign a new band, perhaps 2,000 mc wide, somewhere above 10,000 mc, to be known as The World War II Veterans Amateur Mobile Service Band for use by private passenger automobiles in any way they wish, with one provision that there be designated a few calling channels within this band, and it be, for awhile, only licensed to veterans."

Admiral Hooper added that, "thousands of experts in radio will be returning as veterans of this war, full of experience in new ways of using radio in crowded areas in the services and full of ideas and ambition, as to the parts they may play in the future in the application of new electronics services for the advantage of the public. It would be a gracious thing to give them special consideration in the ether, for a short period, especially where there is no demand for channels, and the public would profit from the developments which are certain to result."

Admiral Hooper's idea was never mentioned again but his speech must have rekindled the memory of somebody at the FCC who happened to be a regular reader of *QST*. In January of 1945, just after the Hooper plan was announced, the FCC took unusually rapid action in announcing their famous CB Docket (#6651).

The name Citizens Radio was resurrected, while the project appeared to be a selection of ideas gently lifted from both W9SDG and Admiral Hooper, plus a few technical standards from the FCC tossed in to fill in the gaps. The probability of the same ideas and exact name reappearing together seven years after W9SDG's *QST* letter seems outside the realm of coincidence.

At any rate, the Docket was there in all of its official glory. The idea was to set aside a band running from 460 to 470 mc for the Citizens Radiocommunication Service. Taking sole credit for the idea, the FCC went on to rehash the ideas of Brooks about using the service for trucks, emergency agencies, etc.

And what a service it was to be! It was a CBer's fantasyland of rural stations running high power, booster and automatic relay stations, no specific channel assignments and plenty of room for future frequency expansion as the service grew. All of this was topped off with the FCC's generous announcement that "the possible uses of this service are as broad as the imagination of the public . . . can devise" and with the promise that ". . . only the minimum requirements of the Communications Act plus a few minimum traffic rules will be set up." The FCC even added that it would take an imperative need before they would resort to any limiting regulations.

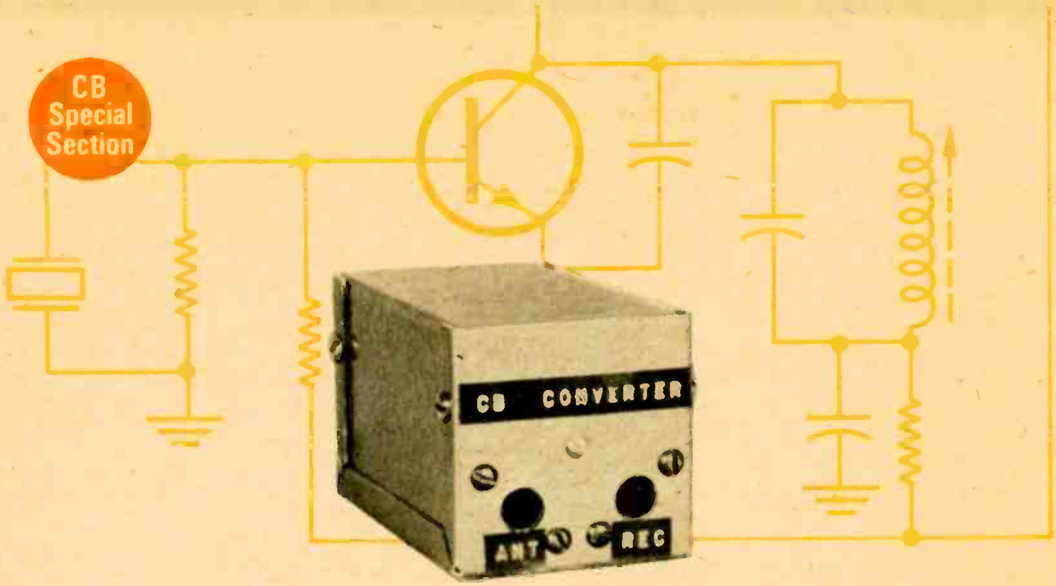
The first CB station to fire up was W2XQD, licensed in February 1947 to John M. Mulligan, a radio engineer from Elmira, N.Y. Using homemade equipment, Mulligan was able to maintain spotty communications on tempermental UHF channels only by means of a secondary 152-mc circuit which was used by CB operators to keep track of feeble and shifting UHF signals. Even after an extensive souping up, the receivers wouldn't permit communications much past 5 mi.

This was a blow to early hopes for the CB service and by the end of 1947 there were only 40 licensed CBers. Nevertheless, the radio magazines were jammed with ads for all sorts of surplus UHF gear which could be purchased for as little as $5 per set and be adapted to operate as a CB rig.

The few CBers licensed in the UHF band relied heavily on this surplus equipment. There was some commercial CB gear, but it was hard to find because the entire electronics industry could muster but two manufacturers willing to attempt to produce the new gear —and the sales of these two companies were most disappointing.

CB would have been considered dead if it hadn't been for the fact that it had never really come to life. It simply remained in a twilight sleep, forgotten and ignored for about 10 years, until the FCC finally decided to once again drum up new interest in Mr. Brooks' old ideas.

CB Special Section



Crystal-Controlled CB Converter

By RUDOLF F. GRAF and GEORGE J. WHALEN

NO DOUBT about it, CB has made two-way radio available inexpensively to anyone who needs it. But at times you may only want to be able to listen to what's going on on the band. For example, while operating your transceiver on one channel, you also might want to monitor other channels or find one that's clear. With our converter and *any* broadcast radio (transistor portable or car) you can tune the entire band easily.

The dual-conversion feature that results from using the converter with a broadcast radio produces sharp selectivity and excellent sensitivity. You will enjoy reception that is uncommon in many CB transceivers.

The converter achieves this performance without expensive crystals or frequency synthesizers. Only one crystal is used and it produces drift-free reception. The Darlington mixer/converter stage provides high gain and favorable input-output matching characteristics that result in high conversion efficiency.

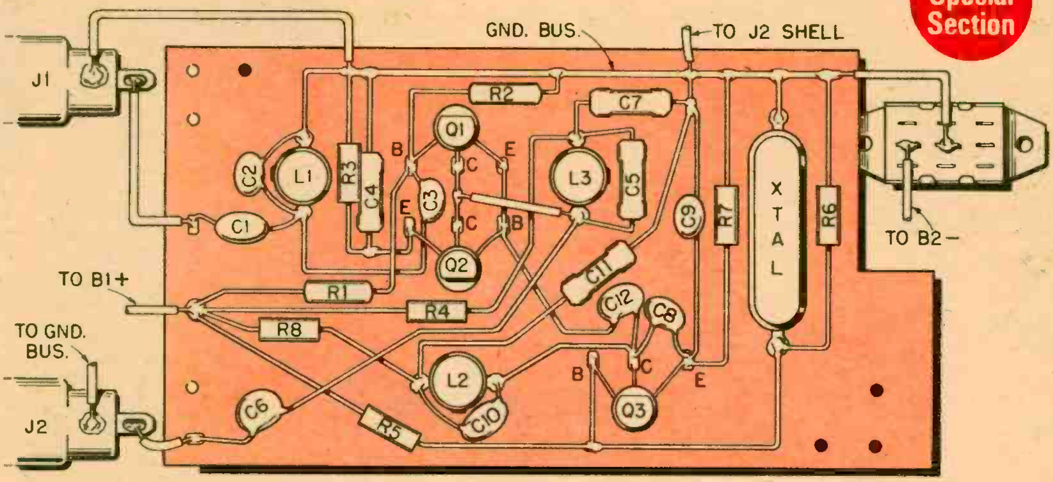
How it Works

The oscillator (Q3) is crystal-controlled and input circuit C2, L1 tunes the entire Citizen's Band. The converter's output falls within the AM broadcast band. The radio provides IF gain and selectivity, detection and audio amplification. Separate mixer and local oscillator stages are used for best conversion efficiency and freedom from spurious responses.

Mixer transistors Q1 and Q2 are connected in a Darlington configuration that has a very high input impedance and provides good gain. Oscillator Q3 is crystal controlled at 26.085 mc in a tuned-base tuned-collector configuration. When mixed with frequencies from 26.965 (channel 1) mc to 27.255 (channel 23) mc, the converter's output is from 880 to 1170 kc. An 18-V power supply is made up of two 9-V batteries. The oscillator signal is injected into the mixer pair via C12. The incoming RF signals are mixed with the local oscillator signal at Q1 and Q2, thus developing sum and difference signals. These signals appear across the output tuned circuit (C5, L3) which resonates at 1000 kc. The output signal appears at output jack J2 and is then fed by coax to the AM radio where it is detected as a conventional AM signal.

Construction

Our model is built in the main section of a 4 x 2¼ x 2¼-in. Minibox. With the exception of the input and output jacks, the power switch and the two batteries, all parts are mounted on a 1¾ x 3-in. piece of perforated board on which flea clips are used for tie points.



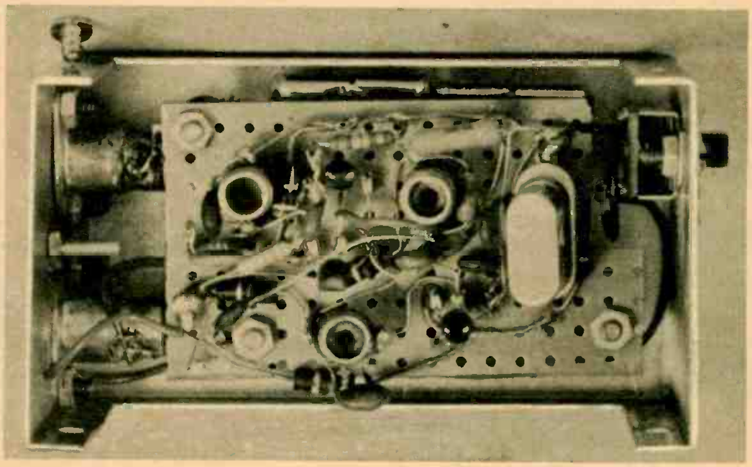


Fig. 1—Pictorial above shows location of parts on 1¾ x 3-in. piece of perforated board. Cut notch in upper right corner to provide clearance for power switch. Crystal is mounted in socket. In photo below, note location of three board mounting screws in upper left, lower left and lower right corners.

Start construction by drilling holes for the input and output jacks, the power switch and three screws on which the circuit board is mounted. Mount the power switch and the jacks. Because of the frequency at which the converter operates, duplicate our layout, shown in Fig. 3, exactly. Keep all leads short.

Tape the 9-V batteries on the bottom of the cabinet between the board's three mounting screws. Using spacers or two nuts at the end of the mounting screws, mount the board 1⅞-in. above the bottom of the cabinet. Slip a piece of heavy paper or cardboard between the board and batteries to prevent the flea clips on the back of the board from touching.

Connection to the Radio

To connect the converter to a car radio, you need a piece of coax fitted with male auto-radio antenna plugs at each end. The low-capacitance antenna cable from an old car-radio antenna is ideal for this purpose. However, for short runs (up to 20 in.) ordinary coax, such as RG59/U, may be used. This cable is connected between the output of the converter and the antenna input of the car radio. Plug the cable from the car-radio antenna, which now also serves as a CB antenna, into the converter's input jack, J1.

If you want to use the converter with a transistor radio, you must add a coupling coil on the radio's ferrite antenna as shown in Fig. 4. This coil consists of 30 turns of No. 30 enameled wire wound on one end of the radio's antenna at least ⅛-in. from the existing winding. Run the wires from the coil through the radio's case, then solder the wires to a firmly-mounted auto-radio antenna

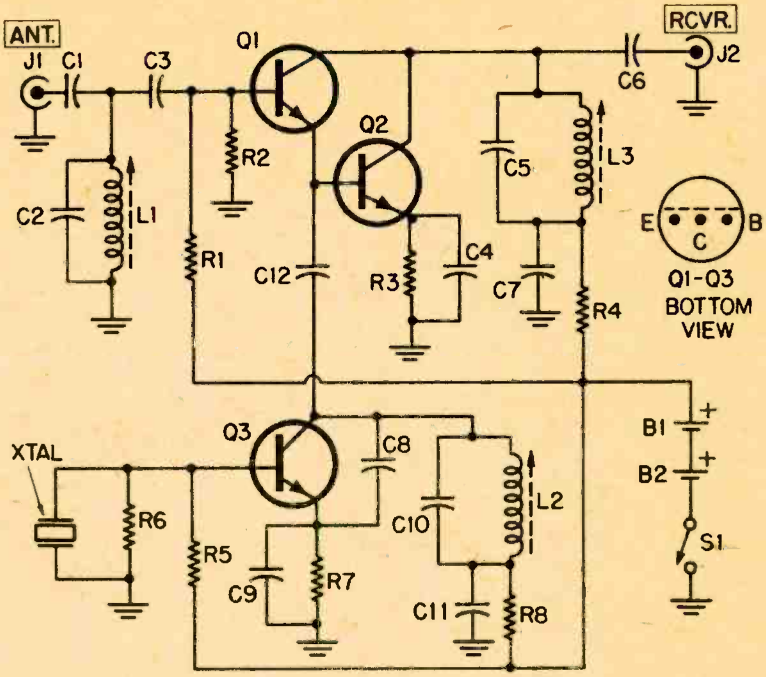


Fig. 2—Converter is broadly tuned by C2 and L1 to entire Citizens Band. Output of crystal-controlled oscillator Q3 (26.085 mc) is coupled by C12 to Darlington mixer stage consisting of Q1 and Q2. Output (at J2) for Citizens-Band channels (26.965 to 27.255 mc) is 880 to 1170 kc. Channel desired is tuned on AM radio.

Crystal-Controlled CB Converter

PARTS LIST

B1,B2—9 V battery (Burgess 2U6 or equiv.)
Capacitors: 25 V or higher unless otherwise indicated
C1—18 μμf disc
C2—47 μμf disc
C3—100 μμf disc
C4,C7,C11—.01 μf, 200 V miniature tubular (Sprague 192P10392, Allied 43 A 0347)
C5—.001 μf, 200 V miniature tubular (Sprague 192P10292, Allied 43 A 0335)
C6—220 μμf disc
C8,C9—10 μμf disc
C10—20 μμf disc
C12—2 μμf disc
J1,J2—Auto-antenna jack (Motorola type)
*L1,L2—.64-1 μh adjustable RF choke (J. W. Miller 23A827RPC)
*L3—22-41 μh adjustable RF choke (J. W. Miller 23A335RPC)
Q1,Q2,Q3—2N3363 transistor (GE)
Resistors: ½ watt, 10% unless otherwise indicated
R1—470,000 ohms R2—68,000 ohms
R3,R6—3,900 ohms, 5% R4,R8—1,000 ohms
R5—27,000 ohms R7—2,700 ohms
S1—SPST slide switch
XTAL—26.085-mc crystal, HC6/U holder (International Crystal Mfg. Co., Inc., 10 N. Lee, Oklahoma City, Okla. 73102. Specify Type EX and frequency. $3.95 plus postage)
Misc.—Perforated board, crystal socket, 4 x 2¼ x 2¼-in. Minibox
*Available from Custom Components, Inc., Box 153, Malverne, N.Y. 11565. L1,L2, $1.90 ea.; L3 $2.20. Add 75¢ for postage and handling.

jack outside the radio.

The converter and a transistor radio can be taped to each other or held together with a rubber band. This makes for a compact, sensitive, continuously tunable CB radio that will stack up favorably against most.

Alignment

Extend the car-radio antenna to about 40 in., or to its maximum length. Then connect the car's antenna cable to the converter's input jack, J1, and connect the converter output to the car radio. Turn on the car radio and the converter. Tune the car radio to about 1000 kc and peak its antenna trimmer for maximum hiss, noise or signal pickup. On many car radios the antenna trimmer is located next to the antenna input jack, while on others it is accessible either through the bottom or the side of the radio. (On some cars, the antenna trimmer is located behind the tuning knob.) Be sure you have the trimmer properly peaked to tune the input circuit of the car radio to compensate for the extra capacitance of the cable and the converter.

After the car-radio antenna trimmer has been peaked, you must peak up the coils in the converter. Using a plastic alignment tool adjust oscillator coil L2 until the receiver noise level rises, indicating that the oscillator

[*Continued on page* 102]

CB Corner

By Len Buckwalter, KQA5012

How Far Will My Signal Go?

SAD to say, "What range will I get?" is an ambiguous, trick question that has more than one answer. But we'll try to answer it anyway, since 'most everyone else has had a turn at it. An old timer might say, "Allow one or two miles per watt, son." An M.I.T. sophomore may declare that transmission range, in miles, is merely 1.23 ($\sqrt{ht} + \sqrt{hr}$), or 1.23 times the sum of the square roots of the transmitting antenna height and the receiving antenna height.

Now let's have another crack at the range game, this one courtesy of the major CB producer, E. F. Johnson. This company offers a simple graph based on the height of your receiving and transmitting antennas (car and home, for example) to predict potential radio mileage. The novel part is that the graph wasn't compiled merely from mathematical data. Johnson technicians trudged out to the muddy, experimented and then combined practical results with book theory.

If you want to try the graph, simply add the height of any two communicating antennas and find the total in the vertical column. Move over to the right to intersect the curve, then down to the bottom line to read your range in miles. The example shown indicates that a combined antenna height of 55 ft. yields a range of about 12 mi. (The base-station antenna might be 50 ft. high and the mobile whip 5 ft. above ground.) As in all range predictions, your answer could be affected by anything from an electrically noisy neighbor to a local albatross with iron-rich blood. Propagation suffers from too many variables—but why not give it a try?

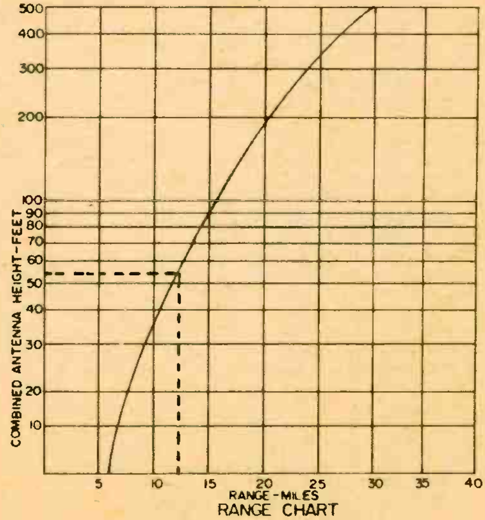
Eat Crow Dept. This corner has always accepted the old chestnut that CB and public-safety officials are as compatible as a mongoose and cobra. CBers who volunteer equipment and services for the commonweal are often greeted by something between a yawn and outright harassment. But change could be creeping through the land. More local governments are making peace with CB operators and getting down to the business at hand—helping people in trouble via two-way radio. Our latest report hails from the timberlands of Washington state.

Six years ago, the Tacoma CB Radio Association started training its members in search and rescue techniques, reports Tom Coleman, a local CB civil-defense official. The club must have done its homework well, for the county sheriff now depends on CBers to help in searches, to provide safety patrols during speedboat racing on local lakes, and to tame the wild spirits on halloween. Their snappy exploits have spread over Pierce County and now some 130 volunteer CB units control crowds during Washington's huge annual Daffodil Parade, respond to calls from fire departments, or assist the State Highway Patrol.

On the night of June 29, 1969, CBers turned in their star performance. Soon after a navy aircraft lifted off the runway at McChord Air Force Base its engines failed. In an apparent last act of desperation, the two pilots aimed their plunging craft at an open field pocketed between a busy interstate highway and two trailer parks. They succeeded, but were killed in the attempt.

No one on the ground was harmed, but public-safety officials still had plenty to worry

[*Continued on page* 101]



Graph is included with operating instructions for E. F. Johnson's Messenger 223 rig (among others) to show signal range for different antenna heights.

The ABCs of Color Television Servicing

By Forest H. Belt

Part VI: Aligning Color Sets

IN the preceding installment (Part V) of this series the operation of the chroma circuits was explained, beginning with the detection of the chroma sidebands in the video detector and ending with the demodulation of the color (R, G and B) signals before they're fed to the video driver output stages. However, one aspect of chroma processing was left unmentioned. This is the treatment of the Y (also called video or luminance) signal. Before we discuss alignment and troubleshooting techniques, let's examine the Y signal briefly. (Also, you now should take the quiz on Part V on the last page.)

Video Signal. Referring back to a general schematic of a color receiver, you can trace the Y signal path through the video amplifiers, the delay line and the contrast control. A direct connection takes the Y signal from the contrast control to a center tap on the demodulator transformer secondary winding. The Y signal is then fed equally to all the demodulators and, through them and the driver stages, to all three cathodes of the CRT.

The delay line compensates for a lag which develops in the timing of the color signals. This lag causes the color signals to reach the CRT a few microseconds later than the Y signal. Thus, the b&w portion of the picture would be offset to the left of the color that goes with it. The delay line is included in the Y channel (video section) of color sets to slow down the video by the right amount.

Alignment. One obvious way to troubleshoot chroma faults in a receiver is to feed a color-bar signal into the set and use an oscilloscope to check on the existence, amplitude and shape of signals which appear in the chroma stages. The service data for most color sets includes photos or sketches of normal waveforms. These cover all key test points in the chroma section, as taken with a keyed-rainbow signal fed into the receiver.

If you suspect the chroma section is in fairly bad shape, perhaps even tampered with, another troubleshooting method—alignment—may be quicker and more thorough. You use familiar test instruments but in unfamiliar ways. The methods, however, are easy to learn.

There are two portions to align: the bandpass amplifiers (color IF stages) and the color-sync stages. The bandpass amplifier stages require a rather elaborate setup, using a sweep generator, signal generator, VTVM and scope. In some sets, you will also need several different external DC

CHROMA ALIGNMENT

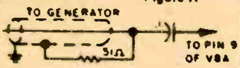
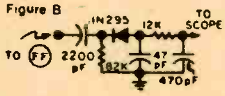
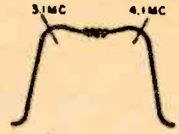
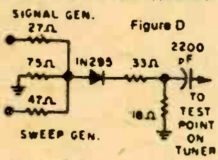
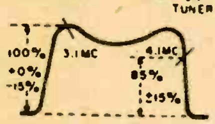
STEP	ALIGNMENT SET-UP NOTES	TEST EQUIPMENT HOOK-UP	ADJUST
1	Set VHF tuner to Channel 11. Disconnect Pin 2 of tube V15 from ground. Load B plus 270V to ground with a 5K 20W resistor. Apply —6 volts bias to tie point (NN) on main board. Apply —35 volt to pins 2 and 9 of V9. Set color control to mid-rotation. Turn core of [L604] toward printed circuit board.	SWEEP GENERATOR—Through network shown in Figure A to Pin 2 of V8B on main board. Set generator to 3.58MC with 3MC sweep. OSCILLOSCOPE—Through Video detector probe shown in Figure B to tie point (FF) on main board. Calibrate scope for 0.25V peak to peak. Figure A  Figure B 	[T600] Top and bottom core for response curve shown in Figure C.  Figure C
2	Same as Step 1. But ground test point (2) on IF Board through a 250K ohm potentiometer. Set potentiometer for zero resistance.   Figure E	SIGNAL GENERATOR—Set to 45.75MC. SWEEP GENERATOR—Set to 3.58MC. Sweep 3MC. The outputs of both generators through network shown in Figure D. To test point on VHF Tuner. VTVM—Point (14) on IF board through a 33K resistor. OSCILLOSCOPE—Through network shown in Figure B to tie point (FF) on main board.	Adjust signal generator output for a +0.6 Volt DC reading on the VTVM. (If 0.6V can not be read set Gen. for max. output and adjust potentiometer installed in the set-up procedure for a 0.6 reading on the VTVM.) Adjust [L604] so that the 4.1 MC marker is at max amplitude and for a response shown in Figure E.

FIG. VI-1

bias voltages. However, if you keep your alignment equipment connected together and warmed up, running through a bandpass alignment is less trouble than doing an ordinary IF alignment job. The service data for every color receiver contains chroma-adjustment instructions, so never turn the core of any chroma coil before reading them.

What follows is an analysis of the instructions for the chroma-section alignment in one specific Sylvania color chassis. Fig. 6-1 is the instruction chart for the bandpass amplifier portion. The schematic isn't really necessary for this discussion, but the chassis is a Sylvania DO2, in case you want to get one to follow the details. First read the following preliminary notes. Then read each instruction step in Fig. 6-1. After each step, read the commentary here which follows. The commentary merely explains further what the instructions mean.

Preliminary Notes. Your choice of sweep generators is important, an ordinary one with an electromechanical sweep is best for chroma alignment. TV-FM sweep generators which have an electronic sweep often have too narrow a sweep width around 3 to 4 mc. Be sure to let the generator and color set warm up a half-hour before you start an alignment.

Notice the three alignment jigs (test probes) shown at positions A, B and D on the instruction sheet (Fig. 6-1)—you should build them before you start.

You'll collect a variety of these as you begin to align different brands of color sets. Label the jigs for easier identification; some of them work with several brands and models. Lastly, you need two test voltages. The highest is minus 35 V, so you can use a resistive voltage divider to develop the minus 6 V.

Commentary on Step 1. Disconnecting pin 2 of V15 disables the horizontal output tube by opening up its cathode circuit. *Hash* caused by horizontal

COLOR APC ALIGNMENT

STEP	ALIGNMENT SET-UP NOTES	TEST EQUIPMENT HOOK-UP	ADJUST
1	Set tint control R631 to center of its range. Set Killer Control R602 full counter-clockwise. Ground Pin 2 of V9 (6LN8).	COLOR BAR GENERATOR—To receiver antenna terminals. Adjust receiver for normal color reception. VTVM—Through a 470K resistor to junction of SC608 and R662.	T604 Bottom for maximum DC reading on VTVM. If 3.58MC oscillator is not running no reading will be obtained. Adjust L612 if necessary to start oscillator.
2	Same as Step 1 but remove ground from V9.	COLOR BAR GENERATOR—Same as Step 1. VTVM—Same as Step 1.	T602 for maximum DC reading on VTVM. Make certain 3.58MC oscillator is running and locked in.
3	Tint control—Same as Step 1. Killer Control—Same as Step 1. Ground test point S	COLOR BAR GENERATOR—Same as Step 1. VTVM—NOT CONNECTED	L612 for zero beat on picture tube (color bars stand still on screen or drift slowly)
4	Tint control—Same as Step 1. Killer control—Same as Step 1.	COLOR BAR GENERATOR—Same as Step 1. (use low level color signal.) OSCILLOSCOPE—To test point Z on Main Board.	T602 So that when tint control is rotated from one extreme to the other there is a minimum of + and − 30 degrees from nominal phase. Return tint control to mid-range 6th bar on R-Y waveform should be cancelled. See Figure A.
REPEAT STEP 3			
5	Tint control—Same as Step 1. Killer control—Same as Step 1.	OSCILLOSCOPE—To test point Z Y X respectively.	Check for proper matrixing. Waveforms and amplitudes should conform to Figure B.
6	Tint control same as Step 1. Set channel selector to channel receiving snowy raster.	No test equipment.	R602 Killer adjust control clockwise until snow on screen appears colored, then rotate R602 counterclockwise until color in the snow just disappears. Check on a color program to assure setting of R602 is not killing on color.

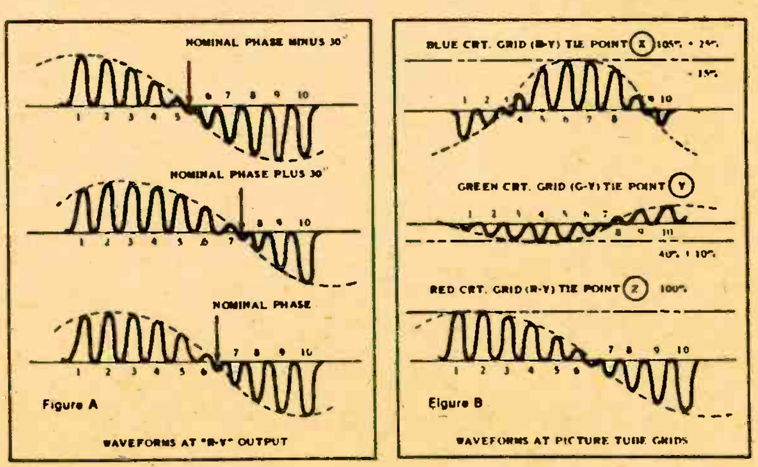


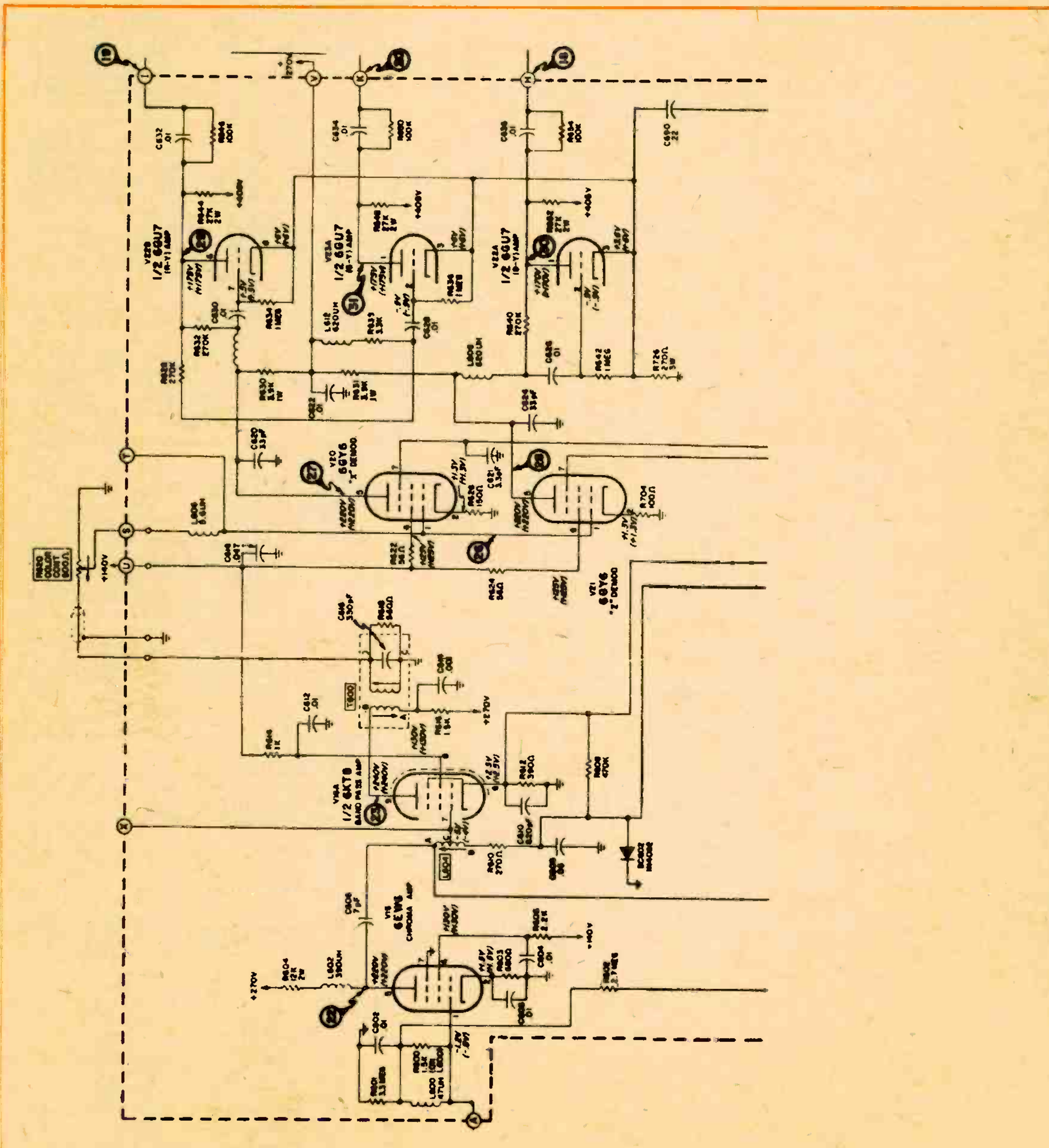
FIG. VI-2

radiation could make it difficult to interpret the sweep response curves.

Putting a 5,000-ohm resistor across the 270-V B+ terminal loads that portion of the power supply just the same as the horizontal-output stage did. This keeps the B+ from being higher than normal.

Don't overlook the two admonitions: the color control goes to midposition and the core of L604 is turned clockwise (if you're adjusting from the top).

Connect the sweep generator to the input of the second bandpass amplifier. You must adjust two cores in T600, the output transformer which couples the



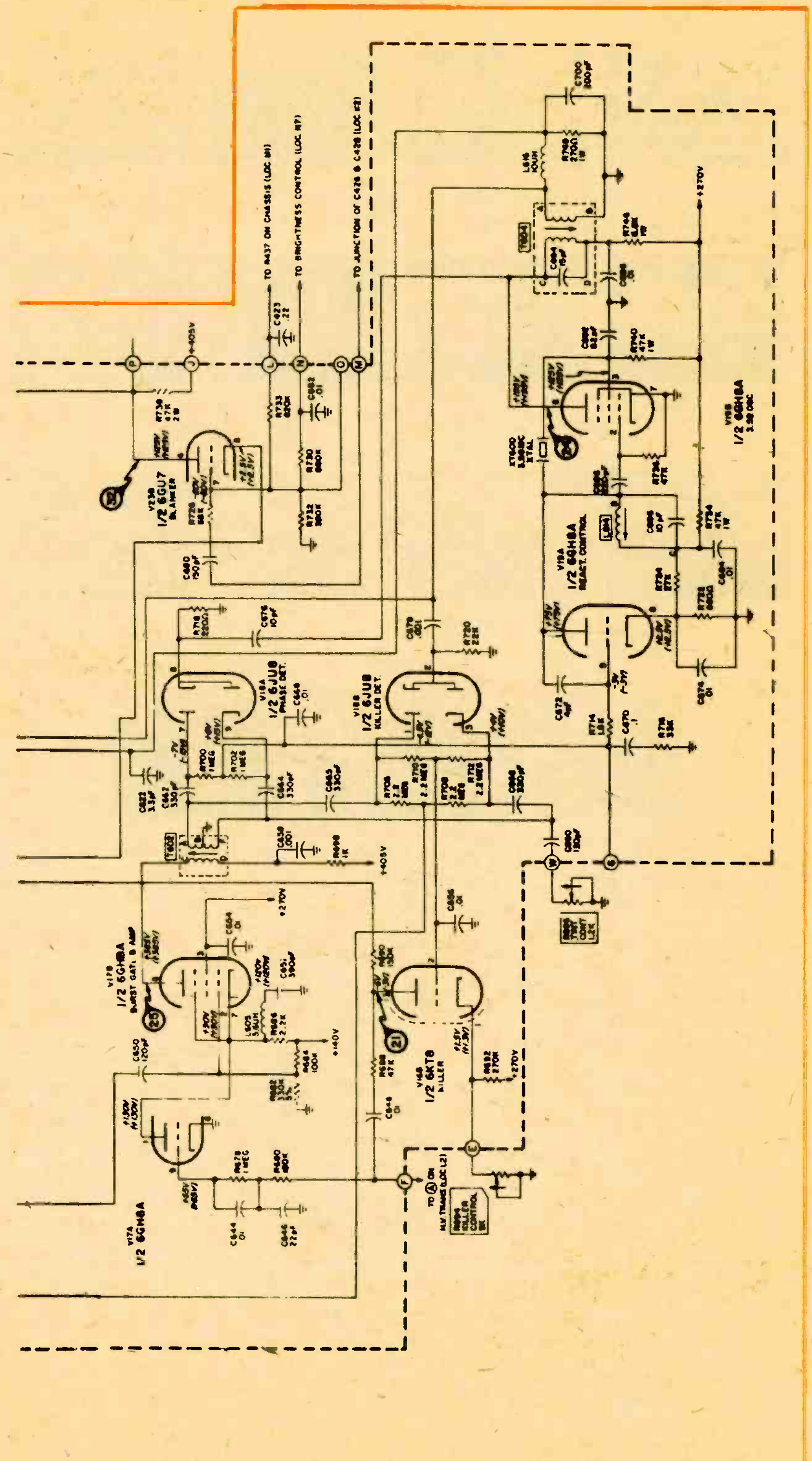


FIG. VI-3

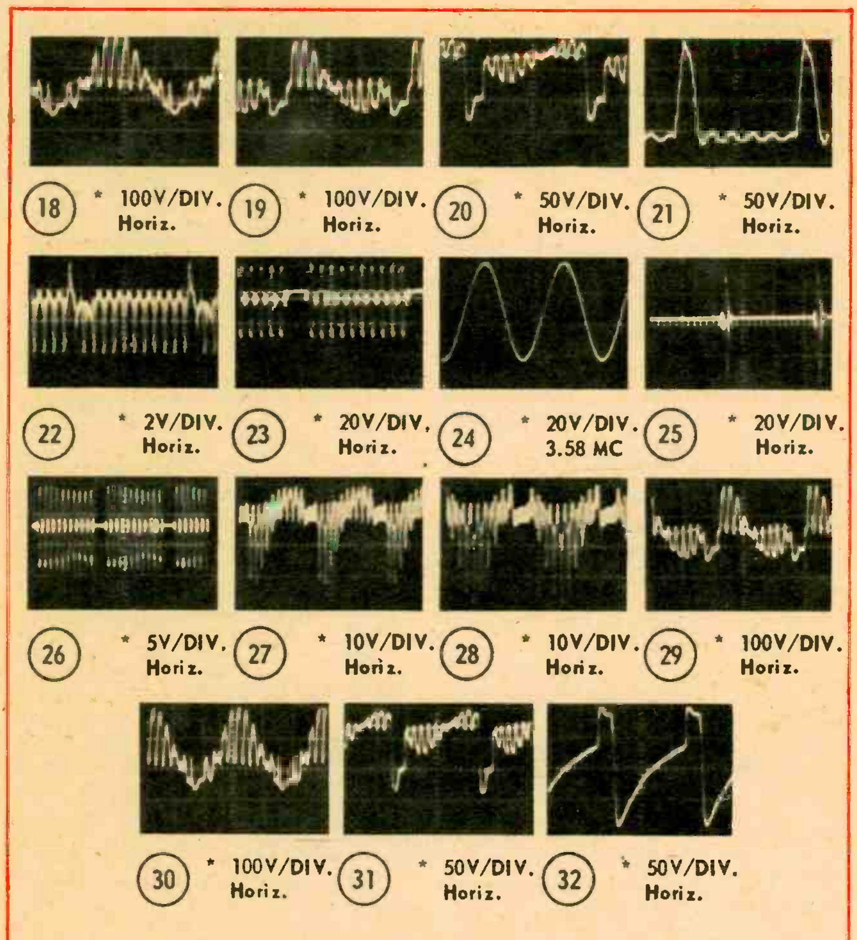


FIG. VI-4

chroma signal to the demodulators. The scope, connected through the demodulator jig (Fig. B in Fig. 6-1), shows you the response of this transformer.

You'll have to use a marker to see that the curve falls at the right points. Couple the marker generator loosely (clip its output lead over the insulation of the sweep generator output lead) and tune the marker first for 3.1 mc, then for 4.1 mc, observing where both marks are situated on the curve. The instructions shows where they should be when T600 is adjusted properly.

Commentary on Step 2. In this step, you add a VTVM and a potentiometer. The signal and sweep generators are connected to a special mixing jig (Fig. D on the instruction sheet). It's important that both generators are fed into the mixer *test point* on the tuner.

Point 2 on the IF circuit board lets you control the gain of the IF stages with the potentiometer. The VTVM is connected at the output of the video detector. The potentiometer and VTVM assure that a signal of known value reaches the chroma section.

The scope remains connected as before. By moving the generators all the way to the front of the IF strip (the mixer test point), you take into consideration the overall alignment of the set.

Coil L604 has only one slug (core). The instruction sheet says adjust it first until the curve is at maximum amplitude at the 4.1-mc marker, and then for a response shaped like the curve which appears at the top right on the same sheet. You may have to compromise between these two adjustments.

The adjustments in the color-sync portion of the receiver require less equipment. You need a color-bar generator, scope and VTVM. The color-sync and associated circuits are often lumped under the heading of *automatic phase control* (APC) or *automatic frequency and phase control* (AFPC). The scope is used to check how well the demodulators are doing their job (the instruction sheet—Fig. 6-2—calls it matrixing). If the waveforms aren't correct, you use the color-bar generator and VTVM to evaluate necessary corrections.

Preliminary Notes. The only special jig or test probe you need is a 470,000-ohm resistor for the VTVM. The color-bar generator should connect to the receiver's antenna terminals. The following remarks refer to Fig. 6-2.

Commentary on Step 1. The *tint* control is on the front panel. The *killer* control is a servicing pot on the rear apron. Connecting pin 2 of V9 to ground shorts out the incoming color-sync signal, so the color oscillator runs freely (without synchronization). The color bars on the screen should run wild and may form a pattern called a *barber pole*.

The VTVM connects to one side of a two-diode phase detector—one similar to those diode color demodulators you've already studied. This adjustment, the bottom core of T604, peaks the tuned-circuit output of the 3.58-mc oscillator. L612 is an efficiency coil located between the oscillator control stage and the oscillator stage itself.

Commentary on Step 2. Removing the ground jumper lets the color-sync signal through. T602 is the coupling transformer from the color-sync amplifier (called a burst amp in this chassis). Peaking the transformer for a maximum reading on the VTVM assures that plenty of color-sync signal will reach the two-diode phase detector. The 3.58-mc oscillator is locked in when the color bars stand solidly on the screen.

Commentary on Step 3. Grounding test point *S* disables the color sync again, but doesn't keep it from the phase detector. The oscillator again runs freely. Making the color bars stand as still as possible with L612 adjusts the oscillator to very nearly correct frequency and phase, but without sync. (You must repeat this after Step 4 because of interaction.)

Commentary on Step 4. Test point *Z* is where the red-only signal comes from the demodulator. It is called the R-Y (R minus Y) signal because the Y (or video) signal hasn't yet been added to it.

This step is actually a slight readjustment of T602. Do it cautiously and carefully. The most important point is this: When you finish, the sixth bar of the waveform must be at minimum amplitude (see Fig. A at bottom of Fig. 6-2). This adjustment sets the range of the *tint* control so that flesh tones are at the center of rotation.

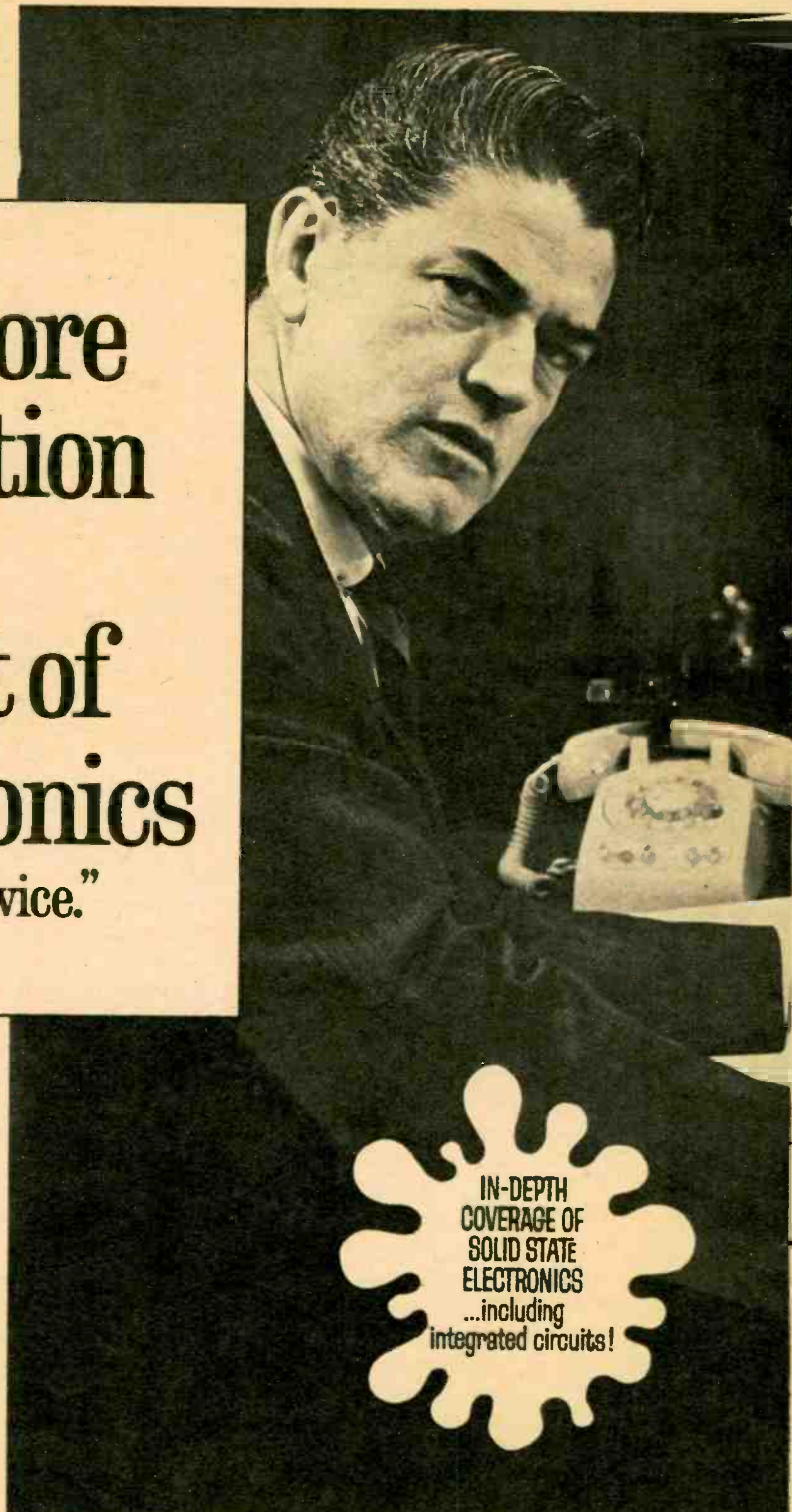
Commentary on Step 5. Using the scope, check for a proper output from all three color demodulators. If the waveforms are not as Fig. B of Fig. 6-2 suggests, a demodulator tube or one of the color-difference amplifiers may be faulty. There could also be trouble in an associated signal or DC supply circuit. If not, go through the color-sync alignment again.

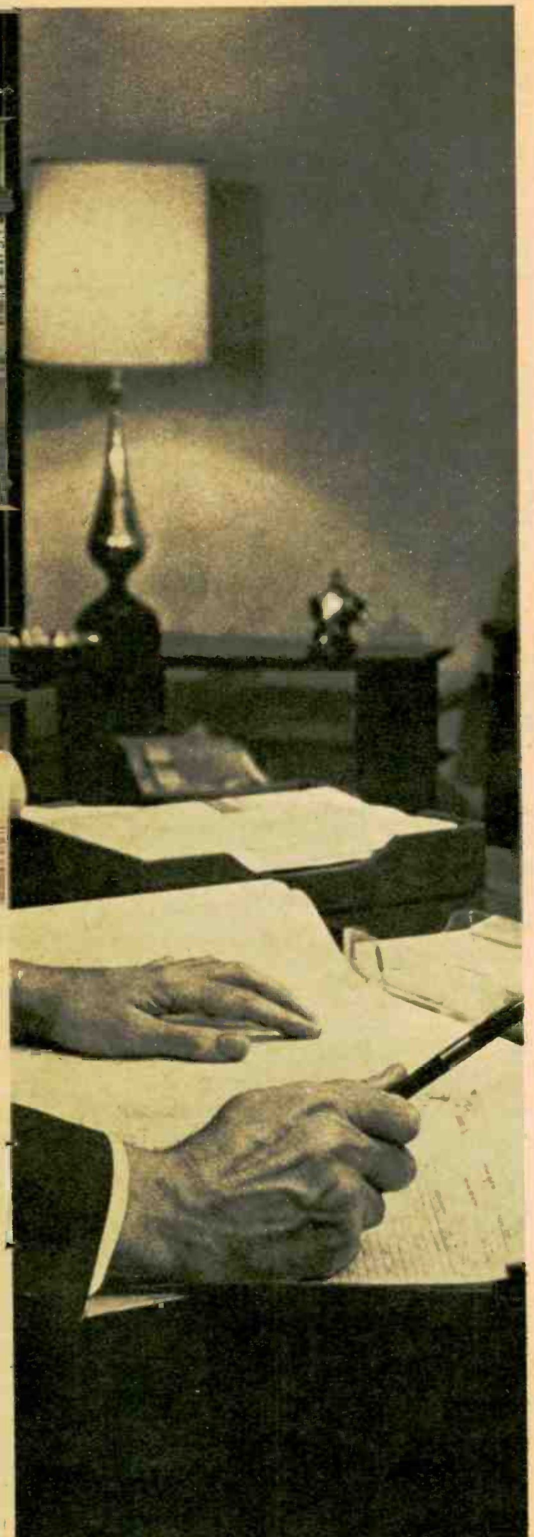
Commentary on Step 6. This step should be done with no station tuned in. In some chassis, you may have to leave a bit of confetti on no-station channels so the set can receive color on weak stations. If set too deep where signals are

[*Continued on page* 92]

"Get more education or get out of electronics

...that's my advice."





strong, the circuit sometimes kills color temporarily after a commercial break.

Troubleshooting. A chroma defect may be revealed when certain adjustments can't be completed. For example, say adjusting transformer T602 can't bring the range of the *tint* control into line. A quick study of the schematic will show the possible trouble spots.

As another example, suppose the color oscillator won't start and you can't get any indication with the VTVM in Step 1 of Fig. 6-2. You have at least isolated the trouble. A study of this stage and its environment should lead you to the final step in basic troubleshooting procedure—pinpointing.

Typical Case History. Here is an example of basic troubleshooting procedure (analyze, inspect, isolate and pinpoint) applied to the chroma section of a receiver. Picture was yellow. Tried new demodulator tubes, color-difference amps and color oscillator tubes; even tried new 3.58-mc crystal, to no avail.

Symptom was analyzed using schematic. Blue was missing, but only when a color program was on. Diagnosis ruled out color-difference amplifiers because they would most likely change colors on monochrome also. A secondary symptom: tint control behaved like color control. This helped direct diagnosis toward X-Z demodulator stages or those supplying signals to them. These stages are shown in Fig. 6-3, a partial schematic of the chroma circuitry in the Sylvania DO2 chassis. The waveforms corresponding to key test points (numerals in circles) can be seen in Fig. 6-4.

A color-bar signal was injected and traced with a scope. Signal was weak at plate of Z demodulator tube V21. DC voltages measured normal.

Because of the secondary symptom, thought it a good idea to work toward tint-control located in the output circuit (transformer secondary) of the burst amplifier. Starting at demodulator tube with weak output and working backward, found a weak signal at grid 3 (pin 7), the 3.58-mc switching grid. Tracing connection back to L616, touched scope probe to the side of L616 connected to other demodulator tube and found signal amplitude slightly above normal.

In fact, the trouble was pinpointed by this isolation procedure. Turned the set off, disconnected one end of L616 and measured it with an ohmmeter. The coil was open. New 10-μH inductance restored all three colors.

Notice the basic technique? Step 2 pointed almost directly to the faulty stage. Step 3 quickly isolated direction of trouble and step 4 nailed it down.

Examination on part V

1. The sidebands which carry the color information come through the video IF strip clustered around what frequency?
2. Which stage of the chroma section acts as a sort of automatic gain control for the color signal?
3. Describe the color-sync burst.
4. Which signals combine at the chroma demodulators and are then applied to the tricolor picture tube?

[Turn to page 101 for correct answers]

Next Issue:
Examination on Part VI

The Listener

By C. M. Stanbury II

DXing The Philippines

NOW, at 1830 EST, Voice of America bases in the Philippines can boast no fewer than eleven 250-kw transmitters broadcasting on the airwaves at once (along with several low-power rigs). This marks the culmination of a Philippine expansion program which really began back in the early 1950s with the installation of a million-watt VOA outlet on 1140 kc. It makes the Philippines one of the world's major short-wave powers—possibly even first in Asia. Certainly VOA in the Philippines can match anything R. Peking's foreign service has in Asia (operating between 3 and 30 mc).

From a purely DX point of view, this means that QSLing the Philippines is hardly a feat anymore—unless you bag their 1140-kc station (which can be done, especially on the West Coast around sign-on at 0300 PST) or you log one of the low-power SWBC stations.

In the latter category you also might try for the Manila Government's Philippine Broadcasting Service on 6170 kc. This station puts out 7.5 kw at 1700-2200 EST, then boosts power to 50 kw until 0330 EST (0030 PST) sign-off. Their equipment also belongs to the VOA.

Another prospect is the independent Far Eastern Broadcasting Co. Its numerous transmissions include English broadcasts at 2000-0030 EST on 17810, just 20 kc below a VOA channel, and at 0745 EST on 11920, just 10 kc below another VOA powerhouse.

Voice of America stations have put the Philippines on DX map. There are a total of 11 VOA transmitters.

Organized DXing. In the November '69 EI, a reader questions (in FEEDBACK) the propriety of putting Washington on the spot by publishing such articles as those on R. Libertad and other clandestine broadcast stations. The counter-argument to this view seems obvious—R. Libertad, R. Americas, South Africa's Radio RCA, Roumania's R. Portugal Libre, etc., are all *broadcast* stations and, by definition, a broadcast is one whose transmissions are intended for the general public. It follows, therefore, that the public has the right to know all there is to know about such transmissions, particularly as to origin, modus operandi and purpose.

Many times a DXer is in an excellent position to provide such information, especially when he's organized to do battle. That is, when he is affiliated with a group which can provide him with facts, technical information and motivation so he can follow up in the search for an interesting signal. Unfortunately, many DX organizations are bogged down in petty politics and fail to direct their energies along positive lines.

Under these circumstances it's no wonder that less than 5 per cent of those American and Canadian SWLs who have some sort of DX listening interest belong to radio clubs. Most DXers want to widen their horizons, not shrink them.

Is there a solution? Can organized DXing ever be brought into the mainstream of electronic exploration? One solution would be the formation of small clubs, such as exist in amateur radio, organized along the lines of special interests (clandestine research, abnormal satellite reception, etc.).

Brief Note. While the supply of about 500 copies lasts, free sets of FCC sunrise-sunset charts are available for the asking from Donald E. Erickson, Publisher, International Radio Club of America, 6059 Essex St., Riverside, Calif. 92504. These are most useful for daytime BCB DXers. Don says that return postage isn't necessary, but including a 6¢ stamp with your request would seem like common courtesy to us.

Shlock Rock Your Guitar With Our Cheapie Adaptor

By VINCE DANIELS

IT ISN'T enough these days just to *amplify* a guitar. You've got to do something different to the sound to make people take notice. One of the most fundamental soup ups is tremolo—a varying of the intensity of the amplified sound. Our cheapie (about $10) adaptor adds just the right amount of tremolo to make your playing rock. Connected between your guitar and amplifier, the adaptor varies the amplitude of the signal at a rate that can be set between 8 and 15 cps. The effect is a deep throbbing sound. Beethoven it isn't. Beatlesque it might be. Music, we all know, depends on the ear of the listener.

The entire circuit of the adaptor—amplifier and oscillator—is pre-wired in a sealed module. All you do is provide the housing, a rate control, battery, in-out switch and the input and output connectors.

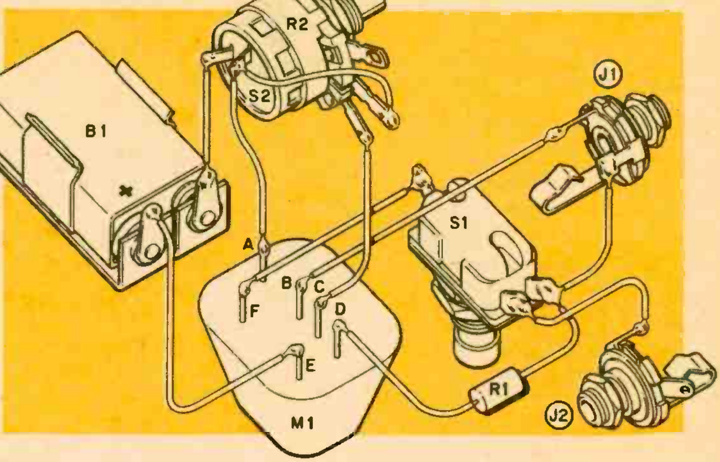
Construction. Our model is built in the U-section of a 5¼ x 3 x 2⅛-in. Minibox. The layout is not critical though we suggest you follow ours as it provides a solid base for the foot-operated in-out switch (S1).

First thing to do is drill the holes for jacks J1, J2 and rate-control R2. Mount the jacks and the control and then position battery B1, the module and in-out switch S1. Arrange the parts so S1 is close to the center of the main section of the Minibox. Mark and drill S1's hole and then cement the module to the cabinet with a silicon rubber adhesive such as GE's RTV.

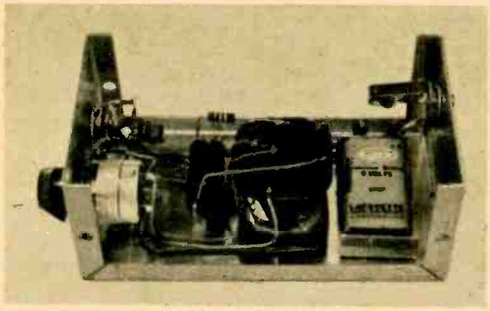
Connections to the circuit are made directly to the wires that protrude from the epoxy module. Wrap the connecting wires around the module's leads, solder and cut off the excess lead length.

Resistor R1 is not shown in the instructions supplied with the module but it should be installed because it equalizes the volume between the direct guitar connection and that from the module. Without R1, switching in the tremolo will cause a sharp increase in both sound level and distortion.

Similarly, do not use the suggested 20,000-



There's plenty of room so don't crowd the components. Just mount S1 as close to the center of the cabinet as possible to provide support.



Tremolo module has no terminals; connections are made to the protruding wires. Twist connections once or twice, solder, then cut off excess length.

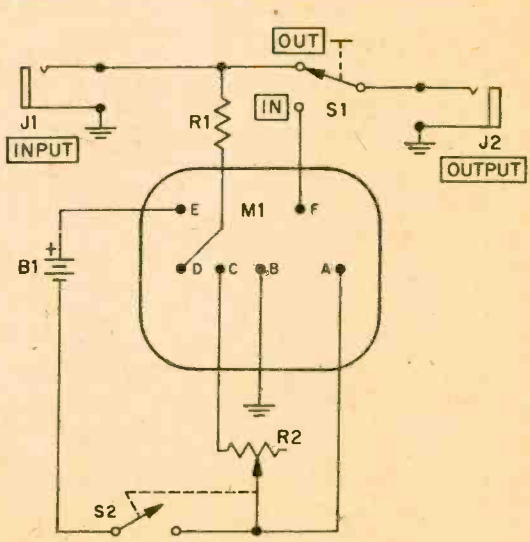
PARTS LIST

B1—9 V battery J1,J2—Phone jack
M1—Tremolo module (Cordover GTM-2. Available for $3.50 plus 50¢ postage from Carl Cordover & Co., 104 Liberty Ave., Mineola, N.Y. 11501)
R1—150,000 ohm, ½ watt, 10% resistor
R2—25,000 ohm potentiometer with SPST switch
S1—SPDT push-push switch (Carling 112 or equiv.)
S2—SPST switch on R2
Misc.—5¼ x 3 x 2⅛-in. Minibox
(The Carling 112 switch is available for $2.50 from Tridac Electronics Corp., Box 313 Alden Manor, Elmont, N.Y. 11003. Canadians add $1.00. N.Y. State residents add sales tax. No foreign orders.)

ohm potentiometer for rate control R2. Instead use a 25,000-ohm pot as it will provide a somewhat larger variation in tremolo speed.

Do not substitute for the switch specified for S1 in the Parts List. The Carling 112 switch has a *push-push* rather than a momentary action. When pressed, the 112 connects a circuit and maintains the connection even after the switch is released.

Using the Adaptor. Plug your guitar cable in J1 and connect J2 to the amplifier input. Push S1 for a direct guitar connection: J1 connected to J2 (no tremolo). Adjust the guitar pickup's volume and tone controls for normal volume. Then set S2 to on. (Just click in R2's switch) and press S1 so the tremolo is in: J2 connected to module terminal *F*. When you pluck the guitar strings the volume should be approximately the same as before but with a tremolo effect. Adjusting R2 will vary the tremolo speed. Tremolo depth and the degree of pulsation is fixed.



With S1 as shown, signal goes from guitar directly to amplifier. Press S1 and signal enters module at D. Tremolo output at F goes to the guitar.

The Ham Shack

By Wayne Green
W2NSD/1

FOR many years emergencies have been the province of amateur radio. Back in the 1930s, when amateurs first achieved a reputation for serving in emergencies, it was a logical choice since there were few radio transmitters around in other hands. Police departments had short-range communications in the larger cities but only the amateurs were omnipresent and able to communicate over any distance.

By the 1950s two-way radio had come into its own and different short-range communications systems evolved. Today, the VHF listener can tune in on police, fire, forestry, FAA, CAP, doctors, public service, mobile telephone, business radio, sheriff's departments, road agents, etc., as well as the citizen's band. Amateurs are now very much in the minority as radio operators, with some 200,000 ham stations set up around the country as compared with well over one million mobile units in other services. There are, perhaps, some 25,000 ham mobile units operating today.

This proliferation of two-way radio communications simplifies the problem of getting emergency communications. But all of these two-way systems have one thing in common which makes amateur radio totally different . . . different enough to keep it solidly involved in the disaster business, no matter how much competition there is.

The big difference is distance. While some emergencies can be handled on a local basis, with no need for dependable communications other than telephones in the immediate area, many troubles require outside help and coordination. Supplies are needed in a disaster area . . . people need help . . . families need information about loved ones . . . all this may have to be directed by radio.

Long-range communications can only be provided by amateur radio. The mile or two range of the CBer is frequently useless. During emergencies, amateurs have set up their stations and operated around the clock, handling tens of thousands of messages, helping to bring supplies, medicine and personnel into troubled areas in record time.

How many of you know that the Pentagon lost all communications with its military bases in Alaska after the earthquake and that it had to depend entirely on amateur radio for several hours before temporary wires could put them back in business? During part of the Congo crisis, our State Department's only communication with their people in that area was via amateur radio. Since no official word had been sent out about phone patches being legal over that route, you might know that one U.S. amateur took it upon himself to try and jam these communications as much as possible. Even so, vital communications were kept up which would have been impossible any other way.

Emergency operations are incidental to most amateur activities, though a few clubs have gone to extremes to be ready for trouble, outfitting themselves with vans of equipment, emergency power units and the like. The annual QST Field Day Contest keeps hundreds of clubs and groups in a state of preparedness. On one sunny weekend in June, the airwaves are jammed with hundreds upon hundreds of amateur stations, all using emergency power, all vying for the most contacts. It's a contest, it's a picnic, it's fun and, best of all, it is a rehearsal for trouble.

Most transceivers sold these days are designed to operate on either house current or off of a 12-V battery. They are small enough so they can be installed in a car; the power units are separate, with either AC or DC supplies available for most. There is a growing tendency to combine the two power supplies. If this kind of rig becomes more popular, we may find that we have a potential of 100,000 or more mobile stations available for emergency duty.

Thousands of amateurs are helping their local Civilian Defense efforts and eventually this may be worth all the trouble they have to put-up with from overbearing CD directors and egoistic coordinators who prefer to use the telephone for all such exercises. But tens of thousands of amateurs have been involved with CD efforts in the past and have grown tired of the lack of planning and enormous wastes which they have witnessed.

Now we are able to cover just about any required distance in emergencies using the appropriate amateur bands. The use of VHF-

[*Continued on page* 100]

COLUMBIA STEREO TAPE CLUB now offers you

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461-3/T1

Four-Channel Stereo

Continued from page 51

the first playing." This engineer noted that cutting and pressing techniques would have to become more precise, as well. So most record executives don't see four-channel discs coming soon.

On the other hand, tape is just the medium for four channels, according to Telex's Russ Molloy. The technology exists and the hardware is already on the market. Although Vanguard's first prerecorded tapes (32 to 45 min. in length, recorded at 7½ ips and retailing for $15 each) are now being marketed only on reels, Molloy predicts that four-channel cartridges and even cassettes may not be too far off in the future.

In fact, his company already has made several endless-loop cartridge demonstrators for Acoustic Research, which has used them in its showroom in New York's Grand Central Station and at hi-fi shows in Los Angeles and Montreal. The endless loop could be recorded either with one set of four tracks, or with two sets (the latter being compatible with existing eight-track equipment).

One question still remains: is four-channel stereo just another gimmick to sell audio equipment, or does it offer a real benefit to the listener? We think it is an improvement. Obviously, some of the people on the four-channel bandwagon regard it strictly as a way of making money by selling you another pair of speakers, or by rendering your tape or record library obsolete. But it's equally true that the finest four-channel recordings do offer a dimension in listening as different from conventional stereo as stereo was from mono.

In music written for four-channels—the Berlioz *Requiem*, the antiphonal brass of Gabrieli and modern works by Morton Gould and others—there's no doubt that four-channel programming creates a sense of realism, a clarity not possible with two-channel stereo. If you're a member of the rock generation who wants to surround himself with music like a womb, it's possible only with four-channel equipment (provided there's a different group of instrumentalists at each speaker). While it hasn't been tried yet with electronic music, it would seem that a combination of the synthesizer and four-channel recording could create a totally new musical form unlike anything heard in the concert hall or night club.

For the man who likes his Beethoven symphonies straight, the benefits of the new system are less obvious. Most serious music lovers don't want to stand on the podium beside Leonard Bernstein or find themselves in the middle of the operatic action in *Cavalleria Rusticana.* They're content to sit back in that proverbial best seat in the concert hall and enjoy the performance.

What four-channel stereo gives that listener is a slightly fuller stereo sound, and more important, it creates the ambience of the hall in his listening room. The results—at least on the recordings we've heard so far—are much more subtle than those derived from pop music or classical showpieces. They're sort of like two-channel stereo recording after the ping pong balls and locomotives roared off into limbo. You are left with a richer, more natural sound, but the listener can't quite put his finger on the reason.

Is four-channel stereo worth the extra money to *you?* It's really too early to say. Will record companies take the obvious path to big, quick profits with rock spectaculars? If they do, and if rock is your bag, you'll want surround stereo at the earliest opportunity. Can recording engineers create a new aesthetic in serious music by putting you in the middle of a string quartet or the Mormon Tabernacle Choir? We'll all have to wait a bit and perhaps do some experimental listening.

Another problem: Do you need the same quality speakers to provide sound from the rear channels? Arne Berg, Chief engineer for Teac, doesn't think so: "The high frequencies are diffused in the hall anyway, so what you want from behind you is another sound source to provide a point of reference for the brain. It doesn't have to be hi-fi—and in a real concert hall, it wouldn't be."

Micro Oscilloscope

Continued from page 46

a division being ¼ in. All ranges except 100 V/div. are frequency compensated. Switch S1 allows selection of AC or DC input signal coupling.

Horizontal Amplifier. Junction FET Q13 (Fig. 4) gives high input impedance. Transistors Q11 and Q12 are emitter coupled to give two signals 180° out of phase to drive the CRT's horizontal plates. Bias of these stages is set by R66. The horizontal amplifier input is either connected to the sweep generator (C25) or to the front-panel horizontal-input terminal (BP3) depending on position of switch S6 (Fig. 6). Switch S2 allows either AC or DC coupling from horizontal input terminal BP3.

Sweep Generator (Fig. 6). Two identical digital integrated circuits IC2 and IC3 are used in a computer type sequential logic circuit. The sweep generator circuit is illustrated in detail in Fig. 5. The gates in IC2 and IC3 are interconnected to form two flip-flops, a one-shot multivibrator and the required signal gating. Another integrated circuit, IC4, contains four transistors; It is shown in Fig. 7. Refer back to Fig. 5 now. Transistor Q4 operates as an emitter follower to maintain high input impedance. The base-emitter junction of Q3 has a reverse zener breakdown of about 7 V, to protect Q4 from large input-voltage swings.

Flip-flops FF1 and FF2 and gates G1 and G2 are interconnected so that FF1 triggers on the positive slope of an input signal and FF2 triggers on the following negative slope. Thus C13 through C18 (switched by S5A) can begin to charge only on the negative slope of an input signal. Control R35 controls the charging rate of C13 through C18. Neon lamp NL1 serves as a voltage regulator for the charging circuit and also as the power-on indicator on the scope panel.

When the sweep voltage reaches sufficient amplitude, Q9 turns on and triggers the one-shot (IC3). Sweep-calibration control R48 sets the voltage at which Q9 turns on and thus controls the amplitude of the peak voltage reached on C13 through C18. The one-shot keeps the input signal from triggering the circuit again until C13 through C18 has time to fully discharge.

The CRT is blanked while C13 through C18 is discharging (retrace time). Transistor Q1 (in IC4) is driven by FF2 and supplies a 13-V blanking pulse through C25 to the control grid of the CRT.

A unique feature of the sweep circuit is sync-lock indicator NL2. With no input signal present NL2 is off. When the circuit is properly triggered, however, Q2 (in IC4) discharges C24 turning off Q10 and NL2 comes on. When in the *auto.* position switch S3 will cause the sweep generator to run continuously even though an input signal is not present. When S3 is closed there is no sweep unless the circuit is triggered by an input signal.

Ham Shack

Continued from page 96

FM repeaters has greatly extended the area covered by amateur mobile (and base) FM units; a range of hundreds of miles is often possible via a nearby mountain-top repeating station. There are some 3000 amateurs enjoying VHF-FM these days, and it is by far the fastest growing facet of amateur radio.

Every amateur has a moral obligation to serve in emergencies. Clubs ought to discuss alternate plans for handling possible troubles and make sure they know where to get power generating equipment on a moment's notice. A little planning will go a long way. Perhaps your club can appoint a director of emergency communications. This chap could make an inventory of the available equipment so that a last minute scramble won't be necessary when the lid blows off. He can also arrange for a progression of club members who will alert others, and perhaps arrange a two-meter channel for club monitoring.

The coordinator could also make arrangements to tie in with all the other two-way radio services in the community. Amateur mobiles could be dispatched to police and fire radio stations, etc. It behooves amateurs to do the planning, since only the amateur can provide this wide range of services.

The Longest DX

Continued from page 33

the Far-East Broadcasting Co., a religious organization which operates its major station in the Phillippines. FEBC considered several sites before finally deciding on the Seychelles Islands. Let's hope the decision is final because the Seychelles Broadcasting Service departed the short-wave scene a few years back.

One of the other Indian Ocean sites first contemplated by the FEBC was Perth, Australia. Strictly speaking, Perth is the most distant location of all for North American DXers located on the East Coast. However, because it is so widely heard via the Australian Broadcasting Commission's regional station VLX9 (9610 kc, mid-mornings EST), the other locations mentioned in this article are much rarer DX. Obviously, VLX9 is the best way for a novice to make his first Indian Ocean contact.

CB Corner

Continued from page 80

about. Hidden at the crash-site were two potentially lethal items, and aircraft wreckage, they knew, casts a spell over the innocent passerby. It could have proven disastrous in this accident; the missing items, strewn over three acres, were the unexploded charges from the pilots' ejection seats.

That's where CB came to the rescue. Summoned to the scene, the Disaster Control Units helped hard-pressed Air Force personnel seal off the entire area. CBers served a record four days on the scene, tallying some 550 man-hours to fend off the curious and morbid from possible death and injury. One Air Force official remarked to CBers, "We'd really be in trouble if it weren't for you guys." That may soon sum up everybody's feeling.

The ABCs of Color Television Servicing

Answers to Examination on Part V:

Continued from page 92

1. The chroma signal in the video IF stages is in sidebands of 42.17 mc.

2. The ACC stage smooths out the chroma signal applied to the demodulators by adjusting the gain of the color IF amplifier.

3. Color sync is eight cycles of a 3.58-mc signal transmitted along with each horizontal-sync pulse during the blanking interval. Seen on a scope, the sync appears to be riding on the back porch of the horizontal pedestal.

4. Chroma sidebands are mixed with the 3.58-mc sync coming from the color oscillator; in this set, the Y signal is also fed to the CRT through the final stages of the chroma section.

CB Converter

Continued from page 79

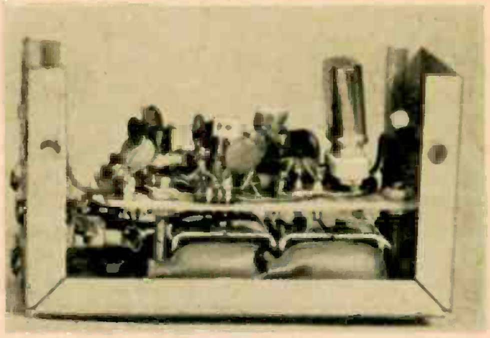

Fig. 3—Side view of converter. Note 9-V batteries taped to cabinet under board. Input, output jacks are at left; power switch is at right.

is working. Now peak output coil L3 for maximum noise level from the radio. Then peak coil L1 for maximum noise. Tune the car radio back and forth between 880 and 1170 kc until you hear CB stations.

By tuning the receiver's antenna (car radio), output coil L3 and input coil L1, you can peak the converter to any desired channel in the Citizen's Band. Or you may choose to leave the converter set at the midpoint of the band for almost equal gain across it.

When using the converter with a transistor radio, connect a suitable CB antenna to the converter via J1. Connect the converter to the radio with coax. You can then follow the same alignment procedure described for the car-radio installation, except of course, that there will be no need to adjust an antenna input trimmer on the transistor radio.

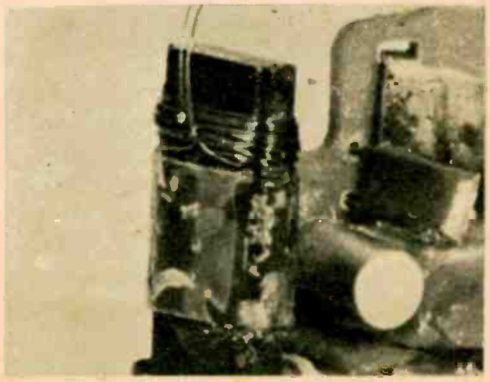

Fig. 4—Signal from converter is coupled to transistor radio by coil (30 turns No. 30 enameled wire) wound over the radio's ferrite-rod antenna.

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

PROGRESSIVE TEACHING METHOD

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

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

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

THE "EDU-KIT" IS COMPLETE

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

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

Progressive "Edu-Kits" Inc., 1189 Broadway, Dept. 607AE, Hewlett, N. Y. 11557

UNCONDITIONAL MONEY-BACK GUARANTEE

Please rush my Progressive Radio "Edu-Kit" to me, as indicated below:
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- ☐ Deluxe Model $31.95.
- ☐ New Expanded Model $34.95 (Same as Deluxe Model plus Television Servicing Course).

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- ☐ I enclose full payment. Ship "Edu-Kit" post paid.
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- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • F.C.C. AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

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

FROM OUR MAIL BAG

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

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

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

PRINTED CIRCUITRY

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

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

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

CIRCLE NUMBER 10 ON PAGE 13

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