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A Fawcett Publication

September 1972 Vol. 15 No. 5

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COMING NEXT ISSUE

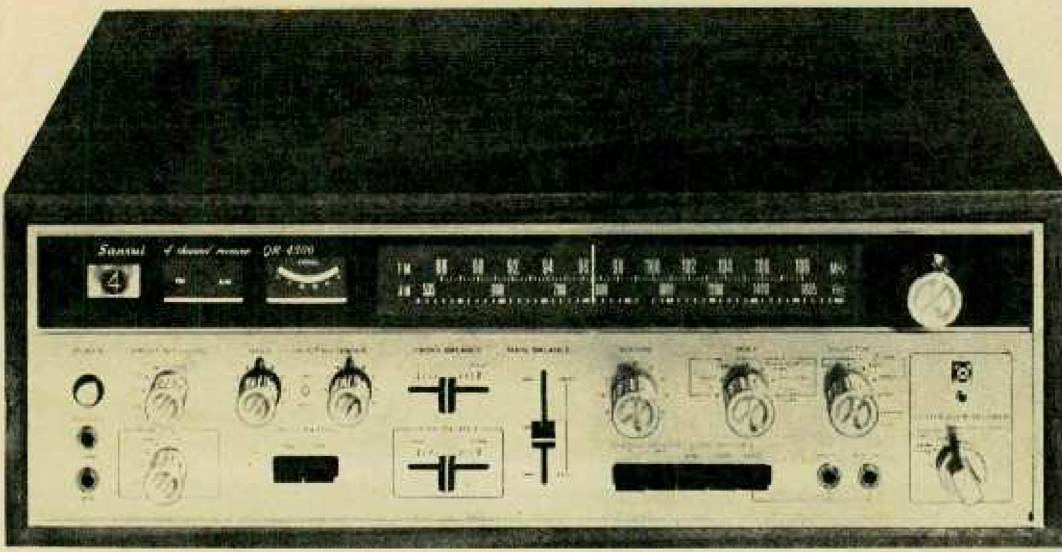
Apartment Dweller's Hi-Fi

Servicing Aids for Hobbyists

Phone Patch for Hams

How to Fix Your Bum Cassettes

WHICH WAY FOUR CHANNEL ?



THIS WAY

If the four-channel merry-go-round has you confused, you have lots of company. Discrete or matrixed. Compatible or non-compatible. This system or that one.

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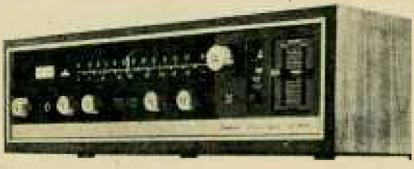

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Woodside, New York 11377 • Gardena, California 90247
ELECTRONIC DISTRIBUTORS (Canada), Vancouver 9, B.C.
SANSUI ELECTRIC CO., LTD., Tokyo, Japan • Sansui Audio Europe S. A., Antwerp, Belgium

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ELECTRONICS ILLUSTRATED is published bi-monthly by Fawcett Publications, Inc., Fawcett Bldg., Greenwich, Conn. 06830. Second-class postage paid at Greenwich, Conn., and at additional mailing offices.

EDITORIAL OFFICES: 1515 Broadway, New York, N.Y. 10036 (phone 212-869-3000). Contributions must be accompanied by sufficient postage and will be handled with care, though the publishers assume no responsibility for return thereof.

ADVERTISING OFFICES: 1515 Broadway, New York, N.Y. 10036 (phone 212-869-3000); Midwestern Representatives, Kingwill Co., 5526 N. Elston Ave., Chicago, Ill. 60630 (phone 312-774-9660); 211 W. Fort St., Suite 1010, Detroit, Mich. 48226 (phone 313-962-4860); 3807 Wilshire Blvd., Los Angeles, Calif. 90010 (phone 213-287-8258); 681 Market St., San Francisco, Calif. 94105 (phone 415-EX 7-3441); 1422 W. Peachtree St., N.W., Atlanta, Ga. 30309 (phone 404-TR 5-0373).

SUBSCRIPTIONS: $3 per year (6 issues) in U.S. and possessions and Canada. All other countries $4 for 6 issues. All subscription correspondence, including changes of address (Form 3579), should be addressed to ELECTRONICS ILLUSTRATED, Subscription Dept., Fawcett Bldg., Greenwich, Conn. 06830. Foreign subscriptions and sales should be remitted by International Money Order in U.S. funds payable at Greenwich, Conn.

PRINTED IN U.S.A. BY FAWCETT PRINTING CORP., LOUISVILLE, KY. 40201. Microfilm copies of current and back issues are available from University Microfilms, 313 N. First St., Ann Arbor, Mich. 48103.

Feedback from Our Readers

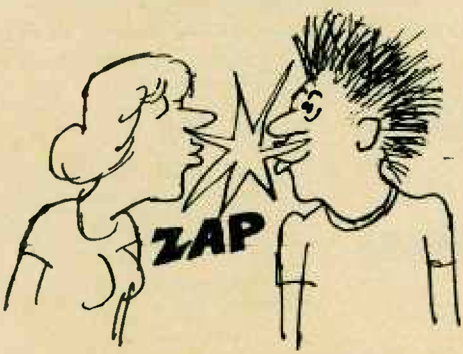
Write to: Letters Editor, Electronics Illustrated, 1515 Broadway, New York, N.Y. 10036

SPREAD THE NEWS

Thanks to you and Art Margolis for your excellent Service Tips and related TV servicing articles. Being the owner of an electronics sales and service business, I look forward to reading Art's little tricks of the trade which are presented so well in your magazine. Living in a small community presents problems of learning most servicing techniques by experience. We limit ourselves by not sharing these techniques with others. Again, thanks for a job well done.

Alan Brown
West Bend, Wis.

A POX ON YOUR PULSE



Built your Cardio-Tach (July '72 EI) and was somewhat surprised by the results. After a bit of hand-holding with my favorite gal, both of us thought it would be a cute idea to try out my latest project. You know, see if she turns me on. No luck. The meter showed nothing more than a normal pulse rate. Too little sensitivity?

Ron Brand
Tupulo, Miss.

Next time try sexier components.

TAKING TIME OUT

Enjoyed your May issue. Heathkit appreciates the coverage given its new desk-top calculator and hi-fi components. Some problems, however. The readouts on the calculator aren't RCA's Numitron incandescent lamps. They are Sperry-Rand gas-discharge displays. Also, we feel it's a mistake to compare our AJ-1510 digital tuner with tuners that have digital readouts but lack the accurate tuning achieved with digital circuits.

Earl Broihier
Heath Co.
Benton Harbor, Mich.

LONG-PLAYING FLAPJACK?

Your article on the new thin LP records (July '72 EI) was quite a shocker. I immediately went to a record store and searched for one. I found one with the help of a salesman, took it home and placed it. Sounded fine—very low noise level as you stated. Only problem is, I can't separate it from the standard LP which was underneath on the changer's platter. Is this going to mean one record for the price of two?

Peter Pearlman
Hempstead, N.Y.

CHIPS FOR EVERYTHING

I read your GOOD READING column in the March '72 EI with interest but was dismayed to find that the information you published about RCA's SK replacement series of transistors, rectifiers, thyristors and ICs is now obsolete. For the record, please note that RCA SK Series Top-of-the-Line devices now replace more than 46,000 domestic and foreign semiconductor types. That's with only 120 SK devices. A new replacement guide (SPG-202M) is now available.

Arnold Durham
RCA Electronic Components
Harrison, N.J.

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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, 1515 Broadway, New York, N.Y. 10036.

★ *My vote for the Useless Idea Gold Medal goes to the logging scales still found on many shortwave and FM receiver dials. I bet that they're never used. What say?*

Ken Greenberg
Chicago, Ill.

I agree, especially the shortwave sets which list Rome, Prague, London, Peking, etc., on the dials. I once saw an FM receiver which listed the frequencies by channel numbers—or didn't you know that the FCC once set up FM channel numbers, just like TV? That was another Gold Medal idea.

★ *I'm a mobile CB nut using a Courier 23-Plus rig in my car. When I used the set as my base station there were no problems but now, in the car, it keeps popping the bulbs in the S-meter. Why?*

Arnie Freeman
McKees Rocks, Pa.

Some of the early production runs of this rig—and it's a common problem for many brands—were noted for this trick. It's due to the fact that most car batteries actually deliver 13 volts or more when the engine's running. Increase the value of the resistor connected to the chassis behind the meter from 15 ohms-1 watt to 33 ohms-2 watts. Instant cure!

★ *There is a station I've heard using voice transmissions on CB channel 5 that identifies in Italian with the callsign ISA232. Is this a gag? Heard it only once with a weak signal. This was at 3 a.m.*

R.S. Brancatto
Arlington, Va.

Can't say if it's a gag but there are Italian CB stations now and they are using the same channels as U.S. stations. His callsign prefix would place him in Salerno.

★ *I like to watch TV Channel 3 coming from Santa Barbara to pick up certain locally blacked-out sports events. Problem is, although the video comes in clearly, there is absolutely no audio signal. TV set seems to work fine on all my local channels, it's this one DX channel which still defies me.*

Elliot V. Chang, WA6FRX
Los Angeles, Calif.

Sounds like your tuner needs some tinkering with. Probably the situation can be cured by adjusting the audio slug. It looks like the set just isn't tuned to the center of the audio portion of the TV channel.

★ *I have a four-band regenerative AM-SW receiver covering 550 kc to 30 mc. When I connect my 100-ft. long-wire antenna to it, no matter where the set is tuned, all I can hear is my local 50-kw AM broadcast station. If I use a whip antenna, I still hear the local station, but not as loud. What can I do so that I no longer hear this station?*

David Kleinschmidt
Parma, Ohio

Don't use any antenna. Problem is, most shortwave rigs aimed at the novice SWL just don't have the selectivity to prevent this kind of situation. My advice is to trade up as soon as possible.

Flying Saucer Dept. Back in 1966, NASA began tracking three satellites which they referred to as unknowns. They're still carried in official NASA records as catalog numbers 2428, 2429 and 2430. The vehicles are still zipping around, but nobody knows where

[*Continued on page* 22]

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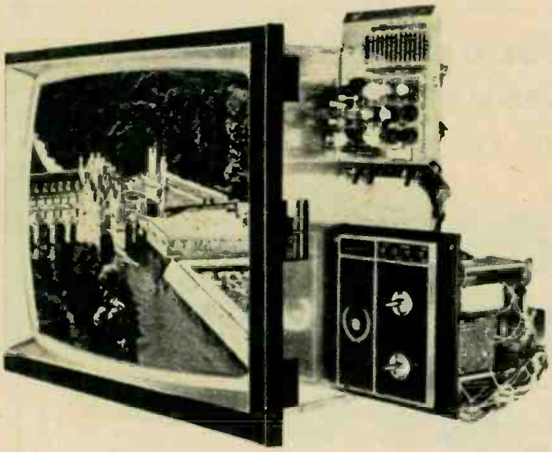


AUTOMATED COLOR TV. New top-of-the-line color TV from Heathkit offers 25-in. diagonal screen, detent UHF tuning, pushbutton electronic VHF/UHF scanning, optional wireless remote control, normal or wide-angle color demodulation, solid-state circuit modules. Set includes dot generator and VOM. $599.95. Heath Co., Benton Harbor, Mich.

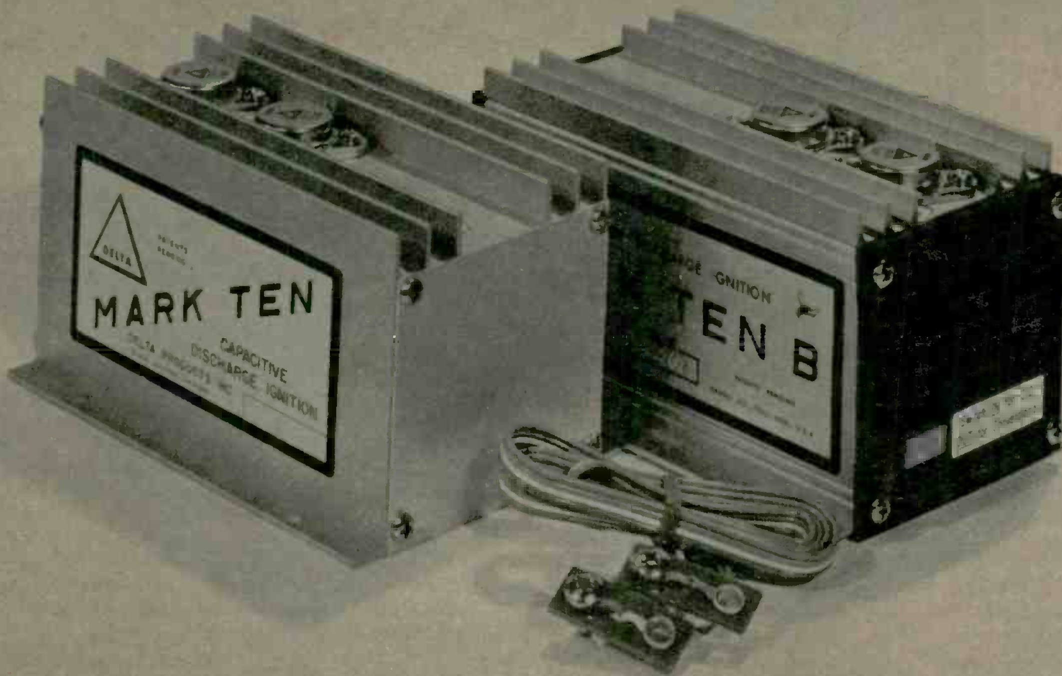
Noise-Free Deck. Model KX-700 stereo cassette deck includes Dolby noise reduction system and extra-hard super-ferrite record-playback head, bias selector switch. Kenwood Electronics, Gardena, Calif.

Boost For Broadcasting. FM wireless condenser mike, Model DM-55, has solid-state FM transmitter tunable from 88 to 108 mc, 9-V battery, is FCC approved. $21.95. E-V/Game Inc., Freeport, N.Y.

Electronic Marketplace

Three-in-one Value. Micronta tester for automotive buffs provides accurate readings of dwell angle and engine speed, checks condition of points. $17.95. Radio Shack, Fort Worth, Tex.

Economical Listening. Marantz has entered headphone market with its Model SD-1 stereo phones. Impedance is 8 ohms, frequency response, 20 cps to 20 kc. $29.95. Marantz Co., Sun Valley, Calif.



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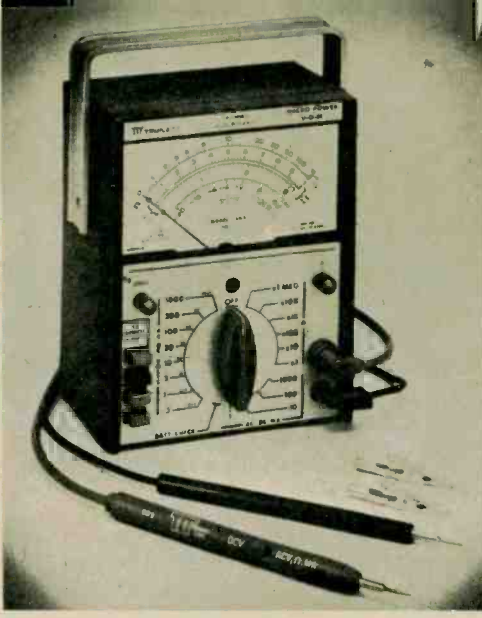
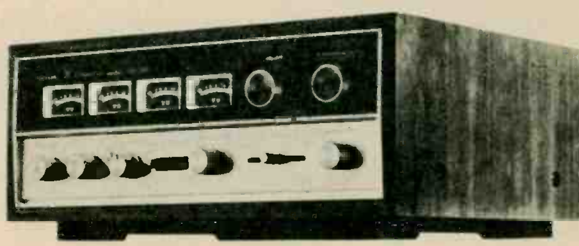


No Current Down the Drain. Battery-operated FET-VOM, Model 603, has one probe for all functions (DC, AC, ma, ohms), may be left on continuously. $150. Triplett, Bluffton, Ohio.

Listening Pleasure. Model 4515 cassette recorder has AM/FM radio, built-in condenser mike, ALC, works off rechargeable batteries. $99.95. Wollensak Div. of 3M Co., St. Paul, Minn.

Electronic Marketplace

Three Ways to Get Four. Sansui offers reproduction of discrete, matrix or synthesized four-channel programming via its Model QS500 four-channel converter and control center. User adds pair of rear-channel speakers. Output is 33 watts per channel into 8 ohms. $289.95. Sansui Electronics Corp., Woodside, N.Y.



CB Walkie-Talkie. CBers get five watts of power on three channels at push of a button with the Model CB-505 portable transceiver from Ray Jefferson. Unit is supplied with transmit and receive crystals for channels 9, 11 and 21. Other channels (for 11 or 21) are optional. $89.95. Ray Jefferson, Philadelphia, Pa.

Finding Your Way. Gladding Islander is portable radio direction finder which covers six bands: AM, FM, beacon, 2-4 mc, aircraft, VHF marine including weather. Includes RF gain, AFC. $139.95. Pearce-Simpson, Miami, Fla.
[*Continued on page* 24]

He made it with his own two hands.

There's a name for a place that employs men and women with serious physical and mental handicaps. It's called a "sheltered workshop."

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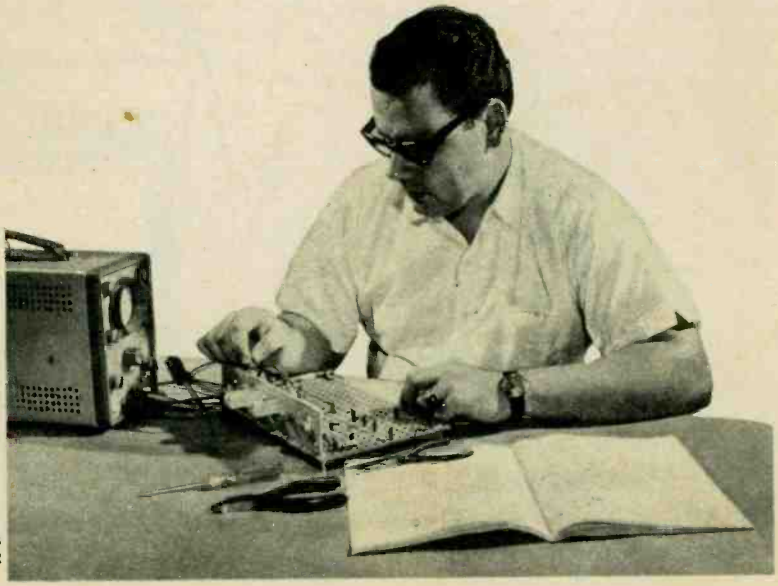


Performing transistor experiments on programmed breadboard – using oscilloscope

Uncle Tom's Corner

they came from. Last year NASA quietly added two additional mystery satellites to the list and the agency is currently tracking them with interest. Officially known by NASA catalog numbers 5309 and 5310, NASA frankly admits that they have not been identified with any launch or country of origin. Their orbits cannot be pinned down to any known launch area. Where are they from, why are they there? NASA doesn't know either. Any guesses?

★ *What do you know about a shortwave broadcaster calling himself The Voice of The Purple Pumpkin?*

George Bennett
Federalsburg, Md.

It's a bootleg station which appears every few years, I suspect, with a different operator and location. It has been on recently operating from somewhere in the national capital area using a frequency near 7345 kc. Sometimes they ID with the callsign WSWL. Operating times vary but I've heard them on in the early and late afternoons. Strictly a teenage prank. The joke has lived long past any humor which might have once existed.

★ *Someone recently told me that the Illinois State Police have added some new channels for mobile operations. Is this true? How can I find out what these are?*

Dennis Walbach
Libertyville, Ill.

Tune to 42.44 mc and 155.46 mc to hear the increased mobile activity from this agency. Incidentally, a catalog showing extensive directories of police, fire and other emergency radio systems throughout the country is available by sending a stamped, self-addressed No. 10 envelope to CRB Research, Inc., P.O. Box 56-EX, Commack, N.Y. 11725.

★ *Voltage and current seem to be indirectly proportional, so if I take a 250-volt 2-ampere fuse, can it be used at 125 volts, 4 amperes?*

Charles Brunkhorst
Paris, Texas

Uncle Tom's Corner

Sorry, Charlie, no dice. The voltage rating relates to the voltage breakdown or the arc created when the fuse blows. A 2-amp 250-volt fuse will still carry only 2 amps on a 120-volt circuit. The carrying capacity depends only on the current which, when excessive, generates sufficient heat to melt the fusing element.

★ *What is the business with the shortwave station which has a lady reading long strings of numbers? The one I heard was on 6730 kc at 0300 GMT. She said, "5 1 9 1 2 3 4 4 7 5 9 8 5." From then on she named a list of numbers too great to be put in this letter.*

Steve Leary
Akron, Ohio

You should have sent along the wild ones because the ones you included in your letter were sort of dull.

★ *Is there any point or satisfaction to be obtained in writing you a serious letter.*

Ted Boglowski
Seattle, Wash.

The glow in knowing that you've accomplished a long cherished dream.

★ *Do you agree with those who feel that plug-in modules are the way of the future? This would seem to imply that all our electronic equipment—including radios, color TVs, CB gear, ham radio stations, test equipment etc.—may arrive at a point in technology where it will be cheaper to buy new rather than replace what's ailing.*

Michael Rogers
Muncie, Ind.

Mike, you're biting off more than I care to chew. It's true, even now, that some items—like pocket transistor radios and battery-operated cassette players—are better thrown away than serviced. Their PC boards are packed so tight with components from Nippon that, next to them, a jeweler's screwdriver looks like a California Redwood. Getting out a bad component and replacing it with a good one (assuming you can get the part) is hardly worth the effort. But plug-in modules can be thrown away, yet you keep all the good stuff. See what I mean?

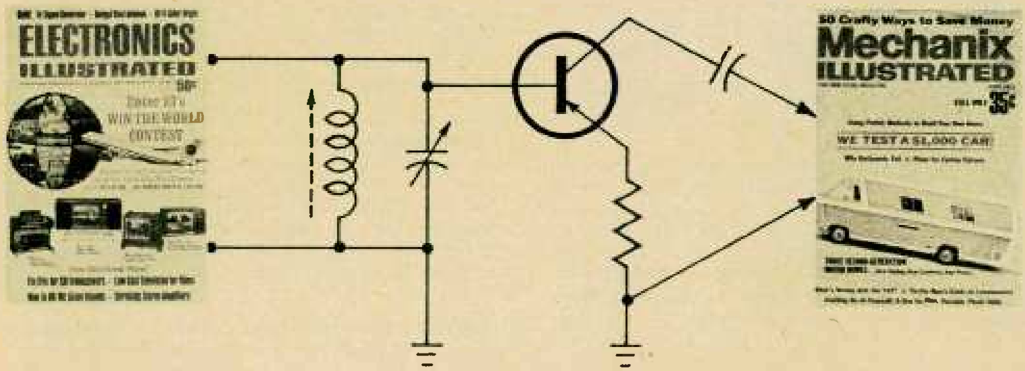
Electronic Marketplace

In on the Action. Model FPM-300 amateur transceiver from Hallicrafters covers 80 through 10 meters. Aside from fixed or mobile amateur communications, unit is said to be useful for networks such as CAP (Civil Air Patrol), MARS (Military Affiliate Radio Stations) and RACES (Radio Amateur Communications Emergency

Service). Rig weighs 25 lb., features solid-state circuitry, speech compressor circuit, is rated at 250 watts PEP for SSB, 180 watts CW. IM products 30db down. Mounting bracket optional. $595. Hallicrafters Co., Rolling Meadows, Ill.

In and Out with Eight-Track. Model TC-228 stereo eight-track cartridge deck permits both recording and playback of eight-track cartridges. New from Sony, the deck features a three-way ejection system that can be programmed to work after each run of each program, after the total run of all programs, or manually. Recorder shuts off when cartridge is ejected. Convenience AC outlet for amplifier or sound system can be programmed to shut off, too. Features in the record mode include level control, VU meters, fast forward, pause control (with lock). Also included are indicator lights, auxiliary inputs, microphone jacks, stereo headphone monitor jack, record

interlock and non-magnetizing record head. Walnut cabinet is included. $169.95 Superscope, Inc., Sun Valley, Calif.



You've got the right hookup if you read ELECTRONICS ILLUSTRATED. But let us introduce you also to MECHANIX ILLUSTRATED, EI's companion publication. MI, America's favorite how-to-do magazine, tunes in electronics sometimes but also deals with the latest on cars, home improvements, family finances, workshop projects, health, the outdoors, recreation vehicles, boating, snowmobiles, power and hand tools and much, much more.

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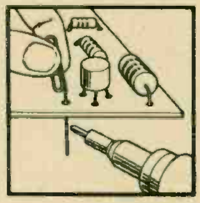
Service Tips

By Art Margolis

WHEN you change the resistance range on your ohmmeter while checking forward and reverse transistor junction resistance, the readings vary for each range. The readings you get are only relative to each other since an ohmmeter cannot accurately read the true resistance of a semiconductor junction. Readings vary between meter models and from scale-to-scale on the same ohmmeter.

—

When soldering components to a printed-circuit board, you'll sometimes fill the wrong hole in the board with solder. To open the hole, straighten a paper clip and push it into the blocked hole as far as it will go. Heat up your low-wattage pencil iron, apply the tip to the clip and let it heat up. When the paper clip reaches the solder's melting point, push it through the hole. First try the clip out to make sure solder won't stick to it.



If your popup toaster blackens bread on one side but hardly tans it on the other, it's time to examine the elements. Even if they seem to be lighting up properly and nothing seems amiss, the elements probably have aged. The resistance of some elements has increased and they are not delivering as much heat as before, while the rest brown as before. New elements will cure the problem.

—

Beginning to collect components for an extensive electronic project? Arrange all parts for easy accumulation and later retrieval. The resistors, capacitors and plugs that you had such a hard time scrounging up can easily get lost. Cookie pans and ice cube trays appropriately labelled are handy receptacles for parts.

—

Service technicians would much rather pull only the color TV chassis when a combination home entertainment/color TV has to be brought to the shop. If you have to service this kind of set and just pull the chassis, keep the limitations of any test jig in mind. Problems traced down to deflection, linearity and brightness are probably caused by the jig itself. When the test jig creates servicing difficulties, the answer is to go back and get the rest of the set, no matter how bulky.

—

When you are checking the heating element in a partially disassembled hair dryer, do not energize the element for long without blowing air across it. Otherwise, the heater can overheat and melt plastic parts nearby.

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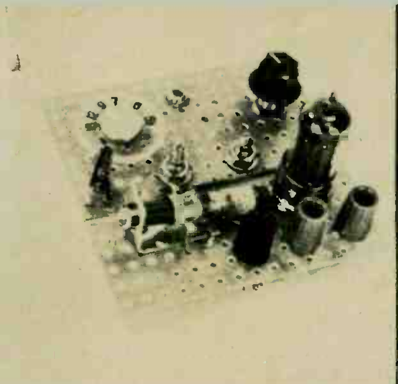
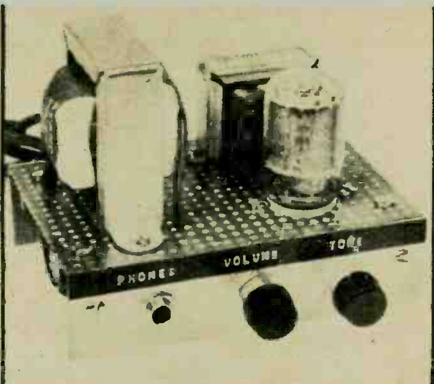
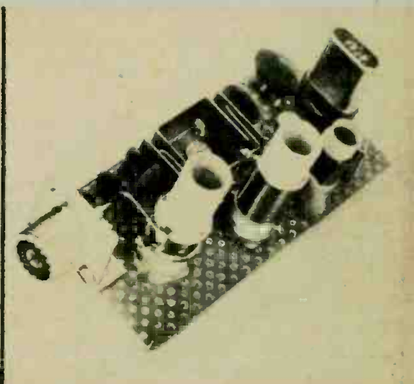


1-Tube Radio for SWLs



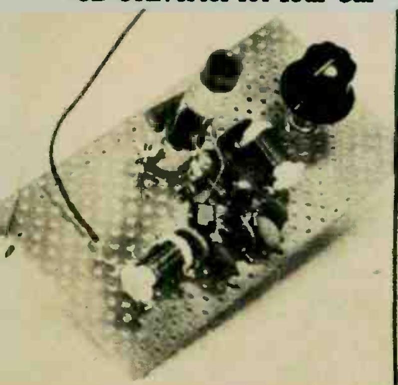
1-Tube Phono Amplifier



Flea-Power Ham Transmitter

Build-It Special! Six Great Projects

CB Converter for Your Car



One-IC Home Intercom

One-IC Signal Tracer

LIKE popular songs that become classics, the six Build-It Specials on these pages are representative of the electronic experimenter's all-time favorites. For some of the projects, popularity outweighs technical sophistication. But this doesn't make any one of the Build-It Specials less versatile—or fun to put together. We've updated these old favorites with revamped circuitry to take advantage of up-to-date components. You don't have to follow layouts exactly. As you can see, anything goes.

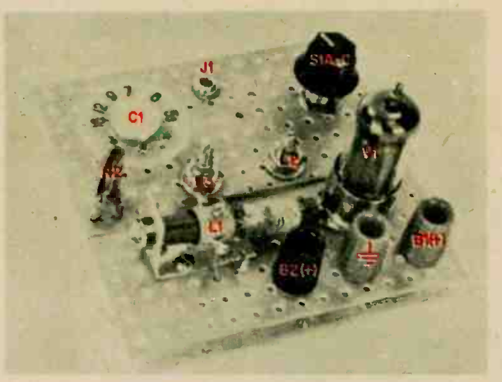
1-Tube Radio for SWLs

OUR first project is a regenerative, 3-band receiver which was quite popular back in the early days of radio. The circuit, which tunes the broadcast band, 3 to 8 mc and 8-14 mc, uses a filamentary-type tube just like the original versions. The tube, labelled V1, is a pentode, or five-element device. This particular class of tube does not have a separate cathode. Instead, electrons are supplied directly by the battery-powered filament. After boiling off the filament surface, the electrons are attracted to the plate, as in any other vacuum tube.

Radio frequencies flowing to the antenna terminal are tuned with variable capacitor C1 and the primary coil of L1-L3 (depending on which tuning inductor is selected by band-switch S1). The tuned signal is injected into the control grid of V1 via components C2 and R1. Both components help the tube self-bias itself on strong incoming signals.

The injected signal is amplified in V1 and appears at the plate terminal. At this point, the signal is fed back to the corresponding RF coil. If coils L1-L3 are wound with primary and secondary windings in-phase, the amplified signal will be added to the incoming signal. The amount of RF fed back to the

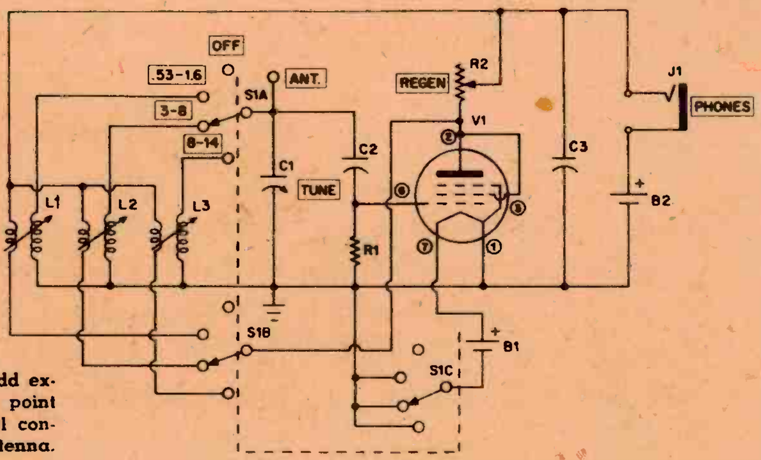
[Continued on page 97]



Layout is not critical. You can add vernier dial to C1's shaft for easier, more-accurate tuning.

PARTS LIST

B1—1.5 V D-cell
B2—45 V battery
C1—13-365 $\mu\mu f$ single-gang, solid-dielectric variable capacitor
C2—100 $\mu\mu f$ disc ceramic
C3—0.0047 μf disc ceramic
J1—Phone jack
L1—Ferrite antenna (see text)
L2—3-8 mc antenna coil (see text)
L3—8-14 mc antenna coil (see text)
R1—1,000,000 ohms, ½ watt
R2—100,000-ohm, linear-taper miniature pot
S1—3-pole, 4-position non-shorting rotary switch
V1—1U4 tube
Misc.—3 five-way universal binding posts, perfboard, push-in clips, knobs, earphone, tube socket, etc.



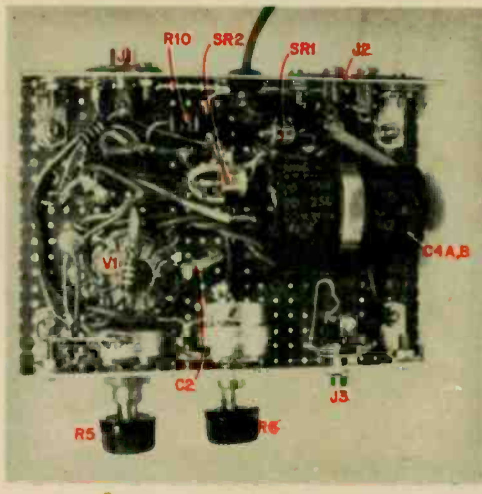
For best reception, add external ground to point shown. ANT terminal connects to outdoor antenna.

1-Tube Phono Amplifier

OUR One-Tube Phono Amplifier operates from a ceramic or crystal phono cartridge. It can produce approximately 1 watt of output audio power and will feed either a speaker or headphone. The input circuit, consisting of resistors R1 and R2, limits voltage applied to the triode grid and also helps to equalize audio signals from the cartridge.

After amplification in the triode section, labelled in the schematic ½V1(T), audio passes through the tone-control network. As control R5 (*Tone*) is turned, it brings C2

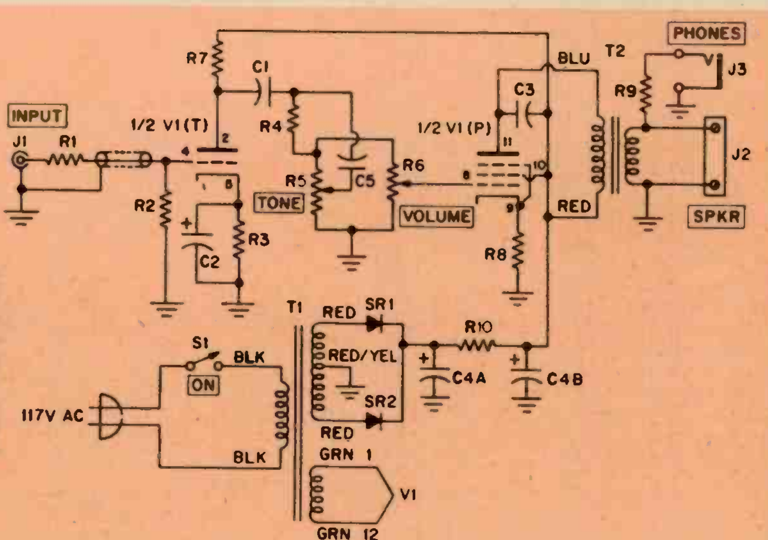
[*Continued on page* 97]



Wiring of phono amplifier is point-to-point. Keep input's shielded lead away from output terminals.

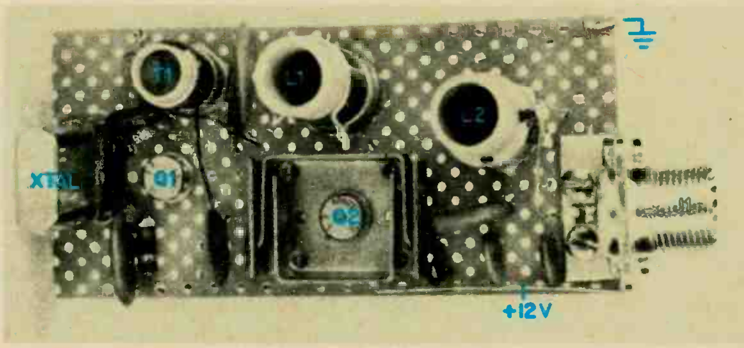
PARTS LIST

Capacitors: 500 VDC disc ceramic unless otherwise noted
C1—0.005 µf
C2—25 µf, 12 V electrolytic
C3—0.0033 µf
C4 A, B—Dual 20-20 µf, 250 V electrolytic
C5—0.001 µf
J1—phone jack
J2—Two-terminal, screw-type terminal strip
J3—¼-in. phone jack
Resistors: ½ watt, 10% unless otherwise noted
R1,R2,R4—470,000 ohms
R3—2,200 ohms
R5—1,000,000-ohm, linear taper pot
R6—1,000,000-ohm, audio-taper pot (with SPST switch)
R7—270,000 ohms
R8—270 ohms
R9—100 ohms
R10—1,500 ohms, 1 watt
S1—SPST switch (part of R6)
SR1,SR2—Silicon rectifier: minimum ratings; 400 PIV @ .75A
T1—Power transformer; secondaries: 250 VCT @ .025A, 6.3 V @ 1A (Stancor PS-8416 or equiv.)
T2—Audio output transformer; primary: 7,000 ohms, secondary: 4 ohms (Stancor A-3878)
V1—6T9 tube



Triode (T) and pentode (P) sections of V1 are housed in 12-pin, Compactron-style tube. To lower distortion of amplifier even further, increase value of bypass capacitor C2.

Flea-Power Ham Transmitter



THINK you're up to the challenge of QRP DX? Our Flea-Power Ham Transmitter belts one healthy watt into a 50-ohm antenna system with a 12-volt source supplying power. This transmitter is just the ticket for QRP contests, field trips and any other time you really want to pit your savvy against the vagaries of radio communications.

To key the transmitter, insert a telegraph key in series with the +12-V line. The rig also can be amplitude modulated if a 500-milliwatt audio exciter is connected in series with the B+ line feeding transistor Q2 via a matching transformer.

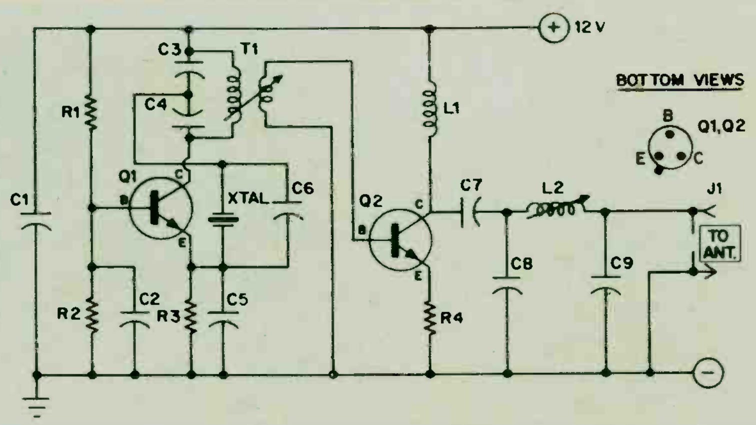
Our super-low-power rig feeds directly into 50-ohm coax. To tune the transmitter, place a 3730-kc rock in its holder and adjust T1 until you reach resonance. A grid-dip meter is a handy instrument for this adjustment.

Then adjust inductor L2 for maximum output power, meanwhile observing a wattmeter connected across output jack J1, for any unusual fluctuations. After T1 and L2 have been aligned, go back and rock the slugs in both coil forms for maximum output on the wattmeter. Final transmitter current drain is about 200 ma.—*By Herb Cohen*

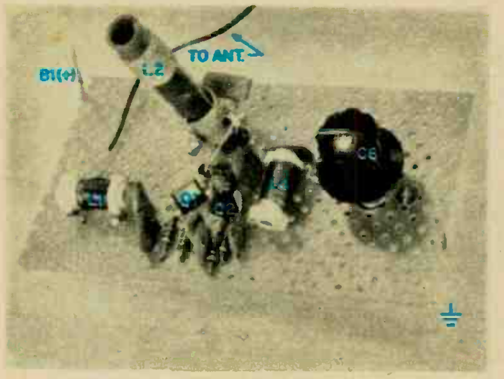
PARTS LIST

Capacitors: 500 V disc ceramic unless otherwise noted
C1—0.1 μf
C2,C5—0.01 μf
C3,8,9—0.001 μf, 1,000 VDC
C4—470 μμf, 5% silver mica
C6—68 μμf, 5% silver mica
C7—.05 μf
J1—Coax socket (type SO-239)
L1—30 turns No. 24 enamelled wire on ½-in dia. ceramic coil form
L2—12 turns No. 24 enamelled wire on ½-in dia. ceramic coil form
Q1—Npn transistor (40407)
Q2—Npn transistor (40409)
Resistors: ½ watt, 10% unless otherwise noted
R1—3,300 ohms
R2—1,000 ohms
R3—47 ohms
R4—2.7 ohms, 5%
T1—RF transformer (see text)
Misc.—perfboard, heatsink for Q2, buswire, etc.

Capacitor C6's value may have to be varied for proper excitation of XTAL. When aligning QRP rig, insert VOM in series with +12-V line. Key current after alignment is about 200 milliamperes. See text.



CB Converter for Your Car



CITIZENS BAND converters can be of use two ways in a car. For once, a CB enthusiast can simply turn on his broadcast radio and, with the converter, listen to what's going on over on the Citizens Band. Alternatively, if there's also a CB rig in the car, the licensee can carry on a two-way while listening to a second channel (such as the local call channel). The converter's inupt transistor (Q1) protects the receiver from damage even while the CB rig is blasting away right next to it.

Our CB Converter was built especially for the mobile installation. It tunes the entire CB band and has above-average performance, thanks to dual-gate mosfet transistor Q1. CB signals are coupled to Q1 via tank circuit L1/C1 into Q1's input gate G1. This transistor and associated components are connected as a conventional frequency converter. RF signals fed into G1 mix with local oscillator Q2's signal via gate G2. The output frequency is the difference between the two RF signals. It is coupled to output tank circuit components C2 and L2.

The output frequency is in the vicinity of 1500 kc or it can be adjusted to fall at some other point on the BCB dial. Signal pickup is achieved by physically placing L2/C2 next to the antenna coil of the radio. A second method of feeding the output signal into the radio, especially if car-mounted, is to wind a three-turn loop of hookup wire around coil L2. Then loop three turns of the free end around the AM antenna coil inside the car radio. Output frequency can be adjusted to cover the top end of the broadcast band by turning the ferrite slug in coil L2.

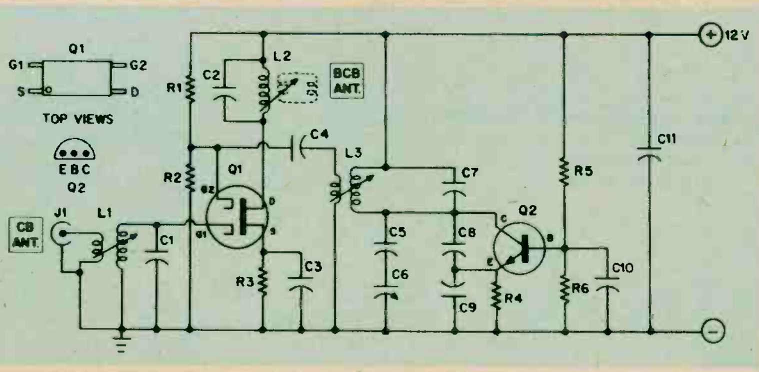
Make RF transformer L1 by winding 11 turns of No. 24 enamelled wire around a 7/32-in.-dia. ceramic coil form. This serves

[Continued on page 98]

PARTS LIST

Capacitors: 50 V disc ceramic unless otherwise noted
C1—24 μμf
C2,C9—100 μμf
C3,C11—0.04 μf
C4—0.0015 μf
C5—5 μμf
C6—2.9-30 μμf variable capacitor
C7,C8—20 μμf
C10—0.01 μf
L1—Input RF transformer (see text)
L2—BCB Ferrite antenna coil (see text)
L3—RF coupling transformer (see text)
Q1—Dual-gate mosfet (Motorola HEP-F2007)
Q2—Npn transistor (2N4401)
Resistors: ¼ watt, 10% unless otherwise noted
R1,R2—150,000 ohms
R3—270 ohms
R4—220 ohms
R5—22,000 ohms
R6—4,700 ohms
Misc.—knob, perfboard, No. 24 enamelled wire, etc.

Variable capacitor C6 tunes converter across Citizens Band. Coil L2's output link, shown in dotted lines, is three turns of hookup wire wound around coil L2 and BCB antenna coil. See text.



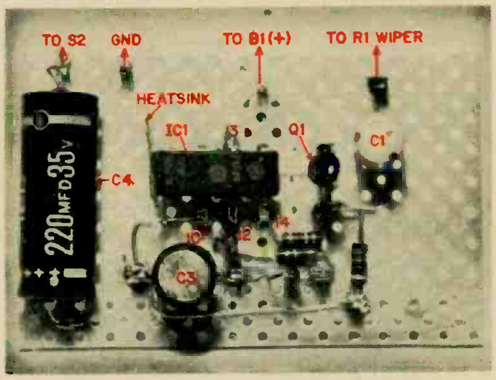
One-IC Home Intercom

ONE of those handy gadgets you can add to your collection of homebrews is an intercom. With ours, the master always monitors the remote station full-time.

Just two wires are needed to connect the remote to master station. It can be used as an electronic baby-sitter, camper-to-cab communicator or doorbell monitor.

The master station consists of speaker-matching transformer T1, gain control R1 and a master amplifier consisting of transistor Q1 and integrated circuit IC1. Only two components, a speaker and its connecting jack are needed for the remote station.

Except for T1 and R1, the master amplifier is wired as a small subassembly that fits into the master station call box. Power can be anything from 18 to 22 volts at about 5 ma idling current. In our model, two series-connected 9V transistor radio batteries supply power.

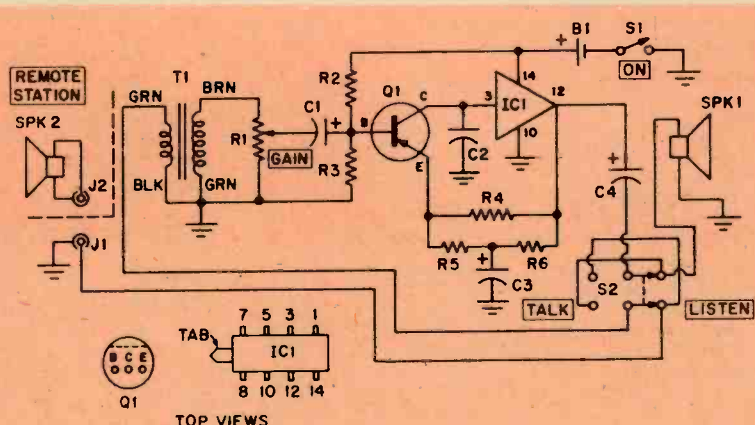


Solder heatsink to tab of IC1 directly. Unused leads of IC1 are cut off before final assembly.

Though the project is simplicity itself, there is a note of caution. Do not eliminate transformer T1. The remote speaker can drive the master amplifier without T1, but direct output from a speaker sounds very bassy and [Continued on page 98]

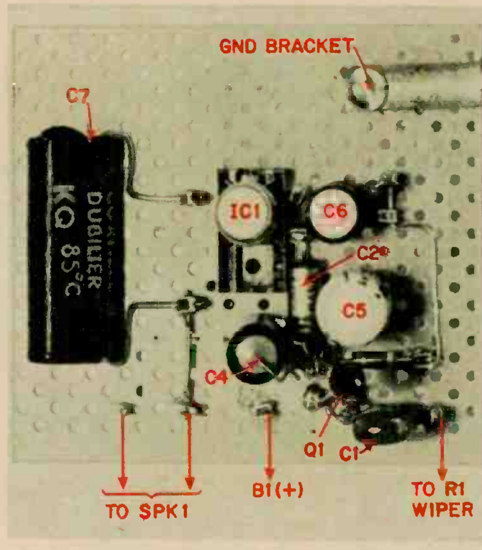
PARTS LIST

B1—Two 9V transistor radio batteries wired in series
Capacitors: 20 VDC electrolytic unless otherwise noted
C1—10 μf
C2—500 μμf disc ceramic
C3—50 μf
C4—250 μf
IC1—Integrated circuit (GE PA-234)
J1,J2—Phono jack
Q1—Pnp transistor (GE 2N5355 or equiv.)
Resistors: ½ watt, 10% unless otherwise noted
R1—10,000-ohm, audio-taper pot with SPST switch
R2—100,000 ohms (see text)
R3—47,000 ohms
R4—10,000 ohms
R5—15 ohms
R6—1,000 ohms
S1—SPST switch (part of R1)
S2—DPDT spring return switch (Lafayette 99R 61830 or equiv.)
SPK1, SPK2—30- to 45-ohm intercom speaker
T1—Audio output transformer: primary; 500 ohms, secondary; 3.2 ohms (Lafayette TR-99)
Misc.—Cabinet, battery holders, heatsink, etc.



Don't omit capacitor C2. Without it, self-oscillation could result. Size of capacitor C4 can be varied to tailor intercom's frequency response.

One-IC Signal Tracer

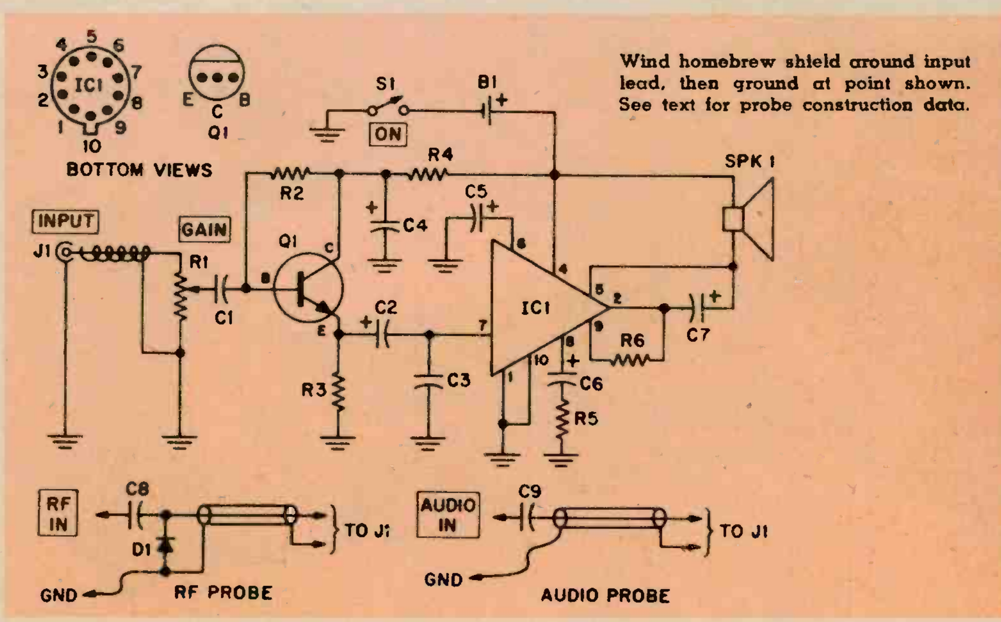


THE easiest way to troubleshoot a defective amplifier or radio is by tracing a signal fed through the device. A high-gain amplifier and suitable probe pinpoints where the signal gets lost or distorted. Virtually any high-impedance-input, high-gain amplifier can troubleshoot an audio amplifier, while an RF detector probe must be provided to detect the modulation on high-frequency signals. The RF signals can be provided by a radio station or modulated signal generator.

Our one-IC Signal Tracer has everything [*Continued on page* 96]

PARTS LIST

B1—9V transistor radio battery
Capacitors: 15VDC electrolytic unless otherwise noted
C1—0.05 µf, 500 V disc ceramic
C2—2 µf
C3—560 µµf disc ceramic
C4—50 µf
C5—100 µf
C6—30 µf
C7—250 µf
C8—0.001 µf, 500 V disc ceramic
C9—0.02 µf, 500 V disc ceramic
D1—IN60 diode
IC1—Integrated circuit (Allied Radio Shack 276-016)
J1—Phono jack
Q1—Npn transistor (2N3394 or equiv.)
Resistors: ½ watt, 10% unless otherwise noted
R1—1,000,000-ohm, audio-taper pot with SPST switch
R2—390,000 ohms
R3—4,700 ohms
R4—27,000 ohms
R5—47 ohms
R6—6,800 ohms
S1—SPST (on rear of R1)
SPK1—8-ohm speaker
Misc.—Cabinet, perfboard, push-in terminals



A Primer For Cuba Watchers

By ALEX BOWER

MONITORING broadcasts coming from Castro's Cuba has long been a favorite sport with political refugees, the U.S. government and DXers alike. And for a good reason . . . there's plenty to listen to. Even SWLs who own the most inexpensive communications receivers can zero in on at least three different targets: Radio Habana Cuba, the medium-wave broadcast band and aeronautical frequencies which become glamorous whenever an airplane is hijacked and flown to Cuba.

Radio Habana Cuba, one of North America's more powerful SWBC stations, comes in loud and clear most any time, and except for the Voice of America, it's the most easily logged station. The easy tuning is due partly to RHC's being a neighbor; also, Radio Habana Cuba's tropical location insures that her signals do not pass through or near the polar zones so they're not subject to ionospheric disturbances.

Radio Habana Cuba provides English-language broadcasts during evenings on 31 meters (9680 kc) and 25 meters (11840 kc) starting at 2000 EST. These signals are so strong that no matter how roughly your receiver is calibrated you should be able to locate them quickly. (Number one headache for most SWLs is finding stations on rigs priced for the novice pocketbook.) Even if you aren't sure of the frequency, the distinctive accents of RHC's announcers should provide a positive station ID.

When Radio Habana Cuba first became operational, shortly after the Bay of Pigs, RHC seemed to be the most effective Communist shortwave station. Even now it still has more hours of programming per evening (most Communist stations simply repeat programs) than its competitors, and there is no American issue which it will not tackle. When it comes to U.S. domestic affairs, the Cubans seem to have done more research than either Radio Moscow or Radio Peking.

Radio Habana Cuba's broadcasts in Spanish to Latin America are the most extensive of any international shortwave organization and employ the same well-thought-out propaganda techniques. Because censorship is practiced so widely in Central and South America, RHC's broadcasts pack quite a punch and are one of Castro's most deadly weapons.

Fact is, however, that no other nation in Latin America practices as much censorship as Cuba. Taking broadcasting networks as an example, Cuba was the most developed of any Latin American nation before Castro came to power. There were four major networks in private hands: Circuito CMQ (now Radio

Liberacion with a key outlet on 640 kc), Cadena Radio Habana Cuba (now Radio Rebelde with a key Havana outlet on 590 kc), Radio Progreso (with a key outlet on 690 kc) and Union Radio (now Radio Musical Nacional with a key outlet on 910 kc), plus some regional hook-ups and a number of independent outlets. All of these stations were expropriated by Castro and now all non-Marxist broadcasts are jammed by the Cuban government.

Unless you have a local station on 630 or 650 kc, Radio Liberacion can be heard almost any evening east of the Mississippi after sunset (PST). Radio station WHLO in Akron is allowed to operate until that hour. Included in Radio Liberacion's schedule is a series of Spanish-language programs produced by other Communist nations such as Czechoslovakia, North Vietnam and North Korea.

Radio Rebelde (including its relay on 720 and 780 kc) and Radio Progreso can be expected to pop up on shortwave receivers any time an ionospheric disturbance knocks out QRM (interference) from American and Canadian stations. Beginning SWLs shouldn't have trouble making these IDs once they've had some practice.

DXers who are the proud owners of more advanced communications receivers can shoot for many lesser known Cuban medium-wave targets. About once a year, an unlisted Radio Liberacion relay appears near Radio Americas' old frequency, 1163 kc. It seems that no one except the Cuban government (and possibly the CIA) knows where this station is located.

Cuba also operates a network of time and news stations called Radio Reloj Nacional. Key outlets are on 760 and 800 kc. Most other networks sign off at midnight but some of their transmitters are used in a special all-night circuit known as La Voz de Cuba. As most adventurous DXers will find out for themselves, Cuba's domestic radio web is one of the most complex to be found anywhere in the world. Latin American countries such as Chile and Peru are starting to copy the regional broadcasting techniques of the Cuban government because of its thoroughness. However, Cuba is still alone when it comes to jamming. These transmitters currently operate around 1140 kc (to combat station WQBA, Radio Cuba, in Miami); a transmitter on 1180 kc interferes with VOA's Marathon station.

Guide to Cuban Aeronautical Frequencies

Frequency (kc)	General Location
2966	Central Caribbean
5619	Western Carribean & Mexico
6537	Central Caribbean
8837	Central Caribbean
10017	Western Caribbean

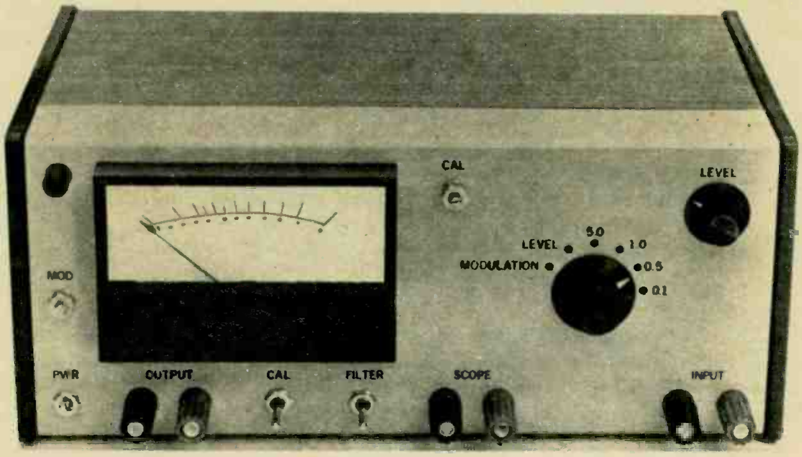
Caribbean aeronautical frequencies are targets for DXers who want to listen in on transmissions from hijacked aircraft. Best bets are 6537 and 8837.

The most difficult task for the average SWL will be to monitor transmissions from hijacked aircraft and to listen in on discussions about them. The chart shows a list of aeronautical frequencies used regularly in the Central and Western Caribbean. Signal strength isn't a problem, but finding the more important frequencies (6537 and 8837 kc) on an inexpensive receiver could be a real headache.

One help for the DXer is New York Aeradio which has weather broadcasts 40 minutes after each hour on 8868 kc—just 31 kc above 8837. A more advanced shortwave receiver, however, should be able to sort out these stations quite easily.

Some aeronautical transmissions are in Spanish (especially on 5619 kc) but a majority are in English. The aeradio station at Havana is known as Boyeros, and except when hijack incidents occur, the exchanges between the U.S. and Cuba are normal.

Build a Direct-Reading



Wow & Flutter Meter

Part 2

By
HARRY KOLBE

IN the July issue, we told you what a Wow & Flutter Meter is and how ours works. You also learned the functions of the components and of the various controls. A Parts List was included, too. In this concluding installment, you'll find out how to build the device and calibrate it. Finally, we describe the use of the Wow & Flutter Meter in more detail.

To begin construction, first study the various pictorials indicating parts placement on the printed-circuit boards and front panel. Most of the wiring is single-conductor shielded audio cable. Any kind of shielded cable will work, although we used a miniature variety which was at hand.

It is quite important that you understand the meaning of the diamond-shape callouts on the pc board and front-panel wiring diagrams. These designations key the lugs on both pc boards. Push-in terminals are soldered to lugs designated. Note that the asterisk (*) is placed by the upper left quadrant of certain designations. This means that the shield wire of a particular cable is connected to it via a push-in terminal.

For example, terminals D and E on the power-supply pc board (labelled PCB1) are connected via shielded cable to R56 (*Modulation*). The cable braid is soldered to terminal E on PCB1, while the inner lead connects to terminal D. The other end of this cable is run to R56 and is soldered to the pot as shown in the pictorial.

Few of the components used in our Wow & Flutter Meter are critical. But try to obtain new resistors and ICs with known tolerances for best results. Performance of the circuit is, however, strongly affected by capacitor tolerance. For this reason, tantalum capacitors indicated in the Parts List may not be substituted with aluminum electrolytics. Capacitors C12, C13, C14 and C16 must be as close to their ratings as possible. Use the Kemet Type A106M010 for C12, C13 and C16 and Sprague Model 105X9035-A2 tantalum capacitor for C14.

A variety of single-turn miniature potentiometers will fit into the pc board holes where these components are called for. The Bourns 3389P is one model with pins that exactly match these holes.

A less-expensive meter can be substituted for M1, Simpson's Model 543 VU meter. This particular meter was used mostly for legibility and good movement characteristics. Either substitute a less expensive VU meter or a 0-100 microampere DC meter.

In either case, you will have to draw your own meter dial. Use the scale shown in Fig. 2

only as a guide. Also, all internal resistors and the rectifier assembly will have to be removed from the substitute VU meter. You probably will find that the value of electrolytic capacitor C17 has to be changed if a non-specified movement is used. Try increasing the value of C17 to 50 μf, 25V if a microampere meter is used instead.

Building the Wow & Flutter Meter

First prepare both printed-circuit boards from the full-size templates. For best results, a reasonably close copy should be made of both boards. Perforated board and push-in terminal wiring is an alternate method but more care will have to be taken to insure that no connections are omitted.

After the pc boards (or their perfboard alternates) are cut to size and prepared, mount the components. Start with capacitor C1, the first board-mounted component shown in the schematic. Continue adding parts until all first-stage components are accounted for. Solder these parts to the board or push-in terminals.

Proceed to wire the next stage (IC1 and associated parts). Repeat this procedure until all components are mounted to PCB2. Do not forget to wire the six jumpers to the board, too. Then wire PCB1 in like manner.

No matter which wiring technique you choose to follow, make sure you observe that the only chassis ground for both pc boards is at the lug shown to the right of designation E on PCB1. Otherwise, ground loops and hum problems will plague instrument accuracy. Chassis ground is achieved by attaching PCB1 to the cabi-

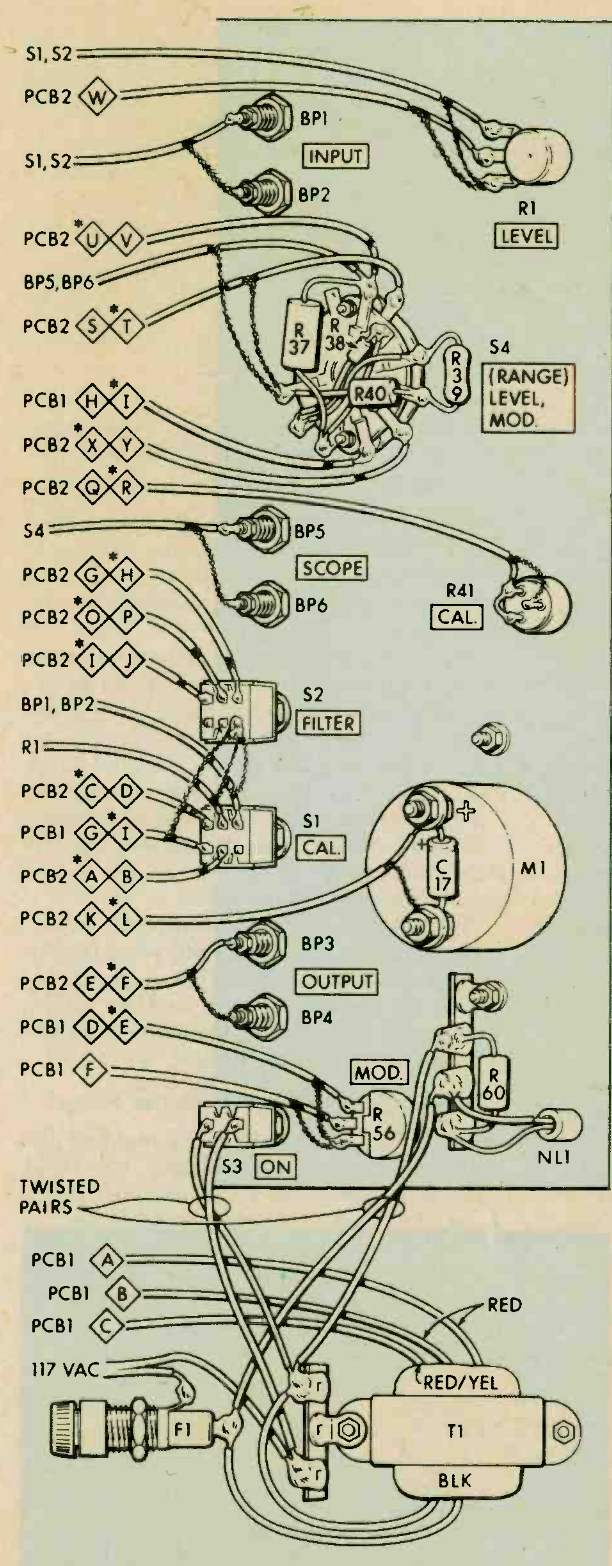


Fig. 1—Top left box is pictorial of front panel wiring. Bottom edge corresponds to lefthand corner of cabinet. Power transformer, fuseholder and tie point mount to cabinet bottom and rear lip.

Build a Direct-Reading Wow & Flutter Meter

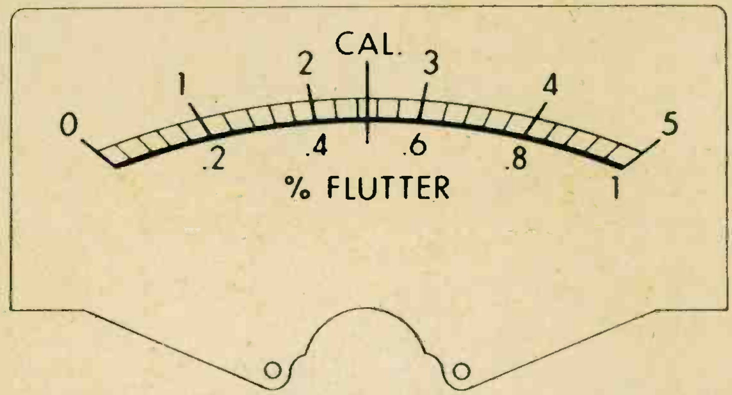


Fig. 2—If specified meter is purchased, glue this face over original dial. Redraw face to fit over dial of other than specified movements. See text.

net with a ½-in aluminum standoff.

After all of the components are soldered to both pc boards, inspect for solder bridging and cold joints. Make sure that all ICs are inserted and soldered properly into PCB2. Recheck all diodes and polarity-sensitive capacitors before you begin to drill holes for front-panel parts.

Lay out the front panel according to Fig. 1. The bottom of the pictorial corresponds to the left hand side of the cabinet. It is not mandatory to follow our parts placement. You should, however, mount each set of binding posts with ¾-in. center spacing between each binding-post pair. This makes it possible to insert dual banana plugs into the binding posts later on.

After all holes are drilled, prewire switch S4 (*Range*). Don't solder those terminals which have shielded cable attached to them at this time. Since S4 is a 2-pole switch, use the lugs for the second pole as a virtual tie strip for resistors R37-40 and interconnecting wires. See Fig. 1.

Before mounting the meter into the cabinet, cut out the meter scale in Fig. 2, or use the markings as a guide when drawing your own scale. Also remove the internal resistors and rectifier assembly. Glue the new scale over the original one in your meter and mount the modified meter assembly to the front panel.

After all components have been attached to the front panel, interconnect them to the pc board with shielded audio cable. Follow the guide shown in Fig. 1. Again, it must be stressed that the cable shields must *not* touch each other unless they are soldered together. Take particular care when wiring switches S1 and S2 to follow this precaution. The last step is to wire S4 to the rest of the circuit and then mount it to the panel.

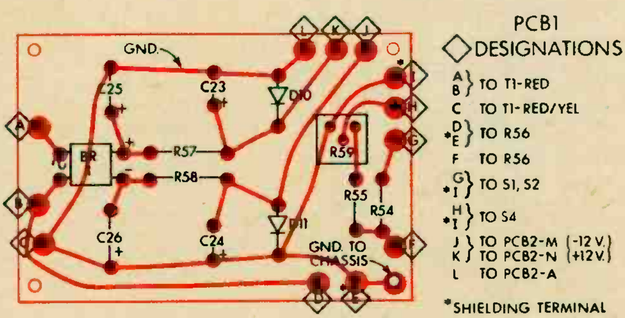
After the power-supply transformer, fuseholder and line cord have been connected to the rest of the circuit, label the control functions with press-on transfer lettering. Spray with a thin coat of clear laquer to bond the lettering to the cabinet surface.

Calibrating the Wow & Flutter Meter

The following equipment is required for initial calibration: oscilloscope, an audio signal generator, audio voltmeter and VTVM.

Set the W & F Meter's controls as fol-

Fig. 3—Power-supply pc board with component placement shown. View of board is front topside. Note that designations J, K, L do not make use of shielded wire. Ordinary hookup wire also is used at designation F. Ground chassis to cabinet where shown. Use an aluminum stand-off.



lows: the Level pot is turned fully counterclockwise.

Range switch is set to the Level mode.

Filter switch turned off.

Calibrate switch is also turned off.

Internal adjustments are as follows: R7 and R56 full ccw. Pots R9,17,29,30,41,45, 48,51,59 set to 50% rotation.

Connect a 100-ohm resistor across M1. Turn the instrument on and adjust R45 for a zero reading on the meter.

Turn on all test instruments listed. Wait until they have stabilized.

Adjust R29 for 0 VDC at pin 6 of IC3.

Adjust R9 for +0.05 VDC at pin 2 of IC1.

Adust R51 for −9 VDC at the junction of components R52 and D9.

Wire a temporary jumper between test points (TP) B and C on PCB2. Similarly, wire a jumper between test points D and E.

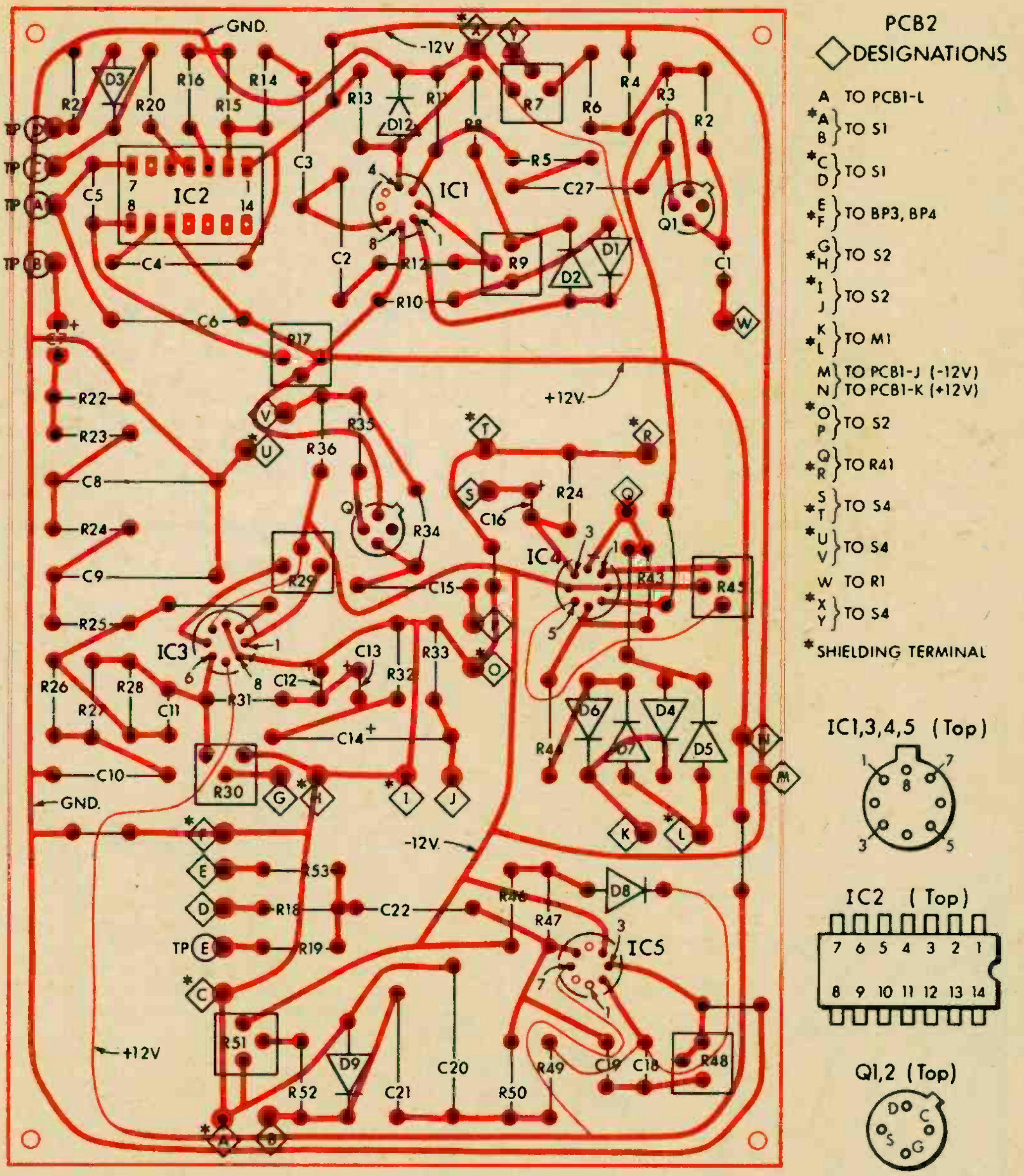
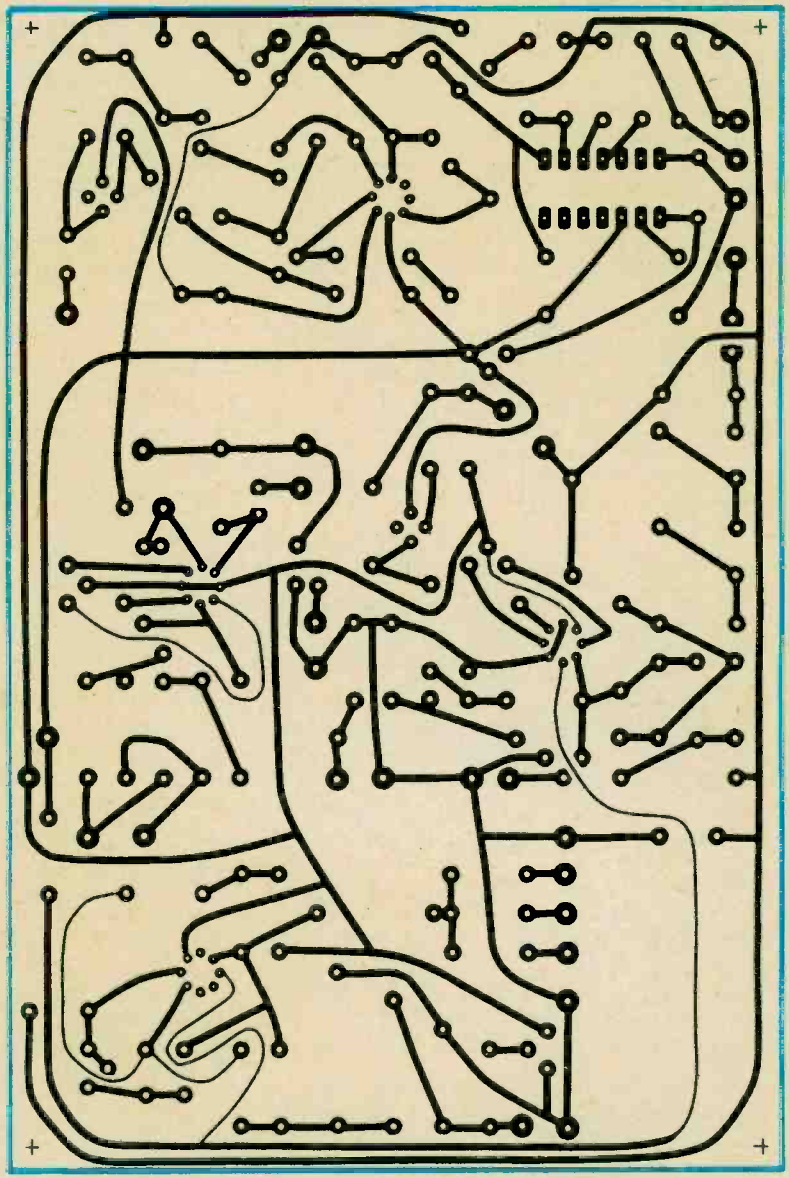


Fig. 4—Topside view of main circuit board. Cut off case (C) leads of Q1, Q2 before mounting transistors.

Build a Direct-Reading Wow & Flutter Meter



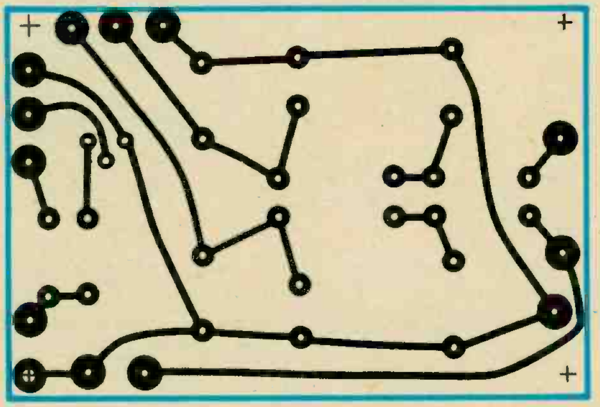


Fig. 5—Full-size template of pc boards. Copy onto board or use perfboard and push-in terminals. Crosshairs indicate position of mounting holes. Note that lower left mounting hole on PCB 1 also serves as circuit chassis ground.

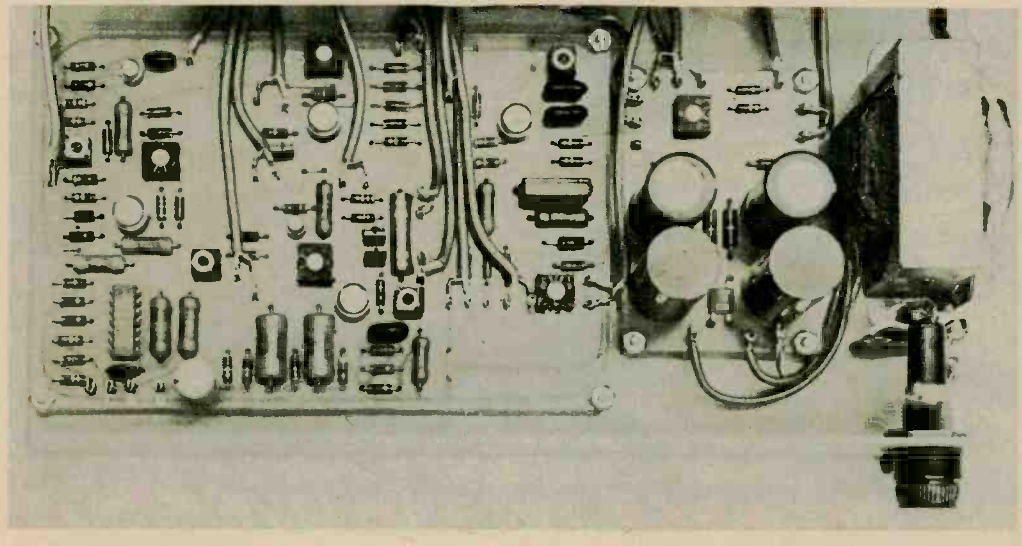


Fig. 6—Mount boards to chassis as shown. Test points A, B are jumpered after meter circuit is calibrated.

Connect the scope's vertical input to test point A and the horizontal input to the audio signal generator, which is set for 3,000 cps. Adjust R17 until a single circle (lissajous pattern) is seen on the scope.

The scope vertical input is attached to binding posts BP3 and BP4 (*Output*). Adjust R48 for a single-circle lissajous pattern on the scope.

Attach the scope vertical input leads to binding posts BP5 and BP6 (*Scope*). Reset the audio signal generator output frequency to 75 cps. It remains connected to the scope's horizontal input. Clip a lead from the VTVM to the junction of components R52 and D9. Adjust R51 ccw for a single-circle lissajous pattern and note the new voltage across D9.

Reset the output of IC5 to 3,000 cps by first readjusting R51 for a −9 VDC reading at the junction of components R52 and D9. Then readjust R48 until a single-circle pattern reappears on the scope. The vertical input jack of the scope is connected to binding posts BP3 and BP4.

Divide the voltage difference previously noted across D9 by 1.41 to determine the rms modulation voltage.

Set S1 to its *Cal* mode. Connect the audio voltmeter to the wiper of R56. Adjust R56 to the rms reading computed in the last step.

Remove the jumpers between points B, C and D,E. Wire a permanent jumper across test points A and B. Remove the 100-ohm [*Continued on page* 102]

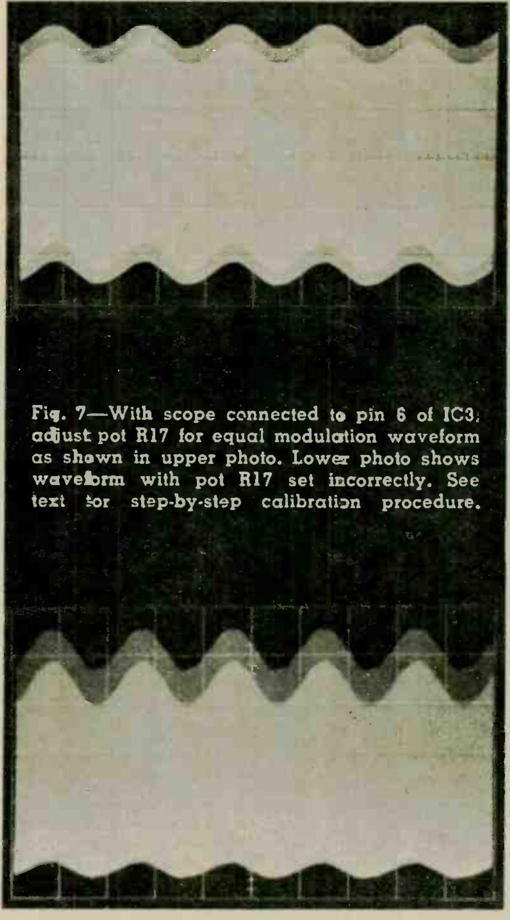
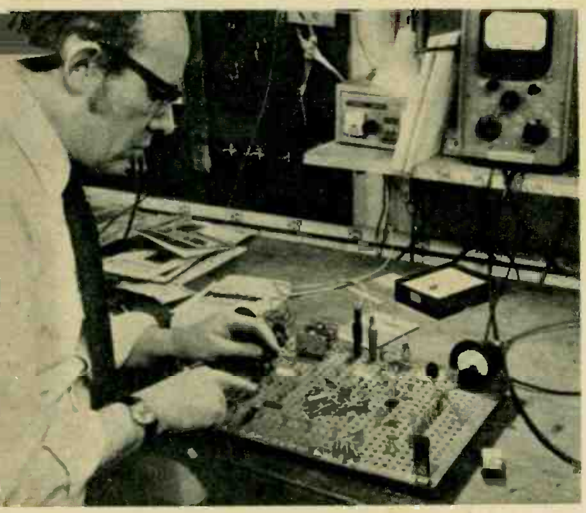


Fig. 7—With scope connected to pin 6 of IC3, adjust pot R17 for equal modulation waveform as shown in upper photo. Lower photo shows waveform with pot R17 set incorrectly. See text for step-by-step calibration procedure.



Beginner's Guide to Basic Transistor Circuits

Information you need to understand the theory and practice of using transistors and integrated circuits.

By LEN BUCKWALTER

WANT to understand the secrets of the transistor? Build and study these six basic circuits and you'll be on your way. The circuits demonstrate the principles of amplification, oscillation and switching. Each circuit also is a practical project in its own right. Before considering how these circuits operate, let's quickly review what happens inside a semiconductor.

First, how do you get electrons moving inside semiconductor materials such as silicon and germanium? Let's examine a diode—the simplest semiconductor—to illustrate how the properties of pure silicon can be changed to enhance the flow of electrons. Remember that a diode acts like a one-way street to block electrons flowing in one direction while passing electrons flowing in the opposite direction.

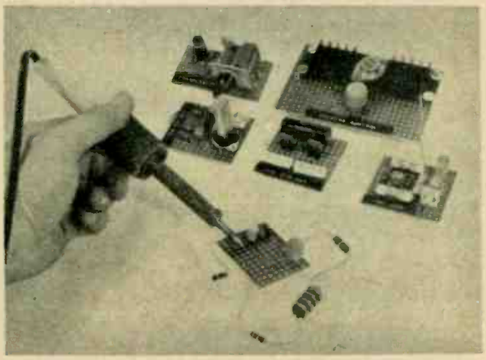
Whereas an NPN transistor has two N (negative) regions separated by a P (positive) region, a diode has only one junction which separates an N region from a P region. To get electrons moving in a diode we need both P-type and N-type semiconductor material. Both types are made by mixing chemical elements—known as impurities—in small quantities with pure silicon. This process is called *doping*. It converts the silicon (an insulator) into a conductor.

Typical N-type dopants are antimony, phosphorous and arsenic. P-type silicon is manufactured by adding boron, gallium or indium. The amount of impurity added is small—something like one part impurity to 10 million parts of silicon—but it's enough to change the silicon into a conductor.

To see how this happens, let's study N-type silicon first. After the doping process, impurity atoms are scattered throughout the silicon-crystal lattice. The impurity atoms occupy locations normally filled by silicon atoms.

When the silicon crystal is doped with an N-type impurity there is a free electron in the outer orbit of every impurity atom. Each impurity atom shares four electrons in highly stable bonds with its silicon neighbors, but its *extra* electron is free to wander about between silicon atoms. The whole purpose of N doping is to create free electrons.

How does N-type silicon conduct electricity? If you connect the terminals of an N-type silicon chip to a battery, electrons will be pumped into the semiconductor from one side and the free electrons created by the



Shown above are six practical projects you can build. They illustrate how basic transistor circuits operate. Schematics have parts information.

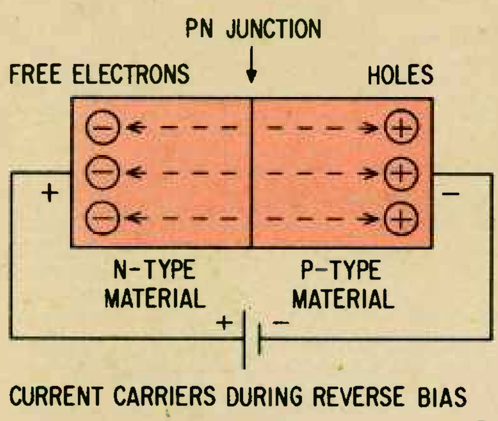


Fig. 1—Semiconductor diode has one P and one N region. During reverse bias, carriers are drawn away from PN junction, causing high resistance.

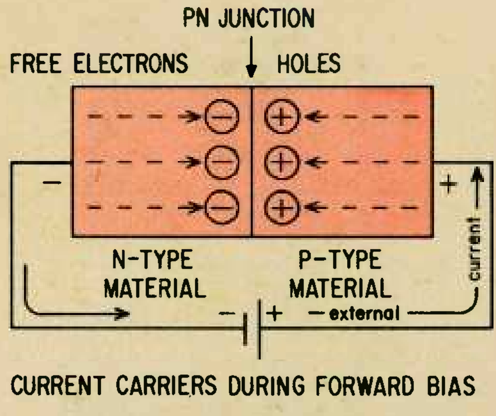


Fig. 2—Action of semiconductor diode during forward bias. Carriers are propelled towards the PN junction. They form a low-resistance bridge.

doping process will be withdrawn from the opposite side and returned to the battery.

To create P-type silicon, a minute amount of P-type dopant is added to the silicon crystal. The impurity atoms replace a small number of silicon atoms in the crystal lattice. Instead of donating an extra electron, the P-type dopant creates an electron deficiency in the crystal lattice. This deficiency is called a *hole*.

This hole is not a physical hole in the silicon chip. It's a location in the bonds between the atoms that has the potential to attract an electron. Electrons are attracted to these locations because each atom tries to stabilize by filling its outer orbit with the required number of *valence* electrons.

An atom can fill its outer orbit two ways. A hole either can capture a free electron that passes by or it can grab a bound electron from a neighboring atom. Whenever an electron does move into a hole location, a new hole is created in the crystal lattice at the point previously occupied by the electron.

Thus, if there is a continuous flow of electrons in one direction, there will be a corresponding flow of holes in the opposite direction. Holes behave as if they were positively charged particles. They are the charge carriers in P-type semiconductors. (Free electrons are the charge carriers in N-type semiconductors.)

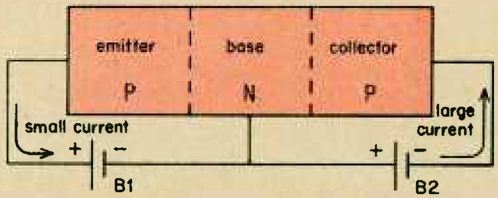


Fig. 3—PNP (or NPN) transistor can be seen as two diodes placed back-to-back. Emitter-base diode has forward bias; base-collector diode has reverse bias.

When the terminals of a P-type silicon chip are connected to a battery, electrons are pumped into the semiconductor. The flow of electrons in one direction is complemented by a flow of holes in the other direction. The more heavily silicon is doped with P-type material, the more holes are created. This enhances the flow of current inside the semiconductor.

Now let's examine a diode to see how the P-type and N-type regions work together to conduct electricity. (Remember that these regions are created by the diffusion of impurities into a bar of silicon—the layers are not constructed by joining seperate pieces of semiconductor material.)

Fig. 1 shows a diode connected to a battery. The dividing line between the two regions is called the PN junction. To the left of the junction is N-type material, to the right is P-type material. It's the behavior of electrons and holes in the vicinity of the PN junction that gives a semiconductor its unique properties.

For a detailed discussion of how electrons and holes flow in solid-state circuits you had better turn to a textbook. We'll speed up now and see how semiconductors operate as devices.

Reverting back to Fig 1. In this circuit, free electrons in the N-type material migrate toward the positive terminal of the battery

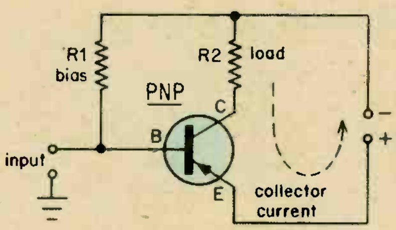


Fig. 4—PNP transistor amplifies when control current flowing through base regulates working current flowing to collector. Note its direction.

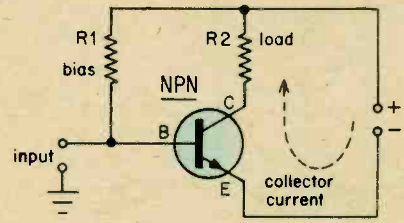


Fig. 5—NPN transistor amplifies in exact same manner only polarities are reversed and different charge carriers are responsible for current flow.

Basic Transistor Circuits

because unlike charges attract each other. Meanwhile, in the P-type material, positively charged holes are pulled toward the negative terminal. This happens instantly so that the diode appears to the battery as a very high resistance (since the charge carriers have moved away from the junction). The diode blocks further current flow around the external circuit and it's said to be in a state of *reverse bias*.

The diode is switched to a *forward bias* condition by reversing battery polarity, as shown in Fig. 2. Now the rules of like and unlike charges dictate that the holes and free electrons be repelled by the battery voltages. Only now they pile up at the junction. By crowding either side of the barrier, they form an electrical bridge that greatly reduces resistance across the PN junction. Now the diode appears as a low resistance in the circuit and external current can soar.

To convert a diode into a transistor, we'll add a second junction. A transistor sometimes is described as two diodes placed back to back and Fig. 3 shows why. When three semiconductor regions are built up into a PNP sandwich, one diode (emitter-base) forms at the left. Battery B1 causes current to flow because the forward bias overcomes junction resistance. Battery B2, however, prevents current flow between the base-collector regions because this diode is biased in the reverse direction.

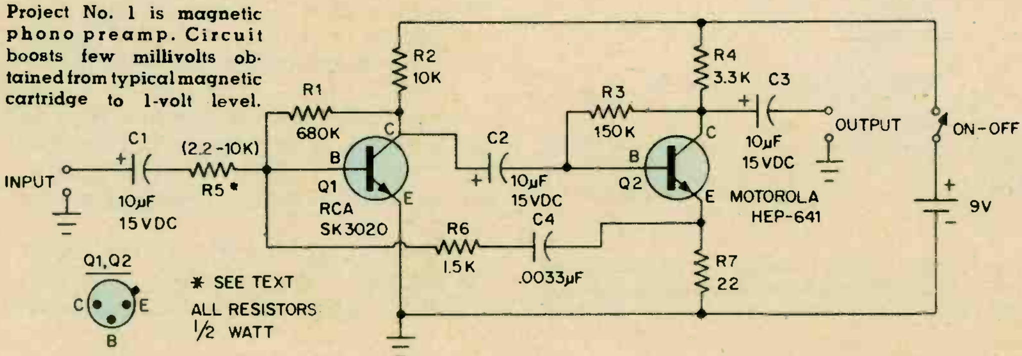
This is the classic PNP transistor poised for action. A tiny current flowing between emitter and base will manipulate a much greater current flowing between emitter and collector.

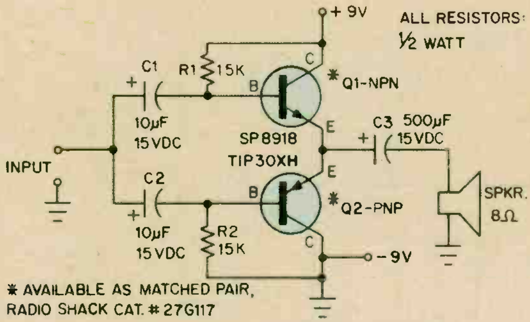
Amplification (see Fig. 4) occurs when the base resistor R1 taps a small bias voltage from the power supply to create forward bias between emitter and base. The base current of any transistor is always limited to a small value because the base region is constructed of extremely thin material. Its job is to reduce junction resistance. This allows a very large collector current to pass through the base region and reach the emitter.

Since a small base current controls a large collector current, the transistor works as an amplifier. In a PNP transistor, current flow is mostly via holes—though these positive charges never travel outside the semiconductor material.

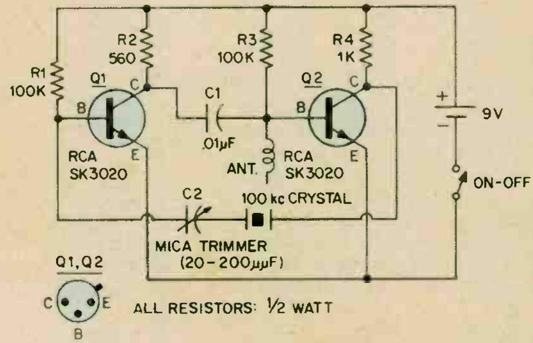
An NPN transistor (shown in Fig. 5) works according to the same rules except that all polarities are reversed and the major charge carriers are free electrons rather than

Project No. 1 is magnetic phono preamp. Circuit boosts few millivolts obtained from typical magnetic cartridge to 1-volt level.





Project No. 2 is complementary-symmetry output stage found in solid-state audio amplifiers. NPN and PNP devices can be hooked up in series.



Project No. 3 is 100-kc crystal calibrator. Circuit is called a multivibrator. Oscillator creates harmonics every 100 kc (up to 30 mc) in receiver.

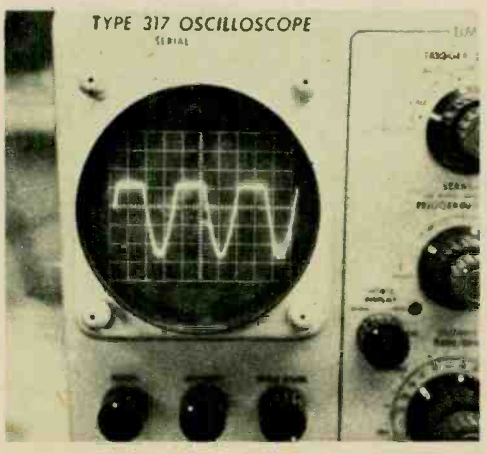
holes. In the early days of the transistor, most models were PNP types constructed from germanium. Today, silicon NPN types are more common.

Magnetic Phono Preamp. Project No. 1 is a circuit commonly found in hi-fi gear which raises the few millivolts obtained from a phono cartridge to the volt or so required by a solid-state power amplifier. Consider how the two NPN transistors are biased to bring them into operating condition.

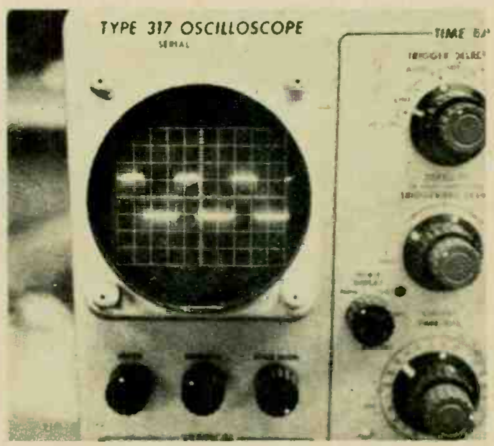
R1 is a base-bias resistor which taps a tiny positive voltage from the battery (through R2). This assures a forward-bias condition between base and emitter and a continuous (and much larger) current flow between collector and emitter. When a signal from the phono cartridge arrives at the base of Q1, the audio swings positive and negative, thereby adding or subtracting from the bias voltage. These changes are impressed on the collector current and an amplified signal emerges. This process is repeated in Q2 for additional gain.

A special feature of this circuit is phono equalization. During a recording session engineers artificially boost high tones to protect a balance between highs and lows that could be upset during the manufacturing process. When the disk is played back, these highs must be reduced in the preamp with an equalizer circuit. This is done by negative feedback.

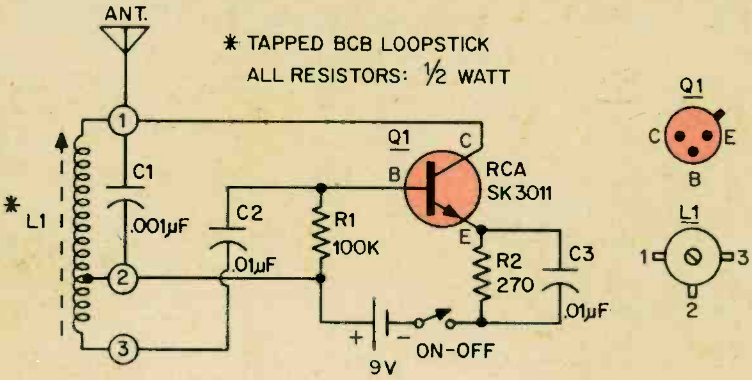
Note that a small resistor (R7) in the emitter lead of Q2 causes a small signal voltage to appear at this point. This sampling is fed back to the input of the preamp through C4 and R6. Since the feedback signal is always opposite in polarity to the input, it reduces the input signal by a slight amount.



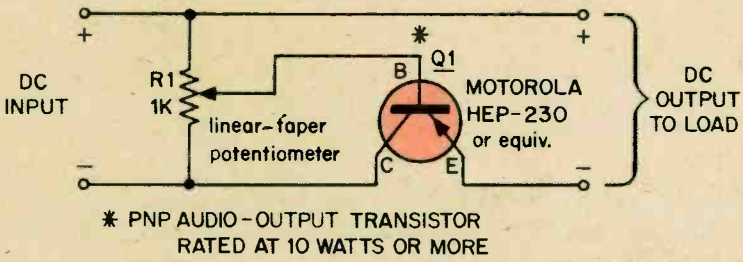
Transistors switch on and off in multivibrator circuit when they reach saturation and cut-off points. Sine wave has flat top when transistor saturates.



Actual square wave produced by multivibrator. Clipping at top is due to saturation; clipping of bottom portion represents transistor's cut-off point.



Project No. 4 is RF oscillator which covers frequency range of 350 kc to 1000 kc. It will serve for troubleshooting and aligning AM radios. To use it as a BFO (beat-frequency oscillator), tune it to standard IF frequency of 455 kc so it beats against carrier.



Project No. 5 shows how power transistor can control flow of current to a working load. Load can be small DC motor, lamp, etc. This voltage-control device requires large transistor heat sink. It's shown in photo on first page.

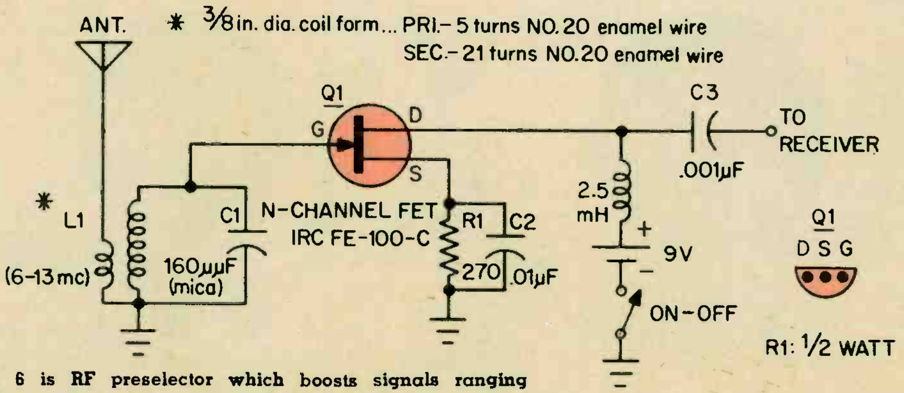
Basic Transistor Circuits

This only happens at high frequencies. The highs easily pass through capacitor C4, while low tones are blocked.

Some practical hints when you build this circuit. It is meant to handle a 5-millivolt cartridge signal (about average), so it may distort higher-level inputs. This can be cured by increasing the value of R5 within the range shown. You also can use this circuit as a dynamic mike preamp by eliminating the two feedback components, R6 and C4. The transistors draw less than 2 milliamperes so any 9-volt battery will work.

Complementary Symmetry. Project No. 2's circuit may jolt anyone brought up solely on vacuum tubes. Standard description of a vacuum tube tells of negative electrons boiling off a hot filament and rushing toward a highly positive plate. Never the reverse. Transistors not only change this image but

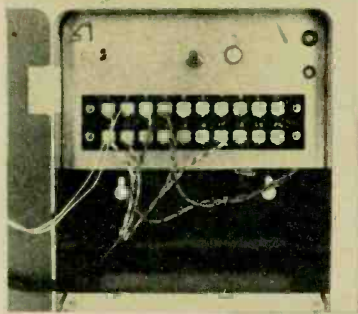
[*Continued on page* 100]



Project No. 6 is RF preselector which boosts signals ranging from 6 to 13 mc to improve performance of ham and shortwave receivers. Extended coverage to 30 mc is possible if coil is modified.

EI Kit Report

EICO FC-100



Wiring sensors and alarms to FC-100 control center, shown above with front panel open, is easy via screw terminals. Reset button is above terminal strips. Accessories for Eico system, seen from left to right, are: 8-in. bell, fire sensors, tamper switch, klaxon horn and a key-switch.

A Home-Protection System

PROTECTING your home used to mean building a fortress with moat and drawbridge. While it might have kept the uninvited from scaling the walls, today's homeowner needs a different kind of setup. Modern electronic home protection with bells and buzzers should not only warn of would-be intruders but also alert the occupants of an emergency inside the home as well.

Furthermore, a good home security system must be able to summon help when needed. Most of all, the system must be reliable and tamper-proof, the protective circuits designed so they cannot be disarmed.

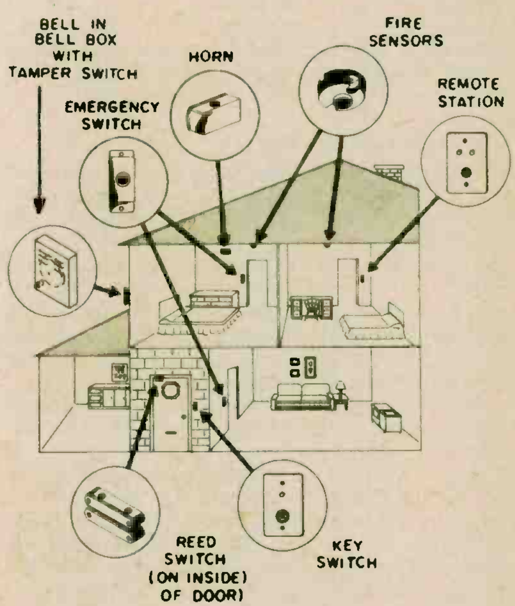
A home-security system offered by Eico can help the homeowner protect his property. Called Fail Safe, the entire system consists of a control center plus a wide variety of accessories enabling the homeowner to customize a protection system to meet his own needs. It requires no soldering to install.

Heart of the system is Eico's model FC-100 control center. This prewired box serves to terminate all sensor and alarm wiring. It also serves as a convenient place to house the power supply.

A wide assortment of sensors connected to the FC-100 gives the Eico system its versatility. Magnetic contact reed switches are available for doors and windows. A momentary key switch with signal light enables you to get into your home without setting off the alarm. Emergency buttons (commonly known as panic buttons in home-security parlance) located around the home can sound the alarm and summon help. Aluminum foil is available and can be stuck around the windows.

Wiring the Eico system is a breeze. Route connections from the various sensors to the

[*Continued on page* 103]



Locations of sensors and alarms in typical home.

CIE graduate builds two-way radio service business into $1,000,000 electronics company!

How about YOU? Growth of two-way transmitters creates demand for new servicemen, field and system troubleshooters. Licensed experts can make big money. Be your own boss, build your own company. And you don't need a college education.

Edward J. Dulaney, Scottsbluff, Nebraska, (above and at right) earned his CIE Diploma in 1961, got his FCC License and moved from TV repairman to lab technician to radio station Chief Engineer. He then founded his own two-way radio business. Now, Mr. Dulaney is also President of D & A Manufacturing, Inc., a $1,000,000 company building and distributing two-way radio equipment of his own design. Several of his 25 employees are taking CIE courses. He says: "While studying with CIE, I learned the electronics theories that made my present business possible."

Two-way radio is booming. There are already nearly seven million two-way transmitters for police cars, fire department vehicles, taxis, trucks, boats, planes, etc., and Citizens Band uses. And the number keeps growing by the thousands every month. Who is going to service them? You can — if you've got the know-how!

Why You'll Earn Top Pay

One reason is that the United States Government doesn't permit anyone to service two-way radio systems unless he's *licensed* by the FCC (Federal Communications Commission).

Another reason is that when two-way radio men are needed, they're *really* needed! A two-way radio *user* must keep those transmitters operating at all times. And, they *must* have their frequency modulation and plate power input checked at regular intervals by licensed personnel to meet FCC requirements.

As a licensed man, working by the hour, you would usually charge at least $5.00 per hour, $7.50 on evenings and Sundays, plus travel expenses.

Or you could set up a regular monthly retainer fee with each customer. Your fixed charge might be $20 a month for the base station and $7.50 for each mobile station. Studies show that one man can easily maintain at least 135 stations—averaging 15 base stations with 120 mobiles! This would add up to at least $12,000 a year.

Be Your Own Boss

There are other advantages, too. You can become your own boss — work entirely by yourself or gradually build your own fully staffed service company. Of course, we can't promise that you will be as successful as Ed Dulaney, or guarantee that you'll establish a successful two-way radio business of your own, but the opportunities for success are available to qualified, licensed men in this expanding field.

How To Get Started

How do you break in? This is probably the best way:

1. Without quitting your present job, learn enough about electronics fundamentals to pass the Government FCC exam and get your Commercial FCC License.
2. Then get a job in a two-way radio service shop and "learn the ropes" of the business.
3. As soon as you've earned a reputation as an expert, there are several ways you can go. You can move *out* and start signing up and servicing your own customers. You might become a franchised service representative of a big manufacturer and then start getting into two-way radio sales.

Cleveland Institute of Electronics has been successfully teaching Electronics for over 37 years. Right at home, in your spare time, you learn Electronics step by step.

CIE's AUTO-PROGRAMMED* Lessons remove the roadblocks by using simple, concise examples. You learn in small, compact steps — each one building on the other!

You'll learn not only the fundamentals that apply to all electronics design and servicing, but also the specific procedures for installing, troubleshooting, and maintaining two-way mobile equipment.

You Get Your FCC License... or Your Money Back!

By the time you've finished your CIE course, you'll be able to pass the FCC License exam. A recent survey of 787 CIE graduates reveals that better than 9 out of 10 CIE grads passed the FCC License exam. That's why we can offer our famous Money-Back Warranty: when you complete any CIE licensing course, you'll get your FCC License or be entitled to a full refund of all tuition paid. This warranty is valid during the completion time allowed for your course. You get your FCC License — or your money back!

It's Up To You

Mail the reply card for two FREE books, "Succeed in Electronics" and "How To Get A Commercial FCC License." If card has been removed, mail coupon or write: Cleveland Institute of Electronics, 1776 E. 17th Street, Cleveland, Ohio 44114.

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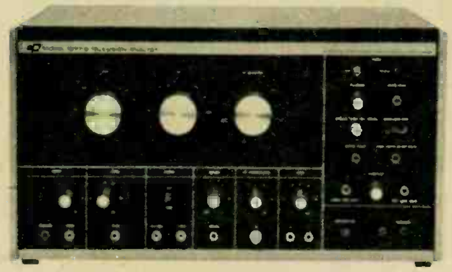
Signal Injecting Pinpoints



B&K's Model 1077 Television Analyst (above) is a miniature TV station which provides signals for any circuit. Sencore's Model SS137 Sweep Circuit Analyzer (at right) provides signals only for horizontal and vertical sweep stages.

Color TV Troubles

By
ART MARGOLIS

ONE of the quickest ways to locate troubles in color and b&w television receivers is to use the signal substitution technique. One generator can provide all of the TV signals broadcast by a television station and these can be injected into the appropriate circuits to pinpoint defects. The TV screen (CRT) displays the signals as they are developed in the set and gives an indication of what may be wrong.

Not only does signal injecting help you track down intermittents but it can save you time. Back in the Forties I realized that I either had to use signal-injection techniques or lose lots of money on each job. Since there were no all-purpose TV-signal generators available, I had to rig one up from an old TV chassis.

The set had a transformer for isolation, so all I had to do was tap into it to obtain the six test signals I wanted (see HOW TO TURN A JUNKED TV INTO A SIGNAL GENERATOR, July '71 EI). These included the tuner output, video output, vertical-grid output, vertical-plate output, horizontal-grid output and horizontal-plate output. Test probes plus a suitable ground brought these key substitute signals into the outside world.

During the Fifties, TV-signal injection gear became available, notably B&K's Television Analyst, Sencore's Sweep Circuit Analyzer and various flying-spot scanners. Most of this gear has been updated and today it's the most strategic test equipment you can have on your bench.

At first glance, signal injecting may seem a complex procedure. It isn't. You start by tackling the set in block-diagram fashion and you don't worry about locating faulty components until the inoperative circuit is pinpointed. A few case histories will prove the value—and quickness—of this technique.

Case of Collapsed Vertical. I had a five-year-old Philco portable on the bench in front of me. Instead of getting a raster, all that appeared on the screen was a white line which ran from side to side. There was no vertical sweep.

I turned down the brightness control to reduce the strength of the electron beam concentrated in that one line. This would prevent burning of the phosphor. Despite the fact that an aluminized picture tube is supposed to stop the heavy ions in the electron beam from striking the phosphor, I've seen plenty of burn marks.

I put a couple of tubes into the set but the condition remained the same. Then I looked around for my B&K Analyst so I could get a 60-cps sawtooth injection signal to troubleshoot the vertical stages. No luck. It was being used by another benchman across the room.

It isn't wise to begin without an injection test. The troublesome stage could be located anywhere from the vertical oscillator, the vertical output, on to the coils in the vertical deflection yoke. It's always best to narrow down suspects.

In this case, voltage readings with a VTVM would probably have been meaningless since with the lack of sweep the vertical oscillator would have lost its grid bias causing false voltage readings throughout.

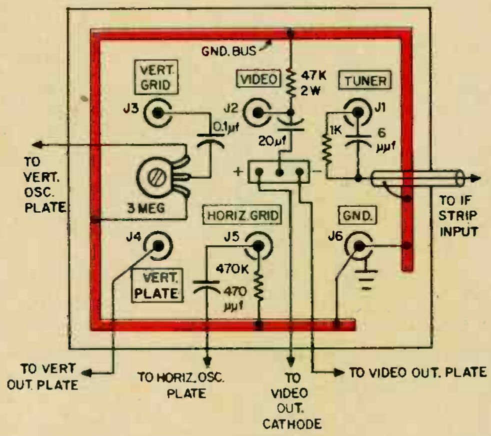
Since I didn't want to wait for the Analyst I reverted to an old trick. I took a jumper lead and a 0.05-microfarad capacitor rated at 600 volts, soldered the jumper to a 6.3-volt heater terminal on the chassis and used the capacitor end as a probe. Then I turned on the TV.

I knew I had a 60-cps signal coming out of the capacitor. Of course, it was a sine wave rather than a sawtooth but I also knew it would produce some sort of sweep—even if it was goofy looking.

I injected the makeshift signal into the control grid of the vertical-output stage. The picture spread out pretty well. It was not linear due to the sine wave but the spread proved that everything from the vertical-output stage onward was cleared of suspicion. The trouble had to be in the oscillator.

I crossed over the grid coupling capacitor and touched down on the plate of the vertical oscillator. Again there was some sweep. This exonerated all the components in the output circuit. Then I touched down on the oscillator's control grid. The white line didn't spread a bit.

I took the 0.05-mike capacitor lead and reattached it at the output. This caused the picture to spread again and restored most of the voltages. Otherwise I would have gotten



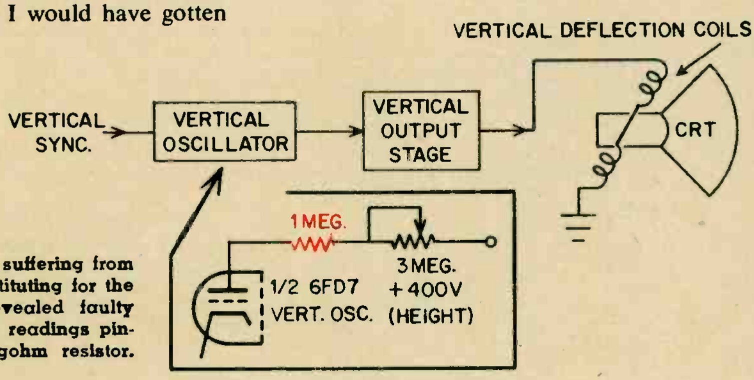
Test panel which author rigged up to tap signals from a junked TV set. Horizontal-output signal is tapped directly from metal cap on output tube.

false readings. Now that I had pinpointed the circuit I switched over to my VTVM.

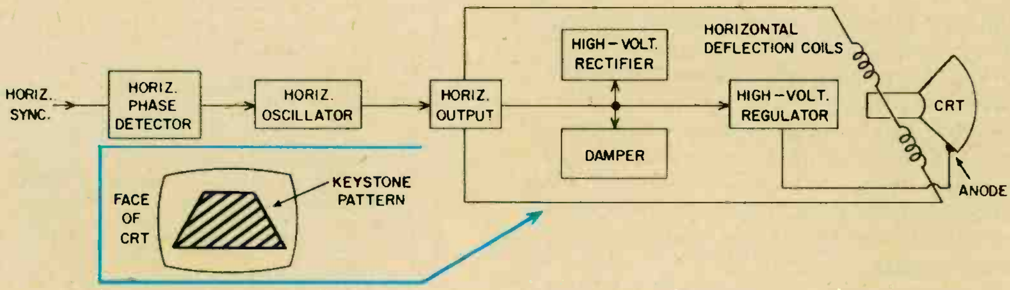
There was low plate voltage on the oscillator. The B+ supply was being fed through a 1-megohm resistor so I read its value. It read about 15 megohms. After I replaced the resistor, sweep was restored and much time was saved by signal injection.

Where's the High Voltage? The high-voltage system also serves as the horizontal sweep. A defect in either one causes the loss of both. There's a lot of circuitry. It extends from the horizontal phase detector, horizontal oscillator and horizontal output stage on through to the high-voltage rectifier, focus rectifier, high-voltage regulator, the damper and the horizontal coils in the deflection yoke.

While high-voltage problems can be tough, they can be sorted out by signal injection. I had a typical job just recently. It would have



In case of Philco portable suffering from loss of vertical sync, substituting for the 60-cps vertical signal revealed faulty vertical oscillator, voltage readings pinpointed defective one-megohm resistor.



Lack of high voltage in Zenith table model was due to bad deflection yoke. Fault was revealed by keystone pattern on set's picture tube. Horizontal sweep signals from B&K Analyst pinpointed defect.

Signal Injecting Pinpoints Color TV Troubles

taken hours of labor if I hadn't used injection techniques.

The set was a b&w Zenith table model with a no-brightness problem. I measured the high voltage at the anode of the CRT and it read about 2 kv instead of the 18 kv specified. Anything in the entire system could have been the cause.

I put in a new set of tubes and then rolled the Analyst over to the bench. The B&K Analyst provides both a horizontal-grid-drive signal and a horizontal-output signal. It's best to use the output signal first since using the grid drive means getting under the chassis or using a tube socket adapter. The output signal can be injected right into the metal cap which crowns the output tube.

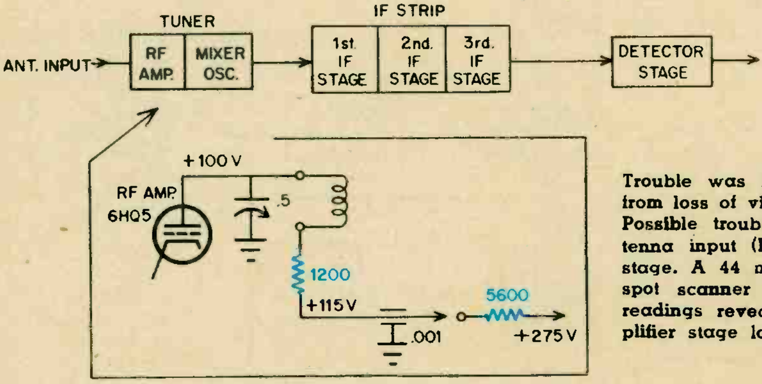
Once I had injected the output signal and turned on the TV, the picture tube seemed to bristle as if there were more high voltage. I was right. It now measured almost 10 kv.

I tried the brightness control. At one setting some light started to appear on the screen. If I could get some kind of image, the picture defect would indicate the source of my problems. I turned out the room lights and gingerly adjusted for brightness. A wedge-shape picture appeared. The classic keystone pattern—narrow at the top and wide at the bottom.

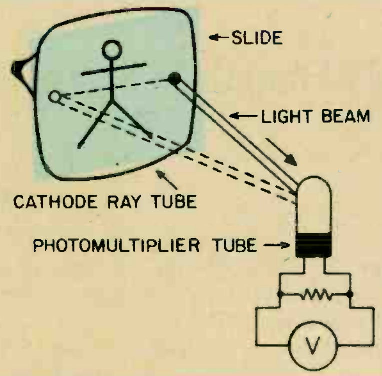
This was a positive indication of a bad deflection yoke. There was a short in one of the horizontal coils. I took a replacement yoke and plugged it in. The high voltage returned to normal and a bright picture appeared.

No Contrast, no Color. The symptom of brightness only, with no sound or picture, is quite common. When it's not caused by a tube, tracking down this defect can be quite a chore. That is, unless you have a flying-spot scanner handy to pinpoint the faulty circuit. This kind of gear can be expensive and isn't easy to come by, but fortunately one is included in the B&K Analyst.

A typical example of loss of video (the whole TV signal) stood before me in the form of a fairly new 23-in. color set. The raster shone brightly but no contrast or color



Trouble was 23-in. color set suffering from loss of video (color, contrast, etc.). Possible troublespots ranged from antenna input (RF amplifier) to detector stage. A 44 mc IF signal from flying-spot scanner plus some DC voltage readings revealed a defective RF amplifier stage located in the set's tuner.



Flying-Spot Scanner. Circuit which is basic to operation of test instruments like B&K's Television Analyst. Like ordinary TV set, flying-spot scanner has a picture tube, high-voltage section, sync, RF and IF stages, plus audio. It does not receive TV transmissions but develops an output from any transparency (test pattern) placed in front of tube. Slide is scanned by CRT's electron beam at vertical sweep of 60 cps and horizontal sweep of 15750 cps. Varying light output is detected by photomultiplier tube and signal voltage is obtained. Video is obtained from driver stages which provide gain in scanner's IF circuits, all other test signals are tapped from other appropriate points inside the scanner.

filled the screen and not a peep came from the speaker. The defective circuit could have been anywhere between the RF amplifier in the tuner to the video detector stage. This ballpark includes RF stages, IF stages, audio and video signals.

Since the IF stages used transistors I checked the only two tubes available but they were good. Then I brought over my flying-spot scanner to get some video into the set. I selected a 44-mc IF signal pattern and began looking for injection points.

You can inject IF signals anywhere in the strip. If you decide on a standard signal-tracing procedure, you might start at the output of the last IF stage and then work toward the input of the first stage. As you inject signals an image will or will not appear on the picture tube.

If an image does appear, the trouble is further back and all the circuitry from the point of injection to the picture tube is cleared. If an image doesn't appear, the troublespot is further along the road toward the picture tube. For instance, should you be working backwards along the IF strip and injecting signals point by point, as soon as the image doesn't appear on the screen you know you have passed over a bad component. If you work the other way, you'll have passed over the defective component once the image does appear on the screen.

With this in mind, I decided to inject the 44-mc signal at the IF input. A display appeared on the CRT. This meant the entire IF strip was okay and that the trouble was in the tuner.

Next step was to take some DC voltage readings. I put a tube socket adapter into the RF amplifier socket and read the plate voltages. There was zero volts instead of the normal B+. A glance at the schematic showed two resistors in series with the B+

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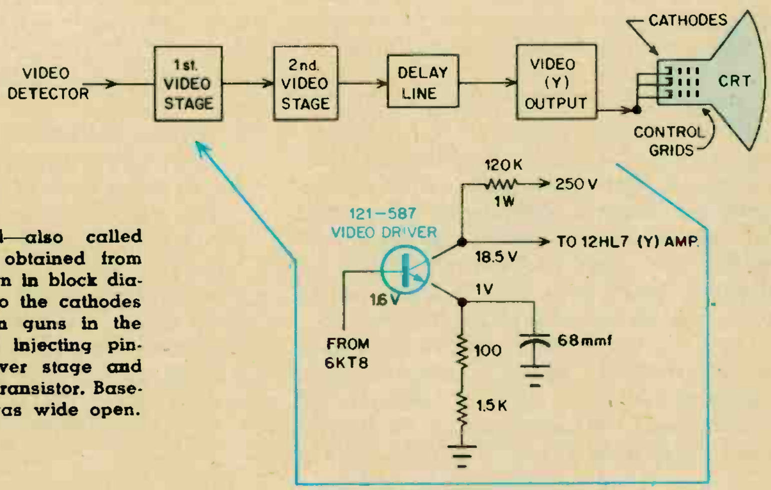

Luminance signal—also called the Y signal—is obtained from video stages shown in block diagram and is fed to the cathodes of all the electron guns in the color CRT. Signal injecting pinpointed video driver stage and isolated defective transistor. Base-to-collector path was wide open.

The Listener

By C. M. Stanbury II

TV From Outer Space?

SOME time ago, North America was scheduled to get its first direct satellite-to-home TV station. Target date was 1973 with the launching of NASA's ATS-F satellite. Parked in a synchronous orbit over the equator, it was supposed to beam educational TV programs into Alaska and the Rocky Mountain states on 850 mc (roughly UHF channel 77). Special receiving gear was to have been set up at schools and other public institutions, but any individual who wanted to tune in merely would have had to put down $200 for a special antenna—not an unreasonable price to get in on the ground floor of a new broadcast medium. Now the script has been changed.

First, the atmosphere at the International Telecommunication Union's space conference held in Geneva during summer of 1971 was somewhat hostile. An example of this is a statement made by Radio Sweden's Edward Ploman, who proclaimed ". . . we wish to get away from abstract or misunderstood ideas about direct-broadcast satellites indiscriminately flinging programs around the earth, since in any case this is not the way such systems will function. Satellite broadcast systems will not be luxury articles, but will be set up for definite purposes in order to answer well-defined requirements. The lack of requirements is also the reason why at present there are no plans for the development of systems designed for broadcasting into augmented or unaugmented home receivers."

The ITU did allocate some UHF-TV frequencies for space (630-790 mc, UHF channels 40 thru 67), but decreed that the video portion of such transmissions must be frequency-modulated, a requirement for which no existing TV receiver is equipped. This clearly was a step backwards, although enthusiasts would have been able to receive the audio portion of ATS-F programs.

NASA is going along with the ITU edict. In fact, the space agency is going even further and will switch satellite operations off conventional UHF channels to the Instructional Television Fixed Service band. The video carrier will be on 2570 mc, audio will be on 2670 mc. According to a recent FCC report, only 16 ITFS systems are operating in the United States (none are equipped for frequency-modulated video).

Meanwhile, the 1974 ATS-F satellite is scheduled to be moved to a spot over the Indian Ocean and will take part in an All India Radio educational TV experiment. AIR definitely favors conventional UHF broadcast channels for reasons of economy. The Russians also have considerable experience with these frequencies as their Molnya Communications Satellites use 800-mc channels.

World's Oldest Daytime Station. Station WDZ, Decatur, Illinois, according to our research, commenced operations in 1921 from nearby Tuscola. Despite its daytime status, WDZ has been one of the most progressive rural, pioneer broadcasters. Back in 1937, the station not only set up alternate studios at Danville, Mattoon and Effingham (all used daily), but was one of the first rural stations to use portable shortwave transmitters (with powers ranging from 2 to 30 watts) for remote broadcasts.

WDZ is not an easy logging for DXers, but because of its central location reception is remotely possible almost anywhere in North America at sunrise and sunset (local time). Exceptions are Toronto and New York City where stations CHUM and WHN hold down WD2's 1050 kc frequency. Chances for success will depend on the quality of your receiver.

DXing the Yemens. Radio broadcasting in rural America was achieved prior to 1940. But in many parts of the world this process is just now taking place. In the Yemeni Republic (Aden), only two transmitters operate regularly—a 7½-kw outlet on 5060 kc (occasionally heard in North America at 2230 EST) and a 50-kw outlet on 755 kc. Under the terms of a pact recently signed with the Soviet Union, a new, more powerful station is on the way.

In the neighboring Yemen Arab Republic

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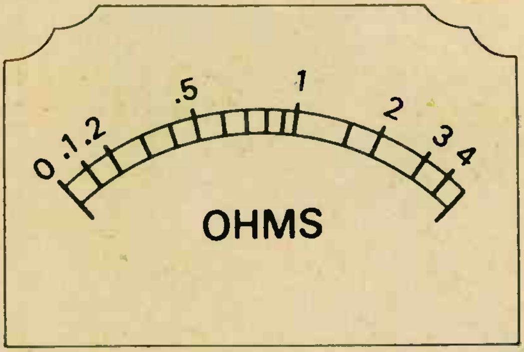

A Lo-Lo-Ohm Ohmmeter

By C. R. LEWART ANYONE familiar with trends in consumer electronics saw the chassis-mounted, plug-in circuit-board take shape some time ago. Plug-in boards obsolete the concept of individual component replacement. This time-saving feature simplifies and speeds up the repair of a TV or other appliance similarly built. Simply remove the defective stage and plug in a new board.

But quick-fix servicing isn't without its own peculiarities. Poor contact between the plug-in board and its mating connector provide the service technician with headaches similar to those experienced when tracking down a cold solder joint.

A bad connector will show an excessive resistance measurement typically from 10 to 50 *milli*ohms between mating surfaces. Ordinary VOMs cannot resolve such low values of resistance for a variety of reasons.

Non-linearity of the ohmmeter scale, sensitivity of the meter and physical width of the meter needle all limit your ability to read low resistances. And the overall lack of scale divisions below a couple of ohms makes resistance readings worthless on a conventional VOM.

Our Lo-Lo-Ohms Ohmmeter lets you measure resistance between 10 milliohms and 40 ohms full-scale. Though precise measurement of contact resistance is a natural chore for our LLO instrument, the experimenter and serviceman also will find it useful in other applications where it is obvious that resistance is low but you need to know just how low.

Commercial milliohmmeters having similar specifications cost several hundred dollars. Even if they were cheaper, none of these lab-grade instruments is readily available to the electronics experimenter. If all new components are used, cost of our milliohmmeter will be approximately $20. And if your junk-box is well stocked, you can built it for considerably less.

Current used to measure resistance of a connector assembly or similar low-value resistance component with our ohmmeter will not exceed 15 ma on any of the instrument's three ranges. Voltage between the meter's probes is limited to 15 mv on the most sensitive (10-400 milliohm) range, 150 mv on the 0.1- to 4-ohm range and 1.3 V on the 1-to-40-ohm setting.

How It Works. A small voltage is developed across probes P1 and P2 via resistors R11, R17 and one of the range resistors (R3 through R7) as selected by the S1A deck of the rotary switch. Amplitude of this voltage is approximately proportional to the parallel combination of resistance selected by S1A and the component being measured .

This voltage is amplified by integrated circuit IC1. Overall gain of this IC is about equal to the ratio of the particular range resistor selected by deck S1B of the rotary switch (R8 through R10) and resistor R1.

The amplified signal drives meter M1. It is calibrated so that measured resistance can be read directly in ohms.

The components at input terminals 4 and

A Lo-Lo-Ohm Ohmmeter

5 (resistors R2, R21, diodes D1 and D2) protect the IC against excessive input voltages. Germanium diodes limit the voltage across the amplifier input to about 0.3 V. Resistor R13 and capacitors C1 and C2 prevent IC1 from oscillating.

Pot R18 (*Calibrate*) is used for initial circuit calibration and to help compensate the circuit for low battery voltage. Pot R14 (*Null*) and resistors R12, R15 and R16 adjust the meter for zero null and compensate for

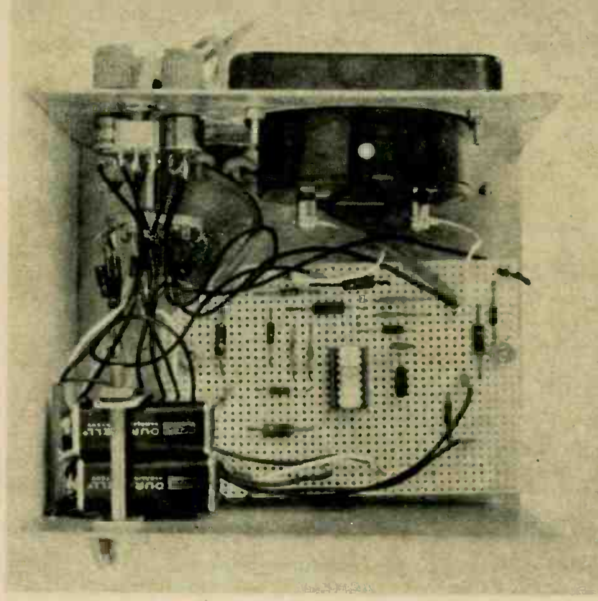

Fig. 1—Ohmmeter layout shown above. Test prod lead is 18-ga. stranded similar to Belden 8898. Battery bracket is made from U-shape sheet aluminum strip. Two battery holders work as well.

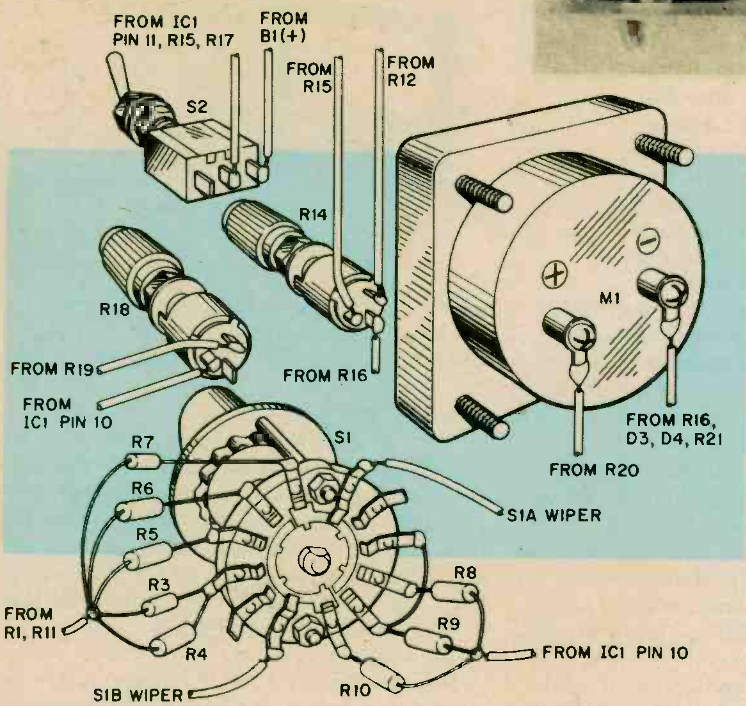

Fig. 2—Take care not to short ends of resistors R8, R9 going to lugs on S1A. Wiring isn't critical and substitutions in component tolerance can be tolerated if less accuracy is all right.

PARTS LIST

B1—Two 9-V transistor radio batteries wired in series
Capacitors: all 20% tolerance, 1000 VDC
C1—470 μμf disc ceramic
C2—22 μμf silvered mica
D1-D4—General-purpose germanium diode (IN34A or equiv.)
IC1—Integrated circuit (Motorola MC1709CL) see text
M1—0-1 ma. DC milliammeter (Lafayette 99R 50403)
P1,P2—Needle-point test prod (Calectro 33-384 or equiv.)
Resistors: ½-watt, 5% unless otherwise noted
R1,R5—100 ohms
R2,R21—1,000 ohms, ¼ watt
R3,R7—1 ohm, ¼ watt
R4,R6—10 ohms
R8,R11,R17—620 ohms, ¼ watt
R9—6,200 ohms
R10—62,000 ohms
R12—470,000 ohms, ¼ watt
R13—1,500 ohms
R14—100,000-ohms, linear-taper pot
R15—100,000 ohms
R16—470,000 ohms (see text)
R18—500-ohm, linear-taper pot
R19—750 ohms
R20—200 ohms
S1—Two-pole, six-position shorting-type rotary switch (Centralab PA-2002 or equiv.)
S2—SPDT miniature toggle switch
2—1-in. spacers
1—14-pin IC socket

Misc.—6 x 5 x 4-in. aluminum cabinet, perfboard, push-in terminals, rubber grommets, hardware, knobs, decals, etc.

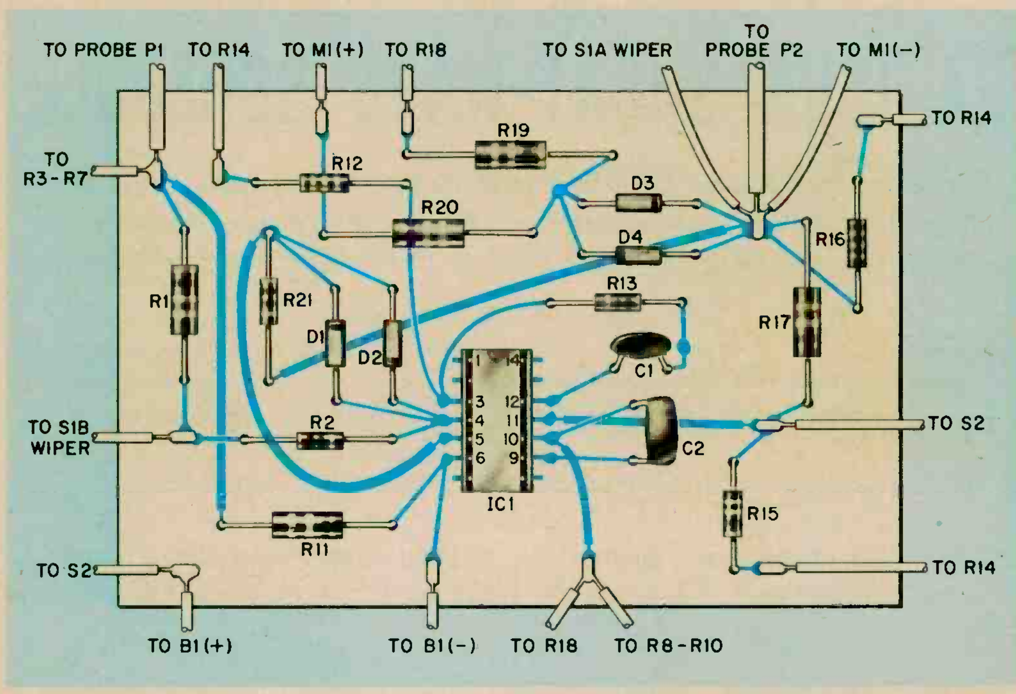

Fig. 3—Observe diode polarity and IC index tab positioning when wiring perfboard. Note 12 push-in lugs.

the resistance of the probe lead. Components R19, R20, D3 and D4 protect M1.

Building the Ohmmeter. Component selection, except for meter M1, is not critical. If you substitute another IC for the specified one, check the substituted IC's socket diagram against that of the MC1709CL. If you wire the socket correctly, the substitute IC should work, too.

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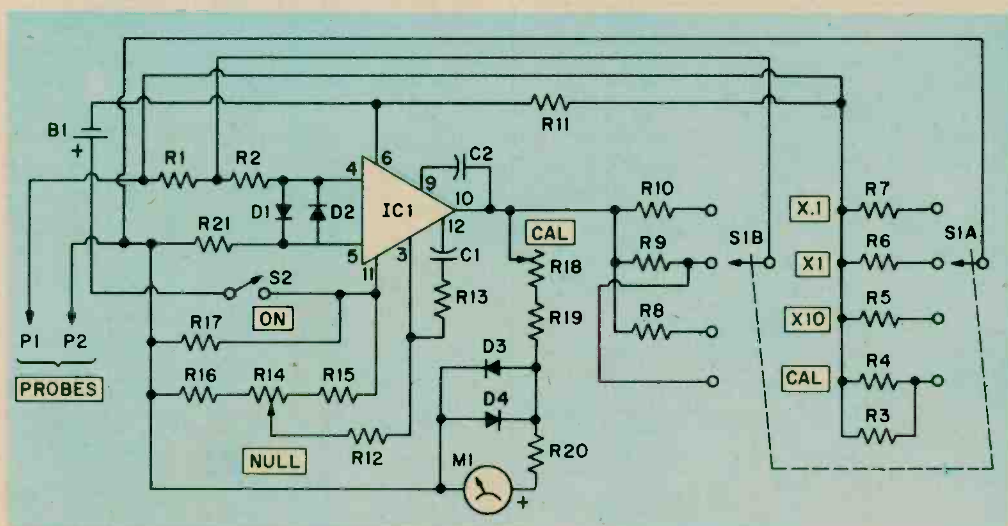
Fig. 4—Schematic of ohmmeter. Check pin connections against ones shown if another IC is used. See text.



24-HOUR SHORT-WAVE SCHEDULE

EI presents an updated Fifth Edition of its famous tabulation of English language short-wave broadcasts for 24 hours of the day—from nearly 100 countries. Keep it near your receiver to help you tune in the world.

ABBREVIATIONS USED IN THIS SCHEDULE

A.—Authority
Af.—African
B.C.—Broadcasting Co. (Corp.)
B.S.—Broadcasting Service (System, Station)
E.—East
Is.—Island(s)
N.—National (Nacional), North
Neth.—Netherlands
R.—Radio (Radiodiffusion, Radiodifusora)
S.—South
Terr.—Territory
TV—Television
V.—Voice (Voz) of the
W.—West
*—Beamed to North America
+—Beamed to western U.S.
#—Beamed to eastern U.S.

All times listed are Eastern Standard Time. To convert, subtract 1 hour for Central Standard Time, 2 hours for Mountain Standard Time and 3 hours for Pacific Standard Time. Schedules are daily, except when noted parenthetically, i.e., (1)—Sunday transmission, (2)—Monday transmission, etc. All frequencies are in kilocycles.

TIME (EST)	FREQ.	STATION (CALL)	LOCATION
12 MIDN.	3,346	Zambia B. S.	Lusaka, Zambia
	3,380	Malawi B. C.	Blantyre, Malawi
	4,925	R. Clube Mocambique	Lorenco Marques, Mozambique
	4,976	R. Uganda	Kampala, Uganda
	6,050	R. Clube Mocambique	Lorenco Marques, Mozambique
	6,145	Deutsche Welle, DMQ9	Cologne, W. Germany
	9,545*	Deutsche Welle, DMQ6	Cologne, W. Germany
	11,715+	R. Nederland Relay	Bonaire, Neth. Antilles
	11,910*	Thai N. B. S.	Bangkok, Thailand
12:15 A.M.	6,144	Nigerian B. C.	Calabar, Nigeria
	6,205	R. Nordsee International	International Waters
12:30 A.M.	3,396	Rhodesia B. C.	Gwelo, Rhodesia
	4,915	R. Ghana	Accra, Ghana
	6,090	RTV Kaduna	Kaduna, Nigeria
	6,155	Swazi Commercial R.	Mbabane, Swaziland
	17,840	R. Sweden	Stockholm, Sweden
12:45 A.M.	4,795	R. Brazzaville	Brazzaville, Congo Rep.
	11,890	R.V. Gospel, ETLF	Addis Ababa, Ethiopia
	15,115	V. Andes, HCJB	Quito, Ecuador
	15,190	R. Brazzaville	Brazzaville, Congo Rep.
1 A.M.	3,316	R. Sierra Leone	Freetown, Sierra Leone
	4,900	Nigerian B. C.	Maiduguri, Nigeria
	4,915	R. Ghana	Accra, Ghana
	4,932	Nigerian B. C.	Benin City, Nigeria
	9,540	R. New Zealand	Wellington, New Zealand
1:15 A.M.	9,720	Deutsche Welle Relay	Kigali, Rwanda
1:30 A.M.	3,255	Liberian B. C., ELBC	Monrovia, Liberia
	6,070	CFRB, Ltd., CFRX	Toronto, Canada
	7,275	V. Nigeria	Lagos, Nigeria
	7,290	Trans World R.	Monte Carlo, Monaco
	15,115	V. Andes, HCJB	Quito, Ecuador
1:45 A.M.	3,220	R. Fiji	Suva, Fiji
	3,227	Sudan Interior Mission, ELWA	Monrovia, Liberia
	6,175	V. Malaysia	Kuala Lumpur, Malaysia
	15,250	R. Bucharest	Bucharest, Rumania
2 A.M.	3,316	Sierra Leone B. C.	Freetown, Sierra Leone
	3,995	Solomon Is. B. S.	Honiara, Solomon Is.
	4,820	R. Gambia	Bathurst, Gambia
	9,505*	R. Japan	Tokyo, Japan
	9,590	Swiss B. C.	Berne, Switzerland
2:15 A.M.	5,990	Canadian B. C., CKNA	Montreal, Canada
	6,155	Far East Network	Tokyo, Japan
	6,205	R. Nordsee International	International Waters
2:30 A.M.	3,925	Australian B. C., VLK3	Port Moresby, Papua Terr.
	4,890	Australian B. C., VLT4	Port Moresby, Papua Terr.
	5,975	Canadian B. C.	Montreal, Canada
	7,245	Austrian R.	Vienna, Austria
	9,540	R. New Zealand	Wellington, New Zealand
	9,570	R. Australia	Melbourne, Australia
	11,735	V. Andes, HCJB	Quito, Ecuador
	17,880	R. Portugal	Lisbon, Portugal
	21,495	R. Portugal	Lisbon, Portugal
2:45 A.M.	3,995	Solomon Is. B. S.	Honiara, Solomon Is.
	5,960	V. Andes, HCJB	Quito, Ecuador
	6,175	V. Malaysia	Kuala Lumpur, Malaysia
	7,290	Trans World R.	Monte Carlo, Monaco
	11,730	R. Nederland Relay	Bonaire, Neth. Antilles
	11,780	R. Prague	Prague, Czechoslovakia
	11,900	V. Malaysia	Kuala Lumpur, Malaysia
3 A.M.	4,890	Australian B. C., VLT4	Port Moresby, Papua Terr.
	5,980	R. Sierra Leone	Freetown, Sierra Leone
	6,540	R. Pyongyang	Pyongyang, N. Korea
	15,150	R. Pyongyang	Pyongyang, N. Korea
	17,815	R. RSA	Johannesburg, South Africa
	21,545	R. RSA	Johannesburg, South Africa
3:15 A.M.	3,995	Solomon Is. B. S., VQO4	Honiara, Solomon Is.
	4,890	Australian B. C., VLT4	Port Moresby, Papua Terr.
	9,520	R. New Zealand	Wellington, New Zealand
	11,850(1)	R. Norway	Oslo, Norway
	15,165	R. Denmark, OZF7	Copenhagen, Denmark
	15,175(1)	R. Norway	Oslo, Norway
3:30 A.M.	3,322	R. Bougainville, VL9BA	Kieta, Bougainville
	11,890	Far East B. C.	Manila, Philippines
	17,830	R. Pakistan	Karachi, Pakistan
	17,880	R. Portugal	Lisbon, Portugal
	21,590	R. Pakistan	Karachi, Pakistan
3:45 A.M.	5,970	Canadian B. C., CKNA	Montreal, Canada
	9,625	Canadian B. C., CKLO	Montreal, Canada
	11,765	R. Australia	Melbourne, Australia
4 A.M.	3,230	R. Fiji	Suva, Fiji
	3,290	Guyana B. S.	Georgetown, Guyana
	5,980	R. Demerara	Georgetown, Guyana
	7,225	Far East B. C.	Manila, Philippines
	9,565	United Nations R.	New York, USA
	11,750	British B. C. Relay	Tebrau, Malaysia
4:15 A.M.	9,505	R. Japan	Tokyo, Japan
	9,585	V. Indonesia	Djakarta, Indonesia

TIME (EST)	FREQ.	STATION (CALL)	LOCATION
	11,850	British B. C. Relay	Tebrau, Malaysia
	15,430	V. Free Korea	Seoul, South Korea
4:30 A.M.	11,875	R. Japan	Tokyo, Japan
	11,940	R. Singapore	Singapore
4:45 A.M.	6,130	Maritime B. C., CHNX	Halifax, Canada
	7,131	V. Free China	Taipei, Taiwan
	7,295	V. Malaysia	Penang, Malaysia
	11,795	Deutsche Welle	Cologne, W. Germany
5 A.M.	3,995	Solomon Is. B. S.	Honiara, Solomon Is.
	6,030	V. Prairies, CFVP	Calgary, Canada
	6,160	Canadian B. C., CKZN	St. Johns, Canada
	9,505	R. Japan	Tokyo, Japan
	15,220	R. RSA	Johannesburg, South Africa
	17,820	R. RSA	Johannesburg, South Africa
	21,520	R. RSA	Johannesburg, South Africa
5:15 A.M.	9,570	R. Australia	Melbourne, Australia
	11,705	R. New Zealand	Wellington, New Zealand
	11,760	R. Australia	Melbourne, Australia
5:30 A.M.	5,052	R. Singapore	Singapore
	7,115	Thai National B. S.	Bangkok, Thailand
	9,520	R. New Zealand	Wellington, New Zealand
	11,905	Thai National B. S.	Bangkok, Thailand
5:45 A.M.	7,165	V. America Relay	Okinawa
	9,560	R. Pakistan	Karachi, Pakistan
	11,672	R. Pakistan	Karachi, Pakistan
	11,785	Deutsche Welle Relay	Kigali, Rwanda
	15,155	V. America Relay	Tinang, Philippines
	15,190	All India R.	New Delhi, India
	15,410	Deutsche Welle Relay	Kigali, Rwanda
6 A.M.	4,950	R. Malaysia Sarawak	Kuching, Sarawak
	4,985	R. Malaysia	Penang, Malaysia
	7,160	R. Malaysia Sarawak	Kuching, Sarawak
	7,165	V. America Relay	Okinawa, Ryukyu Is.
	7,235	British B. C. Relay	Tebrau, Malaysia
	7,280	All India R.	Gauhati, India
	9,585	V. Indonesia, 8FB22	Djakarta, Indonesia
	11,920	R. Bucharest	Bucharest, Rumania
	11,935	Springbok R.	Johannesburg, South Africa
	15,250	R. Bucharest	Bucharest, Rumania
6:15 A.M.	3,990	American Forces Network Taiwan	Taipei, Taiwan
	6,155	Far East Network	Tokyo, Japan
	7,115	Thai National B. S.	Bangkok, Thailand
	9,580	R. Australia	Melbourne, Australia
	17,830	Ceylon B. C.	Colombo, Ceylon
	21,690#	R. Sweden	Stockholm, Sweden
6:30 A.M.	3,335	R. Wewak, VL9CD	Wewak, Papua Terr.
	4,890	Australian B. C., VLT4	Port Morseby, Papua Terr.
	4,920	Australian B. C., VLM4	Brisbane, Australia
	9,610	Australian B. C., VLW9	Perth, Australia
	11,725	All India R.	Delhi, India
6:45 A.M.	5,047	R. Republik Indonesia	Jogjakarta, Indonesia
	6,120	R. 4VEH, 4VE	Cap Haitien, Haiti
	7,160	R. Malaysia Sarawak	Kuching, Sarawak
7 A.M.	4,950	R. Malaysia Sarawak	Kuching, Sarawak
	4,985	V. Malaysia	Penang, Malaysia
	5,052	R. Singapore	Singapore
	7,160	R. Malaysia Sarawak	Kuching, Sarawak
	7,295	V. Malaysia	Penang, Malaysia
	9,580*	R. Australia	Melbourne, Australia
	9,600	R. Tashkent	Tashkent, USSR
	9,660	V. Malaysia	Kuala Lumpur, Malaysia
	11,710*	R. Australia	Melbourne, Australia
	11,925	R. Tashkent	Tashkent, USSR
	15,115	R. Berlin International	Berlin, E. Germany
7:15 A.M.	6,092	V. Khmer Republic	Phnom Penh, Cambodia
	6,130(1)	R. Norway	Oslo, Norway
	7,225	Far East B. C.	Manila, Philippines
	8,890	Ulan Bator R.	Ulan Bator, Mongolia
	9,625*	Canadian B. C., CKLO	Montreal, Canada
	11,720	Canadian B. C., CHSB	Montreal, Canada
	11,820*	Trans World R.	Bonaire, Neth. Antilles
	15,195	R. Nederland Relay	Malagasy Republic
	15,325	Canadian B. C.	Montreal, Canada
	21,655(1)	R. Norway	Oslo, Norway
7:30 A.M.	6,065	R. Sweden	Stockholm, Sweden
	6,090	Australian B. C., VLI6	Sydney, Australia
	7,155	R. Amman	Amman, Jordan
	9,630	R. Sweden	Stockholm, Sweden
	9,640	V. Free Korea	Seoul, S. Korea
	9,770	R. 4VEH, 4VEH	Cap Haitien, Haiti
	15,519	R. Bangladesh	Dacca, Bangladesh
7:45 A.M.	6,005	Marconi R., CFCX	Montreal, Canada
	6,130	R. National Lao	Vientiane, Laos
	6,140	Australian B. C., VLW6	Perth, Australia
	9,480#	R. Peking	Peking, China
	11,835	Far East B. C.	Manila, Philippines
	15,095#	R. Peking	Peking, China
	15,445	Ulan Bator R.	Ulan Bator, Mongolia
	17,700	Ulan Bator R.	Ulan Bator, Mongolia
8 A.M.	6,140	Australian B. C., VLW6	Perth, Australia
	6,155	Far East Network	Tokyo, Japan
	6,160	Canadian B. C., CKZU	Vancouver, Canada
	9,650	S. East Asia R. V.	Manila, Philippines
	9,770	R. 4VEH, 4VEH	Cap Haitien, Haiti
	15,130	R. Pakistan	Islamabad, Pakistan
	15,250	R. Bucharest	Bucharest, Rumania
	15,440	Far East B. C.	Manila, Philippines
	17,710	R. Bucharest	Bucharest, Rumania
	17,935	R. Pakistan	Islamabad, Pakistan
	25,790	R. RSA	Johannesburg, South Africa
8:15 A.M.	4,890	Australian B. C., VLT4	Port Moresby, Papua Terr.
	11,745	V. Andes, HCJB	Quito, Ecuador
	11,810	All India R.	Delhi, India
	17,935	R. Pakistan	Islamabad, Pakistan
	21,725	Swiss B. C.	Berne, Switzerland
8:30 A.M.	6,590	R. Peking	Peking, China
	9,770	R. 4VEH, 4VEH	Cap Haitien, Haiti
	11,650	R. Peking	Peking, China
	11,835	R. 4VEH, 4VEJ	Cap Haitien, Haiti
	15,240	R. Peking	Peking, China
	15,200	R. 4VEH, 4VWI	Cap Haitien, Haiti
	15,315	R. V. Gospel, ETLF	Addis Ababa, Ethiopia
	15,335	All India R.	Delhi, India
	17,845	Swiss B. C.	Berne, Switzerland
8:45 A.M.	11,920	V. Andes, HCJB	Quito, Ecuador
	15,180	R. V. Gospel, ETLF	Addis Ababa, Ethiopia
9 A.M.	4,775	R. Afghanistan	Kabul, Afghanistan
	4,950	R. Malaysia Sarawak	Kuching, Sarawak
	9,560	R. Japan	Tokyo, Japan
	9,600	R. Tashkent	Tashkent, USSR
	11,900	R. RSA	Johannesburg, South Africa
	11,940	R. Singapore	Singapore
	17,810	R. Nederland	Hilversum, Netherlands
9:15 A.M.	6,130	R. Ghana	Accra, Ghana
	7,215	R. Brunei	Tutong, Brunei
	15,260	R. Nederland Relay	Malagasy Rep.
	17,825#(1)	R. Norway, LLN	Oslo, Norway
	17,870	R. Ghana	Accra, Ghana
9:30 A.M.	9,585*	V. Indonesia	Djakarta, Indonesia
	11,795*	V. Indonesia	Djakarta, Indonesia
	21,505	R. Sweden	Stockholm, Sweden
	21,520	R. Berlin International	Berlin, E. Germany
9:45 A.M.	9,515	R. Pyongyang	Pyongyang, N. Korea
	9,610	Australian B. C., VLW9	Perth, Australia
	15,150	R. Pyongyang	Pyongyang, N. Korea
10 A.M.	5,040	Burma B. S.	Rangoon, Burma
	6,130	R. Ghana	Accra, Ghana
	6,160	Canadian B. C., CKZU	Vancouver, Canada
	6,235	R. Pakistan	Karachi, Pakistan
	9,585	V. Indonesia	Djakarta, Indonesia
	9,675	R. Pakistan	Karachi, Pakistan
	11,795	V. Indonesia	Djakarta, Indonesia
	11,800	Ceylon B. C.	Colombo, Ceylon
	11,810	All India R.	Delhi, India
	15,320*	Canadian B. C.	Montreal, Canada

TIME (EST)	FREQ.	STATION (CALL)	LOCATION
10:15 A.M.	11,810(4)	Vatican R.	Vatican City
	11,865	Swiss B. C.	Berne, Switzerland
	15,305	Swiss B. C.	Berne, Switzerland
	17,810	R. Nederland	Hilversum, Netherlands
	17,830	Swiss B. C.	Berne, Switzerland
	21,480	R. Nederland	Hilversum, Netherlands
10:30 A.M.	6,055	R. Prague	Prague, Czechoslovakia
	9,620	R. Belgrade	Belgrade, Yugoslavia
	10,040	V. Vietnam	Hanoi, N. Vietnam
	11,735	R. Belgrade	Belgrade, Yugoslavia
	12,030	V. Vietnam	Hanoi, N. Vietnam
	15,240	R. Belgrade	Belgrade, Yugoslavia
10:45 A.M.	15,200	V. Nigeria	Lagos, Nigeria
	17,840	R. Prague	Prague, Czechoslovakia
	21,545	R. Ghana	Accra, Ghana
11 A.M.	9,595	R. Kuwait	Kuwait
	11,900	R. RSA	Johannesburg, South Africa
	15,220	R. RSA	Johannesburg, South Africa
	15,345	R. Kuwait	Kuwait
	17,880	R. Berlin International	Berlin, E. Germany
	21,735	R. Prague	Prague, Czechoslovakia
11:15 A.M.	9,675	R. Warsaw	Warsaw, Poland
	11,705	Vatican R.	Vatican City
	15,440	Far East B. C.	Manila, Philippines
11:30 A.M.	11,835	R. Omdurman	Omdurman, Sudan
11:45 A.M.	9,560	R. Amman	Amman, Jordan
	9,735	Deutsche Welle Relay	Kigali, Rwanda
	11,965	Deutsche Welle Relay	Kigali, Rwanda
	15,100	R. Grenada	St. George's, Grenada
12 NOON	6,065	R. V. Gospel, ETLF	Addis Ababa, Ethiopia
	9,915	British B. C.	London, England
	11,765	Deutsche Welle	Cologne, W. Germany
	15,275	Deutsche Welle	Cologne, W. Germany
	15,345	Kuwait B. S.	Kuwait
	17,845	R. New York World-wide, WNYW	New York USA
	21,525	R. New York World-wide, WNYW	New York USA
12:15 P.M.	9,735	Deutsche Welle Relay	Kigali, Rwanda
	11,735	RTV Moroccaine	Rabat, Morocco
	11,855	B. S. Kingdom Saudi Arabia	Djeddah, Saudi Arabia
	11,965	Deutsche Welle Relay	Kigali, Rwanda
	15,345	Kuwait B.S.	Kuwait
	21,720	R. Ghana	Accra, Ghana
12:30 P.M.	9,605	R. Prague	Prague, Czechoslovakia
	11,790	American Forces RTVS	Washington, USA
	11,855	B. S. Kingdom Saudi Arabia	Djeddah, Saudi Arabia
	11,950	Far East B. Associates	Victoria, Seychelles
	11,995	R. Prague	Prague, Czechoslovakia
	15,265	R. Prague	Prague, Czechoslovakia
	15,275	Deutsche Welle, DMQ15	Cologne, W. Germany
	17,655	R. Cairo	Cairo, Egypt
12:45 P.M.	15,080	All India R.	Bombay, India
	15,345	Kuwait B. S.	Kuwait
1 P.M.	9,530	R. Afghanistan	Kabul, Afghanistan
	9,550	Finnish B. C., OIX2	Pori, Finland
	9,685	V. Free China	Taipei, Taiwan
	9,705	R. V. Gospel, ETLF	Addis Ababa, Ethiopia
	11,755	Finnish B. C., OIX8	Pori, Finland
	11,780	R. Clube Mocambique	Lorenco Marques, Mozambique
	15,125	V. Free China	Taipei, Taiwan
	15,185	Finnish B. C. OIX5	Pori, Finland
1:15 P.M.	9,530	R. Afghanistan	Kabul, Afghanistan
	9,765	V. Free China	Taipei, Taiwan
	11,780	R. Clube Mocambique	Lorenco Marques, Mozambique
	11,825	V. Free China	Taipei, Taiwan
	11,855	B.S. Kingdom Saudi Arabia	Djeddah, Saudi Arabia
	11,935	R. Portugal	Lisbon, Portugal
	21,495	R. Portugal	Lisbon, Portugal

TIME (EST)	FREQ.	STATION (CALL)	LOCATION
1:30 P.M.	7,215	RTV Ivorienne	Abidjan, Ivory Coast
	7,240	R. Belgrade	Belgrade, Yugoslavia
	9,620	R. Belgrade	Belgrade, Yugoslavia
	11,705	R. Lebanon	Beirut, Lebanon
	11,920	RTV Ivorienne	Abidjan, Ivory Coast
	11,925	Kuwait B. S.	Kuwait
	15,420	British B. C. Relay	Cyprus
	21,570	R. Nederland Relay	Bonaire, Neth. Antilles
1:45 P.M.	7,065	R. Tirana	Tirana, Albania
	9,695	R. RSA	Johannesburg, South Africa
	11,940	Kuwait B. S.	Kuwait
	15,320	Canadian B. C., CKCS	Montreal, Canada
	15,420	British B. C. Relay	Cyprus
	17,720	V. Free China	Taipei, Taiwan
	21,595	Canadian B. C.	Montreal Canada
2 P.M.	6,540	R. Pyongyang	Pyongyang, N. Korea
	7,195	V. America Relay	Monrovia, Liberia
	7,215	All India R.	Delhi, India
	9,515	R. Pyongyang	Pyongyang, N. Korea
	11,875	R. Portugal	Lisbon, Portugal
	11,950	Trans World R.	Monte Carlo, Monaco
	15,105*	R. Japan	Tokyo, Japan
	15,435	R. Tanzania	Dar es Salaam, Tanzania
2:15 P.M.	4,885	V. Kenya	Nairobi, Kenya
	7,240	V. Kenya	Nairobi, Kenya
	11,815	R. Japan	Tokyo, Japan
	11,940	Sudan Interior Mission, ELWA	Monrovia, Liberia
	15,200	V. Nigeria	Lagos, Nigeria
2:30 P.M.	6,070	R. Sofia	Sofia, Bulgaria
	6,150	R. Bucharest	Bucharest, Rumania
	7,195	V. America Relay	Monrovia, Liberia
	9,500	R. Tirana	Tirana, Albania
	9,700	R. Sofia	Sofia, Bulgaria
	9,715	R. Nederland	Hilversum, Netherlands
	9,745	R. Baghdad	Baghdad, Iraq
	17,800	Vatican R.	Vatican City
	21,570	R. Nederland	Hilversum, Netherlands
2:45 P.M.	4,770	Sudan Interior Mission, ELWA	Monrovia, Liberia
	4,800	R. Lesotho	Maseru, Lesotho
	7,275	RAI	Rome, Italy
	9,670	IBRA Radio	Sines, Portugal
	9,710	RAI	Rome, Italy
	11,620	All India R.	Delhi, India
	11,800	RAI	Rome, Italy
	11,910	R. V. Gospel, ETLF	Addis Ababa, Ethiopia
3 P.M.	6,040	V. America Relay	Monrovia, Liberia
	6,090	R. Baghdad	Baghdad, Iraq
	9,575	RAI	Rome, Italy
	11,850*	R. Ghana	Accra, Ghana
	11,910	R. V. Gospel, ETLF	Addis Ababa, Ethiopia
	11,930	R. Grenada	St. George's, Grenada
	15,084	R. Iran	Teheran, Iran
3:15 P.M.	6,205	R. Nordsee Int.	International Waters
	9,690	R. New York World-wide, WNYW	New York, USA
	9,760*	R. Ghana	Accra, Ghana
	11,620	All India R.	Delhi, India
	11,850*	R. Ghana	Accra, Ghana
3:30 P.M.	5,038	R. N. Centrafricaine	Bangui, Central Af. Rep.
	9,655	Syrian B. S.	Damascus, Syria
	11,890	R. New York World-wide, WNYW	New York, USA
	11,920	RTV Ivorienne	Abidjan, Ivory Coast
	15,145	R. N. Espana	Madrid, Spain
	15,185	Office RTV Francaise	Paris, France
	15,340	R. WINB	Red Lion, USA
	15,425	R. Habana Cuba	Havana, Cuba
	17,725	R. Cairo	Cairo, Egypt
	21,525	R. New York World-wide, WNYW	New York, NSA
3:45 P.M.	5,038	R. N. Centrafricaine	Bangui, Central Af. Rep.
	6,065	R. Sweden	Stockholm, Sweden
	6,170	Israel B. A.	Jerusalem, Israel
	6,205	R. Nordsee Int.	International Waters
	9,460	R. Pakistan	Karachi, Pakistan
	9,625	Israel B. A.	Jerusalem, Israel
	9,640	Vatican R.	Vatican City
	11,970	Sudan Interior Mission, ELWA	Monrovia, Liberia
	15,100	R. Grenada	St. George's, Grenada

TIME (EST)	FREQ.	STATION (CALL)	LOCATION
4 P.M.	5,026	R. Uganda	Kampala, Uganda
	9,650	Canadian B. C.	Montreal, Canada
	15,295	R. Australia	Melbourne, Australia
	15,325	Canadian B. C.	Montreal, Canada
	15,340	R. WINB	Red Lion, USA
4:15 P.M.	6,005	Marconi R., CFCX	Montreal, Canada
	7,125	V. Revolution	Conakry, Guinea
	9,009	Israel B. A.	Jerusalem, Israel
	9,625	Israel B. A.	Jerusalem, Israel
	9,650	V. Revolution	Conakry, Guinea
	11,905	United Nations R.	New York, USA
	17,760	R. New York World-wide, WNYW	New York, USA
4:30 P.M.	6,025	R. Budapest	Budapest, Hungary
	6,110	British B. C.	London, England
	9,580	British B. C.	London, England
	11,780	British B. C.	London, England
	15,300	V. Andes, HCJB	Quito, Ecuador
	17,740	V. Andes, HCJB	Quito, Ecuador
4:45 P.M.	15,300	V. Andes, HCJB	Quito, Ecuador
	17,790	American Forces RTVS	Washington, USA
	17,795	R. Australia	Melbourne, Australia
5 P.M.	3,316	R. Sierra Leone	Freetown, Sierra Leone
	4,770	Sudan Interior Mission, ELWA	Monrovia, Liberia
	6,130	R. Ghana	Accra, Ghana
	7,130	British B. C.	London, England
	7,150	R. Moscow	Moscow, USSR
	9,515	R. Ankara	Ankara, Turkey
	9,545	R. Ghana	Accra, Ghana
	9,570	RTV Kaduna	Kaduna, Nigeria
	9,620	R. Belgrade	Belgrade, Yugoslavia
	11,780	British B. C.	London, England
	11,860(1)	R. Norway	Oslo, Norway
	15,195	R. Ankara	Ankara, Turkey
	15,205	V. America Relay	Tangier, Morocco
	15,285	R. Ghana	Accra, Ghana
	17,820	V. America	Dixon, USA
5:15 P.M.	3,255	Liberian B. C.	Monrovia, Liberia
	4,820	R. Gambia	Bathurst, Gambia
	6,010	R. Moscow	Moscow, USSR
	9,695*	R. RSA	Johannesburg, South Africa
	9,715*	R. Nederland	Hilversum, Netherlands
	9,805	R. Cairo	Cairo, Egypt
	11,730*	R. Nederland	Hilversum, Netherlands
	11,970*	R. RSA	Johannesburg, South Africa
5:30 P.M.	6,110	British B. C.	London, England
	9,560	R. RSA	Johannesburg, South Africa
	9,580	British B. C.	London, England
	9,645	R. Norway	Oslo, Norway
	9,710	R. Nederland	Hilversum, Netherlands
	11,730	R. Nederland	Hilversum, Netherlands
	11,850	R. Norway	Oslo, Norway
	11,970	R. RSA	Johannesburg, South Africa
5:45 P.M.	3,316	R. Sierra Leone	Freetown, Sierra Leone
	4,900	Nigerian B. C.	Maiduguri, Nigeria
	4,980	R. Ghana	Accra, Ghana
	5,015	R. Grenada	St. George's, Grenada
	6,050	Western Nigerian B. S.	Ibadan, Nigeria
	9,610	R. Vilnius	Vilnius, USSR
6 P.M.	6,015	V. America Relay	Rhodes, Greece
	7,235	All India R.	Delhi, India
	9,530	All India R.	Delhi, India
	9,550	RTV Belge	Brussels, Belgium
	11,710	All India R.	Delhi, India
	11,945	Canadian B. C.	Montreal, Canada
	15,235	RTV Belge	Brussels, Belgium
	15,345	Trans World R.	Bonaire, Neth. Antilles
6:15 P.M.	5,015	R. Grenada	St. George's, Grenada
	6,015	V. America Relay	Rhodes, Greece
	7,038	V. Vietnam	Hanoi, N. Vietnam
	7,130	British B. C.	London, England
	10,040	V. Vietnam	Hanoi, N. Vietnam
	11,970	R. RSA	Johannesburg, South Africa
	15,435	British B. C. Relay	Tebrau, Malaysia
6:30 P.M.	6,035	R. Warsaw	Warsaw, Poland
	9,560*	R. RSA	Johannesburg, South Africa
	9,695*	R. RSA	Johannesburg, South Africa
	10,006	Liberation Radio	Clandestine

TIME (EST)	FREQ.	STATION (CALL)	LOCATION
	11,970*	R. RSA	Johannesburg, South Africa
	15,185	V. America Relay	Tinang, Philippines
6:45 P.M.	6,080*	R. RSA	Johannesburg, South Africa
	9,695	R. RSA	Johannesburg, South Africa
	11,745	V. Andes, HCJB	Quito, Ecuador
	15,445*	R. Japan	Tokyo, Japan
	17,825*	R. Japan	Tokyo, Japan
7 P.M.	7,065	R. Tirana	Tirana, Albania
	9,700	R. Sofia	Sofia, Bulgaria
	9,780	R. Tirana	Tirana, Albania
	15,095	R. Peking	Peking, China
	15,435	British B. C. Relay	Tebrau, Malaysia
	17,673	R. Peking	Peking, China
	17,860	British B. C. Relay	Tebrau, Malaysia
7:15 P.M.	7,150*	R. Moscow	Moscow, USSR
	9,610(1)	R. Norway	Oslo, Norway
	9,790	R. Tirana	Tirana, Albania
	11,675	R. Peking	Peking, China
	11,835	R. 4VEH	Cap Haitien, Haiti
	11,935*	R. Portugal	Lisbon, Portugal
7:30 P.M.	6,025*	R. Portugal	Lisbon, Portugal
	6,175#	R. Sweden	Stockholm, Sweden
	7,150(2,6,7)	R. Kiev	Kiev, USSR
	7,175	R. Nederland Relay	Malagasy Rep.
	9,510	British B. C. Relay	Ascension Is.
	9,665(2,6,7)	R. Kiev	Kiev, USSR
	9,685(2,6,7)	R. Kiev	Kiev, USSR
	9,770	Austrian R.	Vienna, Austria
	11,970	R. RSA	Johannesburg, South Africa
	11,975	R. Grenada	St. George's, Grenada
	15,145	V. America Relay	Tinang, Philippines
	15,290	V. America Relay	Tinang, Philippines
	5,990	Vatican R.	Vatican City
7:45 P.M.	6,125	RTV Belge	Brussels, Belgium
	9,615	Vatican R.	Vatican City
	9,770	R. Tirana	Tirana, Albania
	11,725	Vatican R.	Vatican City
	11,815	Trans World R.	Bonaire, Neth. Antilles
	11,875	RTV Belge	Brussels, Belgium
	15,235	RTV Belge	Brussels, Belgium
8 P.M.	6,010	RAI	Rome, Italy
	6,075	Ceylon B. C.	Colombo, Ceylon
	6,090	R. Luxembourg	Villa Louvigny, Luxembourg
	6,130	Maritime B. C., CHNX	Halifax, Canada
	6,165*	R. Budapest	Budapest, Hungary
	7,200*	R. Moscow	Moscow, USSR
	9,540	R. Prague	Prague, Czechoslovakia
	9,575*	RAI	Rome, Italy
	9,625	Canadian B. C.	Montreal, Canada
	9,715	R. New York World-wide, WNYW	New York, USA
	9,720	Ceylon B. C.	Colombo, Ceylon
	15,120	Ceylon B. C.	Colombo, Ceylon
	15,320*	R. Australia	Melbourne, Australia
	17,795*	R. Australia	Melbourne, Australia
	17,880	R. Japan	Tokyo, Japan
	21,740*	R. Australia	Melbourne, Australia
8:15 P.M.	3,300	R. Grenada	St. George's, Grenada
	5,930*	R. Prague	Prague, Czechoslovakia
	6,040	Deutsche Welle	Cologne, W. Germany
	6,090	R. Luxembourg	Villa Louvigny, Luxembourg
	7,200*	R. Moscow	Moscow, USSR
	9,510	R. N. Espana	Madrid, Spain
	9,540	R. Prague	Prague, Czechoslovakia
	9,560	R. RSA	Johannesburg, South Africa
	9,575*	RAI	Rome, Italy
	9,690	R. RSA	Johannesburg, South Africa
	11,815	Trans World R.	Bonaire, Neth. Antilles
	11,865	Canadian B. C.	Montreal, Canada
	11,990*	R. Prague	Prague, Czechoslovakia
	15,320*	R. Australia	Melbourne, Australia
	17,795*	R. Australia	Melbourne, Australia
	21,740*	R. Australia	Melbourne, Australia
8:30 P.M.	5,980#	R. Bucharest	Bucharest, Rumania
	6,040*	Deutsche Welle	Cologne, W. Germany
	6,075*	Deutsche Welle	Cologne, W. Germany
	6,150#	R. Bucharest	Bucharest, Rumania
	9,625*	Canadian B. C.	Montreal, Canada
	9,690#	R. Bucharest	Bucharest, Rumania
	9,735*	Deutsche Welle	Cologne, W. Germany
	11,715	Swiss B. C.	Berne, Switzerland
	11,865*	Canadian B. C.	Montreal, Canada
	11,940#	R. Bucharest	Bucharest, Rumania
	15,235	R. Japan	Tokyo, Japan

TIME (EST)	FREQ.	STATION (CALL)	LOCATION
	15,250#	R. Bucharest	Bucharest, Rumania
	17,795*	R. Australia	Melbourne, Australia
	21,740*	R. Australia	Melbourne, Australia
8:45 P.M.	6,080*	R. RSA	Johannesburg, South Africa
	6,120	Swiss B. C.	Berne, Switzerland
	6,200	R. Tirana	Tirana, Albania
	7,300	R. Tirana	Tirana, Albania
	7,345*	R. Prague	Prague, Czechoslovakia
	9,535	Swiss B. C.	Berne, Switzerland
	9,560	R. RSA	Johannesburg, South Africa
	9,630*	R. Prague	Prague, Czechoslovakia
	9,695*	R. RSA	Johannesburg, South Africa
	9,750	Swiss B. C.	Berne, Switzerland
	9,780	R. Tirana	Tirana, Albania
	11,715	Swiss B. C.	Berne, Switzerland
	11,970*	R. RSA	Johannesburg, South Africa
	15,320*	R. Australia	Melbourne, Australia
	15,519	R. Bangladesh	Dacca, Bangladesh
9 P.M.	6,025	R. Portugal	Lisbon, Portugal
	6,035*	R. Warsaw	Warsaw, Poland
	9,585	Finnish B. C.	Pori, Finland
	9,675*	R. Warsaw	Warsaw, Poland
	9,680#	R. Moscow	Moscow, USSR
	11,730	R. Nederland Relay	Bonaire, Neth. Antilles
	11,840*	R. Warsaw	Warsaw, Poland
	11,855	R. New York Worldwide, WNYW	New York, USA
	11,925	R. N. Espana	Madrid, Spain
	15,510#	R. Peking	Peking, China
	17,490#	R. Peking	Peking, China
	17,533#	R. Peking	Peking, China
9:15 P.M.	2,450	R. 4VEH	Cap Haitien, Haiti
	6,025#	R. Portugal	Lisbon, Portugal
	6,040	Deutsche Welle	Cologne, W. Germany
	6,175#	R. Sweden	Stockholm, Sweden
	11,745	V. Andes, HCJB	Quito, Ecuador
	11,935#	R. Portugal	Lisbon, Portugal
	15,345	V. Free China	Taipei, Taiwan
	17,720	V. Free China	Taipei, Taiwan
9:30 P.M.	6,200	R. Tirana	Tirana, Albania
	7,300	R. Tirana	Tirana, Albania
	9,475*	R. Cairo	Cairo, Egypt
	9,545*	R. Lebanon	Beirut, Lebanon
	9,550*	R. Cairo	Cairo, Egypt
	15,320*	R. Australia	Melbourne, Australia
	17,795*	R. Australia	Melbourne, Australia
9:45 P.M.	6,200	R. Tirana	Tirana, Albania
	9,510	British B. C. Relay	Ascension Is.
	9,680	R. Habana Cuba	Havana, Cuba
	11,795	R. V. Gospel, ETLF	Addis Ababa, Ethiopia
	11,830	R. Habana Cuba	Havana, Cuba
	15,125*	V. Free China	Taipei, Taiwan
	15,345*	V. Free China	Taipei, Taiwan
	17,720*	V. Free China	Taipei, Taiwan
	17,780*	V. Free China	Taipei, Taiwan
	17,890*	V. Free China	Taipei, Taiwan
10 P.M.	4,820	V. Evangelica, HRVC	Tegucigalpa, Honduras
	5,980#	R. Bucharest	Bucharest, Rumania
	6,035*	R. Warsaw	Warsaw, Poland
	6,037	Faro del Caribe, TIFC	San Jose, Costa Rica
	6,150#	R. Bucharest	Bucharest, Rumania
	7,170+	R. Moscow	Moscow, USSR
	7,285*	R. Warsaw	Warsaw, Poland
	7,345	R. Prague	Prague, Czechoslovakia
	9,525	R. Cairo	Cairo, Egypt
	9,570#	R. Bucharest	Bucharest, Rumania
	9,615	V. Andes, HCJB	Quito, Ecuador
	9,640+	V. Free Korea	Seoul, S. Korea
	9,645	Faro del Caribe, TIFC	San Jose, Costa Rica
	9,660#	R. Moscow	Moscow, USSR
	9,675*	R. Warsaw	Warsaw, Poland
	9,690	RAE	Buenos Aires, Argentina
	9,700#	R. Moscow	Moscow, USSR
	9,730+	R. Moscow	Moscow, USSR
	11,840*	R. Warsaw	Warsaw, Poland
	11,890	R. Berlin International	Berlin, E. Germany
	15,120	R. Warsaw	Warsaw, Poland
	15,140+	R. Moscow	Moscow, USSR
	15,320#	R. Australia	Melbourne, Australia
	15,335+	V. Free Korea	Seoul, S. Korea
	17,795#	R. Australia	Melbourne, Australia
10:15 P.M.	4,925	R. Clube Mocambique	Lorenco Marques, Mozambique
	5,930*	R. Prague	Prague, Czechoslovakia
	5,980+	R. Bucharest	Bucharest, Rumania
	6,130*	R. N. Espana	Madrid, Spain
	6,150+	R. Bucharest	Bucharest, Rumania
	6,165	R. Budapest	Budapest, Hungary
	9,505	R. Cultural, TGNA	Guatemala City, Guatemala
	9,570+	R. Bucharest	Bucharest, Rumania
	9,630*	R. Prague	Prague, Czechoslovakia
	9,680*	R. Habana Cuba	Havana, Cuba
	9,690	RAE	Buenos Aires, Argentina
	11,830*	R. Habana Cuba	Havana, Cuba
	11,850	R. Erevan	Erevan, USSR
	17,880	R. Japan	Tokyo, Japan
10:30 P.M.	6,037	Faro del Caribe, TIFC	San Jose, Costa Rica
	6,140	R. N. Espana	Madrid, Spain
	7,110+	R. Moscow	Moscow, USSR
	7,345*	R. Prague	Prague, Czechoslovakia
	9,540+	R. Moscow	Moscow, USSR
	9,630*	R. Prague	Prague. Czechoslovakia
	9,645	Faro del Caribe, TIFC	San Jose, Costa Rica
	9,730+	R. Moscow	Moscow, USSR
	11,705+	R. Sweden	Stockholm, Sweden
	11,840	R. Portugal	Lisbon, Portugal
	11,990*	R. Prague	Prague, Czechoslovakia
	12,050+	R. Moscow	Moscow, USSR
	15,140+	R. Moscow	Moscow, USSR
10:45 P.M.	3,346	Zambia B. S.	Lusaka, Zambia
	6,037	Faro del Caribe, TIFC	San Jose, Costa Rica
	7,200	R. Moscow	Moscow, USSR
	7,285*	R. Warsaw	Warsaw, Poland
	9,580+	R. Moscow	Moscow, USSR
	9,645	Faro del Caribe, TIFC	San Jose, Costa Rica
	9,680*	R. Habana Cuba	Havana, Cuba
	11,760*	R. Habana Cuba	Havana, Cuba
	11,815*	R. Warsaw	Warsaw, Poland
	11,830*	R. Habana Cuba	Havana, Cuba
	12,080+	R. Peking	Peking, China
	15,060+	R. Peking	Peking, China
	15,095+	R. Peking	Peking, China
11 P.M.	3,396	Rhodesian B. C.	Gwelo, Rhodesia
	4,875	R. South Africa	Johannesburg, South Africa
	4,965	R. South Africa	Johannesburg, South Africa
	6,025#	R. Portugal	Lisbon, Portugal
	7,150#	R. Moscow	Moscow, USSR
	7,200#	R. Moscow	Moscow, USSR
	7,245	Austrian R.	Vienna, Austria
	9,505*	R. Japan	Tokyo, Japan
	9,535*	Swiss B. C.	Berne, Switzerland
	9,680	R. South Africa	Johannesburg, South Africa
	9,700	R. Sofia	Sofia, Bulgaria
	9,730	R. V. Gospel, ETLF	Addis Ababa, Ethiopia
	11,935#	R. Portugal	Lisbon, Portugal
11:15 P.M.	3,285	R. South Africa	Johannesburg, South Africa
	4,845	R. Botswana	Gaberones, Botswana
	6,025*	R. Portugal	Lisbon, Portugal
	6,120*	Swiss B. C.	Berne, Switzerland
	6,130*	R. Norway	Oslo, Norway
	7,115*	Thai N. B. S.	Bangkok, Thailand
	7,170+	R. Moscow	Moscow, USSR
	7,270	R. RSA	Johannesburg, South Africa
	7,275	RAI	Rome, Italy
	9,540+	R. Moscow	Moscow, USSR
	9,550*	R. Norway	Oslo, Norway
	9,610*	R. Norway	Oslo, Norway
	9,730+	R. Moscow	Moscow, USSR
	11,905*	Thai N. B. S.	Bangkok, Thailand
	11,935*	R. Portugal	Lisbon, Portugal
11:30 P.M.	4,800	R. Lesotho	Maseru, Lesotho
	6,025	Nigerian B. C.	Enugu, Nigeria
	6,050	R. Clube Mocambique	Lorenco Marques, Mozambique
	6,075	Deutsche Welle	Cologne, W. Germany
	6,140	R. N. Espana	Madrid, Spain
	6,145	Deutsche Welle	Cologne, W. Germany
	7,200#	R. Moscow	Moscow, USSR
	7,240#	R. Moscow	Moscow, USSR
	7,310#	R. Moscow	Moscow, USSR
	9,545	Deutsche Welle	Cologne, W. Germany
	9,570	R. Bucharest	Bucharest, Rumania
	9,660#	R. Moscow	Moscow, USSR
	9,760	R. Habana Cuba	Havana, Cuba
	11,760	R. Habana Cuba	Havana, Cuba
11:45 P.M.	5,955	R. South Africa	Johannesburg, South Africa
	6,025#	R. Portugal	Lisbon, Portugal
	7,115*	Thai N. B. S.	Bangkok, Thailand
	7,300	R. Tirana	Tirana, Albania
	9,780	R. Tirana	Tirana, Albania
	11,685	R. Peking	Peking, China
	11,790	R. South Africa	Johannesburg, South Africa
	11,905*	Thai N. B. S.	Bangkok, Thailand
	11,935#	R. Portugal	Lisbon, Portugal
	15,095	R. Peking	Peking, China

CB Corner

By Len Buckwalter, KQA5012

CB in the Big City

THE 24th Precinct in New York City once boasted the second-highest crime rate in town. That's not surprising since it covers a wild area of teeming ghettos and ritzy high-rises beside New York's Central Park. What's remarkable is that 35 neighborhood CBers have invaded the station house and set up a communications center right on enemy turf. At least that's what I believed when I walked into the precinct one evening to investigate what could be billed as a marriage between a mongoose and a cobra.

"Citywide . . . a fight involving 12 persons on the corner of 104th St. and First Ave." This message wasn't crackling over the police radio but was coming from a CB rig parked in a corner of the station house. A CB operator logged the call from a CB mobile and fed it into the police network to be assigned a priority. If the message had been more serious—a case of someone being assaulted or a burglary in progress—the CBer in the precinct house would have dashed into the next room and delivered it directly to the police radio dispatcher. Cops would have been on the scene in seconds.

During the next two hours the Citywide call barked over the CB speaker a dozen times. It's the informal call of the New York Citizens Emergency Radio Service, first CB group in the city to establish a base inside a police station. There's plenty of action. They handle some 400 calls a month on daily shifts running from 4 p.m. to midnight. An antenna 50 ft. atop the station house affords good signal coverage over most of the city. The CB rig was donated by a manufacturer and (here's a surprise) a colinear antenna was purchased and erected for the group by the NYPD.

Most calls into the precinct originate from CBers summoning help on Channel 9. The Citywide network welcomes calls from anyone requiring assistance and often services other outfits—like a CB-equipped bike patrol in the nearby park. By far, disabled cars trigger the most cries for help. Next are auto accidents. A sudden change in the weather also spells trouble. Some 45 calls for help arrived during one dousing downpour. The monitor on duty, with hundreds of phone numbers in a special directory at his side, can cope with anything from a sick animal to a poisoning, or matters for customs officials and the CIA.

Sometimes the scene is more like *The Godfather* than the Good Samaritan. Several months ago two cops were assigned to guard the residence of Manhattan's District Attorney, Frank Hogan. The DA had received threats on his life and the patrolmen were parked in front of his home. When the cops spotted a car going up a one-way street in the wrong direction, they tried to intercept it. As they approached the vehicle, a man in the car aimed a machine gun at the two men, fired and cut them down in the street. Critically injured, they were rushed to a hospital and word of the event hit the police radio in the 24th Precinct. CBers at the station heard the message—there was an urgent need for blood. An appeal broadcast on Channel 9 drew an overwhelming response. Donors drove in from as far as Westchester, in the next county.

Behind this extraordinary partnership of cops and CBers is Bill Wahlin, a psychology professor at a nearby community college. Bill enjoys electronics as a hobby and has a complete radioteletype receiving rig in his home. When Bill got a CB license he saw the medium's great potential for public service. He could also appreciate its seamy side. Volunteer groups too often fall apart because of internal rivalry and what Bill diagnoses as a lack of an institutional base. The institution he selected was the 24th Precinct. Bill presented the idea of internal CB monitoring to the cops and a stroke of coincidence led to its quick acceptance.

At that time the 24th Precinct was becoming a model precinct—an experimental lab the city could use to try out new ways of reducing crime. One of the most important of these developments was better police relations with the community. Bill rode into the station on that wave and today his CB group

[*Continued on page* 104]

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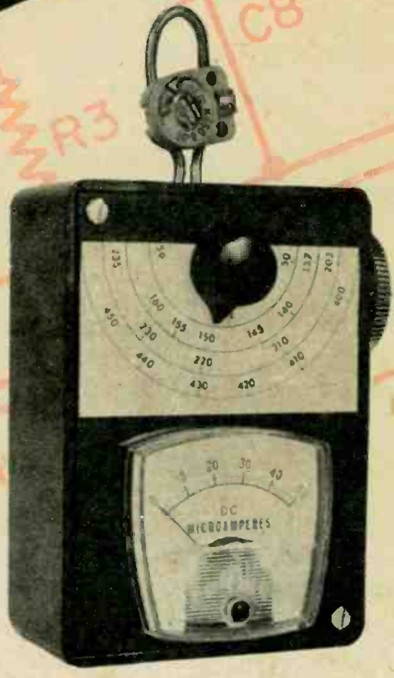
Credit towards a Certified Electronic Technician (C.E.T.) rating will be granted by the National Electronics Association to ICS students upon completion of the ICS Career Program in TV Service/Repair.

First Class E Citizens Band Project!



By HERB COHEN

The E-Dipper

...Hams can use it on VHF & UHF, Too!

THOUGH the Class E Citizens Band, up there at 220 mc, is still in proposal form, Electronics Illustrated looks into the future and presents the first Class E project.

It's a grid-dip oscillator, one of those all-purpose types of gear the CBer, or anyone else interested in this potentially lively new band, will need to get himself established on Class E. A grid-dipper can help the CBer tune his rig, make antenna adjustments and do the chores every CB enthusiast faces before he can punch the talk button.

Hams also will find our GDO a useful accessory around the shack. Our grid-dip oscillator, dubbed the E-Dipper, operates across three of the busiest VHF/UHF ham bands. One of these bands, it happens, includes Class E CB. The E-Dipper's highest

The E-Dipper

band (400-450 mc) enables the ham to adjust his UHF gear. This band is of particular importance since no commercial dipper covers this portion of the spectrum.

The E-Dipper is an inexpensive solution

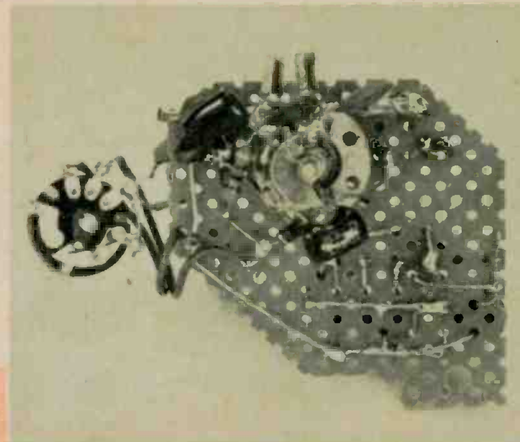


Fig. 1—RF wiring seen above. Lead lengths must be as short as possible. Perfboard is cut to shape shown to make room for battery B1.

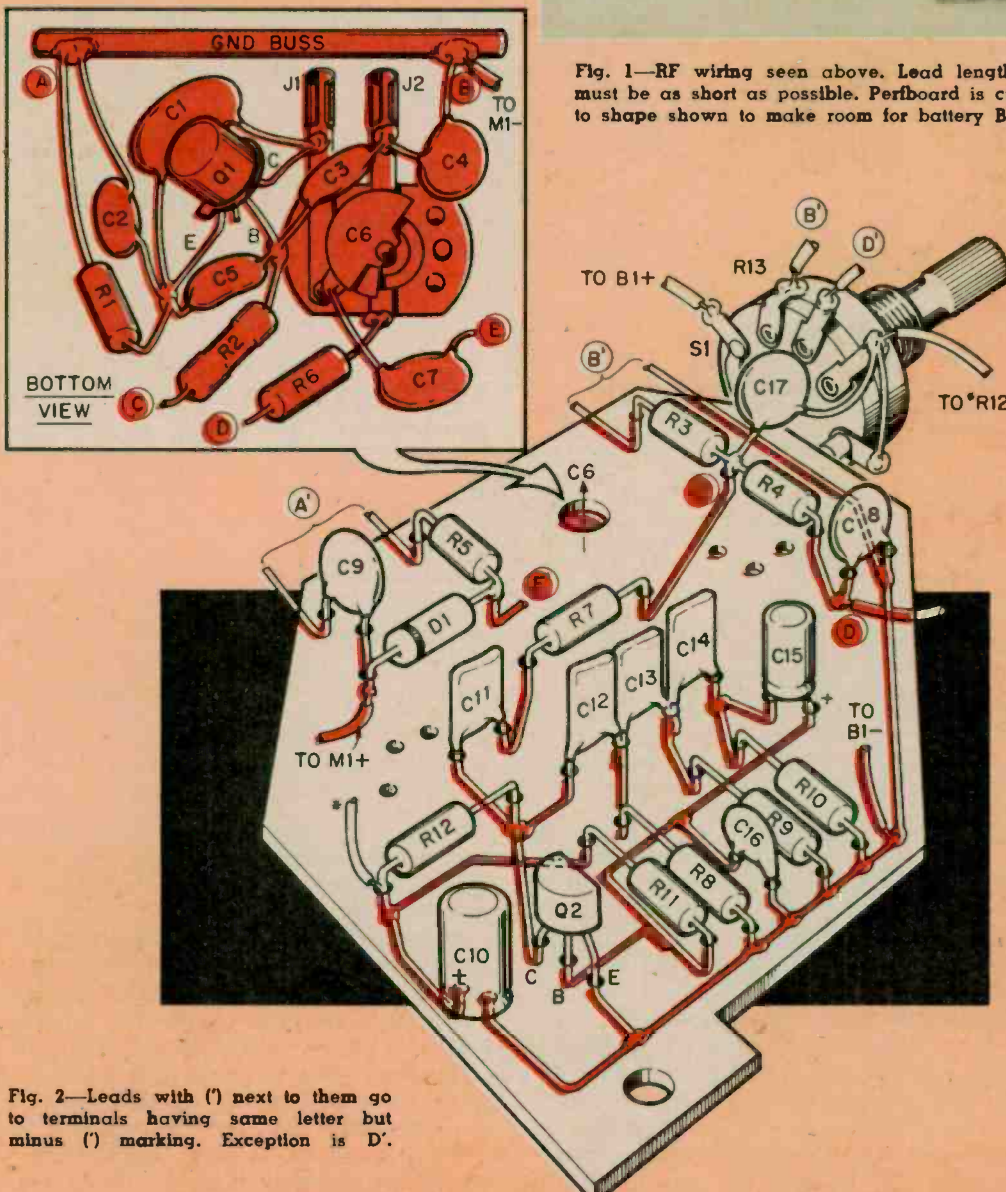


Fig. 2—Leads with (') next to them go to terminals having same letter but minus (') marking. Exception is D'.

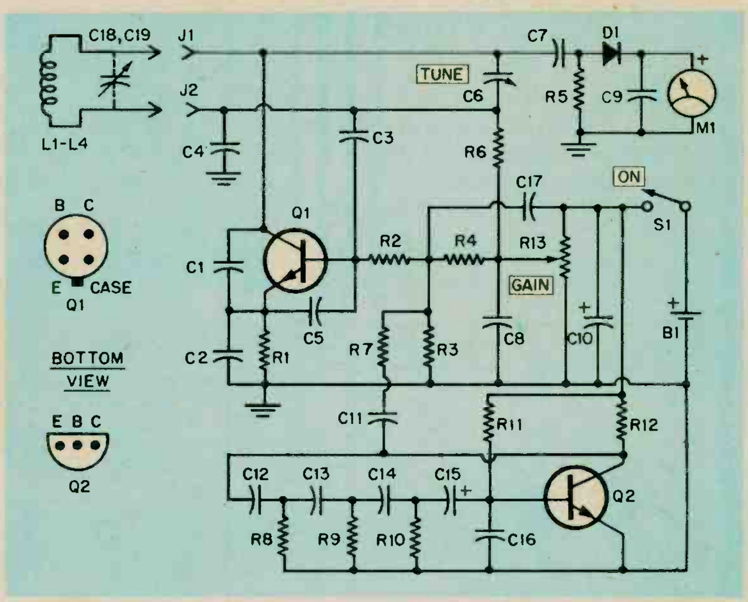


Fig. 3—E-Dipper's wiring diagram. Compare schematic with pictorial on opposite page for exact lead placement. Lead lengths must be as short as possible. Cut off Q1's case lead before soldering transistor to compenents.

PARTS LIST

B1—9.8 V mercury battery (Mallory TR-177)
Capacitors: 1,000 V disc ceramic unless otherwise noted
C1—3.3 μμf, 5% silver mica
C2—15 μμf
C3,C16—200 μμf
C4, C17—0.001 μf
C5—10 μμf, 5% silver mica
C6—1.5-5.0 μμf variable (E. F. Johnson 167-102-1)
C7—10 μμf, 5% silver mica
C8—0.001 μf
C9—0.001 μf
C10—100 μf, 10 V electrolytic
C11-14—0.01 μf
C15—1 μf, 50 V electrolytic
C18, C19—4-30 μμf variable trimmer
D1—1N60 diode
J1,J2—Octal tube pin jacks (see text)
L1-4—see text

M1—0-50 ua. DC microamp meter (Lafayette 99R 50494 or equiv.)
Q1—Npn transistor (RCA SK-3019)
Q2—Npn transistor (Motorola MPS-2924)
Resistors: ¼ watt, 10% unless otherwise noted
R1—470 ohms
R2,R6—150 ohms
R3,R5,R8-10,R12—5,600 ohms
R4—12,000 ohms
R7—100,000 ohms
R11—1,000,000 ohms
R13—5,000 ohms, audio-taper miniature pot with SPST switch
S1—SPST switch (mounted on R13)

Misc.—No. 10 copper buss wire, 4 x 3 x 1¾-in. bakelite case and front panel, ¾-in. insulated standoff, ⅜-in. i.d. plastic tubing, knobs, perfboard, etc.

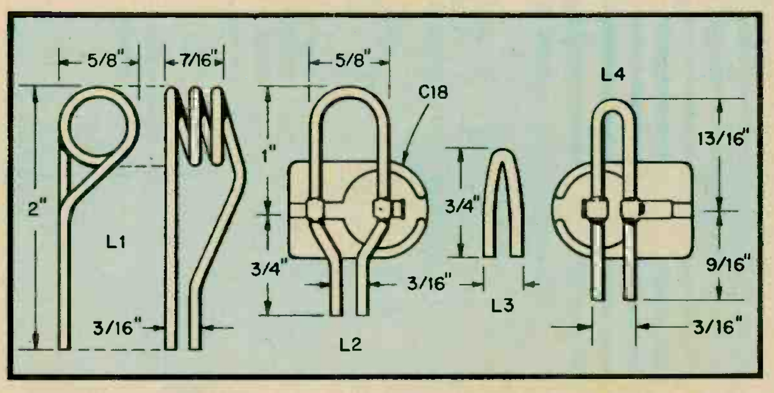
to the problem of trying to adjust gear with a dipper at VHF or UHF frequencies, Basically, it spans three frequency ranges, all of which are of current interest to the ham. Starting with the lowest, or 2-meter band, the other popular frequencies covered are 220-225 mc (Class E) and 420-450 mc. All frequencies are amplitude-modulated.

Our E-Dipper departs from standard GDO design. This dipper uses a regenerative amplifier instead of the more common oscillator/wave-trap circuit. Reason is that sensitivity and selectivity of the dipper can be varied with pot R13 (*Gain*). The sensitivity of a standard GDO is fixed and this can be a problem around low-Q traps or transmitter tank circuits. The selectivity of the E-Dipper's tank circuit also may be varied with R13 in order to simulate a wave-meter.

How the E-Dipper Works. Heart of the circuit is transistor Q1. It is operating as a conventional common-base, collector-to-emitter-feedback oscillator circuit. This enables maximum output power to be developed across the highest frequency range. Capacitors C1 and C2 form the RF feedback network and power match for the oscillator.

All ground symbols in the circuit eventually connect to a piece of No. 10 copper buss. Since this buss appears to be a high impedance

Fig. 4—Wind coils to dimensions as shown. Capacitor soldered to L4's leads is C19. See text for winding data.



The E-Dipper

in the UHF range, the base of Q1 must be bypassed directly to jack J2 through capacitor C3.

Part of the RF voltage appearing at Q1's collector is sampled via capacitor C7. The RF voltage is rectified by diode D1 and is used to drive meter M1.

Potentiometer R13 controls the collector base current to Q1. In the fully clockwise position, Q1 receives maximum voltage and current and oscillates at peak strength. When you back off the control until the meter reads about two-thirds full scale, the E-Dipper simulates a conventional grid dip.

If the control is turned back until the meter reads about 20 on the scale, the circuit becomes a very sensitive wave meter. Transistor Q1 is still oscillating very slightly, making it very sensitive to any RF in the vicinity. The oscillation cancels the losses in the plug-in coil assemblies, giving the meter a very sharp Q and high sensitivity.

Transistor Q2 is a phase shift oscillator circuit. Output frequency is set for about 1,000 cps. This audio oscillator produces a clean sine wave which is coupled to the base of Q1 via components C11, R7 and R2. Result is a clean 1,000 cps signal modulating the RF waveform.

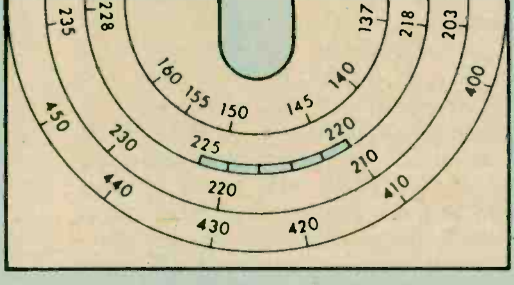


Fig. 5—Class-E band is colored area of dial.

Building the E-Dipper. Jacks J1 and J2, the coil socket pins, are cannibalized from an old octal tube socket. They are the wrap-around variety and are soldered directly to variable capacitor C6. Line up the pins so they are spaced exactly 3/16-in. apart. They will eventually slide into a couple of holes in the plastic case.

Once capacitor C6 is mounted to the perfboard and the pins mounted to C6, wire the RF circuit. A No. 10 piece of buss wire serves as ground. It is 1¾-in. long and is fitted to the bottom edge of the perfboard.

All RF wiring around transistor Q1 must be made as short as possible. The transistor's leads must be especially short. The collector of Q1 should be soldered directly to the tab of J1, with a lead length of less than ¼-in. Cut off the case lead of Q1 before mounting it.

Next step is to wire the phase shift oscillator. Though wiring is not critical, keep the leads of capacitor C16 as close to the base and the emitter of Q2 as possible.

Since the tuning capacitor's shaft is too short, a ⅜-in. dia. plastic sleeve is epoxied to the shaft. Attach the knob to it after assembly. This piece of plastic not only extends the shaft but also decreases stray capacitance.

Final step is to connect meter M1 and mercury battery B1 into the circuit. Then cement the frequency dial scale (Fig. 5) to the cabint. Adjust capacitor C6 for full mesh. Then mount the perfboard into the cabinet with a ¾-in. insulated standoff. Place

[*Continued on page* 98]

EI's Hi-Fi Contest

$200 First Prize goes to R. Iozzo, Mt. Vernon, N.Y., for an elaborate conventional hi-fi layout.

$100 Second Prize is awarded to Robert Johnson of Bethany, Okla., for compact rec-room installation.

$50 Third Prize is won by Richard Packer, Salt Lake City, Utah, for an ingenious hi-fi coffee table.

$25 Fourth Prize is awarded to C. A. Simmons, Bakersfield, Calif., for a novel treasure-chest stereo.

OUR new Hi-Fi Contest begins in this issue with the first group of cash-prize winners. Because of a magazine's far-ahead publishing schedule, the prize installations were chosen from only a small group.

However, we believe these four entries represent some of the criteria we are trying to employ in choosing prize-winning hi-fi installations. The sheer mass of equipment and money spent on audio gear should, we figure, be largely ignored. Otherwise, it becomes a matter of who has the most money.

Instead, we look with favor upon installations which obviously have been the object of much thought and ingenuity by the owner. Thus, an unusual setup that is pleasing to the owner may get the nod over one that looks like a listening room at an audio store.

To enter your installation in our contest, send us one or more good black-and-white photos (8x10s preferred), a list of your equipment and a description of what you've done. Pack the pictures well to avoid damage. We will return unused photos. Mail your entry to: EI's Hi-Fi Contest, 1515 Broadway, New York, N.Y. 10036.

Hi-Fi Today

By Robert Angus

Matrix or Discrete 4 Channel?

READERS will recall the bitter battles between CBS and RCA over the long-playing record vs 45-rpm discs and over rival systems for color TV. Corporate prestige was at stake and no holds were barred. History will record that CBS won the record battle—though it took nearly ten years to do so—while RCA walked away with the color TV honors.

Now they're at it again. The latest contest over four-channel records is regarded by each side as the tie-breaker. For the short term, CBS is the obvious winner with its SQ system of matrixed four-channel sound. Just about every major manufacturer of stereo receivers and amplifiers has at least one model with a built-in SQ decoder. The system has become so popular (in less than a year) that some manufacturers touting their own matrix systems either have modified their own equipment (as Electro-Voice has done) or have a two-position, four-channel switch on their equipment—one for their own system, the other for SQ.

Columbia Records, meanwhile, has culled its catalogue for best-selling albums by artists like Santana, Blood Sweat & Tears, Leonard Bernstein and others, and has persuaded independent labels like Vanguard to go along with the SQ system. In terms of numbers of records sold, SQ has long since passed Sansui and Electro-Voice.

Now RCA enters the scene with a discrete four-channel record. RCA, along with Panasonic and JVC (the latter actually developed the discrete system in Japan), first took the wraps off the record late last year. At that time, they hinted that it would be several months before all the bugs were ironed out. Now, say JVC and Victor, the bugs are out and the records are ready to go.

Because of the mechanics of the hi-fi component business, this means that if you want to play back an RCA record—assuming you can find one by the time you read this—you'll have to buy the equipment from Panasonic or JVC. Nobody else has any. Fortunately for you, JVC has been selling playback equipment in Japan for the past year or two, so there really are some decoders and receivers built for the system. At the same time, the rest of the industry will be pushing SQ for all it's worth. It's simply too late for most American manufacturers to include a multiplex decoder for the RCA system in this year's product line, even if they wanted to.

Combination record changer and discrete four-channel demodulator plus cartridge, Model 4VC-5244, made by JVC America, will cost $189.95.

RCA and JVC will have to wait until next year to test their system in competition with CBS. Meanwhile, RCA's record company promises to build up a library of records to rival CBS, and JVC presumably will be trying to prove to the trade and to audiophiles that bugs like degradation of the four-channel signal and problems with broadcasting the discs over stereo FM stations have indeed been solved. If they're successful, next year's components from Japanese and American manufacturers may feature a multiplex decoder instead of—or in addition to—the SQ circuitry.

It's worth noting that in the LP-45 battle of 1948-1951, RCA was the largest record company, with most of the desirable artists. Columbia was in second place. By lining up support from just about every independent record company, however, Columbia carried the day for the LP. Now Columbia is on top, both in terms of record sales and big-name artists. RCA isn't even second—which means the company will have to try very much harder.

A TV Antenna System That Lasts & Lasts & Lasts

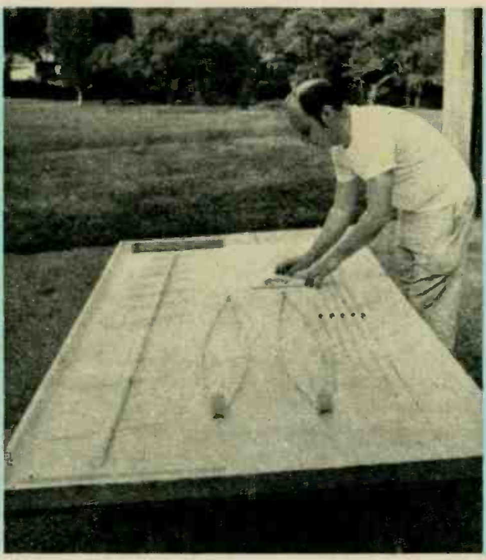
WHAT happens to old TV antennas? Unlike old soldiers, they don't just fade away. No, they tend to hang around—sometimes in shreds from a chimney mast, unfortunately. And with TV coming up on a quarter century of intense popularity, there are a lot of old antennas on the housetops of the world.

We set out to put together a TV antenna system that would give maximum usefulness during the longest life possible. The result is a broadband VHF/UHF/FM setup with a respectable amount of gain for primary viewing areas and the near fringes that should still be going strong when television is beginning to run golden-anniversary programs. Equipment from several manufacturers was used, nearly every piece having some special characteristic to recommend it.

The problem at the top of any system is corrosion, particularly in areas where the air contains a lot of salt. Antenna components made of ferrous metal tend to rust and fall away. The oxidation process on aluminum is slower, but thin-gauge parts do eventually pit badly and weaken. A first step to longer life is to select an antenna with the heaviest-gauge aluminum available. Even better results are possible with gold-anodized elements (and as many related components of plastic as possible). We went even further, however, and selected an antenna made of fiberglass and thin foil conductors made by the Shakespeare Co. of Columbia, S.C. This rig, called the Model 426, has been turned out in limited numbers for use in high-corrosion areas such as coastal New England. The 426, which has moderate gain, sells for $60 to $80 (discounting being what it is) and probably will be around when the houses holding it up have become bug food.

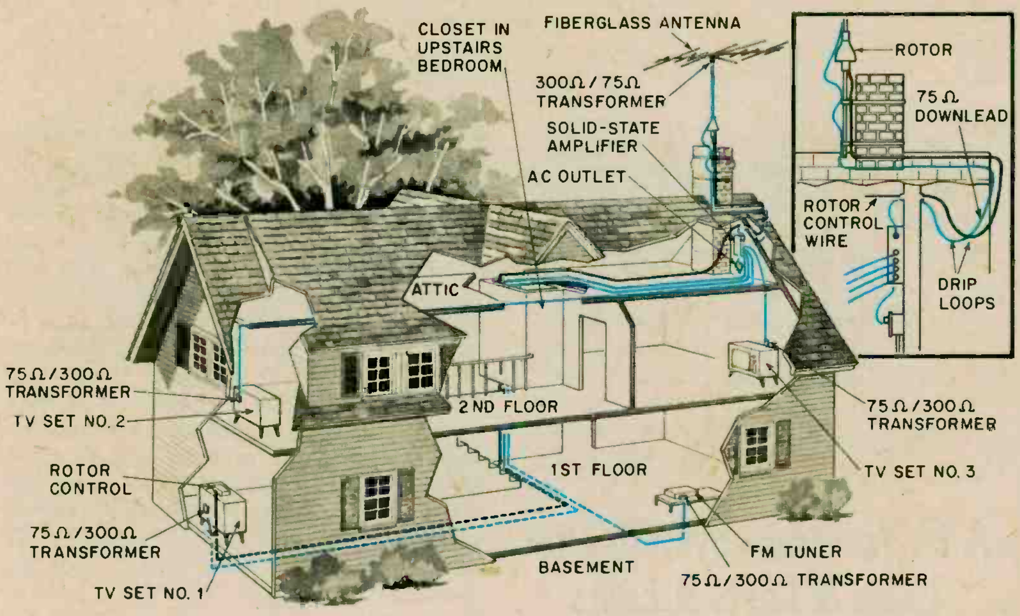
Moving on down, we chose a heavy-gauge steel mast over aluminum. Steel may rust but it holds up better against twisting, turning and bending forces. Our mast and chimney straps came from Lafayette Radio.

Most rotor systems today are pretty rugged affairs. We wanted one with simple controls and minimum whip and backlash action so we chose the AR-33 made by Cornell-Dubilier Electronics. We found the AR-33 to have good mechanical action but at the same time it's light enough to be easily handled on the roof. There are bigger rotors with



Cross and conical elements are laid out and then assembled in fiberglass antenna by Shakespeare.

The antenna has been assembled in photo below. Fiberglass and foil conductors make for long life.



TV antenna system designed to last for many years led to this kind of a layout in an old New England house of two stories, attic and basement. Setup would be somewhat different in other kinds of home designs.

enough power to turn a house around but they are used mainly to hold up large ham arrays—and they weigh enough to give you a hernia.

Everyone seems to agree these days that for the biggest and cleanest signal at the TV set, coax downleads and matching transformers are called for. Our choice was RG-59/U coax with a nominal impedance of 75 ohms (though you may see a listing of 72, 73 or even 70 ohms) and again it was a Lafayette product.

Since TV antennas have an impedance of 300 ohms, it is necessary to have a 300/75-ohm transformer at the antenna and a 75/300-ohm transformer at each TV or FM receiver. We installed the outdoor 300/75 transformer from the Winegard Co. on the antenna's boom as close as possible to the connecting points. The transformer (T-28M)

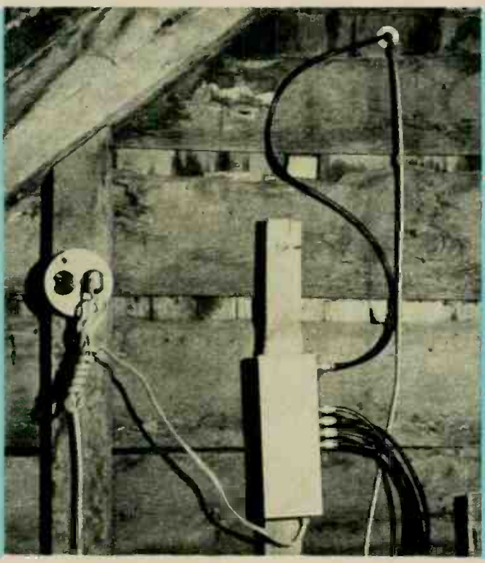
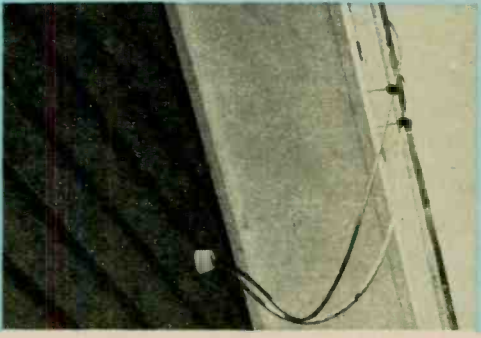


Photo at left shows inside of attic; coax and rotor cable come through wall, connect to booster.

Seen from outside (below) coax and cable form drip loops outside attic; plastic tube goes through wall.



TV Channel	Signal Strength (μV)			
	New System		Old System	
	pix	sound	pix	sound
2	12,200	8,000	7,000	3,600
4	6,000	6,800	2,500	3,250
5	12,000	6,000	6,000	4,500
7	5,000	2,500	3,000	1,100
9	6,000	6,000	1,800	1,700
11	5,500	3,400	1,400	1,700
13	3,500	2,250	1,200	1,100

Two Antenna Systems: Old vs New

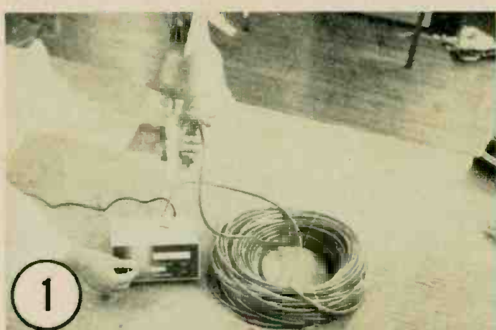
A TV Antenna System That Lasts & Lasts & Lasts

has a snug rubber boot but we also daubed liquid rubber on the seal edges because it's exposed to moisture, wind, ice and the other baddies, and replacement means taking down the whole antenna.

For a signal amplifier and distributor, several choices are available. For instance, there's a wide selection of mast-mounted amplifiers. However, we were looking for maximum life with minimum service so we chose an indoor model, Winegard's BC-782, which is an 82-channel booster-coupler. The BC-782 has an impedance of 75 ohms to match the coax we were using, offers a gain of 6.5db and feeds four TV or FM receivers. Its solid-state circuitry means a long and trouble-free operating life (we trust) up there in the attic. The temperature around it in summer never gets to great heights (over 85°), which is fortunate. Neither tube nor transistor models can stand up to high temperatures for long and a really hot attic usually means moving the booster farther down the line to a closet or some other living area of the house.

The selection of equipment from there on down was pretty obvious (coax, 75/300 transformers at the sets, etc.), with one exception: we decided to run the coax directly to the sets in all but one case rather than
[*Continued on page* 95]

1. Checking Cornell-Dubilier rotor and control.
2. 75/300-ohm JFD transformer on back of TV set.
3. Reading signal strength with Jerrold 718 meter.
4. Outlet in floor couples coax and rotor cable.



The El Ticker

ACCORDING to figures released by the Electronic Industries Association, imports of color television sets in a particular month early this year were 77.9 percent above the figure for the same month last year.

★ ★ ★

Manufacturers of electronic equipment recently polled by the EIA say they back legislation currently being considered by Congress which would set up a National Metric Conversion Board whose job would be to convert measurements in the U.S. to the metric system. Big incentive for manufacturers is prospect of more sales abroad, where most countries do use metric system.

★ ★ ★

Whatever be the plans of the FCC, the EIA wants to look into the problems of transmission of four-channel FM broadcasts to see what can be done to establish performance standards. EIA expects to conduct the study with the help of the FCC and National Association of FM broadcasters.

★ ★ ★

Don't hold your breath, but new FCC study of Citizens Band radio may be around the corner. Complaints are coming fast and furious while FCC's hands are tied.

★ ★ ★

FCC is holding hearings on a proposal for a domestic satellite service which would permit all qualified applicants to own and operate domestic communications satellite systems. General expectation is, there will eventually be four systems (not including international systems already in use). Categories of these systems would be telephone usage, international common carrier, data transmission and television broadcast. Should these services link up to expanding cable television (CATV) operations, a whole new world of home services could be coming.

★ ★ ★

FCC has allocated seven pairs of frequencies in the 460-mc band to improve services for emergency medical communications. Such services telemeter a patient's vital signs—such as an electrocardiogram—through an ambulance telemetry unit to a hospital so doctors can communicate instructions immediately.

★ ★ ★

Electronics division of North American Rockwell Corp. (NRMEC) will start delivering electronic mini-calculators this June to Sears Roebuck, Lloyds of California and other consumer outlets. Machines will be sold under customer labels, but are based on advances made recently by NRMEC in liquid-crystal technology and large-scale integrated circuits.

★ ★ ★

Prices of monochrome television receivers may go up substantially if new ruling by the FCC regarding TV tuners is implemented, according to some consumer electronics manufacturers. Major complaint is that the FCC, when requiring 70-position TV tuners having detent for both VHF and UHF channels to be installed in all sets after July 1, 1974, also required that receivers be equipped with circuits for automatic frequency control (AFC)—seldom included up to now in monochrome sets. Should AFC become mandatory, manufacturers say they'll take small b&w sets off the market and raise prices of the rest.

A Triggered Sweep Scope

Heathkit IO-103

AS a general rule, oscilloscopes built from kits have minimal pretentions to life in the laboratory. They can be useful to the experimenter and the serviceman but they don't as a rule run with the Ferraris and the Lotuses of their tribe.

Heath's new IO-103 kit scope is an exception to the rule of thumb we just reeled off. This instrument is the peer of much of the high-high-price lab gear being sold today. Which helps to explain why so much attention was lavished on it after its arrival in EI's lab. When Heath introduced this 5-inch rig we really wondered whether as a kit it could meet its impressive list of specifications. On paper, at least, the IO-103 looked good and maybe it was the answer to every electronics experimenter's dream of owning a low-cost, high-quality scope.

The IO-103 didn't disappoint us. This instrument met—and exceeded—every spec set forth by Heath. Just for openers, stated frequency response is from DC to 10 mc, plus or minus 3db. That's for at least 3-cm deflection. For input signals that yield 6-cm deflection, Heath states that the IO-103's frequency response is DC to 8 mc, ±3db.

We did not expect this $229.95 kit scope to knock out ruler-flat DC-to-13-mc response with only 3-cm's worth of deflection. With a 6-cm signal fed into the BNC-type vertical input jack, overall response was DC to 10 mc within 3db.

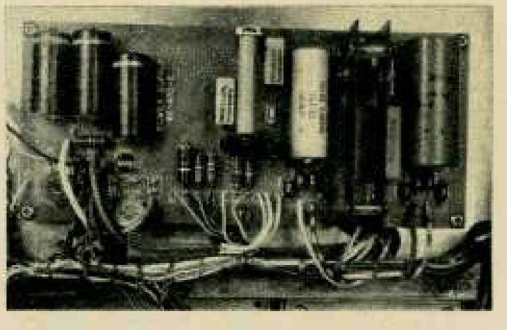
Many criteria are vital to the successful operation of a scope. When all is considered, frequency response doesn't mean a thing if the scope has an ineffective sweep circuit. The IO-103 has a topnotch deflection setup that rivals that of the $2,000 scope we used to test the IO-103.

Besides being triggered, the IC-based sweep circuit is switch-selected over a seven decade range. Sweep speed can be varied from 100 milliseconds to 100 nanoseconds per centimeter. Furthermore, a horizontal expansion control lets you magnify the signal seen on the screen to twice normal size. So the Heath IO-103 really has 14 ranges overall.

Triggering modes can either be set to auto or normal positions, plus- or minus-going inputs, AC or DC and internal or external triggering. Overall accuracy of the time base is 2 percent, against 5 percent as stated by Heath.

Actually, the triggered timebase feature of the IO-103 is almost reason enough to make a hobbyist shell out for this scope. A triggered-sweep scope means that, if you're a ham, SSB output and frequency measurements can be made directly in the shack without extra gear adding to the complexities or expense.

This scope also is an invaluable item to have when you work on hi-fi. Couple it to the output of an audio amplifier and feed the amp with a swept-tone audio signal. The



Both high- and low-voltage power supplies are regulated. Fin-like structures are heat sinks.

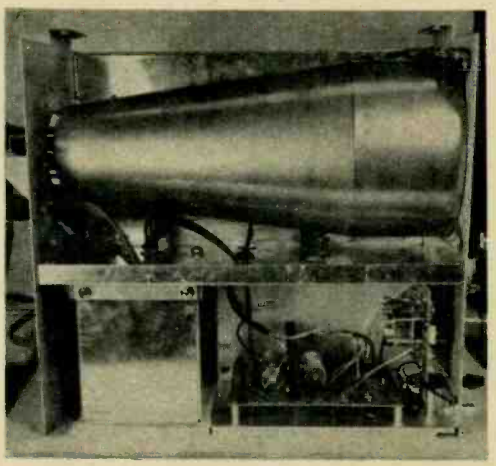
bandwidth of the hi-fi rig is immediately made apparent on the scope's screen. Fact is, swept-audio tests are impossible to make with an ordinary recurrent-sweep scope.

The biggest difference between triggered- and the older recurrent-sweep scope is the ability to measure the frequency of an input voltage directly from the face of the graticule. This means that comparing input frequencies to standards via lissajous patterns is a measurement technique of the past. Merely count off the number of graticule divisions a complete waveform spans and multiply by the sweep setting. Reading frequency on the IO-103 is like reading volts, ohms or amps on a VOM.

Though the Heathkit IO-103 is a good performer, it required some troubleshooting on our part to achieve the figures mentioned. A power transformer with an open high-voltage secondary winding was supplied with the kit. A bad zener diode and open timing capacitor also were wired into the circuit before all three defective components were discovered during the alignment procedure.

At first, this didn't look like an easy kit. After all parts were taken out of the boxes and bags and checked against the parts list, we found there was a total of 56 transistors, 44 diodes and one IC. All these, plus other componentry have to be mounted on four circuit boards and the chassis. We originally thought that the IO-103 was for the intermediate- or advance-level hobbyist.

But a person having no knowledge of electronics could, we came to believe, tackle portions of this scope kit. After learning the color code and reading the instruction manual and kit-builder's guide, we turned loose

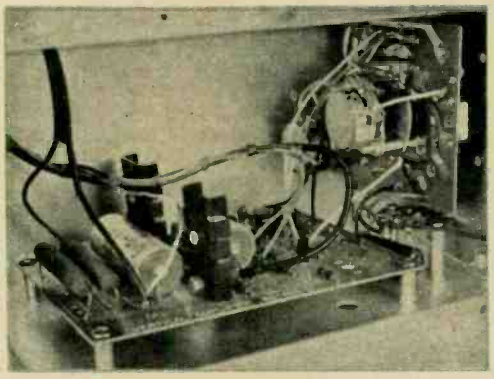


Both power transformer and crt are magnetically shielded from circuit via large metal enclosures.

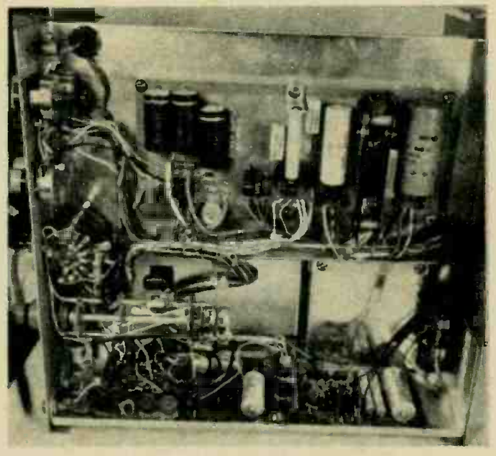
a novice who wired all components to the four circuit boards without a hitch.

After the four boards (power supply, vertical amplifier, attenuator, and combined horizontal amplifier-timebase) are wired, the main chassis wiring is completed. The majority of chassis components are mounted and interconnected to the front panel. A prewired and laced cable harness comes with the IO-103. This shortens construction time and also makes it more difficult to make wiring mistakes.

All of the wiring steps outlined by Heath [*Continued on page* 99]



Standoffs secure vertical amp to chassis. Attenuator pc board is attached to front panel.



Bottom pc board holds sweep generator, horizontal amp. Prewired harness saves wiring time.

Good Reading

By Tim Cartwright

Books, Pamphlets, Booklets, Flyers, Bulletins and Application Notes.

FROM McGraw-Hill Inc., long a leading source for intermediate and advanced electronics texts, two books worth noting. One is **Solid-State Electronics Concepts** by John I. Matthews (406 pages, $8.95), the other is **Instruments and Measurements for Electronics** by Clyde N. Herrick (560 pages, $13.95). The Matthews book is a down-to-earth treatment of such topics as DC and AC circuits, diodes, transistors, FETs and typical applications. The presentation, which includes in each chapter a summary of concepts, glossary, references, review questions, plus problems and answers, seems to make it perfect for home study.

For those involved in servicing, experimenting or any kind of work that involves test gear, Clyde Herrick's book is a must. While it offers only limited information about troubleshooting procedures and applications of test instruments, it does offer excellent descriptions of how the gear operates and details about circuits. VOMs, VTVMs, bridges, scopes, generators, transistor testers, DVMs —they're all there.

Now that I've applauded some basic texts for beginners, I'd like to mention the latest in the series of superb RCA manuals. It's the **Solid-State Power Circuit Designer's Handbook** (SP-52, $7.50). If you're an experimenter or other ampere-pusher, this 704-page powerhouse could surpass your wildest expectations. You won't find delicate receiving circuits here but rather brute power supplies, control systems, ultrasonic equipment and automobile ignition systems. The text grips each circuit, tells how it works, what it's made of and how to design one. If this handbook isn't in a local store, you can order it from: RCA Solid-State Div., Box 3200, Somerville, N.J. 08876.

Think Mallory, and capacitors, batteries and resistors come to mind. It's a surprise to learn that the company's latest catalog covers some 10,000 items. Besides offering many electronic components for project-building, Mallory has new items like security systems, cassette recorders and recording tapes. The **Mallory General Catalog,** which describes them all, should be available from any distributor that carries Mallory products.

The more you tell, the more you sell, so goes the salesman's old saw. General Electric has decided to tell all in its **Nickel-Cadmium Battery Application Engineering Handbook.** The company believes it's the first comprehensive report on these cells. The manual is a bargain if you intend to select a ni-cad for a project, or design one into a new product. Coverage is exhaustive—ranging from theory and cell construction, to selection and application. The word engineering shouldn't put off the hobbyist because the text is written for newcomer and seasoned hand alike. Copies are available at $2.50 each from: Battery Products Section, General Electric Co., Box 114, Gainesville, Fla. 32601.

Some writers of books for electronics experimenters are as about as close to their subject as an ulcer patient is to a hot pepper. Not so with Jim Ashe, whose new book is **Electronics Self-Taught With Experiments and Projects.** (TAB Books, $4.95). He delivers hard-hitting information on setting up a home lab, laying out a workbench and lighting it. He offers valuable tidbits on handiest hardware sizes and parts assortments. Some advice, though, is controversial. Mr. Ashe is utterly opposed to soldering guns and recommends irons controlled by a Variac. He urges an oscilloscope with triggered sweep —while many hobbyists have yet to acquire the simplest service-type scope. He's also on shaky ground when he says, "A voltage regulator (to stabilize the AC line feeding your workbench) has more going for it than an impedance bridge or a sweep generator."

Since most test equipment tolerates almost any line-voltage swing in most localities, Mr. Ashe must be getting his juice from Afghanistan Alternator and Treadmill. He also takes a vicious swipe at QST magazine by calling their construction projects "frozen," then intimating that the more beautiful they look, the worse they perform. The opposition might say QST projects often work better than a brick outhouse (and that's a compliment)!

The Ham Shack

By Wayne Green
W2NSD/1

The Chips are Down on 220!

THE Electronic Industries Association is keeping up a brave front, assuring everyone that its proposal for 80 new CB channels in the present 220-mc amateur band is a sure thing. But amateurs aren't at all convinced and are getting set for a real fight.

There has been relatively little ham activity on 220 in past years for a number of reasons . . . lack of military surplus equipment for these frequencies . . . lack of commercial gear such as mobile FM transceivers for business . . . lack of equipment designed for the amateur . . . severe power limitations, and considerable radar activity in the band—making much of it useless in large parts of the country.

It is interesting that the revival of interest by hams in 220 has coincided with the plot by the EIA to turn it into a big moneymaker for manufacturers who see the Citizens Band as a source of enormous profits. The rapid growth of 146-mc FM tipped the scales. Fact is, the FM part of the 146-mc band is not just full, it's overflowing and room for expansion is desperately needed. Only 220 mc holds promise for growth. If amateurs lose even part of this relatively narrow band (it's one-sixth the width of the next higher band), it could have serious consequences.

Through a series of FM symposiums being held across the country, FM amateurs and repeater operators are being alerted to the seriousness of the situation and are being offered a constructive counter-offensive. The basic theme: 220, Use it or Lose it. At the eastern symposium, users of over 50 repeaters pledged they would set up repeaters on 220 mc as soon as possible. The first repeater went into action a few days after the symposium. A few weeks later, a Midwest symposium was held and the 43 repeater groups represented there also agreed unanimously to set up 220-mc repeaters quickly.

In a few weeks, a third symposium will be held in California. It is hoped that 100 percent cooperation again will be the order of the day. If between 500 and 1000 220-mc repeaters are on the air by this fall, it will be exceedingly difficult for the FCC to go along with the EIA proposal, no matter how strong lobby pressures in Washington are on the Congress . . . and they are strong. Money talks in Washington and there seems to be plenty of CB money. CB manufacturers are thinking of selling about $500 million in equipment for the new band every year.

It's interesting to note that CBers do not want 220. In our opinion, at least. It is only the manufacturers, looking for big profits, who are trying to take the band away from amateurs. There is no skip on 220 . . . which takes away a lot of the fun. Direction finding is infinitely simpler there, which means that CBers will have to buy those $20 licenses which many of them have been skipping for the last couple of years.

The shortage of equipment for 220 is about over. Three manufacturers already have introduced very nice 220-mc transceivers. These rigs will sell in the $220-$300 range and they're quite similar to the present 146-mc FM transceivers. Several other manufacturers are working round the clock to have models available for 220 by fall.

The first 220 rig announced is made by TPL Communications of Hawthorne, Calif. The AM/FM transceiver will sell for about $220, will have crystal-controlled channels and a tunable receiver and transmitter—the best of both worlds. It is being marketed through Henry Radio as the Tempo Model 220. The driving force behind TPL is Tom Litty, K6RAD. Tom designed and builds the Tempo VHF power amplifiers.

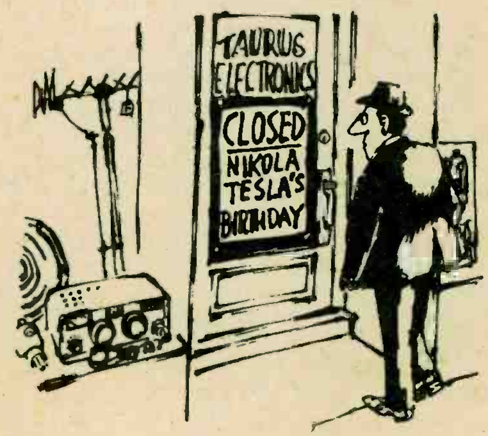
Ed Clegg, W2LOY, the man behind the Clegg Division of ISC, returned from the first FM symposium to start work on a 220-mc transceiver. At the second symposium, he had a sample in hand and promised production several weeks later. His unit has many interesting features and will cost $300.

Engineers in Japan have not ignored the fight for 220 and several rigs are in the offing. The first to arrive is made by the same company which makes the Market Luxury 2-meter FM rig and will be marketed by Drake. Standard and SBE are expected to have similar units soon.

"... Aside from that, Al, it's a good buy..."

Over and Out

rodrigues



Color TV Troubles

Continued from page 61

supply. I looked. They were both charred.

It was a classic case of the RF amplifier tube shorting out and burning up the resistor in the B+ leg. Two new resistors and a new tube restored all.

Lacks the Basics. My next-door neighbors are gift givers. If they happen to be in a store and see something appropriate for a friend they'll buy it and present it as a gift. When their TV went on the blink I was kind of glad. At least now I could do something for them.

The symptom was no Y signal (luminance). The sound was good but only a smeary color picture was displayed. There are four components in every color TV picture: a red signal, a blue signal, a green signal and the Y signal which makes up the b&w picture.

The Y signal has all the required frequencies to display a good b&w picture. Since the frequencies of the color signals are restricted they only fill in the b&w picture with color. Color signals are unable to construct a whole TV picture. When the Y signal is lost, the colors remain but are smeared.

In the color picture tube there are separate control grids in each electron gun for the three primary colors. The Y signal from the video circuits goes into all three cathodes simultaneously. If the Y signal should be absent, signal injecting can pinpoint the defective components in short order.

I brought over my flying-spot scanner from next door and began injecting. First setdown point was the cathode input to the CRT. Often a heater-to-cathode short in the CRT causes loss of Y signal. This wasn't the case here. When I touched down on the cathode a good b&w picture appeared.

I moved back into the Y circuits and began hitting one component after another. First a coupling capacitor, then a series resistor, then the delay line, etc. A good Y display kept reappearing.

I reached the plate of the video amplifier, then the control grid . . . still a good picture. Next came the video driver. The collector came through okay but when I hit the base of the transistor the picture disappeared.

I unsoldered the transistor and resistance measurements revealed the base-to-collector path was open. A new transistor revitalized the TV and the favor to my friends made my day.

Antenna System That Lasts

Continued from page 84

trying for wall outlets. The outlets are neat and handy but in an existing house it is difficult to snake either coax or twinlead in between the studs and to the electrical boxes. In our case, we did mount one box in the floor, behind the most-used TV set, which offers coupling for both the coax line and the five-wire rotor cable.

The antenna itself is folded out (in our case, with the fiberglass model, we worked with the individual elements) and mounted on the main mast. The rotor is mounted on a stub mast that gets the rotor just above the chimney (putting the weight as low as possible). The top bracket of the rotor, which comes off, then is mounted on the bottom of the main mast and, finally, the two halves of the rotor go together and you have a kind of a Christmas tree with coax and rotor cable dangling down like spaghetti.

The rotor and its control are preset by you to a particular direction (such as north) and then you point the antenna in that direction when you mount it. Thus, north at the controls downstairs also means north at the top. Some kind of through-wall tubing (we used Javex Tenna-Tube) is advisable to get coax and rotor cable through and into the attic.

Inside the attic, we cut a BX cable and installed a drop line and outlet box to power the booster/coupler, which we placed on the wall near the entry tubes. Unless you use splitters farther down the line to divide the signal between sets (and thus weaken it), you must run individual coax lines from the amplifier's outputs to each set.

Coax takes careful cutting and stripping before connectors are installed at the ends. The job is not difficult but requires patience. We used a cable cutting and stripping tool and a ferrule crimping tool from Winegard.

As a last step, the mast should be grounded as lightning protection. We used heavy aluminum wire running to a copper stake driven into the ground as far as we could get it—which was about 4 ft.

By the way, the system works. Our chart shows signal strengths we were getting with our old single-conical antenna and what we're getting now. In short, now is better. The figures were obtained from Jerrold's Model A.I.M. 718 antenna-installer's meter. which we found exceptionally sensitive.

One-IC Signal Tracer

Continued from page 35

you need to track down the signal. It's built in one package, and has a high-gain, high-input impedance amplifier with an RF probe, audio probe and built-in power supply.

Our signal tracer basically consists of gain control R1, emitter-follower amplifier Q1 and integrated circuit IC1. The overall input impedance is approximately 280,000 ohms. The IC power amplifier is rated for a maximum of 1 watt output into 8 ohms.

The RF probe consists of DC blocking capacitor C8 and diode detector D1. The capacity of the shielded cable serves as the RF filter. This assembly must be built in a shielded probe to avoid capacity-induced hum pickup from the user's hand. The audio probe consists of capacitor C9 and is housed in a shielded probe.

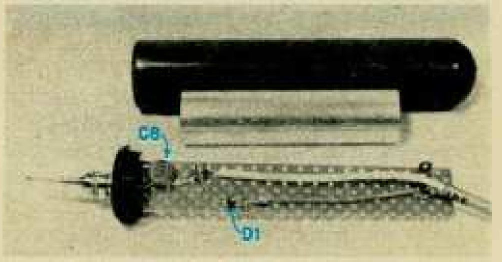
The signal-tracer circuit board is mounted to the main section of a 3 x 5 x 7-in. aluminum cabinet. A small section of perfboard approximately 2½ x 2¾-in. holds the amplifier.

First assemble the amplifier. While standard board can be used, construction will be easier if you use G-pattern perfboard. Although IC1 is round, its correspondingly round socket would be almost impossible to use for point-to-point wiring.

Form IC1's leads so they fit an in-line socket. Carefully bend leads 1 through 5 to one side and leads 6 through 10 to the other side. Note that lead No. 10 is directly opposite the tab. Form two sets of lead groups so they form a straight line. Next, separate out each lead so there is approximately ⅛-in. between leads. They should now fit into the socket. When wiring the amplifier, take care to note that two of the IC socket terminals on each side remain unused.

As long as you wire the layout according to the schematic, there are no special precautions. Make certain the polarities of the electrolytic capacitors are correct. The component leads can be soldered directly to the IC socket terminals but push-in terminals should be used for all other connections. Do not wire without these push-in terminals. Otherwise, complete amplifier instability can result.

When you wire both speaker terminals, make sure that only one connects directly to the positive battery supply. You cannot use a speaker that has one terminal connected



RF probe assembly. Add ground wire before you add metal shield. handle is slipped over perfboard.

to the speaker frame. This terminal would be grounded by the mounting screws to the cabinet, shorting out the battery supply. Both terminals must be insulated from ground.

Though IC1 is rated for an 8-ohm speaker, a 16-ohm type can be substituted with no appreciable loss in output power. Mount the speaker to the cabinet with a piece of scrap G-pattern perfboard serving as grille.

Leave sufficient space for the amplifier assembly and then mark the position of gain control R1, input jack J1 and B1 holder. Remove the speaker and drill the remaining component holes. Don't attempt to drill the cabinet with the speaker in position. Metal chips will most likely fall into the speaker cone and create a raspy sound.

After all cabinet-mounted components are installed, finish the tracer by mounting the amplifier. Secure an L shaped ground bracket to the perfboard amplifier. Fasten the other end of the bracket under one of the speaker mounting screws. Then interconnect all necessary wires.

Except for the connection between components J1 and R1, no shielding is required. The shield is formed by wrapping a section of insulated No. 20 or 22 solid wire around the wire leading from J1's center terminal to R1. Connect one end of the home-brew shield to R1's grounded terminal. Leave the other end of the shield free.

The battery can be fastened to the cabinet with an ordinary metal clamp or battery holder specifically designed for the standard 9 volt transistor radio battery.

The RF test probe is assembled from Keystone's type 1810 test probe kit. It consists of the probe case, an internal perfboard and shield. Screw the test probe tip into the front cap and insert a 0.001 μf disc capacitor into the tip as far as it will go. Wrap the lead protruding through the tip once around the groove at the base of the tip and cut off the excess lead. Tighten the knurled tip nut to secure the lead.

Position the supplied perfboard against the cap and insert one of the supplied terminals into the board about ½-in. from the capacitor. Solder the free capacitor lead and D1's cathode lead to this terminal.

At one end of the 36-in. length of shielded audio cable, trim back the shield and outer insulation. When the shield is soldered to the small solder lug which is already factory-mounted to the perfboard strip, the center conductor will reach the push-in holding down components C8 and D1. Insert the shield into the rivet hole on the solder lug. Solder a short length of wire from this hole to D1's anode lead using a push-in terminal. Bend the solder lug at right angles and slide the shield over the perfboard.

Straighten the solder lug, slide the shield back to the lug and solder the lug to the shield. At the same time, solder about 12 in. of flexible insulated wire to the solder lug. This will be the probe's ground lead.

Cut a small notch about ½-in. deep in the front end of the probe body and slide it over the shielded wire and probe. Bring out the ground lead through the notch and fasten the probe body to the cap with screws. Apply a phono plug to the free end of the shielded wire to complete the RF probe.

Assemble the audio probe the same way. You can use an identical test probe kit for this probe.

Overall gain is very high so all tests should start with the gain control no more than a quarter open. If you are tracing RF circuits, use the RF probe from the antenna through the RF and IF stages to the detector. From the detector to the loudspeaker, use the audio probe.—*By Herb Friedman*

One-tube Radio

Continued from page 30

tank circuit is controlled by pot R2 (*Regeneration*). Sufficient positive feedback reduces losses in the tank. Too much feedback forces the receiver to oscillate.

Coil L1 is a standard ferrite loopstick antenna which covers the broadcast band. The secondary is ten turns of No. 22 wire wound tightly on top of the primary winding. Coil L2's primary winding consists of 22 turns of No. 24 enamelled wire. The secondary is wound with six turns of the same gauge wire. Coil L3's primary is 12 turns of No. 24 gauge wire, while the secondary consists of six turns. After wiring the coils, coat with coil dope and let them dry.

After building the radio, advance R2 on each range and listen for an increase in noise level as the pot wiper is turned. If nothing happens, reverse the secondary leads of the coil.

Make your own dial scale and label it by marking down the frequencies of logged stations. Mount the radio in a cabinet if desired. For best results, connect a long-wire antenna and external ground. *By Herb Cohen*

One-tube Amplifier

Continued from page 31

closer to ground via R5's wiper arm. Tone becomes bassy since more highs are diverted to ground.

Power amplification occurs in the pentode section labelled ½ V1(P). Unbypassed cathode resistor R8 introduces a small amount of negative feedback to reduce distortion and improve fidelity.

The secondary of the output transformer drives either a speaker via J2 or headphones through 100-ohm limiting resistor R9.

Power transformer T1 can be any unit having the specifications shown in the Parts List. The colors keying T1's leads are specifically for the transformer in the prototype.

Power supply rectification is full-wave with resistor-capacitor brute-force filtering. High voltage across capacitor C4B is 125 VDC. Total current to both tube plates is 18 ma.

Output power of the amplifier is nearly 1 watt to the load before distortion appears. High-frequency response is good and extends to 20,000 cps before dropping 3db.

Low-frequency response is not as good. The small size of the output transformer hampers bass response.

If a ceramic phono cartridge sounds too tinny, the problem can be cured by adding more capacity across the primary winding of the output transformer.

Though a test ceramic cartridge did not overload the amplifier input, some models may do so. This is remedied by increasing the value of R1. Also, if resistor R9 fails to reduce earphone volume sufficiently, increase R9's resistance. It was selected to drive 8-ohm phones comfortably. *By Len Buckwalter*

CB Converter

Continued from page 33

as the secondary winding of L1. Two turns of the same wire wound next to the secondary is the primary half of the transformer. Coupling transformer L3 consists of a three-turn primary winding and 11-turn secondary. Both coil windings are wrapped around a 7/32-in. ceramic form. Again, use No. 24 gauge wire.

For best performance, make all component leads as short as possible. Point-to-point wiring with perfboard and push-in clips is a satisfactory wiring method. The prototype model was built on a 2 x 4-in. piece of perfboard. Layout is not critical.

To align the CB converter, tune the broadcast band receiver to 1500 kc (or any other frequency that is unoccupied on the band). Turn L2's slug until a rushing sound is heard. Then turn variable capacitor C6 and listen for an incoming call. While a transmission is in progress, adjust input RF transformer L1 for maximum signal. If the converter only monitors channel 9, peak L1 for maximum response at this frequency and substitute a trimmer capacitor having the same specifications for capacitor C6.—*By Herb Cohen*

Home Intercom

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muffled. The transformer corrects the frequency response.

The master station is housed in a 5⅛ x 3¼ x 7-in. aluminum cabinet. The amplifier we show is built on a 1¾ x 3-in. piece of perfboard. Push-in terminals are used for all tie points.

When installing IC1, take extra care that you solder to the correct terminals. Note that one end of IC1 has a tab, to which a heat sink will be soldered.

Carefully bend IC1's tab upright and coat it with solder. Cut a ½ x ¾-in. piece of metal from a tin can. Solder the metal to the tab. Follow the schematic and complete the subassembly wiring.

Do not eliminate capacitor C2. The amplifier might break into oscillation without it. Make certain capacitor C3's and C4's polarity is correct.

You may have to adjust the value of R2. Temporarily connect B1 to the amplifier. Measure the voltage from IC1 pin 12 to ground with a VOM. If the voltage is approximately one half of the full supply voltage, R2's value is okay. If the voltage at pin 12 is less than 7 volts, change R2 for a lower value (50,000 ohms or so) until the voltage at pin 12 is about half the supply voltage.

Speaker SPK1 (and remote speaker SPK2) can be any intercom-type speaker of 30- to 45-ohm impedance. Any size from 2½-in. and up will handle IC1's output power.

Transformer T1 is soldered directly to the case of gain control R1. To avoid heat damage to T1, first coat R1 with solder where T1's mounting tabs will touch the case. Then coat the transformer tab with solder.

The remote station consists of a speaker and jack installed in a cabinet. The speaker can be cemented to the inside of the cabinet, a model supplied predrilled for speaker grille material and jack J2's mounting hole. Any cabinet can be substituted for the remote unit.—*By Leslie Powell*

The E-Dipper

Continued from page 79

a knob over the plastic extension shaft glued to C6 and orient the pointer at the 137 mc marking on the lowest frequency band. If you built the E-Dipper exactly as shown, the knob pointed should indicate the appropriate frequency as selected by the plug-in coil. Of course, a signal generator is required for a more accurate calibration.

Winding E-Dipper's Coils. Four coils cover the bands described. All are made from No. 10 copper buss wire, the same type used to form the E-Dipper's ground buss.

The 400 to 450 mc coil, labelled L3 in Fig. 4, is a U-shaped piece of wire. Start with a 1-in. long coil and cut off the ends with a pair of nippers until the frequency rises to 450 megahertz at the minimum setting of capacitor C6.

The 203 to 235 mc winding, coil L2, is a larger U-shaped coil. The ends taper down to fit into the socket pins. Trimmer capacitor C18 is soldered across the base of the coil as shown and later adjusted to give the dipper's capacitor the correct frequency range.

The 2-meter coil, L1, is made from three turns of copper buss. It is wound to a ½-in. inside dia. and spaced so the length of L1 is 7/16-in. total.

The 218-228 mc. coil, L4, is a U-shaped coil. Solder C19 in place at the points indicated

A Triggered Sweep Scope

Continued from page 87

in the assembly manual correctly match the component to be wired to the corresponding circuit-board position. A few steps, however, presented more-than-average difficulty to complete. Heatsinks on the power-supply board are referred to in the instructions as having a front and rear surface. We could not tell which side was front and which was rear.

The graticule lamps presented us with difficulties, too. The problem was finally solved by removing the already-mounted tie points which hold the lamp wires and gently pushing the lamps through a couple of rubber grommets which hold the lamps to the front panel. Then we remounted the tie points and soldered the lamp leads to the tie-point terminals. All of this extra work was done so that the extra-fine leads of the graticule lamps were not broken.

One error in the assembly manual that has nothing to do with wiring the kit should be pointed out. The right-hand column in pictorial 2-1 shows a 10 μf electrolytic capacitor being soldered to the vertical-amplifier circuit board. If you later have reason to check circuit-board wiring against the schematic, you will find that the position of this electrolytic (capacitor C102) in the schematic is incorrect. The positive lead of this capacitor should connect to the shield terminal of transistor Q105 instead of the gate, as shown. Otherwise, the schematic is correct.

The final wiring chore consists of assembling an uncompensated coaxial test lead. It has the proper BNC plug on one end and a pair of alligator clips on the other. But don't think for a moment that this hunk of wire with attaching clips can be substituted for a compensated scope probe if you seriously want to make accurate measurements with your IO-103. Only use the supplied coax cable when you're working on low-impedance, low-frequency voltages. For accurately measuring signals, you'll have to invest in Heath's compensated scope probe. It costs \$19.95 and comes assembled.

To sum up, the Heathkit IO-103 is a kit scope that is well worth the intial outlay. It will take time to build and properly calibrate. But once these chores are completed, the IO-103 will more than reward the experimenter's or service technician's efforts.

Continued from page 52

are basic to an intriguing circuit widely used in push-pull audio stages.

If you recall the conventional push-pull output stage, the grids of the tubes are fed signals of opposite polarity via a phase inverter. One tube pushes while the other pulls. An output transformer having a center tap is required so that each tube can add its share of power to the output. Using transistors, the complementary symmetry circuit eliminates tubes, transformers and phase inverters.

The schematic diagram shows one NPN and one PNP transistor connected in series across the power supply. Let's assume the input signal is positive and that it's simultaneously applied to the bases of Q1 and Q2. Since transistor Q1 is an NPN type, a positive-going base signal causes an increase in collector current. At the same time, the positive signal causes a decrease in Q2's collector current (a PNP type).

This circuit draws about 80 ma. So an AC-operated supply of 9 VDC is recommended instead of a battery. The amplifier develops about a half-watt output in an 8-ohm speaker and requires several volts of audio drive. When we connected the amplifier to an FM tuner having a 1-volt output it produced good sound.

Crystal Calibrator. Almost all transistor circuits work as amplifiers even when they're called oscillators and switches. Project No. 3's circuit is a good example of how these various functions intermingle. If you recall the phono preamp, negative feedback was used to reduce high-frequency levels (equalization). In this circuit, we'll use positive feedback so the transistor goes into oscillation.

The oscillator produces a continuous signal when the power is turned on. When a surge of current causes the base of Q1 to become positive, it is instantly amplified as a large collector current. The signal will have its polarity reversed, however, as a consequence of its passing through the transistor. So a negative signal is applied to the base of Q2 which similarly amplifies it and reverses its phase.

A positive signal at the collector of Q2 is fed back to the base of Q1 through a quartz crystal. The result is that a tiny positive input signal to Q1 is rapidly reinforced by positive feedback. This quickly drives Q1 beyond its ability to amplify—its saturation point—and no further signal reaches the base of Q2. This momentarily kills the positive feedback and Q1 starts conducting again.

The overall effect is that the transistors repeatedly switch each other on and off. For this reason, the device is called a multivibrator. It generates a square wave (see photo). Because the transistors alternately are driven into cut-off and saturation, the sine wave signal is clipped on both its positive and negative sides.

A special component is the 100-kc crystal. Since the crystal will pass only one frequency, the transistors are forced to switch at a 100-kc rate. This is the only signal permitted to deliver feedback. The square waves generated by this circuit are extremely rich in harmonics.

RF Oscillator. Millions of solid-state receivers have a radio-frequency oscillator similar to the one shown in the schematic for project No. 4. The tapped coil furnishes the important ingredient for any oscillator—a positive feedback signal of correct polarity. When the switch is turned on, collector current surges through the main winding of coil L1. Electromagnetic flux cuts across the lower coil and induces a current flow which reaches the base of Q1. This secondary flow serves as the positive feedback signal. It causes the base to pass more current.

The transistor quickly saturates, cannot amplify further and positive feedback halts. The coil's electromagnetic field then collapses and the stage drops back to its original state. The process is repeated as RF currents circulate at the resonant frequency determined by L1 and C1.

Selected component values permit the oscillator to operate over a range of 350 kc to 1000 kc. One valuable frequency in this band is 455 kc. You can place your RF oscillator next to a radio and use it as a BFO (beat-frequency oscillator). This will make code stations and single-sideband signals audible. The oscillator also can serve as a signal generator to provide a steady carrier for troubleshooting or receiver alignment.

Voltage Control. The circuit for project No. 5 shows how semiconductors can replace bulky tubes and rheostats in power control. It's also a handy item to have on a workbench.

Basically, the transistor serves as a variable resistance in series with a load. It's easy to control many watts of working power by merely varying the tiny base current with a small potentiometer. The transistor shown is a PNP type, so collector current rises as R1 is rotated toward the negative side of the input. Emitter-collector resistance drops and more current reaches the load. Rotating R1 to the positive side reduces base bias until no current flows to the collector.

This circuit was tried with several loads. It can vary the speed of a small DC motor or the brightness of a pilot lamp. Also, a 6-volt high-intensity lamp was controlled over a range of 0 to 4 amperes. To prevent thermal damage, the transistor is mounted on a heat sink. Any PNP audio-output transistor capable of handling several amperes should work in this circuit.

RF Preselector. The circuit for project No. 6 features a field-effect transistor (FET). The transistors used in our other projects are called *bipolar* because they depend on charge carriers of two types, free electrons and holes. An FET is *unipolar* because it depends on only one carrier. (We will use an N-channel FET. P-channel FETs also are available.)

The two main terminals of an FET are called the source and drain. They lie at either end of a channel. The charge carriers (free electrons in N-channel devices) are drawn from the source to the drain because of a positive voltage applied to the drain. A third terminal, the gate, controls the flow of current.

As a signal on the gate becomes increasingly negative, its electrical field creates a *depletion* region in the channel. This constricts the current. It's comparable to the effect of a vacuum-tube grid. Amplification results when a tiny gate voltage controls a large drain current.

An important characteristic of the FET is that no current flows in its gate circuit. Control is exerted via electrostatic charges, not via a control current. Thus, input resistance is extremely high. This is an advantage in RF amplifiers since it prevents unwanted mixing of signals and annoying crosstalk.

Our RF preselector is designed to boost the performance of a shortwave or ham receiver that works poorly on the higher bands. The coil specified covers 6 to 13 mc, but you can place a tap in the coil or reduce the number of turns for extended coverage up to 30 mc. Keep your leads short for best performance and observe the manufacturer's precautions about handling the FET.

Wow & Flutter Meter

Continued from page 47

resistor from M1's terminals and readjust R45 for a zero reading on M1.

Connect the audio voltmeter to the junction of R3 and the source terminal of Q1. Adjust R1 for a 0.1 V reading. Place S2 in its *On* mode and S4 in the 1.0% position. Adjust R41 for a 0.8% reading on M1. Reset S4 for its 5% position and switch off S2. Adjust R30 for a half-scale (2.5%) meter reading.

Place S4 in the *Level* mode and set R7 for a half-scale reading on M1.

Place S4 in the *Modulation* position and adjust R59 for a half-scale reading.

Connect the scope's vertical input to pin 6 on IC3 (point A). If the scope is triggered, set its sweep rate to 10 milliseconds/centimeter. Readjust R17 so that there is equal modulation at the top and bottom of the 3,000-cps envelope. See Fig. 7 for the proper waveform shape. The Wow & Flutter Meter is now calibrated and ready for use.

How to Use the Wow & Flutter Meter

Most tape decks have internal adjustments for wow & flutter correction. These adjustments usually are of a mechanical nature, affecting pinch pressure on idler wheels, capstan drive belt tension and the like.

Although each manufacturer shows (in his service manual) a complete procedure for adjusting these screws, it is almost always possible to better his specification by patiently trying various combinations of tensions and pressures on those components that directly affect wow & flutter.

The easiest way to improve wow & flutter is to give the tape transport mechanism a thorough cleaning. Bearings must be dust-free. And if you must oil your machine, sparingly apply what came with the deck.

Turntables have no provision for wow & flutter adjustments. One of the ways wow & flutter can increase is if dust and dirt enter the mechanism.

Idler wheels are especially prone to excessive wear and should be suspected if wow & flutter for a particular machine far exceeds a manufacturer's specs. Also check a turntable's spindle by substituting a known good one in its place. If wow & flutter drop significantly, replace the spindle.

The Listener

Continued from page 62

two parallel outlets also are operating presently, one on 5804 kc (rated at 25 kw, sign-on around 2230) and one on 881 kc. A new 100-kw shortwave transmitter is soon to be donated by the recently formed United Arab Emirates, a federation of Persian Gulf principalities.

Propagation Forecast. During daylight hours, the 15-, 17- and 21-mc bands will provide good listening; the 6-, 7-, 9- and 11-mc bands will be best for DX during evening hours. Decreasing noise levels will result in an improvement in BCB DX, while decreasing sporadic-E activity will mean fewer FM- and TV-DX openings.

In September and October, daytime is nearly equal in the northern and southern hemispheres. Because of this, very long DX circuits between hemispheres open up for longer periods of time. Reception of signals from Australia, New Zealand, India, Ceylon and other South Asian countries will be best during the equinox months.

A Home-Protection System

Continued from page 53

control box with ordinary lamp cord. Wires are fastened to appropriate screw terminals.

Although Eico sells all components of the Fail Safe system individually, it offers a complete starter package for $109.95. Called the SS-500, this home-protection kit includes the FC-100 control center, AC power supply, alarm bell, key switch, remote stations, fire sensors for normal room use and an assortment of tamper and contact switches.

All sensors and bells operate from a 6-volt lantern battery or optional AC power supply. If batteries are the sole source of power, the Eico system can provide fail-safe operation only if the cells are fresh. For this reason we recommend Eico's optional power supply.

One of the nice features of the Eico system is a circuit-test and alarm-indicator light. A white lamp located at each remote station and on the control-center front panel indicates that all sensors are energized and the system ready. A red light also is mounted at each remote station and control-box panel. When lit, it indicates that the system will sound the alarm if a door or window is disturbed.

CB Corner

Continued from page 71

is accepted by police officials as a valuable resource. The precinct's commanding officer knows the value of CB as a reporting medium and the set-up has been working well for more than a year.

I asked Bill if he could see the day when ordinary people walking the streets in high crime areas might carry handie-talkies for security. He replied that Channel 9 still isn't completely clear and is occasionally jammed by other signals. He wouldn't bet his life on it. His immediate goal is to help similar groups make contact with police officials in other areas. Three other boroughs of the city soon will have comparable monitoring services, with instant radio communications linking them all. This successful experiment n public service has other implications. As Bill Wahlin remarked, "This is one way to civilize CB!"

A Lo-Lo-Ohm Ohmmeter

Continued from page 65

The circuit is built on a piece of 3x4½-in. perfboard. See Fig. 3. Twelve push-in lugs located around the perimeter of the perfboard, as shown in Fig. 3, terminate all wires which are to be connected to front-panel mounted components and probes P1 and P2.

After completing initial perfboard wiring, drill out two holes in the bottom of the aluminum cabinet and mount the wired perfboard to the chassis, using 1-in. spacers.

Next, replace the original meter dial with the one shown on the first page of this article. Remove the four screws securing the front cover of the meter and remove its cover. Remove both screws holding the dial and carefully lift it out. Cut out the new dial, paste it over the old one and reassemble M1.

After inserting two rubber grommets into holes drilled in the front panel for the probe leads cut and dress a couple of 1½-ft. leads.

Calibrating the Ohmmeter. Turn S1 to its *Cal* position. Short P1 and P2 and null M1 to read zero with pot R14. Then separate the probes and turn the calibrate pot until M1 reads exactly 1. If you can't null the meter when you try it the first time, substitute a higher or lower resistance value for R16. If R18 doesn't bring the meter needle up to 1, it is time to change batteries.

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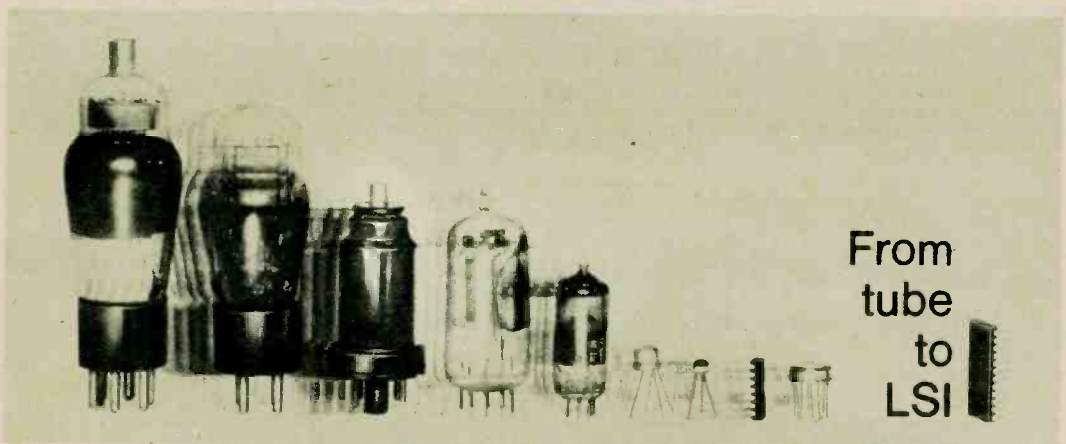

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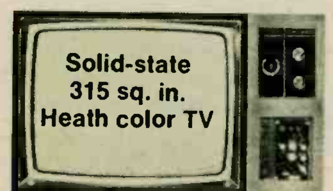

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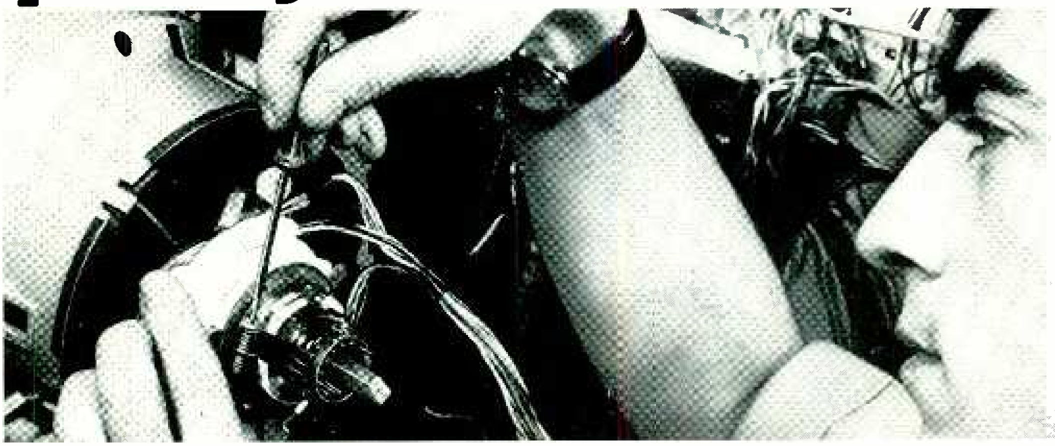

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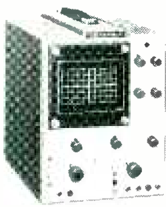

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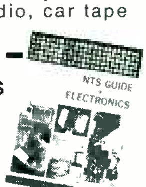

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