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July 1970 Vol. 13 No. 4

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COVER: Ektachrome by John Capotosto

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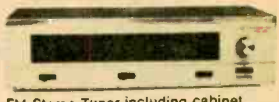

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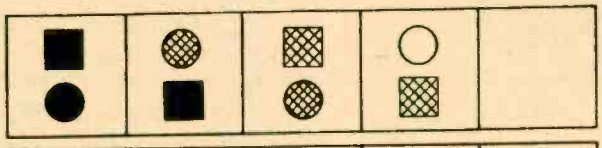
If you can solve this "problem" you could become a computer programmer!

A.



B.

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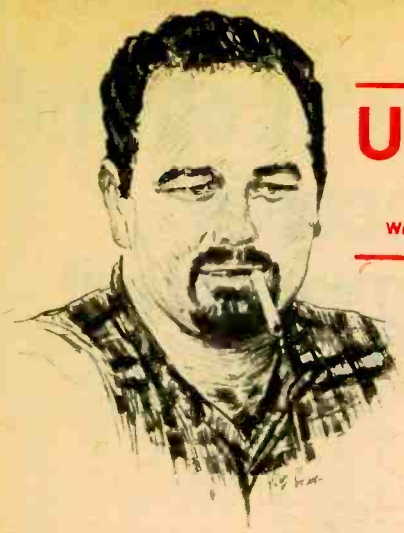

Uncle Tom's Corner

By Tom Kneitel, K2AES/KQD4552

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

★ *Can you give me any information on the Moog Synthesizer?*

David Burleson
Midland, Tex.

It's an invention of Robert A. Moog. The device is a complex $8,000 electronic musical instrument which can belt out some pretty wild sounds in either classical or pop formats. Old-style musicians (humans, that is) are a bit uptight over the infernal contrivance since the first Moog (pronounced like vogue) album, Columbia's Switched-On Bach, was at the top of classical record charts well over a year. One technician mans the controls so record-company execs—already ecstatic about the commercial success and artistic acceptance of the gadget—also are enthusiastic about the possibilities of eliminating union-controlled symphony orchestras on future recordings. A bigger bang for the buck, you might say.

★ *Here's a brain bender. In the foreign phone segment of the 20-meter ham band—in fact, smack on the bottom edge—I logged a voice station signing the call KW2XBP. He switched over to CW and went just outside the edge of the band. This was checked with a good crystal calibrator and I know I have the call copied right. Only problem is, there just isn't any such prefix listed and the frequency was all wrong for ham stations in the U.S. and possessions. The KW part of the prefix leads me to believe he's on Wake Island (KW6-land) or thereabouts. Is he a bootlegger?*

Jack Barnguet
Elko, Nev.

You snagged a dilly but you're looking in the wrong direction. The X behind the numeral in the callsign is a dead giveaway because it brands this one as an experimental (not ham) station. KW2XBP runs a cool kilowatt on 13.9995 mc CW and 14.001 mc phone. He's licensed and located on Fletchers Ice Island in the Arctic. Station is operated by the University of Alaska. Nice going, Jack!

★ *I'm probably the world's most avid golf nut; I frequently travel to various PGA tournaments just to watch the greats in action. One of the little extra enjoyments I have is taking a small receiver with me so I can listen to the PGA officials on the course communicating via walkie-talkie. For a long time they were on 154.57 mc but sometime last February they must have changed frequencies because now I can't hear them anymore. Do you know the new channel so I can order another crystal?*

Wes Schumm
Pasadena, Calif.

A little birdie (oops!) tells me that they now operate on 151.625 mc. If you're an all-around sports fan you'll really swing on this channel because it's also used by officials of the National Football League and the American Motorcycle Association.

Super Surveillance Dept. Two scientists are causing a flurry of excitement due to their recent invention—a lock-on wristwatch transmitter. When hooked to the wrist of a prisoner, parolee or mental patient, the wearer can be tracked by receiving equipment. The inventors say that it can't be given the slip since tampering with it or trying to remove it causes a special signal to be sent out. However, they neglected to say what happens if the wearer decides suddenly to jam his arm into a pail of water. Sorry about that.

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CIRCLE NUMBER 8 ON PAGE 15

Feedback from Our Readers

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

● FOLK FROM POLK

Your article on DXing THE COUNTIES (March '70 EI) was out of sight. However, being a good Iowan I must point out that station WHO, Des Moines, is in Polk County, not Polik! Using a directional antenna, listeners on the East Coast also might try for station KXEL (1540) in Waterloo (Black Hawk County).

D. R. Nelson
Ottumwa, Iowa

● TWO PLUS TWO

Enjoyed your article on 4-CHANNEL STEREO in the May '70 issue, but what does this kind of stereo do for a purist like me? As far as I am concerned, true fidelity is only achieved via a headset. How can I hear four-track material with only two ears?

Max Simon
Latrobe, Pa.

Any ideas from audiophiles?

● BOTTLE COLLECTOR

Reader Horst Jablovsky (Jan. '70 FEEDBACK) offers to blow a Klein Bottle for electronic purposes, then goes on to say that it is "more wondrous and amazing" than the Moebius Strip. Let me assure you, he is right. But the Klein Bottle is not exactly as you pictured it. It's a four-dimensional object because it does not cross itself. In answer to Mr. Jablovsky, let me make him an offer: if he can blow a real Klein Bottle, I will come up with a whopper of a scientific use for it.

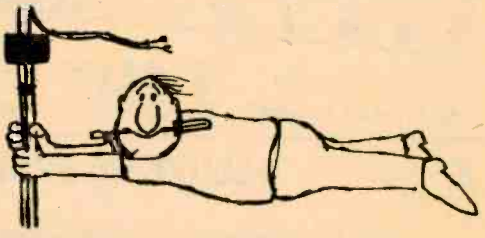
Mark Durst, WA6JKF
Culver City, Calif.

● MILITARY CB?

Alan Levesque, in WHAT'S AHEAD FOR CB (Jan. '70 EI), mentions the possible use of FM equipment in the 27-mc CB band. The U.S. Army has operated via FM in that region for some years. I don't see these two clubs sharing space.

John Allen
Colorado State College
Greeley, Colo.

● LOOSE WIRE



That article on HOW TO SET UP A NEIGHBORHOOD ANTENNA TV SYSTEM (July '70 EI) really caused a stir up here. But tell me, after you have this type of 50-ft. oil rig erected, guyed and sealed in concrete, what do you do if a high wind blows a wire loose from your preamp—located way up there in the clouds?

Patrick Dennis
Wilamantic, Conn.

Consult the service manual.

Now it costs less to own the best oscilloscope you need.

The New RCA WO-505A Solid-State Oscilloscope

*Inexpensive Quality
†Optional Distributor Resale Price

RCA

The best you need is the new 5-inch RCA WO-505A, all solid-state oscilloscope. It makes yesterday's general-purpose 'scopes look old-fashioned.

At just $298.50† the WO-505A offers an unmatched list of features usually found only in more expensive, laboratory-type instruments. For example there's the all solid-state circuitry . . . an illuminated graph screen calibrated directly in volts, and a deep-lip bezel for exceptional clarity. The regulated power supply minimizes trace bounce and provides excellent stability. And the camera mounting studs offer still more evidence of the functional value built into the new WO-505A.

But you've got to see this new RCA 'scope in operation—see the sharp, clean trace it provides—to appreciate it.

Some statistics:

- High-frequency response, usable to 8 MHz.
- High Sensitivity (.05 V p-p range).
- DC vertical amplifier; DC/AC input.
- Return trace blanking... Trace polarity reversal switch... Phase control.
- High-frequency horizontal sweep; solid lock-in on 5 MHz.
- Preset TV "V" and "H" frequencies for instant lock-in.
- Built-in square-wave signal for calibrating P-P voltage measurements.
- Provision for connection to vertical deflection plates of CRT.

Some statistics! For complete details, contact your RCA Distributor.
RCA|Electronic Components|Harrison, N. J. 07029

CIRCLE NUMBER 25 ON PAGE 15

Broadsides

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

A TAPE recorder without **tape accessories** is like a mini minus the maiden. It goes nowhere. Whatever your interest—cassettes, reel-to-reel or phono—the Robins catalog No. 6912 will guide you through the confusing world of tape formats, demagnetizers, splicers, bulk erasers, stylus-pressure gauges, etc. If it hasn't got what you want, we would like to hear what you're doing. Write for your copy to Robins Electronics Corp., 15-58 127th St., Flushing, N.Y. 11356.

Whatever you have in your shack in the way of equipment, it's bound to have a crystal somewhere inside. To keep everything under control, at any frequency, you'll want to examine a catalog of **crystals and frequency meters** published by the International Crystal Manufacturing Co., Inc., 10 North Lee, Oklahoma City, Okla. 73102. It's a must for hams.

Short-wave listening can be a nuisance if you're not used to converting GMT into local time or comparing time differences throughout the world. The Hallicrafters Co., 600 Hicks Rd., Rolling Meadows, Ill. 60008, has come up with a nifty gadget that not only does this chore for you but also lists the frequencies of various services. Called a time dial, this **pocket calculator** can be had for $1 if sent to Dept. PR at Hallicrafters.

A 12-page, illustrated brochure titled, Glow Lamps—Design, Operation and Application, discusses just what the title infers. Topics include the construction of two- and three-element **neon lamps,** their operation and a lengthy treatment of lamps used as trigger tubes. A free copy is available from Signalite Inc., 1933 Heck Ave., Neptune, N.J. 07753.

A 32-page catalog of **trimming potentiometers** has been issued by the Helipot Div. of Beckman Instruments. Their complete line is listed, as well as information on cermet materials and application considerations. For a free copy write on letterhead to Technical Information Section, Helipot Div., Beckman Instruments Inc., 2500 Harbor Blvd., Fullerton, Calif. 92634.

The mobile market keeps moving. If you're interested in **stereo tape players,** reverbs or cassette players for your car, write for a free copy of a four-page brochure describing the Gibbs line to Sales Dept. Gibbs Special Products Corp., 450 N. Main St., Janesville, Wis. 53545.

Magnetic heads for multitrack recorders (ranging from 2 to 28 tracks) are discussed in a catalog available free from Norton Associates Inc., 10 Di Tomas Court, Copiague, N.Y. Both analog and digital models are in their Series 2000 through 7500. Complete specs are provided.

Shakespeare

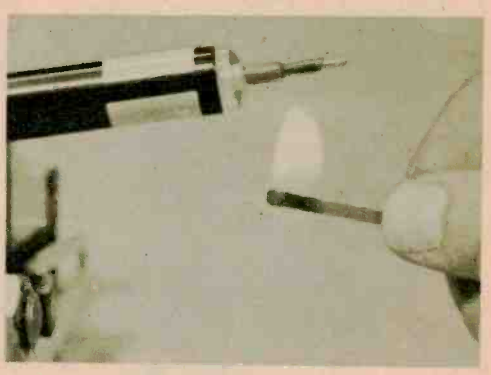
MAKES THE BEST ANTENNAS

This "PERFECT 36" is one of a great, complete line.

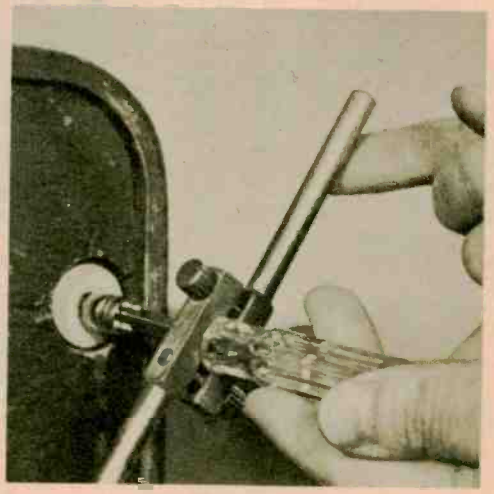
C/P Corporation Division, The Shakespeare Co., P.O. Box 5207, Columbia, S.C. 29205

CIRCLE NUMBER 2 ON PAGE 15

Tips



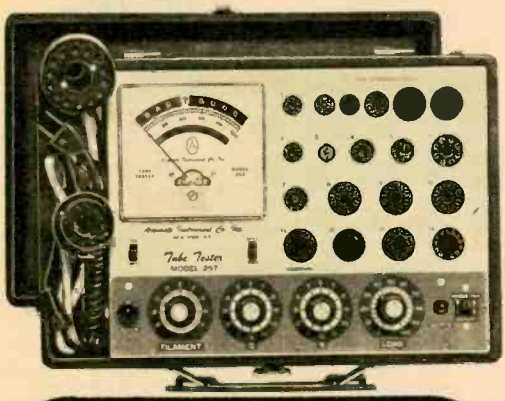
As chassis get smaller and smaller and components get closer together, chances are that the long tip on test probes is going to short a few components. Even an instantaneous short in a solid-state circuit means big trouble. For permanent protection against shorts, insulate most of the probe tip with shrinkable tubing. Unlike spaghetti and tape, shrinkable tubing becomes a permanent part of the tip and won't come off. Slide a piece of shrinkable tubing over the probe tip, then heat with a match. Don't let flame touch the tubing.



Your automobile serviceman saves a great deal of time by spinning his X-shape lug wrench to remove and screw down a car's lug nuts. If time means anything to you—and it probably does if you do full- or part-time servicing—slip a tap wrench over the shaft of your socket wrench and spin it fast. If the socket-wrench handle is large enough, a die stock slipped over the handle will perform the same way. Either of these tools, unless you now own them, can be bought at low cost at electronic parts distributors or hardware stores.

The New 1970 Improved Model 257 **A REVOLUTIONARY NEW**

TUBE TESTING OUTFIT



- **Tests all modern tubes including Novars, Nuvistors, Compactrons and Decals.**
- **All Picture Tubes, Black and White and Color**

ANNOUNCING... for the first time

A complete TV Tube Testing Outfit designed specifically to test all TV tubes, color as well as standard. Don't confuse the Model 257 picture tube accessory components with mass produced "picture tube adapters" designed to work in conjunction with all competitive tube testers. The basic Model 257 circuit was modified to work **compatibly** with our picture tube accessories and those components are not sold by us to be used with other competitive tube testers or even tube testers previously produced by us. They were custom designed and produced to work specifically in conjunction with the Model 257.

COMPLETE WITH ALL ADAPTERS AND ACCESSORIES, NO "EXTRAS"

STANDARD TUBES:

- Tests the new Novars, Nuvistors, 10 Pins, Magnovals, Compactrons and Decals.
- More than 2,500 tube listings.
- Tests each section of multi-section tubes individually for shorts, leakage and Cathode emission.
- Ultra sensitive circuit will indicate leakage up to 5 Megohms.
- Employs new improved 4½" dual scale meter with a unique sealed damping chamber to assure accurate, vibration-less readings.
- Complete set of tube straighteners mounted on front panel.

BLACK AND WHITE PICTURE TUBES:

- Single cable used for testing all Black and White Picture Tubes with deflection angles 50 to 114 degrees.
- The Model 257 tests all Black and White Picture Tubes for emission, inter-element shorts and leakage.

COLOR PICTURE TUBES:

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

The Model 257 is housed in a handsome, sturdy, portable case. Comes complete with all adapters and accessories, ready to plug in and use. No "extras" to buy. Only $52.50

NOTICE

We have been producing radio, TV and electronic test equipment since 1935, which means we were making Tube Testers at a time when there were relatively few tubes on the market, way before the advent of TV. The model 257 employs every design improvement and every technique we have learned over an uninterrupted production period of 34 years.

Accurate Instrument Co., Inc.

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Pay Cash or in EASY MONTHLY PAYMENTS AFTER 15 Day Trial!

Try it for 15 days before you buy. If completely satisfied remit $52.50 plus postage and handling charge. (If you prefer you may **PAY MONTHLY ON OUR EASY PAYMENT PLAN.**) If not completely satisfied, return to us, no explanation necessary.

ACCURATE INSTRUMENT CO., INC. **Dept. 737**
2435 White Plains Road, Bronx, N. Y. 10467

Please rush me one Model 257. If satisfactory I agree to pay at the terms specified at left. If not satisfactory, I may return for cancellation of account.

Name .....

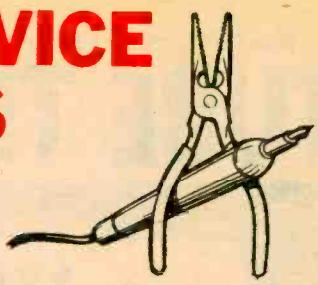
Address .....

City ..... State ..... Zip .....

☐ Save Money! Check here and enclose $52.50 with this coupon and we will pay all shipping charges. You still retain the privilege of returning after 15 day trial for full refund.

CIRCLE NUMBER 11 ON PAGE 15

SERVICE TIPS

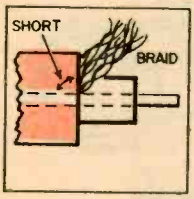


By ART MARGOLIS

FIXING an electric organ but you don't have service notes? Don't fret. There's an easy way out. Most of the circuits are repeated over and over. Simply take voltage and resistance readings from one of the good circuits and compare with those in your suspect circuit. If they don't match you've got a valid clue to troubleshoot.

—

Strategic troublemakers in electronic circuits are the lengths of shielded cable used in critical areas such as IF links, AGC connections, stereo connectors, etc. Often the center strands (or wire) manage to touch the braid, causing a dead short to ground. The illustration on the left shows what we mean. Best thing is to replace the cable.



—

A common tape recorder trouble is slow or inconsistent tape speed. Reason is usually slippage of the drive wheel or drive belt. Check them out by looking at them—if either is worn, cracked or oily, a replacement should clear up the trouble pronto. You can try cleaning the oil off by using alcohol if the component looks good otherwise.

—

Look for two specs when you're scrounging for a transistor to use as a test substitute or permanent replacement. One is type, the other is working voltage. NPNs and PNPs must match; the working voltage must be the same or higher.

—

Don't try too hard to tighten up slipping dial cords, you'll only make things worse. Phono drive anti-slip chemicals do a good job on dial cords. Chances are you can apply the chemical and let dry without removing the cord.

—

Should your window air conditioner kick off, then come back on after half a minute—and keep on doing this—your problem is probably an electric one. Most likely, either the compressor or fan capacitor has shorted. First check whether the fan is quitting or the compressor; your ohmmeter will then confirm the diagnosis.

—

Should you accidentally break up (crumble) a core in a tunable trap or transformer and you're up the creek for a substitute, don't throw away the core fragments. Take some paraffin, insert it into the hole of the component, then, with the equipment turned on, add the fragments until the core is resonant as before. Seal it with drippings from a lit candle.

ELECTRONICS ILLUSTRATED

Product Information Service

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

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

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NRI Has Trained More Men for Electronics Than Any Other School

— By actual count, the number of individuals who have enrolled for Electronics with NRI could easily populate a city the size of New Orleans or Indianapolis. Over three-quarters of a million have enrolled with NRI since 1914. How well NRI training has proved its value is evident from the thousands of letters we receive from graduates. Letters like those excerpted below. Take the first step to a rewarding new career today. Mail the postage-free card. No obligation. No salesman will call. NATIONAL RADIO INSTITUTE, Electronics Division, Washington, D.C. 20016.

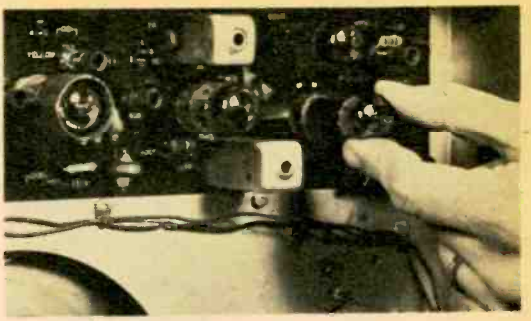
L. V. Lynch, Louisville, Ky., was a factory worker with American Tobacco Co., now he's an Electronics Technician with the same firm. "I don't see how the NRI way of teaching could be improved."

G. L. Roberts, Champaign, Ill., is Senior Technician at the U. of Illinois Coordinated Science Laboratory. In two years he received five pay raises. Says Roberts, "I attribute my present position to NRI training."

Don House, Lubbock, Tex., went into his own Servicing business six months after completing NRI training. This former clothes salesman just bought a new house and reports, "I look forward to making twice as much money as I would have in my former work."

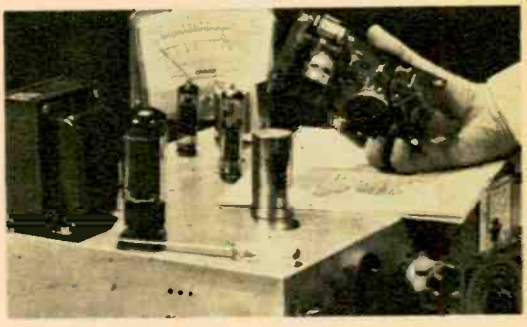
Ronald L. Ritter of Eatontown, N.J., received a promotion before finishing the NRI Communication course, scoring one of the highest grades in Army proficiency tests. He works with the U.S. Army Electronics Lab, Ft. Monmouth, N.J. "Through NRI, I know I can handle a job of responsibility."

APPROVED UNDER NEW GI BILL. If you served since January 31, 1955, or are in service, check GI line on postage-free card.



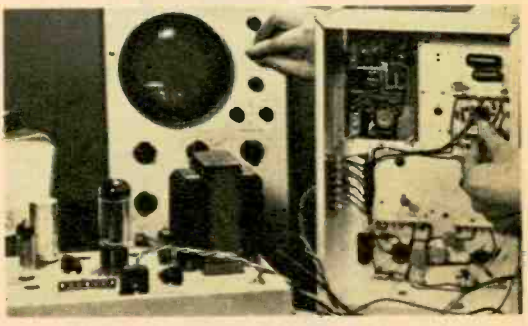
COLOR TV CIRCUITRY COMES ALIVE

as you build, stage-by-stage, the only custom Color-TV engineered for training. You grasp a professional understanding of all color circuits through logical demonstrations never before presented. The TV-Radio Servicing course includes your choice of black and white or color training equipment.



COMMUNICATIONS EXPERIENCE

comparable to many months on the job is yours as you build and use a VTVM with solid-state power supply, perform experiments on transmission line and antenna systems and build and work with an operating, phone-cw, 30-watt transmitter suitable for use on the 80-meter amateur band. Again, no other home-study school offers this equipment. You pass your FCC exams—or get your money back.



COMPETENT TECHNICAL ABILITY

can be instantly demonstrated by you on completing the NRI course in Industrial Electronics. As you learn, you actually build and use your own motor control circuits, telemetering devices and even digital computer circuits which you program to solve simple problems. All major NRI courses include use of transistors, solid-state devices, printed circuits.

Electronic Marketplace

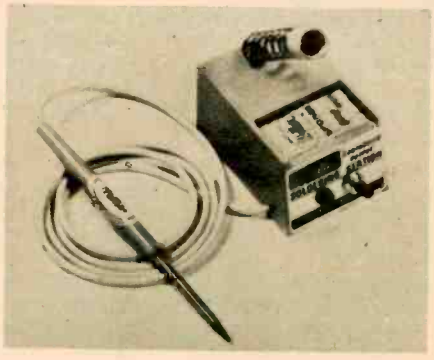
Moving Story. Model 443 transistor-diode curve tracer converts any general-purpose oscilloscope so a direct readout of semiconductor characteristics is obtained on the CRT. Diodes, rectifiers and signal and power transistors may all be

tested. A special matching switch allows you to compare or match sets of transistors. Characteristics of diodes and rectifiers which may be displayed include: forward voltage, forward and reverse current and peak inverse voltage. Transistor tests include: h_{fe}, h_{oe}, I_{ceo}, v_{ce} (sat.) and BV_{ebo}. Beta can be read directly on front panel. $99.95, wired; $69.95, kit. Eico Electronic Instrument Co., Brooklyn, N.Y. 11207.

Twins in Two Ways. Two portable, solid-state cassette recorders feature built-in radios. Model 850AM has an AM radio, Model 860FM (shown) has an AM/FM radio. This combination allows operator to record off the air immediately upon hearing program material which interests him.

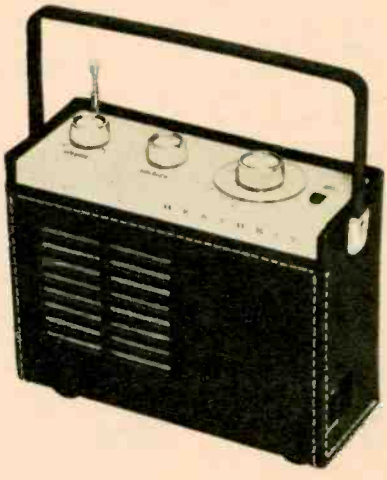
Recorders include keyboard controls for record, rewind, play, fast forward and stop. Model 850AM: $69.95; Model 860FM: $79.95. Atlas-Rand Corp., Paramus, N.J. 07652.

Mini-Brutes. W-MCP series of low-output, voltage-controlled soldering stations offers three models with fixed point temperatures of 550°F. 650°F. and 750°F. Soldering stations have solid-state closed loop control system which is coupled with manufacturer's own Curie Point temperature sensing system to automatically control output and temperature. Power unit is isolated and electrostatically shielded. Pencil iron weighs



1.35 oz. and is 6-1/2 in. long; interchangeable tips are available. $27.10. Weller Electric Corp., Easton, Pa. 18042.

On Top of Things. Model GR-88 VHF-FM monitor receiver covers frequencies of 154 to 174 mc. According to the manufacturer, both narrow- and wide-band FM signals may be tuned due to the receiver's 40-kc selectivity figure; sensitivity is said to be 1.5 μV for 20db quieting.



Features include adjustable, noise-operated squelch, six-to-one vernier tuning and crystal switch for crystal-controlled monitoring of one frequency. $54.95. Heath Co., Benton Harbor, Mich. 49022.

Try these installations with any other five watt unit!

At $99.95 the Messenger 125 fits anywhere ...including your budget.

Best of all, even with its mini-size and price, the Messenger 125 is *big* on performance. Its 5-watt transmitter, with high level class B modulation and speech compression, gives it all the "talk power" you'd expect from a full-size radio. Half-a-microvolt receiver sensitivity pulls in the weak ones. Automatic threshold noise limiting, IF clipping, and special AGC circuitry means less noise—better quieting. Full 2-watt audio lets you hear even in noisy vehicles. And the Messenger 125 looks great, too. Not a single knob—push-buttons select up to 5 channels, slide-levers adjust squelch and volume. Installs between bucket seats, in door pockets, on trail bikes—or over your shoulder with its optional rechargeable battery pack.

Dimensions: 1 1/16" High x 4 15/32" Wide x 7" Deep • 4-watts output at 13.8 VDC • FCC type accepted, DOC approved • All solid state—draws just 0.2 amperes on squelched stand-by • Optional portable pack available with rechargeable battery, charger, antenna, and leather carrying case

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CIRCLE NUMBER 15 ON PAGE 15

Guaranteed Stroke-Saver!

NEW SUPER-DISTANCE GOLF GLOVE adds 50 to 75 yards to your drive

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Cos Cob, Conn. 06807

Yes, I want to improve my golf game. Please send me
_____Men's SUPER DISTANCE GOLF GLOVES, size_____
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@ $6.95 plus .50¢ p.p. & hdlg. I understand that if I am not completely satisfied, I may return for a full refund. (Specify right- or left-handed)

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■Step up to the ball . . take your swing . . . and then watch the ball really whiz down the fairway, straight as an arrow! Not 100 yards, not 150 yards . . . not just 200 yards, but drives of 250 yards and over are common with this amazing SCIENTIFICALLY WEIGHTED GOLF GLOVE. This glove looks like any other fine leather golf glove . . . so just imagine how amazed your friends will be when they see the incredible yardage you get on every shot.

THE SECRET IS IN THE WEIGHTS

Three weights slip into the back of the golf glove. Although they weigh a mere 8 ounces, the effect is beyond belief. The extra weight gives extra power to your swing . . . produces drives up to 50% *farther* than you ever thought possible. This professionally-approved glove has been awarded the coveted United States Patent #3,124,068 for actually *adding distance* to your drives. It's written right there in the patent.

HELPS ELIMINATE SLICING AND HOOKS

Yes . . . this Super-Distance glove does more than add distance to your drives . . . it also *corrects* hooks and slices that cost you so many strokes. The position of your hand is often the cause of hooks or slices. This golf glove comes with three separate weights . . . each one fitting into a separate position on the glove. By removing—or adding—one or more of the weights you can easily alter the position of your hand on the club at the moment of impact.

Add a little more weight to the left and zingo! . . . your bothersome slice might be gone forever. Or perhaps, what you need is more weight to the right to cut out your hooks once and for all. Once you find what adjustment of weight works for *you* . . . just keep on playing with the glove that way. By continually using the glove with the corrective weight, your hands will soon *automatically* keep the right position. In time you will play a no-hook and no-slice game without *any* weight in the glove.

WORKS INSTANTLY

Unlike other glove devices that require hours, days, or weeks of practice . . . the Super-Distance golf glove works the very *first* time you step up to the ball. You don't have to learn any new methods . . . you don't have to remember a thing. It's an automatic action that goes to work for you, improving your game *quickly* . . . *easily* . . . *instantly*.

HAMILTON HOUSE
Cos Cob, Conn. 06807

MADE OF FINE GLOVE LEATHER

Hand-crafted of fine, soft but tough glove leather. Even without the miraculous weights . . . this glove would be a fine value and a glove you use constantly for comfort.

In left- and right-handed models. Color, Black.
Men's sizes S (8), M (8½-9), L (9½-10) and XL (10½-11).
Women's sizes S, M, L. Specify size and if right- or left-handed.

HERE'S WHAT A SPORTS MAGAZINE SAYS:

"This glove will have the same effect on golf that fibreglass had on pole vaulting."

A GOLF MAGAZINE SAYS:

"Will give ANY golfer faster hand action . . . club-head speed . . . more distance . . ."

$6.95 plus 50¢ pp & hdlg.

For use at home, on hobby bench, or in classroom

Assemble these new RCA IC Experimenter's Kits quickly and easily. All the active and passive components, the pre-drilled printed circuit boards, and full clear instructions are included. (Add your own preference of alarm indicator to kits KC4005 and KC4006.)

KC4000: Microphone Preamplifier IC Kit—a high-gain, low-noise, wideband preamplifier that accommodates both low- and high-impedance microphones.

KC4001: 2-Channel Mixer IC Kit—combines any two audio inputs, such as microphone, radio, phono, or oscillator, into a single output.

KC4002: Audio Oscillator IC Kit—for testing audio, hi-fi equipment, and amateur radio transmitters—also for code practice.

KC4003: Amplifier/Oscillator IC Kit—a 500 mW audio amplifier or a variable tone audio oscillator.

7 NEW IC KITS FROM RCA

KC4004: 9-V Regulated Power Supply IC Kit—supplies 9 volts DC output with voltage regulation of 3% at a maximum current of 250 mA.

KC4005: Intruder Alarm IC Kit—a circuit that develops a "whooping" signal for a security system.

KC4006: Fire Alarm IC Kit—a low-melting-point solder sets off this circuit for a warning device.

KC4500: IC Kit Enclosure and Hardware Pack—optional for KC4000, KC4001, and KC4002—a handsome, sturdy, prepunched case with input and output jacks, switch, and other hardware.

Buy these kits from your RCA Distributor. For information, write: RCA Electronic Components, Commercial Engineering, Section E134-5D/S30R, Harrison, N.J. 07029

(STARTING AT UNDER $5.00*) * Optional distributor resale price

RCA

Swap Shop

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

SHORT-WAVE LISTENING

KNIGHT Star-Roamer. Swap for Hammarlund SQ-1295, HQ-129X or best offer. Donald Smith, 423 N. Main, Memphis, Mo. 63555.

HEATH HD-20 100-kc crystal calibrator. Swap for best offer. Michael Williams, 4024 Pleasant Plains Rd., Matthews, N.C. 28105.

SURPLUS R-27/ARC-5 receiver with dynamotor. Swap for walkie-talkie or best offer. Mark Olenski, 321 New Haven Ave., Milford, Conn. 06460.

HALLICRAFTERS SX-62A and S-38D receivers. Will swap for best offer. Ben Spicer, 334 N. Miami St., Trenton, Ohio 45067.

KNIGHT KG-221A (146-175 mc) and Monitoradio (30-50 mc) VHF police & fire receivers. Swap for amateur receiver or best offer. Kenneth Lawing, 2308E Jackson Ave., Ft. Eustis, Va. 23604.

SURPLUS BC-342-N receiver with S-meter. Swap for good metal detector. C. R. Summers, 418 San Mateo St., Fairfield, Calif. 94533.

HALLICRAFTERS S-38 receiver, also Hallicrafters Sky Buddy. Swap for best offer. Charles Wilson, 207 E. Pothouse Rd., Phoenixville, Pa. 19460.

HEATH GR-64 receiver plus headphones. Swap for Heath AA-32 20-watt stereo amplifier or equivalent. Dennis Mominee, Box 25, Williston, Ohio 43468.

KNIGHT Span-Master receiver and Aurora slot car set. Want 5-watt walkie-talkie, CB rig or best offer. Phil Roslaniel, 2060 Dawson N.E., Grand Rapids, Mich. 49505.

HALLICRAFTERS SX-130 receiver with speaker. Will trade for HB-525 23-channel CB rig. James Saribalis, 737 Niantic Ave., Daly City, Calif. 94014.

HEATH GR-81 4-band receiver. Want test equipment or best offer. John Mac Millan, 193 Meta St., Fort Myers, Fla. 33905.

KNIGHT Star-Roamer with Q-multiplier and headphones. Will swap for amateur-band receiver. Charles Weaver, Rt. 1, Box 355-A, Theodore, Ala. 36582.

HEATHKIT GR-64 receiver. Will swap for ham-band receiver or Knight T-60 transmitter. Donald Weinstein, 120 Kenilworth Pl., Brooklyn, N.Y. 11210.

HALLICRAFTERS general-coverage receiver and Lafayette Explor-Air. Swap for best offer. Russ Zears, 64 Whitman Dr., New Providence, N.J. 07974.

HALLICRAFTERS SX-24 receiver. Want complete set of Don Britton correspondence courses and construction plans. J. Wegner, Jr., Box 262, Glendale, Calif. 91209.

HALLICRAFTERS SX-99 with BFO, RCA WO-33A scope and Heath TS-4A sweep generator. Swap for best offer. Edward Tanrath, 3035 La Salle Ave., Rockford, Ill. 61111.

HALLICRAFTERS SW receivers (S-120, S-108); Johnson Viking Challenger 120-watt transmitter. Swap for good AM transmitter or SSB transceiver. Frank Howell, Rt. 2, Box 245, Tennille, Ga. 31089.

AMATEUR RADIO

SURPLUS T-74/CRT-3 transmitter with accessories. Want surplus video gear or best offer. Alan Kozakiewicz, 34 Shirley Dr., Schenectady, N.Y. 12304.

SURPLUS AN/URA-8-RTY converter & tower; misc. test equipment and transmitters. Swap for receiver, stereo rig or best offer. George Bame, OE Div., USS Hancock (CVA-19), FPO San Francisco, Calif. 96601.

HEATH HW-32 20-meter SSB transceiver. Also, field-strength meter. Want stereo FM tuner. Bruce McMohan, 97 S. Hamilton Ave., Lindenhurst, N.Y. 11757.

ASSORTED ham gear and parts. Trade for good stereo amplifier or FM tuner. Danny Boyer, WA5WAI, Box 556, Eldorado, Tex. 76936.

AMECO TX-62 VHF transmitter (6&2). Will swap for Drake 2NT transmitter or equivalent. Robert Williams, 480 Oxford La., Crystal Lake, Ill. 60014.

[Continued on page 26]

Grrrrrr.

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But that's still not all. The Tiger 23 includes an Automatic Noise Limiter *with manual over-ride.* Automatic Modulation Control for ultimate talk power. Television Interference Trap. Receiver Delta Tune Switch that corrects for the other guy's off-frequency transmissions.

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The Tiger 23. If you can handle it.

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First in outdoor recreation since 1816. GLADDING

CIRCLE NUMBER 18 ON PAGE 15

Continued from page 24

VIKING II and Knight VFO. Will swap for Gonset G-76, Lafayette HE-45B, Heathkit HW-32 or tri-band beam & tower. H. F. Mynes, Jr., 2564 Main St., Hurricane, W. Va.

VHF GEAR Hammarlund SP-600JX17, converters for 6 m, 2 m and 220 mc. Swap for best offer. Charles Spitz, Box 4095, Arlington, Va. 22204.

HEATH HW-16 CW transceiver. Will trade for business-band linear amplifier or best offer. Thomas Smith, Rt. 1, Box 752, Bladenboro, N.C. 28320.

HEATH twoer, Knight VFO (80-10), S-120 receiver, surplus BC-669. Swap for HA-350, HW-16, NC-190 or best offer. Roland Hull, WN5AIA, 2748 Darien St., Shreveport, La. 71109.

EICO 753 SSB transceiver, Model 751 AC power supply. Swap for stereo receiver with speakers. Alan Owens, 1859 Country Club Rd., Ann Arbor, Mich. 48105.

LAFAYETTE HA-350 receiver, Heath DX-60 and Simpson 260 test meter. Want Knightkit KG-870 amplifier. Bob Pearson, Box 15650, N.C. State University, Raleigh, N.C. 27607.

SURPLUS RAK-7 and RAL-7 receivers (Navy). Want Heathkit HW-100 transceiver or similar SSB transceiver. Toby Clairmont, 1242 Aalapapa Dr., Lanikai, Oahu, Hawaii 96734.

HALLICRAFTERS SX-111, Ranger II, plus accessories. Trade for stereo system or best offer. Gus Lucas, 516 W. Missouri #1, El Paso, Tex. 79901.

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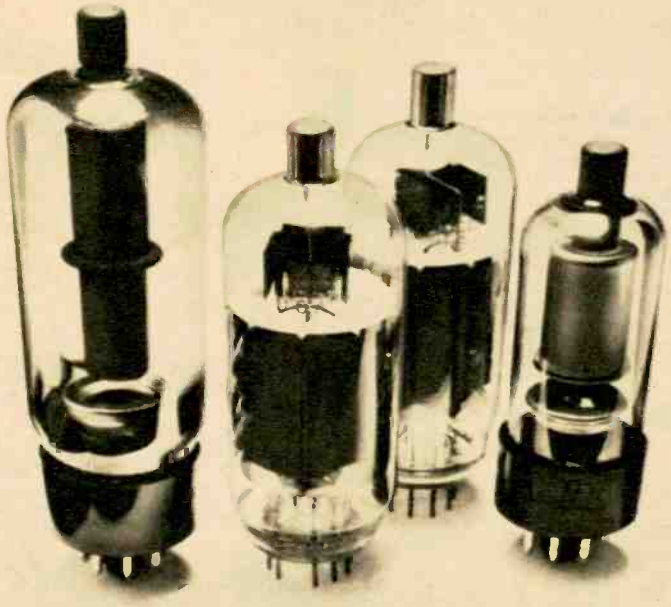
SONY 900A tape recorder, accessories and 37 recorded tapes (pop). Swap for Realistic DX-150 or good SW receiver. Dave Siegel, 28252 Maplewood, Garden City, Mich. 48135.

JENSEN 8-in. loudspeakers. Two are new, two used. Also, Pioneer SE-2P stereo headphones. Swap for surplus receiver or best offer. Mel Brown, 108 S. Maplewood, Rantoul, Ill. 61866.



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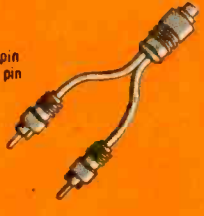

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Carbon	1 Watt −10%	10 Ohm-1 Meg	.19	Ea.
Carbon	2 Watt −10%	10 Ohm-100K	.25	Ea.
Wire Wound	10 Watt −10%	10 Ohm-15K	.36	Ea.

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Cat. No.	Description	Net	Unit
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A1-062	470pF	.25	Pkg. of 2
A1-063	680pF	.25	Pkg. of 2
A1-064	0.001uF	.19	Ea.
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CIRCLE NUMBER 4 ON PAGE 15

Those Special-Application TV Antennas

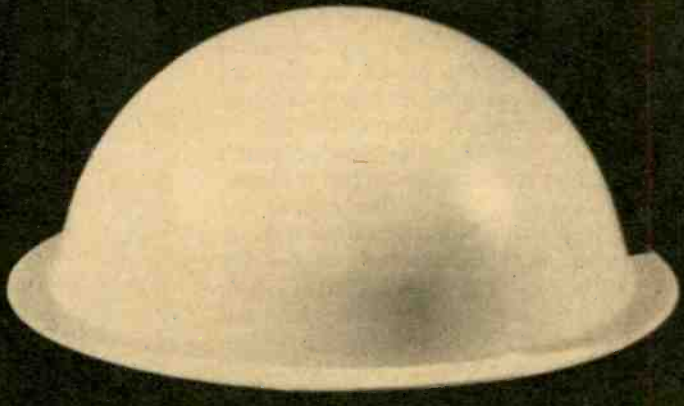
By VINCE DANIELS

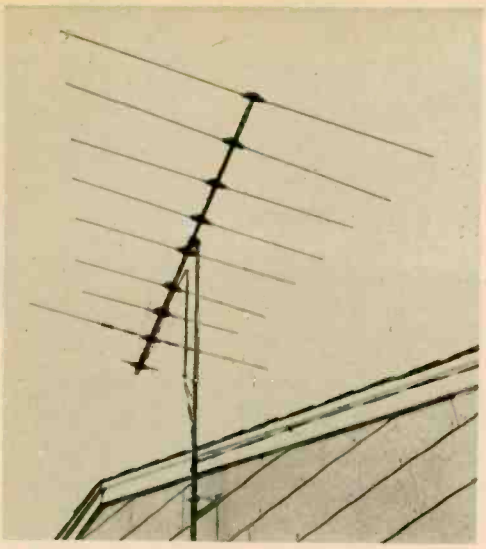
FOR the best TV picture (color or b&w) in *any* area the rule of thumb for antennas is the biggest array at maximum height. But what of those special instances where a big rig is impractical, unsightly or impossible to erect? If faced with one of these problems, what antennas are available to you and what kind of performance can you expect?

Our cover photograph (and the one on this page) shows two special-application antennas. Either is suitable for travel, for instance, and the model resembling a construction worker's hard hat is touted as being especially convenient for installation on the roofs of travel trailers, mobile homes and the like. Either has enough good looks (compared to other outdoor antenna types) to meet esthetic standards anywhere. We bought the two antennas pictured and ran tests on them. Although they are tops in looks, performance figures, frankly, aren't all that beautiful.

The antennas are the Vorta Mark II (Vorta Systems, Inc., Route 1, Box 613, Round Lake, Ill. 60073) priced at $49.95 and the $12.98 Stratoscan (sold under other brand names by several mail-order firms).

The Vorta (below and in Fig. 2) measures 18½ in. in dia. and is 7½ in. high. The attached downlead is 50 ft. of 75-ohm coax with a plug on the end to match the supplied 75/300-ohm matching





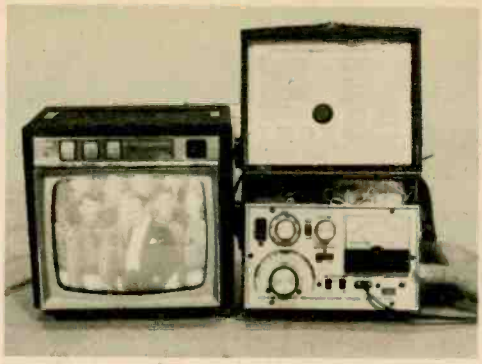


Fig. 1—Antennas were judged by comparing signals delivered to a TV set as measured with Jerrold Model AIM-718 VHF/UHF/FM field-strength meter (above). Pix quality was compared on b&w portable and color set. Reference antenna (left) was an all-channel (VHF/UHF/FM) Jerrold Model VU-933 designed for suburban reception areas. It had seven VHF elements and 11 UHF elements.

Special-Application TV Antennas

transformer. The manufacturer recommends the Vorta be mounted on a $9.95 fiberglass base, which brings the total cost to $59.90. No VHF/UHF matching is provided; the instructions say to connect the receiver's VHF and UHF antenna terminals together.

The Stratoscan (left, first page) is a 3-in-dia. cylinder 18 in. high. It is supplied with a bracket that allows it to be mounted almost anywhere. It has two 25-ft. 300-ohm leads—one for TV and one for radio (FM). A VHF/UHF coupler called a signal sender comes with it.

The test site was a suburban area 20 mi. east of the New York City transmitting antennas on the Empire State Building. Our reference TV antenna, shown in Fig. 1, was installed on the side of the house on a 10-ft. mast. The Vorta and Stratoscan antennas were tried at different places on the roof until the field-strength meter indicated maximum signal strength on most channels.

The Stratoscan's 25-ft. downleads couldn't reach the color set in our lab so two measurements were made: one at the end of the supplied leads with a portable b&w receiver as the monitor. The other was made with about 25 ft. of 300-ohm twinlead added to reach our color set. Since the added lead had no adverse effect, the signal-strength figures in the table are for the supplied 25-ft. lead.

Our chart tells the story at a glance. While the reference TV antenna delivered VHF signals as high as 21,000 μv (microvolts), the Vorta barely reached a top of 1,100 μv. The Stratoscan delivered a maximum of 850 μv.

We connected the Stratoscan's radio lead to the field-strength meter and got from worse to better performance than with the TV lead. UHF performance was less satisfactory. The Vorta barely pulled in a snowy picture on channel 31; we couldn't tell if channel 41 was broadcasting. The Stratoscan didn't produce a picture on channel 31 or 41.

On both ends of the FM band the Vorta and Stratoscan delivered a usable signal but nowhere near that of the reference antenna.

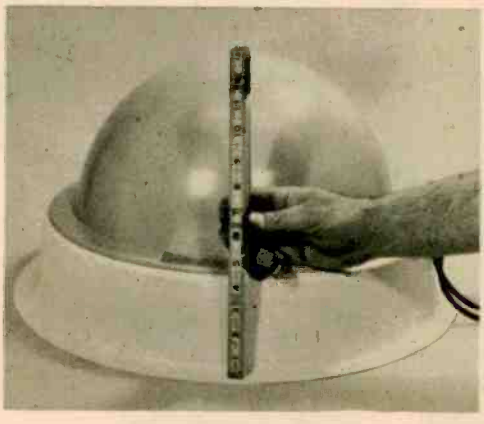


Fig. 2—Vorta Mark II resembles plastic bubble, or construction-worker's hard-hat. It's mounted on fiberglass base recommended by manufacturer.

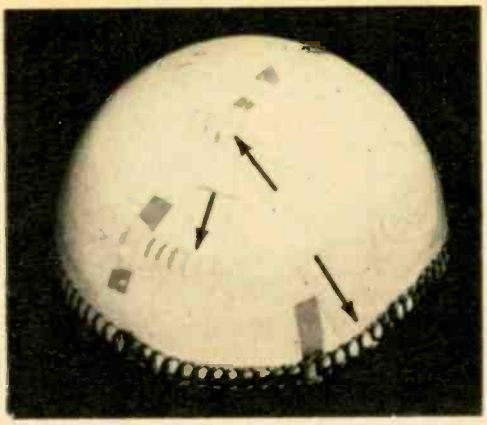


Fig. 3—Vorta's guts are imbedded in foam plastic. Arrows point to clearly visible spiral coil around bottom edge of unit and to two similar smaller coils.

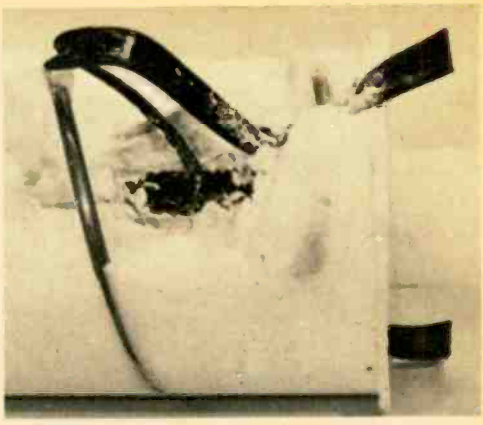


Fig. 4—After cutting away foam plastic around innards of Stratoscan we found FM lead has one wire connected to a metal strap inside the coil.

As for color reception, the Vorta changed color balance on channels 2, 7 and 9; the Stratoscan did the same on 4, 5, 7 and 9.

The Inside. The Vorta comes apart as one large form of foam plastic that chopping could not break up. There appeared to be at least three coils of heavy wire (arrows, Fig. 3). The outer coil at the bottom couldn't do much because several turns were shorted.

The Stratoscan wasn't quite as buried in foam. The guts appeared to be a folded wire surrounded by a coil of heavy wire (Fig. 5). One twinlead was connected to these two sections. The radio lead connected to a 7-in. metal strap inside the coil.

Since the Vorta and Stratoscan were not so hot in the suburbs, we decided to test them in the city. In Brooklyn, 5 mi. from the transmitting antennas, our test antennas delivered more than 2,500 μv on VHF. The Vorta couldn't produce a usable picture on channel 41 and the Stratoscan produced only a weak UHF image. Also, ghosts produced by nearby tall buildings made most of the channels unviewable on VHF and UHF (both antennas). This was caused by omni-directional characteristics. Color was poor.

One thing bothered us—the poor UHF performance of the Stratoscan. To find out why we opened the signal sender. It turned out to be a short section of twinlead with a plastic capsule in the center that shorts the receiver's VHF and UHF terminals.

What it boils down to is that you must make a compromise between application, appearance and performance. If you need a TV antenna on your trailer or camper, it can't be a conventional type because of appearance or high wind resistance.

In areas where TV signals are fairly strong and TV transmitters surround you, the Vorta and Stratoscan could be a solution.

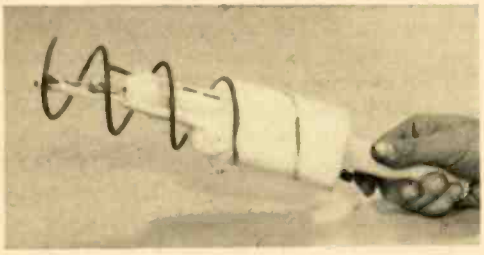
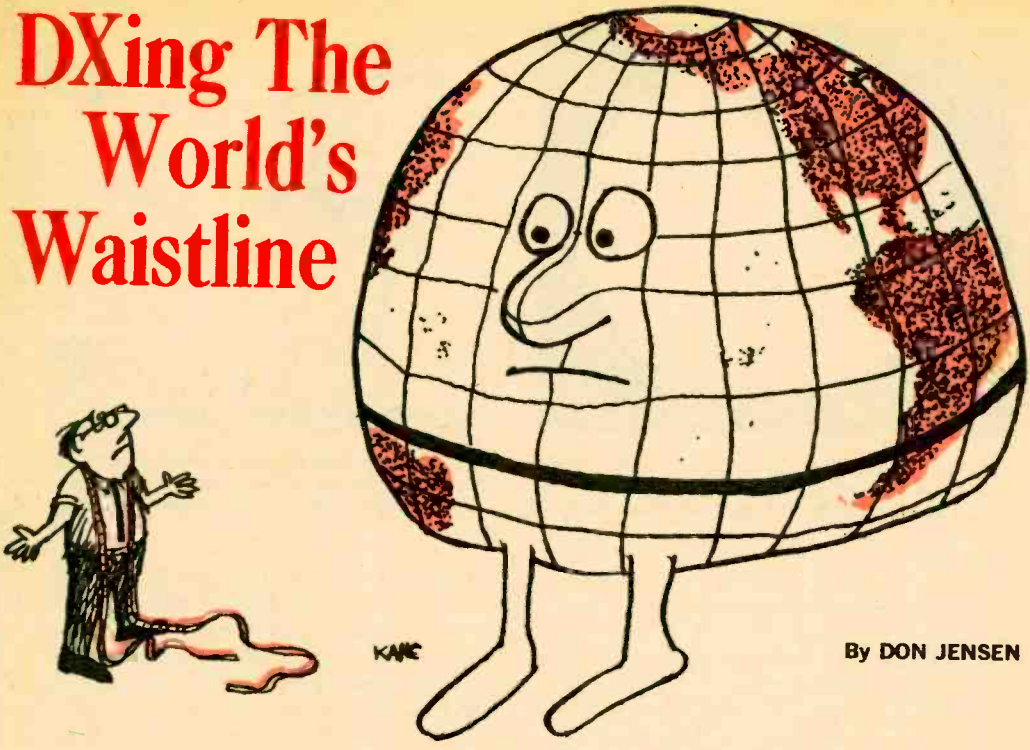


Fig. 5—Inside the Stratoscan's cylinder. The antenna looks like folded coathanger surrounded by wire coil. Both elements connect to TV downlead.

Microvolts Delivered to TV Receiver							
Channel	Reference TV Antenna		Vorta		Stratoscan		
	Pix	Sound	Pix	Sound	Pix	Pix (FM)	Sound
2	10,100	8,000	180	225	110	90	80
4	10,000	8,000	425	180	210	100	250
5	9,000	7,000	250	380	750	110	650
7	16,000	7,500	1,000	250	850	225	350
9	14,000	15,500	500	280	500	1,400	180
11	21,000	13,000	1,100	1,100	120	1,500	140
13 (not on)							
31	750	800	180	225	under 50		
41	1,200	1,100	under 50		under 50		
90 mc (FM)		700		80			280
106 mc (FM)		3,200		150			240

Notes: 1) Reference antenna (Fig. 1) is suburban type installed as on other homes in area. Vorta and Stratoscan were positioned on roof for best possible performance.
2) Stratoscan has separate downleads for TV and FM. Pix (FM) is pix carrier strength using FM downlead. FM signal is from TV downlead.

DXing The World's Waistline



By DON JENSEN

IN this weight-conscious world everyone is watching his waistline. But SWLs, be their belt size 28 or 48, have their eyes and ears on the most expansive waistline ever—our 24,902-mile equator.

DXing short-wave stations scattered along the earth's midriff can be a real challenge. In addition to the myriad of exotic languages abounding there, listeners must contend with tough low-frequency propagation conditions and high noise levels.

The special propagation characteristics of the equatorial regions were recognized by the International Telecommunication Union as early as 1938. The ITU's Cairo Conference established three frequency bands between 2,300 and 4,965 kc for tropical broadcasting. Over the years the exact limits of these bands have been expanded, officially and unofficially, but most tropical stations can be found around 60 meters (4,600-5,100 kc), 90 meters (3,200-3,500 kc), and 120 meters (2,300-2,500 kc).

Since little fellows normally don't swing much clout, it's not surprising that tropical broadcasters wound up with these wavelengths. Low frequencies aren't much use to international SWBC services since ionospheric absorption limits daytime reception to ground-wave range. Even at night they're nobody's first choice for longhaul transmission. But SWBC stations in the tropical latitudes find they fit the bill, supplementing medium-wave channels to provide local and regional coverage.

While many beginners shun these bands, experienced SWLs find some of their best DX catches in the regions lying between the Tropics of Cancer and Capricorn; some of the best originate in the narrow equatorial belt.

Just west of the International Date Line and a hair south of the equator is Tarawa atoll, a mere speck in the Gilbert Islands. A bloody World War II battleground, Tarawa is a series of tiny islets ringing a quiet lagoon. Radio Tarawa's vertical-incident array rises 40 ft. above the coral sands of Betio Islet. Radio technicians who cross the lagoon daily by launch to the transmitter site feed a 2-kw signal into this antenna. Programming, in English and in native languages called Gilbertese and Ellice, is aimed at listeners in the out-islands, but a number of Stateside SWLs have logged this one recently on 4912.5 kc. (See chart for best listening hours.)

From West Irian to Sumatra, Indonesia

EI's GUIDE TO EQUATORIAL DX				
LATITUDE	COUNTRY	STATION & LOCATION	FREQ. (KC)	BEST TIMES (GMT)
00.06 S	Indonesia	RRI-Padang	2,480, 3,960	Early mornings
00.07 S	Kenya	Kisumu Regional	4,804	After 0400
00.14 S	Ecuador	Radio Cenit, Quito	4,865	0300-0500
		E. Gran Colombia, Quito	4,910	Around 0500
		Radio Quito	4,923	0330-0500
		R. N. de Ecuador, Quito	4,940	0430-0500
00.15 N	Indonesia	RRI-Pakanbaru	3,465 (better on 5,955)	Early mornings
00.18 S	Indonesia	RRI-Bukittinggi	4,908	1100-1200
00.20 N	Uganda	Radio Uganda, Kampala	5,026	After 0400
00.21 N	Sao Tome	Radio Clube de Sao Tome	4,807	After 0600
00.25 S	Gabon	Rdf-Tv. Gabonaise, Libreville	4,777	2130-2300; 0500-0600
00.28 S	Indonesia	RRI-Samarinda	3,295, 4,890	Early mornings
00.52 S	Indonesia	RRI-Sorong	4,872	1100-1200
00.55 N	Indonesia	RRI-Tandjung Pinang	4,931	Early mornings
01.21 N	Tarawa	R. Tarawa, Betio Islet	4,912.5	0700-0945; English after 0830
01.27 S	Brazil	Radio Clube do Para, Belem	4,865	Evenings to 0300

stretches 3,000 mi., one-eighth of the equatorial circumference. Along this imaginary line are located at least six of Radio Republik Indonesia's more than 70 domestic short-wave stations. These include outlets at Samarinda, Borneo, and at Tandjung Pinang, Bukittinggi, Padang and Pakanbaru, all on Sumatra. Best bet is the RRI station at Sorong, West Irian, found on 4,872 kc.

Back in the early '60s, before the Djakarta government gained control of what was then called Dutch New Guinea, the Sorong station was owned by a Netherlands-based petroleum company and operated as a service for its field workers. Power was beefed up and the frequency changed when it joined the RRI home-service network. (Many RRI regional stations will now QSL even English-language reception reports.)

Still on the equatorial track, far to the west, is Uganda's capital, Kampala. Radio Uganda's antenna towers rise beside Lake Victoria on the high African plateau. Radio Uganda—assuming good propagation conditions and careful tuning—can be logged on 5,026 kc about 0345 GMT with an English newscast. The station's British technicians seem interested in receiving listeners' reports, but they require solid program details before they will QSL.

For a real shot in the dark—the continent, that is—swing down to 4,804 kc when the bands open up to Africa. The regional station at Kisumu, Kenya, just across the lake from Kampala, runs 5,000 watts. But don't expect too much. This QRM-ridden channel is one of the worst in the 60-meter band and chances of hearing Kisumu are ultra-slim.

You'll have better luck with another equatorial African station—Radio Gabon, heard on 4,777 kc where it identifies in French as *Ici Libreville*. Libreville, Gabon's steamy capital port, is the site of a 30-kw transmitter that is heard quite often in the U.S. East-Coast listeners might try during the mid- to late-afternoon hours, but DXers elsewhere in the country should try for Radio Gabon around 0530 GMT.

Portugal's island of Sao Tome nearly sits on the equator in the Gulf of Guinea. The island's Radio Clube de Sao Tome is a commercial outlet owned by a private broadcasting society (such clubs are common in Portuguese speaking areas) and transmits on 4,807 kc. It suffers from much of the same interference that plagues Kisumu, a few kilocycles down on the band.

Some time ago, Radio Clube de Sao Tome leased airtime to the Portuguese national radio in Lisbon and relayed the well-known *Voice of the West* program. These relays, however, seem to have been discontinued.

Directly across the ocean, not far from the spot where the Amazon spills into the Atlantic, is Belem, Brazil. PRC5, Radio Clube do Para's 2.5-kw station, is one of

[*Continued on page* 103]

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SERVICE IN THE SEVENTIES

Better days are on the way? With service as it is, they'd have to be!

By TIM CARTWRIGHT

THE cool professional in his handsome lab coat with *Doctor of Something* on the left breast stands confidently over the dying machine, listening intently as small *woop-woop-blurp* sounds waft to his ears. He cocks his head. Experience and incredible logic lead him unerringly to the trouble spot. A twist, a snap, a pop . . . and *sput-sput-hummmm* . . . the machine is well again.

Is that an accurate picture of repair service at the beginning of a new decade? If they took your white jacket with the laces in back off just yesterday you might think so. Otherwise, you know one of the most difficult problems we face as the 1970s begin is getting anything fixed—be it automobile, furnace, bathroom or the color TV set.

The man who tells you he can scale Mt. Everest on a tricycle easier than he can get anybody to do anything well at a decent price obviously speaks from wisdom and experience. He's someone you can believe.

Are things going to get better, repairwise? Or worse? Worse, then better? In order not to keep you in suspense, we'll tell you now. In electronics, service is going to get better. No, wait—don't laugh. We mean it. Even now, signs of a sane, repairable world are seen in the land.

Electronic servicing has changed considerably in the last few years. Drastic change is ahead in this decade. Gone will be the one-man shop, the replacement part, even the soldering iron. Due any time now are new technical personnel, new test equipment, new electronic products with amazing serviceability.

The 1970s will be a decade in which modularization will sweep through every area of electronics. It's starting already. Exchangeable, plug-in modules can make life easier both for you and the serviceman. In fact, who said it was a man? Technology that can reduce the 1,000-plus connections and components in a TV set to a few quick-change semiconductor building blocks also make it possible for the service technician to look more like Elke Sommer and less like Jonathan Winters.

The age of the plug-in module in TV was given an auspicious start several months ago when Motorola decided to put its works in a drawer and call the new product Quasar television. The name sounded a little like something out of the science fiction of exploding stars and hurtling spaceships under the control of Quasar, Queen of the Quainties. But not for long. A deft TV commercial, good styling and the concept of easy service which Motorola promoted so assiduously turned into a sales runaway. Motorola, which not long ago scored heavily with the 25-in. rectangular picture tube, had another huge success on its hands.

The works-in-a-drawer bit was of great benefit to Motorola in terms of sales and dollars but what did it offer the serviceman or, more to the point, the buyer? Watches and brains come in neat packages, too, but the average all-thumbs handyman might find them difficult to repair. What do you have when your TV works come in a drawer?

The answer depends on where you (if you are a buyer) live and how your luck is running or, if you are a serviceman, whether the sign over the door says *Motorola*. Ideally, you would go to a Motorola retail-service place and buy your Quasar. The shop preferably would be close to your home. Troubles arise. The set starts going *woop-woop-blurp*. The Motorola service chap comes out, carrying a panel caddy, which is like a tube caddy except it's filled with at least ten different panels, or boards, which comprise about 90 per cent of the set's circuits.

If he can't immediately put his finger on the troublesome module he resorts to troubleshooting charts which pose some yes-no questions based on symptoms, adjustments and meter measurements. All this is bound to lead to the defective module. A new one

is inserted and just like that . . . *sput-sput-hummmm*.

Defective modules are returned to the factory for repair or the serviceman himself may troubleshoot them. In either case the rebuilt blocks go back in the caddy for use in another set.

The big advantage is the reduced amount of time and skill required to repair your set. And that should lead to some savings for you as well as convenience for the service person.

If you buy your Quasar from Big-Hearted Harry's Discount Center and the nearest service shop specializes in antique Atwater Kents your situation may not be quite this rosy. Modules won't mean much to some shops, no matter the name. So that you just have to be content with the comforting thought that your works are in a drawer. Hope may be on the way, though. At the rate Quasars are selling, it soon will be not only profitable but necessary for other-brand shops to stock Big M modules.

The Quasar system right now makes the most sense as a hot product for Motorola. More than that, though, it does show the way to the future.

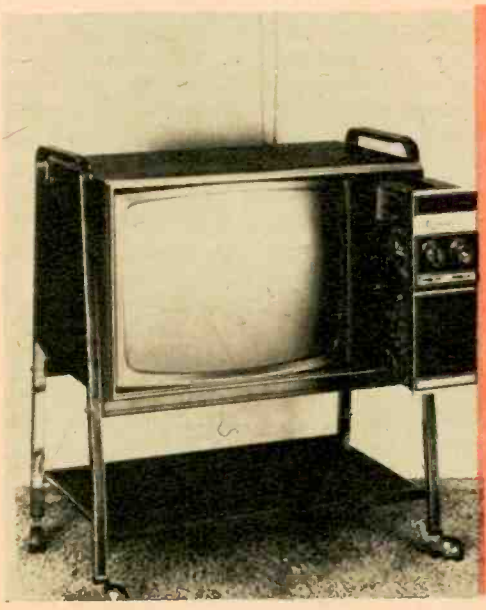
One can foresee a time in the not-so-distant future when the serviceman does not come to the set. The set goes to him—in parts. *You* pull out the modules and take them to him. He tests, sells you a replacement and you're on your way. And then the drug-store tube tester probably will become the drug-store module tester.

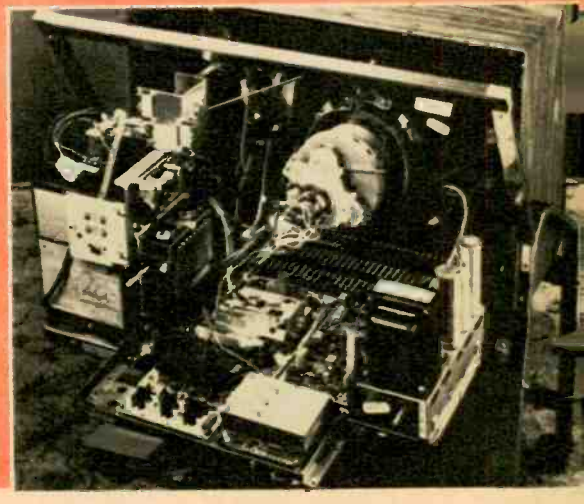
Inevitable, it would seem, is circuitry which can diagnose itself. Your set conks out. You open a drawer or a door or whatever, look inside and see a trouble light glowing on one of the modules. You know that it's the bad one and you buy a replacement—or have one sitting handy on a panel caddy that just happens to be built into the set.

By the end of the decade we're likely to see modules that repair themselves. Printed circuits and microcircuits are extremely cheap to produce once high-quantity production is set up. The self-healing module may have even dozens of tiny duplicate circuits. When one goes, another takes over.

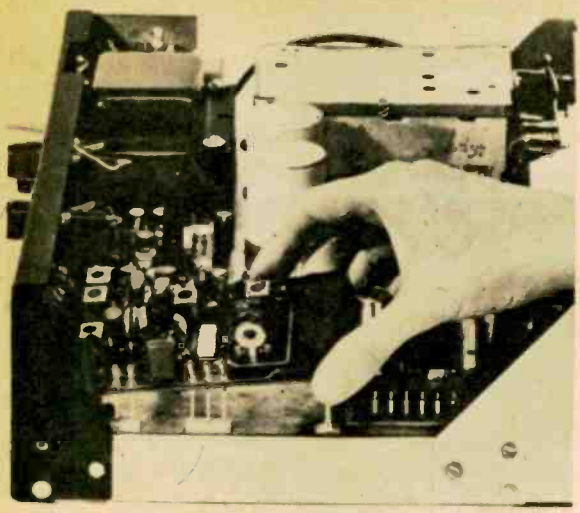
Indicating and self-repairing modules would be expensive, to be sure, because of complex detection, readout and perhaps switching circuitry. But by the end of the decade most electronic gear will have become so complex and so costly that a few more layer of cobwebs and a few more dollars won't matter.

Motorola, as mentioned, got to market first with a big-time modularization but other companies weren't far behind. Zenith now offers a TV set with what they call Dura-Modules. Scott was first off in the hi-fi field with a modularized stereo receiver—and an

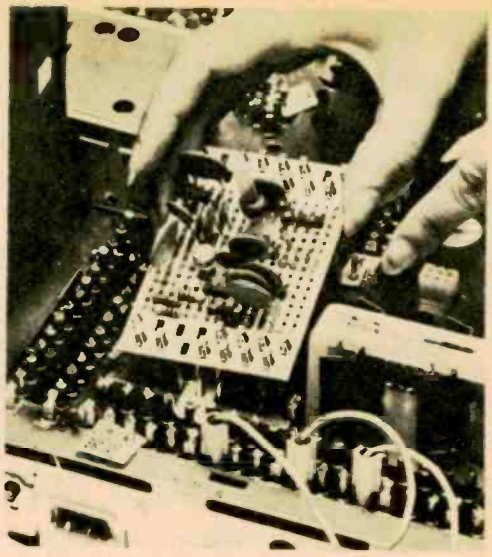




MODULES became big-time in TV when Motorola designed Quasar sets with works in drawer. Original version is at left; newer design is below.



STEREO has entered the modular world with Scott's 342C receiver, which has several modules. Scott offers to exchange any ailing module for flat $10.



TV SET modules are appearing in lines from several manufacturers. Zenith's version is referred to as the Dura-Module. Girl's hands may be hint of future.

SERVICE IN THE SEVENTIES

interesting deal in which they offer to exchange any ailing module for a good one for a flat fee that, at least, for openers was set at $10. Motorola's Quasar panels run from $6.25 (fine-tuning indicator) to $14 (horizontal output). But prices may go up. Electro-Voice also has gone moduleward and Heath became the first kit company to use modules.

Television sets, of course, represent the biggest share of service work today and are getting the big module push. Hi-fi seems to be next in both categories. Communications receivers could follow, but it is doubtful that small transistor radios will be modularized.

Modules, self-diagnosis and even self-repair means no more replacements of individual resistors, transistors or capacitors. Individual components will be fly specks on plastic boards and the soldering iron will gather dust in a drawer. The serviceman will become a merchandiser of products, a seller of modules, a counsellor to the electronically troubled—and an astute dollars-and-cents businessman.

It's not a grim outlook at all. In fact, the future can be rosy. The chap we're talking about still will be a serviceman. Except now he won't as a rule make home calls which most servicemen never enjoyed, anyway, and seldom were profitable (anybody in this business who depends on service-call fees for profits is a trucker, not a serviceman). He'll still do a diagnosis and a snip-solder job once in a while. He will necessarily be an astute businessman with excellent practices—and who would mourn for the days of sloppy business techniques that would look bad even for a lemonade stand?

The smaller shop will become less a service center and more an electronic version of an auto parts store. As in the latter, customers will come in and ask for specific modules ("gimme two 10A477s, Harry, and one 5Z37704") rather than asking why the TV wasn't fixed last week.

All this *will* require service knowledge and training, along with more than a smattering of business acumen, and there is promise of goodly profits and handsome salaries. And that view of a serviceman who also is a good (and prosperous) businessman in a field becoming more exact and demanding while discarding sloppy practices and seat-of-pants service—it's a view that makes a career as a serviceman look exciting, rewarding and satisfying, both to the serviceman and the customer. Because amongst all the other portends is one telling us in a loud noise that *better service is on the way.*

One-Station Radio

Down with tuning knobs! Up with switched-on radio!

Just a twist and our rig gives you what you want.

By CLARE GREEN, W6FFS

IT'S a fact. Radio listeners are a habit-ridden bunch. Most tend to listen to just one favorite station. The younger ones even more are hooked on the loudest local rock transmitter.

So why have a radio that someone else can mess up by turning the tuning knob? Once tuned (with a screwdriver) to your favorite station, our 1-Station Radio will remain on the beam until the FCC freezes over. All you do is turn one knob for on-off and volume.

Specialized programming by stations seeking an individual identification is one of the main reasons for one-station listeners. Some stations go for soft music, some for rock, some for news and so on. Depending on what turns you on, you probably can find a station that does nothing but your thing.

The tone of our 1-Station Radio is excellent because the rig has a 1-watt output and is built in a wooden speaker cabinet containing a 6½-in. speaker. Construction has been simplified because we use a modular IF strip and a modular audio amplifier. The rest of the circuit consists of a one transistor oscillator made of a handful of parts. A 9-in. loopstick antenna gives outstanding sensitivity.

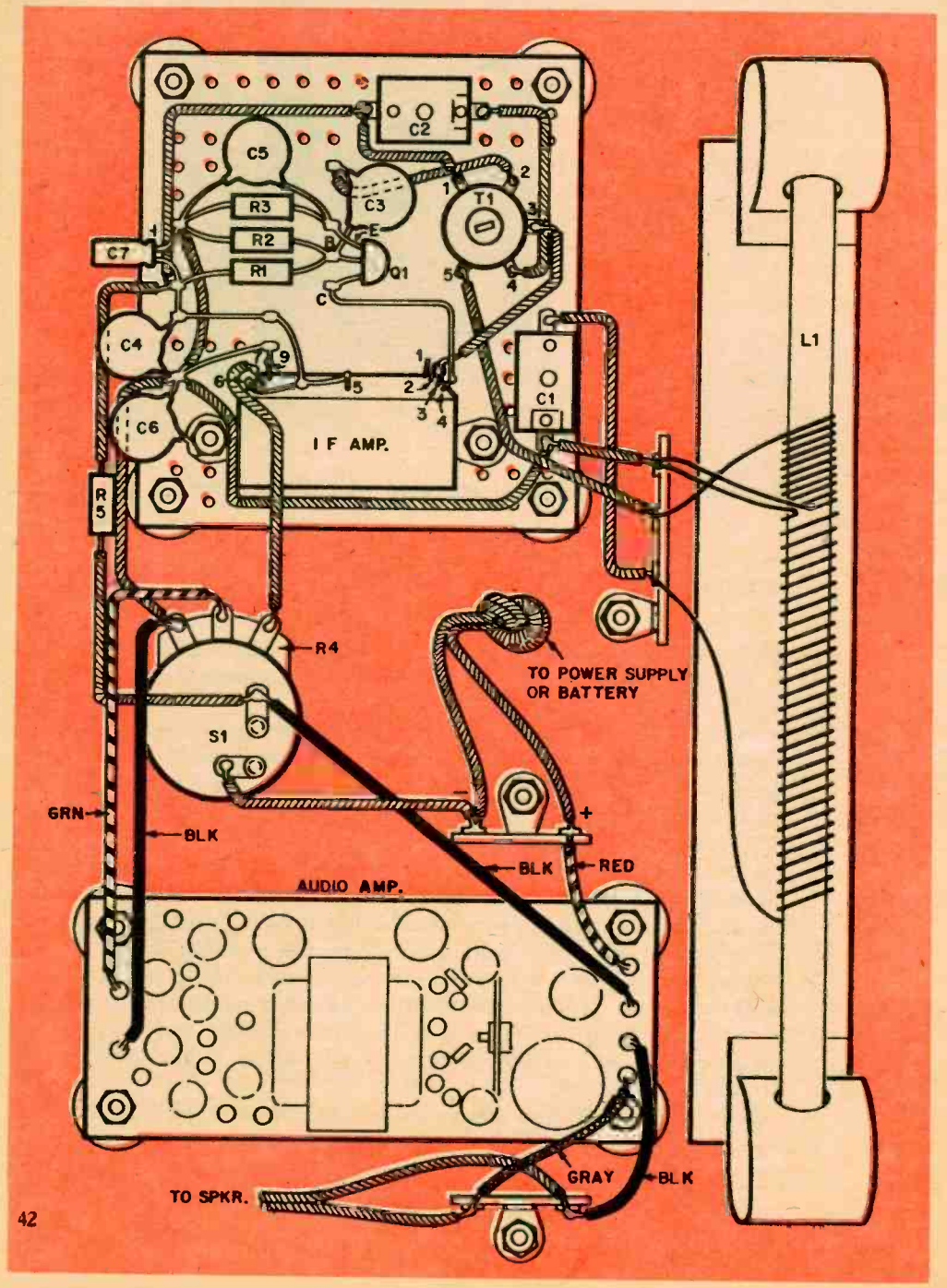
The Circuit. Signals from loopstick antenna L1 are tuned by C1 and coupled via L1's secondary winding (winding below the ground tap in schematic) to T1, and via C3 to the base of Q1. The collector of Q1 is connected by an input

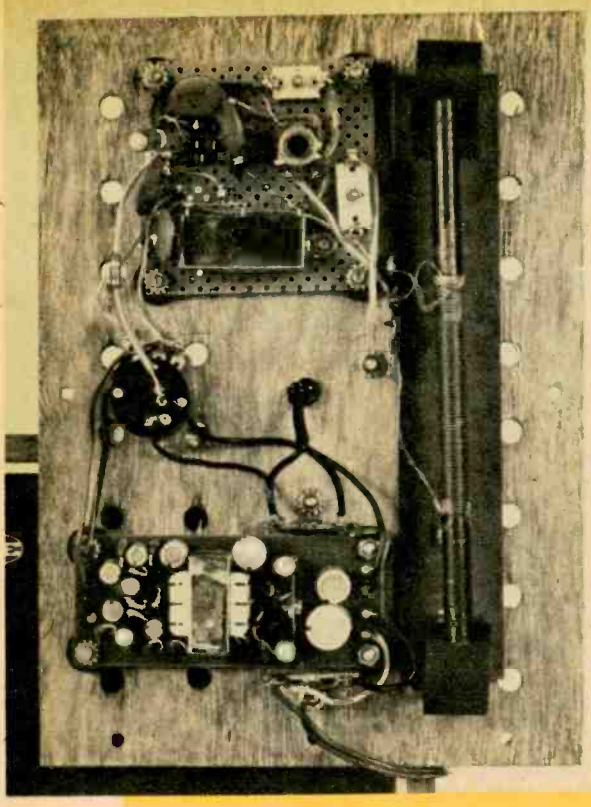
One-Station Radio

transformer in the IF module (IF amp.) to the secondary of T1, which is part of an oscillator circuit. The oscillator is tuned by C2 either 455 kc above or below (depending on whether the set is tuned to the bottom or top half of the broadcast band) the incoming signals, causing a 455-kc IF signal to be produced in the collector of Q1 and fed to the input transformer in the IF amp.

The IF amp. amplifies and detects the 455-kc signal and the resulting audio signal is fed via volume control R4 to the one-watt audio

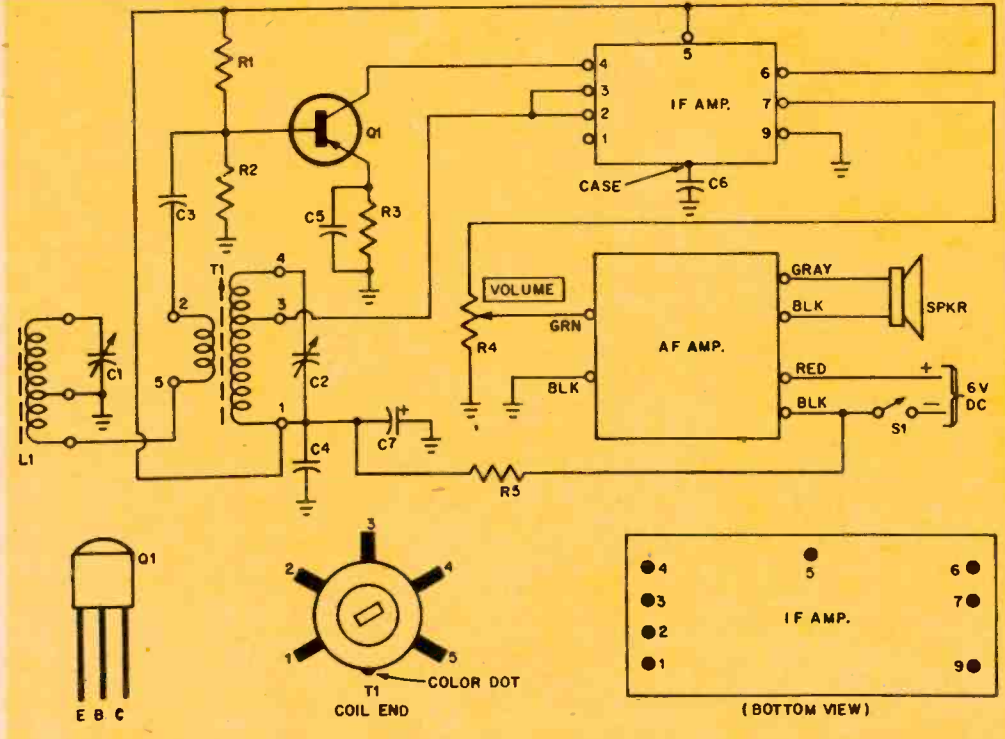
Duplicate our parts layout on oscillator board as shown below. Put grommets between board and audio amp and rear of cabinet. Two-wire tap on antenna goes to top lug on adjacent terminal strip.





PARTS LIST

AF AMP.—1 watt audio amplifier (Lafayette 99 E 90979)
Capacitors: 12 V or higher disc unless otherwise indicated
C1—50-380 μμf trimmer capacitor (Lafayette 34 E 68337 or equiv.)
C2—5-80 μμf trimmer capacitor (Lafayette 34 E 68303 or equiv.)
C3,C4,C5,C6—.01 μf
C7—25 μf, 12 V electrolytic
IF AMP.—455-kc IF amplifier (J. W. Miller 8902-B, Allied 54 A 0099)
L1—Ferrite-rod antenna (J. W. Miller 2000, Lafayette 34 E 88194)
Q1—HEP-57 transistor (Motorola)
Resistors: ½ watt, 10% unless otherwise indicated
R1—22,000 ohms
R2—4,700 ohms
R3,R5—1,000 ohms
R4—5,000 ohm audio-taper potentiometer
S1—SPST switch (on R4)
SPKR—6½-in. speaker and cabinet (Lafayette 99 E 02032W or equiv.)
T1—Miniature transistor oscillator transformer (J. W. Miller 2022, Lafayette 34 E 87014)
Misc.—Perforated board, 6-V power supply (Radio Shack 12-702, $4.95)



Signal picked up by L1 and tuned by C1 is fed via secondary winding (below ground tap) to T1 and Q1's base. Signal at Q1's collector is coupled by transformer in IF amp. to T1's secondary, which is part of local oscillator tuned by C2. 455-kc signal at Q1's collector is fed to IF amp. where it is amplified and detected. Audio is fed via volume control to AF amp. whose output drives speaker.

One-Station Radio

amplifier module (AF amp.) and then to the speaker. The DC power is supplied by an external 6-V power supply or batteries.

Construction. The radio's components are mounted on the rear panel of a Lafayette 99 E 02032W speaker system. The one-transistor converter circuit is built on a 2¾-in. square piece of perforated circuit board. The AF amp., loopstick antenna L1 and volume control R4 are installed on the speaker's rear panel as shown in the pictorial and photo.

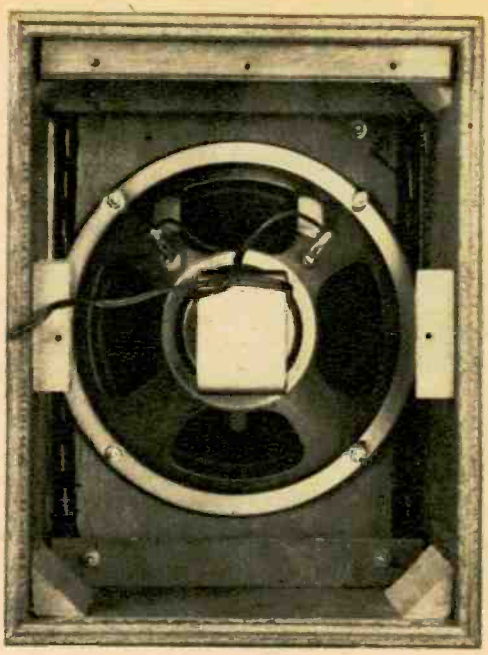
Begin construction by cutting a 2¾-in. square piece of perforated board and mounting the components on it with push-in terminals as shown in the pictorial. The IF amp. is fastened (on its side) to the board with two solder lugs that you solder to the ends of the case. Cut holes in the board for access to C1's and C2's tuning screws and mount C1 and C2 on push-in terminals with short stiff wires.

Carefully bend out the IF amp's connecting pins to prevent shorts and solder the leads to them as shown. Mount and wire the remaining board components keeping the leads short and stiff.

Before mounting the components permanently, position them in from the edges of the speaker's rear panel as shown in the photo. Locate and drill holes through the cabinet's back to allow access to C1's and C2's adjustment screws. Cut off the cardboard ends of L1's bracket before mounting it on the rear panel. Position L1 as necessary to allow the rear panel to fit on the speaker cabinet.

Cut L1's leads to size and connect them to the three-lug strip. Connect L1 via wires on this strip to the board. We mounted a two-lug terminal strip on each side of the AF amp. for the connecting wires to the speaker and for the wires from the power supply. Drill a hole in the center of the cabinet's back for the wire from the power supply. Make sure that the speaker leads are long enough to allow the rear panel to be placed away from the speaker cabinet during alignment.

Alignment. Wait a few hours for the components to cool down to room temperature before starting alignment. Adjust the tuning slug of T2 so it is about ⅛-in. in from the top of the coil form (at the coil end). Set C1 to near maximum capacitance and set C2 to near minimum capacitance. Turn on power and turn volume control R4 to mid-position.



Outstanding tone of radio is due to fact that speaker diameter is 6½ in. and cabinet is made of wood. The 1-watt amplifier helps a lot, too.

You will need a signal generator to properly align the radio. Set up the signal generator for a modulated 455-kc output and connect the generator across C1 (ground lead to the ground side and hot lead to the other side).

Adjust the signal generator's frequency control for maximum audio output. Carefully adjust the tuning slug at the end of the IF amp. for maximum audio output. Reduce the signal generator's output to avoid overloading the radio. A VOM (set to a low AC range) can be connected across the speaker leads to give a more precise tuning indication. After IF alignment is completed, disconnect the signal generator from C1.

If you want to tune the receiver to a frequency in the *top half* of the broadcast band, set C1 to near minimum capacitance and set C2 to near maximum capacitance. (The oscillator will now operate at a lower frequency than the frequency of the incoming signal.) If the receiver is to be tuned to a frequency in the *lower half* of the band, set C1 to near maximum capacitance and set C2 to near minimum capacitance. (The oscillator will operate higher than the frequency of the incoming signal.) [*Continued on page* 103]

Low-Cost Harmonic-Distortion Meter

By HERB COHEN

ONE of the specs most talked about by manufacturers of stereo amplifiers after they get through bragging about power is distortion. Specifically, *harmonic distortion*. What's harmonic distortion? It's a form of distortion which adds undesirable harmonics of the input signal to an amplifier's output signal (more about that later). The lower the figure the better. The harmonic distortion of a top-quality amplifier is 0.5 per cent or lower.

You can't determine an amplifier's harmonic distortion with such basic test equipment as a VOM, VTVM or a scope. First, you need at least a $50 audio generator—and it might have up to 0.25 per cent distortion. Then you'd have to shell out up to $100 for a harmonic-distortion meter that can measure at least 1 per cent distortion, full scale. You can now measure distortion down to 0.5 per cent—but this has cost you about $150.

By using our harmonic-distortion meter you can save money two ways. To begin with, our meter costs only about $40. Because of its design you'll be able to get away with using a less expensive audio generator—one whose distortion can be as high as 1 per cent. Despite the fact that the audio generator might have this much distortion, our meter will measure an amplifier's distortion down to 0.1 per cent with good accuracy.

Harmonic distortion is a part of an amplifier's output signal that does not appear in the input signal. If you were to take a 1,000-cps sine-wave signal and deliberately distort it, no matter how, the distorted waveform would consist of the original 1,000-cps signal and a series of harmonics of the signal. For example, if you were to feed a 1,000-cps signal into an amplifier and increase the gain until the amplifier started to clip, the output would begin to look like a 1,000-cps square wave.

The 1,000-cps sine wave is still in the output waveform; however, because the amplifier has been driven into its non-linear region, it amplifies some parts of the waveform more than others. This produces a series of harmonics which, when algebraically added to the 1,000-cps sine wave, becomes a waveform that is squared off at the top and bottom.

Frequently, harmonic distortion is caused by the non-linear region of an amplifier's transfer characteristic. An example of this is crossover distortion generated in the output stage of some solid-state amplifiers. It occurs at the point where the signal crosses over from one output transistor to the other—the non-linear cutoff region of the transistors. Crossover distortion is independent of frequency; therefore, a single-frequency distortion check tells a good deal about the amplifier. Distortion is also caused by defective tubes or component.

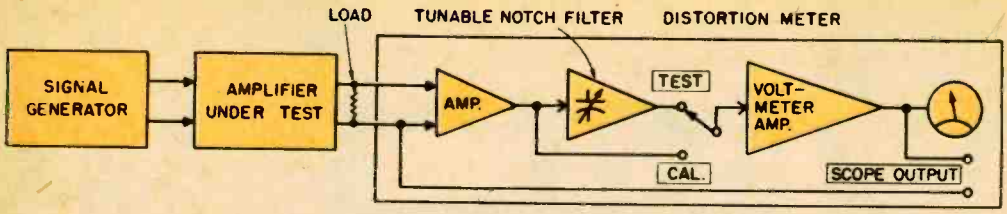


Fig. 1—Block diagram of a notch-filter harmonic-distortion meter. Disadvantage of instrument of this design is that meter also indicates any distortion that may be produced in the audio signal generator.

Harmonic-Distortion Meter

The operation of most commercial harmonic-distortion meters is based on a notch filter design (Fig. 1). This distortion meter takes a portion of the output of the amplifier under test, amplifies it and sends it to a tunable notch filter which traps out the fundamental. What's left of the signal, the distortion, is fed to the voltmeter. The voltmeter is first switched to the *cal.* position where it measures the total signal. This is indicated on the voltmeter as 100 per cent. The switch is then set to the test position and the output of the notch filter is indicated as a percentage of the total signal.

The output of the notch filter, however, contains more than harmonic distortion. Hum or noise produced in the signal generator and amplifier under test also appear at the output of the notch filter. How does the meter distinguish between distortion in the test signal and distortion in the amplifier? It doesn't. Since the distortion meter detects simply deviation from a sine-wave input, it doesn't care what the deviation consists of or where it came from. It could have originated in the signal generator. You must have a signal generator whose hum, noise and distortion (according to IHF standards) are at least 20 per cent lower than the hum, noise and distortion of the amplifier under test. This can be a problem when you want to measure distortion down to 0.1 per cent.

There's a way to get around this problem. If a portion of the amplifier's output signal is compared to the input signal (provided that they are 180° out of phase and of the same amplitude) they will cancel each other out. Distortion generated in the amplifier will not be cancelled out and will be indicated by the meter.

This method has two big advantages over the notch-filter method: 1) Any distortion in the input-signal waveform is cancelled. 2) Hum and noise in the input signal are also cancelled out.

Our distortion meter consists of two parts: the voltmeter and comparator section and the generator-input reference amplifier. (Figs. 3 and 5) The signal generator output (must be 1 to 2 V) is connected to *gen. input* terminals BP1 and BP2. Here the signal passes through a phase-shift network (C1, C2, R1 and R2) that allows you to shift phase ±30° by adjusting R3 and R4. This is neces-

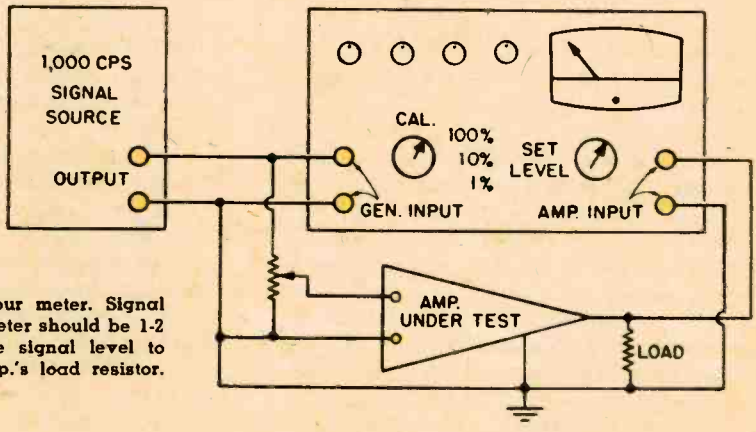


Fig. 2—Test set up for our meter. Signal from audio generator to meter should be 1-2 V. Pot is used to reduce signal level to amp. Don't forget the amp.'s load resistor.

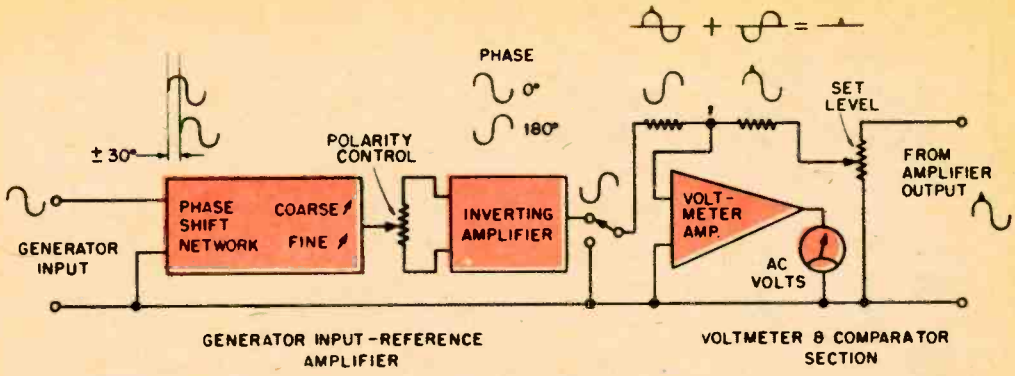


Fig. 3—Block diagram of our meter. Phase-shift network compensates for phase shift in amplifier. Noise or distortion from signal generator is cancelled out in summing network (resistors above voltmeter amp.).

sary to correct for phase shift in the amplifier under test.

Transistor Q1 is an emitter follower which isolates the phase-shift network from inverting amplifier IC1. Pot R6, the *coarse polarity control*, feeds the signal to the inverted or to the non-inverted input of IC1. This produces an output at pin 6 of IC1 that can vary from zero-phase maximum voltage when R6 is at midrange, to 180° phase maximum voltage when R6 is fully clockwise.

The output of the amplifier under test (it must be at least 1.5 V) is applied to *amp. input* terminals BP3 and BP4 and goes through the arm of *set-level* control R23 into comparator resistors R13 and R16. The voltmeter circuit of IC2 measures the voltage at the junction of R13 and R16. The voltage is the algebraic sum of the output voltage of the amplifier under test and the generator's input-reference voltage.

When function switch S2 is in the *cal.* position, R13 is grounded. *Set-level* control R23 is then adjusted until the meter indicates full scale. When function switch S2 is set to the 100-per cent position, the generator input-reference amplifier (IC1) is connected to comparator resistor R13. The R13, R16 junction sums the two voltages. The generator input-reference voltage can be adjusted for phase and amplitude so that maximum cancellation is obtained.

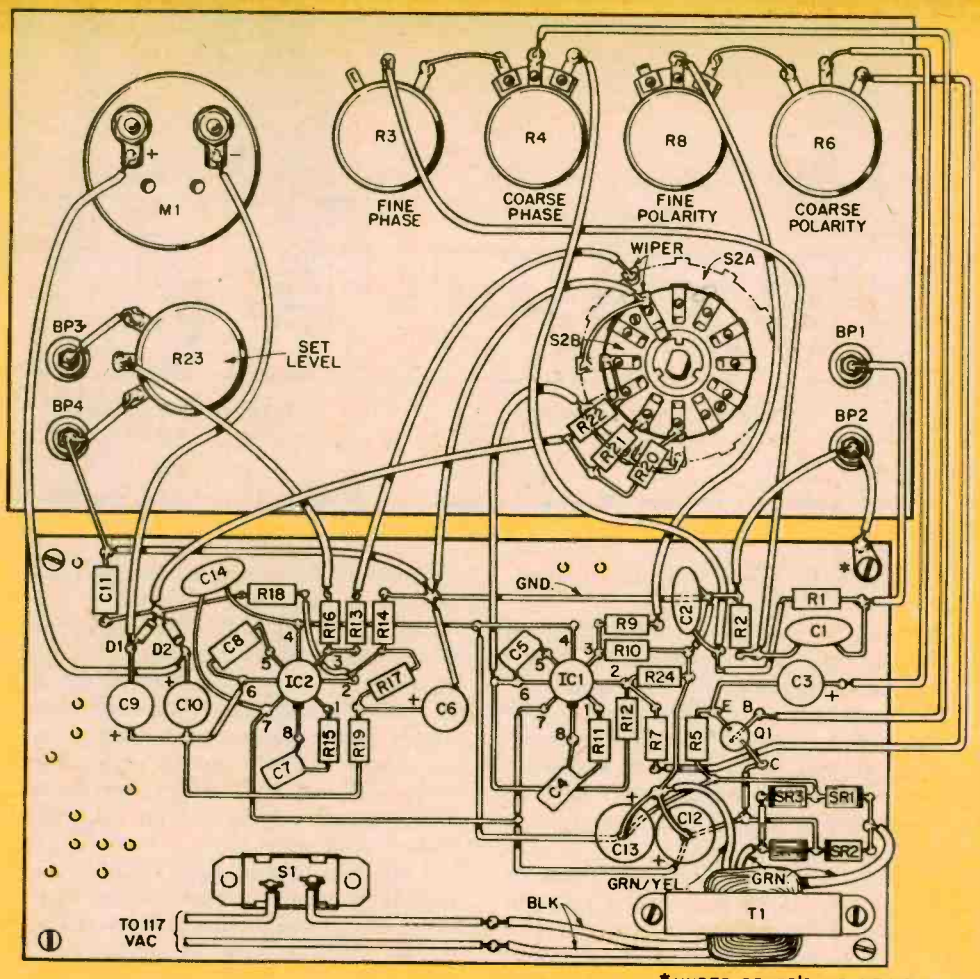
Construction. The majority of parts in our model are mounted on a 4¼ x 7¾-in. piece of perforated board. We used brass eyelets for tie points, but push-in terminals will work just as well. In the photo in Fig. 4 you can see that the wiring in the author's model is under the board. In the pictorial, however, we show all the wiring as though it is above the board. The choice is yours.

Because you may find the cabinet we used difficult to come by (our cabinet is a cowl-type box with a built-in chassis) we suggest you use a standard cowl-type Minibox and simply mount the perforated board with 1-in. spacers above the bottom of the U-section of the cabinet. The cabinet must be aluminum. A steel cabinet will change the panel meter's calibration.

Lead lengths and part locations are not terribly important because of the frequency at which the meter operates. Here's an important point to keep in mind. The circuit must be grounded to the cabinet at only one point. The point is a ground lug under the circuit board spacer at the upper right corner of the board (as shown in the pictorial in Fig. 4).

Try to duplicate our front-panel layout for ease of operation. The polarity and phase controls and the center of the panel meter are on a line near the top of the panel. The function switch and the set-level controls are on a line about 2½ in. below. The amplifier and generator-input binding posts are centered above and below the line on which the function switch and set-level controls are mounted.

The author did not install an AC power switch on his model; however, we show one in the schematic and pictorial. A slide or toggle switch will fill the bill and can be mounted on the front or rear panel of the cabinet. (Twist the leads going to the switch.) Do not install a switch on the back of any of the pots because this may affect performance. All ground buses and DC power lines should



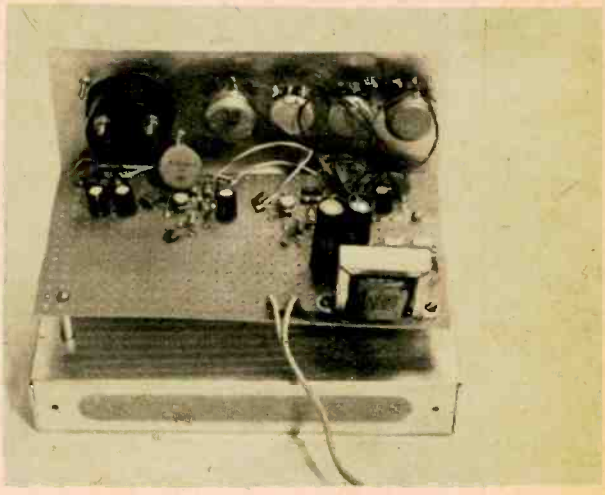
Harmonic-Distortion Meter

Fig. 4—Note in pictorial above that circuit is grounded to cabinet at one point only—under board's mounting screw in upper right corner. The photo below shows construction of author's model.

be No. 18 wire to minimize power-supply impedance to RF.

Operation. Harmonic distortion can be checked at any power level. However, you should know what the amplifier looks like at maximum output power. Take a look at the diagram in Fig. 2, which shows a test set up. Before turning on the amplifier or meter, position the meter's controls as follows: set the *fine* and *coarse phase* and *polarity* controls to the center of rotation. The *set-level* control (R23) should be set full counter-clockwise. Function switch S2 should be set to the *cal.* position.

Connect a signal generator set to 1,000 cps to *gen. input* binding posts BP1 and BP2 and to the input of the amplifier under test. A potentiometer can be used to bring down the level of the signal to the amplifier. Connect



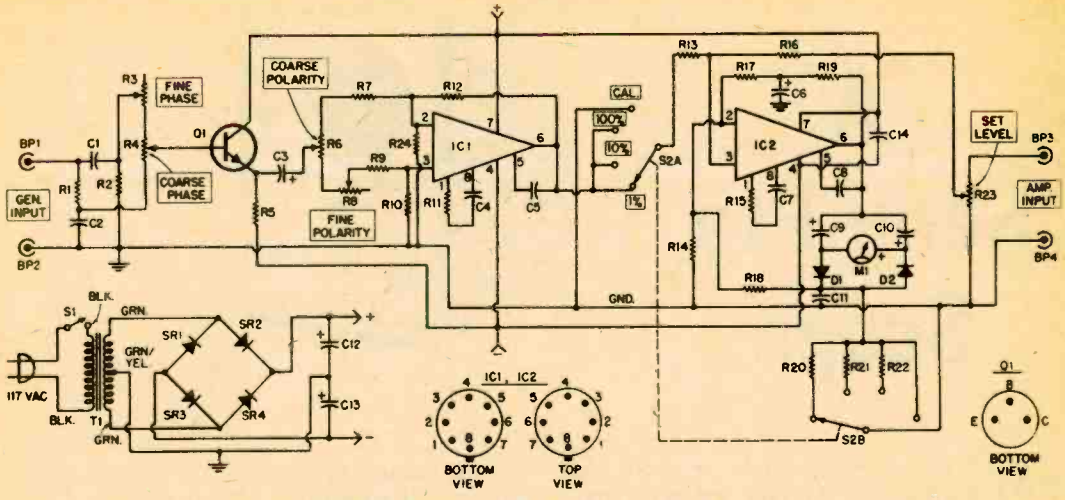


Fig. 5—To cancel out distortion from audio generator, signals from generator and amplifier (180° out of phase) are added in R13, R16. Remaining distortion is from amplifier.

the output of the amplifier under test to *amp. input* terminals BP3 and BP4. The level of the signal to the *amp. input* should be at least 2 V.

Turn on the meter and the amplifier. Now adjust *set-level* control R23 for full scale deflection of M1. Next, set function switch S2 to the 100-per cent position. Adjust *coarse polarity* control R6 until the meter needle dips to a minimum (not necessarily zero).

Then adjust *coarse-phase* control R4 for minimum indication on M1. If the needle dips below 10 per cent (0.1 ma on the meter scale) when S2 is in the 100-per cent position, set S2 to the 10-per cent position and adjust the *phase* and *polarity* controls again for minimum meter indication. If the needle dips below 1 per cent (0.1 ma on the meter scale), set S2 to the 1-per cent position and adjust the *polarity* and *phase* controls for lowest meter indication. When the *coarse* controls become too tricky to adjust, use the *fine* controls. The lowest meter indication you get using the *fine* controls is the amplifier's harmonic distortion.

Now that you know the amplifier's harmonic distortion, what do you do with this figure? If the amplifier is new or old and the distortion is within the manufacturer's rating, you've got it made. If the amplifier is new and the distortion exceeds the manufacturer's rating appreciably, exchange it.

If the amplifier is old and distortion is high, you've got a bit of service work facing you. The problem could be caused by old tubes or components that are defective.

PARTS LIST

BP1-BP4—Insulated binding post
Capacitors: 50 V or higher unless otherwise indicated
C1,C2—.01 μf disc
C3,C6,C9,C10—100 μf, 10 V electrolytic
C4,C7—.001 μf disc
C5,C8—50 μμf silvered mica
C11—150 μμf silvered mica
C12,C13—500 μf, 15 V electrolytic
C14—.05 μf disc
D1,D2—1N34A diode
IC1,IC2—μ5B770939X integrated circuit (Fairchild)
M1—0-1 ma DC milliammeter (Calectro D1-912 or equiv.)
Q1—2N3391 transistor (GE)
Resistors: ½ watt, 10% unless otherwise indicated
R1,R2—20,000 ohms, 5%
R3—5,000 ohm linear-taper pot
R4—100,000 ohm linear-taper pot
R5—10,000 ohms
R6—25,000 ohm linear-taper pot
R7,R10,R14,R18,R24—4,700 ohms
R8—600 ohm linear-taper pot
R9—2,200 ohms
R11,R15—1,500 ohms
R12—47,000 ohms
R13,R16—39,000 ohms
R17,R19—22,000 ohms
R20—10 ohms
R21—100 ohms
R22—1,000 ohms
R23—50,000 ohm linear-taper pot
S1—SPST switch
S2—four pole, four-position rotary switch
SR1-SR4—Silicon rectifier; minimum ratings: 100 ma, 50 PIV
T1—Filament transformer; secondary: 12.6 V center tapped @ 100 ma
The Fairchild μ5B770939X integrated circuit is available for $5 postpaid from Custom Components, Inc., Box 153, Malverne, N.Y. 11565 (Canada add $1).

EI Kit Report

A Semi-Pro Scope

Eico 465

WITHOUT an oscilloscope on your bench, you don't have a chance of making the big leagues in servicing. In addition to saving you time (which means more money) a scope always results in a better service job.

Referred to by Eico as a professional oscilloscope, the $179.95 Model 465 ($249.95 assembled) is a standard wide-band TV service design with some of the most common and useful features of professional lab scopes. For example, the sweep-frequency ranges and sync are standard. Variable sweep frequencies go from about 10 cps to 100 kc in four overlapping ranges and there are +, −, 60-cps and external-sync options. Even the stepped vertical-input attenuator is more or less standard on all but the least expensive scopes. The CRT is a 5-in. flat-face design.

The professional features of the 465 are those added to the standard features, hence, a semi-pro scope. Among the features are horizontal- and vertical-balance adjustments on the front panel (not buried inside), a Tektronix-type camera and hood mount, 8 x 10-cm graticule with even, adjustable edge lighting, stepped horizontal-gain control, and most important, built-in calibration for both the horizontal and vertical amplifiers.

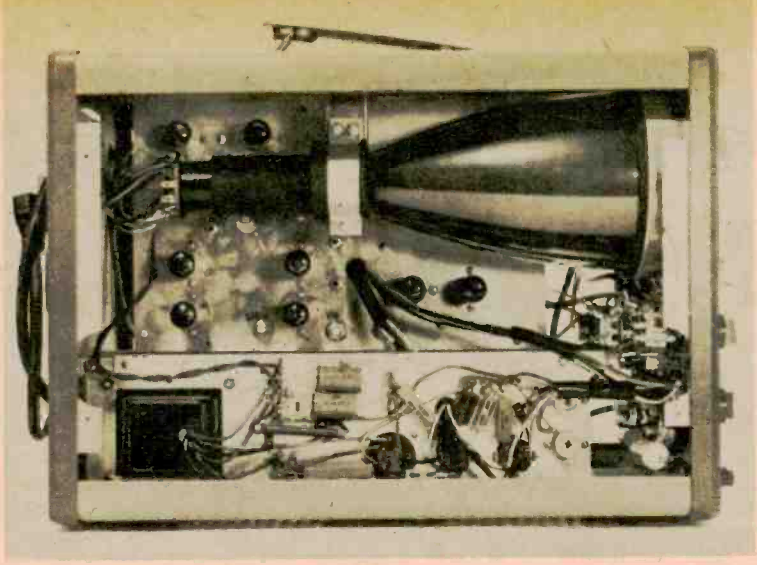
Eico claims the frequency response of vertical amplifier is DC to 8 mc (±1db, −5db). Our kit checked out within 1db to 5.2 mc and was down 6db at 6 mc. This was caused by improper factory alignment of the vertical-amplifier peaking coils. With a signal generator that goes out to 8 mc you can easily re-align the peaking coils to flatten the response out to 8 mc.

Eico claims the frequency response of the horizontal amplified is DC to 1 mc (+1db, −3db). This checked out as such, though the horizontal-input frequency-correction adjustments are almost impossible to set correctly following the instruction manual.

Both the horizontal- and vertical-input attenuators have a calibrate position. The vertical calibration signal is a 60-cps square wave. The horizontal input is calibrated with a horizontal line. Though the calibration traces work well, the vertical calibration procedure is confusing because the graticule is engraved with the words *V calibration* and an arrow that spans 2 cm. The manual says to adjust the calibration voltage for 4 cm. We adjusted for the arrow spacing which was half the required gain. When you initially adjust the calibration voltage control, set the CRT pattern for 2 cm—the distance indicated by the arrow.

The sweep-range-selector switch has, in addition to four positions for 10 to 100 kc, two fixed-frequency positions of 30 cps and 7,875 cps (vertical and horizontal sweep) for TV servicing. Unfortunately, the trimmer capacitor used to set 7,875 cps is buried in the guts. We had no desire to reach in near high-voltage points to get at this trimmer. It is necessary, for safety's sake, to disconnect the line cord, adjust the trimmer and then check the pattern. You would have to do this several times until the two-cycle trace is obtained.

The 465 even has a little reserve vertical-amplifier gain above the specified 35-mv (peak-to-peak) cm sensitivity to allow for component aging. DC balance stability was good after a 20-minute warmup, which is



Left side of scope. Note mu-metal shield around neck of CRT. Chassis at bottom contains power-supply components. Main chassis (above) is on other side of scope. Wires going from main chassis to power supply were too short and had to have short lengths of wire spliced to each of them.

about the same time required by scopes priced considerably more.

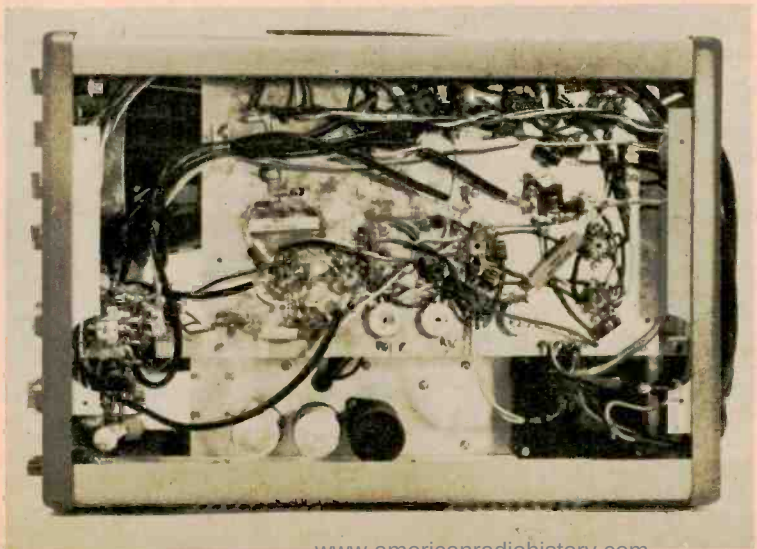
You might wonder why the calibrated horizontal feature is needed. The answer is that the 465 is designed for use with Eico's Model 443 Transistor-Diode Curve Tracer. Having both the horizontal and vertical inputs calibrated makes for convenient operation of the curve tracer.

It took us 22 hours to build and calibrate the 465. Generally speaking the steps in the manual were clear, although at times the illustrations required extra-careful study. When installing a terminal strip on one chassis we found the mounting hole was missing and had to be drilled.

But when we got to the final connections between the two side-mounted chassis we ran into some difficulties. Wires previously connected to each chassis now had to be connected to the other chassis. Most of the wires were too short (in spite of the fact that we cut them to the specified lengths). We had to splice short lengths of wire to each of them so they would reach their destination. And the grommeted holes through which these wires passed were very tight. It took patience, perseverance, poking and pulling to get the wires through.

We suggest, therefore, that before cutting the wires that go from one chassis to the other you add two or three inches to each. When we finished the kit we found there was wire left over, so there's no chance of your running short. And to make it easier to slip the wires through the grommeted holes in each chassis, put a slight bit of silicone grease on each wire before you pull it through.

As far as operating conveniences are concerned, the 465 provides the most useful lab scope features at a serviceman's or hobbyists price.



Right side of scope. Back of main chassis is wide open and we had no problems wiring it. Coax cables connect main chassis to front-panel controls. Controls are installed on front panel early in the game making connections to them easy. 7,875-cps trimmer on sync-selector switch in center of front ended up under CRT facing straight up.

Better than 9 out of 10 CIE men win their "ticket" the very first time they try
(NATIONAL AVERAGE IS ONLY 1 OUT OF 3.)

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NOT SATISFIED with your present income? The most practical thing you can do about it is "bone up" on your electronics, pass the FCC exam, and get your Government license.

The demand for licensed men is enormous. Ten years ago there were about 100,000 licensed communications stations, including those for police and fire departments, airlines, the merchant marine, pipelines, telephone companies, taxicabs, railroads, trucking firms, delivery services, and so on.

Today there are over a million such stations on the air, and the number is growing constantly. And according to Federal law, no one is permitted to operate or service such equipment without a Commercial FCC License or without being under the direct supervision of a licensed operator.

This has resulted in a gold mine of new business for licensed service technicians. A typical mobile radio service contract pays an average of about $100 a month. It's possible for one trained technician to maintain eight to ten such mobile systems. Some men cover as many as fifteen systems, each with perhaps a dozen units.

Coming Impact of UHF

This demand for licensed operators and service technicians will be boosted again in the next 5 years by the mushrooming of UHF television. To the 500 or so VHF television stations now in operation, several times that many UHF stations may be added by the licensing of UHF channels and the sale of 10 million all-channel sets per year.

Opportunities in Plants

And there are other exciting opportunities in aerospace industries, electronics manufacturers, telephone companies, and plants operated by electronic automation. Inside industrial plants like these, it's the licensed technician who is always considered first for promotion and in-plant training programs. The reason is simple. Passing the Federal government's FCC exam and getting your license is widely accepted proof that you know the fundamentals of electronics.

So why doesn't everybody who "tinkers" with electronic components get an FCC License and start cleaning up?

The answer: it's not that simple. The government's licensing exam is tough. In fact, an average of two out of every three men who take the FCC exam fail.

There is one way, however, of being pretty certain that you will pass the FCC exam. And that is to take one of the FCC home study courses offered by the Cleveland Institute of Electronics.

CIE courses are so effective that better than 9 out of every 10 CIE-trained graduates who take the exam pass it. That's why we can afford to back our courses with the iron-clad Warranty shown on the facing page: you get your FCC License or your money back.

There's a reason for this remarkable record. From the beginning, CIE has specialized in electronics courses designed for home study. We have developed techniques that make learning at home easy, even if you've had trouble studying before.

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Your CIE instructor gives his undivided personal attention to the lessons and questions you send in. It's like being the only student in his "class." He not only grades your work, he analyzes it. Even your correct answers can reveal misunderstandings he will help you clear up. And he mails back his corrections and comments the same day he receives your assignment, so you can read his notations while everything is still fresh in your mind.

It Really Works

Our files are crammed with success stories of men whose CIE training has gained them their FCC "tickets" and admission to a higher income bracket.

Mark Newland of Santa Maria, Calif., boosted his earnings by $120 a month after getting his FCC License. He says: "Of 11 different correspondence courses I've taken, CIE's was the best prepared, most interesting, and easiest to understand."

Once he could show his FCC License, CIE graduate Calvin Smith of Salinas, California, landed the mobile phone job he'd been after for over a year.

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Want to know more? The postpaid reply card bound-in here will bring you free copies of our school catalog describing opportunities in electronics, our teaching methods, and our courses, together with our special booklet, "How to Get a Commercial FCC License." If card has been removed, just mail the coupon at right.

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Matt Stuczynski, Senior Transmitter Operator, Radio Station WBOE

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Chuck Hawkins, Chief Radio Technician, Division 12, Ohio Dept. of Highways

"My CIE Course enabled me to pass both the 2nd and 1st Class License Exams on my first attempt...I had no prior electronics training either. I'm now in charge of Division Communications. We service 119 mobile units and six base stations. It's an interesting, challenging and rewarding job. And incidentally, I got it through CIE's Job Placement Service."

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EI-90

Hi-Fi Today *

By John Milder

Long Live the Super Cassette

THE long-awaited arrival of the *super* cassette recorder is finally imminent. That was brought home to me at a recent demonstration held by the Advent Corp. This Massachusetts firm was showing both its new Model 100 Noise Reduction Unit (the first accessory using the Dolby System in a format which can be used with any good tape recorder) and a cassette unit also using the Dolby System. Advent announced that it would have a Dolby-licensed cassette deck by mid-summer (Harman-Kardon and others may follow before very long).

The most interesting aspect of the Advent demonstration was the company's insistence that it had no monopoly on the super cassette field, and that both Advent and everyone else would profit most only if the audio industry and the recording companies got together right now—while it's still relatively early in the cassette game—to do the whole thing right.

I agree with that. It's possible right now using existing technology, including the Dolby System, to optimize every aspect of cassette performance and make cassettes a serious medium—and it had better be done now before some entrepreneur decides to do something flashy, like making cassettes at a non-standard higher speed (which Philips could fight in the courts, but probably be too late to win).

As one example of how to do things right, Advent demonstrated the new Wollensak 4700 cassette deck. The Wollensak is the first machine to treat the mechanics of cassette recording with as much care as open-reel recorders. Though Advent will have its own transport mechanism, the company showed a competitive product to indicate the jump in performance which occurs from doing one simple thing, i.e., getting wow and flutter down where they should have been all along.

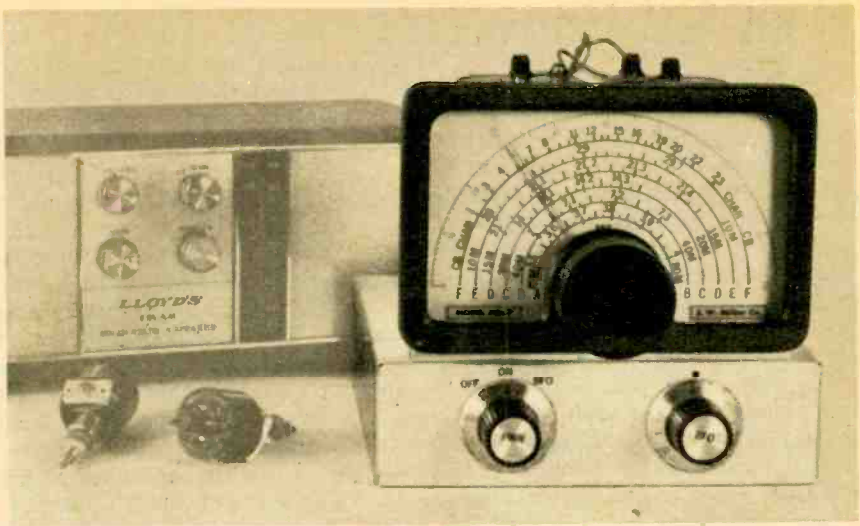
Noise Reduction Center by Advent is first component to use Dolby System for home tape recording. Unit goes between amplifier and recorder.

As for all the things which ought to be done, here's my own list:

- The Dolby System (under license) should be used in all serious cassette machines. Without it, the hiss level stays too high and dynamic range is limited.
- Dolbyized (or stretched, if you prefer the term) prerecorded cassettes should be the only kind of cassettes released for serious listening. No other technique can do the trick. The worst compatibility problem which results from playing a stretched cassette on a non-Dolby machine is a bit of extra brightness, which should actually make things sound better on the usual dull-sounding cassette system.
- Good, low-noise electronic circuitry should be implemented to avoid watering down the Dolby System's advantages.
- Good tape heads which go to 12 kc and beyond are available now and must be used.
- The mechanical performance of cassette machines must receive the same attention as in good open-reel recorders.
- The mechanical performance of the cassette cartridge needs optimizing. To often, the plastic surfaces are crudely made and put together and needless wow and flutter results.
- The best available tape should be used. This means not only the glamorous chromium dioxide tape which will be available this year, but also more conventional low-noise varieties like TDK and BASF. And the serious cassette machines should come with two-position equalization-bias switches to make best use of both basic tape breeds.

Why bother to do all that? Because, as the Advent demonstration showed to a skeptical audience, what you get is a cassette which sounds as good as most excellent records, and in some respects even better.

Believe me, it's worth the effort.



Easy-to-Build Ham-CB Converter

By CHARLES GREEN, W6FFQ

INFLATION and tight money have made dollar watching our new national pastime. The price of everything keeps going up, up, up while the bread available to buy things gets scarcer and scarcer. To hams on a budget we have something to keep the expenditure for a receiver down. It's a low-cost converter that tunes the 80, 40, 20, 15 and 10-meter bands (CB, too) on any broadcast receiver. The converter has three FETs in a circuit that uses plug-in coils. A varactor diode tunes the BFO for CW or sideband reception. The rig is built on a 7 x 7 x 2-in. chassis; a vernier dial makes for easy tuning. The power requirement is 18 VDC at 10 ma.

Construction

Lay out the chassis using the photo of the underside in Fig. 1 as a guide. Allow space for the BFO which is built in a 3¼ x 2½ x 1⅛-in. aluminum box and mounted on the top of the chassis at the rear as shown in Fig. 4.

Mount the dial on a homemade sheet-aluminum bracket fastened to the top of the chassis. Before installing C4, remove the side-mounted trimmer capacitors as they are unnecessary in this circuit. Make sure that the shaft of C4 is properly aligned with the dial's bushing to prevent binding when you tune. Mount octal sockets SO1 and SO2 and install grommets in the chassis holes for the wires that go to C4.

Cut a 2½ x 3½-in. piece of perforated board and mount it under the chassis between SO1 and SO2; use ⅜-in. metal spacers at each corner. Mount the remaining components on the front and rear chassis aprons.

Ham-CB Converter

We used push-in terminals to mount parts on the perforated board. Install the components exactly where shown because the location of parts is critical. Transistors Q1 and Q2 should be mounted upside down on the board. Make sure that their leads are positioned as shown to prevent shorts. When installing other parts on the board, keep their leads short and direct. You make the gimmick capacitor by twisting together for three turns two pieces of No. 22 solid hookup wire.

Connect the board components to the other chassis parts as shown in the pictorial. Wind two turns of No. 22 solid hookup wire over the center of the winding on L4, twist the leads together and connect them to J2. Make sure the lead from J1 to SO1 is away from the chassis.

For the BFO cut a 1⅞ x 3-in. piece of perforated board and drill a ⅜-in. hole in the left side of it as shown in Fig. 3. Drill a matching ⅜-in. hole in the main section of the 3¼ x 2⅛ x 1⅛-in. aluminum chassis box, then mount the board in the box with ¾-in. machine screws. Use spacers at each corner to keep the back of the push-in terminals from shorting to the box. Drill a hole in the end of the box and mount L3 as shown in Fig. 3, making sure its lugs will not touch the box's cover.

Next, position the BFO box on top of the main chassis and determine the place to drill a hole in the chassis for the two leads that come from the main-chassis board to the BFO board. Remove the BFO box, drill the hole then mount the BFO box on the main chassis.

The 12 plug-in coils are built in bases of discarded octal tubes. To make the job easier, try to locate tubes with large dia. bases. The 5U4GB is a popular tube and should be easy to find. It has a large base—1⅜ in. dia.

Using the schematics in Fig. 6, first make up a list of which coils go with which capacitors for each coil assembly. Refer to Fig. 7. First solder stiff pieces of wire to the appropriate lugs on each coil. Then connect the trimmer capacitor and, when required, the disc capacitors to the lugs. After you have double checked to make sure the connections are correct, slip the coil assembly into the tube base making sure the wires go into the

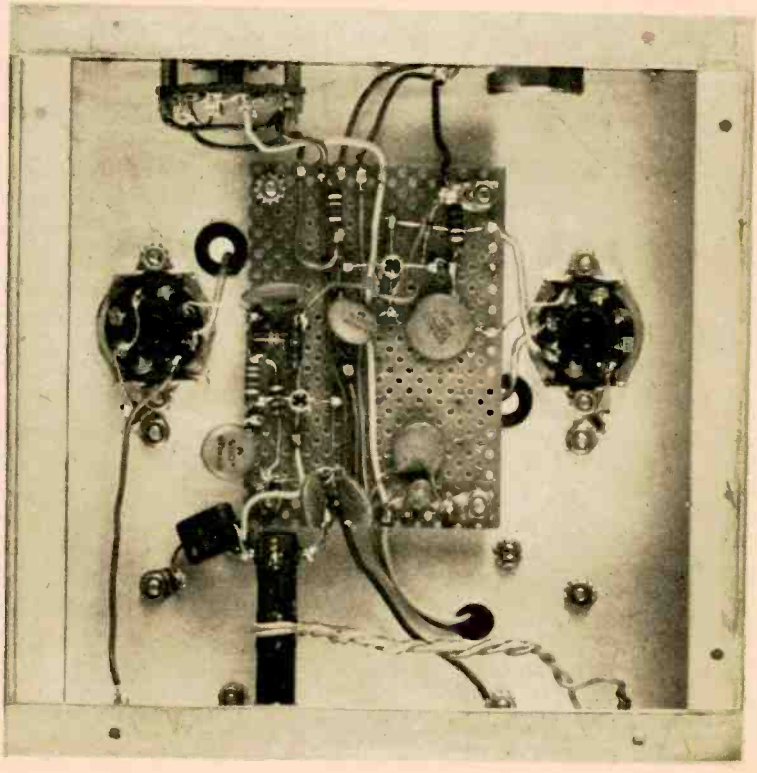


Fig. 1—Underside of chassis. Front is at top, rear is at bottom. Note short direct wiring on circuit board and from board to sockets, switch and pot R10 (top, right). Twisted wire at bottom, going to two-turn coil over L4, should be kept away from the chassis.

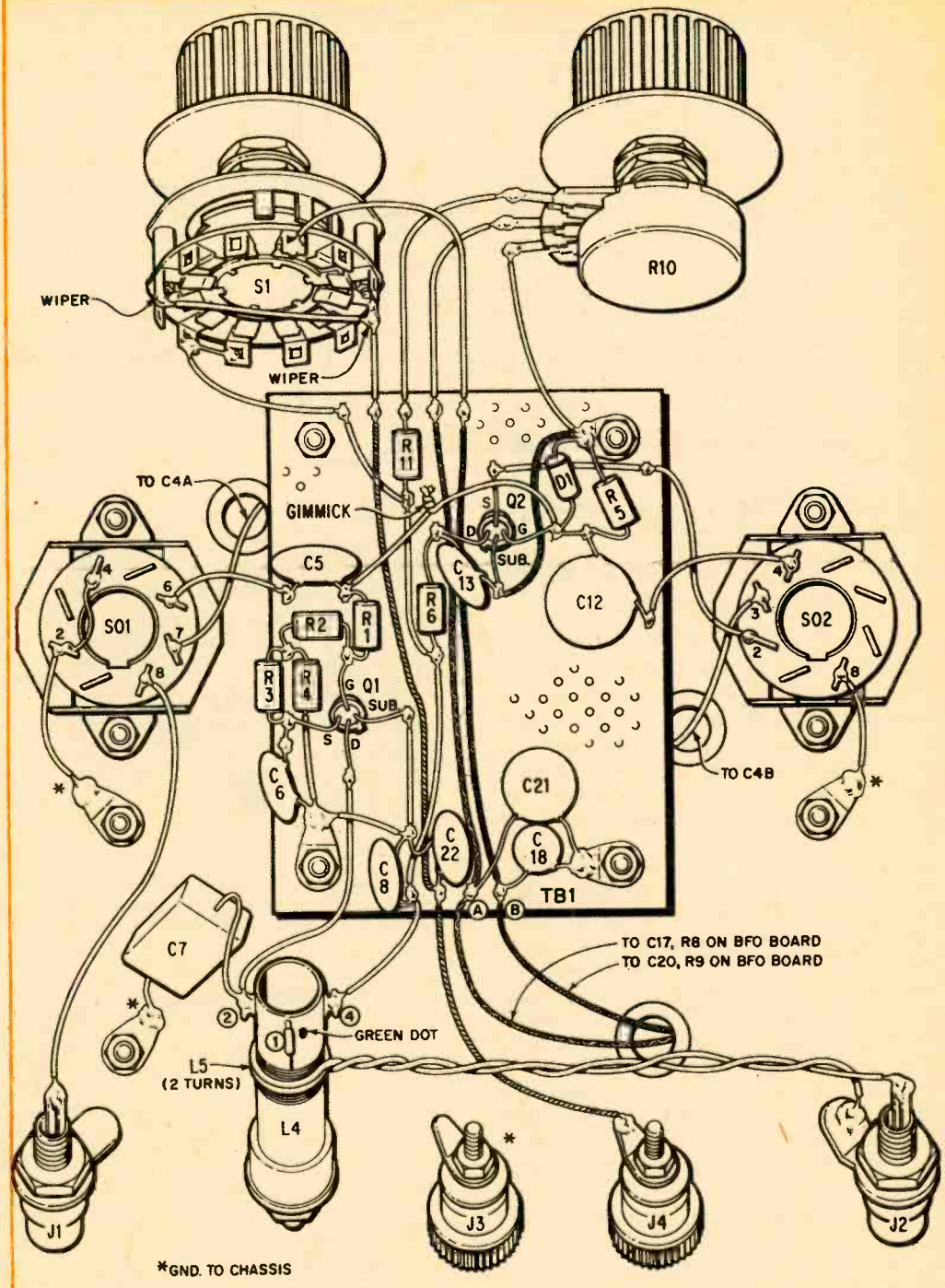


Fig. 2—Pictorial of underside of main chassis shows connections of all parts. Coil L5 is made by winding two turns of No. 22 hookup wire over winding on L4. Lug on post J3 should connect to chassis.

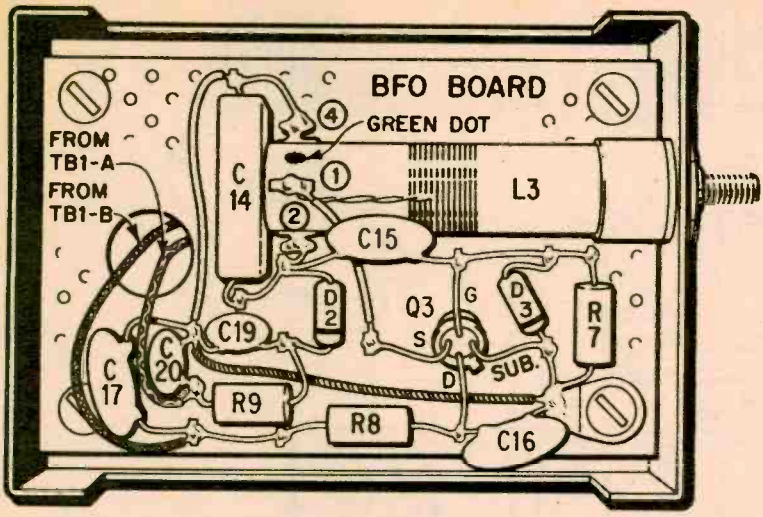


Fig. 3—BFO is built on 1⅞ x 3-in. piece of perf board which is mounted in main section of chassis box. Ground connection of BFO circuit is made to main chassis, through mounting screw in lower right corner. Two wires from main chassis to BFO go through ⅜-in. hole in main chassis. BFO box and perforated circuit board.

Ham-CB Converter

correct base pins as shown in the sketches.

Alignment and Calibration

Set your broadcast receiver's tuning dial to a clear spot on the dial near 1550 kc. Wind two turns of hookup wire around the receiver's loopstick antenna, twist the wires and connect them via a phono plug to J2. To minimize the chance of shock, do not make a direct connection between the converter and the chassis of a hot-chassis AC-DC receiver.

Connect 18-VDC power to J3 and J4, set C4 near maximum capacitance, R10 to midrange and S1 to *on*. Set up a signal generator for a 1550-kc modulated output and connect the generator to J1. Adjust L4 for maximum signal from the receiver. Use a low-level signal from the generator to prevent overload. Set up the signal generator for an unmodulated 1550-kc signal and set S1 to *BFO*. Adjust L3 for zero beat with R10 at midrange. Rotate R10 and make sure that the BFO pitch can be varied on both sides of zero beat. Set S1 to *off*, and plug in the 80-meter coils.

For easier alignment of the 80-meter coils adjust the screw of L2A so it is ¾-in. out of the top of the coil bushing. Adjust L1A's tuning screw so it is 1/16-in. out of the top of bushing. Set C1A and C9A at maximum capacitance.

Turn S1 *on*, and set up the signal generator for a modulated RF output. Set the trimmer capacitors on all coils to near maximum ca-

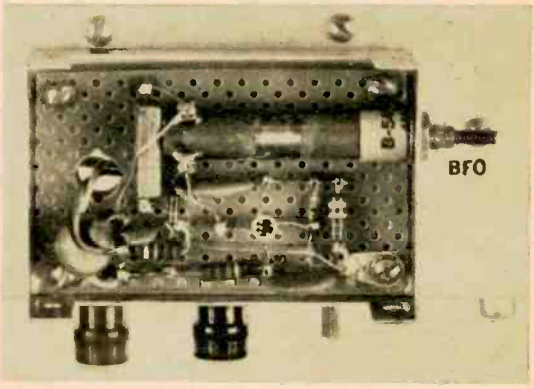
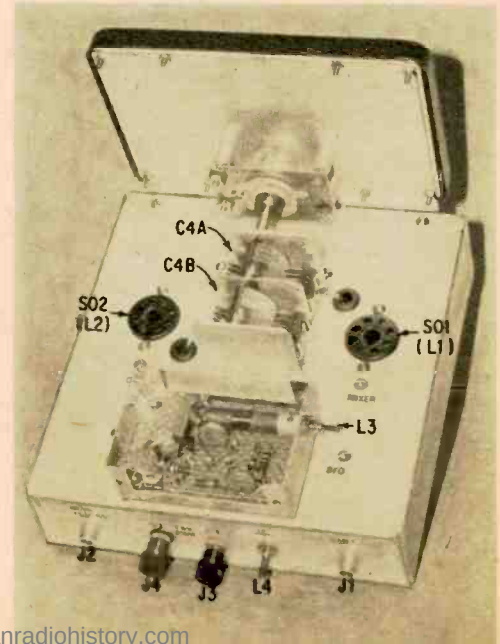


Fig. 4—Note in top view of our model the location of BFO box at rear of chassis. Dial specified in Parts List is different from dial here.



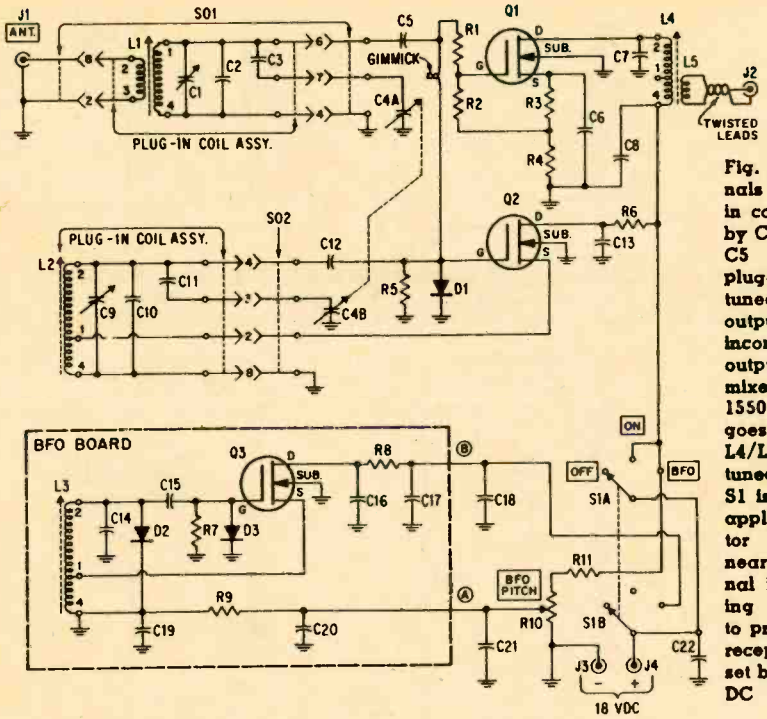


Fig. 5—Incoming signals are fed to L1 plug-in coil assembly, tuned by C4A and coupled by C5 to Q1's gate. L2 plug-in coil assembly is tuned by C4B so Q2's output is 1550 kc above incoming signal. Q2's output is coupled to mixer Q1 via gimmick. 1550-kc output of Q1 goes from Q1's drain to L4/L5 and J2 to radio tuned to 1550 kc. When S1 is set to BFO, DC is applied to BFO oscillator Q3. Q3 oscillates near 1550 kc IF. Signal is coupled by wiring capacitance to Q1 to produce tone for CW reception. BFO pitch is set by R10 which varies DC to varactor D2.

PARTS LIST

Capacitors: disc, 50 V or higher unless otherwise indicated

C1A to C1F, C9A to C9F—4-40 $\mu\mu$f trimmer capacitor (Arco 422, Allied 43 D 7079. 23¢ plus postage, not listed in catalog

C2A,C2B,C5,C10A,C10B,C12—100 $\mu\mu$f type NPO (Allied 43 D 9972. 15¢ plus postage, not listed in catalog)

C2C,C2D,C10C,C10D,C15—47 $\mu\mu$f type NPO (Allied 43 D 9968. 15¢ plus postage, not listed in catalog)

C3A,C11A—22 $\mu\mu$f type NPO (Allied 43 D 9964. 15¢ plus postage, not listed in catalog)

C3B,C11B—10 $\mu\mu$f type NPO (Allied 43 D 9961. 15¢ plus postage, not listed in catalog)

C4—6.6-22.7 $\mu\mu$f two-gang variable capacitor (J. W. Miller 1461-2. J. W. Miller Coil Co., 19070 Reyes Ave., P.O. Box 5825, Compton, Calif. 90224 $3.18)

C7,C14—380 $\mu\mu$f mica

C8,C13,C16,C17,C21,C22—5,000 $\mu\mu$f

C18,C19,C20—1,000 $\mu\mu$f

D1,D3—1N914 diode (Sylvania)

D2—HEP-158 diode (Motorola)

J1,J2—Phono jack

J3,J4—Insulated binding post

L1A—1.7-5.5 mc antenna coil (J. W. Miller B-5495-A, Lafayette 34 E 87147)

L1B,L1D,L1E,L1F—12-36 mc antenna coil (J. W. Miller D-5495-A, Lafayette 34 E 87204)

L1C—5-15 mc antenna coil (J. W. Miller C-5495-A, Lafayette 34 E 87519)

L2A,L3,L4—455-kc tapped oscillator coil (J. W. Miller B-5496-C, Lafayette 34 E 88188)

L2B,L2D,L2E,L2F—12-36 mc tapped oscillator coil (J. W. Miller D-5496-C, Lafayette 34 E 87238)

L2C—5-15 mc tapped oscillator coil (J. W. Miller C-5496-C, Lafayette 34 E 87196)

L5—Two turns No. 22 hookup wire wound on L4 (see text)

Q1,Q2,Q3—3N128 field-effect transistor (RCA)

Resistors: ½ watt, 10% unless otherwise indicated

R1—12 ohms

R2—180,000 ohms

R3,R4—680 ohms

R5,R7,R9—22,000 ohms

R6,R8—220 ohms

R10—5,000 ohm linear-taper potentiometer

R11—4,700 ohms

S1—Two-pole, three-position rotary switch (Centralab PA-1003 five-position switch used: Allied 56 A 5066)

SO1,SO2—Octal tube socket

Misc.—Vernier dial (Lafayette 99 E 25678), 7 x 7 x 2-in. aluminum chassis, 3¼ x 2⅛ x 1⅛-in. box chassis (LMB J-872), perforated board, push-in terminals, octal tube bases.

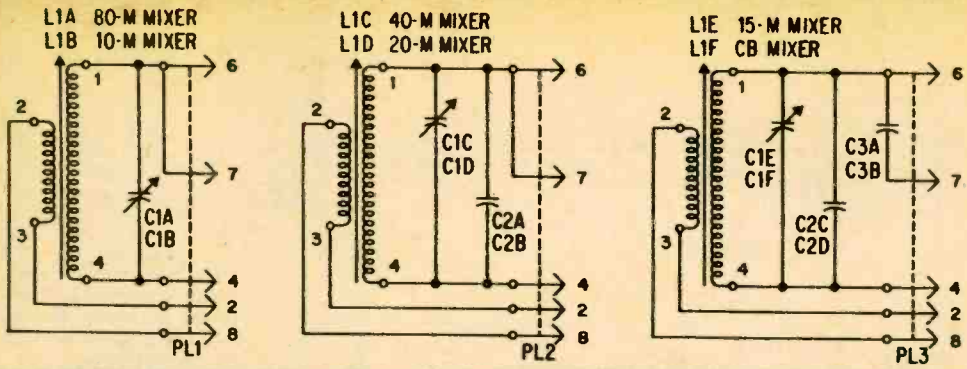
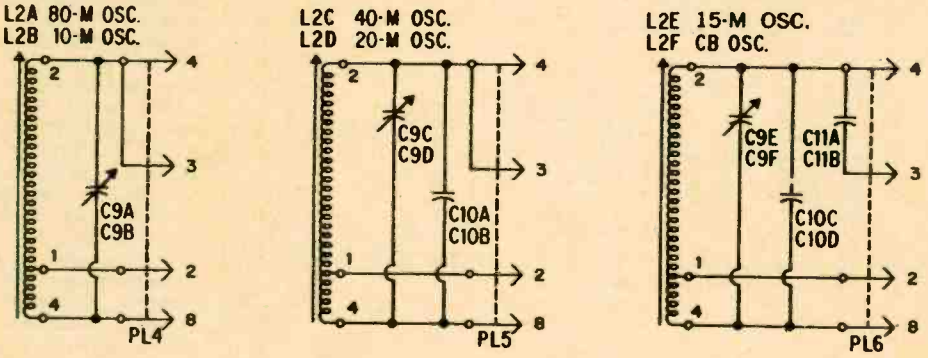


Fig. 6—Group coil parts as follows. Mixers: 80 m. (C1A,L1A), 10 m. (C1B,L1B), 40 m. (C1C,C2A,L1C), 20 m. (C1D,C2B,L1D), 15 m. (C1E,C2C,C3A,L1E), CB (C1F,C2D,C3B,L1F). Oscillators: 80 m. (C9A,L2A), 10 m. (C9B, L2B), 40 m. (C9C,C10A,L2C), 20 m. (C9D,C10B,L2D), 15 m. (C9E,C10C,C11A,L2E), CB (C9F,C10D,C11B,L2F).



pacitance. Align each set of coils as described in the Alignment Table and calibrate the dial after each set of coils is aligned. After coil alignment, place a drop of clear cement on the screw of each coil and trimmer.

Operation

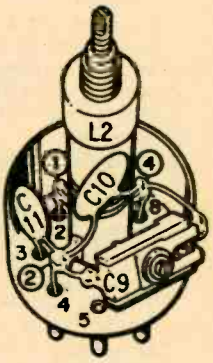
For best reception you will need a good

[*Continued on page* 100]

ALIGNMENT TABLE				
Step	Sig. gen. freq. (mc)	C4 setting	Adj. for max. sig.	Repeat steps
1	3.5	Near max. cap.	L1A,L2A	
2	4.0	Near min. cap.	C1A,C9A	
3				1,2
4	7.0	Near max. cap.	L1C,L2C	
5	7.3	Near min. cap.	C1C,C9C	
6				4,5
7	14.0	Near max. cap.	L1D,L2D	
8	14.3	¾ cap.	C1D,C9D	
9				7,8
10	21.0	Near max. cap.	L1E,L2E	
11	21.45	Near min. cap.	C1E,C9E	
12				10,11
13	28.0	Near max. cap.	L1B,L2B	
14	29.7	Near min. cap.	C1B,C9B	
15				13,14
16	26.965	Near max. cap.	L1F,L2F	
17	27.255	Near min. cap.	C1F,C9F	
18				16,17

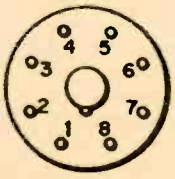
Note: After steps 3,6,9,12,15 and 18 calibrate the dial with the signal generator.

Fig. 7—At right are cutaway views of most complicated coil assemblies. If you get these right, others will be easy. Letter designations after part numbers have been omitted to save space. (For example, on coil L2E, C9 is actually C9E.) Trimmer capacitors are shown off to side so as not to obscure connections. Actually they fit between coil and tube base at about 45° angle. PL1-PL12 are bases from octal tubes.

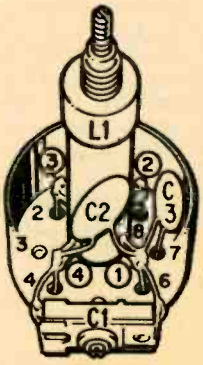


L2E, L2F

L1-L4
(FROM LUG END)



PL1-PL12
(BOTTOM VIEW)



L1E, L1F

New designs coming at you for 1970 include (from left to right) the Dual 1219 automatic turntable, a stereo FM receiver from Acoustic Research and Pioneer's T-600 solid-state tape deck.

Stereo '70

A convenience market goes full steam ahead—and cassettes will reign supreme.

By ROBERT ANGUS MARK 1970 down as the year when everybody had a $249 stereo receiver, when each 100-watt rig seemed exactly like every other, and when manufacturers altogether stopped telling you what was under the hood of your 1970 tuner, tape recorder, stereo compact or amplifier. Chances are you couldn't tell one brand from another unless you looked closely.

What's Here. Does that mean that the breakthroughs in stereo pickup or electronic circuits are all behind us, that there's really nothing new under the audio sun? The answer is an emphatic no. To cite just a few examples: omnidirectional speakers, electronic (varactor) tuning, the made-in-Japan label on equipment, separate amplifier inputs and outputs for reel-to-reel decks and cartridge or cassette players and a greater interest in bigger speakers.

Nowhere is the contrast between look-alike styling and innovative ideas more evident than in the stereo receiver—the hottest single component on the market (it forms the heart of some 85 per cent of all stereo rigs sold last year). During 1969, such traditional component manufacturers as Fisher, Scott, Harman-Kardon, Sherwood and others found their products sharing dealers' shelves with names like Nivico, Sansui, Pioneer, Hitachi, Kenwood, Denon and others.

The Japanese landed with receivers which looked suspiciously like the domestic variety and like each other. To compete, some American manufacturers—Harman-Kardon and Marantz, in particular—began manufacturing some of their products in Japan. Though the products were engineered and designed in the U.S. they looked like the invaders.

However, the careful shopper will notice some significant differences. Nivico and Panasonic offer receivers which break up the audio spectrum into sections. The audiophile can boost bass and treble to compensate for a lack in his speakers or he can insert a definite peak at, say, 2,000 cps without affecting the rest of the playback curve.

In general, the Japanese have concentrated on performance, trying to do as well as or better than their American counterpart. While there have been few technical innovations (one exception is Hitachi's acoustic-feedback receiver-speaker combination), manufacturers like Nivico and Panasonic have come up with equipment which looks good, is convenient to operate and performs well for the price.

The variable-capacitance diode, or varactor, has made an appearance in several American receivers (including Fisher and Bogen). Automatic push-button and remote-control tuning are said to be its main advantages. Most experts agree that it does nothing to improve fidelity. Still, it can make life easier for the listener by helping him find a station without his getting out of an armchair, or by enabling him to quickly switch

Electronic tuning has arrived—in stereo receivers, at least. These are first: Bogen DB240 (upper left), Fisher 500-TX (left) and Kenwood KR-7070 (above).

Stereo '70

back and forth among several stations.

Bogen is responsible for two other ideas: sliding volume and tone controls (the type used on studio consoles) and a Crescendo Control, an electronic sound expander and compressor built into the circuit of their BR-360 receiver. Though Bogen is the first manufacturer to incorporate such a noise suppression system, it's expected that several models to be introduced later this year will include a similar device.

The Bose speaker system kicked off two trends—one toward omnidirectional speakers, as well as a renewed interest in big loudspeaker systems. Since the Bose reflective system proved highly successful with hard-to-please audiophiles, manufacturers like Harman-Kardon, Scott, Wharfedale, University and others speeded up their own work on omnidirectional speakers so as to produce a wide choice of bookshelf models.

The introduction of four-channel stereo has sparked interest in omnis. Instead of spraying sound out into the room like a flashlight beam, as do conventional bookshelf loudspeakers, omnis diffuse it to provide stereo sound anywhere in the listening room. This diffusion is said to make four-channel sound more natural and spread it more evenly throughout the room.

Though the Bose system isn't a big loudspeaker, its use with full-sized woofers has caused audiophiles to take another look at the speakers of James B. Lansing, Electro-Voice and such relative newcomers as Peploe and L. W. Erath. Peploe Electronics, which recently purchased the firm that manufactures the Janszen electrostatic loudspeaker, is offering a combination cone woofer and electrostatic midrange/tweeter in a variety of cabinets.

The Japanese are eyeing the loudspeaker market, too. However, you'll find no technical innovations (with the possible exception of Nivico's spherical speaker), just solid engineering and workmanship—and good sound.

Record-playing equipment has shown no strides, either technical or for convenience. You can buy a Pickering cartridge for $9.95 or $65. Shure and Empire offer you a similar model with similar performance characteristics for exactly the same price. You can buy a Garrard for $44.95, $79.95 or $99.95—and a Dual or BSR for approximately the same amount. What has happened is that the prospective buyer has a wider choice of models and prices than ever before. There are some new manual turntables from companies like Empire, Hitachi, Kenwood, Nivico, Sony and Toshiba. The prices and quality are high, but they offer few features not already available.

The tape field is a mass of conflicting trends. On the one hand, manufacturers are having trouble keeping up with the demand for cassette recorders—both the low-cost portable units and quality decks for the living room and automobile—and yet, despite the promise of automatic changing, Dolby noise-reduction circuits, automatic reverse and other such features, the *super* cassette (hi-fi quality) has failed to materialize and new entries have contented themselves with offering the consumer a wider

The stereo compact is most convenient item in a convenience market. At right is Scott Model 2513 compact which includes a Dual turntable plus Scott AM/FM receiver and two speakers. This system costs $399.95.

choice in styling, size and price. One notable exception may prove to be a cassette deck and Noise-Reduction Center soon to be marketed by the Advent Corp. under a license granted by the Dolby Laboratories, Inc.

It's also possible that a good cassette changer will appear this year, that more than one manufacturer will offer automatic-reverse cassette players and that there may be a four-channel stereo cassette unit. Though it was announced last year, the eight-track cartridge changer isn't a reality yet and it may not be one this year, either.

While all this activity has been going on at the medium-fi level, more tape buyers are turning to expensive tape recorders for features like automatic reverse, self-threading, or for the guarantee of ultimate fidelity and trouble-free operation. Such performance brings to mind super decks like the Revox A-77 and Tandberg 1600X, both of which sell for $495. Other advertised features include Dolby circuitry and four-channel operation.

As various tape systems compete some general battle lines are emerging. Four-track cartridges, the system which started it all, have become something of a relic; they account for less than 10 per cent of all tape units sold and are bought mainly by teenagers on a budget. Eight-track, which has largely replaced the earlier format, dominates the dashboard market but has yet to make serious inroads on the carry-along trade or in the living room.

Portable players, by a margin of more than four to one, are likely to be cassette recorders. The cassettes, in fact, have long since driven low-cost portable reel recorders off the market (the only reel portables left are special-purpose units like the Uher 4000-L or the Nagra). In the living room, reel-to-reel recorders still rule the roost, with cassette decks gradually replacing the less expensive models. It seems likely that by this time next year, you may have trouble finding a reel tape deck priced under $150; there'll be plenty of cassette models instead.

Finally, there's the Cinderella of hi-fi, the stereo compact. All sorts of manufacturers are in this field; differences are reflected in part by price, but even more by less visible indicators such as power rating, type of cartridge, loudspeaker complement and quality of record changer. Since component producers like Garrard, BSR and Dual now offer changers in a wide variety of prices, it's possible for a manufacturer to use an inexpensive Garrard which at first glance looks much like a higher-priced Garrard in a better compact. So brand names won't always help you.

The problem for the hi-fi shopper is that traditional phonograph manufacturers have improved their products tremendously, while component manufacturers have been lifting their styling ideas to make products look better, at the same time effecting economies pioneered by the mass producers. This narrows the price gap between a good phonograph and an inexpensive component compact.

What's To Come. As for the revolution in sound that audiophiles keep hoping for, it may be here via four-channel stereo (see 4-CHANNEL STEREO in May '70 EI),

[*Continued on page* 103]

CB Corner

By Len Buckwalter, KQA5012

The Battle Over Channel 9

CITIZENS Band radio may lay its biggest egg if channel 9 is finally reserved for distress calls only. So say the critics as the FCC dickers over whether to limit 9 to emergency and assistance use. CB boosters, on the other hand, believe the egg will be golden. Though the final outcome is a year or so away, here's how the battle lines appear to be forming.

Mayday, maybe. Channel 9 is already recognized as an unofficial emergency channel, but it's an unreliable one because of man-made interference. A new 9 would certainly have to silence the chatter to be viable. The channel somehow must remain clear to be workable; this is an important reason why the FCC has hesitated so long in making it a special channel. The Commission would create for itself an obligation to enforce the rule since lives and property would hang in the balance.

This could have awesome complications. For example, you have an auto accident and want to summon an ambulance for an injured victim. You call on 9, but cannot get the message through because of chit-chat on the frequency. The victim dies and a suit is brought against the FCC because it failed to maintain 9 as an unobstructed emergency channel. Far-fetched? Maybe not. Air-crash victims have successfully sued the U.S. because blame could be attributed to the FAA's air-traffic control system.

Guard Duty. The channel must be guarded after interference has been silenced, meaning that someone must be listening continuously for calls. This now is done on international distress channels (500 kc for ships and 243 mc for military aircraft). Such frequencies are monitored officially and an emergency call brings a prompt, professional answer. Let's see who'll shoulder the responsibility for CB.

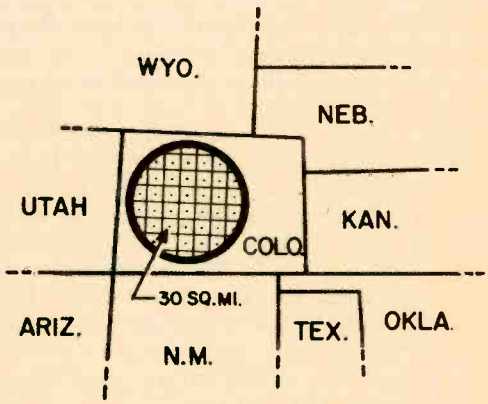
Optimists believe that once channel 9 is clear of blather, officials (police, civil defense, etc.) would install CB rigs alongside other monitoring receivers. This has already shown some promise when tried by highway agencies and local CBers didn't clobber the channel.

But even with such monitors, there's still the range problem. Almost every other mobile service outdistances CB because of its greater power or higher antennas. CB range from a car to base station is at most 15 mi., which could leave gaping holes in its coverage over the nation. For an emergency system to win widespread confidence the service should respond anywhere. According to our calculations (see map) it would take about 3,000 monitoring stations to guard the continental U.S.

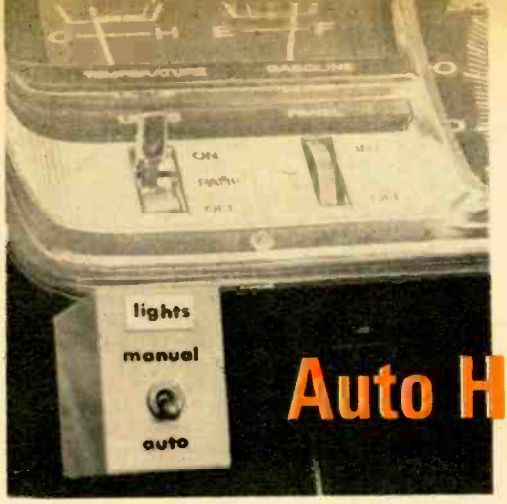
The REACT organization has plenty of CB volunteers to man listening posts. But the obstacles are still imposing. Maintaining a reliable 24-hour radio watch in the homes of CBers could prove too tedious.

Another problem is effective control. A distress situation is sometimes made worse by anxious eavesdroppers who jump on the air and want to help out. As you may suspect, distress traffic must be tightly controlled to dispatch help with the least delay.

Those are the challenges of channel 9. After years of widespread clamor for official recognition of 9, the final chapter is just about here. It could deliver CB another sorry setback or render the greatest boost to Good Samaritanism the country has ever witnessed.



Circle which zeros in on Colorado shows how channel-9 monitoring system might work on nationwide basis. Each dot represents one CB station.



By GEORGE J. WHALEN and RUDOLF F. GRAF

Auto Headlight Shutoff

YOU pull into your garage, turn off the engine and lights then close the garage door. Enveloped in total darkness you take out your keys, stumble over the garbage cans, almost break your neck on your kids skates then fumble for the keyhole in the door to the house.

Happened too many times? Probably, and we'd guess that every time it did you wished your parking lights or headlights would stay on for another minute or after you'd gotten out of the car so that you can safely find the keyhole without fumbling. This can now be done with our Auto Headlight Shutoff. After a predetermined time it will automatically turn your headlights off after you've entered the house.

Looking at it another way, the Shutoff will automatically turn off your car's lights should *you forget* to do so. This happens often on foggy or gray mornings when you put on your lights to drive to work. Forget to turn them off after you arrive and you'll discover your battery's dead as a doornail when you start the car to go home. The Shutoff will turn off your lights automatically about one minute (or whatever time you choose) after you turn off the engine.

How It Works. The Shutoff consists of a Darlington switch (Q1, Q2 and Q3 that controls the operation of relay RY1. Separate sets of contacts on RY1 are connected in series with the wires to the headlights and parking lights. Operating power for the Shutoff is obtained from car's light wires via diodes SR1 and SR2 so that unit will operate either when the car's headlights or parking lights are on.

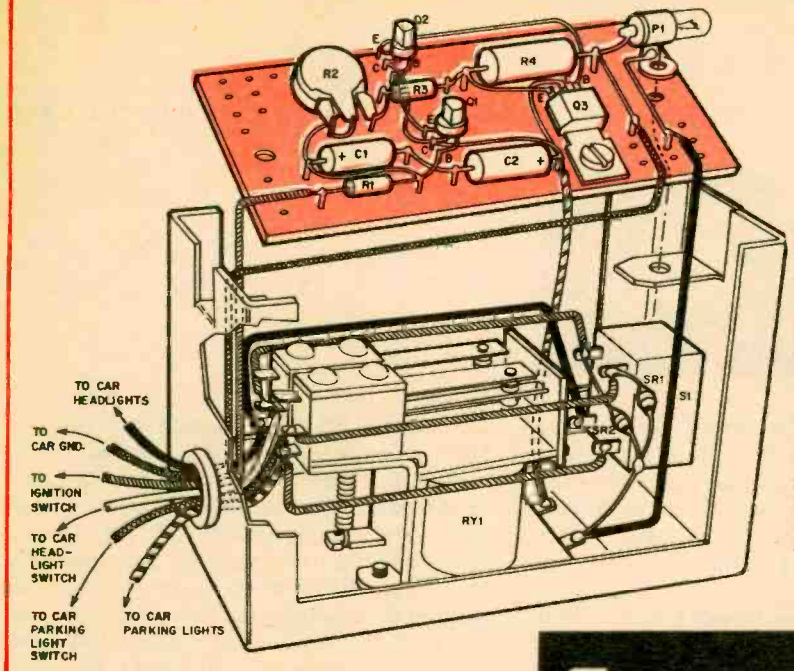
The Darlington switch has two inputs: an *arming* input via R1 from the ignition switch and an *initiate* input obtained from the car's light switch. When the ignition switch is *on*, Q1 is forward biased by R1. However, RY1 cannot close until the car's light switch is set to the parking or headlight position. If the car's light switch remains off, the Shutoff remains in the armed state but is inoperative. If the car's light switch is set to either the parking or headlight position while the unit is armed, Q1, Q2 and Q3 conduct and close RY1. Power to the selected lights is then furnished via the closed contacts of RY1.

When the ignition switch is turned *off*, the arming input is lost. However, the charge on C1 and C2 holds Q1, Q2 and Q3 forward biased, maintaining RY1 closed. The discharge path for C1 and C2 is several megohms, due to the high input resistance of Q1, Q2, Q3 and the high resistance of R2 and R3 and the positive opposing voltage across R4.

Thus, the charge on C1 and C2 leaks off at a rate determined by the setting of R2. The Darlington switch holds RY1 closed until C1 and C2 discharge to about 1.8 V from 12 V. This period can range from 15 seconds to 5 minutes, depending on the setting of R2.

Assuming that the car's light switch *has* been left in either *on* position, the Shutoff will open the lamp circuits after the delay. (If the light switch *had* been moved to off when the ignition switch was turned *off*, RY1 would open immediately.)

The Shutoff will allow limited operation of the headlights or parking lights without the ignition switch being turned on. However, to make the setup tamper-proof and child-proof, light operation is limited to one delayed *on* period, after which the light switch would have to be set to *off* for a period of about three times the *on* time of



In bottom of main section of Minibox mount relay and switch. At top edge, cut tabs (which support board) and bend them in. All parts are mounted on 1¾ x 3¾-in. perforated board. Follow line patterns on wires at left to be sure you get connections correct. Wires to car's light switch and to lights should be No. 16.

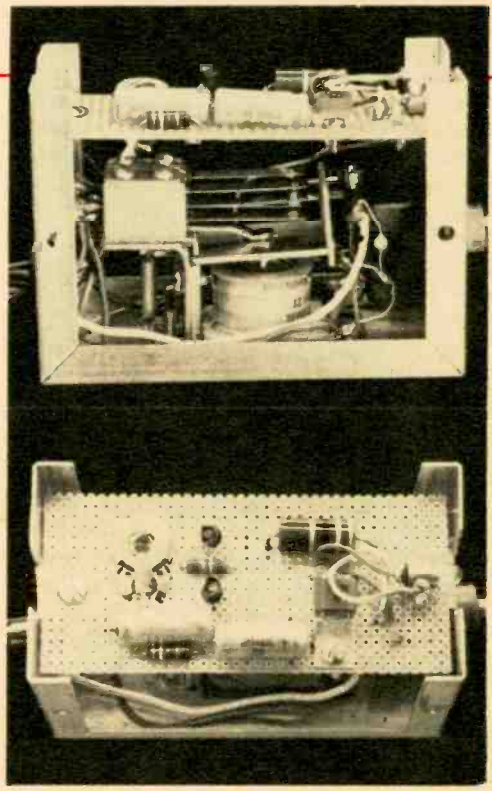
Auto Headlight Shutoff

the circuit before the Shutoff would again allow such operation. Or, the ignition switch would have to be turned on.

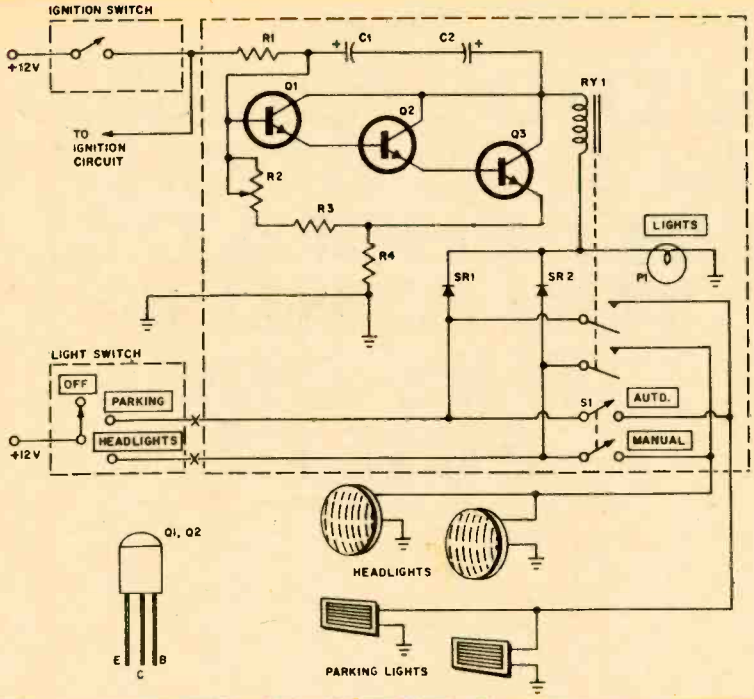
Operation of the circuit under these ignition-off conditions is as follows: when the car's light switch is set to *on* (either parking or headlights), a voltage is coupled to the base of Q1 through the coil of RY1, C1 and C2. This voltage holds the Darlington switch in conduction and puts a 12-V charge on C1 and C2. This charge holds the Darlington switch forward-biased for the period determined by R2, thus holding RY1 closed and applying power to the selected lights.

At the end of the delay RY1 opens, and turns off the car's lights. Capacitors C1 and C2 now charge in a direction which reverse biases Q1, Q2 and Q3. Unless either the ignition switch is turned *off* and allowed to remain off for about three times the *on* time of the circuit, the Shutoff cannot be re-triggered using the car's light switch alone.

Construction. The Shutoff is built on a 1¾ x 3¾-in. piece of perforated board which is mounted in the top of the main sec-



Top photo is side view of Shutoff. Note how circuit board is mounted over relay. Bottom view shows mounting of parts on circuit board; wiring is under board. Solder leads to pilot light.



Schematic. Parts enclosed in dashed lines are mounted on circuit board. Wires from car's lights marked with X must be broken and connected to Shutoff. Capacitors C1 and C2 are connected back to back to form non-polarized capacitor. Don't substitute a single electrolytic for them.

SHUTOFF FUNCTIONS			
Ignition Switch	Car Light Switch	Light Condition (*)	Remarks
Off	Off	Off	
Off	On (first time)	On then off	Shutoff will turn on lights for one delay period. If ignition switch is not turned on, Shutoff will time-out and turn off lights to save battery.
On	On	On	Shutoff pulls in and holds due to continuous input from ignition switch.
Off	On	On then off	Shutoff remains pulled in after ignition switch is turned off for a period of one time delay. After delay, Shutoff turns off lights. Lights cannot be turned back on with headlight switch alone for about three times the time delay. Shutoff requires input from ignition switch; this makes operation tamper proof.

Note: Manual/automatic switch provides operating safeguard against unpredictable failure. Switch removes Shutoff from car's light circuit.

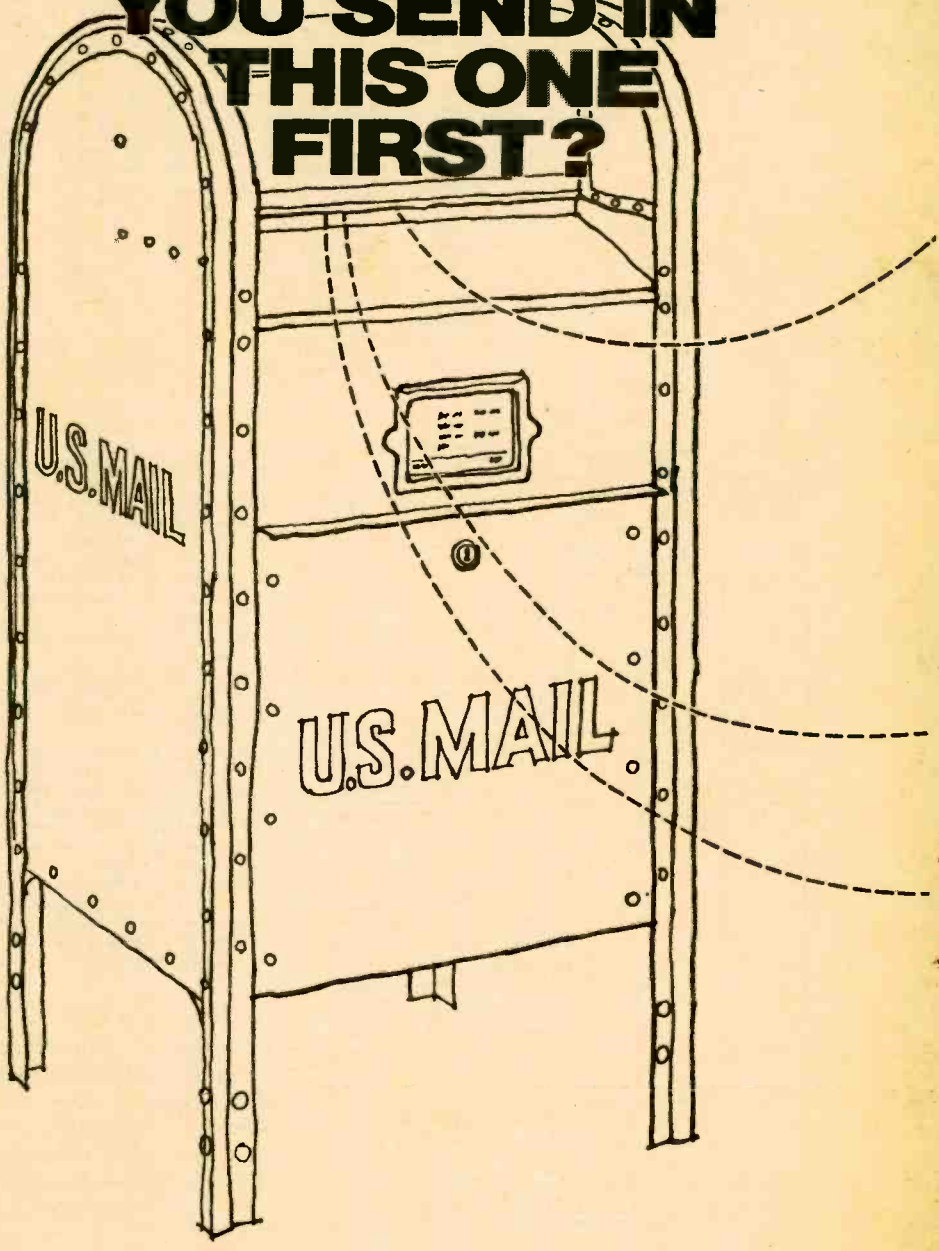
* Applies to either parking or headlights, depending on car's light switch position.

PARTS LIST

C1, C2—25 μf, 50 V electrolytic capacitor
P1—12-V miniature pilot lamp (GE miniature type 330 or equiv.)
Q1, Q2—2N2926 transistor (GE, Newark Electronics Corp., 500 N. Pulaski Rd., Chicago, Ill. 60624. 25¢ plus postage, $5 minimum order)
Q3—D27C1 transistor (GE, Newark, $1.44 plus postage)
R1—3,900 ohm, ½ watt, 10% resistor
R2—3.5 megohm printed-circuit potentiometer (Mallory MTC-355L4, Lafayette 33 E 16643 or equiv.)
R3—15,000 ohm, ½ watt, 10% resistor
R4—33 ohm, 2 watt, 10% resistor
RY1—12 VDC relay, 200-ohm coil, 8-A DPDT contacts (coil assembly: Guardian 200-12D, Allied 41 A 5710. Switch contact assembly: Guardian 200-2, Allied 41 A 5708)
S1—DPST switch
SR1—Silicon rectifier; minimum ratings: 1 A, 200 PIV, Motorola HEP-156 or equiv.
Misc.—4 x 2 x 2¾-in. box chassis (LMB Type T-F776, Newark 91F1038; $1 plus postage), perforated board

tion of a 4 x 2 x 2¾-in. Minibox as shown. The relay is mounted on the bottom. The board is held in place over the relay by screws fastened onto lips formed by bending over two small strips cut from the sides of the case. Mount switch S1 on the front side of the case below the pilot light. The unit can be mounted anywhere under the dash.

WITH ALL THE POSTCARDS IN THIS BOOK, WHY SHOULD YOU SEND IN THIS ONE FIRST?



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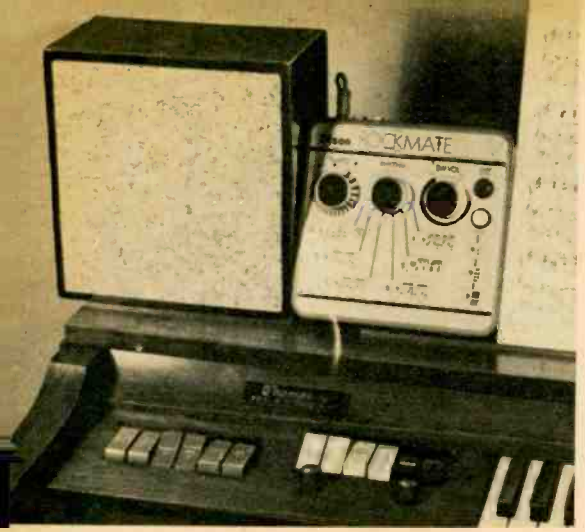


Sideman's Sideman

By LESLIE POWELL

AS ENJOYABLE as it is to play a musical instrument, it is even more fun when you play along with others. Since it isn't always easy to get a group together for a practice session, do the next best thing—prop a rhythm generator (sideman) on top of your piano or organ—or next to your guitar—and go to it. While you play, the sideman will lay down a steady beat on the bass drum, snare and high hat.

Inexpensive rhythm generators that you can use for this purpose are the Olson X-92 *Rockmate* (shown above), the Lafayette 99 H 90102 *Rockbeat* and the Knight-Kit KG-392 *Combo Sideman*. But you won't hear anything from these sidemen alone. They, too, need a sideman—an amplifier and speaker such as our Sideman's Sideman.

Normally, a rhythm generator would feed a large powerful amplifier so that the bass drum would have solid *boom* sound. But you don't need 100 watts and multiple 12-in. speakers while you're sitting alone at the piano. An 8-in. speaker and the IC amplifier used in our Sideman's Sideman gives plenty of sock for solo practice sessions.

The entire amplifier is a single IC which provides preamp, driver and up to 5 watts output from a package about half the size of your thumb. The amplifier construction is trouble-free because it is assembled on a printed-circuit board. The only components external to the board are the speaker and power transformer.

Construction. First step is to build the amplifier. Cut a 3¾ x 4½-in. piece of copper-clad board. Scrub the copper clean with a household cleanser such as Ajax and place a piece of carbon paper over the foil, carbon side toward the foil. Slip the board and carbon under the foil template shown in Fig. 4 and using a ball-point, trace the *outline* of the copper foil areas. Then, using an ice pick or similar pointed instrument, indent the foil at the hole locations by pressing the pick through the template into the foil. Remove the template and carbon and, using a resist ink pen, fill in the spaces inside the outlines on the foil. Also place a drop of resist at the mounting hole locations in the corners. Immerse the board in etchant solution for approximately 20 minutes, agitating frequently. Check the foil. If all the unwanted copper foil is etched away, rinse the board under running water for two minutes and scrub off the resist with steel wool. Finally, scrub the board with a cleanser and rinse the board thoroughly. (If the excess copper has not been etched away after 20 minutes, immerse

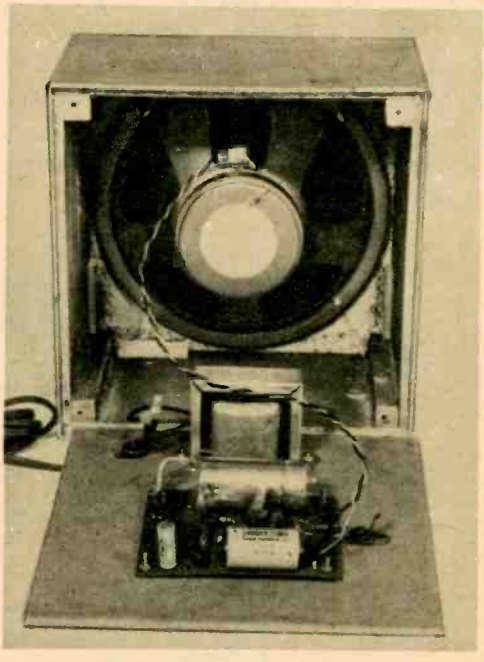


Fig. 1—Inside of our model. Mount circuit board on rear of cabinet with ¼-in. spacers. Power transformer is below, input jack is at the right.

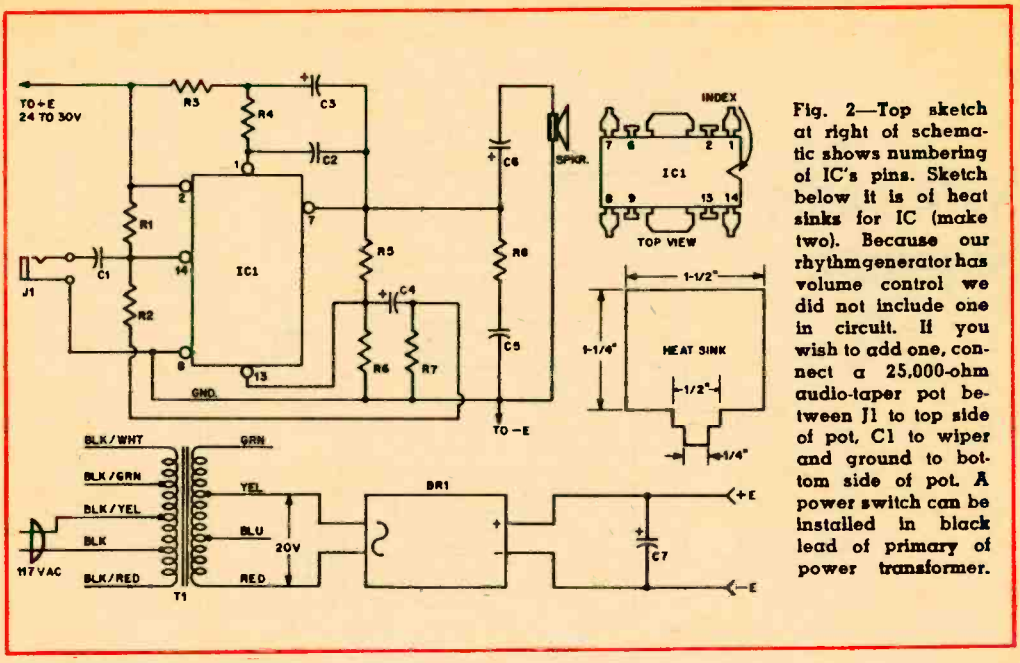


Fig. 2—Top sketch at right of schematic shows numbering of IC's pins. Sketch below it is of heat sinks for IC (make two). Because our rhythm generator has volume control we did not include one in circuit. If you wish to add one, connect a 25,000-ohm audio-taper pot between J1 to top side of pot, C1 to wiper and ground to bottom side of pot. A power switch can be installed in black lead of primary of power transformer.

the board in the etchant again for one minute intervals until all the excess copper has been removed.)

Most of the component holes are drilled with a No. 57 drill bit, but a larger bit will probably have to be used for C7's leads. Connections are made to the board with Vector T-28 push-in terminals (soldered to the foil) which require a No. 50 drill bit. The two slots for the IC's heat sink tabs are cut by drilling a series of very close-spaced holes with a No. 57 drill bit and then filing the holes into a slot. The corner mounting holes should be large enough to clear a No. 4 or No. 6 mounting screw.

Cut the heat sinks for the IC from a tin can following the template shown in Fig. 2. They are installed when the IC is installed.

Mount all the components except IC1 and BR1 (bridge rectifier), then mount BR1. Note that BR1 has a symbol on one edge indicating the AC input and + and − marks or the other edge indicating the DC output. Make certain the symbol side faces up, with the ∼ symbol facing the edge of the push-in terminals (towards the edge of the board). Integrated circuit IC1 must be mounted correctly the first time, or else. The terminals are pre-shaped so there should be no confusion over which side is down. However, make certain the small notch at one end of IC1's body *faces the center of the board* and not the edge of the board.

PARTS LIST

BR1—Full-wave bridge rectifier; minimum ratings: 50 PIV, 500 ma. (Motorola HEP-175)

Capacitors:

C1—.1 μf, 75 V tubular
C2—.001 μf, 75 V tubular
C3—50 μf, 25 V electrolytic
C4—6 μf, 15 V electrolytic
C5—.05 μf, 75 V disc
C6—500 μf, 25 V electrolytic
C7—3,000 μf, 30 V electrolytic
*IC1—PA246 IC amplifier (GE)
J1—Phone jack

Resistors: ½ watt, 10% unless otherwise indicated

R1—750,000 ohms, 5% R2—75,000 ohms, 5%
R3—1,000 ohms R4—18,000 ohms
R5—330,000 ohms R6—82,000 ohms
R7—6,800 ohms R8—22 ohms
SPKR.—8-in. speaker, 16 to 40 ohms
T1—Low-voltage rectifier transformer; secondaries: 10-20 V center tapped, 40 V center tapped @ 100 ma (Allied 54 A 4732)
Misc.—Printed-circuit supplies, cabinet

*The PA246 IC is available for $6.15 plus 75¢ for postage (Canada, $1.75) from Custom Components, Box 153, Malverne, N.Y. 11565. N.Y. State residents add sales tax. No foreign orders.

While T1 is rated at 100 ma you'll get somewhat cleaner bass if T1 is rated at 200 ma or more. (Allied transformer 54A4733). The speaker should be rated 16 to 40 ohms—preferably 16 to 20 ohms. If you cannot obtain an 8-in. 16-ohm speaker, use a 6 x 9 in.

Sideman's Sideman

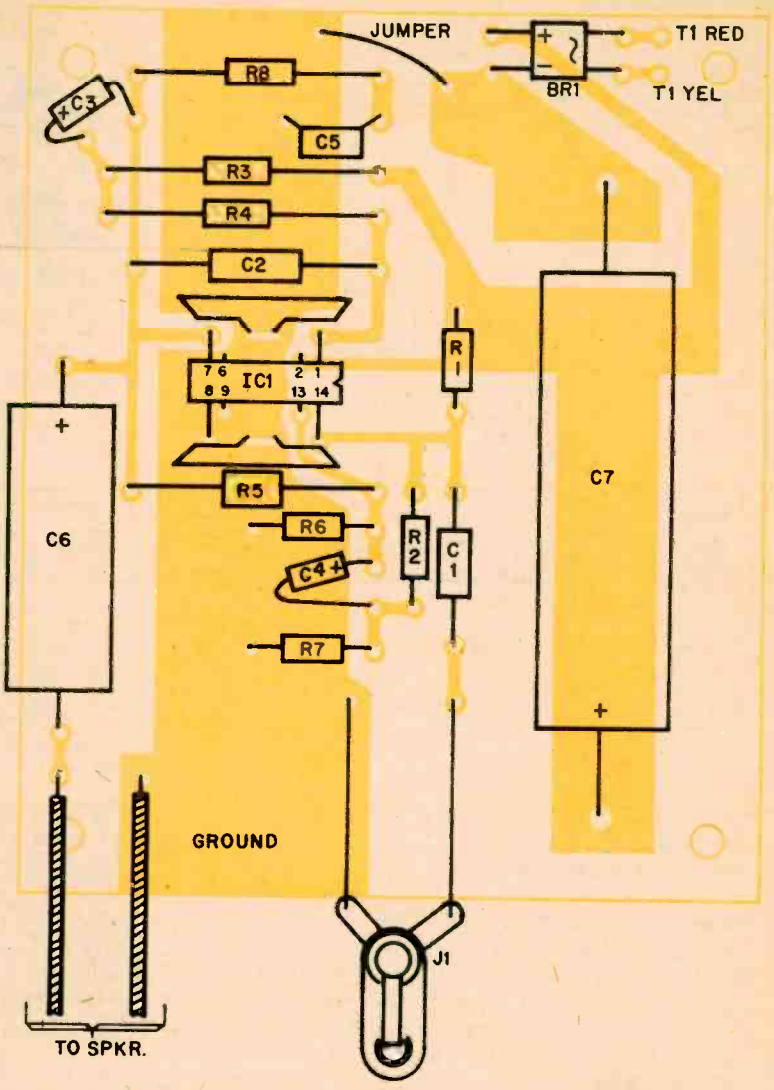
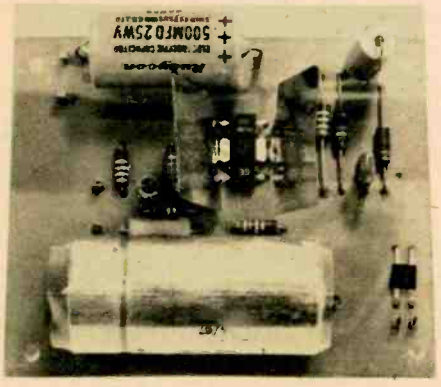


Fig. 3—Diagram (right) is an X-ray view of the board that shows the location of all parts. Capacitors C3 and C4 must be mounted vertically. Leads from power transformer are connected to push-in terminals at upper right corner. Objects above and below IC1 are heat sinks. In photo of board below you can see heat sinks more clearly. They are squeezed through slit in board with wide center tabs on heat sink and soldered to the foil.



oval (or something larger than 6 in.) of the multiple-impedance type such as a 10/20/40 ohm speaker. Use the 20 ohm terminals.

Checkout and Adjustment. As soon as power is applied you should hear a hiss from the speaker. If you fail to, kill power immediately and check for an incorrectly placed part or a short across foils.

Because of the 8-in. speaker the bass will be very weak, or nonexistent, and the high-hat and snare sounds will be very loud. Set the volume control for a low output. Then remove the sideman's cover so you can get at the internal controls. Locate (lower right corner of board when positioned as in Fig. 5) the miniature trimmer pot labeled (in

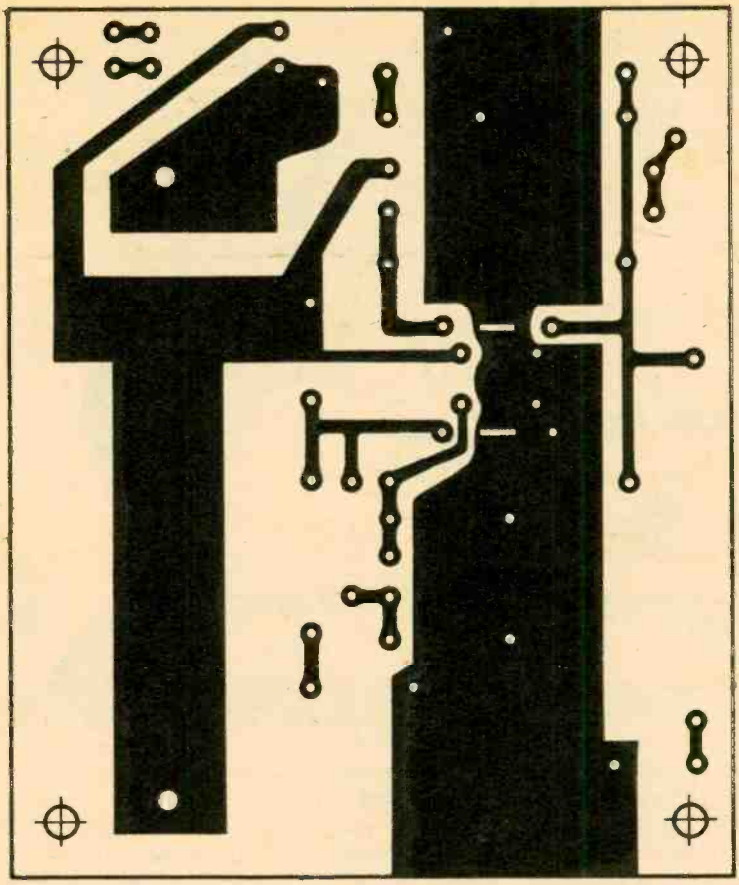


Fig. 4—Cut out this full-size template to make your circuit board. Place a piece of carbon paper (carbon side down) on foil of 3¾ x 4½-in. copper-clad board. Lay template on carbon paper then trace outline of all foils. Then using pointed tool, make indents in all circles. Succeeding steps are described in the text.

Knight-Kit) *bd len* (bass-drum length) and turn the control counterclockwise until the sideman breaks into oscillation; then back off until the oscillation just stops. Adjust the *bd pit* (bass-drum pitch) control (to the left of previous control) counterclockwise until you get a solid *thud*—not a boom sound. Don't go too far or the sound turns into a low-pitched click (like a wood block). Next, adjust the *noise* (snare drum) control (right edge of board, second pot down from top pot) in either direction until you just hear a solid snare sound. Overadjustment will produce a snare sound that drowns out the bass or a click sound—you want the rimshot sound. Then adjust the *hh vol* (high-hat volume) control (top edge of board) until you can just hear the high-hats come in under the snare sound. There is slight interaction between the controls so you will have to repeat the adjustments. Finally, adjust the *gain* pot (right edge, top control) full on—full counterclockwise.

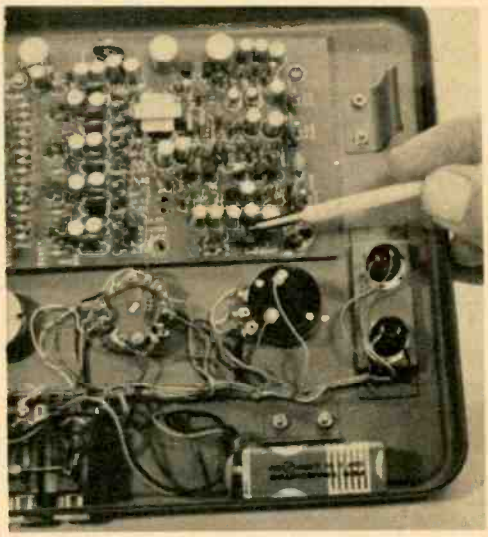
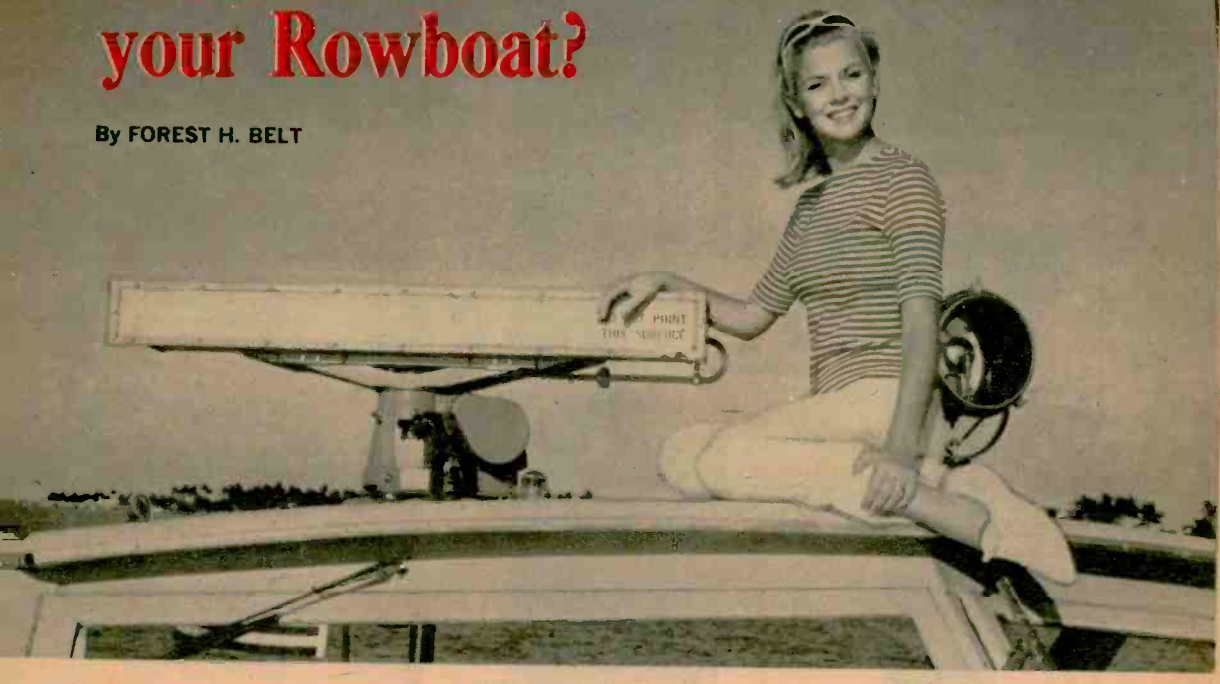


Fig. 5—Tool touches "bd pit" (bass-drum pitch) pot in Knight-Kit. To find pots in other units, position units as shown and locate as in the text.

A Radar for your Rowboat?

By FOREST H. BELT



WELL, now. Let's suppose you like the water. Problem is, what do you do with it? A little goes fine with Scotch but larger quantities—lakes, rivers, oceans—can be deep and muddy for the electronics enthusiast. Electronics is an indoor sport if ever there was one.

You say you're not enthusiastic? Take another look at the girl in the photo above (that's a radar antenna next to her) and try again. Do you think a seabird like that hovers around single-sideband transmitters? Her parents would never permit it.

Okay. Since you're passionate about electronics and girls, it's obvious you've got to move your hobby . . . or part of it . . . out-of-doors. What better place could you find than a boat?

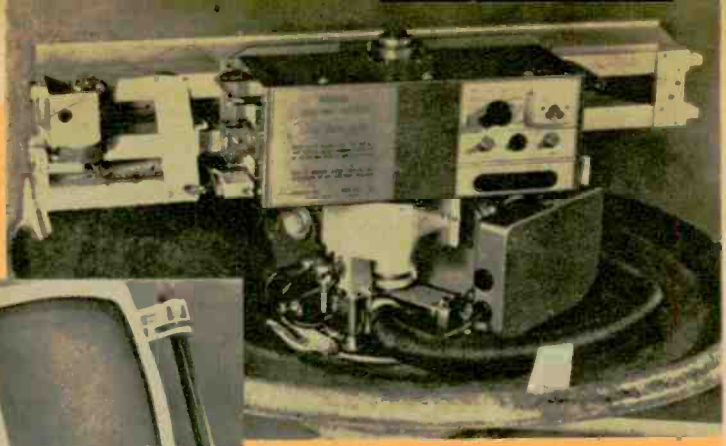
Not that you won't find some competition. According to latest figures, there are now some 8 million pleasure-boat fanatics churning up the briny deep in the United States (see EI's Special Section on Pleasure Boat Electronics in the March '70 issue) and most probably are looking for the same breed of seabird you are. Being a weekend sailor *and* an electronics buff, however, should give you an advantage. If you can combine the two interests into an exotic package, you could have more seabirds hovering about you than you can shake an anchor at.

Exotic, yes. State-of-the-art, of course! But what about the state of your bank account? If you're like most of us, and scraping rust off of old coins, a 50-ft. cruiser outfitted with electronic gear might be a bit inopportune at the moment, unless you want to use it to escape the boys from the Fed.

Should you finally decide on a rowboat, dinghy or some other unmentionable, the trick is where and how you are going to stow the glamor. Anchors run the gamut of A to C—. Girls know how to talk without benefit of a radiotelephone. Depth sounders? Like, who is interested in psychological testing out on a bright calm sea? So, how about a radar?

According to some hobbyists we know, there is a good deal of logic in spending $195 for a boat and then going blotto on a $2,800 radar. Of course, you can always mount the screen first and then add components over a 30-year period. The important thing to remember is that it's glamor we want, not sea clutter.

The annual Boat Show staged in New York's famed Coliseum is a good place to browse for a radar. There are other things



Beauty and the beast? Not really. Both packages are as compact as you could want. At left, indicator of Plessey MR-12 radar. Above, scanning antenna minus the radome.

there, too—and they come in minis, midis, maxis and bikinis. Seabirds, one and all. Many of the new small-boat radars for 1970 are just as sleek and have attracted almost as much attention. Skeptical?

Radiomarine's Model CRM-N6A-10 radar has a nifty $3,600 price tag and a design that's just as impressive. Its scanning antenna is at the left of the girl in the photo. This radar is a hybrid version—it uses transistors mostly, few tubes—and has a range of half a mile to 32 mi. (on open water).

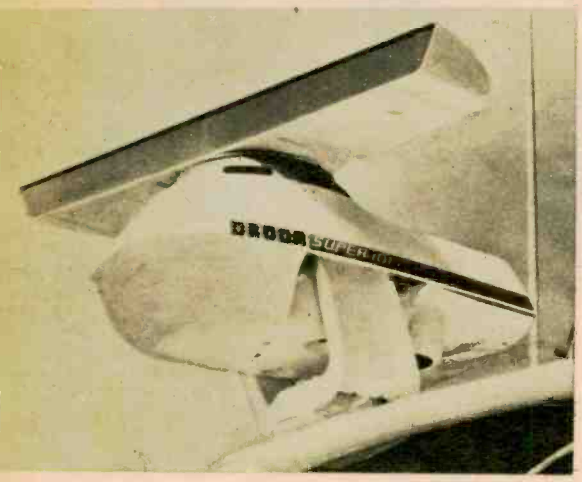
Radiomarine's transmit/receive (T/R) unit operates around 9450 mc and is stowed below decks along with a power supply which works on 32 VDC. Up on top of your craft is where you look for the scanner, an antenna which rotates and makes your boat look like an aircraft carrier.

Slotted-waveguide antennas like this one radiate short pulses of microwave energy in a narrow beam (approximately 2° wide) and then pick up the echoes between pulses. The narrower the beam, the greater the resolution of your radar, natch. This beam peaks at 10 kw during a pulse—that's how you get out to 32 mi.

Only problem is, the T/R unit connects to the scanner via a very unflexible copper pipe called a waveguide (microwave energy is usually routed through ducts similar to those found in air conditioning systems). Some of

Raytheon has it, hands-down—on the controls, at least. Going from left to right, control panels and CRT displays of Raytheon Models 2900, 2840 and 1900A hybrid pleasure-boat radars.

A Radar for your Rowboat?



Radar antennas go in circles. At left is scanner of Decca's new Super 101 radar, at the right is radome of Raytheon's 2900. Both connect to T/R unit via coaxial cable; usual microwave plumbing is absent.

the newer designs, however, are doing away with this kind of plumbing.

Raytheon's Models 1900A and 2840 have cut a pretty good figure recently. The 1900A is small, operates of a 12-V battery and costs $2,770. Perfect for the smaller boat, it has a range of half a mile to 12 mi. and concentrates 3.5-kw power in a 3° beam. Its ppi display (plan-position indicator) can be seen at the bottom of the preceding page.

The 2840, a larger hybrid rig, features control knobs shaped like cookie-cutters. When you use the hood to watch the radar screen during daylight fog, should you look up to adjust the knobs you could be blinded to the CRT display for several critical seconds. You can identify these controls by their feel, even in the dark. The 2840 sells for $5,975, so it's a fairly serious purchase. But its 20-kw beam —only 1.6° wide—can get you a range of 48 mi. That's a lot of power and you have your choice of 24 VDC or 115 VAC to turn it on.

Raytheon's newest entry, the 2900, boasts a lightweight antenna (46 lb.) which is protected by a fiberglass radome. This could prove a boon to craft that don't like being topheavy. Also a hybrid, the 2900 has a 7-kw output which gives you a range of half a mile to 32 mi. This package comes at a price, however. You've got to pour 2,850 clams into their basket for this baby.

Leave it to the British to ring the bell with a unique small-boat radar. Plessey's Model MR-12 (marketed by Benmar) is the first—and so far the only—marine radar to have a display (ppi indicator) shaped like a TV screen. Believe it or not, the controls are located in the handles on either side of the set. All this costs $2,592; maximum range is 16 mi.

One other MR-12 feature is that the T/R unit is mounted right in with the antenna (they turn together), so there is no waveguide —plumbing, that is—required to connect the two gadgets. One cable carries modulator pulses to the scanner and video (target) signals back to the indicator, along with necessary power and control voltages. Raytheon's 2900, among others, has this feature, too. It makes for a much nicer installation.

Another British firm, Decca, has a Super 101 radar which was introduced last spring. This is an updated version of the popular Model 101 so the new Super 101 is designed to bring ever better performance to small-boat operation. Again, the T/R unit is located in with the scanning mechanism.

One glance at the photo of the Super 101 scanner may be enough to convince you that you just could pick up enemy aircraft. The Super 101 costs $2,992; its hybrid circuits work on anything from 6 to 220 VDC and on 115 or 230 VAC. Maximum range is 18 mi.; the radar beam peaks at 3 kw.

Just remember installation costs are extra.

The Listener

By C. M. Stanbury II

Short-Wave Contests & Propaganda

IN recent years, short-wave contests have become a major propaganda weapon. R. Portugal annually awards three vacation trips to its sunny little realm while R. Havana, Cuba, has a similar contest going.

Late last fall Radio RSA held a DX-oriented extravaganza where SWLs were asked to hunt down some special South African frequencies. It was a fair test of tuning skill.

In addition to the two or three major prizes, most SW contests wind up dispensing a number of smaller goodies—tourist trinkets mostly. The thinking seems to be that if you offer the listener something for nothing (except a little of his time) he's more apt to buy what your station is peddling, no matter what it is. Sometimes that psychology works.

Last winter and early spring eight Marxist stations put the contest weapon to its severest test. Even now, in 1970, almost two years after the Soviet invasion of Czechoslovakia, the Communists are suffering from the bad publicity their blunder in international persuasion generated. Thus, with the 100th anniversary of Lenin's birth as an excuse, R. Moscow persuaded (without tanks, this time) R. Prague, R. Bucharest (Roumania), R. Ulan Bator (Outer Mongolia), R. Sofia (Bulgaria), R. Budapest (Hungary), R. Berlin International and Polskie Radio to stage a joint short-wave contest.

The motive behind such a gigantic undertaking obviously was to establish the idea of Marxist solidarity in the minds of international listeners. Though a large order even for this sure-fire propaganda operation, chances for success might have been improved had Moscow been able to entice R. Havana, R. Pyongyang and R. Hanoi into the contest network. Also, if the contest's theme had been made something less dogmatic than, "When and in what circumstances have you come across Lenin's name, and what does he represent to you?"

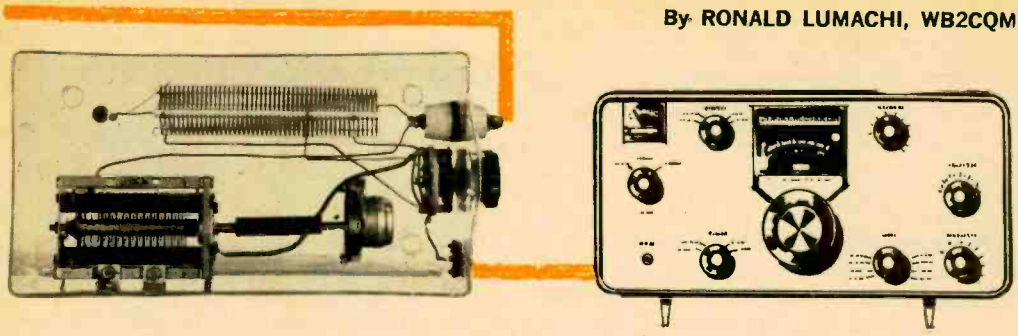
International TV. As coincidence would have it, about the time our piece on portable broadcast stations (Jan. '70 EI) was going to press, the chairman of the USSR Academy of Sciences announced that Russia had postponed plans for a manned flight to the moon in favor of large satellite stations which are to be launched piece by piece and then built while in orbit. Though no one seems to have taken notice, this technique of constructing satellite stations would permit Radio Moscow to beam powerful video signals directly into the home.

Such a station is possible now even without the piece-by-piece approach, but with present methods it would have an operating life of only a few hours. The new Soviet technique permits, among other things, replenishment of the fuel supply and, therefore, full-time high-power operation.

However, almost everyone, from the International Telecommunication Union on down to the VOA, is playing down the prospects for direct international broadcasting via satellites. Though not usually cited as the official reason, such transmissions would escalate the international power struggle far beyond anything tried so far.

QSL card issued by Radio Prague in 1968 for reception of Free Czech Radio. Early this year R. Prague joined other stations in a SW contest.

By RONALD LUMACHI, WB2CQM



Remotely-Tuned SWL Antenna

TAKE it from experienced hams or short-wave listeners—the only way to pull in those weak DX stations is with an antenna that's tuned as sharp as a razor. The finest receiver in the world might just as well be a $40 bomb if it has a poor antenna connected to it. A second-rate skyhook will degrade the performance of a receiver to the point where only the strongest signals will squeak through.

Unfortunately, you don't collect a great many QSL cards by confirming contacts with only the most powerful stations. To QSL those weak, hard-to-hear stations, you need an antenna that can be tuned to a particular frequency.

Such an antenna is our remotely-tuned SWL (and ham) antenna. You tune it two ways: First, you switch-tune it to a broad band of frequencies in which you want to operate. Then you fine-tune it to a particular frequency in that band by pressing a push-button switch near your receiver. This energizes a 1-rpm motor which turns a variable capacitor in the tuner. While you hold the button you will see your S-meter rise as the antenna is tuned to the frequency the receiver is tuned to.

The antenna is basically a long-wire inverted-L (a variation of a Marconi antenna) as shown in Fig. 1. Total antenna length is 50 ft. At the bottom of the verticle element there's a parallel-connected inductor and variable capacitor between the feed line and the element. The inductor electrically lengthens the wire. The motor-driven capacitor tunes the antenna precisely.

Since the elements of the antenna are hori-

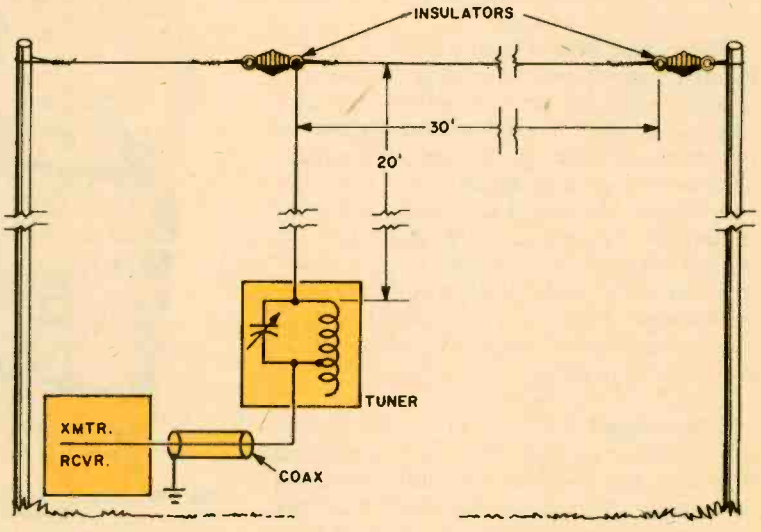


Fig. 1—Schematic shows a typical installation. Vertical element could be attached to the peak of your house's roof. Tuner should be connected to bottom of vertical element. RG58/U coax from receiver or transmitter should be grounded at transmitter or receiver.

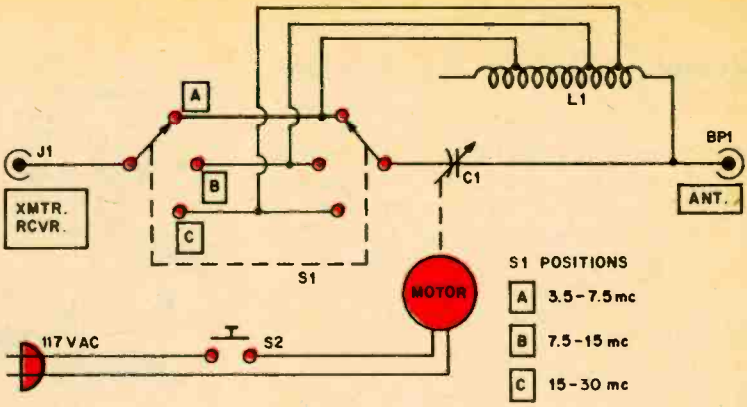


Fig. 2—Schematic of tuner. Left section of S1 selects tap on coil L1 for particular band of frequencies you operate on. Right section of S1 connects variable capacitor C1 in parallel with selected section of L1. S2 activates motor which turns capacitor.

zontal and vertical, the antenna has good horizontal and vertical pickup characteristics. This is especially important for shortwave listening since radio waves of either vertical or horizontal polarization may be intercepted by the antenna. Although a signal may be transmitted with a vertical polarization, ionospheric reflection and refraction may alter the original polarization. It is an advantage, therefore, to incorporate both types of polarization in one design.

You can make small changes in the lengths of the vertical and horizontal elements to suit the space you have available providing the overall 50-ft. length is not changed. The coil/capacitor combination will let you tune from 3.5 to 30 mc (10 through 80 meters) in three bands. Take a look at the schematic in Fig. 2. When S1 is in position *A* the antenna in broadly tuned to 3.5 to 7.5 mc. Position *B* covers 7.5 to 15 mc. In positi *C* you're set up for 15 to 30 mc. Since the antenna exhibits identical electrical characteristics whether receiving or transmitting, it may be used with equal success in either mode. For transmitting power less than 150 watts (input power) you can use a phone jack at the input end. For input power up to 1 kw, substitute a SO-239 connector for J1. No other changes are necessary.

Construction

Our tuner (see Figs. 5 and 6) is built in a 12 x 7 x 4-in. plastic food-storage box. Such boxes are available in houseware stores and are inexpensive. Mount the coil, rotary switch, motor and capacitor as shown in our model. The motor is mounted on a homemade right-angle aluminum bracket. Cut the coil to a length of 6 in. and then unwind one turn at each end. Mount one end on the porcelain feed-thru insulator and the other on the porcelain stand-off insulator. The vari-

PARTS LIST

*BP1—Porcelain feed-thru insulator (55¢, 12A262)

*C1—12-250 μμf variable capacitor (Hammarlund MC250M. $3.70, 12A1924)

*J1—Phono jack (7¢, 12A1088)

L1—Air-core inductor. 1¼-in. dia., eight turns-per-inch, 10-in. long (Air-Dux 1008T, World Radio, 3415 W. Bway., Council Bluffs, Iowa 51501. Stock No. 20A086, $2.80 plus postage)

MOTOR—Synchronous motor, 1 rpm (Allied 41 A 5800 C, specify 1 rpm)

*S1—three-pole, three-position ceramic rotary switch (49¢, 18A531)

S2—SPST push-button switch

Misc.—*Porcelain stand-off insulator (36¢, 12A249), No. 14 solid wire, plastic box

Note: parts listed with (*) are available from Burstein-Applebee Co., 3199 Mercier St., Kansas City, Mo. 64111. Price (add postage) and stock No. are enclosed in parenthesis.

Fig. 3—Photo shows how wire is soldered to tap point on coil. To prevent short to adjacent turns, push in wires on each side of turn to be tapped.

able capacitor may be mounted on the side or bottom of the plastic box. The holes for the switch, input jack, feed-thru insulator and screw holes should be made by melting through the plastic with a soldering iron. A drill will crack the plastic unless you are very careful and back up the plastic with a piece of wood.

When installing band-selector switch S1, orient it so that one pole is close to input connector J1. Make all connections with No. 14 wire. Solid wire is easy to work with and will handle the high power if the tuner is used with a transmitter.

It is important that the synchronous motor be insulated from the variable capacitor. To connect the shafts, make a coupling with a short length of a wood dowel or a plastic rod. Drill a hole in each end of the coupling to accommodate the shaft dia. of the capacitor and the motor.

The coils taps should be made at the following points:

3.5-7 mc—1 turn from the ungrounded end
7.5-15 mc—15 turns from the antenna end
15-30 mc—5 turns from antenna end

A low-loss ceramic switch should be used for S1. It must be a two-pole, three-position heavy-duty type capable of handling at least moderate power if the system is to be used with a transmitter. For receiving, any type rotary switch can be used. One pole selects the coil tap. The other pole connects the capacitor in parallel with the selected section

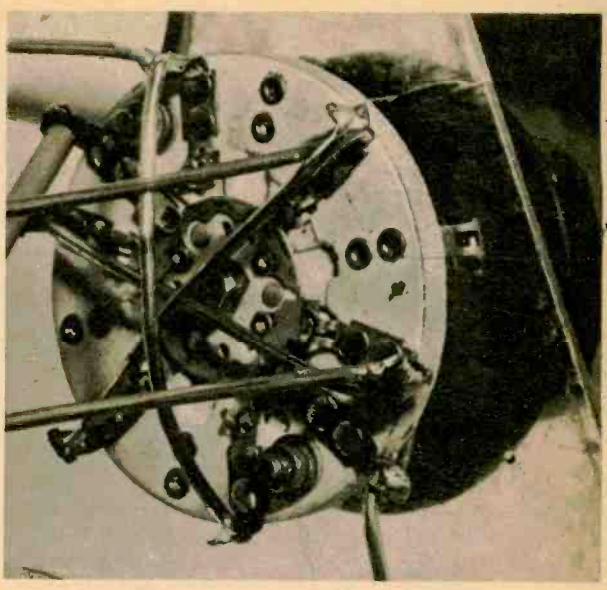


Fig. 4—S1 wiring. One wiper lug has wire coming to it from bottom of photo. Insulated wire is connected to other wiper in the upper left corner.

of the coil being used. Be sure the wires don't touch or even come too close to each other (especially if the tuner is to be used with a high-power transmitter).

Installation

After erecting the antenna as shown in Fig. 1, connect the bottom of the vertical element to feed-thru connector BP1 and connect your receiver (or transmitter) with RG58/U coax to J1. Depending on your

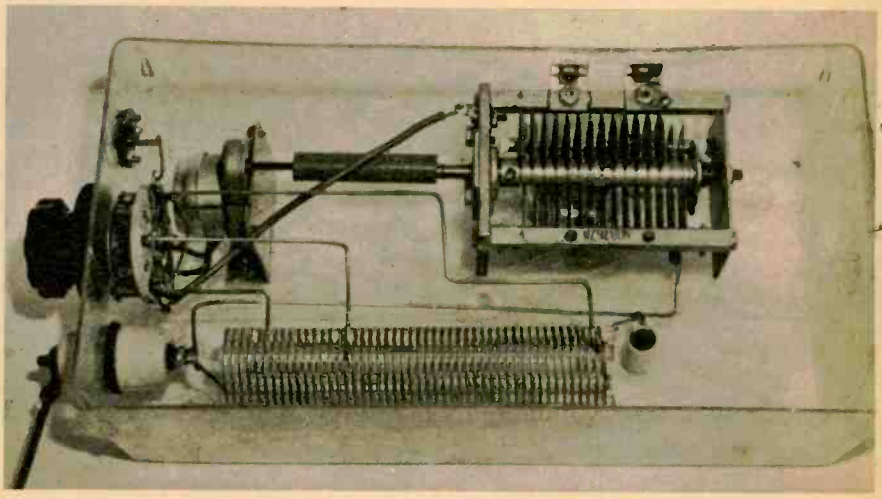


Fig. 5—Tuner can be built in smaller box if available. Note wood coupling used to connect motor's shaft to variable capacitor's shaft. If you substitute capacitor for one we specify in Parts List, be sure rotor can turn 360°.

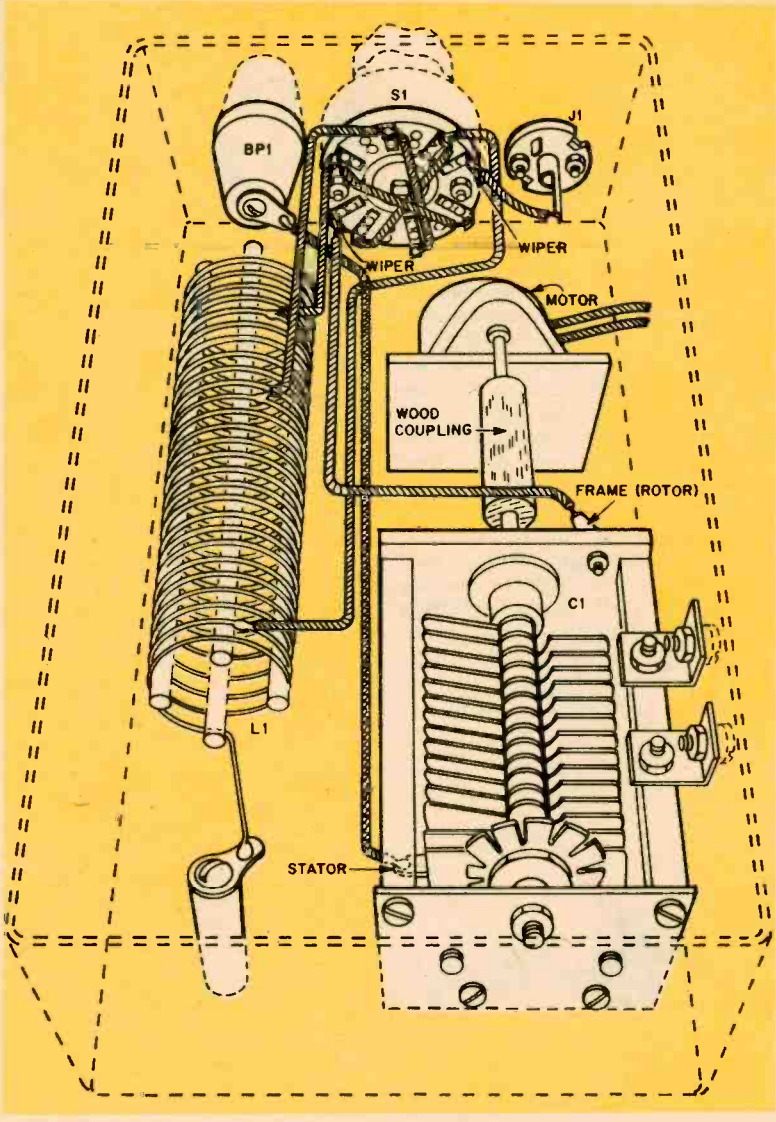


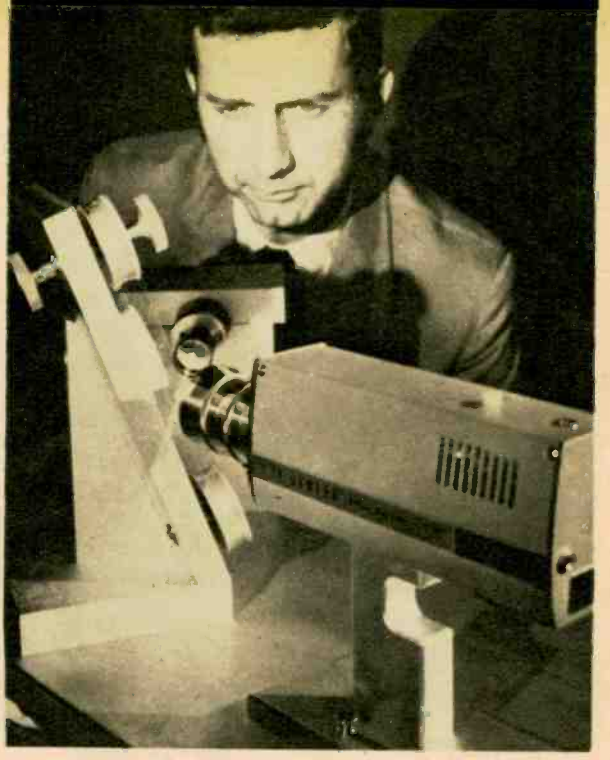
Fig. 6—Rear end of L1 is supported on porcelain stand-off insulator; connection is not made to this end. Capacitor we specify for C1 looks different from type used in author's model, but this will present no problem. It can be mounted on side of box, as shown, or on bottom. Put tape over heads of its mounting screws. If tuner is to be used with transmitters whose input power is greater than 150 watts, substitute an SO-239 coax connector for Jack J1.

shack's location the tuner may be installed close to the receiver (providing the tuner is at the bottom of the vertical element) or a good distance from it. One safety precaution: put tape over the heads of screws used to mount the variable capacitor to prevent accidentally grounding it to something nearby.

Run a length of lamp wire from the motor to your operating position. The control circuit for the motor consists of a series hookup of a push-button switch, the motor and 117 VAC, as shown in the schematic. Instead of just plugging into an AC outlet, we suggest you use a 1:1 isolation transformer between the outlet and the motor circuit.

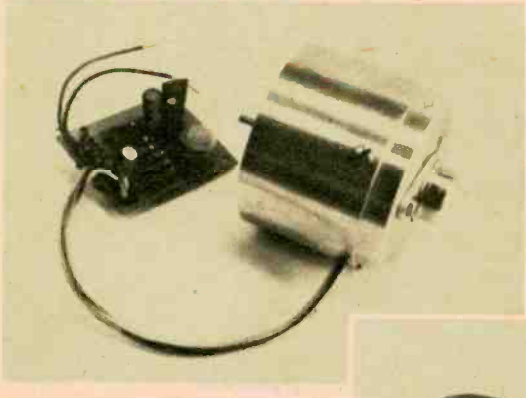
Operation

First, select the band in which you want to operate with switch S1. Then tune your receiver and peak the antenna by pressing the push-button switch. Observe your S-meter. You'll know at a glance when the antenna is tuned because the meter will peak. Frequency changes are easy to make. Simply retune the receiver to another portion of the band within the range previously selected by S1, hit the push-button switch and watch the S-meter peak again. When you want to operate another band, just flip S1.

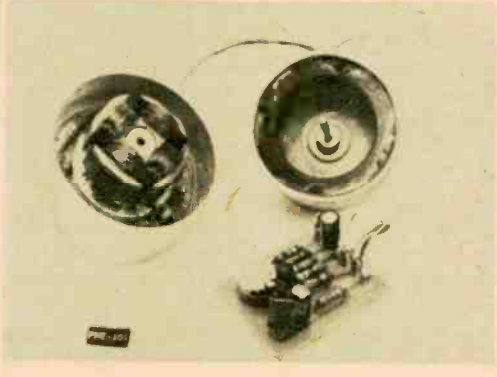


CONSUMER LASER. Recorded tapes for your TV will be a reality in the '70s. First on the scene was the CBS EVR system. Now, RCA has its own version called Selecta-Vision. Employing laser technology, the system utilizes a video cartridge player that plays pre-recorded tapes made of clear vinyl. A color program is first recorded on conventional film by means of an electron-beam recorder. This color-encoded master is then developed and converted by laser into a series of holograms (three-dimensional images) recorded on vinyl tape. Using photo-resist methods, a hologram master and nickel master are developed to reproduce copies of the original. For playback, a low-power laser projects the holographic images on the tape into a TV camera. Photo shows lab version of playback process.

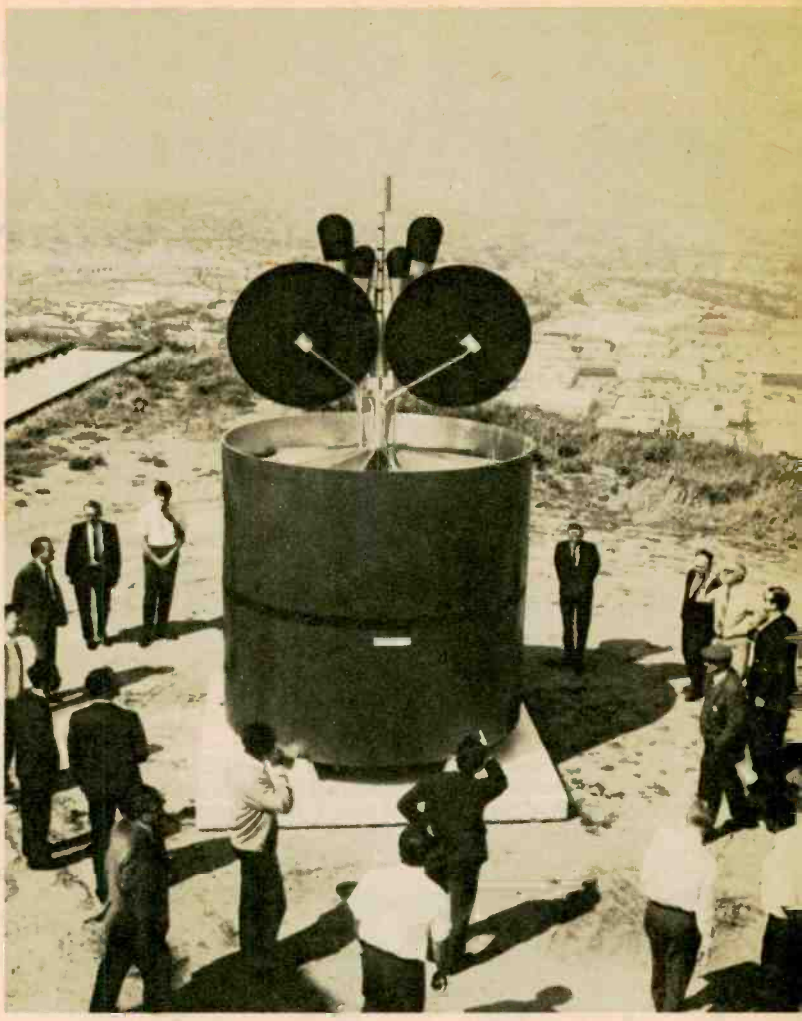
Electronics in the News



Brushless DC . . . The Hall effect was discovered in 1879 by the American physicist Edwin Hall. When a magnetic field is vertically applied to a strip of conductive material, a voltage is created across two points on the strip. This phenomenon can be used to electronically switch current into the windings of DC motors, eliminating the need for commutators and brushes. The Pioneer Corp. of Tokyo now has developed inexpensive Hall semiconductors for use in the motors of its tape machines. Components are shown below.



International Satellite . . . No, it's not a round-table discussion, just engineers at the Hughes Aircraft Co. in California gathering for a close-up look at a full-scale model of the Intelsat IV communications satellite, an international project if there ever was one. Hughes is building four of them with the aid of 12 sub-contractors based in ten foreign countries. These companies contributed over 100 engineers from distant lands to the Hughes effort. The Comsat Corp. is directing the program for the 69-nation International Telecommunications Satellite Consortium. Intelsat IV will launched into a synchronous orbit 22,300 mi. above the earth early in 1971. It can carry nearly 6000 two-way telephone calls simultaneously or 12 color TV programs, or a combination of voice and video transmissions.



Symbology? . . . Canada's Dept. of Transport feels sorry for its air traffic controllers. To make life easier—if that's possible—they are evaluating a radar data processing system made by the Airborne Instruments Laboratory Div. of Cutler-Hammer. The system uses digital techniques to convert conventional radar data into synthetic displays on a CRT. Increased air traffic has meant clutter on the screen. To make target blips more legible, and also provide information about the identity and altitude of aircraft, positional symbology and alphanumeric codes team up to turn the radar screen into an instant road map of the sky.

Every one of these men was a "Doubting Thomas" about the opportunities in Electronics

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"**It's wonderful to really enjoy your work,** a feeling I certainly have today. My thanks to Bell & Howell's valuable background and training in Electronics. It gave me the career opportunity I've always wanted." Don W. Helms, Birmingham, Michigan

"**I've opened a new $10,000 building** and now have two people working for me. My diploma—displayed as proof of my technical preparation—has been a big factor in the growth of my TV repair business." Charles R. Wagoner, Keithsburg, Illinois

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Recent developments create new opportunities for you

You, as a reader of Electronics magazines, are probably better informed than the average person about the opportunities in this growing field. Yet you may not be fully aware of two recent developments which promise to increase the demand for Electronics specialists in the next few years. For example:

• **Medical electronics.** Devices for physiological monitoring and the heart pacemaker are among several new, and highly sophisticated

pieces of equipment requiring expert Electronics personnel.

• **Electronic switching systems.** A major manufacturer of telephone equipment has already invested $175 million in ESS. Estimates indicate a $20 BILLION investment in the next 30 years!

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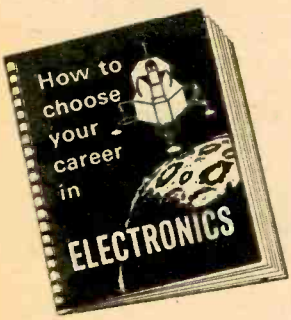

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The Ham Shack

By Wayne Green
W2NSD/1

BROADCASTING via FM, at long last, has caught up with amateur radio; the hobby is now in the middle (or at least the beginning) of one of the biggest booms since the switch to sideband ten years ago.

This boom, fueled by massive amounts of commercial surplus gear left over after bandwidth changes occurred on taxi and police frequencies, was really put into orbit by the development of the repeater station.

The range of low-power two- and six-meter units was quite limited, naturally; not many people wanted to go to the trouble of installing them at home and in their cars for a range of just 5 or 10 mi. The obvious answer to the problem was a retransmitting (relay) station located atop a local mountain or high building. Today, mountain tops are studded with these relay stations all over the country—there are almost 350 of them in use at present, with more coming every week.

Up here where I live, in New Hampshire, there are seven repeaters that I can trigger with a ten-watt transmitter. I've even triggered three of them with a one-watt rig and a ground-plane antenna! So my little ten-watt rig enables me to talk with just about any two-meter FM operator in New England and in a good portion of eastern New York. It won't be long before this network is extended into Ohio and down to Washington.

While on a short visit to the San Francisco area I watched one fellow contact stations in southern California through a repeater network that ran over to Nevada and back again into California. When he operated I could hear the squelch tails from the seven repeaters that made that long path possible. I'll be surprised if we don't have coast-to-coast repeating on two meters in a few years.

This new hobby got off to a slow start because the fellows that did most of the engineering work were just not the types to write articles. As a result, not much appeared in amateur magazines. With the appearance of the now defunct FM Journal (in Detroit), interest began to grow. There are an estimated 10,000 operators presently working FM, with perhaps double that number expected to join in the next year or so.

In addition to all of the surplus equipment, there are several manufacturers and importers coming out with FM units. These are pretty good bargains so they're beginning to appear in more and more ham shacks. American models are getting very popular with Civilian Defense organizations and should quickly replace all of the older two-meter AM gear for this kind of work. For emergencies, the repeater is the key to a whole system; it can be fed by base units, mobile units or even hand-held units. I have a solid-state transceiver that measures 1½ x 2 x 7 in. which puts out two watts and activates repeaters 50 mi. away.

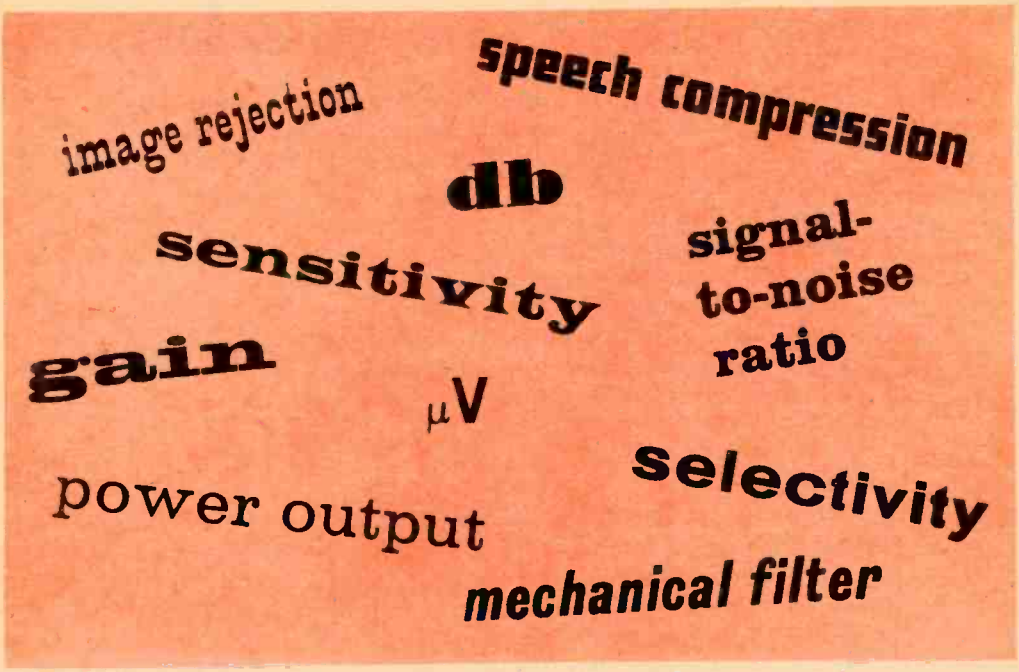
How do repeaters work? Since you cannot easily transmit and receive simultaneously on the same frequency, the repeaters have a receiver tuned to one frequency (often 146.34 mc) which is connected to a transmitter operating on another channel (often 146.94 mc). The FM boys have put practically all of the repeaters in the 146-mc part of the band and they speak of the above combination as a 34-94 repeater.

Specialized equipment is beginning to show up. Automatic channel-scanning receivers will scan up to ten different repeater channels continuously, stopping at any one that is active and turning off the squelch so you can hear what is happening.

Most repeaters are put up by clubs or individuals who have access to surplus equipment. In addition to the receiver/transmitter setup, there also must be a control link on 450 mc to satisfy FCC regulations. As you can imagine, some of the repeater functions are quite complex. For instance there is the repeater in Concord, N.H., that features the regular 34-94 system most of the time, but for three minutes in every fifteen repeats across bands running from 52.525 mc on up to two meters. During six-meter openings some local amateurs have managed to contact ten or more states while operating mobile on two meters and then being repeated through W1ALE.

In areas where there are overlapping repeaters, a system has evolved of using a short tone at the start of a transmission to trigger a particular repeater rather than all repeaters. This is known as tone-burst entry

(*Continued on page* 102)



How To Read CB Transceiver Specs

You might outwit the manufacturer of a rig that's just too good to be true.

By JOSEPH RITCHIE

NEXT time you buy a CB transceiver will you first examine the spec sheet in detail to see what you're getting? If you're the average buyer, you probably won't. You'll buy from experience, word of mouth, recognizable brand name, price—or because it'll just fit the hole in your dash. What if you *do* pay a lot of attention to the specs? With few exceptions, they'd turn out to be meaningless and, even worse, you might find out later you didn't get the performance you paid for. And that could make you unhappy.

The truth is that transceiver specifications often reflect marketing or promotion policy. In short, such specs—technical as they may be—are meant to convince you that brand A is somehow superior to brand B. They are not intended to convey performance information.

It is true that often the larger and more respected CB manufacturers do provide comprehensive, professional specs. Still, they're often buried in meaningless performance information which is based on testing systems specifically designed to make the equipment look better than gear produced by the competition.

Confused? Let's clear up the picture a bit by looking at the pros and cons of different CB specs. We'll start with the **receiver.**

Signal-To-Noise Ratio

Years ago, after countless listening tests, some communications people determined that a 10db signal-plus-noise to noise ratio (S+N/N) would result in approximately 80 per cent intelligence being extracted from an AM signal—with almost 100 per cent intelligence extraction occurring with a 15db ratio. Since 80 per cent is enough to get the mean-

ing of a message across, a sensitivity rating in terms of this 10db figure was accepted as a *minimum* value—but with a 15db ratio preferred. For years no manufacturer would dare insult his customer's intelligence by listing anything less than a 10db ratio. But then came CB!

Look through CB performance specs and you'll find a 6db (S+N/N) reference for sensitivity. Now, depending on background noise level, a 6db ratio can produce less than 50 per cent intelligence extraction—almost totally valueless performance. Sad fact is, a receiver with a 0.2 μV (6db) sensitivity can easily approach the standard 1 μV (10db) sensitivity. Also, never get bogged down with a term like *tangential sensitivity*. No one has explained clearly how tangential sensitivity can be correlated with intelligence extraction.

Bandwidth

Bandwith, or selectivity, is another term which leads CBers astray. Bandwidth indicates a receiver's ability to reject adjacent signal interference. For instance, if a receiver has a bandwidth of 20 kc at 60db, this means that a signal $\pm$10 kc distant from the tuned signal will be attenuated by a factor of 60db; the interfering signal must be 1,000 times stronger (remember, we're talking about voltage) than the tuned signal in order to be heard at the same volume. (For the sake of clarity, we have avoided talking about modulation sidebands in this example.)

Most CB manufacturers indicate the 6db bandwidth, meaning the frequency attenuated 6db from the tuned signal. This spec is really useless to the CBer since it reflects the received audio-frequency response (which when given with another bandwidth spec, such as 60db at 10 kc, can tell an engineer the exact shape of the bandwidth curve). However, a CBer isn't helped because selectivity is determined by the *complete* bandwidth curve. He's only given the low end of the curve.

For example, receiver A with a curve of 6db at 5 kc and 60db at 12 kc is quite selective, while receiver B—which appears more selective due to its 6db at 4 kc—is actually only 35db down at 12 kc and therefore subject to greater interference from adjacent signals.

The most important bandwidth spec for the CBer reflects what's happening 10 kc away from the tuned channel. But if you look for a spec that reflects 10 kc, remember that if you want to be selective 10 kc on the high side you also have a 10 kc factor on the low side, and the bandwidth is rated for a 20 kc frequency spread. (If the manufacturer specifies a 10 kc bandwidth, he means 5 kc on either side of the tuned signal. When he refers to *adjacent channel selectivity*, he means 10 kc (or some other value) only on one side of the tuned signal—you double this value to get the total bandwidth.)

Image Rejection

Image rejection is another spec favored by CB manufacturers since it conceals a number of ills. An image is a signal occurring at twice the IF frequency. Usually, the receiver's local oscillator beats against the tuned signal and one located at twice the IF frequency (either higher or lower, depending on the local oscillator's frequency). It's the function of the tuned RF stage to eliminate

this image frequency, otherwise both signals will be detected.

Image rejection indicates attenuation of the image frequency—20db is the minimum acceptable value. However, CB rigs often use double conversion to push the image rejection anywhere from 40 to 80db down (which is the only real advantage of double conversion). Unfortunately, the use of frequency synthesizers has made image rejection somewhat meaningless; the two or three local oscillators in such a rig produce many beat frequencies, where each beat acts as a local oscillator to produce more spurious responses. When tested, several of these rigs show very good image rejection, but the spurious response to CB signals is almost as good as for the tuned channel.

Automatic Gain Control

In recent years an AVC or AGC specification has become standard in the CB literature. Unfortunately, a standard test reference for AVC doesn't exist. One manufacturer may claim his transceiver will compress a 5 to 80,000-μV input signal range into a 5db audio output variation, while another manufacturer will give the AVC performance for, say, a 2 to 10,000-μV range. They select the range that looks best in print.

What they don't specify is the *breakout* signal level (particularly for solid-state gear. This is the input level at which the AVC no longer holds, thereby producing a very sharp, sudden increase in the audio output. As a rule, the wider the specified input range, the better.

With few exceptions, no CB rig carries a front-end overload specification, yet solid-state equipment is particularly susceptible to overload. The overload point is an input level which causes the RF amplifier to either break into oscillation or function as a detector/mixer. The result: a very strong signal produces either cross modulation (where you can hear the modulation of different channels on top of the tuned signal) or it desensitizes the receiver, so that a strong adjacent signal reduces the rig's sensitivity to the tuned signal—or you just get distortion. Early solid-state gear was particularly vulnerable to strong-signal overload, with strong signals being approximately 5,000 μV. (A level usually termed *medium* strength.) A modern transceiver should handle at least 20,000 μV without overload.

Transmitter specs should be easy to understand, but unfortunately the accepted reference standards are so broad just about anything will meet them.

Modulation

Just about any rig carries a claim of 80 or 100 per cent modulation. What they don't specify is at what frequency or frequencies. Professional equipment first specifies a *modulation frequency response,* something like −3db from 350 to 3,500 cps. Then there is a modulation figure of, say, 85 per cent. This means that any frequency in the range of 350 to 3,500 cps will modulate the transmitter within 3db of 85 per cent, with a reference frequency of either 1,000 or 400 cps producing exactly 85 per cent modulation.

Contrast this with most CB specs—they never tie the two together. All you are guaranteed is that some frequency will modulate the transmitter 80 or 100 per cent. There have been CB transceivers which produced the rated modulation only around 300 to 500 cps, which resulted in extreme bass that is very hard to read at weak signal levels or under interference conditions.

[*Continued Overleaf*]

Another misleading specification is the so-called 100 per cent modulation limiting or clipping, which means that at no time can 100 per cent modulation ever be exceeded. Again, many transceivers meet the specification only at selected frequencies—no limiting is provided at other frequencies. To meet FCC regulations and to prevent overmodulation distortion products, modulation limiting must be effective at all frequencies.

Audio Compression

Range boost or some other feature which implies an audio compressor is common to many higher-price transceivers. But there is a good way and a poor way of doing it and the specs usually don't say which method was used.

For example, if the audio compression device—which is sometimes a clipper—produces distortion products by either squaring or otherwise deforming the modulation waveform, the distortion products must be removed with an appropriate filter network. If the distortion isn't removed the receiving station picks up a mess of garbage (great talk power under strong signal conditions, but virtually unintelligible under QRM). An examination of many CB rigs will show that some compressors are effectively filtered, while others produce almost pure square waves with high distortion. Specs don't tell the whole story.

Microphone or modulation sensitivity is a forgotten specification. Every manufacturer designs for an average voice level. This results in transceivers which require almost a shout to obtain 85 per cent modulation, while other models are so sensitive even a whisper will produce limiting (with distortion) as well as severe pickup of background noise.

The ABCs of Color Television Servicing

By Forest H. Belt

Examination on Part VI

1. Which service technique is good for troubleshooting the chroma section quickly?

2. Why is a potentiometer used to control IF gain during bandpass alignment?

3. How can you tell when the 3.58-mc oscillator is locked in during color-sync alignment?

4. What are the four basic steps in 1-2-3-4 troubleshooting?

[Turn to page 100 for correct answers]

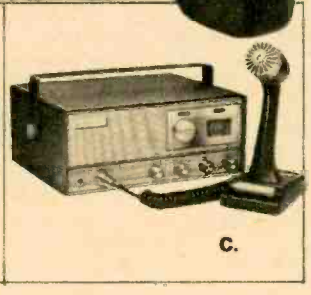
Keep in touch with Penneys CB radios

A. GOLDEN PINTO... compact, easy to operate • Delta fine tuning • Silencer reduces station interference • S-RF meters measure incoming signal strength and output wattage • Ready-to-operate on all 23 channels and has an illuminated color coded dial • Solid state circuitry; squelch control; sensitive hand microphone; gold color facing **$159**—F.C.C. type accepted

A.

B. PINTO 23—ready to operate on all 23 channels • Solid state circuitry • Transmits and receives on all 23 channels • Illuminated dial with color coded channels • S meter; squelch control; PA system; external speaker jack • Sensitive hand microphone; modulation indicator light • Wood grain vinyl over steel
$129—F.C.C. type accepted

B.



C.

C. PINTO 23B BASE STATION — for home or mobile use • Solid state circuitry • Ready to operate on all 23 channels • Illuminated dial with color coded channels • Variable automatic noise limiter • Base station microphone • S-RF meter; modulation indicator light • 2 power cords... one for mobile, one for base use
$159—F.C.C. type accepted

Pinto transceivers manufactured exclusively for Penneys by HITACHI *of Japan*

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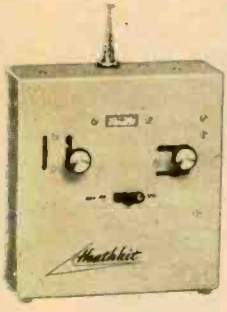
CIRCLE NUMBER 7 ON PAGE 15

8 New Action-Packed Kits From Heath—

Heathkit GD-101
$49.95*



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Heathkit GD-57
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Battery Pack

Servos

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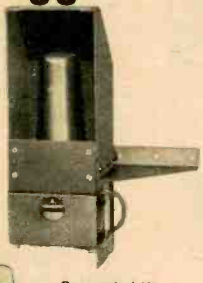

Exterior Horn

Concealed Horn

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Kit GD-18, Siren/PA Amplifier, 7 lbs. **$54.95***
Assembled GDA-18-1, Exterior Horn, 9 lbs. **$49.95***
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CIRCLE NUMBER 3 ON PAGE 15

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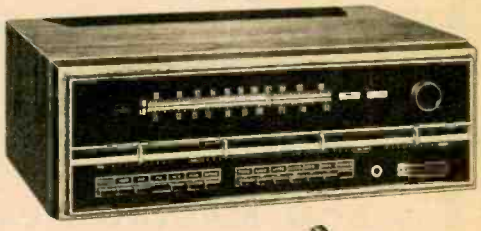

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CIRCLE NUMBER 3 ON PAGE 15

Ham-CB Converter

Continued from page 62

outside antenna and ground connected to J1. Sensitivity and selectivity depend upon careful alignment of the converter and of your broadcast receiver. We used three series-connected 6-V lantern batteries to power the the converter; however, since the circuit only draws about 10 ma, smaller batteries can be used.

For CW reception, set S1 to *BFO* and adjust R10 for the desired pitch. With careful tuning, sideband signals can also be received using the BFO. Make sure that you set S1 to *off* each time the coils are to be changed.

The ABCs of Color Television Servicing

Answers to Examination on Part VI:

Continued from page 96

1. Alignment.

2. To assure a signal of known value reaches the chroma section. Voltage level is read with a VTVM connected to the output of the video amplifier.

3. The color bars stand still on the CRT.

4. Analyze, inspect, isolate and pinpoint.

CIRCLE NUMBER 21 ON PAGE 15

HAM SHACK

Continued from page 92

Pulsars Revisited. Wishful thinkers, like myself, suffered a setback recently when astronomers managed to come up with a rather convincing proof that pulsars are a natural phenomenon. The sense of loss was not acute, however, because I believe that there is a completely new and different method of communications which will be discovered soon.

Now that several millions of people have seen the UFO's moving about our planet, and a respectable number of our scientists have investigated the sightings and found them difficult to impeach, the question arises . . . what sort of communications are all these ships using? We don't seem to have detected anything in the spectrums of radio waves or visible light. And if these visitors are coming from outside of our solar system, they probably have a communications medium that is instantaneous. It is unlikely that they use any type of electromagnetic system at all.

There is no point in our sitting around, waiting for the scientists to discover this new type of communications. Most of the money allocated for basic research was cut off about 30 years ago and today a project has to have a high degree of certainty before any laboratory will let someone spend a lot of money on its development. Basically new discoveries are now in the realm of the amateur . . . us. Here is an area where we have a decided advantage over the professionals, though there is no such thing as a professional in a newly discovered field. One has only to read the Condon report on UFO's to see the great difficulty an established scientist has when he tries to conceive of something that does not fit in with what has been basic to him.

Now, if we can discover how to tune in UFO's the extrasensory world, or even thought process, we're going to have advanced civilization enormously. And amateurs can succeed at undertakings like this. Of course, if you prefer something less far out you may want to do some tinkering with the mechanism of gravity fields? Anyone know the progagation velocity of a gravity field?

Some think it may be some sort of vibration . . . if so, a whole new energy spectrum may be revealed. Once we do discover an instantaneous means of communications I think we'll find that this is what the UFO's are using. —

Stereo '70

Continued from page 65

the basic premise being that conventional two-channel stereo doesn't provide enough distinct information in recording or playback for ultimate realism.

The extra information which four-channel stereo provides is the sound of the hall in which the recording is made. The acoustic characteristics of the hall are presented separately by an extra pair of channels. These two channels are derived from mikes placed somewhere near the rear of the hall or studio. Occasionally, such special musical material as the Berlioz Requiem (which uses performers at the rear of the hall as well as at the front) makes direct use of these two channels, but the usual objective is the new dimension of hall sound.

This purist approach is already doing battle with the very special four-channel sound effects required by the promoters of hard rock. The serious audiophiles who developed four-channel stereo may turn vermillion at that thought, but if pop rock turns people on in the numbers the promoters are really hoping for, the spectacular version of four-channel stereo won't be denied very easily.

Before the year is out, watch for an increased number of highly specialized audio products. Altec, Frazier and others are marketing devices intended to tune the acoustics of your living room; Advent is offering a Frequency Balance Control which involves both room acoustics and the overall balance of equipment and recordings. And Advent, and possibly AR as well, will have the separate Dolby unit for any good tape recorder.

Cassettes may be further advanced by the appearance this fall of the first batch of chromium-dioxide tape, which may bring cassette recording quality well within accepted hi-fi parameters.

It seems certain that the big action and excitement during 1970 will concern cassette recorders. If Dolby cassette decks are accompanied by Dolby prerecorded cassettes (and it appears that some independents like Vanguard are planning this move for the fall) things will really get interesting. Once the audiophile is presented with a serious alternative to records, there is no telling where it will all end.

DXing The World's Waistline

Continued from page 33

several SW outlets serving Belem's half million population. DXers can hear this one on 4,865 kc until sign-off at 0300 GMT. Like the nearly 100 other Brazilian stations using tropical bands, Radio Clube do Para transmits programs in Portuguese to domestic audiences. It isn't known as a particularly good verifier, but some DXers have managed to get QSLs.

Last stop on our DX tour is Quito, Ecuador. Despite its location, less than a degree of latitude south of the equator, Quito's elevation (9,000 ft.) gives it a distinctly non-tropical climate.

Though not operating in the low-frequency bands, HCJB, the Voice of the Andes, is familiar to even the most inexperienced listeners. But Quito also has a number of tropical-band outlets, at least four of which have been putting fine signals into North America during the past year.

Radio Quito (4,923 kc) on many nights is the strongest Latin American station in the 60-meter band. Programming, naturally, is in Spanish, but the identification is easy to hear. Also widely reported are Radio Cenit on 4,865 kc, Emisora Gran Colombia on 4,910 kc, and the official government station, Radio Nacional de Ecuador, on 4,940 kc. These can be heard around 0500 GMT.

One-Station Radio

Continued from page 44

Set up the signal generator for a modulated signal at the frequency of the broadcast station you want to listen to. Place the signal generator hot lead near the top end of L1. Adjust C1 and then C2 for maximum signal. Repeat the adjustments, then remove the signal generator lead and install the board in the speaker cabinet. Position the speaker leads away from L1 and T2. Repeat the adjustment to C1 and C2 for best reception of the station. Because the radio has a directional loopstick antenna, you will have to try it in different positions for best reception.

The radio may have to be retuned to compensate for nearby metal objects such as appliances with metal cabinets or electric wiring, etc. And after the components have aged, it may also be necessary to retune the radio.

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

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- • HIGH FIDELITY GUIDE • QUIZZES
- • TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- • MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • F.C.C. AMATEUR LICENSE TRAINING
- • PRINTED CIRCUITRY

SERVICING LESSONS

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

FROM OUR MAIL BAG

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

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

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

PRINTED CIRCUITRY

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

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

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