Service: Using a TV Color Bar Generator

Electronics ILLUSTRATED

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MAY 1972

By the Publishers of MECHANIX ILLUSTRATED

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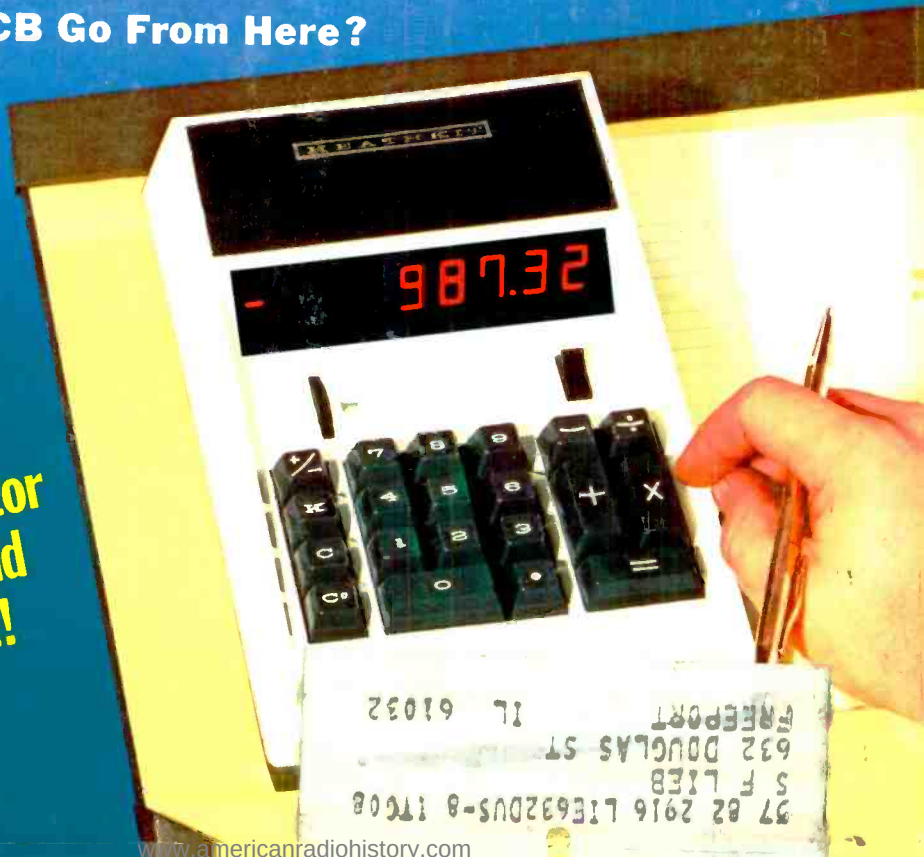

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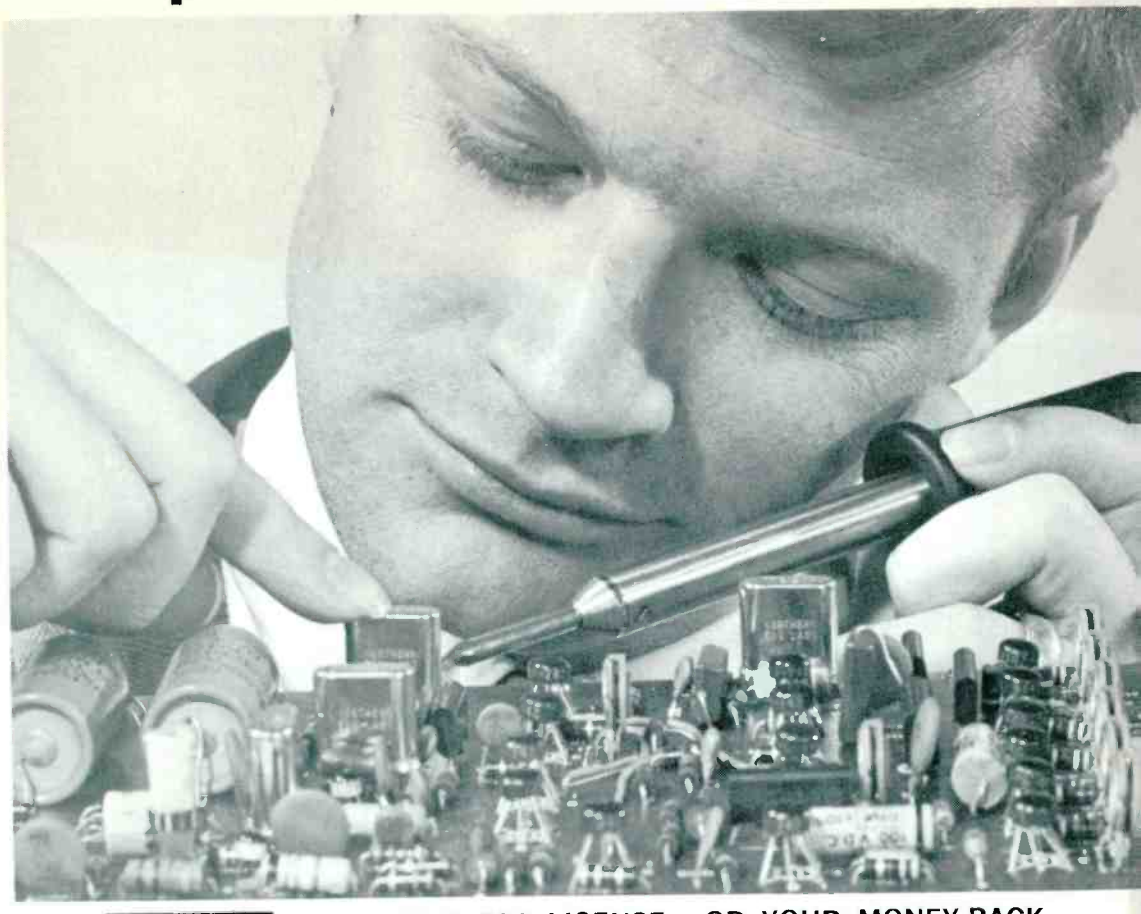

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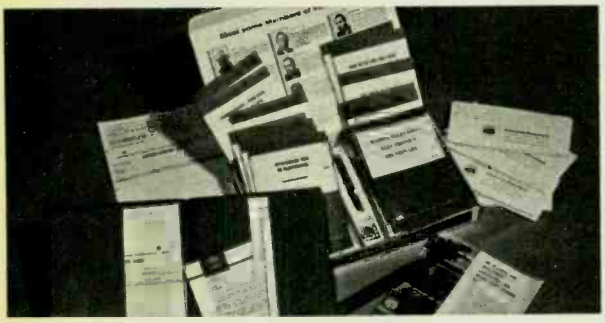

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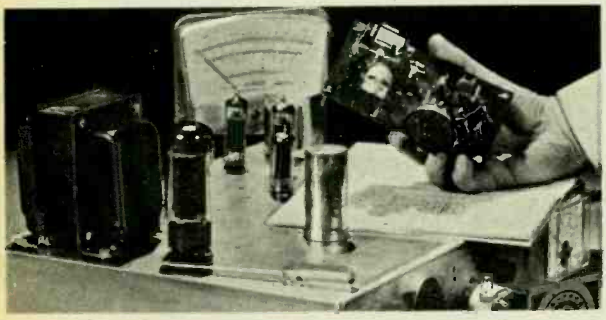

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Electronics ILLUSTRATED

A Fawcett Publication

May 1972 Vol. 15 No. 3

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COMING NEXT ISSUE

Channel 9 Over-Ride Monitor for CBers

Troubleshooting with a Scope

Cardio-Tach measures Your Pulse

Horizontal Antenna Array for TV

PUZZLE: FIND AL

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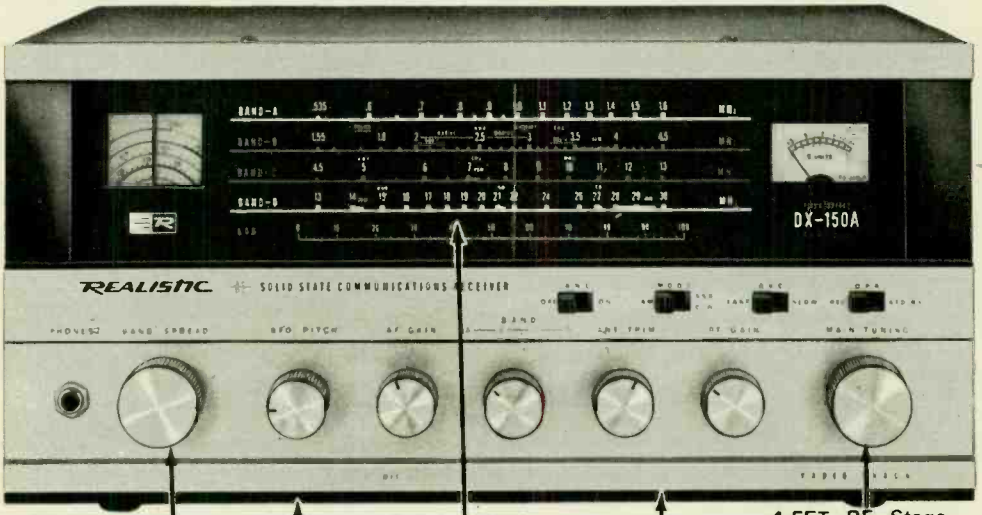

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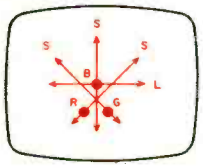
CIRCLE NUMBER 2 ON PAGE 13

Service Tips

By Art Margolis

EVER wonder why an antenna mast should be grounded, yet the driven elements of the antenna remain ungrounded? Reason is that transformerless equipment poses the threat of a shock hazard. If the driven elements of the antenna are grounded and the line plug is installed so the hot side is attached to the chassis, an undesirable condition of a hot chassis shorted to ground through the antenna could occur. To avoid all sparks, never ground driven elements.

—



S = STATIC
L = LATERAL

You can safely eyeball a convergence problem on a color TV screen if the problem is at screen center. Put a stationary pattern on the screen and then adjust red, and green static controls. Then adjust blue static, and lastly, blue lateral control. Don't touch the dynamic convergence board.

—

When using a long outdoor extension cord, try to get a loop of wire around a pole or stake. That way, if the line is pulled, the plug won't come out; the cord will simply tighten up around the stake.

—

It is useful when working in solid-state circuits to know what polarity the voltage source of an ohmmeter is. The positive jack is *usually* connected to the positive side of the internal battery. Note, I said *usually*, sometimes it's not. To dispel doubt connect the ohmmeter to another voltmeter. A positive deflection indicates the positive terminal.

—

Heater pins in miniature tube sockets have a tendency to carbonize and break. The symptom shows up as dead or intermittently lit heaters. Don't replace the entire socket in tight spots. Just replace the defective pin or pins.

—

Should your electric bottle warmer or vaporizer stop working don't bother to look for a heating element—there isn't any. The actual heating element is the resistance formed by the water between the electrodes. That's why the unit shuts off when the water boils away. Problem is most likely that the line cord has burned out or there is a salt coating on the electrodes.

—

Signal tracing a transistor radio is by far the fastest way to isolate the trouble inside. Connect a signal generator to the radio's antenna either directly or inductively. Set the generator to deliver 455 kc or 10.7 mc and modulate the signal with a 400 cps note. Attach a demodulator probe to your scope and then follow the signal.

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

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

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

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

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

In addition, you receive Printed Circuit materials, including Printed Circuits 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 your to keep.

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

FROM OUR MAIL BAG

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

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

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

PRINTED CIRCUITRY

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

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

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Feedback from Our Readers

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

● AHH . . . CHU!

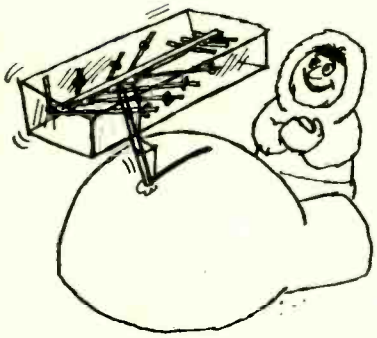
In a recent issue of EI (Nov. '71), there appeared a question in Uncle Tom's Corner concerning radio station CHU, Canada's equivalent of time-signal station WWV. For the record, federal responsibility for astronomy in Canada has changed and the time service now has become a part of the National Research Council of Canada. The station's new address is CHU, Time and Frequency Section, National Research Council, Ottawa, Ont.

As Uncle Tom stated, we welcome reception reports and reply with a QSL card. For those who request it, we'll be happy to send a copy of bulletin B-27, a bilingual description of the station's time signals.

Malcolm M. Thomson
National Research Council
Ottawa, Ont.

CHU's frequencies: 3330, 7335, 14670 kc.

● SKYHOOKS THAT STAY . . .

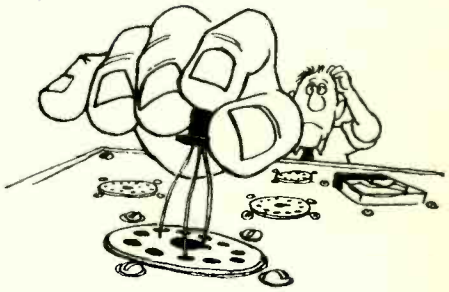


There's a little argument going on between an SWL friend and myself. I once told him that if you really have the right size antenna up—meaning one that's as big as possible—and there's a big ice storm, your antenna *should* fall down. If it doesn't you know right away that what you had up was not big enough. We had a storm like that last winter. My antenna came down but his didn't. He says I'm nuts and my antenna theory is worse. What do you think?

Elmer Foster
Bangor, Ma.

Your theory is brilliant, Elmer, but . . .

● TOO SMALL FOR COMFORT



I hope it's not too late for you to help me solve a Christmas problem. A fond uncle gave me a dandy (and expensive) tube tester. Which was a nice idea. Only problem is, everything in the house down to the TV set is solid-state. What the heck am I to do?

Jonas Wilson
Kansas City, Mo.

At least your kids won't be tempted to play with it!

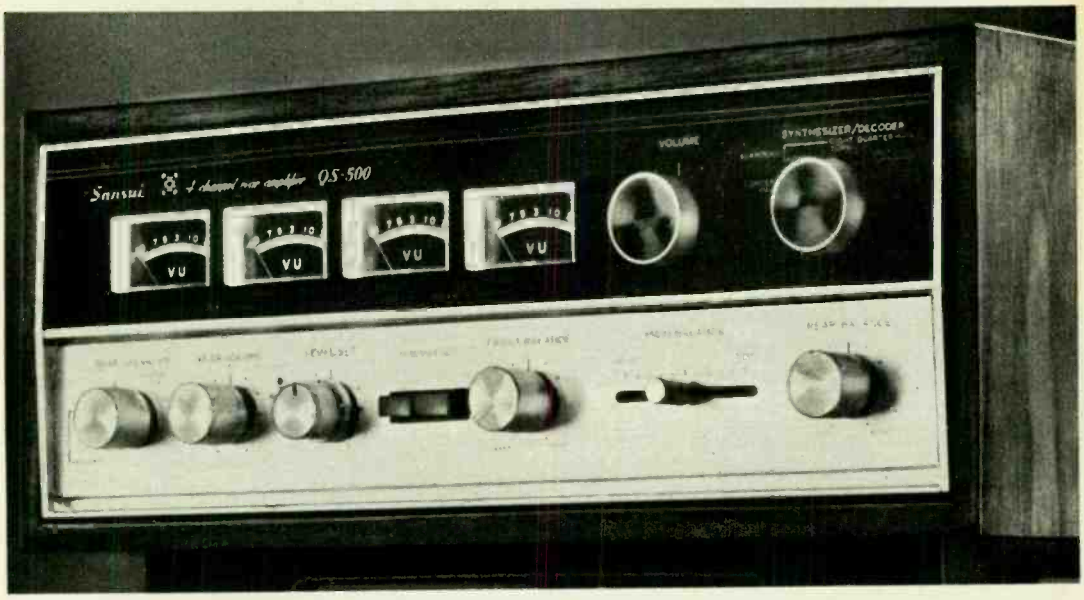
● WHO'S BIASED?

EI is to be complimented on Robert Angus' evaluation of the new audio cassettes (Nov. '71 EI). We were, of course, pleased with your favorable appraisal of TDK's Super Dynamic cassettes. However, we must take exception to one important point: You grouped SD cassettes with those requiring special bias. In our opinion, this is likely to discourage prospective users from taking advantage of SD's high-performance capability.

First, it is illusory to assume a standard bias with respect to all cassette recorders. Individual machines show considerable variation, leaving an exact match between tape and machine a lucky but infrequent accident. Secondly, the bias recommended for Super Dynamic tape has never been more than 10 percent above the bias frequency considered standard. Some of the cassettes you grouped under standard bias are no closer. Many recorder manufacturers now specifically bias for TDK's SD tape.

George T. Saddler
TDK Electronics Corp.
Long Island City, N.Y.

if you go for four channel...



you don't have to go for broke

Buy yourself a miracle for as little as $214.95 That's all it takes to get your conventional two-channel stereo to do anything any total four-channel receiver and control center can do, now or in the future.

The Sansui QS500 and QS100 converters are complete Four-Channel Synthesizer-Decoder-Rear-Amplifier-and-Control-Center combinations that transform standard two-channel stereo totally. The only other equipment you need is another pair of speakers.

You can decode any compatibly matrixed four-channel broadcasts or recordings and reproduce them in four authentic channels. You can detect the ambient signals present in most two-channel recordings or broadcasts and propagate them through the rear channels. In Sansui matrixing, the exclusive phase-shift technique prevents the cancellation of some signals and the change in location of others that occur in many matrixing systems. And the exclusive phase modulators restore the effect of the live sound field.

You can plug in a four-channel reel-to-reel or cartridge deck or any other discrete source. In the future – if you should have to – you can add any adaptor, decoder or what-have-you for any four-channel system for disc or broadcast that anyone's even hinted at. And a full complement of streamlined controls lets you select any function or make any adjustment quickly and positively.

The QS500 features three balance controls for front-rear and left-right, separate positions for decoding and synthesizing, two-channel and four-channel tape monitors, electrical rotation of speaker output, alternate-pair speaker selection, and four VU meters. Total IHF power for the rear speakers is 120 watts (continuous power per channel is 40 watts at 4 ohms, 33 watts at 8 ohms), with TH or IM distortion below 0.5% over a power bandwidth of 20 to 40,000 Hz. In its own walnut cabinet, the QS500 sells for $289.95

An alternate four-channel miracle-maker is the modest but well-endowed QS100, with total IHF music power of 50 watts (continuous power per channel of 18 watts at 4 ohms and 15 watts at 8 ohms). In a walnut cabinet, it sells for $214.95

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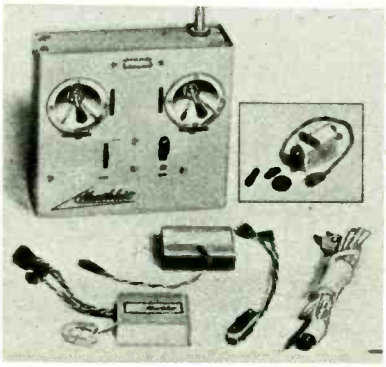
CIRCLE NUMBER 18 ON PAGE 13

Electronic Marketplace

Teeny Tiny. GD-19S radio-control system has servos the size of a chipmunk's glove for use in model planes. The little jobs measure 1⅞ in. from mounting ear to mounting ear and weigh in at just 1¼ oz. each. System has 5-channel



capability, comes as kit. For $224.95 you get transmitter, receiver, 4 servos, 2 flat-pack nickel-cad batteries, choice of frequency desired. Heath Co., Benton Harbor, Mich. 49022.

—

Refillable. Electronics chemicals have become so common in the servicing of TV tuners (as common as a screwdriver and soldering iron, says this manufacturer) that they're beginning to be packaged in combinations. The one we show

features Slim-Jim caddy-size, refillable sprays, along with bench-top cans of Tun-O-Wash cleaner-degreaser, Tun-O-Brite cleaner-lube-polisher. Three combos are available for the serviceman, ranging in price from $6.98 to $8.24. Chemtronics, Inc., 1260 Ralph Ave., Brooklyn, N.Y. 11236.

[*Continued on page* 24]

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Uncle Tom's Corner

By Tom Kneitel, K2AES/KBG4303

Uncle Tom answers his most interesting letters in this column. Write him at Electronics Illustrated, 1515 Broadway, New York, N.Y. 10036.

★ *Can you dig up any information on a broadcast station which ID's as KPOT? It was on the air here with a beautiful signal one day, playing some cool sounds. Next day it was gone and I have never heard it since. Not listed in any of my directories.*

Red Sitwell
Los Angeles, Calif.

KPOT was a fantastic bootlegger which had a brilliant but brief (three-day) career. Located in West Los Angeles, it was a 50 watter that had a 15-mi. range. Some guy who felt that the public has a right to directly participate in broadcasting went out and spent about $35,000 for military and commercial surplus broadcast gear to set this up. The FCC didn't agree that the public's right included broadcasting without a license so they silenced KPOT.

★ *In your January '72 column you ran a letter from someone who said he was being bombarded by signals from some sort of spy-type radar or audio equipment. I have somewhat the same problem. When I attached a 15-in. woofer to a strip chart I got a picture of a 1-cps signal with a 30-cps signal superimposed on it. Can you offer any information on this?*

E.W.S.
Glendale, Calif.

I doubt if such frequencies would be used for any type of spying equipment. Because of the low-frequency pickup of your woofer, it sounds like you are picking up some mechanical vibrations from a local source. Perhaps your room or building is a bit too resonant for comfort.

★ *It occurs to me that there are a lot of VIP's driving around with mobile telephones in their cars. Is there any way these units can be tuned in on a VHF monitor receiver? What band do they operate in? Are the messages scrambled?*

Gary Mondfrans
San Bruno, Calif.

These units can be tuned easily and they aren't scrambled. You even get to eavesdrop on both sides of the conversation and some of 'em are dillies. Tune around 152.50 to 152.85 mc. Some areas also have stations between 35 and 36 mc, and a few larger cities even use the UHF bands around 454.40 to 454.70 mc. But don't write for QSL's!

★ *Ma Bell is on my back. The company says it must charge extra because of connecting arrangements for my Code-A-Phone automatic answering device. A 5-year-old child can hook this thing up. So why the racket? How can they get away with this?*

Harold McEwen
Lunenburg, Maine

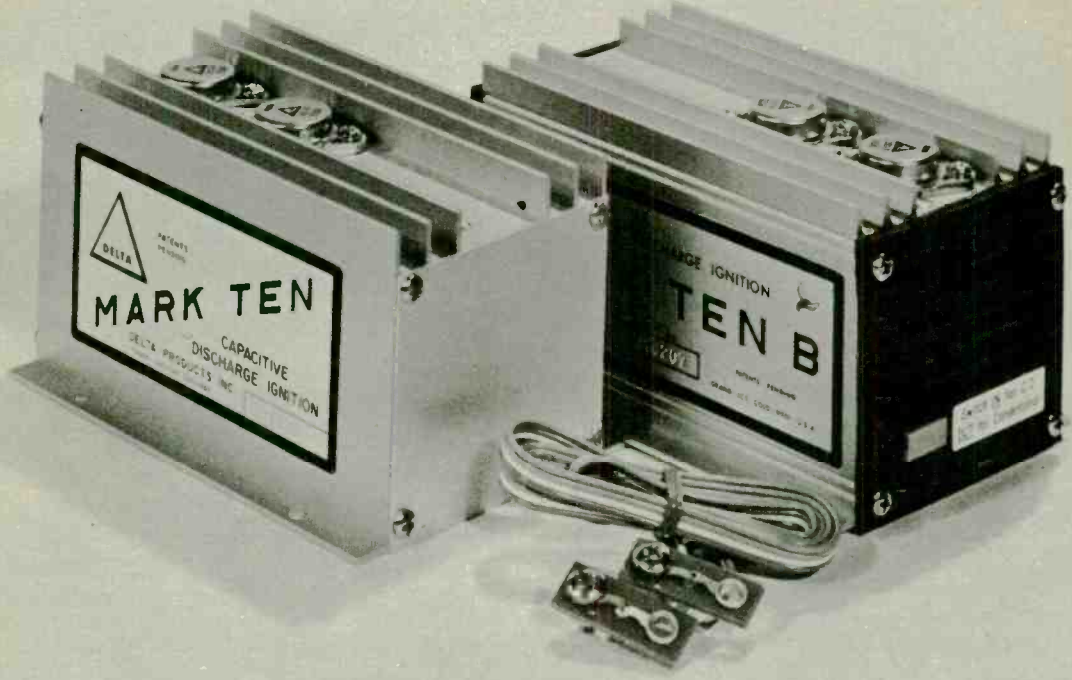
They can't anymore. The FCC recently told the phone company that it can't pull this sleazy trick when the customer is going to use certain specified brand-name automatic dialers and automatic answering units. Your rig is on the approved list.

★ *I have a distortion problem in my solid-state AM transmitter; a few of my buddies also report distortion while they are modulating their rigs.*

Al Hoffman
Eau Claire, Wis.

When checking out an AM solid-state rig, modulation should be applied to both the

[Continued on page 16]



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CIRCLE NUMBER 19 ON PAGE 13

Uncle Tom's Corner

Continued from page 14

driver and power amp. collectors. There should be adequate drive for the power amp. and both stages should be properly biased. Usually the amplifier stages must be turned up for maximum modulation rather than for maximum carrier output. Do this while using a scope. Also, the modulator must be capable of delivering adequate audio power, otherwise you'll end up with low modulation or severe clipping and distortion.

Confession Dept. I must confess to being instrumental in the assignment of the old WPE callsigns for DXers, but wha' hoppen, baby? When they stopped giving out WPE callsigns it seems that everybody and his neighbor started grinding out their own—not only to SWLs, but to tapespondents, stereo buffs and probably even computers, too! I received a card the other day which identified the sender with the following prefixes to his callsigns: WPE, WDX, WTC, WRT, WCM, plus a CB call. Ridiculous!

★ *I DX on the AM band and have noted that there are many 50-kw powerhouse stations to be heard. But some stations putting out only 5 kw from as far away as Buffalo and Louisville seem to come in loud and clear even during daylight hours. How come?*

David Kleinschmidt
Parma, Ohio

It's a combination of factors, including the type and direction of the broadcast antenna used, the number of other stations using the channel, and the receiver and antenna at your end. Seems that you've stumbled upon the fascination of broadcast-band DX. Good hunting!

★ *I desperately need a schematic for an unusual rig designed for electrolysis. It's full of neat 5U4's, 605's, 6L6's, and even a crystal for 6780 kc. The plate on the side reads: Hoffman Electrolysis Eqpt. Co., N.Y., Model S-108, FCC #ME-514.*

W. A. Pierce
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[*Continued on page* 22]

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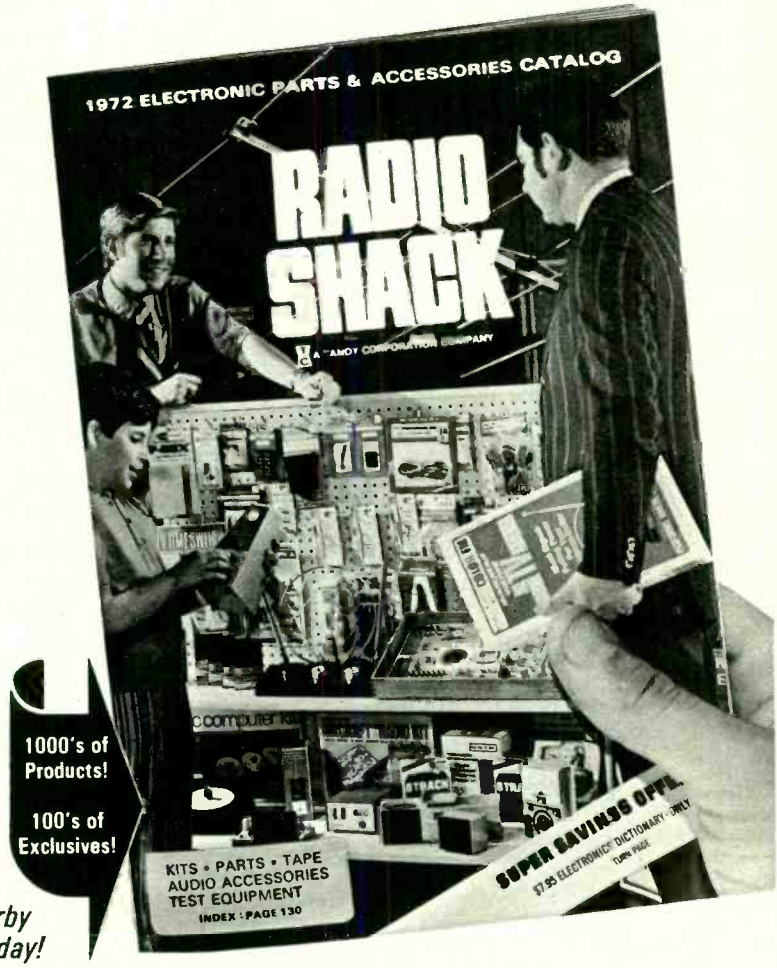

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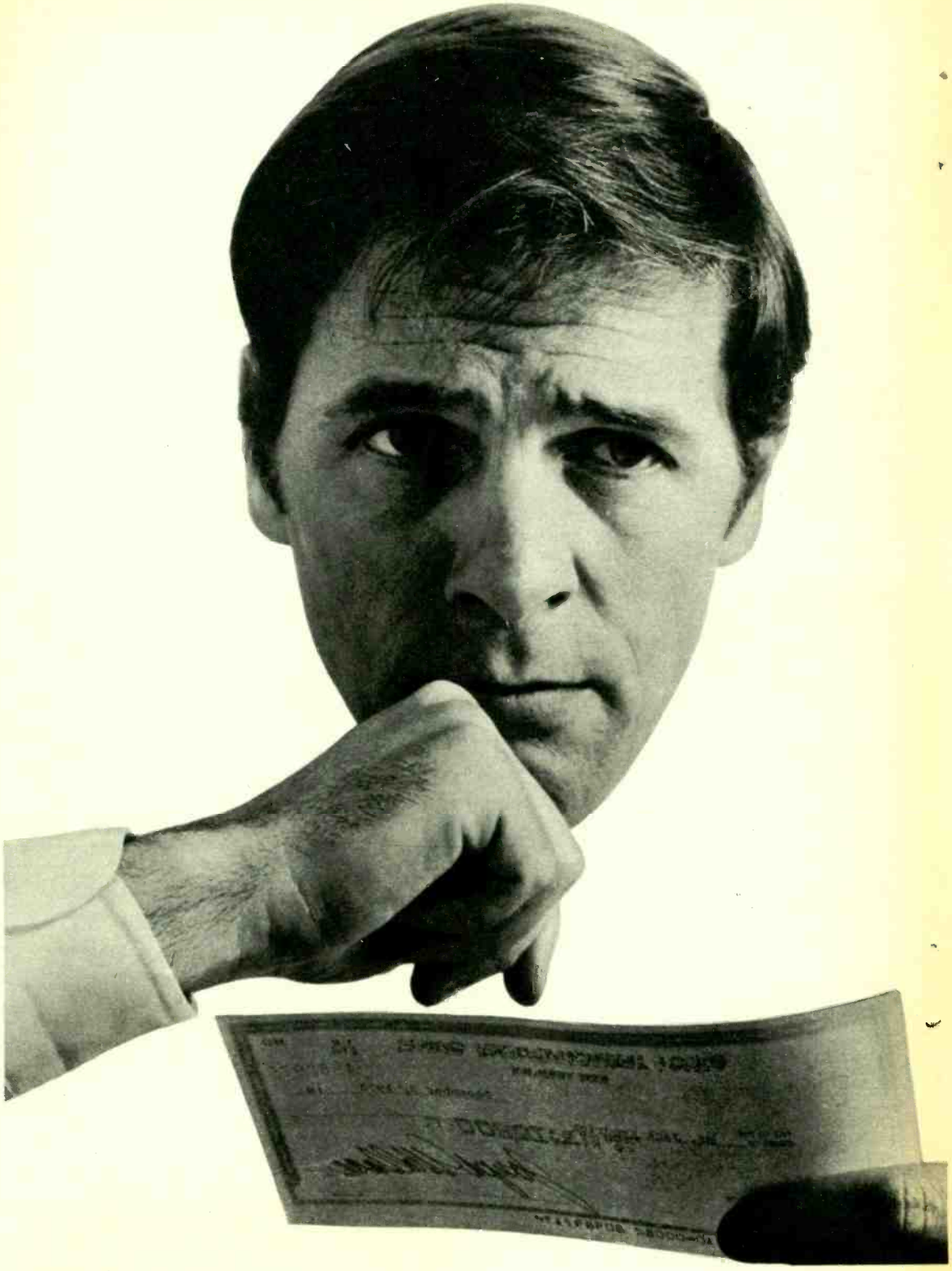

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Uncle Tom's Corner

Continued from page 16

Wonder if it puts out a hairy signal? If any readers can help out Mr. Pierce, here's his address.

★ *One thing that bugs me is, when you are trying to tune in a good SW station all of a sudden the BBC or Radio Moscow breaks in. How can they do it?*

David Coskey
Haddonfield, N.J.

Big transmitters, big antennas and poor manners.

★ *Why is the letter X used in abbreviations such as xformer, xtal and xmitter for such radio terms as transformer, crystal and transmitter?*

Ken Greenberg
Chicago, Ill.

If they used a Q or a Z would you know what they were talking about? Why argue with standard usage?

★ *I'm a student at International Correspondence Schools (ICS) and since you've never commented on the subject, I'm wondering how you feel about home study as opposed to classroom learnin'.*

Tom Wirch
Salem, Ore.

Abe Lincoln didn't do so badly with it—I never argue with success.

★ *I want to start SWLing with a Hallicrafters S-40 receiver, but I see that the antenna terminals consist of three screws marked A-1, A-2 and G. Are these for coaxial cable? How do they get hooked up? It's an old receiver and I can't get an instruction book.*

Dave L. Warren
San Antonio, Tex.

Many older rigs use this type of terminal system. Best bet is to simply run a 50- to 100-ft. long-wire antenna from terminal A-1; then connect A-2 to G with a paper clip or short wire.

CIRCLE NUMBER 21 ON PAGE 13

Electronic Marketplace

Bearly Loaded. Model 8 AM/FM Stereo Tuner-Amplifier comes out of the Rising Sun with enough power and modes to singe a bear's tail. The rig claims 200 watts (IHF music power), includes preamps, amps and AM/FM tuner, capability of driving 3 sets of speaker systems,

phono and tape inputs. It'll also act as deck-to-deck tape go-between to shape and control a program, has two separate phono-input circuits. The triple-range tone controls are step switches calibrated directly in db's. In the FM mode there are two tuning meters, one for signal strength, one indicating center of a channel. Claimed frequency response is 5 to 50,000 cycles ±1db with harmonic distortion under 0.3%, intermodulation under 0.4%. $499.95. Sansui Electronics, 32-17 61st St., Woodside, N.Y. 11377.

—

It Figures. Model 1440 oscilloscope takes the guesswork out of voltage measurements, which can be hard to figure on many scopes, with a direct-reading digital display above the screen. It's called Cali-Brain and it provides an instantaneous peak-to-peak reading of even complex

waveforms, so the manufacturer claims. The 1440 is a 5-in. job with DC to 10-mc range and features all solid-state circuitry. Operates on 117 VAC of 50 or 60 cycles, also can be had with 234-V option in addition to 117. Scope measures 9x10x17 in. $299.95. Dynascan Corp., 1801 W. Belle Plaine Ave., Chicago, Ill. 60613.

[*Continued on page* 26]

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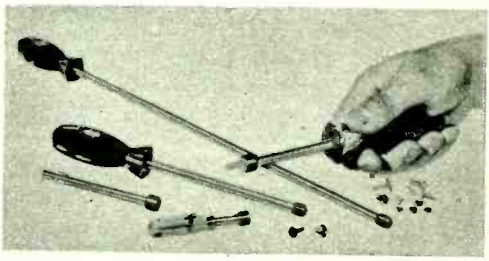
TURNER DIVISION
CONRAC
CORPORATION

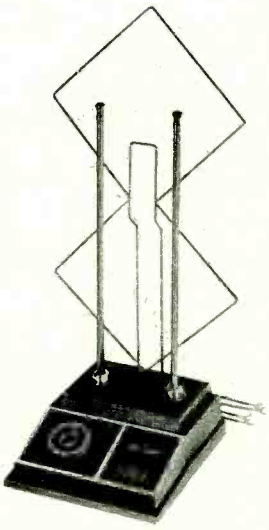
CIRCLE NUMBER 4 ON PAGE 13

Electronic Marketplace

Alnico-aided Nutdrivers. An Alnico magnet inserted in the socket of Xcelite's latest ¼ and 5/16-in. hex socket nutdriver set makes it easy to hold fasteners firmly for one-hand starting, driving, or retrieving hex screws, bolts and nuts in hard-to-reach places. The magnet is insulated so that the tool's socket itself remains unmagnetized. The magnetic feature is being offered in several sizes ranging from a ¼-in. midget pocket clip driver selling for $1, up to a 5/16-in. super long fixed-handle driver costing $4.50. Available from local distributors. Xcelite, Orchard Park, New York.



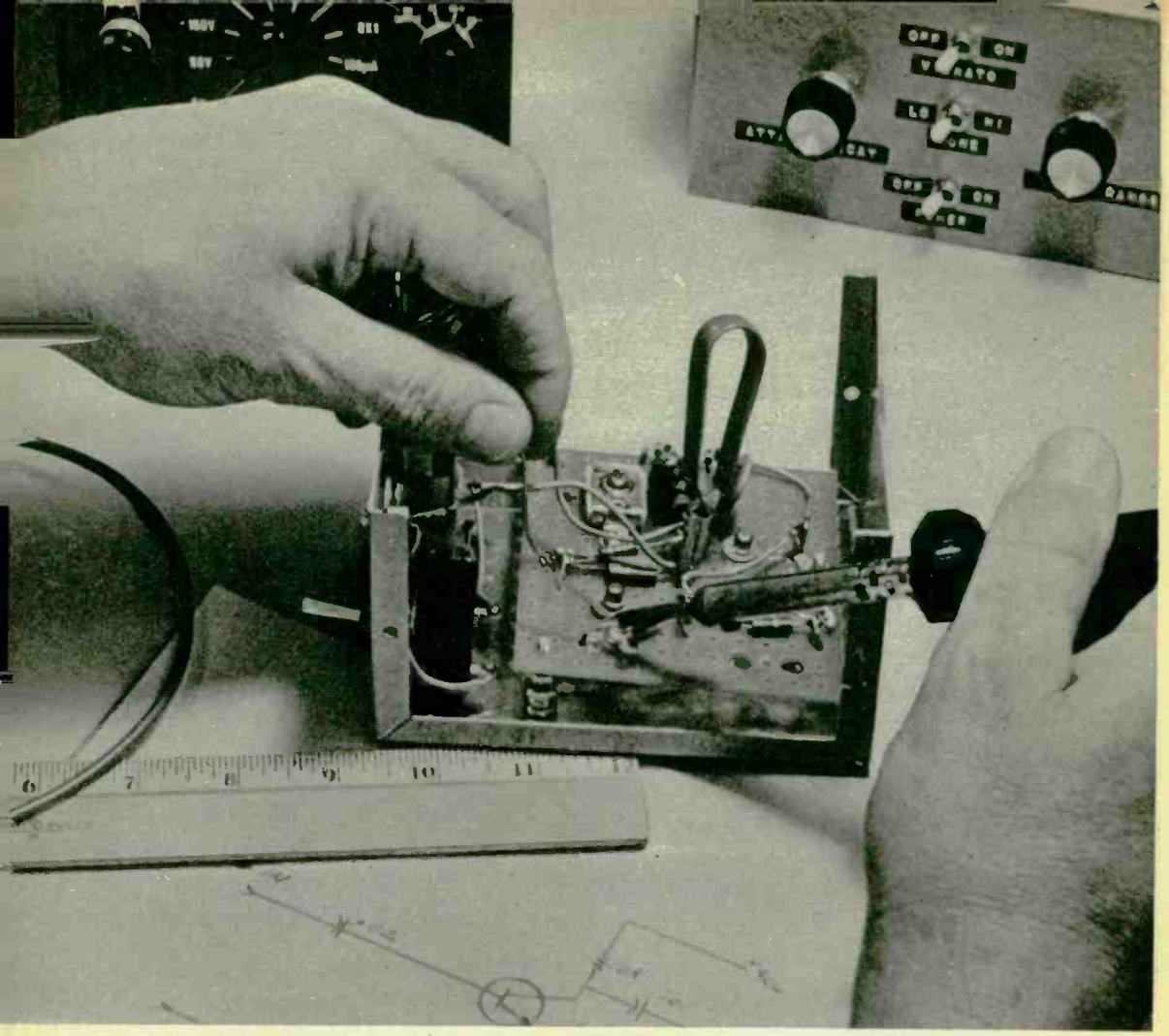
Color It Phase. Jerrold Electronics says that its Color Phaser Model JIN-5 indoor antenna delivers all color signals to a TV set in phase, thereby eliminating annoying color smears in the picture. Besides providing VHF and FM reception from telescoping elements, the antenna also receives UHF signals from a double-diamond shaped element. $14.95. Jerrold Electronics, Philadelphia, Pa.



Electronic Marketplace

Tape Tuneup. Dubbed a Professional Cassette Alignment Tape, Nortronics' Model AT-200 provides suitable tones for zero reference, azimuth alignment and frequency response tests of your cassette tape deck. Each splice-free tape is first generation. $21.00. Nortronics, Minneapolis, Minn.

Popeye Power. Raytheon Company's RAY-45 12½ channel VHF/FM marine radio-telephone operates at 25 watts, the maximum power allowed in the VHF marine band. The transistorized ship-to-shore and ship-to-ship rig has a front panel switch, enabling this legal-limit power to be reduced to less than one watt for calls between boats close aboard or calls within the harbor. The 12 two-way channels are crystal controlled. The half channel, also crystal controlled, receives weather reports. The basic radio includes three pairs of crystals, a weather-channel crystal, mount and antenna. $449. Raytheon Marine Products, Manchester, N.H.



Most electronic hobbyists aren't

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Our Low-Cost Calibrator is a portable version of the square-wave generator built into a typical laboratory scope. Depending on the tolerance of the components used, its output frequency is anywhere from 800 to 1000 cps. Precise output voltages of 5, 0.5 and .05V peak-to-peak are available at the output jacks. But, best of all, parts aren't critical, since most components can be scrounged from your junkbox.

With our calibrator, you'll be able to adjust your scope's vertical input so that each vertical division on the graticule represents an exact peak-to-peak voltage. For example, you can set up your scope so that one box equals 5 V peak-to-peak. A waveform that fills, say, three-and-a-half boxes would equal 17.5 V pk-pk. Or you might set your scope's gain control so that one division equals .05 V. Then, if you feed in a waveform taking up five graticule divisions, you would be eyeballing .25 V pk-pk.

Since our calibrator delivers a clean square-wave-

Low-Cost Scope Calibrator

form voltage, it will help you adjust your scope's low-capacity probes for proper frequency response. Feed the calibration square-wave output into the probe. The shape of the waveform produced indicates immediately whether the variable capacitor in the low-capacity probe is under- or over-compensating input frequencies.

How it Works. Transistors Q1, Q2 and related circuit components form a flip-flop multivibrator producing an output of approximately 1000 cps. The multivibrator's output is fed into transistor Q3. This stage turns the multi's slightly ragged output into a clean, symmetrical square voltage waveform. Transistor Q3 provides current gain while zener diode D1 exactly limits the square wave output to a precise level regardless of power supply fluctuations.

Potentiometer R8 sets the output voltage to 5 V peak-to-peak. A resistor network consisting of R9, R10 and R11 divides the output voltage to 0.5 and .05 V pk-pk, respectively.

The calibrator can be built into a metal cabinet as shown. Or, the pc board can be mounted directly inside your scope. Install small tip jacks on the front of the scope—all you need is a terminal that can be touched with the tip of the scope probe.

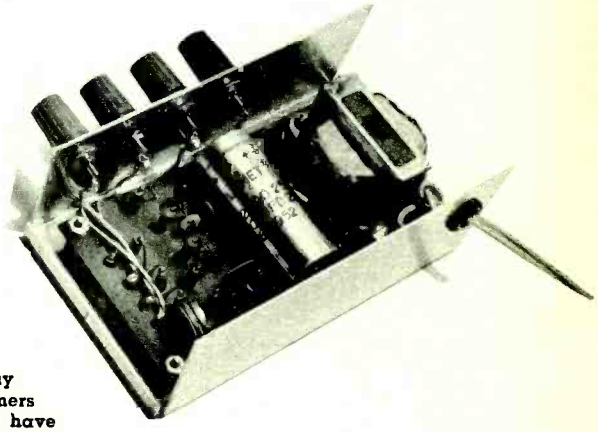
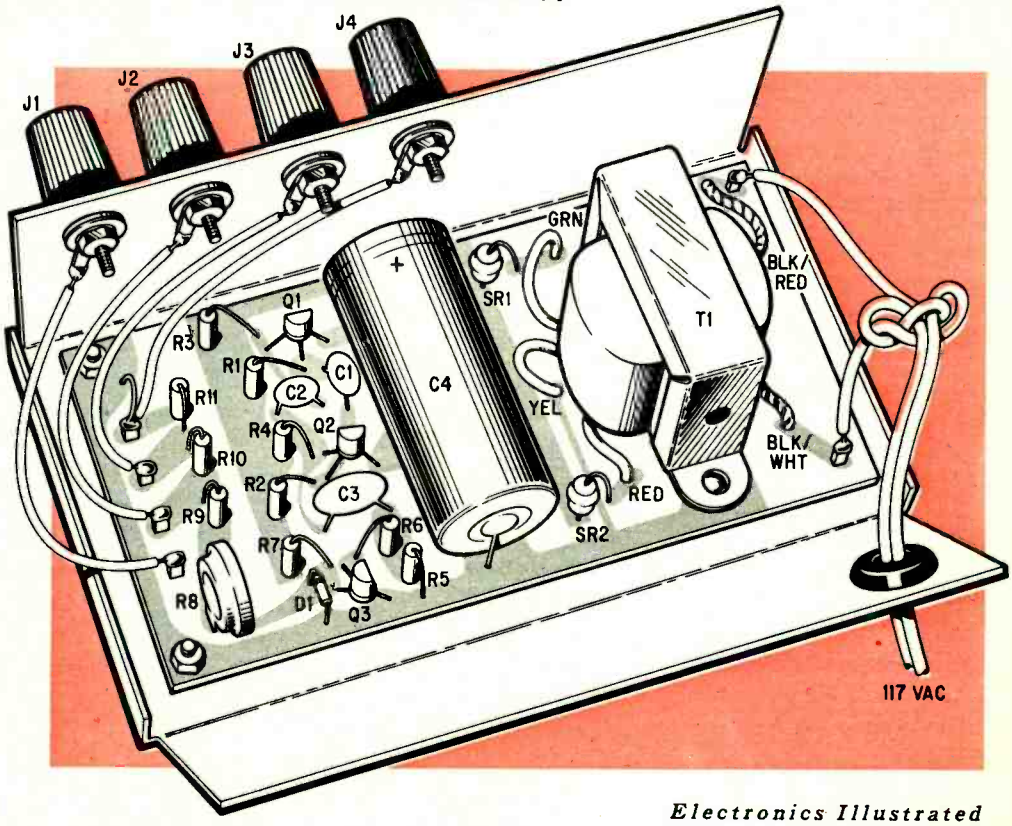


Fig. 1—Wire T1 into circuit as shown if you buy transformer specified in Parts List. Other transformers capable of supplying 28 VAC, centertapped, may have wires colored differently. Wire them into circuit accordingly.



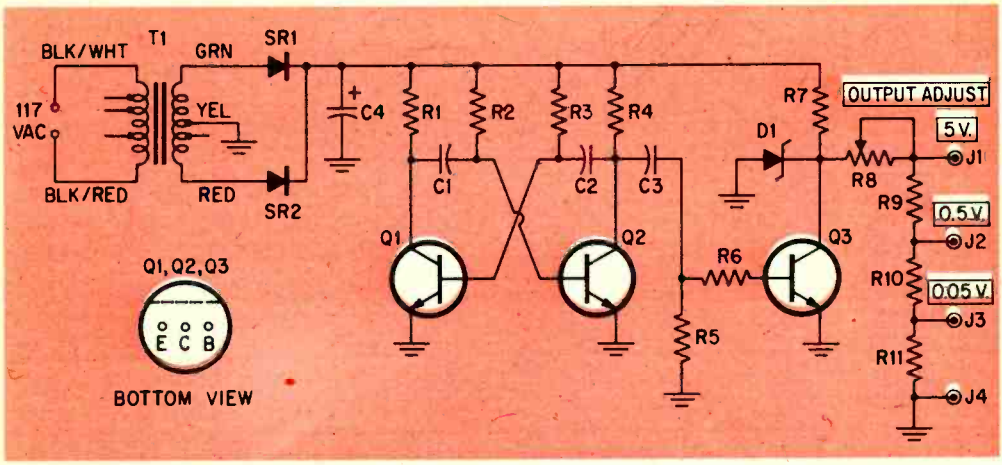


Fig. 2—Schematic of oscilloscope calibrator. If perfectly symmetrical waveform is desired, substitute pot for either R2 or R3. Miniature 250,000-ohm, linear-taper pot is fine for this purpose. Adjust pot until positive-going waveform takes as much space as negative-going waveform on oscilloscope's graticule.

PARTS LIST

C1,C2—.01 μf 75 V disc ceramic capacitor
C3—.1 μf 75 V disc ceramic capacitor
C4—2,000 μf, 25 V electrolytic capacitor (see text)
D1—Zener diode; 6.2 V @ 1 watt (Motorola HEP-103)
J1-J4—Insulated five-way binding posts (see text)
Q1-Q3—2N3391 or equiv.
Resistors: ½ watt, 10% unless otherwise specified
R1,R4—33,000 ohms
R2,R3,R5—100,000 ohms
R6—1,000 ohms
R7—680 ohms (see text)
R8—3,000-ohm trimmer pot. (Mallory type MTC33L1)
R9—910 ohms, 5%
R10—91 ohms, 5%
R11—10 ohms, 5%
SR1,SR2—Silicon rectifier: 50 PIV @ 100 ma.
T1—Low-voltage rectifier transformer; secondaries: 10/20CT/40CT @ .035 A. See note below.
1—2¼ x 3 x 5⅛-in. cabinet
Misc.—Printed circuit materials, solder, wire, etc.

Note: T1 available from Allied Industrial Electronics, 2400 W. Washington Blvd., Chicago, Ill. 60612. Order stock No. 705-0126. $5.47 plus shipping charges and tax.

Nothing is critical. For example, capacitors C1 and C2 can be any disc or Mylar type. A mismatch in component value will have no effect on performance. The unit shown was made with surplus grade capacitors.

Any silicon NPN transistor type works in this project if it is similar to the 2N3391 and has a gain (Beta) between 250 and 500. Do not use transistors with a Beta rating less than 250.

Capacitor C4 can have any rating from 500 to 2000 μf. Use the highest value capacitor that fits on the printed circuit board. Similarly, zener diode D1 can be any 1-watt zener rated between 6.2 and 8.4 V.

Construction. First, you'll have to make the pc board. Cut a piece of copper-clad board (any type) to 2½ x 4⅞-in. Scrub the copper clean with a strong household cleanser. Place a piece of carbon paper, carbon side against the foil, over the board and secure the board and carbon under the supplied template with tape.

Using a sharp pointed tool such as an ice pick, indent the foil at each component hole by forcing the point of the tool through the template into the foil. Then trace the outline of the foil areas with a ball-point pen. After removing the board from the template and carbon with the resist fill in the outlined areas.

Allow the resist to dry for at least 15 minutes and then immerse the board under at least ¼ in. of etchant. Let the board etch for about one hour, all the while agitating frequently. When all the excess copper is removed, rinse the board thoroughly under running water.

Drill the mounting holes for power transformer T1 with a No. 27 bit. Secure T1 with No. 4 or No. 6 hardware. Use a No. 50 bit to drill R8's mounting holes and for the push-in terminals used. Last of all, use a No. 57 or No. 58 bit for all other component holes.

Although the exact placement of the board

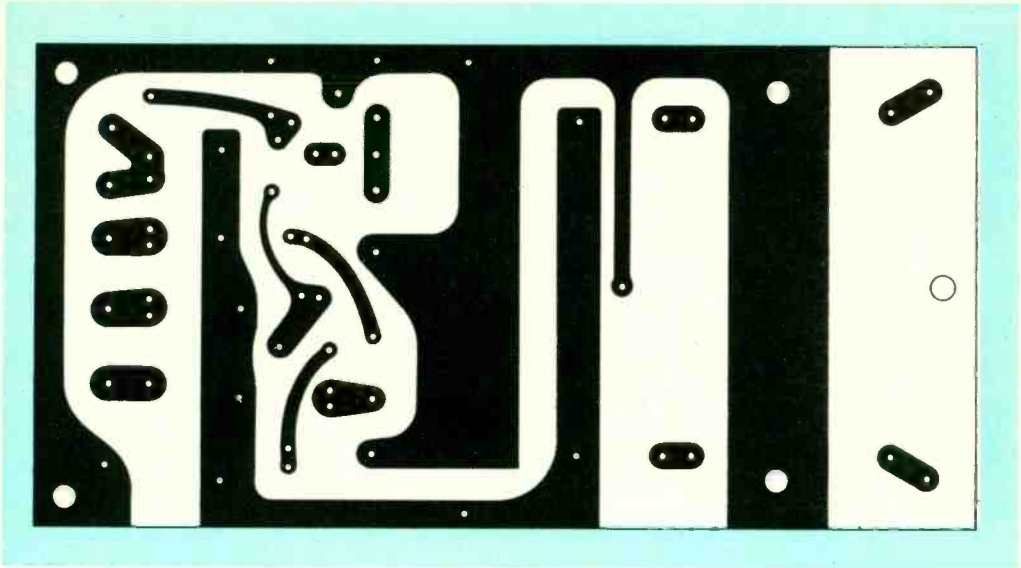


Fig. 3—Full-size printed-circuit board template. Follow instructions given in text to make pc board.

Low-Cost Scope Calibrator

is up to you, mounting holes are indicated on the pc board template. Position the corner holes at least ¼ in. from the board edges. If you plan to mount the board in a 2¼ x 3 x 5⅛-in. cabinet as shown, drill a single hole between the AC input terminals.

Mount all components to the printed-circuit board except for capacitor C3. Zener diode D1's leads are at least ⅜-in. long to avoid heat damage while soldering. Make certain D1's polarity is correct. The end marked with a white or silver band connects to Q3's collector and indicates D1's cathode terminal.

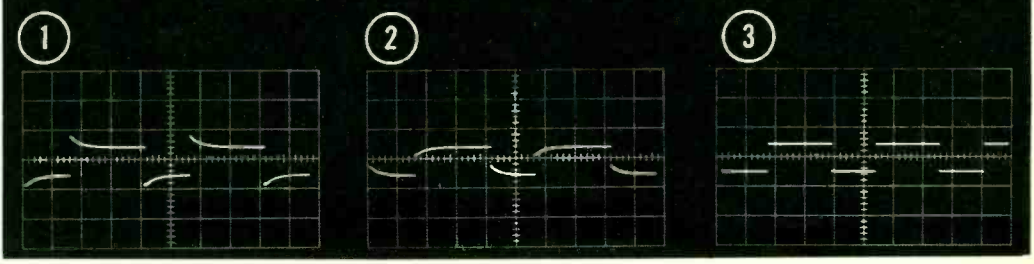
Temporarily solder a power cord to the AC terminals and connect a voltmeter (set to the 10 VDC scale) across D1. Apply power to the calibrator. The voltmeter should indicate D1's exact rating. For example, if the zener is rated at 6.2 V, the meter reads (within normal tolerance) 6.2 V.

If you have used a zener rated from 7.1 to 8.8V, it is possible that R7 will limit the zener current. If the voltage across D1 is less than its known rating, lower R7's value to 470 ohms, 1 watt. When you are certain the zener voltage is correct, remove power and install capacitor C3.

If the PC board is installed inside a scope, output ground terminal J4 is not needed. If the board is installed in a metal cabinet, jack J4 must be included. Jacks J1-J4 can be any-

[*Continued on page* 97]

Fig. 4—Picture 1 shows input attenuator adjusted for undercompensation—leading edge is peaked. Picture 2 shows overcompensation, and some waveform droop. Picture 3 shows proper waveform.



The El Ticker

UNEXPECTEDLY bowing to the profit squeeze, top management at CBS has decided to abandon its EVR (electronic video recording) videocassette system aimed primarily at industrial/institutional markets. Marketing and manufacturing (including film processing) rights are being sold to a British conglomerate called EVR Partnership in Europe, with CBS retaining patent royalty rights. Since most companies now are concentrating on products and services that bring a quick return for an invested dollar, the videocassette industry may be in for even more trouble. Business is that slow.

★ ★ ★

At a session of the Fall Joint Computer Conference held last November in Las Vegas, results of a survey based on 1,000 telephone interviews were presented. Subject of the survey: The Public's Attitudes towards Computers. Seventy-one percent of those interviewed felt that computers had made life better for everyone. However, major concerns were voiced regarding computers and the resulting invasion of privacy, increasing dehumanization, too much dependence on machines and the danger of unemployment due to automation.

★ ★ ★

A noted radar scientist, Dr. Peter Swerling, recently predicted that the '70s will witness the development of machines—specifically computers—that talk to one another without human control. This machine-machine interface will pose extraordinary problems for people working in both the military and business. Key to the operation of these machines is multiple-input sensors such as are found in ground-to-air and ballistic-missile defense systems.

★ ★ ★

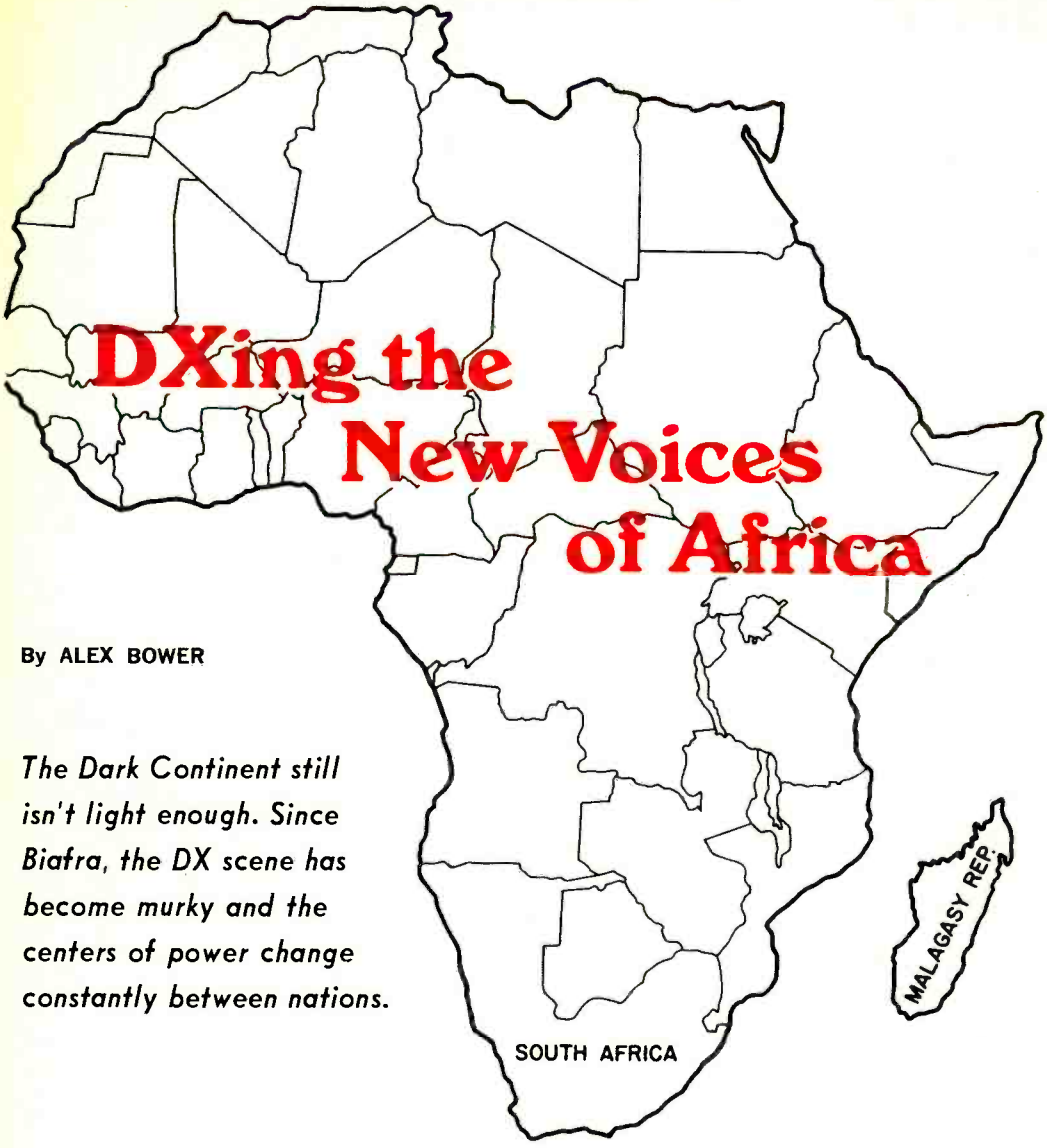
New rules which would require hi-fi and stereo manufacturers to specify the output power of every amplifier have been postponed by the Federal Trade Commission until 1973. The new requirements, when adopted, will ensure that all advertisements and labels on hi-fi and stereo gear will disclose the continuous rms output power of the amplifier. This should bring to an end such misleading claims as peak and instantaneous power and make shopping comparisons easier.

★ ★ ★

The Federal Trade Commission also has imposed some new restrictions on television set advertising which require that the size of each TV screen be clearly indicated by the manufacturer. However screen size may be measured—horizontally, diagonally or whatever—this information must be spelled out without abbreviations in the primary description of the set.

★ ★ ★

A non-memory, 70-position detent tuning device for UHF television channels 14 through 83 has been approved by the FCC for use until July 1, 1974. The tuner must have a display for all channel numbers or at least have an indicator mark between every other number, and for each channel, the tuner must not vary from the correct frequency by more than 3 mc. After July 1, 1974, the FCC expects all sets to have detent UHF/VHF tuners with AFC and a channel-selection mechanism capable of pulling in each station within the range of the AFC circuits.



DXing the New Voices of Africa

By ALEX BOWER

The Dark Continent still isn't light enough. Since Biafra, the DX scene has become murky and the centers of power change constantly between nations.

THE SECRET of successful DXing is knowing which targets are hot and then staying on top of these select few. However, in Africa it seems that every two or three years a new crop of nations comes to international prominence. In the mid and late '60s the hot spots were Botswana, South Africa, Rhodesia, Zambia, Nigeria and Biafra. Now the list is highlighted by Swaziland, the Malagasy Republic (Madagascar), both mainland Guineas, and possibly Sierra Leone.

DXers eagerly awaited action from Swaziland throughout 1971. In January, Trans World Radio announced plans to build a high-power relay in this tiny kingdom. Then, in August, TWR shook up a lot of people by announcing that its new station would be built in the Republic of South Africa instead.

Simultaneously with the TWR bombshell, Mark L. Wodlinger, president of Intermedia, Inc., announced plans to build a commercial station in Swaziland

GUIDE TO NEW AFRICAN VOICES			
Freq.(kc)	Station	Location	Time (EST)
3250	R. Springbok	Bloemfontein South Africa	night
3278	R. Clube de Mocambique	Lourenco Marques Mocambique	night
3316	R. Sierra Leone	Freetown	0100
3997	R. Springbok	Bloemfontein	night
4854	R. Clube de Mocambique	Lourenco Marques	night
4910	La Voix de la Revolution	Conakry, Guinea	night
4970	R. Conakry	clandestine	0130
5040	Emissora Provincial	Bissau, Portuguese Guinea	1800
5980	R. Sierra Leone	Freetown	0100
6035	Nigerian Broadcasting Corp.	Enugu, Nigeria	0000
6080	Radio RSA	Bloemfontein	evenings
6143	Nigerian Broadcasting Corp.	Calabar, Nigeria	0000
6195	R. Springbok	Bloemfontein	night
7125	La Voix de la Revolution	Conakry	night
9560	Radio RSA	Bloemfontein	evenings
9650	La Voix de la Revolution	Conakry	various
9695	Radio RSA	Bloemfontein	evenings
11780	R. Clube de Mocambique	Lourenco Marques	2200
11895	R. Nederland	Madagascar	1030-1150
11970	Radio RSA	Bloemfontein	evenings
15305	La Voix de la Revolution	Conakry	various

(which is surrounded by South Africa and the Portuguese colony of Mozambique). In the U.S., Intermedia owns KBEA, a daytimer in Kansas City on 1480 kc, as well as several TV and FM outlets. Wodlinger will do business in Africa as Swaziland Commercial Radio Ltd. and beam pop music into an affluent South African market. SCR's medium-wave frequency will be—according to IRCA sources—1376 kc, with another shortwave channel on 49 Meters yet to be announced.

It's interesting to note that back in 1967 the South African government created legislation to counter the effects of stations broadcasting . . . "with the aim of endangering the country's peace, order and public safety." This law made it illegal for listeners in South Africa to quote from, publish schedules of or write to any station on the government's prohibited list.

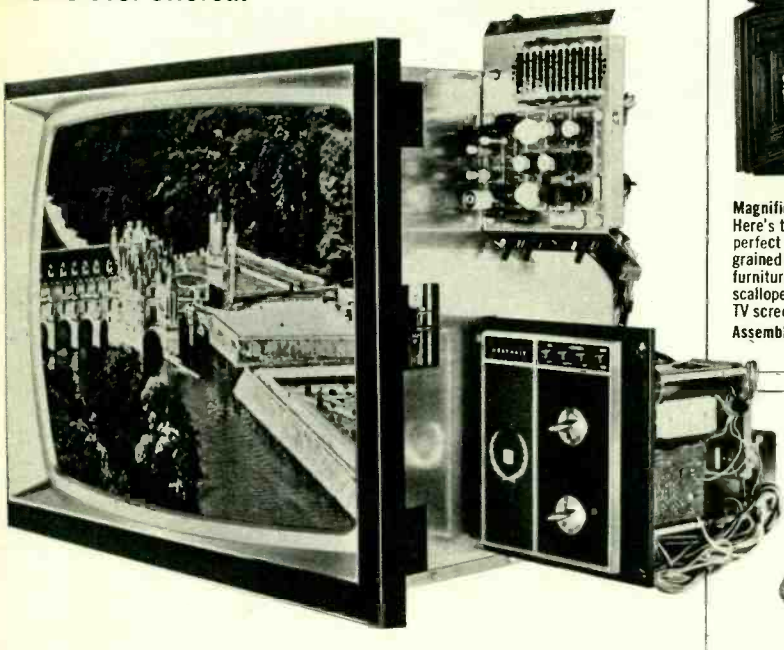
At the time, it was generally felt this legislation had been designed solely to maintain the status quo. However, a spokesman for Radio RSA later said the motivation was as follows: "The South African government introduced this legislation for three reasons—economic, technical and sociological. We have in our midst and on our northern borders, countries that have recently become independent or whose independence is forthcoming. These countries are not economically viable and it is quite feasible that they will open commercial radio stations near our borders which will beam programs into South Africa. This could have a detrimental effect on our economy. Secondly, the AM band is, as you know, very crowded . . . sociologically, the government considers it its duty, especially in a country with such a heterogenous population in various stages of development as ours, to protect our youth against entertainment of the lowest common denominator, which usually is broadcast by such commercial stations."

Just what action South Africa might take against Swaziland Commercial Radio

[*Continued on page* 101]

More kits than ever...over 350...all in your

The most advanced color TV kit we've ever offered.



The new Heathkit GR-900 25V Color TV has UHF/VHF detent tuning & varactor UHF tuner, angular tint control — more features than any other color TV kit! Better performance than any other set.

UHF/VHF detent power tuning. Push a button and you scan the channels in either direction with detent action locking in on VHF channels 2-13 and any 12 preselected UHF stations. A pushbutton selects either UHF or VHF mode, and a lighted dial indicates tuner position. And you can have full remote-control selection too for just a few dollars more.

New voltage-controlled varactor UHF tuner and specially designed VHF tuner with MOS Field Effect Transistor contribute to better fringe-area reception, increased sensitivity.

New angular tint control. A switch now gives you either "normal" or "wide angle" color demodulation to reduce tint and flesh tone change when changing stations and when programs change. Other deluxe features include "instant on" operation with override for conventional on/off operation; automatic fine tuning; adjustable tone control, and an output for playing TV audio through your stereo hi/fi system.

Exclusive Heath MTX-5 ultra-rectangular tube. It's the largest color screen you can buy anywhere, with a full 25 inch meas. diag., 315 sq. in. viewing area. You see virtually everything the station transmits, in the corners and at the sides. The specially etched face plate cuts glare, and reflection, increases contrast without sacrificing brightness, and each dot is projected through a matrix screen to stand out crisply against a solid black background.

Modular solid-state circuitry. Plug-in circuit boards and plug-in transistors make assembly, adjustment and servicing easy. There are 46 transistors, 57 diodes and four ICs — making this one of the most reliable sets we've ever designed.

Other features include automatic chroma control, adjustable video peaking, adjustable noise limiting and gated AGC.

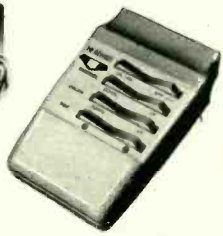
Exclusive Heath self-service built-ins. Your Heathkit GR-900 includes built-in dot generator, tilt-out convergence panel for set-up and periodic adjustments. A handy volt-ohm meter included in the circuitry helps you check your work during assembly, and can be used in conjunction with the manual for any servicing. Like all Heathkit color TVs, the GR-900 gives you complete installation flexibility. There are four beautiful Heath cabinets to choose from plus the new built-in electronic wall mount with hide-away tambour doors. Or you can custom install your GR-900. We think you'll agree, the GR-900 is truly the most impressive color receiver we've ever offered.

Kit GR-900, TV less cabinet, 125 lbs. **599.95***

CIRCLE NUMBER 3 ON PAGE 13

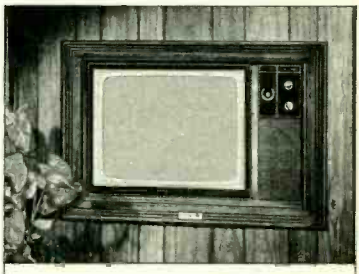
Magnificent Mediterranean Console. Here's the finest TV cabinet we offer, a perfect choice for a GR-900. Has deep-grained pecan veneers on hand-rubbed furniture grade hardwood solids. Two scalloped double-hinged doors hide the TV screen when not in use.

Assembled GRA-405-25, 100 lbs. **179.95***



Wireless Remote for your GR-900. The ultimate in armchair viewing. Gives you eight-function across-the-room control of on/off, three preset volume levels, power tuning (up or down), color, tint, UHF/VHF channel selection. Also activates Custom Wall Mount doors.

Kit GRA-900-6, 6 lbs. **79.95***



New Custom Wall Mount. Touch a button on the frame or on your Heathkit Remote Control unit and the folding tambour doors open to reveal your color TV. Kit includes everything needed to build your Heathkit GR-371MX or GR-900 into a wall.

Kit GRA-402-25, walnut finish, 50 lbs. **114.95***

Kit GRA-407-25, unfinished, 50 lbs. **109.95***

FREE '72 HEATHKIT Catalog

New AR-1500 stereo receiver **379.95***

Successor to the famed Heathkit AR-15, with impressive improvements in every critical area. 180 watts Dynamic Music Power, 90 watts per channel, 8 ohm load. Less than 0.2% IM and 0.25% harmonic distortion. Greater than 90 dB FM selectivity and 1.8 uV sensitivity. Vastly superior AM, too. It's the talk of the audio world. Order yours now.

Kit AR-1500, 42 lbs. (less cabinet). . **379.95***

ARA-1500-1, walnut cabinet, 6 lbs. . . . **24.95***

New digital multimeter

229.95*

Now, a digital multimeter that meets lab specs at a low, low kit price! 3½ digits for 100 uV resolution on 200 mV range; 1V on 1000V; 5 DC ranges (100 uV—1000V, either polarity); 5 AC ranges (100 uV—500V); 10 current ranges (100 nA—2A AC or DC); 6 resistance ranges (0.1 ohm—20 megohms.) DC calibrator supplied for 0.2% accuracy without external equipment. Can be lab calibrated to 0.1%. Don't miss this outstanding instrument value.

Kit IM-102, 9 lbs. **229.95***

New 10 MHz triggered scope

229.95*

A 5" triggered sweep scope at a low kit price you can't afford to pass up. AC—10 MHz response, calibrated attenuator, 50 ns sweep rate with magnification, AC-DC coupling, 50 mV sensitivity. One of the outstanding scope values on the market. Order one for your ham shack, shop, lab or classroom, today.

Kit IO-103, 37 lbs. **229.95***

The better-than-ever '72 Heathkit Catalog has the world's largest selection of fun-to-build, money-saving electronic kits...including color TV, stereo/hi-fi, organs, home appliances, engine tune-up tools, radio control, portables, shortwave, marine gear, metal locator, instruments, hundreds more. If you don't have this catalog, you've missed seeing over 50 new kits, introduced since the last edition. Send today for your free copy.

New...Heathkit solid-state 100 MHz counter...only 269.95*

With the IB-1101, Heath closes the price gap in high frequency counters. Till now, "low cost" counters were confined pretty much to the 15 MHz range. Instruments above that range were complex, costly, and often more counter than you could ever use. Now, with the IB-1101, you have a truly low-cost counter in kit form with 1 Hz to 100 MHz capability and a list of features to rival counters costing much more. Compare for yourself.

Exclusive Heath-designed input circuit accepts input levels from less than 50 mV to over 200V, depending on frequency, without damaging the instrument; full 5-digit readout can be expanded to 8-digit capability with range selector and overrange circuitry; decimal point automatically positioned with range selection; MHz, kHz, overrange and gating conditions indicated by illuminated legends on front panel; one megohm input impedance & low input capacitance minimize possibility of circuit loading; all solid-state circuitry with cold cathode readout tubes for instant operation; count storage circuitry gives non-blinking or count-up readout, changing only with count; stable time-base crystal has better than ±3 ppm from 17° to 32° C; dual primary, 3-wire line cord & regulated supply for stable operation over long periods. About 10 hrs. assembly time puts the IB-1101 together. The 26 digital IC packages & readout tubes plug into sockets. All other components, including shielded MOSFET, 10 silicon transistors, 9 diodes & 2 zener diodes mount neatly on one double-sided fiberglass board. If you've been putting off buying that better counter because you "couldn't afford it,"...you've just lost your excuse. Order your IB-1101, today!

Kit IB-1101, 8 lbs. **269.95***

Send for your FREE 1972 Heathkit Catalog today

HEATHKIT
Schlumberger

HEATH COMPANY, Dept. 39-5
Benton Harbor, Michigan 49022

☐ Please send FREE Heathkit Catalog.

☐ Enclosed is $_____, plus shipping.

Please send model(s)_____

Name_____

Address_____

City_____ State_____ Zip_____

Prices & specifications subject to change without notice.
*Mail order prices; F.O.B. factory. CL-430-R

HEATHKIT ELECTRONIC CENTERS – **ARIZ.:** Phoenix, 2727 W. Indian School Rd.; **CALIF.:** Anaheim, 330 E. Ball Rd.; El Cerrito, 6000 Potrero Ave.; Los Angeles, 2309 S. Flower St.; Redwood City, 2001 Middlefield Rd.; San Diego (La Mesa), 8363 Center Dr.; Woodland Hills, 22504 Ventura Blvd.; **COLO.:** Denver, 5940 W. 38th Ave.; **FLA.:** Miami (Hialeah), 4705 W. 16th Ave.; **GA.:** Atlanta, 5285 Roswell Rd.; **ILL.:** Chicago, 3462-66 W. Devon Ave.; Downers Grove, 224 Ogden Ave.; **KANSAS:** Kansas City (Mission), 5960 Lamar Ave.; **MD.:** Rockville, 5542 Nicholson Lane; **MASS.:** Boston (Wellesley), 165 Worcester St.; **MICH.:** Detroit, 18645 W. Eight Mile Rd. & 18149 E. Eight Mile Rd.; **MINN.:** Minneapolis (Hopkins), 101 Shady Oak Rd.; **MO.:** St. Louis, 9296 Gravois Ave.; **N.J.:** Fair Lawn, 35-07 Broadway (Rte. 4); **N.Y.:** Buffalo (Amherst), 3476 Sheridan Dr.; New York, 35 W. 45th St.; Jericho, L.I., 15 Jericho Turnpike; Rochester, Long Ridge Plaza; **OHIO:** Cincinnati (Woodlawn), 10133 Springfield Pike; Cleveland, 5444 Pearl Rd.; **PA.:** Philadelphia, 6318 Roosevelt Blvd.; Pittsburgh, 3482 Wm. Penn Hwy.; **TEXAS:** Dallas, 2715 Ross Ave.; Houston, 3705 Westheimer; **WASH.:** Seattle, 2221 Third Ave.; **WIS.:** Milwaukee, 5215 Fond du Lac.

CIRCLE NUMBER 3 ON PAGE 13

Super Booster for SWLs

Work all continents with our low-cost RF preamp and a budget shortwave rig.

By HERB FRIEDMAN WITH even the best receiver at his disposal, the devoted SWL has—posted on his roster of most-wanted DX—at least one signal too weak to be heard. And if the DXer is saddled by a budget receiver, many signals can go unlogged. If you want to work the world, connect our Super Booster for SWLs between your skyhook and rig. Then there'll be mighty few stations you can't log if your antenna picks them up.

The Super Booster is a high-gain, tuneable RF preamplifier covering the international shortwave and ham bands between 5 and 30 mc. The preamp provides about 40 db overall gain—that's almost 7 S-units—the exact value will depend on your receiver's input circuit.

Using a dual-gate, diode-protected FET, the preamp is virtually immune to electrical damage caused by man-made or natural signal overload conditions.

Transistor Q2, connected as an emitter follower, provides a low impedance match to

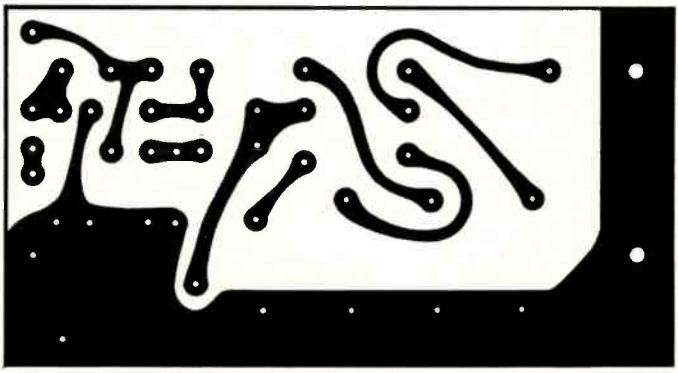


Fig. 1—Full-size template of printed circuit board. As you etch your own pc board, follow pattern exactly as shown. Preamp has sufficient gain to break into oscillation if layout of pc board isn't carefully copied. Work slowly.

Map courtesy of
The Old Print Shop, New York

your receiver input. It also provides about 10 db overall power gain.

Our RF preamp is powered by an inexpensive transistor-type 9-volt battery. Since battery drain is only 2 ma. the circuit will work with almost full efficiency at voltages as low as 4 volts. This allows the battery to last many months, even under continuous service.

Preamp Construction. *Construction is critical.* Because of the very high overall circuit gain, printed-circuit board layout is critical. Assemble and wire the preamp exactly as described. It will be stable with no spurious oscillations upsetting performance. If the layout is changed, the preamp will most likely break into oscillation at the higher frequencies. Do *not* make substitutions, not even for the specified cabinet.

First step is to prepare the printed circuit board. Cut a piece of copper clad board (any type) to 3½ x 1¾-in. Scrub the copper clean with steel wool or a household cleanser. Dry thoroughly, and then place a piece of carbon paper—carbon towards the copper—over the board.

Tape the board in position under our full-scale template. Take a sharp, pointed tool such as a scribe or ice pick, and indent the copper at each component mounting hole by forcing the point of the tool through the template into the copper foil.

Using a ball point pen, trace the foil outlines. Use sufficient force or pressure to insure that the pattern will be completely transferred to the foil. After tracing the foil outline, remove the board from under the template.

Fig. 2—Shortwave antenna connects to five-way binding post on righthand side of cabinet. Preamp output is taken from jack J1. And don't connect spiral ground wire to J1.

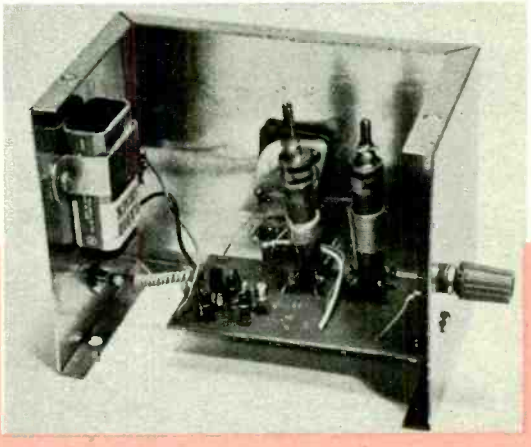
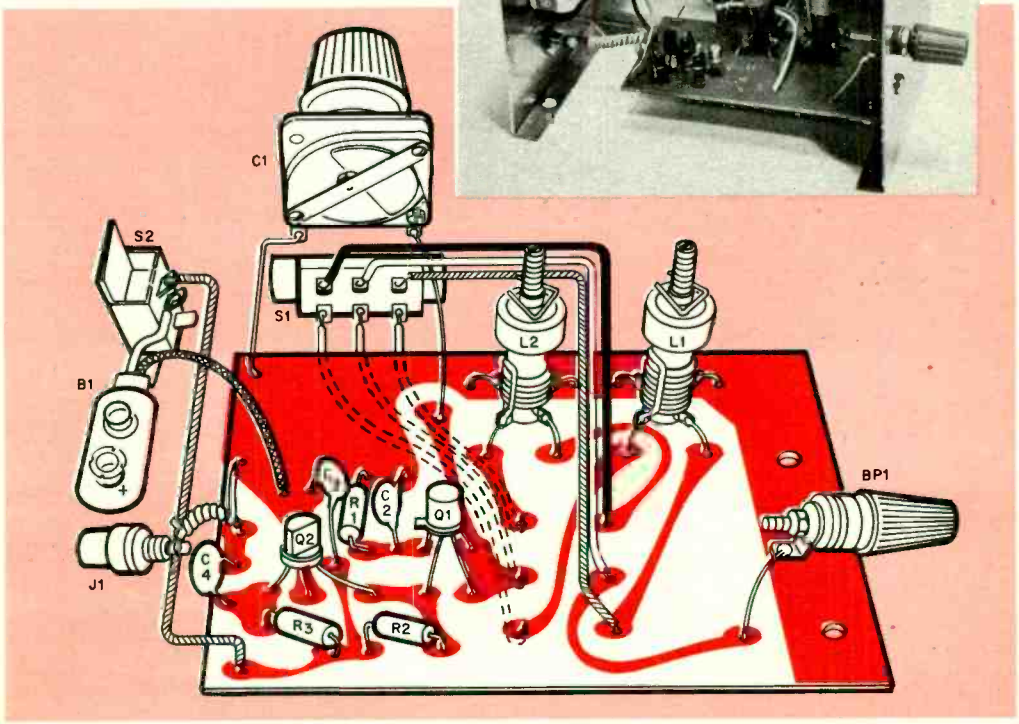


Fig. 3—Short leads are the rule on this high-gain RF preamp. Note that the shield running to jack J1 consists of 12 turns of insulated hook-up wire, connected to ground only at the printed circuit board.



Super Booster for SWLs

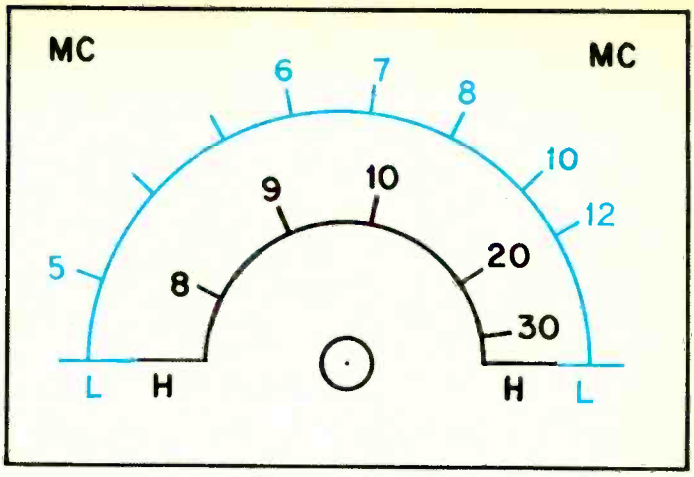


Fig. 4—Cement this full-size dial scale onto the cabinet if you don't want to calibrate your own. Although dial scale is not linear, this doesn't affect performance of preamp.

Fill in the foil outlines with a resist pen. Allow the resist to dry for about 15 minutes and then immerse the board (face up) under at least ¼ in. of etchant.

Agitate the resist container every 5 minutes. After about 20 minutes, check the board from time to time. When all the ex-

[*Continued on page* 97]

PARTS LIST

B1—9-V transistor radio battery (Burgess type 2U6 or equiv.)
BP1—5-way insulated binding post
C1—365 $\mu\mu$f miniature tuning capacitor (Calectro A1-233 or equiv.)
C2-C4—0.001 μf, 50 V miniature ceramic capacitor
J1—Phono jack
L1—5-18 mc. antenna coil (J. W. Miller type C-5495A)
L2—12-36 mc. antenna coil (J. W. Miller type D-5495A)
Q1—Field effect transistor (RCA type 40822)
Q2—Npn transistor (General Electric type 2N5355)

Resistors: ½-watt, 10% tolerance unless otherwise indicated
R1—470 ohms
R2—4,700 ohms
R3—2,200 ohms
S1—DPDT slide switch
S2—SPST switch
1—3 x 4 x 5-in. aluminum cabinet
1—Battery terminal connector

Note: A kit containing these components is available from Custom Components, Box 153, Malverne, N.Y. 11565. Cost is $15.95 plus 90¢ for postage and handling. New York state residents must add sales tax. Add $2 for Canadian orders.

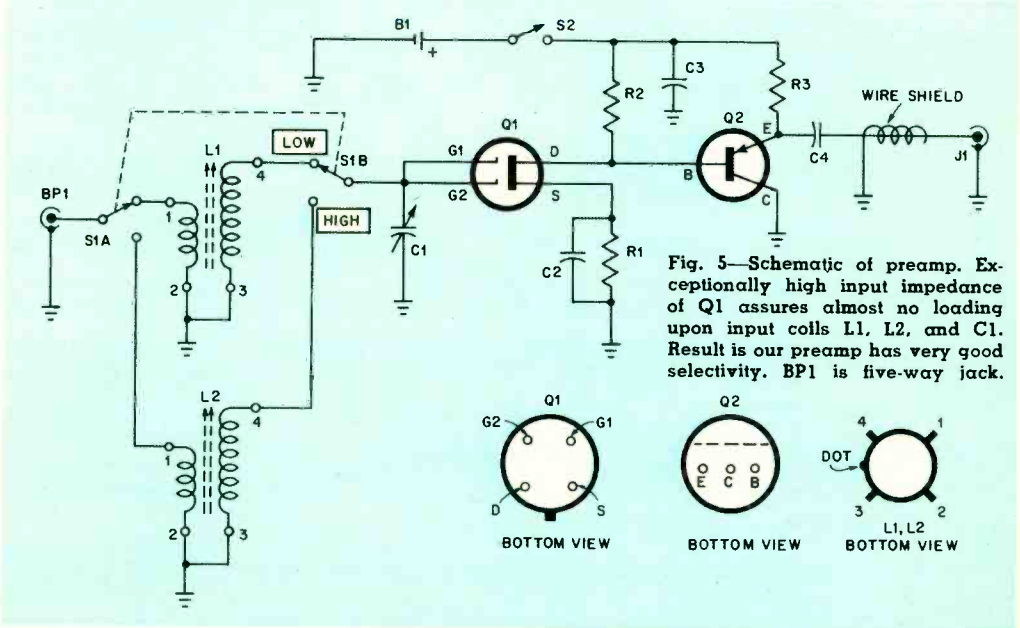


Fig. 5—Schematic of preamp. Exceptionally high input impedance of Q1 assures almost no loading upon input coils L1, L2, and C1. Result is our preamp has very good selectivity. BP1 is five-way jack.

The Listener

By C. M. Stanbury II

TWR to South Africa?

IN THIS issue, EI reports on Africa's current hot spots. One item falling into this category is Trans World Radio's announcement that its newest high-power relay will be built in the Republic of South Africa. The Pretoria government never before has allowed a privately owned broadcast station to operate from its territory. One wonders what service TWR has performed in the past, or promised for the future, to rate such a concession.

Meanwhile, Trans World Radio's 500-kw medium-wave transmitter on the island of Bonaire continues to act as a relay for Radio Nederland. Radio Nederland's world radio service is broadcast on 800 kc from 1800 until 1930 EST followed by TWR's religious programming. At times this outlet can be logged on any general-purpose receiver throughout most of North America. There are no U.S. stations on the frequency at night (except in Alaska) and even when there's semi-local QRM from a Canadian or Mexican transmitter, TWR often makes it through.

Radio New York Worldwide, the oldest shortwave station in the U.S. and this country's only commercial HF broadcaster, has been sold to Good Family Stations, Inc., a group of religious broadcasters operating AM and FM stations in the northeast.

Radio New York, whose callsign is WNYW, operates four shortwave transmitters at Scituate, Mass. Its programs are beamed to Latin America, Africa and Europe. During the past four years WNYW has been an international affiliate of CBS and has been carrying CBS news on the hour and half-hour, as well as selected CBS in-depth news programs. Other programming has included recorded music supplied by WRFM, New York's ranking FM station.

WNYW, formerly WRUL, has been in operation since 1927. After many years of private ownership under the late Walter Lemmon, the station was sold to Metromedia, Inc. in 1960. Several years later, the Bonneville International Corp. of Salt Lake City, Utah, a Mormon Church organization, purchased the station. It has continued to operate in the red. Bonneville also owns WRFM.

Under Good Family Stations ownership, WNYW will no longer accept commercial programming of any kind and it plans—when current contractual obligations have expired—to adopt an entirely religious format.

Radio New York has had a varied, and at times mysterious, history. Many people in broadcasting circles have believed for years that the station was owned and operated by the CIA. This was not the case, however, as WRUL was never actually involved in secret radio operations. During and immediately after the Cuban crisis, the station did carry programs beamed to Latin America which were sponsored by CIA-backed refugee groups, but this was as close as the station actually got to CIA control.

In 1967, a fire of mysterious origin destroyed the transmitter site and the station nearly went off the air. Commercial facilities provided by RCA Communications kept the station operating on assigned frequencies until new transmitters could be purchased.

All three privately owned shortwave broadcast stations operating in the U.S. now have religious formats. These are: World International Broadcasters, WINB, located at Red Lion, Penn.; KGEI, owned by the Far East Broadcasting Corp. and transmitting from the San Francisco area, and WNYW.

The problem of how to prove a reception report for any station logged has always been tricky. Many beginning SWLs don't understand the problem, while some techniques employed by veteran DXers are rapidly becoming obsolete. For broadcast stations using only one or two transmitters, a description of programs heard is still the only answer. But this means something more specific that telling a rock station they were playing "popular rock music from 11:15 to 11:45 p.m."

However, when a DXer tackles giant electronics nets such as Radio Moscow in its various East European disguises (R. Espana Independiente, R. Budapest, R. Prague, etc.)—or the Voice of America—program descrip-

[*Continued on page* 104]

Heathkit's IC-2008 desk-top electronic calculator kit costs $129.95 and takes just eight hours to build. Two circuit boards are all there is.

A Home Calculator in Kit Form

Now, for homeowners, hobbyists, students and housewives—a desk-top electronic calculator you can build from a kit for under $150!

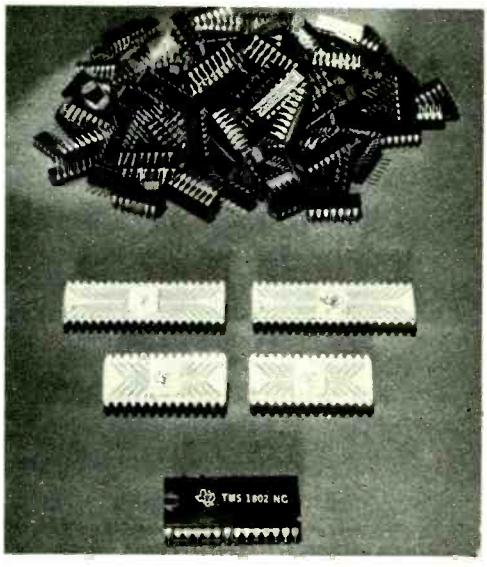
FOR MOST of 1971 you couldn't buy an electronic mini-calculator—a portable machine that does the basic calculations of addition, subtraction, multiplication and division—for under $300. The least expensive, four-function, pocket-size electronic calculators are available from manufacturers such as Sharp, Sanyo, Canon, Busicom, SCM, Sony, Toshiba and Friden (note the lineup from Nippon), but they have prices tagged at $325 and up. These small machines are aimed mostly at businesses, offices and banks.

Now, however, the homeowner, student, housewife and small businessman can get into the act, too, and buy American to boot. Heathkit has just introduced its Model IC-2008 eight-digit, desk-top calculator which sells for $129.95 and, it is said, takes only eight hours to build.

The IC-2008, a beautiful looking instrument, uses only one complex, large-scale IC made by Texas Instruments Inc. and it will perform addition, subtraction, multiplication and division and display up to eight-figure totals on its cold-cathode (Numitron) display tubes.

Since practically all the circuitry is contained on the TI chip—which measures less than a quarter of an inch square and replaces over 6000 transistors—there are only two circuit boards to solder, plus you get Heathkit's famous instructions to guide you.

The calculator allows you to perform algebraic operations with positive and negative numbers and there is a provision for constant or chain calculating. By pushing the



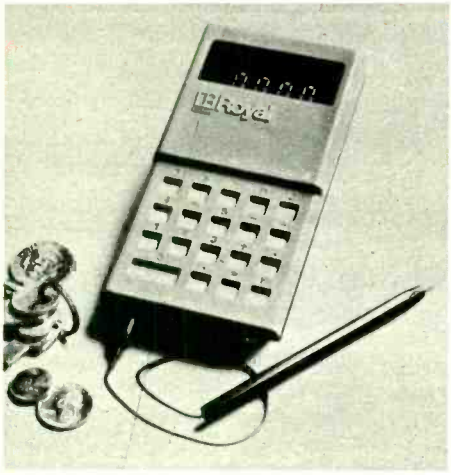
Texas Instruments' Model TMS-1802 one-chip digital circuit (bottom) is responsible for many low-cost calculators. It replaces all of the ICs above.

constant (K) key you can multiply or divide a series of figures by one preselected number or simply multiply a constant by itself for squaring or taking it to some other power. Note that the calculator's memory holds all the data until you push the total key. Also, since the calculator automatically indicates a minus result it can be used to balance the family checkbook.

Decimal placement is either fixed or floating. Via a thumbwheel switch you can place the decimal point in one of eight fixed positions (the calculator automatically rounds off the total to that point), or you can select the floating decimal mode for totals you wish to

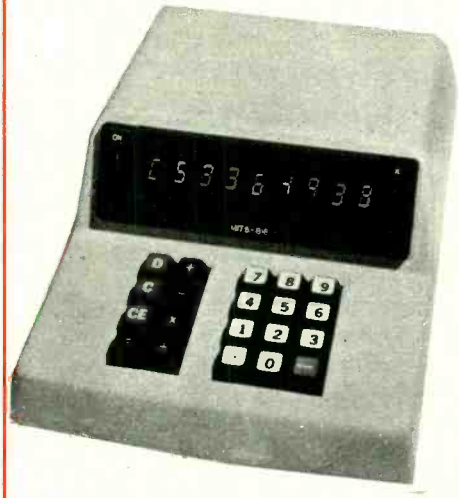
[*Continued on page* 98]

Other Home Calculators You Can Buy for under $200.



Litton's Royal Digital III pocket calculator uses rechargeable batteries, has eight-digit capacity, requires a special pen stylus and costs $139.95.

Ragen Precision Industries electronic calculator costs $99.95, has eight-digit capacity, works on ordinary batteries, has liquid-crystal display.



Electronic calculator available either in kit form or assembled from Micro Instrumentation and Telemetry Systems (Albuquerque, N.M.). $160.

Bowmar Industries and Craig Corp. jointly are marketing a pocket-size calculator which sells for around $200. Device uses an LED display.

A New System for 4-Channel FM

Lou Dorren, a 23-year-old inventor, may or may not have the answer to the broadcaster's problem of how to put four-channel stereo FM out over the airwaves. Here's how his idea works.

By PAUL RICHARDS

HI-FI led to stereo, and stereo records and tapes finally led to stereo FM broadcasting. Will the four-channel boomlet (see BIG NOISE IN FOUR-CHANNEL, Nov. '71 EI) lead to quadraphonic FM?

The answer seems now to be affirmative—yes, we'll have regular four-channel FM programs sometime in the future. But right now the FCC is examining proposals and trying to make up its mind on which four-channel system to approve.

A small-scale war currently is being waged over the respective merits of *discrete* vs. *matrix* four-channel programming. In a discrete system, four physically separate channels of information (such as on four-track magnetic recording tape) are provided. In a matrix system, only two physically separate channels are used, but each is electrically treated (encoded) so that four channels of information can be obtained (Left Front, Left Rear, Right Front and Right Rear).

The benefits derived from the matrix approach are obvious—ordinary stereo equipment can be used to transmit the two coded channels containing the four channels of information and the arrangement is totally compatible with present FCC regulations governing stereocasting. The discrete approach, however, demands that additional equipment be bought to transmit four separate channels (carriers) and—since the system has to be FCC compatible—that all this information must be squeezed into the present bandwidth limitations of FM broadcasting. You're only allowed to use just so much of the spectrum (unless the FCC changes things) and no more.

Many audiophiles and engineers—who are technical purists down to their bones—feel that only discrete four-channel stereo provides true fidelity; they feel that the matrix approach produces only a *four-channel effect*. Since this argument depends greatly on psychoacoustics, a big word for plain old personal taste, the powers that be will have to fight this out.

One purist who is not satisfied with the matrix approach to four-channel FM broadcasting is Lou Dorren, a 23-year-old engineer who lives and works in California (his company is called Quadracast Systems Inc., San Mateo, Calif.). Dorren, at the tender age of 21, demonstrated his own *discrete* four-channel FM broadcasting and receiving system, the Dorren Quadraplex System, which took the industry by surprise. It also shook things up a bit because it apparently meets all FCC requirements.

How does the Dorren System work? Since it would take an engineer with a background in stereo FM multiplexing to understand the whole concept, our presentation will, of necessity, be of limited scope.

Let's start with today's two-channel method of FM stereocasting. Shown in Fig. 1 are all the audio signals which appear at an FM receiver's detector. First, there is the conventional Main Channel which contains the total audio

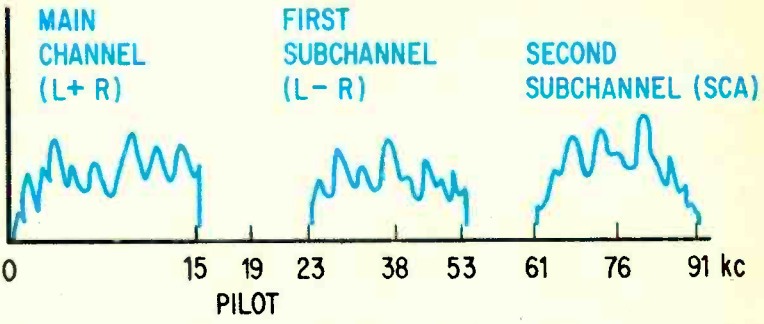


Fig. 1—Present-day stereocasting requires a 200-kc bandwith: FM transmitter can deviate ±75 kc and there's a 50-kc guard band. Spectrum of modulating signals is shown at right. Note that stereo SCA subchannel is centered on 67 kc, not 76 kc.

in the original performance—program material having a frequency range of about 50 cps to 15 kc. This provides old-fashioned mono FM receivers with a compatible (Left + Right) signal.

Additional signals for stereocasting are located further up the audio spectrum and centered on 38 kc. This is the First Subchannel, a subcarrier which bears the *difference* information (Left minus Right) hidden in the Main Channel.

What's amazing is that these Difference signals alone furnish sufficient information for the receiver to add and subtract audio information (algebraically) between main and subchannels to reconstruct the original Right and Left channels. It's just as if your stereo receiver could do an algebra problem (L + R—(L-R), etc.) and come up with the right values of L and R. We'll see later that four-channel stereo works the same way (where you have Lf, Lr, Rf and Rr) but that it's more complex.

Note that still another subcarrier is located higher in the band on 67 kc. This is the SCA (Subsidiary Communications Authorization) channel leased by commercial background-music operators (Muzak, etc.) to broadcast private programming. It is the Second Subchannel in the spectrum (shown in Fig. 1). Any discrete four-channel system has to interweave itself into this already crowded spectrum.

Looking for extra space to accommodate signals for the rear speakers, Lou Dorren fell upon a multiplex technique called *quadrature modulation*.

Communications engineers when broadcasting TV use quadrature multiplexing (where a subcarrier is used to transmit *two* modulated signals on *one* main carrier) to broadcast two color signals, called I and Q, on a 3.58-mc subcarrier which in turn modulates the main carrier. Because the I and Q signals are 90 degrees out-of-phase, their identity is maintained and they can be detected by suitable demodulating circuits inside your TV set.

Dorren does much the same thing, using circuitry he invented himself. He starts out with the same three channels, a main channel and two subchannels, but then goes back to the First Subchannel and *splits* it in two! In other words, he gets his fourth channel into the alloted bandwidth by modulating the First Subchannel with two signals that are 90 degrees out-of-phase—just like they do in color TV broadcasting. By looking ahead at Fig. 5, you will note, how-

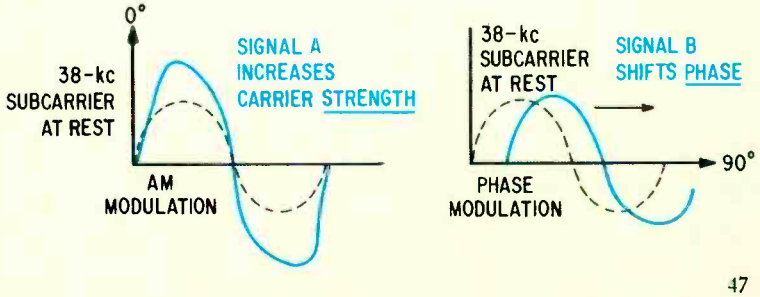
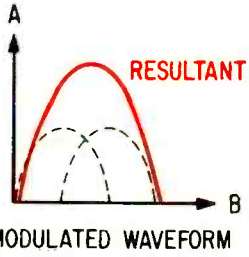


Fig. 2—Quadrature multiplexing means that two signals, A and B, can be used to modulate one subcarrier. Since signals are 90 degrees out-of-phase, one affects amplitude—the other, phase.

A New System for 4-Channel FM



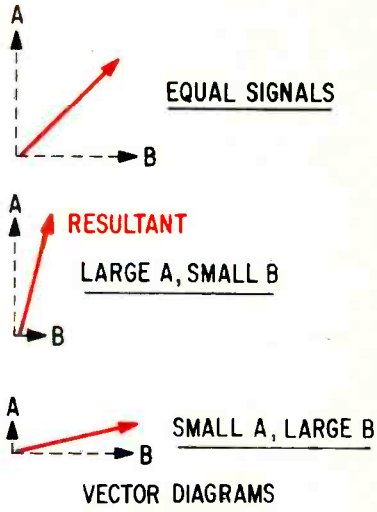


Fig. 3—Interaction of signals A and B produces waveform shown at left. Vector diagrams, however, shown at right are more representative of how phase and amplitude can affect the subcarrier.

ever, that the SCA subchannel has been sacrificed in favor of a subcarrier which contains four-channel (quadraphonic) information.

The idea behind a quadrature modulating technique is that any sine wave—like a subcarrier—can be distorted in two directions at once (see Fig. 2). Note that signal A causes the carrier to increase in amplitude, while signal B changes its phase. The carrier is being modulated along axes which are 90 degrees apart, or in quadrature.

Now take a look at Fig. 3. As both signals A and B are simultaneously applied to the subcarrier, the result is the waveform shown at the left. The resultant curve contains information from both axes. It is more convenient, however, to picture this relationship with the simple vector diagrams shown at the right. The resultant vector (a vector represents a quantity having both amplitude and direction) depends on how large or small signals A and B are. Thus, the phase and amplitude of the subcarrier will depend on the modulating signals.

This means the subcarrier's parameters will be functions of the two applied signals and that these two signals will have separate identities all the time the subcarrier and main carrier are transmitted. Since the signals retain identity they can be recovered (detected) by a suitable receiver. This is diagrammed in Fig. 4.

Here we reverse the process. The FM receiver generates a precise 38-kc reference carrier (which is synchronized to the 19-kc pilot generated at the transmitter). This reference sine wave permits the detector to distinguish phase relationships. Since the modulating signals are 90 degrees apart, the

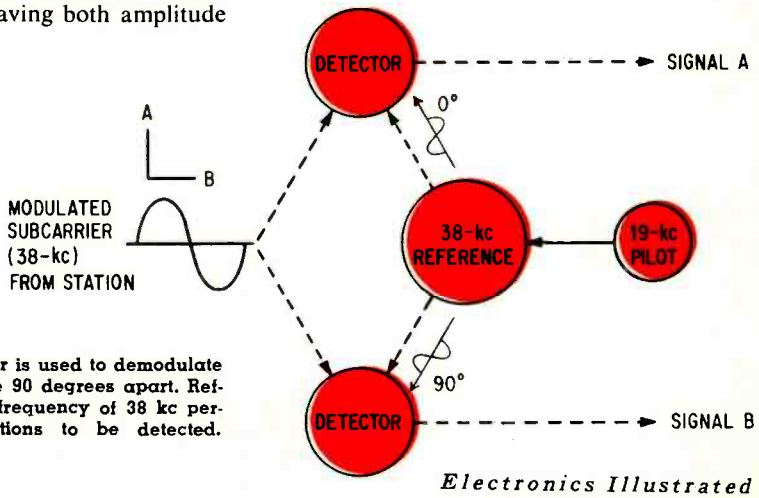


Fig. 4—Quadrature detector is used to demodulate signals A and B which are 90 degrees apart. Reference sine wave having frequency of 38 kc permits these phase distinctions to be detected.

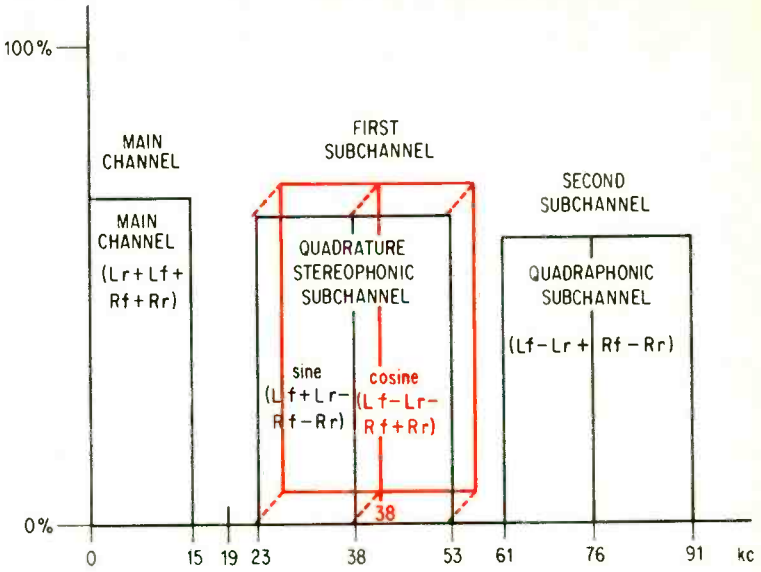


Fig. 5—Spectrum of frequencies that modulate carriers in Dorren Quadraplex System. Main Channel remains where it is, Quadrature Channel takes the place of regular stereo signal and Quadraphonic Channel replaces SCA channel that was centered on 67 kc frequency.

reference carrier is similarly split and divided into two components that are 90 degrees out-of-phase. The detector can then recover the A and B components from the subcarrier and recreate the original audio signals.

Looking now at Fig. 5, we see that the First Subchannel has undergone quadrature modulation but that both the Main Channel and the Second Subchannel (now quadraphonic) remain the same. But the Second Subchannel is now where the SCA channel used to be.

Just as the stereo (Difference) subchannel allows an FM receiver to do its algebra and come up with separate Right and Left signals, so in the Dorren system the combination of the quadrature subchannel and the quadraphonic subchannel permits a properly equipped FM receiver to do a more complex algebra problem and come up with *four* separate audio signals, Left Front, Left Rear, Right Front and Right Rear. That's really modern math!

Lou Dorren, inventor of the Dorren Quadraplex System, adjusts a quadraplex generator and FM transmitter prior to a demonstration of his system.

Without going into the details of all the algebraic equations that have to be transmitted by the four carriers and Lou Dorren's unique matrixing circuitry which recovers them in a decoding unit (which will be available commercially should the FCC approve the Dorren system), let it suffice to say that once Dorren's complex signals are combined in the receiver's detector stage you get a standard mono output, a standard stereo output, plus a quadraphonic output for four-channel stereo. Technically speaking, the Dorren Quadraplex System is fully compatible with FCC regulations.

There are, however, some important questions which remain to be answered. First, what happens to SCA programming once the 67-kc SCA subcarrier is removed? Many FM stations count on this revenue (they have salesmen who make the rounds selling SCA broadcast time). In his proposal to the FCC, Dorren describes how the SCA subcarrier could be moved up to 114 kc and then phase-locked onto the 19-kc pilot. Problem is, all SCA receivers now in service would have to be modified or replaced, which costs money. Who's going to pay?

[*Continued on page* 99]

EI Kit Report

Metrotec Stereo-4 and Heathkit AD-2002

A Pair of Four-Channel Decoders

DO you regularly read catalogs of kit manufacturers for their latest four-channel offerings? If so, you've probably seen what looks like the Electro-Voice four-channel decoder. It's been introduced by Heath and Metrotec as kit versions of E-V's Fixler/Feldman system of quadraphonic decoding.

Like the decoder built by E-V, both kits provide a master gain control, extra tape input and output jacks and a selector switch which interconnects a tape recorder to the decoder. With this switch, you may either record or monitor tape deck audio.

Since both the decoders rely upon an integrated circuit supplied by Electro-Voice, they operate in essentially the same way as the original E-V unit. But for the audio buff hoping to build his first piece of four-channel equipment from a kit, differences in construction technique and assembly manuals between the Heathkit AD-2002 and Metrotec Stereo-4 could determine which decoder the constructor builds.

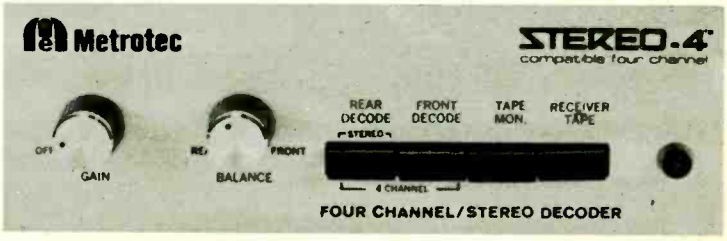
The Heathkit AD-2002, costing $29.95, is practically the Electro-Voice decoder in kit form. The Metrotec Stereo-4, priced at $49.95, is somewhat different. Added to this decoder are a couple of modifications to the E-V unit which increases the flexibility of the Electro-Voice encode/decode system.

Two push buttons, labelled *Front Decode* and *Rear Decode*, enable the listener to control the decoding functions and match them to different types of program material.

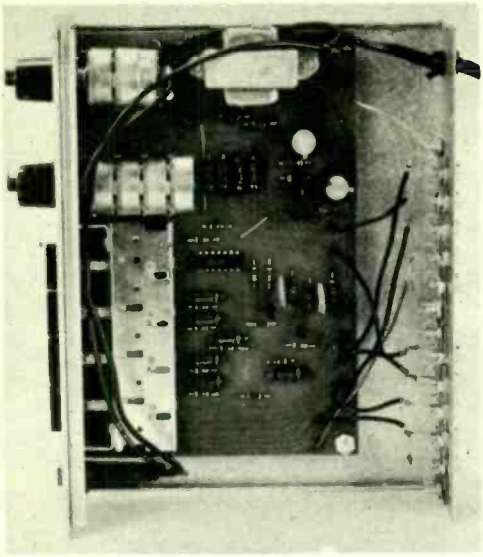
Conventional stereo sources can be presented as regular two-channel stereo with rear ambiance or as fully decoded four-channel sources. This feature is especially useful when the program source contains a soloist. With full decoding, the soloist sounds smeared, almost as if his mouth extends along the width of an entire wall.

The rear decode switch on the Stereo-4 lets you remove the soloist from the rear channels. The soloist now appears between the front speakers, sending only ambiance and hall acoustics information to the rear speakers. Since the front channel is not processed, it remains as a two-channel stereo signal.

A second feature added by Metrotec to the basic E-V design is a front-to-rear *Bal-*



Rear and Front Decode switches expand usefulness of Metrotec decoder. Depress both switches for matrixed four-channel sound. With only Rear Decode switch pushed in, unmatrixed stereo signal goes to front speakers while the rear channels receive only hall ambiance signal.



Top view of Metrotec decoder showing fairly open layout of pc board. Base diagram of Q1-Q3 is needed before soldering to board. See text.

ance control. The balance pot makes it easy when you're initially setting up your quadraphonic playback system.

Construction Notes. There were errors in both Heathkit and Metrotec assembly manuals. An addenda supplied with the AD-2002 to replace page 15 in their manual created another problem elsewhere in the assembly manual. As a consequence to a corrected diagram on this page, we found an error on page 20. In the second step in the right column, the soldering instruction should read S-3 instead of S-2.

The Metrotec assembly sheet has an error in its Fig. 1. Resistor R7, located between diode D3 and transistor Q3, should be labelled R17. Also, switch assembly S1-S4 was omitted from the Parts List. It is shown in Fig. 1. The major difference between these kits is not just a matter of price, it's the way the kits are packaged.

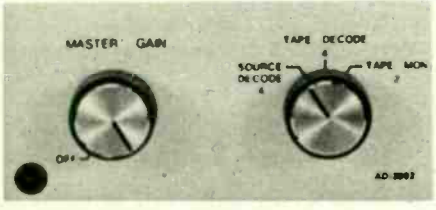
The Heathkit assembly manual is very well thought out. The technically unsophisticated kit builder should have no problem constructing the AD-2002. Parts location is clearly identified on the printed-circuit board. And all parts are properly labelled and easily identifiable. The Heathkit decoder was built in just a shade under three hours.

The Metrotec assembly sheet is not as easy to follow. This kit was probably designed for the audiophile who has already built a few projects. The printed-circuit board, for instance, is not labelled to show parts location.

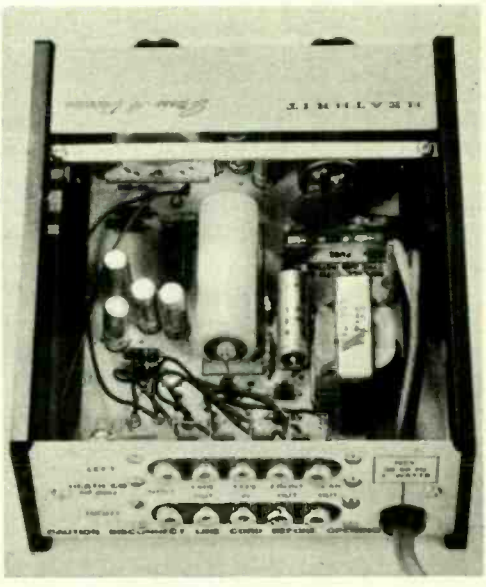
Although all components that come with the kit are banded, labelled or identified, nowhere in the assembly sheet are these parts shown to avoid ambiguity.

Better have a transistor manual on hand, too. Basing diagrams for all transistors are omitted, making it easy to improperly install these components. Lock washers are not included, and there isn't enough hookup wire.

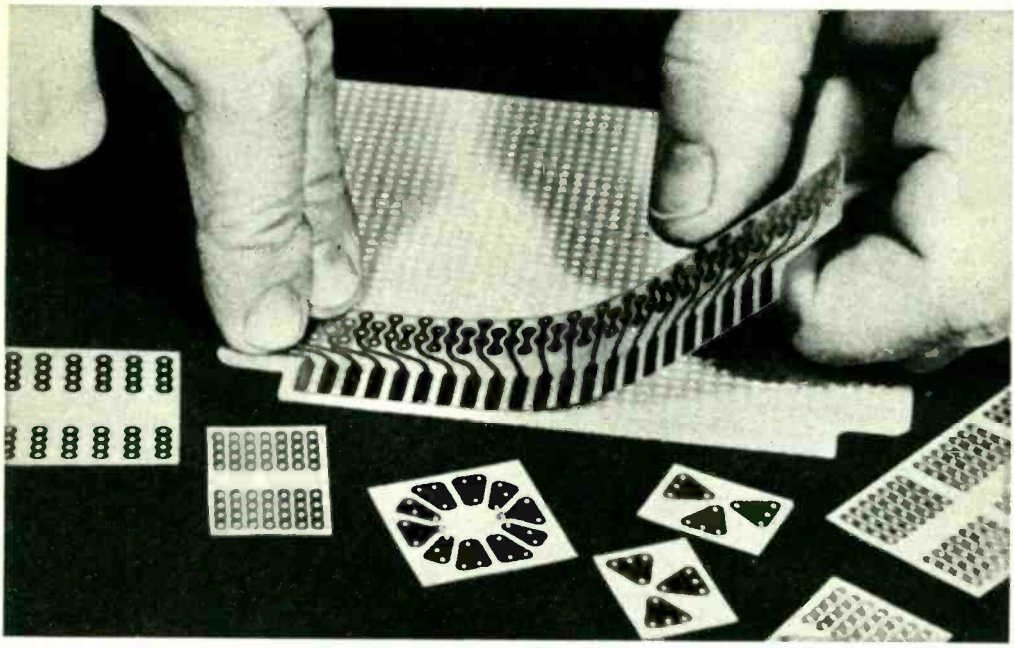
Final Thoughts. The performance of either kit cannot be distinguished from that of the original Electro-Voice decoder. Both the Heathkit AD-2002 and Metrotec Stereo-4 do a good job synthesizing four channels from nonencoded two channel stereo sources.



Heathkit front panel has only master gain pot with on/off control plus selector switch. Tape monitoring function is now handled by decoder.



Rear panel of Heathkit is easy to figure out. Although pc board is tighter than Metrotec's, all component locations are clearly marked.



How to Make Instant PC Boards

The mess of acids and resists is gone if a stick-down process makes it.

By RUFUS CARTWRIGHT

THE printed-circuit board has been one of the key elements in making the new world of solid-state electronics accessible to the hobbyist. Pinhead components with leads the size of a gnat's foot would have been impossible if all depended on point-to-point wiring.

Only problem has been a bit of sloppiness with acid resists, etching solutions and the rest when a hobbyist wanted to roll his own board. Many did not mind such a witches' brew but some did. Now there's a new product on the market that produces an item comparable to a printed circuit but without the etching process. The product is called Circuit-Stik. At the heart of Circuit-Stik are pressure-sensitive adhesive copper patterns.

These copper patterns come in the shape of integrated circuits, transistors and other components just as one finds them on the foil side of factory-produced PC boards. In the Circuit-Stik kit also comes perforated board with a .100-in. grid pattern. The holes in the copper stick-downs match those in the boards.

So, in general, to lash up a circuit, you select the patterns for the components you'll be using (2 ICs, 3 transistors, a couple of diodes, an IF transformer, etc.). The patterns come in big sheets. You cut them apart to get what you want. Next step is to remove a backing paper from the adhesive side (a razor blade helps).

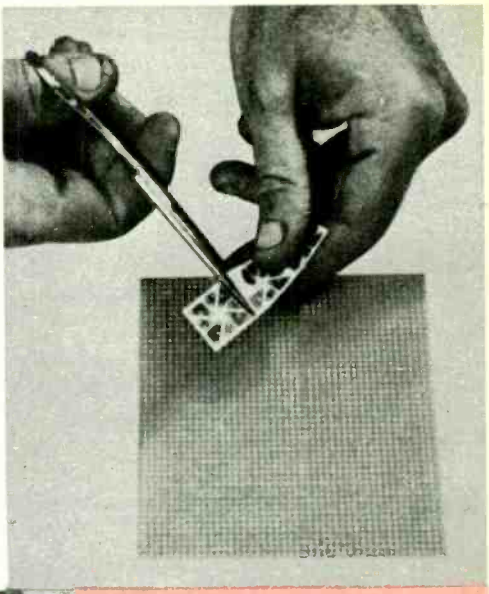
By this time you should have figured out some kind of general layout for your circuit (an RF coil on the left, then two transistors followed by an IF coil, etc.). You mount the patterns in that order, peeling away the backings and then pressing down on one side of the perf board, making sure to align all of the holes.

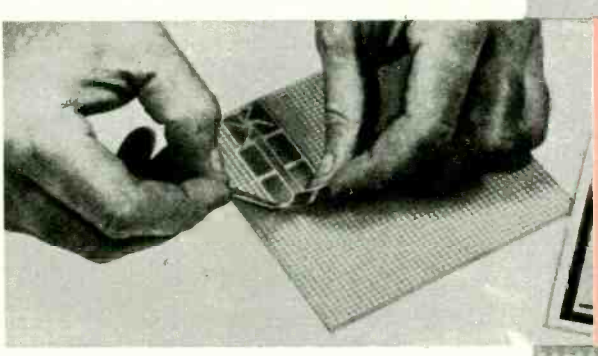
The Circuit-Stik foil takes solder just like a conventional PC board so the next step is to insert component leads from the bare side

of the board and then, flipping over to the foil side, to solder each lead to the foil with a small bit of solder, using a low-wattage pencil iron. Clip the leads short, as with any PC board, and the job is finished. Almost. There's a little matter of interconnection of the components to make a bunch of hardware turn into a working circuit.

Either wire or conductive foil may be used for the interconnection job. Foil might be a little easier to use because it can be laid down flat and it will stay there while you put down the rest of the interconnecting leads. Then you can solder all the connections at the same time.

Wire works as well, of course, but it's a bit more awkward to handle. Wire does give you one option, however. Foil connecting leads must go on the foil side, of course.





PATTERNS of components in foil form are cut apart (above). Scissors work best, but a sharp knife will do, too.

BACKING paper comes off (left) and the pattern is adhesive-mounted on board. Align pattern with PC board.

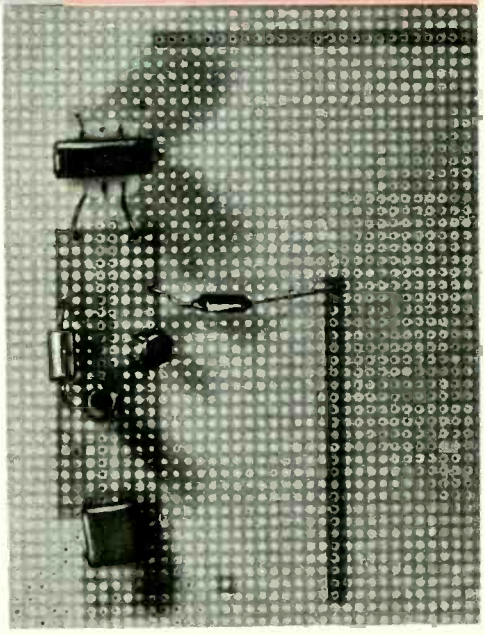
COMPONENTS go on bare side and leads run to foil side, then are soldered. But don't overheat foil.

Wire can be run between holes on the bare side, the ends stuck through and then soldered and trimmed as with component leads. Or it can be applied to the foil side, either tip-to-tip between pieces of foil or mounted mechanically between holes before the soldering job on the foil side.

Many Circuit-Stik patterns can be used for more than one component (a resistor or capacitor, for instance) but they also include such highly specialized items as parallel multi-contact strips. These are for mounting on the edge of plug-in modules. Mating multi-contact connectors hook up to the strips.

Products of Circuit-Stik, Inc., which also uses the name Quik-Circuit, can be found in large electronic-supply stores.

Circuit-Stik patterns are meant for two markets—the hobbyist and also the professional designer and engineer.



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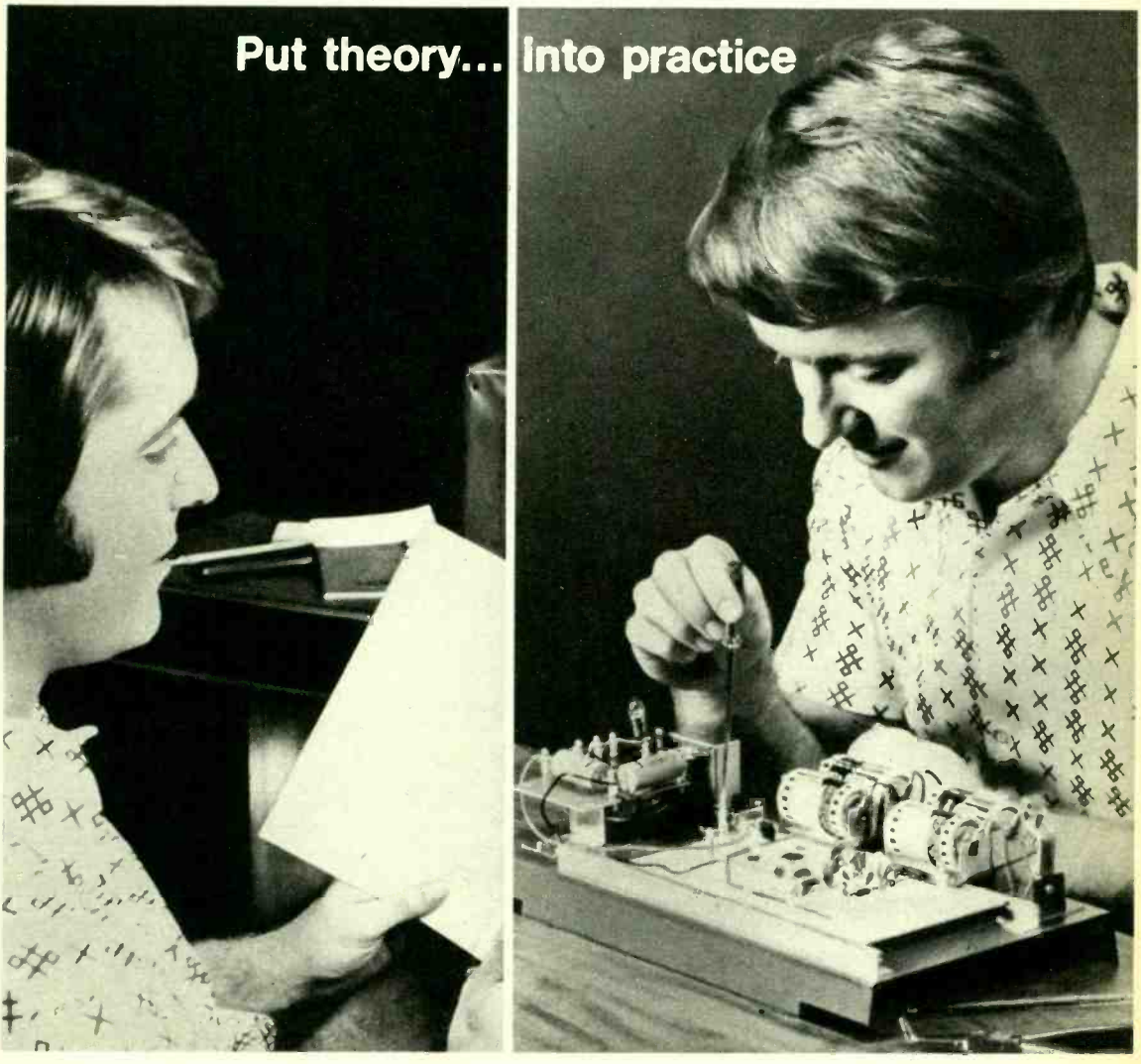

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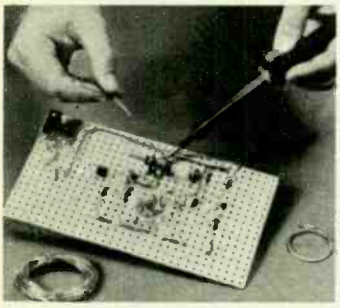

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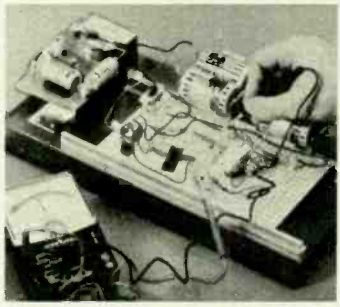
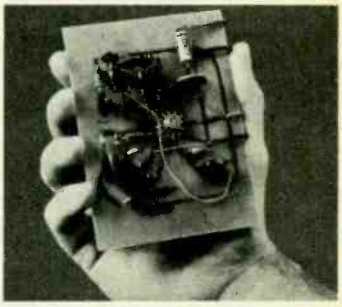


Testing and troubleshooting are an important part of your learning experience. Included in your laboratory is a precision "multimeter" to diagnose electrical and electronic troubles quickly and accurately.



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Here's how two outstanding CIE students carved out new careers: After his CIE training, Edward J. Dulaney, President of D & A Manufacturing, Inc., Scottsbluff, Nebraska, moved from TV repairman to lab technician to radio station chief engineer to manufacturer of electronic equipment with annual sales of more than $500,000. Ed Dulaney says, "While studying with CIE, I learned the electronics theories that made my present business possible."

Marvin Hutchens, Woodbridge, Virginia, says: "I was surprised at the relevancy of the CIE course to actual working conditions. I'm now servicing two-way radio systems in the Greater Washington area. My earnings have increased $3,000. I bought a new home for my family and I feel more financially secure than ever before."

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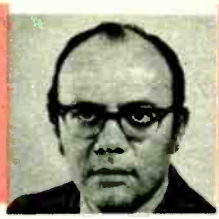
CB Corner

By Len Buckwalter, KQA5012



What's Ahead for CB?

THE Citizens Radio Service is now 14 years old and the big news is the possible creation of a vast new Class E band. But as official Washington ponders the proposal, CBers, legislators, manufacturers and interested observers everywhere are trying to guess what the next few years will bring. The medium is reaching an equilibrium of about 900,000 licenses as CB dropouts are replenished by new waves of citizens anxious to operate their own radiotelephones.

This has led to a radio service whose proportions loom larger than anything the communications world has ever known and it is gaining momentum as dozens of Congressmen begin to appreciate CB's pressing problems. It is even attracting the attention and sympathy of the White House. The FCC, still blinking at the monster it unwittingly conceived, is beginning to realize that it can't ignore the wishes of nearly a million citizens, even if they clash with laws which date back to the Titanic.

CB has not only arrived, but is on its way to even more remarkable achievements—some good, others otherwise. To peer into the future, consider these trends in equipment, operation, rules and a bold idea or two to increase the band's effectiveness.

One place CB is going is outdoors. The trend shows up in seasonal peaks and dips at retail stores. About three years ago, merchandisers would point to October and November as the best months for moving electronic equipment—April, May and June were the down period. This is changing. Now early spring is becoming the second-best time of the year. What's more, items that move most nimbly off the shelves are high-power handie-talkies and compact mobiles. The conclusion is that campers, boaters and other outdoor types are rapidly becoming CB's new subculture.

Even the most popular model in transceivers hints at CB's roving lifestyle. One major importer says his fastest-selling rig is the 23-channel mobile with a retail price of from $100 to $140. Mobile activity, he says, is much livelier than base-station operation —where larger sets are often the rule. Another producer hastens to add that deluxe sets upwards of $300 have carved a comfortable niche in the marketplace and sell steadily in the face of a declining national economy. This is echoed by single-sideband makers, whose output is now small but on the increase.

CBers must thank the engineers. Technical progress in equipment is nothing short of dazzling. Some of it, of course, is strictly Detroit. The CBer must be enticed each year with new goodies and catchwords. Ten years ago this led to rigs that resembled a Wurlitzer. Today, electronics can deliver solid benefits at lower prices.

That popular mobile rig mentioned a moment ago is now a miniature jewel loaded with features that once cost twice as much. Single sideband, once scoffed at as being too complex, is now field-proven and becoming established. Adjacent-channel interference, a plague on transistor sets, now is easily licked. Even hams, whose equipment often is in the battleship-gray class, are startled by the technical prowess that gleams from CB. Can it continue?

A large market will spur these advances, but signs are that it has reached a temporary plateau. FETs, ICs, ceramic filters and other spage-age fallout are standard equipment and circuits tend to be state-of-the-art. So the new and exciting for CB probably will involve the way circuits are applied, rather than exotic innards. An example is the scanning receiver. It uses an IC logic circuit that automatically informs the listener of an emergency call on Channel 9 while he is tuned to some other channel. Another example is a completely new method of operation that could rock CB to the roots of its public image.

I spoke to a manufacturer in Kansas City who remarked how well CBers monitor Channel 9 in his town. If there's an accident in the area, a call on 9 brings help. Other cities, though, are not so fortunate and an emergency may go unheeded because of

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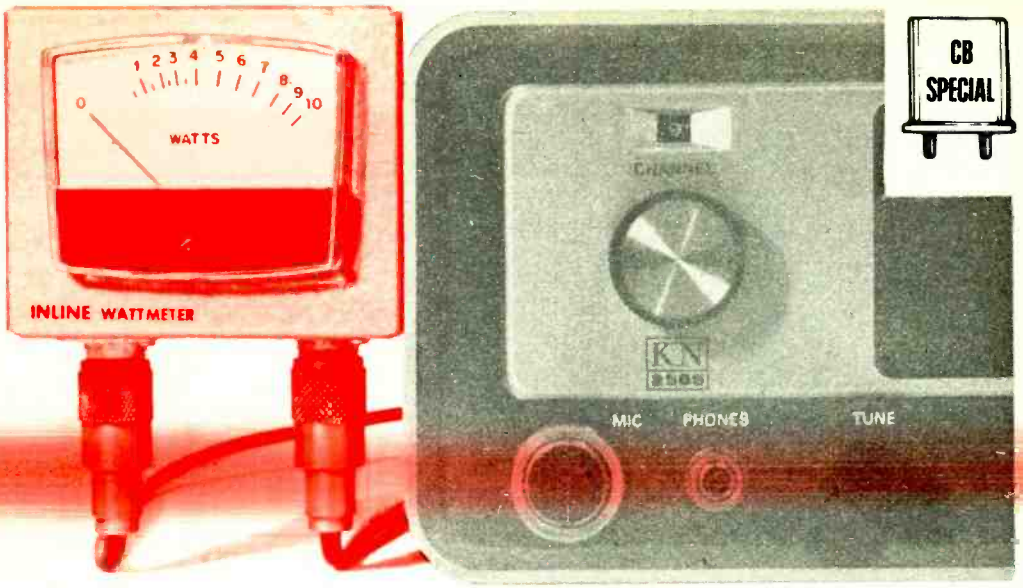

Inline RF Wattmeter for CBers

By HERB FRIEDMAN, KBI9457

EVERY 11-meter licensee would like to know in advance whether his transmitter really is going to put out when he starts talking. The only way to be certain is to monitor both the rig's output and the antenna.

A sudden drop in power out or a jump in the antenna's standing-wave ratio (SWR) are sure signs that something is going wrong—and fast. No CBer, though, bothers to connect special test instruments to his equipment on a regular daily or weekly basis to find out how it's doing.

Our Inline RF Wattmeter, connected in series with the coaxial feed line running to the antenna, adds a vital continuous reading to any CB transceiver and can enable you to spot the beginnings of trouble. What it gives you is a constant check on your transmitter's power output and, indirectly, a good idea of how the complete antenna system is doing (a shifting SWR or other skyhook ills have an immediate effect on any rig's ability to transmit power from the output stage).

Our wattmeter examines a minute amount of the energy fed into the antenna system to indicate the transceiver's RF output power. Since the antenna provides a load for the wattmeter, any changes in it also are indicated by the meter.

Suppose the wattmeter suddenly indicates a 5-watt reading. You know this figure can't be true, especially since the transmitter portion of your rig is limited to 5 watts input. Actually, a high SWR somewhere between your rig and antenna caused the higher-than-normal reading. Similarly, a reading on the low side that cannot be varied by adjusting the transceiver's loading control also indicates that something is amiss at the antenna.

Our inline wattmeter works with both base station and mobile installations. And, it's light enough so that you can hang it on the wall of your shack, or on the dashboard of your car.

Though amplitude-modulated CB rigs normally can never deliver 10 watts into the antenna, our meter face is calibrated to read the relative output of an SSB CB transceiver.

Wattmeter Construction. The wattmeter is built into the main section of 2 x 3 x 4-in. aluminum cabinet. The meter scale supplied is accurate only with the specified components. It might not be as accurate if a substitution is made for the diode D1 or meter M1.

First step is to apply the new meter scale. Using a small screwdriver, gently pry the plastic front off the meter. There is an indent in the center of each of the four sides of the cover where it meets the case. Place the tip of a screwdriver in the indent and rotate the handle until the cover suddenly pops off.

Using extreme care to avoid damaging the

CB SPECIAL

Inline RF Wattmeter for CBers

meter's pointer, remove the two screws holding the scale in place. Slide the scale out from under the pointer. Copy the meter scale or cut it out.

Place a thin coating of rubber cement over the scale and let it dry for several minutes until it is tacky, but not wet. In one motion, place the new scale over the old one, rubbing it down with a cloth. Mount the new scale correctly the first time because tacky rubber cement is a contact adhesive.

Punch out the two screw holes in the new dial, and then reinstall the dial in the meter. Make certain you do not damage the pointer when sliding the new scale into position.

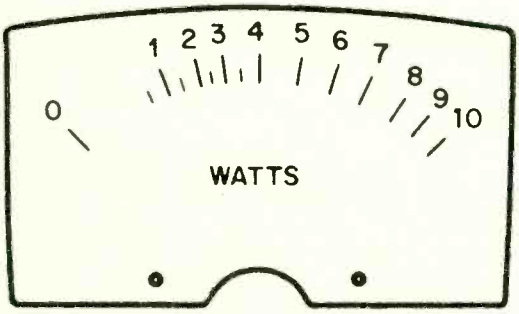

Fig. 2—Cement meter scale over movement face.

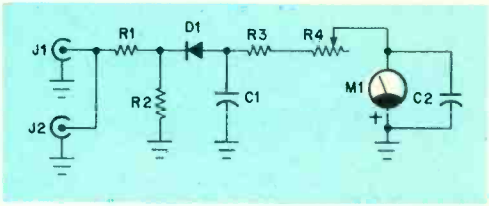

Fig. 1—Wattmeter samples a small portion of RF output, detects and filters it, which drives meter M1. C2 bypasses remaining RF around M1.

PARTS LIST

C1,C2—0.001 μf, 75 VDC disc ceramic capacitor
D1—Germanium diode (1N60 or equiv.)
M1—0-1 ma. DC meter (Calectro D1-912. See text)
Resistors: ½-watt, 10% unless otherwise specified
R1—3,300 ohms
R2—4,700 ohms
R3—10,000 ohms
R4—10,000-ohm trimmer pot. (Calectro 81-644 or equiv.)
J1,J2—Coaxial jacks (SO-239)
Misc.—Cabinet, perfboard, push-in terminals, No. 18 or 16 solid copper wire, hook-up wire, etc.

Cut holes in the cabinet for M1 and coaxial jacks J1 and J2. Next, mount these components. Connect the jacks together with

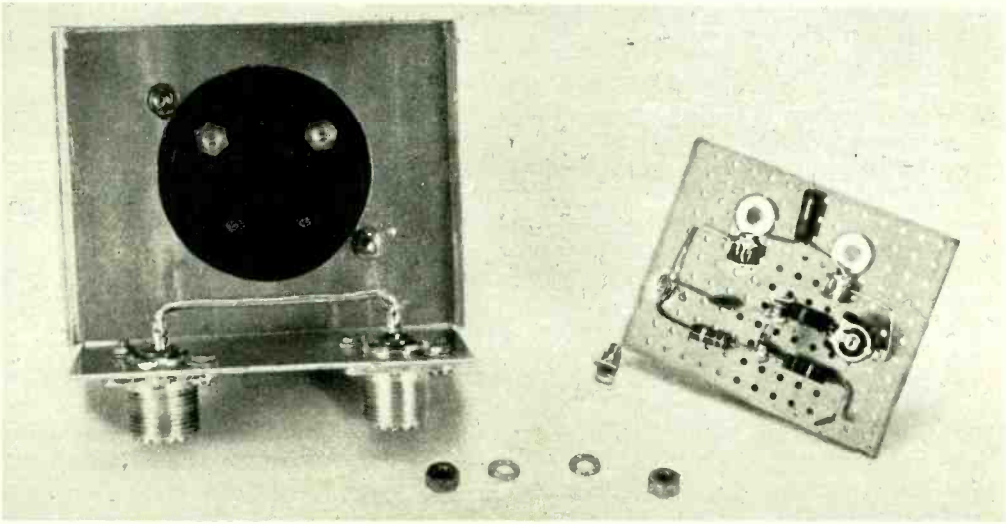

Fig. 3—Meter M1 shown installed in minibox along with J1, J2 and connecting wire. Prewire perfboard chassis before mounting it with hardware supplied. Connect ground lug from pc board circuit to minibox.

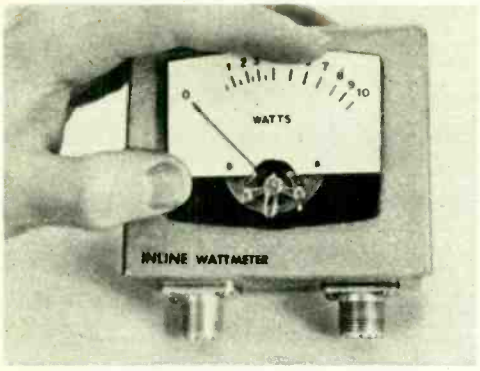

Fig. 4—New meter scale (shown full-size on opposite page) is cemented to piece of card stock. Then carefully position it over M1's face as shown.

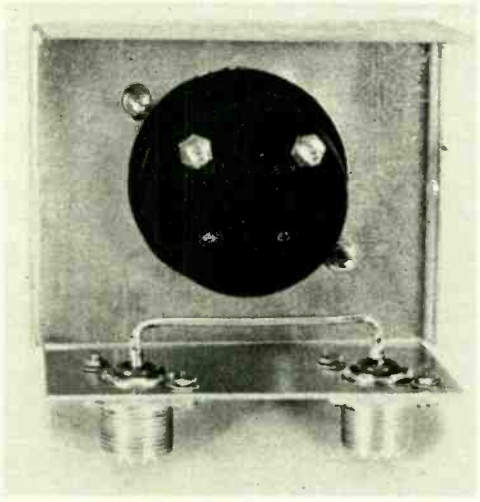

Fig. 5—Number four hardware attaches coaxial jacks J1, J2 to minibox. Bend connecting wire as shown, keeping it as straight as possible.

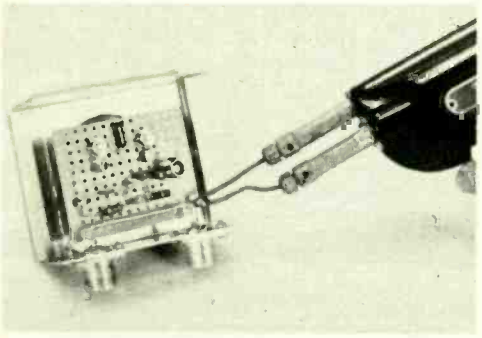

Fig. 6—Last step in wattmeter construction is soldering R1's free lead to connecting wire. You may solder lead to any point along this wire.

CB SPECIAL

a length of solid No. 18 or 16 wire.

Install a 2⅛ x 2¾-in. section of perfboard on the meter terminals. Push flea clips into the terminals on this G-pattern perfboard and complete the electronics assembly.

No special wiring precautions are necessary other than leaving ½-in. leads on diode D1 to avoid soldering heat damage. Only two of trimmer pot R4's leads are connected. They exactly fit the perfboard hole spacing, plugging into two push-in terminals.

Wattmeter Calibration. The inline wattmeter is calibrated with the aid of a standard wattmeter. Connect either jack J1 or J2 to your transceiver via a coax cable. Connect the standard wattmeter to the remaining jack. Push the talk button with the rig's volume control turned down. Note the power output reading on the standard wattmeter.

Adjust R4 until the inline wattmeter indicates the same reading. The unit is now calibrated and ready for use.

Bear in mind that some CB wattmeters read on the high side, giving the CBer a false sense of powerhouse output. It is not unusual for a CB wattmeter to read at least 1 watt high. If you want real accuracy, try

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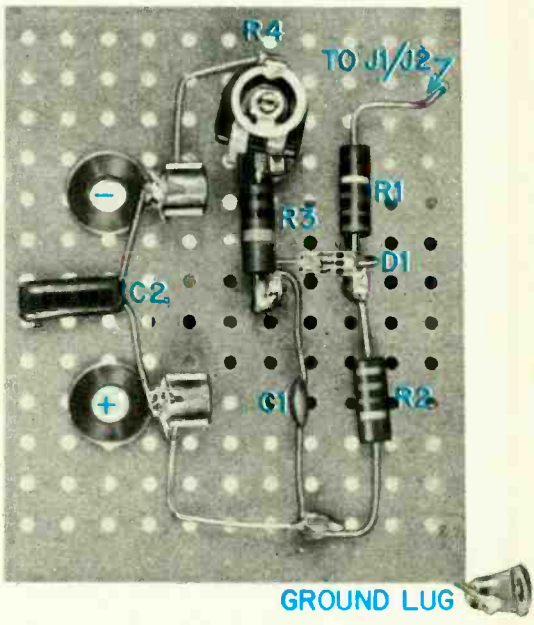
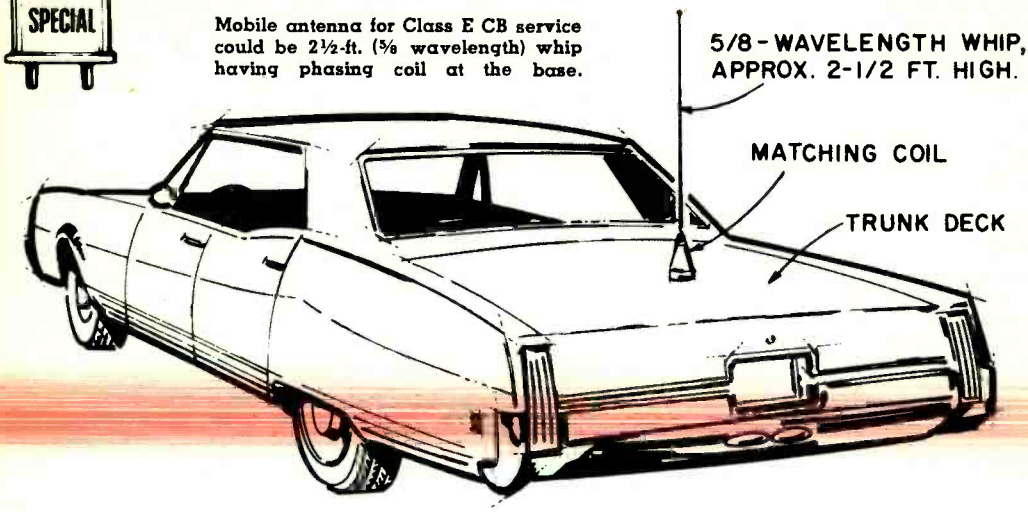


Fig. 7—Full-size photo of perfboard circuit. Note only two leads are used on pot R4. Solder lugs are supplied with M1. Observe D1's polarity.

CB SPECIAL

Mobile antenna for Class E CB service could be 2½-ft. (⅝ wavelength) whip having phasing coil at the base.



What's Happening with Class E for CB

A skip-free band offers line-of-sight range on 80 interference-free channels.

By LEN BUCKWALTER

A DRAMATIC new proposal to expand Citizens Band radio arrived at the FCC's Washington headquarters in February 1971, as we've previously reported. Called the Class E band, the idea was not just another crackpot scheme from rebellious CBers, but a carefully worked-out petition from the EIA.

The Electronics Industries Association is a prestigious organization whose members form the heart of the electronics industry in the U.S. In a six-page document, the EIA presented a specific plan of action to remedy the problems of today's Class D band—overcrowding, murderous interference, and crushing restrictions on personal hobby communications.

The idea is simply this: take a 2-mc portion from a little-used ham band on 220-225 mc and divide it into 80 new CB channels. This region would be free of skip (and its temptations) and CBers would be permitted to run 25 watts to assure good line-of-sight range (about 20 mi. mobile). Antennas could then rise higher to clear nearby obstructions.

It is now about a year since the plan reached the FCC. Although a deathly silence prevails in the nation's capital, where the Commissioners are deciding Class E's fate, there is no lack of controversy and speculation among some half-dozen vested interests. Here's what's been happening in government, industry, ham and CB circles.

The Big Switch. Not long after the Class E proposal appeared, CB discovered a new friend in high places. It's the OTP—Office of Telecommunications Policy—an agency with a pipeline right into the White House (it aids the President in coordinating radio frequencies which lie under direct control of the U.S. Government).

Responding to the proposal, OTP came up with some surprising revelations about the spectrum lying between 220 and 225 mc. The primary activity on this band isn't ham radio, it turns out, but radiolocation. The U.S. Navy, for example, operates radar equipment in the band around the country's coastal regions. The band is also used during missile tests on ranges located in New Mexico.

So 220 mc turned out to be government property. When the Class E proposal came along, OTP sat down with military departments to study the problem. The conclusion: Government activity on the band is limited and sharing it with a new Citizens Band radio

Chart below shows how 80 Class E channels may be used in near future. While complete 220 band may be available, top end is better guess.

QUICK LOOK AT 80 POSSIBLE CLASS E CHANNELS

Channels	Function	Channels	Function
1-8	Mobile to same license	36-44	For units of the same or different license
9	Emergency use only; per Class D Channel 9	45	For units of the same or different license—limited to contact only; units must change to alternate channel for message
10	Mobile to same license	46-54	Limited to units of same license; for business communications only
11	Mobile general calling for contact only; must change to alternate channel for message	55	Limited to units of same license—limited to contact only; units must change to alternate channel for message
12-13	Travel assistance use only; mobile general calling permitted	56-57	Marine use only
14	Weather advisory use; general calling permitted	58-60	Marine use only; limit of 1 watt
15	Traffic advisory use; general calling permitted	61-65	Local use of units with same call sign; limit of 1 watt
16-20	Mobile to unit of same or different license	66-70	In-plant use only; limit of 1 watt
21	Mobile general calling for contact only; must change to alternate channel for message	71-75	Local traffic control use only; limit of 1 watt
22-35	Mobile to unit of same or different license	76-80	Road condition information only; limit of 1-watt TX audio call signs

service is perfectly feasible.

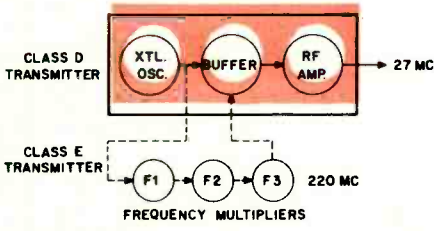
There was only one wrinkle. Channels for the new CB band were supposed to be cut from the low end—between 220 and 222 mc—and it was discovered that government radiolocation equipment is especially concentrated in that area. It would prove far more practical to shift CB to the top end, between 223 and 225 mc, and that's where it stands today. (The 80-channel idea remains the same.) This frees a large portion of the country for relatively interference-free CB operation.

There can be little doubt that OTP is sympathetic to the CB cause. A spokesman for the agency told me that it is in the national interest to make best use of government frequencies through sharing and that the administration in Washington is aware of widespread interest in expanding the CB service.

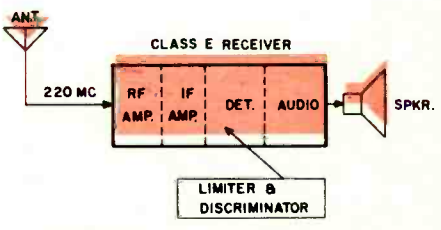
He also pointed out that final approval is still in the hands of the FCC. All OTP can do is declare the band available for CB. The FCC must make the final decision and formulate regulations. A formal letter was sent to the FCC in August, 1971, detailing all of this. The OTP is (at the time of this writing) still awaiting a reply.

Ham History Repeats? The amateur-radio fraternity has its dander up. If Class E is adopted, it'll be a replay of what happened 14 years ago when the 11-meter band was surrendered to Citizens Radio. (This time, though, CB won't take it all.)

One long-time ham winced when he told me: "They have such a helluva proportion of scofflaws they just don't have any right to come in and ask for more frequencies." He went on to say that hams have shown their mettle by passing examinations and have a



Class E transmitter could use frequency multipliers to get frequency of crystal oscillator up to 220 mc. FM mode will be used, not AM.



Class E receiver differs from Class D (27 mc) version only in that it detects an FM signal. Detector circuit uses limiter/discriminator.

What's Happening with Class E for CB

right to these frequencies. His argument, however, is less forceful when challenged with the fact of meager ham activity on the 220-mc band.

"Whether it's used or not," he replied, "is totally irrelevant. If I'm not using my home should I let a bunch of dope addicts use it?" (He didn't say whether the comparison was intentional.)

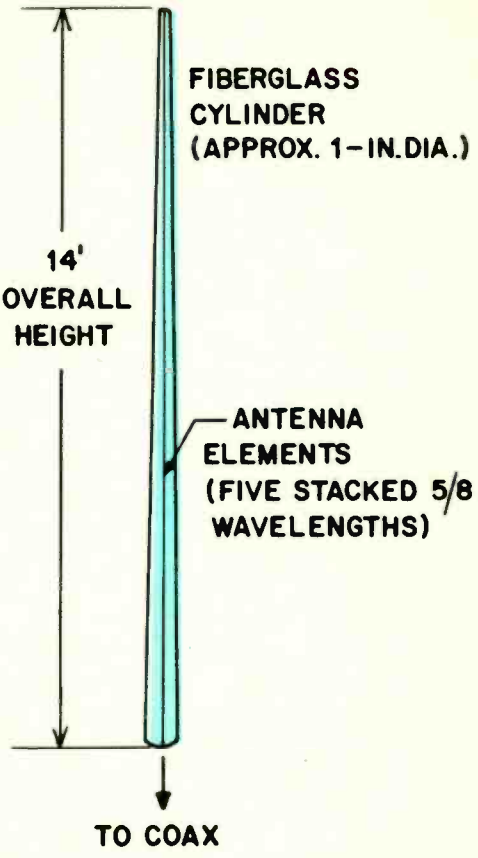
I then asked an important official of the ARRL if anything could trigger more activity on the threatened band. He replied that 2 Meters (144 to 148 mc) is becoming loaded with repeater stations and 220 mc is a logical band to take the spillover. But he predicts that no mass exodus will occur until a couple of pioneers lead the way.

There is evidence, however, that this frail hope could be doomed. Repeater stations in California are already leaping beyond 220 to the 420-mc ham band. The reason is a combination of economics and available equipment. Because there has been a negligible market for equipment on 220 mc, manufacturers offer little more than a few converters. But up on 420 mc, the ham can feast on sophisticated GE and Motorola surplus gear now obsolete in the commercial market. That's exactly what launched the 2-Meter boom (via repeater systems) earlier.

Hams, of course, can hardly be blamed for their bitter reaction. They're fighting an erosion of spectrum space in a day when frequencies are a scarce commodity. Also joining hams in opposition to the new CB band is another radio group with even more at stake. These are the *landmobile* people—the manufacturers and users of commercial and industrial two-way radio. The Class E service could easily attract large numbers of small businessmen who now shun CB on Class D because of interference and chit-chat.

Skip should disappear totally on 220 and special channels are set aside for business operations (see chart). Add the low cost of CB equipment, often less than half that of comparable commercial gear, and you can see why landmobile people feel threatened.

As special-interest groups everywhere speculate about the new band, engineers are also getting ready. They're looking at the technical side of communications on 220-mc and at circuits and hardware to serve this



Base station antenna for Class E service proposed by one CB antenna manufacturer. Five stacked 5/8 wavelength elements would provide gain of 9.5db.

new medium. Let's see what we can expect in the way of equipment.

The New Transceiver. No manufacturer has shown a rig labelled Class E, but we can venture some safe guesses (see diagrams). The innards will be more complex and costly (mode will be FM instead of AM) than Class D equipment since the rig jumps nearly ten times in frequency—from 27 to 220 mc. This calls for more transmitter stages to multiply fundamental frequencies up to the final value of the carrier.

The receiver, too, requires more stages. Good selectivity is important because the front end broadens at higher frequencies and tolerates more interference. This can be solved by dual-conversion design in the IF stages, and with filters. What's more, transmitter power may go as high as 25 watts and this also raises the cost. If the FCC demands

[*Continued on page* 105]

CB SPECIAL

Low-Cost Dummy Load for CBers

By ROBERT F. LEWIS, K7YBF

THE easiest-to-build Citizens Band accessory no doubt is a dummy load. Yet few CBers have one. Instead, when they want to fire up the old rig for some tuning they just do it on the air—which invites a citation from the FCC.

A dummy load, hooked to the transceiver's output, dissipates the full power of any 5-watt job and ends worries about illegal emissions and knock notes from the feds.

Our dummy load has a resistance value of 52 ohms, an SWR of 1:1 and will mate with any CB rig with a similar coax connector. It can handle as much as 12 watts, which takes care of even the sharpest sideband transmitter. Hams could use the load if they run at reduced power.

Begin construction by obtaining four 330-ohm and two 270-ohm 2-watt carbon resistors. Do not buy wirewound resistors. They act as inductors at 27 mc, and are worthless as dissipating elements.

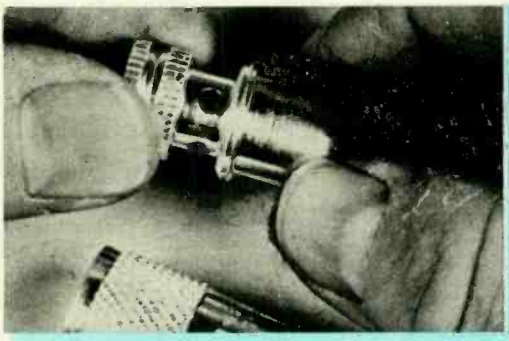
Unscrew the outer shell from a PL-259 (83-1SP) coax connector. Using steel wool or fine sandpaper, burnish the rear bushing to a bright shine so it will take solder readily. Reinstall the outer shell.

Cut the leads of all resistors down to ½ in. at one end, and ¼ in. at the other.

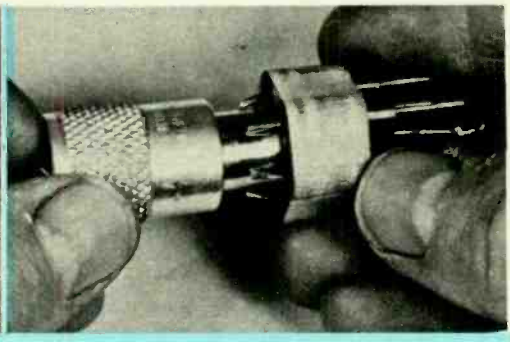
Using an extra 2-watt resistor as a center filler, arrange the other six resistors in a hexagonal configuration. Arrange the resistors so that the ½-in. cut ends all point in the same direction. Secure the assembly tightly by wrapping with masking tape.

Bend the ¼-in. cut ends inward equally until the assembly stays in place when the leads are slipped onto the plug bushing. Be sure that all leads are making contact with

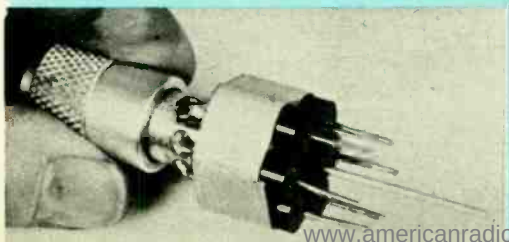
[*Continued on page* 100]



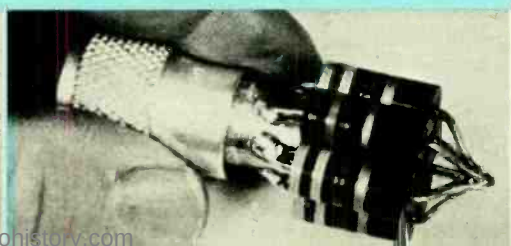
Unscrew outer shell of coaxial connector and buff rear bushing to a bright shine with steel wool. Solder must flow readily into bushing.



Tape all resistors together. Cut ends to ¼ in. and ½ in. Insert ¼-in. end on coax end bushing with wires bent so they firmly contact bushing.



Remove extra 2-watt resistor from pack and insert 3-in. length of bare or tinned No. 14 copper wire into coax plug pin. Solder wire to coax pin.



Solder ½ in. leads to center wire, trimming excess as shown. Measure resistance of dummy load with VOM. It should read exactly 52 ohms.

How To Use A Color Bar Generator

If you haven't got a color bar generator, you haven't got what it takes to fix a color TV. These true case histories are proof.

By ART MARGOLIS

COLOR TV sales are booming again and chances are you now either have a color set in your home or you service them on a full-time or part-time basis.

As basic as a cheater cord, VOM and diddlestick are to the serviceman, most troubleshooters would agree that a color bar generator ranks highest on a list of test equipment for color servicing. If it wasn't such an expensive proposition it would be built into the set. (In fact, Heathkit color TV does just that.)

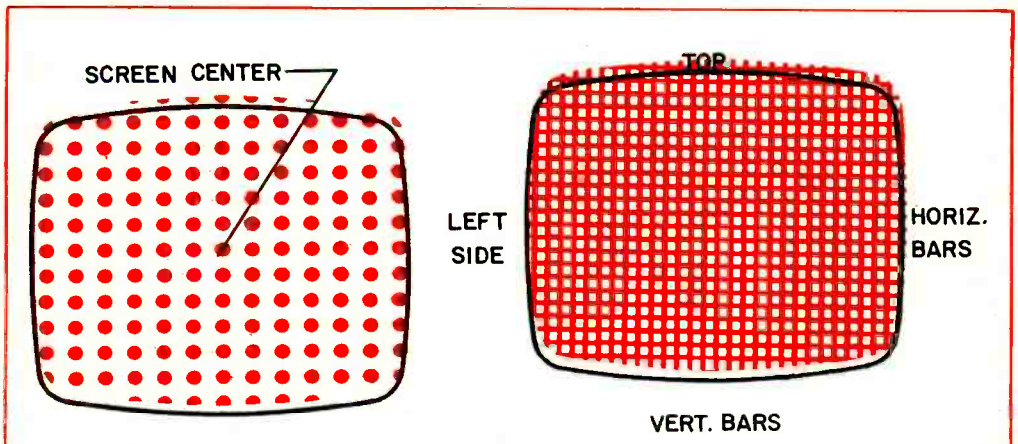
In the three-gun color TV, basic challenges to the serviceman are the convergence circuitry and the color circuits. To intelligently adjust and troubleshoot these circuits you need a color bar generator. While there are many brands for sale they all basically do the same job—that is, provide patterns of dots, bars or colors on the TV screen. Let's go through some actual case histories where a color bar generator was a must.

Mystery of the Misplaced Blue. My call book read under the complaint section, "Too much blue." I knocked on the door of the neat bungalow and a young woman dressed in blue opened the door. As I entered I noticed the carpeting was light blue, the walls were dark blue, the furniture varying shades of blue—including the TV cabinet. I guessed this gal liked blue.

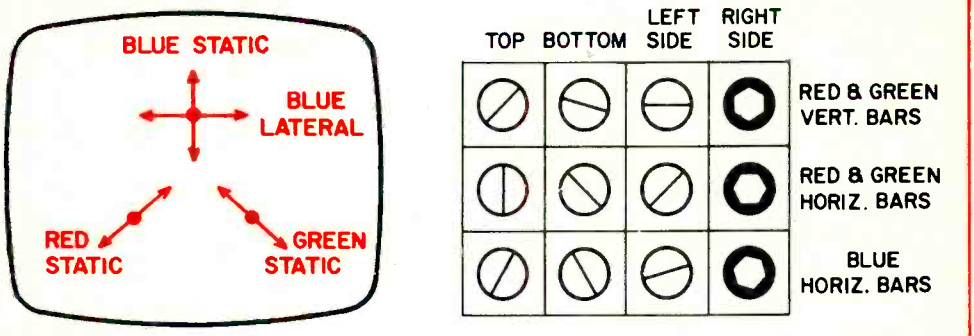
I turned on the TV, a 23-in. color set. A quiz program in color came on. I turned the color-level control down and examined the picture. My call book was correct. There was too much blue. Instead of a black and white picture, blue was bleeding out from all objects on the TV screen.

Bleeding colors, whether red, green or blue, are due to poor convergence of the CRT's three electron beams on the shadow mask. This means the three colors do not register one on top of the other on the screen.

When you see this bleeding it's hard to figure out what is causing the misconvergence. There are static permanent magnets that adjust the convergence across the entire screen and dynamic electromagnets that have the ability to adjust individual sections of the screen. There are sixteen convergence adjust-



Color bar generator provides two basic patterns. Dot pattern shown at left is used for static convergence at screen's center. Bar pattern at right is used for dynamic convergence across entire screen.



At left, static convergence is achieved by aligning color dots with four controls to get pure white. Dynamic convergence board is shown at right. Here there are 12 adjustments (out of a total of 16).

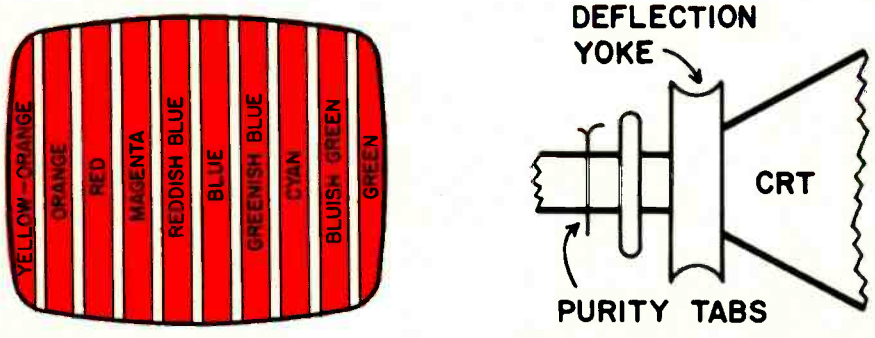
ments—four static and twelve dynamic. Unless you adjust the right control for a particular misconvergence you'll only make it worse.

That's where the color bar generator comes in. It displays a pattern on the screen that enables you to see which area is misconverged, so you can go straight to that adjustment for any correction.

I installed my generator and started with a dot pattern. With the dots you can adjust dead center on the TV screen by manipulating the static magnets. However, in this call, the dots at the center were all converged. No bleeding whatsoever; only white dots were displayed at dead center.

I switched the generator to produce a crosshatch pattern. I could see a good white crosshatch in the center, as the dots indicated, but blue was bleeding out of the horizontal bars on the left and right sides, top and bottom. All the vertical bars were pure white. Now my job was defined by the generator. I had to adjust blue-horizontal at left, right, top and bottom. There are four such adjustments.

I began manipulating the controls. The blue didn't seem to move. I looked closely. No amount of turning budged the bleeding. The controls were inoperative. I immediately began checking the convergence circuitry and found that the convergence socket was corroded. I removed the plug, cleaned off all pins, sprayed down the socket with contact lube and plugged it back in. Now it worked. A couple of touchups on the controls and all the blue bleeding receded till a perfect white crosshatch appeared on the screen.



Generator's color bars (at left) will indicate trouble spots in various color circuits. Sequence of red-blue-green helps pinpoint trouble. At right, purity tabs near CRT yoke affect sweep of CRT's beams.

How To Use A Color Bar Generator

I turned the TV back on and the quiz program returned in black and white. You couldn't tell the difference between this black and white and a regular black-and-white TV's picture. I turned up the color level and filled the performers faces with color. The unwanted blue was gone.

I asked the woman, "How's the picture now?" She whined, "I guess it's okay, I sorta miss that blue background though."

Deceptive Gray Scale. One of my summer employees, Jack, is a college student studying to be an electronic engineer. He follows a textbook fine and can do bench work like a pro—that is, almost. He gets crossed up occasionally when the instructions in the service manual steer him wrong.

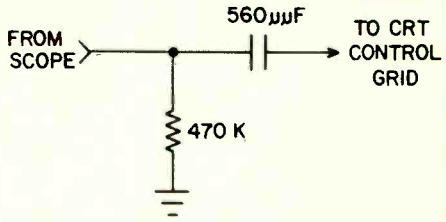
One such case was a 21-in. color TV being repaired on the bench. It came in as a dead set but new silicon rectifiers squared that away. During checkout Jack called me over. "Art, the colors are incorrect. It looks like demodulator trouble. Before I dig into this maybe you better take a peek."

I looked at the colors. They were all wrong. The blues and greens were way off and the reds were purple. I turned the color-level control down and observed the black-and-white picture. It wasn't bad. There was definitely no coloring, but the whites were grayish.

I turned the color level back up and tried the tint control. Instead of varying flesh tones from green through normal to purple, it varied from blue through purple to a poor orange. It did look like demodulator trouble but I suggested, "Let's first put some color bars on the screen."

The bars appeared and produced some strange colors. However, a shade of green was on the extreme right bar and a reddish bar was located third from the left. While the colors weren't true they were in the right places. This meant the phase relationship of the demodulators was correct! But there was no other color circuit that could possibly cause this crazy condition, except the purity adjustments. Still, there were no purity blotches on the screen. I said, "Let's check purity anyway," and turned off the generator.

First I turned down all three CRT screen-grid controls and then turned up just the red. That was it. Instead of a red field, a yellowish-green field appeared. The color bar generator had been right—the phase of the three primary colors had been good.



High-impedance probe for oscilloscope display can be constructed using a 560-micromicrofarad capacitor, a 470 kilohm resistor and some ordinary hookup wire.

I began adjusting the purity tabs. A red field began to appear on most of the picture except the edges. I loosened the yoke and pushed it forward. The edges went red. Then I went back and forth from purity tabs to yoke till I had a perfect red field. I turned down the red and tried the blue- and green-screen controls. They produced perfect fields in their own color, too.

Jack reset the gray scale for a perfect black-and-white picture with the screen controls. The colors were now perfect. The tint control worked as it should. We degaussed the set, too, just as a make-sure procedure.

Proof of Color. A customer brought his 18-in. color portable in for repair. The symptom was no color. It wasn't the tubes so I told him to leave it for benchwork. He said, "Fine. I'm doing some work in my playroom anyway. It should be safe here, and no sawdust will get into it."

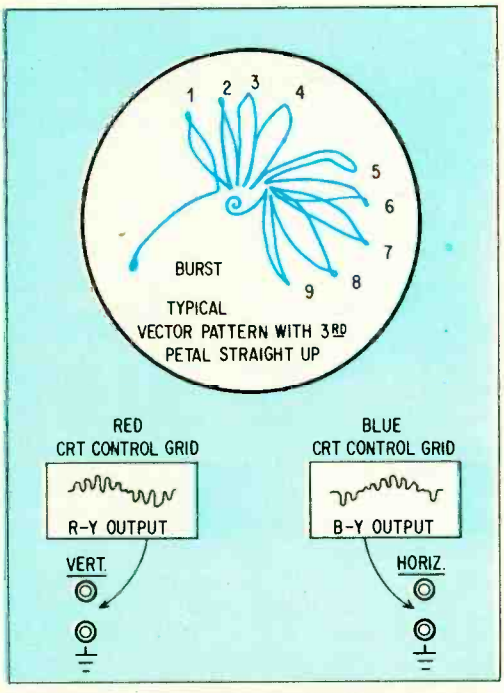
The repair was easy. There was an open peaking coil in the control-grid circuit of the bandpass amplifier. I found it quickly as I routinely shorted the peaking coils, one by one. I replaced the coil and the color returned beautifully.

The set owner picked up the TV a few days later. About an hour after his pickup the phone jangled. It was him. "Art, old buddy, the TV is doing the same thing. There is no color on any of the channels except the UHF ones."

I said, "There wasn't any color on the UHF channels before."

He answered, "All right, you did something, but there's still no color."

The fact that there was color on the UHF band cleared most of the TV's circuitry, including my repair of the bandpass amplifier. The only troublespots that remained were the



Vectorscope's flower-like display is produced by feeding CRT's red output to scope's vertical input and CRT's blue output to horizontal input of scope.

VHF tuner and the outdoor antenna system. He had a ring element on for UHF. I thought about his tuner. It was in excellent condition. I doubted if anything could have occurred there to kill color. It must be his antenna system.

I said, "The color was good here, there could be a problem with your antenna."

"Impossible," was the curt reply, "the antenna was working fine before."

I obviously had a prove-it case, so I said, "I'll be right over." There was no sense benching the TV again if the antenna was the problem.

I inspected the TV in his newly renovated playroom. Sure enough, UHF was as colorful as could be, while the VHF channels produced only black-and-white pictures. He said smugly, "See what I mean?" I nodded.

I went out to the truck and brought in my color bar generator. I disconnected his VHF antenna and installed the generator output at the antenna terminals. I flicked the dials and beautiful color bars appeared on channel four. He didn't say a word.

I rotated the color-level control and the TV screen displayed all shades of color. I rocked the tint control back and forth and the color bars changed colors as they should. I said, "Now we know your TV is producing colors and the antenna system is defective." He nodded.

I reinstalled his lead-in wire. Then I followed the 300-ohm flat ribbon; it ran to the nearest windowsill and ducked out through a hole. Then I spotted something. He had just installed a new storm window. The bottom of it had pinned the lead-in tightly against the outside of the sill.

I pointed to it. He went outside and pried it loose. The colors reappeared on channel four. I said, "There's your trouble."

Then I told him, "Why don't you install coaxial cable instead of the inexpensive lead. Besides lasting years longer it will cure the problem. It won't matter if it touches metal."

I sold him some coax. He insisted on my taking a service charge and all was well.

Vectorscope Procedures. While the color bar generator permits you to perform convergence adjustments, appraise intelligently the appearance of colors and substitute for a color signal transmitted at the studio, a newer procedure has become common. Called the *vectorscope* technique, it has its basis in the gated color signal output of the color bar generator.

There are all kinds of marvelous vectorscopes on the market but you can tackle the procedure with ordinary equipment. For instance, take the time I was called out to Harry Gray's house. He is a teller at my bank and loves electronics. He has a bench in his basement where he repairs radios and such.

As I descended the basement steps I saw Harry's color TV sitting on the bench. It had

[*Continued on page* 102]

	TROUBLE	SYMPTOM	CURE
Step 1	TVI	shaking flower	adjust 4.5-mc trap
Step 2	barber pole	blurred flower	ground the reactance grid; adjust reactance coil for float-by
Step 3	wrong flesh tones	3rd bar not standing up	adjust burst transformer
Step 4	weak color	compressed flower	adjust bandpass slugs for maximum amplitude; adjust oscillator transformer for maximum amplitude

Chart shows procedures to use for various color mix-ups. Flower-like Lissajous figures (red beating against blue) display color phase relationships.

Electronics Comes to the Aid...

Soon you may not have to stop on interstate highways to help a stranded motorist. If enough people flash their headlights at a sensor, help will come.

By ALBERT LEE

CARS WHIZ by a disabled vehicle on the shoulder of the expressway with hardly a pause. Passing motorists would like to help but stopping could mean a rear-end collision or even a robbery. So the stranded motorist waits and waits for police to arrive.

Getting help to motorists stalled on interstate highways is one of the perplexing problems facing traffic engineers. Many different systems have been tried with only limited success.

In 1966, the Airborne Instruments Laboratory, a division of Cutler-Hammer Corp., decided to tackle the problem via electronics. AIL's subsequent studies showed that an effective aid program should rely on passing motorists to spot vehicles needing help and have them report these disabled vehicles as conveniently as possible. Motorists would help, AIL concluded, but only if they did not have to leave their cars, slow down or deviate from their own route.

With the help of a $500,000 grant from the U S. Bureau of Public Roads and the State of Florida, AIL developed an electronic system to meet these criteria. The company calls the system FLASH, an acronym for Flash Lights and Send Help.

To passing motorists FLASH looks something like this. A sign along the highway advises motorists who have seen a stranded vehicle to *report vehicles needing help at FLASH sign*. Two mi. down the road is another sign instructing: *flash brights three times at FLASH sign for vehicles needing help*. The third sign merely says FLASH. The motorist responds and a sophisticated sensor picks up the signal and transmits it to the highway patrol dispatch office. Within minutes help arrives.

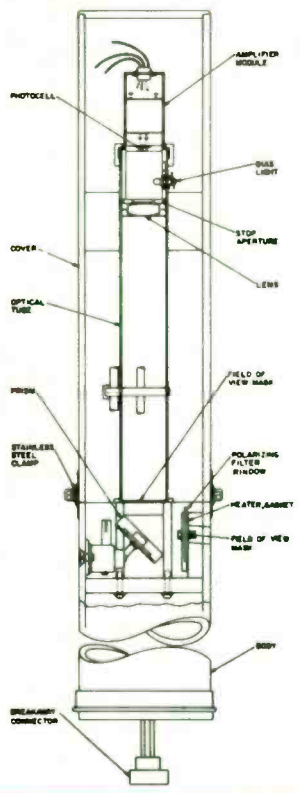
AIL built 20 prototype FLASH units and placed them in operation in November 1969 along 50 mi. of Florida's State Highway 4 between Lakeland and Orlando. Since then. FLASH has aided more than 2000 stranded motorists. Average time between distress signal and the arrival of assistance has been 10 minutes—day or night.

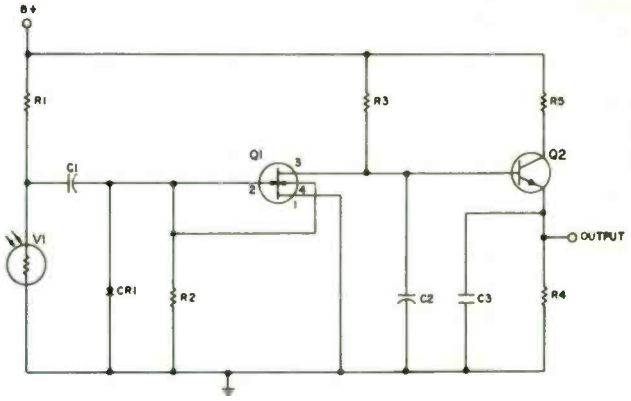
The success of the entire FLASH project depended largely on the design of a roadside detector. The detector had to house a sophisticated photocell device which would respond to headlight signals and at the same time screen out false alarms caused by sunlight reflected off passing cars, car lights at night and lightning. The detector also would have to be concealed to prevent vandalism since it would be near the road.

AIL housed the detector in a 4-in.-diameter plastic cylinder that's about 4 ft. high. With a reflector attached and some black paint to cover the housing, the detector looks like any one of hundreds of reflector posts along the highway.

Disguising the detector as a reflector post posed another problem. A vehicle might accidentally run off the road and strike the post, thereby destroying the delicate instrumentation. A notch around the base of the housing was added so that if hit by a car, the entire unit would shear off. The con-

FLASH monitor at police headquarters in Lakeland, Fla., signals emergencies to radio-dispatch officer.





FLASH detector (shown in diagram at left) picks up light through small rectangular slot; the small aperture reduces field of view and keeps ambient light to a minimum. Polarizing filter cancels out reflections off passing vehicles and heater/gasket prevents internal condensation on window. Prism redirects light up the tube toward fixed-focus lens where image is focused on photocell. Since amount of light changes drastically between night and day, a bias light automatically switches on at dusk to eliminate need for a variable diaphragm. Amplifier module which contains photocell (schematic is shown above) is mounted at top of tube. Light hitting photocell produces signal which is amplified and fed to processer.

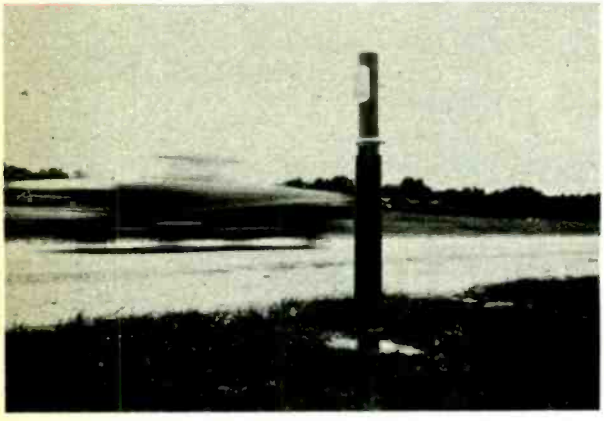
nector that supplies power to the detector also separates, this in turn signals the monitoring station that the detector is no longer in service. If the impact doesn't damage the detector mechanism it can be reused by covering the separated pieces with a short plastic sleeve.

When the detector receives three flashes within a five-second interval, a signal processor transmits a coded tone over telephone lines to a monitor at police headquarters. Here the signal is routed through a central processing unit and a monitor console. This input starts an electronic timer. To minimize false alarms, more than one distress signal is required before the monitor console will signal an emergency.

The number of FLASH signals needed to produce an alarm varies depending on the time of day and frequency of traffic. For example, on heavily travelled roads, four or five vehicles have to flash within a three-minute interval to alert the monitoring console. During early morning hours and on less frequented highways, only two vehicles have to flash to send a signal to the monitor.

The monitor console at police head-

[*Continued on page* 100]



Detector alongside highway is disguised as a reflector. Circuits are programmed for time of day.

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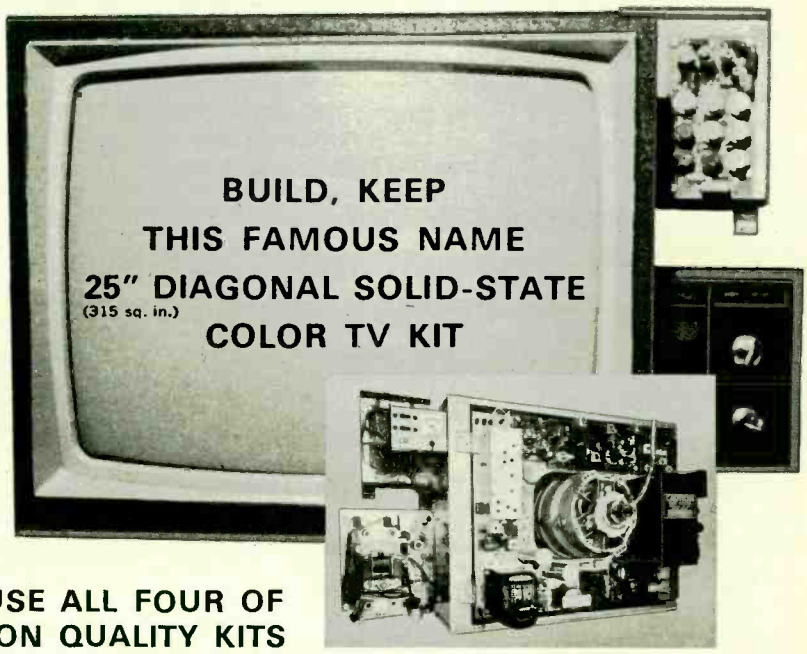

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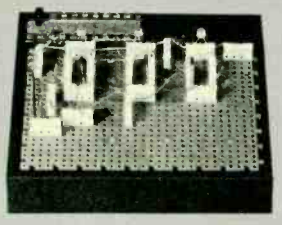

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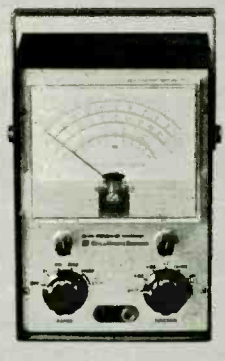

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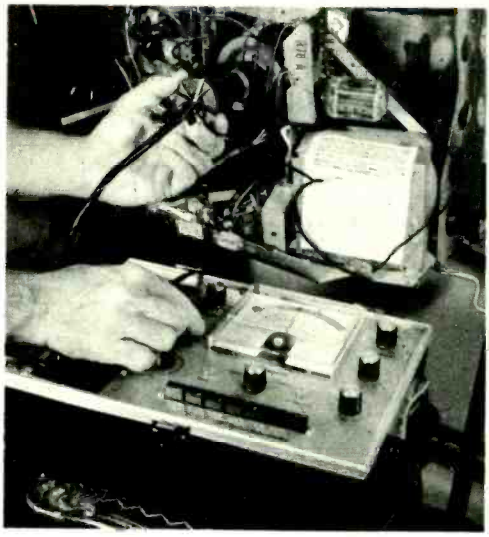
EI Kit Report

CRT Tester & Rejuvenator

Eico 633



ONE OF the more embarrassing and costly mistakes a TV serviceman can make is to buy a new picture tube for a customer, then discover after it's installed that the original wasn't bad, after all. To spare you this grief, there's an Eico Model 633 CRT Tester and Rejuvenator. The kit runs $89.95; assembled rig is $119.95.

The tester/rejuvenator not only reveals the quality of a picture tube but can also rejuvenate one to youthful brightness or bring one back to life after it has been pronounced dead. (For further information about the instrument see HOW TO STRETCH THE LIFE OF A PICTURE TUBE, March '71 EI.)

The 633 checks a CRT by sending into an electron gun (three in a color tube) an exploratory current that comes out at the meter as an indication of either percentage of emission, microamperes of electron-beam current or the amount of resistance between elements. From these tests you can tell what's wrong, then rejuvenate the cathode, clear shorts between elements, weld breaks in the structure or pronounce the CRT dead.

The boost function of the instrument also can get a marginal CRT back in service. Without this function a brightener in the set wouldn't work. Lastly, the tester can tell you the CRT is okay and that the trouble, while seemingly CRT related, is actually elsewhere in the set. All this can be done on b&w and color tubes.

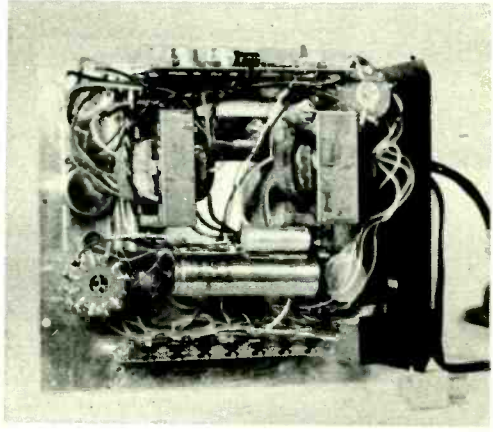
The Eico 633 does all these things with perhaps a bit more accuracy in measuring the parameters than some other testers. We used the 633 to check several CRTs on service calls.

There is a *line adjust* switch and corresponding *line-adjust* mark on the meter face. This allows you to set up the instrument for the line voltage at the service site.

The 633 tests the continuity between electron-gun elements with the heaters hot. Lack of continuity means an open element and suggests the weld-together procedure.

The emission test is routine except that in addition to the familiar bad/good indication an actual percentage of emission is displayed on the meter. This can reveal a dying tube

[*Continued on page* 103]



You wire the two rotary switches before installing them on the back of the panel. A printed-circuit board containing 21 parts is located at top.

The Selling Side of Electronics

Some people would rather be on the go. If you like electronics, excitement and challenge, a career in sales may be just for you.

By FOREST H. BELT

SELLING isn't a thing just anyone can do. But if you've got the knack—to keep customers satisfied and buying—and you can really move merchandise, it can be well worth your while in dollars and prestige.

Take Bill. He became a stock clerk for a parts distributor when he got out of high school. He learned products, moved up to counterman, then to outside salesman.

Bill's imagination and drive made him bad news for the competition. One sales company, whose customers he was taking away, decided they'd better hire him. Once turned loose in a bigger territory Bill really took off. Today he earns around $40,000 a year. He'll soon be a partner in the company.

Selling electronics can take you in several directions. You might work for a parts distributor, like Bill did. You could also work your way up in an electronics store, selling hi-fi year, CB and ham equipment, antennas and so on. You might even become manager (see THE BIG FRANCHISING DEAL IN ELECTRONICS, Jan. '71 EI) of your own store.

As a salesman for a manufacturer, you might sell small parts or large electronic systems to industry or government. You'd likely have a title such as field sales engineer, applications analyst, systems development expert or customer service coordinator. Your key job would be to sell the product

and keep the buyer happy.

You might be a manufacturer's representative, as Bill is now. Independent reps often sell for several manufacturers (working alone or with a rep firm). They sell components, systems or even services in carefully divided territories.

What kind of guy wants to sell? What makes selling fascinating? Ed, the manager of a medium-size electronic parts store, says, "This business is so dynamic. There are endless opportunities, if you're enthusiastic and alert. First of all, I *like* selling. I would probably be happy selling kites to cavemen.

"For instance, I showed a customer recently how he could save $500 a year buying relays from me with one lump (blanket) order. He'd been buying in small quantities, sometimes from other distributors. My idea finally got me all of his relay business. We ship him a hundred a month now, and I don't have to phone for every order."

That's creative selling. An inside man (working in the store as opposed to

The Selling Side of Electronics

being on the road) can sell that way over the counter. "You spot the TV guy who comes in every day for a dozen tubes and a few parts. You show him how to save an hour a day by phoning you, and you've made a friend. We deliver to his shop quicker than he could drive over here. He gets more work done and we sell him more parts." So says one such salesman.

It pays to like people. Plenty of customers you run into at parts distributors and electronics stores don't know exactly what they want. It takes patience—and imagination—to help them. You need to have a good memory for what's in inventory and where it's shelved. The best sales people can remember catalog sheets, know who makes what, and can tell a customer if there's something newer, better or less expensive available. Some salesmen specialize in certain product lines, such as semiconductors or capacitors. They often know every item that a particular manufacturer makes.

A sincere wish to help is a good attribute. But too much helpfulness isn't good, either, says one distributor. He sometimes worries if a counterman is too experienced. Too experienced? "Yes. He will exercise his brain by spending half his day fixing tough jobs on paper for borderline technicians. You gotta watch that kind of thing."

Nevertheless, knowing some electronics is a plus for beginners. One store manager I know hires students from a nearby electronics school; they work part time. He applauds by saying, "They're bright, willing to work and I can train them quick."

Working conditions will depend on the store. Most are open Saturdays. This means a 48-hour work week. Schedules, however, may be staggered so that you only work five days most weeks.

On the road, you can expect to work only five days. Successful outside salesmen, however, admit some important selling is done at business dinners after hours. Most fellows feel lucky if they get by with no more than 60 hours or so a week. But they insist that's offset by greater freedom, a company car, a usually ample expense account, etc.

A young man with a high-school education—and maybe some electronics school—might start as a shipping or receiving clerk. His pay could range from $5000 to $6500 a year. If he's sharp and enthusiastic, and knows just what merchandise the store carries, in a year or so his pay is usually up to $7500. Then he's working at the counter, on the sales floor, or making telephone sales.

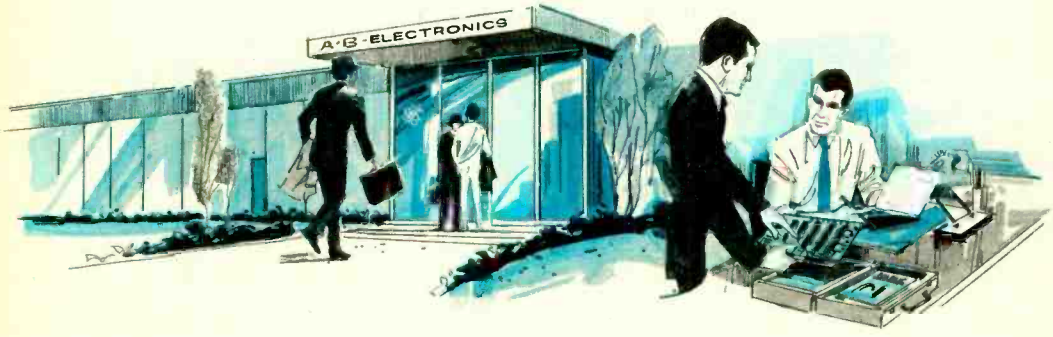
Suppose he shows promise as an outside man. On the road, he may call at small factories, radio-TV shops, and maybe mass merchandisers in his locality. Within a few years, as he develops his territory, he can make from $10,000 to $15,000 a year, or more. Much depends on the size of his company and on how

much business he writes. His pay could be in the form of a straight salary, base salary plus commission, or simply on a commission basis.

Running his own store, or working as manager of a branch store, the salary could range from $12,000 to $20,000. Here, he's paid for management talent more than for selling ability. But he has to be able to manage sales people. Naturally, operating a chain of stores could push his income far higher.

Sales engineer is a position sought by some holders of the BSEE degree. The engineering students get a strong sell from large-company recruiters—with such attractions as big expense accounts, travel, glamorous and exciting products to sell, fat salaries, etc., dangled in front of them.

Actually, the life of a manufacturer's sales engineer (or whatever that company calls him) is a trifle more mundane. But it has more appeal to some fellows than, say, selling over a counter. The job could go something like this: You find someone who can use your product. You study his operations. You figure out



how and why he needs your product, then you try to convince him. If he buys, you'll probably follow through and show him how to use it. If you've been effective, his orders—and your commissions—may go on for years.

This kind of selling demands that you know electronics well, at least your phase of it. Your starting pay is no more than you'd make in design or research. But if you're good and your company has incentive- or commission-pay plans, you'll eventually earn more than you ever would as a practicing engineer. In fact, many engineers today consider their technical training as just a good background for more glamorous (and more lucrative) positions in sales, marketing or top management.

Electronic engineers nowadays start at from $8000 to $11,000 a year. They later top out at $15,000 to $18,000 annually. In sales, the first few years are at about the same level. However, if you really have it on the ball, you can expect more like $20,000—maybe even $25,000 to $30,000 with the right company.

However, not everyone lands a selling job like this. Despite the recruiters, not many field salesmen start out right from college. A more common route is through some other job in a company.

Eric followed that route. Eight years in the lab left him bored with design work. He showed ambition so his company transferred him to sales. "Then came far more hard work than I'd counted on. Nights, weekends, whenever and wherever there was a problem to solve or a sale to make." That was six years ago. Eric today drives a late-model company car, stays in plush motels and totals up a big chunk of business for his company every year.

A rep operates as salesman for a manufacturer that is without a sales organization (overall, or in a particular territory). If he is self-employed, he or his firm may handle lines for several manufacturers.

As an electronics rep, you work much like the sales engineer. You sell to

[*Continued on page* 98]

Adapting Stereo Phones for Hams

Equip your shack for listening comfort with our stereo phones adaptor.

By RONALD M. BENREY

ONE of the most uncomfortable situations confronting a ham is the prospect of spending hours in front of his rig—all the while wearing a set of so-called communications headphones. There isn't one good reason why an otherwise sane amateur will try to squeeze his head between a pair of hard plastic slabs. Especially while DXing a particularly QRM-ridden channel.

Two traditional criteria bestowed upon the taken-for-granted headphone are its ability to blank out background noise in a shack and how well it milks the last bit of intelligibility from a weak signal. But tradition flies out the window if you can't wear your headphones because they're downright uncomfortable.

Since hams are basically comfort-loving creatures, the ideal headphone should offer both good listening quality and comfort. Half of our solution to the quest for a perfect headphone for hams is to adapt a pair of ultra-comfortable stereo cans. Designed to be worn for hours without discomfort, stereo headphones have an abundance of padding and soft surfaces. And, best of all, the ear cups are shaped to fit a human head.

But, you can't just plug a set of stereo phones into your ham rig. To begin with, this type of headphone generally offers a low-impedance to the output jack of a hi-fi receiver—somewhere between 4 and 50 ohms. The phone jack on a communications rig, however, accepts headphones having a higher impedance—on the order of 2,000 to 4,000 ohms and more.

Even more important, stereo headphones respond to audio voltages in a more linear fashion than those designed for communications work. And, stereophones reproduce signals across a considerably wider frequency range. They will faithfully capture every bit of man-made and natural static fed into a receiver.

By contrast, the typical pair of phones worn by a ham has a frequency response that peaks its output around 800 cps. Good voice reproduction is the result. Both higher and lower incoming frequencies are attenuated.

In order to enjoy the comfort of stereo phones and still have the advantage of tail-

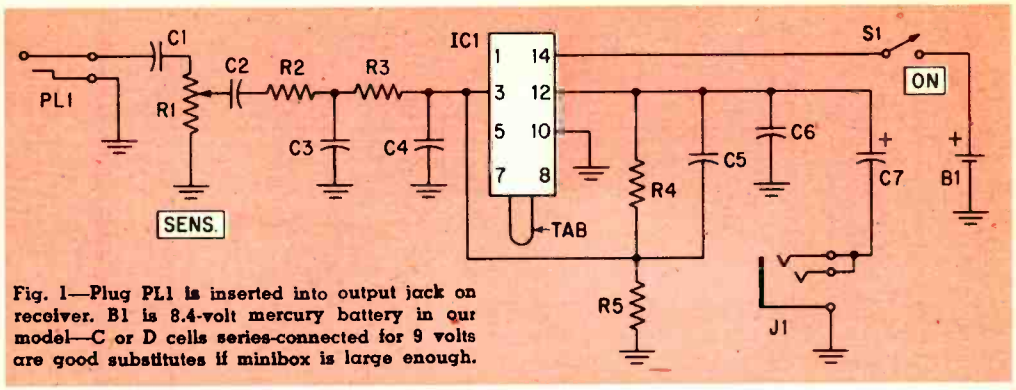


Fig. 1—Plug PL1 is inserted into output jack on receiver. B1 is 8.4-volt mercury battery in our model—C or D cells series-connected for 9 volts are good substitutes if minibox is large enough.

PARTS LIST

B1—8.4-V or 9-V battery (see text)
Capacitors: 100 VDC unless otherwise specified
C1—0.1 μf tubular paper
C2—0.47 μf mylar
C3—0.02 μf paper
C4—0.005 μf tubular paper
C5—0.001 μf mylar
C6—0.1 μf tubular paper
C7—10 μf, 10 V electrolytic
IC1—Integrated circuit (General Electric PA-234. See note.)
J1—Stereo phone jack (Calectro F2-848 or equiv.)
PL1—¼-in. phone plug (Calectro F2-816 or equiv.)
Resistors: ½-watt, 10% unless otherwise specified
R1—2,500-ohm audio taper pot. with screwdriver adjustment
R2—4,700 ohms
R3,R5—33,000 ohms
R4—82,000 ohms
S1—SPST switch
1—aluminum minibox
Misc.—perfboard, push-in terminals, rubber grommet, two-conductor cable, battery connector (Calectro F3-052 or equiv.)
Note: Order IC1 from Circuit Specialists Co., Box 3047, Scottsdale, Ariz. 85257. Cost is $3.35 postpaid.

ored frequency response, our Stereo Phones Adaptor evolved. Its heart is a General Electric PA-234 integrated circuit. Labelled IC1 in our schematic, this integrated circuit has a high input impedance and a low output impedance—the perfect match for a pair of stereo phones.

A three-stage input RC filter, output filter and a frequency-sensitive feedback network are built into our adaptor. The frequency characteristics of a communications headset are thereby simulated by an ordinary pair of stereo phones.

How It Works. The GE PA-234's internal circuit consists of seven transistors, three diodes and three resistors. Circuitwise, the chip contains a driver stage feeding a transformerless power output stage. The PA-234 is capable of supplying one watt of audio but in our stereo phones adaptor its output is limited to 200 milliwatts.

Since little power is dissipated within IC1, no external heat sink is needed. Although the device has a heatsink tab protruding from one end, it's left bare in our adaptor.

The first stage consists of capacitor C1 and potentiometer R1. Together they form a high-pass filter that gradually rolls off frequencies below 800 cps. Pot R1 also serves as the input *Sensitivity* control.

Components R2 and C3, and R3 and C4 form a two-stage, low-pass filter that gradually cuts frequency response above 800 cps.

Capacitor C5, wired across feedback resistor R4, attenuates the amplifier's high-frequency response. And capacitor C7, in series with the headphones, serves as the final high-pass, frequency-shaping element.

Building the Adaptor. Our circuit fits with room to spare in a 5¼ x 3 x 2⅛-in. aluminum minibox. Wire the circuit elements on a piece of perforated board. Be careful not to overheat them when you solder their leads to the push-in terminals. And watch out for short circuits between adjacent leads.

Figure 2 is the pictorial of our stereo phones adapter. Note that the integrated circuit terminals are numbered one through 14, even though IC1 has only eight leads. Reason is, the standard dual inline plastic IC package is arranged to accept up to seven pins on each side of it.

When General Electric built this integrated circuit into this more or less standard shell, they removed the pins that didn't connect to any portion of the IC's internal circuit. If you look very carefully between the pins of IC1, you can see the metallic stubs of these nonexistent pins.

Hold the PA 234 so that the top faces up-

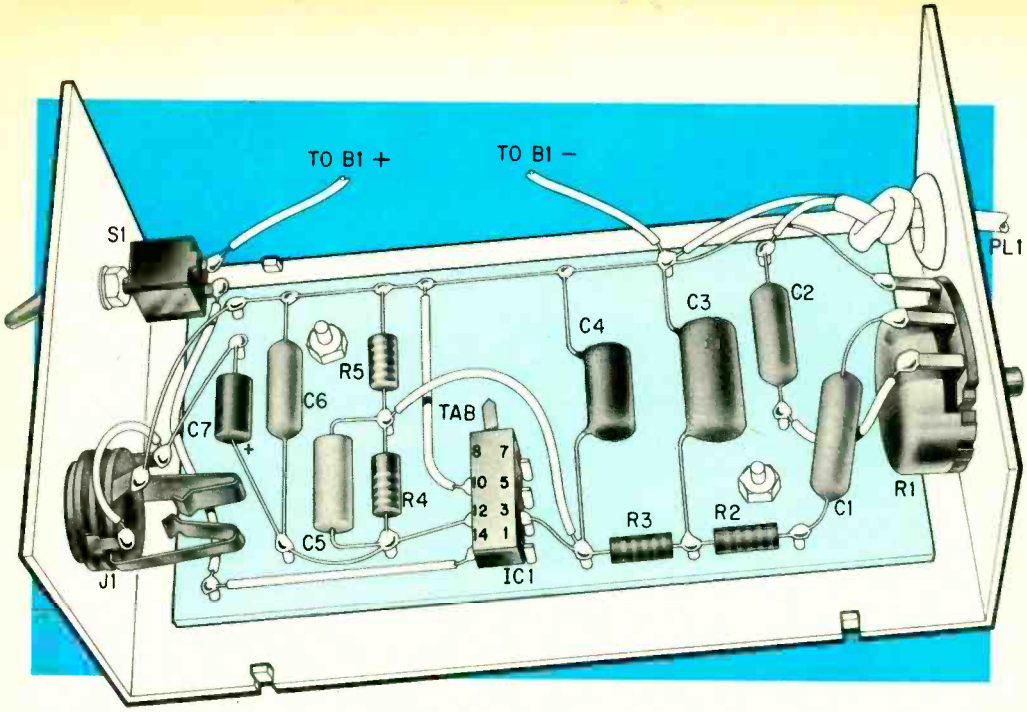
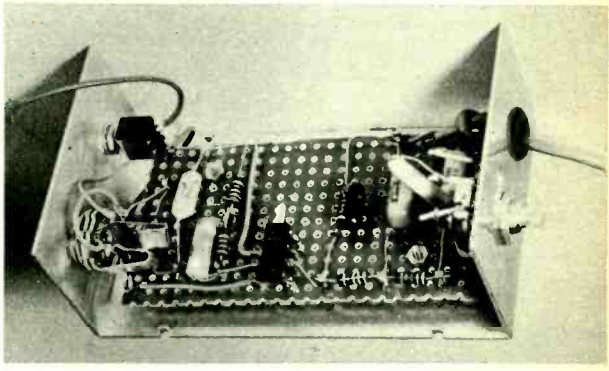


Fig. 2—Two-wire cable connecting PL1 to chassis components can be any length desired. Mount IC1 exactly as shown with tab facing towards center of chassis. Solder IC1 to flea clips with low-wattage soldering iron to avoid solder bridging.



Adapting Stereo Phones for Hams

wards and the heatsink tab points away from you. The pin in the lower righthand corner is pin one. The next pin is number three, *not* pin two, as you might expect. Make careful note of this before you start construction. Odd numbered pins are on the right, while even numbered pins are on IC1's left.

Begin construction by first determining circuit layout. Follow Fig. 2 as a guide. The ground circuit buss is a continuous length of solid copper hookup wire with its insulation stripped off. Use flea clips to hold the wire in place.

Next, insert eight flea clips into the circuit board and space them so IC1's leads can easily slip directly into the clips. Solder the integrated circuit to these clips with a low-wattage soldering iron. Take particular care not to overheat IC1. Those hams who don't have a low-wattage soldering iron (25-35 watts) should buy an IC socket and solder it to the clips.

Connect the live terminals of Jack J1 together. Run a single length of hookup wire from J1's live terminals to the circuit board. (See Fig. 2.) Now both left- and right-channel reproducer elements are wired in parallel whenever the headphone is plugged into J1.

Finally, fasten the battery to the chassis lid with a dab of contact cement. We found that an 8.4-volt mercury battery was the ideal energy source for the adaptor. Advantage was taken of this battery type because it maintains a steady output voltage during its life. Audio distortion is held to a minimum as a result.

An ordinary 9-volt transistor radio battery will not work as well in the adaptor. It cannot supply the current required. But if you have sufficient room in your minibox, a group of C or D cells soldered in series to deliver 9 volts under load will provide more than enough power for our adaptor.

The Persuaders Come to Stereo

When you buy stereo components you may be satisfying irrational needs and unconscious wishes—not just buying a nice product at a good price.

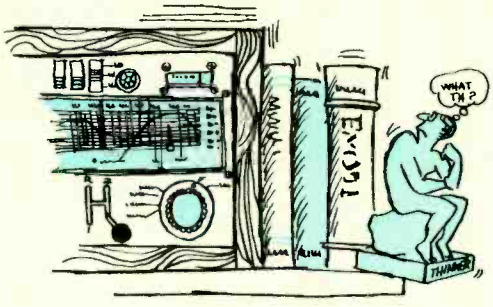
By ROBERT ANGUS

WHEN you buy a car, you kick the tires and slam the door to check if the car has a quality feel about it. But when you buy a stereo rig, do you twist the knobs and check the weight of the equipment before buying? If so, you're a target for the persuaders—marketing men influenced by psychologists like Ernest Dichter and Burleigh Gardner and market researchers like Daniel Starch and Alfred Politz.

The motivational researcher has been part of the American retailing scene since the early '50s, but his influence on the design and manufacture of stereo gear is a comparatively recent phenomenon. What he's telling manufacturers about hi-fi enthusiasts is revealing.

"Motivational research isn't all evil," says one manufacturer of receivers and stereo compacts who admits—off the record—that he's been using a consultant. "It helps us design a product which is more useful to the customer. The researcher helps us decide which controls are used most frequently and how they can best be located.

"For instance, when we were considering adding a tape recorder to our product line, the consultant advised us to simplify the design since most buyers want to use their recorders immediately and don't want to bother with a complicated instruction book. Instead, he said, design the controls so the buyer can't botch anything before he learns how to operate it properly."



Bookshelf stereo receivers and speaker systems aren't really designed for bookshelves at all. Overhang may be four inches or more.

One of the first things the persuaders have discovered about the stereo buff is that he wants value for his money. When he graduates from a $200 rig to a $500 system he wants much more performance. But, say the researchers, what the average shopper means by *more* isn't necessarily a better or more powerful unit, but typically one which is bigger and heavier than the less expensive model.

One motivational consultant explains it this way. "These days, most people house their stereo components on bookshelves. This offers the advantage of compactness (the average built-in bookcase is only 8½ in. deep). Yet, people buying stereo equipment—especially those systems priced over $250—will refuse to buy an amplifier or receiver that's shallow enough to fit on that shelf."

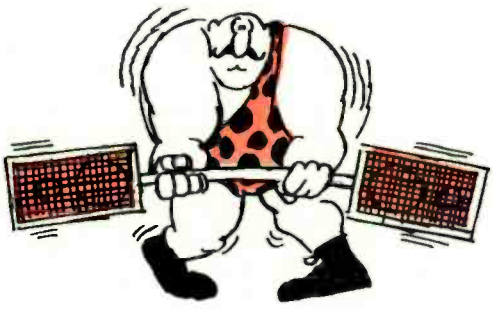
According to the marketing experts, the optimum depth for a stereo receiver is about 12 in.—which means that it's sure to overhang any shelf you put it on. But these receivers can be made smaller. If you look inside the chassis you'll discover that what's inside is mostly air. Using today's integrated circuits, it's possible to design a powerful stereo receiver that's no larger than a Gideon Bible.

The Persuaders Come to Stereo

Manufacturers like Electro-Voice have tried, only to find the buying public rejecting their compact receivers, tuners and amplifiers in droves. But the reasons for buying an oversize receiver are subtle, according to market researchers. For one thing, many early transistor models weren't very good. They helped foster the idea that the bigger you are, the better.

Another factor is, the consumer has to pay upwards of $300 for a good stereo receiver. He can't admit to his wife, his friends or himself that all he got for his money was a little black box the size of a phone book—no matter how many features it has or how powerful it is.

When a customer spends more money, he wants something bigger, just as he wants more watts from his dollars. It seems logical, say the researchers, that more watts should come in a bigger box. There is, however, an optimum size! Once the receiver's profile gets deeper than 12 in., wider than 17½ in. or higher than five in., it becomes "bulky," or "too big."



Average consumer does a balancing act. The more money he spends, the heavier and more impressive his equipment should be.

Weight is an important consideration as well. When Electro-Voice engineers designed one of the first compact receivers, they cut the weight in half. When the first reports came back that customers weren't taking to the slim profiles, E-V's marketing department came up with an idea—a walnut enclosure with slate endpieces that not only added to the overall dimensions, but more than doubled the weight of the receiver.

"I never mention weight when somebody comes in here to buy," says a salesman for Lafayette Radio, "and customers rarely ask about it. But about half the time, the prospective buyer will wait until he thinks I'm not looking and then try to lift the unit. When he finds it's fairly heavy, he seems pleased."

If size and weight are important features in a receiver, they're also equally important in record changers, stereo compacts and, to a lesser extent, in speakers. "There must be an orderly progression," says Marvin Lazansky, chief audio buyer for E. J. Korvette. "When you show a customer a stereo rig or compact in the store, he wants to see a visible improvement over the cheaper model and he wants the more expensive model to look as if it's worth more."

That's what made the minichanger such a success in inexpensive compacts and such a dud in higher-priced systems. The minichanger's small dimensions make it ideal for mounting in bookshelves or small cabinets—but serious audiophiles won't take one as a gift, even if its performance were to rank with the better full-size changers and turntables.

"Weight can be a reliable indicator of quality in record players," a researcher says, "because a heavy hysteresis motor usually is better than a lighter two-pole or four-pole type. And a cast plate obviously indicates better construction than one stamped out of tin."

However, it's possible for a manufacturer to save on costs and make up the weight by using a heavy turntable or—as one manufacturer did—by soldering lead weights to the underside of the metal plate.

Establishment of the two-cubic-foot bookshelf loudspeaker as the optimum combination of sound quality and convenient size has set some limits on the *size progression*—as one motivational researcher calls it. "To call it a bookshelf loudspeaker is a bit of a misnomer, because it actually overhangs the bookshelf by at least three inches," he says. "Nevertheless, when you walk into a store—particularly one that offers stereo gear in several different price ranges—you'll notice that the cheapest model uses a very small loudspeaker. A slightly more expensive model offers a speaker that's somewhat bigger, and so on until you reach a price level near $300. That's when the two-cubic-foot speaker begins to appear. From there on up, you just get better bookshelf speaker systems."

Appeal to the eye is an important consideration for every manufacturer of hi-fi components. Before the motivational researchers appeared on the scene, a number of manufacturers decided that their products would sell better if they looked better. They hired style and decor consultants to help make the components presentable in the living room.

The motivational people second the motion. To catch your eye, they advocate such devices as bright colored indicator beacons, function indicators and other readouts which utilize bright splashes of light.

Pointing out that among the first things a child responds to are brilliant flashes of light and lots of color, a consultant who has advised receiver manufacturers on designs for their tuning dials observes that the first stereo indicator lights were nothing more than tubes which glowed when a pilot signal flowed into the multiplexer.

"The glow wasn't particularly bright, but it did attract attention. By using a brighter bulb and color filters, the manufacturer now can create a real attention-getter. I recommend using at least three or four of these bright beacons, having two or three different colors, if possible. If you have too many colors or bulbs on at once, the receiver starts to look like a Christmas tree."

Like small children, hi-fi enthusiasts are attracted to gear that utilizes illuminated controls, VU meters and fancy switching devices.

As the motivational researchers see us, stereo component buyers have Walter Mitty fantasies of sitting at the master control panel at NBC or some other leading recording studio. We daydream, they say, of sending Metropolitan Opera broadcasts out across the nation, or of taking personal charge of an electronically enhanced rock recording session.

To help us act out these fantasies, researchers encourage manufacturers to utilize plenty of knobs, sliding pots and toggle switches to control just about every conceivable function. The same is true for meters.

Once upon a time, tape recorder manufacturers used cat's eyes or neon lamps to indicate recording levels. In some cases, these devices were more accurate than the cheapie VU meters available on lower-price recorders. But the machines using glow lamps didn't sell as well as those having meters. The motivational people explain this is because the would-be recording engineer can't compromise his image of himself watching all those flicking needles on a 24-position professional console.

In the case of stereo tuners (or receivers), the more expensive models now include both signal-strength meters and center-channel tuning meters. "The meters and indicators cost maybe 50 cents to $1 for the manufacturer to buy and install," says one salesman, "but they increase the saleability of his product. He gets a far greater return."

The subject of knobs and switches creates a difference of opinion among motivational researchers as well as among manufacturers of high-fidelity equipment. Some argue that only a minimum of controls is necessary, and that extras simply frighten off potential buyers (such as housewives, who are intimidated by an array of knobs and levers). Others say that a multiplicity of controls gratifies the Walter Mitty urge to sit behind a studio control panel.

"Price has something to do with it," one consultant says. "I advice my clients to keep their less expensive models relatively simple. But if they're offering a $500 stereo receiver, it had better have separate bass and treble controls for each channel, separate volume controls and other goodies like a front-panel speaker selection switch, slide controls to accentuate different parts of the tonal spectrum so you can plot your own recording curve, and so on."

Motivational researchers believe in reaching the consumer through all five senses to satisfy his irrational needs. "Take the matter of controls," says one researcher. "Consumers respond to subtlety when using controls —like a sliding lever switch or a rocker switch. These switching devices don't cost much more than conventional types, but they do gratify the tactile sense in all of us. It's something like pressing a mercury wall switch and not hearing a click—it's different and buyers respond to it."

E. J. Korvette's Marvin Lazansky agrees. "Subtlety in controls is something we can't

[*Continued on page* 99]

Hi-Fi Today

By Robert Angus

4-Channel Discs!

SHADES of the LP/45-rpm war. RCA and Columbia Records are at it again, this time over the question of four-channel records. Old-timers will recall that when Columbia introduced the LP back in 1948, RCA didn't go along. Instead, the electronics giant came out with its own doughnut-shaped record, guaranteed not to play on any of the turntables designed to accommodate the Columbia disc. Later, when color TV came along in the '50s, RCA and Columbia went at it again with opposing systems. Now it's four-channel's turn and each label has been lining up support.

Columbia fired the first salvo, announcing its SQ disc last year. Quickly, such manufacturers as Vanguard and Ampex Records fell in line—and Sony Corp. elected to make the playback equipment. Electro-Voice, which had announced the first four-channel disc, quickly modified its system to work with SQ, and the record companies which had produced E-V discs—Ovation, Crewe, Audio Spectrum, Project 3 and Command—found themselves allied with CBS.

RCA actually hasn't marketed a record yet. But it plans to soon, and Panasonic and JVC (which developed the original discrete four-channel disc system) are making the playback equipment. As things stand now, CBS' matrixed four-channel technique is incompatible with RCA's discrete disc—if you want to listen to both the *The Guess Who* and *Chicago* rock groups you'll need two playback decoders.

Panasonic's Model CD-4 four-channel disc demodulator (like similar JVC equipment) is designed to demultiplex supersonic subcarrier on RCA discs.

RCA's record works something like an FM stereocast. A modulator adds the rear channels to the front channels and inscribes the result as a conventional stereo groove. In the same groove, however, is the difference between front and rear, inscribed as a supersonic carrier. The CBS record simply blends (encodes) front and rear through techniques such as phase shift, and a decoder reconstitutes them from a regular stereo groove.

Because of the subcarrier, whose frequency is in excess of 30 kc, the RCA disc requires a highly compliant cartridge having a frequency response up to 50 kc (most of today's best cartridges don't respond much above 22 kc). Then there's a chance that the stylus may wear out the subcarrier groove in only 100 plays or less.

CBS' matrixed four-channel sound lacks the sharpness and directionality—the punch—of RCA's multiplexed signals. But the latter system costs more and has technical problems which have yet to be solved—among them, how the record is to be broadcast quadraphonically without creating trouble for the station's own multiplex equipment. Who's going to win this battle is anybody's guess. As of now, the troops are only getting into position.

If you're planning to buy audio equipment and you're looking for something that will be convertible to four-channel at some future date, take a close look at any components advertised as being *four-channel ready*. The term, originally applied by Fisher Radio and a few others to receivers and amplifiers which would accept an additional plug-in amplifier so that the four-channel ready rig could serve as the master control unit, now is being applied indiscriminately to many conventional two-channel receivers, amplifiers and even stereo compacts. Most any component can be added to a four-channel system—but 4-channel capability isn't necessarily built in.

Good Reading

By Tim Cartwright

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

A BRAND NEW handbook for semiconductor sleuths is available—its title is **Handbook of Practical Solid-State Troubleshooting** by John D. Lenk (310 pages, $12, Prentice-Hall Inc.)—which has technical tips for both the beginning and advanced technician. Most readers probably will benefit from chapters 1, 2 and 6. These cover general techniques and specific problems relating to transistor and IC troubleshooting, plus solid-state TV circuitry. For more adventurous types, detailed information on servicing computer (digital) circuitry and operational amplifiers is included. Some of this is more theory than practice. If you like to get to the bottom of things and want to troubleshoot systematically this is a book for you.

Remember when the Sears, Roebuck catalog listed bolts of gingham and rolls of chicken wire? If you do, you'll be pleasantly surprised by a new edition which shows a $1,000 color TV console and $600 hi-fi sets. The mammoth retailer has just published its 1972 **Home Entertainment/Electronics Catalog** to complement the mighty Big Book. The glowing illustrations alone could make a Rumanian music-lover defect to the nearest Sears catalog office.

Amid stereo receivers, compacts and cassette decks are some surprises. Unlike the big catalog, products in this special edition don't carry the Sears private labels (such as Silvertone) but bear familiar tags like Sony, Fisher and Harman-Kardon. There's also a section for CB sets, monitor receivers and antennas made by other well-known manufacturers. To get a copy write: Sears, Dept. 703, 303 E. Ohio, Chicago, Ill. 60611.

If you can ignore its breathtaking title—**The Truth About CB Antennas!**—this new book is an excellent guide to the mysteries of a popular topic. Authors William Orr and Stuart Cowan have prepared clear, entertaining text on a subject often muddier than the Ganges after a typhoon. They start with the experiments of Heinrich Hertz, describe every important antenna type and offer assembly information for the CB constructor. The writers have been around antennas for decades and Mr. Orr is an authority on ham radio.

But Ralph Nader they're not. The book huffs about a unique truth table that is supposed to unmask false antenna claims and tell it like it is. By the time the table is presented, the reader is ready to garrote the nearest antenna manufacturer. After inspecting the table, however, you discover how fleeting truth can be.

The chart is nothing more than a listing of generally accepted gain figures (in decibels) for each major antenna type. The names of manufacturers and model numbers are missing. This reviewer, in fact, tried using the table to rate about a half-dozen CB products and discovered some manufacturers were claiming fewer db's than the table. The authors further weaken the chart's hair-splitting distinctions by stating that "a power decrease of 3db is not especially harmful." Sure, antenna manufacturers do boost products with glittering promises and chicks wearing Tarzan suits. But, alas, so does this book. Ignore the bombast and it's worth the $4.95 cover price (Radio Publications, Inc., Box 149, Wilton, Conn.).

Dynascan, the instrument maker, has released a new 24-page **Catalog of B&K Test Equipment.** Besides the conventional voltmeters, generators and other gear for electronic servicing, the catalog describes Dynascan's novel Television Analyst, probably the ultimate substitution box. This device can inject the appropriate signals into a TV anywhere from its antenna terminals to a CRT grid and display them as a test pattern on its own screen.

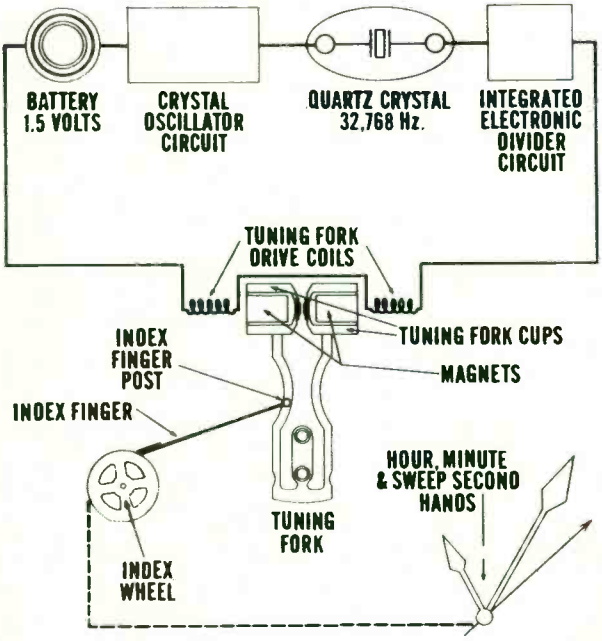
Another goody described is a sophisticated B&K sweep generator that flashes lights on its panel to frame the ideal response curves in the TV receiver that you're aligning. A free copy of this catalog, BK2, is available from Dynascan Corp., 1801 W. Belle Plaine Ave., Chicago, Ill. 60613.

MOV ZAPS THAT URGE TO SURGE. General Electric Co. scientists have discovered the long-sought-after device considered to be the missing link in electronic's evolutionary chain of line transient surge equipment. Called MOV—for Metal Oxide Varistor—these solid-state suppressors sense a power-line transient long before it damages the gear being protected. The size of disc ceramic capacitors, MOVs are filled with conductive oxide grains, each coated with a thin bismuth oxide film. The film insulates the oxide grains from each other, but begins to conduct as the applied voltage rises. The MOV, seen protecting a diode against a 5,000 volt simulated line transient, quenches the transient quicker than conventional electronic protective devices.

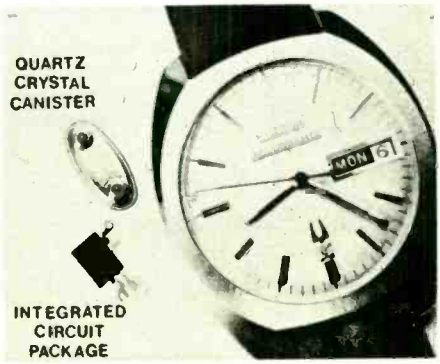
Electronics in the News

Closing the Generation Gap. Monitoring the electricity sent out on a power grid once was a seat-of-the-pants affair for the Philadelphia Electric Co. Thanks to an automated control system that monitor's PE's entire power grid, the generation of juice will be made more efficient and reliable. The computerized system monitors line voltage and power delivered into the grid. If trouble develops anywhere, the CRTs start blinking in red and a warning device sounds off.

Shoot and Scoot. An Air-launched, TV-guided missile that increases pilot safety has been developed for use against ground targets by the Hughes Aircraft Co. Built into the missile, the miniature TV camera shown peering out of the missile's nose cone homes in on a target the same way a television camera zooms in on the action at a sports event. The pilot focusses the camera onto the target and locks the missile onto it at the press of a button. After launch, the missile continues toward the target, to impact at the exact spot at which the TV camera was originally locked on. Meanwhile, the pilot is free to seek other targets or scoot away.

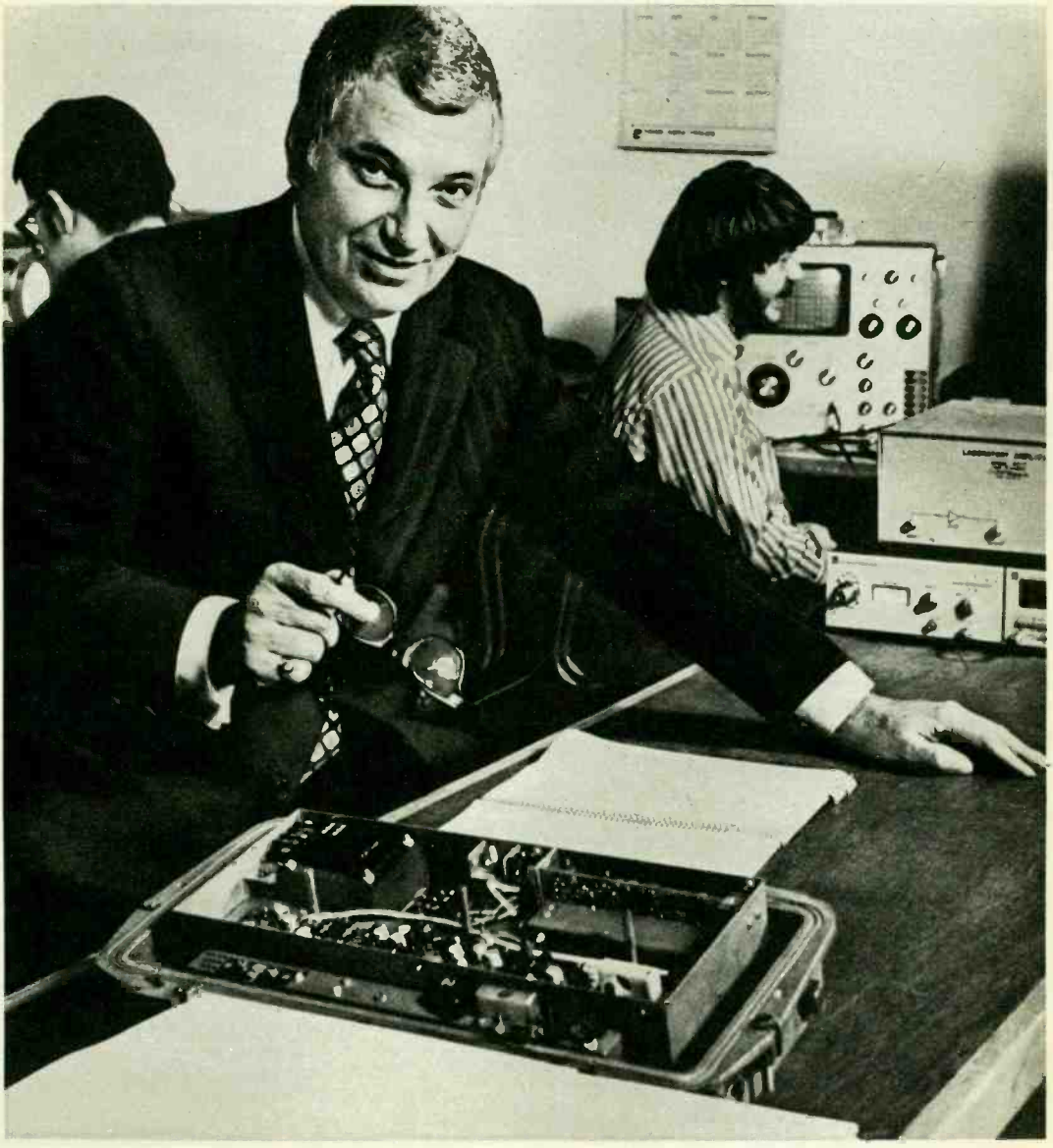


Quartz Ticker Rocks the Clock. The Bulova Watch Co now has introduced a quartz-driven wristwatch said to be many times more accurate than a conventional wrist timepiece. The watch utilizes a quartz-crystal master oscillator running at 32,768 cps. This frequency is divided down by a built-in IC to 341 1/3 cps and is used to drive a tuning fork motor. Regulation accuracy shows that the watch gains or loses no more than 1 to 2 seconds per week in actual use.



"At ComSonics we encourage all our technicians and engineers to enroll with CREI. Know why?"

WARREN BRAUN, *President, ComSonics Inc., Virginia Engineer Of The Year, ASE International Award Winner,* **CREI Graduate**



Photographed at ComSonics, Inc., Harrisonburg, Va.

"As a CREI graduate myself, I know the advantages of their home-study programs. CREI education has proven an excellent tool of continuing education for our employees and for me. And I strongly believe in CREI's ability to teach a man to learn independently and to use reference materials on his own.

"As President of ComSonics, I see changes taking place in our Electronics business every day. We're in closed circuit TV and acoustical engineering...and pioneered in Cable TV. CREI gives my men the knowledge they need to work in new areas...CREI's new course in Cable TV is an example. The CATV industry is expected to grow 250% in the next three years. I know the opportunities in Cable TV. I designed one of the first CATV systems in 1950. But technical advances are constantly changing the field. And since CREI's experts know most of what's going on in all areas of Electronics, I know that CREI can give my men some of the important, specialized training they'll need to maintain our position in Cable TV and our reputation in Electronics.

"We've interviewed many technicians and engineers for jobs in the past year and had to reject them because their knowledge is archaic and out-of-date. A man is of no value to us if he doesn't keep up-to-date."

Some of the biggest names in electronics buy CREI courses for their own employees. CREI students and graduates prove themselves on the job. They move ahead of the pack by earning promotions and salary increases.

The Future Belongs To You

You've been in Electronics long enough to know that the field is changing more rapidly than ever. New industries, like Cable TV, are born almost overnight. But surveys show that three out of four men now working in Electronics aren't technically qualified to work in these new areas. Clearly, the future will belong to the man who gets the right education *now*.

Start Learning At Home

But what you learn depends on which school you choose. Here's why CREI is among the best.

With the CREI program you study at home. At your own pace. There are no classes to miss, no work to make up. Each lesson is explained in clear, easy-to-read language. That's why many men do far better in home study than they ever did in school...even if they've been out of school for years. And the study habits they learn from CREI are sustained through life.

As a CREI student, you'll be assigned to an experienced instructor who will grade your assignments and offer constructive comments and criticism. If there's a special problem, the instructor will work with you until you understand it fully. You'll receive personal attention from your instructor because he deals with each student individually—as a class of one.

What Will I Learn?

You'll be learning the latest in advanced technology, geared to specific industry programs. Both theory and practical material are presented to meet all phases of job-related training needs.

CREI courses are written for the man who knows basic Electronics, but whose advancement depends on keeping his technical know-how current. You choose what you want to learn. You study subjects which help you grow and advance in your present job and which relate to your career objectives. CREI offers you the opportunity to continue your education throughout your working life.

Constantly Up-Dated Courses

Because of rapid changes in Electronics, CREI courses are constantly being revised and up-dated by professionals who work in Electronics every day. New developments are included as quickly as they occur. Right now, CREI students are getting the latest up-to-the-minute information on such things as Cable TV, LSI chips, microminiaturization, lasers and masers, telemetry systems, servomechanisms, and data links. If it's new in electronics, CREI—and you—will know about it!

Developed By Top Scientists And Engineers

CREI maintains a full-time advisory faculty of some of the top names in Electronics. Each is a specialist in his own field, an expert who plans and develops CREI lesson material. After each expert submits his course plan, it is carefully reviewed and written by the CREI educational staff. Then each course is broken down into individual lessons. And they make certain each lesson is clear and self-explanatory. Just the right length for easy understanding and effective study.

How Can I Qualify?

If you've read this far, your interest in getting ahead in Electronics is evident. Send for our famous book on how to prepare for tomorrow's jobs in Electronics—the book that has helped thousands of men just like you get ahead. For your free copy, simply mail postpaid card today.

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Employed by _____

Type of Present Work _____ G.I. Bill _____

APPROVED FOR TRAINING UNDER NEW G.I. BILL

The Ham Shack

By Wayne Green
W2NSD/1

How to Go 2 Meters

TWO-METER FM is still the biggest news in amateur radio, providing groundwave coverage that would make a CBer's eyes pop. FM repeaters (automatic relay stations) are being installed on top of more and more mountains and tall buildings, enabling you to communicate with inexpensive ten-watt mobile transceivers over one or two hundred mi. From the time I drive out of my garage in New Hampshire until I park my car in New York City I am never out of range of any of several repeaters and I'm able to maintain interesting conversations throughout my trips.

You do have to obtain at least a Technician Class amateur-radio license to use two-meter FM and get in on the fun of repeaters. This license can be obtained through your local friendly amateur (if he has a General, Advanced or Extra Class ticket). The code requirement of five words per minute shouldn't take you longer than a few hours to master. By the time you've learned the code you are almost ready to copy at that rate. The theory is a bit more difficult to handle, but if you have the latest teaching aids it should go quickly. The *General Class Licensing Study Course* (Tab Books) presents the theory in about as sugar-coated a form as you could ask. Many amateurs have written me to say that the theory is presented in this book so clearly that just reading it was enough to permit them to pass the FCC exam.

The fun of FM (even if you never do anything else with your ham license) is enough to make it well worth the effort. A friendly amateur will do all he can to make the test as painless as possible.

Okay, you've gotten that license and you've bought yourself one of the new FM transceivers. Now you have to get it set up in your car . . . is it a big deal?

Only a few years ago it was a great big headache setting up FM in a car. The transceiver was usually a surplus unit taken from a taxi and it just about filled the trunk.

Today, however, your modern transceiver is about the same size as a regular car radio. Most run ten to 15 watts and this is more than adequate to operate through most repeaters—out to 50 mi. or so. Power amplifiers can be added if you want to extend your range. A 100-watt amplifier isn't much larger than the radio! Power for the rig comes from a plug which goes into the cigarette lighter so you don't need to run power cables around your car. The antenna comes with a magnetic base which attaches firmly to the car roof, with the coax running in through the door and down to the transceiver located in the glove compartment or sitting on the dashboard.

The installation of more and more repeaters has increased the cost of crystals for multi-channel rigs, but this problem is being alleviated both by substantial reductions in prices of crystals (by some manufacturers) and by the development of frequency synthesizer circuits which replace crystals entirely. Before ICs, a synthesizer was possible but not practical—often requiring up to 100 tubes to handle the complex adding and dividing of frequencies. Now, when engineers can cram upwards of 1000 transistors into one little can, almost anything is possible.

You don't have to have much of a memory to recall when frequency counters were very big and very expensive. Thanks to ICs, a counter that displays frequency with nixie tubes sells for under $200 in kit form and is about the size of a car radio—at half the weight. Like many other things in this life, once you try it you wonder how you ever got along without it.

For instance, I recently got an updated version of the old Gonset Communicator, the Comcraft, a solid-state AM-FM two-meter transceiver that has a tunable receiver and both a crystal and variable-frequency oscillator (VFO) transmitter. I figured it was about time to try a good VFO and tunable receiver. Now, when I hear a repeater, I turn on my frequency counter and zip the transmitter VFO to the repeater's input frequency and I'm in. This saves me about 30 crystals, which add up to maybe $150 or more, assuming I want to hit all active channels.

Win-The-World Contest . . . The Finish!

IT'S all over!

EI's Win-the-World Contest has been decided down to the last winner.

Our hearty congratulations to the winners, especially to Raymond Ginn of Hermosa Beach, Calif., who took the Grand Prize. Ray claimed 950 QSLs and then substantiated his claim by sending in no less than 1,058 cards. He's a shortwave listener, as were about half of our winners—the rest being hams. At presstime Ray had not yet decided where in the world he wants to go via Pan Am (taking along his Hallicrafters CR-44A receiver). Most of Ray's QSLs were from hams.

PRIZE	DESCRIPTION	WINNER
GRAND PRIZE	A trip to your favorite country anywhere in the world via Pan American World Airways, the world's most experienced airline, and a Hallicrafters CR-44A shortwave receiver	Raymond Ginn, Hermosa Beach, Calif.
2nd	RCA G-2000 color TV set	Garry Hammond, Atwood, Ont.
3rd	Heathkit/Thomas Legato organ kit	Karl Geng, Medway, Mass.
4th-5th	Heathkit GR-370 color TV kits	Verne Read, Surrey, B.C., and K. Hollatz, Elmira, Ont.
6th-7th	Conar color TV kits by National Radio Institute	Jeff Angwin, Palo Alto, Calif., and Jim Leonard, Santa Ana, Calif.
8th-13th	Your choice of home-study course from: Cleveland Institute of Electronics, CREI, ICS, National Radio Institute, National Technical Schools, RCA Institutes	Larry DesJardin, San Andreas, Calif., Peter Hollatz, Elmira, Ont., Terry Batt, Elmhurst, Ill., N. L. Cohen, Milton, Mass., David Shultz, Tulsa, Okla. and Michael Jones, Austin, Tex.
14th	Hallicrafters SX-122A receiver	Jerome Pumo, Des Moines, Iowa
15th-19th	Hallicrafters SX-133 receiver	Robert Bowman, Roanoke, Va., Douglas Garlinger, Portland, Ind., Don Twietmeyer, Rochester, N.Y., Phil Zurowsky, Baltimore, Md., and Joel Leonard, Rochester, N.Y.
20th	Advent 201 cassette tape deck	Stephen Martin, Upper Marlboro, Md.
21st	Sony STR-6055 stereo FM/AM receiver	John Boegehold, Orchard Lake, Mich.
22nd	RCA WO-505A solid-state scope	Richie Scalco, Wheaton, Md.
23rd	Lafayette Radio Telstat SSB-25 SSB CB transceiver	Chuck Edwards, Fort Lauderdale, Fla.
24th	RCA WR-52A Stereo FM Signal Simulator	Bob Emery, Allentown, Pa.
25th	Allied Radio Shack Patrolman PRO-3 VHF/UHF receiver	Ronald Szymczak, Chicago, Ill.
26th	Sansui QS-1 Quadphonic Synthesizer	Robert G. Fritz, Moline, Ill.
27th	Weston 666 solid-state VOM	Robert Brossell, Milwaukee, Wis.
28th	Courier Citation solid-state base-station CB transceiver	Roy Thompson, Decatur, Ill.
29th	Olson RA-280 stereo FM/AM solid-state receiver	Phillip Singer, E. Lansing, Mich.
30th	RCA WR-502A solid-state colorbar generator	Konstantine Rychalsky, Bridgeport, Conn.
31st-35th	Hallicrafters CR-44A Ranger portable shortwave receiver	Steve Jess, Escondido, Calif., Jimmy Parker, Napa, Calif., Donald Lechthaler, Baltimore, Md., Michael Barnard, Liberty, Ind., and Freddy Katz, Nashville, Tenn.
36th	Avanti Moonraker CB base-station antenna	Randy Iliff, Alton, Ill.,
37th	Ameco R-5A receiver	James Hall, Champaign, Ill.
38th	DeltaAlert ultrasonic intrusion detector	Jordan Roderick, Pt. Washington, N.Y.
39th-41st	Hallicrafters S-240 entertainment/communications receiver	Paul Murphy, Goshen, N.Y., Raymond Merigold, Plainville, Mass. and Michael Antonucci, Granby, Conn.
42nd	Two CB mikes from Turner	Richard Koret, Rochester, N.Y.
43rd	Edmund Scientific Deluxe Visual Effects Projections Set plus Rippling Color Accessory	Steve Steckly, Madras, Ore.
44th-45th	Hallicrafters skip-band receiver	Lewis Masson, North Chatham, Mass. and Dave McDonald, Kitchener, Ont.
46th	Eico 3450 four-channel color organ	Gary Franklin, Salinas, Calif.
47th	$100 credit with Electro-Voice for any equipment in their latest catalog, including miniature 651C communications mike	Richard Saxton, Middletown, N.Y.
48th	Complete library designed for hams and SWLs from the Howard W. Sams Publishing Co.	Lee Slivi, Fairport Harbor, Ohio
49th	$100 credit for any antenna in the latest catalog of Antenna Specialists	Tom Sattler, Jupiter, Fla.
50th	Mallory MCR-1232 portable cassette recorder	Francis Murphy, Buena Park, Calif.
51st	$100 credit with Shakespeare, one of the leaders in the CB antenna field	John Brunst, Neptune Beach, Fla.
52nd	A library of the latest bestsellers from Tab Books Co.	Peter Barthelson, Hockessin, Del.

Continued Overleaf

Contest [Continued from preceding page]

53rd-100th. A year of El: Henry Seidner, Pearl River, N.Y., D. DiDomenica, Needham, Mass., J. Bell, LaSalle, Que., Thomas Tesch, Millbrae, Calif., Joe Larabell, Brighton, Mich., Jeffrey Peltz, Brooklyn, N.Y., Thomas Twine, Suffolk, Va., Steven Kaplan, North Miami Beach, Fla., William Cronin, Worcester, Mass., James Wildrick, South Bend, Ind., Steve Ceder, Arverne, N.Y., Thomas Carrigan, Worcester, Mass., Roger Gant, Antioch, Calif., Philip Hanrahan, New York, N.Y., Randy Hanrahan, Whitetail, Montana, W. W. Forbes, Cudahy, Calif., Alan Hunter, Wadena, Sask., Canada, David Sternberg, Deerfield, Ill., Andrew Graham, Leavenworth, Ks., Leonard Oshushek, Camden, N.J., James Preston, San Diego, Calif., E. H. Hamill, Burlingame, Calif., Robert Vance, Kansas City, Mo., Harold Sullivan, Fridley, Minn., Tibor Tancs, Roselle Pk., N.J., Alan McNeil, Chicago, Ill., David Chaffin, Memphis, Tenn., Greg Neson, Largo, Fla., Herbert Foster, Kalaheo, Hawaii, Jim Keys, Windsor, Ont., and Rod Montrose, Windsor, Ont., Wendell Sweeney, Tampa, Fla., Anthony Tiona, Bradenton, Fla., Robert Dobson, Williamsburg, Va., S. A. Hayward, Dayton, Ohio, Mark Korrech, Lansing, Mich., Kent Allingham, Manhattan, Kansas, J. VanWinkle, Tucson, Ariz., Paul Dureno, Maidstone, Ont., Greg Pfauth, Michigan City, Ind., Bruce Greene, Howell, Mich., Marc Schlessinger, Philadelphia, Pa., Rodney George, Urbana, Ohio, David Hudson, Lynchburg, Va., Lester Reynolds, Lyons, N.Y., Stanley Golemski, Passaic, N.J., Mark Lewis, Kenmore, N.Y., Ronald Shurtz, Topeka, Kans.

Heathkit Turns to Computer Hi-Fi!

Model AJ-1510 digital tuner costs $499.95, incorporates phase-locked-loop frequency synthesis circuitry, varactor-diode tuning and FET front end.

NOT satisfied with the recent introduction of its new AR-1500 stereo receiver—attested to be one of the finest hi-fi components on the market—the Heath Company now is coming out with two more top-of-the-line components for people who (frankly) have plenty of bread and are planning to go whole hog on a deluxe stereo system.

Leading off is the Model AJ-1510 digital tuner which, along with similar tuners made by Scott and Sherwood, displays the frequency of the FM station you've tuned in via four digits rather than the standard, illuminated slide-rule dial.

Station selection is achieved three ways. Program cards punched for FM frequencies desired are plugged in at front of the tuner—three cards (for favorite stations) can be installed at the same time and selected at the touch of pushbuttons labeled A, B and C. Or you can select a frequency by punching out digits on a keyboard just as you would on an electronic calculator.

Finally, by selecting the sweep mode, electronic tuning (using varactor diodes) will scan the entire FM band at an adjustable rate, stopping at all stations, stereo-only stations, or stations having a minimum-quality signal whose level is determined by the user when he adjusts for ANL and AGC. Program cards and secondary controls are hidden behind a hinged front panel.

Number two at bat for Heath is its AA-2004 four-channel amplifier. Specs for this powerhouse include outputs of 65 watts per channel into 4-ohm loads, 50 watts per channel into 8-ohm loads and 30 watts per channel into 16-ohm loads. Total harmonic distortion is said to be 0.25 percent over total power bandwidth of 5 cps to 30 kc, with IM distortion less than 0.2 percent.

Included in the package are four calibrated VU meters plus a meter-range switch for indication of three different power levels.

Model AA-2004 4-channel amplifier costs $349.95, operates in any of four modes: mono, stereo, discrete or matrix four-channel. Decoder is built in.

Super Booster For SWLs

Continued from page 42

cess copper has been removed, rinse the board under running water. Remove the resist by scrubbing the board with steel wool or a rag soaked with acetone.

Drill out all indented hole positions with a No. 55 or 57 bit. Then drill the two mounting holes for a No. 6 screw.

Find a piece of scrap aluminum and fashion an L-shaped ½ x ½ x 1¾-in. bracket.

Note that two of the coil's leads connect to the copper foil ground. These leads are the *ground* ends of the primary and secondary windings. You have properly oriented the coil if the colored dot between terminals 3 and 4 is pointing at the edge of the board opposite the mounting bracket.

Before mounting C1 to the cabinet, solder a 1½-in. bare wire to each terminal of C1. You may find that the terminals do not readily accept solder. Do not try to work the iron until solder flows on the terminals. This procedure will damage the capacitor. Instead, coat each terminal with a drop of non-corrosive solder flux before soldering the bare wires to them.

Connect a short, direct lead from the board output point to jack J1's center conductor. Then connect about 3 in. of solid, insulated wire to the board output ground tightly wrapping the wire around the output lead to J1. Cut off any excess wire and do not connect the spiral wire shield to J1—the wire shield is connected to ground only at the pc board.

Alignment. Install a phono plug to a piece of coaxial cable such as RG-58/U or RG-59/U. Connect the free end to your receiver and attach an appropriate antenna to BP1. Set S2 to its *high-band* position and turn on the receiver. Tune to 30 mc and turn on the preselector.

Adjust C1 to its fully-clockwise position and then back off very slightly. Set the receiver's RF gain control—if so equipped—wide open and the volume control at least half-way open. Using an insulated alignment screwdriver, adjust the slug in coil L2 for maximum noise in the receiver.

Set S2 to low band position and tune receiver to 18 mc. Turn C1 to extreme clockwise and adjust L1 for maximum noise in the receiver. With L1 and L2 so adjusted the supplied dial will be reasonably accurate.

Low-Cost Scope Calibrator

Continued from page 32

thing you have lying around, such as phono jacks. But five-way binding posts are best.

Calibration. Best initial calibration is achieved with either a calibrated scope or a true peak-to-peak AC VTVM. You cannot use an RMS-weighted AC VTVM that is also calibrated to read peak-to-peak voltages. The ac meter must be equal to a service-grade VTVM. You can generally assume that an AC VTVM gives a true peak-to-peak reading if the pointer slowly settles to zero after the applied AC voltage is removed. If the pointer instantly drops to zero, the VTVM is not a true peak-to-peak reading model.

When a meter is employed during initial set-up, connect the negative (or ground lead) to J4 and the positive lead to J1. Set the meter's range switch to read voltages higher than 5V pk-pk. and apply power to the calibrator. Allow a few seconds for the meter pointer to stabilize. Adjust R8 until the VTVM indicates 5V pk-pk. The scope calibrator is ready for use.

If you use a scope for initial adjustment, set the scope's vertical gain so that the scope's own calibrator yields 5 V pk-pk for each division. Now connect the scope to J1 and J4, and adjust the sweep frequency to obtain two or three waveform cycles. Then adjust R8 so the trace just fills one graticule division.

A reasonably good calibration can even be obtained with a scope and battery. Set the scope's mode input to DC and connect the vertical input across a 1.5 V D-cell. Adjust vertical gain until the CRT's trace moves exactly three graticule divisions when the battery is connected. Each division represents 0.5 V. With the scope input attached to J2 (0.5 V pk-pk) and J4, adjust R8 until the trace fills one graticule division.

Scopes that have some means of externally trimming the vertical attenuator for best frequency compensation can be adjusted very simply. Connect the calibrator to the scope and adjust the compensation trimmers for a perfect square waveform. See the photos. Box 3 in Fig. 4 shows a properly compensated wave-form—one having sharp leading and trailing edges. Overcompensation, or too much capacity, will produce a waveform with rounded edges. Undercompensation—too little capacity—will peak the leading edge.

Selling Side of Electronics

Continued from page 79

distributors and to small and large companies. You may have a company car or use your own. If you're employed by a rep firm, you have an expense account. If you're independent, you pay your own expenses. You usually have a geographic area and you cover it as often as your customers demand.

The major difference between you and the factory man is an engineering degree. Fewer than half the 10,000 reps in this country are graduate engineers. Those who are generally worked for some large company first.

For instance, Philip got into repping merely by answering a newspaper ad. He was tired of writing tech manuals for one of the electronic giants. Hank worked for a distributor. He applied to a rep firm that called on his boss and landed a new job.

One small distributor, Tom, let his business go. He approached three of the manufacturers whose lines he had carried. Result: he now represents all three in a five-state area.

You can't learn to be a rep in school. There's no course for industrial salesmen. Train yourself, if this kind of selling is your bag.

Pick a specialty. Work for a distributor or in a store. Learn the lines. Finally, branch into a sales specialty. Choose a certain group of products, a particular kind of customer, or a territory you like. Experience and ambition will count as much as talent. Put them all to work and selling in electronics may really turn you on.

A Home Calculator in Kit Form

Continued from page 45

carry out to completion, e.g., 4.5 x 4.5 = 20.25. Overflow is indicated on the ninth display tube.

Of course, Heathkit's IC-2008 isn't the only low-price calculator that has arrived on the consumer scene (see box). Other pocket-size—and larger—calculators priced under $200 are popping up thanks to glamorous integrated circuits like Texas Instrument's one-chip calculator circuit and some other ICs just like it.

If you have a yen to do some instant figuring, chances are 1972 will be your year.

A New System for 4-Channel FM

Continued from page 49

Second, according to Dorren's own figures, the cost of converting from two-channel stereo to four-channel stereo—for a commercial FM station—would be about 15 percent higher than the original changeover from mono to stereo. Does the present four-channel market justify this expense?

Third, is it possible to squeeze five channels of information (assuming the SCA channel is retained) into the FCC-approved bandwidth of 200 kc without having the signal-to-noise ratios of all program components deteriorate seriously? Dorren's channel-separation figures look good, but in his report to the FCC he does mention a noise increase that's "less than 7db." This could mean the range of an FM station might be affected.

It should be said that Lou Dorren's system has been tested successfully via four-channel broadcasts that were run for two months over station KIOI in the San Francisco Bay area. Further tests also have been carried out with good results in Canada.

Persuaders Come to Stereo

Continued from page 85

talk about. But I do encourage customers to try the controls for themselves—or they'll wait until your back is turned and then try them. They respond immediately to something that feels unique. Weighted flywheels, rocker switches, sliding lever switches, pushbuttons of varying types, these are just a few of the controls being offered to stereo enthusiasts to make components seem different."

Even the sense of smell hasn't been forgotten. Lazansky, a strong believer in motivational research, recently told the trade paper *Audio Times,* "If you've ever bought a new car, you have noticed that the new car smell lingers around for the first few months. It's an indescribable combination of odors—metal, enamel, rubber, leather, and who knows what else—that tells you 'this car is new.' A stereo compact, a speaker system, a receiver or tape deck should have the same kind of smell when you take it out of the carton—and some do. Maybe they should package this aroma in an aerosol can and spray the inside of the carton before they seal it."

Electronics Comes To The Aid

Continued from page 71

quarters is within arm's reach of the on-duty radio operator. On the console, two horizontal light strips represent (in this case) the east- and west-bound directions of the highway. Vertical strips represent interchanges.

When the highway is clear of disabled vehicles the light strips are green. When an alarm signal is recorded, a brief tone sounds to alert the radio operator, and the reporting spot on the highway is indicated by a console light which changes from green to red. The word *dispatch* is illuminated.

The radio operator dispatches a patrol car, then presses the dispatch button which illuminates an amber button marked *service*. When the patrol officer reports he has found the disabled vehicle the radio operator presses the service button and the console lights return to green.

Inline RF Wattmeter for CBers

Continued from page 61

to borrow a standard communications-quality wattmeter.

Using the Inline Wattmeter. Leave your wattmeter permanently connected into the antenna coax line. Plug your transceiver into J1 or J2, and connect the transmission line to the remaining jack. Every time you activate the transmitter portion of your CB rig, the meter will indicate the RF output power.

Note that when the transmitter is modulated, M1 will kick slightly downwards. This is normal for an amplitude-modulated transmitter. If D1 is reversed, the meter will kick upwards. Again, disregard this reading.

Low-Cost Dummy Load For CBers

Continued from page 65

the bushing. Solder the ¼-in. ends to plug.

Remove the extra 2-watt resistor from the center of the assembly. Solder one end of a 3-in. length of bare or tinned No. 14 copper wire into the coax plug pin. Center the end of the wire in the resistor assembly.

Bend all ½-in. resistor leads inward until they are in contact with the center conductor. Solder all leads together and cut off the excess length of center wire. Finally, remove the masking tape from the assembly.

DXing Africa's Voices

Continued from page 35

is pure conjecture. However, it should be noted that Radio Clube de Mocambique has been beaming commercial broadcasts into South Africa for many years without reprisal.

On the island of Madagascar, some 400 mi. east of Portuguese Mozambique, Radio Nederland has opened its new relay station. One of the first things the station did was to beam RN transmissions into the Republic of South Africa on 6080 kc. In view of the close ties existing between Radio Nederland and Trans World Radio, its unlikely that South Africa will take exception to the Madagascar operation. In our part of the world these transmissions can be most readily logged on 11895 kc around 1100 EST.

If you think this picture is a complex one, you haven't heard anything yet. In November 1970, the Republic of Guinea was invaded by troops from neighboring Portuguese Guinea. In retaliation, the Conakry regime (represented on shortwave frequencies by La Voix de La Revolution) embarked on a campaign of political repression and terror.

A few months later, Portugal followed up the advantage provided by Conakry's Marxist propaganda with a supposedly anti-Marxist clandestine station, Radio Conakry, La Voix Libre du People du Guinea, on 4970 kc. According to a reliable French newspaper source, La Monde, this is really a disguise assumed by Emissora Provincial at Bissau (the colonial capital of Portuguese Guinea) which normally holds down a spot around 5040 kc.

Portuguese propaganda voices have played these games before in Africa. During the Nigerian civil war, Lisbon saw to it that Biafran rebels were supplied with sufficient equipment to carry on the conflict. By August 1968, this included enough electronic gear to build a whole network of radio stations. This was accomplished through a firm calling itself Mebo Ltd., a company which does business from offices in Zurich, Lisbon and Freetown—the capital of Sierra Leone on the Guinea Republic's southern border. Mebo Ltd. is, of course, better known these days as the owner of a controversial European pop pirate, R. Northsea International. But it was profits from the Biafran caper which financed RNI in the first place.

Color Bar Generator

Continued from page 69

a good black-and-white picture. He moaned, "It should be in color. The colors were a little weak so I brought it down here to play with. I played with it all right. Now there's no color."

He had diddled all the transformer cores in the color circuits. I told him, "If it's just the alignment we can give it a vectorscope." His eyes lit up.

I pointed to an oscilloscope that he built from a kit about ten years ago. "Bring it over."

He looked questioningly, "That old scope isn't a vectorscope."

I nodded, "Any old scope will do, wide- or narrow-band. All it needs is the right horizontal and vertical external input." He shrugged and brought it over. I asked, "Do you have any high-impedance probes?"

He shook his head. I continued, "Then get some wire and a couple of 560-micromicrofarad capacitors and a couple of half watters at around 470K."

He did. I attached the 560-$\mu\mu$f capacitor in series with the wire and ran a 470K resistor in parallel. Two long pieces of hookup wire plus the components made a probe. I made two of them and attached one to the scope's vertical input and the other to the scope's horizontal input and then switched the scope's horizontal sweep to *external*.

I attached the vertical probe to the color CRT's *red* control grid and the horizontal probe to the CRT's *blue* control grid. Then I installed my color bar generator and put the gated color signal on at 100 percent modulation. With the TV on, a Lissajous figure appeared on the scope that resembled a jumbled-up flower. I said, "That's a vectorscope display." He adjusted the vertical and horizontal gain on the scope for best linearity.

"Now," I continued, "let's start with the 4.5-mc trap in the third IF output. If it's not set properly you get hash in the picture. Note the petals are shaking. That's from the hash. Adjust the trap until the flower stands still." He did.

"Next we'll set up your reactance circuit. Ground the control grid of the reactance tube." He took a jumper lead and did so. The flower began to spin. I said, "Adjust the reactance coil till the flower stops." He tried it. It almost stopped but still continued to rotate ever so slightly no matter how he tried. I said, "Fine, that's close enough. Remove the short." When he did, the flower stood still.

"Next we'll set the tint control. Place the control at midrange." He reached around the front of the TV and did so. I continued, "Do you see the third petal—counting from just after the burst—which looks like the stem of the flower. Adjust the burst transformer until that petal is standing straight up at 12 o'clock." He adjusted the transformer and

the petal moved into this position easily.

"Lastly we're going to set up the bandpass amplifier and the color oscillator. Tune the bandpass plate coils and the oscillator for maximum amplitude of the petals." He did. "That's it," and I shook his hand.

He asked, "Where did that flower pattern come from?"

"It's the gated color signal from the generator applied to both scope plates simultaneously. They produce the flower in the same way you get a circle pattern when two 60-cps signals are applied to the two plates."

He chuckled and examined his TV picture. The colors were vivid and strong. He said, "From now on I'll only think good thoughts about you while I correct your addition on your bank deposits."

CRT Tester & Rejuvenator

Continued from page 76

and also is used in the life-expectancy test.

In other testers the life test simply turns off the heaters. You judge the tube's condition by the speed of drop of the meter needle. The 633 lowers heater voltage 10 percent. If the needle hardly drops off, the tube has a long life ahead.

The kit is supplied with five wired CRT socket adaptors which, when plugged in the 12-pin CRT socket (on a 15-in. cable), enable you to connect the 633 to any CRT.

It took us eight hours to build the kit. We discovered two minor inconsistencies in the Assembly Manual. In one step we were told to make a tie point with hookup wire on one wafer of a rotary switch. We didn't have to because there already was a lug there.

In Fig. 2 in the Assembly Manual there were two views (180° apart) of a rotary switch. The callouts *Locating Tab Facing Up* on one view and *Locating Tab Faces Down* on the other view were interchanged. Other than that, we had no difficulty with construction.

We found the 633 to be an excellent, sturdy instrument. Although its performance was satisfactory, the tube data listing was a bit skimpy. There was no data for a 19EJP4. Cross referencing in other books told us that the 19EJP4 was also a 19FEP4, which was in the list. Also, there were no foreign CRT listings to speak of. We couldn't test a Japanese 490AJB22 which is a fairly common 18-in. color CRT.

CB Corner

Continued from page 58

CB's limited range.

The solution being buzzed about in some circles is the Channel 9 repeater. Shades of 2 meters! This is precisely the idea now sweeping ham radio on 144-148 mc. A ham in Chicago, for example, can use a 10-watt mobile rig to activate a remote receiver which repeats his signal through another transmitter. Since the repeater is located on a high hill or building, the line-of-sight signal travels about 75 mi. If the ham's signal trips a second repeater, he might extend his feeble mobile output to more than 100 mi. Access to the repeater runs about 95 percent of the time.

A CB repeater? The idea would be outlandish for most channels because CB, by definition, is short-range. But a repeater confined to Channel-9 use might vastly improve CB's reliability as a rescue medium. This could overcome objections by public-safety officials that CB is so limited in distance and so clobbered by interference that it can't be taken seriously for emergencies.

The Listener

Continued from page 43

tions, no matter how detailed, establish absolutely nothing because the same transmission can be carried simultaneously on maybe ten or more frequencies from up to a half-dozen different locations. To prove anything, the DXer has to come up with a list of frequencies, break in a carrier, or sudden change in signal strength.

Propagation Forecast. During the summer months the sun is almost directly overhead in the northern hemisphere. As a result, the ionosphere is heated up and its characteristics change. These changes affect the manner in which radio signals are propagated.

For example, the range of useful frequencies increases at night and decreases during daylight hours. During summer nights, DX is possible on all bands from 49 to 16 meters, though the period during which the latter band is good is limited. During the day, DX in the higher bands—13 and 11 meters in particular—is not as good as it was during the winter and spring. The best daytime DX occurs in the 16- and 19-meter bands.

Broadcast-band DX is poorest during this time of year because of increased noise levels and longer periods of daylight. During the day, frequencies below 1.5 mc do not propagate via the ionosphere and coverage is limited to groundwave range. This coverage depends on the power of the transmitter and the kind of terrain over which the signal travels. It rarely exceeds several hundred miles in the United States.

Class E for CB

Continued from page 64

good stability, the Class E circuit could require thermostatically controlled ovens to keeps its crystals from drifting.

Manufacturers seem undaunted by the greater complexity of a Class E transceiver because they have a proverbial ace-in-the-hole. A considerable amount of two-way-radio gear is now manufactured just above and below the proposed band. No one has to invent anything. Thousands of police, fire and business users now operate in the 150-mc and 450-mc bands which border Class E. Several CB producers, in fact, make such equipment and say they'll merely switch their front ends to come up with the Class E set.

How much more will these fancier rigs cost? One manufacturer guesses a Class E set will run about the same as a deluxe Class D model—which places it in the $300 category. If volume production commences, this figure could easily drop to $200.

The Antennas. Because of Class E's higher frequency, its wavelength—and therefore antenna size—drops sharply. A halfwave on the old Class D band measures about 18 ft., while on the new one it's merely two ft. This means a 9-ft. whip mounted on a car shrinks to one foot. But not quite. Smaller size in any antenna invariably means *less* signal capacity, so Class E antennas will make up for miniscule length by means of stacking.

A major CB antenna maker is already talking about a base-station antenna with 9db gain in all directions and no radials (see illustration). Rising to 14 ft., it would stack five ⅝-wavelength elements, as compared to today's Class D antenna that has one ⅝-wavelength element rising to about 19 ft. A mobile antenna might turn out to be a stacked ⅝-wavelength (2½ ft.) element with a phasing coil at the bottom. Price should be about the same as today's models.

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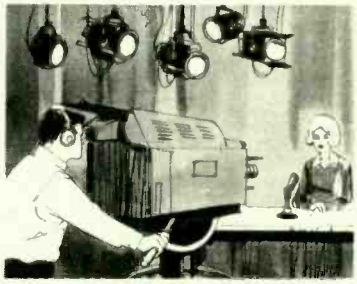

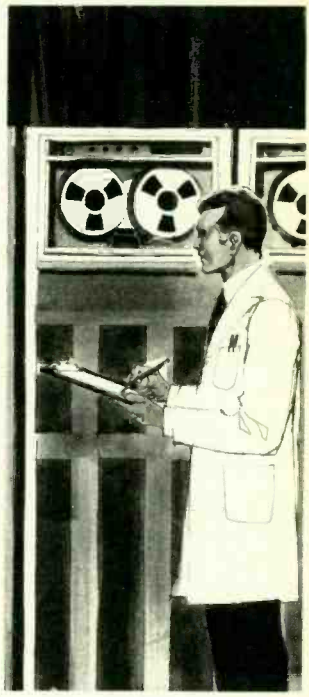

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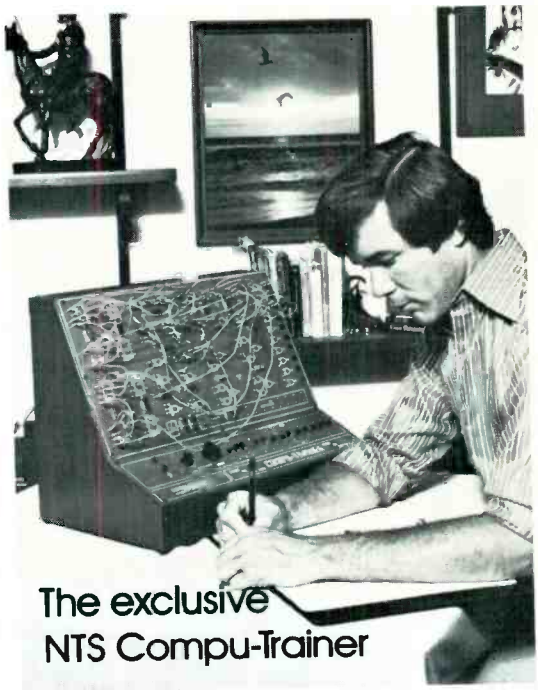

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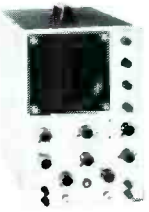

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